Data Lake Insight

SQL Syntax Reference

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Contents

1 Notice on Taking This Syntax Reference Offline

DLI SQL Syntax Reference is split into *Spark SQL Syntax Reference* and *Flink SQL Syntax Reference* due to document structure adjustment.

DLI SQL Syntax Reference is to be taken offline. For details about syntax, see **Spark SQL Syntax Reference** and **Flink SQL Syntax Reference**.

2 Spark SQL Syntax Reference (Unavailable Soon)

2.1 Common Configuration Items of Batch SQL Jobs

This section describes the common configuration items of the SQL syntax for DLI batch jobs.

Table 2-1 Common configuration items

Item	Default Value	Description
spark.sql.files.maxRecordsPerFile	0	Maximum number of records to be written into a single file. If the value is zero or negative, there is no limit.
spark.sql.autoBroadcastJoinThreshold	209715200	Maximum size of the table that displays all working nodes when a connection is executed. You can set this parameter to **-1** to disable the display. **NOTE** Currently, only the configuration unit metastore table that runs the **ANALYZE TABLE COMPUTE statistics noscan** command and the file-based data source table that directly calculates statistics based on data files are supported.
spark.sql.shuffle.partitions	200	Default number of partitions used to filter data for join or aggregation.

Item	Default Value	Description
spark.sql.dynamicPartitionOverwrite.enabled	false	Whether DLI overwrites the partitions where data will be written into during runtime. If you set this parameter to **false**, all partitions that meet the specified condition will be deleted before data overwrite starts. For example, if you set **false** and use INSERT OVERWRITE to write partition 2021-02 to a partitioned table that has the 2021-01 partition, this partition will be deleted. If you set this parameter to **true**, DLI does not delete partitions before overwrite starts.
spark.sql.files.maxPartitionBytes	134217728	Maximum number of bytes to be packed into a single partition when a file is read.
spark.sql.badRecordsPath	-	Path of bad records.

2.2 SQL Syntax Overview of Batch Jobs

This section describes the Spark SQL syntax list provided by DLI. For details about the parameters and examples, see the syntax description.

Table 2-2 SQL syntax of batch jobs

Classification	Reference
Database-related Syntax	**Creating a Database**
	Deleting a Database
	Viewing a Specified Database
	Viewing All Databases
Syntax for Creating an OBS Table	**Creating an OBS Table Using the Datasource Syntax**
	Creating an OBS Table Using the Hive Syntax
Syntax for Creating a DLI Table	**Creating a DLI Table Using the Datasource Syntax**
	Creating a DLI Table Using the Hive Syntax
Syntax for Deleting a Table	**Deleting a Table**

Classification	Reference
Syntax for Viewing a Table	**Viewing All Tables**
	Viewing Table Creation Statements
	Viewing Table Properties
	Viewing All Columns in a Specified Table
	Viewing All Partitions in a Specified Table
	Viewing Table Statistics
Syntax for Modifying a Table	**Adding a Column**
Syntax for Partitioning a Table	**Adding a Partition (Only OBS Tables Supported)**
	Renaming a Partition
	Deleting a Partition
	Altering the Partition Location of a Table (Only OBS Tables Supported)
	Updating Partitioned Table Data (Only OBS Tables Supported)
Syntax for Importing Data	**Importing Data**
Syntax for Inserting Data	**Inserting Data**
Syntax for Clearing Data	**Clearing Data**
Syntax for Exporting Query Results	**Exporting Query Result**
Syntax for Datasource Connection to an HBase Table	**Creating a Table and Associating It with HBase**
	Inserting Data to an HBase Table
	Querying an HBase Table
Syntax for Datasource Connection to an OpenTSDB Table	**Creating a Table and Associating It with OpenTSDB**
	Inserting Data to an OpenTSDB Table
	Querying an OpenTSDB Table
Syntax for Datasource Connection to a DWS Table	**Creating a Table and Associating It with DWS**
	Inserting Data to a DWS Table
	Querying a DWS Table

Classification	Reference
Syntax for Datasource Connection to an RDS Table	Creating a Table and Associating It with RDS
	Inserting Data to an RDS Table
	Querying an RDS Table
Syntax for Datasource Connection to a CSS Table	Creating a Table and Associating It with CSS
	Inserting Data to a CSS Table
	Querying a CSS Table
Syntax for Datasource Connection to a DCS Table	Creating a Table and Associating It with DCS
	Inserting Data to a DCS Table
	Querying a DCS Table
Syntax for Datasource Connection to a DDS Table	Creating a Table and Associating It with DDS
	Inserting Data to a DDS Table
	Querying a DDS Table
View-related Syntax	Creating a View
	Deleting a View
Syntax for Viewing the Execution Plan	Viewing the Execution Plan
Syntax Related to Data Permissions	Creating a Role
	Deleting a Role
	Binding a Role
	Unbinding a Role
	Displaying a Role
	Granting a Permission
	Revoking a Permission
	Displaying the Granted Permissions
	Displaying the Binding Relationship Between All Roles and Users
UDF-related Syntax	Creating a Function
	Deleting a Function
	Displaying Function Details
	Displaying All Functions

Classification	Reference
Multiversion-related Syntax	**Enabling Multiversion Backup When Creating an OBS Table** **Enabling or Disabling Multiversion Backup When Modifying a Table** **Setting the Retention Period for Multiversion Backup Data** **Viewing Multiversion Backup Data** **Restoring Multiversion Backup Data** **Configuring the Trash Bin for Expired Multiversion Data** **Deleting Multiversion Backup Data**

2.3 Databases

2.3.1 Creating a Database

Function

This statement is used to create a database.

Syntax

```
CREATE [DATABASE | SCHEMA] [IF NOT EXISTS] db_name
  [COMMENT db_comment]
  [WITH DBPROPERTIES (property_name=property_value, ...)];
```

Keyword

- **IF NOT EXISTS**: Prevents system errors if the database to be created exists.
- **COMMENT**: Describes a database.
- **DBPROPERTIES**: Specifies database attributes. The attribute name and attribute value appear in pairs.

Parameters

Table 2-3 Parameter description

Parameter	Description
db_name	Database name, which consists of letters, digits, and underscores (_). The value cannot contain only digits or start with a digit or underscore (_).
db_comment	Database description
property_name	Database property name

Parameter	Description
property_value	Database property value

Precautions

- **DATABASE** and **SCHEMA** can be used interchangeably. You are advised to use **DATABASE**.
- The **default** database is a built-in database. You cannot create a database named **default**.

Example

NOTE

For details about the complete process for submitting SQL jobs, see **Submitting a SQL Job**.

1. Create a queue. A queue is the basis for using DLI. Before executing SQL statements, you need to create a queue.
2. On the DLI management console, click **SQL Editor** in the navigation pane on the left. The **SQL Editor** page is displayed.
3. In the editing window on the right of the **SQL Editor** page, enter the following SQL statement for creating a database and click **Execute**. Read and agree to the privacy agreement, and click **OK**.

   If database **testdb** does not exist, run the following statement to create database **testdb**:

   ```
   CREATE DATABASE IF NOT EXISTS testdb;
   ```

2.3.2 Deleting a Database

Function

This statement is used to delete a database.

Syntax

```
DROP [DATABASE | SCHEMA] [IF EXISTS] db_name [RESTRICT|CASCADE];
```

Keyword

IF EXISTS: Prevents system errors if the database to be deleted does not exist.

Precautions

- **DATABASE** and **SCHEMA** can be used interchangeably. You are advised to use **DATABASE**.
- **RESTRICT**: If the database is not empty (tables exist), an error is reported and the **DROP** operation fails. **RESTRICT** is the default logic.
- **CASCADE**: Even if the database is not empty (tables exist), the **DROP** will delete all the tables in the database. Therefore, exercise caution when using this function.

Parameters

Table 2-4 Parameter description

Parameter	Description
db_name	Database name, which consists of letters, digits, and underscores (_). The value cannot contain only digits or start with a digit or underscore (_).

Example

1. Create a database, for example, **testdb**, by referring to **Example**.
2. Run the following statement to delete database **testdb** if it exists:

```
DROP DATABASE IF EXISTS testdb;
```

2.3.3 Viewing a Specified Database

Function

This syntax is used to view the information about a specified database, including the database name and database description.

Syntax

```
DESCRIBE DATABASE [EXTENDED] db_name;
```

Keyword

EXTENDED: Displays the database properties.

Parameters

Table 2-5 Parameter description

Parameter	Description
db_name	Database name, which consists of letters, digits, and underscores (_). The value cannot contain only digits or start with a digit or underscore (_).

Precautions

If the database to be viewed does not exist, the system reports an error.

Example

1. Create a database, for example, **testdb**, by referring to **Example**.
2. Run the following statement to query information about the **testdb** database:

```
DESCRIBE DATABASE testdb;
```

2.3.4 Viewing All Databases

Function

This syntax is used to query all current databases.

Syntax

```
SHOW [DATABASES | SCHEMAS] [LIKE regex_expression];
```

Keyword

None

Parameters

Table 2-6 Parameter description

Parameter	Description
regex_expression	Database name

Precautions

Keyword DATABASES is equivalent to SCHEMAS. You can use either of them in this statement.

Example

View all the current databases.

```
SHOW DATABASES;
```

View all databases whose names start with **test**.

```
SHOW DATABASES LIKE "test.*";
```

2.4 Creating an OBS Table

2.4.1 Creating an OBS Table Using the DataSource Syntax

Function

Create an OBS table using the DataSource syntax.

The main differences between the DataSource and the Hive syntax lie in the supported data formats and the number of supported partitions. For details, see syntax and precautions.

NOTE

You are advised to use the OBS parallel file system for storage. A parallel file system is a high-performance file system that provides latency in milliseconds, TB/s-level bandwidth, and millions of IOPS. It applies to interactive big data analysis scenarios.

Usage

- The size of the table will not be calculated during table creation.
- When data is added, the table size will be changed to 0.
- You can view the table size on OBS.

Precautions

- The table and column names are case-insensitive.
- Descriptions of table names and column names support only string constants.
- During table creation, you need to specify the column name and corresponding data type. The data type is primitive type.
- If a folder and a file have the same name in the OBS directory, the file is preferred as the path when creating an OBS table.
- During table creation, if the specified path is an OBS directory and it contains subdirectories (or nested subdirectories), all file types and content in the subdirectories are considered table content.

  Ensure that all file types in the specified directory and its subdirectories are consistent with the storage format specified in the table creation statement. All file content must be consistent with the fields in the table. Otherwise, errors will be reported in the query.

  You can set **multiLevelDirEnable** to **true** in the **OPTIONS** statement to query the content in the subdirectory. The default value is **false** (Note that this configuration item is a table attribute, exercise caution when performing this operation). Hive tables do not support this configuration item.
- The OBS storage path must be a directory on OBS.
- When a partitioned table is created, the column specified in PARTITIONED BY must be a column in the table, and the partition type must be specified. The partition column supports only the **string**, **boolean**, **tinyint**, **smallint**, **short**, **int**, **bigint**, **long**, **decimal**, **float**, **double**, **date**, and **timestamp** type.
- When a partitioned table is created, the partition field must be the last one or several fields of the table field, and the sequence of the partition fields must be the same. Otherwise, an error occurs.
- A maximum of 7,000 partitions can be created in a single table.
- The CREATE TABLE AS statement cannot specify table attributes or create partitioned tables.

Syntax

```
CREATE TABLE [IF NOT EXISTS] [db_name.]table_name
  [(col_name1 col_type1 [COMMENT col_comment1], ...)]
  USING file_format
  [OPTIONS (path 'obs_path', key1=val1, key2=val2, ...)]
  [PARTITIONED BY (col_name1, col_name2, ...)]
  [COMMENT table_comment]
  [AS select_statement]
```


Keywords

- **IF NOT EXISTS**: Prevents system errors when the created table exists.
- **USING**: Storage format.
- **OPTIONS**: Property name and property value when a table is created.
- **COMMENT**: Field or table description.
- **PARTITIONED BY**: Partition field.
- **AS**: Run the **CREATE TABLE AS** statement to create a table.

Parameter

Table 2-7 Parameter description

Parameter	Description
db_name	Database name The value can contain letters, numbers, and underscores (_), but cannot contain only numbers or start with a number or underscore (_).
table_name	Name of the table to be created in the database The value can contain letters, numbers, and underscores (_), but cannot contain only numbers or start with a number or underscore (_). The matching rule is **^(?!_)(?![0-9]+$)[A-Za-z0-9_$]*$**. Special characters must be enclosed in single quotation marks ('').
col_name	Column names with data types separated by commas (,) The column name contains letters, digits, and underscores (_). It cannot contain only digits and must contain at least one letter.
col_type	Data type of a column field
col_comment	Column field description
file_format	Input format of the table. The value can be **orc**, **parquet**, **json**, **csv**, or **avro**.
path	OBS storage path where data files are stored. You are advised to use an OBS parallel file system for storage. Format: **obs://bucketName/tblPath** *bucketName*: bucket name *tblPath*: directory name. You do not need to specify the file name following the directory. For details about attribute names and values during table creation, see **Table 2-8**. For details about the table attribute names and values when **file_format** is set to **csv**, see **Table 2-8** and **Table 2-9**.

Parameter	Description
table_comment	Description of the table
select_statement	The **CREATE TABLE AS** statement is used to insert the **SELECT** query result of the source table or a data record to a new table in OBS bucket.

Table 2-8 OPTIONS parameter description

Parameter	Description	Default Value
path	Specified table storage location. Currently, only OBS is supported.	-
multiLevelDirEnable	Whether to iteratively query data in subdirectories when subdirectories are nested. When this parameter is set to **true**, all files in the table path, including files in subdirectories, are iteratively read when a table is queried.	false
dataDelegated	Whether to clear data in the path when deleting a table or partition	false
compression	Specified compression format. Generally, you need to set this parameter to **zstd** for parquet files.	-

When the file format is set to **CSV**, you can set the following OPTIONS parameters:

Table 2-9 OPTIONS parameter description of the CSV data format

Parameter	Description	Default Value
delimiter	Data separator	Comma (,)
quote	Quotation character	Double quotation marks (" ")
escape	Escape character	Backslash (\)
multiLine	Whether the column data contains carriage return characters or transfer characters. The value **true** indicates yes and the value **false** indicates no.	false
dateFormat	Date format of the **date** field in a CSV file	yyyy-MM-dd

Parameter	Description	Default Value
timestampFormat	Date format of the **timestamp** field in a CSV file	yyyy-MM-dd HH:mm:ss
mode	Mode for parsing CSV files. The options are as follows: • **PERMISSIVE**: Permissive mode. If an incorrect field is encountered, set the field to **Null**. • **DROPMALFORMED**: When an incorrect field is encountered, the entire line is discarded. • **FAILFAST**: Error mode. If an error occurs, it is automatically reported.	PERMISSIVE
header	Whether CSV contains header information. The value **true** indicates that the table header information is contained, and the value **false** indicates that the information is not included.	false
nullValue	Character that represents the null value. For example, **nullValue= "\\N"** indicates that **\N** represents the null value.	-
comment	Character that indicates the beginning of the comment. For example, **comment= '#'** indicates that the line starting with **#** is a comment.	-
compression	Data compression format. Currently, **gzip**, **bzip2**, and **deflate** are supported. If you do not want to compress data, enter **none**.	none
encoding	Data encoding format. Available values are **utf-8**, **gb2312**, and **gbk**. Value **utf-8** will be used if this parameter is left empty.	utf-8

Example

NOTE

Before creating a table, refer to **Example** to create a queue and database. In the upper part of the editing window on the right of the **SQL Editor** page, select the created queue and database, and run the following example SQL statements.

- Create a **parquetTable** OBS table.

```
CREATE TABLE parquetTable (name string, id int) USING parquet OPTIONS (path "obs://bucketName/filePath");
```

- Create a **parquetZstdTable** OBS table and set the compression format to **zstd**.

```
CREATE TABLE parquetZstdTable (name string, id string) USING parquet OPTIONS (path "obs://bucketName/filePath",compression='zstd');
```

- Create a **student** table that has two fields **name** and **score**and partition the table by **classNo**.
  ```
  CREATE TABLE IF NOT EXISTS student(name STRING, score DOUBLE, classNo INT) USING csv
  OPTIONS (PATH 'obs://bucketName/filePath') PARTITIONED BY (classNo);
  ```

  NOTE

  The **classNo** field is a partition field and must be placed at the end of the table field, that is, **student(name STRING, score DOUBLE, classNo INT)**.
- To create table **t1** and insert data of table **t2** into table **t1**, run the following statement: To use this example, ensure that the OBS storage path is a directory on OBS and the directory is created in advance and is empty.
  ```
  CREATE TABLE IF NOT EXISTS t2(name STRING, score DOUBLE, classNo INT) USING csv OPTIONS
  (PATH 'obs://bucketName/filePath') PARTITIONED BY (classNo);
  CREATE TABLE t1 USING parquet OPTIONS(path 'obs://bucketName/tblPath') AS select * from t2;
  ```

2.4.2 Creating an OBS Table Using the Hive Syntax

Function

This statement is used to create an OBS table using the Hive syntax. The main differences between the DataSource and the Hive syntax lie in the supported data formats and the number of supported partitions. For details, see syntax and precautions.

NOTE

You are advised to use the OBS parallel file system for storage. A parallel file system is a high-performance file system that provides latency in milliseconds, TB/s-level bandwidth, and millions of IOPS. It applies to interactive big data analysis scenarios.

Usage

- The size of the table will be calculated during creation.
- When data is added, the table size will not be changed.
- You can view the table size on OBS.

Syntax

```
CREATE [EXTERNAL] TABLE [IF NOT EXISTS] [db_name.]table_name
  [(col_name1 col_type1 [COMMENT col_comment1], ...)]
  [COMMENT table_comment]
  [PARTITIONED BY (col_name2 col_type2, [COMMENT col_comment2], ...)]
  [ROW FORMAT row_format]
  [STORED AS file_format]
  LOCATION 'obs_path'
  [TBLPROPERTIES (key = value)]
  [AS select_statement]
row_format:
  : SERDE serde_cls [WITH SERDEPROPERTIES (key1=val1, key2=val2, ...)]
  | DELIMITED [FIELDS TERMINATED BY char [ESCAPED BY char]]
      [COLLECTION ITEMS TERMINATED BY char]
      [MAP KEYS TERMINATED BY char]
      [LINES TERMINATED BY char]
      [NULL DEFINED AS char]
```

Keyword

- EXTERNAL: Creates an OBS table.

- IF NOT EXISTS: Prevents system errors when the created table exists.
- COMMENT: Field or table description.
- PARTITIONED BY: Partition field.
- ROW FORMAT: Row data format.
- STORED AS: Specifies the format of the file to be stored. Currently, only the TEXTFILE, AVRO, ORC, SEQUENCEFILE, RCFILE, and PARQUET format are supported.
- LOCATION: Specifies the path of OBS. This keyword is mandatory when you create OBS tables.
- TBLPROPERTIES: Allows you to add the **key/value** properties to a table.
  - You can use this statement to enable the multiversion function to back up and restore table data. After the multiversion function is enabled, the system automatically backs up table data when you delete or modify the data using **insert overwrite** or **truncate**, and retains the data for a certain period. You can quickly restore data within the retention period. For details about the SQL syntax for the multiversion function, see **Enabling or Disabling Multiversion Backup** and **Backing Up and Restoring Data of Multiple Versions**.

    When creating an OBS table, you can use **TBLPROPERTIES ("dli.multi.version.enable"="true")** to enable multiversion. For details, see the following example.

    Table 2-10 TBLPROPERTIES parameters

Key	Value
dli.multi.version.enable	• **true**: Enable the multiversion backup function. • **false**: Disable the multiversion backup function.
comment	Description of the table
orc.compress	An attribute of the ORC table, which specifies the compression mode of the ORC storage. Available values are as follows: • **ZLIB** • **SNAPPY** • **NONE**
auto.purge	If this parameter is set to **true**, the deleted or overwritten data is removed and will not be dumped to the recycle bin.

- AS: You can run the CREATE TABLE AS statement to create a table.

Parameter

Table 2-11 Parameter description

Parameter	Description
db_name	Database name that contains letters, digits, and underscores (_). The value cannot contain only digits and cannot start with a digit or underscore (_).
table_name	Table name of a database that contains letters, digits, and underscores (_). The value cannot contain only digits and cannot start with a digit or underscore (_). The matching rule is **^(?!_)(?![0-9]+$)[A-Za-z0-9_$]*$**. If special characters are required, use single quotation marks ('') to enclose them.
col_name	Field name
col_type	Field type
col_comment	Field description
row_format	Line data format
file_format	OBS table storage format. TEXTFILE, AVRO, ORC, SEQUENCEFILE, RCFILE, and PARQUET are supported.
table_comment	Table description
obs_path	OBS path
key = value	Set table properties and values. For example, if you want to enable multiversion, you can set **"dli.multi.version.enable"="true"**.
select_statement	The CREATE TABLE AS statement is used to insert the SELECT query result of the source table or a data record to a new table in OBS bucket.

Precautions

- The table and column names are case-insensitive.
- Descriptions of table names and column names support only string constants.
- During table creation, you need to specify the column name and corresponding data type. The data type is primitive type.
- If a folder and a file have the same name in the OBS directory, the file is preferred as the path when creating an OBS table.
- When you create a partitioned table, ensure that the specified column in **PARTITIONED BY** is not a column in the table and the data type is specified. The partition column supports only the open-source Hive table types including **string**, **boolean**, **tinyint**, **smallint**, **short**, **int**, **bigint**, **long**, **decimal**, **float**, **double**, **date**, and **timestamp**.

- Multiple partition fields can be specified. The partition fields need to be specified after the **PARTITIONED BY** keyword, instead of the table name. Otherwise, an error occurs.
- A maximum of 100,000 partitions can be created in a single table.
- The CREATE TABLE AS statement cannot specify table attributes or create partitioned tables.

Example

NOTE

Before creating a table, refer to **Example** to create a queue and database. In the upper part of the editing window on the right of the **SQL Editor** page, select the created queue and database, and run the following example SQL statements.

- To create a Parquet table named **student**, in which the **id**, **name**, and **score** fields are contained and the data types of the respective fields are INT, STRING, and FLOAT, run the following statement:
```
CREATE TABLE student (id INT, name STRING, score FLOAT) STORED AS PARQUET LOCATION 'obs://bucketName/filePath';
```
- To create a table named **student**, for which **classNo** is the partition field and two fields **name** and **score** are specified, run the following statement:
```
CREATE TABLE IF NOT EXISTS student(name STRING, score DOUBLE) PARTITIONED BY (classNo INT) STORED AS PARQUET LOCATION 'obs://bucketName/filePath';
```

  NOTE

  classNo is a partition field and must be specified after the PARTITIONED BY keyword, that is, **PARTITIONED BY (classNo INT)**. It cannot be specified after the table name as a table field.
- To create table **t1** and insert data of table **t2** into table **t1** by using the Hive syntax, run the following statement:
```
CREATE TABLE IF NOT EXISTS t2(name STRING, score DOUBLE, classNo INT) USING csv OPTIONS (PATH 'obs://bucketName/filePath') PARTITIONED BY (classNo);
CREATE TABLE t1 STORED AS parquet LOCATION 'obs://bucketName/filePath' as select * from t2;
```
- Create the **student** table and enable multiversion by using the Hive syntax.
```
CREATE TABLE student (id INT, name STRING, score FLOAT) STORED AS PARQUET LOCATION 'obs://bucketName/filePath' TBLPROPERTIES ("dli.multi.version.enable"="true");
```

2.5 Creating a DLI Table

2.5.1 Creating a DLI Table Using the DataSource Syntax

Function

This DataSource syntax can be used to create a DLI table. The main differences between the DataSource and the Hive syntax lie in the supported data formats and the number of supported partitions. For details, see syntax and precautions.

Syntax

```
CREATE TABLE [IF NOT EXISTS] [db_name.]table_name
  [(col_name1 col_type1 [COMMENT col_comment1], ...)]
  USING file_format
  [OPTIONS (key1=val1, key2=val2, ...)]
```

```
[PARTITIONED BY (col_name1, col_name2, ...)]
[COMMENT table_comment]
[AS select_statement];
```

Keywords

- **IF NOT EXISTS**: Prevents system errors when the created table exists.
- **USING**: Storage format.
- **OPTIONS**: Property name and property value when a table is created.
- **COMMENT**: Field or table description.
- **PARTITIONED BY**: Partition field.
- **AS**: Run the **CREATE TABLE AS** statement to create a table.

Parameter Description

Table 2-12 Parameter description

Parameter	Description
db_name	Database name that contains letters, digits, and underscores (_). The value cannot contain only digits and cannot start with a digit or underscore (_).
table_name	Table name of a database that contains letters, digits, and underscores (_). The value cannot contain only digits and cannot start with a digit or underscore (_). The matching rule is **^(?!_)(?![0-9]+$)[A-Za-z0-9_$]*$**. If special characters are required, use single quotation marks ('') to enclose them.
col_name	Column names with data types separated by commas (,). The column name contains letters, digits, and underscores (_). It cannot contain only digits and must contain at least one letter.
col_type	Field type
col_comment	Field description
file_format	Data storage format of DLI tables. The value can be **parquet** only.
table_comment	Table description
select_statement	The CREATE TABLE AS statement is used to insert the SELECT query result of the source table or a data record to a newly created DLI table.

Table 2-13 OPTIONS parameter description

Parameter	Description	Default Value
multiLevelDirEnable	Whether to iteratively query data in subdirectories. When this parameter is set to **true**, all files in the table path, including files in subdirectories, are iteratively read when a table is queried.	false
compression	Specified compression format. Generally, you need to set this parameter to **zstd** for parquet files.	-

Precautions

- If no delimiter is specified, the comma (,) is used by default.
- When a partitioned table is created, the column specified in PARTITIONED BY must be a column in the table, and the partition type must be specified. The partition column supports only the **string**, **boolean**, **tinyint**, **smallint**, **short**, **int**, **bigint**, **long**, **decimal**, **float**, **double**, **date**, and **timestamp** type.
- When a partitioned table is created, the partition field must be the last one or several fields of the table field, and the sequence of the partition fields must be the same. Otherwise, an error occurs.
- A maximum of 7,000 partitions can be created in a single table.
- The CREATE TABLE AS statement cannot specify table attributes or create partitioned tables.

Example

NOTE

Before creating a table, refer to **Example** to create a queue and database. In the upper part of the editing window on the right of the **SQL Editor** page, select the created queue and database, and run the following example SQL statements.

- Create a **src** table that has two columns **key** and **value** in INT and STRING types respectively, and set the compression format to **zstd**.
```
CREATE TABLE src(key INT, value STRING) USING PARQUET OPTIONS(compression = 'zstd');
```
- Create a **student** table that has **name**, **score**, and **classNo** columns and stores data in **Parquet** format. Partition the table by **classNo**.
```
CREATE TABLE student(name STRING, score INT, classNo INT) USING PARQUET
OPTIONS(compression = 'zstd') PARTITIONED BY(classNo) ;
```

  NOTE

  classNo is the partition field, which must be placed at the end of the table field, that is, **student(name STRING, score INT, classNo INT)**.

- Create table **t1** and insert **t2** data into table **t1**.
```
CREATE TABLE t2(name STRING, score INT, classNo INT) USING PARQUET OPTIONS(compression =
'zstd') PARTITIONED BY(classNo) ;
CREATE TABLE t1 USING parquet AS select * from t2;
```

2.5.2 Creating a DLI Table Using the Hive Syntax

Function

This Hive syntax is used to create a DLI table. The main differences between the DataSource and the Hive syntax lie in the supported data formats and the number of supported partitions. For details, see syntax and precautions.

Syntax

```
CREATE TABLE [IF NOT EXISTS] [db_name.]table_name
  [(col_name1 col_type1 [COMMENT col_comment1], ...)]
  [COMMENT table_comment]
  [PARTITIONED BY (col_name2 col_type2, [COMMENT col_comment2], ...)]
  [ROW FORMAT row_format]
  STORED AS file_format
  [TBLPROPERTIES (key = value)]
  [AS select_statement];

row_format:
  : SERDE serde_cls [WITH SERDEPROPERTIES (key1=val1, key2=val2, ...)]
  | DELIMITED [FIELDS TERMINATED BY char [ESCAPED BY char]]
      [COLLECTION ITEMS TERMINATED BY char]
      [MAP KEYS TERMINATED BY char]
      [LINES TERMINATED BY char]
      [NULL DEFINED AS char]
```

Keyword

- IF NOT EXISTS: Prevents system errors when the created table exists.
- COMMENT: Field or table description.
- PARTITIONED BY: Partition field.
- ROW FORMAT: Row data format.
- STORED AS: Specifies the format of the file to be stored. Currently, only the TEXTFILE, AVRO, ORC, SEQUENCEFILE, RCFILE, and PARQUET format are supported. This keyword is mandatory when you create DLI tables.
- TBLPROPERTIES: This keyword is used to add a **key/value** property to a table.
  - If the table storage format is Parquet, you can use **TBLPROPERTIES(parquet.compression = 'zstd')** to set the table compression format to **zstd**.
- AS: Run the CREATE TABLE AS statement to create a table.

Parameter Description

Table 2-14 Parameter description

Parameter	Description
db_name	Database name that contains letters, digits, and underscores (_). The value cannot contain only digits and cannot start with a digit or underscore (_).

Parameter	Description
table_name	Table name of a database that contains letters, digits, and underscores (_). The value cannot contain only digits and cannot start with a digit or underscore (_). The matching rule is **^(?!_)(?![0-9]+$)[A-Za-z0-9_$]*$**. If special characters are required, use single quotation marks ('') to enclose them.
col_name	Column names with data types separated by commas (,). The column name contains letters, digits, and underscores (_). It cannot contain only digits and must contain at least one letter.
col_type	Field type
col_comment	Field description
row_format	Line data format
file_format	Data storage format: TEXTFILE, AVRO, ORC, SEQUENCEFILE, RCFILE, PARQUET.
table_comment	Table description
key = value	Set table properties and values. If the table storage format is Parquet, you can use **TBLPROPERTIES(parquet.compression = 'zstd')** to set the table compression format to **zstd**.
select_statement	The **CREATE TABLE AS** statement is used to insert the **SELECT** query result of the source table or a data record to a newly created DLI table.

Precautions

- When you create a partitioned table, ensure that the specified column in **PARTITIONED BY** is not a column in the table and the data type is specified. The partition column supports only the open-source Hive table types including **string**, **boolean**, **tinyint**, **smallint**, **short**, **int**, **bigint**, **long**, **decimal**, **float**, **double**, **date**, and **timestamp**.
- Multiple partition fields can be specified. The partition fields need to be specified after the **PARTITIONED BY** keyword, instead of the table name. Otherwise, an error occurs.
- A maximum of 100,000 partitions can be created in a single table.
- The CREATE TABLE AS statement cannot specify table attributes or create partitioned tables.

Example

NOTE

Before creating a table, refer to **Example** to create a queue and database. In the upper part of the editing window on the right of the **SQL Editor** page, select the created queue and database, and run the following example SQL statements.

- Create a **src** table that has **key** and **value** columns in INT and STRING types respectively, and specify a property as required.

```
CREATE TABLE src
  (key INT, value STRING)
  STORED AS PARQUET
  TBLPROPERTIES('key1' = 'value1');
```

- Create a **student** table that has **name**, **score**, and **classNo** columns, and partition the table by **classNo**.

```
CREATE TABLE student
  (name STRING, score INT)
  STORED AS PARQUET
  TBLPROPERTIES(parquet.compression = 'zstd') PARTITIONED BY(classNo INT);
```

- Create table **t1** and insert **t2** data into table **t1**.

```
CREATE TABLE t2(name STRING, score INT, classNo INT)
  USING PARQUET OPTIONS('key1' = 'value1') PARTITIONED BY(classNo) ;
CREATE TABLE t1
  STORED AS PARQUET
  AS select * from t2;
```

2.6 Deleting a Table

Function

This statement is used to delete tables.

Syntax

```
DROP TABLE [IF EXISTS] [db_name.]table_name;
```

Keyword

- If the table is stored in OBS, only the metadata is deleted. The data stored on OBS is not deleted.
- If the table is stored in DLI, the data and the corresponding metadata are all deleted.

Parameters

Table 2-15 Parameter description

Parameter	Description
db_name	Database name, which consists of letters, digits, and underscores (_). The value cannot contain only digits or start with a digit or underscore (_).
table_name	Table name

Precautions

The to-be-deleted table must exist in the current database. Otherwise, an error is reported. To avoid this error, add **IF EXISTS** in this statement.

Example

1. Create a table. For details, see **Creating an OBS Table** or **Creating a DLI Table**.
2. Run the following statement to delete table **test** from the current database:

```
DROP TABLE IF EXISTS test;
```

2.7 Viewing Tables

2.7.1 Viewing All Tables

Function

This statement is used to view all tables and views in the current database.

Syntax

```
SHOW TABLES [IN | FROM db_name] [LIKE regex_expression];
```

Keyword

FROM/IN: followed by the name of a database whose tables and views will be displayed.

Parameters

Table 2-16 Parameter description

Parameter	Description
db_name	Database name, which consists of letters, digits, and underscores (_). The value cannot contain only digits or start with a digit or underscore (_).
regex_expression	Name of a database table.

Precautions

None

Example

1. Create a table. For details, see **Creating an OBS Table** or **Creating a DLI Table**.

2. To show all tables and views in the current database, run the following statement:
```
SHOW TABLES;
```
3. To show all tables started with **test** in the **testdb** database, run the following statement:
```
SHOW TABLES IN testdb LIKE "test*";
```

2.7.2 Viewing Table Creation Statements

Function

This statement is used to show the statements for creating a table.

Syntax

```
SHOW CREATE TABLE table_name;
```

Keyword

CREATE TABLE: statement for creating a table

Parameters

Table 2-17 Parameter description

Parameter	Description
table_name	Table name

Precautions

The table specified in this statement must exist. Otherwise, an error will occur.

Example

1. Create a table. For details, see **Creating an OBS Table** or **Creating a DLI Table**.
1. Run the following statement to view the statement that is used to create table **test**:
```
SHOW CREATE TABLE test;
```

2.7.3 Viewing Table Properties

Function

Check the properties of a table.

Syntax

```
SHOW TBLPROPERTIES table_name [('property_name')];
```


Keyword

TBLPROPERTIES: This statement allows you to add a **key/value** property to a table.

Parameters

Table 2-18 Parameter description

Parameter	Description
table_name	Table name
property_name	• If this parameter is not specified, all properties and their values are returned. • If a property name is specified, only the specified property and its value are returned.

Precautions

property_name is case sensitive. You cannot specify multiple **property_name** attributes at the same time. Otherwise, an error occurs.

Example

To return the value of **property_key1** in the test table, run the following statement:

```
SHOW TBLPROPERTIES test ('property_key1');
```

2.7.4 Viewing All Columns in a Specified Table

Function

This statement is used to query all columns in a specified table.

Syntax

```
SHOW COLUMNS {FROM | IN} table_name [{FROM | IN} db_name];
```

Keyword

- COLUMNS: columns in the current table
- FROM/IN: followed by the name of a database whose tables and views will be displayed. Keyword FROM is equivalent to IN. You can use either of them in a statement.

Parameters

Table 2-19 Parameter description

Parameter	Description
table_name	Table name
db_name	Database name

Precautions

The specified table must exist in the database. If the table does not exist, an error is reported.

Example

Run the following statement to view all columns in the **student** table.

```
SHOW COLUMNS IN student;
```

2.7.5 Viewing All Partitions in a Specified Table

Function

This statement is used to view all partitions in a specified table.

Syntax

```
SHOW PARTITIONS [db_name.]table_name
  [PARTITION partition_specs];
```

Keyword

- PARTITIONS: partitions in a specified table
- PARTITION: a specified partition

Parameters

Table 2-20 Parameter description

Parameter	Description
db_name	Database name that contains letters, digits, and underscores (_). It cannot contain only digits and cannot start with an underscore (_).

Parameter	Description
table_name	Table name of a database that contains letters, digits, and underscores (_). It cannot contain only digits and cannot start with an underscore (_). The matching rule is **^(?!_)(?![0-9]+$)[A-Za-z0-9_$]*$**. If special characters are required, use single quotation marks ('') to enclose them.
partition_specs	Partition information, in the format of "key=value", where **key** indicates the partition field and **value** indicates the partition value. If a partition field contains multiple fields, the system displays all partition information that matches the partition field.

Precautions

The table specified in this statement must exist and must be a partitioned table. Otherwise, an error is reported.

Example

- To show all partitions in the **student** table, run the following statement:
  ```
  SHOW PARTITIONS student;
  ```
- Check the **dt='2010-10-10'** partition in the **student** table, run the following statement:
  ```
  SHOW PARTITIONS student PARTITION(dt='2010-10-10')
  ```

2.7.6 Viewing Table Statistics

Function

This statement is used to view the table statistics. The names and data types of all columns in a specified table will be returned.

Syntax

```
DESCRIBE [EXTENDED|FORMATTED] [db_name.]table_name;
```

Keyword

- EXTENDED: displays all metadata of the specified table. It is used during debugging in general.
- FORMATTED: displays all metadata of the specified table in a form.

Parameters

Table 2-21 Parameter description

Parameter	Description
db_name	Database name that contains letters, digits, and underscores (_). It cannot contain only digits or start with an underscore (_).
table_name	Table name of a database that contains letters, digits, and underscores (_). It cannot contain only digits or start with an underscore (_). The matching rule is **^(?!_)(?![0-9]+$)[A-Za-z0-9_$]*$**. If special characters are required, use single quotation marks ('') to enclose them.

Precautions

The to-be-queried table must exist. If this statement is used to query the information about a table that does not exist, an error is reported.

Example

To query the names and data types of all columns in the **student** table, run the following statement:

```
DESCRIBE student;
```

2.8 Modifying a Table

2.8.1 Adding a Column

Function

This statement is used to add one or more new columns to a table.

Syntax

```
ALTER TABLE [db_name.]table_name ADD COLUMNS (col_name1 col_type1 [COMMENT
col_comment1], ...);
```

Keyword

- ADD COLUMNS: columns to add
- COMMENT: column description

Parameters

Table 2-22 Parameter description

Parameter	Description
db_name	Database name that contains letters, digits, and underscores (_). It cannot contain only digits or start with an underscore (_).
table_name	Table name
col_name	Column name
col_type	Field type
col_comment	Column description

Precautions

Do not run this SQL statement concurrently. Otherwise, columns may be overwritten.

Example

```
ALTER TABLE t1 ADD COLUMNS (column2 int, column3 string);
```

2.8.2 Modifying Column Comments

Function

You can modify the column comments of non-partitioned or partitioned tables.

Syntax

```
ALTER TABLE [db_name.]table_name CHANGE COLUMN col_name col_name col_type COMMENT
'col_comment';
```

Keyword

- CHANGE COLUMN: Modify a column.
- COMMENT: column description

Parameters

Table 2-23 Parameter description

Parameter	Mandatory	Description
db_name	No	Database name. Only letters, digits, and underscores (_) are allowed. The name cannot contain only digits or start with an underscore (_).
table_name	Yes	Table name
col_name	Yes	Column name. The value must be the name of an existing column.
col_type	Yes	Column data type specified when the table is created, which cannot be modified.
col_comment	Yes	Column comment after modification. The comment can contain a maximum of 1024 bytes.

Example

Change the comment of the **c1** column in the **t1** table to **the new comment**.

```
ALTER TABLE t1 CHANGE COLUMN c1 c1 STRING COMMENT 'the new comment';
```

2.8.3 Enabling or Disabling Multiversion Backup

Function

DLI controls multiple versions of backup data for restoration. After the multiversion function is enabled, the system automatically backs up table data when you delete or modify the data using **insert overwrite** or **truncate**, and retains the data for a certain period. You can quickly restore data within the retention period. For details about the syntax related to the multiversion function, see **Backing Up and Restoring Data of Multiple Versions**.

Currently, the multiversion function supports only OBS tables created using the Hive syntax. For details about the syntax for creating a table, see **Creating an OBS Table Using the Hive Syntax**.

Syntax

- Enable the multiversion function.
  ```
  ALTER TABLE [db_name.]table_name
  SET TBLPROPERTIES ("dli.multi.version.enable"="true");
  ```
- Disable the multiversion function.
  ```
  ALTER TABLE [db_name.]table_name
  UNSET TBLPROPERTIES ("dli.multi.version.enable");
  ```

  After multiversion is enabled, data of different versions is automatically stored in the OBS storage directory when **insert overwrite** or **truncate** is executed.

After multiversion is disabled, run the following statement to restore the multiversion backup data directory:

```
RESTORE TABLE [db_name.]table_name TO initial layout;
```

Keyword

- SET TBLPROPERTIES: Used to set table properties and enable multiversion.
- UNSET TBLPROPERTIES: Used to unset table properties and disable multiversion.

Parameter

Table 2-24 Parameter description

Parameter	Description
db_name	Database name that contains letters, digits, and underscores (_). It cannot contain only digits or start with an underscore (_).
table_name	Table name

Precautions

Currently, the multiversion function supports only OBS tables created using the Hive syntax. For details about the syntax for creating a table, see **Creating an OBS Table Using the Hive Syntax**.

Example

- Modify the **test_table** table to enable multiversion.

```
ALTER TABLE test_table
SET TBLPROPERTIES ("dli.multi.version.enable"="true");
```

- Modify the **test_table** table to disable multiversion.

```
ALTER TABLE test_table
UNSET TBLPROPERTIES ("dli.multi.version.enable");
```

Restore the multiversion backup data directory.

```
RESTORE TABLE test_table TO initial layout;
```

2.9 Syntax for Partitioning a Table

2.9.1 Adding Partition Data (Only OBS Tables Supported)

Function

After an OBS partitioned table is created, no partition information is generated for the table. Partition information is generated only after you:

- Insert data to the OBS partitioned table. After the data is inserted successfully, the partition metadata can be queried, for example, by partition columns.

- Copy the partition directory and data into the OBS path of the partitioned table, and run the partition adding statements described in this section to generate partition metadata. Then you can perform operations such as table query by partition columns.

The following describes how to use the **ALTER TABLE** statement to add a partition.

Syntax

```
ALTER TABLE table_name ADD [IF NOT EXISTS]
  PARTITION partition_specs1
  [LOCATION 'obs_path1']
  PARTITION partition_specs2
  [LOCATION 'obs_path2'];
```

Keyword

- IF NOT EXISTS: prevents errors when partitions are repeatedly added.
- PARTITION: specifies a partition.
- LOCATION: specifies the partition path.

Parameters

Table 2-25 Parameter description

Parameter	Description
table_name	Table name
partition_specs	Partition fields
obs_path	OBS path

Precautions

- When you add a partition to a table, the table and the partition column (specified by PARTITIONED BY during table creation) must exist, and the partition to be added cannot be added repeatedly. Otherwise, an error is reported. You can use **IF NOT EXISTS** to avoid errors if the partition does not exist.
- If tables are partitioned by multiple fields, you need to specify all partitioning fields in any sequence when adding partitions.
- By default, parameters in **partition_specs** contain parentheses (). For example: **PARTITION (dt='2009-09-09',city='xxx')**.
- If you need to specify an OBS path when adding a partition, the OBS path must exist. Otherwise, an error occurs.
- To add multiple partitions, you need to use spaces to separate each set of **LOCATION 'obs_path'** in the **PARTITION partition_specs**. The following is an example:

PARTITION partition_specs LOCATION 'obs_path' PARTITION partition_specs LOCATION 'obs_path'

- If the path specified in the new partition contains subdirectories (or nested subdirectories), all file types and content in the subdirectories are considered partition records. Ensure that all file types and file content in the partition directory are the same as those in the table. Otherwise, an error is reported.

Example

- The following example shows you how to add partition data when the OBS table is partitioned by a single column.
  a. Use the DataSource syntax to create an OBS table, and partition the table by column **external_data**. The partition data is stored in **obs://bucketName/datapath**.
  ```
  create table testobstable(id varchar(128), external_data varchar(16)) using JSON OPTIONS (path 'obs://bucketName/datapath') PARTITIONED by (external_data);
  ```
  b. Copy the partition directory to **obs://bucketName/datapath**. In this example, copy all files in the partition column **external_data=22** to **obs://bucketName/datapath**.
  c. Run the following command to add partition data:
  ```
  ALTER TABLE testobstable ADD
    PARTITION (external_data='22')
    LOCATION 'obs://bucketName/datapath/external_data=22';
  ```
  d. After the partition data is added successfully, you can perform operations such as data query based on the partition column.
  ```
  select * from testobstable where external_data='22';
  ```
- The following example shows you how to add partition data when the OBS table is partitioned by multiple columns.
  a. Use the DataSource syntax to create an OBS table, and partition the table by columns **external_data** and **dt**. The partition data is stored in **obs://bucketName/datapath**.
  ```
  create table testobstable(
    id varchar(128),
    external_data varchar(16),
    dt varchar(16)
  ) using JSON OPTIONS (path 'obs://bucketName/datapath') PARTITIONED by (external_data, dt);
  ```
  b. Copy the partition directories to **obs://bucketName/datapath**. In this example, copy files in **external_data=22** and its subdirectory **dt=2021-07-27** to **obs://bucketName/datapath**.
  c. Run the following command to add partition data:
  ```
  ALTER TABLE
    testobstable
  ADD
    PARTITION (external_data = '22', dt = '2021-07-27') LOCATION 'obs://bucketName/datapath/external_data=22/dt=2021-07-27';
  ```
  d. After the partition data is added successfully, you can perform operations such as data query based on the partition columns.
  ```
  select * from testobstable where external_data = '22';
  select * from testobstable where external_data = '22' and dt='2021-07-27';
  ```


2.9.2 Renaming a Partition (Only OBS Tables Supported)

Function

This statement is used to rename partitions.

Syntax

```
ALTER TABLE table_name
  PARTITION partition_specs
  RENAME TO PARTITION partition_specs;
```

Keyword

- PARTITION: a specified partition
- RENAME: new name of the partition

Parameters

Table 2-26 Parameter description

Parameter	Description
table_name	Table name
partition_specs	Partition fields

Precautions

- **This statement is used for OBS table operations.**
- The table and partition to be renamed must exist. Otherwise, an error occurs. The name of the new partition must be unique. Otherwise, an error occurs.
- If a table is partitioned using multiple fields, you are required to specify all the fields of a partition (at random order) when renaming the partition.
- By default, the **partition_specs** parameter contains **()**. For example: **PARTITION (dt='2009-09-09',city='xxx')**

Example

To modify the name of the **city='xxx',dt='2008-08-08'** partition in the **student** table to **city='xxx',dt='2009-09-09'**, run the following statement:

```
ALTER TABLE student
  PARTITION (city='xxx',dt='2008-08-08')
  RENAME TO PARTITION (city='xxx',dt='2009-09-09');
```

2.9.3 Deleting a Partition

Function

Deletes one or more partitions from a partitioned table.

Precautions

- The table in which partitions are to be deleted must exist. Otherwise, an error is reported.
- The to-be-deleted partition must exist. Otherwise, an error is reported. To avoid this error, add **IF EXISTS** in this statement.

Syntax

```
ALTER TABLE [db_name.]table_name
  DROP [IF EXISTS]
  PARTITION partition_spec1[,PARTITION partition_spec2,...];
```

Keyword

- DROP: deletes a partition.
- IF EXISTS: The partition to be deleted must exist. Otherwise, an error is reported.
- PARTITION: specifies the partition to be deleted

Parameters

Table 2-27 Parameter description

Parameter	Description
db_name	Database name that contains letters, digits, and underscores (_). It cannot contain only digits and cannot start with an underscore (_).
table_name	Table name of a database that contains letters, digits, and underscores (_). It cannot contain only digits and cannot start with an underscore (_). The matching rule is **^(?!_)(?![0-9]+$)[A-Za-z0-9_$]*$**. If special characters are required, use single quotation marks ('') to enclose them.
partition_specs	Partition information, in the format of "key=value", where **key** indicates the partition field and **value** indicates the partition value. In a table partitioned using multiple fields, if you specify all the fields of a partition name, only the partition is deleted; if you specify only some fields of a partition name, all matching partitions will be deleted. By default, the **partition_specs** parameter contains **()**. For example: **PARTITION (dt='2009-09-09',city='xxx')**

Example

To delete the **dt = '2008-08-08', city = 'xxx'** partition in the **student** table, run the following statement:

```
ALTER TABLE student
  DROP
  PARTITION (dt = '2008-08-08', city = 'xxx');
```


2.9.4 Deleting Partitions by Specifying Filter Criteria (Only OBS Tables Supported)

Function

This statement is used to delete one or more partitions based on specified conditions.

Precautions

- **This statement is used for OBS table operations only.**
- The table in which partitions are to be deleted must exist. Otherwise, an error is reported.
- The to-be-deleted partition must exist. Otherwise, an error is reported. To avoid this error, add **IF EXISTS** in this statement.

Syntax

```
ALTER TABLE [db_name.]table_name
  DROP [IF EXISTS]
  PARTITIONS partition_filtercondition;
```

Keyword

- DROP: deletes specified partitions.
- IF EXISTS: Partitions to be deleted must exist. Otherwise, an error is reported.
- PARTITIONS: specifies partitions meeting the conditions

Parameters

Table 2-28 Parameter description

Parameter	Description
db_name	Database name that contains letters, digits, and underscores (_). It cannot contain only digits or start with an underscore (_).
table_name	Table name of a database that contains letters, digits, and underscores (_). It cannot contain only digits or start with an underscore (_). The matching rule is **^(?!_)(?![0-9]+$)[A-Za-z0-9_$]*$**. If special characters are required, use single quotation marks ('') to enclose them. **This statement is used for OBS table operations.**

Parameter	Description
partition_filter condition	Condition used to search partitions to be deleted. The format is as follows: • *Partition column name* **Operator** *Value to compare* Example: start_date < '201911' • <partition_filtercondition1> AND|OR <partition_filtercondition2> Example: start_date < '201911' OR start_date >= '202006' • (<partition_filtercondition1>) [,partitions (<partition_filtercondition2>), ...] Example: (start_date <> '202007'), partitions(start_date < '201912')

Example

You can run the following statements to delete partitions of the **student** table using different conditions:

```
alter table student drop partitions(start_date < '201911');
alter table student drop partitions(start_date >= '202007');
alter table student drop partitions(start_date BETWEEN '202001' AND '202007');
alter table student drop partitions(start_date < '201912' OR start_date >= '202006');
alter table student drop partitions(start_date > '201912' AND start_date <= '202004');
alter table student drop partitions(start_date != '202007');
alter table student drop partitions(start_date <> '202007');
alter table student drop partitions(start_date <> '202007'), partitions(start_date < '201912');
```

2.9.5 Altering the Partition Location of a Table (Only OBS Tables Supported)

Function

This statement is used to modify the positions of table partitions.

Syntax

```
ALTER TABLE table_name
  PARTITION partition_specs
  SET LOCATION obs_path;
```

Keyword

- PARTITION: a specified partition
- LOCATION: path of the partition

Parameters

Table 2-29 Parameter description

Parameter	Description
table_name	Table name
partition_specs	Partition fields
obs_path	OBS path

Precautions

- For a table partition whose position is to be modified, the table and partition must exist. Otherwise, an error is reported.
- By default, the **partition_specs** parameter contains **()**. For example: **PARTITION (dt='2009-09-09',city='xxx')**
- The specified OBS path must be an absolute path. Otherwise, an error is reported.
- If the path specified in the new partition contains subdirectories (or nested subdirectories), all file types and content in the subdirectories are considered partition records. Ensure that all file types and file content in the partition directory are the same as those in the table. Otherwise, an error is reported.

Example

To set the OBS path of partition **dt='2008-08-08',city='xxx'** in table **student** to **obs://bucketName/fileName/student/dt=2008-08-08/city=xxx**, run the following statement:

```
ALTER TABLE student
  PARTITION(dt='2008-08-08',city='xxx')
  SET LOCATION 'obs://bucketName/fileName/student/dt=2008-08-08/city=xxx';
```

2.9.6 Updating Partitioned Table Data (Only OBS Tables Supported)

Function

This statement is used to update the partition information about a table in the Metastore.

Syntax

```
MSCK REPAIR TABLE table_name;
```

Or

```
ALTER TABLE table_name RECOVER PARTITIONS;
```


Keyword

- PARTITIONS: partition information
- SERDEPROPERTIES: Serde attribute

Parameters

Table 2-30 Parameter description

Parameter	Description
table_name	Table name
partition_specs	Partition fields
obs_path	OBS path

Precautions

- This statement is applied only to partitioned tables. After you manually add partition directories to OBS, run this statement to update the newly added partition information in the metastore. The **SHOW PARTITIONS table_name** statement can be used to query the newly-added partitions.
- The partition directory name must be in the specified format, that is, **tablepath/partition_column_name=partition_column_value**.

Example

Run the following statements to update the partition information about table **ptable** in the Metastore:

```
MSCK REPAIR TABLE ptable;
```

Or

```
ALTER TABLE ptable RECOVER PARTITIONS;
```

2.9.7 Updating Table Metadata with REFRESH TABLE

Function

Spark caches Parquet metadata to improve performance. If you update a Parquet table, the cached metadata is not updated. Spark SQL cannot find the newly inserted data and an error similar with the following is reported:

```
DLI.0002: FileNotFoundException: getFileStatus on  error message
```

You can use REFRESH TABLE to solve this problem. REFRESH TABLE reorganizes files of a partition and reuses the original table metadata information to detect the increase or decrease of table fields. This statement is mainly used when the metadata in a table is not modified but the table data is modified.

Syntax

```
REFRESH TABLE [db_name.]table_name;
```

Keyword

None

Parameter

Table 2-31 Parameter description

Parameter	Description
db_name	Database name that contains letters, digits, and underscores (_). It cannot contain only digits or start with an underscore (_).
table_name	Table name of a database that contains letters, digits, and underscores (_). It cannot contain only digits or start with an underscore (_). The matching rule is **^(?!_)(?![0-9]+$)[A-Za-z0-9_$]*$**. If special characters are required, use single quotation marks ('') to enclose them.

Precautions

None

Example

Update metadata of the **test** table.

```
REFRESH TABLE test;
```

2.10 Importing Data to the Table

Function

The **LOAD DATA** function can be used to import data in **CSV**, **Parquet**, **ORC**, **JSON**, and **Avro** formats. The data is converted into the **Parquet** data format for storage.

Syntax

```
LOAD DATA INPATH 'folder_path' INTO TABLE [db_name.]table_name
  OPTIONS(property_name=property_value, ...);
```

Keyword

- INPATH: path of data to be imported
- OPTIONS: list of properties

Parameter

Table 2-32 Parameter description

Parameter	Description
folder_path	OBS path of the file or folder used for storing the raw data.
db_name	Enter the database name. If this parameter is not specified, the current database is used.
table_name	Name of the table to which data is to be imported.

The following configuration options can be used during data import:

- DATA_TYPE: specifies the type of data to be imported. Currently, **CSV**, **Parquet**, **ORC**, **JSON**, and **Avro** are supported. The default value is **CSV**.

  The configuration item is **OPTIONS** ('DATA_TYPE' = 'CSV').

  When importing a **CSV** file or a **JSON** file, you can select one of the following modes:

  - **PERMISSIVE**: When the **PERMISSIVE** mode is selected, the data of a column is set to **null** if its data type does not match that of the target table column.
  - **DROPMALFORMED**: When the **DROPMALFORMED** mode is selected, the data of a column s not imported if its data type does not match that of the target table column.
  - **FAILFAST**: When the **FAILFAST** mode is selected, exceptions might occur and the import may fail if a column type does not match.

  You can set the mode by adding **OPTIONS ('MODE' = 'PERMISSIVE')** to the **OPTIONS** parameter.
- **DELIMITER**: You can specify a separator in the import statement. The default value is **,**.

  The configuration item is **OPTIONS('DELIMITER'=',')**.

  For CSV data, the following delimiters are supported:

  - Tab character, for example, **'DELIMITER'='\t'**.
  - Any binary character, for example, **'DELIMITER'='\u0001(^A)'**.
  - Single quotation mark ('). A single quotation mark must be enclosed in double quotation marks (" "). For example, **'DELIMITER'= "'"**.
  - **\001(^A)** and **\017(^Q)** are also supported, for example, **'DELIMITER'='\001(^A)'** and **'DELIMITER'='\017(^Q)'**.
- **QUOTECHAR**: You can specify quotation marks in the import statement. The default value is double quotation marks (**"**).

  The configuration item is **OPTIONS('QUOTECHAR'='"')**.
- **COMMENTCHAR**: You can specify the comment character in the import statement. During the import operation, if a comment character is at the beginning of a row, the row is considered as a comment and will not be imported. The default value is a pound key (#).

The configuration item is *OPTIONS('COMMENTCHAR'='#')*.

- **HEADER**: Indicates whether the source file contains a header. Possible values can be **true** and **false**. **true** indicates that the source file contains a header, and **false** indicates that the source file does not contain a header. The default value is **false**. If no header exists, specify the **FILEHEADER** parameter in the **LOAD DATA** statement to add a header.

  The configuration item is *OPTIONS('HEADER'='true')*.

- **FILEHEADER**: If the source file does not contain any header, add a header to the **LOAD DATA** statement.

  OPTIONS('FILEHEADER'='column1,column2')

- **ESCAPECHAR**: Is used to perform strict verification of the escape character on CSV files. The default value is a slash (\\).

  The configuration item is OPTIONS. (ESCAPECHAR?=?\\?)

  NOTE

  Enter **ESCAPECHAR** in the CSV data. **ESCAPECHAR** must be enclosed in double quotation marks (" "). For example, "a\b".

- **MAXCOLUMNS**: This parameter is optional and specifies the maximum number of columns parsed by a CSV parser in a line.

  The configuration item is *OPTIONS('MAXCOLUMNS'='400')*.

  Table 2-33 MAXCOLUMNS

Name of the Optional Parameter	Default Value	Maximum Value
MAXCOLUMNS	2000	20000

  NOTE

  After the value of **MAXCOLUMNS Option** is set, data import will require the memory of **executor**. As a result, data may fail to be imported due to insufficient **executor** memory.

- **DATEFORMAT**: Specifies the date format of a column.

  OPTIONS('DATEFORMAT'='dateFormat')

  NOTE

  - The default value is yyyy-MM-dd.
  - The date format is specified by the date mode string of **Java**. For the Java strings describing date and time pattern, characters **A** to **Z** and **a** to **z** without single quotation marks (') are interpreted as pattern characters , which are used to represent date or time string elements. If the pattern character is quoted by single quotation marks ('), text matching rather than parsing is performed. For the definition of pattern characters in Java, see **Table 2-34**.

Table 2-34 Definition of characters involved in the date and time patterns

Character	Date or Time Element	Example
G	Epoch ID	AD
y	Year	1996; 96
M	Month	July; Jul; 07
w	Number of the week in a year	27 (the twenty-seventh week of the year)
W	Number of the week in a month	2 (the second week of the month)
D	Number of the day in a year	189 (the 189th day of the year)
d	Number of the day in a month	10 (the tenth day of the month)
u	Number of the day in a week	1 (Monday), ..., 7 (Sunday)
a	am/pm flag	pm (12:00-24:00)
H	Hour time (0-23)	2
h	Hour time (1-12)	12
m	Number of minutes	30
s	Number of seconds	55
S	Number of milliseconds	978
z	Time zone	Pacific Standard Time; PST; GMT-08:00

- **TIMESTAMPFORMAT**: Specifies the timestamp format of a column.
  OPTIONS('TIMESTAMPFORMAT'='timestampFormat')

  NOTE

  - Default value: yyyy-MM-dd HH:mm:ss.
  - The timestamp format is specified by the Java time pattern character string. For details, see **Table 3 Definition of date and time pattern characters**.

- **Mode**: Specifies the processing mode of error records while importing. The options are as follows: **PERMISSIVE**, **DROPMALFORMED**, and **FAILFAST**.
  OPTIONS('MODE'='permissive')

NOTE

- **PERMISSIVE (default)**: Parse bad records as much as possible. If a field cannot be converted, the entire row is null.
- **DROPMALFORMED**: Ignore the **bad records** that cannot be parsed.
- **FAILFAST**: If a record cannot be parsed, an exception is thrown and the job fails.

- **BADRECORDSPATH**: Specifies the directory for storing error records during the import.

  OPTIONS('BADRECORDSPATH'='obs://bucket/path')

  NOTE

  It is recommended that this option be used together with the **DROPMALFORMED** pattern to import the records that can be successfully converted into the target table and store the records that fail to be converted to the specified error record storage directory.

Precautions

- When importing or creating an OBS table, you must specify a folder as the directory. If a file is specified, data import may be failed.
- Only the raw data stored in the OBS path can be imported.
- You are advised not to concurrently import data in to a table. If you concurrently import data into a table, there is a possibility that conflicts occur, leading to failed data import.
- Only one path can be specified during data import. The path cannot contain commas (,).
- If a folder and a file with the same name exist in the OBS bucket directory, the data is preferentially to be imported directed to the file rather than the folder.
- When importing data of the PARQUET, ORC, or JSON format, you must specify *DATA_TYPE*. Otherwise, the data is parsed into the default format **CSV**. In this case, the format of the imported data is incorrect.
- If the data to be imported is in the CSV or JSON format and contains the date and columns, you need to specify *DATEFORMAT* and *TIMESTAMPFORMAT*. Otherwise, the data will be parsed into the default date and timestamp formats.

Example

NOTE

Before importing data, you must create a table. For details, see **Creating an OBS Table** or **Creating a DLI Table**.

- To import a CSV file to a DLI table named **t**, run the following statement:

```
LOAD DATA INPATH 'obs://dli/data.csv' INTO TABLE t
  OPTIONS('DELIMITER'=',' , 'QUOTECHAR'='"','COMMENTCHAR'='#','HEADER'='false');
```

- To import a JSON file to a DLI table named **jsontb**, run the following statement:

```
LOAD DATA INPATH 'obs://dli/alltype.json' into table jsontb
  OPTIONS('DATA_TYPE'='json','DATEFORMAT'='yyyy/MM/dd','TIMESTAMPFORMAT'='yyyy/MM/dd
HH:mm:ss');
```

2.11 Inserting Data

Function

This statement is used to insert the SELECT query result or a certain data record into a table.

Syntax

- Insert the SELECT query result into a table.

```
INSERT INTO [TABLE] [db_name.]table_name
  [PARTITION part_spec] select_statement;
INSERT OVERWRITE TABLE [db_name.]table_name
  [PARTITION part_spec] select_statement;
part_spec:
  : (part_col_name1=val1 [, part_col_name2=val2, ...])
```

- Insert a data record into a table.

```
INSERT INTO [TABLE] [db_name.]table_name
  [PARTITION part_spec] VALUES values_row [, values_row ...];
INSERT OVERWRITE TABLE [db_name.]table_name
  [PARTITION part_spec] VALUES values_row [, values_row ...];
values_row:
  : (val1 [, val2, ...])
```

Keyword

Table 2-35 INSERT parameter description

Parameter	Description
db_name	Name of the database where the target table resides.
table_name	Name of the target table.
part_spec	Detailed partition information. If there are multiple partition fields, all fields must be contained, but the corresponding values are optional. The system matches the corresponding partition. A maximum of 100,000 partitions can be created in a single table.
select_statement	SELECT query on the source table (DLI and OBS tables).
values_row	Value to be inserted to a table. Use commas (,) to separate columns.

Precautions

- The target DLI table must exist.
- If no partition needs to be specified for dynamic partitioning, place **part_spec** in the SELECT statement as a common field.
- During creation of the target OBS table, only the folder path can be specified.
- The source table and the target table must have the same data types and column field quantity. Otherwise, data insertion fails.

- You are advised not to concurrently insert data into a table. If you concurrently insert data into a table, there is a possibility that conflicts occur, leading to failed data insertion.
- The **INSERT INTO** statement is used to add the query result to the target table.
- The **INSERT OVERWRITE** statement is used to overwrite existing data in the source table.
- The **INSERT INTO** statement can be batch executed, but the **INSERT OVERWRITE** statement can be batch executed only when data of different partitioned tables is inserted to different static partitions.
- The **INSERT INTO** and **INSERT OVERWRITE** statements can be executed at the same time. However, the result is unknown.
- When you insert data of the source table to the target table, you cannot import or update data of the source table.
- The dynamic INSERT OVERWRITE statement of Hive partitioned tables can overwrite the involved partition data but cannot overwrite the entire table data.
- To overwrite data in a specified partition of the datasource table, set **dli.sql.dynamicPartitionOverwrite.enabled** to **true** and run the **insert overwrite** statement. The default value of **dli.sql.dynamicPartitionOverwrite.enabled** is **false**, indicating that data in the entire table is overwritten. The following is an example:

```
insert overwrite table tb1 partition(part1='v1', part2='v2') select * from ...
```

  NOTE

  On the DLI management console, click **SQL Editor**. In the upper right corner of the editing window, click **Settings** to configure parameters.

- You can configure the **spark.sql.shuffle.partitions** parameter to set the number of files to be inserted into the OBS bucket in the non-DLI table. In addition, to avoid data skew, you can add **distribute by rand()** to the end of the INSERT statement to increase the number of concurrent jobs. The following is an example:

```
insert into table table_target select * from table_source distribute by cast(rand() * N as int);
```

Example

NOTE

Before importing data, you must create a table. For details, see **Creating an OBS Table** or **Creating a DLI Table**.

- Insert the SELECT query result into a table.
  - Use the DataSource syntax to create a parquet partitioned table.

    ```
    CREATE TABLE data_source_tab1 (col1 INT, p1 INT, p2 INT)
      USING PARQUET PARTITIONED BY (p1, p2);
    ```

  - Insert the query result to the partition (p1 = 3, p2 = 4).

    ```
    INSERT INTO data_source_tab1 PARTITION (p1 = 3, p2 = 4)
      SELECT id FROM RANGE(1, 3);
    ```

  - Insert the new query result to the partition (p1 = 3, p2 = 4).

    ```
    INSERT OVERWRITE TABLE data_source_tab1 PARTITION (p1 = 3, p2 = 4)
      SELECT id FROM RANGE(3, 5);
    ```

- Insert a data record into a table.

- Create a Parquet partitioned table with Hive format
```
CREATE TABLE hive_serde_tab1 (col1 INT, p1 INT, p2 INT)
 USING HIVE OPTIONS(fileFormat 'PARQUET') PARTITIONED BY (p1, p2);
```
- Insert two data records into the partition (p1 = 3, p2 = 4).
```
INSERT INTO hive_serde_tab1 PARTITION (p1 = 3, p2 = 4)
 VALUES (1), (2);
```
- Insert new data to the partition (p1 = 3, p2 = 4).
```
INSERT OVERWRITE TABLE hive_serde_tab1 PARTITION (p1 = 3, p2 = 4)
 VALUES (3), (4);
```

2.12 Clearing Data

Function

This statement is used to delete data from the DLI or OBS table.

Syntax

```
TRUNCATE TABLE tablename [PARTITION (partcol1=val1, partcol2=val2 ...)];
```

Keyword

Table 2-36 Parameter

Parameter	Description
tablename	Name of the target DLI or OBS table that runs the **Truncate** statement.
partcol1	Partition name of the DLI or OBS table to be deleted.

Precautions

Only data in the DLI or OBS table can be deleted.

Example

```
truncate table test PARTITION (class = 'test');
```

2.13 Exporting Search Results

Function

This statement is used to directly write query results to a specified directory. The query results can be stored in CSV, Parquet, ORC, JSON, or Avro format.

Syntax

```
INSERT OVERWRITE DIRECTORY path
 USING file_format
 [OPTIONS(key1=value1)]
 select_statement;
```


Keyword

- USING: Specifies the storage format.
- OPTIONS: Specifies the list of attributes to be exported. This parameter is optional.

Parameter

Table 2-37 INSERT OVERWRITE DIRECTORY parameter description

Parameter	Description
path	The OBS path to which the query result is to be written.
file_format	Format of the file to be written. The value can be CSV, Parquet, ORC, JSON, or Avro.

NOTE

If the file format is set to **CSV**, see the **Table 2-9** for the OPTIONS parameters.

Precautions

- You can configure the **spark.sql.shuffle.partitions** parameter to set the number of files to be inserted into the OBS bucket in the non-DLI table. In addition, to avoid data skew, you can add **distribute by rand()** to the end of the INSERT statement to increase the number of concurrent jobs. The following is an example:
  ```
  insert into table table_target select * from table_source distribute by cast(rand() * N as int);
  ```
- When the configuration item is **OPTIONS('DELIMITER'=',')**, you can specify a separator. The default value is **,**.

  For CSV data, the following delimiters are supported:
  - Tab character, for example, **'DELIMITER'='\t'**.
  - Any binary character, for example, **'DELIMITER'='\u0001(^A)'**.
  - Single quotation mark ('). A single quotation mark must be enclosed in double quotation marks (" "). For example, **'DELIMITER'= "'"**.
  - **\001(^A)** and **\017(^Q)** are also supported, for example, **'DELIMITER'='\001(^A)'** and **'DELIMITER'='\017(^Q)'**.

Example

```
INSERT OVERWRITE DIRECTORY 'obs://bucket/dir'
  USING csv
  OPTIONS(key1=value1)
  select * from db1.tb1;
```

2.14 Backing Up and Restoring Data of Multiple Versions

2.14.1 Setting the Retention Period for Multiversion Backup Data

Function

After multiversion is enabled, backup data is retained for seven days by default. You can change the retention period by setting system parameter **dli.multi.version.retention.days**. Multiversion data out of the retention period will be automatically deleted when the **insert overwrite** or **truncate** statement is executed. You can also set table attribute **dli.multi.version.retention.days** to adjust the retention period when adding a column or modifying a partitioned table.

For details about the syntax for enabling or disabling the multiversion function, see **Enabling or Disabling Multiversion Backup**.

Currently, the multiversion function supports only OBS tables created using the Hive syntax. For details about the syntax for creating a table, see **Creating an OBS Table Using the Hive Syntax**.

Syntax

```
ALTER TABLE [db_name.]table_name
SET TBLPROPERTIES ("dli.multi.version.retention.days"="days");
```

Keyword

- TBLPROPERTIES: This keyword is used to add a **key/value** property to a table.

Parameter

Table 2-38 Parameter description

Parameter	Description
db_name	Database name, which consists of letters, digits, and underscores (_). The value cannot contain only digits or start with a digit or underscore (_).
table_name	Table name
days	Date when the multiversion backup data is reserved. The default value is 7 days. The value ranges from 1 to 7 days.

Precautions

Currently, the multiversion function supports only OBS tables created using the Hive syntax. For details about the syntax for creating a table, see **Creating an OBS Table Using the Hive Syntax**.

Example

Set the retention period of multiversion backup data to 5 days.

```
ALTER TABLE test_table
SET TBLPROPERTIES ("dli.multi.version.retention.days"="5");
```

2.14.2 Viewing Multiversion Backup Data

Function

After the multiversion function is enabled, you can run the **SHOW HISTORY** command to view the backup data of a table. For details about the syntax for enabling or disabling the multiversion function, see **Enabling or Disabling Multiversion Backup**.

Currently, the multiversion function supports only OBS tables created using the Hive syntax. For details about the syntax for creating a table, see **Creating an OBS Table Using the Hive Syntax**.

Syntax

- View the backup data of a non-partitioned table.
  ```
  SHOW HISTORY FOR TABLE [db_name.]table_name;
  ```
- View the backup data of a specified partition.
  ```
  SHOW HISTORY FOR TABLE [db_name.]table_name PARTITION (column = value, ...);
  ```

Keyword

- SHOW HISTORY FOR TABLE: Used to view backup data
- PARTITION: Used to specify the partition column

Parameter

Table 2-39 Parameter description

Parameter	Description
db_name	Database name, which consists of letters, digits, and underscores (_). The value cannot contain only digits or start with a digit or underscore (_).
table_name	Table name
column	Partition column name
value	Value corresponding to the partition column name

Precautions

Currently, the multiversion function supports only OBS tables created using the Hive syntax. For details about the syntax for creating a table, see **Creating an OBS Table Using the Hive Syntax**.

Example

- View multiversion backup data of the **test_table** table.

```
SHOW HISTORY FOR TABLE test_table;
```

- View multiversion backup data of the **dt** partition in the **test_table** partitioned table.

```
SHOW HISTORY FOR TABLE test_table PARTITION (dt='2021-07-27');
```

2.14.3 Restoring Multiversion Backup Data

Function

After the multiversion function is enabled, you can run the **RESTORE TABLE** statement to restore a table or partition of a specified version. For details about the syntax for enabling or disabling the multiversion function, see **Enabling or Disabling Multiversion Backup**.

Currently, the multiversion function supports only OBS tables created using the Hive syntax. For details about the syntax for creating a table, see **Creating an OBS Table Using the Hive Syntax**.

Syntax

- Restore the non-partitioned table data to the backup data of a specified version.

```
RESTORE TABLE [db_name.]table_name TO VERSION 'version_id';
```

- Restore the data of a single partition in a partitioned table to the backup data of a specified version.

```
RESTORE TABLE [db_name.]table_name PARTITION (column = value, ...) TO VERSION 'version_id';
```

Keyword

- RESTORE TABLE: Used to restore backup data
- PARTITION: Used to specify the partition column
- TO VERSION: Used to specify the version number You can run the **SHOW HISTORY** command to obtain the version number. For details, see **Viewing Multiversion Backup Data**.

Parameter

Table 2-40 Parameter description

Parameter	Description
db_name	Database name, which consists of letters, digits, and underscores (_). The value cannot contain only digits or start with a digit or underscore (_).
table_name	Table name
column	Partition column name
value	Value corresponding to the partition column name
version_id	Target version of the backup data to be restored You can run the **SHOW HISTORY** command to obtain the version number. For details, see **Viewing Multiversion Backup Data**.

Precautions

Currently, the multiversion function supports only OBS tables created using the Hive syntax. For details about the syntax for creating a table, see **Creating an OBS Table Using the Hive Syntax**.

Example

- Restore the data in non-partitioned table **test_table** to version 20210930.
  ```
  RESTORE TABLE test_table TO VERSION '20210930';
  ```
- Restore the data of partition **dt** in partitioned table **test_table** to version 20210930.
  ```
  RESTORE TABLE test_table PARTITION (dt='2021-07-27') TO VERSION '20210930';
  ```

2.14.4 Configuring the Trash Bin for Expired Multiversion Data

Function

After the multiversion function is enabled, expired backup data will be directly deleted by the system when the **insert overwrite** or **truncate** statement is executed. You can configure the trash bin of the OBS parallel file system to accelerate the deletion of expired backup data. To enable the trash bin, add **dli.multi.version.trash.dir** to the table properties. For details about the syntax for enabling or disabling the multiversion function, see **Enabling or Disabling Multiversion Backup**.

Currently, the multiversion function supports only OBS tables created using the Hive syntax. For details about the syntax for creating a table, see **Creating an OBS Table Using the Hive Syntax**.

Syntax

```
ALTER TABLE [db_name.]table_name
SET TBLPROPERTIES ("dli.multi.version.trash.dir"="OBS bucket for expired multiversion backup data");
```

Keyword

- TBLPROPERTIES: This keyword is used to add a **key/value** property to a table.

Parameter

Table 2-41 Parameter description

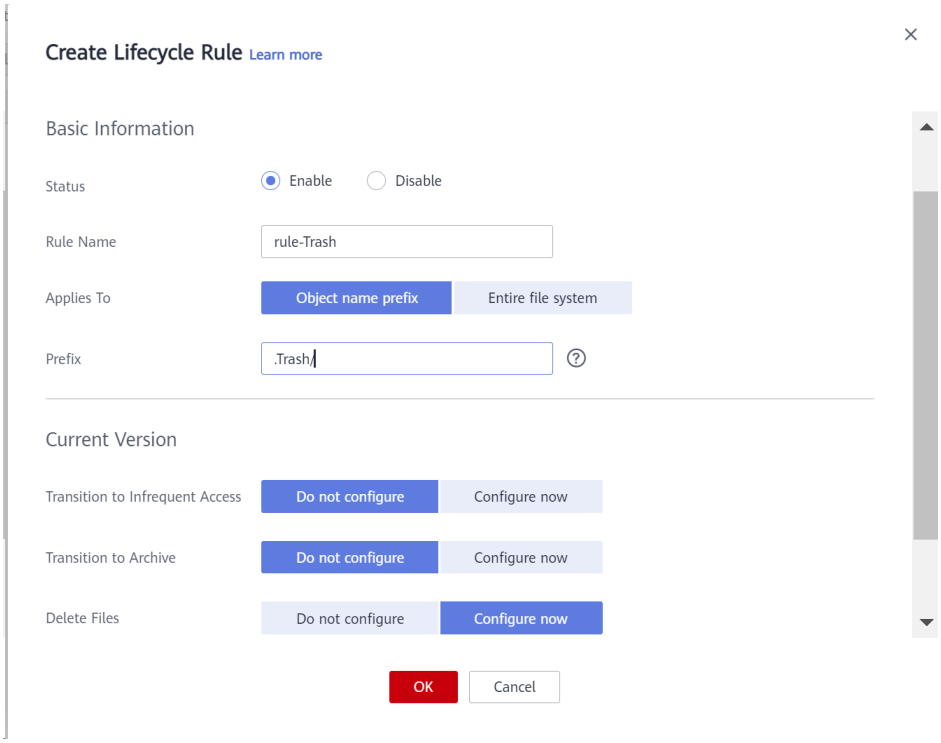
Parameter	Description
db_name	Database name, which consists of letters, digits, and underscores (_). The value cannot contain only digits or start with a digit or underscore (_).
table_name	Table name

Parameter	Description
OBS bucket for expired multiversion backup data	A directory in the bucket where the current OBS table locates. You can change the directory path as needed. For example, if the current OBS table directory is **obs://bucketName/filePath** and a **Trash** directory has been created in the OBS table directory, you can set the trash bin directory to **obs://bucketName/filePath/Trash**.

Precautions

- Currently, the multiversion function supports only OBS tables created using the Hive syntax. For details about the syntax for creating a table, see **Creating an OBS Table Using the Hive Syntax**.
- To automatically empty the trash bin, you need to configure a lifecycle rule for the bucket of the OBS parallel file system. The procedure is as follows:
  a. On the OBS console, choose **Parallel File System** in the left navigation pane. Click the name of the target file system. The **Overview** page is displayed.
  b. In the left navigation pane, choose **Basic Configurations** > **Lifecycle Rules** to create a lifecycle rule.

  Figure 2-1 Creating a lifecycle rule



Example

Configure the trash bin to accelerate the deletion of expired backup data. The data is dumped to the **/.Trash** directory in OBS.

```
ALTER TABLE test_table
SET TBLPROPERTIES ("dli.multi.version.trash.dir"="/.Trash");
```

2.14.5 Deleting Multiversion Backup Data

Function

The retention period of multiversion backup data takes effect each time the **insert overwrite** or **truncate** statement is executed. If neither statement is executed for the table, multiversion backup data out of the retention period will not be automatically deleted. You can run the SQL commands described in this section to manually delete multiversion backup data.

Syntax

Delete multiversion backup data out of the retention period.

```
clear history for table [db_name.]table_name older_than 'timestamp';
```

Keyword

- clear history for table: Used to delete multiversion backup data
- older_than: Used to specify the time range for deleting multiversion backup data

Parameter

Table 2-42 Parameter description

Parameter	Description
db_name	Database name, which consists of letters, digits, and underscores (_). The value cannot contain only digits or start with a digit or underscore (_).
table_name	Table name
Timestamp	Multiversion backup data generated before the timestamp will be deleted. Timestamp format: yyyy-MM-dd HH:mm:ss

Precautions

- Currently, the multiversion function supports only OBS tables created using the Hive syntax. For details about the syntax for creating a table, see **Creating an OBS Table Using the Hive Syntax**.
- This statement does not delete the backup data of the current version.

Example

Delete the multiversion backup data generated before 2021-09-25 23:59:59 in the **dliTable** table. When the multiversion backup data is generated, a timestamp is generated.

```
clear history for table dliTable older_than '2021-09-25 23:59:59';
```


2.15 Table Lifecycle Management

2.15.1 Specifying the Lifecycle of a Table When Creating the Table

Function

DLI provides table lifecycle management to allow you to specify the lifecycle of a table when creating the table. DLI determines whether to reclaim a table based on the table's last modification time and its lifecycle. By setting the lifecycle of a table, you can better manage a large number of tables, automatically delete data tables that are no longer used for a long time, and simplify the process of reclaiming data tables. Additionally, data restoration settings are supported to prevent data loss caused by misoperations.

Table Reclamation Rules

- When creating a table, use **TBLPROPERTIES** to specify the lifecycle of the table.
  - **Non-partitioned table**

    If the table is not a partitioned table, the system determines whether to reclaim the table after the lifecycle time based on the last modification time of the table.
  - **Partitioned table**

    If the table is a partitioned table, the system determines whether the partition needs to be reclaimed based on the last modification time (LAST_ACCESS_TIME) of the partition. After the last partition of a partitioned table is reclaimed, the table is not deleted.

    Only table-level lifecycle management is supported for partitioned tables.
- Lifecycle reclamation starts at a specified time every day to scan all partitions.

  Lifecycle reclamation starts at a specified time every day. Reclamation only occurs if the last modification time of the table data (**LAST_ACCESS_TIME**) detected when scanning complete partitions exceeds the time specified by the lifecycle.

  Assume that the lifecycle of a partitioned table is one day and the last modification time of the partitioned data is 15:00 on May 20, 2023. If the table is scanned before 15:00 on May 20, 2023 (less than one day), the partitions in the table will not be reclaimed. If the last data modification time (**LAST_ACCESS_TIME**) of a table partition exceeds the time specified by the lifecycle during reclamation scan on May 20, 2023, the partition will be reclaimed.
- The lifecycle function periodically reclaims tables or partitions, which are reclaimed irregularly every day depending on the level of busyness of the service. It cannot ensure that a table or partition will be reclaimed immediately after its lifecycle expires.

- After a table is deleted, all properties of the table, including the lifecycle, will be deleted. After a table with the same name is created again, the lifecycle of the table will be determined by the new property.

Constraints and Limitations

- The table lifecycle function is currently in the open beta test (OBT) phase. If necessary, contact customer service to whitelist it.
- Before using the lifecycle function, log in to the DLI console, choose **Global Configuration** > **Service Authorization**, select **Tenant Administrator(Project-level)**, and click **Update** on the **Assign Agency Permissions** page.
- The table lifecycle function currently only supports creating tables and versioning tables using Hive and Datasource syntax.
- The unit of the lifecycle is in days. The value should be a positive integer.
- The lifecycle can be set only at the table level. The lifecycle specified for a partitioned table applies to all partitions of the table.
- After the lifecycle is set, DLI and OBS tables will support data backup. The backup directory for OBS tables needs to be set manually. The backup directory must be in the parallel file system and in the same bucket as the original table directory. It cannot have the same directory or subdirectory name as the original table.

Syntax

- **Creating a DLI table using the Datasource syntax**

```
CREATE TABLE table_name(name string, id int)
USING parquet
TBLPROPERTIES( "dli.lifecycle.days"=1 );
```

- **Creating a DLI table using the Hive syntax**

```
CREATE TABLE table_name(name string, id int)
stored as parquet
TBLPROPERTIES( "dli.lifecycle.days"=1 );
```

- **Creating an OBS table using the Datasource syntax**

```
CREATE TABLE table_name(name string, id int)
USING parquet
OPTIONS (path "obs://dli-test/table_name")
TBLPROPERTIES( "dli.lifecycle.days"=1, "external.table.purge"='true', "dli.lifecycle.trash.dir"='obs://dli-test/Lifecycle-Trash' );
```

- **Creating an OBS table using the Hive syntax**

```
CREATE TABLE table_name(name string, id int)
STORED AS parquet
LOCATION 'obs://dli-test/table_name'
TBLPROPERTIES( "dli.lifecycle.days"=1, "external.table.purge"='true', "dli.lifecycle.trash.dir"='obs://dli-test/Lifecycle-Trash' );
```

Keywords

- **TBLPROPERTIES**: Table properties, which can be used to extend the lifecycle of a table.
- **OPTIONS**: path of the new table, which is applicable to OBS tables created using the Datasource syntax.
- **LOCATION**: path of the new table, which is applicable to OBS tables created using the Hive syntax.

Parameters

Table 2-43 Parameters

Parameter	Mandatory	Description
table_name	Yes	Name of the table whose lifecycle needs to be set
dli.lifecycle.days	Yes	Lifecycle duration. The value must be a positive integer, in days.
external.table.purge	No	This parameter is available only for OBS tables. Whether to clear data in the path when deleting a table or partition. The data is not cleared by default. When this parameter is set to **true**: • After a file is deleted from a non-partitioned OBS table, the table directory is also deleted. • The custom partition data in the partitioned OBS table is also deleted.
dli.lifecycle.trash.dir	No	This parameter is available only for OBS tables. When **external.table.purge** is set to **true**, the backup directory will be deleted. By default, backup data is deleted seven days later.

Example

- **Create the test_datasource_lifecycle table using the Datasource syntax. The lifecycle is set to 100 days.**

```
CREATE TABLE test_datasource_lifecycle(id int)
USING parquet
TBLPROPERTIES( "dli.lifecycle.days"=100);
```

- **Create the test_hive_lifecycle table using the Hive syntax. The lifecycle is set to 100 days.**

```
CREATE TABLE test_hive_lifecycle(id int)
stored as parquet
TBLPROPERTIES( "dli.lifecycle.days"=100);
```

- **Create the test_datasource_lifecycle_obs table using the Datasource syntax. The lifecycle is set to 100 days. When the lifecycle expires, data is deleted by default and backed up to the obs://dli-test/ directory.**

```
CREATE TABLE test_datasource_lifecycle_obs(name string, id int)
USING parquet
OPTIONS (path "obs://dli-test/xxx")
TBLPROPERTIES( "dli.lifecycle.days"=100, "external.table.purge"='true', "dli.lifecycle.trash.dir"='obs://dli-test/Lifecycle-Trash' );
```

- **Create the test_hive_lifecycle_obs table using the Hive syntax. The lifecycle is set to 100 days. When the lifecycle expires, data is deleted by default and backed up to the obs://dli-test/ directory.**

```
CREATE TABLE test_hive_lifecycle_obs(name string, id int)
STORED AS parquet
LOCATION 'obs://dli-test/xxx'
TBLPROPERTIES( "dli.lifecycle.days"=100, "external.table.purge"='true', "dli.lifecycle.trash.dir"='obs://dli-test/Lifecycle-Trash' );
```

2.15.2 Modifying the Lifecycle of a Table

Function

This section describes how to modify the lifecycle of an existing partitioned or non-partitioned table.

When the lifecycle function is enabled for the first time, the system scans tables or partitions, scans table data files in the path, and updates **LAST_ACCESS_TIME** of tables or partitions. The time required depends on the number of partitions and files.

Constraints and Limitations

- The table lifecycle function is currently in the OBT phase. If necessary, contact customer service to whitelist it.
- The table lifecycle function currently only supports creating tables and versioning tables using Hive and Datasource syntax.
- The unit of the lifecycle is in days. The value should be a positive integer.
- The lifecycle can be set only at the table level. The lifecycle specified for a partitioned table applies to all partitions of the table.

Syntax

```
ALTER TABLE table_name
SET TBLPROPERTIES("dli.lifecycle.days"='N')
```

Keywords

TBLPROPERTIES: Table properties, which can be used to extend the lifecycle of a table.

Parameters

Table 2-44 Parameters

Parameter	Mandatory	Description
table_name	Yes	Name of the table whose lifecycle needs to be modified
dli.lifecycle.days	Yes	Lifecycle duration after the modification. The value must be a positive integer, in days.

Example

- Example 1: Enable the lifecycle function for the **test_lifecycle_exists** table and set the lifecycle to 50 days.
```
alter table test_lifecycle_exists
SET TBLPROPERTIES("dli.lifecycle.days"='50');
```
- Example 2: Enable the lifecycle function for an existing partitioned or non-partitioned table for which lifecycle is not set, for example, for the **test_lifecycle_exists** table, and set the lifecycle to 50 days.
```
alter table test_lifecycle_exists
SET TBLPROPERTIES(
    "dli.lifecycle.days"='50',
    "dli.table.lifecycle.status"='enable'
);
```

2.15.3 Disabling or Restoring the Lifecycle of a Table

Function

This section describes how to disable or restore the lifecycle of a specified table or partition.

You can disable or restore the lifecycle of a table in either of the following scenarios:

1. If the lifecycle function has been enabled for a table or partitioned table, the system allows you to disable or restore the lifecycle of the table by changing the value of **dli.table.lifecycle.status**.
2. If the lifecycle function is not enabled for a table or partitioned table, the system will add the **dli.table.lifecycle.status** property to allow you to disable or restore the lifecycle function of the table.

Constraints and Limitations

- The table lifecycle function is currently in the open beta test (OBT) phase. If necessary, contact customer service to whitelist it.
- The table lifecycle function currently only supports creating tables and versioning tables using Hive and Datasource syntax.
- The unit of the lifecycle is in days. The value should be a positive integer.
- The lifecycle can be set only at the table level. The lifecycle specified for a partitioned table applies to all partitions of the table.

Syntax

- This syntax can be used to disable or restore the lifecycle of a table at the table level.
```
ALTER TABLE table_name SET TBLPROPERTIES("dli.table.lifecycle.status"={enable|disable});
```
- This syntax can be used to disable or restore the lifecycle of a specified table at the table or partition table level.
```
ALTER TABLE table_name [pt_spec] LIFECYCLE {enable|disable};
```


Keywords

TBLPROPERTIES: Table properties, which can be used to extend the lifecycle of a table.

Parameters

Table 2-45 Parameters

Parameter	Mandatory	Description
table_name	Yes	Name of the table whose lifecycle is to be disabled or restored
pt_spec	No	Partition information of the table whose lifecycle is to be disabled or restored. The format is **partition_col1=col1_value1, partition_col2=col2_value1...**. For a table with multi-level partitions, all partition values must be specified.
enable	No	Restores the lifecycle function of a table or a specified partition. • The table and its partitions participate in lifecycle reclamation again. By default, the lifecycle configuration of the current table and its partitions is used. • Before enabling the table lifecycle function, it is recommended to modify the lifecycle configuration of the table and its partitions. This will help prevent any accidental data reclamation caused by the previous configuration once the table lifecycle function is enabled.

Parameter	Mandatory	Description
disable	No	Disables the lifecycle function of a table or a specified partition. ● Prevents a table and all its partitions from being reclaimed by the lifecycle. It takes priority over restoring the lifecycle of a table and its partitions. That is, when the lifecycle function of a table or a specified partition is disabled, the partition information of the table whose lifecycle is to be disabled or restored is invalid. ● After the lifecycle function of a table is disabled, the lifecycle configuration of the table and the enable and disable flags of its partitions are retained. ● After the lifecycle function of a table is disabled, the lifecycle configuration of the table and partitioned table can still be modified.

Example

- Example 1: Disable the lifecycle function of the **test_lifecycle** table.
  ```
  alter table test_lifecycle SET TBLPROPERTIES("dli.table.lifecycle.status"='disable');
  ```
- Example 2: Disable the lifecycle function for the partition whose time is **20230520** in the **test_lifecycle** table.
  ```
  alter table test_lifecycle partition (dt='20230520') LIFECYCLE 'disable';
  ```

  NOTE

  - After the lifecycle function of a partitioned table is disabled, the lifecycle function of all partitions within the table will also be disabled.

2.16 Creating a Datasource Connection with an HBase Table

2.16.1 Creating a DLI Table and Associating It with HBase

Function

This statement is used to create a DLI table and associate it with an existing HBase table.

NOTE

In Spark cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

For details about datasource authentication, see **Introduction to Datasource Authentication**.

Prerequisites

- Before creating a DLI table and associating it with HBase, you need to create a datasource connection. For details about operations on the management console, see **Enhanced Datasource Connection**.
- Ensure that the **/etc/hosts** information of the master node in the MRS cluster is added to the host file of the DLI queue.

  For details about how to add an IP-domain mapping, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.
- The syntax is not supported for security clusters.

Syntax

- Single row key

```
CREATE TABLE [IF NOT EXISTS] TABLE_NAME (
  ATTR1 TYPE,
  ATTR2 TYPE,
  ATTR3 TYPE)
  USING [CLOUDTABLE | HBASE] OPTIONS (
  'ZKHost'='xx',
  'TableName'='TABLE_IN_HBASE',
  'RowKey'='ATTR1',
  'Cols'='ATTR2:CF1.C1, ATTR3:CF1.C2');
```

- Combined row key

```
CREATE TABLE [IF NOT EXISTS] TABLE_NAME (
  ATTR1 String,
  ATTR2 String,
  ATTR3 TYPE)
  USING [CLOUDTABLE | HBASE] OPTIONS (
  'ZKHost'='xx',
  'TableName'='TABLE_IN_HBASE',
  'RowKey'='ATTR1:2, ATTR2:10',
  'Cols'='ATTR2:CF1.C1, ATTR3:CF1.C2'
```

Keyword

Table 2-46 CREATE TABLE parameter description

Parameter	Description
USING [CLOUDTABLE | HBASE]	Specify the HBase datasource to CLOUDTABLE or HBASE. The value is case insensitive.

Parameter	Description
ZKHost	ZooKeeper IP address of the HBase cluster. Before obtaining the ZooKeeper IP address, you need to create a datasource connection first.For details about operations on the management console, see **Enhanced Datasource Connections**. • Access the CloudTable cluster and enter the ZooKeeper IP address (internal network). • To access the MRS cluster, enter the IP address of the node where the ZooKeeper is located and the external port number of the ZooKeeper. The format is **ZK_IP1:ZK_PORT1,ZK_IP2:ZK_PORT2**. **NOTE** To connect to an MRS cluster, you can create an enhanced datasource connection and configure host information. For details about operations on the management console, see **Enhanced Datasource Connection**. For related API reference, see **Creating an Enhanced Datasource Connections**.
TableName	Specifies the name of a table that has been created in the HBase cluster.
RowKey	Specifies the row key field of the table connected to DLI. The single and composite row keys are supported. A single row key can be of the numeric or string type. The length does not need to be specified. The composite row key supports only fixed-length data of the string type. The format is ***attribute name 1*:*Length*, *attribute name 2*:*length***.
Cols	Provides mappings between fields in the DLI table and columns in the HBase table. The mappings are separated by commas (,). In a mapping, the field in the DLI table is located before the colon (:) and information about the HBase table follows the colon (:). In the HBase table information, the column family and column name are separated using a dot (.).

Precautions

- If the to-be-created table exists, an error is reported. To avoid such error, add **IF NOT EXISTS** in this statement.
- All parameters in OPTIONS are mandatory. Parameter names are case-insensitive, while parameter values are case-sensitive.
- In OPTIONS, spaces are not allowed before or after the value in the quotation marks because spaces are also considered as a part of the value.
- Descriptions of table names and column names support only string constants.
- When creating a table, specify the column name and the corresponding data types. Currently, supported data types include Boolean, short, int, long, float, double, and string.
- The value of **row key** (for example, ATTR1) cannot be null, and its length must be greater than 0 and less than or equal to 32767.

- The total number of fields in **Cols** and **row key** must be the same as that in the DLI table. Specifically, all fields in the table are mapped to **Cols** and **row key** without sequence requirements specified.
- The combined row key only supports data of the string type. If the combined row key is used, the length must follow each attribute name. If only one field is specified as the row key, the field type can be any supported data type and you do not need to specify the length.
- If the combined row key is used:
  - When the row key is inserted, if the actual attribute length is shorter than the specified length when the attribute is used as the row key, add **\0** after the attribute. If it is longer, the attribute will be truncated when it is inserted into HBase.
  - When reading the **row key** field in HBase, if the actual data length of an attribute is shorter than that specified when the attribute is used as the **row key**, an error message (**OutofBoundException**) is reported. If it is longer, the attribute will be truncated during data reading.

Example

```
CREATE TABLE test_hbase(
ATTR1 int,
ATTR2 int,
ATTR3 string)
using hbase OPTIONS (
'ZKHost'='to-hbase-1174405101-CE1bDm5B.datasource.com:2181',
'TableName'='HBASE_TABLE',
'RowKey'='ATTR1',
'Cols'='ATTR2:CF1.C1, ATTR3:CF1.C2');
```

2.16.2 Inserting Data to an HBase Table

Function

This statement is used to insert data in a DLI table to the associated HBase table.

Syntax

- Insert the SELECT query result into a table.

```
INSERT INTO DLI_TABLE
  SELECT field1,field2...
  [FROM DLI_TEST]
  [WHERE where_condition]
  [LIMIT num]
  [GROUP BY field]
  [ORDER BY field] ...;
```

- Insert a data record into a table.

```
INSERT INTO DLI_TABLE
  VALUES values_row [, values_row ...];
```

Keyword

For details about the SELECT keywords, see **Basic SELECT Statements**.

Parameter description

Table 2-47 Parameter description

Parameter	Description
DLI_TABLE	Name of the DLI table for which a datasource connection has been created.
DLI_TEST	indicates the table that contains the data to be queried.
field1,field2..., field	Column values in the DLI_TEST table must match the column values and types in the DLI_TABLE table.
where_condition	Query condition.
num	Limit the query result. The num parameter supports only the INT type.
values_row	Value to be inserted to a table. Use commas (,) to separate columns.

Precautions

- A DLI table is available.
- In the column family created in **Creating a Table and Associating It with HBase**, if the column family specified by **Cols** in **OPTIONS** does not exist, an error is reported when **INSERT INTO** is executed.
- If the row key, column family, or column you need to insert to the HBase table already exists, the existing data in HBase table will be overwritten.
- You are advised not to concurrently insert data into a table. If you concurrently insert data into a table, there is a possibility that conflicts occur, leading to failed data insertion.
- **INSERT OVERWRITE** is not supported.

Example

- Query data in the user table and insert the data into the test table.

```
INSERT INTO test
  SELECT ATTR_EXPR
  FROM user
  WHERE user_name='cyz'
  LIMIT 3
  GROUP BY user_age
```

- Insert data 1 into the test table.

```
INSERT INTO test
  VALUES (1);
```

2.16.3 Querying an HBase Table

This statement is used to query data in an HBase table.

Syntax

```
SELECT * FROM table_name LIMIT number;
```

Keyword

LIMIT is used to limit the query results. Only INT type is supported by the **number** parameter.

Precautions

The table to be queried must exist. Otherwise, an error is reported.

Example

Query data in the **test_ct** table.

```
SELECT * FROM test_hbase limit 100;
```

Query Pushdown

Query pushdown implements data filtering using HBase. Specifically, the HBase Client sends filtering conditions to the HBase server, and the HBase server returns only the required data, speeding up your Spark SQL queries. For the filter criteria that HBase does not support, for example, query with the composite row key, Spark SQL performs data filtering.

- Scenarios where query pushdown is supported
  - Query pushdown can be performed on data of the following types:
    - Int
    - boolean
    - short
    - long
    - double
    - string

      NOTE

      Data of the float type does not support query pushdown.
  - Query pushdown is not supported for the following filter criteria:
    - >, <, >=, <=, =, !=, and, or

      The following is an example:

      ```
      select * from tableName where (column1 >= value1 and column2<= value2) or column3 != value3
      ```
    - The filtering conditions are **like** and **not like**. The prefix, suffix, and inclusion match are supported.

      The following is an example:


```
select * from tableName where column1 like "%value" or column2 like "value%" or column3 like "%value%"
```

- IsNotNull()

  The following is an example:

  ```
  select * from tableName where IsNotNull(column)
  ```

- in and not in

  The following is an example:

  ```
  select * from tableName where column1 in (value1,value2,value3)  and column2 not in (value4,value5,value6)
  ```

- between _ and _

  The following is an example:

  ```
  select * from tableName where column1 between value1 and value2
  ```

- Filtering of the row sub-keys in the composite row key

  For example, to perform row sub-key query on the composite row key **column1+column2+column3**, run the following statement:

  ```
  select * from tableName where column1= value1
  ```

- Scenarios where query pushdown is not supported
  - Query pushdown can be performed on data of the following types:

    Except for the preceding data types where query pushdown is supported, data of other types does not support query pushdown.
  - Query pushdown is not supported for the following filter criteria:
    - Length, count, max, min, join, groupby, orderby, limit, and avg
    - Column comparison

      The following is an example:

      ```
      select * from tableName where column1 > (column2+column3)
      ```

2.17 Creating a Datasource Connection with an OpenTSDB Table

2.17.1 Creating a DLI Table and Associating It with OpenTSDB

Function

Run the CREATE TABLE statement to create the DLI table and associate it with the existing metric in OpenTSDB. This syntax supports the OpenTSDB of CloudTable and MRS.

Prerequisites

Before creating a DLI table and associating it with OpenTSDB, you need to create a datasource connection. For details about operations on the management console, see **Enhanced Datasource Connection**.

Syntax

```
CREATE TABLE [IF NOT EXISTS] UQUERY_OPENTSDB_TABLE_NAME
  USING OPENTSDB OPTIONS (
  'host' = 'xx;xx',
  'metric' = 'METRIC_NAME',
  'tags' = 'TAG1,TAG2');
```

Keyword

Table 2-48 CREATE TABLE parameter description

Parameter	Description
host	OpenTSDB IP address. Before obtaining the OpenTSDB IP address, you need to create a datasource connection first.**Enhanced Datasource Connections**. • After successfully created a connection, you can access the CloudTable OpenTSDB by entering the IP address of the OpenTSDB. • You can also access the MRS OpenTSDB. If you have created an enhanced datasource connection, enter the IP address and port number of the node where the OpenTSDB is located. The format is **IP:PORT**. If the OpenTSDB has multiple nodes, enter one of the node IP addresses.
metric	Name of the metric in OpenTSDB corresponding to the DLI table to be created.
tags	Tags corresponding to the metric. The tags are used for classification, filtering, and quick retrieval. You can set 1 to 8 tags, which are separated by commas (,). The parameter value includes values of all tagKs in the corresponding metric.

Precautions

When creating a DLI table, you do not need to specify the **timestamp** and **value** fields. The system automatically builds the following fields based on the specified tags. The fields **TAG1** and **TAG2** are specified by tags.

- TAG1 String
- TAG2 String
- timestamp Timestamp
- value double

Example

```
CREATE table opentsdb_table
  USING OPENTSDB OPTIONS (
  'host' = 'opentsdb-3xcl8dir15m58z3.cloudtable.com:4242',
  'metric' = 'city.temp',
  'tags' = 'city,location');
```

2.17.2 Inserting Data to the OpenTSDB Table

Function

Run the **INSERT INTO** statement to insert the data in the DLI table to the associated **OpenTSDB metric**.

NOTE

If no metric exists on the OpenTSDB, a new metric is automatically created on the OpenTSDB when data is inserted.

Syntax

```
INSERT INTO TABLE TABLE_NAME SELECT * FROM DLI_TABLE;
INSERT INTO TABLE TABLE_NAME VALUES(XXX);
```

Keyword

Table 2-49 INSERT INTO parameter description

Parameter	Description
TABLE_NAME	Name of the associated OpenTSDB table.
DLI_TABLE	Name of the DLI table created.

Precautions

- The inserted data cannot be **null**. If the inserted data is the same as the original data or only the **value** is different, the inserted data overwrites the original data.
- **INSERT OVERWRITE** is not supported.
- You are advised not to concurrently insert data into a table. If you concurrently insert data into a table, there is a possibility that conflicts occur, leading to failed data insertion.
- The **TIMESTAMP** format supports only yyyy-MM-dd hh:mm:ss.

Example

```
INSERT INTO TABLE opentsdb_table VALUES('xxx','xxx','2018-05-03 00:00:00',21);
```

2.17.3 Querying an OpenTSDB Table

This **SELECT** command is used to query data in an OpenTSDB table.

NOTE

- If no metric exists in OpenTSDB, an error will be reported when the corresponding DLI table is queried.
- If the security mode is enabled, you need to set **conf:dli.sql.mrs.opentsdb.ssl.enabled** to **true** when connecting to OpenTSDB.

Syntax

```
SELECT * FROM table_name LIMIT number;
```

Keyword

LIMIT is used to limit the query results. Only INT type is supported by the **number** parameter.

Precautions

The table to be queried must exist. Otherwise, an error is reported.

Example

Query data in the **opentsdb_table** table.

```
SELECT * FROM opentsdb_table limit 100;
```

2.18 Creating a Datasource Connection with a DWS table

2.18.1 Creating a DLI Table and Associating It with DWS

Function

This statement is used to create a DLI table and associate it with an existing DWS table.

NOTE

In Spark cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

For details about datasource authentication, see **Introduction to Datasource Authentication**.

Prerequisites

Before creating a DLI table and associating it with DWS, you need to create a datasource connection. For details about operations on the management console, see **Enhanced Datasource Connection**.

Syntax

```
CREATE TABLE [IF NOT EXISTS] TABLE_NAME
  USING JDBC OPTIONS (
  'url'='xx',
  'dbtable'='db_name_in_DWS.table_name_in_DWS',
  'passwdauth' = 'xxx',
  'encryption' = 'true');
```


Keyword

Table 2-50 CREATE TABLE parameter description

Parameter	Description
url	Before obtaining the DWS IP address, you need to create a datasource connection first.. For details about operations on the management console, see **Enhanced Datasource Connection**. If you have created an enhanced datasource connection, you can use the **JDBC Connection String (intranet)** provided by DWS or the intranet address and port number to access DWS. The format is ***protocol header*: //*Internal IP address*:*Internal network port*/*Database name***, for example: **jdbc:postgresql://192.168.0.77:8000/postgres**. **NOTE** The DWS IP address is in the following format: ***protocol header*://*IP address*:*port number*/*database name*** The following is an example: jdbc:postgresql://to-dws-1174405119-ihlUr78j.datasource.com:8000/postgres If you want to connect to a database created in DWS, change **postgres** to the corresponding database name in this connection.
dbtable	Specifies the name or **Schema name.Table name** of the table that is associated with the DWS. For example: **public.table_name**.
user	(Discarded) DWS username.
password	User password of the DWS cluster.
passwdauth	Datasource password authentication name. For details about how to create datasource authentication, see in the *Data Lake Insight User Guide*.
encryption	Set this parameter to **true** when datasource password authentication is used.
partitionColumn	This parameter is used to set the numeric field used concurrently when data is read. **NOTE** • The **partitionColumn**, **lowerBound**, **upperBound**, and **numPartitions** parameters must be set at the same time. • To improve the concurrent read performance, you are advised to use auto-increment columns.
lowerBound	Minimum value of a column specified by **partitionColumn**. The value is contained in the returned result.
upperBound	Maximum value of a column specified by **partitionColumn**. The value is not contained in the returned result.

Parameter	Description

numPartitions	Number of concurrent read operations.
	NOTE
	When data is read, the number of concurrent operations are evenly allocated to each task according to the **lowerBound** and **upperBound** to obtain data. The following is an example:
	`'partitionColumn'='id',`
	`'lowerBound'='0',`
	`'upperBound'='100',`
	`'numPartitions'='2'`
	Two concurrent tasks are started in DLI. The execution ID of one task is greater than or equal to **0** and the ID is less than **50**, and the execution ID of the other task is greater than or equal to **50** and the ID is less than **100**.

fetchsize	Number of data records obtained in each batch during data reading. The default value is **1000**. If this parameter is set to a large value, the performance is good but more memory is occupied. If this parameter is set to a large value, memory overflow may occur.
batchsize	Number of data records written in each batch. The default value is **1000**. If this parameter is set to a large value, the performance is good but more memory is occupied. If this parameter is set to a large value, memory overflow may occur.
truncate	Indicates whether to clear the table without deleting the original table when **overwrite** is executed. The options are as follows: ● true ● false The default value is **false**, indicating that the original table is deleted and then a new table is created when the **overwrite** operation is performed.
isolationLevel	Transaction isolation level. The options are as follows: ● NONE ● READ_UNCOMMITTED ● READ_COMMITTED ● REPEATABLE_READ ● SERIALIZABLE The default value is **READ_UNCOMMITTED**.

Precautions

When creating a table associated with DWS, you do not need to specify the **Schema** of the associated table. DLI automatically obtains the schema of the table in the **dbtable** parameter of DWS.

Example

```
CREATE TABLE IF NOT EXISTS dli_to_dws
  USING JDBC OPTIONS (
```

```
'url'='jdbc:postgresql://to-dws-1174405119-ih1Ur78j.datasource.com:8000/postgres',
'dbtable'='test_dws',
'passwdauth' = 'xxx',
'encryption' = 'true');
```

2.18.2 Inserting Data to the DWS Table

Function

This statement is used to insert data in a DLI table to the associated DWS table.

Syntax

- Insert the SELECT query result into a table.

```
INSERT INTO DLI_TABLE
  SELECT field1,field2...
  [FROM DLI_TEST]
  [WHERE where_condition]
  [LIMIT num]
  [GROUP BY field]
  [ORDER BY field] ...;
```

- Insert a data record into a table.

```
INSERT INTO DLI_TABLE
  VALUES values_row [, values_row ...];
```

Keyword

For details about the SELECT keywords, see **Basic SELECT Statements**.

Parameter description

Table 2-51 Parameter description

Parameter	Description
DLI_TABLE	Name of the DLI table for which a datasource connection has been created.
DLI_TEST	indicates the table that contains the data to be queried.
field1,field2..., field	Column values in the DLI_TEST table must match the column values and types in the DLI_TABLE table.
where_condition	Query condition.
num	Limit the query result. The num parameter supports only the INT type.
values_row	Value to be inserted to a table. Use commas (,) to separate columns.

Precautions

- A DLI table is available.

- When creating the DLI table, you do not need to specify the **Schema** information. The **Schema** information complies with that in the DWS table. If the number and type of fields selected in the **SELECT** clause do not match the **Schema** information in the DWS table, the system reports an error.
- You are advised not to concurrently insert data into a table. If you concurrently insert data into a table, there is a possibility that conflicts occur, leading to failed data insertion.

Example

- Query data in the user table and insert the data into the test table.

```
INSERT INTO test
  SELECT ATTR_EXPR
  FROM user
  WHERE user_name='cyz'
  LIMIT 3
  GROUP BY user_age
```

- Insert data 1 into the test table.

```
INSERT INTO test
  VALUES (1);
```

2.18.3 Querying the DWS Table

This statement is used to query data in a DWS table.

Syntax

```
SELECT * FROM table_name LIMIT number;
```

Keyword

LIMIT is used to limit the query results. Only INT type is supported by the **number** parameter.

Precautions

The table to be queried must exist. Otherwise, an error is reported.

Example

To query data in the **dli_to_dws** table, enter the following statement:

```
SELECT * FROM dli_to_dws limit 100;
```

2.19 Creating a Datasource Connection with an RDS Table

2.19.1 Creating a DLI Table and Associating It with RDS

Function

This statement is used to create a DLI table and associate it with an existing RDS table. This function supports access to the MySQL and PostgreSQL clusters of RDS.

NOTE

In Spark cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

For details about datasource authentication, see **Introduction to Datasource Authentication**.

Prerequisites

Before creating a DLI table and associating it with RDS, you need to create a datasource connection. For details about operations on the management console, see **Enhanced Datasource Connection**.

Syntax

```
CREATE TABLE [IF NOT EXISTS] TABLE_NAME
  USING JDBC OPTIONS (
  'url'='xx',
  'driver'='DRIVER_NAME',
  'dbtable'='db_name_in_RDS.table_name_in_RDS',
  'passwdauth' = 'xxx',
  'encryption' = 'true');
```

Keyword

Table 2-52 CREATE TABLE parameter description

Parameter	Description
url	Before obtaining the RDS IP address, you need to create a datasource connection first.. For details about operations on the management console, see **Enhanced Datasource Connection**. After an enhanced datasource connection is created, use the internal network domain name or internal network address and database port number provided by RDS to connect to DLI. If MySQL is used, the format is ***protocol header.//internal IP address:internal network port number***. If PostgreSQL is used, the format is ***protocol header.//internal IP address:internal network port number/database name***. For example: **jdbc:mysql://192.168.0.193:3306** or **jdbc:postgresql://192.168.0.193:3306/postgres**.
driver	JDBC driver class name. To connect to a MySQL cluster, enter **com.mysql.jdbc.Driver**. To connect to a PostgreSQL cluster, enter **org.postgresql.Driver**.

Parameter	Description
dbtable	• To access the MySQL cluster, enter ***Database name.Table name***. **CAUTION** The name of the RDS database cannot contain hyphens (-) or ^. Otherwise, the table fails to be created. • To access the PostGre cluster, enter ***Schema name.Table name*** **NOTE** The schema name is the name of the database schema. A schema is a collection of database objects, including tables and views.
user	(Discarded) Specifies the RDS username.
password	(Discarded) Specifies the RDS username and password.
passwdauth	Datasource password authentication name. For details about how to create datasource authentication, see Datasource Authentication in the *Data Lake Insight User Guide*.
encryption	Set this parameter to **true** when datasource password authentication is used.
partitionColumn	This parameter is used to set the numeric field used concurrently when data is read. **NOTE** • The **partitionColumn**, **lowerBound**, **upperBound**, and **numPartitions** parameters must be set at the same time. • To improve the concurrent read performance, you are advised to use auto-increment columns.
lowerBound	Minimum value of a column specified by **partitionColumn**. The value is contained in the returned result.
upperBound	Maximum value of a column specified by **partitionColumn**. The value is not contained in the returned result.

numPartitions	Number of concurrent read operations.
	NOTE
	When data is read, the number of concurrent operations are evenly allocated to each task according to the **lowerBound** and **upperBound** to obtain data. The following is an example:
	`'partitionColumn'='id',`
	`'lowerBound'='0',`
	`'upperBound'='100',`
	`'numPartitions'='2'`
	Two concurrent tasks are started in DLI. The execution ID of one task is greater than or equal to **0** and the ID is less than **50**, and the execution ID of the other task is greater than or equal to **50** and the ID is less than **100**.

fetchsize	Number of data records obtained in each batch during data reading. The default value is **1000**. If this parameter is set to a large value, the performance is good but more memory is occupied. If this parameter is set to a large value, memory overflow may occur.

Parameter	Description
batchsize	Number of data records written in each batch. The default value is **1000**. If this parameter is set to a large value, the performance is good but more memory is occupied. If this parameter is set to a large value, memory overflow may occur.
truncate	Indicates whether to clear the table without deleting the original table when **overwrite** is executed. The options are as follows: ● true ● false The default value is **false**, indicating that the original table is deleted and then a new table is created when the **overwrite** operation is performed.
isolationLevel	Transaction isolation level. The options are as follows: ● NONE ● READ_UNCOMMITTED ● READ_COMMITTED ● REPEATABLE_READ ● SERIALIZABLE The default value is **READ_UNCOMMITTED**.

Precautions

When creating a table associated with RDS, you do not need to specify the **Schema** of the associated table. DLI automatically obtains the schema of the table in the **dbtable** parameter of RDS.

Example

Accessing MySQL

```
CREATE TABLE IF NOT EXISTS dli_to_rds
  USING JDBC OPTIONS (
  'url'='jdbc:mysql://to-rds-117405104-3eAHxnlz.datasource.com:3306',
  'driver'='com.mysql.jdbc.Driver',
  'dbtable'='rds_test.test1',
  'passwdauth' = 'xxx',
  'encryption' = 'true');
```

Accessing PostgreSQL

```
CREATE TABLE IF NOT EXISTS dli_to_rds
  USING JDBC OPTIONS (
  'url'='jdbc:postgresql://to-rds-1174405119-oLRHAGE7.datasource.com:3306/postgreDB',
  'driver'='org.postgresql.Driver',
  'dbtable'='pg_schema.test1',
  'passwdauth' = 'xxx',
  'encryption' = 'true');
```


2.19.2 Inserting Data to the RDS Table

Function

This statement is used to insert data in a DLI table to the associated RDS table.

Syntax

- Insert the SELECT query result into a table.

```
INSERT INTO DLI_TABLE
  SELECT field1,field2...
  [FROM DLI_TEST]
  [WHERE where_condition]
  [LIMIT num]
  [GROUP BY field]
  [ORDER BY field] ...;
```

- Insert a data record into a table.

```
INSERT INTO DLI_TABLE
  VALUES values_row [, values_row ...];
```

Keyword

For details about the SELECT keywords, see **Basic SELECT Statements**.

Parameter description

Table 2-53 Parameter description

Parameter	Description
DLI_TABLE	Name of the DLI table for which a datasource connection has been created.
DLI_TEST	indicates the table that contains the data to be queried.
field1,field2..., field	Column values in the DLI_TEST table must match the column values and types in the DLI_TABLE table.
where_condition	Query condition.
num	Limit the query result. The num parameter supports only the INT type.
values_row	Value to be inserted to a table. Use commas (,) to separate columns.

Precautions

- A DLI table is available.
- When creating the DLI table, you do not need to specify the **Schema** information. The **Schema** information complies with that in the RDS table. If the number and type of fields selected in the **SELECT** clause do not match the **Schema** information in the RDS table, the system reports an error.

- You are advised not to concurrently insert data into a table. If you concurrently insert data into a table, there is a possibility that conflicts occur, leading to failed data insertion.

Example

- Query data in the user table and insert the data into the test table.

```
INSERT INTO test
  SELECT ATTR_EXPR
  FROM user
  WHERE user_name='cyz'
  LIMIT 3
  GROUP BY user_age
```

- Insert data 1 into the test table.

```
INSERT INTO test
  VALUES (1);
```

2.19.3 Querying the RDS Table

This statement is used to query data in an RDS table.

Syntax

```
SELECT * FROM table_name LIMIT number;
```

Keyword

LIMIT is used to limit the query results. Only INT type is supported by the **number** parameter.

Precautions

The table to be queried must exist. Otherwise, an error is reported.

Example

Query data in the **test_ct** table.

```
SELECT * FROM dli_to_rds limit 100;
```

2.20 Creating a Datasource Connection with a CSS Table

2.20.1 Creating a DLI Table and Associating It with CSS

Function

This statement is used to create a DLI table and associate it with an existing CSS table.

NOTE

In Spark cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

For details about datasource authentication, see **Introduction to Datasource Authentication**.

Prerequisites

Before creating a DLI table and associating it with CSS, you need to create a datasource connection. For details about operations on the management console, see **Enhanced Datasource Connection**.

Syntax

```
CREATE TABLE [IF NOT EXISTS] TABLE_NAME(
  FIELDNAME1 FIELDTYPE1,
  FIELDNAME2 FIELDTYPE2)
  USING CSS OPTIONS (
  'es.nodes'='xx',
  'resource'='type_path_in_CSS',
  'pushdown'='true',
  'strict'='false',
  'batch.size.entries'= '1000',
  'batch.size.bytes'= '1mb',
  'es.nodes.wan.only' = 'true',
  'es.mapping.id' = 'FIELDNAME');
```

Keyword

Table 2-54 CREATE TABLE parameter description

Parameter	Description
es.nodes	Before obtaining the CSS IP address, you need to create a datasource connection first.. For details about operations on the management console, see **Enhanced Datasource Connection**. If you have created an enhanced datasource connection, you can use the internal IP address provided by CSS. The format is ***IP1*:*PORT1*,*IP2*:*PORT2***.
resource	The **resource** is used to specify the CSS datasource connection name. You can use **/index/type** to specify the resource location (for easier understanding, the **index** can be seen as **database** and **type** as **table**). **NOTE** • In ES 6.X, a single index supports only one type, and the type name can be customized. • In ES 7.X, a single index uses **_doc** as the type name and cannot be customized. To access ES 7.X, set this parameter to **index**.
pushdown	Indicates whether the press function of CSS is enabled. The default value is set to **true**. If there are a large number of I/O transfer tables, the **pushdown** can be enabled to reduce I/Os when the **where** filtering conditions are met.

Parameter	Description
strict	Indicates whether the CSS **pushdown** is strict. The default value is set to **false**. In exact match scenarios, more I/Os are reduced than **pushdown**.
batch.size.entries	Maximum number of entries that can be inserted to a batch processing. The default value is **1000**. If the size of a single data record is so large that the number of data records in the bulk storage reaches the upper limit of the data amount of a single batch processing, the system stops storing data and submits the data based on the **batch.size.bytes**.
batch.size.bytes	Maximum amount of data in a single batch processing. The default value is 1 MB. If the size of a single data record is so small that the number of data records in the bulk storage reaches the upper limit of the data amount of a single batch processing, the system stops storing data and submits the data based on the **batch.size.entries**.
es.nodes.wan.only	Indicates whether to access the Elasticsearch node using only the domain name. The default value is **false**. If the original internal IP address provided by CSS is used as the **es.nodes**, you do not need to set this parameter or set it to **false**.
es.mapping.id	Specifies a field whose value is used as the document ID in the Elasticsearch node. **NOTE** • The document ID in the same **/index/type** is unique. If a field that functions as a document ID has duplicate values, the document with the duplicate ID will be overwritten when the ES is inserted. • This feature can be used as a fault tolerance solution. When data is being inserted, the DLI job fails and some data has been inserted into Elasticsearch. The data is redundant. If Document id is set, the last redundant data will be overwritten when the DLI job is executed again.
es.net.ssl	Whether to connect to the secure CSS cluster. The default value is **false**.
es.certificate.name	Name of the datasource authentication used to connect to the secure CSS cluster. For details about how to create datasource authentication, see Datasource Authentication in the *Data Lake Insight User Guide*.

NOTE

batch.size.entries and **batch.size.bytes** limit the number of data records and data volume respectively.

Example

```
CREATE TABLE IF NOT EXISTS dli_to_css (doc_id String, name string, age int)
  USING CSS OPTIONS (
  es.nodes 'to-css-1174404703-LzwpJEyx.datasource.com:9200',
  resource '/dli_index/dli_type',
```

```
pushdown 'false',
strict 'true',
es.nodes.wan.only 'true',
es.mapping.id 'doc_id');
```

2.20.2 Inserting Data to the CSS Table

Function

This statement is used to insert data in a DLI table to the associated CSS table.

Syntax

- Insert the SELECT query result into a table.

```
INSERT INTO DLI_TABLE
  SELECT field1,field2...
  [FROM DLI_TEST]
  [WHERE where_condition]
  [LIMIT num]
  [GROUP BY field]
  [ORDER BY field] ...;
```

- Insert a data record into a table.

```
INSERT INTO DLI_TABLE
  VALUES values_row [, values_row ...];
```

Keyword

For details about the SELECT keywords, see **Basic SELECT Statements**.

Parameter description

Table 2-55 Parameter description

Parameter	Description
DLI_TABLE	Name of the DLI table for which a datasource connection has been created.
DLI_TEST	indicates the table that contains the data to be queried.
field1,field2..., field	Column values in the DLI_TEST table must match the column values and types in the DLI_TABLE table.
where_condition	Query condition.
num	Limit the query result. The num parameter supports only the INT type.
values_row	Value to be inserted to a table. Use commas (,) to separate columns.

Precautions

- A DLI table is available.

- When creating the DLI table, you need to specify the **schema** information. If the number and type of fields selected in the **SELECT** clause or in **Values** do not match the **Schema** information in the CSS table, the system reports an error.
- Inconsistent types may not always cause error reports. For example, if the data of the **int** type is inserted, but the **text** type is saved in the CSS **Schema**, the **int** type will be converted to the **text** type and no error will be reported.
- You are advised not to concurrently insert data into a table. If you concurrently insert data into a table, there is a possibility that conflicts occur, leading to failed data insertion.

Example

- Query data in the user table and insert the data into the test table.

```
INSERT INTO test
  SELECT ATTR_EXPR
  FROM user
  WHERE user_name='cyz'
  LIMIT 3
  GROUP BY user_age
```

- Insert data 1 into the test table.

```
INSERT INTO test
  VALUES (1);
```

2.20.3 Querying the CSS Table

This statement is used to query data in a CSS table.

Syntax

```
SELECT * FROM table_name LIMIT number;
```

Keyword

LIMIT is used to limit the query results. Only INT type is supported by the **number** parameter.

Precautions

The table to be queried must exist. Otherwise, an error is reported.

Example

To query data in the **dli_to_css** table, enter the following statement:

```
SELECT * FROM dli_to_css limit 100;
```

2.21 Creating a Datasource Connection with a DCS Table

2.21.1 Creating a DLI Table and Associating It with DCS

Function

This statement is used to create a DLI table and associate it with an existing DCS key.

NOTE

In Spark cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

For details about datasource authentication, see **Introduction to Datasource Authentication**.

Prerequisites

Before creating a DLI table and associating it with DCS, you need to create a datasource connection and bind it to a queue. For details about operations on the management console, see **Enhanced Datasource Connection**.

Syntax

- Specified key

```
CREATE TABLE [IF NOT EXISTS] TABLE_NAME(
   FIELDNAME1 FIELDTYPE1,
   FIELDNAME2 FIELDTYPE2)
  USING REDIS OPTIONS (
  'host'='xx',
  'port'='xx',
  'passwdauth' = 'xxx',
  'encryption' = 'true',
  'table'='namespace_in_redis:key_in_redis',
  'key.column'= 'FIELDNAME1'
);
```

- Wildcard key

```
CREATE TABLE [IF NOT EXISTS] TABLE_NAME(
   FIELDNAME1 FIELDTYPE1,
   FIELDNAME2 FIELDTYPE2)
  USING REDIS OPTIONS (
  'host'='xx',
  'port'='xx',
  'passwdauth' = 'xxx',
  'encryption' = 'true',
  'keys.pattern'='key*:*',
  'key.column'= 'FIELDNAME1'
);
```

Keyword

Table 2-56 CREATE TABLE parameter description

Parameter	Description
host	To connect to DCS, you need to create a datasource connection first. For details about operations on the management console, see **Enhanced Datasource Connection**. After creating an enhanced datasource connection, use the connection address provided by DCS. If there are multiple connection addresses, select one of them. **NOTE** Currently, only enhanced datasource is supported.
port	DCS connection port, for example, 6379.
password	Password entered during DCS cluster creation. You do not need to set this parameter when accessing a non-secure Redis cluster.
passwdauth	Datasource password authentication name. For details about how to create datasource authentication, see Datasource Authentication in the *Data Lake Insight User Guide*.
encryption	Set this parameter to **true** when datasource password authentication is used.
table	The key or hash key in Redis. • This parameter is mandatory when Redis data is inserted. • Either this parameter or the **keys.pattern** parameter when Redis data is queried.
keys.pattern	Use a regular expression to match multiple keys or hash keys. This parameter is used only for query. Either this parameter or **table** is used to query Redis data.
key.column	(Optional) Specifies a field in the schema as the key ID in Redis. This parameter is used together with the **table** parameter when data is inserted.
partitions.number	Number of concurrent tasks during data reading.
scan.count	Number of data records read in each batch. The default value is **100**. If the CPU usage of the Redis cluster still needs to be improved during data reading, increase the value of this parameter.
iterator.grouping.size	Number of data records inserted in each batch. The default value is **100**. If the CPU usage of the Redis cluster still needs to be improved during the insertion, increase the value of this parameter.
timeout	Timeout interval for connecting to the Redis, in milliseconds. The default value is **2000** (2 seconds).

NOTE

When connecting to DCS, complex data types such as Array, Struct, and Map are not supported.

The following methods can be used to process complex data:

- Place the fields of the next level in the Schema field of the same level.
- Write and read data in binary mode, and encode and decode it using user-defined functions.

Example

- Specifying a table

```
create table test_redis(name string, age int) using redis options(
  'host' = '192.168.4.199',
  'port' = '6379',
  'passwdauth' = 'xxx',
  'encryption' = 'true',
  'table' = 'person'
);
```

- Wildcarding the table name

```
create table test_redis_keys_patten(id string, name string, age int) using redis options(
  'host' = '192.168.4.199',
  'port' = '6379',
  'passwdauth' = 'xxx',
  'encryption' = 'true',
  'keys.pattern' = 'p*:*',
  'key.column' = 'id'
);
```

2.21.2 Inserting Data to a DCS Table

Function

This statement is used to insert data in a DLI table to the DCS key.

Syntax

- Insert the SELECT query result into a table.

```
INSERT INTO DLI_TABLE
  SELECT field1,field2...
  [FROM DLI_TEST]
  [WHERE where_condition]
  [LIMIT num]
  [GROUP BY field]
  [ORDER BY field] ...;
```

- Insert a data record into a table.

```
INSERT INTO DLI_TABLE
  VALUES values_row [, values_row ...];
```

Keyword

For details about the SELECT keywords, see **Basic SELECT Statements**.

Parameter description

Table 2-57 Parameter description

Parameter	Description
DLI_TABLE	Name of the DLI table for which a datasource connection has been created.
DLI_TEST	indicates the table that contains the data to be queried.
field1,field2..., field	Column values in the DLI_TEST table must match the column values and types in the DLI_TABLE table.
where_condition	Query condition.
num	Limit the query result. The num parameter supports only the INT type.
values_row	Value to be inserted to a table. Use commas (,) to separate columns.

Precautions

- A DLI table is available.
- When creating a DLI table, you need to specify the schema information.
- If **key.column** is specified during table creation, the value of the specified field is used as a part of the Redis key name. The following is an example:

```
create table test_redis(name string, age int) using redis options(
  'host' = '192.168.4.199',
  'port' = '6379',
  'password' = '******',
  'table' = 'test_with_key_column',
  'key.column' = 'name'
);
insert into test_redis values("James", 35), ("Michael", 22);
```

  The Redis database contains two tables, naming **test_with_key_column:James** and **test_with_key_column:Michael** respectively.

```
192.168.7.238:6379> keys test_with_key_column:*
1) "test_with_key_column:Michael"
2) "test_with_key_column:James"
192.168.7.238:6379>
```

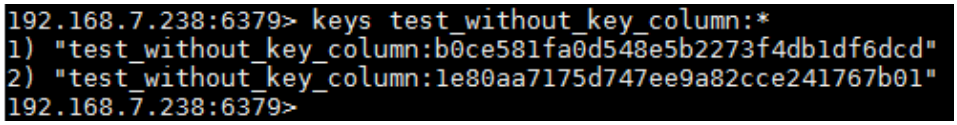
```
192.168.7.238:6379> hgetall "test_with_key_column:Michael"
1) "age"
2) "22"
192.168.7.238:6379> hgetall "test_with_key_column:James"
1) "age"
2) "35"
192.168.7.238:6379>
```

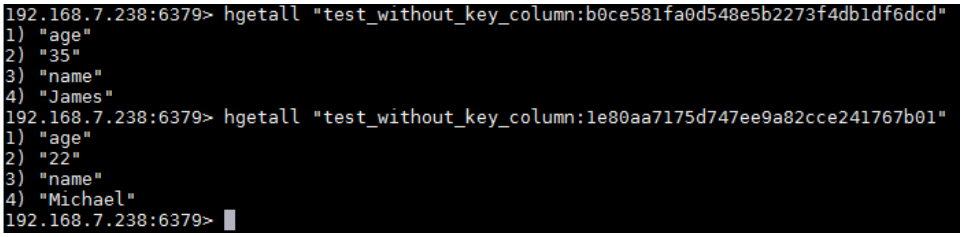
- If **key.column** is not specified during table creation, the key name in Redis uses the UUID. The following is an example:

```
create table test_redis(name string, age int) using redis options(
  'host' = '192.168.7.238',
```

```
  'port' = '6379',
  'password' = '******',
  'table' = 'test_without_key_column'
);
insert into test_redis values("James", 35), ("Michael", 22);
```

In Redis, there are two tables named **test_without_key_column:uuid**.





Example

```
INSERT INTO test_redis
  VALUES("James", 35), ("Michael", 22);
```

2.21.3 Querying the DCS Table

This statement is used to query data in a DCS table.

Syntax

```
SELECT * FROM table_name LIMIT number;
```

Keyword

LIMIT is used to limit the query results. Only INT type is supported by the **number** parameter.

Example

Query data in the **test_redis** table.

```
SELECT * FROM test_redis limit 100;
```

2.22 Creating a Datasource Connection with a DDS Table

2.22.1 Creating a DLI Table and Associating It with DDS

Function

This statement is used to create a DLI table and associate it with an existing DDS collection.

NOTE

In Spark cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

For details about datasource authentication, see **Introduction to Datasource Authentication**.

Prerequisites

Before creating a DLI table and associating it with DDS, you need to create a datasource connection and bind it to a queue. For details about operations on the management console, see **Enhanced Datasource Connection**.

Syntax

```
CREATE TABLE [IF NOT EXISTS] TABLE_NAME(
   FIELDNAME1 FIELDTYPE1,
   FIELDNAME2 FIELDTYPE2)
 USING MONGO OPTIONS (
 'url'='IP:PORT[,IP:PORT]/[DATABASE][.COLLECTION][AUTH_PROPERTIES]',
 'database'='xx',
 'collection'='xx',
 'passwdauth' = 'xxx',
 'encryption' = 'true'
);
```

Keyword

Table 2-58 CREATE TABLE parameter description

Parameter	Description
url	Before obtaining the DDS IP address, you need to create a datasource connection first.**Enhanced Datasource Connections**. After creating an enhanced datasource connection, use the random connection address provided by DDS. The format is as follows: "IP:PORT[,IP:PORT]/[DATABASE][.COLLECTION][AUTH_PROPERTIES]" Example: "192.168.4.62:8635,192.168.5.134:8635/test?authSource=admin"
database	DDS database name. If the database name is specified in the URL, the database name in the URL does not take effect.
collection	Collection name in the DDS. If the collection is specified in the URL, the collection in the URL does not take effect.
user	(Discarded) Username for accessing the DDS cluster.
password	(Discarded) Password for accessing the DDS cluster.
passwdauth	Datasource password authentication name. For details about how to create datasource authentication, see Datasource Authentication in the *Data Lake Insight User Guide*.

Parameter	Description
encryption	Set this parameter to **true** when datasource password authentication is used.

NOTE

If a collection already exists in DDS, you do not need to specify schema information when creating a table. DLI automatically generates schema information based on data in the collection.

Example

```
create table 1_datasource_mongo.test_mongo(id string, name string, age int) using mongo options(
  'url' = '192.168.4.62:8635,192.168.5.134:8635/test?authSource=admin',
  'database' = 'test',
  'collection' = 'test',
  'passwdauth' = 'xxx',
  'encryption' = 'true');
```

2.22.2 Inserting Data to the DDS Table

Function

This statement is used to insert data in a DLI table to the associated DDS table.

Syntax

- Insert the SELECT query result into a table.

```
INSERT INTO DLI_TABLE
  SELECT field1,field2...
  [FROM DLI_TEST]
  [WHERE where_condition]
  [LIMIT num]
  [GROUP BY field]
  [ORDER BY field] ...;
```

- Insert a data record into a table.

```
INSERT INTO DLI_TABLE
  VALUES values_row [, values_row ...];
```

- Overwriting the inserted data

```
INSERT OVERWRITE TABLE DLI_TABLE
  SELECT field1,field2...
  [FROM DLI_TEST]
  [WHERE where_condition]
  [LIMIT num]
  [GROUP BY field]
  [ORDER BY field] ...;
```

Keyword

For details about the SELECT keywords, see **Basic SELECT Statements**.

Parameter description

Table 2-59 Parameter description

Parameter	Description
DLI_TABLE	Name of the DLI table for which a datasource connection has been created.
DLI_TEST	indicates the table that contains the data to be queried.
field1,field2..., field	Column values in the DLI_TEST table must match the column values and types in the DLI_TABLE table.
where_condition	Query condition.
num	Limit the query result. The num parameter supports only the INT type.
values_row	Value to be inserted to a table. Use commas (,) to separate columns.

Precautions

A DLI table is available.

Example

- Query data in the user table and insert the data into the test table.

```
INSERT INTO test
  SELECT ATTR_EXPR
  FROM user
  WHERE user_name='cyz'
  LIMIT 3
  GROUP BY user_age
```

- Insert data 1 into the test table.

```
INSERT INTO test
  VALUES (1);
```

2.22.3 Querying the DDS Table

This statement is used to query data in a DDS table.

Syntax

```
SELECT * FROM table_name LIMIT number;
```

Keyword

LIMIT is used to limit the query results. Only INT type is supported by the **number** parameter.

Precautions

If schema information is not specified during table creation, the query result contains the **_id** field for storing **_id** in the DOC file.

Example

Query data in the **test_mongo** table.

```
SELECT * FROM test_mongo limit 100;
```

2.23 Creating a Datasource Connection with an Oracle Table

2.23.1 Creating a DLI Table and Associating It with Oracle

Function

This statement is used to create a DLI table and associate it with an existing Oracle table.

Prerequisites

- Before creating a DLI table and associating it with Oracle, you need to create an enhanced datasource connection.

  For details about operations on the management console, see **Enhanced Datasource Connections**.
- Only enhanced datasource connections can be used to connect to Oracle, and only pay-per-use and yearly/monthly queues support enhanced datasource connections. So, only SQL jobs on pay-per-use and yearly/monthly queues can be connected to Oracle databases.

Syntax

```
CREATE TABLE [IF NOT EXISTS] TABLE_NAME
  USING ORACLE OPTIONS (
  'url'='xx',
  'driver'='DRIVER_NAME',
  'dbtable'='db_in_oracle.table_in_oracle',
  'user' = 'xxx',
  'password' = 'xxx',
  'resource' = 'obs://rest-authinfo/tools/oracle/driver/ojdbc6.jar'
);
```


Keyword

Table 2-60 CREATE TABLE parameter description

Parameter	Description
url	URL of the Oracle database. The URL can be in either of the following format: ● Format 1: **jdbc:oracle:thin:@host:port:***SID*, in which *SID* is the unique identifier of the Oracle database. ● Format 2: **jdbc:oracle:thin:@//host:port/***service_name*. This format is recommended by Oracle. For a cluster, the SID of each node may differ, but their service name is the same.
driver	Oracle driver class name: **oracle.jdbc.driver.OracleDriver**
dbtable	Name of the table associated with the Oracle database or *Username*.*Table name*, for example, **public.table_name**.
user	Oracle username.
password	Oracle password.
resource	OBS path of the Oracle driver package. Example: **obs://rest-authinfo/tools/oracle/driver/ojdbc6.jar** If the driver JAR file defined in this parameter is updated, you need to restart the queue for the update to take effect.

Example

Creating an Oracle datasource table

```
CREATE TABLE IF NOT EXISTS oracleTest
  USING ORACLE OPTIONS (
  'url'='jdbc:oracle:thin:@//192.168.168.40:1521/helowin',
  'driver'='oracle.jdbc.driver.OracleDriver',
  'dbtable'='test.Student',
  'user' = 'test',
  'password' = 'test',
  'resource' = 'obs://rest-authinfo/tools/oracle/driver/ojdbc6.jar'
);
```

2.23.2 Inserting Data to an Oracle Table

Function

This statement is used to insert data into an associated Oracle table.

Syntax

- Insert the SELECT query result into a table.

```
INSERT INTO DLI_TABLE
  SELECT field1,field2...
  [FROM DLI_TEST]
  [WHERE where_condition]
```



```
[LIMIT num]
[GROUP BY field]
[ORDER BY field] ...;
```

- Insert a data record into a table.

```
INSERT INTO DLI_TABLE
 VALUES values_row [, values_row ...];
```

- Overwriting the inserted data

```
INSERT OVERWRITE TABLE DLI_TABLE
 SELECT field1,field2...
 [FROM DLI_TEST]
 [WHERE where_condition]
 [LIMIT num]
 [GROUP BY field]
 [ORDER BY field] ...;
```

Keyword

For details about the SELECT keywords, see **Basic SELECT Statements**.

Parameter description

Table 2-61 Parameter description

Parameter	Description
DLI_TABLE	Name of the DLI table for which a datasource connection has been created.
DLI_TEST	indicates the table that contains the data to be queried.
field1,field2..., field	Column values in the DLI_TEST table must match the column values and types in the DLI_TABLE table.
where_condition	Query condition.
num	Limit the query result. The num parameter supports only the INT type.
values_row	Value to be inserted to a table. Use commas (,) to separate columns.

Precautions

A DLI table is available.

Example

- Query data in the user table and insert the data into the test table.

```
INSERT INTO test
 SELECT ATTR_EXPR
 FROM user
 WHERE user_name='cyz'
 LIMIT 3
 GROUP BY user_age
```

- Insert data 1 into the test table.


```
INSERT INTO test
 VALUES (1);
```

2.23.3 Querying an Oracle Table

Function

This statement is used to query data in an Oracle table.

Syntax

```
SELECT * FROM table_name LIMIT number;
```

Keyword

LIMIT is used to limit the query results. Only INT type is supported by the **number** parameter.

Precautions

If schema information is not specified during table creation, the query result contains the **_id** field for storing **_id** in the DOC file.

Example

Querying data in the **test_oracle** table

```
SELECT * FROM test_oracle limit 100;
```

2.24 Views

2.24.1 Creating a View

Function

This statement is used to create views.

Syntax

```
CREATE [OR REPLACE] VIEW view_name AS select_statement;
```

Keyword

- CREATE VIEW: creates views based on the given select statement. The result of the select statement will not be written into the disk.
- OR REPLACE: updates views using the select statement. No error is reported and the view definition is updated using the SELECT statement if a view exists.

Precautions

- The view to be created must not exist in the current database. Otherwise, an error will be reported. When the view exists, you can add keyword **OR REPLACE** to avoid the error message.
- The table or view information contained in the view cannot be modified. If the table or view information is modified, the query may fail.
- If the compute engines used for creating tables and views are different, the view query may fail due to incompatible varchar types.

  For example, if a table is created using Spark 3.*x*, you are advised to use Spark 2.*x* to create a view.

Example

To create a view named **student_view** for the queried ID and name of the **student** table, run the following statement:

```
CREATE VIEW student_view AS SELECT id, name FROM student;
```

2.24.2 Deleting a View

Function

This statement is used to delete views.

Syntax

```
DROP VIEW [IF EXISTS] [db_name.]view_name;
```

Keyword

DROP: Deletes the metadata of a specified view. Although views and tables have many common points, the DROP TABLE statement cannot be used to delete views.

Precautions

The to-be-deleted view must exist. If you run this statement to delete a view that does not exist, an error is reported. To avoid such an error, you can add **IF EXISTS** in this statement.

Example

To delete a view named **student_view**, run the following statement:

```
DROP VIEW student_view;
```

2.25 Viewing the Execution Plan

Function

This statement returns the logical plan and physical execution plan for the SQL statement.

Syntax

```
EXPLAIN [EXTENDED | CODEGEN] statement;
```

Keyword

EXTENDED: After this keyword is specified, the logical and physical plans are outputted at the same time.

CODEGEN: After this keyword is specified, code generated by using the Codegen is also outputted.

Precautions

None

Example

To return the logical and physical plans of **SELECT * FROM test**, run the following statement:

```
EXPLAIN EXTENDED select * from test;
```

2.26 Data Permissions Management

2.26.1 Data Permissions List

Table 2-62 describes the SQL statement permission matrix in DLI in terms of permissions on databases, tables, and roles.

Table 2-62 Permission matrix

Category	SQL statement	Permission	Description
Database	DROP DATABASE db1	The **DROP_DATABASE** permission of **database.db1**	-
	CREATE TABLE tb1(...)	The **CREATE_TABLE** permission of **database.db1**	-
	CREATE VIEW v1	The **CREATE_VIEW** permission of **database.db1**	-
	EXPLAIN query	The **EXPLAIN** permission of **database.db1**	Depending on the permissions required by **query** statements.

Category	SQL statement	Permission	Description
Table	SHOW CREATE TABLE tb1	The **SHOW_CREATE_TABLE** permission of **database.db1.tables.tb1**	-
	DESCRIBE [EXTENDED| FORMATTED] tb1	The **DESCRIBE_TABLE** permission of **databases.db1.tables.tb1**	-
	DROP TABLE [IF EXISTS] tb1	The **DROP_TABLE** permission of **database.db1.tables.tb1**	-
	SELECT * FROM tb1	The **SELECT** permission of **database.db1.tables.tb1**	-
	SELECT count(*) FROM tb1	The **SELECT** permission of **database.db1.tables.tb1**	-
	SELECT * FROM view1	The **SELECT** permission of **database.db1.tables.view1**	-
	SELECT count(*) FROM view1	The **SELECT** permission of **database.db1.tables.view1**	-
	LOAD DLI TABLE	The **INSERT_INTO_TABLE** permission of **database.db1.tables.tb1**	-
	INSERT INTO TABLE	The **INSERT_INTO_TABLE** permission of **database.db1.tables.tb1**	-
	INSERT OVERWRITE TABLE	The **INSERT_OVERWRITE_TABLE** permission of **database.db1.tables.tb1**	-
	ALTER TABLE ADD COLUMNS	The **ALTER_TABLE_ADD_COLUMNS** permission of **database.db1.tables.tb1**	-
	ALTER TABLE RENAME	The **ALTER_TABLE_RENAME** permission of **database.db1.tables.tb1**	-
ROLE&PRIVILEGE	CREATE ROLE	The **CREATE_ROLE** permission of **db**	-
	DROP ROLE	The **DROP_ROLE** permission of **db**	-
	SHOW ROLES	The **SHOW_ROLES** permission of **db**	-

Category	SQL statement	Permission	Description
	GRANT ROLES	The **GRANT_ROLE** permission of **db**	-
	REVOKE ROLES	The **REVOKE_ROLE** permission of **db**	-
	GRANT PRIVILEGE	The **GRANT_PRIVILEGE** permission of **db** or **table**	-
	REVOKE PRIVILEGE	The **REVOKE_PRIVILEGE** permission of **db** or **table**	-
	SHOW GRANT	The **SHOW_GRANT** permission of **db** or **table**	-

For privilege granting or revocation on databases and tables, DLI supports the following permissions:

- Permissions that can be assigned or revoked on databases are as follows:
  - DROP_DATABASE (Deleting a database)
  - CREATE_TABLE (Creating a table)
  - CREATE_VIEW (Creating a view)
  - EXPLAIN (Explaining a SQL statement as an execution plan)
  - CREATE_ROLE (Creating a role)
  - DROP_ROLE (Deleting a role)
  - SHOW_ROLES (Displaying a role)
  - GRANT_ROLE (Bounding a role)
  - REVOKE_ROLE (Unbinding a role)
  - DESCRIBE_TABLE (Describing a table)
  - DROP_TABLE (Deleting a table)
  - Select (Querying a table)
  - INSERT_INTO_TABLE (Inserting)
  - INSERT_OVERWRITE_TABLE (Overwriting)
  - GRANT_PRIVILEGE (Granting permissions to a database)
  - REVOKE_PRIVILEGE (Revoking permissions from a database)
  - SHOW_PRIVILEGES (Viewing the database permissions of other users)
  - ALTER_TABLE_ADD_PARTITION (Adding partitions to a partitioned table)
  - ALTER_TABLE_DROP_PARTITION (Deleting partitions from a partitioned table)
  - ALTER_TABLE_RENAME_PARTITION (Renaming table partitions)
  - ALTER_TABLE_RECOVER_PARTITION (Restoring table partitions)
  - ALTER_TABLE_SET_LOCATION (Setting the path of a partition)

  - SHOW_PARTITIONS (Displaying all partitions)
  - SHOW_CREATE_TABLE (Viewing table creation statements)
- Permissions that can be assigned or revoked on tables are as follows:
  - DESCRIBE_TABLE (Describing a table)
  - DROP_TABLE (Deleting a table)
  - Select (Querying a table)
  - INSERT_INTO_TABLE (Inserting)
  - INSERT_OVERWRITE_TABLE (Overwriting)
  - GRANT_PRIVILEGE (Granting permissions to a table)
  - REVOKE_PRIVILEGE (Revoking permissions from a table)
  - SHOW_PRIVILEGES (Viewing the table permissions of other users)
  - ALTER_TABLE_ADD_COLUMNS (Adding a column)
  - ALTER_TABLE_RENAME (Renaming a table)
  - ALTER_TABLE_ADD_PARTITION (Adding partitions to a partitioned table)
  - ALTER_TABLE_DROP_PARTITION (Deleting partitions from a partitioned table)
  - ALTER_TABLE_RENAME_PARTITION (Renaming table partitions)
  - ALTER_TABLE_RECOVER_PARTITION (Restoring table partitions)
  - ALTER_TABLE_SET_LOCATION (Setting the path of a partition)
  - SHOW_PARTITIONS (Displaying all partitions)
  - SHOW_CREATE_TABLE (Viewing table creation statements)

2.26.2 Creating a Role

Function

- This statement is used to create a role in the current database or a specified database.
- Only users with the CREATE_ROLE permission on the database can create roles. For example, the administrator, database owner, and other users with the CREATE_ROLE permission.
- Each role must belong to only one database.

Syntax

```
CREATE ROLE [db_name].role_name;
```

Keyword

None

Precautions

- The **role_name** to be created must not exist in the current database or the specified database. Otherwise, an error will be reported.
- If **db_name** is not specified, the role is created in the current database.

Example

```
CREATE ROLE role1;
```

2.26.3 Deleting a Role

Function

This statement is used to delete a role in the current database or a specified database.

Syntax

```
DROP ROLE [db_name].role_name;
```

Keyword

None

Precautions

- The **role_name** to be deleted must exist in the current database or the specified database. Otherwise, an error will be reported.
- If **db_name** is not specified, the role is deleted in the current database.

Example

```
DROP ROLE role1;
```

2.26.4 Binding a Role

Function

This statement is used to bind a user with a role.

Syntax

```
GRANT ([db_name].role_name,...) TO (user_name,...);
```

Keyword

None

Precautions

The **role_name** and **username** must exist. Otherwise, an error will be reported.

Example

```
GRANT role1 TO user_name1;
```


2.26.5 Unbinding a Role

Function

This statement is used to unbind the user with the role.

Syntax

```
REVOKE ([db_name].role_name,...) FROM (user_name,...);
```

Keyword

None

Precautions

role_name and user_name must exist and user_name has been bound to role_name.

Example

To unbind the user_name1 from role1, run the following statement:

```
REVOKE role1 FROM user_name1;
```

2.26.6 Displaying a Role

Function

This statement is used to display all roles or roles bound to the **user_name** in the current database.

Syntax

```
SHOW [ALL] ROLES [user_name];
```

Keyword

ALL: Displays all roles.

Precautions

Keywords ALL and user_name cannot coexist.

Example

- To display all roles bound to the user, run the following statement:
  ```
  SHOW ROLES;
  ```
- To display all roles in the project, run the following statement:
  ```
  SHOW ALL ROLES;
  ```

  NOTE

  Only the administrator has the permission to run the **show all roles** statement.

- To display all roles bound to the user named **user_name1**, run the following statement:
  ```
  SHOW ROLES user_name1;
  ```

2.26.7 Granting a Permission

Function

This statement is used to grant permissions to a user or role.

Syntax

```
GRANT (privilege,...) ON (resource,..) TO ((ROLE [db_name].role_name) | (USER user_name)),...);
```

Keyword

ROLE: The subsequent **role_name** must be a role.

USER: The subsequent **user_name** must be a user.

Precautions

- The privilege must be one of the authorizable permissions. If the object has the corresponding permission on the resource or the upper-level resource, the permission fails to be granted. For details about the permission types supported by the privilege, see **Data Permissions List**.
- The resource can be a queue, database, table, view, or column. The formats are as follows:
  - Queue format: queues.queue_name

    The following table lists the permission types supported by a queue.

Operation	Description
DROP_QUEUE	Deleting a queue
SUBMIT_JOB	Submitting a job
CANCEL_JOB	Cancel a job
RESTART	Restarting a queue
SCALE_QUEUE	Scaling out/in a queue
GRANT_PRIVILEGE	Granting queue permissions
REVOKE_PRIVILEGE	Revoking queue permissions
SHOW_PRIVILEGES	Viewing queue permissions of other users

  - Database format: databases.db_name

    For details about the permission types supported by a database, see **Data Permissions List**.
  - Table format: databases.db_name.tables.table_name

For details about the permission types supported by a table, see **Data Permissions List**.

- View format: databases.db_name.tables.view_name

  Permission types supported by a view are the same as those supported by a table. For details, see table permissions in **Data Permissions List**.

- Column format: databases.db_name.tables.table_name.columns.column_name

  Columns support only the SELECT permission.

Example

Run the following statement to grant user_name1 the permission to delete the **db1** database:

```
GRANT DROP_DATABASE ON databases.db1 TO USER user_name1;
```

Run the following statement to grant user_name1 the SELECT permission of data table **tb1** in the **db1** database:

```
GRANT SELECT ON databases.db1.tables.tb1 TO USER user_name1;
```

Run the following statement to grant **role_name** the SELECT permission of data table **tb1** in the **db1** database:

```
GRANT SELECT ON databases.db1.tables.tb1 TO ROLE role_name;
```

2.26.8 Revoking a Permission

Function

This statement is used to revoke permissions granted to a user or role.

Syntax

```
REVOKE (privilege,...) ON (resource,..) FROM ((ROLE [db_name].role_name) | (USER user_name)),...);
```

Keyword

ROLE: The subsequent **role_name** must be a role.

USER: The subsequent **user_name** must be a user.

Precautions

- The privilege must be the granted permissions of the authorized object in the resource. Otherwise, the permission fails to be revoked. For details about the permission types supported by the privilege, see **Data Permissions List**.
- The resource can be a queue, database, table, view, or column. The formats are as follows:
  - Queue format: queues.queue_name
  - Database format: databases.db_name
  - Table format: databases.db_name.tables.table_name
  - View format: databases.db_name.tables.view_name

  - Column format: databases.db_name.tables.table_name.columns.column_name

Example

To revoke the permission of user **user_name1** to delete database **db1**, run the following statement:

```
REVOKE DROP_DATABASE ON databases.db1 FROM USER user_name1;
```

To revoke the SELECT permission of user **user_name1** on table **tb1** in database **db1**, run the following statement:

```
REVOKE SELECT ON databases.db1.tables.tb1 FROM USER user_name1;
```

To revoke the SELECT permission of role **role_name** on table **tb1** in database **db1**, run the following statement:

```
REVOKE SELECT ON databases.db1.tables.tb1 FROM ROLE role_name;
```

2.26.9 Showing Granted Permissions

Function

This statement is used to show the permissions granted to a user on a resource.

Syntax

```
SHOW GRANT USER user_name ON resource;
```

Keyword

USER: The subsequent **user_name** must be a user.

Precautions

The resource can be a queue, database, table, view, or column. The formats are as follows:

- Queue format: queues.queue_name
- Database format: databases.db_name
- Table format: databases.db_name.tables.table_name
- Column format: databases.db_name.tables.table_name.columns.column_name
- View format: databases.db_name.tables.view_name

Example

Run the following statement to show permissions of **user_name1** in the **db1** database:

```
SHOW GRANT USER user_name1 ON databases.db1;
```


2.26.10 Displaying the Binding Relationship Between All Roles and Users

Function

This statement is used to display the binding relationship between roles and a user in the current database.

Syntax

```
SHOW PRINCIPALS ROLE;
```

Keyword

None

Precautions

The ROLE variable must exist.

Example

```
SHOW PRINCIPALS role1;
```

2.27 Data Types

2.27.1 Overview

Data type is a basic attribute of data. It is used to distinguish different types of data. Different data types occupy different storage space and support different operations. Data is stored in data tables in the database. A data type is specified for each column of a data table. Therefore, data to be stored in a data table must comply with the attribute of the specific data type. Otherwise, errors may occur.

DLI only supports primitive data types.

2.27.2 Primitive Data Types

Table 2-63 lists the primitive data types supported by DLI.

Table 2-63 Primitive data types

Data Type	Description	Storage Space	Value Range	Support by OBS Table	
INT	Signed integer	4 bytes	–2147483648 to 2147483647	Yes	Yes
STRING	Character string	-	-	Yes	Yes
FLOAT	Single-precision floating point	4 bytes	-	Yes	Yes
DOUBLE	Double-precision floating-point	8 bytes	-	Yes	Yes

Data Type	Description	Storage Space	Value Range	Support by OBS Table	
DECIMAL(precision,scale)	Decimal number. Data type of valid fixed places and decimal places, for example, 3.5. • **precision**: indicates the maximum number of digits that can be displayed. • **scale**: indicates the number of decimal places.	-	1<=precision<=38 0<=scale<=38 If **precision** and **scale** are not specified, **DECIMAL(38, 38)** is used by default.	Yes	Yes

Data Type	Description	Storage Space	Value Range	Support by OBS Table	
BOOLEAN	Boolean	1 byte	TRUE/FALSE	Yes	Yes
SMALLINT/SHORT	Signed integer	2 bytes	-32768~32767	Yes	Yes
TINYINT	Signed integer	1 byte	-128~127	Yes	No
BIGINT/LONG	Signed integer	8 bytes	–9223372036854775808 to 9223372036854775807	Yes	Yes
TIMESTAMP	Timestamp in raw data format, indicating the date and time Example: 1621434131222	-	-	Yes	Yes

Data Type	Description	Storage Space	Value Range	Support by OBS Table	
CHAR	Fixed-length character string	-	-	Yes	Yes
VARCHAR	Variable-length character string	-	-	Yes	Yes
DATE	Date type in the format of ***yyyy-mm-dd***, for example, **2014-05-29**	-	**DATE** does not contain time information. Its value ranges from **0000-01-01** to **9999-12-31**.	Yes	Yes

NOTE

- VARCHAR and CHAR data is stored in STRING type on DLI. Therefore, the string that exceeds the specified length will not be truncated.
- FLOAT data is stored as DOUBLE data on DLI.

INT

Signed integer with a storage space of 4 bytes. Its value ranges from –2147483648 to 2147483647. If this field is NULL, value 0 is used by default.

STRING

Character string.

FLOAT

Single-precision floating point with a storage space of 4 bytes. If this field is NULL, value 0 is used by default.

Due to the limitation of storage methods of floating point data, do not use the formula a==b to check whether two floating point values are the same. You are advised to use the formula: absolute value of (a-b) <= EPSILON. EPSILON indicates the allowed error range which is usually 1.19209290E-07F. If the formula is satisfied, the compared two floating point values are considered the same.

DOUBLE

Double-precision floating point with a storage space of 8 bytes. If this field is NULL, value 0 is used by default.

Due to the limitation of storage methods of floating point data, do not use the formula a==b to check whether two floating point values are the same. You are advised to use the formula: absolute value of (a-b) <= EPSILON. EPSILON indicates the allowed error range which is usually 2.2204460492503131E-16. If the formula is satisfied, the compared two floating point values are considered the same.

DECIMAL

Decimal(p,s) indicates that the total digit length is **p**, including **p – s** integer digits and **s** fractional digits. **p** indicates the maximum number of decimal digits that can be stored, including the digits to both the left and right of the decimal point. The value of **p** ranges from 1 to 38. **s** indicates the maximum number of decimal digits that can be stored to the right of the decimal point. The fractional digits must be values ranging from 0 to **p**. The fractional digits can be specified only after significant digits are specified. Therefore, the following inequality is concluded: 0 ≤ **s** ≤ **p**. For example, decimal (10,6) indicates that the value contains 10 digits, in which there are four integer digits and six fractional digits.

BOOLEAN

Boolean, which can be **TRUE** or **FALSE**.

SMALLINT/SHORT

Signed integer with a storage space of 2 bytes. Its value ranges from –32768 to 32767. If this field is NULL, value 0 is used by default.

TINYINT

Signed integer with a storage space of 1 byte. Its value ranges from –128 to 127. If this field is NULL, value 0 is used by default.

BIGINT/LONG

Signed integer with a storage space of 8 bytes. Its value ranges from –9223372036854775808 to 9223372036854775807. It does not support scientific notation. If this field is NULL, value 0 is used by default.

TIMESTAMP

Legacy UNIX TIMESTAMP is supported, providing the precision up to the microsecond level. **TIMESTAMP** is defined by the difference between the specified time and UNIX epoch (UNIX epoch time: 1970-01-01 00:00:00) in seconds. Data of the STRING type supports implicit conversion to TIMESTAMP. (The STRING must in the yyyy-MM-dd HH:MM:SS[.ffffff] format. The precision after the decimal point is optional.)

CHAR

Character string with a fixed length. In DLI, the STRING type is used.

VARCHAR

VARCHAR is declared with a length that indicates the maximum number of characters in a string. During conversion from **STRING** to **VARCHAR**, if the number of characters in **STRING** exceeds the specified length, the excess characters of **STRING** are automatically trimmed. Similar to **STRING**, the spaces at the end of **VARCHAR** are meaningful and affect the comparison result. In DLI, the STRING type is used.

DATE

DATE supports only explicit conversion (cast) with **DATE**, **TIMESTAMP**, and **STRING**. For details, see **Table 2-64**.

Table 2-64 cast function conversion

Explicit Conversion	Conversion Result
cast(date as date)	Same as value of **DATE**.
cast(timestamp as date)	The date (yyyy-mm-dd) is obtained from **TIMESTAMP** based on the local time zone and returned as the value of **DATE**.
cast(string as date)	If the STRING is in the **yyyy-MM-dd** format, the corresponding date (yyyy-mm-dd) is returned as the value of **DATE**. If the STRING is not in the **yyyy-MM-dd** format, **NULL** is returned.
cast(date as timestamp)	Timestamp that maps to the zero hour of the date (yyyy-mm-dd) specified by **DATE** is generated based on the local time zone and returned as the value of **DATE**.

Explicit Conversion	Conversion Result
cast(date as string)	A STRING in the **yyyy-MM-dd** format is generated based on the date (yyyy-mm-dd) specified by **DATE** and returned as the value of **DATE**.

2.27.3 Complex Data Types

Spark SQL supports complex data types, as shown in **Table 2-65**.

Table 2-65 Complex data types

Data Type	Description	Syntax
ARRAY	A set of ordered fields that construct an ARRAY with the specified values. The value can be of any type and the data type of all fields must be the same.	array(<value>,<value>[, ...]) For details, see **Example of ARRAY**.
MAP	A group of unordered key/value pairs used to generate a MAP. The key must be native data type, but the value can be either native data type or complex data type. The type of the same MAP key, as well as the MAP value, must be the same.	map(K <key1>, V <value1>, K <key2>, V <value2>[, ...]) For details, see **Example of Map**.
STRUCT	Indicates a group of named fields. The data types of the fields can be different.	struct(<value1>,<value2>[, ...]) For details, see **Example of STRUCT**.

Restrictions

- When a table containing fields of the complex data type is created, the storage format of this table cannot be CSV (txt).
- If a table contains fields of the complex data type, data in CSV (txt) files cannot be imported to the table.
- When creating a table of the MAP data type, you must specify the schema and do not support the **date**, **short**, and **timestamp** data types.
- For the OBS table in JSON format, the key type of the MAP supports only the STRING type.
- The key of the MAP type cannot be **NULL**. Therefore, the MAP key does not support implicit conversion between inserted data formats where NULL values are allowed. For example, the STRING type cannot be converted to other native types, the FLOAT type cannot be converted to the TIMESTAMP type, and other native types cannot be converted to the DECIMAL type.

- Values of the **double** or **boolean** data type cannot be included in the **STRUCT** data type does not support the.

Example of ARRAY

Create an **array_test** table, set **id** to **ARRAY<INT>**, and **name** to **STRING**. After the table is created, insert test data into **array_test**. The procedure is as follows:

1. Create a table.

   CREATE TABLE array_test(name STRING, id ARRAY < INT >) USING PARQUET;

2. Run the following statements to insert test data:

   INSERT INTO array_test VALUES ('test',array(1,2,3,4));

   INSERT INTO array_test VALUES ('test2',array(4,5,6,7))

   INSERT INTO array_test VALUES ('test3',array(7,8,9,0));

3. Query the result.

   To query all data in the **array_test** table, run the following statement:

   SELECT * FROM array_test;

   ```
   test3    [7,8,9,0]
   test2    [4,5,6,7]
   test     [1,2,3,4]
   ```

   To query the data of element **0** in the **id** array in the **array_test** table, run the following statement:

   SELECT id[0] FROM array_test;

   ```
   7
   4
   1
   ```

Example of Map

Create the **map_test** table and set **score** to **map<STRING,INT>**. The key is of the **STRING** type and the value is of the **INT** type. After the table is created, insert test data to **map_test**. The procedure is as follows:

1. Create a table.

   CREATE TABLE map_test(id STRING, score map<STRING,INT>) USING PARQUET;

2. Run the following statements to insert test data:

   INSERT INTO map_test VALUES ('test4',map('math',70,'chemistry',84));

   INSERT INTO map_test VALUES ('test5',map('math',85,'chemistry',97));

   INSERT INTO map_test VALUES ('test6',map('math',88,'chemistry',80));

3. Query the result.

   To query all data in the **map_test** table, run the following statement:

   SELECT * FROM map_test;

   ```
   test6    {"chemistry":80,"math":88}
   test5    {"chemistry":97,"math":85}
   test4    {"chemistry":84,"math":70}
   ```

   To query the math score in the **map_test** table, run the following statement:

   SELECT id, score['Math'] FROM map_test;


```
test6   88
test5   85
test4   70
```

Example of STRUCT

Create a **struct_test** table and set **info** to the **STRUCT<name:STRING, age:INT>** data type (the field consists of **name** and **age**, where the type of **name** is **STRING** and **age** is **INT**). After the table is created, insert test data into the **struct_test** table. The procedure is as follows:

1. Create a table.

   CREATE TABLE struct_test(id INT, info STRUCT<name:STRING,age:INT>) USING PARQUET;

2. Run the following statements to insert test data:

   INSERT INTO struct_test VALUES (8, struct('zhang',23));

   INSERT INTO struct_test VALUES (9, struct('li',25));

   INSERT INTO struct_test VALUES (10, struct('wang',26));

3. Query the result.

   To query all data in the **struct_test** table, run the following statement:

   SELECT * FROM struct_test;

   ```
   8   {"name":"zhang","age":23}
   10   {"name":"wang","age":26}
   9   {"name":"li","age":25}
   ```

   Query **name** and **age** in the **struct_test** table.

   SELECT id,info.name,info.age FROM struct_test;

   ```
   8   zhang   23
   10   wang   26
   9   li   25
   ```

2.28 User-Defined Functions

2.28.1 Creating a Function

Function

DLI allows you to create and use user-defined functions (UDF) and user-defined table functions (UDTF) in Spark jobs.

For details about the custom functions, see **Calling UDFs for Spark SQL Jobs** and **Calling UDTF for Spark SQL Jobs**.

Syntax

```
CREATE [TEMPORARY][OR REPLACE] FUNCTION [db_name.]function_name AS class_name
  [USING resource,...]

resource:
  : JAR file_uri
```


Precautions

- If a function with the same name exists in the database, the system reports an error.
- Only the Hive syntax can be used to create functions.
- If you specify the same class name for two UDFs, the functions conflict though the package names are different. Avoid this problem because it causes failure of job execution.
- **To use the OR REPLACE statement, you need to submit a service ticket.**

Keyword

- TEMPORARY: The created function is available only in the current session and is not persisted to the underlying metabase, if any. The database name cannot be specified for a temporary function.
- USING <resources>: resources to be loaded. It can be a list of JARs, files, or URIs.
- OR REPLACE: Whether to reload function resources
  - The following table describes scenarios where you do not need OR REPLACE.

Table 2-66 Scenarios where OR REPLACE is not specified

No.	Description	Examples	Take Effect When	Operation Impact
1	You modify the implementation of the original class and specify the original JAR package name and class name for a new function.	1. UDF F1 created for a Spark SQL queue is contained in C1 in the JAR package J1. 2. You modify the implementation of function in the J1 package, save the function as UDF F2, and specify its class as C1 and the JAR package as J1. **NOTE** Note that if UDF names conflict, the function will fail to be created. In this case, you can use **OR REPLACE** to replace F1 in all jobs with F2.	The Spark SQL queue is restarted.	1. Running jobs are interrupted because the Spark SQL queue must be restarted. 2. After the queue is restarted, original UDF F1 becomes the same as F2.

No.	Description	Examples	Take Effect When	Operation Impact
2	You create a new class in the original package, specify the new class to the UDF you created, and retain the original package name.	1. UDF F1 created for a Spark SQL queue is contained in C1 in the JAR package J1. 2. You add class C2 to the JAR package J1. C1 remains unchanged. You create UDF F2 and specify its class name to C2 and its JAR package to J1.	The Spark SQL queue is restarted.	1. Running jobs are interrupted because the Spark SQL queue must be restarted. 2. After the queue is restarted, F1 remains unchanged.

No.	Description	Examples	Take Effect When	Operation Impact
3	You keep the implementation of the original functions unchanged, and repack the program. You specify a new JAR package for the new function and retain the original class name.	1. UDF F1 created for a Spark SQL queue is contained in C1 in the JAR package J1. 2. You repack the JAR package as J2. The function logic remains unchanged. You specify the class of the created UDF to C1, and the JAR package name to J2.	UDF F2 is created.	None

- If OR REPLACE is used when you create a UDF, the existing function will be replaced and the replacement takes effect immediately.

CAUTION

- **To use the OR REPLACE keyword, you need to submit a service ticket.**
- To make the replacement take effect immediately on all SQL queues, run the statement for each SQL queue. The replacement may take effect 0 to 12 hours later on the queues where the statement is not executed.
- If you modify the J1 package (for example, CREATE OR REPLACE FUNCTION F1) in the middle of job execution, jobs being executed run the original UDF F1 (of the C1 class in the J1 package) and jobs that starts after the modification run the new F1 logic.

Table 2-67 Scenarios where OR REPLACE is used

No.	Description	Examples	Take Effect When	Operation Impact
1	You modify the implementation of the original class and specify the original JAR package name and class name for a new function.	1. UDF F1 created for a Spark SQL queue is contained in C1 in the JAR package J1. 2. You modify the implementation of a function in the J1 package, save the function as UDF F1, and specify its class as C1 and the JAR package as J1.	Immediately	F1 is changed.

No.	Description	Examples	Take Effect When	Operation Impact
2	You create a new class in the original package, specify the new class to the UDF you created, and retain the original package name.	1. UDF F1 created for a Spark SQL queue is contained in C1 in the JAR package J1. 2. You add class C2 to the JAR package J1. C1 remains unchanged. You create UDF F2 and specify its class name to C2 and its JAR package to J1. F2 does not take effect immediately because it is the first function specified to the C2 class.	Either of the following happens: • CREATE OR REPLACE F2 FUNCTION is executed again. • The Spark SQL queue is restarted.	If you restart the Spark SQL queue, running jobs will be affected.

No.	Description	Examples	Take Effect When	Operation Impact
3	You change the class name and specify the new class name to the new UDF. The package name remains unchanged.	1. UDF F1 created for a Spark SQL queue is contained in C1 in the JAR package J1. 2. You change C1 in the JAR package of J1 to C2, create the UDF F2, specify its class name to C2, and its JAR package name to J1.	Immediately	F1 is replaced by F2 immediately.
4	You keep the implementation of the original functions unchanged, and repack the program. You specify a new JAR package for the new function and retain the original class name.	1. UDF F1 created for a Spark SQL queue is contained in C1 in the JAR package J1. 2. You repack the JAR package as J2. The function logic remains unchanged. You specify the class of the created UDF to C1, and the JAR package name to J2.	Immediately	None

Example

Create the mergeBill function.

```
CREATE FUNCTION mergeBill AS 'com.xxx.hiveudf.MergeBill'
  using jar 'obs://onlyci-7/udf/MergeBill.jar';
```

2.28.2 Deleting a Function

Function

This statement is used to delete functions.

Syntax

```
DROP [TEMPORARY] FUNCTION [IF EXISTS] [db_name.] function_name;
```

Keyword

- TEMPORARY: Indicates whether the function to be deleted is a temporary function.
- IF EXISTS: Used when the function to be deleted does not exist to avoid system errors.

Precautions

- An existing function is deleted. If the function to be deleted does not exist, the system reports an error.
- Only the HIVE syntax is supported.

Example

The mergeBill function is deleted.

```
DROP FUNCTION mergeBill;
```

2.28.3 Displaying Function Details

Function

Displays information about a specified function.

Syntax

```
DESCRIBE FUNCTION [EXTENDED] [db_name.] function_name;
```

Keyword

EXTENDED: displays extended usage information.

Precautions

The metadata (implementation class and usage) of an existing function is returned. If the function does not exist, the system reports an error.

Example

Displays information about the mergeBill function.

```
DESCRIBE FUNCTION mergeBill;
```

2.28.4 Displaying All Functions

Function

View all functions in the current project.

Syntax

```
SHOW [USER|SYSTEM|ALL] FUNCTIONS ([LIKE] regex | [db_name.] function_name);
```

In the preceding statement, regex is a regular expression. For details about its parameters, see **Table 2-68**.

Table 2-68 Parameter examples

Expression	Description
'xpath*'	Matches all functions whose names start with **xpath**. Example: SHOW FUNCTIONS LIKE'xpath* ; Matches functions whose names start with **xpath**, including **xpath**, **xpath_int**, and **xpath_string**.
'x[a-z]+'	Matches functions whose names start with **x** and is followed by one or more characters from a to z. For example, **xpath** and **xtest** can be matched.
'x.*h'	Matches functions whose names start with **x**, end with **h**, and contain one or more characters in the middle. For example, **xpath** and **xtesth** can be matched.

For details about other expressions, see the official website.

Keyword

LIKE: This qualifier is used only for compatibility and has no actual effect.

Precautions

The function that matches the given regular expression or function name are displayed. If no regular expression or name is provided, all functions are displayed.

If USER or SYSTEM is specified, user-defined Spark SQL functions and system-defined Spark SQL functions are displayed, respectively.

Example

This statement is used to view all functions.

```
SHOW FUNCTIONS;
```

2.29 Built-in Functions

2.29.1 Date Functions

2.29.1.1 Overview

Table 2-69 lists the date functions supported by DLI.

Table 2-69 Date/time functions

Function	Syntax	Value Type	Description
add_months	add_months(string start_date, int num_months)	STRING	Returns the date that is **num_months** after **start_date**.
current_date	current_date()	DATE	Returns the current date, for example, **2016-07-04**.
current_timestamp	current_timestamp()	TIMESTAMP	Returns the current time, for example, **2016-07-04 11:18:11.685**.
date_add	date_add(string startdate, int days)	STRING or DATE	Adds a number of days to a date.

Function	Syntax	Value Type	Description
dateadd	dateadd(string date, bigint delta, string datepart)	STRING or DATE	Changes a date based on **datepart** and **delta**. **date**: This parameter is mandatory. Date value, which is of the STRING type. The time format is **yyyy-mm-dd hh:mi:ss**, for example, **2021-08-28 00:00:00**. **delta**: This parameter is mandatory. Adjustment amplitude, which is of the BIGINT type. **datepart**: Adjustment unit, which is a constant of the STRING type. This parameter is mandatory.
date_sub	date_sub(string startdate, int days)	STRING	Subtracts a number of days from a date.
date_format	date_format(string date, string format)	STRING	Converts a date into a string based on the format specified by **format**.
datediff	datediff(string date1, string date2)	BIGINT	Calculates the difference between **date1** and **date2**.
datediff1	datediff1(string date1, string date2, string datepart)	BIGINT	Calculates the difference between **date1** and **date2** and returns the difference in a specified datepart.
datepart	datepart (string date, string datepart)	BIGINT	Returns the value of the field that meets a specified time unit in the date.
datetrunc	datetrunc (string date, string datepart)	STRING	Calculates the date otained through the truncation of a specified date based on a specified datepart. **date**: The value is in the **yyyy-mm-dd** or **yyyy-mm-dd hh:mi:ss** format. This parameter is mandatory. **datepart**: Supported date format, which is a STRING constant. This parameter is mandatory.
day/ dayofmonth	day(string date), dayofmonth(string date)	INT	Returns the date of a specified time.

Function	Syntax	Value Type	Description
from_unixtime	from_unixtime(bigint unixtime)	STRING	Converts a timestamp to a time, in **yyyy-MM-dd HH:mm:ss** or **yyyyMMddHHmmss.uuuuuu** format. For example, **select FROM_UNIXTIME(1608135036,'yyyy-MM-dd HH:mm:ss')**.
from_utc_timestamp	from_utc_timestamp(string timestamp, string timezone)	TIMESTAMP	Converts a UTC timestamp to a timestamp in a given time zone, for example, **from_utc_timestamp('1970-01-01 08:00:00','PST') returns 1970-01-01 00:00:00**.
getdate	getdate()	STRING	Obtains the current system time.
hour	hour(string date)	INT	Returns the hour (from 0 to 23) of a specified time.
isdate	isdate(string date , string format)	BOOLEAN	**date**: Date, which is implicitly converted to the STRING type and then used for calculation. This parameter is mandatory. **format**: Unsupported date extension format, which is a STRING constant. This parameter is mandatory. If there are redundant format strings in **format**, only the date value corresponding to the first format string is used. Other format strings are used as separators. For example, **isdate("1234-yyyy", "yyyy-yyyy")** returns **True**.
last_day	last_day(string date)	DATE	Returns the last day of the month a date belongs to, in the format of **yyyy-MM-dd**, for example, **2015-08-31**.
lastday	lastday(string date)	STRING	Returns the last day of the month a date belongs to. The value is of the STRING type and is in the **yyyy-mm-dd hh:mi:ss** format.
minute	minute(string date)	INT	Returns the minute (from 0 to 59) of a specified time.
month	month(string date)	INT	Returns the month (from January to December) of a specified time.

Function	Syntax	Value Type	Description
months_between	months_between(string date1, string date2)	DOUBLE	Returns the month difference between **date1** and **date2**.
next_day	next_day(string start_date, string day_of_week)	DATE	Returns the date closest to **day_of_week** after **start_date**, in the **yyyy-MM-dd** format. **day_of_week** indicates a day in a week, for example, Monday or Friday.
quarter	quarter(string date)	INT	Returns the quarter of the date, timestamp, or string, for example, **quarter('2015-04-01')=2**.
second	second(string date)	INT	Returns the second (from 0 to 59) of a specified time.
to_char	to_char(string date, string format)	STRING	Converts a date into a string in a specified format.
to_date	to_date(string timestamp)	DATE	Returns the date part of a time string, for example, **to_date("1970-01-01 00:00:00") = "1970-01-01"**.
to_date1	to_date1(string date, string format)	STRING	The value is of the STRING type, in the **yyyy-mm-dd hh:mi:ss** format. If the value of **date** or **format** is **NULL**, **NULL** is returned. Converts a string in a specified format to a date value.
to_utc_timestamp	to_utc_timestamp(string timestamp, string timezone)	TIMESTAMP	Converts a timestamp in a given time zone to a UTC timestamp, for example, **to_utc_timestamp('1970-01-01 00:00:00','PST') returns 1970-01-01 08:00:00**.
trunc	trunc(string date, string format)	DTAE	Resets the date in a specified format. Supported formats are **MONTH/MON/MM** and **YEAR/YYYY/YY**, for example, **trunc('2015-03-17', 'MM') = 2015-03-01**.
unix_timestamp	unix_timestamp(string timestamp, string pattern)	BIGINT	Returns a Unix timestamp (the number of seconds since **1970-01-01 00:00:00**) as an unsigned integer if the function is called without parameters.

Function	Syntax	Value Type	Description
weekday	weekday (string date)	INT	Returns the day of the current week.
weekofyear	weekofyear(string date)	INT	Returns the week number (from 0 to 53) of a specified date.
year	year(string date)	INT	Returns the year of a specified date.

2.29.1.2 add_months

This function is used to calculate the date after a date value is increased by a specified number of months. That is, it calculates the data that is **num_months** after **start_date**.

Syntax

```
add_months(string start_date, int num_months)
```

Parameters

Table 2-70 Parameters

Parameter	Mandatory	Type	Description
start_date	Yes	DATE or STRING	Start date The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3
num_months	Yes	INT	Number of months to be added

Return Values

The date that is **num_months** after **start_date** is returned, in the **yyyy-mm-dd** format.

The return value is of the DATE type.

NOTE

- If the value of **start_date** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **start_date** is of the DATE or STRING type but is not in one of the supported formats, **NULL** is returned.
- If the value of **start_date** is **NULL**, an error is reported.
- If the value of **num_months** is **NULL**, **NULL** is returned.

Example Code

The value **2023-05-26** is returned.

```
select add_months('2023-02-26',3);
```

The value **2023-05-14** is returned.

```
select add_months('2023-02-14 21:30:00',3);
```

The value **NULL** is returned.

```
select add_months('20230815',3);
```

The value **NULL** is returned.

```
select add_months('2023-08-15 20:00:00',null);
```

2.29.1.3 current_date

This function is used to return the current date, in the **yyyy-mm-dd** format.

Similar function: **getdate**. The getdate function is used to return the current system time, in the **yyyy-mm-dd hh:mi:ss** format.

Syntax

```
current_date()
```

Parameters

None

Return Values

The return value is of the DATE type, in the **yyyy-mm-dd** format.

Example Code

The value **2023-08-16** is returned.

```
select current_date();
```

2.29.1.4 current_timestamp

This function is used to return the current timestamp.

Syntax

```
current_timestamp()
```


Parameters

None

Return Values

The return value is of the TIMESTAMP type.

Example Code

The value **1692002816300** is returned.

```
select current_timestamp();
```

2.29.1.5 date_add

This function is used to calculate the number of days in which **start_date** is increased by **days**.

To obtain the date with a specified change range based on the current date, use this function together with the **current_date** or **getdate** function.

Note that the logic of this function is opposite to that of the **date_sub** function.

Syntax

```
date_add(string startdate, int days)
```

Parameters

Table 2-71 Parameters

Parameter	Mandatory	Type	Description
start_date	Yes	DATE or STRING	Start date The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3
days	Yes	BIGINT	Number of days to be added • If the value is greater than 0, the number of days is increased. • If the value is less than 0, the number of days is subtracted. • If the value is 0, the date does not change. • If the value is **NULL**, **NULL** is returned.

Return Values

The return value is of the DATE type, in the **yyyy-mm-dd** format.

NOTE

- If the value of **start_date** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **start_date** is of the DATE or STRING type but is not in one of the supported formats, **NULL** is returned.
- If the value of **start_date** is **NULL**, **NULL** is returned.
- If the value of **days** is **NULL**, **NULL** is returned.

Example Code

The value **2023-03-01** is returned after one day is added.

```
select date_add('2023-02-28 00:00:00', 1);
```

The value **2023-02-27** is returned after one day is subtracted.

```
select date_add(date '2023-02-28', -1);
```

The value **2023-03-20** is returned.

```
select date_add('2023-02-28 00:00:00', 20);
```

If the current time is **2023-08-14 16:00:00**, **2023-08-13** is returned.

```
select date_add(getdate(),-1);
```

The value **NULL** is returned.

```
select date_add('2023-02-28 00:00:00', null);
```

2.29.1.6 dateadd

This function is used to change a date based on **datepart** and **delta**.

To obtain the date with a specified change range based on the current date, use this function together with the **current_date** or **getdate** function.

Syntax

```
dateadd(string date, bigint delta, string datepart)
```

Parameters

Table 2-72 Parameters

Parameter	Mandatory	Type	Description
date	Yes	DATE or STRING	Start date The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3
delta	Yes	BIGINT	Amplitude, based on which the date is modified
datepart	Yes	BIGINT	Unit, based on which the date is modified This parameter supports the following extended date formats: year, month or mon, day, and hour. • **YYYY** or **yyyy** indicates the year. • **MM** indicates the month. • **mm** indicates the minute. • **dd** indicates the day. • **HH** indicates the 24-hour clock. • **hh** indicates the 12-hour clock. • **mi** indicates the minute. • **ss** indicates the second. • **SSS** indicates the millisecond.

Return Values

The return value is of the STRING type.

NOTE

- If the value of **date** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **date** is of the DATE or STRING type but is not in one of the supported formats, **NULL** is returned.
- If the value of **date** is **NULL**, **NULL** is returned.
- If the value of **delta** or **datepart** is **NULL**, **NULL** is returned.

Example Code

The value **2023-08-15 17:00:00** is returned after one day is added.

```
select dateadd( '2023-08-14 17:00:00', 1, 'dd');
```

The value **2025-04-14 17:00:00** is returned after 20 months are added.

```
select dateadd('2023-08-14 17:00:00', 20, 'mm');
```

The value **2023-09-14 17:00:00** is returned.

```
select dateadd('2023-08-14 17:00:00', 1, 'mm');
```

The value **2023-09-14** is returned.

```
select dateadd('2023-08-14', 1, 'mm');
```

If the current time is **2023-08-14 17:00:00**, **2023-08-13 17:00:00** is returned.

```
select dateadd(getdate(),-1,'dd');
```

The value **NULL** is returned.

```
select dateadd(date '2023-08-14', 1, null);
```

2.29.1.7 date_sub

This function is used to calculate the number of days in which **start_date** is subtracted by **days**.

To obtain the date with a specified change range based on the current date, use this function together with the **current_date** or **getdate** function.

Note that the logic of this function is opposite to that of the **date_add** function.

Syntax

```
date_sub(string startdate, int days)
```

Parameters

Table 2-73 Parameters

Parameter	Mandatory	Type	Description
start_date	Yes	DATE or STRING	Start date The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3

Parameter	Mandatory	Type	Description
days	Yes	BIGINT	Number of days to be reduced • If the value is greater than 0, the number of days is increased. • If the value of days is less than 0, the number of days is subtracted. • If the value is 0, the date does not change. • If the value is **NULL**, **NULL** is returned.

Return Values

The return value is of the DATE type.

NOTE

- If the value of **start_date** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **start_date** is of the DATE or STRING type but is not in one of the supported formats, NULL is returned.
- If the value of **date** is **NULL**, **NULL** is returned.
- If the value of **format** is **NULL**, **NULL** is returned.

Example Code

The value **2023-08-12** is returned after two days are subtracted.

```
select date_sub('2023-08-14 17:00:00', 2);
```

The value **2023-08-15** is returned after one day is added.

```
select date_sub(date'2023-08-14', -1);
```

If the current time is **2023-08-14 17:00:00**, **2022-08-13** is returned.

```
select date_sub(getdate(),1);
```

The value **NULL** is returned.

```
select date_sub('2023-08-14 17:00:00', null);
```

2.29.1.8 date_format

This function is used to convert a date into a string based on the format specified by **format**.

Syntax

```
date_format(string date, string format)
```

Parameters

Table 2-74 Parameters

Parameter	Mandatory	Type	Description
date	Yes	DATE or STRING	Date to be converted The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3
format	Yes	STRING	Format, based on which the date is converted The value is a combination of the time unit (year, month, day, hour, minute, and second) and any character. • **YYYY** or **yyyy** indicates the year. • **MM** indicates the month. • **mm** indicates the minute. • **dd** indicates the day. • **HH** indicates the 24-hour clock. • **hh** indicates the 12-hour clock. • **mi** indicates the minute. • **ss** indicates the second. • **SSS** indicates millisecond.

Return Values

The return value is of the STRING type.

NOTE

- If the value of **date** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **date** is of the DATE or STRING type but is not in one of the supported formats, **NULL** is returned.
- If the value of **date** is **NULL**, **NULL** is returned.
- If the value of **format** is **NULL**, **NULL** is returned.

Example Code

Assume that the current time is **2023-08-14 16:59**.

The value **2023-08-14 04:59:15.997** is returned.

```
select date_format(from_utc_timestamp(getdate(), 'UTC'),'yyyy-MM-dd hh:mm:ss.SSS');
```

The value **2023-08-14** is returned.

```
select date_format('2023-08-14','yyyy-MM-dd');
```

The value **2023-08** is returned.

```
select date_format('2023-08-14','yyyy-MM')
```

The value **20230814** is returned.

```
select date_format('2023-08-14','yyyyMMdd')
```

2.29.1.9 datediff

This function is used to calculate the difference between **date1** and **date2**.

Similar function: **datediff1**. The **datediff1** function is used to calculate the difference between **date1** and **date2** and return the difference in a specified datepart.

Syntax

```
datediff(string date1, string date2)
```

Parameters

Table 2-75 Parameters

Parameter	Mandatory	Type	Description
date1	Yes	DATE or STRING	Minuend of the date difference between **date1** and **date2**. The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3
date2	Yes	DATE or STRING	Subtrahend of the date difference between **date1** and **date2**. The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3

Return Values

The return value is of the BIGINT type.

NOTE

- If the values of **date1** and **date2** are not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the values of **date1** and **date2** are of the DATE or STRING type but are not in one of the supported formats, **NULL** is returned.
- If the value of **date1** is smaller than that of **date2**, the return value is a negative number.
- If the value of **date1** or **date2** is **NULL**, **NULL** is returned.

Example Code

The value **10** is returned.

```
select datediff('2023-06-30 00:00:00', '2023-06-20 00:00:00');
```

The value **11** is returned.

```
select datediff(date '2023-05-21', date '2023-05-10');
```

The value **NULL** is returned.

```
select datediff(date '2023-05-21', null);
```

2.29.1.10 datediff1

This function is used to calculate the difference between **date1** and **date2** and return the difference in a specified datepart.

Similar function: **datediff**. The **datediff** function is used to calculate the difference between **date1** and **date2** but does not return the difference in a specified datepart.

Syntax

```
datediff1(string date1, string date2, string datepart)
```

Parameters

Table 2-76 Parameters

Parameter	Mandatory	Type	Description
date1	Yes	DATE or STRING	Minuend of the date difference between **date1** and **date2**. The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3

Parameter	Mandatory	Type	Description
date2	Yes	DATE or STRING	Subtrahend of the date difference between **date1** and **date2**. The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3
datepart	Yes	STRING	Unit of the time to be returned This parameter supports the following extended date formats: year, month or mon, day, and hour. • **YYYY** or **yyyy** indicates the year. • **MM** indicates the month. • **mm** indicates the minute. • **dd** indicates the day. • **HH** indicates the 24-hour clock. • **hh** indicates the 12-hour clock. • **mi** indicates the minute. • **ss** indicates the second. • **SSS** indicates millisecond.

Return Values

The return value is of the BIGINT type.

NOTE

- If the values of **date1** and **date2** are not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the values of **date1** and **date2** are of the DATE or STRING type but are not in one of the supported formats, **NULL** is returned.
- If the value of **date1** is smaller than that of **date2**, the return value is a negative number.
- If the value of **date1** or **date2** is **NULL**, **NULL** is returned.
- If the value of **datepart** is **NULL**, **NULL** is returned.

Example Code

The value **14400** is returned.

```
select datediff1('2023-06-30 00:00:00', '2023-06-20 00:00:00', 'mi');
```

The value **10** is returned.

```
select datediff1(date '2023-06-21', date '2023-06-11', 'dd');
```

The value **NULL** is returned.

```
select datediff1(date '2023-05-21', date '2023-05-10', null);
```

The value **NULL** is returned.

```
select datediff1(date '2023-05-21', null, 'dd');
```

2.29.1.11 datepart

This function is used to calculate the value that meets the specified **datepart** in **date**.

Syntax

```
datepart (string date, string datepart)
```

Parameters

Table 2-77 Parameters

Parameter	Mandatory	Type	Description
date	Yes	DATE or STRING	Start date The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3
datepart	Yes	STRING	Time unit of the value to be returned This parameter supports the following extended date formats: year, month or mon, day, and hour. • **YYYY** or **yyyy** indicates the year. • **MM** indicates the month. • **mm** indicates the minute. • **dd** indicates the day. • **HH** indicates the 24-hour clock. • **hh** indicates the 12-hour clock. • **mi** indicates the minute. • **ss** indicates the second. • **SSS** indicates millisecond.

Return Values

The return value is of the BIGINT type.

NOTE

- If the value of **date** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **date** is of the DATE or STRING type but is not in one of the supported formats, **NULL** is returned.
- If the value of **datepart** is **NULL**, **NULL** is returned.
- If the value of **datepart** is **NULL**, **NULL** is returned.

Example Code

The value **2023** is returned.

```
select datepart(date '2023-08-14 17:00:00', 'yyyy');
```

The value **2023** is returned.

```
select datepart('2023-08-14 17:00:00', 'yyyy');
```

The value **0** is returned.

```
select datepart(date '2023-08-14 17:00:00', 'mi');
```

The value **NULL** is returned.

```
select datepart(date '2023-08-14', null);
```

2.29.1.12 datetrunc

This function is used to calculate the date otained through the truncation of a specified date based on a specified datepart.

It truncates the date before the specified datepart and automatically fills the remaining part with the default value. For details, see **Example Code**.

Syntax

```
datetrunc (string date, string datepart)
```

Parameters

Table 2-78 Parameters

Parameter	Mandatory	Type	Description
date	Yes	DATE or STRING	Start date The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3

Parameter	Mandatory	Type	Description
datepart	Yes	STRING	Time unit of the value to be returned This parameter supports the following extended date formats: year, month or mon, day, and hour. • **YYYY** or **yyyy** indicates the year. • **MM** indicates the month. • **mm** indicates the minute. • **dd** indicates the day. • **HH** indicates the 24-hour clock. • **hh** indicates the 12-hour clock. • **mi** indicates the minute. • **ss** indicates the second. • **SSS** indicates millisecond.

Return Values

The return value is of the DATE or STRING type.

NOTE

- If the value of **date** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **date** is of the DATE or STRING type but is not in one of the supported formats, **NULL** is returned.
- If the value of **datepart** is **NULL**, **NULL** is returned.
- If the value of **datepart** is hour, minute, or second, the date is truncated to the day and returned.

Example Code

Example static data

The value **2023-01-01 00:00:00** is returned.

```
select datetrunc('2023-08-14 17:00:00', 'yyyy');
```

The value **2023-08-01 00:00:00** is returned.

```
select datetrunc('2023-08-14 17:00:00', 'month');
```

The value **2023-08-14** is returned.

```
select datetrunc('2023-08-14 17:00:00', 'DD');
```

The value **2023-01-01** is returned.

```
select datetrunc('2023-08-14', 'yyyy');
```

The value **2023-08-14** is returned.

```
select datetrunc('2023-08-14 17:00:00', 'HH');
```

The value **NULL** is returned.

```
select datetrunc('2023-08-14', null);
```

2.29.1.13 day/dayofmonth

This function is used to return the day of a specified date.

Syntax

```
day(string date), dayofmonth(string date)
```

Parameters

Table 2-79 Parameter

Parameter	Mandatory	Type	Description
date	Yes	DATE or STRING	Date that needs to be processed The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3

Return Values

The return value is of the INT type.

NOTE

- If the value of **date** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **date** is of the DATE or STRING type but is not in one of the supported formats, **NULL** is returned.
- If the value of **date** is **NULL**, **NULL** is returned.

Example Code

The value **1** is returned.

```
select day('2023-08-01');
```

The value **NULL** is returned.

```
select day('20230816');
```

The value **NULL** is returned.

```
select day(null);
```


2.29.1.14 from_unixtime

This function is used to convert a timestamp represented by a numeric UNIX value to a date value.

Syntax

```
from_unixtime(bigint unixtime)
```

Parameters

Table 2-80 Parameter

Parameter	Mandatory	Type	Description
unixtime	Yes	BIGINT	Timestamp to be converted, in UNIX format Set this parameter to the first 10 digits of the timestamp in UNIX format.

Return Values

The return value is of the STRING type, in the **yyyy-mm-dd hh:mi:ss** format.

NOTE

If the value of **unixtime** is **NULL**, **NULL** is returned.

Example Code

The value **2023-08-16 09:39:57** is returned.

```
select from_unixtime(1692149997);
```

The value **NULL** is returned.

```
select from_unixtime(NULL);
```

Example table data

```
select unixdate, from_unixtime(unixdate) as timestamp_from_unixtime from database_t;
Output:
+-----------------+-----------------------------+
| unixdate        | timestamp_from_unixtime     |
+-----------------+-----------------------------+
| 1690944759224   | 2023-08-02 10:52:39         |
| 1690944999811   | 2023-08-02 10:56:39         |
| 1690945005458   | 2023-08-02 10:56:45         |
| 1690945011542   | 2023-08-02 10:56:51         |
| 1690945023151   | 2023-08-02 10:57:03         |
+-----------------+-----------------------------+
```

2.29.1.15 from_utc_timestamp

This function is used to convert a UTC timestamp to a UNIX timestamp in a given time zone.

Syntax

```
from_utc_timestamp(string timestamp, string timezone)
```

Parameters

Table 2-81 Parameters

Parameter	Mandatory	Type	Description
timestamp	Yes	DATE STRING TINYINT SMALLINT INT BIGINT	Time to be converted Date value of the DATE or STRING type, or timestamp of the TINYINT, SMALLINT, INT, or BIGINT type. The following formats are supported: yyyy-mm-dd yyyy-mm-dd hh:mi:ss yyyy-mm-dd hh:mi:ss.ff3
timezone	Yes	STRING	Time zone where the time to be converted belongs

Return Values

The return value is of the TIMESTAMP type.

NOTE

- If the value of **timestamp** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **timestamp** is of the DATE or STRING type but is not in one of the supported formats, **NULL** is returned.
- If the value of **timestamp** is **NULL**, **NULL** is returned.
- If the value of **timezone** is **NULL**, **NULL** is returned.

Example Code

The value **1691978400000** is returned, indicating 2023-08-14 10:00:00.

```
select from_utc_timestamp('2023-08-14 17:00:00','PST');
```

The value **1691917200000** is returned, indicating 2023-08-13 17:00:00.

```
select from_utc_timestamp(date '2023-08-14 00:00:00','PST');
```

The value **NULL** is returned.

```
select from_utc_timestamp('2023-08-13',null);
```

2.29.1.16 getdate

This function is used to return the current system time, in the **yyyy-mm-dd hh:mi:ss** format.

Similar function: **current_date**. The **current_date** function is used to return the current date, in the **yyyy-mm-dd** format.

Syntax

```
getdate()
```

Parameters

None

Return Values

The return value is of the STRING type, in the **yyyy-mm-dd hh:mi:ss** format.

Example Code

If the current time is **2023-08-10 10:54:00**, **2023-08-10 10:54:00** is returned.

```
select getdate();
```

2.29.1.17 hour

This function is used to return the hour (from 0 to 23) of a specified time.

Syntax

```
hour(string date)
```

Parameters

Table 2-82 Parameter

Parameter	Mandatory	Type	Description
date	Yes	DATE or STRING	Date that needs to be processed The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3

Return Values

The return value is of the INT type.

NOTE

- If the value of **date** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **date** is of the DATE or STRING type but is not in one of the supported formats, **NULL** is returned.
- If the value of **date** is **NULL**, **NULL** is returned.

Example Code

The value **10** is returned.

```
select hour('2023-08-10 10:54:00');
```

The value **12** is returned.

```
select hour('12:00:00');
```

The value **NULL** is returned.

```
select hour('20230810105600');
```

The value **NULL** is returned.

```
select hour(null);
```

2.29.1.18 isdate

This function is used to determine whether a date string can be converted into a date value based on a specified format.

Syntax

```
isdate(string date , string format)
```

Parameters

Table 2-83 Parameters

Parameter	Mandatory	Type	Description
date	Yes	DATE or STRING	String to be checked If the value is of the BIGINT, DOUBLE, DECIMAL, or DATETIME type, the value is implicitly converted to the STRING type for calculation. The value can be any string.

Parameter	Mandatory	Type	Description
format	Yes	STRING	Format of the date to be converted Constant of the STRING type. Extended date formats are not supported. The value is a combination of the time unit (year, month, day, hour, minute, and second) and any character. • **YYYY** or **yyyy** indicates the year. • **MM** indicates the month. • **mm** indicates the minute. • **dd** indicates the day. • **HH** indicates the 24-hour clock. • **hh** indicates the 12-hour clock. • **mi** indicates the minute. • **ss** indicates the second. • **SSS** indicates millisecond.

Return Values

The return value is of the BOOLEAN type.

NOTE

If the value of **date** or **format** is **NULL**, **NULL** is returned.

Example Code

The value **true** is returned.

```
select isdate('2023-08-10','yyyy-mm-dd');
```

The value **false** is returned.

```
select isdate(123456789,'yyyy-mm-dd');
```

2.29.1.19 last_day

This function is used to return the last day of the month a date belongs to.

Similar function: **lastday**. The **lastday** function is used to return the last day of the month a date belongs to. The hour, minute, and second part is 00:00:00.

Syntax

```
last_day(string date)
```

Parameters

Table 2-84 Parameter

Parameter	Mandatory	Type	Description
date	Yes	DATE or STRING	Date that needs to be processed The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3

Return Values

The return value is of the DATE type, in the **yyyy-mm-dd** format.

NOTE

- If the value of **date** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **date** is of the DATE or STRING type but is not in one of the supported formats, **NULL** is returned.
- If the value of **date** is **NULL**, **NULL** is returned.

Example Code

The value **2023-08-31** is returned.

```
select last_day('2023-08-15');
```

The value **2023-08-31** is returned.

```
select last_day('2023-08-10 10:54:00');
```

The value **NULL** is returned.

```
select last_day('20230810');
```

2.29.1.20 lastday

This function is used to return the last day of the month a date belongs to. The hour, minute, and second part is 00:00:00.

Similar function: **last_day**. The **last_day** function is used to return the last day of the month a date belongs to. The return value is in the **yyyy-mm-dd** format.

Syntax

```
lastday(string date)
```

Parameters

Table 2-85 Parameter

Parameter	Mandatory	Type	Description
date	Yes	DATE or STRING	Date that needs to be processed The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3

Return Values

The return value is of the STRING type, in the **yyyy-mm-dd hh:mi:ss** format.

NOTE

- If the value of **date** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **date** is of the DATE or STRING type but is not in one of the supported formats, **NULL** is returned.
- If the value of **date** is **NULL**, **NULL** is returned.

Example Code

The value **2023-08-31** is returned.

```
select lastday('2023-08-10');
```

The value **2023-08-31 00:00:00** is returned.

```
select lastday ('2023-08-10 10:54:00');
```

The value **NULL** is returned.

```
select lastday (null);
```

2.29.1.21 minute

This function is used to return the minute (from 0 to 59) of a specified time.

Syntax

```
minute(string date)
```

Parameters

Table 2-86 Parameter

Parameter	Mandatory	Type	Description
date	Yes	DATE or STRING	Date that needs to be processed The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3

Return Values

The return value is of the INT type.

NOTE

- If the value of **date** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **date** is of the DATE or STRING type but is not in one of the supported formats, **NULL** is returned.
- If the value of **date** is **NULL**, **NULL** is returned.

Example Code

The value **54** is returned.

```
select minute('2023-08-10 10:54:00');
```

The value **54** is returned.

```
select minute('10:54:00');
```

The value **NULL** is returned.

```
select minute('20230810105400');
```

The value **NULL** is returned.

```
select minute(null);
```

2.29.1.22 month

This function is used to return the month (from January to December) of a specified time.

Syntax

```
month(string date)
```


Parameters

Table 2-87 Parameter

Parameter	Mandatory	Type	Description
date	Yes	DATE or STRING	Date that needs to be processed If the value is of the STRING type, the value must contain at least yyyy-mm-dd and cannot contain redundant strings. The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3

Return Values

The return value is of the INT type.

NOTE

- If the value of **date** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **date** is of the DATE or STRING type but is not in one of the supported formats, **NULL** is returned.
- If the value of **date** is **NULL**, **NULL** is returned.

Example Code

The value **8** is returned.

```
select month('2023-08-10 10:54:00');
```

The value **NULL** is returned.

```
select month('20230810');
```

The value **NULL** is returned.

```
select month(null);
```

2.29.1.23 months_between

This function returns the month difference between **date1** and **date2**.

Syntax

```
months_between(string date1, string date2)
```


Parameters

Table 2-88 Parameters

Parameter	Mandatory	Type	Description
date1	Yes	DATE or STRING	Minuend The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3
date2	Yes	DATE or STRING	Subtrahend The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3

Return Values

The return value is of the DOUBLE type.

NOTE

- If the values of **date1** and **date2** are not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the values of **date1** and **date2** are of the DATE or STRING type but are not in one of the supported formats, **NULL** is returned.
- If **date1** is later than **date2**, the return value is positive. If **date2** is later than **date1**, the return value is negative.
- If **date1** and **date2** correspond to the last day of two different months, an integer month is returned. Otherwise, the calculation is based on the number of days between **date1** and **date2** divided by 31.
- If the value of **date1** or **date2** is **NULL**, **NULL** is returned.

Example Code

The value **0.0563172** is returned.

```
select months_between('2023-08-16 10:54:00', '2023-08-14 17:00:00');
```

The value **0.06451613** is returned.

```
select months_between('2023-08-16','2023-08-14');
```

The value **NULL** is returned.

```
select months_between('2023-08-16',null);
```


2.29.1.24 next_day

This function is used to return the date closest to **day_of_week** after **start_date**.

Syntax

```
next_day(string start_date, string day_of_week)
```

Parameters

Table 2-89 Parameters

Parameter	Mandatory	Type	Description
start_date	Yes	DATE or STRING	Date that needs to be processed If the value is of the STRING type, the value must contain at least yyyy-mm-dd and cannot contain redundant strings. The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3
day_of_week	Yes	STRING	One day of a week, either the first two or three letters of the word, or the full name of the word for that day. For example, **TU** indicates Tuesday.

Return Values

The return value is of the DATE type, in the **yyyy-mm-dd** format.

NOTE

- If the value of **start_date** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **start_date** is of the DATE or STRING type but is not in one of the supported formats, **NULL** is returned.
- If the value of **start_date** is **NULL**, **NULL** is returned.
- If the value of **day_of_week** is **NULL**, **NULL** is returned.

Example Code

The value **2023-08-22** is returned.

```
select next_day('2023-08-16','TU');
```

The value **2023-08-22** is returned.


```
select next_day('2023-08-16 10:54:00','TU');
```

The value **2023-08-23** is returned.

```
select next_day('2023-08-16 10:54:00','WE');
```

The value **NULL** is returned.

```
select next_day('20230816','TU');
```

The value **NULL** is returned.

```
select next_day('20230816 20:00:00',null);
```

2.29.1.25 quarter

This function is used to return the quarter of a date. The value ranges from 1 to 4.

Syntax

```
quarter(string date)
```

Parameters

Table 2-90 Parameter

Parameter	Mandatory	Type	Description
date	Yes	DATE or STRING	Date that needs to be processed The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3

Return Values

The return value is of the INT type.

NOTE

- If the value of **date** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **date** is of the DATE or STRING type but is not in one of the supported formats, **NULL** is returned.
- If the value of **date** is **NULL**, **NULL** is returned.

Example Code

The value **3** is returned.

```
select quarter('2023-08-16 10:54:00');
```

The value **3** is returned.


```
select quarter('2023-08-16');
```

The value **NULL** is returned.

```
select quarter(null);
```

2.29.1.26 second

This function is used to return the second (from 0 to 59) of a specified time.

Syntax

```
second(string date)
```

Parameters

Table 2-91 Parameter

Parameter	Mandatory	Type	Description
date	Yes	DATE or STRING	Date that needs to be processed The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3

Return Values

The return value is of the INT type.

NOTE

- If the value of **date** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **date** is of the DATE or STRING type but is not in one of the supported formats, **NULL** is returned.
- If the value of **date** is **NULL**, **NULL** is returned.

Example Code

The value **36** is returned.

```
select second('2023-08-16 10:54:36');
```

The value **36** is returned.

```
select second('10:54:36');
```

The value **NULL** is returned.

```
select second('20230816105436');
```

The value **NULL** is returned.

```
select second(null);
```

2.29.1.27 to_char

This function is used to convert a date into a string in a specified format.

Syntax

```
to_char(string date, string format)
```

Parameters

Table 2-92 Parameters

Parameter	Mandatory	Type	Description
date	Yes	DATE or STRING	Date that needs to be processed The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3
format	Yes	STRING	Format of the date to be converted Constant of the STRING type. Extended date formats are not supported. The value is a combination of the time unit (year, month, day, hour, minute, and second) and any character. • **YYYY** or **yyyy** indicates the year. • **MM** indicates the month. • **mm** indicates the minute. • **dd** indicates the day. • **HH** indicates the 24-hour clock. • **hh** indicates the 12-hour clock. • **mi** indicates the minute. • **ss** indicates the second. • **SSS** indicates millisecond.

Return Values

The return value is of the STRING type.

NOTE

- If the value of **date** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **date** is of the DATE or STRING type but is not in one of the supported formats, **NULL** is returned.
- If the value of **format** is **NULL**, **NULL** is returned.

Example Code

The static data **2023-08*16** is returned.

```
select to_char('2023-08-16 10:54:36','Example static data yyyy-mm*dd');
```

The value **20230816** is returned.

```
select to_char('2023-08-16 10:54:36', 'yyyymmdd');
```

The value **NULL** is returned.

```
select to_char('Example static data 2023-08-16','Example static data yyyy-mm*dd');
```

The value **NULL** is returned.

```
select to_char('20230816', 'yyyy');
```

The value **NULL** is returned.

```
select to_char('2023-08-16 10:54:36', null);
```

2.29.1.28 to_date

This function is used to return the year, month, and day in a time.

Similar function: **to_date1**. The **to_date1** function is used to convert a string in a specified format to a date value. The date format can be specified.

Syntax

```
to_date(string timestamp)
```

Parameters

Table 2-93 Parameter

Parameter	Mandatory	Type	Description
timestamp	Yes	DATE STRING	Time to be processed The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3

Return Values

The return value is of the DATE type, in the **yyyy-mm-dd** format.

NOTE

- If the value of **timestamp** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **timestamp** is of the DATE or STRING type but is not in one of the supported formats, **NULL** is returned.

Example Code

The value **2023-08-16** is returned.

```
select to_date('2023-08-16 10:54:36');
```

The value **NULL** is returned.

```
select to_date(null);
```

2.29.1.29 to_date1

This function is used to convert a string in a specified format to a date value.

Similar function: **to_date**. The **to_date** function is used to return the year, month, and day in a time. The date format cannot be specified.

Syntax

```
to_date1(string date, string format)
```

Parameters

Table 2-94 Parameters

Parameter	Mandatory	Type	Description
date	Yes	STRING	String to be converted The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3

Parameter	Mandatory	Type	Description
format	Yes	STRING	Format of the date to be converted Constant of the STRING type. Extended date formats are not supported. The value is a combination of the time unit (year, month, day, hour, minute, and second) and any character. • **YYYY** or **yyyy** indicates the year. • **MM** indicates the month. • **mm** indicates the minute. • **dd** indicates the day. • **HH** indicates the 24-hour clock. • **hh** indicates the 12-hour clock. • **mi** indicates the minute. • **ss** indicates the second. • **SSS** indicates the millisecond.

Return Values

The return value is of the STRING type.

NOTE

- If the value of **date** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **date** is of the DATE or STRING type but is not in one of the supported formats, **NULL** is returned.
- If the value of **date** is **NULL**, **NULL** is returned.
- If the value of **format** is **NULL**, a date in the **yyyy-mm-dd** format is returned.

Example Code

The value **NULL** is returned.

```
select to_date1('2023-08-16 10:54:36','yyyy-mm-dd');
```

The value **2023-08-16 00:00:00** is returned.

```
select to_date1('2023-08-16','yyyy-mm-dd');
```

The value **NULL** is returned.

```
select to_date(null);
```

The value **2023-08-16** is returned.

```
select to_date1('2023-08-16 10:54:36');
```

2.29.1.30 to_utc_timestamp

This function is used to convert a timestamp in a given time zone to a UTC timestamp.

Syntax

```
to_utc_timestamp(string timestamp, string timezone)
```

Parameters

Table 2-95 Parameters

Parameter	Mandatory	Type	Description
timestamp	Yes	DATE STRING TINYINT SMALLINT INT BIGINT	Time to be processed Date value of the DATE or STRING type, or timestamp of the TINYINT, SMALLINT, INT, or BIGINT type. The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3
timezone	Yes	STRING	Time zone where the time to be converted belongs

Return Values

The return value is of the BIGINT type.

NOTE

- If the value of **timestamp** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **timestamp** is of the DATE or STRING type but is not in one of the supported formats, **NULL** is returned.
- If the value of **timestamp** is **NULL**, **NULL** is returned.
- If the value of **timezone** is **NULL**, **NULL** is returned.

Example Code

The value **1692003600000** is returned.

```
select to_utc_timestamp('2023-08-14 17:00:00','pst');
```

The value **NULL** is returned.

```
select to_utc_timestamp(null);
```


2.29.1.31 trunc

This function is used to reset a date to a specific format.

Resetting means returning to default values, where the default values for year, month, and day are **01**, and the default values for hour, minute, second, and millisecond are **00**.

Syntax

```
trunc(string date, string format)
```

Parameters

Table 2-96 Parameters

Parameter	Mandatory	Type	Description
date	Yes	DATE or STRING	Date that needs to be processed The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3
format	Yes	STRING	Format of the date to be converted The value is a combination of the time unit (year, month, day, hour, minute, and second) and any character. • **YYYY** or **yyyy** indicates the year. • **MM** indicates the month. • **mm** indicates the minute. • **dd** indicates the day. • **HH** indicates the 24-hour clock. • **hh** indicates the 12-hour clock. • **mi** indicates the minute. • **ss** indicates the second. • **SSS** indicates the millisecond.

Return Values

The return value is of the DATE type, in the **yyyy-mm-dd** format.

NOTE

- If the value of **date** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **date** is of the DATE or STRING type but is not in one of the supported formats, **NULL** is returned.
- If the value of **date** is **NULL**, **NULL** is returned.
- If the value of **format** is **NULL**, **NULL** is returned.

Example Code

The value **2023-08-01** is returned.

```
select trunc('2023-08-16', 'MM');
```

The value **2023-08-01** is returned.

```
select trunc('2023-08-16 10:54:36', 'MM');
```

The value **NULL** is returned.

```
select trunc(null, 'MM');
```

2.29.1.32 unix_timestamp

This function is used to convert a date value to a numeric date value in UNIX format.

The function returns the first ten digits of the timestamp in normal UNIX format.

Syntax

```
unix_timestamp(string timestamp, string pattern)
```

Parameters

Table 2-97 Parameters

Parameter	Mandatory	Type	Description
timestamp	No	DATE or STRING	Date to be converted The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3

Parameter	Mandatory	Type	Description
pattern	No	STRING	Format to be converted If this parameter is left blank, the default format **yyyy-mm-dd hh:mm:ss** is used. The value is a combination of the time unit (year, month, day, hour, minute, and second) and any character. • **YYYY** or **yyyy** indicates the year. • **MM** indicates the month. • **mm** indicates the minute. • **dd** indicates the day. • **HH** indicates the 24-hour clock. • **hh** indicates the 12-hour clock. • **mi** indicates the minute. • **ss** indicates the second. • **SSS** indicates the millisecond.

Return Values

The return value is of the BIGINT type.

NOTE

- If the value of **timestamp** is **NULL**, **NULL** is returned.
- If both **timestamp** and **pattern** are left blank, the timestamp represented by the number of seconds since 1970-01-01 00:00:00 is returned.

Example Code

The value **1692149997** is returned.

```
select unix_timestamp('2023-08-16 09:39:57')
```

If the current system time is **2023-08-16 10:23:16**, **1692152596** is returned.

```
select unix_timestamp();
```

The value **1692115200** (2023-08-16 00:00:00) is returned.

```
select unix_timestamp("2023-08-16 10:56:45", "yyyy-MM-dd");
```

Example table data

```
select timestamp1, unix_timestamp(timestamp1) as date1_unix_timestamp, timestamp2,
unix_timestamp(datetime1) as date2_unix_timestamp, timestamp3, unix_timestamp(timestamp1) as
date3_unix_timestamp from database_t; output:
+------------+-------------------------+----------------------+---------------------- --
+-----------------------------------+----------------------------+
| timestamp1| date1_unix_timestamp | timestamp2              | date2_unix_timestamp |
timestamp3                          | date3_unix_timestamp      |
```



```
+------------+-------------------------+-----------------------+-------------------------
+-----------------------------------+---------------------------+
| 2023-08-02 | 1690905600000           | 2023-08-02 11:09:14 | 1690945754793           | 2023-01-11
00:00:00.123456789 | 1673366400000              |
| 2023-08-03 | 1690992000000           | 2023-08-02 11:09:31 | 1690945771994           | 2023-02-11
00:00:00.123456789 | 1676044800000              |
| 2023-08-04 | 1691078400000           | 2023-08-02 11:09:41 | 1690945781270           | 2023-03-11
00:00:00.123456789 | 1678464000000              |
| 2023-08-05 | 1691164800000           | 2023-08-02 11:09:48 | 1690945788874           | 2023-04-11
00:00:00.123456789 | 1681142400000              |
| 2023-08-06 | 1691251200000           | 2023-08-02 11:09:59 | 1690945799099           | 2023-05-11
00:00:00.123456789 | 1683734400000              |
+------------+-------------------------+-----------------------+-------------------------
+-----------------------------------+---------------------------+
```

2.29.1.33 weekday

This function is used to return the day of the current week.

Syntax

```
weekday (string date)
```

Parameters

Table 2-98 Parameter

Parameter	Mandatory	Type	Description
date	Yes	DATE or STRING	Date that needs to be processed The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3

Return Values

The return value is of the INT type.

NOTE

- If Monday is used as the first day of a week, the value **0** is returned. For other weekdays, the return value increases in ascending order. For Sunday, the value **6** is returned.
- If the value of **date** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **date** is of the DATE or STRING type but is not in one of the supported formats, **NULL** is returned.
- If the value of **date** is **NULL**, **NULL** is returned.

Example Code

The value **2** is returned.


```
select weekday ('2023-08-16 10:54:36');
```

The value **NULL** is returned.

```
select weekday (null);
```

2.29.1.34 weekofyear

This function is used to return the week number (from 0 to 53) of a specified date.

Syntax

```
weekofyear(string date)
```

Parameters

Table 2-99 Parameter

Parameter	Mandatory	Type	Description
date	Yes	DATE or STRING	Date that needs to be processed The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3

Return Values

The return value is of the INT type.

NOTE

- If the value of **date** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **date** is of the DATE or STRING type but is not in one of the supported formats, **NULL** is returned.
- If the value of **date** is **NULL**, **NULL** is returned.

Example Code

The value **33** is returned.

```
select weekofyear('2023-08-16 10:54:36');
```

The value **NULL** is returned.

```
select weekofyear('20230816');
```

The value **NULL** is returned.

```
select weekofyear(null);
```


2.29.1.35 year

This function is used to return the year of a specified date.

Syntax

```
year(string date)
```

Parameters

Table 2-100 Parameter

Parameter	Mandatory	Type	Description
date	Yes	DATE or STRING	Date that needs to be processed The following formats are supported: • yyyy-mm-dd • yyyy-mm-dd hh:mi:ss • yyyy-mm-dd hh:mi:ss.ff3

Return Values

The return value is of the INT type.

NOTE

- If the value of **date** is not of the DATE or STRING type, the error message "data type mismatch" is displayed.
- If the value of **date** is of the DATE or STRING type but is not in one of the supported formats, **NULL** is returned.
- If the value of **date** is **NULL**, **NULL** is returned.

Example Code

The value **2023** is returned.

```
select year('2023-08-16 10:54:36');
```

The value **NULL** is returned.

```
select year('23-01-01');
```

The value **NULL** is returned.

```
select year('2023/08/16');
```

The value **NULL** is returned.

```
select year(null);
```

2.29.2 String Functions

2.29.2.1 Overview

Table 2-101 lists the string functions supported by DLI.

Table 2-101 String functions

Function	Syntax	Value Type	Description
ascii	ascii(string <str>)	BIGINT	Returns the numeric value of the first character in a string.
concat	concat(array<T> <a>, array<T> <b>[,...]), concat(string <str1>, string <str2>[,...])	ARRAY or STRING	Returns a string concatenated from multiple input strings. This function can take any number of input strings.
concat_ws	concat_ws(string <separator>, string <str1>, string <str2>[,...]), concat_ws(string <separator>, array<string> <a>)	ARRAY or STRUCT	Returns a string concatenated from multiple input strings that are separated by specified separators.
char_matchcount	char_matchcount(string <str1>, string <str2>)	BIGINT	Returns the number of characters in str1 that appear in str2.
encode	encode(string <str>, string <charset>)	BINARY	Returns strs encoded in charset format.
find_in_set	find_in_set(string <str1>, string <str2>)	BIGINT	Returns the position (stating from 1) of str1 in str2 separated by commas (,).
get_json_object	get_json_object(string <json>, string <path>)	STRING	Parses the JSON object in a specified JSON path. The function will return **NULL** if the JSON object is invalid.
instr	instr(string <str>, string <substr>)	INT	Returns the index of substr that appears earliest in str. Returns **NULL** if either of the arguments are **NULL** and returns **0** if substr does not exist in str. Note that the first character in str has index 1.

Function	Syntax	Value Type	Description
instr1	instr1(string <str1>, string <str2>[, bigint <start_position>[, bigint <nth_appearance>]])	BIGINT	Returns the position of str2 in str1.
initcap	initcap(string A)	STRING	Converts the first letter of each word of a string to upper case and all other letters to lower case.
keyvalue	keyvalue(string <str>,[string <split1>,string <split2>,] string <key>)	STRING	Splits str by split1, converts each group into a key-value pair by split2, and returns the value corresponding to the key.
length	length(string <str>)	BIGINT	Returns the length of a string.
lengthb	lengthb(string <str>)	STRING	Returns the length of a specified string in bytes.
levenshtein	levenshtein(string A, string B)	INT	Returns the Levenshtein distance between two strings, for example, **levenshtein('kitten','sitting') = 3**.
locate	locate(string <substr>, string <str>[, bigint <start_pos>])	BIGINT	Returns the position of substr in str.
lower/lcase	lower(string A) , lcase(string A)	STRING	Converts all characters of a string to the lower case.
lpad	lpad(string <str1>, int <length>, string <str2>)	STRING	Returns a string of a specified length. If the length of the given string (str1) is shorter than the specified length (length), the given string is left-padded with str2 to the specified length.
ltrim	ltrim([<trimChars>,] string <str>)	STRING	Trims spaces from the left hand side of a string.

Function	Syntax	Value Type	Description
parse_url	parse_url(string urlString, string partToExtract [, string keyToExtract])	STRING	Returns the specified part of a given URL. Valid values of **partToExtract** include **HOST**, **PATH**, **QUERY**, **REF**, **PROTOCOL**, **AUTHORITY**, **FILE**, and **USERINFO**. For example, **parse_url('http://facebook.com/path1/p.php?k1=v1&k2=v2#Ref1', 'HOST')** returns **'facebook.com'**. When the second parameter is set to **QUERY**, the third parameter can be used to extract the value of a specific parameter. For example, **parse_url('http://facebook.com/path1/p.php?k1=v1&k2=v2#Ref1', 'QUERY', 'k1')** returns **'v1'**.
printf	printf(String format, Obj... args)	STRING	Prints the input in a specific format.
regexp_count	regexp_count(string <source>, string <pattern>[, bigint <start_position>])	BIGINT	Returns the number of substrings that match a specified pattern in the source, starting from the **start_position** position.
regexp_extract	regexp_extract(string <source>, string <pattern>[, bigint <groupid>])	STRING	Matches the string **source** based on the **pattern** grouping rule and returns the string content that matches **groupid**.
replace	replace(string <str>, string <old>, string <new>)	STRING	Replaces the substring that matches a specified string in a string with another string.

Function	Syntax	Value Type	Description
regexp_replace	• For Spark 2.4.5: regexp_replace(string <source>, string <pattern>, string <replace_string>) • For Spark 3.3.1: regexp_replace(string <source>, string <pattern>, string <replace_string>[, bigint <occurrence>])	STRING	• For Spark 2.4.5: Replaces the substring that matches the pattern for the occurrence time in the source string and the substring that matches the pattern later with the specified string **replace_string** and returns the result string. • For Spark 3.3.1: Replaces the substring that matches the pattern for the occurrence time in the source string and the substring that matches the pattern later with the specified string **replace_string** and returns the result string.
regexp_replace1	regexp_replace1(string <source>, string <pattern>, string <replace_string>[, bigint <occurrence>])	STRING	Replaces the substring that matches pattern for the occurrence time in the source string with the specified string **replace_string** and returns the result string.
regexp_instr	regexp_instr(string <source>, string <pattern>[,bigint <start_position>[, bigint <occurrence>[, bigint <return_option>]]])	BIGINT	Returns the start or end position of the substring that matches a specified pattern for the occurrence time, starting from **start_position** in the source string.
regexp_substr	regexp_substr(string <source>, string <pattern>[, bigint <start_position>[, bigint <occurrence>]])	STRING	Returns the substring that matches a specified pattern for the occurrence time, starting from **start_position** in the source string.
repeat	repeat(string <str>, bigint <n>)	STRING	Repeats a string for *N* times.
reverse	reverse(string <str>)	STRING	Returns a string in reverse order.

Function	Syntax	Value Type	Description
rpad	rpad(string <str1>, int <length>, string <str2>)	STRING	Right-pads str1 with str2 to the specified length.
rtrim	rtrim([<trimChars>,]string <str>), rtrim(trailing [<trimChars>] from <str>)	STRING	Trims spaces from the right hand side of a string.
soundex	soundex(string <str>)	STRING	Returns the soundex string from str, for example, **soundex('Miller') = M460**.
space	space(bigint <n>)	STRING	Returns a specified number of spaces.
substr/ substring	substr(string <str>, bigint <start_position>[, bigint <length>]), substring(string <str>, bigint <start_position>[, bigint <length>])	STRING	Returns the substring of str, starting from **start_position** and with a length of **length**.
substring_index	substring_index(string <str>, string <separator>, int <count>)	STRING	Truncates the string before the **count** separator of str. If the value of **count** is positive, the string is truncated from the left. If the value of **count** is negative, the string is truncated from the right.
split_part	split_part(string <str>, string <separator>, bigint <start>[, bigint <end>])	STRING	Splits a specified string based on a specified separator and returns a substring from the start to end position.
translate	translate(string|char|varchar input, string|char|varchar from, string|char|varchar to)	STRING	Translates the input string by replacing the characters or string specified by **from** with the characters or string specified by **to**. For example, replaces **bcd** in **abcde** with **BCD** using **translate("abcde", "bcd", "BCD")**.

Function	Syntax	Value Type	Description
trim	trim([<trimChars>,]string <str>), trim([BOTH] [<trimChars>] from <str>)	STRING	Trims spaces from both ends of a string.
upper/ucase	upper(string A), ucase(string A)	STRING	Converts all characters of a string to the upper case.

2.29.2.2 ascii

This function is used to return the ASCII code of the first character in str.

Syntax

```
ascii(string <str>)
```

Parameters

Table 2-102 Parameter

Parameter	Mandatory	Type	Description
str	Yes	STRING	If the value is of the BIGINT, DOUBLE, DECIMAL, or DATETIME type, the value is automatically converted to the STRING type for calculation. Example: **ABC**

Return Values

The return value is of the BIGINT type.

NOTE

- If the value of **str** is not of the STRING, BIGINT, DOUBLE, DECIMAL, or DATETIME type, an error is reported.
- If the value of **str** is **NULL**, **NULL** is returned.

Example Code

- Returns the ASCII code of the first character in string ABC. An example command is as follows:

  The value **97** is returned.

  ```
  select ascii('ABC');
  ```

- The value of the input parameter is **NULL**. An example command is as follows:

  The value **NULL** is returned.

```
select ascii(null);
```

2.29.2.3 concat

This function is used to concatenate arrays or strings.

Syntax

If multiple arrays are used as the input, all elements in the arrays are connected to generate a new array.

```
concat(array<T> <a>, array<T> <b>[,...])
```

If multiple strings are used as the input, the strings are connected to generate a new string.

```
concat(string <str1>, string <str2>[,...])
```

Parameters

- Using arrays as the input

  Table 2-103 Parameters

Parameter	Mandatory	Type	Description
a, b	Yes	STRING	Array In array<T>, **T** indicates the data type of the elements in the array. The elements in the array can be of any type. The data types of elements in arrays a and b must be the same. If the values of the elements in an array are **NULL**, the elements are involved in the operation.

- Using strings as the input

Table 2-104 Parameters

Parameter	Mandatory	Type	Description
str1, str2	Yes	STRING	String If the value of the input parameter is of the BIGINT, DOUBLE, DECIMAL, or DATETIME type, the value is automatically converted to the STRING type for calculation. For other types of values, an error is reported.

Return Values

The return value is of the ARRAY or STRING type.

NOTE

- If the return value is of the ARRAY type and any input array is **NULL**, **NULL** is returned.
- If the return value is of the STRING type and there is no parameter or any parameter is **NULL**, **NULL** is returned.

Example Code

- Connect the array (1, 2) and array (2, -2). An example command is as follows:

  The value **[1, 2, 2, -2]** is returned.

  ```
  select concat(array(1, 2), array(2, -2));
  ```

- Any array is **NULL**. An example command is as follows:

  The value **NULL** is returned.

  ```
  select concat(array(10, 20), null);
  ```

- Connect strings ABC and DEF. An example command is as follows:

  The value **aabcabcde** is returned.

  ```
  select concat('ABC','DEF');
  ```

- The input is empty. An example command is as follows:

  The value **NULL** is returned.

  ```
  select concat();
  ```

- The value of any string is **NULL**. An example command is as follows:

  The value **NULL** is returned.

  ```
  select concat('abc', 'def', null);
  ```

2.29.2.4 concat_ws

This function is used to return a string concatenated from multiple input strings that are separated by specified separators.

Syntax

```
concat_ws(string <separator>, string <str1>, string <str2>[,...])
```

or

```
concat_ws(string <separator>, array<string> <a>)
```


Returns the result of joining all the strings in the parameters or the elements in an array using a specified separator.

Parameters

Table 2-105 Parameters

Parameter	Mandatory	Type	Description
separator	Yes	STRING	Separator of the STRING type
str1, str2	Yes	STRING	At least two strings must be specified. The value is of the STRING type. If the value is of the BIGINT, DECIMAL, DOUBLE, or DATETIME type, the value is implicitly converted to the STRING type for calculation.
a	Yes	ARRAY	The elements in an array are of the STRING type.

Return Values

The return value is of the STRING or STRUCT type.

NOTE

- If the value of **str1** or **str2** is not of the STRING, BIGINT, DECIMAL, DOUBLE, or DATETIME type, an error is reported.
- If the value of the parameter (string to be concatenated) is **NULL**, the parameter is ignored.
- If there is no input parameter (string to be concatenated), **NULL** is returned.

Example Code

- Use a colon (:) to connect strings ABC and DEF. An example command is as follows:

  The value **ABC:DEF** is returned.

  ```
  select concat_ws(':','ABC','DEF');
  ```

- The value of any input parameter is **NULL**. An example command is as follows:

  The value **avg:18** is returned.

  ```
  select concat_ws(':','avg',null,'18');
  ```

- Use colons (:) to connect elements in the array ('name', 'lilei'). An example command is as follows:

  The value **name:lilei** is returned.

  ```
  select concat_ws(':',array('name', 'lilei'));
  ```


2.29.2.5 char_matchcount

This parameter is used to return the number of characters in str1 that appear in str2.

Syntax

```
char_matchcount(string <str1>, string <str2>)
```

Parameters

Table 2-106 Parameter

Parameter	Mandatory	Type	Description
str1, str2	Yes	STRING	str1 and str2 to be calculated

Return Values

The return value is of the BIGINT type.

NOTE

If the value of **str1** or **str2** is **NULL**, **NULL** is returned.

Example Code

The value **3** is returned.

```
select char_matchcount('abcz','abcde');
```

The value **NULL** is returned.

```
select char_matchcount(null,'abcde');
```

2.29.2.6 encode

This function is used to encode str in charset format.

Syntax

encode(string <str>, string <charset>)

Parameters

Table 2-107 Parameters

Parameter	Mandatory	Type	Description
str	Yes	STRING	At least two strings must be specified. The value is of the STRING type. If the value is of the BIGINT, DECIMAL, DOUBLE, or DATETIME type, the value is implicitly converted to the STRING type for calculation.
charset	Yes	STRING	Encoding format. The options are **UTF-8**, **UTF-16**, **UTF-16LE**, **UTF-16BE**, **ISO-8859-1**, and **US-ASCII**.

Return Values

The return value is of the BINARY type.

NOTE

If the value of **str** or **charset** is **NULL**, **NULL** is returned.

Example Code

- Encodes string abc in UTF-8 format. An example command is as follows:

  The value **abc** is returned.

  ```
  select encode("abc", "UTF-8");
  ```

- The value of any input parameter is **NULL**. An example command is as follows:

  The return value is **NULL**.

  ```
  select encode("abc", null);
  ```

2.29.2.7 find_in_set

This function is used to return the position (stating from 1) of str1 in str2 separated by commas (,).

Syntax

```
find_in_set(string <str1>, string <str2>)
```

Parameters

Table 2-108 Parameters

Parameter	Mandatory	Type	Description
str1	Yes	STRING	String to be searched for
str2	Yes	STRING	String separated by a comma (,)

Return Values

The return value is of the BIGINT type.

NOTE

- If str1 cannot be matched in str2 or str1 contains commas (,), **0** is returned.
- If the value of **str1** or **str2** is **NULL**, **NULL** is returned.

Example Code

- Search for the position of string **ab** in string **abc,123,ab,c**. An example command is as follows:

  The value **3** is returned.

  ```
  select find_in_set('ab', 'abc,123,ab,c');
  ```

- Search for the position of string **hi** in string **abc,123,ab,c**. An example command is as follows:

  The value **0** is returned.

  ```
  select find_in_set('hi', 'abc,123,ab,c');
  ```

- The value of any input parameter is **NULL**. An example command is as follows:

  The value **NULL** is returned.

  ```
  select find_in_set(null, 'abc,123,ab,c');
  ```

2.29.2.8 get_json_object

This function is used to parse the JSON object in a specified JSON path. The function will return **NULL** if the JSON object is invalid.

Syntax

```
get_json_object(string <json>, string <path>)
```

Parameters

Table 2-109 Parameters

Parameter	Mandatory	Type	Description
json	Yes	STRING	Standard JSON object, in the **{Key:Value, Key:Value,...}** format.
path	Yes	STRING	Path of the object in JSON format, which starts with $. The meanings of characters are as follows: • **$** indicates the root node. • **.** indicates a subnode. • **[]** indicates the index of an array, which starts from 0. • ***** indicates the wildcard for []. The entire array is returned. * does not support escape.

Return Values

The return value is of the STRING type.

NOTE

- If the value of **json** is empty or in invalid JSON format, **NULL** is returned.
- If the value of **json** is valid and **path** is specified, the corresponding string is returned.

Example Code

- Extracts information from the JSON object **src_json.json**. An example command is as follows:

  ```
  jsonString = {"store": {"fruit":[{"weight":8,"type":"apple"},{"weight":9,"type":"pear"}], "bicycle":{"price":19.95,"color":"red"} }, "email":"amy@only_for_json_udf_test.net", "owner":"Tony" }
  ```

  Extracts the information of the **owner** field and returns **Tony**.

  ```
  select get_json_object(jsonString, '$.owner');
  ```

  Extracts the first array information of the **store.fruit** field and returns **{"weight":8,"type":"apple"}**.

  ```
  select get_json_object(jsonString, '$.store.fruit[0]');
  ```

  Extracts information about a field that does not exist and returns **NULL**.

  ```
  select get_json_object(jsonString, '$.non_exist_key');
  ```

- Extracts information about an array JSON object. An example command is as follows:

  The value **22** is returned.

  ```
  select get_json_object('{"array":[["a",11],["b",22],["c",33]]}','$.array[1][1]');
  ```

  The value **["h00","h11","h22"]** is returned.

  ```
  select get_json_object('{"a":"b","c":{"d":"e","f":"g","h":["h00","h11","h22"]},"i":"j"}','$.c.h[*]');
  ```


The value **["h00","h11","h22"]** is returned.

```
select get_json_object('{"a":"b","c":{"d":"e","f":"g","h":["h00","h11","h22"]},"i":"j"}','$.c.h');
```

The value **h11** is returned.

```
select get_json_object('{"a":"b","c":{"d":"e","f":"g","h":["h00","h11","h22"]},"i":"j"}','$.c.h[1]');
```

- Extracts information from a JSON object with a period (.). An example command is as follows:

  Create a table.

  ```
  create table json_table (id string, json string);
  ```

  Insert data into the table. The key contains a period (.).

  ```
  insert into table json_table (id, json) values ("1", "{\"China.hangzhou\":{\"region\":{\"rid\":6}}}");
  ```

  Insert data into the table. The key does not contain a period (.).

  ```
  insert into table json_table (id, json) values ("2", "{\"China_hangzhou\":{\"region\":{\"rid\":7}}}");
  ```

  Obtain the value of **rid**. If the key is **China.hangzhou**, **6** is returned. Only [''] can be used for parsing because a period (.) is included.

  ```
  select get_json_object(json, "$['China.hangzhou'].region['id']") from json_table where id =1;
  ```

  Obtain the value of **rid**. If the key is **China_hangzhou**, **7** is returned. You can use either of the following methods:

  ```
  select get_json_object(json, "$['China_hangzhou'].region['id']") from json_table where id =2;
  select get_json_object(json, "$.China_hangzhou.region['id']") from json_table where id =2;
  ```

- The **json** parameter is either empty or has an invalid format. An example command is as follows:

  The value **NULL** is returned.

  ```
  select get_json_object('','$.array[2]');
  ```

  The value **NULL** is returned.

  ```
  select get_json_object('"array":["a",1],"b":["c",3]','$.array[1][1]');
  ```

- A JSON string involves escape. An example command is as follows:

  The value **3** is returned.

  ```
  select get_json_object('{"a":"\\"3\\"","b":"6"}', '$.a');
  ```

  The value **3** is returned.

  ```
  select get_json_object('{"a":"\'3\'","b":"6"}', '$.a');
  ```

- A JSON object can contain the same key and can be parsed successfully.

  The value **1** is returned.

  ```
  select get_json_object('{"b":"1","b":"2"}', '$.b');
  ```

- The result is output in the original sorting mode of the JSON string.

  The value **{"b":"3","a":"4"}** is returned.

  ```
  select get_json_object('{"b":"3","a":"4"}', '$');
  ```

2.29.2.9 instr

This function is used to return the index of substr that appears earliest in str.

It returns **NULL** if either of the arguments are **NULL** and returns **0** if substr does not exist in str. Note that the first character in str has index 1.

Similar function: **instr1**. The **instr1** function is used to calculate the position of the substring str2 in the string str1. The **instr1** function allows you to specify the start search position and the number of matching times.

Syntax

```
instr(string <str>, string <substr>)
```

Parameters

Table 2-110 Parameters

Parameter	Mandatory	Type	Description
str	Yes	STRING	Target string to be searched for If the value is of the BIGINT, DOUBLE, DECIMAL, or DATETIME type, the value is implicitly converted to the STRING type for calculation. For other types of values, an error is reported.
substr	Yes	STRING	Substring to be matched If the value is of the BIGINT, DOUBLE, DECIMAL, or DATETIME type, the value is implicitly converted to the STRING type for calculation. For other types of values, an error is reported.

Return Values

The return value is of the BIGINT type.

NOTE

- If **str2** is not found in **str1**, **0** is returned.
- If **str2** is an empty string, the matching is always successful. For example, **select instr('abc','');** returns **1**.
- If the value of **str1** or **str2** is **NULL**, **NULL** is returned.

Example Code

- Returns the position of character b in string abc. An example command is as follows:

  The value **2** is returned.

  ```
  select instr('abc', 'b');
  ```

- The value of any input parameter is **NULL**. An example command is as follows:

  The value **NULL** is returned.

  ```
  select instr('abc', null)
  ```

2.29.2.10 instr1

This function is used to return the position of substring str2 in string str1.

Similar function: **instr**. The **instr** function is used to return the index of substr that appears earliest in **str**. However, instr does not support specifying the start search position and matching times.

Syntax

```
instr1(string <str1>, string <str2>[, bigint <start_position>[, bigint <nth_appearance>]])
```

Parameters

Table 2-111 Parameters

Parameter	Mandatory	Type	Description
str1	Yes	STRING	Target string to be searched for If the value is of the BIGINT, DOUBLE, DECIMAL, or DATETIME type, the value is implicitly converted to the STRING type for calculation. For other types of values, an error is reported.
str2	Yes	STRING	Substring to be matched If the value is of the BIGINT, DOUBLE, DECIMAL, or DATETIME type, the value is implicitly converted to the STRING type for calculation. For other types of values, an error is reported.
start_position	No	BIGINT	Sequence number of the character in str1 the search starts from. The default start position is position 1 (position of the first character). If this parameter is set to a negative number, the search starts from the end to the beginning of the string, and the last character is **-1**.
nth_appearance	No	BIGINT	Position of str2 that is matched for the nth_appearance time in str1. If the value is of another type or is less than or equal to 0, an error is reported.

Return Values

The return value is of the BIGINT type.

NOTE

- If **str2** is not found in **str1**, **0** is returned.
- If str2 is an empty string, the matching is always successful.
- If the value of **str1**, **str2**, **start_position**, or **nth_appearance** is **NULL**, **NULL** is returned.

Example Code

The value **10** is returned.

```
select instr1('Tech on the net', 'h', 5, 1);
```

The value **2** is returned.

```
select instr1('abc', 'b');
```

The value **NULL** is returned.

```
select instr('abc', null);
```

2.29.2.11 initcap

This function is used to convert the first letter of each word of a string to upper case and all other letters to lower case.

Syntax

```
initcap(string A)
```

Parameters

Table 2-112 Parameter

Parameter	Mandatory	Type	Description
A	Yes	STRING	Text string to be converted

Return Values

The return value is of the STRING type. In the string, the first letter of each word is capitalized, and the other letters are lowercased.

Example Code

The value **Dli Sql** is returned.

```
SELECT initcap("dLI sql");
```

2.29.2.12 keyvalue

This function is used to split str by split1, convert each group into a key-value pair by split2, and return the value corresponding to the key.

Syntax

```
keyvalue(string <str>,[string <split1>,string <split2>,] string <key>)
```

Parameters

Table 2-113 Parameters

Parameter	Mandatory	Type	Description
str	Yes	STRING	String to be split
split1, split2	No	STRING	Strings used as separators to split the source string. If these two separators are not specified in the expression, the default values are **;** for **split1** and **:** for **split2**. If there are multiple occurrences of split2 within a string that has been split by split1, the result is undefined.
key	No	BIGINT	The corresponding value when the string is split using **split1** and **split2**.

Return Values

The return value is of the STRING type.

NOTE

- If the value of **split1** or **split2** is **NULL**, **NULL** is returned.
- If the value of **str** or **key** is **NULL** or no matching key is found, **NULL** is returned.
- If multiple key-value pairs are matched, the value corresponding to the first matched key is returned.

Example Code

The value **2** is returned.

```
select keyvalue('a:1;b:2', 'b');
```

The value **2** is returned.

```
select keyvalue("\;abc:1\;def:2","\;",":","def");
```

2.29.2.13 length

This function is used to return the length of a string.

Similar function: **lengthb**. The **lengthb** function is used to return the length of string **str** in bytes and return a value of the STRING type.

Syntax

```
length(string <str>)
```


Parameters

Table 2-114 Parameter

Parameter	Mandatory	Type	Description
str	Yes	STRING	Target string to be searched for If the value is of the BIGINT, DOUBLE, DECIMAL, or DATETIME type, the value is implicitly converted to the STRING type for calculation. For other types of values, an error is reported.

Return Values

The return value is of the BIGINT type.

NOTE

- If the value of **str** is not of the STRING, BIGINT, DOUBLE, DECIMAL, or DATETIME type, an error is reported.
- If the value of **str** is **NULL**, **NULL** is returned.

Example Code

- Calculate the length of string abc. An example command is as follows:

  The value **3** is returned.

  ```
  select length('abc');
  ```

- The value of the input parameter is **NULL**. An example command is as follows:

  The value **NULL** is returned.

  ```
  select length(null);
  ```

2.29.2.14 lengthb

This function is used to return the length of a specified string in bytes.

Similar function: **length**. The **length** function is used to return the length of a string and return a value of the BIGINT type.

Syntax

```
lengthb(string <str>)
```

Parameters

Table 2-115 Parameter

Parameter	Mandatory	Type	Description
str	Yes	STRING	Input string

Return Values

The return value is of the STRING type.

NOTE

- If the value of **str** is not of the STRING, BIGINT, DOUBLE, DECIMAL, or DATETIME type, an error is reported.
- If the value of **str** is **NULL**, **NULL** is returned.

Example Code

The value **5** is returned.

```
select lengthb('hello');
```

The value **NULL** is returned.

```
select lengthb(null);
```

2.29.2.15 levenshtein

This function is used to returns the Levenshtein distance between two strings, for example, **levenshtein('kitten','sitting') = 3**.

NOTE

Levenshtein distance is a type of edit distance. It indicates the minimum number of edit operations required to convert one string into another.

Syntax

```
levenshtein(string A, string B)
```

Parameters

Table 2-116 Parameter

Parameter	Mandatory	Type	Description
A, B	Yes	STRING	String to be entered for calculating the Levenshtein distance

Return Values

The return value is of the INT type.

Example Code

The value **3** is returned.

```
SELECT levenshtein('kitten','sitting');
```

2.29.2.16 locate

This function is used to return the position of substr in str. You can specify the starting position of your search using "start_pos," which starts from 1.

Syntax

```
locate(string <substr>, string <str>[, bigint <start_pos>])
```

Parameters

Table 2-117 Parameters

Parameter	Mandatory	Type	Description
str	Yes	STRING	Target string to be searched for If the value is of the BIGINT, DOUBLE, DECIMAL, or DATETIME type, the value is implicitly converted to the STRING type for calculation. For other types of values, an error is reported.
substr	Yes	STRING	Substring to be matched If the value is of the BIGINT, DOUBLE, DECIMAL, or DATETIME type, the value is implicitly converted to the STRING type for calculation. For other types of values, an error is reported.
start_pos	No	BIGINT	Start position for the search

Return Values

The return value is of the BIGINT type.

NOTE

- If substr cannot be matched in str, **0** is returned.
- If the value of **str** or **substr** is **NULL**, **NULL** is returned.
- If the value of **start_pos** is **NULL**, **0** is returned.

Example Code

- Search for the position of string **ab** in string **abhiab**. An example command is as follows:

  The value **1** is returned.

  ```
  select locate('ab', 'abhiab');
  ```

  The value **5** is returned.

  ```
  select locate('ab', 'abhiab', 2);
  ```

  The value **0** is returned.

  ```
  select locate('ab', 'abhiab', null);
  ```

- Search for the position of string **hi** in string **hanmeimei and lilei**. An example command is as follows:

  The value **0** is returned.

  ```
  select locate('hi', 'hanmeimei and lilei');
  ```

2.29.2.17 lower/lcase

This function is used to convert all characters of a string to the lower case.

Syntax

```
lower(string A) / lcase(string A)
```

Parameters

Table 2-118 Parameter

Parameter	Mandatory	Type	Description
A	Yes	STRING	Text string to be converted

Return Values

The return value is of the STRING type.

NOTE

- If the value of the input parameter is not of the STRING, BIGINT, DOUBLE, DECIMAL, or DATETIME type, an error is reported.
- If the value of the input parameter is **NULL**, **NULL** is returned.

Example Code

Converts uppercase characters in a string to the lower case. An example command is as follows:

The value **abc** is returned.

```
select lower('ABC');
```

The value of the input parameter is **NULL**. An example command is as follows:

The value **NULL** is returned.

```
select lower(null);
```

2.29.2.18 lpad

This function is used to return a string of a specified length. If the length of the given string (str1) is shorter than the specified length (length), the given string is left-padded with str2 to the specified length.

Syntax

```
lpad(string <str1>, int <length>, string <str2>)
```

Parameters

Table 2-119 Parameters

Parameter	Mandatory	Type	Description
str1	Yes	STRING	String to be left-padded
length	Yes	STRING	Number of digits to be padded to the left
str2	No	STRING	String used for padding

Return Values

The return value is of the STRING type.

NOTE

- If the value of **length** is smaller than the number of digits in **str1**, the string whose length is truncated from the left of str1 is returned.
- If the value of **length** is **0**, an empty string is returned.
- If there is no input parameter or the value of any input parameter is **NULL**, **NULL** is returned.

Example Code

- Uses string **ZZ** to left pad string **abcdefgh** to 10 digits. An example command is as follows:

  The value **ZZabcdefgh** is returned.

  ```
  select lpad('abcdefgh', 10, 'ZZ');
  ```

- Uses string **ZZ** to left pad string **abcdefgh** to 5 digits. An example command is as follows:

  The value **abcde** is returned.

  ```
  select lpad('abcdefgh', 5, 'ZZ');
  ```

- The value of **length** is **0**. An example command is as follows:

  An empty string is returned.


```
select lpad('abcdefgh', 0, 'ZZ');
```

- The value of any input parameter is **NULL**. An example command is as follows:

  The value **NULL** is returned.

  ```
  select lpad(null ,0, 'ZZ');
  ```

2.29.2.19 ltrim

This function is used to remove characters from the left of **str**.

- If **trimChars** is not specified, spaces are removed by default.
- If **trimChars** is specified, the function removes the longest possible substring from the left end of **str** that consists of characters in the **trimChars** set.

Similar functions:

- **rtrim**. This function is used to remove characters from the right of **str**.
- **trim**. This function is used to remove characters from the left and right of **str**.

Syntax

```
ltrim([<trimChars>,] string <str>)
```

Parameters

Table 2-120 Parameters

Parameter	Mandatory	Type	Description
str	Yes	STRING	String from which characters on the left are to be removed. If the value is of the BIGINT, DECIMAL, DOUBLE, or DATETIME type, the value is implicitly converted to the STRING type for calculation.
trimChars	Yes	STRING	Characters to be removed

Return Values

The return value is of the STRING type.

NOTE

- If the value of **str** is not of the STRING, BIGINT, DOUBLE, DECIMAL, or DATETIME type, an error is reported.
- If the value of **str** or **trimChars** is **NULL**, **NULL** is returned.

Example Code

- Removes spaces on the left of string **abc**. An example command is as follows:

  The value **stringabc** is returned.


```
select ltrim('     abc');
```

It is equivalent to the following statement:

```
select trim(leading from '     abc');
```

leading indicates that the leading spaces in a string are removed.

- The value of the input parameter is **NULL**. An example command is as follows:

  The value **NULL** is returned.

  ```
  select ltrim(null);
  select ltrim('xy', null);
  select ltrim(null, 'xy');
  ```

- Removes all substrings from the left end of the string **yxlucyxx** that consist of characters in the set **xy**.

  The function returns **lucyxx**, as any substring starting with **x** or **y** from the left end is removed.

  ```
  select ltrim( 'xy','yxlucyxx');
  ```

  It is equivalent to the following statement:

  ```
  select trim(leading 'xy' from 'yxlucyxx');
  ```

2.29.2.20 parse_url

This character is used to return the specified part of a given URL. Valid values of **partToExtract** include **HOST**, **PATH**, **QUERY**, **REF**, **PROTOCOL**, **AUTHORITY**, **FILE**, and **USERINFO**.

For example, **parse_url('http://facebook.com/path1/p.php?k1=v1&k2=v2#Ref1', 'HOST')** returns **'facebook.com'**.

When the second parameter is set to **QUERY**, the third parameter can be used to extract the value of a specific parameter. For example, **parse_url('http://facebook.com/path1/p.php?k1=v1&k2=v2#Ref1', 'QUERY', 'k1')** returns **'v1'**.

Syntax

```
parse_url(string urlString, string partToExtract [, string keyToExtract])
```

Parameters

Table 2-121 Parameters

Parameter	Mandatory	Type	Description
urlString	Yes	STRING	URL. If the URL is invalid, an error is reported.
partToExtract	Yes	STRING	The value is case-insensitive and can be **HOST**, **PATH**, **QUERY**, **REF**, **PROTOCOL**, **AUTHORITY**, **FILE**, or **USERINFO**.
keyToExtract	No	STRING	If the value of **partToExtract** is **QUERY**, the value is obtained based on the key.

Return Values

The return value is of the STRING type. The return rules are as follows:

NOTE

- If the value of **urlString**, **partToExtract**, or **keyToExtract** is **NULL**, **NULL** is returned.
- If the value of **partToExtract** does not meet requirements, an error is reported.

Example Code

The value **example.com** is returned.

```
select parse_url('file://username@example.com:666/over/there/index.dtb?
type=animal&name=narwhal#nose', 'HOST');
```

The value **/over/there/index.dtb** is returned.

```
select parse_url('file://username@example.com:666/over/there/index.dtb?
type=animal&name=narwhal#nose', 'PATH');
```

The value **animal** is returned.

```
select parse_url('file://username@example.com:666/over/there/index.dtb?
type=animal&name=narwhal#nose', 'QUERY', 'type');
```

The value **nose** is returned.

```
select parse_url('file://username@example.com:666/over/there/index.dtb?
type=animal&name=narwhal#nose', 'REF');
```

The value **file** is returned.

```
select parse_url('file://username@example.com:666/over/there/index.dtb?
type=animal&name=narwhal#nose', 'PROTOCOL');
```

The value **username@*example*.com:8042** is returned.

```
select parse_url('file://username@example.com:666/over/there/index.dtb?
type=animal&name=narwhal#nose', 'AUTHORITY');
```

The value **username** is returned.

```
select parse_url('file://username@example.com:666/over/there/index.dtb?
type=animal&name=narwhal#nose', 'USERINFO');
```

2.29.2.21 printf

This function is used to print the input in a specific format.

Syntax

```
printf(String format, Obj... args)
```

Parameters

Table 2-122 Parameters

Parameter	Mandatory	Type	Description
format	Yes	STRING	Output format
Obj	No	STRING	Other input parameters

Return Values

The return value is of the STRING type.

The value is returned after the parameters that filled in **Obj** are specified for **format**.

Example Code

The string **name: Zhang San, age: 20, gender: female, place of origin: city 1** is returned.

```
SELECT printf('Name: %s, Age: %d, Gender: %s, Place of origin: %s', "Zhang San", 20, "Female", "City 1");
```

2.29.2.22 regexp_count

This function is used to return the number of substrings that match a specified pattern in the source, starting from the **start_position** position.

Syntax

```
regexp_count(string <source>, string <pattern>[, bigint <start_position>])
```

Parameters

Table 2-123 Parameters

Parameter	Mandatory	Type	Description
source	Yes	STRING	String to be searched for. For other types, an error is reported.
pattern	Yes	STRING	Constant or regular expression of the STRING type. Pattern to be matched. If the value of this parameter is an empty string or of other types, an error is reported.

Parameter	Mandatory	Type	Description
start_position	No	BIGINT	Constant of the BIGINT type. The value must be greater than 0. If the value is of another type or is less than or equal to 0, an error is reported. If this parameter is not specified, the default value **1** is used, indicating that the matching starts from the first character of **source**.

Return Values

The return value is of the BIGINT type.

NOTE

- If no match is found, **0** is returned.
- If the value of **source** or **pattern** is **NULL**, **NULL** is returned.

Example Code

The value **4** is returned.

```
select regexp_count('ab0a1a2b3c', '[0-9]');
```

The value **3** is returned.

```
select regexp_count('ab0a1a2b3c', '[0-9]', 4);
```

The value **null** is returned.

```
select regexp_count('ab0a1a2b3c', null);
```

2.29.2.23 regexp_extract

This function is used to match the string **source** based on the **pattern** grouping rule and return the string content that matches **groupid**.

Syntax

regexp_extract(string <source>, string <pattern>[, bigint <groupid>])

Parameters

Table 2-124 Parameters

Parameter	Mandatory	Type	Description
source	Yes	STRING	String to be split

Parameter	Mandatory	Type	Description
pattern	Yes	STRING	Constant or regular expression of the STRING type. Pattern to be matched.
groupid	No	BIGINT	Constant of the BIGINT type. The value must be greater than or equal to 0.

Return Values

The return value is of the STRING type.

NOTE

- If the value of **pattern** is an empty string or there is no group in **pattern**, an error is reported.
- If the value of **groupid** is not of the BIGINT type or is less than 0, an error is reported.
- If this parameter is not specified, the default value **1** is used, indicating that the first group is returned.
- If the value of **groupid** is **0**, the substring that meets the entire pattern is returned.
- If the value of **source**, **pattern**, or **groupid** is **NULL**, **NULL** is returned.

Example Code

Splits **basketball** by **bas(.*?)(ball)**. The value **ket** is returned.

```
select regexp_extract('basketball', 'bas(.*?)(ball)');
```

The value **basketball** is returned.

```
select regexp_extract('basketball', 'bas(.*?)(ball)',0);
```

The value **99** is returned. When submitting SQL statements for regular expression calculation on DLI, two backslashes (\) are used as escape characters.

```
select regexp_extract('8d99d8', '8d(\\d+)d8');
```

The value **[Hello]** is returned.

```
select regexp_extract('[Hello] hello', '([^\\x{00}-\\x{ff}]+)');
```

The value **Hello** is returned.

```
select regexp_extract('[Hello] hello', '([\\x{4e00}-\\x{9fa5}]+)');
```

2.29.2.24 replace

This function is used to replace the part in a specified string that is the same as the string **old** with the string new and return the result.

If the string has no same characters as the string **old**, **str** is returned.

Syntax

```
replace(string <str>, string <old>, string <new>)
```


Parameters

Table 2-125 Parameters

Parameter	Mandatory	Type	Description
str	Yes	STRING	String to be replaced
old	Yes	STRING	String to be compared
new	Yes	STRING	String after replacement

Return Values

The return value is of the STRING type.

NOTE

If the value of any input parameter is **NULL**, **NULL** is returned.

Example Code

The value **AA123AA** is returned.

```
select replace('abc123abc','abc','AA');
```

The value **NULL** is returned.

```
select replace('abc123abc',null,'AA');
```

2.29.2.25 regexp_replace

This function has slight variations in its functionality depending on the version of Spark being used.

- For Spark 2.4.5 or earlier: Replaces the substring that matches **pattern** in the string **source** with the specified string **replace_string** and returns the result string.
- For Spark 3.3.1: Replaces the substring that matches the pattern for the occurrence time in the source string and the substring that matches the pattern later with the specified string **replace_string** and returns the result string.

Similar function: **regexp_replace1**. The **regexp_replace1** function is used to replace the substring that matches pattern for the occurrence time in the source string with the specified string **replace_string** and return the result string. However, the egexp_replace1 function applies only to Spark 2.4.5 or earlier.

The regexp_replace1 function is applicable to Spark 2.4.5. It supports specifying the **occurrence** parameter, whereas the **regexp_replace** function does not support it.

Syntax

- Spark 2.4.5 or earlier
  ```
  regexp_replace(string <source>, string <pattern>, string <replace_string>)
  ```
- Spark 3.1.1
  ```
  regexp_replace(string <source>, string <pattern>, string <replace_string>[, bigint <occurrence>])
  ```

Parameters

Table 2-126 Parameters

Parameter	Mandatory	Type	Description
source	Yes	STRING	String to be replaced
pattern	Yes	STRING	Constant or regular expression of the STRING type. Pattern to be matched. For more guidelines on writing regular expressions, refer to the regular expression specifications. If the value of this parameter is an empty string, an error is reported.
replace_string	Yes	STRING	String that replaces the one matching the **pattern** parameter
occurrence	No	BIGINT	The value must be greater than or equal to 1, indicating that the string that is matched for the occurrence time is replaced with **replace_string**. When the value is **1**, all matched substrings are replaced. If the value is of another type or is less than 1, an error is reported. The default value is **1**. **NOTE** This parameter is available only when Spark 3.1.1 is used.

Return Values

The return value is of the STRING type.

NOTE

- If the value of **pattern** is an empty string or there is no group in **pattern**, an error is reported.
- If a group that does not exist is referenced, the group is not replaced.
- If the value of **replace_string** is **NULL** and the pattern is matched, **NULL** is returned.
- If the value of **replace_string** is **NULL** but the pattern is not matched, **NULL** is returned.
- If the value of **source**, **pattern**, or **occurrence** is **NULL**, **NULL** is returned.

Example Code

- For Spark 2.4.5 or earlier

  The value **num-num** is returned.

  ```
  SELECT regexp_replace('100-200', '(\\d+)', 'num');
  ```

- For Spark 3.1.1

  The value **2222** is returned.

  ```
  select regexp_replace('abcd', '[a-z]', '2');
  ```

  The value **2222** is returned.

  ```
  select regexp_replace('abcd', '[a-z]', '2', 1);
  ```

  The value **a222** is returned.

  ```
  select regexp_replace('abcd', '[a-z]', '2', 2);
  ```

  The value **ab22** is returned.

  ```
  select regexp_replace('abcd', '[a-z]', '2', 3);
  ```

  The value **abc2** is returned.

  ```
  select regexp_replace('abcd', '[a-z]', '2', 4);
  ```

2.29.2.26 regexp_replace1

This function is used to replace the substring that matches pattern for the occurrence time in the source string with the specified string **replace_string** and return the result string.

NOTE

This function applies only to Spark 2.4.5 or earlier.

Similar function: **regexp_replace**. The **regexp_replace** function has slightly different functionalities for different versions of Spark. For details, see **regexp_replace**.

Syntax

```
regexp_replace1(string <source>, string <pattern>, string <replace_string>[, bigint <occurrence>])
```

Parameters

Table 2-127 Parameters

Parameter	Mandatory	Type	Description
source	Yes	STRING	String to be replaced
pattern	Yes	STRING	Constant or regular expression of the STRING type. Pattern to be matched. For more guidelines on writing regular expressions, refer to the regular expression specifications. If the value of this parameter is an empty string, an error is reported.

Parameter	Mandatory	Type	Description
replace_string	Yes	STRING	String that replaces the one matching the **pattern** parameter
occurrence	No	BIGINT	The value must be greater than or equal to 1, indicating that the string that is matched for the occurrence time is replaced with **replace_string**. When the value is **1**, all matched substrings are replaced. If the value is of another type or is less than 1, an error is reported. The default value is **1**.

Return Values

The return value is of the STRING type.

NOTE

- If a group that does not exist is referenced, the group is not replaced.
- If the value of **replace_string** is **NULL** and the pattern is matched, **NULL** is returned.
- If the value of **replace_string** is **NULL** but the pattern is not matched, **NULL** is returned.
- If the value of **source**, **pattern**, or **occurrence** is **NULL**, **NULL** is returned.

Example Code

The value **2222** is returned.

```
select regexp_replace('abcd', '[a-z]', '2');
```

The value **2bcd** is returned.

```
select regexp_replace('abcd', '[a-z]', '2', 1);
```

The value **a2cd** is returned.

```
select regexp_replace('abcd', '[a-z]', '2', 2);
```

The value **ab2d** is returned.

```
select regexp_replace('abcd', '[a-z]', '2', 3);
```

The value **abc2** is returned.

```
select regexp_replace('abcd', '[a-z]', '2', 4);
```

2.29.2.27 regexp_instr

This function is used to return the start or end position of the substring that matches a specified pattern for the occurrence time, starting from **start_position** in the string **source**.

Syntax

```
regexp_instr(string <source>, string <pattern>[,bigint <start_position>[, bigint <occurrence>[, bigint <return_option>]]])
```

Parameters

Table 2-128 Parameters

Parameter	Mandatory	Type	Description
source	Yes	STRING	Source string
pattern	Yes	STRING	Constant or regular expression of the STRING type. Pattern to be matched. If the value of this parameter is an empty string, an error is reported.
start_position	No	BIGINT	Constant of the BIGINT type. Start position of the search. If it is not specified, the default value **1** is used.
occurrence	No	BIGINT	Constant of the BIGINT type. It indicates the specified number of matching times. If this parameter is not specified, the default value **1** is used, indicating that the first occurrence position is searched.
return_option	No	BIGINT	Constant of the BIGINT type. This parameter indicates the location to be returned. The value can be **0** or **1**. If this parameter is not specified, the default value **0** is used. If this parameter is set to a value of another type or a value that is not allowed, an error message is returned. The value **0** indicates that the start position of the match is returned, and the value **1** indicates that the end position of the match is returned.

Return Values

The return value is of the BIGINT type. **return_option** indicates the start or end position of the matched substring in **source**.

NOTE

- If the value of **pattern** is an empty string, an error is reported.
- If the value of **start_position** or **occurrence** is not of the BIGINT type or is less than or equal to 0, an error is reported.
- If the value of **source**, **pattern**, **start_position**, **occurrence**, or **return_option** is **NULL**, **NULL** is returned.

Example Code

The value **6** is returned.

```
select regexp_instr('a1b2c3d4', '[0-9]', 3, 2);
```

The value **NULL** is returned.

```
select regexp_instr('a1b2c3d4', null, 3, 2);
```

2.29.2.28 regexp_substr

This function is used to return the substring that matches a specified pattern for the occurrence time, starting from **start_position** in the string **source**.

Syntax

```
regexp_substr(string <source>, string <pattern>[, bigint <start_position>[, bigint <occurrence>]])
```

Parameters

Table 2-129 Parameters

Parameter	Mandatory	Type	Description
source	Yes	STRING	String to be searched for
pattern	Yes	STRING	Constant or regular expression of the STRING type. Pattern to be matched.
start_position	No	BIGINT	Start position. The value must be greater than 0. If this parameter is not specified, the default value **1** is used, indicating that the matching starts from the first character of **source**.
occurrence	No	BIGINT	The value is a constant of the BIGINT type, which must be greater than 0. If it is not specified, the default value **1** is used, indicating that the substring matched for the first time is returned.

Return Values

The return value is of the STRING type.

NOTE

- If the value of **pattern** is an empty string, an error is reported.
- If no match is found, **NULL** is returned.
- If the value of **start_position** or **occurrence** is not of the BIGINT type or is less than or equal to 0, an error is reported.
- If the value of **source**, **pattern**, **start_position**, **occurrence**, or **return_option** is **NULL**, **NULL** is returned.

Example Code

The value **a** is returned.

```
select regexp_substr('a1b2c3', '[a-z]');
```

The value **b** is returned.

```
select regexp_substr('a1b2c3', '[a-z]', 2, 1);
```

The value **c** is returned.

```
select regexp_substr('a1b2c3', '[a-z]', 2, 2);
```

The value **NULL** is returned.

```
select regexp_substr('a1b2c3', null);
```

2.29.2.29 repeat

This function is used to return the string after **str** is repeated for **n** times.

Syntax

```
repeat(string <str>, bigint <n>)
```

Parameters

Table 2-130 Parameters

Parameter	Mandatory	Type	Description
str	Yes	STRING	If the value is of the BIGINT, DOUBLE, DECIMAL, or DATETIME type, the value is implicitly converted to the STRING type for calculation.
n	Yes	BIGINT	Number used for repetition

Return Values

The return value is of the STRING type.

NOTE

- If the value of **str** is not of the STRING, BIGINT, DOUBLE, DECIMAL, or DATETIME type, an error is reported.
- If the value of **n** is empty, an error is reported.
- If the value of **str** or **n** is **NULL**, **NULL** is returned.

Example Code

The value **123123** is returned after the string **123** is repeated twice.

```
SELECT repeat('123', 2);
```


2.29.2.30 reverse

This function is used to return a string in reverse order.

Syntax

```
reverse(string <str>)
```

Parameters

Table 2-131 Parameter

Parameter	Mandatory	Type	Description
str	Yes	STRING	If the value is of the BIGINT, DOUBLE, DECIMAL, or DATETIME type, the value is implicitly converted to the STRING type for calculation.

Return Values

The return value is of the STRING type.

NOTE

- If the value of **str** is not of the STRING, BIGINT, DOUBLE, DECIMAL, or DATETIME type, an error is reported.
- If the value of **str** is **NULL**, **NULL** is returned.

Example Code

The value **LQS krapS** is returned.

```
SELECT reverse('Spark SQL');
```

The value **[3,4,1,2]** is returned.

```
SELECT reverse(array(2, 1, 4, 3));
```

2.29.2.31 rpad

This function is used to right pad **str1** with **str2** to the specified length.

Syntax

```
rpad(string <str1>, int <length>, string <str2>)
```

Parameters

Table 2-132 Parameters

Parameter	Mandatory	Type	Description
str1	Yes	STRING	String to be right-padded
length	Yes	INT	Number of digits to be padded to the right
str2	Yes	STRING	String used for padding

Return Values

The return value is of the STRING type.

NOTE

- If the value of **length** is smaller than the number of digits in **str1**, the string whose length is truncated from the left of str1 is returned.
- If the value of **length** is **0**, an empty string is returned.
- If there is no input parameter or the value of any input parameter is **NULL**, **NULL** is returned.

Example Code

The value **hi???** is returned.

```
SELECT rpad('hi', 5, '??');
```

The value **h** is returned.

```
SELECT rpad('hi', 1, '??');
```

2.29.2.32 rtrim

This function is used to remove characters from the right of **str**.

- If **trimChars** is not specified, spaces are removed by default.
- If **trimChars** is specified, the function removes the longest possible substring from the right end of **str** that consists of characters in the **trimChars** set.

Similar functions:

- **ltrim**. This function is used to remove characters from the left of **str**.
- **trim**. This function is used to remove characters from the left and right of **str**.

Syntax

```
rtrim([<trimChars>, ]string <str>)
```

or

```
rtrim(trailing [<trimChars>] from <str>)
```


Parameters

Table 2-133 Parameters

Parameter	Mandatory	Type	Description
str	Yes	STRING	String from which characters on the right are to be removed. If the value is of the BIGINT, DECIMAL, DOUBLE, or DATETIME type, the value is implicitly converted to the STRING type for calculation.
trimChars	Yes	STRING	Characters to be removed

Return Values

The return value is of the STRING type.

NOTE

- If the value of **str** is not of the STRING, BIGINT, DOUBLE, DECIMAL, or DATETIME type, an error is reported.
- If the value of **str** or **trimChars** is **NULL**, **NULL** is returned.

Example Code

- Removes spaces on the right of the string **yxabcxx**. An example command is as follows:

  The value **yxabcxx** is returned.

  ```
  select rtrim('yxabcxx  ');
  ```

  It is equivalent to the following statement:

  ```
  select trim(trailing from ' yxabcxx ');
  ```

- Removes all substrings from the right end of the string **yxabcxx** that consist of characters in the set **xy**.

  The function returns **yxabc**, as any substring starting with **x** or **y** from the right end is removed.

  ```
  select rtrim('xy', 'yxabcxx');
  ```

  It is equivalent to the following statement:

  ```
  select trim(trailing 'xy' from 'yxabcxx');
  ```

- The value of the input parameter is **NULL**. An example command is as follows:

  The value **NULL** is returned.

  ```
  select rtrim(null);
  select ltrim('yxabcxx', 'null');
  ```

2.29.2.33 soundex

This function is used to return the soundex string from **str**, for example, **soundex('Miller') = M460**.

Syntax

```
soundex(string <str>)
```

Parameters

Table 2-134 Parameter

Parameter	Mandatory	Type	Description
str	Yes	STRING	String to be converted

Return Values

The return value is of the STRING type.

NOTE

If the value of **str** is **NULL**, **NULL** is returned.

Example Code

The value **M460** is returned.

```
SELECT soundex('Miller');
```

2.29.2.34 space

This function is used to return a specified number of spaces.

Syntax

```
space(bigint <n>)
```

Parameters

Table 2-135 Parameter

Parameter	Mandatory	Type	Description
n	Yes	BIGINT	Number of spaces

Return Values

The return value is of the STRING type.

NOTE

- If the value of **n** is empty, an error is reported.
- If the value of **n** is **NULL**, **NULL** is returned.

Example Code

The value **6** is returned.

```
select length(space(6));
```

2.29.2.35 substr/substring

This function is used to return the substring of **str**, starting from **start_position** and with a length of **length**.

Syntax

```
substr(string <str>, bigint <start_position>[, bigint <length>])
```

or

```
substring(string <str>, bigint <start_position>[, bigint <length>])
```

Parameters

Table 2-136 Parameters

Parameter	Mandatory	Type	Description
str	Yes	STRING	If the value is of the BIGINT, DECIMAL, DOUBLE, or DATETIME type, the value is implicitly converted to the STRING type for calculation.
start_position	Yes	BIGINT	Start position. The default value is **1**. If the value is positive, the substring is returned from the left. If the value is negative, the substring is returned from the right.
length	No	BIGINT	Length of the substring. The value must be greater than 0.

Return Values

The return value is of the STRING type.

NOTE

- If the value of **str** is not of the STRING, BIGINT, DECIMAL, DOUBLE, or DATETIME type, an error is reported.
- If the value of **length** is not of the BIGINT type or is less than or equal to 0, an error is reported.
- When the **length** parameter is omitted, a substring that ends with **str** is returned.
- If the value of **str**, **start_position**, or **length** is **NULL**, **NULL** is returned.

Example Code

The value **k SQL** is returned.

```
SELECT substr('Spark SQL', 5);
```

The value **SQL** is returned.

```
SELECT substr('Spark SQL', -3);
```

The value **k** is returned.

```
SELECT substr('Spark SQL', 5, 1);
```

2.29.2.36 substring_index

This function is used to truncate the string before the **count** separator of **str**. If the value of **count** is positive, the string is truncated from the left. If the value of **count** is negative, the string is truncated from the right.

Syntax

```
substring_index(string <str>, string <separator>, int <count>)
```

Parameters

Table 2-137 Parameters

Parameter	Mandatory	Type	Description
str	Yes	STRING	String to be truncated
separator	Yes	STRING	Separator of the STRING type
count	No	INT	Position of the delimiter

Return Values

The return value is of the STRING type.

NOTE

If the value of any input parameter is **NULL**, **NULL** is returned.

Example Code

The value **hello.world** is returned.

```
SELECT substring_index('hello.world.people', '.', 2);
```

The value **world.people** is returned.

```
select substring_index('hello.world.people', '.', -2);
```

2.29.2.37 split_part

This function is used to split a specified string based on a specified separator and return a substring from the start to end position.

Syntax

```
split_part(string <str>, string <separator>, bigint <start>[, bigint <end>])
```

Parameters

Table 2-138 Parameters

Parameter	Mandatory	Type	Description
str	Yes	STRING	String to be split
separator	Yes	STRING	Constant of the STRING type. Separator used for splitting. The value can be a character or a string.
start	Yes	STRING	Constant of the BIGINT type. The value must be greater than 0. Start number of the returned part, starting from 1.
end	No	BIGINT	Constant of the BIGINT type. The value must be greater than or equal to the value of **start**. End number of the returned part and can be omitted. The default value indicates that the value is the same as that of **start**, and the part specified by **start** is returned.

Return Values

The return value is of the STRING type.

NOTE

- If the value of **start** is greater than the actual number of segments after splitting, for example, if there are four segments after string splitting and the value of **start** is greater than 4, an empty string is returned.
- If **separator** does not exist in **str** and **start** is set to **1**, the entire **str** is returned. If the value of **str** is an empty string, an empty string is output.
- If the value of **separator** is an empty string, the original string **str** is returned.
- If the value of **end** is greater than the number of segments, the substring starting from **start** is returned.
- If the value of **str** is not of the STRING, BIGINT, DOUBLE, DECIMAL, or DATETIME type, an error is reported.
- If the value of **start** or **end** is not a constant of the BIGINT type, an error is reported.
- If the value of any parameter except **separator** is **NULL**, **NULL** is returned.

Example Code

The value **aa** is returned.

```
select split_part('aa,bb,cc,dd', ',', 1);
```

The value **aa,bb** is returned.

```
select split_part('aa,bb,cc,dd', ',', 1, 2);
```

An empty string is returned.

```
select split_part('aa,bb,cc,dd', ',', 10);
```

The value **aa,bb,cc,dd** is returned.

```
select split_part('aa,bb,cc,dd', ':', 1);
```

An empty string is returned.

```
select split_part('aa,bb,cc,dd', ':', 2);
```

The value **aa,bb,cc,dd** is returned.

```
select split_part('aa,bb,cc,dd', '', 1);
```

The value **bb,cc,dd** is returned.

```
select split_part('aa,bb,cc,dd', ',', 2, 6);
```

The value **NULL** is returned.

```
select split_part('aa,bb,cc,dd', ',', null);
```

2.29.2.38 translate

This function is used to translate the input string by replacing the characters or string specified by **from** with the characters or string specified by **to**.

For example, it replaces **bcd** in **abcde** with **BCD**.

```
translate("abcde", "bcd", "BCD")
```

Syntax

```
translate(string|char|varchar input, string|char|varchar from, string|char|varchar to)
```


Parameters

Table 2-139 Parameters

Parameter	Mandatory	Type	Description
str	Yes	STRING	String to be truncated
separator	Yes	STRING	Separator of the STRING type
count	No	INT	Position of the delimiter

Return Values

The return value is of the STRING type.

NOTE

If the value of any input parameter is **NULL**, **NULL** is returned.

Example Code

The value **A1B2C3** is returned.

```
SELECT translate('AaBbCc', 'abc', '123');
```

2.29.2.39 trim

This function is used to remove characters from the left and right of **str**.

- If **trimChars** is not specified, spaces are removed by default.
- If **trimChars** is specified, the function removes the longest possible substring from both the left and right ends of **str** that consists of characters in the **trimChars** set.

Similar functions:

- **ltrim**. This function is used to remove characters from the left of **str**.
- **rtrim**. This function is used to remove characters from the right of **str**.

Syntax

```
trim([<trimChars>,]string <str>)
```

or

```
trim([BOTH] [<trimChars>] from <str>)
```

Parameters

Table 2-140 Parameters

Parameter	Mandatory	Type	Description
str	Yes	STRING	String from which characters on both left and right are to be removed If the value is of the BIGINT, DECIMAL, DOUBLE, or DATETIME type, the value is implicitly converted to the STRING type for calculation.
trimChars	No	STRING	Characters to be removed

Return Values

The return value is of the STRING type.

NOTE

- If the value of **str** is not of the STRING, BIGINT, DOUBLE, DECIMAL, or DATETIME type, an error is reported.
- If the value of **str** or **trimChars** is **NULL**, **NULL** is returned.

Example Code

- Removes spaces on both left and right of the string **yxabcxx**. An example command is as follows:

  The value **yxabcxx** is returned.

  ```
  select trim(' yxabcxx ');
  ```

  It is equivalent to the following statement:

  ```
  select trim(both from ' yxabcxx ');
  select trim(from ' yxabcxx ');
  ```

- Removes all substrings from both the left and right ends of the string **yxabcxx** that consist of characters in the set **xy**.

  The function returns **Txyom**, as any substring starting with **x** or **y** from both the left and right ends is removed.

  ```
  select trim('xy', 'yxabcxx');
  ```

  It is equivalent to the following statement:

  ```
  select trim(both 'xy' from 'yxabcxx');
  ```

- The value of the input parameter is **NULL**. An example command is as follows:

  The value **NULL** is returned.

  ```
  select trim(null);
  select trim(null, 'yxabcxx');
  ```

2.29.2.40 upper/ucase

This function is used to convert all characters of a string to the upper case.

Syntax

```
upper(string A)
```

or

```
ucase(string A)
```

Parameters

Table 2-141 Parameter

Parameter	Mandatory	Type	Description
A	Yes	STRING	Text string to be converted

Return Values

The return value is of the STRING type.

NOTE

- If the value of the input parameter is not of the STRING, BIGINT, DOUBLE, DECIMAL, or DATETIME type, an error is reported.
- If the value of the input parameter is **NULL**, **NULL** is returned.

Example Code

Converts lowercase characters in a string to the upper case. An example command is as follows:

The value **ABC** is returned.

```
select upper('abc');
```

The value of the input parameter is **NULL**. An example command is as follows:

The value **NULL** is returned.

```
select upper(null);
```

2.29.3 Mathematical Functions

2.29.3.1 Overview

Table 2-142 lists the mathematical functions supported by DLI.

Table 2-142 Mathematical functions

Function	Syntax	Value Type	Description
abs	abs(DOUBLE a)	DOUBLE or INT	Returns the absolute value.
acos	acos(DOUBLE a)	DOUBLE	Returns the arc cosine value of **a**.
asin	asin(DOUBLE a)	DOUBLE	Returns the arc sine value of **a**.
atan	atan(DOUBLE a)	DOUBLE	Returns the arc tangent value of **a**.
bin	bin(BIGINT a)	STRING	Returns a number in binary format.
bround	bround(DOUBLE a)	DOUBLE	In HALF_EVEN rounding, the digit 5 is rounded up if the digit before 5 is an odd number and rounded down if the digit before 5 is an even number. For example, bround(7.5) = 8.0, bround(6.5) = 6.0.
bround	bround(DOUBLE a, INT d)	DOUBLE	The value is rounded off to d decimal places in HALF_EVEN mode. The digit 5 is rounded up if the digit before 5 is an odd number and rounded down if the digit before 5 is an even number. For example, bround(8.25, 1) = 8.2, bround(8.35, 1) = 8.4.
cbrt	cbrt(DOUBLE a)	DOUBLE	Returns the cube root of **a**.
ceil	ceil(DOUBLE a)	DECIMAL	Returns the smallest integer that is greater than or equal to **a**. For example, ceil(21.2) = 22.
conv	conv(BIGINT num, INT from_base, INT to_base), conv(STRING num, INT from_base, INT to_base)	STRING	Converts a number from **from_base** to **to_base**. For example, convert 5 from decimal to quaternary using conv(5,10,4) = 11.
cos	cos(DOUBLE a)	DOUBLE	Returns the cosine value of **a**.
cot	cot1(DOUBLE a)	DOUBLE or DECIMAL	Returns the cotangent of a specified radian value.

Function	Syntax	Value Type	Description
degress	degrees(DOUBLE a)	DOUBLE	Returns the angle corresponding to the radian.
e	e()	DOUBLE	Returns the value of **e**.
exp	exp(DOUBLE a)	DOUBLE	Returns the value of **e** raised to the power of **a**.
factorial	factorial(INT a)	BIGINT	Returns the factorial of **a**.
floor	floor(DOUBLE a)	BIGINT	Returns the largest integer that is less than or equal to A. For example, floor(21.2) = 21.
greatest	greatest(T v1, T v2, ...)	DOUBLE	Returns the greatest value of a list of values.
hex	hex(BIGINT a) hex(STRING a)	STRING	Converts an integer or character into its hexadecimal representation.
least	least(T v1, T v2, ...)	DOUBLE	Returns the least value of a list of values.
ln	ln(DOUBLE a)	DOUBLE	Returns the natural logarithm of a given value.
log	log(DOUBLE base, DOUBLE a)	DOUBLE	Returns the natural logarithm of a given base and exponent.
log10	log10(DOUBLE a)	DOUBLE	Returns the base-10 logarithm of a given value.
log2	log2(DOUBLE a)	DOUBLE	Returns the base-2 logarithm of a given value.
median	median(colname)	DOUBLE or DECIMAL	Returns the median.
negative	negative(INT a)	DECIMAL or INT	Returns the opposite number of **a**. For example, if negative(2) is given, **–2** is returned.

Function	Syntax	Value Type	Description
percentile	percentile(colname,DOUBLE p)	DOUBLE or ARRAY	Returns the exact percentile, which is applicable to a small amount of data. Sorts a specified column in ascending order, and then obtains the exact pth percentage. The value of **p** must be between 0 and 1.
percentile_approx	percentile_approx (colname,DOUBLE p)	DOUBLE or ARRAY	Returns the approximate percentile, which is applicable to a large amount of data. Sorts a specified column in ascending order, and then obtains the value corresponding to the pth percentile.
pi	pi()	DOUBLE	Returns the value of **pi**.
pmod	pmod(INT a, INT b)	DECIMAL or INT	Returns the positive value of the remainder after division of **x** by **y**.
positive	positive(INT a)	DECIMAL, DOUBLE, or INT	Returns the value of **a**, for example, **positive(2) = 2**.
pow	pow(DOUBLE a, DOUBLE p), power(DOUBLE a, DOUBLE p)	DOUBLE	Returns the value of **a** raised to the power of **p**.
radians	radians(DOUBLE a)	DOUBLE	Returns the radian corresponding to the angle.
rand	rand(INT seed)	DOUBLE	Returns an evenly distributed random number that is greater than or equal to 0 and less than 1. If the seed is specified, a stable random number sequence is displayed.
round	round(DOUBLE a)	DOUBLE	Round off
round	round(DOUBLE a, INT d)	DOUBLE	Rounds **a** to **d** decimal places, for example, **round(21.263,2) = 21.26**.
shiftleft	shiftleft(BIGINT a, INT b)	INT	Bitwise signed left shift. Interprets **a** as a binary number and shifts the binary number **b** positions to the left.
shiftright	shiftright(BIGINT a, INT b)	INT	Bitwise signed right shift. Interprets **a** as a binary number and shifts the binary number **b** positions to the right.

Function	Syntax	Value Type	Description
shiftrightunsigned	shiftrightunsigned(BIGINT a, INT b)	INT	Bitwise unsigned right shift. Interprets **a** as a binary number and shifts the binary number **b** positions to the right.
sign	sign(DOUBLE a)	DOUBLE	Returns the sign of **a**. **1.0** is returned if **a** is positive. **–1.0** is returned if **a** is negative. Otherwise, **0.0** is returned.
sin	sin(DOUBLE a)	DOUBLE	Returns the sine value of the given angle **a**.
sqrt	sqrt(DOUBLE a)	DOUBLE	Returns the square root of **a**.
tan	tan(DOUBLE a)	DOUBLE	Returns the tangent value of the given angle **a**.

2.29.3.2 abs

This function is used to calculate the absolute value of an input parameter.

Syntax

```
abs(DOUBLE a)
```

Parameters

Table 2-143 Parameter

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.

Return Values

The return value is of the DOUBLE or INT type.

NOTE

If the value of **a** is **NULL**, **NULL** is returned.

Example Code

The value **NULL** is returned.

```
select abs(null);
```

The value **1** is returned.

```
select abs(-1);
```

The value **3.1415926** is returned.

```
select abs(-3.1415926);
```

2.29.3.3 acos

This function is used to return the arc cosine value of a given angle **a**.

Syntax

```
acos(DOUBLE a)
```

Parameters

Table 2-144 Parameter

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value range is [-1,1]. The value can be a float, integer, or string. If the value is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.

Return Values

The return value is of the DOUBLE type. The value ranges from 0 to π.

NOTE

- If the value of **a** is not within the range [-1,1], **NaN** is returned.
- If the value of **a** is **NULL**, **NULL** is returned.

Example Code

The value **3.141592653589793** is returned.

```
select acos(-1);
```

The value **0** is returned.

```
select acos(1);
```

The value **NULL** is returned.

```
select acos(null);
```

The value **NAN** is returned.

```
select acos(10);
```

2.29.3.4 asin

This function is used to return the arc sine value of a given angle **a**.

Syntax

```
asin(DOUBLE a)
```

Parameters

Table 2-145 Parameter

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value range is [-1,1]. The value can be a float, integer, or string. If the value is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.

Return Values

The return value is of the DOUBLE type. The value ranges from -π/2 to π/2.

NOTE

- If the value of **a** is not within the range [-1,1], **NaN** is returned.
- If the value of **a** is **NULL**, **NULL** is returned.

Example Code

The value **1.5707963267948966** is returned.

```
select asin(1);
```

The value **0.6435011087932844** is returned.

```
select asin(0.6);
```

The value **NULL** is returned.

```
select asin(null);
```

The value **NAN** is returned.

```
select asin(10);
```


2.29.3.5 atan

This function is used to return the arc tangent value of a given angle **a**.

Syntax

```
atan(DOUBLE a)
```

Parameters

Table 2-146 Parameter

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.

Return Values

The return value is of the DOUBLE type. The value ranges from -π/2 to π/2.

NOTE

- If the value of **a** is not within the range [-1,1], **NaN** is returned.
- If the value of **a** is **NULL**, **NULL** is returned.

Example Code

The value **0.7853981633974483** is returned.

```
select atan(1);
```

The value **0.5404195002705842** is returned.

```
select atan(0.6);
```

The value **NULL** is returned.

```
select atan(null);
```

2.29.3.6 bin

This function is used to return the binary format of **a**.

Syntax

```
bin(BIGINT a)
```


Parameters

Table 2-147 Parameter

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value is an integer. If the value is not of the BIGINT type, the system will implicitly convert it to the BIGINT type for calculation.

Return Values

The return value is of the STRING type.

NOTE

If the value of **a** is **NULL**, **NULL** is returned.

Example Code

The value **1** is returned.

```
select bin(1);
```

The value **NULL** is returned.

```
select bin(null);
```

The value **1000** is returned.

```
select bin(8);
```

The value **1000** is returned.

```
select bin(8.123456);
```

2.29.3.7 bround

This function is used to return a value that is rounded off to **d** decimal places.

Syntax

```
bround(DOUBLE a, INT d)
```

Parameters

Table 2-148 Parameters

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. It indicates the value that needs to be rounded. The digit 5 is rounded up if the digit before 5 is an odd number and rounded down if the digit before 5 is an even number. If the value is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.
d	No	DOUBLE, BIGINT, DECIMAL, or STRING	It indicates the number of decimal places to which the value needs to be rounded. If the value is not of the INT type, the system will implicitly convert it to the INT type for calculation.

Return Values

The return value is of the DOUBLE type.

NOTE

If the value of **a** or **d** is **NULL**, **NULL** is returned.

Example Code

The value **1** is returned.

```
select bin(1);
```

The value **NULL** is returned.

```
select bin(null);
```

The value **1000** is returned.

```
select bin(8);
```

The value **1000** is returned.

```
select bin(8.123456);
```

2.29.3.8 cbrt

This function is used to return the cube root of **a**.

Syntax

```
cbrt(DOUBLE a)
```

Parameters

Table 2-149 Parameter

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.

Return Values

The return value is of the DOUBLE type.

NOTE

If the value of **a** is **NULL**, **NULL** is returned.

Example Code

The value **3** is returned.

```
select cbrt(27);
```

The value **3.3019272488946267** is returned.

```
select cbrt(36);
```

The value **NULL** is returned.

```
select cbrt(null);
```

2.29.3.9 ceil

This function is used to round up **a** to the nearest integer.

Syntax

```
ceil(DOUBLE a)
```


Parameters

Table 2-150 Parameter

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.

Return Values

The return value is of the DECIMAL type.

NOTE

If the value of **a** is **NULL**, **NULL** is returned.

Example Code

The value **2** is returned.

```
select ceil(1.3);
```

The value **-1** is returned.

```
select ceil(-1.3);
```

The value **NULL** is returned.

```
select ceil(null);
```

2.29.3.10 conv

This function is used to convert a number from **from_base** to **to_base**.

Syntax

```
conv(BIGINT num, INT from_base, INT to_base)
```


Parameters

Table 2-151 Parameters

Parameter	Mandatory	Type	Description
num	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	Number whose base needs to be converted The value can be a float, integer, or string.
from_base	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	It represents the base from which the number is converted. The value can be a float, integer, or string.
to_base	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	It represents the base to which the number is converted. The value can be a float, integer, or string.

Return Values

The return value is of the STRING type.

NOTE

- If the value of **num**, **from_base**, or **to_base** is **NULL**, **NULL** is returned.
- The conversion process works with 64-bit precision and returns **NULL** when there is overflow.
- If the value of **num** is a decimal, it will be converted to an integer before the base conversion, and the decimal part will be discarded.

Example Code

The value **8** is returned.

```
select conv('1000', 2, 10);
```

The value **B** is returned.

```
select conv('1011', 2, 16);
```

The value **703710** is returned.

```
select conv('ABCDE', 16, 10);
```

The value **27** is returned.

```
select conv(1000.123456, 3.123456, 10.123456);
```

The value **18446744073709551589** is returned.

```
select conv(-1000.123456, 3.123456, 10.123456);
```

The value **NULL** is returned.

```
select conv('1100', null, 10);
```

2.29.3.11 cos

This function is used to calculate the cosine value of **a**, with input in radians.

Syntax

```
cos(DOUBLE a)
```

Parameters

Table 2-152 Parameter

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.

Return Values

The return value is of the DOUBLE type.

NOTE

If the value of **a** is **NULL**, **NULL** is returned.

Example Code

The value **-0.99999999999999999986** is returned.

```
select cos(3.1415926);
```

The value **NULL** is returned.

```
select cos(null);
```

2.29.3.12 cot1

This function is used to calculate the cotangent value of **a**, with input in radians.

Syntax

```
cot1(DOUBLE a)
```


Parameters

Table 2-153 Parameter

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.

Return Values

The return value is of the DOUBLE or DECIMAL type.

NOTE

If the value of **a** is **NULL**, **NULL** is returned.

Example Code

The value **1.0000000000000002** is returned.

```
select cot1(pi()/4);
```

The value **NULL** is returned.

```
select cot1(null);
```

2.29.3.13 degrees

This function is used to calculate the angle corresponding to the returned radian.

Syntax

```
degrees(DOUBLE a)
```

Parameters

Table 2-154 Parameter

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.

Return Values

The return value is of the DOUBLE type.

NOTE

If the value of **a** is **NULL**, **NULL** is returned.

Example Code

The value **90.0** is returned.

```
select degrees(1.5707963267948966);
```

The value **0** is returned.

```
select degrees(0);
```

The value **NULL** is returned.

```
select degrees(null);
```

2.29.3.14 e

This function is used to return the value of **e**.

Syntax

```
e()
```

Return Values

The return value is of the DOUBLE type.

Example Code

The value **2.718281828459045** is returned.

```
select e();
```

2.29.3.15 exp

This function is used to return the value of **e** raised to the power of **a**.

Syntax

```
exp(DOUBLE a)
```

Parameters

Table 2-155 Parameter

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.

Return Values

The return value is of the DOUBLE type.

NOTE

If the value of **a** is **NULL**, **NULL** is returned.

Example Code

The value **7.38905609893065** is returned.

```
select exp(2);
```

The value **20.085536923187668** is returned.

```
select exp(3);
```

The value **NULL** is returned.

```
select exp(null);
```

2.29.3.16 factorial

This function is used to return the factorial of **a**.

Syntax

```
factorial(INT a)
```

Parameters

Table 2-156 Parameter

Parameter	Mandatory	Type	Description
a	Yes	BIGINT, INT, SMALLINT, or TINYINT	The value is an integer. If the value is not of the INT type, the system will implicitly convert it to the INT type for calculation. The string is converted to its corresponding ASCII code.

Return Values

The return value is of the BIGINT type.

NOTE

- If the value of **a** is **0**, **1** is returned.
- If the value of **a** is **NULL** or outside the range of [0,20], **NULL** is returned.

Example Code

The value **720** is returned.

```
select factorial(6);
```

The value **1** is returned.

```
select factorial(1);
```

The value **120** is returned.

```
select factorial(5.123456);
```

The value **NULL** is returned.

```
select factorial(null);
```

The value **NULL** is returned.

```
select factorial(21);
```

2.29.3.17 floor

This function is used to round down **a** to the nearest integer.

Syntax

```
floor(DOUBLE a)
```


Parameters

Table 2-157 Parameter

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.

Return Values

The return value is of the BIGINT type.

NOTE

If the value of **a** is **NULL**, **NULL** is returned.

Example Code

The value **1** is returned.

```
select floor(1.2);
```

The value **-2** is returned.

```
select floor(-1.2);
```

The value **NULL** is returned.

```
select floor(null);
```

2.29.3.18 greatest

This function is used to return the greatest value in a list of values.

Syntax

```
greatest(T v1, T v2, ...)
```

Parameters

Table 2-158 Parameters

Parameter	Mandatory	Type	Description
v1	Yes	DOUBLE, BIGINT, or DECIMAL	The value can be a float or integer.

Parameter	Mandatory	Type	Description
v2	Yes	DOUBLE, BIGINT, or DECIMAL	The value can be a float or integer.

Return Values

The return value is of the DOUBLE type.

NOTE

If the value of **a** is **NULL**, **NULL** is returned.

Example Code

The value **4.0** is returned.

```
select greatest(1,2.0,3,4.0);
```

The value **NULL** is returned.

```
select greatest(null);
```

2.29.3.19 hex

This function is used to convert an integer or character into its hexadecimal representation.

Syntax

```
hex(BIGINT a)
```

Parameters

Table 2-159 Parameter

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the BIGINT type, the system will implicitly convert it to the BIGINT type for calculation. The string is converted to its corresponding ASCII code.

Return Values

The return value is of the STRING type.

NOTE

- If the value of **a** is **0**, **0** is returned.
- If the value of **a** is **NULL**, **NULL** is returned.

Example Code

The value **0** is returned.

```
select hex(0);
```

The value **61** is returned.

```
select hex('a');
```

The value **10** is returned.

```
select hex(16);
```

The value **31** is returned.

```
select hex('1');
```

The value **3136** is returned.

```
select hex('16');
```

The value **NULL** is returned.

```
select hex(null);
```

2.29.3.20 least

This function is used to return the smallest value in a list of values.

Syntax

```
least(T v1, T v2, ...)
```

Parameters

Table 2-160 Parameters

Parameter	Mandatory	Type	Description
v1	Yes	DOUBLE, BIGINT, or DECIMAL	The value can be a float or integer.
v2	Yes	DOUBLE, BIGINT, or DECIMAL	The value can be a float or integer.

Return Values

The return value is of the DOUBLE type.

NOTE

- If the value of **v1** or **v2** is of the STRING type, an error is reported.
- If the values of all parameters are **NULL**, **NULL** is returned.

Example Code

The value **1.0** is returned.

```
select least(1,2.0,3,4.0);
```

The value **NULL** is returned.

```
select least(null);
```

2.29.3.21 ln

This function is used to return the natural logarithm of a given value.

Syntax

```
ln(DOUBLE a)
```

Parameters

Table 2-161 Parameter

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.

Return Values

The return value is of the DOUBLE type.

NOTE

- If the value of **a** is negative or **0**, **NULL** is returned.
- If the value of **a** is **NULL**, **NULL** is returned.

Example Code

The value **1.144729868791239** is returned.

```
select ln(3.1415926);
```


The value **1** is returned.

```
select ln(2.718281828459045);
```

The value **NULL** is returned.

```
select ln(null);
```

2.29.3.22 log

This function is used to return the natural logarithm of a given base and exponent.

Syntax

```
log(DOUBLE base, DOUBLE a)
```

Parameters

Table 2-162 Parameters

Parameter	Mandatory	Type	Description
base	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.

Return Values

The return value is of the DOUBLE type.

NOTE

- If the value of **base** or **a** is **NULL**, **NULL** is returned.
- If the value of **base** or **a** is negative or **0**, **NULL** is returned.
- If the value of **base** is **1** (would cause a division by zero), **NULL** is returned.

Example Code

The value **2** is returned.

```
select log(2, 4);
```

The value **NULL** is returned.

```
select log(2, null);
```


The value **NULL** is returned.

```
select log(null, 4);
```

2.29.3.23 log10

This function is used to return the natural logarithm of a given value with a base of 10.

Syntax

```
log10(DOUBLE a)
```

Parameters

Table 2-163 Parameter

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.

Return Values

The return value is of the DOUBLE type.

NOTE

If the value of **a** is negative, **0**, or **NULL**, **NULL** is returned.

Example Code

The value **NULL** is returned.

```
select log10(null);
```

The value **NULL** is returned.

```
select log10(0);
```

The value **0.9542425094393249** is returned.

```
select log10(9);
```

The value **1** is returned.

```
select log10(10);
```

2.29.3.24 log2

This function is used to return the natural logarithm of a given value with a base of 2.

Syntax

```
log2(DOUBLE a)
```

Parameters

Table 2-164 Parameter

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.

Return Values

The return value is of the DOUBLE type.

NOTE

If the value of **a** is negative, **0**, or **NULL**, **NULL** is returned.

Example Code

The value **NULL** is returned.

```
select log2(null);
```

The value **NULL** is returned.

```
select log2(0);
```

The value **3.1699250014423126** is returned.

```
select log2(9);
```

The value **4** is returned.

```
select log2(16);
```

2.29.3.25 median

This function is used to calculate the median of input parameters.

Syntax

```
median(colname)
```

Parameters

Table 2-165 Parameter

Parameter	Mandatory	Type	Description
colname	Yes	DOUBLE, DECIMAL, STRING, or BIGINT	Name of the column to be sorted The elements in a column are of the DOUBLE type. If an element in a column is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.

Return Values

The return value is of the DOUBLE or DECIMAL type.

NOTE

If the column name does not exist, an error is reported.

Example Code

Assume that the elements in the **int_test** column are 1, 2, 3, and 4 and they are of the INT type.

The value **2.5** is returned.

```
select median(int_test) FROM int_test;
```

2.29.3.26 negative

This function is used to return the additive inverse of **a**.

Syntax

```
negative(INT a)
```

Parameters

Table 2-166 Parameter

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string.

Return Values

The return value is of the DECIMAL or INT type.

NOTE

If the value of **a** is **NULL**, **NULL** is returned.

Example Code

The value **-1** is returned.

```
SELECT negative(1);
```

The value **3** is returned.

```
SELECT negative(-3);
```

2.29.3.27 percentlie

This function is used to return the exact percentile, which is applicable to a small amount of data. It sorts a specified column in ascending order, and then obtains the exact value of the pth percentile.

Syntax

```
percentile(colname,DOUBLE p)
```

Parameters

Table 2-167 Parameters

Parameter	Mandatory	Type	Description
colname	Yes	STRING	Name of the column to be sorted The elements in the column must be integers.
p	Yes	DOUBLE	The value ranges from 0 to 1. The value is a float.

Return Values

The return value is of the DOUBLE or ARRAY type.

NOTE

- If the column name does not exist, an error is reported.
- If the value of **p** is **NULL** or outside the range of [0,1], an error is reported.

Example Code

Assume that the elements in the **int_test** column are 1, 2, 3, and 4 and they are of the INT type.

The value **3.0999999999999996** is returned.

```
select percentile(int_test,0.7) FROM int_test;
```

The value **3.997** is returned.

```
select percentile(int_test,0.999) FROM int_test;
```

The value **2.5** is returned.

```
select percentile(int_test,0.5) FROM int_test;
```

The value **[1.3, 1.9, 2.5, 2.8, 3.7]** is returned.

```
select percentile (int_test,ARRAY(0.1,0.3,0.5,0.6,0.9)) FROM int_test;
```

2.29.3.28 percentlie_approx

This function is used to return the approximate percentile, which is applicable to a large amount of data. It sorts a specified column in ascending order, and then obtains the value closest to the pth percentile.

Syntax

```
percentile_approx (colname,DOUBLE p)
```

Parameters

Table 2-168 Parameters

Parameter	Mandatory	Type	Description
colname	Yes	STRING	Name of the column to be sorted The elements in a column are of the DOUBLE type. If an element in a column is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.
p	Yes	DOUBLE	The value can be a float, integer, or string. The value ranges from 0 to 1. The value is a float.

Return Values

The return value is of the DOUBLE or ARRAY type.

NOTE

- If the column name does not exist, an error is reported.
- If the value of **p** is **NULL** or outside the range of [0,1], an error is reported.

Example Code

Assume that the elements in the **int_test** column are 1, 2, 3, and 4 and they are of the INT type.

The value **3** is returned.

```
select percentile_approx(int_test,0.7) FROM int_test;
```

The value **3** is returned.

```
select percentile_approx(int_test,0.75) FROM int_test;
```

The value **2** is returned.

```
select percentile_approx(int_test,0.5) FROM int_test;
```

The value **[1,2,2,3,4]** is returned.

```
select percentile_approx (int_test,ARRAY(0.1,0.3,0.5,0.6,0.9)) FROM int_test;
```

2.29.3.29 pi

This function is used to return the value of π.

Syntax

```
pi()
```

Return Values

The return value is of the DOUBLE type.

Example Code

The value **3.141592653589793** is returned.

```
select pi();
```

2.29.3.30 pmod

This function is used to return the positive value of the remainder after division of **x** by **y**.

Syntax

pmod(INT a, INT b)

Parameters

Table 2-169 Parameters

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string.
b	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string.

Return Values

The return value is of the DECIMAL or INT type.

NOTE

- If the value of **a** or **b** is **NULL**, **NULL** is returned.
- If the value of **b** is **0**, **NULL** is returned.

Example Code

The value **2** is returned.

```
select pmod(2,5);
```

The value **3** is returned.

```
select pmod (-2,5) (parse: -2=5* (-1)...3);
```

The value **NULL** is returned.

```
select pmod(5,0);
```

The value **1** is returned.

```
select pmod(5,2);
```

The value **0.877** is returned.

```
select pmod(5.123,2.123);
```

2.29.3.31 positive

This function is used to return the value of **a**.

Syntax

```
positive(INT a)
```

Parameters

Table 2-170 Parameter

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string.

Return Values

The return value is of the DECIMAL, DOUBLE, or INT type.

NOTE

If the value of **a** is **NULL**, **NULL** is returned.

Example Code

The value **3** is returned.

```
SELECT positive(3);
```

The value **-3** is returned.

```
SELECT positive(-3);
```

The value **123** is returned.

```
SELECT positive('123');
```

2.29.3.32 pow

This function is used to calculate and return the pth power of **a**.

Syntax

```
pow(DOUBLE a, DOUBLE p),
power(DOUBLE a, DOUBLE p)
```

Parameters

Table 2-171 Parameters

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.
p	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.

Return Values

The return value is of the DOUBLE type.

NOTE

If the value of **a** or **p** is **NULL**, **NULL** is returned.

Example Code

The value **16** returned.

```
select pow(2, 4);
```

The value **NULL** is returned.

```
select pow(2, null);
```

The value **17.429460393524256** is returned.

```
select pow(2, 4.123456);
```

2.29.3.33 radians

This function is used to return the radian corresponding to an angle.

Syntax

```
radians(DOUBLE a)
```

Parameters

Table 2-172 Parameter

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.

Return Values

The return value is of the DOUBLE type.

NOTE

If the value of **a** is **NULL**, **NULL** is returned.

Example Code

The value **1.0471975511965976** is returned.

```
select radians(60);
```

The value **0** is returned.

```
select radians(0);
```

The value **NULL** is returned.

```
select radians(null);
```

2.29.3.34 rand

This function is used to return an evenly distributed random number that is greater than or equal to 0 and less than 1.

Syntax

```
rand(INT seed)
```


Parameters

Table 2-173 Parameter

Parameter	Mandatory	Type	Description
seed	No	INT	The value can be a float, integer, or string. If this parameter is specified, a stable random number sequence is obtained within the same running environment.

Return Values

The return value is of the DOUBLE type.

Example Code

The value **0.3668915240363728** is returned.

```
select rand();
```

The value **0.25738143505962285** is returned.

```
select rand(3);
```

2.29.3.35 round

This function is used to calculate the rounded value of **a** up to **d** decimal places.

Syntax

```
round(DOUBLE a, INT d)
```

Parameters

Table 2-174 Parameters

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	It indicates the value to be rounded off. The value can be a float, integer, or string.

Parameter	Mandatory	Type	Description
d	No	INT	The default value is **0**. It indicates the number of decimal places to which the value needs to be rounded. If the value is not of the INT type, the system will implicitly convert it to the INT type for calculation.

Return Values

The return value is of the DOUBLE type.

NOTE

- If the value of **d** is negative, an error is reported.
- If the value of **a** or **d** is **NULL**, **NULL** is returned.

Example Code

The value **123.0** is returned.

```
select round(123.321);
```

The value **123.4** is returned.

```
select round(123.396, 1);
```

The value **NULL** is returned.

```
select round(null);
```

The value **123.321** is returned.

```
select round(123.321, 4);
```

The value **123.3** is returned.

```
select round(123.321,1.33333);
```

The value **123.3** is returned.

```
select round(123.321,1.33333);
```

2.29.3.36 shiftleft

This function is used to perform a signed bitwise left shift. It takes the binary number **a** and shifts it **b** positions to the left.

Syntax

shiftleft(BIGINT a, BIGINT b)

Parameters

Table 2-175 Parameters

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the BIGINT type, the system will implicitly convert it to the BIGINT type for calculation.
b	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the BIGINT type, the system will implicitly convert it to the BIGINT type for calculation.

Return Values

The return value is of the INT type.

NOTE

If the value of **a** or **b** is **NULL**, **NULL** is returned.

Example Code

The value **8** is returned.

```
select shiftleft(1,3);
```

The value **48** is returned.

```
select shiftleft(6,3);
```

The value **48** is returned.

```
select shiftleft(6.123456,3.123456);
```

The value **NULL** is returned.

```
select shiftleft(null,3);
```

2.29.3.37 shiftright

This function is used to perform a signed bitwise right shift. It takes the binary number **a** and shifts it **b** positions to the right.

Syntax

```
shiftright(BIGINT a, BIGINT b)
```


Parameters

Table 2-176 Parameters

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the BIGINT type, the system will implicitly convert it to the BIGINT type for calculation.
b	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the BIGINT type, the system will implicitly convert it to the BIGINT type for calculation.

Return Values

The return value is of the INT type.

NOTE

If the value of **a** or **b** is **NULL**, **NULL** is returned.

Example Code

The value **2** is returned.

```
select shiftright(16,3);
```

The value **4** is returned.

```
select shiftright(36,3);
```

The value **4** is returned.

```
select shiftright(36.123456,3.123456);
```

The value **NULL** is returned.

```
select shiftright(null,3);
```

2.29.3.38 shiftrightunsigned

This function is used to perform an unsigned bitwise right shift. It takes the binary number **a** and shifts it **b** positions to the right.

Syntax

```
shiftrightunsigned(BIGINT a, BIGINT b)
```

Parameters

Table 2-177 Parameters

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the BIGINT type, the system will implicitly convert it to the BIGINT type for calculation.
b	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the BIGINT type, the system will implicitly convert it to the BIGINT type for calculation.

Return Values

The return value is of the INT type.

NOTE

If the value of **a** or **b** is **NULL**, **NULL** is returned.

Example Code

The value **2** is returned.

```
select shiftrightunsigned(16,3);
```

The value **536870910** is returned.

```
select shiftrightunsigned(-16,3);
```

The value **2** is returned.

```
select shiftrightunsigned(16.123456,3.123456);
```

The value **NULL** is returned.

```
select shiftrightunsigned(null,3);
```

2.29.3.39 sign

This function is used to return the positive and negative signs corresponding to **a**.

Syntax

```
sign(DOUBLE a)
```


Parameters

Table 2-178 Parameter

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string.

Return Values

The return value is of the DOUBLE type.

NOTE

- If the value of **a** is a positive number, **1** is returned.
- If the value of **a** is a negative number, **-1** is returned.
- If the value of **a** is **0**, **0** is returned.
- If the value of **a** is **NULL**, **NULL** is returned.

Example Code

The value **-1** is returned.

```
select sign(-3);
```

The value **1** is returned.

```
select sign(3);
```

The value **0** is returned.

```
select sign(0);
```

The value **1** is returned.

```
select sign(3.1415926);
```

The value **NULL** is returned.

```
select sign(null);
```

2.29.3.40 sin

This function is used to return the sine value of **a**, with input in radians.

Syntax

```
sin(DOUBLE a)
```

Parameters

Table 2-179 Parameter

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.

Return Values

The return value is of the DOUBLE type.

NOTE

If the value of **a** is **NULL**, **NULL** is returned.

Example Code

The value **1** is returned.

```
select sin(pi()/2);
```

The value **NULL** is returned.

```
select sin(null);
```

2.29.3.41 sqrt

This function is used to return the square root of a value.

Syntax

```
sqrt(DOUBLE a)
```

Parameters

Table 2-180 Parameter

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.

Return Values

The return value is of the DOUBLE type.

NOTE

If the value of **a** is **NULL**, **NULL** is returned.

Example Code

The value **2.8284271247461903** is returned.

```
select sqrt(8);
```

The value **4** is returned.

```
select sqrt(16);
```

The value **NULL** is returned.

```
select sqrt(null);
```

2.29.3.42 tan

This function is used to return the tangent value of **a**, with input in radians.

Syntax

```
tan(DOUBLE a)
```

Parameters

Table 2-181 Parameter

Parameter	Mandatory	Type	Description
a	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	The value can be a float, integer, or string. If the value is not of the DOUBLE type, the system will implicitly convert it to the DOUBLE type for calculation.

Return Values

The return value is of the DOUBLE type.

NOTE

If the value of **a** is **NULL**, **NULL** is returned.

Example Code

The value **0.9999999999999999999** is returned.

```
select tan(pi()/4);
```

The value **NULL** is returned.

```
select tan(null);
```

2.29.4 Aggregate Functions

2.29.4.1 Overview

Table 2-182 lists the aggregate functions supported by DLI.

Table 2-182 Aggregate functions

Function	Syntax	Value Type	Description
avg	avg(col), avg(DISTINCT col)	DOUBLE	Returns the average value.
corr	corr(col1, col2)	DOUBLE	Returns the coefficient of correlation of a pair of numeric columns.
count	count([distinct|all] <colname>)	BIGINT	Returns the number of records.
covar_pop	covar_pop(col1, col2)	DOUBLE	Returns the covariance of a pair of numeric columns.
covar_samp	covar_samp(col1, col2)	DOUBLE	Returns the sample covariance of a pair of numeric columns.
max	max(col)	DOUBLE	Returns the maximum value.
min	min(col)	DOUBLE	Returns the minimum value.
percentile	percentile(BIGINT col, p)	DOUBLE	Returns the percentage value point of the value area. The value of **p** must be between 0 and 1. Otherwise, **NULL** is returned. The value cannot be a float.

Function	Syntax	Value Type	Description
percentile_approx	percentile_approx(DOUBLE col, p [, B])	DOUBLE	Returns the approximate pth percentile of a numerical column within the group, including floating-point numbers. The value of p should be between 0 and 1. The parameter B controls the accuracy of the approximation, with a higher value of B resulting in a higher level of approximation. The default value is **10000**. If the number of non-repeating values in the column is less than B, an exact percentile is returned.
stddev_pop	stddev_pop(col)	DOUBLE	Returns the deviation of a specified column.
stddev_samp	stddev_samp(col)	DOUBLE	Returns the sample deviation of a specified column.
sum	sum(col), sum(DISTINCT col)	DOUBLE	Returns the sum of the values in a column.
variance/var_pop	variance(col), var_pop(col)	DOUBLE	Returns the variance of a column.
var_samp	var_samp(col)	DOUBLE	Returns the sample variance of a specified column.

2.29.4.2 avg

This function is used to return the average value.

Syntax

```
avg(col), avg(DISTINCT col)
```

Parameters

Table 2-183 Parameter

Parameter	Mandatory	Type	Description
col	Yes	All data types	The value can be of any data type and can be converted to the DOUBLE type for calculation.

Return Values

The return value is of the DOUBLE type.

NOTE

If the value of **col** is **NULL**, the column is not involved in calculation.

Example Code

- Calculates the average number of items across all warehouses. An example command is as follows:

```
select avg(items) from warehouse;
```

The command output is as follows:

```
_c0
100.0
```

- Calculates the average inventory of all items in each warehouse when used with **group by**. An example command is as follows:

```
select warehourseId, avg(items) from warehourse group by warehourseId;
```

The command output is as follows:

```
warehouseId _c1
city1    155
city2    101
city3    194
```

2.29.4.3 corr

This function is used to return the correlation coefficient between two columns of numerical values.

Syntax

```
corr(col1, col2)
```

Parameters

Table 2-184 Parameters

Parameter	Mandatory	Type	Description
col1	Yes	DOUBLE, BIGINT, INT, SMALLINT, TINYINT, FLOAT, or DECIMAL	Columns with a data type of numeric. If the value is of any other type, **NULL** is returned.
col2	Yes	DOUBLE, BIGINT, INT, SMALLINT, TINYINT, FLOAT, or DECIMAL	Columns with a data type of numeric. If the values are of any other type, **NULL** is returned.

Return Values

The return value is of the DOUBLE type.

Example Code

- Calculates the correlation coefficient between the inventory (items) and the price of all products. An example command is as follows:

```
select corr(items,price) from warehouse;
```

The command output is as follows:

```
_c0
1.242355
```

- When used with **group by**, it groups all offerings by warehouse (warehourseId) and returns the correlation coefficient between the inventory (items) and the price of offerings within each group. An example command is as follows:

```
select warehourseId, corr(items,price) from warehourse group by warehourseId;
```

The command output is as follows:

```
warehouseId _c1
city1   0.43124
city2   0.53344
city3   0.73425
```

2.29.4.4 count

This function is used to return the number of records.

Syntax

```
count([distinct|all] <colname>)
```

Parameters

Table 2-185 Parameters

Parameter	Mandatory	Description
distinct or all	No	Determines whether duplicate records should be excluded during counting. **all** is used by default, indicating that all records will be included in the count. If **distinct** is specified, only the number of unique values is counted.
colname	Yes	The column value can be of any type. The value can be *****, that is, **count(*)**, indicating that the number of all rows is returned.

Return Values

The return value is of the BIGINT type.

NOTE

If the value of **colname** is **NULL**, the row is not involved in calculation.

Example Code

- Calculates the total number of records in the warehouse table. An example command is as follows:

```
select count(*) from warehouse;
```

The command output is as follows:

```
_c0
10
```

- When used with **group by**, it groups all offerings by warehouse (warehouseId) and calculates the number of offerings in each warehouse (warehouseId). An example command is as follows:

```
select warehouseId, count(*) from warehouse group by warehouseId;
```

The command output is as follows:

```
warehouseId _c1
city1   6
city2   5
city3   6
```

Example 3: Calculates the number of warehouses through distinct deduplication. An example command is as follows:

```
select count(distinct warehouseId) from warehouse;
```

The command output is as follows:

```
_c0
 3
```

2.29.4.5 covar_pop

This function is used to return the covariance between two columns of numerical values.

Syntax

```
covar_pop(col1, col2)
```

Parameters

Table 2-186 Parameters

Parameter	Mandatory	Description
col1	Yes	Columns with a data type of numeric. If the values are of any other type, **NULL** is returned.
col2	Yes	Columns with a data type of numeric. If the values are of any other type, **NULL** is returned.

Return Values

The return value is of the DOUBLE type.

Example Code

- Calculates the covariance between the inventory (items) and the price of all offerings. An example command is as follows:

```
select covar_pop(items, price) from warehouse;
```

  The command output is as follows:

```
_c0
1.242355
```

- When used with **group by**, it groups all offerings by warehouse (warehourseId) and returns the covariance between the inventory (items) and the price of offerings within each group. An example command is as follows:

```
select warehourseId, covar_pop(items, price) from warehourse group by warehourseId;
```

  The command output is as follows:

```
warehouseId _c1
city1    1.13124
city2    1.13344
city3    1.53425
```

2.29.4.6 covar_samp

This function is used to return the sample covariance between two columns of numerical values.

Syntax

```
covar_samp(col1, col2)
```

Parameters

Table 2-187 Parameters

Parameter	Mandatory	Description
col1	Yes	Columns with a data type of numeric. If the values are of any other type, **NULL** is returned.
col2	Yes	Columns with a data type of numeric. If the values are of any other type, **NULL** is returned.

Return Values

The return value is of the DOUBLE type.

Example Code

- Calculates the sample covariance between the inventory (items) and the price of all offerings. An example command is as follows:

```
select covar_samp(items,price) from warehouse;
```


The command output is as follows:

```
_c0
1.242355
```

- When used with **group by**, it groups all offerings by warehouse (warehourseId) and returns the sample covariance between the inventory (items) and the price of offerings within each group. An example command is as follows:

```
select warehourseId, covar_samp(items,price) from warehourse group by warehourseId;
```

The command output is as follows:

```
warehouseId _c1
city1    1.03124
city2    1.03344
city3    1.33425
```

2.29.4.7 max

This function is used to return the maximum value.

Syntax

```
max(col)
```

Parameters

Table 2-188 Parameter

Parameter	Mandatory	Type	Description
col	Yes	Any type except BOOLEAN	The value can be of any type except BOOLEAN.

Return Values

The return value is of the DOUBLE type.

NOTE

The return type is the same as the type of **col**. The return rules are as follows:

- If the value of **col** is **NULL**, the row is not involved in calculation.
- If the value of **col** is of the BOOLEAN type, it cannot be used for calculation.

Example Code

- Calculates the maximum inventory (items) of all offerings. An example command is as follows:

```
select max(items) from warehouse;
```

The command output is as follows:

```
_c0
900
```

- When used with **group by**, it returns the maximum inventory of each warehouse. An example command is as follows:


```
select warehourseId, max(items) from warehouse group by warehourseId;
```

The command output is as follows:

```
warehouseId _c1
city1    200
city2    300
city3    400
```

2.29.4.8 min

This function is used to return the minimum value.

Syntax

```
min(col)
```

Parameters

Table 2-189 Parameter

Parameter	Mandatory	Type	Description
col	Yes	Any type except BOOLEAN	The value can be of any type except BOOLEAN.

Return Values

The return value is of the DOUBLE type.

NOTE

The return type is the same as the type of **col**. The return rules are as follows:

- If the value of **col** is **NULL**, the row is not involved in calculation.
- If the value of **col** is of the BOOLEAN type, it cannot be used for calculation.

Example Code

- Calculates the minimum inventory (items) of all offerings. An example command is as follows:

  ```
  select min(items) from warehouse;
  ```

  The command output is as follows:

  ```
  _c0
  600
  ```

- When used with **group by**, it returns the minimum inventory of each warehouse. An example command is as follows:

  ```
  select warehourseId, min(items) from warehouse group by warehourseId;
  ```

  The command output is as follows:

  ```
  warehouseId _c1
  city1    15
  city2    10
  city3    19
  ```


2.29.4.9 percentile

This function is used to return the numerical value at a certain percentage point within a range of values.

Syntax

```
percentile(BIGINT col, p)
```

Parameters

Table 2-190 Parameters

Parameter	Mandatory	Description
col	Yes	Columns with a data type of numeric. If the values are of any other type, **NULL** is returned.
p	Yes	The value should be between 0 and 1. Otherwise, **NULL** is returned.

Return Values

The return value is of the DOUBLE type.

NOTE

The value should be between 0 and 1. Otherwise, **NULL** is returned.

Example Code

- Calculates the 0.5 percentile of all offering inventories (items). An example command is as follows:

  ```
  select stddev_samp(items,0.5) from warehouse;
  ```

  The command output is as follows:

  ```
  _c0
  500.6
  ```

- When used with **group by**, it groups all offerings by warehouse (warehourseId) and returns the 0.5 percentile of the offering inventory (items) in the same group. An example command is as follows:

  ```
  select warehourseId, stddev_samp(items, 0.5) from warehourse group by warehourseId;
  ```

  The command output is as follows:

  ```
  warehouseId _c1
  city1    499.6
  city2    354.8
  city3    565.7
  ```

2.29.4.10 percentile_approx

This function is used to approximate the pth percentile (including floating-point numbers) of a numeric column within a group.

Syntax

```
percentile_approx(DOUBLE col, p [, B])
```

Parameters

Table 2-191 Parameters

Parameter	Mandatory	Description
col	Yes	Columns with a data type of numeric. If the values are of any other type, **NULL** is returned.
p	Yes	The value should be between 0 and 1. Otherwise, **NULL** is returned.
B	Yes	The parameter B controls the accuracy of the approximation, with a higher value of B resulting in a higher level of approximation. The default value is **10000**. If the number of non-repeating values in the column is less than B, an exact percentile is returned.

Return Values

The return value is of the DOUBLE type.

Example Code

- Calculates the 0.5 percentile of all offering inventories (items), with an accuracy of 100. An example command is as follows:
  ```
  select stddev_samp(items,0.5, 100) from warehouse;
  ```
  The command output is as follows:
  ```
  _c0
  500
  ```
- When used with **group by**, it groups all offerings by warehouse (warehourseId) and returns the 0.5 percentile of the offering inventory (items) in the same group, with an accuracy of 100. An example command is as follows:
  ```
  select warehourseId, stddev_samp(items, 0.5, 100) from warehourse group by warehourseId;
  ```
  The command output is as follows:
  ```
  warehouseId _c1
  city1    499
  city2    354
  city3    565
  ```

2.29.4.11 stddev_pop

This function is used to return the deviation of a specified column.

Syntax

```
stddev_pop(col)
```


Parameters

Table 2-192 Parameter

Parameter	Mandatory	Description
col	Yes	Columns with a data type of numeric. If the value is of any other type, **NULL** is returned.

Return Values

The return value is of the DOUBLE type.

Example Code

- Calculates the deviation of all offering inventories (items). An example command is as follows:

```
select stddev_pop(items) from warehouse;
```

  The command output is as follows:

```
_c0
1.342355
```

- When used with **group by**, it groups all offerings by warehouse (warehourseId) and returns the deviation of the offering inventory (items) in the same group. An example command is as follows:

```
select warehourseId, stddev_pop(items) from warehourse group by warehourseId;
```

  The command output is as follows:

```
warehouseId _c1
city1    1.23124
city2    1.23344
city3    1.43425
```

2.29.4.12 stddev_samp

This function is used to return the sample deviation of a specified column.

Syntax

```
stddev_samp(col)
```

Parameters

Table 2-193 Parameter

Parameter	Mandatory	Description
col	Yes	Columns with a data type of numeric. If the values are of any other type, **NULL** is returned.

Return Values

The return value is of the DOUBLE type.

Example Code

- Calculates the sample covariance between the inventory (items) and the price of all offerings. An example command is as follows:

```
select covar_samp(items,price) from warehouse;
```

  The command output is as follows:

```
_c0
1.242355
```

- When used with **group by**, it groups all offerings by warehouse (warehourseId) and returns the sample covariance between the inventory (items) and the price of offerings within each group. An example command is as follows:

```
select warehourseId, covar_samp(items,price) from warehourse group by warehourseId;
```

  The command output is as follows:

```
warehouseId _c1
city1    1.03124
city2    1.03344
city3    1.33425
```

2.29.4.13 sum

This function is used to calculate the total sum.

Syntax

```
sum(col),
sum(DISTINCT col)
```

Parameters

Table 2-194 Parameter

Parameter	Mandatory	Description
col	Yes	The value can be of any data type and can be converted to the DOUBLE type for calculation. The value can be of the DOUBLE, DECIMAL, or BIGINT type. If the value is of the STRING type, the system implicitly converts it to DOUBLE for calculation.

Return Values

The return value is of the DOUBLE type.

NOTE

If the value of **col** is **NULL**, the row is not involved in calculation.

Example Code

- Calculates the total number of offerings (items) in all warehouses. An example command is as follows:

```
select sum(items) from warehouse;
```

  The command output is as follows:

```
_c0
55357
```

- When used with **group by**, it groups all offerings by warehouse (warehouseId) and calculates the total number of offerings in all warehouses. An example command is as follows:

```
select warehouseId, sum(items) from warehouse group by warehouseId;
```

  The command output is as follows:

```
warehouseId| _c1
city1    15500
city2    10175
city3    19400
```

2.29.4.14 variance/var_pop

This function is used to return the variance of a column.

Syntax

```
variance(col),
var_pop(col)
```

Parameters

Table 2-195 Parameter

Parameter	Mandatory	Description
col	Yes	Columns with a data type of numeric. If the value is of any other type, **NULL** is returned.

Return Values

The return value is of the DOUBLE type.

Example Code

- Calculates the variance of all offering inventories (items). An example command is as follows:

```
select variance(items) from warehouse;
-- It is equivalent to the following statement:
select var_pop(items) from warehouse;
```

  The command output is as follows:

```
_c0
203.42352
```


- When used with **group by**, it groups all offerings by warehouse (warehourseId) and returns the variance of the offering inventory (items) in the same group. An example command is as follows:

```
select warehourseId, variance(items) from warehourse group by warehourseId;
-- It is equivalent to the following statement:
select warehourseId, var_pop(items) from warehourse group by warehourseId;
```

The command output is as follows:

```
warehouseId _c1
city1    19.23124
city2    17.23344
city3    12.43425
```

2.29.4.15 var_samp

This function is used to return the sample variance of a specified column.

Syntax

```
var_samp(col)
```

Parameters

Table 2-196 Parameter

Parameter	Mandatory	Description
col	Yes	Columns with a data type of numeric. If the values are of any other type, **NULL** is returned.

Return Values

The return value is of the DOUBLE type.

Example Code

- Calculates the sample variance of all offering inventories (items). An example command is as follows:

```
select var_samp(items) from warehouse;
```

The command output is as follows:

```
_c0
294.342355
```

- When used with **group by**, it groups all offerings by warehouse (warehourseId) and returns the sample variance of the offering inventory (items) in the same group. An example command is as follows:

```
select warehourseId, var_samp(items) from warehourse group by warehourseId;
```

The command output is as follows:

```
warehouseId _c1
city1    18.23124
city2    16.23344
city3    11.43425
```


2.29.5 Window Functions

2.29.5.1 Overview

Table 2-197 lists the window functions supported by DLI.

Table 2-197 Window functions

Function	Syntax	Value Type	Description
cume_dist	cume_dist()	DOUBLE	Returns the cumulative distribution, which is equivalent to calculating the proportion of data in the partition that is greater than or equal to, or less than or equal to, the current row.
first_value	first_value(col)	Data type of the argument	Returns the value of the first data record in a column in a result set.
last_value	last_value(col)	Data type of the argument	Returns the value of the last data record from a column.
lag	lag (col,n,DEFAULT)	Data type of the argument	Returns the value from the *n*th row preceding the current row. The first argument specifies the column name. The second argument specifies the *n*th row preceding the current row. The configuration of the second argument is optional, and the default argument value is **1** if the argument is not specified. The third argument is set to a default value. If the *n*th row preceding the current row is **null**, the default value is used. The default value of the third argument is **NULL** if the argument is not specified.

Function	Syntax	Value Type	Description
lead	lead (col,n,DEFAULT)	Data type of the argument	Returns the value from the *n*th row following the current row. The first argument specifies the column name. The second argument specifies the *n*th row following the current row. The configuration of the second argument is optional, and the default argument value is **1** if the argument is not specified. The third argument is set to a default value. If the *n*th row following the current row is **null**, the default value is used. The default value of the third argument is **NULL** if the argument is not specified.
percent_rank	percent_rank()	DOUBLE	Returns the rank of a value from the column specified by the ORDER BY clause of the window. The return value is a decimal between 0 and 1, which is calculated using (RANK - 1)/(- 1).
rank	rank()	INT	Returns the rank of a value in a set of values. When multiple values share the same rank, the next rank in the sequence is not consecutive.
row_number	row_number() over (order by col_1[,col_2 ...])	INT	Assigns a unique number to each row.

2.29.5.2 cume_dist

This function is used to return the cumulative distribution, which is equivalent to calculating the proportion of data in the partition that is greater than or equal to, or less than or equal to, the current row.

Restrictions

The restrictions on using window functions are as follows:

- Window functions can be used only in select statements.
- Window functions and aggregate functions cannot be nested in window functions.

- Window functions cannot be used together with aggregate functions of the same level.

Syntax

```
cume_dist() over([partition_clause] [orderby_clause])
```

Parameters

Table 2-198 Parameters

Parameter	Mandatory	Description
partition_clause	No	Partition. Rows with the same value in partition columns are considered to be in the same window.
orderby_clause	No	How data is sorted in a window

Return Values

The return value is of the DOUBLE type.

NOTE

If the value of **a** is **NULL**, **NULL** is returned.

Example Code

To help you understand how to use functions, this example provides source data and function examples based on the source data. Run the following command to create the salary table and add data:

```
CREATE EXTERNAL TABLE salary (
dept STRING, -- Department name
userid string, -- Employee ID
sal INT -- Salary
) ROW FORMAT DELIMITED FIELDS TERMINATED BY ','
stored as textfile;
```

Adds the following data:

```
d1,user1,1000
d1,user2,2000
d1,user3,3000
d2,user4,4000
d2,user5,5000
```

- Calculates the proportion of employees whose salary is less than or equal to the current salary.

```
select dept, userid, sal,
      cume_dist() over(order by sal) as cume1
from salary;
-- Result:
d1 user1 1000 0.2
d1 user2 2000 0.4
d1 user3 3000 0.6
d2 user4 4000 0.8
d2 user5 5000 1.0
```


- Calculates the proportion of employees whose salary is less than or equal to the current salary by department.

```
select dept, userid, sal,
      cume_dist() over (partition by dept order by sal) as cume2
from salary;
-- Result:
d1 user1 1000 0.3333333333333333
d1 user2 2000 0.6666666666666666
d1 user3 3000 1.0
d2 user4 4000 0.5
d2 user5 5000 1.0
```

- After sorting by **sal** in descending order, the result is the ratio of employees whose salary is greater than or equal to the current salary.

```
select dept, userid, sal,
      cume_dist() over(order by sal desc) as cume3
from salary;
-- Result:
d2 user5 5000 0.2
d2 user4 4000 0.4
d1 user3 3000 0.6
d1 user2 2000 0.8
d1 user1 1000 1.0
select dept, userid, sal,
      cume_dist() over(partition by dept order by sal desc) as cume4
from salary;
-- Result:
d1 user3 3000 0.3333333333333333
d1 user2 2000 0.6666666666666666
d1 user1 1000 1.0
d2 user5 5000 0.5
d2 user4 4000 1.0
```

2.29.5.3 first_value

This function is used to obtain the value of the first data record in the window corresponding to the current row.

Restrictions

The restrictions on using window functions are as follows:

- Window functions can be used only in select statements.
- Window functions and aggregate functions cannot be nested in window functions.
- Window functions cannot be used together with aggregate functions of the same level.

Syntax

```
first_value(<expr>[, <ignore_nulls>]) over ([partition_clause] [orderby_clause] [frame_clause])
```


Parameters

Table 2-199 Parameters

Parameter	Mandatory	Description
expr	Yes	Expression whose return result is to be calculated
ignore_nulls	No	The value is of the BOOLEAN type, indicating whether to ignore NULL values. The default value is **False**. If the value is **True**, the first non-null value in the window is returned.
partition_clause	No	Partition. Rows with the same value in partition columns are considered to be in the same window.
orderby_clause	No	It is used to specify how data is sorted in a window.
frame_clause	No	It is used to determine the data boundary.

Return Values

The return value is of the data type of the parameter.

Example Code

Example data

To help you understand how to use functions, this example provides source data and function examples based on the source data. Run the following command to create the **logs** table and add data:

```
create table logs(
 cookieid string,
 createtime string,
 url string
)
STORED AS parquet;
```

Adds the following data:

```
cookie1 2015-04-10 10:00:02 url2
cookie1 2015-04-10 10:00:00 url1
cookie1 2015-04-10 10:03:04 url3
cookie1 2015-04-10 10:50:05 url6
cookie1 2015-04-10 11:00:00 url7
cookie1 2015-04-10 10:10:00 url4
cookie1 2015-04-10 10:50:01 url5
cookie2 2015-04-10 10:00:02 url22
cookie2 2015-04-10 10:00:00 url11
cookie2 2015-04-10 10:03:04 url33
cookie2 2015-04-10 10:50:05 url66
cookie2 2015-04-10 11:00:00 url77
```

```
cookie2 2015-04-10 10:10:00 url44
cookie2 2015-04-10 10:50:01 url55
```

Example: Groups all records by **cookieid**, sorts the records by **createtime** in ascending order, and returns the first row of data in each group. An example command is as follows:

```
SELECT cookieid, createtime, url,
    FIRST_VALUE(url) OVER (PARTITION BY cookieid ORDER BY createtime) AS first
FROM logs;

The command output is as follows:
cookieid createtime        url  first
cookie1 2015-04-10 10:00:00 url1 url1
cookie1 2015-04-10 10:00:02 url2 url1
cookie1 2015-04-10 10:03:04 url3 url1
cookie1 2015-04-10 10:10:00 url4 url1
cookie1 2015-04-10 10:50:01 url5 url1
cookie1 2015-04-10 10:50:05 url6 url1
cookie1 2015-04-10 11:00:00 url7 url1
cookie2 2015-04-10 10:00:00 url11 url11
cookie2 2015-04-10 10:00:02 url22 url11
cookie2 2015-04-10 10:03:04 url33 url11
cookie2 2015-04-10 10:10:00 url44 url11
cookie2 2015-04-10 10:50:01 url55 url11
cookie2 2015-04-10 10:50:05 url66 url11
cookie2 2015-04-10 11:00:00 url77 url11
```

2.29.5.4 last_value

This function is used to obtain the value of the last data record in the window corresponding to the current row.

Restrictions

The restrictions on using window functions are as follows:

- Window functions can be used only in select statements.
- Window functions and aggregate functions cannot be nested in window functions.
- Window functions cannot be used together with aggregate functions of the same level.

Syntax

```
last_value(<expr>[, <ignore_nulls>]) over ([partition_clause] [orderby_clause] [frame_clause])
```

Parameters

Table 2-200 Parameters

Parameter	Mandatory	Description
expr	Yes	Expression whose return result is to be calculated

Parameter	Mandatory	Description
ignore_nulls	No	The value is of the BOOLEAN type, indicating whether to ignore NULL values. The default value is **False**. If the value is **True**, the first non-null value in the window is returned.
partition_clause	No	Partition. Rows with the same value in partition columns are considered to be in the same window.
orderby_clause	No	It is used to specify how data is sorted in a window.
frame_clause	No	It is used to determine the data boundary.

Return Values

The return value is of the data type of the parameter.

Example Code

To help you understand how to use functions, this example provides source data and function examples based on the source data. Run the following command to create the **logs** table and add data:

```
create table logs(
 cookieid string,
 createtime string,
 url string
)
STORED AS parquet;
```

Adds the following data:

```
cookie1 2015-04-10 10:00:02 url2
cookie1 2015-04-10 10:00:00 url1
cookie1 2015-04-10 10:03:04 url3
cookie1 2015-04-10 10:50:05 url6
cookie1 2015-04-10 11:00:00 url7
cookie1 2015-04-10 10:10:00 url4
cookie1 2015-04-10 10:50:01 url5
cookie2 2015-04-10 10:00:02 url22
cookie2 2015-04-10 10:00:00 url11
cookie2 2015-04-10 10:03:04 url33
cookie2 2015-04-10 10:50:05 url66
cookie2 2015-04-10 11:00:00 url77
cookie2 2015-04-10 10:10:00 url44
cookie2 2015-04-10 10:50:01 url55
```

Example: Groups all records by **cookieid**, sorts the records by **createtime** in ascending order, and returns the last row of data in each group. An example command is as follows:

```
SELECT cookieid, createtime, url,
      LAST_VALUE(url) OVER(PARTITION BY cookieid ORDER BY createtime) AS last
FROM logs;
```



```
-- Returned result:
cookieid createtime         url last
cookie1 2015-04-10 10:00:00 url1 url1
cookie1 2015-04-10 10:00:02 url2 url2
cookie1 2015-04-10 10:03:04 url3 url3
cookie1 2015-04-10 10:10:00 url4 url4
cookie1 2015-04-10 10:50:01 url5 url5
cookie1 2015-04-10 10:50:05 url6 url6
cookie1 2015-04-10 11:00:00 url7 url7
cookie2 2015-04-10 10:00:00 url11 url11
cookie2 2015-04-10 10:00:02 url22 url22
cookie2 2015-04-10 10:03:04 url33 url33
cookie2 2015-04-10 10:10:00 url44 url44
cookie2 2015-04-10 10:50:01 url55 url55
cookie2 2015-04-10 10:50:05 url66 url66
cookie2 2015-04-10 11:00:00 url77 url77
```

NOTE

The last value in the current row is actually just itself.

2.29.5.5 lag

This function is used to return the value of the *n*th row upwards within a specified window.

Restrictions

The restrictions on using window functions are as follows:

- Window functions can be used only in select statements.
- Window functions and aggregate functions cannot be nested in window functions.
- Window functions cannot be used together with aggregate functions of the same level.

Syntax

```
lag(<expr>[, bigint <offset>[, <default>]]) over([partition_clause] orderby_clause)
```

Parameters

Table 2-201 Parameters

Parameter	Mandatory	Description
expr	Yes	Expression whose return result is to be calculated
offset	No	Offset. It is a constant of the BIGINT type and its value is greater than or equal to 0. The value **0** indicates the current row, the value **1** indicates the previous row, and so on. The default value is **1**. If the input value is of the STRING or DOUBLE type, it is implicitly converted to the BIGINT type before calculation.

Parameter	Mandatory	Description
default	Yes	Constant. The default value is **NULL**. Default value when the range specified by **offset** is out of range. The value must be the same as the data type corresponding to **expr**. If **expr** is non-constant, the evaluation is performed based on the current row.
partition_clause	No	Partition. Rows with the same value in partition columns are considered to be in the same window.
orderby_clause	No	It is used to specify how data is sorted in a window.

Return Values

The return value is of the data type of the parameter.

Example Code

Example data

To help you understand how to use functions, this example provides source data and function examples based on the source data. Run the following command to create the **logs** table and add data:

```
create table logs(
 cookieid string,
 createtime string,
 url string
)
STORED AS parquet;
```

Adds the following data:

```
cookie1 2015-04-10 10:00:02 url2
cookie1 2015-04-10 10:00:00 url1
cookie1 2015-04-10 10:03:04 url3
cookie1 2015-04-10 10:50:05 url6
cookie1 2015-04-10 11:00:00 url7
cookie1 2015-04-10 10:10:00 url4
cookie1 2015-04-10 10:50:01 url5
cookie2 2015-04-10 10:00:02 url22
cookie2 2015-04-10 10:00:00 url11
cookie2 2015-04-10 10:03:04 url33
cookie2 2015-04-10 10:50:05 url66
cookie2 2015-04-10 11:00:00 url77
cookie2 2015-04-10 10:10:00 url44
cookie2 2015-04-10 10:50:01 url55
```

Groups all records by **cookieid**, sorts the records by **createtime** in ascending order, and returns the value of the second row above the window. An example command is as follows:

Example 1:

```
SELECT cookieid, createtime, url,
    LAG(createtime, 2) OVER (PARTITION BY cookieid ORDER BY createtime) AS last_2_time
```



```
FROM logs;
-- Returned result:
cookieid createtime         url  last_2_time
cookie1 2015-04-10 10:00:00 url1 NULL
cookie1 2015-04-10 10:00:02 url2 NULL
cookie1 2015-04-10 10:03:04 url3 2015-04-10 10:00:00
cookie1 2015-04-10 10:10:00 url4 2015-04-10 10:00:02
cookie1 2015-04-10 10:50:01 url5 2015-04-10 10:03:04
cookie1 2015-04-10 10:50:05 url6 2015-04-10 10:10:00
cookie1 2015-04-10 11:00:00 url7 2015-04-10 10:50:01
cookie2 2015-04-10 10:00:00 url11 NULL
cookie2 2015-04-10 10:00:02 url22 NULL
cookie2 2015-04-10 10:03:04 url33 2015-04-10 10:00:00
cookie2 2015-04-10 10:10:00 url44 2015-04-10 10:00:02
cookie2 2015-04-10 10:50:01 url55 2015-04-10 10:03:04
cookie2 2015-04-10 10:50:05 url66 2015-04-10 10:10:00
cookie2 2015-04-10 11:00:00 url77 2015-04-10 10:50:01
```

NOTE

Note: Because no default value is set, **NULL** is returned when the preceding two rows do not exist.

Example 2:

```
SELECT cookieid, createtime, url,
    LAG(createtime,1,'1970-01-01 00:00:00') OVER (PARTITION BY cookieid ORDER BY createtime) AS
last_1_time
FROM cookie4;
-- Result:
cookieid createtime         url last_1_time
cookie1 2015-04-10 10:00:00 url1 1970-01-01 00:00:00 (The default value is displayed.)
cookie1 2015-04-10 10:00:02 url2 2015-04-10 10:00:00
cookie1 2015-04-10 10:03:04 url3 2015-04-10 10:00:02
cookie1 2015-04-10 10:10:00 url4 2015-04-10 10:03:04
cookie1 2015-04-10 10:50:01 url5 2015-04-10 10:10:00
cookie1 2015-04-10 10:50:05 url6 2015-04-10 10:50:01
cookie1 2015-04-10 11:00:00 url7 2015-04-10 10:50:05
cookie2 2015-04-10 10:00:00 url11 1970-01-01 00:00:00 (The default value is displayed.)
cookie2 2015-04-10 10:00:02 url22 2015-04-10 10:00:00
cookie2 2015-04-10 10:03:04 url33 2015-04-10 10:00:02
cookie2 2015-04-10 10:10:00 url44 2015-04-10 10:03:04
cookie2 2015-04-10 10:50:01 url55 2015-04-10 10:10:00
cookie2 2015-04-10 10:50:05 url66 2015-04-10 10:50:01
cookie2 2015-04-10 11:00:00 url77 2015-04-10 10:50:05
```

2.29.5.6 lead

This function is used to return the value of the *n*th row downwards within a specified window.

Restrictions

The restrictions on using window functions are as follows:

- Window functions can be used only in select statements.
- Window functions and aggregate functions cannot be nested in window functions.
- Window functions cannot be used together with aggregate functions of the same level.

Syntax

```
lead(<expr>[, bigint <offset>[, <default>]]) over([partition_clause] orderby_clause)
```


Parameters

Table 2-202 Parameters

Parameter	Mandatory	Description
expr	Yes	Expression whose return result is to be calculated
offset	No	Offset. It is a constant of the BIGINT type and its value is greater than or equal to 0. The value **0** indicates the current row, the value **1** indicates the previous row, and so on. The default value is **1**. If the input value is of the STRING or DOUBLE type, it is implicitly converted to the BIGINT type before calculation.
default	Yes	Constant. The default value is **NULL**. Default value when the range specified by **offset** is out of range. The value must be the same as the data type corresponding to **expr**. If **expr** is non-constant, the evaluation is performed based on the current row.
partition_clause	No	Partition. Rows with the same value in partition columns are considered to be in the same window.
orderby_clause	No	It is used to specify how data is sorted in a window.

Return Values

The return value is of the data type of the parameter.

Example Code

Example data

To help you understand how to use functions, this example provides source data and function examples based on the source data. Run the following command to create the **logs** table and add data:

```
create table logs(
 cookieid string,
 createtime string,
 url string
)
STORED AS parquet;
```

Adds the following data:

```
cookie1 2015-04-10 10:00:02 url2
cookie1 2015-04-10 10:00:00 url1
cookie1 2015-04-10 10:03:04 url3
cookie1 2015-04-10 10:50:05 url6
```



```
cookie1 2015-04-10 11:00:00 url7
cookie1 2015-04-10 10:10:00 url4
cookie1 2015-04-10 10:50:01 url5
cookie2 2015-04-10 10:00:02 url22
cookie2 2015-04-10 10:00:00 url11
cookie2 2015-04-10 10:03:04 url33
cookie2 2015-04-10 10:50:05 url66
cookie2 2015-04-10 11:00:00 url77
cookie2 2015-04-10 10:10:00 url44
cookie2 2015-04-10 10:50:01 url55
```

Groups all records by **cookieid**, sorts them by **createtime** in ascending order, and returns the values of the second and first rows downwards within the specified window. An example command is as follows:

```
SELECT cookieid, createtime, url,
    LEAD(createtime, 2) OVER(PARTITION BY cookieid ORDER BY createtime) AS next_2_time,
    LEAD(createtime, 1, '1970-01-01 00:00:00') OVER(PARTITION BY cookieid ORDER BY createtime) AS
next_1_time
FROM logs;

-- Returned result:
cookieid createtime         url  next_2_time          next_1_time
cookie1 2015-04-10 10:00:00 url1 2015-04-10 10:03:04  2015-04-10 10:00:02
cookie1 2015-04-10 10:00:02 url2 2015-04-10 10:10:00  2015-04-10 10:03:04
cookie1 2015-04-10 10:03:04 url3 2015-04-10 10:50:01  2015-04-10 10:10:00
cookie1 2015-04-10 10:10:00 url4 2015-04-10 10:50:05  2015-04-10 10:50:01
cookie1 2015-04-10 10:50:01 url5 2015-04-10 11:00:00  2015-04-10 10:50:05
cookie1 2015-04-10 10:50:05 url6 NULL                 2015-04-10 11:00:00
cookie1 2015-04-10 11:00:00 url7 NULL                 1970-01-01 00:00:00
cookie2 2015-04-10 10:00:00 url11 2015-04-10 10:03:04 2015-04-10 10:00:02
cookie2 2015-04-10 10:00:02 url22 2015-04-10 10:10:00 2015-04-10 10:03:04
cookie2 2015-04-10 10:03:04 url33 2015-04-10 10:50:01 2015-04-10 10:10:00
cookie2 2015-04-10 10:10:00 url44 2015-04-10 10:50:05 2015-04-10 10:50:01
cookie2 2015-04-10 10:50:01 url55 2015-04-10 11:00:00 2015-04-10 10:50:05
cookie2 2015-04-10 10:50:05 url66 NULL                 2015-04-10 11:00:00
cookie2 2015-04-10 11:00:00 url77 NULL                 1970-01-01 00:00:00
```

2.29.5.7 percent_rank

This function is used to return the value of the column specified in the ORDER BY clause of a window, expressed as a decimal between 0 and 1. It is calculated as (the rank value of the current row within the group – 1) divided by (the total number of rows in the group – 1).

Restrictions

The restrictions on using window functions are as follows:

- Window functions can be used only in select statements.
- Window functions and aggregate functions cannot be nested in window functions.
- Window functions cannot be used together with aggregate functions of the same level.

Syntax

```
percent_rank() over([partition_clause] [orderby_clause])
```


Parameters

Table 2-203 Parameters

Parameter	Mandatory	Description
partition_clause	No	Partition. Rows with the same value in partition columns are considered to be in the same window.
orderby_clause	No	It is used to specify how data is sorted in a window.

Return Values

The return value is of the DOUBLE type.

Example Code

Example data

To help you understand how to use functions, this example provides source data and function examples based on the source data. Run the following command to create the salary table and add data:

```
CREATE EXTERNAL TABLE salary (
dept STRING, -- Department name
userid string, -- Employee ID
sal INT -- Salary
) ROW FORMAT DELIMITED FIELDS TERMINATED BY ','
stored as textfile;
```

Adds the following data:

```
d1,user1,1000
d1,user2,2000
d1,user3,3000
d2,user4,4000
d2,user5,5000
```

Example: Calculates the percentage ranking of employees' salaries in a department.

```
select dept, userid, sal,
      percent_rank() over(partition by dept order by sal) as pr2
from salary;
-- Result analysis:
d1 user1 1000 0.0    -- (1-1)/(3-1)=0.0
d1 user2 2000 0.5    -- (2-1)/(3-1)=0.5
d1 user3 3000 1.0    -- (3-1)/(3-1)=1.0
d2 user4 4000 0.0    -- (1-1)/(2-1)=0.0
d2 user5 5000 1.0    -- (2-1)/(2-1)=1.0
```

2.29.5.8 rank

This function is used to return the rank of a value in a set of values. When multiple values share the same rank, the next rank in the sequence is not consecutive.

Restrictions

The restrictions on using window functions are as follows:

- Window functions can be used only in select statements.
- Window functions and aggregate functions cannot be nested in window functions.
- Window functions cannot be used together with aggregate functions of the same level.

Syntax

```
rank() over ([partition_clause] [orderby_clause])
```

Parameters

Table 2-204 Parameters

Parameter	Mandatory	Description
partition_clause	No	Partition. Rows with the same value in partition columns are considered to be in the same window.
orderby_clause	No	It is used to specify how data is sorted in a window.

Return Values

The return value is of the INT type.

NOTE

If the value of **a** is **NULL**, **NULL** is returned.

Example Code

To help you understand how to use functions, this example provides source data and function examples based on the source data. Run the following command to create the **logs** table and add data:

```
CREATE TABLE logs (
cookieid string,
createtime string,
pv INT
) ROW FORMAT DELIMITED FIELDS TERMINATED BY ','
stored as textfile;
```

Adds the following data:

```
cookie1 2015-04-10 1
cookie1 2015-04-11 5
cookie1 2015-04-12 7
cookie1 2015-04-13 3
cookie1 2015-04-14 2
cookie1 2015-04-15 4
```



```
cookie1 2015-04-16 4
cookie2 2015-04-10 2
cookie2 2015-04-11 3
cookie2 2015-04-12 5
cookie2 2015-04-13 6
cookie2 2015-04-14 3
cookie2 2015-04-15 9
cookie2 2015-04-16 7
```

Example: Groups all records by **cookieid**, sorts them by **pv** in descending order, and returns the sequence number of each row in the group. An example command is as follows:

```
select cookieid, createtime, pv,
      rank() over(partition by cookieid order by pv desc) as rank
from logs
where cookieid = 'cookie1';
-- Result:
cookie1 2015-04-12 7 1
cookie1 2015-04-11 5 2
cookie1 2015-04-16 4 3 (third in parallel)
cookie1 2015-04-15 4 3
cookie1 2015-04-13 3 5 (skip 4 and start from 5)
cookie1 2015-04-14 2 6
cookie1 2015-04-10 1 7
```

2.29.5.9 row_number

This function is used to return the row number, starting from 1 and increasing incrementally.

Restrictions

The restrictions on using window functions are as follows:

- Window functions can be used only in select statements.
- Window functions and aggregate functions cannot be nested in window functions.
- Window functions cannot be used together with aggregate functions of the same level.

Syntax

```
row_number() over([partition_clause] [orderby_clause])
```

Parameters

Table 2-205 Parameters

Parameter	Mandatory	Description
partition_clause	No	Partition. Rows with the same value in partition columns are considered to be in the same window.
orderby_clause	No	It is used to specify how data is sorted in a window.

Return Values

The return value is of the DOUBLE type.

NOTE

If the value of **a** is **NULL**, **NULL** is returned.

Example Code

To help you understand how to use functions, this example provides source data and function examples based on the source data. Run the following command to create the **logs** table and add data:

```
CREATE TABLE logs (
cookieid string,
createtime string,
pv INT
) ROW FORMAT DELIMITED FIELDS TERMINATED BY ','
stored as textfile;
```

Adds the following data:

```
cookie1 2015-04-10 1
cookie1 2015-04-11 5
cookie1 2015-04-12 7
cookie1 2015-04-13 3
cookie1 2015-04-14 2
cookie1 2015-04-15 4
cookie1 2015-04-16 4
cookie2 2015-04-10 2
cookie2 2015-04-11 3
cookie2 2015-04-12 5
cookie2 2015-04-13 6
cookie2 2015-04-14 3
cookie2 2015-04-15 9
cookie2 2015-04-16 7
```

Example: Groups all records by **cookieid**, sorts them by **pv** in descending order, and returns the sequence number of each row in the group. An example command is as follows:

```
select cookieid, createtime, pv,
    row_number() over (partition by cookieid order by pv desc) as index
from logs;

-- Returned result:
cookie1 2015-04-12 7 1
cookie1 2015-04-11 5 2
cookie1 2015-04-16 4 3
cookie1 2015-04-15 4 4
cookie1 2015-04-13 3 5
cookie1 2015-04-14 2 6
cookie1 2015-04-10 1 7
cookie2 2015-04-15 9 1
cookie2 2015-04-16 7 2
cookie2 2015-04-13 6 3
cookie2 2015-04-12 5 4
cookie2 2015-04-11 3 5
cookie2 2015-04-14 3 6
cookie2 2015-04-10 2 7
```

2.29.6 Other Functions

2.29.6.1 Overview

The following table lists the functions provided by DLI, such as **decode1**, **javahash**, and **max_pt**.

Table 2-206 Added functions

Function	Syntax	Value Type	Description
decode1	decode1(<expression>, <search>, <result>[, <search>, <result>]...[, <default>])	Data type of the argument	Implements if-then-else branch selection.
javahash	javahash(string a)	STRING	Returns a hash value.
max_pt	max_pt(<table_full_name>)	STRING	Returns the name of the largest level-1 partition that contains data in a partitioned table and reads the data of this partition.
ordinal	ordinal(bigint <nth>, <var1>, <var2>[,...])	DOUBLE or DATETIME	Sorts input variables in ascending order and returns the value at the position specified by nth.
trans_array	trans_array (<num_keys>, <separator>, <key1>,<key2>, …,<col1>,<col2>, <col3>) as (<key1>,<key2>,..,<col1>, <col2>)	Data type of the argument	Converts an array split by a fixed separator in a column into multiple rows.
trunc_numeric	trunc_numeric(<number>[, bigint<decimal_places>])	DOUBLE or DECIMAL	Truncates the **number** value to a specified decimal place.
url_decode	url_decode(string <input>[, string <encoding>])	STRING	Converts a string from the **application/x-www-form-urlencoded MIME** format to regular characters.
url_encode	url_encode(string <input>[, string <encoding>])	STRING	Encodes a string in the **application/x-www-form-urlencoded MIME** format.

2.29.6.2 decode1

This function is used to implement if-then-else branch selection.

Syntax

```
decode1(<expression>, <search>, <result>[, <search>, <result>]...[, <default>])
```

Parameters

Table 2-207 Parameters

Parameter	Mandatory	Type	Description
expression	Yes	All data types	Expression to be compared
search	Yes	Same as that of **expression**	Search item to be compared with **expression**
result	Yes	All data types	Return value when the values of **search** and **expression** match
default	No	Same as that of **result**	If all search items do not match, the value of this parameter is returned. If no search item is specified, **NULL** is returned.

Return Values

result and **default** are return values. These values can be of any data type.

NOTE

- If they match, the value of **result** is returned.
- If no match is found, the value of **default** is returned.
- If **default** is not specified, **NULL** is returned.
- If the search options are duplicate and matched, the first value is returned.

Example Code

To help you understand how to use functions, this example provides source data and function examples based on the source data. Run the following command to create the salary table and add data:

```
CREATE EXTERNAL TABLE salary (
dept_id STRING, -- Department
userid string, -- Employee ID
sal INT
```

```
) ROW FORMAT DELIMITED FIELDS TERMINATED BY ','
stored as textfile;
```

Adds the following data:

```
d1,user1,1000
d1,user2,2000
d1,user3,3000
d2,user4,4000
d2,user5,5000
```

Example

Returns the name of each department.

If **dept_id** is set to **d1**, **DLI** is returned. If it is set to **d2**, **MRS** is returned. In other scenarios, **Others** is returned.

```
select dept, decode1(dept, 'd1', 'DLI', 'd2', 'MRS', 'Others') as result from sale_detail;
```

Returned result:

```
d1 DLI
d2 MRS
d3 Others
d4 Others
d5 Others
```

2.29.6.3 javahash

This function is used to return the hash value of **a**.

Syntax

```
javahash(string a)
```

Parameters

Table 2-208 Parameter

Parameter	Mandatory	Type	Description
a	Yes	STRING	Data whose hash value needs to be returned

Return Values

The return value is of the STRING type.

NOTE

The hash value is returned. If the value of **a** is **null**, an error is reported.

Example Code

The value **48690** is returned.


```
select javahash("123");
```

The value **123** is returned.

```
select javahash(123);
```

2.29.6.4 max_pt

This function is used to return the name of the largest level-1 partition that contains data in a partitioned table and read the data of this partition.

Syntax

```
max_pt(<table_full_name>)
```

Parameters

Table 2-209 Parameter

Parameter	Mandatory	Type	Description
table_full_name	Yes	STRING	Specified table name. You must have the read permission on the table.

Return Values

The return value is of the STRING type.

NOTE

- The value of the largest level-1 partition is returned.
- If a partition is added to a table using the **ALTER TABLE** command, but it does not contain any data, it will not be included in the returned values.

Example Code

For example, table1 is a partitioned table with partitions of **20120801** and **20120802**, both of which contain data, and the **max_pt** value in the following statement will be **20120802**. The DLI SQL statement will read data from the partition with pt = 20120802.

An example command is as follows:

```
select * from tablel where pt = max_pt('dbname.table1');
```

It is equivalent to the following statement:

```
select * from table1 where pt = (select max(pt) from dbname.table1);
```

2.29.6.5 ordinal

This function is used to sort input variables in ascending order and return the value at the position specified by **nth**.

Syntax

```
ordinal(bigint <nth>, <var1>, <var2>[,...])
```

Parameters

Table 2-210 Parameters

Parameter	Mandatory	Type	Description
nth	Yes	BIGINT	Position value to be returned
var	Yes	BIGINT, DOUBLE, DATETIME, or STRING	Value to be sorted

Return Values

The return value is of the DOUBLE or DECIMAL type.

NOTE

- Value of the nth bit. If there are no implicit conversions, the return value has the same data type as the input parameter.
- If there are type conversions, **DOUBLE** is returned for the conversion between **DOUBLE**, **BIGINT**, and **STRING**, and **DATETIME** is returned for the conversion between **STRING** and **DATETIME**. Other implicit conversions are not allowed.
- **NULL** indicates the minimum value.

Example Code

The value **2** is returned.

```
select ordinal(3, 1, 3, 2, 5, 2, 4, 9);
```

2.29.6.6 trans_array

This function is used to convert an array split by a fixed separator in a column into multiple rows.

Restrictions

- All columns used as keys must be placed before the columns to be transposed.
- Only one UDTF is allowed in a select statement.
- This function cannot be used together with **group by**, **cluster by**, **distribute by**, or sort by.

Syntax

```
trans_array (<num_keys>, <separator>, <key1>,<key2>,...,<col1>,<col2>,<col3>) as (<key1>,<key2>,...,<col1>,
<col2>)
```

Parameters

Table 2-211 Parameters

Parameter	Mandatory	Type	Description
num_keys	Yes	BIGINT	The value is a constant of the BIGINT type and must be greater than or equal to 0. This parameter indicates the number of columns that are used as transposed keys when being converted to multiple rows.
separator	Yes	STRING	The value is a constant of the STRING type, which is used to split a string into multiple elements. If this parameter is left blank, an error is reported.
keys	Yes	STRING	Columns used as keys during transpose. The number of columns is specified by **num_keys**. If **num_keys** specifies that all columns are used as keys (that is, **num_keys** is equal to the number of all columns), only one row is returned.
cols	Yes	STRING	Array to be converted to rows. All columns following **keys** are regarded as arrays to be transposed and must be of the STRING type.

Return Values

The return value is of the data type of the parameter.

NOTE

- Transposed rows are returned. The new column name is specified by **as**.
- The type of the key column does not change, and the type of other columns is **STRING**.
- The number of rows after the split is subject to the array with more rows. If there are not enough rows, **NULL** is added.

Example Code

To help you understand how to use functions, this example provides source data and function examples based on the source data. Run the following command to create the salary table and add data:

```
CREATE EXTERNAL TABLE salary (
dept_id STRING, -- Department
```



```
userid string, -- Employee ID
sal INT -- Salary
) ROW FORMAT DELIMITED FIELDS TERMINATED BY ','
stored as textfile;
```

Adds the following data:

```
d1,user1/user4,1000/6000
d1,user2/user5,2000/7000
d1,user3/user6,3000
d2,user4/user7,4000
d2,user5/user8,5000/8000
```

Executes the SQL statement

```
select trans_array(1, "/", dept_id, user_id, sal) as (dept_id, user_id, sal) from salary;
```

The command output is as follows:

```
d1,user1,1000
d1,user4,6000
d1,user2,2000
d1,user5,7000
d1,user3,3000
d1,user6,NULL
d2,user4,4000
d2,user7,NULL
d2,user5,5000
d2,user8,8000
```

2.29.6.7 trunc_numeric

This function is used to truncate the **number** value to a specified decimal place.

Syntax

```
trunc_numeric(<number>[, bigint<decimal_places>])
```

Parameters

Table 2-212 Parameters

Parameter	Mandatory	Type	Description
number	Yes	DOUBLE, BIGINT, DECIMAL, or STRING	Data to be truncated
decimal_places	No	BIGINT	The default value is **0**, indicating that the decimal place at which the number is truncated.

Return Values

The return value is of the DOUBLE or DECIMAL type.

NOTE

The return rules are as follows:

- If the **number** value is of the DOUBLE or DECIMAL type, the corresponding type is returned.
- If the **number** value is of the STRING or BIGINT type, **DOUBLE** is returned.
- If the **decimal_places** value is not of the BIGINT type, an error is reported.
- If the value of **number** is **NULL**, **NULL** is returned.

Example Code

The value **3.141** is returned.

```
select trunc_numeric(3.1415926, 3);
```

The value **3** is returned.

```
select trunc_numeric(3.1415926);
```

An error is reported.

```
select trunc_numeric(3.1415926, 3.1);
```

2.29.6.8 url_decode

This function is used to convert a string from the **application/x-www-form-urlencoded MIME** format to regular characters.

Syntax

```
url_decode(string <input>[, string <encoding>])
```

Parameters

Table 2-213 Parameters

Parameter	Mandatory	Type	Description
input	Yes	STRING	String to be entered
endcoding	No	STRING	Encoding format. Standard encoding formats such as GBK and UTF-8 are supported. If this parameter is not specified, **UTF-8** is used by default.

Return Values

The return value is of the STRING type.

NOTE

UTF-8-encoded string of the STRING type

Example Code

The value **Example for URL_DECODE:// dsf (fasfs)** is returned.

```
select url_decode('Example+for+url_decode+%3A%2F%2F+dsf%28fasfs%29', 'GBK');
```

2.29.6.9 url_encode

This function is used to encode a string in the **application/x-www-form-urlencoded MIME** format.

Syntax

url_encode(string <input>[, string <encoding>])

Parameters

Table 2-214 Parameters

Parameter	Mandatory	Type	Description
input	Yes	STRING	String to be entered
endcoding	No	STRING	Encoding format. Standard encoding formats such as GBK and UTF-8 are supported. If this parameter is not specified, **UTF-8** is used by default.

Return Values

The return value is of the STRING type.

NOTE

If the value of **input** or **encoding** is **NULL**, **NULL** is returned.

Example Code

The value **Example+for+url_encode+%3A%2F%2F+dsf%28fasfs%29** is returned.

```
select url_encode('Example for url_encode:// dsf(fasfs)', 'GBK');
```

2.30 Basic SELECT Statements

Function

This statement is a basic query statement and is used to return the query results.

Syntax

```
SELECT [ALL | DISTINCT] attr_expr_list FROM table_reference
  [WHERE where_condition]
```



```
[GROUP BY col_name_list]
[ORDER BY col_name_list][ASC | DESC]
[CLUSTER BY col_name_list | DISTRIBUTE BY col_name_list]
[SORT BY col_name_list]]
[LIMIT number];
```

Keyword

Table 2-215 SELECT parameter description

Parameter	Description
ALL	Returns duplicate rows. By default, all repeated rows are returned. It is followed by asterisks (*) only. Otherwise, an error will occur.
DISTINCT	Removes duplicate rows from the result set.
WHERE	Specifies the filter criteria for a query. Arithmetic operators, relational operators, and logical operators are supported.
where_condition	Filter criteria.
GROUP BY	Specifies the grouping field. Single-field grouping and multi-field grouping are supported.
col_name_list	Field list
ORDER BY	Sort the query results.
ASC/DESC	ASC sorts from the lowest value to the highest value. DESC sorts from the highest value to the lowest value. ASC is the default sort order.
CLUSTER BY	CLUSTER BY is used to bucket the table according to the bucketing fields and then sort within the bucketed table. If the field of DISTRIBUTE BY is the same as the field of SORT BY and the sorting is in descending order, the combination of DISTRIBUTE BY and SORT BY achieves the same function as CLUSTER BY.
DISTRIBUTE BY	Specifies the bucketing fields without sorting the table.
SORT BY	The objects will be sorted in the bucket.
LIMIT	LIMIT is used to limit the query results. Only INT type is supported by the **number** parameter.

Precautions

The table to be queried must exist. Otherwise, an error is reported.

Example

To filter the record, in which the name is Mike, from the **student** table and sort the results in ascending order of score, run the following statement:

```
SELECT * FROM student
  WHERE name = 'Mike'
  ORDER BY score;
```

2.31 Filtering

2.31.1 WHERE Filtering Clause

Function

This statement is used to filter the query results using the WHERE clause.

Syntax

```
SELECT [ALL | DISTINCT] attr_expr_list FROM table_reference
  WHERE where_condition;
```

Keyword

- All is used to return repeated rows. By default, all repeated rows are returned. It is followed by asterisks (*) only. Otherwise, an error will occur.
- DISTINCT is used to remove the repeated line from the result.
- WHERE is used to filter out records that do not meet the condition and return records that meet the condition.

Precautions

The to-be-queried table must exist.

Example

To filter the records in which the scores are higher than 90 and lower than 95 in the **student** table, run the following statement:

```
SELECT * FROM student
  WHERE score > 90 AND score < 95;
```

2.31.2 HAVING Filtering Clause

Function

This statement is used to filter the query results using the HAVING clause.

Syntax

```
SELECT [ALL | DISTINCT] attr_expr_list FROM table_reference
  [WHERE where_condition]
  [GROUP BY col_name_list]
  HAVING having_condition;
```


Keyword

- All is used to return repeated rows. By default, all repeated rows are returned. It is followed by asterisks (*) only. Otherwise, an error will occur.
- DISTINCT is used to remove the repeated line from the result.
- Generally, HAVING and GROUP BY are used together. GROUP BY applies first for grouping and HAVING then applies for filtering. The arithmetic operation and aggregate function are supported by the HAVING clause.

Precautions

- The to-be-queried table must exist.
- If the filtering condition is subject to the query results of GROUP BY, the HAVING clause, rather than the WHERE clause, must be used for filtering.

Example

Group the **student** table according to the **name** field and filter the records in which the maximum score is higher than 95 based on groups.

```
SELECT name, max(score) FROM student
  GROUP BY name
  HAVING max(score) >95;
```

2.32 Sorting

2.32.1 ORDER BY

Function

This statement is used to order the result set of a query by the specified field.

Syntax

```
SELECT attr_expr_list FROM table_reference
  ORDER BY col_name
  [ASC | DESC] [,col_name [ASC | DESC],...];
```

Keyword

- **ASC/DESC**: ASC sorts from the lowest value to the highest value. DESC sorts from the highest value to the lowest value. **ASC** is the default sort order.
- **ORDER BY**: specifies that the values in one or more columns should be sorted globally. When **ORDER BY** is used with **GROUP BY**, **ORDER BY** can be followed by the aggregate function.

Precautions

The to-be-sorted table must exist. If this statement is used to sort a table that does not exist, an error is reported.

Example

To sort table **student** in ascending order according to field **score** and return the sorting result, run the following statement:

```
SELECT * FROM student
  ORDER BY score;
```

2.32.2 SORT BY

Function

This statement is used to achieve the partial sorting of tables according to fields.

Syntax

```
SELECT attr_expr_list FROM table_reference
  SORT BY col_name
  [ASC | DESC] [,col_name [ASC | DESC],...];
```

Keyword

- ASC/DESC: ASC sorts from the lowest value to the highest value. DESC sorts from the highest value to the lowest value. ASC is the default sort order.
- SORT BY: Used together with GROUP BY to perform local sorting of a single column or multiple columns for PARTITION.

Precautions

The to-be-sorted table must exist. If this statement is used to sort a table that does not exist, an error is reported.

Example

To sort the **student** table in ascending order of the **score** field in Reducer, run the following statement:

```
SELECT * FROM student
  SORT BY score;
```

2.32.3 CLUSTER BY

Function

This statement is used to bucket a table and sort the table within buckets.

Syntax

```
SELECT attr_expr_list FROM table_reference
  CLUSTER BY col_name [,col_name ,...];
```

Keyword

CLUSTER BY: Buckets are created based on specified fields. Single fields and multiple fields are supported, and data is sorted in buckets.

Precautions

The to-be-sorted table must exist. If this statement is used to sort a table that does not exist, an error is reported.

Example

To bucket the **student** table according to the **score** field and sort tables within buckets in descending order, run the following statement:

```
SELECT * FROM student
  CLUSTER BY score;
```

2.32.4 DISTRIBUTE BY

Function

This statement is used to bucket a table according to the field.

Syntax

```
SELECT attr_expr_list FROM table_reference
  DISTRIBUTE BY col_name [,col_name ,...];
```

Keyword

DISTRIBUTE BY: Buckets are created based on specified fields. A single field or multiple fields are supported, and the fields are not sorted in the bucket. This parameter is used together with SORT BY to sort data after bucket division.

Precautions

The to-be-sorted table must exist. If this statement is used to sort a table that does not exist, an error is reported.

Example Value

To bucket the **student** table according to the **score** field, run the following statement:

```
SELECT * FROM student
  DISTRIBUTE BY score;
```

2.33 Grouping

2.33.1 Column-Based GROUP BY

Function

This statement is used to group a table based on columns.

Syntax

```
SELECT attr_expr_list FROM table_reference
  GROUP BY col_name_list;
```

Keyword

Column-based GROUP BY can be categorized into single-column GROUP BY and multi-column GROUP BY.

- Single-column GROUP BY indicates that the GROUP BY clause contains only one column. The fields in **col_name_list** must exist in **attr_expr_list**. The aggregate function, **count()** and **sum()** for example, is supported in **attr_expr_list**. The aggregate function can contain other fields.
- Multi-column GROUP BY indicates that there is more than one column in the GROUP BY clause. The query statement is grouped according to all the fields in the GROUP BY clause. The records with the same fields are put in the same group. Similarly, the fields in the GROUP BY clause must be in the fields in **attr_expr_list**. The **attr_expr_list** field can also use the aggregate function.

Precautions

The to-be-grouped table must exist. Otherwise, an error is reported.

Example

Group the **student** table according to the score and name fields and return the grouping results.

```
SELECT score, count(name) FROM student
  GROUP BY score,name;
```

2.33.2 Expression-Based GROUP BY

Function

This statement is used to group a table according to expressions.

Syntax

```
SELECT attr_expr_list FROM table_reference
  GROUP BY groupby_expression [, groupby_expression, ...];
```

Keyword

The **groupby_expression** can contain a single field or multiple fields, and also can call aggregate functions or string functions.

Precautions

- The to-be-grouped table must exist. Otherwise, an error is reported.
- In the same single-column group, built-in functions and self-defined functions are supported in the expression in the GRUOP BY fields that must exit in **attr_expr_list**.

Example

To use the **substr** function to obtain the character string from the **name** field, group the student table according to the obtained character string, and return each sub character string and the number of records, run the following statement:

```
SELECT substr(name,6),count(name) FROM student
  GROUP BY substr(name,6);
```

2.33.3 GROUP BY Using HAVING

Function

This statement filters a table after grouping it using the HAVING clause.

Syntax

```
SELECT attr_expr_list FROM table_reference
  GROUP BY groupby_expression [, groupby_expression...]
  HAVING having_expression;
```

Keyword

The groupby_expression can contain a single field or multiple fields, and can also call aggregate functions or string functions.

Precautions

- The to-be-grouped table must exist. Otherwise, an error is reported.
- If the filtering condition is subject to the query results of GROUP BY, the HAVING clause, rather than the WHERE clause, must be used for filtering. If HAVING and GROUP BY are used together, GROUP BY applies first for grouping and HAVING then applies for filtering. The arithmetic operation and aggregate function are supported by the HAVING clause.

Example

Group the **transactions** according to **num**, use the HAVING clause to filter the records in which the maximum value derived from multiplying **price** with **amount** is higher than 5000, and return the filtered results.

```
SELECT num, max(price*amount) FROM transactions
  WHERE time > '2016-06-01'
  GROUP BY num
  HAVING max(price*amount)>5000;
```

2.33.4 ROLLUP

Function

This statement is used to generate the aggregate row, super-aggregate row, and the total row. The statement can achieve multi-layer statistics from right to left and display the aggregation of a certain layer.

Syntax

```
SELECT attr_expr_list FROM table_reference
  GROUP BY col_name_list
  WITH ROLLUP;
```

Keyword

ROLLUP is the expansion of GROUP BY. For example, ***SELECT a, b, c, SUM(expression) FROM table GROUP BY a, b, c WITH ROLLUP;*** can be transformed into the following query statements:

- Counting the (a, b, c) combinations
  ```
  SELECT a, b, c, sum(expression) FROM table
    GROUP BY a, b, c;
  ```
- Counting the (a, b) combinations
  ```
  SELECT a, b, NULL, sum(expression) FROM table
    GROUP BY a, b;
  ```
- Counting the (a) combinations
  ```
  SELECT a, NULL, NULL, sum(expression) FROM table
    GROUP BY a;
  ```
- Total
  ```
  SELECT NULL, NULL, NULL, sum(expression) FROM table;
  ```

Precautions

The to-be-grouped table must exist. If this statement is used to group a table that does not exist, an error is reported.

Example

To generate the aggregate row, super-aggregate row, and total row according to the group_id and job fields and return the total salary on each aggregation condition, run the following statement:

```
SELECT group_id, job, SUM(salary) FROM group_test
  GROUP BY group_id, job
  WITH ROLLUP;
```

2.33.5 GROUPING SETS

Function

This statement is used to generate the cross-table row and achieve the cross-statistics of the GROUP BY field.

Syntax

```
SELECT attr_expr_list FROM table_reference
  GROUP BY col_name_list
  GROUPING SETS(col_name_list);
```

Keyword

GROUPING SETS is the expansion of GROUP BY. For example:

- ***SELECT a, b, sum(expression) FROM table GROUP BY a, b GROUPING SETS((a,b));***

It can be converted to the following query:

```
SELECT a, b, sum(expression) FROM table
  GROUP BY a, b;
```

- ***SELECT a, b, sum(expression) FROM table GROUP BY a, b GROUPING SETS(a,b);***

  It can be converted to the following two queries:

  ```
  SELECT a, NULL, sum(expression) FROM table GROUP BY a;
  UNION
  SELECT NULL, b, sum(expression) FROM table GROUP BY b;
  ```

- ***SELECT a, b, sum(expression) FROM table GROUP BY a, b GROUPING SETS((a,b), a);***

  It can be converted to the following two queries:

  ```
  SELECT a, b, sum(expression) FROM table GROUP BY a, b;
  UNION
  SELECT a, NULL, sum(expression) FROM table GROUP BY a;
  ```

- ***SELECT a, b, sum(expression) FROM table GROUP BY a, b GROUPING SETS((a,b), a, b, ());***

  It can be converted to the following four queries:

  ```
  SELECT a, b, sum(expression) FROM table GROUP BY a, b;
  UNION
  SELECT a, NULL, sum(expression) FROM table GROUP BY a, NULL;
  UNION
  SELECT NULL, b, sum(expression) FROM table GROUP BY NULL, b;
  UNION
  SELECT NULL, NULL, sum(expression) FROM table;
  ```

Precautions

- The to-be-grouped table must exist. Otherwise, an error is reported.
- Different from ROLLUP, there is only one syntax for GROUPING SETS.

Example

To generate the cross-table row according to the **group_id** and **job** fields and return the total salary on each aggregation condition, run the following statement:

```
SELECT group_id, job, SUM(salary) FROM group_test
  GROUP BY group_id, job
  GROUPING SETS (group_id, job);
```

2.34 JOIN

2.34.1 INNER JOIN

Function

This statement is used to join and return the rows that meet the JOIN conditions from two tables as the result set.

Syntax

```
SELECT attr_expr_list FROM table_reference
  {JOIN | INNER JOIN} table_reference ON join_condition;
```

Keyword

JOIN/INNER JOIN: Only the records that meet the JOIN conditions in joined tables will be displayed.

Precautions

- The to-be-joined table must exist. Otherwise, an error is reported.
- INNER JOIN can join more than two tables at one query.

Example

To join the course IDs from the **student_info** and **course_info** tables and check the mapping between student names and courses, run the following statement:

```
SELECT student_info.name, course_info.courseName FROM student_info
  JOIN course_info ON (student_info.courseId = course_info.courseId);
```

2.34.2 LEFT OUTER JOIN

Function

Join the left table with the right table and return all joined records of the left table. If no joined record is found, NULL will be returned.

Syntax

```
SELECT attr_expr_list FROM table_reference
  LEFT OUTER JOIN table_reference ON join_condition;
```

Keyword

LEFT OUTER JOIN: Returns all joined records of the left table. If no record is matched, NULL is returned.

Precautions

The to-be-joined table must exist. Otherwise, an error is reported.

Example

To join the courseId from the **student_info** table to the **courseId** from the **course_info** table for inner join and return the name of the students who have selected course, run the following statement. If no joined record is found, NULL will be returned.

```
SELECT student_info.name, course_info.courseName FROM student_info
  LEFT OUTER JOIN course_info ON (student_info.courseId = course_info.courseId);
```

2.34.3 RIGHT OUTER JOIN

Function

Match the right table with the left table and return all matched records of the right table. If no matched record is found, NULL will be returned.

Syntax

```
SELECT attr_expr_list FROM table_reference
  RIGHT OUTER JOIN table_reference ON join_condition;
```

Keyword

RIGHT OUTER JOIN: Return all matched records of the right table. If no record is matched, NULL is returned.

Precautions

The to-be-joined table must exist. Otherwise, an error is reported.

Example

To join the courseId from the **course_info** table to the **courseId** from the **student_info** table for inner join and return the records in the **course_info** table, run the following statement. If no joined record is found, NULL will be returned.

```
SELECT student_info.name, course_info.courseName FROM student_info
  RIGHT OUTER JOIN course_info ON (student_info.courseId = course_info.courseId);
```

2.34.4 FULL OUTER JOIN

Function

Join all records from the right table and the left table and return all joined records. If no joined record is found, NULL will be returned.

Syntax

```
SELECT attr_expr_list FROM table_reference
  FULL OUTER JOIN table_reference ON join_condition;
```

Keyword

FULL OUTER JOIN: Matches all records in the left and right tables. If no record is matched, NULL is returned.

Precautions

The to-be-joined table must exist. Otherwise, an error is reported.

Example

To join all records from the right table and the left table and return all joined records, run the following statement. If no joined record is found, NULL will be returned.

```
SELECT student_info.name, course_info.courseName FROM student_info
  FULL OUTER JOIN course_info ON (student_info.courseId = course_info.courseId);
```


2.34.5 IMPLICIT JOIN

Function

This statement has the same function as INNER JOIN, that is, the result set that meet the WHERE condition is returned. However, IMPLICIT JOIN does not use the condition specified by JOIN.

Syntax

```
SELECT table_reference.col_name, table_reference.col_name, ... FROM table_reference, table_reference
  WHERE table_reference.col_name = table_reference.col_name;
```

Keyword

The keyword WHERE achieves the same function as JOIN...ON... and the mapped records will be returned. **Syntax** shows the WHERE filtering according to an equation. The WHERE filtering according to an inequation is also supported.

Precautions

- The to-be-joined table must exist. Otherwise, an error is reported.
- The statement of IMPLICIT JOIN does not contain keywords JOIN...ON.... Instead, the WHERE clause is used as the condition to join two tables.

Example

To return the student names and course names that match **courseId**, run the following statement:

```
SELECT student_info.name, course_info.courseName FROM student_info,course_info
  WHERE student_info.courseId = course_info.courseId;
```

2.34.6 Cartesian JOIN

Function

Cartesian JOIN joins each record of table A with all records in table B. For example, if there are *m* records in table A and *n* records in table B, *m* x *n* records will be generated by Cartesian JOIN.

Syntax

```
SELECT attr_expr_list FROM table_reference
  CROSS JOIN table_reference ON join_condition;
```

Keyword

The join_condition is the condition for joining. If join_condition is always true, for example **1=1**, the join is Cartesian JOIN. Therefore, the number of records output by Cartesian join is equal to the product of the number of records in the joined table. If Cartesian join is required, use the special keyword CROSS JOIN. CROSS JOIN is the standard way to calculate Cartesian product.

Precautions

The to-be-joined table must exist. Otherwise, an error is reported.

Example

To return all the JOIN results of the student name and course name from the **student_info** and **course_info** tables, run the following statement:

```
SELECT student_info.name, course_info.courseName FROM student_info
  CROSS JOIN course_info ON (1 = 1);
```

2.34.7 LEFT SEMI JOIN

Function

This statement is used to query the records that meet the JOIN condition from the left table.

Syntax

```
SELECT attr_expr_list FROM table_reference
  LEFT SEMI JOIN table_reference ON join_condition;
```

Keyword

LEFT SEMI JOIN: Indicates to only return the records from the left table. LEFT SEMI JOIN can be achieved by nesting subqueries in LEFT SEMI JOIN, WHERE...IN, or WHERE EXISTS. LEFT SEMI JOIN returns the records that meet the JOIN condition from the left table, while LEFT OUTER JOIN returns all the records from the left table or NULL if no records that meet the JOIN condition are found.

Precautions

- The to-be-joined table must exist. Otherwise, an error is reported.
- he fields in attr_expr_list must be the fields in the left table. Otherwise, an error is reported.

Example

To return the names of students who select the courses and the course IDs, run the following statement:

```
SELECT student_info.name, student_info.courseId FROM student_info
  LEFT SEMI JOIN course_info ON (student_info.courseId = course_info.courseId);
```

2.34.8 NON-EQUIJOIN

Function

This statement is used to join multiple tables using unequal values and return the result set that meet the condition.

Syntax

```
SELECT attr_expr_list FROM table_reference
  JOIN table reference ON non_equi_join_condition;
```

Keyword

The **non_equi_join_condition** is similar to **join_condition**. The only difference is that the JOIN condition is inequation.

Precautions

The to-be-joined table must exist. Otherwise, an error is reported.

Example

To return all the pairs of different student names from the **student_info_1** and **student_info_2** tables, run the following statement:

```
SELECT student_info_1.name, student_info_2.name FROM student_info_1
  JOIN student_info_2 ON (student_info_1. name <> student_info_2. name);
```

2.35 Subquery

2.35.1 Subquery Nested by WHERE

Function

Subqueries are nested in the WHERE clause, and the subquery result is used as the filtering condition.

Syntax

```
SELECT [ALL | DISTINCT] attr_expr_list FROM table_reference
  WHERE {col_name operator (sub_query) | [NOT] EXISTS sub_query};
```

Keyword

- All is used to return repeated rows. By default, all repeated rows are returned. It is followed by asterisks (*) only. Otherwise, an error will occur.
- DISTINCT is used to remove the repeated line from the result.
- The subquery results are used as the filter condition in the subquery nested by WHERE.
- The operator includes the equation and inequation operators, and IN, NOT IN, EXISTS, and NOT EXISTS operators.
  - If the operator is IN or NOT IN, the returned records are in a single column.
  - If the operator is EXISTS or NOT EXISTS, the subquery must contain WHERE. If any a field in the subquery is the same as that in the external query, add the table name before the field in the subquery.

Precautions

The to-be-queried table must exist. If this statement is used to query a table that does not exist, an error is reported.

Example

To query the courseId of Biology from the course_info table, and then query the student name matched the courseId from the student_info table, run the following statement:

```
SELECT name FROM student_info
  WHERE courseId = (SELECT courseId FROM course_info WHERE courseName = 'Biology');
```

2.35.2 Subquery Nested by FROM

Function

This statement is used to nest subquery by FROM and use the subquery results as the data source of the external SELECT statement.

Syntax

```
SELECT [ALL | DISTINCT] attr_expr_list FROM (sub_query) [alias];
```

Keyword

- All is used to return repeated rows. By default, all repeated rows are returned. It is followed by asterisks (*) only. Otherwise, an error will occur.
- DISTINCT is used to remove the repeated line from the result.

Precautions

- The to-be-queried table must exist. If this statement is used to query a table that does not exist, an error is reported.
- The subquery nested in FROM must have an alias. The alias must be specified before the running of the statement. Otherwise, an error is reported. It is advised to specify a unique alias.
- The subquery results sequent to FROM must be followed by the specified alias. Otherwise, an error is reported.

Example

To return the names of students who select the courses in the **course_info** table and remove the repeated records using DISTINCT, run the following statement:

```
SELECT DISTINCT name FROM (SELECT name FROM student_info
  JOIN course_info ON student_info.courseId = course_info.courseId) temp;
```

2.35.3 Subquery Nested by HAVING

Function

This statement is used to embed a subquery in the HAVING clause. The subquery result is used as a part of the HAVING clause.

Syntax

```
SELECT [ALL | DISTINCT] attr_expr_list FROM table_reference
  GROUP BY groupby_expression
  HAVING aggregate_func(col_name) operator (sub_query);
```

Keyword

- All is used to return repeated rows. By default, all repeated rows are returned. It is followed by asterisks (*) only. Otherwise, an error will occur.
- DISTINCT is used to remove the repeated line from the result.
- The **groupby_expression** can contain a single field or multiple fields, and also can call aggregate functions or string functions.
- The operator includes the equation and inequation operators, and IN and NOT IN operators.

Precautions

- The to-be-queried table must exist. If this statement is used to query a table that does not exist, an error is reported.
- The sequence of **sub_query** and the aggregate function cannot be changed.

Example

To group the **student_info** table according to the name field, count the records of each group, and return the number of records in which the name fields in the **student_info** table equal to the name fields in the **course_info** table if the two tables have the same number of records, run the following statement:

```
SELECT name FROM student_info
  GROUP BY name
  HAVING count(name) = (SELECT count(*) FROM course_info);
```

2.35.4 Multi-Layer Nested Subquery

Function

This statement is used to nest queries in the subquery.

Syntax

```
SELECT attr_expr FROM ( SELECT attr_expr FROM ( SELECT attr_expr FROM... ... ) [alias] ) [alias];
```

Keyword

- All is used to return repeated rows. By default, all repeated rows are returned. It is followed by asterisks (*) only. Otherwise, an error will occur.
- DISTINCT is used to remove the repeated line from the result.

Precautions

- The to-be-queried table must exist. If this statement is used to query a table that does not exist, an error is reported.
- The alias of the subquery must be specified in the nested query. Otherwise, an error is reported.

- The alias must be specified before the running of the statement. Otherwise, an error is reported. It is advised to specify a unique alias.

Example

To return the name field from the **user_info** table after three queries, run the following statement:

```
SELECT name FROM ( SELECT name, acc_num FROM ( SELECT name, acc_num, password FROM ( SELECT name, acc_num, password, bank_acc FROM user_info) a ) b ) c;
```

2.36 Alias

2.36.1 AS for Table

Function

This statement is used to specify an alias for a table or the subquery result.

Syntax

```
SELECT attr_expr_list FROM table_reference [AS] alias;
```

Keyword

- table_reference: Can be a table, view, or subquery.
- As: Is used to connect to table_reference and alias. Whether this keyword is added or not does not affect the command execution result.

Precautions

- The to-be-queried table must exist. Otherwise, an error is reported.
- The alias must be specified before execution of the statement. Otherwise, an error is reported. You are advised to specify a unique alias.

Example

- To specify alias **n** for table **simple_table** and visit the name field in table **simple_table** by using n.name, run the following statement:
  ```
  SELECT n.score FROM simple_table n WHERE n.name = "leilei";
  ```
- To specify alias **m** for the subquery result and return all the query results using **SELECT * FROM m**, run the following statement:
  ```
  SELECT * FROM (SELECT * FROM simple_table WHERE score > 90) AS m;
  ```

2.36.2 AS for Column

Function

This statement is used to specify an alias for a column.

Syntax

```
SELECT attr_expr [AS] alias, attr_expr [AS] alias, ... FROM table_reference;
```

Keyword

- alias: gives an alias for the **attr_expr** field.
- AS: Whether to add AS does not affect the result.

Precautions

- The to-be-queried table must exist. Otherwise, an error is reported.
- The alias must be specified before execution of the statement. Otherwise, an error is reported. You are advised to specify a unique alias.

Example

Run **SELECT name AS n FROM simple_table WHERE score > 90** to obtain the subquery result. The alias **n** for **name** can be used by external SELECT statement.

```
SELECT n FROM (SELECT name AS n FROM simple_table WHERE score > 90) m WHERE n = "xiaoming";
```

2.37 Set Operations

2.37.1 UNION

Function

This statement is used to return the union set of multiple query results.

Syntax

```
select_statement UNION [ALL] select_statement;
```

Keyword

UNION: The set operation is used to join the head and tail of a table based on certain conditions. The number of columns returned by each SELECT statement must be the same. The column type and column name may not be the same.

Precautions

- By default, the repeated records returned by UNION are removed. The repeated records returned by UNION ALL are not removed.
- Do not add brackets between multiple set operations, such as UNION, INTERSECT, and EXCEPT. Otherwise, an error is reported.

Example

To return the union set of the query results of the **SELECT * FROM student _1** and **SELECT * FROM student _2** commands with the repeated records removed, run the following statement:

```
SELECT * FROM student_1 UNION SELECT * FROM student_2;
```


2.37.2 INTERSECT

Function

This statement is used to return the intersection set of multiple query results.

Syntax

```
select_statement INTERSECT select_statement;
```

Keyword

INTERSECT returns the intersection of multiple query results. The number of columns returned by each SELECT statement must be the same. The column type and column name may not be the same. By default, INTERSECT deduplication is used.

Precautions

Do not add brackets between multiple set operations, such as UNION, INTERSECT, and EXCEPT. Otherwise, an error is reported.

Example

To return the intersection set of the query results of the **SELECT * FROM student _1** and **SELECT * FROM student _2** commands with the repeated records removed, run the following statement:

```
SELECT * FROM student _1 INTERSECT SELECT * FROM student _2;
```

2.37.3 EXCEPT

Function

This statement is used to return the difference set of two query results.

Syntax

```
select_statement EXCEPT select_statement;
```

Keyword

EXCEPT minus the sets. A EXCEPT B indicates to remove the records that exist in both A and B from A and return the results. The repeated records returned by EXCEPT are not removed by default. The number of columns returned by each SELECT statement must be the same. The types and names of columns do not have to be the same.

Precautions

Do not add brackets between multiple set operations, such as UNION, INTERSECT, and EXCEPT. Otherwise, an error is reported.

Example

To remove the records that exist in both **SELECT * FROM student_1** and **SELECT * FROM student_2** from **SELECT * FROM student_1** and return the results, run the following statement:

```
SELECT * FROM student_1 EXCEPT SELECT * FROM student_2;
```

2.38 WITH...AS

Function

This statement is used to define the common table expression (CTE) using WITH...AS to simplify the query and make the result easier to read and maintain.

Syntax

```
WITH cte_name AS (select_statement) sql_containing_cte_name;
```

Keyword

- cte_name: Name of a public expression. The name must be unique.
- select_statement: complete SELECT clause.
- sql_containing_cte_name: SQL statement containing the defined common expression.

Precautions

- A CTE must be used immediately after it is defined. Otherwise, the definition becomes invalid.
- Multiple CTEs can be defined by WITH at a time. The CTEs are separated by commas and the CTEs defined later can quote the CTEs defined earlier.

Example

Define **SELECT courseId FROM course_info WHERE courseName = 'Biology'** as CTE **nv** and use **nv** as the SELECT statement in future queries.

```
WITH nv AS (SELECT courseId FROM course_info WHERE courseName = 'Biology') SELECT DISTINCT courseId FROM nv;
```

2.39 CASE...WHEN

2.39.1 Basic CASE Statement

Function

This statement is used to display **result_expression** according to the joined results of **input_expression** and **when_expression**.

Syntax

```
CASE input_expression WHEN when_expression THEN result_expression [...n] [ELSE else_result_expression] END;
```

Keyword

CASE: Subquery is supported in basic CASE statement. However, input_expression and when_expression must be joinable.

Precautions

If there is no input_expression = when_expression with the TRUE value, else_result_expression will be returned when the ELSE clause is specified. If the ELSE clause is not specified, NULL will be returned.

Example

To return the name field and the character that is matched to id from the student table with the following matching rules, run the following statement:

- If id is 1, 'a' is returned.
- If id is 2, 'b' is returned.
- If id is 3, 'c' is returned.
- Otherwise, **NULL** is returned.

```
SELECT name, CASE id WHEN 1 THEN 'a' WHEN 2 THEN 'b' WHEN 3 THEN 'c' ELSE NULL END FROM student;
```

2.39.2 CASE Query Statement

Function

This statement is used to obtain the value of **boolean_expression** for each WHEN statement in a specified order. Then return the first **result_expression** with the value **TRUE** of **boolean_expression**.

Syntax

```
CASE WHEN boolean_expression THEN result_expression [...n] [ELSE else_result_expression] END;
```

Keyword

boolean_expression: can include subquery. However, the return value of boolean_expression can only be of Boolean type.

Precautions

If there is no Boolean_expression with the TRUE value, else_result_expression will be returned when the ELSE clause is specified. If the ELSE clause is not specified, NULL will be returned.

Example

To query the student table and return the related results for the name and score fields: EXCELLENT if the score is higher than 90, GOOD if the score ranges from 80 to 90, and BAD if the score is lower than 80, run the following statement:

```
SELECT name, CASE WHEN score >= 90 THEN 'EXCELLENT' WHEN 80 < score AND score < 90 THEN 'GOOD'
ELSE 'BAD' END AS level FROM student;
```

2.40 OVER Clause

Function

This statement is used together with the window function. The OVER statement is used to group data and sort the data within the group. The window function is used to generate serial numbers for values within the group.

Syntax

```
SELECT window_func(args) OVER
  ([PARTITION BY col_name, col_name, ...]
   [ORDER BY col_name, col_name, ...]
   [ROWS | RANGE BETWEEN (CURRENT ROW | (UNBOUNDED |[num]) PRECEDING)
  AND (CURRENT ROW | ( UNBOUNDED | [num]) FOLLOWING)]);
```

Keyword

- PARTITION BY: used to partition a table with one or multiple fields. Similar to GROUP BY, PARTITION BY is used to partition table by fields and each partition is a window. The window function can apply to the entire table or specific partitions. A maximum of 7,000 partitions can be created in a single table.
- ORDER BY: used to specify the order for the window function to obtain the value. ORDER BY can be used to sort table with one or multiple fields. The sorting order can be ascending (specified by **ASC**) or descending (specified by **DESC**). The window is specified by WINDOW. If the window is not specified, the default window is ROWS BETWEEN UNBOUNDED PRECEDING AND CURRENT ROW. In other words, the window starts from the head of the table or partition (if PARTITION BY is used in the OVER clause) to the current row.
- WINDOW: used to define the window by specifying a range of rows.
- CURRENT ROW: indicates the current row.
- num PRECEDING: used to specify the start of the defined window. The window starts from the num row precedes the current row.
- UNBOUNDED PRECEDING: used to indicate that there is no start of the window.
- num FOLLOWING: used to specify the end of the defined window. The window ends from the num row following the current row.
- UNBOUNDED FOLLOWING: used to indicate that there is no end of the window.
- The differences between ROWS BETWEEN... and RANGE BETWEEN... are as follows:

  - ROWS refers to the physical window. After the data is sorted, the physical window starts at the *n*th row in front of the current row and ends at the *m*th row following the current row.
  - RANGE refers to the logic window. The column of the logic window is determined by the values rather than the location of rows.
- The scenarios of the window are as follows:
  - The window only contains the current row.
    ```
    ROWS BETWEEN CURRENT ROW AND CURRENT ROW
    ```
  - The window starts from three rows precede the current row and ends at the fifth row follows the current row.
    ```
    ROWS BETWEEN 3 PRECEDING AND 5 FOLLOWING
    ```
  - The window starts from the beginning of the table or partition and ends at the current row.
    ```
    ROWS BETWEEN UNBOUNDED PRECEDING AND CURRENT ROW
    ```
  - The window starts from the current window and ends at the end of the table or partition.
    ```
    ROWS BETWEEN CURRENT ROW AND UNBOUNDED FOLLOWING
    ```
  - The window starts from the beginning of the table or partition and ends at the end of the table or partition.
    ```
    ROWS BETWEEN UNBOUNDED PRECEDING AND UNBOUNDED FOLLOWING
    ```

Precautions

The three options of the OVER clause are PARTITION BY, ORDER BY, and WINDOW. They are optional and can be used together. If the OVER clause is empty, the window is the entire table.

Example

To start the window from the beginning of the table or partition and end the window at the current row, sort the over_test table according to the id field, and return the sorted id fields and corresponding serial numbers, run the following statement:

```
SELECT id, count(id) OVER (ORDER BY id ROWS BETWEEN UNBOUNDED PRECEDING AND CURRENT ROW) FROM over_test;
```


3 Flink OpenSource SQL 1.12 Syntax Reference

3.1 Constraints and Definitions

3.1.1 Supported Data Types

STRING, BOOLEAN, BYTES, DECIMAL, TINYINT, SMALLINT, INTEGER, BIGINT, FLOAT, DOUBLE, DATE, TIME, TIMESTAMP, TIMESTAMP WITH LOCAL TIME ZONE, INTERVAL, ARRAY, MULTISET, MAP, ROW

3.1.2 Syntax

3.1.2.1 Data Definition Language (DDL)

3.1.2.1.1 CREATE TABLE

Syntax

```
CREATE TABLE table_name
  (
    { <column_definition> | <computed_column_definition> }[ , ...n]
    [ <watermark_definition> ]
    [ <table_constraint> ][ , ...n]
  )
  [COMMENT table_comment]
  [PARTITIONED BY (partition_column_name1, partition_column_name2, ...)]
  WITH (key1=val1, key2=val2, ...)

<column_definition>:
  column_name column_type [ <column_constraint> ] [COMMENT column_comment]

<column_constraint>:
  [CONSTRAINT constraint_name] PRIMARY KEY NOT ENFORCED

<table_constraint>:
  [CONSTRAINT constraint_name] PRIMARY KEY (column_name, ...) NOT ENFORCED

<computed_column_definition>:
```



```
  column_name AS computed_column_expression [COMMENT column_comment]

<watermark_definition>:
  WATERMARK FOR rowtime_column_name AS watermark_strategy_expression

<source_table>:
  [catalog_name.][db_name.]table_name
```

Function

Create a table with a specified name.

Description

COMPUTED COLUMN

A computed column is a virtual column generated using **column_name AS computed_column_expression**. A computed column evaluates an expression that can reference other columns declared in the same table. The column itself is not physically stored within the table. A computed column could be defined using **cost AS price * quantity**. This expression can contain any combination of physical columns, constants, functions, or variables, but cannot contain any subquery.

In Flink, a computed column is used to define the time attribute in **CREATE TABLE** statements. A processing time attribute can be defined easily via **proc AS PROCTIME()** using the system's **PROCTIME()** function. The event time column may be obtained from an existing field. In this case, you can use the computed column to obtain event time. For example, if the original field is not of the **TIMESTAMP(3)** type or is nested in a JSON string, you can use computed columns.

Note:

- An expression that defines a computed column in a source table is calculated after data is read from the data source. The column can be used in the **SELECT** statement.
- A computed column cannot be the target of an **INSERT** statement. In an **INSERT** statement, the schema of the **SELECT** statement must be the same as that of the target table that does not have a computed column.

WATERMARK

The **WATERMARK** clause defines the event time attribute of a table and takes the form **WATERMARK FOR rowtime_column_name AS watermark_strategy_expression**.

rowtime_column_name defines an existing column that is marked as the event time attribute of the table. The column must be of the **TIMESTAMP(3)** type and must be the top-level column in the schema. It can also be a computed column.

watermark_strategy_expression defines the watermark generation strategy. It allows arbitrary non-query expressions, including computed columns, to calculate the watermark. The expression return type must be **TIMESTAMP(3)**, which represents the timestamp since the Epoch. The returned watermark will be emitted only if it is non-null and its value is greater than the previously emitted local watermark (to preserve the contract of ascending watermarks). The watermark generation expression is evaluated by the framework for every record.

The framework will periodically emit the largest generated watermark. If the current watermark is still identical to the previous one, or is null, or the value of the returned watermark is smaller than that of the last emitted one, then no new watermark will be emitted. A watermark is emitted in an interval defined by **pipeline.auto-watermark-interval**. If the watermark interval is 0 ms, a watermark will be emitted per record if it is not null and greater than the last emitted one.

When using event time semantics, tables must contain an event time attribute and watermark strategy.

Flink provides several commonly used watermark strategies.

- Strictly ascending timestamps: **WATERMARK FOR rowtime_column AS rowtime_column**

  Emits a watermark of the maximum observed timestamp so far. Rows that have a timestamp bigger than the maximum timestamp are not late.

- Ascending timestamps: **WATERMARK FOR rowtime_column AS rowtime_column - INTERVAL '0.001' SECOND**

  Emits a watermark of the maximum observed timestamp so far minus 1. Rows that have a timestamp bigger than or equal to the maximum timestamp are not late.

- Bounded out-of-order timestamps: **WATERMARK FOR rowtime_column AS rowtime_column - INTERVAL 'string' timeUnit**

  Emits a watermark, which is the maximum observed timestamp minus the specified delay, for example, **WATERMARK FOR rowtime_column AS rowtime_column - INTERVAL '5' SECOND** is a 5-second delayed watermark strategy.

  ```
  CREATE TABLE Orders (
      user BIGINT,
      product STRING,
      order_time TIMESTAMP(3),
      WATERMARK FOR order_time AS order_time - INTERVAL '5' SECOND
  ) WITH ( . . . );
  ```

PRIMARY KEY

The primary key constraint is a hint for Flink to leverage for optimizations. It tells that a column or a set of columns of a table or a view are unique and they do not contain null. Neither of columns in a primary can be nullable. The primary key therefore uniquely identifies a row in a table.

The primary key constraint can be either declared along with a column definition (a column constraint) or as a single line (a table constraint). For both cases, it should only be declared as a singleton. If you define multiple primary key constraints at the same time, an exception would be thrown.

Validity Check

SQL standard specifies that a constraint can either be **ENFORCED** or **NOT ENFORCED**. This controls if the constraint checks are performed on the incoming/outgoing data. Flink does not own the data and therefore the only mode we want to support is the **NOT ENFORCED** mode. It is up to the user to ensure that the query enforces key integrity.

Flink will assume correctness of the primary key by assuming that the columns nullability is aligned with the columns in the primary key. Connectors should ensure those are aligned.

Note: In a **CREATE TABLE** statement, creating a primary key constraint will alter the columns nullability, which means, a column with a primary key constraint is not nullable.

PARTITIONED BY

Partition the created table by the specified columns. A directory is created for each partition if this table is used as a file system sink.

WITH OPTIONS

Table properties used to create a table source/sink. The properties are usually used to find and create the underlying connector.

The key and value of expression **key1=val1** should both be string literal.

Note: The table registered with the **CREATE TABLE** statement can be used as both the table source and table sink. We cannot decide if it is used as a source or sink until it is referenced in the DMLs.

3.1.2.1.2 CREATE VIEW

Syntax

```
CREATE VIEW [IF NOT EXISTS] view_name
  [{columnName [, columnName ]* }] [COMMENT view_comment]
  AS query_expression
```

Function

Create a view with multiple layers nested in it to simplify the development process.

Description

IF NOT EXISTS

If the view already exists, nothing happens.

Example

Create a view named **viewName**.

```
create view viewName as select * from dataSource
```

3.1.2.1.3 CREATE FUNCTION

Syntax

```
CREATE FUNCTION
  [IF NOT EXISTS] function_name
  AS identifier [LANGUAGE JAVA|SCALA]
```


Function

Create a user-defined function.

For details about how to create a user-defined function, see **User-Defined Functions (UDFs)**.

Description

IF NOT EXISTS

If the function already exists, nothing happens.

LANGUAGE JAVA|SCALA

The language tag is used to instruct Flink runtime how to execute the function. Currently, only **JAVA** and **SCALA** language tags are supported, the default language for a function is **JAVA**.

Example

Create a function named **STRINGBACK**.

```
create function STRINGBACK as 'com.dli.StringBack'
```

3.1.2.2 Data Manipulation Language (DML)

DML Statements

Syntax

```
INSERT INTO table_name [PARTITION part_spec] query

part_spec:  (part_col_name1=val1 [, part_col_name2=val2, ...])

query:
  values
  | {
      select
      | selectWithoutFrom
      | query UNION [ ALL ] query
      | query EXCEPT query
      | query INTERSECT query
    }
    [ ORDER BY orderItem [, orderItem ]* ]
    [ LIMIT { count | ALL } ]
    [ OFFSET start { ROW | ROWS } ]
    [ FETCH { FIRST | NEXT } [ count ] { ROW | ROWS } ONLY]

orderItem:
  expression [ ASC | DESC ]

select:
  SELECT [ ALL | DISTINCT ]
  { * | projectItem [, projectItem ]* }
  FROM tableExpression
  [ WHERE booleanExpression ]
  [ GROUP BY { groupItem [, groupItem ]* } ]
  [ HAVING booleanExpression ]
  [ WINDOW windowName AS windowSpec [, windowName AS windowSpec ]* ]

selectWithoutFrom:
  SELECT [ ALL | DISTINCT ]
```



```
  { * | projectItem [, projectItem ]* }

projectItem:
  expression [ [ AS ] columnAlias ]
  | tableAlias . *

tableExpression:
  tableReference [, tableReference ]*
  | tableExpression [ NATURAL ] [ LEFT | RIGHT | FULL ] JOIN tableExpression [ joinCondition ]

joinCondition:
  ON booleanExpression
  | USING '(' column [, column ]* ')'

tableReference:
  tablePrimary
  [ matchRecognize ]
  [ [ AS ] alias [ '(' columnAlias [, columnAlias ]* ')' ] ]

tablePrimary:
  [ TABLE ] [ [ catalogName . ] schemaName . ] tableName
  | LATERAL TABLE '(' functionName '(' expression [, expression ]* ')' ')'
  | UNNEST '(' expression ')'

values:
  VALUES expression [, expression ]*

groupItem:
  expression
  | '(' ')'
  | '(' expression [, expression ]* ')'
  | CUBE '(' expression [, expression ]* ')'
  | ROLLUP '(' expression [, expression ]* ')'
  | GROUPING SETS '(' groupItem [, groupItem ]* ')'

windowRef:
    windowName
  | windowSpec

windowSpec:
    [ windowName ]
    '('
    [ ORDER BY orderItem [, orderItem ]* ]
    [ PARTITION BY expression [, expression ]* ]
    [
        RANGE numericOrIntervalExpression {PRECEDING}
      | ROWS numericExpression {PRECEDING}
    ]
    ')'

matchRecognize:
      MATCH_RECOGNIZE '('
      [ PARTITION BY expression [, expression ]* ]
      [ ORDER BY orderItem [, orderItem ]* ]
      [ MEASURES measureColumn [, measureColumn ]* ]
      [ ONE ROW PER MATCH ]
      [ AFTER MATCH
            ( SKIP TO NEXT ROW
            | SKIP PAST LAST ROW
            | SKIP TO FIRST variable
            | SKIP TO LAST variable
            | SKIP TO variable )
      ]
      PATTERN '(' pattern ')'
      [ WITHIN intervalLiteral ]
      DEFINE variable AS condition [, variable AS condition ]*
      ')'

measureColumn:
```



```
    expression AS alias

pattern:
    patternTerm [ '|' patternTerm ]*

patternTerm:
    patternFactor [ patternFactor ]*

patternFactor:
    variable [ patternQuantifier ]

patternQuantifier:
    '*'
  | '*?'
  | '+'
  | '+?'
  | '?'
  | '??'
  | '{' { [ minRepeat ], [ maxRepeat ] } '}' ['?']
  | '{' repeat '}'
```

Precautions

Flink SQL uses a lexical policy for identifier (table, attribute, function names) similar to Java:

- The case of identifiers is preserved whether they are quoted.
- Identifiers are matched case-sensitively.
- Unlike Java, back-ticks allow identifiers to contain non-alphanumeric characters (for example, **SELECT a AS `my field` FROM t**).

String literals must be enclosed in single quotes (for example, **SELECT'Hello World'**). Duplicate a single quote for escaping (for example, **SELECT 'It''s me.'**). Unicode characters are supported in string literals. If explicit Unicode points are required, use the following syntax:

- Use the backslash (\) as an escaping character (default): **SELECT U&'\263A'**
- Use a custom escaping character: **SELECT U&'#263A' UESCAPE '#'**

3.2 Overview

This section describes the Flink open source SQL 1.12 syntax supported by DLI. For details about the parameters and examples, see the syntax description.

Creating Tables

Table 3-1 Syntax for creating tables

Classification	Function
Creating a source table	DataGen Source Table
	GaussDB(DWS) Source Table
	HBase Source Table
	JDBC Source Table

Classification	Function
	Kafka Source Table
	MySQL CDC Source Table
	Postgres CDC Source Table
	Redis Source Table
	Upsert Kafka Source Table
Creating a result table	BlackHole Result Table
	ClickHouse Result Table
	GaussDB(DWS) Result Table
	Elasticsearch Result Table
	HBase Result Table
	JDBC Result Table
	Kafka Result Table
	Print Result Table
	Redis Result Table
	Upsert Kafka Result Table
Creating a dimension table	GaussDB(DWS) Dimension Table
	HBase Dimension Table
	JDBC Dimension Table
	Redis Dimension Table
Format	Avro
	Canal
	Confluent Avro
	CSV
	Debezium
	JSON
	Maxwell
	Raw

3.3 DDL Syntax

3.3.1 Creating Source Tables

3.3.1.1 DataGen Source Table

Function

DataGen is used to generate random data for debugging and testing.

Prerequisites

None

Precautions

- When you create a DataGen table, the table field type cannot be Array, Map, or Row. You can use **COMPUTED COLUMN** in **CREATE TABLE** to construct similar functions.
- When creating a Flink OpenSource SQL job, you need to set **Flink Version** to **1.12** on the **Running Parameters** tab of the job editing page, select **Save Job Log**, and set the OBS bucket for saving job logs.

Syntax

```
create table dataGenSource(
  attr_name attr_type
  (',' attr_name attr_type)*
  (',' WATERMARK FOR rowtime_column_name AS watermark-strategy_expression)
)
with (
  'connector' = 'datagen'
);
```

Parameters

Table 3-2 Parameter description

Parameter	Mandatory	Default Value	Data Type	Description
connector	Yes	None	String	Connector to be used. Set this parameter to **datagen**.
rows-per-second	No	10000	Long	Number of rows generated per second, which is used to control the emit rate.

Parameter	Mandatory	Default Value	Data Type	Description
fields.#.kind	No	random	String	Generator of the # field. The # field must be an actual field in the DataGen table. Replace # with the corresponding field name. The meanings of the # field for other parameters are the same. The value can be **sequence** or **random**. • **random** is the default generator. You can use the **fields.#.max** and **fields.#.min** parameters to specify the maximum and minimum values that are randomly generated. If the specified field type is char, varchar, or string, you can also use the **fields.#.length** field to specify the length. A random generator is an unbounded generator. • Sequence generator. You can use **fields.#.start** and **fields.#.end** to specify the start and end values of a sequence. A sequence generator is a bounded generator. When the sequence number reaches the end value, the reading ends.
fields.#.min	No	Minimum value of the field type specified by #	Field type specified by #	This parameter is valid only when **fields.#.kind** is set to **random**. Minimum value of the random generator. It applies only to numeric field types specified by #.
fields.#.max	No	Maximum value of the field type specified by #	Field type specified by #	This parameter is valid only when **fields.#.kind** is set to **random**. Maximum value of the random generator. It applies only to numeric field types specified by #.
fields.#.length	No	100	Integer	This parameter is valid only when **fields.#.kind** is set to **random**. Length of the characters generated by the random generator. It applies only to char, varchar, and string types specified by #.

Parameter	Mandatory	Default Value	Data Type	Description
fields.#.start	No	None	Field type specified by #	This parameter is valid only when **fields.#.kind** is set to **sequence**. Start value of a sequence generator.
fields.#.end	No	None	Field type specified by #	This parameter is valid only when **fields.#.kind** is set to **sequence**. End value of a sequence generator.

Example

Create a Flink OpenSource SQL job. Run the following script to generate random data through the DataGen table and output the data to the Print result table.

When you create a job, set **Flink Version** to **1.12** on the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs.

```
create table dataGenSOurce(
  user_id string,
  amount int
) with (
  'connector' = 'datagen',
  'rows-per-second' = '1', --Generates a piece of data per second.
  'fields.user_id.kind' = 'random', --Specifies a random generator for the user_id field.
  'fields.user_id.length' = '3' --Limits the length of user_id to 3.
);

create table printSink(
  user_id string,
  amount int
) with (
  'connector' = 'print'
);

insert into printSink select * from dataGenSOurce;
```

After the job is submitted, the job status changes to **Running**. You can perform the following operations to view the output result:

- Method 1:
  a. Log in to the DLI console. In the navigation pane, choose **Job Management** > **Flink Jobs**.
  b. Locate the row that contains the target Flink job, and choose **More** > **FlinkUI** in the **Operation** column.
  c. On the Flink UI, choose **Task Managers**, click the task name, and select **Stdout** to view job logs.
- Method 2: If you select **Save Job Log** on the **Running Parameters** tab before submitting the job, perform the following operations:

a. Log in to the DLI console. In the navigation pane, choose **Job Management** > **Flink Jobs**.
b. Click the name of the corresponding Flink job, choose **Run Log**, click **OBS Bucket**, and locate the folder of the log you want to view according to the date.
c. Go to the folder of the date, find the folder whose name contains **taskmanager**, download the **taskmanager.out** file, and view result logs.

3.3.1.2 GaussDB(DWS) Source Table

Function

DLI reads data of Flink jobs from GaussDB(DWS). GaussDB(DWS) database kernel is compliant with PostgreSQL. The PostgreSQL database can store data of more complex types and deliver space information services, multi-version concurrent control (MVCC), and high concurrency. It applies to location applications, financial insurance, and e-Commerce.

GaussDB(DWS) is an online data processing database based on the cloud infrastructure and platform and helps you mine and analyze massive sets of data.

For more information about DWS, see **Data Warehouse Service (DWS)**

Prerequisites

- You have created a GaussDB(DWS) cluster.

  For details about how to create a GaussDB(DWS) cluster, see **Creating a Cluster** in the *Data Warehouse Service Management Guide*.
- You have created a GaussDB(DWS) database table.
- An enhanced datasource connection has been created for DLI to connect to GaussDB(DWS) clusters, so that jobs can run on the dedicated queue of DLI and you can set the security group rules as required.
  - For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.
  - For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.
- In Flink cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

  For details about datasource authentication, see **Introduction to Datasource Authentication**.

Precautions

When creating a Flink OpenSource SQL job, you need to set **Flink Version** to **1.12** on the **Running Parameters** tab of the job editing page, select **Save Job Log**, and set the OBS bucket for saving job logs.

Syntax

```
create table dwsSource (
  attr_name attr_type
```



```
  (',' attr_name attr_type)*
  (','PRIMARY KEY (attr_name, ...) NOT ENFORCED)
  (',' watermark for rowtime_column_name as watermark-strategy_expression)
)
with (
  'connector' = 'gaussdb',
  'url' = '',
  'table-name' = '',
  'username' = '',
  'password' = ''
);
```

Parameters

Table 3-3 Parameter description

Parameter	Mandatory	Default Value	Data Type	Description
connector	Yes	None	String	Connector to be used. Set this parameter to **gaussdb**.
url	Yes	None	String	JDBC connection address. Set the IP address in this parameter to the internal IP address of GaussDB(DWS). If you use the gsjdbc4 driver, set the value in jdbc:postgresql://${ip}:${port}/${dbName} format. If you use the gsjdbc200 driver, set the value in jdbc:gaussdb://${ip}:${port}/${dbName} format.
table-name	Yes	None	String	Name of the GaussDB(DWS) table to be operated. If the GaussDB(DWS) table is in a schema, refer to the description of **GaussDB(DWS) table in a schema**.
driver	No	org.postgresql.Driver	String	JDBC connection driver. The default value is **org.postgresql.Driver**. • If you use the gsjdbc4 driver for connection, set this parameter to **org.postgresql.Driver**. • If you use the gsjdbc200 driver for connection, set this parameter to **com.huawei.gauss200.jdbc.Driver**.
username	No	None	String	Username for GaussDB(DWS) database authentication. This parameter must be configured in pair with **password**.
password	No	None	String	Password for GaussDB(DWS) database authentication. This parameter must be configured in pair with **username**.

Parameter	Mandatory	Default Value	Data Type	Description
scan.partition.column	No	None	String	Name of the column used to partition the input. Note: This parameter must be used together with **scan.partition.lower-bound**, **scan.partition.upper-bound**, and **scan.partition.num**.
scan.partition.lower-bound	No	None	Integer	Lower bound of values to be fetched for the first partition. This parameter must be used together with **scan.partition.column**, **scan.partition.upper-bound**, and **scan.partition.num**.
scan.partition.upper-bound	No	None	Integer	Upper bound of values to be fetched for the last partition. This parameter must be used together with **scan.partition.column**, **scan.partition.lower-bound**, and **scan.partition.num**.
scan.partition.num	No	None	Integer	Number of partitions to be created. This parameter must be used together with **scan.partition.column**, **scan.partition.upper-bound**, and **scan.partition.upper-bound**.
scan.fetch-size	No	0	Integer	Number of rows fetched from the database each time. The default value is **0**, indicating that the number of rows is not limited.
pwd_auth_name	No	None	String	Name of password datasource authentication created on DLI. If datasource authentication is used, you do not need to set the username and password for jobs.

Example

In this example, data is read from the GaussDB(DWS) data source and written to the Print result table. The procedure is as follows:

1. Create a table named **dws_order** in GaussDB(DWS).

```
create table public.dws_order(
  order_id VARCHAR,
  order_channel VARCHAR,
  order_time VARCHAR,
  pay_amount FLOAT8,
  real_pay FLOAT8,
  pay_time VARCHAR,
  user_id VARCHAR,
```

```
  user_name VARCHAR,
  area_id VARCHAR);
```

Insert data into the **dws_order** table.

```
insert into public.dws_order
  (order_id,
  order_channel,
  order_time,
  pay_amount,
  real_pay,
  pay_time,
  user_id,
  user_name,
  area_id) values
  ('202103241000000001', 'webShop', '2021-03-24 10:00:00', '100.00', '100.00', '2021-03-24 10:02:03',
'0001', 'Alice', '330106'),
  ('202103251202020001', 'miniAppShop', '2021-03-25 12:02:02', '60.00', '60.00', '2021-03-25 12:03:00',
'0002', 'Bob', '330110');
```

2. Create an enhanced datasource connection in the VPC and subnet where GaussDB(DWS) locates, and bind the connection to the required Flink elastic resource pool. For details, see **Enhanced Datasource Connections**.
3. Set GaussDB(DWS) security groups and add inbound rules to allow access from the Flink queue. Test the connectivity using the GaussDB(DWS) address by referring to **Testing Address Connectivity**. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.
4. Create a Flink OpenSource SQL job. Enter the following job script and submit the job. The job script uses the GaussDB(DWS) data source and the Print result table.

   When you create a job, set **Flink Version** to **1.12** on the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs. **Change the values of the parameters in bold as needed in the following script.**

```
CREATE TABLE dwsSource (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'gaussdb',
  'url' = 'jdbc:postgresql://DWSIP:DWSPort/DWSdbName',
  'table-name' = 'dws_order',
  'driver' = 'org.postgresql.Driver',
  'username' = 'DWSUserName',
  'password' = 'DWSPassword'
);

CREATE TABLE printSink (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'print'
);
```



```
insert into printSink select * from dwsSource;
```

5. Perform the following operations to view the data result in the **taskmanager.out** file:

   a. Log in to the DLI console. In the navigation pane, choose **Job Management** > **Flink Jobs**.

   b. Click the name of the corresponding Flink job, choose **Run Log**, click **OBS Bucket**, and locate the folder of the log you want to view according to the date.

   c. Go to the folder of the date, find the folder whose name contains **taskmanager**, download the **taskmanager.out** file, and view result logs.

   The data result is as follows:

```
+I(20210324100000001,webShop,2021-03-24 10:00:00,100.0,100.0,2021-03-24
10:02:03,0001,Alice,330106)
+I(20210325120202001,miniAppShop,2021-03-25 12:02:02,60.0,60.0,2021-03-25
12:03:00,0002,Bob,330110)
```

FAQ

- Q: What should I do if the job execution fails and the log contains the following error information?

```
java.io.IOException: unable to open JDBC writer
...
Caused by: org.postgresql.util.PSQLException: The connection attempt failed.
...
Caused by: java.net.SocketTimeoutException: connect timed out
```

  A: The datasource connection is not bound or the binding fails.

  – To reconfigure datasource connections, refer to **Enhanced Datasource Connection**. Rectify the fault by referring to **DLI Failed to Connect to GaussDB(DWS) Through an Enhanced Datasource Connection**.

- Q: How can I configure a GaussDB(DWS) table that is in a schema?

  A: The following provides an example of configuring the **dws_order** table in the **dbuser2** schema:

```
CREATE TABLE dwsSource (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'gaussdb',
  'url' = 'jdbc:postgresql://DWSIP:DWSPort/DWSdbName',
  'table-name' = 'dbuser2\".\"dws_order',
  'driver' = 'org.postgresql.Driver',
  'username' = 'DWSUserName',
  'password' = 'DWSPassword'
);
```


3.3.1.3 HBase Source Table

Function

Create a source stream to obtain data from HBase as input for jobs. HBase is a column-oriented distributed cloud storage system that features enhanced reliability, excellent performance, and elastic scalability. It applies to the storage of massive amounts of data and distributed computing. You can use HBase to build a storage system capable of storing TB- or even PB-level data. With HBase, you can filter and analyze data with ease and get responses in milliseconds, rapidly mining data value. DLI can read data from HBase for filtering, analysis, and data dumping.

Prerequisites

- An enhanced datasource connection has been created for DLI to connect to HBase, so that jobs can run on the dedicated queue of DLI and you can set the security group rules as required.
  - For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.
  - For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.
- If MRS HBase is used, IP addresses of all hosts in the MRS cluster have been added to host information of the enhanced datasource connection.

  .

  For details, see section "Modifying the Host Information" in the *Data Lake Insight User Guide*.
- In Flink cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

  For details about datasource authentication, see **Introduction to Datasource Authentication**.

Precautions

- When creating a Flink OpenSource SQL job, you need to set **Flink Version** to **1.12** on the **Running Parameters** tab of the job editing page, select **Save Job Log**, and set the OBS bucket for saving job logs.
- The column families in created HBase source table must be declared as the ROW type, the field names map the column family names, and the nested field names map the column qualifier names.

  There is no need to declare all the families and qualifiers in the schema. Users can declare what is used in the query. Except the ROW type fields, the single atomic type field (for example, STRING or BIGINT) will be recognized as the HBase rowkey. The rowkey field can be an arbitrary name, but should be quoted using backticks if it is a reserved keyword.

Syntax

```
create table hbaseSource (
  attr_name attr_type
  (',' attr_name attr_type)*
```



```
  (',' watermark for rowtime_column_name as watermark-strategy_expression)
  ','PRIMARY KEY (attr_name, ...) NOT ENFORCED)
)
with (
  'connector' = 'hbase-2.2',
  'table-name' = '',
  'zookeeper.quorum' = ''
);
```

Parameters

Table 3-4 Parameter description

Parameter	Mandatory	Default Value	Data Type	Description
connector	Yes	None	String	Connector to be used. Set this parameter to **hbase-2.2**.
table-name	Yes	None	String	Name of the HBase table to connect.
zookeeper.quorum	Yes	None	String	HBase ZooKeeper quorum, in the format of "ZookeeperAddress:ZookeeperPort". The following uses an MRS HBase cluster as an example to describe how to obtain the IP address and port number of ZooKeeper used by this parameter: ● On MRS Manager, choose **Cluster** and click the name of the desired cluster. Choose **Services** > **ZooKeeper** > **Instance**, and obtain the IP address of the ZooKeeper instance. ● On MRS Manager, choose **Cluster** and click the name of the desired cluster. Choose **Services** > **ZooKeeper** > **Configurations** > **All Configurations**, search for the **clientPort** parameter, and obtain its value, that is, the ZooKeeper port number.
zookeeper.znode.parent	No	/hbase	String	Root directory in ZooKeeper. The default value is **/hbase**.
null-string-literal	No	None	String	Representation for null values for string fields. HBase source encodes/decodes empty bytes as null values for all types except the string type.
krb_auth_name	No	None	String	Name of datasource authentication of the Kerberos type created on DLI.

Data Type Mapping

HBase stores all data as byte arrays. The data needs to be serialized and deserialized during read and write operations.

When serializing and de-serializing, Flink HBase connector uses utility class **org.apache.hadoop.hbase.util.Bytes** provided by HBase (Hadoop) to convert Flink data types to and from byte arrays.

Flink HBase connector encodes null values to empty bytes, and decode empty bytes to null values for all data types except the string type. For the string type, the null literal is determined by the **null-string-literal** option.

Table 3-5 Data type mapping

Flink SQL Type	HBase Conversion
CHAR/VARCHAR/STRING	byte[] toBytes(String s) String toString(byte[] b)
BOOLEAN	byte[] toBytes(boolean b) boolean toBoolean(byte[] b)
BINARY/VARBINARY	Returns byte[] as is.
DECIMAL	byte[] toBytes(BigDecimal v) BigDecimal toBigDecimal(byte[] b)
TINYINT	new byte[] { val } bytes[0] // returns first and only byte from bytes
SMALLINT	byte[] toBytes(short val) short toShort(byte[] bytes)
INT	byte[] toBytes(int val) int toInt(byte[] bytes)
BIGINT	byte[] toBytes(long val) long toLong(byte[] bytes)
FLOAT	byte[] toBytes(float val) float toFloat(byte[] bytes)
DOUBLE	byte[] toBytes(double val) double toDouble(byte[] bytes)
DATE	Stores the number of days since epoch as an int value.
TIME	Stores the number of milliseconds of the day as an int value.
TIMESTAMP	Stores the milliseconds since epoch as a long value.

Flink SQL Type	HBase Conversion
ARRAY	Not supported
MAP/MULTISET	Not supported
ROW	Not supported

Example

In this example, data is read from the HBase data source and written to the Print result table. The procedure is as follows (the HBase versions used in this example are 1.3.1, 2.1.1, and 2.2.3):

1. Create an enhanced datasource connection in the VPC and subnet where HBase locates, and bind the connection to the required Flink queue. For details, see **Enhanced Datasource Connections**. .
2. Set HBase cluster security groups and add inbound rules to allow access from the Flink job queue. Test the connectivity using the HBase address by referring to **Testing Address Connectivity**. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.
3. Use the HBase shell to create HBase table **order** that has only one column family **detail**. The creation statement is as follows:
   ```
   create 'order', {NAME => 'detail'}
   ```
4. Run the following command in the HBase shell to insert a data record:
   ```
   put 'order', '202103241000000001', 'detail:order_channel','webShop'
   put 'order', '202103241000000001', 'detail:order_time','2021-03-24 10:00:00'
   put 'order', '202103241000000001', 'detail:pay_amount','100.00'
   put 'order', '202103241000000001', 'detail:real_pay','100.00'
   put 'order', '202103241000000001', 'detail:pay_time','2021-03-24 10:02:03'
   put 'order', '202103241000000001', 'detail:user_id','0001'
   put 'order', '202103241000000001', 'detail:user_name','Alice'
   put 'order', '202103241000000001', 'detail:area_id','330106'
   ```
5. Create a Flink OpenSource SQL job. Enter the following job script and submit the job. The job script uses the HBase data source and the Print result table.

   When you create a job, set **Flink Version** to **1.12** on the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs.
   Change the values of the parameters in bold as needed in the following script.
   ```
   create table hbaseSource (
     order_id string,-- Indicates the unique rowkey.
     detail Row( -- Indicates the column family.
       order_channel string,
       order_time string,
       pay_amount string,
       real_pay string,
       pay_time string,
       user_id string,
       user_name string,
       area_id string),
     primary key (order_id) not enforced
   ) with (
     'connector' = 'hbase-2.2',
      'table-name' = 'order',
      'zookeeper.quorum' = '*ZookeeperAddress*:*ZookeeperPort*'
   ) ;
   ```



```
create table printSink (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount string,
  real_pay string,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) with (
 'connector' = 'print'
);

insert into printSink select order_id,
detail.order_channel,detail.order_time,detail.pay_amount,detail.real_pay,
detail.pay_time,detail.user_id,detail.user_name,detail.area_id from hbaseSource;
```

6. Perform the following operations to view the data result in the **taskmanager.out** file:

   a. Log in to the DLI console. In the navigation pane, choose **Job Management** > **Flink Jobs**.

   b. Click the name of the corresponding Flink job, choose **Run Log**, click **OBS Bucket**, and locate the folder of the log you want to view according to the date.

   c. Go to the folder of the date, find the folder whose name contains **taskmanager**, download the **taskmanager.out** file, and view result logs.

   The data result is as follows:

   ```
   +I(20210324100000001,webShop,2021-03-24 10:00:00,100.00,100.00,2021-03-24
   10:02:03,0001,Alice,330106)
   ```

FAQ

- Q: What should I do if the Flink job execution fails and the log contains the following error information?

  ```
  java.lang.IllegalArgumentException: offset (0) + length (8) exceed the capacity of the array: 6
  ```

  A: If data in the HBase table is imported in other modes, the data is represented in the string format. Therefore, this error is reported when other data formats are used. Change the type of the non-string fields in the HBase source table created by Flink to the string format.

- Q: What should I do if the Flink job execution fails and the log contains the following error information?

  ```
  org.apache.zookeeper.ClientCnxn$SessionTimeoutException: Client session timed out, have not heard
  from server in 90069ms for connection id 0x0
  ```

  A: The datasource connection is not bound, the binding fails, or the security group of the HBase cluster is not configured to allow access from the network segment of the DLI queue. Configure the datasource connection by referring to **Enhanced Datasource Connection** or configure the security group of the HBase cluster to allow access from the DLI queue.

3.3.1.4 JDBC Source Table

Function

The JDBC connector is a Flink's built-in connector to read data from a database.

Prerequisites

- An enhanced datasource connection with the instances has been established, so that you can configure security group rules as required.
- For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.
- For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.
- In Flink cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

  For details about datasource authentication, see **Introduction to Datasource Authentication**.

Precautions

When creating a Flink OpenSource SQL job, you need to set **Flink Version** to **1.12** on the **Running Parameters** tab of the job editing page, select **Save Job Log**, and set the OBS bucket for saving job logs.

Syntax

```
create table jbdcSource (
  attr_name attr_type
  (',' attr_name attr_type)*
  (',PRIMARY KEY (attr_name, ...) NOT ENFORCED)
  (',' watermark for rowtime_column_name as watermark-strategy_expression)
) with (
  'connector' = 'jdbc',
  'url' = '',
  'table-name' = '',
  'username' = '',
  'password' = ''
);
```

Parameters

Table 3-6 Parameter description

Parameter	Mandatory	Default Value	Data Type	Description
connector	Yes	None	String	Connector to be used. Set this parameter to **jdbc**.
url	Yes	None	String	Database URL.
table-name	Yes	None	String	Name of the table where the data will be read from the database.

Parameter	Mandatory	Default Value	Data Type	Description
driver	No	None	String	Driver required for connecting to the database. If you do not set this parameter, it will be automatically derived from the URL.
username	No	None	String	Database authentication username. This parameter must be configured in pair with **password**.
password	No	None	String	Database authentication password. This parameter must be configured in pair with **username**.
scan.partition.column	No	None	String	Name of the column used to partition the input. For details, see **Partitioned Scan**.
scan.partition.num	No	None	Integer	Number of partitions to be created. For details, see **Partitioned Scan**.
scan.partition.lower-bound	No	None	Integer	Lower bound of values to be fetched for the first partition. For details, see **Partitioned Scan**.
scan.partition.upper-bound	No	None	Integer	Upper bound of values to be fetched for the last partition. For details, see **Partitioned Scan**.
scan.fetch-size	No	0	Integer	Number of rows fetched from the database each time. If this parameter is set to **0**, the SQL hint is ignored.
scan.auto-commit	No	true	Boolean	Whether each statement is committed in a transaction automatically.
pwd_auth_name	No	None	String	Name of datasource authentication of the password type created on DLI. If this parameter is set, you do not need to set the username and password in SQL statements.

Partitioned Scan

To accelerate reading data in parallel Source task instances, Flink provides the partitioned scan feature for the JDBC table. The following parameters describe how to partition the table when reading in parallel from multiple tasks.

- **scan.partition.column**: name of the column used to partition the input. The data type of the column must be number, date, or timestamp.

- **scan.partition.num**: number of partitions.
- **scan.partition.lower-bound**: minimum value of the first partition.
- **scan.partition.upper-bound**: maximum value of the last partition.

NOTE

- **When a table is created, the preceding partitioned scan parameters must all be specified if any of them is specified.**
- The **scan.partition.lower-bound** and **scan.partition.upper-bound** parameters are used to decide the partition stride instead of filtering rows in the table. All rows in the table are partitioned and returned.

Data Type Mapping

Table 3-7 Data type mapping

MySQL Type	PostgreSQL Type	Flink SQL Type
TINYINT	-	TINYINT
SMALLINT TINYINT UNSIGNED	SMALLINT INT2 SMALLSERIAL SERIAL2	SMALLINT
INT MEDIUMINT SMALLINT UNSIGNED	INTEGER SERIAL	INT
BIGINT INT UNSIGNED	BIGINT BIGSERIAL	BIGINT
BIGINT UNSIGNED	-	DECIMAL(20, 0)
BIGINT	BIGINT	BIGINT
FLOAT	REAL FLOAT4	FLOAT
DOUBLE DOUBLE PRECISION	FLOAT8 DOUBLE PRECISION	DOUBLE
NUMERIC(p, s) DECIMAL(p, s)	NUMERIC(p, s) DECIMAL(p, s)	DECIMAL(p, s)
BOOLEAN TINYINT(1)	BOOLEAN	BOOLEAN
DATE	DATE	DATE

MySQL Type	PostgreSQL Type	Flink SQL Type
TIME [(p)]	TIME [(p)] [WITHOUT TIMEZONE]	TIME [(p)] [WITHOUT TIMEZONE]
DATETIME [(p)]	TIMESTAMP [(p)] [WITHOUT TIMEZONE]	TIMESTAMP [(p)] [WITHOUT TIMEZONE]
CHAR(n) VARCHAR(n) TEXT	CHAR(n) CHARACTER(n) VARCHAR(n) CHARACTER VARYING(n) TEXT	STRING
BINARY VARBINARY BLOB	BYTEA	BYTES
-	ARRAY	ARRAY

Example

This example uses JDBC as the data source and Print as the sink to read data from the RDS MySQL database and write the data to the Print result table.

1. Create an enhanced datasource connection in the VPC and subnet where RDS MySQL locates, and bind the connection to the required Flink elastic resource pool. For details, see **Enhanced Datasource Connections**.
2. Set RDS MySQL security groups and add inbound rules to allow access from the Flink queue. Test the connectivity using the RDS address by referring to **Testing Address Connectivity**. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.
3. Log in to the RDS MySQL database, create table **orders** in the Flink database, and insert data.

   Create table **orders** in the Flink database.

```
CREATE TABLE `flink`.`orders` (
  `order_id` VARCHAR(32) NOT NULL,
  `order_channel` VARCHAR(32) NULL,
  `order_time` VARCHAR(32) NULL,
  `pay_amount` DOUBLE UNSIGNED NOT NULL,
  `real_pay` DOUBLE UNSIGNED NULL,
  `pay_time` VARCHAR(32) NULL,
  `user_id` VARCHAR(32) NULL,
  `user_name` VARCHAR(32) NULL,
  `area_id` VARCHAR(32) NULL,
  PRIMARY KEY (`order_id`)
```



```
)    ENGINE = InnoDB
   DEFAULT CHARACTER SET = utf8mb4
   COLLATE = utf8mb4_general_ci;
```

Insert data into the table.

```
insert into orders(
  order_id,
  order_channel,
  order_time,
  pay_amount,
  real_pay,
  pay_time,
  user_id,
  user_name,
  area_id) values
  ('202103241000000001', 'webShop', '2021-03-24 10:00:00', '100.00', '100.00', '2021-03-24 10:02:03',
'0001', 'Alice', '330106'),
  ('202103251202020001', 'miniAppShop', '2021-03-25 12:02:02', '60.00', '60.00', '2021-03-25 12:03:00',
'0002', 'Bob', '330110');
```

4. Create a Flink OpenSource SQL job. Enter the following job script and submit the job.

   When you create a job, set **Flink Version** to **1.12** on the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs. **Change the values of the parameters in bold as needed in the following script.**

```
CREATE TABLE jdbcSource (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'jdbc',
  'url' = 'jdbc:mysql://MySQLAddress:MySQLPort/flink',--flink is the database name created in RDS
MySQL.
  'table-name' = 'orders',
  'username' = 'MySQLUsername',
  'password' = 'MySQLPassword'
);

CREATE TABLE printSink (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'print'
);

insert into printSink select * from jdbcSource;
```

5. Perform the following operations to view the data result in the **taskmanager.out** file:

   a. Log in to the DLI console. In the navigation pane, choose **Job Management** > **Flink Jobs**.

b. Click the name of the corresponding Flink job, choose **Run Log**, click **OBS Bucket**, and locate the folder of the log you want to view according to the date.

c. Go to the folder of the date, find the folder whose name contains **taskmanager**, download the **taskmanager.out** file, and view result logs.

The data result is as follows:

```
+I(20210324100000001,webShop,2021-03-24 10:00:00,100.0,100.0,2021-03-24
10:02:03,0001,Alice,330106)
+I(20210325120202001,miniAppShop,2021-03-25 12:02:02,60.0,60.0,2021-03-25
12:03:00,0002,Bob,330110)
```

FAQ

None

3.3.1.5 Kafka Source Table

Function

Create a source stream to obtain data from Kafka as input data for jobs.

Apache Kafka is a fast, scalable, and fault-tolerant distributed message publishing and subscription system. It delivers high throughput and built-in partitions and provides data replicas and fault tolerance. Apache Kafka is applicable to scenarios of handling massive messages.

Prerequisites

- You have created a Kafka cluster.
- An enhanced datasource connection has been created for DLI to connect to Kafka clusters, so that jobs can run on the dedicated queue of DLI and you can set the security group rules as required.
  - For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.
  - For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.
- In Flink cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

  For details about datasource authentication, see **Introduction to Datasource Authentication**.

Precautions

- When creating a Flink OpenSource SQL job, you need to set **Flink Version** to **1.12** on the **Running Parameters** tab of the job editing page, select **Save Job Log**, and set the OBS bucket for saving job logs.
- For details about how to use data types when creating tables, see **Format**.

Syntax

```
create table kafkaSource(
  attr_name attr_type
```

```
  (',' attr_name attr_type)*
  (','PRIMARY KEY (attr_name, ...) NOT ENFORCED)
  (',' WATERMARK FOR rowtime_column_name AS watermark-strategy_expression)
)
with (
  'connector' = 'kafka',
  'topic' = '',
  'properties.bootstrap.servers' = '',
  'properties.group.id' = '',
  'scan.startup.mode' = '',
  'format' = ''
);
```

Parameters

Table 3-8 Parameter description

Parameter	Mandatory	Default Value	Data Type	Description
connector	Yes	None	String	Connector to be used. Set this parameter to **kafka**.
topic	Yes	None	String	Topic name of the Kafka record. Note: • Only one of **topic** and **topic-pattern** can be specified. • If there are multiple topics, separate them with semicolons (;), for example, **topic-1;topic-2**.
topic-pattern	No	None	String	Regular expression for a pattern of topic names to read from. Only one of **topic** and **topic-pattern** can be specified. For example: 'topic.*' '(topic-c|topic-d)' '(topic-a|topic-b|topic-\\d*)' '(topic-a|topic-b|topic-[0-9]*)'
properties.bootstrap.servers	Yes	None	String	Comma separated list of Kafka brokers.
properties.group.id	Yes	None	String	ID of the consumer group for the Kafka source.

Parameter	Mandatory	Default Value	Data Type	Description
properties.*	No	None	String	This parameter can set and pass arbitrary Kafka configurations. Note: • The suffix to **properties.** must match the configuration key in **Apache Kafka**. For example, you can disable automatic topic creation via **'properties.allow.auto.create.topics' = 'false'**. • Some configurations are not supported, for example, **'key.deserializer'** and **'value.deserializer'**.
format	Yes	None	String	Format used to deserialize and serialize the value part of Kafka messages. Note: Either this parameter or the **value.format** parameter is required. Refer to **Format** for more details and format parameters.
key.format	No	None	String	Format used to deserialize and serialize the key part of Kafka messages. Note: • If a key format is defined, the **key.fields** parameter is required as well. Otherwise, the Kafka records will have an empty key. • Refer to **Format** for more details and format parameters.
key.fields	No	[]	List<String>	Defines the columns in the table as the list of keys. This parameter must be configured in pair with **key.format**. This parameter is left empty by default. Therefore, no key is defined. The format is like **field1;field2**.
key.fields-prefix	No	None	String	Defines a custom prefix for all fields of the key format to avoid name clashes with fields of the value format.

Parameter	Mandatory	Default Value	Data Type	Description
value.format	Yes	None	String	Format used to deserialize and serialize the value part of Kafka messages. Note: • Either this parameter or the **format** parameter is required. If two parameters are configured, a conflict occurs. • Refer to **Format** for more details and format parameters.
value.fields-include	No	ALL	Enum Possible values: [ALL, EXCEPT_KEY]	Whether to contain the key field when parsing the message body. Possible values are: • **ALL** (default): All defined fields are included in the value of Kafka messages. • **EXCEPT_KEY**: All the fields except those defined by **key.fields** are included in the value of Kafka messages.
scan.startup.mode	No	group-offsets	String	Start position for Kafka to read data. Possible values are: • **earliest-offset**: Data is read from the earliest Kafka offset. • **latest-offset**: Data is read from the latest Kafka offset. • **group-offsets** (default): Data is read based on the consumer group. • **timestamp**: Data is read from a user-supplied timestamp. When setting this option, you also need to specify **scan.startup.timestamp-millis** in **WITH**. • **specific-offsets**: Data is read from user-supplied specific offsets for each partition. When setting this option, you also need to specify **scan.startup.specific-offsets** in **WITH**.

Parameter	Mandatory	Default Value	Data Type	Description
scan.startup.specific-offsets	No	None	String	This parameter takes effect only when **scan.startup.mode** is set to **specific-offsets**. It specifies the offsets for each partition, for example, **partition:0,offset:42;partition:1,offset:300**.
scan.startup.timestamp-millis	No	None	Long	Startup timestamp. This parameter takes effect when **scan.startup.mode** is set to **timestamp**.
scan.topic-partition-discovery.interval	No	None	Duration	Interval for a consumer to periodically discover dynamically created Kafka topics and partitions.
ssl_auth_name	No	None	String	Name of datasource authentication of the Kafka_SSL type created on DLI. This configuration is used when SSL is configured for Kafka. Note: If only the SSL type is used, you need to set **properties.security.protocol** to **SSL**. If SASL_SSL is used, set the following parameters: ● 'properties.security.protocol' = 'SASL_SSL'; ● 'properties.sasl.mechanism' = 'GSSAPI or PLAIN'; ● 'properties.sasl.jaas.config' = 'org.apache.kafka.common.security.plain.PlainLoginModule required username=\"xxx\" password=\"xxx\";'
krb_auth_name	No	None	String	Name of datasource authentication of the Kerberos type created on DLI. This configuration is used when SASL is configured for Kafka. Note: If the SASL_PLAINTEXT type and Kerberos authentication are used, you need to set **properties.sasl.mechanism** to **GSSAPI** and **properties.security.protocol** to **SASL_PLAINTEXT**.

Metadata Column

You can define metadata columns in the source table to obtain the metadata of Kafka messages. For example, if multiple topics are defined in the **WITH** parameter and the metadata column is defined in the Kafka source table, the data read by Flink is labeled with the topic from which the data is read.

Table 3-9 Metadata column

Key	Data Type	R/W	Description
topic	STRING NOT NULL	R	Topic name of the Kafka record.
partition	INT NOT NULL	R	Partition ID of the Kafka record.
headers	MAP<STRING, BYTES> NOT NULL	R/W	Headers of Kafka messages.
leader-epoch	INT NULL	R	Leader epoch of the Kafka record. **For details, see example 1.**
offset	BIGINT NOT NULL	R	Offset of the Kafka record.
timestamp	TIMESTAMP(3) WITH LOCAL TIME ZONE NOT NULL	R/W	Timestamp of the Kafka record.
timestamp-type	STRING NOT NULL	R	Timestamp type of the Kafka record. The options are as follows: • **NoTimestampType**: No timestamp is defined in the message. • **CreateTime**: time when the message is generated. • **LogAppendTime**: time when the message is added to the Kafka broker. **For details, see example 1.**

Example (SASL_SSL Disabled for the Kafka Cluster)

- **Example 1: Read data from the Kafka metadata column and write it to the Print sink.**

  a. Create an enhanced datasource connection in the VPC and subnet where Kafka locates, and bind the connection to the required Flink elastic resource pool. For details, see **Enhanced Datasource Connections**.

  b. Set Kafka security groups and add inbound rules to allow access from the Flink queue. Test the connectivity using the Kafka address by referring to **Testing Address Connectivity**. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.

  c. Create a Flink OpenSource SQL job. Enter the following job script and submit the job.

  When you create a job, set **Flink Version** to **1.12** on the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs. **Change the values of the parameters in bold as needed in the following script.**

```
CREATE TABLE orders (
  `topic` String metadata,
  `partition` int metadata,
  `headers` MAP<STRING, BYTES> metadata,
  `leaderEpoch` INT metadata from 'leader-epoch',
  `offset` bigint metadata,
  `timestamp` TIMESTAMP(3) metadata,
  `timestampType` string metadata from 'timestamp-type',
  `message` string
) WITH (
  'connector' = 'kafka',
  'topic' = '***KafkaTopic***',
  'properties.bootstrap.servers' = '***KafkaAddress1:KafkaPort,KafkaAddress2:KafkaPort***',
  'properties.group.id' = '***GroupId***',
  'scan.startup.mode' = 'latest-offset',
  "format" = "csv",
  "csv.field-delimiter" = "\u0001",
  "csv.quote-character" = """
);

CREATE TABLE printSink (
  `topic` String,
  `partition` int,
  `headers` MAP<STRING, BYTES>,
  `leaderEpoch` INT,
  `offset` bigint,
  `timestamp` TIMESTAMP(3),
  `timestampType` string,
  `message` string -- Indicates that data written by users is read from Kafka.
) WITH (
  'connector' = 'print'
);

insert into printSink select * from orders;
```

  If you need to read the value of each field instead of the entire message, use the following statements:

```
CREATE TABLE orders (
  `topic` String metadata,
  `partition` int metadata,
  `headers` MAP<STRING, BYTES> metadata,
  `leaderEpoch` INT metadata from 'leader-epoch',
  `offset` bigint metadata,
  `timestamp` TIMESTAMP(3) metadata,
  `timestampType` string metadata from 'timestamp-type',
  order_id string,
```



```
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = '<yourTopic>',
  'properties.bootstrap.servers' = 'KafkaAddress1:KafkaPort,KafkaAddress2:KafkaPort',
  'properties.group.id' = 'GroupId',
  'scan.startup.mode' = 'latest-offset',
  "format" = "json"
);

CREATE TABLE printSink (
  `topic` String,
  `partition` int,
  `headers` MAP<STRING, BYTES>,
  `leaderEpoch` INT,
  `offset` bigint,
  `timestamp` TIMESTAMP(3),
  `timestampType` string,
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'print'
);

insert into printSink select * from orders;
```

d. Send the following data to the corresponding topics in Kafka:

```
{"order_id":"202103241000000001", "order_channel":"webShop", "order_time":"2021-03-24 10:00:00", "pay_amount":"100.00", "real_pay":"100.00", "pay_time":"2021-03-24 10:02:03", "user_id":"0001", "user_name":"Alice", "area_id":"330106"}

{"order_id":"202103241606060001", "order_channel":"appShop", "order_time":"2021-03-24 16:06:06", "pay_amount":"200.00", "real_pay":"180.00", "pay_time":"2021-03-24 16:10:06", "user_id":"0001", "user_name":"Alice", "area_id":"330106"}

{"order_id":"202103251202020001", "order_channel":"miniAppShop", "order_time":"2021-03-25 12:02:02", "pay_amount":"60.00", "real_pay":"60.00", "pay_time":"2021-03-25 12:03:00", "user_id":"0002", "user_name":"Bob", "area_id":"330110"}
```

e. Perform the following operations to view the output:

i. Log in to the DLI console. In the navigation pane, choose **Job Management** > **Flink Jobs**.

ii. Click the name of the corresponding Flink job, choose **Run Log**, click **OBS Bucket**, and locate the folder of the log you want to view according to the date.

iii. Go to the folder of the date, find the folder whose name contains **taskmanager**, download the **taskmanager.out** file, and view result logs.

The data result is as follows:

```
+I(fz-source-json,0,{},0,243,2021-12-27T09:23:32.253,CreateTime,
{"order_id":"202103241000000001", "order_channel":"webShop", "order_time":"2021-03-24
```



```
10:00:00", "pay_amount":"100.00", "real_pay":"100.00", "pay_time":"2021-03-24 10:02:03",
"user_id":"0001", "user_name":"Alice", "area_id":"330106"})
+I(fz-source-json,0,{},0,244,2021-12-27T09:23:39.655,CreateTime,
{"order_id":"202103241606060001", "order_channel":"appShop", "order_time":"2021-03-24
16:06:06", "pay_amount":"200.00", "real_pay":"180.00", "pay_time":"2021-03-24 16:10:06",
"user_id":"0001", "user_name":"Alice", "area_id":"330106"})
+I(fz-source-json,0,{},0,245,2021-12-27T09:23:48.405,CreateTime,
{"order_id":"202103251202020001", "order_channel":"miniAppShop", "order_time":"2021-03-25
12:02:02", "pay_amount":"60.00", "real_pay":"60.00", "pay_time":"2021-03-25 12:03:00",
"user_id":"0002", "user_name":"Bob", "area_id":"330110"})
```

- **Example 2: Use the Kafka source table and Print result table to read JSON data from Kafka and output it to the log file.**

  a. Create an enhanced datasource connection in the VPC and subnet where Kafka locates, and bind the connection to the required Flink elastic resource pool. For details, see **Enhanced Datasource Connections**.

  b. Set Kafka security groups and add inbound rules to allow access from the Flink queue. Test the connectivity using the Kafka address by referring to **Testing Address Connectivity**. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.

  c. Create a Flink OpenSource SQL job. Enter the following job script and submit the job.

     When you create a job, set **Flink Version** to **1.12** on the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs. **Change the values of the parameters in bold as needed in the following script.**

```
CREATE TABLE orders (
  order_id string,
  order_channel string,
  order_time timestamp(3),
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = '<yourTopic>',
  'properties.bootstrap.servers' = '***KafkaAddress1:KafkaPort,KafkaAddress2:KafkaPort***',
  'properties.group.id' = '***GroupId***',
  'scan.startup.mode' = 'latest-offset',
  "format" = "json"
);

CREATE TABLE printSink (
  order_id string,
  order_channel string,
  order_time timestamp(3),
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'print'
);

insert into printSink select * from orders;
```

  d. Send the following test data to the corresponding topics in Kafka:

```
{"order_id":"202103241000000001", "order_channel":"webShop", "order_time":"2021-03-24
10:00:00", "pay_amount":"100.00", "real_pay":"100.00", "pay_time":"2021-03-24 10:02:03",
```



```
"user_id":"0001", "user_name":"Alice", "area_id":"330106"}

{"order_id":"202103241606060001", "order_channel":"appShop", "order_time":"2021-03-24 16:06:06", "pay_amount":"200.00", "real_pay":"180.00", "pay_time":"2021-03-24 16:10:06", "user_id":"0001", "user_name":"Alice", "area_id":"330106"}

{"order_id":"202103251202020001", "order_channel":"miniAppShop", "order_time":"2021-03-25 12:02:02", "pay_amount":"60.00", "real_pay":"60.00", "pay_time":"2021-03-25 12:03:00", "user_id":"0002", "user_name":"Bob", "area_id":"330110"}
```

e. Perform the following operations to view the output:

i. Log in to the DLI console. In the navigation pane, choose **Job Management** > **Flink Jobs**.

ii. Click the name of the corresponding Flink job, choose **Run Log**, click **OBS Bucket**, and locate the folder of the log you want to view according to the date.

iii. Go to the folder of the date, find the folder whose name contains **taskmanager**, download the **taskmanager.out** file, and view result logs.

The data result is as follows:

```
+I(20210324100000001,webShop,2021-03-24T10:00,100.0,100.0,2021-03-2410:02:03,0001,Alice,330106)
+I(202103241606060001,appShop,2021-03-24T16:06:06,200.0,180.0,2021-03-2416:10:06,0001,Alice,330106)
+I(202103251202020001,miniAppShop,2021-03-25T12:02:02,60.0,60.0,2021-03-2512:03:00,0002,Bob,330110)
```

Example (SASL_SSL Enabled for the Kafka Cluster)

- **Example 1: Enable SASL_SSL authentication for the DMS cluster.**

  Create a Kafka cluster for DMS, enable SASL_SSL, download the SSL certificate, and upload the downloaded certificate **client.jks** to an OBS bucket.

```
CREATE TABLE ordersSource (
  order_id string,
  order_channel string,
  order_time timestamp(3),
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = 'xx',
  'properties.bootstrap.servers' = 'xx:9093,xx:9093,xx:9093',
  'properties.group.id' = 'GroupId',
  'scan.startup.mode' = 'latest-offset',
  'properties.connector.auth.open' = 'true',
  'properties.ssl.truststore.location' = 'obs://xx/xx.jks',  -- Location where the user uploads the certificate to
  'properties.sasl.mechanism' = 'PLAIN',  --  Value format: SASL_PLAINTEXT
  'properties.security.protocol' = 'SASL_SSL',
  'properties.sasl.jaas.config' = 'org.apache.kafka.common.security.plain.PlainLoginModule required username=\"xx\" password=\"xx\";', -- Account and password set when the Kafka cluster is created
  "format" = "json"
);

CREATE TABLE ordersSink (
  order_id string,
  order_channel string,
```



```
  order_time timestamp(3),
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = 'xx',
  'properties.bootstrap.servers' = 'xx:9093,xx:9093,xx:9093',
  'properties.connector.auth.open' = 'true',
  'properties.ssl.truststore.location' = 'obs://xx/xx.jks',
  'properties.sasl.mechanism' = 'PLAIN',
  'properties.security.protocol' = 'SASL_SSL',
  'properties.sasl.jaas.config' = 'org.apache.kafka.common.security.plain.PlainLoginModule required
username=\"xx\" password=\"xx\";',
  "format" = "json"
);

insert into ordersSink select * from ordersSource;
```

- **Example 2: Enable Kafka SASL_SSL authentication for the MRS cluster.**
  - Enable Kerberos authentication for the MRS cluster.
  - Click the **Components** tab and click **Kafka**. In the displayed page, click the **Service Configuration** tab, locate the **security.protocol**, and set it to **SASL_SSL**.
  - Log in to the FusionInsight Manager of the MRS cluster and download the user credential. Choose **System** > **Permission** > **User**. Locate the row that contains the target user, choose **More** > **Download Authentication Credential**.

    Obtain the **truststore.jks** file using the authentication credential and store the credential and **truststore.jks** file in OBS.
  - If "Message stream modified (41)" is displayed, the JDK version may be incorrect. Change the JDK version in the sample code to a version earlier than 8u_242 or delete the **renew_lifetime = 0m** configuration item from the **krb5.conf** configuration file.
  - Set the port to the **sasl_ssl.port** configured in the Kafka service configuration.
  - In the following statements, set **security.protocol** to **SASL_SSL**.

```
CREATE TABLE ordersSource (
  order_id string,
  order_channel string,
  order_time timestamp(3),
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = 'xx',
  'properties.bootstrap.servers' = 'xx:21009,xx:21009',
  'properties.group.id' = 'GroupId',
  'scan.startup.mode' = 'latest-offset',
  'properties.sasl.kerberos.service.name' = 'kafka',
  'properties.connector.auth.open' = 'true',
  'properties.connector.kerberos.principal' = 'xx', --Username
  'properties.connector.kerberos.krb5' = 'obs://xx/krb5.conf',
  'properties.connector.kerberos.keytab' = 'obs://xx/user.keytab',
  'properties.security.protocol' = 'SASL_SSL',
```



```
  'properties.ssl.truststore.location' = 'obs://xx/truststore.jks',
  'properties.ssl.truststore.password' = 'xx',  -- Password set for generating truststore.jks
  'properties.sasl.mechanism' = 'GSSAPI',
  "format" = "json"
);

CREATE TABLE ordersSink (
  order_id string,
  order_channel string,
  order_time timestamp(3),
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = 'xx',
  'properties.bootstrap.servers' = 'xx:21009,xx:21009',
  'properties.sasl.kerberos.service.name' = 'kafka',
  'properties.connector.auth.open' = 'true',
  'properties.connector.kerberos.principal' = 'xx',
  'properties.connector.kerberos.krb5' = 'obs://xx/krb5.conf',
  'properties.connector.kerberos.keytab' = 'obs://xx/user.keytab',
  'properties.ssl.truststore.location' = 'obs://xx/truststore.jks',
  'properties.ssl.truststore.password' = 'xx',
  'properties.security.protocol' = 'SASL_SSL',
  'properties.sasl.mechanism' = 'GSSAPI',
  "format" = "json"
);

insert into ordersSink select * from ordersSource;
```

- **Example 3: Enable Kerberos SASL_PAINTEXT authentication for the MRS cluster**
  - Enable Kerberos authentication for the MRS cluster.
  - Click the **Components** tab and click **Kafka**. In the displayed page, click the **Service Configuration** tab, locate the **security.protocol**, and set it to **SASL_PLAINTEXT**.
  - Log in to the FusionInsight Manager of the MRS cluster and download the user credential. Choose **System** > **Permission** > **User**. Locate the row that contains the target user, choose **More** > **Download Authentication Credential**. Upload the credential to OBS.
  - If error message "Message stream modified (41)" is displayed, the JDK version may be incorrect. Change the JDK version in the sample code to a version earlier than 8u_242 or delete the **renew_lifetime = 0m** configuration item from the **krb5.conf** configuration file.
  - Set the port to the **sasl.port** configured in the Kafka service configuration.
  - In the following statements, set **security.protocol** to **SASL_PLAINTEXT**.

```
CREATE TABLE ordersSources (
  order_id string,
  order_channel string,
  order_time timestamp(3),
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
```



```
  'connector' = 'kafka',
  'topic' = 'xx',
  'properties.bootstrap.servers' = 'xx:21007,xx:21007',
  'properties.group.id' = 'GroupId',
  'scan.startup.mode' = 'latest-offset',
  'properties.sasl.kerberos.service.name' = 'kafka',
  'properties.connector.auth.open' = 'true',
  'properties.connector.kerberos.principal' = 'xx',
  'properties.connector.kerberos.krb5' = 'obs://xx/krb5.conf',
  'properties.connector.kerberos.keytab' = 'obs://xx/user.keytab',
  'properties.security.protocol' = 'SASL_PLAINTEXT',
  'properties.sasl.mechanism' = 'GSSAPI',
  "format" = "json"
);

CREATE TABLE ordersSink (
  order_id string,
  order_channel string,
  order_time timestamp(3),
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = 'xx',
  'properties.bootstrap.servers' = 'xx:21007,xx:21007',
  'properties.sasl.kerberos.service.name' = 'kafka',
  'properties.connector.auth.open' = 'true',
  'properties.connector.kerberos.principal' = 'xx',
  'properties.connector.kerberos.krb5' = 'obs://xx/krb5.conf',
  'properties.connector.kerberos.keytab' = 'obs://xx/user.keytab',
  'properties.security.protocol' = 'SASL_PLAINTEXT',
  'properties.sasl.mechanism' = 'GSSAPI',
  "format" = "json"
);

insert into ordersSink select * from ordersSource;
```

- **Example 4: Use SSL for the MRS cluster**
  - Do not enable Kerberos authentication for the MRS cluster.
  - Log in to the FusionInsight Manager of the MRS cluster and download the user credential. Choose **System** > **Permission** > **User**. Locate the row that contains the target user, choose **More** > **Download Authentication Credential**.

    Obtain the **truststore.jks** file using the authentication credential and store the credential and **truststore.jks** file in OBS.
  - Set the port to the **ssl.port** configured in the Kafka service configuration.
  - In the following statements, set **security.protocol** to **SSL**.
  - Set **ssl.mode.enable** to **true**.

```
CREATE TABLE ordersSource (
  order_id string,
  order_channel string,
  order_time timestamp(3),
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = 'xx',
```



```
 'properties.bootstrap.servers' = 'xx:9093,xx:9093,xx:9093',
 'properties.group.id' = 'GroupId',
 'scan.startup.mode' = 'latest-offset',
 'properties.connector.auth.open' = 'true',
 'properties.ssl.truststore.location' = 'obs://xx/truststore.jks',
 'properties.ssl.truststore.password' = 'xx',  -- Password set for generating truststore.jks
 'properties.security.protocol' = 'SSL',
 "format" = "json"
);

CREATE TABLE ordersSink (
 order_id string,
 order_channel string,
 order_time timestamp(3),
 pay_amount double,
 real_pay double,
 pay_time string,
 user_id string,
 user_name string,
 area_id string
) WITH (
 'connector' = 'print'
);

insert into ordersSink select * from ordersSource;
```

FAQ

- **Q: What should I do if the Flink job execution fails and the log contains the following error information?**

  ```
  org.apache.kafka.common.errors.TimeoutException: Timeout expired while fetching topic metadata
  ```

  A: The datasource connection is not bound, the binding fails, or the security group of the Kafka cluster is not configured to allow access from the network segment of the DLI queue. Configure the datasource connection by referring to **Enhanced Datasource Connection** or configure the security group of the Kafka cluster to allow access from the DLI queue.

- **Q: What should I do if the Flink job execution fails and the log contains the following error information?**

  ```
  Caused by: java.lang.RuntimeException: RealLine:45;Table 'default_catalog.default_database.printSink' declares persistable metadata columns, but the underlying DynamicTableSink doesn't implement the SupportsWritingMetadata interface. If the column should not be persisted, it can be declared with the VIRTUAL keyword.
  ```

  A: The metadata type is defined in the sink table, but the Print connector does not support deletion of matadata from the sink table.

3.3.1.6 MySQL CDC Source Table

Function

The MySQL CDC source table, that is, the MySQL streaming source table, reads all historical data in the database first and then smoothly switches data read to the Binlog to ensure data integrity.

Prerequisites

- MySQL CDC requires MySQL 5.7 or 8.0.*x*.
- An enhanced datasource connection has been created for DLI to connect to the MySQL database, so that you can configure security group rules as required.

  - For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.
  - For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.
- In Flink cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

  For details about datasource authentication, see **Introduction to Datasource Authentication**.
- Binlog is enabled for MySQL, and **binlog_row_image** is set to **FULL**.
- A MySQL user has been created and granted the **SELECT**, **SHOW DATABASES**, **REPLICATION SLAVE**, and **REPLICATION CLIENT** permissions.

Precautions

- When creating a Flink OpenSource SQL job, you need to set **Flink Version** to **1.12** on the **Running Parameters** tab of the job editing page, select **Save Job Log**, and set the OBS bucket for saving job logs.
- Each client that synchronizes database data has a unique ID, that is, the server ID. You are advised to configure a unique server ID for each MySQL CDC job in the same database.

  Main reasons are as follows:
  - The MySQL server maintains the network connection and Binlog location based on the ID. Therefore, if a large number of clients with the same server ID connect to the MySQL server, the CPU usage of the MySQL server may increase sharply, affecting the stability of online services.
  - If multiple jobs share the same server ID, Binlog locations will be disordered, making data read inaccurate. Therefore, you are advised to configure different server IDs for each MySQL CDC job.
- Watermarks cannot be defined for MySQL CDC source tables. For details about window aggregation, see **FAQ**.
- If you connect to a sink source that supports upsert, such as GaussDB(DWS) and MySQL, you need to define the primary key in the statement for creating the sink table. For details, see the printSink table creation statement in **Example**.

Syntax

```
create table mySqlCdcSource (
  attr_name attr_type
  (',' attr_name attr_type)*
  (',PRIMARY KEY (attr_name, ...) NOT ENFORCED)
)
with (
  'connector' = 'mysql-cdc',
  'hostname' = 'mysqlHostname',
  'username' = 'mysqlUsername',
  'password' = 'mysqlPassword',
  'database-name' = 'mysqlDatabaseName',
  'table-name' = 'mysqlTableName'
);
```


Parameters

Table 3-10 Parameter description

Parameter	Mandatory	Default Value	Data Type	Description
connector	Yes	None	String	Connector to be used. Set this parameter to **mysql-cdc**.
hostname	Yes	None	String	IP address or hostname of the MySQL database.
username	Yes	None	String	Username of the MySQL database.
password	Yes	None	String	Password of the MySQL database.
database-name	Yes	None	String	Name of the database to connect. The database name supports regular expressions to read data from multiple databases. For example, **flink(.)*** indicates all database names starting with **flink**.
table-name	Yes	None	String	Name of the table to read data from. The table name supports regular expressions to read data from multiple tables. For example, **cdc_order(.)*** indicates all table names starting with **cdc_order**.
port	No	3306	Integer	Port number of the MySQL database.
server-id	No	A random value from 5400 to 6000	String	A numeric ID of the database client, which must be globally unique in the MySQL cluster. You are advised to set a unique ID for each job in the same database. By default, a random value ranging from 5400 to 6400 is generated.

Parameter	Mandatory	Default Value	Data Type	Description
scan.startup.mode	No	initial	String	Startup mode for consuming data. • **initial** (default): In the first startup, the database scans all historical data and then reads the latest Binlog data. • **latest-offset**: In the first startup, the database reads data directly from the end of the Binlog (the latest Binlog) instead of scanning all historical data. That is, it reads only the latest changes after the connector is started.
server-time-zone	No	None	String	Time zone of the session used by the database. For example, **Asia/Shanghai**.
pwd_auth_name	No	None	String	Name of datasource authentication of the password type created on DLI. If datasource authentication is used, you do not need to set the username and password for jobs.

Example

In this example, MySQL-CDC is used to read data from RDS for MySQL in real time and write the data to the Print result table. The procedure is as follows (MySQL 5.7.32 is used in this example):

1. Create an enhanced datasource connection in the VPC and subnet where MySQL locates, and bind the connection to the required Flink elastic resource pool. For details, see **Enhanced Datasource Connections**.
2. Set MySQL security groups and add inbound rules to allow access from the Flink queue. Test the connectivity using the MySQL address by referring to **Testing Address Connectivity**. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.
3. Create a table named **cdc_order** in database **flink** of the MySQL database.

```
CREATE TABLE `flink`.`cdc_order` (
    `order_id` VARCHAR(32) NOT NULL,
    `order_channel` VARCHAR(32) NULL,
    `order_time` VARCHAR(32) NULL,
    `pay_amount` DOUBLE  NULL,
    `real_pay` DOUBLE  NULL,
    `pay_time` VARCHAR(32) NULL,
    `user_id` VARCHAR(32) NULL,
    `user_name` VARCHAR(32) NULL,
    `area_id` VARCHAR(32) NULL,
    PRIMARY KEY (`order_id`)
)   ENGINE = InnoDB
    DEFAULT CHARACTER SET = utf8mb4
    COLLATE = utf8mb4_general_ci;
```


4. Create a Flink OpenSource SQL job. Enter the following job script and submit the job.

   When you create a job, set **Flink Version** to **1.12** on the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs. **Change the values of the parameters in bold as needed in the following script.**

```
create table mysqlCdcSource(
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id STRING
) with (
  'connector' = 'mysql-cdc',
  'hostname' = '***mysqlHostname***',
  'username' = '***mysqlUsername***',
  'password' = '***mysqlPassword***',
  'database-name' = '***mysqlDatabaseName***',
  'table-name' = '***mysqlTableName***'
);

create table printSink(
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id STRING,
  primary key(order_id) not enforced
) with (
  'connector' = 'print'
);

insert into printSink select * from mysqlCdcSource;
```

5. Insert test data in MySQL.

```
insert into cdc_order values
('202103241000000001','webShop','2021-03-24 10:00:00','100.00','100.00','2021-03-24
10:02:03','0001','Alice','330106'),
('202103241606060001','appShop','2021-03-24 16:06:06','200.00','180.00','2021-03-24
16:10:06','0001','Alice','330106');

delete from cdc_order  where order_channel = 'webShop';

insert into cdc_order values('202103251202020001','miniAppShop','2021-03-25
12:02:02','60.00','60.00','2021-03-25 12:03:00','0002','Bob','330110');
```

6. Perform the following operations to view the data result in the **taskmanager.out** file:

   a. Log in to the DLI console. In the navigation pane, choose **Job Management** > **Flink Jobs**.

   b. Click the name of the corresponding Flink job, choose **Run Log**, click **OBS Bucket**, and locate the folder of the log you want to view according to the date.

   c. Go to the folder of the date, find the folder whose name contains **taskmanager**, download the **taskmanager.out** file, and view result logs.

   The data result is as follows:


```
+I(20210324100000001,webShop,2021-03-2410:00:00,100.0,100.0,2021-03-2410:02:03,0001,Alice,330106)
+I(20210324160606001,appShop,2021-03-2416:06:06,200.0,180.0,2021-03-2416:10:06,0001,Alice,330106)
-D(20210324100000001,webShop,2021-03-2410:00:00,100.0,100.0,2021-03-2410:02:03,0001,Alice,330106)
+I(20210325120202001,miniAppShop,2021-03-2512:02:02,60.0,60.0,2021-03-2512:03:00,0002,Bob,330110)
```

FAQ

Q: How do I perform window aggregation if the MySQL CDC source table does not support definition of watermarks?

A: You can use the non-window aggregation method. That is, convert the time field into a window value, and then use **GROUP BY** to perform aggregation based on the window value.

For example, you can use the following script to collect statistics on the number of orders per minute (**order_time** indicates the order time, in the string format):

```
insert into printSink select DATE_FORMAT(order_time, 'yyyy-MM-dd HH:mm'), count(*) from mysqlCdcSource group by DATE_FORMAT(order_time, 'yyyy-MM-dd HH:mm');
```

3.3.1.7 Postgres CDC Source Table

Function

The Postgres CDC source table, that is, Postgres streaming source table, is used to read the full snapshot data and changed data of the PostgreSQL database in sequence. The exactly-once processing semantics is used to ensure data accuracy even if a failure occurs.

Prerequisites

- The PostgreSQL version be 9.6, 10, 11, or 12.
- An enhanced datasource connection with the database has been established, so that you can configure security group rules as required.
  - For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.
  - For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.
- In Flink cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

  For details about datasource authentication, see **Introduction to Datasource Authentication**.

Precautions

- When you create a Flink OpenSource SQL job, set **Flink Version** to **1.12** on the **Running Parameters** tab of the job editing page, select **Save Job Log**, and set the OBS bucket for saving job logs.
- The PostgreSQL version cannot be earlier than PostgreSQL 11.

- If operations such as update will be performed on the Postgres table, you need to run the following statement in PostgreSQL. Note: Replace **test.cdc_order** with the actual database and table.
  ```
  ALTER TABLE test.cdc_order REPLICA IDENTITY FULL
  ```
- Before creating the PostgreSQL CDC source table, check whether the current PostgreSQL contains the default plug-in. You can run the following statement in PostgreSQL to query the current plug-ins:
  ```
  SELECT name FROM pg_available_extensions;
  ```
  If the default plug-in **decoderbufs** is not available, you need to set the **decoding.plugin.name** parameter to specify an existing plug-in in PostgreSQL when creating the PostgreSQL CDC source table.

Syntax

```
create table postgresCdcSource (
  attr_name attr_type
  (',' attr_name attr_type)*
  (','PRIMARY KEY (attr_name, ...) NOT ENFORCED)
)
with (
  'connector' = 'postgres-cdc',
  'hostname' = 'PostgresHostname',
  'username' = 'PostgresUsername',
  'password' = 'PostgresPassword',
  'database-name' = 'PostgresDatabaseName',
  'schema-name' = 'PostgresSchemaName',
  'table-name' = 'PostgresTableName'
);
```

Parameters

Table 3-11 Parameter description

Parameter	Mandatory	Default Value	Data Type	Description
connector	Yes	None	String	Connector to be used. Set this parameter to **postgres-cdc**.
hostname	Yes	None	String	IP address or hostname of the Postgres database.
username	Yes	None	String	Username of the Postgres database.
password	Yes	None	String	Password of the Postgres database.
database-name	Yes	None	String	Database name.

Parameter	Mandatory	Default Value	Data Type	Description
schema-name	Yes	None	String	Postgres schema name. The schema name supports regular expressions to read data from multiple schemas. For example, **test(.)*** indicates all schema names starting with **test**.
table-name	Yes	None	String	Postgres table name. The table name supports regular expressions to read data from multiple tables. For example, **cdc_order(.)*** indicates all table names starting with **cdc_order**.
port	No	5432	Integer	Port number of the Postgres database.
decoding.plugin.name	No	decoderbufs	String	Determined based on the plug-in that is installed in the PostgreSQL database. The value can be: • decoderbufs (default) • wal2json • wal2json_rds • wal2json_streaming • wal2json_rds_streaming • pgoutput
debezium.*	No	None	String	Fine-grained control over the behavior of Debezium clients, for example, **'debezium.snapshot.mode' = 'never'**. For details, see **Connector configuration properties**. You are advised to set the **debezium.slot.name** parameter for each table to avoid the following error: "PSQLException: ERROR: replication slot "debezium" is active for PID 974"
pwd_auth_name	No	None	String	Name of datasource authentication of the password type created on DLI. If datasource authentication is used, you do not need to set the username and password for jobs.

Example

In this example, Postgres-CDC is used to read data from RDS for PostgreSQL in real time and write the data to the Print result table. The procedure is as follows (PostgreSQL 11.11 is used in this example):

1. Create an enhanced datasource connection in the VPC and subnet where PostgreSQL locates, and bind the connection to the required Flink elastic resource pool. For details, see **Enhanced Datasource Connections**.
2. Set PostgreSQL security groups and add inbound rules to allow access from the Flink queue. Test the connectivity using the PostgreSQL address by referring to **Testing Address Connectivity**. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.
3. In PostgreSQL, create database **flink** and schema **test**.
4. Create table **cdc_order** in the schema **test** of database **flink** in PostgreSQL.

   ```
   create table test.cdc_order(
     order_id VARCHAR,
     order_channel VARCHAR,
     order_time VARCHAR,
     pay_amount FLOAT8,
     real_pay FLOAT8,
     pay_time VARCHAR,
     user_id VARCHAR,
     user_name VARCHAR,
     area_id VARCHAR,
     primary key(order_id)
   );
   ```

5. Run the following SQL statement in PostgreSQL. If you do not run this statement, an error will be reported when the Flink job is executed. For details, see the error message in **FAQ**.

   ```
   ALTER TABLE test.cdc_order REPLICA IDENTITY FULL
   ```

6. Create a Flink OpenSource SQL job. Enter the following job script and submit the job.

   When you create a job, set **Flink Version** to **1.12** on the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs. **Change the values of the parameters in bold as needed in the following script.**

   ```
   create table postgresCdcSource(
     order_id string,
     order_channel string,
     order_time string,
     pay_amount double,
     real_pay double,
     pay_time string,
     user_id string,
     user_name string,
     area_id STRING,
     primary key (order_id) not enforced
   ) with (
     'connector' = 'postgres-cdc',
     'hostname' = '***PostgresHostname***',
     'username' = '***PostgresUsername***',
     'password' = '***PostgresPassword***',
     'database-name' = 'flink',
     'schema-name' = 'test',
     'table-name' = 'cdc_order'
   );

   create table printSink(
     order_id string,
     order_channel string,
   ```



```
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id STRING,
  primary key(order_id) not enforced
) with (
  'connector' = 'print'
);

insert into printSink select * from postgresCdcSource;
```

7. Run the following command in PostgreSQL:

```
insert into test.cdc_order
  (order_id,
  order_channel,
  order_time,
  pay_amount,
  real_pay,
  pay_time,
  user_id,
  user_name,
  area_id) values
  ('202103241000000001', 'webShop', '2021-03-24 10:00:00', '100.00', '100.00', '2021-03-24 10:02:03',
'0001', 'Alice', '330106'),
  ('202103251202020001', 'miniAppShop', '2021-03-25 12:02:02', '60.00', '60.00', '2021-03-25 12:03:00',
'0002', 'Bob', '330110');

update test.cdc_order set order_channel = 'webShop' where order_id = '202103251202020001';

delete from test.cdc_order where order_id = '202103241000000001';
```

8. Perform the following operations to view the data result in the **taskmanager.out** file:

   a. Log in to the DLI console. In the navigation pane, choose **Job Management** > **Flink Jobs**.

   b. Click the name of the corresponding Flink job, choose **Run Log**, click **OBS Bucket**, and locate the folder of the log you want to view according to the date.

   c. Go to the folder of the date, find the folder whose name contains **taskmanager**, download the **taskmanager.out** file, and view result logs.

   The data result is as follows:

```
+I(202103241000000001,webShop,2021-03-24 10:00:00,100.0,100.0,2021-03-24
10:02:03,0001,Alice,330106)
+I(202103251202020001,miniAppShop,2021-03-25 12:02:02,60.0,60.0,2021-03-25
12:03:00,0002,Bob,330110)
-U(202103251202020001,miniAppShop,2021-03-25 12:02:02,60.0,60.0,2021-03-25
12:03:00,0002,Bob,330110)
+U(202103251202020001,webShop,2021-03-25 12:02:02,60.0,60.0,2021-03-25
12:03:00,0002,Bob,330110)
-D(202103241000000001,webShop,2021-03-24 10:00:00,100.0,100.0,2021-03-24
10:02:03,0001,Alice,330106)
```

FAQ

- Q: What should I do if the Flink job execution fails and the log contains the following error information?

```
org.postgresql.util.PSQLException: ERROR: logical decoding requires wal_level >= logical
```

- A: Change the value of **wal_level** to **logical** and restart the PostgreSQL database.

After modifying the PostgreSQL parameter, restart the RDS PostgreSQL instance for the modification to take effect.

- Q: What should I do if the Flink job execution fails and the log contains the following error information?

  ```
  java.lang.IllegalStateException: The "before" field of UPDATE/DELETE message is null, please check the Postgres table has been set REPLICA IDENTITY to FULL level. You can update the setting by running the command in Postgres 'ALTER TABLE test.cdc_order REPLICA IDENTITY FULL'.
  ```

  A: If a similar error is reported in the run log, run the **ALTER TABLE test.cdc_order REPLICA IDENTITY FULL** statement in PostgreSQL.

3.3.1.8 Redis Source Table

Function

Create a source stream to obtain data from Redis as input for jobs.

Prerequisites

- An enhanced datasource connection has been created for DLI to connect to the Redis database, so that you can configure security group rules as required.
  - For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.
  - For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.
- In Flink cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

  For details about datasource authentication, see **Introduction to Datasource Authentication**.

Precautions

- When creating a Flink OpenSource SQL job, you need to set **Flink Version** to **1.12** on the **Running Parameters** tab of the job editing page, select **Save Job Log**, and set the OBS bucket for saving job logs.
- To obtain the key values, you can set the primary key in Flink. The primary key maps to the Redis key.
- The primary key cannot be a composite primary key, and only can be one field.
- Constraints on **schema-syntax**:
  - If **schema-syntax** is **map** or **array**, there can be only one non-primary key and it must be of the same **map** or **array** type.
  - If **schema-syntax** is **fields-scores**, the number of non-primary keys must be an even number, and the second key of every two keys except the primary key must be of the **double** type. The **double** value is the score of the previous key. The following is an example:

    ```
    CREATE TABLE redisSource (
      redisKey string,
      order_id string,
      score1 double,
      order_channel string,
      score2 double,
    ```



```
  order_time string,
  score3 double,
  pay_amount double,
  score4 double,
  real_pay double,
  score5 double,
  pay_time string,
  score6 double,
  user_id string,
  score7 double,
  user_name string,
  score8 double,
  area_id string,
  score9 double,
  primary key (redisKey) not enforced
) WITH (
  'connector' = 'redis',
  'host' = 'RedisIP',
  'password' = 'RedisPassword',
  'data-type' = 'sorted-set',
  'deploy-mode' = 'master-replica',
  'schema-syntax' = 'fields-scores'
);
```

- Restrictions on **data-type**:
  - When **data-type** is **set**, the types of non-primary keys defined in Flink must be the same.
  - If **data-type** is **sorted-set** and **schema-syntax** is **fields** or **array**, only **sorted-set** values can be read from Redis, and the **score** value cannot be read.
  - If **data-type** is **string**, only one non-primary key field is allowed.
  - If **data-type** is **sorted-set** and **schema-syntax** is **map**, only one non-primary key field is allowed besides the primary key field.

    This non-primary key field must be of the **map** type. The map value of the field must be of the **double** type, indicating the score. The map key of the field indicates the value in the Redis set.
  - If **data-type** is **sorted-set** and **schema-syntax** is **array-scores**, only two non-primary keys are allowed and must be of the **array** type.

    The first key indicates values in the Redis set. The second key is of the **array<double>** type, indicating index scores. The following is an example:

```
CREATE TABLE redisSink (
  order_id string,
  arrayField Array<String>,
  arrayScore array<double>,
  primary key (order_id) not enforced
) WITH (
  'connector' = 'redis',
  'host' = 'RedisIP',
  'password' = 'RedisPassword',
  'data-type' = 'sorted-set',
  "default-score" = '3',
  'deploy-mode' = 'master-replica',
  'schema-syntax' = 'array-scores'
);
```

Syntax

```
create table dwsSource (
  attr_name attr_type
  (',' attr_name attr_type)*
  (',' watermark for rowtime_column_name as watermark-strategy_expression)
  ,PRIMARY KEY (attr_name, ...) NOT ENFORCED
```



```
)
with (
  'connector' = 'redis',
  'host' = ''
);
```

Parameters

Table 3-12 Parameter description

Parameter	Mandatory	Default Value	Data Type	Description
connector	Yes	None	String	Connector to be used. Set this parameter to **redis**.
host	Yes	None	String	Redis connector address.
port	No	6379	Integer	Redis connector port.
password	No	None	String	Redis authentication password.
namespace	No	None	String	Redis key namespace.
delimiter	No	:	String	Delimiter between the Redis key and namespace.
data-type	No	hash	String	Redis data type. Available values are as follows: • hash • list • set • sorted-set • string For details about the constraints, see **Constraints on data-type**.

Parameter	Mandatory	Default Value	Data Type	Description
schema-syntax	No	fields	String	Redis schema semantics. Available values are as follows (for details, see **Precautions** and **FAQ**): • **fields**: applicable to all data types • **fields-scores**: applicable to **sorted-set** data • **array**: applicable to **list**, **set**, and **sorted-set** data • **array-scores**: applicable to **sorted-set** data • **map**: applicable to **hash** and **sorted-set** data For details about the constraints, see **Constraints on schema-syntax**.
deploy-mode	No	standalone	String	Deployment mode of the Redis cluster. The value can be **standalone**, **master-replica**, or **cluster**. The default value is **standalone**.
retry-count	No	5	Integer	Number of attempts to connect to the Redis cluster.
connection-timeout-millis	No	10000	Integer	Maximum timeout for connecting to the Redis cluster.
commands-timeout-millis	No	2000	Integer	Maximum time for waiting for a completion response.
rebalancing-timeout-millis	No	15000	Integer	Sleep time when the Redis cluster fails.
scan-keys-count	No	1000	Integer	Number of data records read in each scan.
default-score	No	0	Double	Default score when **data-type** is **sorted-set**.

Parameter	Mandatory	Default Value	Data Type	Description
deserialize-error-policy	No	fail-job	Enum	Policy of how to process a data parsing failure. Available values are as follows: • **fail-job**: Fail the job. • **skip-row**: Skip the current data. • **null-field**: Set the current data to null.
skip-null-values	No	true	Boolean	Whether null values will be skipped.
pwd_auth_name	No	None	String	Name of datasource authentication of the password type created on DLI. If datasource authentication is used, you do not need to set the username and password for jobs.

Example

In this example, data is read from the DCS Redis data source and written to the Print result table. The procedure is as follows:

1. Create an enhanced datasource connection in the VPC and subnet where Redis locates, and bind the connection to the required Flink elastic resource pool. For details, see **Enhanced Datasource Connections**.
2. Set Redis security groups and add inbound rules to allow access from the Flink queue. Test the connectivity using the Redis address by referring to **Testing Address Connectivity**. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.
3. Run the following commands on the Redis client to insert data into different keys and store the data in hash format:

   ```
   HMSET redisSource order_id 202103241000000001 order_channel webShop order_time "2021-03-24 10:00:00" pay_amount 100.00 real_pay 100.00 pay_time "2021-03-24 10:02:03" user_id 0001 user_name Alice area_id 330106

   HMSET redisSource1 order_id 202103241606060001 order_channel appShop order_time "2021-03-24 16:06:06" pay_amount 200.00 real_pay 180.00 pay_time "2021-03-24 16:10:06" user_id 0001 user_name Alice area_id 330106

   HMSET redisSource2 order_id 202103251202020001 order_channel miniAppShop order_time "2021-03-25 12:02:02" pay_amount 60.00 real_pay 60.00 pay_time "2021-03-25 12:03:00" user_id 0002 user_name Bob area_id 330110
   ```

4. Create a Flink OpenSource SQL job. Enter the following job script to read data in hash format from Redis.

   When you create a job, set **Flink Version** to **1.12** on the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs.

Change the values of the parameters in bold as needed in the following script.

```
CREATE TABLE redisSource (
  redisKey string,
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string,
  primary key (redisKey) not enforced  --Obtains the key value from Redis.
) WITH (
  'connector' = 'redis',
  'host' = '***RedisIP***',
  'password' = '***RedisPassword***',
  'data-type' = 'hash',
  'deploy-mode' = 'master-replica'
);

CREATE TABLE printSink (
  redisKey string,
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'print'
);

insert into printSink select * from redisSource;
```

5. Perform the following operations to view the data result in the **taskmanager.out** file:
   a. Log in to the DLI console. In the navigation pane, choose **Job Management** > **Flink Jobs**.
   b. Click the name of the corresponding Flink job, choose **Run Log**, click **OBS Bucket**, and locate the folder of the log you want to view according to the date.
   c. Go to the folder of the date, find the folder whose name contains **taskmanager**, download the **taskmanager.out** file, and view result logs.

   The data result is as follows:

```
+I(redisSource1,202103241606060001,appShop,2021-03-24 16:06:06,200.0,180.0,2021-03-24
16:10:06,0001,Alice,330106)
+I(redisSource,202103241000000001,webShop,2021-03-24 10:00:00,100.0,100.0,2021-03-24
10:02:03,0001,Alice,330106)
+I(redisSource2,202103251202020001,miniAppShop,2021-03-25 12:02:02,60.0,60.0,2021-03-25
12:03:00,0002,Bob,330110)
```

FAQ

- Q: What should I do if the Flink job execution fails and the log contains the following error information?

```
Caused by: org.apache.flink.client.program.ProgramInvocationException: The main method caused an
error: RealLine:36;Usage of 'set' data-type and 'fields' schema syntax in source Redis connector with
multiple non-key column types. As 'set' in Redis is not sorted, it's not possible to map 'set's values to
table schema with different types.
```


A: If **data-type** is **set**, the data types of non-primary key fields in Flink are different. As a result, this error is reported. When **data-type** is **set**, the types of non-primary keys defined in Flink must be the same.

- Q: If **data-type** is **hash**, what are the differences between **schema-syntax** set to **fields** and that to **map**?

  A: When **schema-syntax** is set to **fields**, the hash value in the Redis key is assigned to the field with the same name in Flink. When **schema-syntax** is set to **map**, the hash key and hash value of each hash in Redis are put into a map, which represents the value of the corresponding Flink field. Specifically, this map contains all hash keys and hash values of a key in Redis.

  - For **fields**:

    i. Insert the following data into Redis:

    ```
    HMSET redisSource order_id 202103241000000001 order_channel webShop order_time "2021-03-24 10:00:00" pay_amount 100.00 real_pay 100.00 pay_time "2021-03-24 10:02:03" user_id 0001 user_name Alice area_id 330106
    ```

    ii. When **schema-syntax** is set to **fields**, use the following job script:

    ```
    CREATE TABLE redisSource (
      redisKey string,
      order_id string,
      order_channel string,
      order_time string,
      pay_amount double,
      real_pay double,
      pay_time string,
      user_id string,
      user_name string,
      area_id string,
      primary key (redisKey) not enforced
    ) WITH (
      'connector' = 'redis',
      'host' = '***RedisIP***',
      'password' = '***RedisPassword***',
      'data-type' = 'hash',
      'deploy-mode' = 'master-replica'
    );

    CREATE TABLE printSink (
      redisKey string,
      order_id string,
      order_channel string,
      order_time string,
      pay_amount double,
      real_pay double,
      pay_time string,
      user_id string,
      user_name string,
      area_id string
    ) WITH (
      'connector' = 'print'
    );

    insert into printSink select * from redisSource;
    ```

    iii. The job execution result is as follows:

    ```
    +I(redisSource,202103241000000001,webShop,2021-03-24 10:00:00,100.0,100.0,2021-03-24 10:02:03,0001,Alice,330106)
    ```

  - For **map**:

    i. Insert the following data into Redis:

    ```
    HMSET redisSource order_id 202103241000000001 order_channel webShop order_time "2021-03-24 10:00:00" pay_amount 100.00 real_pay 100.00 pay_time "2021-03-24 10:02:03" user_id 0001 user_name Alice area_id 330106
    ```


ii. When **schema-syntax** is set to **map**, use the following job script:

```
CREATE TABLE redisSource (
  redisKey string,
  order_result map<string, string>,
  primary key (redisKey) not enforced
) WITH (
  'connector' = 'redis',
  'host' = '***RedisIP***',
  'password' = '***RedisPassword***',
  'data-type' = 'hash',
  'deploy-mode' = 'master-replica',
  'schema-syntax' = 'map'
);

CREATE TABLE printSink (
  redisKey string,
  order_result map<string, string>
) WITH (
  'connector' = 'print'
);

insert into printSink select * from redisSource;
```

iii. The job execution result is as follows:

```
+I(redisSource,{user_id=0001, user_name=Alice, pay_amount=100.00, real_pay=100.00,
order_time=2021-03-24 10:00:00, area_id=330106, order_id=202103241000000001,
order_channel=webShop, pay_time=2021-03-24 10:02:03})
```

3.3.1.9 Upsert Kafka Source Table

Function

Apache Kafka is a fast, scalable, and fault-tolerant distributed message publishing and subscription system. It delivers high throughput and built-in partitions and provides data replicas and fault tolerance. Apache Kafka is applicable to scenarios of handling massive messages.

As a source, the upsert-kafka connector produces a changelog stream, where each data record represents an update or delete event. More precisely, the value in a data record is interpreted as an UPDATE of the last value for the same key, if any (if a corresponding key does not exist yet, the UPDATE will be considered an INSERT). Using the table analogy, a data record in a changelog stream is interpreted as an UPSERT, also known as INSERT/UPDATE, because any existing row with the same key is overwritten. Also, null values are interpreted in a special way: A record with a null value represents a DELETE.

Prerequisites

- An enhanced datasource connection has been created for DLI to connect to Kafka clusters, so that jobs can run on the dedicated queue of DLI and you can set the security group rules as required.
  - For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.
  - For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.
- In Flink cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

For details about datasource authentication, see **Introduction to Datasource Authentication**.

Precautions

- When creating a Flink OpenSource SQL job, you need to set **Flink Version** to **1.12** on the **Running Parameters** tab of the job editing page, select **Save Job Log**, and set the OBS bucket for saving job logs.
- The Upsert Kafka always works in the upsert fashion and requires to define the primary key in the DDL. With the assumption that records with the same key should be ordered in the same partition, the primary key semantic on the changelog source means the materialized changelog is unique on the primary keys. The primary key definition will also control which fields should end up in Kafka's key.
- Because the connector is working in upsert mode, the last record on the same key will take effect when reading back as a source.
- For details about how to use data types, see section **Format**.

Syntax

```
create table kafkaSource(
  attr_name attr_type
  (',' attr_name attr_type)*
  (',PRIMARY KEY (attr_name, ...) NOT ENFORCED)
)
with (
  'connector' = 'upsert-kafka',
  'topic' = '',
  'properties.bootstrap.servers' = '',
  'key.format' = '',
  'value.format' = ''
);
```

Parameters

Table 3-13 Parameter description

Parameter	Mandatory	Default Value	Data Type	Description
connector	Yes	None	String	Connector to be used. Set this parameter to **upsert-kafka**.
topic	Yes	None	String	Kafka topic name.
properties.bootstrap.servers	Yes	None	String	Comma separated list of Kafka brokers.

Parameter	Mandatory	Default Value	Data Type	Description
key.format	Yes	None	String	Format used to deserialize and serialize the key part of Kafka messages. The key fields are specified by the **PRIMARY KEY** syntax. The following formats are supported: • csv • json • avro Refer to **Format** for more details and format parameters.
key.fields-prefix	No	None	String	Defines a custom prefix for all fields of the key format to avoid name clashes with fields of the value format. By default, the prefix is empty. If a custom prefix is defined, both the table schema and **key.fields** will work with prefixed names. When constructing the data type of the key format, the prefix will be removed and the non-prefixed names will be used within the key format. Note that this option requires that **value.fields-include** must be set to **EXCEPT_KEY**.
value.format	Yes	None	String	Format used to deserialize and serialize the value part of Kafka messages. The following formats are supported: • csv • json • avro Refer to **Format** for more details and format parameters.
value.fields-include	Yes	ALL	String	Controls which fields should appear in the value part. Possible values are: • **ALL**: All fields in the schema, including the primary key field, are included in the value part. • **EXCEPT_KEY**: All the fields of the table schema are included, except the primary key field.

Parameter	Mandatory	Default Value	Data Type	Description
properties.*	No	None	String	This option can set and pass arbitrary Kafka configurations. The suffix to **properties.** must match the parameter defined in **Kafka Configuration documentation**. Flink will remove the **properties.** key prefix and pass the transformed key and value to the underlying KafkaClient. For example, you can disable automatic topic creation via **'properties.allow.auto.create.topics' = 'false'**. But there are some configurations that do not support to set, because Flink will override them, for example, **'key.deserializer'** and **'value.deserializer'**.
ssl_auth_name	No	None	String	Name of datasource authentication of the Kafka_SSL type created on DLI. This configuration is used when SSL is configured for Kafka. Note: If only the SSL type is used, you need to set **properties.security.protocol** to **SSL**. If the SASL_SSL type is used, you need to set **properties.security.protocol** to **SASL_SSL**, **properties.sasl.mechanism** to **GSSAPI** or **PLAIN**, and **properties.sasl.jaas.config** to **org.apache.kafka.common.security.plain.PlainLoginModule required username=\"xxx\" password=\"xxx\";**.
krb_auth_name	No	None	String	Name of datasource authentication of the Kerberos type created on DLI. This configuration is used when SASL is configured for Kafka. Note: If the SASL_PLAINTEXT type and Kerberos authentication are used, you need to set **properties.sasl.mechanism** to **GSSAPI** and **properties.security.protocol** to **SASL_PLAINTEXT**.

Example

In this example, data is read from the Kafka data source and written to the Print result table. The procedure is as follows:

1. Create an enhanced datasource connection in the VPC and subnet where Kafka locates, and bind the connection to the required Flink elastic resource pool. For details, see **Enhanced Datasource Connections**.
2. Set Kafka security groups and add inbound rules to allow access from the Flink queue. Test the connectivity using the Kafka address by referring to **Testing Address Connectivity**. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.
3. Create a Flink OpenSource SQL job. Enter the following job script and submit the job.

   When you create a job, set **Flink Version** to **1.12** on the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs. **Change the values of the parameters in bold as needed in the following script.**

```
CREATE TABLE upsertKafkaSource (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string,
  PRIMARY KEY (order_id) NOT ENFORCED
) WITH (
  'connector' = 'upsert-kafka',
  'topic' = '***KafkaTopic***',
  'properties.bootstrap.servers' =  '***KafkaAddress1:KafkaPort,KafkAddress2:KafkaPort***',
  'key.format' = 'csv',
  'value.format' = 'json'
);

CREATE TABLE printSink (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string,
  PRIMARY KEY (order_id) NOT ENFORCED
) WITH (
  'connector' = 'print'
);

INSERT INTO printSink
SELECT * FROM upsertKafkaSource;
```

4. Insert the following data to the specified topics in Kafka. (Note: Specify the key when inserting data to Kafka.)

```
{"order_id":"202103251202020001", "order_channel":"miniAppShop", "order_time":"2021-03-25 12:02:02", "pay_amount":"60.00", "real_pay":"60.00", "pay_time":"2021-03-25 12:03:00", "user_id":"0002", "user_name":"Bob", "area_id":"330110"}

{"order_id":"202103251505050001", "order_channel":"qqShop", "order_time":"2021-03-25 15:05:05", "pay_amount":"500.00", "real_pay":"400.00", "pay_time":"2021-03-25 15:10:00", "user_id":"0003", "user_name":"Cindy", "area_id":"330108"}
```



```
{"order_id":"202103251202020001", "order_channel":"miniAppShop", "order_time":"2021-03-25 12:02:02", "pay_amount":"60.00", "real_pay":"60.00", "pay_time":"2021-03-25 12:03:00", "user_id":"0002", "user_name":"Bob", "area_id":"330110"}
```

5. Perform the following operations to view the output:
   a. Log in to the DLI console. In the navigation pane, choose **Job Management** > **Flink Jobs**.
   b. Click the name of the corresponding Flink job, choose **Run Log**, click **OBS Bucket**, and locate the folder of the log you want to view according to the date.
   c. Go to the folder of the date, find the folder whose name contains **taskmanager**, download the **taskmanager.out** file, and view result logs.

   The data result is as follows:

```
+I(202103251202020001,miniAppShop,2021-03-2512:02:02,60.0,60.0,2021-03-2512:03:00,0002,Bob,330110)
+I(202103251505050001,qqShop,2021-03-2515:05:05,500.0,400.0,2021-03-2515:10:00,0003,Cindy,330108)
-U(202103251202020001,miniAppShop,2021-03-2512:02:02,60.0,60.0,2021-03-2512:03:00,0002,Bob,330110)
+U(202103251202020001,miniAppShop,2021-03-2512:02:02,60.0,60.0,2021-03-2512:03:00,0002,Bob,330110)
```

FAQ

None

3.3.2 Creating Result Tables

3.3.2.1 BlackHole Result Table

Function

The BlackHole connector allows for swallowing all input records. It is designed for high-performance testing and UDF output. It is not a substantive sink. The BlackHole result table is a built-in connector.

For example, if an error is reported when you register a result table of another type, but you are not sure whether it is caused by a system fault or an invalid setting of the **WITH** parameter for the result table, you can change the value of **connector** to **blackhole** and click **Run**. If no error is reported, the system is normal. You must check the settings of the **WITH** parameter.

Prerequisites

None

Precautions

When creating a Flink OpenSource SQL job, you need to set **Flink Version** to **1.12** on the **Running Parameters** tab of the job editing page, select **Save Job Log**, and set the OBS bucket for saving job logs.

Syntax

```
create table blackhole_table (
 attr_name attr_type (',' attr_name attr_type) *
) with (
 'connector' = 'blackhole'
);
```

Parameters

Table 3-14

Parameter	Mandatory	Default Value	Data Type	Description
connector	Yes	None	String	Connector to be used. Set this parameter to **blackhole**.

Example

The DataGen source table generates data, and the BlackHole result table receives the data.

```
create table datagenSource (
 user_id string,
 user_name string,
 user_age int
) with (
 'connector' = 'datagen',
 'rows-per-second'='1'
);
create table blackholeSink (
 user_id string,
 user_name string,
 user_age int
) with (
 'connector' = 'blackhole'
);
insert into blackholeSink select * from datagenSource;
```

3.3.2.2 ClickHouse Result Table

Function

DLI can output Flink job data to the ClickHouse database. ClickHouse is a column-based database oriented to online analysis and processing. It supports SQL query and provides good query performance. The aggregation analysis and query performance based on large and wide tables is excellent, which is one order of magnitude faster than other analytical databases.

Prerequisites

- Your jobs are running on a dedicated queue (non-shared queue) of DLI.
- You have established an enhanced datasource connection to ClickHouse and set the port in the security group rule of the ClickHouse cluster as needed.

- For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.
- For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.

Precautions

- When creating a Flink OpenSource SQL job, you need to set **Flink Version** to **1.12** on the **Running Parameters** tab of the job editing page, select **Save Job Log**, and set the OBS bucket for saving job logs.
- When you create a ClickHouse cluster for MRS, set the cluster version to MRS 3.1.0 or later and do not enable Kerberos authentication.
- The ClickHouse result table does not support table data deletion.
- Flink supports the following data types: string, tinyint, smallint, int, long, float, double, date, timestamp, decimal, and array.

  The array supports only the int, bigint, string, float, and double data types.

Syntax

```
create table clickhouseSink (
  attr_name attr_type
  (',' attr_name attr_type)*
)
with (
  'connector.type' = clickhouse,
  'connector.url' = '',
  'connector.table' = ''
);
```

Parameters

Table 3-15 Parameter description

Parameter	Mandatory	Default Value	Data Type	Description
connector.type	Yes	None	String	Result table type. Set this parameter to **clickhouse**.

Parameter	Mandatory	Default Value	Data Type	Description
connector.url	Yes	None	String	ClickHouse URL. Parameter format: **jdbc:clickhouse://***ClickHouseBalancer instance IP address***:***HTTP port number for ClickHouseBalancer instances***/***Database name* • IP address of a ClickHouseBalancer instance: Log in to the MRS console and choose **Clusters** > **Active Clusters** in the navigation pane. Click a cluster name, and choose **Components** > **ClickHouse** > **Instances** to obtain the business IP address of the ClickHouseBalancer instance. • HTTP port of a ClickHouseBalancer instance: Log in to the MRS console and choose **Clusters** > **Active Clusters** in the navigation pane. Click a cluster name, and choose **Components** > **ClickHouse** > **Service Configuration**. On the **Service Configuration** page, select **ClickHouseBalancer** from the **All Roles** drop-down list, search for **lb_http_port**, and obtain the parameter value. The default value is **21425**. • The database name is the name of the database created for the ClickHouse cluster.
connector.table	Yes	None	String	Name of the ClickHouse table to be created.

Parameter	Mandatory	Default Value	Data Type	Description
connector.driver	No	ru.yandex.clickhouse.ClickHouseDriver	String	Driver required for connecting to the database. • If this parameter is not specified during table creation, the driver automatically extracts the value from the ClickHouse URL. • If this parameter is specified during table creation, the value must be **ru.yandex.clickhouse.ClickHouseDriver**.
connector.username	No	None	String	Username for connecting to the ClickHouse database.
connector.password	No	None	String	Password for connecting to the ClickHouse database.
connector.write.flush.max-rows	No	5000	Integer	Maximum number of rows to be updated when data is written. The default value is **5000**.
connector.write.flush.interval	No	0	Duration	Interval for data update. The unit can be ms, milli, millisecond/s, sec, second/min, or minute. Value **0** indicates that data is not updated.
connector.write.max-retries	No	3	Integer	Maximum number of retries for writing data to the result table. The default value is **3**.

Example

In this example, data is from Kafka and inserted to table **order** in ClickHouse database **flink**. The procedure is as follows (the ClickHouse version is 21.3.4.25 in MRS):

1. Create an enhanced datasource connection in the VPC and subnet where ClickHouse and Kafka clusters locate, and bind the connection to the required Flink queue. For details, see **Enhanced Datasource Connections**.
2. Set ClickHouse and Kafka cluster security groups and add inbound rules to allow access from the Flink queue. Test the connectivity using the ClickHouse address by referring to **Testing Address Connectivity**. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.
3. Use the ClickHouse client to connect to the ClickHouse server and run the following command to query other environment parameters such as the cluster ID:


```
select cluster,shard_num,replica_num,host_name from system.clusters;
```

The following information is displayed:

```
┌─cluster─────┬─shard_num─┐
│ default_cluster │ 1 │ 1 │
│ default_cluster │ 1 │ 2 │
└─────────────┴─────┴─────┘
```

4. Run the following command to create database **flink** on a node of the ClickHouse cluster based on the obtained cluster ID, for example, **default_cluster**:

```
CREATE DATABASE flink ON CLUSTER default_cluster;
```

5. Run the following command to create the ReplicatedMergeTree table named **order** on the node of cluster **default_cluster** and on database **flink**:

```
CREATE TABLE flink.order ON CLUSTER default_cluster(order_id String,order_channel
String,order_time String,pay_amount Float64,real_pay Float64,pay_time String,user_id
String,user_name String,area_id String) ENGINE = ReplicatedMergeTree('/clickhouse/tables/{shard}/
flink/order', '{replica}')ORDER BY order_id;
```

6. Create a Flink OpenSource SQL job. Enter the following job script and submit the job. The job script uses the Kafka data source and the ClickHouse result table.

   When you create a job, set **Flink Version** to **1.12** on the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs. **Change the values of the parameters in bold as needed in the following script.**

```
CREATE TABLE orders (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = '***KafkaTopic***',
  'properties.bootstrap.servers' = '***KafkaAddress1:KafkaPort,KafkaAddress2:KafkaPort***',
  'properties.group.id' = '***GroupId***',
  'scan.startup.mode' = 'latest-offset',
  'format' = 'json'
);

create table clickhouseSink(
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) with (
  'connector.type' = 'clickhouse',
  'connector.url' = 'jdbc:clickhouse://***ClickhouseAddress:ClickhousePort***/flink',
  'connector.table' = 'order',
  'connector.write.flush.max-rows' = '1'
);

insert into clickhouseSink select * from orders;
```

7. Connect to the Kafka cluster and insert the following test data into Kafka:

```
{"order_id":"202103241000000001", "order_channel":"webShop", "order_time":"2021-03-24 10:00:00",
"pay_amount":"100.00", "real_pay":"100.00", "pay_time":"2021-03-24 10:02:03", "user_id":"0001",
```



```
"user_name":"Alice", "area_id":"330106"}

{"order_id":"202103241606060001", "order_channel":"appShop", "order_time":"2021-03-24 16:06:06",
"pay_amount":"200.00", "real_pay":"180.00", "pay_time":"2021-03-24 16:10:06", "user_id":"0001",
"user_name":"Alice", "area_id":"330106"}

{"order_id":"202103251202020001", "order_channel":"miniAppShop", "order_time":"2021-03-25
12:02:02", "pay_amount":"60.00", "real_pay":"60.00", "pay_time":"2021-03-25 12:03:00",
"user_id":"0002", "user_name":"Bob", "area_id":"330110"}
```

8. Use the ClickHouse client to connect to the ClickHouse and run the following command to query the data written to table **order** in database **flink**:

```
select * from flink.order;
```

The query result is as follows:

```
202103241000000001 webShop 2021-03-24 10:00:00 100 100 2021-03-24 10:02:03 0001 Alice 330106

202103241606060001 appShop 2021-03-24 16:06:06 200 180 2021-03-24 16:10:06 0001 Alice 330106

202103251202020001 miniAppShop 2021-03-25 12:02:02 60 60 2021-03-25 12:03:00 0002 Bob
330110
```

FAQ

None

3.3.2.3 GaussDB(DWS) Result Table

Function

DLI outputs the Flink job output data to GaussDB(DWS). GaussDB(DWS) database kernel is compliant with PostgreSQL. The PostgreSQL database can store data of more complex types and deliver space information services, multi-version concurrent control (MVCC), and high concurrency. It applies to location applications, financial insurance, and e-Commerce.

GaussDB(DWS) is an online data processing database based on the cloud infrastructure and platform and helps you mine and analyze massive sets of data.

Prerequisites

- When creating a Flink OpenSource SQL job, you need to set **Flink Version** to **1.12** on the **Running Parameters** tab of the job editing page, select **Save Job Log**, and set the OBS bucket for saving job logs.
- You have created a GaussDB(DWS) cluster. For details about how to create a GaussDB(DWS) cluster, see **Creating a Cluster** in the *Data Warehouse Service Management Guide*.
- You have created a GaussDB(DWS) database table.
- An enhanced datasource connection has been created for DLI to connect to GaussDB(DWS) clusters, so that jobs can run on the dedicated queue of DLI and you can set the security group rules as required.
  - For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.
  - For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.

- In Flink cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

  For details about datasource authentication, see **Introduction to Datasource Authentication**.

Precautions

- To use the upsert mode, you must define the primary key for both the GaussDB(DWS) result table and the GaussDB(DWS) table connected to the result table.
- If tables with the same name exist in different GaussDB(DWS) schemas, you need to specify the schemas in the Flink open source SQL statements.
- Before submitting a Flink job, you are advised to select **Save Job Log** and set the OBS bucket for saving job logs. This helps you view logs and locate faults when the job fails to be submitted or runs abnormally.
- If you use the gsjdbc4 driver for connection, set **driver** to **org.postgresql.Driver**. You can omit this parameter because the gsjdbc4 driver is the default one.

  For example, run the following statements to use the gsjdbc4 driver to write data to GaussDB(DWS) in upsert mode:

```
create table dwsSink(
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_speed INT
) with (
  'connector' = 'gaussdb',
  'url' = 'jdbc:postgresql://DwsAddress:DwsPort/DwsDatabase',
  'table-name' = 'car_info',
  'username' = 'DwsUserName',
  'password' = 'DwsPasswrod',
  'write.mode' = 'upsert'
);
```

- If you use the gsjdbc200 driver for connection, set **driver** to **com.huawei.gauss200.jdbc.Driver**.

  For example, run the following statements to write data to GaussDB(DWS) result table **test** that is in schema **ads_game_sdk_base**:

```
create table dwsSink(
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_speed INT
) with (
  'connector' = 'gaussdb',
  'table-name' = 'ads_game_sdk_base\".\"test',
  'driver' = 'com.huawei.gauss200.jdbc.Driver',
  'url' = 'jdbc:gaussdb://DwsAddress:DwsPort/DwsDatabase',
  'username' = 'DwsUserName',
  'password' = 'DwsPasswrod',
  'write.mode' = 'upsert'
);
```

Syntax

NOTE

Do not set all attributes in a GaussDB(DWS) result table to **PRIMARY KEY**.


```
create table dwsSink (
  attr_name attr_type
  (',' attr_name attr_type)*
  (',PRIMARY KEY (attr_name, ...) NOT ENFORCED)
)
with (
  'connector' = 'gaussdb',
  'url' = '',
  'table-name' = '',
  'driver' = '',
  'username' = '',
  'password' = ''
);
```

Parameters

Table 3-16 Parameter description

Parameter	Mandatory	Default Value	Data Type	Description
connector	Yes	None	String	Connector to be used. Set this parameter to **gaussdb**.
url	Yes	None	String	JDBC connection address. If you use the gsjdbc4 driver, set the value in jdbc:postgresql://${ip}:${port}/${dbName} format. If you use the gsjdbc200 driver, set the value in jdbc:gaussdb://${ip}:${port}/${dbName} format.
table-name	Yes	None	String	Name of the table to be operated. If the GaussDB(DWS) table is in a schema, the format is **schema\".\"***Table name*. For details, see **FAQ**.
driver	No	org.postgresql.Driver	String	JDBC connection driver. The default value is **org.postgresql.Driver**. • If you use the gsjdbc4 driver for connection, set this parameter to **org.postgresql.Driver**. • If you use the gsjdbc200 driver for connection, set this parameter to **com.huawei.gauss200.jdbc.Driver**.
username	No	None	String	Username for GaussDB(DWS) database authentication. This parameter must be configured in pair with **password**.
password	No	None	String	Password for GaussDB(DWS) database authentication. This parameter must be configured in pair with **username**.

Parameter	Mandatory	Default Value	Data Type	Description
write.mode	No	None	String	Data write mode. The value can be **copy**, **insert**, or **upsert**. The default value is **upsert**. This parameter must be configured depending on **primary key**. ● If **primary key** is not configured, data can be appended in **copy** and **insert** modes. ● If **primary key** is configured, all the three modes are available. Note: GaussDB(DWS) does not support the update of distribution columns. The primary keys of columns to be updated must cover all distribution columns defined in the GaussDB(DWS) table.
sink.buffer-flush.max-rows	No	100	Integer	Maximum number of rows to buffer for each write request. It can improve the performance of writing data, but may increase the latency. You can set this parameter to **0** to disable it.
sink.buffer-flush.interval	No	1s	Duration	Interval for refreshing the buffer, during which data is refreshed by asynchronous threads. It can improve the performance of writing data to the database, but may increase the latency. You can set this parameter to **0** to disable it. Note: If **sink.buffer-flush.max-size** and **sink.buffer-flush.max-rows** are both set to **0** and the buffer refresh interval is configured, the buffer is asynchronously refreshed. The format is {length value}{time unit label}, for example, **123ms, 321s**. The supported time units include d, h, min, s, and ms (default unit).
sink.max-retries	No	3	Integer	Maximum number of write retries.

Parameter	Mandatory	Default Value	Data Type	Description
write.escape-string-value	No	false	Boolean	Whether to escape values of the string type. This parameter is used only when **write.mode** is set to **copy**.
pwd_auth_name	No	None	String	Name of datasource authentication of the password type created on DLI. If datasource authentication is used, you do not need to set the username and password for jobs.

Example

In this example, data is read from the Kafka data source and written to the GaussDB(DWS) result table in insert mode. The procedure is as follows:

1. Create an enhanced datasource connection in the VPC and subnet where GaussDB(DWS) and Kafka locate, and bind the connection to the required Flink elastic resource pool. For details, see **Enhanced Datasource Connections**.
2. Set GaussDB(DWS) and Kafka security groups and add inbound rules to allow access from the Flink queue. Test the connectivity using the GaussDB(DWS) and Kafka address by referring to **Testing Address Connectivity**. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.
3. Connect to the GaussDB(DWS) database and create a table named **dws_order**.

   ```
   create table public.dws_order(
     order_id VARCHAR,
     order_channel VARCHAR,
     order_time VARCHAR,
     pay_amount FLOAT8,
     real_pay FLOAT8,
     pay_time VARCHAR,
     user_id VARCHAR,
     user_name VARCHAR,
     area_id VARCHAR);
   ```

4. Create a Flink OpenSource SQL job. Enter the following job script and submit the job. The job script uses the Kafka data source and the GaussDB(DWS) result table.

   When you create a job, set **Flink Version** to **1.12** on the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs. **Change the values of the parameters in bold as needed in the following script.**

   ```
   CREATE TABLE kafkaSource (
     order_id string,
     order_channel string,
     order_time string,
     pay_amount double,
     real_pay double,
     pay_time string,
     user_id string,
   ```



```
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = 'KafkaTopic',
  'properties.bootstrap.servers' = 'KafkaAddress1:KafkaPort,KafkaAddress2:KafkaPort',
  'properties.group.id' = 'GroupId',
  'scan.startup.mode' = 'latest-offset',
  'format' = 'json'
);

CREATE TABLE dwsSink (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'gaussdb',
  'url' = 'jdbc:postgresql://DWSAddress:DWSPort/DWSdbName',
  'table-name' = 'dws_order',
  'driver' = 'org.postgresql.Driver',
  'username' = 'DWSUserName',
  'password' = 'DWSPassword',
  'write.mode' = 'insert'
);

insert into dwsSink select * from kafkaSource;
```

5. Connect to the Kafka cluster and enter the following test data to Kafka:

```
{"order_id":"202103241000000001", "order_channel":"webShop", "order_time":"2021-03-24 10:00:00", "pay_amount":"100.00", "real_pay":"100.00", "pay_time":"2021-03-24 10:02:03", "user_id":"0001", "user_name":"Alice", "area_id":"330106"}
```

6. Run the following SQL statement in GaussDB(DWS) to view the data result:

```
 select * from dws_order
```

   The data result is as follows:

```
202103241000000001    webShop    2021-03-24 10:00:00    100.0    100.0    2021-03-24 10:02:03    0001    Alice    330106
```

FAQ

- Q: What should I do if the Flink job execution fails and the log contains the following error information?

  ```
  java.io.IOException: unable to open JDBC writer
  ...
  Caused by: org.postgresql.util.PSQLException: The connection attempt failed.
  ...
  Caused by: java.net.SocketTimeoutException: connect timed out
  ```

  A: The datasource connection is not bound or the binding fails.

  - To reconfigure datasource connections, refer to **Enhanced Datasource Connection**. Rectify the fault by referring to **DLI Failed to Connect to GaussDB(DWS) Through an Enhanced Datasource Connection**.

- Q: How can I configure a GaussDB(DWS) table that is in a schema?

  A: When GaussDB(DWS) table **test** is in schema **ads_game_sdk_base**, refer to the **'table-name'** parameter setting in the following example:

  ```
  CREATE TABLE ads_rpt_game_sdk_realtime_ada_reg_user_pay_mm (
    ddate DATE,
    dmin TIMESTAMP(3),
    game_appkey VARCHAR,
    channel_id VARCHAR,
  ```



```
  pay_user_num_1m bigint,
  pay_amt_1m bigint,
  PRIMARY KEY (ddate, dmin, game_appkey, channel_id) NOT ENFORCED
) WITH (
  'connector' = 'gaussdb',
  'url' = 'jdbc:postgresql://<yourDwsAddress>:<yourDwsPort>/dws_bigdata_db',
  'table-name' = 'ads_game_sdk_base\".\"test',
  'username' = '<yourUsername>',
  'password' = '<yourPassword>',
  'write.mode' = 'upsert'
);
```

- Q: What can I do if a job is running properly but there is no data in GaussDB(DWS)?

  A: Check the following items:

  - Check whether the JobManager and TaskManager logs contain error information. To view logs, perform the following steps:
    i. Log in to the DLI console. In the navigation pane, choose **Job Management** > **Flink Jobs**.
    ii. Click the name of the corresponding Flink job, choose **Run Log**, click **OBS Bucket**, and locate the folder of the log you want to view according to the date.
    iii. Go to the folder of the date, find the folder whose name contains **taskmanager** or **jobmanager**, download the **taskmanager.out** or **jobmanager.out** file, and view result logs.
  - Check whether the datasource connection is correctly bound and whether a security group rule allows access of the queue.
  - Check whether the GaussDB(DWS) table to which data is to be written exists in multiple schemas. If it does, specify the schemas in the Flink job.

3.3.2.4 Elasticsearch Result Table

Function

DLI outputs Flink job output data to Elasticsearch of Cloud Search Service (CSS). Elasticsearch is a popular enterprise-class Lucene-powered search server and provides the distributed multi-user capabilities. It delivers multiple functions, including full-text retrieval, structured search, analytics, aggregation, and highlighting. With Elasticsearch, you can achieve stable, reliable, real-time search. Elasticsearch applies to diversified scenarios, such as log analysis and site search.

CSS is a fully managed, distributed search service. It is fully compatible with open-source Elasticsearch and provides DLI with structured and unstructured data search, statistics, and report capabilities.

Prerequisites

- When creating a Flink OpenSource SQL job, you need to set **Flink Version** to **1.12** on the **Running Parameters** tab of the job editing page, select **Save Job Log**, and set the OBS bucket for saving job logs.
- You have created a cluster on CSS.
- An enhanced datasource connection has been created for DLI to connect to CSS, so that jobs can run on the dedicated queue of DLI and you can set the security group rules as required.

  - For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.
  - For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.
- In Flink cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

  For details about datasource authentication, see **Introduction to Datasource Authentication**.

Precautions

- Currently, only CSS 7.X and later versions are supported. Version 7.6.2 is recommended.
- ICMP must be enabled for the security group inbound rules of the CSS cluster.
- For details about how to use data types, see section **Format**.
- Before submitting a Flink job, you are advised to select **Save Job Log** and set the OBS bucket for saving job logs. This helps you view logs and locate faults when the job fails to be submitted or runs abnormally.
- The Elasticsearch sink can work in either upsert mode or append mode, depending on whether a primary key is defined.
  - If a primary key is defined, the Elasticsearch sink works in upsert mode, which can consume queries containing UPDATE and DELETE messages.
  - If a primary key is not defined, the Elasticsearch sink works in append mode which can only consume queries containing INSERT messages.

  In the Elasticsearch result table, the primary key is used to calculate the Elasticsearch document ID. The document ID is a string of up to 512 bytes. It cannot have spaces. The Elasticsearch result table generates a document ID string for every row by concatenating all primary key fields in the order defined in the DDL using a key delimiter specified by **document-id.key-delimiter**. Certain types are not allowed as a primary key field as they do not have a good string representation, for example, BYTES, ROW, ARRAY, and MAP. If no primary key is specified, Elasticsearch will generate a document ID automatically.
- The Elasticsearch result table supports both static index and dynamic index.
  - If you want to have a static index, the index option value should be a plain string, such as **myusers**, all the records will be consistently written into the **myusers** index.
  - If you want to have a dynamic index, you can use **{field_name}** to reference a field value in the record to dynamically generate a target index. You can also use **{field_name|date_format_string}** to convert a field value of the TIMESTAMP, DATE, or TIME type into the format specified by **date_format_string**. **date_format_string** is compatible with Java's **DateTimeFormatter**. For example, if the option value is **myusers-{log_ts|yyyy-MM-dd}**, then a record with **log_ts** field value **2020-03-27 12:25:55** will be written into the **myusers-2020-03-27** index.

Syntax

```
create table esSink (
  attr_name attr_type
```



```
  (',' attr_name attr_type)*
  (','PRIMARY KEY (attr_name, ...) NOT ENFORCED)
)
with (
  'connector' = 'elasticsearch-7',
  'hosts' = '',
  'index' = ''
);
```

Parameters

Table 3-17 Parameter description

Parameter	Mandatory	Default Value	Data Type	Description
connector	Yes	None	String	Connector to be used. Set this parameter to **elasticsearch-7**, indicating to connect to a cluster of Elasticsearch 7.x or later.
hosts	Yes	None	String	Host name of the cluster where Elasticsearch is located. Use semicolons (;) to separate multiple host names.
index	Yes	None	String	Elasticsearch index for every record. The index can be a static index (for example, **'myIndex'**) or a dynamic index (for example, **'index-{log_ts|yyyy-MM-dd}'**).
username	No	None	String	Username of the cluster where Elasticsearch locates. This parameter must be configured in pair with **password**.
password	No	None	String	Password of the cluster where Elasticsearch locates. This parameter must be configured in pair with **username**.
document-id.key-delimiter	No	_	String	Delimiter of composite primary keys. The default value is _.

Parameter	Mandatory	Default Value	Data Type	Description
failure-handler	No	fail	String	Failure handling strategy in case a request to Elasticsearch fails. Valid strategies are: • **fail**: throws an exception if a request fails and thus causes a job failure. • **ignore**: ignores failures and drops the request. • **retry-rejected**: re-adds requests that have failed due to queue capacity saturation. • **Custom class name**: for failure handling with an **ActionRequestFailureHandler** subclass.
sink.flush-on-checkpoint	No	true	Boolean	Whether to flush on checkpoint. If this parameter is set to **false**, the connector will not wait for all pending action requests to be acknowledged by Elasticsearch on checkpoints. Therefore, the connector does not provide any strong guarantees for at-least-once delivery of action requests.
sink.bulk-flush.max-actions	No	1000	Interger	Maximum number of buffered actions per bulk request. You can set this parameter to **0** to disable it.
sink.bulk-flush.max-size	No	2mb	MemorySize	Maximum size in memory of buffered actions per bulk request. It must be in MB granularity. You can set this parameter to **0** to disable it.
sink.bulk-flush.interval	No	1s	Duration	Interval for flushing buffered actions. You can set this parameter to **0** to disable it. Note: Both **sink.bulk-flush.max-size** and **sink.bulk-flush.max-actions** can be set to **0** with the flush interval set allowing for complete asynchronous processing of buffered actions.

Parameter	Mandatory	Default Value	Data Type	Description
sink.bulk-flush.backoff.strategy	No	DISABLED	String	Specifies how to perform retries if any flush actions failed due to a temporary request error. Valid strategies are: • **DISABLED**: no retry performed, that is, fail after the first request error. • **CONSTANT**: wait for backoff delay between retries. • **EXPONENTIAL**: initially wait for backoff delay and increase exponentially between retries.
sink.bulk-flush.backoff.max-retries	No	8	Integer	Maximum number of backoff retries.
sink.bulk-flush.backoff.delay	No	50ms	Duration	Delay between each backoff attempt. For **CONSTANT** backoff, this is simply the delay between each retry. For **EXPONENTIAL** backoff, this is the initial base delay.
connection.max-retry-timeout	No	None	Duration	Maximum timeout between retries.
connection.path-prefix	No	None	String	Prefix string to be added to every REST communication, for example, **'/v1'**.
format	No	json	String	The Elasticsearch connector supports to specify a format. The format must produce a valid JSON document. By default, the built-in JSON format is used. Refer to **Format** for more details and format parameters.
pwd_auth_name	No	None	String	Datasource authentication name of the password type. • Set this parameter only when datasource authentication of the CSS type is used. • Set either **es_auth_name** or this parameter.

Example

In this example, data is read from the Kafka data source and written to the Elasticsearch result table. The procedure is as follows:

1. Create an enhanced datasource connection in the VPC and subnet where Elasticsearch and Kafka locate, and bind the connection to the required Flink elastic resource pool. For details, see **Enhanced Datasource Connections**.
2. Set Elasticsearch and Kafka security groups and add inbound rules to allow access from the Flink queue. Test the connectivity using the Elasticsearch and Kafka address by referring to **Testing Address Connectivity**. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.
3. Log in to Kibana of the Elasticsearch cluster, select Dev Tools, enter and execute the following statement to create an index whose value is **orders**:

```
PUT /orders
{
  "settings": {
    "number_of_shards": 1
  },
    "mappings": {
      "properties": {
        "order_id": {
          "type": "text"
        },
        "order_channel": {
          "type": "text"
        },
        "order_time": {
          "type": "text"
        },
        "pay_amount": {
          "type": "double"
        },
        "real_pay": {
          "type": "double"
        },
        "pay_time": {
          "type": "text"
        },
        "user_id": {
          "type": "text"
        },
        "user_name": {
          "type": "text"
        },
        "area_id": {
          "type": "text"
        }
      }
    }
}
```

4. Create a Flink OpenSource SQL job. Enter the following job script and submit the job.

   When you create a job, set **Flink Version** to **1.12** on the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs. **Change the values of the parameters in bold as needed in the following script.**

```
CREATE TABLE kafkaSource (
  order_id string,
  order_channel string,
  order_time string,
```



```
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = '***KafkaTopic***',
  'properties.bootstrap.servers' = '***KafkaAddress1:KafkaPort,KafkaAddress2:KafkaPort***',
  'properties.group.id' = '***GroupId***',
  'scan.startup.mode' = 'latest-offset',
  "format" = "json"
);

CREATE TABLE elasticsearchSink (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'elasticsearch-7',
  'hosts' = '***ElasticsearchAddress:ElasticsearchPort***',
  'index' = 'orders'
);

insert into elasticsearchSink select * from kafkaSource;
```

5. Connect to the Kafka cluster and insert the following test data into Kafka:

```
{"order_id":"202103241000000001", "order_channel":"webShop", "order_time":"2021-03-24 10:00:00",
"pay_amount":"100.00", "real_pay":"100.00", "pay_time":"2021-03-24 10:02:03", "user_id":"0001",
"user_name":"Alice", "area_id":"330106"}

{"order_id":"202103241606060001", "order_channel":"appShop", "order_time":"2021-03-24 16:06:06",
"pay_amount":"200.00", "real_pay":"180.00", "pay_time":"2021-03-24 16:10:06", "user_id":"0001",
"user_name":"Alice", "area_id":"330106"}
```

6. Enter the following statement in Kibana of the Elasticsearch cluster and view the result:

```
GET orders/_search
{
  "took" : 1,
  "timed_out" : false,
  "_shards" : {
    "total" : 1,
    "successful" : 1,
    "skipped" : 0,
    "failed" : 0
  },
  "hits" : {
    "total" : {
      "value" : 2,
      "relation" : "eq"
    },
    "max_score" : 1.0,
    "hits" : [
      {
        "_index" : "orders",
        "_type" : "_doc",
        "_id" : "ae7wpH4B1dV9conjpXeB",
        "_score" : 1.0,
        "_source" : {
          "order_id" : "202103241000000001",
          "order_channel" : "webShop",
          "order_time" : "2021-03-24 10:00:00",
```



```
        "pay_amount" : 100.0,
        "real_pay" : 100.0,
        "pay_time" : "2021-03-24 10:02:03",
        "user_id" : "0001",
        "user_name" : "Alice",
        "area_id" : "330106"
      }
    },
    {
      "_index" : "orders",
      "_type" : "_doc",
      "_id" : "au7xpH4B1dV9conjn3er",
      "_score" : 1.0,
      "_source" : {
        "order_id" : "202103241606060001",
        "order_channel" : "appShop",
        "order_time" : "2021-03-24 16:06:06",
        "pay_amount" : 200.0,
        "real_pay" : 180.0,
        "pay_time" : "2021-03-24 16:10:06",
        "user_id" : "0001",
        "user_name" : "Alice",
        "area_id" : "330106"
      }
    }
  ]
 }
}
```

3.3.2.5 HBase Result Table

Function

DLI outputs the job data to HBase. HBase is a column-oriented distributed cloud storage system that features enhanced reliability, excellent performance, and elastic scalability. It applies to the storage of massive amounts of data and distributed computing. You can use HBase to build a storage system capable of storing TB- or even PB-level data. With HBase, you can filter and analyze data with ease and get responses in milliseconds, rapidly mining data value. Structured and semi-structured key-value data can be stored, including messages, reports, recommendation data, risk control data, logs, and orders. With DLI, you can write massive volumes of data to HBase at a high speed and with low latency.

Prerequisites

- An enhanced datasource connection has been created for DLI to connect to HBase, so that jobs can run on the dedicated queue of DLI and you can set the security group rules as required.
  - For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.
  - For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.
- If MRS HBase is used, IP addresses of all hosts in the MRS cluster have been added to host information of the enhanced datasource connection.

  .
- In Flink cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

For details about datasource authentication, see **Introduction to Datasource Authentication**.

Precautions

- When creating a Flink OpenSource SQL job, you need to set **Flink Version** to **1.12** on the **Running Parameters** tab of the job editing page, select **Save Job Log**, and set the OBS bucket for saving job logs.
- The column families in created HBase result table must be declared as the ROW type, the field names map the column family names, and the nested field names map the column qualifier names. There is no need to declare all the families and qualifiers in the schema. Users can declare what is used in the query. Except the ROW type fields, the single atomic type field (for example, STRING or BIGINT) will be recognized as the HBase rowkey. The rowkey field can be an arbitrary name, but should be quoted using backticks if it is a reserved keyword.

Syntax

```
create table hbaseSink (
  attr_name attr_type
  (',' attr_name attr_type)*
  ','PRIMARY KEY (attr_name, ...) NOT ENFORCED)
) with (
  'connector' = 'hbase-2.2',
  'table-name' = '',
  'zookeeper.quorum' = ''
);
```

Parameters

Table 3-18 Parameter description

Parameter	Mandatory	Default Value	Data Type	Description
connector	Yes	None	String	Connector to be used. Set this parameter to **hbase-2.2**.
table-name	Yes	None	String	Name of the HBase table to connect.

Parameter	Mandatory	Default Value	Data Type	Description
zookeeper.quorum	Yes	None	String	HBase ZooKeeper instance information, in the format of ZookeeperAddress:ZookeeperPort. The following uses an MRS HBase cluster as an example to describe how to obtain the IP address and port number of ZooKeeper used by this parameter: • On MRS Manager, choose **Cluster** and click the name of the desired cluster. Choose **Services** > **ZooKeeper** > **Instance**, and obtain the IP address of the ZooKeeper instance. • On MRS Manager, choose **Cluster** and click the name of the desired cluster. Choose **Services** > **ZooKeeper** > **Configurations** > **All Configurations**, search for the **clientPort** parameter, and obtain its value, that is, the ZooKeeper port number.
zookeeper.znode.parent	No	/hbase	String	Root directory in ZooKeeper. The default value is **/hbase**.
null-string-literal	No	null	String	Representation for null values for string fields. The HBase sink encodes/decodes empty bytes as null values for all types except the string type.
sink.buffer-flush.max-size	No	2mb	MemorySize	Maximum size in memory of buffered rows for each write request. This can improve performance for writing data to the HBase database, but may increase the latency. You can set this parameter to **0** to disable it.
sink.buffer-flush.max-rows	No	1000	Integer	Maximum number of rows to buffer for each write request. This can improve performance for writing data to the HBase database, but may increase the latency. You can set this parameter to **0** to disable it.

Parameter	Mandatory	Default Value	Data Type	Description
sink.buffer-flush.interval	No	1s	Duration	Interval for refreshing the buffer, during which data is refreshed by asynchronous threads. This can improve performance for writing data to the HBase database, but may increase the latency. You can set this parameter to **0** to disable it. Note: If **sink.buffer-flush.max-size** and **sink.buffer-flush.max-rows** are both set to **0** and the buffer refresh interval is configured, the buffer is asynchronously refreshed. The format is *{length value}{time unit label}*, for example, **123ms, 321s**. The supported time units include **d**, **h**, **min**, **s**, and **ms** (default unit).
sink.parallelism	No	None	Integer	Defines the parallelism of the HBase sink operator. By default, the parallelism is determined by the framework using the same parallelism of the upstream chained operator.
krb_auth_name	No	None	String	Name of datasource authentication of the Kerberos type created on DLI. If datasource authentication is used, you do not need to set the username and password for jobs.

Data Type Mapping

HBase stores all data as byte arrays. The data needs to be serialized and deserialized during read and write operations.

When serializing and de-serializing, Flink HBase connector uses utility class **org.apache.hadoop.hbase.util.Bytes** provided by HBase (Hadoop) to convert Flink data types to and from byte arrays.

Flink HBase connector encodes null values to empty bytes, and decode empty bytes to null values for all data types except the string type. For the string type, the null literal is determined by the **null-string-literal** option.

Table 3-19 Data type mapping

Flink SQL Type	HBase Conversion
CHAR / VARCHAR / STRING	byte[] toBytes(String s) String toString(byte[] b)
BOOLEAN	byte[] toBytes(boolean b) boolean toBoolean(byte[] b)
BINARY / VARBINARY	Returns byte[] as is.
DECIMAL	byte[] toBytes(BigDecimal v) BigDecimal toBigDecimal(byte[] b)
TINYINT	new byte[] { val } bytes[0] // returns first and only byte from bytes
SMALLINT	byte[] toBytes(short val) short toShort(byte[] bytes)
INT	byte[] toBytes(int val) int toInt(byte[] bytes)
BIGINT	byte[] toBytes(long val) long toLong(byte[] bytes)
FLOAT	byte[] toBytes(float val) float toFloat(byte[] bytes)
DOUBLE	byte[] toBytes(double val) double toDouble(byte[] bytes)
DATE	Stores the number of days since epoch as an int value.
TIME	Stores the number of milliseconds of the day as an int value.
TIMESTAMP	Stores the milliseconds since epoch as a long value.
ARRAY	Not supported
MAP / MULTISET	Not supported
ROW	Not supported

Example

In this example, data is read from the Kafka data source and written to the HBase result table. The procedure is as follows (the HBase versions used in this example are 1.3.1 and 2.2.3):

1. Create an enhanced datasource connection in the VPC and subnet where HBase and Kafka locate, and bind the connection to the required Flink elastic resource pool. For details, see **Enhanced Datasource Connections**. .
2. Set HBase and Kafka security groups and add inbound rules to allow access from the Flink queue. Test the connectivity using the HBase and Kafka address by referring to **Testing Address Connectivity**. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.
3. Use the HBase shell to create HBase table **order** that has only one column family **detail**.

   ```
   create 'order', {NAME => 'detail'}
   ```

4. Create a Flink OpenSource SQL job. Enter the following job script and submit the job. The job script uses Kafka as the data source and HBase as the result table (the Rowkey is **order_id** and the column family name is **detail**).

   When you create a job, set **Flink Version** to **1.12** on the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs. **Change the values of the parameters in bold as needed in the following script.**

   ```
   CREATE TABLE orders (
     order_id string,
     order_channel string,
     order_time string,
     pay_amount double,
     real_pay double,
     pay_time string,
     user_id string,
     user_name string,
     area_id string
   ) WITH (
     'connector' = 'kafka',
     'topic' = '***KafkaTopic***',
     'properties.bootstrap.servers' = '***KafkaAddress1:KafkaPort,KafkaAddress2:KafkaPort***',
     'properties.group.id' = '***GroupId***',
     'scan.startup.mode' = 'latest-offset',
     'format' = 'json'
   );

   create table hbaseSink(
     order_id string,
     detail Row(
       order_channel string,
       order_time string,
       pay_amount double,
       real_pay double,
       pay_time string,
       user_id string,
       user_name string,
       area_id string)
   ) with (
     'connector' = 'hbase-2.2',
     'table-name' = 'order',
     'zookeeper.quorum' = '***ZookeeperAddress:ZookeeperPort***',
     'sink.buffer-flush.max-rows' = '1'
   );

   insert into hbaseSink select order_id,
   Row(order_channel,order_time,pay_amount,real_pay,pay_time,user_id,user_name,area_id) from orders;
   ```

5. Connect to the Kafka cluster and enter the following data to Kafka:

   ```
   {"order_id":"202103241000000001", "order_channel":"webShop", "order_time":"2021-03-24 10:00:00",
   "pay_amount":"100.00", "real_pay":"100.00", "pay_time":"2021-03-24 10:02:03", "user_id":"0001",
   "user_name":"Alice", "area_id":"330106"}

   {"order_id":"202103241606060001", "order_channel":"appShop", "order_time":"2021-03-24 16:06:06",
   "pay_amount":"200.00", "real_pay":"180.00", "pay_time":"2021-03-24 16:10:06", "user_id":"0001",
   ```



```
"user_name":"Alice", "area_id":"330106"}

{"order_id":"202103251202020001", "order_channel":"miniAppShop", "order_time":"2021-03-25
12:02:02", "pay_amount":"60.00", "real_pay":"60.00", "pay_time":"2021-03-25 12:03:00",
"user_id":"0002", "user_name":"Bob", "area_id":"330110"}
```

6. Run the following statement on the HBase shell to view the data result:

```
scan 'order'
```

The data result is as follows:

```
202103241000000001    column=detail:area_id, timestamp=2021-12-16T21:30:37.954, value=330106

202103241000000001    column=detail:order_channel, timestamp=2021-12-16T21:30:37.954,
value=webShop

202103241000000001    column=detail:order_time, timestamp=2021-12-16T21:30:37.954,
value=2021-03-24 10:00:00

202103241000000001    column=detail:pay_amount, timestamp=2021-12-16T21:30:37.954, value=@Y
\x00\x00\x00\x00\x00\x00

202103241000000001    column=detail:pay_time, timestamp=2021-12-16T21:30:37.954,
value=2021-03-24 10:02:03

202103241000000001    column=detail:real_pay, timestamp=2021-12-16T21:30:37.954, value=@Y
\x00\x00\x00\x00\x00\x00

202103241000000001    column=detail:user_id, timestamp=2021-12-16T21:30:37.954, value=0001

202103241000000001    column=detail:user_name, timestamp=2021-12-16T21:30:37.954, value=Alice

202103241606060001    column=detail:area_id, timestamp=2021-12-16T21:30:44.842, value=330106

202103241606060001    column=detail:order_channel, timestamp=2021-12-16T21:30:44.842,
value=appShop

202103241606060001    column=detail:order_time, timestamp=2021-12-16T21:30:44.842,
value=2021-03-24 16:06:06

202103241606060001    column=detail:pay_amount, timestamp=2021-12-16T21:30:44.842, value=@i
\x00\x00\x00\x00\x00\x00

202103241606060001    column=detail:pay_time, timestamp=2021-12-16T21:30:44.842,
value=2021-03-24 16:10:06

202103241606060001    column=detail:real_pay, timestamp=2021-12-16T21:30:44.842, value=@f
\x80\x00\x00\x00\x00\x00

202103241606060001    column=detail:user_id, timestamp=2021-12-16T21:30:44.842, value=0001

202103241606060001    column=detail:user_name, timestamp=2021-12-16T21:30:44.842, value=Alice

202103251202020001    column=detail:area_id, timestamp=2021-12-16T21:30:52.181, value=330110

202103251202020001    column=detail:order_channel, timestamp=2021-12-16T21:30:52.181,
value=miniAppShop

202103251202020001    column=detail:order_time, timestamp=2021-12-16T21:30:52.181,
value=2021-03-25 12:02:02

202103251202020001    column=detail:pay_amount, timestamp=2021-12-16T21:30:52.181, value=@N
\x00\x00\x00\x00\x00\x00

202103251202020001    column=detail:pay_time, timestamp=2021-12-16T21:30:52.181,
value=2021-03-25 12:03:00

202103251202020001    column=detail:real_pay, timestamp=2021-12-16T21:30:52.181, value=@N
\x00\x00\x00\x00\x00\x00

202103251202020001    column=detail:user_id, timestamp=2021-12-16T21:30:52.181, value=0002
```



```
202103251202020001    column=detail:user_name, timestamp=2021-12-16T21:30:52.181, value=Bob
```

FAQ

Q: What should I do if the Flink job execution fails and the log contains the following error information?

```
org.apache.zookeeper.ClientCnxn$SessionTimeoutException: Client session timed out, have not heard from server in 90069ms for connection id 0x0
```

A: The datasource connection is not bound or the binding fails. Configure the datasource connection by referring to **Enhanced Datasource Connection** or configure the security group of the Kafka cluster to allow access from the DLI queue.

3.3.2.6 JDBC Result Table

Function

DLI outputs the Flink job output data to RDS through the JDBC result table.

Prerequisites

- An enhanced datasource connection with the instances has been established, so that you can configure security group rules as required.
  - For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.
  - For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.
- In Flink cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

  For details about datasource authentication, see **Introduction to Datasource Authentication**.

Precautions

- When creating a Flink OpenSource SQL job, you need to set **Flink Version** to **1.12** on the **Running Parameters** tab of the job editing page, select **Save Job Log**, and set the OBS bucket for saving job logs.
- The connector operates in upsert mode if the primary key was defined; otherwise, the connector operates in append mode.
  - In upsert mode, Flink will insert a new row or update the existing row according to the primary key. Flink can ensure the idempotence in this way. To guarantee the output result is as expected, it is recommended to define a primary key for the table.
  - In append mode, Flink will interpret all records as INSERT messages. The INSERT operation may fail if a primary key or unique constraint violation happens in the underlying database.

Syntax

```
create table jdbcSink (
  attr_name attr_type
  (',' attr_name attr_type)*
  (','PRIMARY KEY (attr_name, ...) NOT ENFORCED)
)
with (
  'connector' = 'jdbc',
  'url' = '',
  'table-name' = '',
  'driver' = '',
  'username' = '',
  'password' = ''
);
```

Parameters

Parameter	Mandatory	Default Value	Data Type	Description
connector	Yes	None	String	Connector to be used. Set this parameter to **jdbc**.
url	Yes	None	String	Database URL.
table-name	Yes	None	String	Name of the table where the data will be read from the database.
driver	No	None	String	Driver required for connecting to the database. If you do not set this parameter, it will be automatically derived from the URL.
username	No	None	String	Database authentication username. This parameter must be configured in pair with **password**.
password	No	None	String	Database authentication password. This parameter must be configured in pair with **username**.
sink.buffer-flush.max-rows	No	100	Integer	Maximum number of rows to buffer for each write request. It can improve the performance of writing data, but may increase the latency. You can set this parameter to **0** to disable it.

Parameter	Mandatory	Default Value	Data Type	Description
sink.buffer-flush.interval	No	1s	Duration	Interval for refreshing the buffer, during which data is refreshed by asynchronous threads. It can improve the performance of writing data, but may increase the latency. You can set this parameter to **0** to disable it. Note: If **sink.buffer-flush.max-rows** is set to **0** and the buffer refresh interval is configured, the buffer is asynchronously refreshed. The format is *{length value}{time unit label}*, for example, **123ms, 321s**. The supported time units include **d**, **h**, **min**, **s**, and **ms** (default unit).
sink.max-retries	No	3	Integer	Maximum number of retries if writing records to the database failed.
pwd_auth_name	No	None	String	Name of datasource authentication of the password type created on DLI. If datasource authentication is used, you do not need to set the username and password for jobs.

Data Type Mapping

Table 3-20 Data type mapping

MySQL Type	PostgreSQL Type	Flink SQL Type
TINYINT	-	TINYINT
SMALLINT TINYINT UNSIGNED	SMALLINT INT2 SMALLSERIAL SERIAL2	SMALLINT
INT MEDIUMINT SMALLINT UNSIGNED	INTEGER SERIAL	INT

MySQL Type	PostgreSQL Type	Flink SQL Type
BIGINT INT UNSIGNED	BIGINT BIGSERIAL	BIGINT
BIGINT UNSIGNED	-	DECIMAL(20, 0)
BIGINT	BIGINT	BIGINT
FLOAT	REAL FLOAT4	FLOAT
DOUBLE DOUBLE PRECISION	FLOAT8 DOUBLE PRECISION	DOUBLE
NUMERIC(p, s) DECIMAL(p, s)	NUMERIC(p, s) DECIMAL(p, s)	DECIMAL(p, s)
BOOLEAN TINYINT(1)	BOOLEAN	BOOLEAN
DATE	DATE	DATE
TIME [(p)]	TIME [(p)] [WITHOUT TIMEZONE]	TIME [(p)] [WITHOUT TIMEZONE]
DATETIME [(p)]	TIMESTAMP [(p)] [WITHOUT TIMEZONE]	TIMESTAMP [(p)] [WITHOUT TIMEZONE]
CHAR(n) VARCHAR(n) TEXT	CHAR(n) CHARACTER(n) VARCHAR(n) CHARACTER VARYING(n) TEXT	STRING
BINARY VARBINARY BLOB	BYTEA	BYTES
-	ARRAY	ARRAY

Example

In this example, Kafka is used to send data, and Kafka data is written to the MySQL database through the JDBC result table.

1. Create an enhanced datasource connection in the VPC and subnet where MySQL and Kafka locate, and bind the connection to the required Flink elastic resource pool. For details, see **Enhanced Datasource Connections**.
2. Set MySQL and Kafka security groups and add inbound rules to allow access from the Flink queue. Test the connectivity using the MySQL and Kafka address by referring to **Testing Address Connectivity**. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.
3. Log in to the MySQL database and create table **orders** in database **flink**.

```
CREATE TABLE `flink`.`orders` (
    `order_id` VARCHAR(32) NOT NULL,
    `order_channel` VARCHAR(32) NULL,
    `order_time` VARCHAR(32) NULL,
    `pay_amount` DOUBLE UNSIGNED NOT NULL,
    `real_pay` DOUBLE UNSIGNED NULL,
    `pay_time` VARCHAR(32) NULL,
    `user_id` VARCHAR(32) NULL,
    `user_name` VARCHAR(32) NULL,
    `area_id` VARCHAR(32) NULL,
    PRIMARY KEY (`order_id`)
)   ENGINE = InnoDB
    DEFAULT CHARACTER SET = utf8mb4
    COLLATE = utf8mb4_general_ci;
```

4. Create a Flink OpenSource SQL job. Enter the following job script and submit the job.

   When you create a job, set **Flink Version** to **1.12** on the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs. **Change the values of the parameters in bold as needed in the following script.**

```
CREATE TABLE kafkaSource (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = '***KafkaTopic***',
  'properties.bootstrap.servers' = '***KafkaAddress1:KafkaPort,KafkaAddress2:KafkaPort***',
  'properties.group.id' = '***GroupId***',
  'scan.startup.mode' = 'latest-offset',
  'format' = 'json'
);

CREATE TABLE jdbcSink (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'jdbc',
  'url? = 'jdbc:mysql://***MySQLAddress:MySQLPort***/flink',-- flink is the MySQL database where the **orders** table locates.
  'table-name' = 'orders',
  'username' = '***MySQLUsername***',
  'password' = '***MySQLPassword***',
```



```
  'sink.buffer-flush.max-rows' = '1'
);

insert into jdbcSink select * from kafkaSource;
```

5. Connect to the Kafka cluster and send the following test data to the Kafka topics:

```
{"order_id":"202103241000000001", "order_channel":"webShop", "order_time":"2021-03-24 10:00:00", "pay_amount":"100.00", "real_pay":"100.00", "pay_time":"2021-03-24 10:02:03", "user_id":"0001", "user_name":"Alice", "area_id":"330106"}

{"order_id":"202103241606060001", "order_channel":"appShop", "order_time":"2021-03-24 16:06:06", "pay_amount":"200.00", "real_pay":"180.00", "pay_time":"2021-03-24 16:10:06", "user_id":"0001", "user_name":"Alice", "area_id":"330106"}
```

6. Run the SQL statement in the MySQL database to view data in the table:

```
select * from orders;
```

   The following is an example of the result (note that the following data is replicated from the MySQL database but not the data style in the MySQL database):

```
202103241000000001,webShop,2021-03-24 10:00:00,100.0,100.0,2021-03-24 10:02:03,0001,Alice,330106
202103241606060001,appShop,2021-03-24 16:06:06,200.0,180.0,2021-03-24 16:10:06,0001,Alice,330106
```

FAQ

None

3.3.2.7 Kafka Result Table

Function

DLI outputs the Flink job output data to Kafka through the Kafka result table.

Apache Kafka is a fast, scalable, and fault-tolerant distributed message publishing and subscription system. It delivers high throughput and built-in partitions and provides data replicas and fault tolerance. Apache Kafka is applicable to scenarios of handling massive messages.

Prerequisites

- You have created a Kafka cluster.
- An enhanced datasource connection has been created for DLI to connect to Kafka clusters, so that jobs can run on the dedicated queue of DLI and you can set the security group rules as required.
  - For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.
  - For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.
- In Flink cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

  For details about datasource authentication, see **Introduction to Datasource Authentication**.

Precautions

- When creating a Flink OpenSource SQL job, you need to set **Flink Version** to **1.12** on the **Running Parameters** tab of the job editing page, select **Save Job Log**, and set the OBS bucket for saving job logs.
- For details about how to use data types, see section **Format**.

Syntax

```
create table kafkaSink(
  attr_name attr_type
  (',' attr_name attr_type)*
  (','PRIMARY KEY (attr_name, ...) NOT ENFORCED)
)
with (
  'connector' = 'kafka',
  'topic' = '',
  'properties.bootstrap.servers' = '',
  'format' = ''
);
```

Parameters

Table 3-21 Parameter description

Parameter	Mandatory	Default Value	Data Type	Description
connector	Yes	None	string	Connector to be used. Set this parameter to **kafka**.
topic	Yes	None	string	Topic name of the Kafka result table.
properties.bootstrap.servers	Yes	None	string	Kafka broker address. The value is in the format of **host:port,host:port,host:port**. Multiple **host:port** pairs are separated with commas (,).
format	Yes	None	string	Format used by the Flink Kafka connector to serialize Kafka messages. Either this parameter or the **value.format** parameter is required. The following formats are supported: • csv • json • avro Refer to **Format** for more details and format parameters.

Parameter	Mandatory	Default Value	Data Type	Description
topic-pattern	No	None	String	Regular expression for matching the Kafka topic name. Only one of **topic** and **topic-pattern** can be specified. Example: 'topic.*' '(topic-c|topic-d)' '(topic-a|topic-b|topic-\\d*)' '(topic-a|topic-b|topic-[0-9]*)'
properties.*	No	None	String	This parameter can set and pass arbitrary Kafka configurations. Note: • Suffix names must match the configuration key defined in **Apache Kafka**. For example, you can disable automatic topic creation via **'properties.allow.auto.create.topics' = 'false'**. • Some configurations are not supported, for example, **'key.deserializer'** and **'value.deserializer'**.

Parameter	Mandatory	Default Value	Data Type	Description
key.format	No	None	String	Format used to deserialize and serialize the key part of Kafka messages. Note: • If a key format is defined, the **key.fields** parameter is required as well. Otherwise, the Kafka records will have an empty key. • Possible values are: csv json avro debezium-json canal-json maxwell-json avro-confluent raw Refer to **Format** for more details and format parameters.
key.fields	No	[]	List<String>	Defines the columns in the table as the list of keys. This parameter must be configured in pair with **key.format**. This parameter is left empty by default. Therefore, no key is defined. The format is like **field1;field2**.
key.fields-prefix	No	None	String	Defines a custom prefix for all fields of the key format to avoid name clashes with fields of the value format.

Parameter	Mandatory	Default Value	Data Type	Description
value.format	Yes	None	String	Format used to deserialize and serialize the value part of Kafka messages. Note: • Either this parameter or the **format** parameter is required. If two parameters are configured, a conflict occurs. • Refer to **Format** for more details and format parameters.
value.fields-include	No	ALL	Enum Possible values: [ALL, EXCEPT_KEY]	Whether to contain the key field when parsing the message body. Possible values are: • **ALL** (default): All defined fields are included in the value of Kafka messages. • **EXCEPT_KEY**: All the fields except those defined by **key.fields** are included in the value of Kafka messages.
sink.partitioner	No	None	string	Mapping from Flink's partitions into Kafka's partitions. Valid values are as follows: • **fixed** (default): Each Flink partition ends up in at most one Kafka partition. • **round-robin**: A Flink partition is distributed to Kafka partitions in a round-robin manner. • **Custom FlinkKafkaPartitioner subclass**: If **fixed** and **round-robin** do not meet your requirements, you can create subclass **FlinkKafkaPartitioner** to customize the partition mapping, for example, **org.mycompany.MyPartitioner**.

Parameter	Mandatory	Default Value	Data Type	Description
sink.semantic	No	at-least-once	String	Defines the delivery semantic for the Kafka sink. Valid values are as follows: • at-least-once • exactly-once • none
sink.parallelism	No	None	Integer	Defines the parallelism of the Kafka sink operator. By default, the parallelism is determined by the framework using the same parallelism of the upstream chained operator.
ssl_auth_name	No	None	String	Name of datasource authentication of the Kafka_SSL type created on DLI. This configuration is used when SSL is configured for Kafka. Note: If only the SSL type is used, you need to set **properties.security.protocol** to **SSL**. If the SASL_SSL type is used, you need to set **properties.security.protocol** to **SASL_SSL**, **properties.sasl.mechanism** to **GSSAPI** or **PLAIN**, and **properties.sasl.jaas.config** to **org.apache.kafka.common.security.plain.PlainLoginModule required username=\"xxx\" password=\"xxx\";**.
krb_auth_name	No	None	String	Name of datasource authentication of the Kerberos type created on DLI. This configuration is used when SASL is configured for Kafka. Note: If the SASL_PLAINTEXT type and Kerberos authentication are used, you need to set **properties.sasl.mechanism** to **GSSAPI** and **properties.security.protocol** to **SASL_PLAINTEXT**.

Example (SASL_SSL Disabled for the Kafka Cluster)

In this example, data is read from a Kafka topic and written to another using a Kafka result table.

1. Create an enhanced datasource connection in the VPC and subnet where Kafka locates, and bind the connection to the required Flink elastic resource pool. For details, see **Enhanced Datasource Connections**.
2. Set Kafka security groups and add inbound rules to allow access from the Flink queue. Test the connectivity using the Kafka address by referring to **Testing Address Connectivity**. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.
3. Create a Flink OpenSource SQL job. Enter the following job script and submit the job.

   When you create a job, set **Flink Version** to **1.12** on the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs. **Change the values of the parameters in bold as needed in the following script.**

   ```
   CREATE TABLE kafkaSource (
     order_id string,
     order_channel string,
     order_time string,
     pay_amount double,
     real_pay double,
     pay_time string,
     user_id string,
     user_name string,
     area_id string
   ) WITH (
     'connector' = 'kafka',
     'topic' = '***KafkaTopic***',
     'properties.bootstrap.servers' = '***KafkaAddress1:KafkaPort,KafkaAddress2:KafkaPort***',
     'properties.group.id' = '***GroupId***',
     'scan.startup.mode' = 'latest-offset',
     "format" = "json"
   );

   CREATE TABLE kafkaSink (
     order_id string,
     order_channel string,
     order_time string,
     pay_amount double,
     real_pay double,
     pay_time string,
     user_id string,
     user_name string,
     area_id string
   ) WITH (
     'connector' = 'kafka',
     'topic' = '***KafkaSinkTopic***',
     'properties.bootstrap.servers' = '***KafkaAddress1:KafkaPort,KafkaAddress2:KafkaPort***',
     "format" = "json"
   );

   insert into kafkaSink select * from kafkaSource;
   ```

4. Connect to the Kafka cluster and insert the following test data into the source topic in Kafka:

   ```
   {"order_id":"202103241000000001","order_channel":"webShop","order_time":"2021-03-24 10:00:00","pay_amount":100.0,"real_pay":100.0,"pay_time":"2021-03-24 10:02:03","user_id":"0001","user_name":"Alice","area_id":"330106"}
   ```



```
{"order_id":"202103241606060001","order_channel":"appShop","order_time":"2021-03-24
16:06:06","pay_amount":200.0,"real_pay":180.0,"pay_time":"2021-03-24
16:10:06","user_id":"0001","user_name":"Alice","area_id":"330106"}
```

5. Connect to the Kafka cluster and read data from the sink topic of Kafka.

```
{"order_id":"202103241000000001","order_channel":"webShop","order_time":"2021-03-24
10:00:00","pay_amount":100.0,"real_pay":100.0,"pay_time":"2021-03-24
10:02:03","user_id":"0001","user_name":"Alice","area_id":"330106"}

{"order_id":"202103241606060001","order_channel":"appShop","order_time":"2021-03-24
16:06:06","pay_amount":200.0,"real_pay":180.0,"pay_time":"2021-03-24
16:10:06","user_id":"0001","user_name":"Alice","area_id":"330106"}
```

Example (SASL_SSL Enabled for the Kafka Cluster)

- **Example 1: Enable SASL_SSL authentication for the DMS cluster.**

  Create a Kafka cluster for DMS, enable SASL_SSL, download the SSL certificate, and upload the downloaded certificate **client.jks** to an OBS bucket.

```
CREATE TABLE ordersSource (
  order_id string,
  order_channel string,
  order_time timestamp(3),
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = 'xx',
  'properties.bootstrap.servers' = 'xx:9093,xx:9093,xx:9093',
  'properties.group.id' = 'GroupId',
  'scan.startup.mode' = 'latest-offset',
  'properties.connector.auth.open' = 'true',
  'properties.ssl.truststore.location' = 'obs://xx/xx.jks',  -- Location where the user uploads the
certificate to
  'properties.sasl.mechanism' = 'PLAIN',  --  Value format: SASL_PLAINTEXT
  'properties.security.protocol' = 'SASL_SSL',
  'properties.sasl.jaas.config' = 'org.apache.kafka.common.security.plain.PlainLoginModule required
username=\"xx\" password=\"xx\";', -- Account and password set when the Kafka cluster is created
  "format" = "json"
);

CREATE TABLE ordersSink (
  order_id string,
  order_channel string,
  order_time timestamp(3),
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = 'xx',
  'properties.bootstrap.servers' = 'xx:9093,xx:9093,xx:9093',
  'properties.connector.auth.open' = 'true',
  'properties.ssl.truststore.location' = 'obs://xx/xx.jks',
  'properties.sasl.mechanism' = 'PLAIN',
  'properties.security.protocol' = 'SASL_SSL',
  'properties.sasl.jaas.config' = 'org.apache.kafka.common.security.plain.PlainLoginModule required
username=\"xx\" password=\"xx\";',
  "format" = "json"
);
```



```
insert into ordersSink select * from ordersSource;
```

- **Example 2: Enable Kafka SASL_SSL authentication for the MRS cluster.**
  - Enable Kerberos authentication for the MRS cluster.
  - Click the **Components** tab and click **Kafka**. In the displayed page, click the **Service Configuration** tab, locate the **security.protocol**, and set it to **SASL_SSL**.
  - Log in to the FusionInsight Manager of the MRS cluster and download the user credential. Choose **System** > **Permission** > **User**. Locate the row that contains the target user, choose **More** > **Download Authentication Credential**.

    Obtain the **truststore.jks** file using the authentication credential and store the credential and **truststore.jks** file in OBS.
  - If "Message stream modified (41)" is displayed, the JDK version may be incorrect. Change the JDK version in the sample code to a version earlier than 8u_242 or delete the **renew_lifetime = 0m** configuration item from the **krb5.conf** configuration file.
  - Set the port to the **sasl_ssl.port** configured in the Kafka service configuration.
  - In the following statements, set **security.protocol** to **SASL_SSL**.

```
CREATE TABLE ordersSource (
  order_id string,
  order_channel string,
  order_time timestamp(3),
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = 'xx',
  'properties.bootstrap.servers' = 'xx:21009,xx:21009',
  'properties.group.id' = 'GroupId',
  'scan.startup.mode' = 'latest-offset',
  'properties.sasl.kerberos.service.name' = 'kafka',
  'properties.connector.auth.open' = 'true',
  'properties.connector.kerberos.principal' = 'xx', --Username
  'properties.connector.kerberos.krb5' = 'obs://xx/krb5.conf',
  'properties.connector.kerberos.keytab' = 'obs://xx/user.keytab',
  'properties.security.protocol' = 'SASL_SSL',
  'properties.ssl.truststore.location' = 'obs://xx/truststore.jks',
  'properties.ssl.truststore.password' = 'xx',  -- Password set for generating truststore.jks
  'properties.sasl.mechanism' = 'GSSAPI',
  "format" = "json"
);

CREATE TABLE ordersSink (
  order_id string,
  order_channel string,
  order_time timestamp(3),
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = 'xx',
```

```
  'properties.bootstrap.servers' = 'xx:21009,xx:21009',
  'properties.sasl.kerberos.service.name' = 'kafka',
  'properties.connector.auth.open' = 'true',
  'properties.connector.kerberos.principal' = 'xx',
  'properties.connector.kerberos.krb5' = 'obs://xx/krb5.conf',
  'properties.connector.kerberos.keytab' = 'obs://xx/user.keytab',
  'properties.ssl.truststore.location' = 'obs://xx/truststore.jks',
  'properties.ssl.truststore.password' = 'xx',
  'properties.security.protocol' = 'SASL_SSL',
  'properties.sasl.mechanism' = 'GSSAPI',
  "format" = "json"
);

insert into ordersSink select * from ordersSource;
```

- **Example 3: Enable Kerberos SASL_PAINTEXT authentication for the MRS cluster**
  - Enable Kerberos authentication for the MRS cluster.
  - Click the **Components** tab and click **Kafka**. In the displayed page, click the **Service Configuration** tab, locate the **security.protocol**, and set it to **SASL_PLAINTEXT**.
  - Log in to the FusionInsight Manager of the MRS cluster and download the user credential. Choose **System** > **Permission** > **User**. Locate the row that contains the target user, choose **More** > **Download Authentication Credential**. Upload the credential to OBS.
  - If error message "Message stream modified (41)" is displayed, the JDK version may be incorrect. Change the JDK version in the sample code to a version earlier than 8u_242 or delete the **renew_lifetime = 0m** configuration item from the **krb5.conf** configuration file.
  - Set the port to the **sasl.port** configured in the Kafka service configuration.
  - In the following statements, set **security.protocol** to **SASL_PLAINTEXT**.

```
CREATE TABLE ordersSources (
  order_id string,
  order_channel string,
  order_time timestamp(3),
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = 'xx',
  'properties.bootstrap.servers' = 'xx:21007,xx:21007',
  'properties.group.id' = 'GroupId',
  'scan.startup.mode' = 'latest-offset',
  'properties.sasl.kerberos.service.name' = 'kafka',
  'properties.connector.auth.open' = 'true',
  'properties.connector.kerberos.principal' = 'xx',
  'properties.connector.kerberos.krb5' = 'obs://xx/krb5.conf',
  'properties.connector.kerberos.keytab' = 'obs://xx/user.keytab',
  'properties.security.protocol' = 'SASL_PLAINTEXT',
  'properties.sasl.mechanism' = 'GSSAPI',
  "format" = "json"
);

CREATE TABLE ordersSink (
  order_id string,
  order_channel string,
  order_time timestamp(3),
```



```
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = 'xx',
  'properties.bootstrap.servers' = 'xx:21007,xx:21007',
  'properties.sasl.kerberos.service.name' = 'kafka',
  'properties.connector.auth.open' = 'true',
  'properties.connector.kerberos.principal' = 'xx',
  'properties.connector.kerberos.krb5' = 'obs://xx/krb5.conf',
  'properties.connector.kerberos.keytab' = 'obs://xx/user.keytab',
  'properties.security.protocol' = 'SASL_PLAINTEXT',
  'properties.sasl.mechanism' = 'GSSAPI',
  "format" = "json"
);

insert into ordersSink select * from ordersSource;
```

- **Example 4: Use SSL for the MRS cluster**
  - Do not enable Kerberos authentication for the MRS cluster.
  - Log in to the FusionInsight Manager of the MRS cluster and download the user credential. Choose **System** > **Permission** > **User**. Locate the row that contains the target user, choose **More** > **Download Authentication Credential**.

    Obtain the **truststore.jks** file using the authentication credential and store the credential and **truststore.jks** file in OBS.
  - Set the port to the **ssl.port** configured in the Kafka service configuration.
  - In the following statements, set **security.protocol** to **SSL**.
  - Set **ssl.mode.enable** to **true**.

```
CREATE TABLE ordersSource (
  order_id string,
  order_channel string,
  order_time timestamp(3),
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = 'xx',
  'properties.bootstrap.servers' = 'xx:9093,xx:9093,xx:9093',
  'properties.group.id' = 'GroupId',
  'scan.startup.mode' = 'latest-offset',
  'properties.connector.auth.open' = 'true',
  'properties.ssl.truststore.location' = 'obs://xx/truststore.jks',
  'properties.ssl.truststore.password' = 'xx',  -- Password set for generating truststore.jks
  'properties.security.protocol' = 'SSL',
  "format" = "json"
);

CREATE TABLE ordersSink (
  order_id string,
  order_channel string,
  order_time timestamp(3),
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
```

```
  area_id string
) WITH (
  'connector' = 'print'
);

insert into ordersSink select * from ordersSource;
```

3.3.2.8 Print Result Table

Function

The Print connector is used to print output data to the error file or TaskManager file, making it easier for you to view the result in code debugging.

Prerequisites

None

Precautions

- The Print result table supports the following output formats:

Print	Condition 1	Condition 2
Identifier:Task ID> Output data	A print identifier prefix must be provided. That is, you must specify **print-identifier** in the **WITH** parameter when creating the Print result table.	parallelism > 1
Identifier> Output data	A print identifier prefix must be provided. That is, you must specify **print-identifier** in the **WITH** parameter when creating the Print result table.	parallelism == 1
Task ID> Output data	A print identifier prefix is not needed. That is, you do not specify **print-identifier** in the **WITH** parameter when creating the Print result table.	parallelism > 1
Output data	A print identifier prefix is not needed. That is, you do not specify **print-identifier** in the **WITH** parameter when creating the Print result table.	parallelism == 1

- When creating a Flink OpenSource SQL job, you need to set **Flink Version** to **1.12** on the **Running Parameters** tab of the job editing page, select **Save Job Log**, and set the OBS bucket for saving job logs.

Syntax

```
create table printSink (
  attr_name attr_type
  (',' attr_name attr_type) *
  (',' PRIMARY KEY (attr_name,...) NOT ENFORCED)
) with (
  'connector' = 'print',
  'print-identifier' = '',
  'standard-error' = ''
);
```

Parameters

Table 3-22 Parameter description

Parameter	Mandatory	Default Value	Data Type	Description
connector	Yes	None	String	Connector to be used. Set this parameter to **print**.
print-identifier	No	None	String	Message that identifies print and is prefixed to the output of the value.
standard-error	No	false	Boolean	The value can be only **true** or **false**. The default value is **false**. • If the value is **true**, data is output to the error file of the TaskManager. • If the value is **false**, data is output to the **out** file of the TaskManager.

Example

Create a Flink OpenSource SQL job. Run the following script to generate random data through the DataGen table and output the data to the Print result table.

When you create a job, set **Flink Version** to **1.12** on the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs.

```
create table dataGenSOurce(
  user_id string,
  amount int
) with (
  'connector' = 'datagen',
  'rows-per-second' = '1', --Generate a piece of data per second.
  'fields.user_id.kind' = 'random', --Specify a random generator for the user_id field.
  'fields.user_id.length' = '3' --Limit the length of user_id to 3.
);

create table printSink(
  user_id string,
```



```
  amount int
) with (
  'connector' = 'print'
);

insert into printSink select * from dataGenSOurce;
```

After the job is submitted, the job status changes to **Running**. You can perform the following operations of either method to view the output result:

- Method 1:
  a. Log in to the DLI console. In the navigation pane, choose **Job Management** > **Flink Jobs**.
  b. Locate the row that contains the target Flink job, and choose **More** > **FlinkUI** in the **Operation** column.
  c. On the Flink UI, choose **Task Managers**, click the task name, and select **Stdout** to view job logs.
- Method 2: If you select **Save Job Log** on the **Running Parameters** tab before submitting the job, perform the following operations:
  a. Log in to the DLI console. In the navigation pane, choose **Job Management** > **Flink Jobs**.
  b. Click the name of the corresponding Flink job, choose **Run Log**, click **OBS Bucket**, and locate the folder of the log you want to view according to the date.
  c. Go to the folder of the date, find the folder whose name contains **taskmanager**, download the **taskmanager.out** file, and view result logs.

3.3.2.9 Redis Result Table

Function

DLI outputs the Flink job output data to Redis. Redis is a key-value storage system that supports multiple types of data structures. It can be used in scenarios such as caching, event publish/subscribe, and high-speed queuing. Redis supports direct read/write of strings, hashes, lists, queues, and sets. Redis works with in-memory datasets and provides persistence. For more information about Redis, visit **https://redis.io/**.

Prerequisites

- An enhanced datasource connection with Redis has been established, so that you can configure security group rules as required.
  - For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.
  - For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.
- In Flink cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

  For details about datasource authentication, see **Introduction to Datasource Authentication**.

Precautions

- When creating a Flink OpenSource SQL job, you need to set **Flink Version** to **1.12** on the **Running Parameters** tab of the job editing page, select **Save Job Log**, and set the OBS bucket for saving job logs.
- If the Redis key field is not defined in the statement for creating the Redis result table, the generated UUID is used as the key.
- To specify a key in Redis, you need to define a primary key in the Redis result table of Flink. The value of the primary key is the Redis key.
- If the primary key defined for the Redis result table, it cannot be a composite primary key and only can be one field.
- Constraints on **schema-syntax**:
  - If **schema-syntax** is **map** or **array**, there can be only one non-primary key and it must be of the same **map** or **array** type.
  - If **schema-syntax** is **fields-scores**, the number of non-primary keys must be an even number, and the second key of every two keys except the primary key must be of the **double** type. The **double** value is the score of the previous key. The following is an example:

```
CREATE TABLE redisSink (
  order_id string,
  order_channel string,
  order_time double,
  pay_amount STRING,
  real_pay double,
  pay_time string,
  user_id double,
  user_name string,
  area_id double,
  primary key (order_id) not enforced
) WITH (
  'connector' = 'redis',
  'host' = '***RedisIP***',
  'password' = '***RedisPassword***',
  'data-type' = 'sorted-set',
  'deploy-mode' = 'master-replica',
  'schema-syntax' = 'fields-scores'
);
```

- Restrictions on **data-type**:
  - If **data-type** is **string**, only one non-primary key field is allowed.
  - If **data-type** is **sorted-set** and **schema-syntax** is **fields** or **array**, **default-score** is used as the score.
  - If **data-type** is **sorted-set** and **schema-syntax** is **map**, there can be only one non-primary key in addition to the primary key and the non-primary key must be of the **map** type. The **map** values of the non-primary key must be of the **double** type, indicating the score. The keys in the map are the values in the Redis set.
  - If **data-type** is **sorted-set** and **schema-syntax** is **array-scores**, only two non-primary keys are allowed and must be of the **array** type.

    The first key indicates values in the Redis set. The second key is of the **array<double>** type, indicating index scores. The following is an example:

```
CREATE TABLE redisSink (
  order_id string,
  arrayField Array<String>,
  arrayScore array<double>,
  primary key (order_id) not enforced
) WITH (
```



```
  'connector' = 'redis',
  'host' = 'RedisIP',
  'password' = 'RedisPassword',
  'data-type' = 'sorted-set',
  "default-score" = '3',
  'deploy-mode' = 'master-replica',
  'schema-syntax' = 'array-scores'
);
```

Syntax

```
create table dwsSink (
  attr_name attr_type
  (',' attr_name attr_type)*
  (',PRIMARY KEY (attr_name) NOT ENFORCED)
)
with (
  'connector' = 'redis',
  'host' = ''
);
```

Parameters

Table 3-23 Parameter description

Parameter	Mandatory	Default Value	Data Type	Description
connector	Yes	None	String	Connector to be used. Set this parameter to **redis**.
host	Yes	None	String	Redis connector address.
port	No	6379	Integer	Redis connector port.
password	No	None	String	Redis authentication password.
namespace	No	None	String	Redis key namespace. For example, if the value is set to "person" and the key is "jack", the value in the Redis is person:jack.
delimiter	No	:	String	Delimiter between the Redis key and namespace.
data-type	No	hash	String	Redis data type. Available values are as follows: • hash • list • set • sorted-set • string For details about the constraints, see **Constraints on data-type**.

Parameter	Mandatory	Default Value	Data Type	Description
schema-syntax	No	fields	String	Redis schema semantics. Available values are as follows: • **fields**: applicable to all data types. This value indicates that multiple fields can be set and the value of each field is read when data is written. • **fields-scores**: applicable to **sorted-set** data, indicating that each field is read as an independent score. • **array**: applicable to **list**, **set**, and **sorted-set** data. • **array-scores**: applicable to **sorted-set** data. • **map**: applicable to **hash** and **sorted-set** data. For details about the constraints, see **Constraints on schema-syntax**.
deploy-mode	No	standalone	String	Deployment mode of the Redis cluster. The value can be **standalone**, **master-replica**, or **cluster**. The default value is **standalone**. For details about the setting, see the instance type description of the Redis cluster.
retry-count	No	5	Integer	Number of attempts to connect to the Redis cluster.
connection-timeout-millis	No	10000	Integer	Maximum timeout for connecting to the Redis cluster.
commands-timeout-millis	No	2000	Integer	Maximum time for waiting for a completion response.
rebalancing-timeout-millis	No	15000	Integer	Sleep time when the Redis cluster fails.
default-score	No	0	Double	Default score when **data-type** is **sorted-set**.
ignore-retraction	No	false	Boolean	Whether to ignore Retract messages.

Parameter	Mandatory	Default Value	Data Type	Description
skip-null-values	No	true	Boolean	Whether null values will be skipped. If this parameter is **false**, **null** will be assigned for null values.
pwd_auth_name	No	None	String	Name of datasource authentication of the password type created on DLI. If datasource authentication is used, you do not need to set the username and password for jobs.
key-ttl-mode	No	no-ttl	String	Whether the Redis sink TTL function will be enabled. The value can be **no-ttl**, **expire-msec**, **expire-at-date** or **expire-at-timestamp**. ● **no-ttl**: No expiration time is set. ● **expire-msec**: validity period of the key. The parameter is a long string, in milliseconds. ● **expire-at-date**: Date and time when the key expires. The value is in UTC time format. ● **expire-at-timestamp**: Timestamp when the key expires.

Parameter	Mandatory	Default Value	Data Type	Description
key-ttl	No	None	String	Supplementary parameter of **key-ttl-mode**. Available values are as follows: • If **key-ttl-mode** is **no-ttl**, this parameter does not need to be configured. • If **key-ttl-mode** is **expire-msec**, set this parameter to a string that can be parsed into the Long type. For example, **5000** indicates that the key will expire in 5000 ms. • If **key-ttl-mode** is **expire-at-date**, set this parameter to a date. For example, **2011-12-03T10:15:30** indicates that the expiration time is 2011-12-03 18:15:30 (UTC+8). • If **key-ttl-mode** is **expire-at-timestamp**, set this parameter to a timestamp, in milliseconds. For example, **1679385600000** indicates that the expiration time is 2023-03-21 16:00:00.

Example

In this example, data is read from the Kafka data source and written to the Redis result table. The procedure is as follows:

1. Create an enhanced datasource connection in the VPC and subnet where Redis locates, and bind the connection to the required Flink elastic resource pool. For details, see **Enhanced Datasource Connections**.
2. Set Redis security groups and add inbound rules to allow access from the Flink queue. Test the connectivity using the Redis address by referring to **Testing Address Connectivity**. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.
3. Create a Flink OpenSource SQL job. Enter the following job script and submit the job.

   When you create a job, set **Flink Version** to **1.12** on the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs. **Change the values of the parameters in bold as needed in the following script.**

```
CREATE TABLE orders (
  order_id string,
  order_channel string,
```



```
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = '<yourTopic>',
  'properties.bootstrap.servers' = '<yourKafka>:<port>',
  'properties.group.id' = '<yourGroupId>',
  'scan.startup.mode' = 'latest-offset',
  'format' = 'json'
);
--In the following redisSink table, data-type is set to default value hash, schema-syntax is fields, and order_id is defined as the primary key. Therefore, the value of this field is used as the Redis key.
CREATE TABLE redisSink (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string,
  primary key (order_id) not enforced
) WITH (
  'connector' = 'redis',
  'host' = '<yourRedis>',
  'password' = '<yourPassword>',
  'deploy-mode' = 'master-replica',
  'schema-syntax' = 'fields'
);

insert into redisSink select * from orders;
```

4. Connect to the Kafka cluster and insert the following test data into Kafka:

```
{"order_id":"202103241000000001", "order_channel":"webShop", "order_time":"2021-03-24 10:00:00", "pay_amount":"100.00", "real_pay":"100.00", "pay_time":"2021-03-24 10:02:03", "user_id":"0001", "user_name":"Alice", "area_id":"330106"}

{"order_id":"202103241606060001", "order_channel":"appShop", "order_time":"2021-03-24 16:06:06", "pay_amount":"200.00", "real_pay":"180.00", "pay_time":"2021-03-24 16:10:06", "user_id":"0001", "user_name":"Alice", "area_id":"330106"}
```

5. Run the following commands in Redis and view the result:
   - Obtain the result whose key is **202103241606060001**.

     Run following command:

     ```
     HGETALL 202103241606060001
     ```

     Command output:

     ```
      1) "user_id"
      2) "0001"
      3) "user_name"
      4) "Alice"
      5) "pay_amount"
      6) "200.0"
      7) "real_pay"
      8) "180.0"
      9) "order_time"
     10) "2021-03-24 16:06:06"
     11) "area_id"
     12) "330106"
     13) "order_channel"
     14) "appShop"
     15) "pay_time"
     16) "2021-03-24 16:10:06"
     ```


- Obtain the result whose key is **202103241000000001**.

  Run following command:

  ```
  HGETALL 202103241000000001
  ```

  Command output:

  ```
  1) "user_id"
  2) "0001"
  3) "user_name"
  4) "Alice"
  5) "pay_amount"
  6) "100.0"
  7) "real_pay"
  8) "100.0"
  9) "order_time"
  10) "2021-03-24 10:00:00"
  11) "area_id"
  12) "330106"
  13) "order_channel"
  14) "webShop"
  15) "pay_time"
  16) "2021-03-24 10:02:03"
  ```

FAQ

- Q: When data-type is **set**, why is the final result data less than the input data?

  A: This is because the input data contains duplicate data. Deduplication is performed in the Redis set, and the number of records in the result decreases.

- Q: What should I do if Flink job logs contain the following error information?

  ```
  org.apache.flink.table.api.ValidationException: SQL validation failed. From line 1, column 40 to line 1, column 105: Parameters must be of the same type
  ```

  A: The array type is used. However, the types of fields in the array are different. You need to ensure that the types of fields in the array in Redis are the same.

- Q: What should I do if Flink job logs contain the following error information?

  ```
  org.apache.flink.addons.redis.core.exception.RedisConnectorException: Wrong Redis schema for 'map' syntax: There should be a key (possibly) and 1 MAP non-key column.
  ```

  A: When **schema-syntax** is **map**, the table creation statement in Flink can contain only one non-primary key column, and the column type must be **map**.

- Q: What should I do if Flink job logs contain the following error information?

  ```
  org.apache.flink.addons.redis.core.exception.RedisConnectorException: Wrong Redis schema for 'array' syntax: There should be a key (possibly) and 1 ARRAY non-key column.
  ```

  A: When **schema-syntax** is **array**, the table creation statement in Flink can contain only one non-primary key column, and the column type must be **array**.

- Q: What is the function of **schema-syntax** since **data-type** has been set?

  A: **schema-syntax** is used to process special types, such as **map** and **array**.

  - If it is set to **fields**, the value of each field is processed. If it is set to **array** or **map**, each element in the field is processed. For **fields**, the field value of the **map** or **array** type is directly used as a value in Redis.
  - For **array** or **map**, each value in the array is used as a Redis value, and the field value of the map is used as the Redis value. **array-scores** is used to process the **sorted-set** data type. It indicates that two array fields are used, the first one is the value in the set, and the second one is the score. **fields-scores** is used to process the **sorted-set** data type, indicating that

the score is derived from the defined field. The field of an odd number except the primary key indicates the value in the set, and its next field indicates its score. Therefore, its next field must be of the **double** type.

- Q: If **data-type** is **hash**, what are the differences between **schema-syntax** set to **fields** and that to **map**?

  A: When **fields** is used, the field name in Flink is used as the Redis field of the hash data type, and the value of that field is used as the value of the hash data type in Redis. When **map** is used, the field key in Flink is used as the Redis field of the hash data type, and the value of that field is used as the value of the hash data type in Redis. The following is an example:

  - For **fields**:

    i. The execution script of the Flink job is as follows:

    ```
    CREATE TABLE orders (
      order_id string,
      order_channel string,
      order_time string,
      pay_amount double,
      real_pay double,
      pay_time string,
      user_id string,
      user_name string,
      area_id string
    ) WITH (
      'connector' = 'kafka',
      'topic' = '***kafkaTopic***',
      'properties.bootstrap.servers' = '***KafkaAddress1:KafkaPort,KafkaAddress2:KafkaPort***',
      'properties.group.id' = '***GroupId***',
      'scan.startup.mode' = 'latest-offset',
      'format' = 'json'
    );

    CREATE TABLE redisSink (
      order_id string,
      maptest Map<string, String>,
      primary key (order_id) not enforced
    ) WITH (
      'connector' = 'redis',
      'host' = '***RedisIP***',
      'password' = '***RedisPassword***',
      'deploy-mode' = 'master-replica',
      'schema-syntax' = 'fields'
    );

    insert into redisSink select order_id, Map[user_id, area_id] from orders;
    ```

    ii. Connect to the Kafka cluster and insert the following test data into the Kafka topic:

    ```
    {"order_id":"202103241000000001", "order_channel":"webShop",
    "order_time":"2021-03-24 10:00:00", "pay_amount":"100.00", "real_pay":"100.00",
    "pay_time":"2021-03-24 10:02:03", "user_id":"0001", "user_name":"Alice",
    "area_id":"330106"}
    ```

    iii. In the Redis, the result is as follows:

    ```
    1) "maptest"
    2) "{0001=330106}"
    ```

  - For **map**:

    i. The execution script of the Flink job is as follows:

    ```
    CREATE TABLE orders (
      order_id string,
      order_channel string,
      order_time string,
      pay_amount double,
      real_pay double,
    ```



```
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = '***kafkaTopic***',
  'properties.bootstrap.servers' = '***KafkaAddress1:KafkaPort,KafkaAddress2:KafkaPort***',
  'properties.group.id' = '***GroupId***',
  'scan.startup.mode' = 'latest-offset',
  'format' = 'json'
);

CREATE TABLE redisSink (
  order_id string,
  maptest Map<string, String>,
  primary key (order_id) not enforced
) WITH (
  'connector' = 'redis',
  'host' = '***RedisIP***',
  'password' = '***RedisPassword***',
  'deploy-mode' = 'master-replica',
  'schema-syntax' = 'map'
);

insert into redisSink select order_id, Map[user_id, area_id] from orders;
```

ii. Connect to the Kafka cluster and insert the following test data into the Kafka topic:

```
{"order_id":"202103241000000001", "order_channel":"webShop",
"order_time":"2021-03-24 10:00:00", "pay_amount":"100.00", "real_pay":"100.00",
"pay_time":"2021-03-24 10:02:03", "user_id":"0001", "user_name":"Alice",
"area_id":"330106"}
```

iii. In the Redis, the result is as follows:

```
1) "0001"
2) "330106"
```

- Q: If **data-type** is **list**, what are the differences between **schema-syntax** set to **fields** and that to **array**?

  A: The setting to **fields** or **array** does not result in different results. The only difference is that in the Flink table creation statement. **fields** can be multiple fields. However, **array** requires that the field is of the **array** type and the data types in the array must be the same. Therefore, **fields** are more flexible.

  – For **fields**:

    i. The execution script of the Flink job is as follows:

```
CREATE TABLE orders (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = '***kafkaTopic***',
  'properties.bootstrap.servers' = '***KafkaAddress1:KafkaPort,KafkaAddress2:KafkaPort***',
  'properties.group.id' = '***GroupId***',
  'scan.startup.mode' = 'latest-offset',
  'format' = 'json'
);

CREATE TABLE redisSink (
```



```
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string,
  primary key (order_id) not enforced
) WITH (
  'connector' = 'redis',
  'host' = '***RedisIP***',
  'password' = '***RedisPassword***',
  'data-type' = 'list',
  'deploy-mode' = 'master-replica',
  'schema-syntax' = 'fields'
);

insert into redisSink select * from orders;
```

ii. Connect to the Kafka cluster and insert the following test data into the Kafka topic:

```
{"order_id":"202103241000000001", "order_channel":"webShop",
"order_time":"2021-03-24 10:00:00", "pay_amount":"100.00", "real_pay":"100.00",
"pay_time":"2021-03-24 10:02:03", "user_id":"0001", "user_name":"Alice",
"area_id":"330106"}
```

iii. View the result.

Run the following command in Redis:

```
LRANGE 202103241000000001 0 8
```

The command output is as follows:

```
1) "webShop"
2) "2021-03-24 10:00:00"
3) "100.0"
4) "100.0"
5) "2021-03-24 10:02:03"
6) "0001"
7) "Alice"
8) "330106"
```

– For **array**:

i. The execution script of the Flink job is as follows:

```
CREATE TABLE orders (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = '***kafkaTopic***',
  'properties.bootstrap.servers' = '***KafkaAddress1:KafkaPort,KafkaAddress2:KafkaPort***',
  'properties.group.id' = '***GroupId***',
  'scan.startup.mode' = 'latest-offset',
  'format' = 'json'
);

CREATE TABLE redisSink (
  order_id string,
  arraytest Array<String>,
  primary key (order_id) not enforced
) WITH (
  'connector' = 'redis',
```



```
 'host' = 'RedisIP',
 'password' = 'RedisPassword',
 'data-type' = 'list',
 'deploy-mode' = 'master-replica',
 'schema-syntax' = 'array'
);

insert into redisSink select order_id,
array[order_channel,order_time,pay_time,user_id,user_name,area_id] from orders;
```

ii. Connect to the Kafka cluster and insert the following test data into the Kafka topic:

```
{"order_id":"202103241000000001", "order_channel":"webShop",
"order_time":"2021-03-24 10:00:00", "pay_amount":"100.00", "real_pay":"100.00",
"pay_time":"2021-03-24 10:02:03", "user_id":"0001", "user_name":"Alice",
"area_id":"330106"}
```

iii. In Redis, view the result. (The result is different from that of **fields** because data of the **double** type is not added to the table creation statement of the sink in Flink. Therefore, two values are missing. This is not caused by the difference between **fields** and **array**.)

```
1) "webShop"
2) "2021-03-24 10:00:00"
3) "2021-03-24 10:02:03"
4) "0001"
5) "Alice"
6) "330106"
```

3.3.2.10 Upsert Kafka Result Table

Function

Apache Kafka is a fast, scalable, and fault-tolerant distributed message publishing and subscription system. It delivers high throughput and built-in partitions and provides data replicas and fault tolerance. Apache Kafka is applicable to scenarios of handling massive messages. DLI outputs the Flink job output data to Kafka in upsert mode.

The Upsert Kafka connector allows for reading data from and writing data into Kafka topics in the upsert fashion.

As a sink, the Upsert Kafka connector can consume a changelog stream. It will write INSERT/UPDATE_AFTER data as normal Kafka messages value, and write DELETE data as Kafka messages with null values (indicate tombstone for the key). Flink will guarantee the message ordering on the primary key by partition data on the values of the primary key columns, so the UPDATE/DELETE messages on the same key will fall into the same partition.

Prerequisites

- You have created a Kafka cluster.
- An enhanced datasource connection has been created for DLI to connect to Kafka clusters, so that jobs can run on the dedicated queue of DLI and you can set the security group rules as required.
  - For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.
  - For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.

- In Flink cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

  For details about datasource authentication, see **Introduction to Datasource Authentication**.

Precautions

- When creating a Flink OpenSource SQL job, you need to set **Flink Version** to **1.12** on the **Running Parameters** tab of the job editing page, select **Save Job Log**, and set the OBS bucket for saving job logs.
- For details about how to use data types, see section **Format**.
- The Upsert Kafka always works in the upsert fashion and requires to define the primary key in the DDL.
- By default, an Upsert Kafka sink ingests data with at-least-once guarantees into a Kafka topic if the query is executed with checkpointing enabled. This means that Flink may write duplicate records with the same key into the Kafka topic. Therefore, the Upsert Kafka connector achieves idempotent writes.

Syntax

```
create table kafkaSource(
  attr_name attr_type
  (',' attr_name attr_type)*
  (',PRIMARY KEY (attr_name, ...) NOT ENFORCED)
)
with (
  'connector' = 'upsert-kafka',
  'topic' = '',
  'properties.bootstrap.servers' = '',
  'key.format' = '',
  'value.format' = ''
);
```

Parameters

Table 3-24 Parameter description

Parameter	Mandatory	Default Value	Data Type	Description
connector	Yes	(none)	String	Connector to be used. Set this parameter to **upsert-kafka**.
topic	Yes	(none)	String	Kafka topic name.
properties.bootstrap.servers	Yes	(none)	String	Comma separated list of Kafka brokers.

Parameter	Mandatory	Default Value	Data Type	Description
key.format	Yes	(none)	String	Format used to deserialize and serialize the key part of Kafka messages. The key fields are specified by the **PRIMARY KEY** syntax. The following formats are supported: • csv • json • avro Refer to **Format** for more details and format parameters.
key.fields-prefix	No	(none)	String	Defines a custom prefix for all fields of the key format to avoid name clashes with fields of the value format. By default, the prefix is empty. If a custom prefix is defined, both the table schema and **key.fields** will work with prefixed names. When constructing the data type of the key format, the prefix will be removed and the non-prefixed names will be used within the key format. Note that this option requires that **value.fields-include** must be set to **EXCEPT_KEY**.
value.format	Yes	(none)	String	Format used to deserialize and serialize the value part of Kafka messages. The following formats are supported: • csv • json • avro Refer to **Format** for more details and format parameters.
value.fields-include	No	'ALL'	String	Controls which fields should appear in the value part. Options: • **ALL**: All fields in the schema, including the primary key field, are included in the value part. • **EXCEPT_KEY**: All the fields of the table schema are included, except the primary key field.

Parameter	Mandatory	Default Value	Data Type	Description
sink.parallelism	No	(none)	Interger	Defines the parallelism of the Upsert Kafka sink operator. By default, the parallelism is determined by the framework using the same parallelism of the upstream chained operator.
properties.*	No	(none)	String	This option can set and pass arbitrary Kafka configurations. The suffix of this parameter must match the parameter defined in **Kafka Configuration documentation**. Flink will remove the **properties.** key prefix and pass the transformed key and value to the underlying KafkaClient. For example, you can disable automatic topic creation via **'properties.allow.auto.create.topics' = 'false'**. But there are some configurations that do not support to set, because Flink will override them, for example, **'key.deserializer'** and **'value.deserializer'**.
ssl_auth_name	No	None	String	Name of datasource authentication of the Kafka_SSL type created on DLI. This configuration is used when SSL is configured for Kafka. Note: If only the SSL type is used, you need to set **properties.security.protocol** to **SSL**. If the SASL_SSL type is used, you need to set **properties.security.protocol** to **SASL_SSL**, **properties.sasl.mechanism** to **GSSAPI** or **PLAIN**, and **properties.sasl.jaas.config** to **org.apache.kafka.common.security.plain.PlainLoginModule required username=\"xxx\" password=\"xxx\";**.

Parameter	Mandatory	Default Value	Data Type	Description
krb_auth_name	No	None	String	Name of datasource authentication of the Kerberos type created on DLI. This configuration is used when SASL is configured for Kafka. Note: If the SASL_PLAINTEXT type and Kerberos authentication are used, you need to set **properties.sasl.mechanism** to **GSSAPI** and **properties.security.protocol** to **SASL_PLAINTEXT**.

Example

In this example, Kafka source topic data is read from the Kafka source table and written to the Kafka sink topic through the Upsert Kafka result table.

1. Create an enhanced datasource connection in the VPC and subnet where Kafka locates, and bind the connection to the required Flink elastic resource pool. For details, see **Enhanced Datasource Connections**.
2. Set Kafka security groups and add inbound rules to allow access from the Flink queue. Test the connectivity using the Kafka address by referring to **Testing Address Connectivity**. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.
3. Create a Flink OpenSource SQL job. Enter the following job script and submit the job.

   When you create a job, set **Flink Version** to **1.12** on the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs.
   Change the values of the parameters in bold as needed in the following script.

```
CREATE TABLE orders (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = '***KafkaTopic***',
  'properties.bootstrap.servers' = '***KafkaAddress1:KafkaPort,KafkAddress2:KafkaPort***',
  'properties.group.id' = '***GroupId***',
  'scan.startup.mode' = 'latest-offset',
  "format" = "json"
);
CREATE TABLE UPSERTKAFKASINK (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
```



```
  pay_time string,
  user_id string,
  user_name string,
  area_id string,
  PRIMARY KEY (order_id) NOT ENFORCED
) WITH (
  'connector' = 'upsert-kafka',
  'topic' = '***KafkaTopic***',
  'properties.bootstrap.servers' =  '***KafkaAddress1:KafkaPort,KafkAddress2:KafkaPort***',
  'key.format' = 'json',
  'value.format' = 'json'
);
insert into UPSERTKAFKASINK
select * from orders;
```

4. Connect to the Kafka cluster and send the following test data to the Kafka source topic:

```
{"order_id":"202103251202020001", "order_channel":"miniAppShop", "order_time":"2021-03-25 12:02:02", "pay_amount":"60.00", "real_pay":"60.00", "pay_time":"2021-03-25 12:03:00", "user_id":"0002", "user_name":"Bob", "area_id":"330110"}

{"order_id":"202103251505050001", "order_channel":"qqShop", "order_time":"2021-03-25 15:05:05", "pay_amount":"500.00", "real_pay":"400.00", "pay_time":"2021-03-25 15:10:00", "user_id":"0003", "user_name":"Cindy", "area_id":"330108"}

{"order_id":"202103251202020001", "order_channel":"miniAppShop", "order_time":"2021-03-25 12:02:02", "pay_amount":"60.00", "real_pay":"60.00", "pay_time":"2021-03-25 12:03:00", "user_id":"0002", "user_name":"Bob", "area_id":"330110"}
```

5. Connect to the Kafka cluster and read data from the Kafka sink topic. The result is as follows:

```
{"order_id":"202103251202020001", "order_channel":"miniAppShop", "order_time":"2021-03-25 12:02:02", "pay_amount":"60.00", "real_pay":"60.00", "pay_time":"2021-03-25 12:03:00", "user_id":"0002", "user_name":"Bob", "area_id":"330110"}

{"order_id":"202103251505050001", "order_channel":"qqShop", "order_time":"2021-03-25 15:05:05", "pay_amount":"500.00", "real_pay":"400.00", "pay_time":"2021-03-25 15:10:00", "user_id":"0003", "user_name":"Cindy", "area_id":"330108"}

{"order_id":"202103251202020001", "order_channel":"miniAppShop", "order_time":"2021-03-25 12:02:02", "pay_amount":"60.00", "real_pay":"60.00", "pay_time":"2021-03-25 12:03:00", "user_id":"0002", "user_name":"Bob", "area_id":"330110"}
```

FAQ

None

3.3.2.11 FileSystem Result Table

Function

The FileSystem result (sink) table is used to export data to the HDFS or OBS file system. It is applicable to scenarios such as data dumping, big data analysis, data backup, and active, deep, or cold archiving.

Considering that the input stream can be unbounded, you can put the data in each bucket into **part** files of a limited size. Data can be written into a bucket based on time. For example, you can write data into a bucket every hour. This bucket contains the records received within one hour, and

data in the bucket directory is split into multiple **part** files. Each sink bucket that receives data contains at least one **part** file for each subtask. Other **part** files are created based on the configured rolling policy. For Row Formats, the default

rolling policy is based on the **part** file size. You need to specify the maximum timeout period for opening a file and the timeout period for the inactive state after closing a file. Bulk Formats are rolled each time a checkpoint is created. You can add other rolling conditions based on size or time.

NOTE

- To use FileSink in STREAMING mode, you need to enable the checkpoint function. **Part** files are generated only when the checkpoint is successful. If the checkpoint function is not enabled, the files remain in the in-progress or pending state, and downstream systems cannot securely read the file data.
- The number recorded by the sink end operator is the number of checkpoints, not the actual volume of the sent data. For the actual volume, see the number recorded by the streaming-writer or StreamingFileWriter operator.

Syntax

```
CREATE TABLE sink_table (
  name string,
  num INT,
  p_day string,
  p_hour string
) partitioned by (p_day, p_hour) WITH (
  'connector' = 'filesystem',
  'path' = 'obs://*** ',
  'format' = 'parquet',
  'auto-compaction' = 'true'
);
```

Usage

- **Rolling Policy**

  The Rolling Policy defines when a given in-progress part file will be closed and moved to the pending and later to finished state. Part files in the "finished" state are the ones that are ready for viewing and are guaranteed to contain valid data that will not be reverted in case of failure.

  In STREAMING mode, the Rolling Policy in combination with the checkpointing interval (pending files become finished on the next checkpoint) control how quickly part files become available for downstream readers and also the size and number of these parts. For details, see **Parameters**.

- **Part File Lifecycle**

  To use the output of the FileSink in downstream systems, we need to understand the naming and lifecycle of the output files produced.

  Part files can be in one of three states:

  - **In-progress**: The part file that is currently being written to is in-progress.
  - **Pending**: Closed (due to the specified rolling policy) in-progress files that are waiting to be committed.
  - **Finished**: On successful checkpoints (STREAMING) or at the end of input (BATCH) pending files transition to **Finished**

  Only finished files are safe to read by downstream systems as those are guaranteed to not be modified later.

  By default, the file naming strategy is as follows:

  - **In-progress / Pending**: part-<uid>-<partFileIndex>.inprogress.uid

  - **Finished**: part-<uid>-<partFileIndex>

  uid is a random ID assigned to a subtask of the sink when the subtask is instantiated. This **uid** is not fault-tolerant so it is regenerated when the subtask recovers from a failure.

- **Compaction**

  FileSink supports compaction of the pending files, which allows the application to have smaller checkpoint interval without generating a lot of small files.

  Once enabled, the compaction happens between the files become pending and get committed. The pending files will be first committed to temporary files whose path starts with a dot (.). Then these files will be compacted according to the strategy by the compactor specified by the users, and the new compacted pending files will be generated. Then these pending files will be emitted to the committer to be committed to the formal files. After that, the source files will be removed.

- **Partitions**

  Filesystem sink supports the partitioning function. Partitions are generated based on the selected fields by using the **partitioned by** syntax. The following is an example:

```
path
└── datetime=2022-06-25
    └── hour=10
        ├── part-0.parquet
        ├── part-1.parquet
└── datetime=2022-06-26
    └── hour=16
        ├── part-0.parquet
    └── hour=17
        ├── part-0.parquet
```

  Similar to files, partitions also need to be submitted to notify downstream applications that files in the partitions can be securely read. Filesystem sink provides multiple configuration submission policies.

Parameters

Table 3-25 Parameter description

Parameter	Mandatory	Default Value	Type	Description
connector	Yes	None	String	The value is fixed at **filesystem**.
path	Yes	None	String	OBS path
format	Yes	None	String	File format Available values are: **csv** and **parquet**

Parameter	Mandatory	Default Value	Type	Description
sink.rolling-policy.file-size	No	128 MB	MemorySize	Maximum size of a part file. If the size of a part file exceeds this value, a new file will be generated. **NOTE** The Rolling Policy defines when a given in-progress part file will be closed and moved to the pending and later to finished state. Part files in the "finished" state are the ones that are ready for viewing and are guaranteed to contain valid data that will not be reverted in case of failure. In STREAMING mode, the Rolling Policy in combination with the checkpointing interval (pending files become finished on the next checkpoint) control how quickly part files become available for downstream readers and also the size and number of these parts.
sink.rolling-policy.rollover-interval	No	30 min	Duration	Maximum duration that a part file can be opened. If a part file is opened longer than the maximum duration, a new file will be generated in rolling mode. The default value is 30 minutes so that there will not be a large number of small files. The check frequency is specified by **sink.rolling-policy.check-interval**. **NOTE** There must be a space between the number and the unit. The supported time units include **d**, **h**, **min**, **s**, and **ms**. For bulk files (parquet, orc, and avro), the checkpoint interval also controls the maximum open duration of a part file.
sink.rolling-policy.check-interval	No	1 min	Duration	Check interval of the time-based rolling policy This parameter controls the frequency of checking whether a file should be rolled based on **sink.rolling-policy.rollover-interval**.
auto-compaction	No	false	Boolean	Whether automatic compaction is enabled for the streaming sink. Data is first written to temporary files. After the checkpoint is complete, the temporary files generated by the checkpoint are compacted.

Parameter	Mandatory	Default Value	Type	Description
compaction.file-size	No	Size of **sink.rolling-policy.file-size**	MemorySize	Size of the files that will be compacted. The default value is the size of the files that will be rolled. **NOTE** • Only files in the same checkpoint are compacted. The final files must be more than or equal to the number of checkpoints. • If the compaction takes a long time, back pressure may occur and the checkpointing may be prolonged. • After this function is enabled, final files are generated during checkpoint and a new file is opened to receive the data generated at the next checkpoint.

Example 1

Use datagen to randomly generate data and write the data into the **fileName** directory in the OBS bucket **bucketName**. The file generation time is irrelevant to the checkpoint. When the file is opened more than 30 minutes or is bigger than 128 MB, a new file is generated.

```
create table orders(
  name string,
  num INT
) with (
  'connector' = 'datagen',
  'rows-per-second' = '100',
  'fields.name.kind' = 'random',
  'fields.name.length' = '5'
);

CREATE TABLE sink_table (
   name string,
   num INT
) WITH (
   'connector' = 'filesystem',
   'path' = 'obs://bucketName/fileName',
   'format' = 'csv',
   'sink.rolling-policy.file-size'='128m',
   'sink.rolling-policy.rollover-interval'='30 min'
);
INSERT into sink_table SELECT * from orders;
```

Example 2

Use datagen to randomly generate data and write the data into the **fileName** directory in the OBS bucket **bucketName**. The file generation time is relevant to the checkpoint. When the checkpoint interval is reached or the file size reaches 100 MB, a new file is generated.

```
create table orders(
  name string,
```



```
  num INT
) with (
  'connector' = 'datagen',
  'rows-per-second' = '100',
  'fields.name.kind' = 'random',
  'fields.name.length' = '5'
);

CREATE TABLE sink_table (
   name string,
   num INT
) WITH (
   'connector' = 'filesystem',
   'path' = 'obs://bucketName/fileName',
   'format' = 'csv',
   'sink.rolling-policy.file-size'='128m',
   'sink.rolling-policy.rollover-interval'='30 min',
   'auto-compaction'='true',
   'compaction.file-size'='100m'

);
INSERT into sink_table SELECT * from orders;
```

3.3.3 Creating Dimension Tables

3.3.3.1 GaussDB(DWS) Dimension Table

Function

Create a GaussDB(DWS) table to connect to source streams for wide table generation.

Prerequisites

- Ensure that you have created a GaussDB(DWS) cluster using your account.
- A DWS database table has been created.
- An enhanced datasource connection has been created for DLI to connect to DWS clusters, so that jobs can run on the dedicated queue of DLI and you can set the security group rules as required.
  - For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.
  - For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.
- In Flink cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

  For details about datasource authentication, see **Introduction to Datasource Authentication**.

Precautions

When you create a Flink OpenSource SQL job, set **Flink Version** to **1.12** in the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs.

Syntax

```
create table dwsSource (
  attr_name attr_type
  (',' attr_name attr_type)*
)
with (
  'connector' = 'gaussdb',
  'url' = '',
  'table-name' = '',
  'username' = '',
  'password' = ''
);
```

Parameters

Table 3-26 Parameter description

Parameter	Mandatory	Default Value	Data Types	Description
connector	Yes	None	String	Connector type. Set this parameter to **gaussdb**.
url	Yes	None	String	JDBC connection address. If you use the gsjdbc4 driver, set the value in jdbc:postgresql://${ip}:${port}/${dbName} format. If you use the gsjdbc200 driver, set the value in jdbc:gaussdb://${ip}:${port}/${dbName} format.
table-name	Yes	None	String	Name of the table where the data will be read from the database
driver	No	None	String	JDBC connection driver. The default value is **org.postgresql.Driver**. • If you use the gsjdbc4 driver for connection, set **connector.driver** to **org.postgresql.Driver**. • If you use the gsjdbc200 driver for connection, set **connector.driver** to **com.huawei.gauss200.jdbc.Driver**.
username	No	None	String	Database authentication user name. This parameter must be configured in pair with **password**.
password	No	None	String	Database authentication password. This parameter must be configured in pair with **username**.

Parameter	Mandatory	Default Value	Data Types	Description
scan.partition.column	No	None	String	Name of the column used to partition the input This parameter must be set when **scan.partition.lower-bound**, **scan.partition.upper-bound**, and **scan.partition.num** are all configured, and should not be set when other three parameters are not.
scan.partition.lower-bound	No	None	Integer	Lower bound of values to be fetched for the first partition This parameter must be set when **scan.partition.column**, **scan.partition.upper-bound**, and **scan.partition.num** are all configured, and should not be set when other three parameters are not.
scan.partition.upper-bound	No	None	Integer	Upper bound of values to be fetched for the last partition This parameter must be set when **scan.partition.column**, **scan.partition.lower-bound**, and **scan.partition.num** are all configured, and should not be set when other three parameters are not.
scan.partition.num	No	None	Integer	Number of partitions to be created This parameter must be set when **scan.partition.column**, **scan.partition.upper-bound**, and **scan.partition.upper-bound** are all configured, and should not be set when other three parameters are not.
scan.fetch-size	No	0	Integer	Number of rows fetched from the database each time. The default value **0** indicates that the number of rows is not limited.
scan.auto-commit	No	true	Boolean	Automatic commit flag. It determines whether each statement is committed in a transaction automatically.

Parameter	Mandatory	Default Value	Data Types	Description
lookup.cache.max-rows	No	None	Integer	The max number of rows of lookup cache. Caches exceeding the TTL will be expired. Lookup cache is disabled by default.
lookup.cache.ttl	No	None	Duration	Maximum time to live (TTL) of for every rows in lookup cache. Caches exceeding the TTL will be expired. The format is {length value}{time unit label}, for example, **123ms, 321s**. The supported time units include d, h, min, s, and ms (default unit). Lookup cache is disabled by default.
lookup.max-retries	No	3	Integer	Maximum retry times if lookup database failed.
pwd_auth_name	No	None	String	Name of datasource authentication of the password type created on DLI. If datasource authentication is used, you do not need to set the username and password for jobs.

Example

Read data from a Kafka source table, use a GaussDB(DWS) table as the dimension table. Write wide table information generated by the source and dimension tables to a Kafka result table. The procedure is as follows:

1. Create an enhanced datasource connection in the VPC and subnet where DWS and Kafka locate, and bind the connection to the required Flink elastic resource pool. For details, see **Enhanced Datasource Connections**.
2. Set GaussDB(DWS) and Kafka security groups and add inbound rules to allow access from the Flink queue. Test the connectivity using the DWS and Kafka address by referring to **Testing Address Connectivity**. If the connection passes the test, it is bound to the queue.
3. Connect to the GaussDB(DWS) database instance, create a table as a dimension table, and name the table **area_info**. Example SQL statements are as follows:

```
create table public.area_info(
  area_id VARCHAR,
  area_province_name VARCHAR,
  area_city_name VARCHAR,
  area_county_name VARCHAR,
  area_street_name VARCHAR,
  region_name VARCHAR);
```

4. Connect to the database and run the following statement to insert test data into the dimension table **area_info**:


```
insert into area_info
(area_id, area_province_name, area_city_name, area_county_name, area_street_name, region_name)
values
('330102', 'a1', 'b1', 'c1', 'd1', 'e1'),
('330106', 'a1', 'b1', 'c2', 'd2', 'e1'),
('330108', 'a1', 'b1', 'c3', 'd3', 'e1'),
('330110', 'a1', 'b1', 'c4', 'd4', 'e1');
```

5. Create a Flink OpenSource SQL job Enter the following job script and submit the job. The job script uses Kafka as the data source and a GaussDB(DWS) table as the dimension table. Data is output to a Kafka result table.

   When you create a job, set **Flink Version** to **1.12** in the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs. **Set the values of the parameters in bold in the following script as needed.**

```
CREATE TABLE orders (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string,
  proctime as Proctime()
) WITH (
  'connector' = 'kafka',
  'topic' = '***KafkaSourceTopic***',
  'properties.bootstrap.servers' = '***KafkaAddress1:KafkaPort,KafkaAddress2:KafkaPort***',
  'properties.group.id' = 'dws-order',
  'scan.startup.mode' = 'latest-offset',
  'format' = 'json'
);

-- Create an address dimension table
create table area_info (
    area_id string,
    area_province_name string,
    area_city_name string,
    area_county_name string,
    area_street_name string,
    region_name string
) WITH (
  'connector' = 'gaussdb',
  'driver' = 'org.postgresql.Driver',
  'url' = 'jdbc:gaussdb://***DwsAddress:DwsPort/DwsDbName***',
  'table-name' = 'area_info',
  'username' = '***DwsUserName***',
  'password' = '***DwsPassword***',
  'lookup.cache.max-rows' = '10000',
  'lookup.cache.ttl' = '2h'
);

-- Generate a wide table based on the address dimension table containing detailed order information.
create table order_detail(
    order_id string,
    order_channel string,
    order_time string,
    pay_amount double,
    real_pay double,
    pay_time string,
    user_id string,
    user_name string,
    area_id string,
    area_province_name string,
    area_city_name string,
    area_county_name string,
    area_street_name string,
```

```
    region_name string
) with (
  'connector' = 'kafka',
  'topic' = '***KafkaSinkTopic***',
  'properties.bootstrap.servers' = '***KafkaAddress1:KafkaPort,KafkaAddress2:KafkaPort***',
  'format' = 'json'
);

insert into order_detail
    select orders.order_id, orders.order_channel, orders.order_time, orders.pay_amount, orders.real_pay,
orders.pay_time, orders.user_id, orders.user_name,
           area.area_id, area.area_province_name, area.area_city_name, area.area_county_name,
           area.area_street_name, area.region_name  from orders
    left join area_info for system_time as of orders.proctime as area on orders.area_id = area.area_id;
```

6. Connect to the Kafka cluster and insert the following test data into the source topic in Kafka:

```
{"order_id":"202103241606060001", "order_channel":"appShop", "order_time":"2021-03-24 16:06:06",
"pay_amount":"200.00", "real_pay":"180.00", "pay_time":"2021-03-24 16:10:06", "user_id":"0001",
"user_name":"Alice", "area_id":"330106"}

{"order_id":"202103251202020001", "order_channel":"miniAppShop", "order_time":"2021-03-25
12:02:02", "pay_amount":"60.00", "real_pay":"60.00", "pay_time":"2021-03-25 12:03:00",
"user_id":"0002", "user_name":"Bob", "area_id":"330110"}

{"order_id":"202103251505050001", "order_channel":"qqShop", "order_time":"2021-03-25 15:05:05",
"pay_amount":"500.00", "real_pay":"400.00", "pay_time":"2021-03-25 15:10:00", "user_id":"0003",
"user_name":"Cindy", "area_id":"330108"}
```

7. Connect to the Kafka cluster and read data from the sink topic of Kafka. The result is as follows:

```
{"order_id":"202103241606060001","order_channel":"appShop","order_time":"2021-03-24
16:06:06","pay_amount":200.0,"real_pay":180.0,"pay_time":"2021-03-24
16:10:06","user_id":"0001","user_name":"Alice","area_id":"330106","area_province_name":"a1","area_ci
ty_name":"b1","area_county_name":"c2","area_street_name":"d2","region_name":"e1"}

{"order_id":"202103251202020001","order_channel":"miniAppShop","order_time":"2021-03-25
12:02:02","pay_amount":60.0,"real_pay":60.0,"pay_time":"2021-03-25
12:03:00","user_id":"0002","user_name":"Bob","area_id":"330110","area_province_name":"a1","area_cit
y_name":"b1","area_county_name":"c4","area_street_name":"d4","region_name":"e1"}

{"order_id":"202103251505050001","order_channel":"qqShop","order_time":"2021-03-25
15:05:05","pay_amount":500.0,"real_pay":400.0,"pay_time":"2021-03-25
15:10:00","user_id":"0003","user_name":"Cindy","area_id":"330108","area_province_name":"a1","area_c
ity_name":"b1","area_county_name":"c3","area_street_name":"d3","region_name":"e1"}
```

FAQs

- Q: What should I do if Flink job logs contain the following error information?

```
java.io.IOException: unable to open JDBC writer
...
Caused by: org.postgresql.util.PSQLException: The connection attempt failed.
...
Caused by: java.net.SocketTimeoutException: connect timed out
```

  A: The datasource connection is not bound or the binding fails.

  – To reconfigure datasource connections, refer to **Enhanced Datasource Connection**. Rectify the fault by referring to **DLI Failed to Connect to GaussDB(DWS) Through an Enhanced Datasource Connection**.

- Q: How can I configure a GaussDB(DWS) table that is in a schema?

  A: In the following example configures the **area_info** table in the **dbuser2** schema.

```
-- Create an address dimension table
create table area_info (
    area_id string,
    area_province_name string,
```



```
  area_city_name string,
  area_county_name string,
  area_street_name string,
  region_name string
) WITH (
 'connector' = 'gaussdb',
  'driver' = 'org.postgresql.Driver',
  'url' = 'jdbc:postgresql://DwsAddress:DwsPort/DwsDbname',
  'table-name' = 'dbuser2.area_info',
  'username' = 'DwsUserName',
  'password' = 'DwsPassword',
  'lookup.cache.max-rows' = '10000',
  'lookup.cache.ttl' = '2h'
);
```

3.3.3.2 HBase Dimension Table

Function

Create a Hbase dimension table to connect to the source streams for wide table generation.

Prerequisites

- An enhanced datasource connection has been created for DLI to connect to HBase, so that jobs can run on the dedicated queue of DLI and you can set the security group rules as required.
  - For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.
  - For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.
- If MRS HBase is used, IP addresses of all hosts in the MRS cluster have been added to host information of the enhanced datasource connection.

  .
- In Flink cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

  For details about datasource authentication, see **Introduction to Datasource Authentication**.

Precautions

- When you create a Flink OpenSource SQL job, set **Flink Version** to **1.12** in the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs.
- All the column families in HBase table must be declared as ROW type, the field name maps to the column family name, and the nested field names map to the column qualifier names. There is no need to declare all the families and qualifiers in the schema, users can declare what is used in the query. Except the ROW type fields, the single atomic type field (for example, STRING, BIGINT) will be recognized as HBase rowkey. The rowkey field can be an arbitrary name, but should be quoted using backticks if it is a reserved keyword.

Syntax

```
create table hbaseSource (
  attr_name attr_type
  (',' attr_name attr_type)*
 )
with (
  'connector' = 'hbase-2.2',
  'table-name' = '',
  'zookeeper.quorum' = ''
);
```

Parameters

Table 3-27 Parameter description

Parameter	Mandatory	Default Value	Type	Description
connector	Yes	None	String	Connector type. Set this parameter to **hbase-2.2**.
table-name	Yes	None	String	Name of the HBase table
zookeeper.quorum	Yes	None	String	HBase Zookeeper quorum. The format is ZookeeperAddress:ZookeeperPort. The following describes how to obtain the ZooKeeper IP address and port number: ● On the MRS Manager console, choose **Cluster** > *Name of the desired cluster* > **Service** > **ZooKeeper** > **Instance**. On the displayed page, obtain the IP address of the ZooKeeper instance. ● On the MRS Manager console, choose **Cluster** > *Name of the desired cluster* > **Service** > **ZooKeeper** > **Configuration**, and click **All Configurations**. Search for the **clientPort** parameter, and obtain the ZooKeeper port number.
zookeeper.znode.parent	No	/hbase	String	Root directory in ZooKeeper for the HBase cluster.
lookup.async	No	false	Boolean	Whether async lookup is enabled.

Parameter	Mandatory	Default Value	Type	Description
lookup.cache.max-rows	No	-1	Long	The max number of rows of lookup cache. Caches exceeding the TTL will be expired. Lookup cache is disabled by default.
lookup.cache.ttl	No	-1	Long	Maximum time to live (TTL) of for every rows in lookup cache. Caches exceeding the TTL will be expired. The format is {length value}{time unit label}, for example, **123ms, 321s**. The supported time units include d, h, min, s, and ms (default unit). Lookup cache is disabled by default.
lookup.max-retries	No	3	Integer	Maximum retry times if lookup database failed.
krb_auth_name	No	None	String	Name of datasource authentication of the Kerberos type created on DLI.

Data Type Mapping

HBase stores all data as byte arrays. The data needs to be serialized and deserialized during read and write operation.

When serializing and de-serializing, Flink HBase connector uses utility class **org.apache.hadoop.hbase.util.Bytes** provided by HBase (Hadoop) to convert Flink data types to and from byte arrays.

Flink HBase connector encodes null values to empty bytes, and decode empty bytes to null values for all data types except string type. For string type, the null literal is determined by null-string-literal option.

Table 3-28 Data type mapping

Flink SQL Type	HBase Conversion
CHAR / VARCHAR / STRING	byte[] toBytes(String s) String toString(byte[] b)
BOOLEAN	byte[] toBytes(boolean b) boolean toBoolean(byte[] b)
BINARY / VARBINARY	Return byte[] as is.

Flink SQL Type	HBase Conversion
DECIMAL	byte[] toBytes(BigDecimal v) BigDecimal toBigDecimal(byte[] b)
TINYINT	new byte[] { val } bytes[0] // returns first and only byte from bytes
SMALLINT	byte[] toBytes(short val) short toShort(byte[] bytes)
INT	byte[] toBytes(int val) int toInt(byte[] bytes)
BIGINT	byte[] toBytes(long val) long toLong(byte[] bytes)
FLOAT	byte[] toBytes(float val) float toFloat(byte[] bytes)
DOUBLE	byte[] toBytes(double val) double toDouble(byte[] bytes)
DATE	Number of days since 1970-01-01 00:00:00 UTC. The value is an integer.
TIME	Number of milliseconds since 1970-01-01 00:00:00 UTC. The value is an integer.
TIMESTAMP	Number of milliseconds since 1970-01-01 00:00:00 UTC. The value is of the long type.
ARRAY	Not supported
MAP / MULTISET	Not supported
ROW	Not supported

Example

In this example, data is read from a Kafka data source, an HBase table is used as a dimension table to generate a wide table, and the result is written to a Kafka result table. The procedure is as follows (the HBase versions in this example are 1.3.1 and 2.2.3):

1. Create an enhanced datasource connection in the VPC and subnet where HBase and Kafka locate, and bind the connection to the required Flink elastic resource pool. For details, see **Enhanced Datasource Connections**. Add MRS host information for the enhanced datasource connection..

2. Set HBase and Kafka security groups and add inbound rules to allow access from the Flink queue. Test the connectivity using the HBase and Kafka address by referring to **Testing Address Connectivity**. If the connection passes the test, it is bound to the queue.
3. Create a HBase table and name it **area_info** using the HBase shell. The table has only one column family **detail**. The creation statement is as follows:

```
create 'area_info', {NAME => 'detail'}
```

4. Run the following statement in the HBase shell to insert dimension table data:

```
put 'area_info', '330106', 'detail:area_province_name', 'a1'
put 'area_info', '330106', 'detail:area_city_name', 'b1'
put 'area_info', '330106', 'detail:area_county_name', 'c2'
put 'area_info', '330106', 'detail:area_street_name', 'd2'
put 'area_info', '330106', 'detail:region_name', 'e1'

put 'area_info', '330110', 'detail:area_province_name', 'a1'
put 'area_info', '330110', 'detail:area_city_name', 'b1'
put 'area_info', '330110', 'detail:area_county_name', 'c4'
put 'area_info', '330110', 'detail:area_street_name', 'd4'
put 'area_info', '330110', 'detail:region_name', 'e1'
```

5. Create a Flink OpenSource SQL job Enter the following job script and submit the job. The job script uses Kafka as the data source and an HBase table as the dimension table. Data is output to a Kafka result table.

   When you create a job, set **Flink Version** to **1.12** in the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs. **Set the values of the parameters in bold in the following script as needed.**

```
CREATE TABLE orders (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string,
  proctime as Proctime()
) WITH (
  'connector' = 'kafka',
  'topic' = '***KafkaSourceTopic***',
  'properties.bootstrap.servers' = '***KafkaAddress1:KafkaPort,KafkaAddress2:KafkaPort***',
  'properties.group.id' = '***GroupId***',
  'scan.startup.mode' = 'latest-offset',
  'format' = 'json'
);

-- Create an address dimension table
create table area_info (
  area_id string,
  detail row(
    area_province_name string,
    area_city_name string,
    area_county_name string,
    area_street_name string,
    region_name string)
) WITH (
  'connector' = 'hbase-2.2',
  'table-name' = 'area_info',
  'zookeeper.quorum' = '***ZookeeperAddress:ZookeeperPort***',
  'lookup.async' = 'true',
  'lookup.cache.max-rows' = '10000',
  'lookup.cache.ttl' = '2h'
);
```



```
-- Generate a wide table based on the address dimension table containing detailed order information.
create table order_detail(
    order_id string,
    order_channel string,
    order_time string,
    pay_amount double,
    real_pay double,
    pay_time string,
    user_id string,
    user_name string,
    area_id string,
    area_province_name string,
    area_city_name string,
    area_county_name string,
    area_street_name string,
    region_name string
) with (
  'connector' = 'kafka',
  'topic' = '<yourSinkTopic>',
  'properties.bootstrap.servers' = 'KafkaAddress1:KafkaPort,KafkaAddress2:KafkaPort',
  'format' = 'json'
);

insert into order_detail
    select orders.order_id, orders.order_channel, orders.order_time, orders.pay_amount, orders.real_pay,
orders.pay_time, orders.user_id, orders.user_name,
           area.area_id, area.area_province_name, area.area_city_name, area.area_county_name,
           area.area_street_name, area.region_name  from orders
    left join area_info for system_time as of orders.proctime as area on orders.area_id = area.area_id;
```

6. Connect to the Kafka cluster and insert the following test data into the source topic in Kafka:

```
{"order_id":"202103241000000001", "order_channel":"webShop", "order_time":"2021-03-24 10:00:00",
"pay_amount":"100.00", "real_pay":"100.00", "pay_time":"2021-03-24 10:02:03", "user_id":"0001",
"user_name":"Alice", "area_id":"330106"}

{"order_id":"202103241606060001", "order_channel":"appShop", "order_time":"2021-03-24 16:06:06",
"pay_amount":"200.00", "real_pay":"180.00", "pay_time":"2021-03-24 16:10:06", "user_id":"0001",
"user_name":"Alice", "area_id":"330106"}

{"order_id":"202103251202020001", "order_channel":"miniAppShop", "order_time":"2021-03-25
12:02:02", "pay_amount":"60.00", "real_pay":"60.00", "pay_time":"2021-03-25 12:03:00",
"user_id":"0002", "user_name":"Bob", "area_id":"330110"}
```

7. Connect to the Kafka cluster and read data from the sink topic of Kafka. The result data is as follows:

```
{"order_id":"202103241000000001","order_channel":"webShop","order_time":"2021-03-24
10:00:00","pay_amount":100.0,"real_pay":100.0,"pay_time":"2021-03-24
10:02:03","user_id":"0001","user_name":"Alice","area_id":"330106","area_province_name":"a1","area_ci
ty_name":"b1","area_county_name":"c2","area_street_name":"d2","region_name":"e1"}

{"order_id":"202103241606060001","order_channel":"appShop","order_time":"2021-03-24
16:06:06","pay_amount":200.0,"real_pay":180.0,"pay_time":"2021-03-24
16:10:06","user_id":"0001","user_name":"Alice","area_id":"330106","area_province_name":"a1","area_ci
ty_name":"b1","area_county_name":"c2","area_street_name":"d2","region_name":"e1"}

{"order_id":"202103251202020001","order_channel":"miniAppShop","order_time":"2021-03-25
12:02:02","pay_amount":60.0,"real_pay":60.0,"pay_time":"2021-03-25
12:03:00","user_id":"0002","user_name":"Bob","area_id":"330110","area_province_name":"a1","area_cit
y_name":"b1","area_county_name":"c4","area_street_name":"d4","region_name":"e1"}
```

FAQs

Q: What should I do if Flink job logs contain the following error information?

```
org.apache.zookeeper.ClientCnxn$SessionTimeoutException: Client session timed out, have not heard from
server in 90069ms for connection id 0x0
```


A: The datasource connection is not bound or the binding fails. Configure the datasource connection by referring to **Enhanced Datasource Connection** or configure the security group of the Kafka cluster to allow access from the DLI queue.

3.3.3.3 JDBC Dimension Table

Create a JDBC dimension table to connect to the source stream.

Prerequisites

You have created a JDBC instance for your account.

Precautions

- When you create a Flink OpenSource SQL job, set **Flink Version** to **1.12** in the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs.
- In Flink cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

  For details about datasource authentication, see **Introduction to Datasource Authentication**.

Syntax

```
CREATE TABLE  table_id (
  attr_name attr_type
  (',' attr_name attr_type)*
)
  WITH (
  'connector' = 'jdbc',
  'url' = '',
  'table-name' = '',
  'driver' = '',
  'username' = '',
  'password' = ''
);
```

Parameters

Table 3-29 Parameter descriptions

Parameter	Mandatory	Description
connector	Yes	Data source type. The value is fixed to **jdbc**.
url	Yes	Database URL
table-name	Yes	Name of the table where the data will be read from the database
driver	No	Driver required for connecting to the database. If you do not set this parameter, the automatically extracted URL will be used.

Parameter	Mandatory	Description
username	No	Database authentication user name. This parameter must be configured in pair with **password**.
password	No	Database authentication password. This parameter must be configured in pair with **username**.
scan.partition.column	No	Name of the column used to partition the input This parameter must be set when **scan.partition.lower-bound**, **scan.partition.upper-bound**, and **scan.partition.num** are all configured, and should not be set when other three parameters are not.
scan.partition.lower-bound	No	Lower bound of values to be fetched for the first partition This parameter must be set when **scan.partition.column**, **scan.partition.upper-bound**, and **scan.partition.num** are all configured, and should not be set when other three parameters are not.
scan.partition.upper-bound	No	Upper bound of values to be fetched for the last partition This parameter must be set when **scan.partition.column**, **scan.partition.lower-bound**, and **scan.partition.num** are all configured, and should not be set when other three parameters are not.
scan.partition.num	No	Number of partitions to be created This parameter must be set when **scan.partition.column**, **scan.partition.upper-bound**, and **scan.partition.upper-bound** are all configured, and should not be set when other three parameters are not.
scan.fetch-size	No	Number of rows fetched from the database each time. The default value is **0**, indicating the hint is ignored.

Parameter	Mandatory	Description
lookup.cache.max-rows	No	Maximum number of cached rows in a dimension table. If the number of cached rows exceeds the value , old data will be deleted. The value **-1** indicates that data cache disabled.
lookup.cache.ttl	No	Maximum time to live (TTL) of for every rows in lookup cache. Caches exceeding the TTL will be expired. The format is {length value}{time unit label}, for example, **123ms, 321s**. The supported time units include d, h, min, s, and ms (default unit).
lookup.max-retries	No	Maximum number of attempts to obtain data from the dimension table. The default value is **3**.
pwd_auth_name	No	Name of datasource authentication of the password type created on DLI.

Data Type Mapping

Table 3-30 Data type mapping

MySQL Type	PostgreSQL Type	Flink SQL Type
TINYINT	-	TINYINT
SMALLINT TINYINT UNSIGNED	SMALLINT INT2 SMALLSERIAL SERIAL2	SMALLINT
INT MEDIUMINT SMALLINT UNSIGNED	INTEGER SERIAL	INT
BIGINT INT UNSIGNED	BIGINT BIGSERIAL	BIGINT
BIGINT UNSIGNED	-	DECIMAL(20, 0)
BIGINT	BIGINT	BIGINT
FLOAT	REAL FLOAT4	FLOAT

MySQL Type	PostgreSQL Type	Flink SQL Type
DOUBLE DOUBLE PRECISION	FLOAT8 DOUBLE PRECISION	DOUBLE
NUMERIC(p, s) DECIMAL(p, s)	NUMERIC(p, s) DECIMAL(p, s)	DECIMAL(p, s)
BOOLEAN TINYINT(1)	BOOLEAN	BOOLEAN
DATE	DATE	DATE
TIME [(p)]	TIME [(p)] [WITHOUT TIMEZONE]	TIME [(p)] [WITHOUT TIMEZONE]
DATETIME [(p)]	TIMESTAMP [(p)] [WITHOUT TIMEZONE]	TIMESTAMP [(p)] [WITHOUT TIMEZONE]
CHAR(n) VARCHAR(n) TEXT	CHAR(n) CHARACTER(n) VARCHAR(n) CHARACTER VARYING(n) TEXT	STRING
BINARY VARBINARY BLOB	BYTEA	BYTES
-	ARRAY	ARRAY

Example

Read data from a Kafka source table, use a JDBC table as the dimension table. Write table information generated by the source and dimension tables to a Kafka result table. The procedure is as follows:

1. Create an enhanced datasource connection in the VPC and subnet where MySQL and Kafka locate, and bind the connection to the required Flink elastic resource pool. For details, see **Enhanced Datasource Connections**.
2. Set MySQL and Kafka security groups and add inbound rules to allow access from the Flink queue. Test the connectivity using the MySQL and Kafka address by referring to **Testing Address Connectivity**. If the connection passes the test, it is bound to the queue.
3. Connect to the MySQL database instance, create a table in the flink database as a dimension table, and name the table **area_info**. Example SQL statements are as follows:


```
CREATE TABLE `flink`.`area_info` (
    `area_id` VARCHAR(32) NOT NULL,
    `area_province_name` VARCHAR(32) NOT NULL,
    `area_city_name` VARCHAR(32) NOT NULL,
    `area_county_name` VARCHAR(32) NOT NULL,
    `area_street_name` VARCHAR(32) NOT NULL,
    `region_name` VARCHAR(32) NOT NULL,
    PRIMARY KEY (`area_id`)
)   ENGINE = InnoDB
    DEFAULT CHARACTER SET = utf8mb4
    COLLATE = utf8mb4_general_ci;
```

4. Connect to the MySQL database and run the following statement to insert test data into the JDBC dimension table **area_info**:

```
insert into flink.area_info
  (area_id, area_province_name, area_city_name, area_county_name, area_street_name, region_name)
  values
  ('330102', 'a1', 'b1', 'c1', 'd1', 'e1'),
  ('330106', 'a1', 'b1', 'c2', 'd2', 'e1'),
  ('330108', 'a1', 'b1', 'c3', 'd3', 'e1'),  ('330110', 'a1', 'b1', 'c4', 'd4', 'e1');
```

5. Create a Flink OpenSource SQL job Enter the following job script and submit the job. The job script uses Kafka as the data source and a JDBC table as the dimension table. Data is output to a Kafka result table.

   When you create a job, set **Flink Version** to **1.12** in the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs. **Set the values of the parameters in bold in the following script as needed.**

```
CREATE TABLE orders (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string,
  proctime as Proctime()
) WITH (
  'connector' = 'kafka',
  'topic' = '***KafkaSourceTopic***',
  'properties.bootstrap.servers' = '***KafkaAddress1:KafkaPort,KafkaAddress2:KafkaPort***',
  'properties.group.id' = 'jdbc-order',
  'scan.startup.mode' = 'latest-offset',
  'format' = 'json'
);

-- Create an address dimension table
create table area_info (
    area_id string,
    area_province_name string,
    area_city_name string,
    area_county_name string,
    area_street_name string,
    region_name string
) WITH (
  'connector' = 'jdbc',
  'url' = 'jdbc:mysql://***JDBCAddress:JDBCPort***/flink',--flink is the MySQL database where the area_info table locates.
  'table-name' = 'area_info',
  'username' = '***JDBCUserName***',
  'password' = '***JDBCPassWord***'
);

-- Generate a wide table based on the address dimension table containing detailed order information.
create table order_detail(
    order_id string,
    order_channel string,
```



```
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string,
  area_province_name string,
  area_city_name string,
  area_county_name string,
  area_street_name string,
  region_name string
) with (
 'connector' = 'kafka',
 'topic' = '***KafkaSinkTopic***',
 'properties.bootstrap.servers' = '***KafkaAddress1:KafkaPort,KafkaAddress2:KafkaPort***',
 'format' = 'json'
);

insert into order_detail
   select orders.order_id, orders.order_channel, orders.order_time, orders.pay_amount, orders.real_pay,
orders.pay_time, orders.user_id, orders.user_name,
          area.area_id, area.area_province_name, area.area_city_name, area.area_county_name,
          area.area_street_name, area.region_name  from orders
          left join area_info for system_time as of orders.proctime as area on orders.area_id =
area.area_id;
```

6. Connect to the Kafka cluster and insert the following test data into the source topic in Kafka:

```
{"order_id":"202103241606060001", "order_channel":"appShop", "order_time":"2021-03-24 16:06:06",
"pay_amount":"200.00", "real_pay":"180.00", "pay_time":"2021-03-24 16:10:06", "user_id":"0001",
"user_name":"Alice", "area_id":"330106"}

{"order_id":"202103251202020001", "order_channel":"miniAppShop", "order_time":"2021-03-25
12:02:02", "pay_amount":"60.00", "real_pay":"60.00", "pay_time":"2021-03-25 12:03:00",
"user_id":"0002", "user_name":"Bob", "area_id":"330110"}

{"order_id":"202103251505050001", "order_channel":"qqShop", "order_time":"2021-03-25 15:05:05",
"pay_amount":"500.00", "real_pay":"400.00", "pay_time":"2021-03-25 15:10:00", "user_id":"0003",
"user_name":"Cindy", "area_id":"330108"}
```

7. Connect to the Kafka cluster and read data from the sink topic of Kafka.

```
{"order_id":"202103241606060001","order_channel":"appShop","order_time":"2021-03-24
16:06:06","pay_amount":200.0,"real_pay":180.0,"pay_time":"2021-03-24
16:10:06","user_id":"0001","user_name":"Alice","area_id":"330106","area_province_name":"a1","area_ci
ty_name":"b1","area_county_name":"c2","area_street_name":"d2","region_name":"e1"}

{"order_id":"202103251202020001","order_channel":"miniAppShop","order_time":"2021-03-25
12:02:02","pay_amount":60.0,"real_pay":60.0,"pay_time":"2021-03-25
12:03:00","user_id":"0002","user_name":"Bob","area_id":"330110","area_province_name":"a1","area_cit
y_name":"b1","area_county_name":"c4","area_street_name":"d4","region_name":"e1"}

{"order_id":"202103251505050001","order_channel":"qqShop","order_time":"2021-03-25
15:05:05","pay_amount":500.0,"real_pay":400.0,"pay_time":"2021-03-25
15:10:00","user_id":"0003","user_name":"Cindy","area_id":"330108","area_province_name":"a1","area_c
ity_name":"b1","area_county_name":"c3","area_street_name":"d3","region_name":"e1"}
```

FAQs

None

3.3.3.4 Redis Dimension Table

Function

Create a Redis table to connect to source streams for wide table generation.

Prerequisites

- An enhanced datasource connection with Redis has been established, so that you can configure security group rules as required.
  - For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.
  - For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.
- In Flink cross-source development scenarios, there is a risk of password leakage if datasource authentication information is directly configured. You are advised to use the datasource authentication provided by DLI.

  For details about datasource authentication, see **Introduction to Datasource Authentication**.

Precautions

- When you create a Flink OpenSource SQL job, set **Flink Version** to **1.12** in the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs.
- To obtain the key values, you can set the primary key in Flink. The primary key maps to the Redis key.
- If the primary key cannot be a composite primary key, and only can be one field.
- Constraints on **schema-syntax**:
  - If **schema-syntax** is **map** or **array**, there can be only one non-primary key and it must be of the same **map** or **array** type.
  - If **schema-syntax** is **fields-scores**, the number of non-primary keys must be an even number, and the second key of every two keys except the primary key must be of the **double** type. The **double** value is the score of the previous key. The following is an example:

```
CREATE TABLE redisSource (
  redisKey string,
  order_id string,
  score1 double,
  order_channel string,
  score2 double,
  order_time string,
  score3 double,
  pay_amount double,
  score4 double,
  real_pay double,
  score5 double,
  pay_time string,
  score6 double,
  user_id string,
  score7 double,
  user_name string,
  score8 double,
  area_id string,
  score9 double,
  primary key (redisKey) not enforced
) WITH (
  'connector' = 'redis',
  'host' = 'RedisIP',
  'password' = 'RedisPassword',
  'data-type' = 'sorted-set',
  'deploy-mode' = 'master-replica',
```



```
  'schema-syntax' = 'fields-scores'
);
```

- Restrictions on **data-type**:
  - When **data-type** is **set**, the types of non-primary keys defined in Flink must be the same.
  - If **data-type** is **sorted-set** and **schema-syntax** is **fields** or **array**, only **sorted set** values can be read from Redis, and the **score** value cannot be read.
  - If **data-type** is **string**, only one non-primary key field is allowed.
  - If **data-type** is **sorted-set** and **schema-syntax** is **map**, there can be only one non-primary key in addition to the primary key and the non-primary key must be of the **map** type. The **map** values of the non-primary key must be of the **double** type, indicating the score. The keys in the map are the values in the Redis set.
  - If **data-type** is **sorted-set** and **schema-syntax** is **array-scores**, only two non-primary keys are allowed and must be of the **array** type.

    The first key indicates values in the Redis set. The second key is of the **array<double>** type, indicating index scores. The following is an example:

```
CREATE TABLE redisSink (
  order_id string,
  arrayField Array<String>,
  arrayScore array<double>,
  primary key (order_id) not enforced
) WITH (
  'connector' = 'redis',
  'host' = 'RedisIP',
  'password' = 'RedisPassword',
  'data-type' = 'sorted-set',
  "default-score" = '3',
  'deploy-mode' = 'master-replica',
  'schema-syntax' = 'array-scores'
);
```

Syntax

```
create table dwsSource (
  attr_name attr_type
  (',' attr_name attr_type)*
  (',' watermark for rowtime_column_name as watermark-strategy_expression)
  ,PRIMARY KEY (attr_name, ...) NOT ENFORCED
)
with (
  'connector' = 'redis',
  'host' = ''
);
```

Parameters

Table 3-31 Parameter description

Parameter	Mandatory	Default Value	Data Types	Description
connector	Yes	None	String	Connector type. Set this parameter to **redis**.

Parameter	Mandatory	Default Value	Data Types	Description
host	Yes	None	String	Redis connector address
port	No	6379	Integer	Redis connector port
password	No	None	String	Redis authentication password
namespace	No	None	String	Redis key namespace
delimiter	No	:	String	Delimiter between the Redis key and namespace
data-type	No	hash	String	Redis data type. Available values are as follows: • hash • list • set • sorted-set • string For details about the constraints, see **Constraints on data-type**.
schema-syntax	No	fields	String	Redis schema semantics. Available values are as follows: • **fields**: applicable to all data types • **fields-scores**: applicable to **sorted set** data • **array**: applicable to **list**, **set**, and **sorted set** data • **array-scores**: applicable to **sorted set** data • **map**: applicable to **hash** and **sorted set** data For details about the constraints, see **Constraints on schema-syntax**.
deploy-mode	No	standalone	String	Deployment mode of the Redis cluster. The value can be **standalone**, **master-replica**, or **cluster**. The default value is **standalone**.

Parameter	Mandatory	Default Value	Data Types	Description
retry-count	Yes	5	Integer	Size of each connection request queue. If the number of connection requests in a queue exceeds the queue size, command calling will cause RedisException. Setting **requestQueueSize** to a small value will cause exceptions to occur earlier during overload or disconnection. A larger value indicates more time required to reach the boundary, but more requests may be queued and more heap space may be used. The default value is **2147483647**.
connection-timeout-millis	No	10000	Integer	Maximum timeout for connecting to the Redis cluster
commands-timeout-millis	No	2000	Integer	Maximum time for waiting for a completion response
rebalancing-timeout-millis	No	15000	Integer	Sleep time when the Redis cluster fails
scan-keys-count	No	1000	Integer	Number of data records read in each scan
default-score	No	0	Double	Default score when **data-type** is **sorted-set**
deserialize-error-policy	No	fail-job	Enum	How to process a data parsing failure Available values are as follows: • **fail-job**: Fail the job • **skip-row**: Skip the current data. • **null-field**: Set the current data to null.
skip-null-values	No	true	Boolean	Whether null values will be skipped
lookup.async	No	false	Boolean	Whether asynchronous I/O will be used when this table is used as a dimension table

Parameter	Mandatory	Default Value	Data Types	Description
pwd_auth_name	No	None	String	Name of datasource authentication of the password type created on DLI. If datasource authentication is used, you do not need to set the username and password for jobs.

Example

Read data from a Kafka source table, use a Redis table as the dimension table. Write wide table information generated by the source and dimension tables to a Kafka result table. The procedure is as follows:

1. Create an enhanced datasource connection in the VPC and subnet where Redis and Kafka locates, and bind the connection to the required Flink elastic resource pool. For details, see **Enhanced Datasource Connections**.
2. Set Redis and Kafka security groups and add inbound rules to allow access from the Flink queue. Test the connectivity using the Redis address by referring to **Testing Address Connectivity**. If the connection passes the test, it is bound to the queue.
3. Run the following commands on the Redis client to send data to Redis:

```
HMSET 330102  area_province_name a1 area_province_name b1 area_county_name c1 area_street_name d1 region_name e1

HMSET 330106  area_province_name a1 area_province_name b1 area_county_name c2 area_street_name d2 region_name e1

HMSET 330108  area_province_name a1 area_province_name b1 area_county_name c3 area_street_name d3 region_name e1

HMSET 330110  area_province_name a1 area_province_name b1 area_county_name c4 area_street_name d4 region_name e1
```

4. Create a Flink OpenSource SQL job Enter the following job script and submit the job. The job script uses Kafka as the data source and a Redis table as the dimension table. Data is output to a Kafka result table.

   When you create a job, set **Flink Version** to **1.12** in the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs. **Set the values of the parameters in bold in the following script as needed.**

```
CREATE TABLE orders (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string,
  proctime as Proctime()
) WITH (
  'connector' = 'kafka',
  'topic' = '***kafkaSourceTopic***',
```



```
  'properties.bootstrap.servers' = 'KafkaAddress1:KafkaPort,KafkaAddress2:KafkaPort',
  'properties.group.id' = 'GroupId',
  'scan.startup.mode' = 'latest-offset',
  'format' = 'json'
);

-- Create an address dimension table
create table area_info (
    area_id string,
    area_province_name string,
    area_city_name string,
    area_county_name string,
    area_street_name string,
    region_name string,
    primary key (area_id) not enforced -- Redis key
) WITH (
  'connector' = 'redis',
  'host' = 'RedisIP',
  'password' = 'RedisPassword',
  'data-type' = 'hash',
  'deploy-mode' = 'master-replica'
);

-- Generate a wide table based on the address dimension table containing detailed order information.
create table order_detail(
    order_id string,
    order_channel string,
    order_time string,
    pay_amount double,
    real_pay double,
    pay_time string,
    user_id string,
    user_name string,
    area_id string,
    area_province_name string,
    area_city_name string,
    area_county_name string,
    area_street_name string,
    region_name string
) with (
  'connector' = 'kafka',
  'topic' = 'kafkaSinkTopic',
  'properties.bootstrap.servers' = 'KafkaAddress1:KafkaPort,KafkaAddress2:KafkaPort',
  'format' = 'json'
);

insert into order_detail
    select orders.order_id, orders.order_channel, orders.order_time, orders.pay_amount, orders.real_pay,
orders.pay_time, orders.user_id, orders.user_name,
           area.area_id, area.area_province_name, area.area_city_name, area.area_county_name,
           area.area_street_name, area.region_name  from orders
    left join area_info for system_time as of orders.proctime as area on orders.area_id = area.area_id;
```

5. Connect to the Kafka cluster and insert the following test data into the source topic in Kafka:

```
{"order_id":"202103241606060001", "order_channel":"appShop", "order_time":"2021-03-24 16:06:06",
"pay_amount":"200.00", "real_pay":"180.00", "pay_time":"2021-03-24 16:10:06", "user_id":"0001",
"user_name":"Alice", "area_id":"330106"}

{"order_id":"202103251202020001", "order_channel":"miniAppShop", "order_time":"2021-03-25
12:02:02", "pay_amount":"60.00", "real_pay":"60.00", "pay_time":"2021-03-25 12:03:00",
"user_id":"0002", "user_name":"Bob", "area_id":"330110"}

{"order_id":"202103251505050001", "order_channel":"qqShop", "order_time":"2021-03-25 15:05:05",
"pay_amount":"500.00", "real_pay":"400.00", "pay_time":"2021-03-25 15:10:00", "user_id":"0003",
"user_name":"Cindy", "area_id":"330108"}
```

6. Connect to the Kafka cluster and read data from the sink topic of Kafka. The result data is as follows:

{"order_id":"202103241606060001","order_channel":"appShop","order_time":"2021-03-24 16:06:06","pay_amount":200.0,"real_pay":180.0,"pay_time":"2021-03-24 16:10:06","user_id":"0001","user_name":"Alice","area_id":"330106","area_province_name":"a1","area_city_name":"b1","area_county_name":"c2","area_street_name":"d2","region_name":"e1"}

{"order_id":"202103251202020001","order_channel":"miniAppShop","order_time":"2021-03-25 12:02:02","pay_amount":60.0,"real_pay":60.0,"pay_time":"2021-03-25 12:03:00","user_id":"0002","user_name":"Bob","area_id":"330110","area_province_name":"a1","area_city_name":"b1","area_county_name":"c4","area_street_name":"d4","region_name":"e1"}

{"order_id":"202103251505050001","order_channel":"qqShop","order_time":"2021-03-25 15:05:05","pay_amount":500.0,"real_pay":400.0,"pay_time":"2021-03-25 15:10:00","user_id":"0003","user_name":"Cindy","area_id":"330108","area_province_name":"a1","area_city_name":"b1","area_county_name":"c3","area_street_name":"d3","region_name":"e1"}

FAQs

If Chinese characters are written to the Redis in the Windows environment, an exception will occur during data writing.

3.3.4 Format

3.3.4.1 Avro

Function

Apache Avro is supported for you to read and write Avro data based on an Avro schema with Flink. The Avro schema is derived from the table schema.

Supported Connectors

- Kafka
- Upsert Kafka

Parameters

Table 3-32 Parameter

Parameter	Mandatory	Default value	Type	Description
format	Yes	None	String	Format to be used. Set the value to **avro**.

Parameter	Mandatory	Default value	Type	Description
avro.codec	No	None	String	Avro compression codec for the file system only The codec is disabled by default. Available values are **deflate**, **snappy**, **bzip2**, and **xz**.

Data Type Mapping

Currently, the Avro schema is derived from the table schema and cannot be explicitly defined. The following table lists mappings between Flink to Avro types.

In addition to the following types, Flink supports reading/writing nullable types. Flink maps nullable types to Avro **union(something, null)**, where **something** is an Avro type converted from Flink type.

You can refer to **Apache Avro 1.11.0 Specification** for more information about Avro types.

Table 3-33 Data Type Mapping

Flink SQL Type	Avro Type	Avro Logical Type
CHAR / VARCHAR / STRING	string	-
BOOLEAN	boolean	-
BINARY / VARBINARY	bytes	-
DECIMAL	fixed	decimal
TINYINT	int	-
SMALLINT	int	-
INT	int	-
BIGINT	long	-
FLOAT	float	-
DOUBLE	double	-

Flink SQL Type	Avro Type	Avro Logical Type
DATE	int	date
TIME	int	time-millis
TIMESTAMP	long	timestamp-millis
ARRAY	array	-
MAP (keys must be of the string, char, or varchar type.)	map	-
MULTISET (elements must be of the string, char, or varchar type.)	map	-
ROW	record	-

Example

Read data from Kafka, deserialize the data to the Avro format, and outputs the data to print.

Step 1 Create a datasource connection for access to the VPC and subnet where Kafka locates and bind the connection to the queue. Set a security group and inbound rule to allow access of the queue and test the connectivity of the queue using the Kafka IP address. For example, locate a general-purpose queue where the job runs and choose **More** > **Test Address Connectivity** in the **Operation** column. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.

Step 2 Create a Flink OpenSource SQL job and select Flink 1.12. Copy the following statement and submit the job:

```
CREATE TABLE kafkaSource (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = '<yourTopic>',
  'properties.bootstrap.servers' =
'<yourKafkaAddress1>:<yourKafkaPort>,<yourKafkaAddress2>:<yourKafkaPort>,<yourKafkaAddress3>:<yourK
afkaPort>',
  'properties.group.id' = '<yourGroupId>',
  'scan.startup.mode' = 'latest-offset',
  "format" = "avro"
);

CREATE TABLE printSink (
  order_id string,
  order_channel string,
```



```
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'print'
);

insert into printSink select * from kafkaSource;
```

Step 3 Insert the following data to Kafka using Avro data serialization:

```
{"order_id":"202103241000000001","order_channel":"webShop","order_time":"2021-03-24
10:00:00","pay_amount":100.0,"real_pay":100.0,"pay_time":"2021-03-24
10:02:03","user_id":"0001","user_name":"Alice","area_id":"330106"}

{"order_id":"202103241606060001","order_channel":"appShop","order_time":"2021-03-24
16:06:06","pay_amount":200.0,"real_pay":180.0,"pay_time":"2021-03-24
16:10:06","user_id":"0001","user_name":"Alice","area_id":"330106"}
```

Step 4 Perform the following operations to view the output:

- Method 1: Locate the job and click **More** > **FlinkUI**. Choose **Task Managers** > **Stdout**.
- Method 2: If you allow DLI to save job logs in OBS, view the output in the **taskmanager.out** file.

  ```
  +I(202103241000000001,webShop,2021-03-2410:00:00,100.0,100.0,2021-03-2410:02:03,0001,Alice,330
  106)
  +I(202103241606060001,appShop,2021-03-2416:06:06,200.0,180.0,2021-03-2416:10:06,0001,Alice,3301
  06)
  ```

----End

3.3.4.2 Canal

Function

Canal is a Changelog Data Capture (CDC) tool that can stream changes in real-time from MySQL into other systems. Canal provides a unified format schema for changelog and supports to serialize messages using JSON and protobuf (the default format for Canal).

Flink supports to interpret Canal JSON messages as INSERT, UPDATE, and DELETE messages into the Flink SQL system. This is useful in many cases to leverage this feature, such as:

- synchronizing incremental data from databases to other systems
- Auditing logs
- Real-time materialized view on databases
- Temporal join changing history of a database table, etc.

Flink also supports to encode the INSERT, UPDATE, and DELETE messages in Flink SQL as Canal JSON messages, and emit to storage like Kafka. However, currently Flink cannot combine UPDATE_BEFORE and UPDATE_AFTER into a single UPDATE message. Therefore, Flink encodes UPDATE_BEFORE and UPDATE_AFTER as DELETE and INSERT Canal messages.

Parameters

Table 3-34 Parameter description

Parameter	Mandatory	Default Value	Type	Description
format	Yes	None	String	Format to be used. In this example.Set this parameter to **canal-json**.
canal-json.ignore-parse-errors	No	false	Boolean	Whether fields and rows with parse errors will be skipped or failed. The default value is **false**, indicating that an error will be thrown. Fields are set to null in case of errors.
canal-json.timestamp-format.standard	No	'SQL'	String	Input and output timestamp formats. Currently supported values are **SQL** and **ISO-8601**: • **SQL** will parse input timestamp in "yyyy-MM-dd HH:mm:ss.s{precision}" format, for example **2020-12-30 12:13:14.123** and output timestamp in the same format. • **ISO-8601** will parse input timestamp in "yyyy-MM-ddTHH:mm:ss.s{precision}" format, for example **2020-12-30T12:13:14.123** and output timestamp in the same format.
canal-json.map-null-key.mode	No	'FALL'	String	Handling mode when serializing null keys for map data. Available values are as follows: • **FAIL** will throw exception when encountering map value with null key. • **DROP** will drop null key entries for map data. • **LITERAL** replaces the empty key value in the map with a string constant. The string literal is defined by **canal-json.map-null-key.literal** option.

Parameter	Mandatory	Default Value	Type	Description
canal-json.map-null-key.literal	No	'null'	String	String literal to replace null key when **canal-json.map-null-key.mode** is **LITERAL**.
canal-json.database.include	No	None	String	An optional regular expression to only read the specific databases changelog rows by regular matching the **database** meta field in the Canal record.
canal-json.table.include	No	None	String	An optional regular expression to only read the specific tables changelog rows by regular matching the **table** meta field in the Canal record.

Supported Connectors

- Kafka

Example

Use Kafka to send data and output the data to print.

Step 1 Create a datasource connection for the communication with the VPC and subnet where Kafka locates and bind the connection to the queue. Set a security group and inbound rule to allow access of the queue and test the connectivity of the queue using the Kafka IP address. For example, locate a general-purpose queue where the job runs and choose **More** > **Test Address Connectivity** in the **Operation** column. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.

Step 2 Create a Flink OpenSource SQL job and select Flink 1.12. Copy the following statement and submit the job:

```
create table kafkaSource(
  id bigint,
  name string,
  description string,
  weight DECIMAL(10, 2)
  ) with (
    'connector' = 'kafka',
    'topic' = '<yourTopic>',
    'properties.group.id' = '<yourGroupId>',
    'properties.bootstrap.servers' = '<yourKafkaAddress>:<yourKafkaPort>',
    'scan.startup.mode' = 'latest-offset',
    'format' = 'canal-json'
);
create table printSink(
  id bigint,
  name string,
  description string,
  weight DECIMAL(10, 2)
```

```
  ) with (
    'connector' = 'print'
  );
insert into printSink select * from kafkaSource;
```

Step 3 Insert the following data to the corresponding topic in Kafka:

```
{
  "data": [
    {
      "id": "111",
      "name": "scooter",
      "description": "Big 2-wheel scooter",
      "weight": "5.18"
    }
  ],
  "database": "inventory",
  "es": 1589373560000,
  "id": 9,
  "isDdl": false,
  "mysqlType": {
    "id": "INTEGER",
    "name": "VARCHAR(255)",
    "description": "VARCHAR(512)",
    "weight": "FLOAT"
  },
  "old": [
    {
      "weight": "5.15"
    }
  ],
  "pkNames": [
    "id"
  ],
  "sql": "",
  "sqlType": {
    "id": 4,
    "name": 12,
    "description": 12,
    "weight": 7
  },
  "table": "products",
  "ts": 1589373560798,
  "type": "UPDATE"
}
```

Step 4 View the output through either of the following methods:

- Method 1: Locate the job and click **More** > **FlinkUI**. Choose **Task Managers** > **Stdout**.
- Method 2: If you allow DLI to save job logs in OBS, view the output in the **taskmanager.out** file.

```
-U(111,scooter,Big2-wheel scooter,5.15)
+U(111,scooter,Big2-wheel scooter,5.18)
```

----End

3.3.4.3 Confluent Avro

Function

The Avro Schema Registry (**avro-confluent**) format allows you to read records that were serialized by the **io.confluent.kafka.serializers.KafkaAvroSerializer** and to write records that can in turn be read by the **io.confluent.kafka.serializers.KafkaAvroDeserializer**.

When reading (deserializing) a record with this format the Avro writer schema is fetched from the configured Confluent Schema Registry based on the schema version ID encoded in the record while the reader schema is inferred from table schema.

When writing (serializing) a record with this format the Avro schema is inferred from the table schema and used to retrieve a schema ID to be encoded with the data The lookup is performed with in the configured Confluent Schema Registry under the **subject**. The subject is specified by **avro-confluent.schema-registry.subject**.

Supported Connectors

- kafka
- upsert kafka

Parameters

Table 3-35 Parameter description

Parameter	Mandatory	Default Value	Type	Description
format	Yes	None	String	Format to be used. Set this parameter to **avro-confluent**.
avro-confluent.schema-registry.subject	No	None	String	The Confluent Schema Registry subject under which to register the schema used by this format during serialization. By default, **kafka** and **upsert-kafka** connectors use **<topic_name>-value** or **<topic_name>-key** as the default subject name if this format is used as the value or key format.
avro-confluent.schema-registry.url	Yes	None	String	URL of the Confluent Schema Registry to fetch/register schemas.

Example

1. Read JSON data from the source topic in Kafka and write the data in Confluent Avro format to the sink topic.

Step 1 Create a datasource connection for the communication with the VPC and subnet where Kafka and ECS locate and bind the connection to the queue. Set a security group and inbound rule to allow access of the queue and test the connectivity of

the queue using the Kafka and ECS IP addresses. For example, locate a general-purpose queue where the job runs and choose **More** > **Test Address Connectivity** in the **Operation** column. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.

Step 2 Purchase an ECS cluster, download Confluent 5.5.2 (**https://packages.confluent.io/archive/5.5/**) and jdk1.8.0_232, and upload them to the ECS cluster. Run the following command to decompress the packages (assume that the decompression directories are **confluent-5.5.2** and **jdk1.8.0_232**):

```
tar zxvf confluent-5.5.2-2.11.tar.gz
tar zxvf jdk1.8.0_232.tar.gz
```

Step 3 Run the following commands to install jdk1.8.0_232 in the current ECS cluster. You can run the **pwd** command in the **jdk1.8.0_232 folder** to view the value of **yourJdkPath**.

```
export JAVA_HOME=<yourJdkPath>
export PATH=$JAVA_HOME/bin:$PATH
export CLASSPATH=.:$JAVA_HOME/lib:$JAVA_HOME/jre/lib
```

Step 4 Go to the **confluent-5.5.2/etc/schema-registry/** directory and modify the following configuration items in the **schema-registry.properties** file:

```
listeners=http://<yourEcsIp>:8081
kafkastore.bootstrap.servers=<yourKafkaAddress1>:<yourKafkaPort>,<yourKafkaAddress2>:<yourKafkaPort>
```

Step 5 Switch to the **confluent-5.5.2** directory and run the following command to start Confluent:

```
bin/schema-registry-start etc/schema-registry/schema-registry.properties
```

Step 6 Create a Flink opensource SQL job, select the Flink 1.12 version, and allow DLI to save job logs in OBS. Add the following statement to the job and submit it:

```
CREATE TABLE kafkaSource (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'properties.bootstrap.servers' =
'<yourKafkaAddress1>:<yourKafkaPort>,<yourKafkaAddress2>:<yourKafkaPort>',
  'topic' = '<yourSourceTopic>',
  'properties.group.id' = '<yourGroupId>',
  'scan.startup.mode' = 'latest-offset',
  'format' = 'json'
);
CREATE TABLE kafkaSink (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'properties.bootstrap.servers' =
'<yourKafkaAddress1>:<yourKafkaPort>,<yourKafkaAddress2>:<yourKafkaPort>',
  'topic' = '<yourSinkTopic>',
```



```
  'format' = 'avro-confluent',
  'avro-confluent.schema-registry.url' = 'http://<yourEcsIp>:8081',
  'avro-confluent.schema-registry.subject' = '<yourSubject>'
);
insert into kafkaSink select * from kafkaSource;
```

Step 7 Insert the following data into Kafka:

```
{"order_id":"202103241000000001", "order_channel":"webShop", "order_time":"2021-03-24 10:00:00",
"pay_amount":"100.00", "real_pay":"100.00", "pay_time":"2021-03-24 10:02:03", "user_id":"0001",
"user_name":"Alice", "area_id":"330106"}

{"order_id":"202103241606060001", "order_channel":"appShop", "order_time":"2021-03-24 16:06:06",
"pay_amount":"200.00", "real_pay":"180.00", "pay_time":"2021-03-24 16:10:06", "user_id":"0001",
"user_name":"Alice", "area_id":"330106"}
```

Step 8 Read the data of the sink Kafka topic. You will find that the data has been written and the schema has been saved to the **_schema** topic of Kafka.

----End

3.3.4.4 CSV

Function

The CSV format allows you to read and write CSV data based on a CSV schema. Currently, the CSV schema is derived from table schema.

Supported Connectors

- Kafka
- Upsert Kafka

Parameters

Table 3-36

Parameter	Mandatory	Default value	Type	Description
format	Yes	None	String	Format to be used. Set the value to **csv**.
csv.field-delimiter	No	,	String	Field delimiter character, which must be a single character. You can use backslash to specify special characters, for example, **\t** represents the tab character. You can also use unicode to specify them in plain SQL, for example, **'csv.field-delimiter' = '\u0001'** represents the 0x01 character.

Parameter	Mandatory	Default value	Type	Description
csv.disable-quote-character	No	false	Boolean	Disabled quote character for enclosing field values. If you set this parameter to **true**, **csv.quote-character** cannot be set.
csv.quote-character	No	''	String	Quote character for enclosing field values.
csv.allow-comments	No	false	Boolean	Ignore comment lines that start with **#**. If you set this parameter to **true**, make sure to also ignore parse errors to allow empty rows.
csv.ignore-parse-errors	No	false	Boolean	Whether fields and rows with parse errors will be skipped or failed. The default value is **false**, indicating that an error will be thrown. Fields are set to null in case of errors.
csv.array-element-delimiter	No	;	String	Array element delimiter string for separating array and row element values.
csv.escape-character	No	None	String	Escape character for escaping values
csv.null-literal	No	None	String	Null literal string that is interpreted as a null value.

Example

Use Kafka to send data and output the data to print.

Step 1 Create a datasource connection for the communication with the VPC and subnet where Kafka locates and bind the connection to the queue. Set a security group and inbound rule to allow access of the queue and test the connectivity of the queue using the Kafka IP address. For example, locate a general-purpose queue where the job runs and choose **More** > **Test Address Connectivity** in the **Operation** column. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.

Step 2 Create a Flink OpenSource SQL job. Copy the following statement and submit the job:

```
CREATE TABLE kafkaSource (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
```



```
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = '<yourSourceTopic>',
  'properties.bootstrap.servers' = '<yourKafkaAddress>:<yourKafkaPort>',
  'properties.group.id' = '<yourGroupId>',
  'scan.startup.mode' = 'latest-offset',
  "format" = "csv"
);

CREATE TABLE kafkaSink (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = '<yourSinkTopic>',
  'properties.bootstrap.servers' = '<yourKafkaAddress>:<yourKafkaPort>',
  "format" = "csv"
);

insert into kafkaSink select * from kafkaSource;
```

Step 3 Insert the following data into the source Kafka topic:

```
202103251505050001,qqShop,2021-03-25 15:05:05,500.00,400.00,2021-03-25 15:10:00,0003,Cindy,330108

202103241606060001,appShop,2021-03-24 16:06:06,200.00,180.00,2021-03-24 16:10:06,0001,Alice,330106
```

Step 4 Read data from the sink Kafka topic. The result is as follows:

```
202103251505050001,qqShop,"2021-03-25 15:05:05",500.0,400.0,"2021-03-25 15:10:00",0003,Cindy,330108

202103241606060001,appShop,"2021-03-24 16:06:06",200.0,180.0,"2021-03-24 16:10:06",0001,Alice,330106
```

----End

3.3.4.5 Debezium

Function

Debezium is a Changelog Data Capture (CDC) tool that can stream changes in real-time from other databases into Kafka. Debezium provides a unified format schema for changelog and supports to serialize messages using JSON.

Flink supports to interpret Debezium JSON and Avro messages as INSERT/ UPDATE/DELETE messages into Flink SQL system. This is useful in many cases to leverage this feature, such as:

- synchronizing incremental data from databases to other systems
- Auditing logs
- Real-time materialized view on databases
- Temporal join changing history of a database table, etc.

Parameters

Table 3-37

Parameter	Mandatory	Default Value	Mandatory	Description
format	Yes	None	String	Format to be used. In this example.Set this parameter to **debezium-json**.
debezium-json.schema-include	No	false	Boolean	Whether the Debezium JSON messages contain the schema. When setting up Debezium Kafka Connect, enable the Kafka configuration **value.converter.schemas.enable** to include the schema in the message.
debezium-json.ignore-parse-errors	No	false	Boolean	Whether fields and rows with parse errors will be skipped or failed. The default value is **false**, indicating that an error will be thrown. Fields are set to null in case of errors.
debezium-json.timestamp-format.standard	No	'SQL'	String	Input and output timestamp formats. Currently supported values are **SQL** and **ISO-8601**. • **SQL** will parse input timestamp in "yyyy-MM-dd HH:mm:ss.s{precision}" format, for example **2020-12-30 12:13:14.123** and output timestamp in the same format. • **ISO-8601** will parse input timestamp in "yyyy-MM-ddTHH:mm:ss.s{precision}" format, for example **2020-12-30T12:13:14.123** and output timestamp in the same format.

Parameter	Mandatory	Default Value	Mandatory	Description
debezium-json.map-null-key.mode	No	'FAIL'	String	Handling mode when serializing null keys for map data. Available values are as follows: • **FAIL** will throw exception when encountering map value with null key. • **DROP** will drop null key entries for map data. • **LITERAL** replaces the empty key value in the map with a string constant. The string literal is defined by **debezium-json.map-null-key.literal** option.
debezium-json.map-null-key.literal	No	'null'	String	String literal to replace null key when **debezium-json.map-null-key.mode** is **LITERAL**.

Supported Connectors

- Kafka

Example

Use Kafka to send data and output the data to print.

Step 1 Create a datasource connection for the communication with the VPC and subnet where Kafka locates and bind the connection to the queue. Set a security group and inbound rule to allow access of the queue and test the connectivity of the queue using the Kafka IP address. For example, locate a general-purpose queue where the job runs and choose **More** > **Test Address Connectivity** in the **Operation** column. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.

Step 2 Create a Flink OpenSource SQL job. Copy the following statement and submit the job:

```
create table kafkaSource(
  id BIGINT,
  name STRING,
  description STRING,
  weight DECIMAL(10, 2)
  ) with (
    'connector' = 'kafka',
    'topic' = '<yourTopic>',
    'properties.group.id' = '<yourGroupId>',
    'properties.bootstrap.servers' = '<yourKafkaAddress>:<yourKafkaPort>',
    'scan.startup.mode' = 'latest-offset',
    'format' = 'debezium-json'
);
create table printSink(
```



```
  id BIGINT,
  name STRING,
  description STRING,
  weight DECIMAL(10, 2)
   ) with (
     'connector' = 'print'
   );
insert into printSink select * from kafkaSource;
```

Step 3 Insert the following data to the corresponding topic in Kafka:

```
{
  "before": {
    "id": 111,
    "name": "scooter",
    "description": "Big 2-wheel scooter",
    "weight": 5.18
  },
  "after": {
    "id": 111,
    "name": "scooter",
    "description": "Big 2-wheel scooter",
    "weight": 5.15
  },
  "source": {
    "version": "0.9.5.Final",
    "connector": "mysql",
    "name": "fullfillment",
    "server_id" :1,
    "ts_sec": 1629607909,
    "gtid": "mysql-bin.000001",
    "pos": 2238,"row": 0,
    "snapshot": false,
    "thread": 7,
    "db": "inventory",
    "table": "test",
    "query": null},
  "op": "u",
  "ts_ms": 1589362330904,
  "transaction": null
}
```

Step 4 View the output through either of the following methods:

- Method 1: Locate the job and click **More** > **FlinkUI**. Choose **Task Managers** > **Stdout**.
- Method 2: If you allow DLI to save job logs in OBS, view the output in the **taskmanager.out** file.

```
-U(111,scooter,Big2-wheel scooter,5.18)
+U(111,scooter,Big2-wheel scooter,5.15)
```

----End

3.3.4.6 JSON

Function

The JSON format allows you to read and write JSON data based on a JSON schema. Currently, the JSON schema is derived from table schema.

Supported Connectors

- Kafka
- Upsert Kafka

- Elasticsearch

Parameters

Table 3-38

Parameter	Mandatory	Default Value	Type	Description
format	Yes	None	String	Format to be used. Set this parameter to **json**.
json.fail-on-missing-field	No	false	Boolean	Whether to skip the field or row or throws an error when a field to be parsed is missing. The default value is **false**, indicating that no error will be thrown.
json.ignore-parse-errors	No	false	Boolean	Whether fields and rows with parse errors will be skipped or failed. The default value is **false**, indicating that an error will be thrown. Fields are set to null in case of errors.

Parameter	Mandatory	Default Value	Type	Description
json.timestamp-format.standard	No	'SQL'	String	Input and output timestamp format for TIMESTAMP and TIMESTAMP WITH LOCAL TIME ZONE. Currently supported values are **SQL** and **ISO-8601**: • **SQL** will parse the input TIMESTAMP values in "yyyy-MM-dd HH:mm:ss.s{precision}" format, for example, **2020-12-30 12:13:14.123**, parse TIMESTAMP WITH LOCAL TIME ZONE values in "yyyy-MM-dd HH:mm:ss.s{precision}'Z'" format, for example, **2020-12-30 12:13:14.123Z** and output timestamp in the same format. • **ISO-8601** will parse the input TIMESTAMP values in "yyyy-MM-ddTHH:mm:ss.s{precision}" format, for example, **2020-12-30T12:13:14.123** parse TIMESTAMP WITH LOCAL TIME ZONE values in "yyyy-MM-ddTHH:mm:ss.s{precision}'Z'" format, for example, **2020-12-30T12:13:14.123Z** and output timestamp in the same format.

Parameter	Mandatory	Default Value	Type	Description
json.map-null-key.mode	No	'FALL'	String	Handling mode when serializing null keys for map data. Available values are as follows: • **FAIL** will throw exception when encountering map value with null key. • **DROP** will drop null key entries for map data. • **LITERAL** replaces the empty key value in the map with a string constant. The string literal is defined by **json.map-null-key.literal** option.
json.map-null-key.literal	No	'null'	String	String literal to replace null key when **json.map-null-key.mode** is **LITERAL**.

Example

In this example, data is read from a topic and written to another using a Kafka sink.

Step 1 Create a datasource connection for the communication with the VPC and subnet where Kafka locates and bind the connection to the queue. Set an inbound rule for the security group to allow access of the queue and test the connectivity using the Kafka address. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.

Step 2 Create a Flink OpenSource SQL job, select Flink 1.12, and allow DLI to save job logs in OBS. Use the following statement in the job and submit it:

```
CREATE TABLE kafkaSource (
  order_id string,
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = '<yourSourceTopic>',
  'properties.bootstrap.servers' = '<yourKafkaAddress>:<yourKafkaPort>',
  'properties.group.id' = '<yourGroupId>',
  'scan.startup.mode' = 'latest-offset',
  "format" = "json"
);

CREATE TABLE kafkaSink (
  order_id string,
```



```
  order_channel string,
  order_time string,
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string
) WITH (
  'connector' = 'kafka',
  'topic' = '<yourSinkTopic>',
  'properties.bootstrap.servers' = '<yourKafkaAddress>:<yourKafkaPort>',
  "format" = "json"
);

insert into kafkaSink select * from kafkaSource;
```

Step 3 Insert the following data into the source Kafka topic:

```
{"order_id":"202103241000000001","order_channel":"webShop","order_time":"2021-03-24
10:00:00","pay_amount":100.0,"real_pay":100.0,"pay_time":"2021-03-24
10:02:03","user_id":"0001","user_name":"Alice","area_id":"330106"}

{"order_id":"202103241606060001","order_channel":"appShop","order_time":"2021-03-24
16:06:06","pay_amount":200.0,"real_pay":180.0,"pay_time":"2021-03-24
16:10:06","user_id":"0001","user_name":"Alice","area_id":"330106"}
```

Step 4 Read data from the sink topic. The result is as follows:

```
{"order_id":"202103241000000001","order_channel":"webShop","order_time":"2021-03-24
10:00:00","pay_amount":100.0,"real_pay":100.0,"pay_time":"2021-03-24
10:02:03","user_id":"0001","user_name":"Alice","area_id":"330106"}

{"order_id":"202103241606060001","order_channel":"appShop","order_time":"2021-03-24
16:06:06","pay_amount":200.0,"real_pay":180.0,"pay_time":"2021-03-24
16:10:06","user_id":"0001","user_name":"Alice","area_id":"330106"}
```

----End

3.3.4.7 Maxwell

Function

Flink supports to interpret Maxwell JSON messages as INSERT/UPDATE/DELETE messages into Flink SQL system. This is useful in many cases to leverage this feature,

such as:

- Synchronizing incremental data from databases to other systems
- Auditing logs
- Real-time materialized views on databases
- Temporal join changing history of a database table and so on

Flink also supports to encode the INSERT/UPDATE/DELETE messages in Flink SQL as Maxwell JSON messages, and emit to external systems like Kafka. However, currently Flink cannot combine UPDATE_BEFORE and UPDATE_AFTER into a single UPDATE message. Therefore, Flink encodes UPDATE_BEFORE and UDPATE_AFTER as DELETE and INSERT Maxwell messages.

Parameters

Table 3-39

Parameter	Mandatory	Default Value	Type	Description
format	Yes	None	String	Format to be used. Set this parameter to **maxwell-json**.
maxwell-json.ignore-parse-errors	No	false	Boolean	Whether fields and rows with parse errors will be skipped or failed. Fields are set to null in case of errors.
maxwell-json.timestamp-format.standard	No	'SQL'	String	Input and output timestamp formats. Currently supported values are **SQL** and **ISO-8601**: **SQL** will parse input timestamp in "yyyy-MM-dd HH:mm:ss.s{precision}" format, for example, **2020-12-30 12:13:14.123** and output timestamp in the same format. **ISO-8601** will parse input timestamp in "yyyy-MM-ddTHH:mm:ss.s{precision}" format, for example **2020-12-30T12:13:14.123** and output timestamp in the same format.
maxwell-json.map-null-key.mode	No	'FAIL'	String	Handling mode when serializing null keys for map data. Currently supported values are 'FAIL', 'DROP' and 'LITERAL': **FAIL** will throw exception when encountering map with null key. **DROP** will drop null key entries for map data. **LITERAL** will replace null key with string literal. The string literal is defined by **maxwell-json.map-null-key.literal** option.
maxwell-json.map-null-key.literal	No	'null'	String	String literal to replace null key when **maxwell-json.map-null-key.mode** is **LITERAL**.

Supported Connectors

- Kafka

Example

Use Kafka to send data and output the data to print.

Step 1 Create a datasource connection for the communication with the VPC and subnet where Kafka locates and bind the connection to the queue. Set a security group and inbound rule to allow access of the queue and test the connectivity of the queue using the Kafka IP address. For example, locate a general-purpose queue where the job runs and choose **More** > **Test Address Connectivity** in the **Operation** column. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.

Step 2 Create a Flink OpenSource SQL job and select Flink 1.12. Copy the following statement and submit the job:

```
create table kafkaSource(
  id bigint,
  name string,
  description string,
  weight DECIMAL(10, 2)
  ) with (
    'connector' = 'kafka',
    'topic' = '<yourTopic>',
    'properties.group.id' = '<yourGroupId>',
    'properties.bootstrap.servers' =
'<yourKafkaAddress1>:<yourKafkaPort>,<yourKafkaAddress2>:<yourKafkaPort>',
    'scan.startup.mode' = 'latest-offset',
    'format' = 'maxwell-json'
);
create table printSink(
  id bigint,
  name string,
  description string,
  weight DECIMAL(10, 2)
   ) with (
     'connector' = 'print'
   );
insert into printSink select * from kafkaSource;
```

Step 3 Insert the following data to the corresponding topic in Kafka:

```
{
  "database":"test",
  "table":"e",
  "type":"insert",
  "ts":1477053217,
  "xid":23396,
  "commit":true,
  "position":"master.000006:800911",
  "server_id":23042,
  "thread_id":108,
  "primary_key": [1, "2016-10-21 05:33:37.523000"],
  "primary_key_columns": ["id", "c"],
  "data":{
    "id":111,
    "name":"scooter",
    "description":"Big 2-wheel scooter",
    "weight":5.15
  },
  "old":{
    "weight":5.18
  }
}
```

Step 4 View the output through either of the following methods:

- Method 1: Locate the job and click **More** > **FlinkUI**. Choose **Task Managers** > **Stdout**.

- Method 2: If you allow DLI to save job logs in OBS, view the output in the **taskmanager.out** file.

```
+I(111,scooter,Big 2-wheel scooter,5.15)
```

----End

3.3.4.8 Raw

Function

The raw format allows you to read and write raw (byte based) values as a single column.

Note: This format encodes null values as **null** of the **byte[]** type. This may have limitation when used in **upsert-kafka**, because **upsert-kafka** treats null values as a tombstone message (DELETE on the key). Therefore, we recommend avoiding using **upsert-kafka** connector and the **raw** format as a **value.format** if the field can have a null value.

The raw format connector is built-in, no additional dependencies are required.

Parameters

Table 3-40

Parameter	Mandatory	Default Value	Type	Description
format	Yes	None	String	Format to be used. Set this parameter to **raw**.
raw.charset	No	UTF-8	String	Charset to encode the text string.
raw.endianness	No	big-endian	String	Endianness to encode the bytes of numeric value. Valid values are **big-endian** and **little-endian**. You can search for endianness for more details.

Supported Connectors

- Kafka
- UpsertKafka

Example

Use Kafka to send data and output the data to print.

Step 1 Create a datasource connection for the communication with the VPC and subnet where Kafka locates and bind the connection to the queue. Set a security group and inbound rule to allow access of the queue and test the connectivity of the queue using the Kafka IP address. For example, locate a general-purpose queue where the job runs and choose **More** > **Test Address Connectivity** in the **Operation** column. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.

Step 2 Create a Flink OpenSource SQL job and select Flink 1.12. Copy the following statement and submit the job:

```
create table kafkaSource(
  log string
  ) with (
    'connector' = 'kafka',
    'topic' = '<yourTopic>',
    'properties.group.id' = '<yourGroupId>',
    'properties.bootstrap.servers' = '<yourKafkaAddress>:<yourKafkaPort>',
    'scan.startup.mode' = 'latest-offset',
    'format' = 'raw'
);
create table printSink(
  log string
   ) with (
     'connector' = 'print'
   );
insert into printSink select * from kafkaSource;
```

Step 3 Insert the following data to the corresponding topic in Kafka:

```
47.29.201.179 - - [28/Feb/2019:13:17:10 +0000] "GET /?p=1 HTTP/2.0" 200 5316 "https://domain.com/?
p=1" "Mozilla/5.0 (Windows NT 6.1) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/72.0.3626.119
Safari/537.36" "2.75"
```

Step 4 View the output through either of the following methods:

- Method 1: Locate the job and click **More** > **FlinkUI**. Choose **Task Managers** > **Stdout**.
- Method 2: If you allow DLI to save job logs in OBS, view the output in the **taskmanager.out** file.

```
+I(47.29.201.179 - - [28/Feb/2019:13:17:10 +0000] "GET /?p=1 HTTP/2.0"2005316"https://domain.com/?
p=1"
"Mozilla/5.0 (Windows NT 6.1) AppleWebKit/537.36 (KHTML, like Gecko) Chrome/72.0.3626.119 Safari/
537.36" "2.75")
```

----End

3.4 DML Snytax

3.4.1 SELECT

SELECT

Syntax

```
SELECT [ ALL | DISTINCT ]
  { * | projectItem [, projectItem ]* }
  FROM tableExpression
  [ WHERE booleanExpression ]
  [ GROUP BY { groupItem [, groupItem ]* } ]
  [ HAVING booleanExpression ]
```

Description

SELECT is used to select data from a table.

ALL indicates that all results are returned.

DISTINCT indicates that the duplicated results are removed.

Precautions

- The to-be-queried table must exist. Otherwise, an error is reported.
- WHERE is used to specify the search condition, which can be the arithmetic operator, relational operator, or logical operator.
- GROUP BY is used to specify the grouping field, which can be one or more multiple fields.

Example

Select the order which contains more than 3 pieces of data.

```
insert into temp SELECT  * FROM Orders WHERE units > 3;
```

Insert a group of constant data.

```
insert into temp select 'Lily', 'male', 'student', 17;
```

WHERE

Syntax

```
SELECT   { * | projectItem [, projectItem ]* }
  FROM tableExpression
  [ WHERE booleanExpression ]
```

Description

This clause is used to filter the query results using the WHERE clause.

Precautions

- The to-be-queried table must exist.
- WHERE filters the records that do not meet the requirements.

Example

Search orders which contain more than 3 pieces and fewer than 10 pieces of data.

```
insert into temp SELECT  * FROM Orders
  WHERE units > 3 and units < 10;
```


HAVING

Function

This clause is used to search for the query results that meet the search condition.

Syntax

```
SELECT [ ALL | DISTINCT ]   { * | projectItem [, projectItem ]* }
  FROM tableExpression
  [ WHERE booleanExpression ]
  [ GROUP BY { groupItem [, groupItem ]* } ]
  [ HAVING booleanExpression ]
```

Description

Generally, HAVING and GROUP BY are used together. You can use GROUP BY for grouping and then use HAVING for filtering. Arithmetic operations and aggregate functions are supported in the HAVING clause.

Precautions

If the filtering condition is subject to the results of GROUP BY, the HAVING clause, rather than the WHERE clause, must be used for search.

Example

Group the **student** table according to the **name** field and search for the records in which the maximum score is higher than 95 in the group.

```
insert into temp SELECT name, max(score) FROM student
  GROUP BY name
  HAVING max(score) >95;
```

Column-Based GROUP BY

Function

This clause is used to group a table based on columns.

Syntax

```
SELECT [ ALL | DISTINCT ]   { * | projectItem [, projectItem ]* }
  FROM tableExpression
  [ WHERE booleanExpression ]
  [ GROUP BY { groupItem [, groupItem ]* } ]
```

Description

Column-based GROUP BY can be categorized into single-column GROUP BY and multi-column GROUP BY.

- Single-column GROUP BY indicates that the GROUP BY clause contains only one column.
- Multi-column GROUP BY indicates that the GROUP BY clause contains multiple columns. The table will be grouped according to all fields in the GROUP BY clause. The records whose fields are the same are grouped into one group.

Precautions

GroupBy generates update results in the stream processing table.

Example

Group the **student** table according to the score and name fields and return the grouping results.

```
insert into temp SELECT name,score, max(score) FROM student
  GROUP BY name,score;
```

Expression-Based GROUP BY

Function

This clause is used to group streams according to expressions.

Syntax

```
SELECT [ ALL | DISTINCT ]   { * | projectItem [, projectItem ]* }
  FROM tableExpression
  [ WHERE booleanExpression ]
  [ GROUP BY { groupItem [, groupItem ]* } ]
```

Description

groupItem can have one or more fields. The fields can be called by string functions, but cannot be called by aggregate functions.

Precautions

None

Example

Use the substring function to obtain the character string from the name field, group the **student** table according to the obtained character string, and return each sub character string and the number of records.

```
insert into temp SELECT substring(name,6),count(name) FROM student
  GROUP BY substring(name,6);
```

Grouping sets, Rollup, Cube

Function

- The GROUP BY GROUPING SETS generates a result set equivalent to that generated by multiple simple GROUP BY UNION ALL statements. Using GROUPING SETS is more efficient.
- The ROLLUP and CUBE generate multiple groups based on certain rules and then collect statistics by group.
- The result set generated by CUBE contains all the combinations of values in the selected columns.
- The result set generated by ROLLUP contains the combinations of a certain layer structure in the selected columns.

Syntax

```
SELECT [ ALL | DISTINCT ]   { * | projectItem [, projectItem ]* }
  FROM tableExpression
  [ WHERE booleanExpression ]
  [ GROUP BY groupingItem]
```

Description

Values of **groupingItem** can be **Grouping sets(columnName [, columnName]*)**, **Rollup(columnName [, columnName]*)**, and **Cube(columnName [, columnName]*)**.

Precautions

None

Example

Return the results generated based on **user** and **product**.

```
INSERT INTO temp SELECT SUM(amount)
FROM Orders
GROUP BY GROUPING SETS ((user), (product));
```

GROUP BY Using HAVING

Function

This clause filters a table after grouping it using the HAVING clause.

Syntax

```
SELECT [ ALL | DISTINCT ]   { * | projectItem [, projectItem ]* }
  FROM tableExpression
  [ WHERE booleanExpression ]
  [ GROUP BY { groupItem [, groupItem ]* } ]
  [ HAVING booleanExpression ]
```

Description

Generally, HAVING and GROUP BY are used together. You can use GROUP BY for grouping and the HAVING for filtering.

Precautions

- If the filtering condition is subject to the results of GROUP BY, the HAVING clause, rather than the WHERE clause, must be used for search. HAVING and GROUP BY are used together. Use GROUP BY for grouping and the HAVING for filtering.
- Fields used in HAVING, except for those used for aggregate functions, must exist in GROUP BY.
- The arithmetic operation and aggregate function are supported by the HAVING clause.

Example

Group the **transactions** by **num**, use the HAVING clause to search for the records in which the maximum value derived from multiplying **price** with **amount** is higher than 5000, and return the filtered results.

```
insert into temp SELECT num, max(price*amount) FROM transactions
  WHERE time > '2016-06-01'
  GROUP BY num
  HAVING max(price*amount)>5000;
```


3.4.2 Set Operations

Union/Union ALL/Intersect/Except

Syntax

```
query UNION [ ALL ] | Intersect | Except query
```

Description

- UNION is used to return the union set of multiple query results.
- INTERSECT is used to return the intersection of multiple query results.
- EXCEPT is used to return the difference set of multiple query results.

Precautions

- Set operations join tables from head to tail under certain conditions. The quantity of columns returned by each SELECT statement must be the same. Column types must be the same. Column names can be different.
- By default, UNION takes only distinct records while UNION ALL does not remove duplicates from the result.

Example

Output distinct records found in either Orders1 and Orders2 tables.

```
insert into temp SELECT  * FROM Orders1
  UNION SELECT  * FROM Orders2;
```

IN

Syntax

```
SELECT [ ALL | DISTINCT ]   { * | projectItem [, projectItem ]* }
  FROM tableExpression
  WHERE column_name IN (value (, value)* ) | query
```

Description

The IN operator allows multiple values to be specified in the WHERE clause. It returns true if the expression exists in the given table subquery.

Precautions

The subquery table must consist of a single column, and the data type of the column must be the same as that of the expression.

Example

Return **user** and **amount** information of the products in **NewProducts** of the **Orders** table.

```
insert into temp SELECT user, amount
FROM Orders
WHERE product IN (
    SELECT product FROM NewProducts
);
```


3.4.3 Window

GROUP WINDOW

Description

Group Window is defined in GROUP BY. One record is generated from each group. Group Window involves the following functions:

- Array functions

Table 3-41 Array functions

Grouping Window Function	Description
TUMBLE(time_attr, interval)	Defines a tumbling time window. A tumbling time window assigns rows to non-overlapping, continuous windows with a fixed duration (interval). For example, a tumbling window of 5 minutes groups rows in 5 minutes intervals. Tumbling windows can be defined on event-time (stream + batch) or processing-time (stream).
HOP(time_attr, interval, interval)	Defines a hopping time window (called sliding window in the Table API). A hopping time window has a fixed duration (second interval parameter) and hops by a specified hop interval (first interval parameter). If the hop interval is smaller than the window size, hopping windows are overlapping. Thus, rows can be assigned to multiple windows. For example, a hopping window of 15 minutes size and 5 minute hop interval assigns each row to 3 different windows of 15 minute size, which are evaluated in an interval of 5 minutes. Hopping windows can be defined on event-time (stream + batch) or processing-time (stream).
SESSION(time_attr, interval)	Defines a session time window. Session time windows do not have a fixed duration but their bounds are defined by a time interval of inactivity, that is, a session window is closed if no event appears for a defined gap period. For example a session window with a 30 minute gap starts when a row is observed after 30 minutes inactivity (otherwise the row would be added to an existing window) and is closed if no row is added within 30 minutes. Session windows can work on event-time (stream + batch) or processing-time (stream).

Notes:

CAUTION

In streaming mode, the **time_attr** argument of the group window function must refer to a valid time attribute that specifies the processing time or event time of rows.

- **event-time**: The type is timestamp(3).
- **processing-time**: No need to specify the type.

In batch mode, the **time_attr** argument of the group window function must be an attribute of type timestamp.

- Window auxiliary functions

  The start and end timestamps of group windows as well as time attributes can be selected with the following auxiliary functions.

  Table 3-42 Window auxiliary functions

Auxiliary Function	Description
TUMBLE_START(time_attr, interval) HOP_START(time_attr, interval, interval) SESSION_START(time_attr, interval)	Returns the timestamp of the inclusive lower bound of the corresponding tumbling, hopping, or session window.
TUMBLE_END(time_attr, interval) HOP_END(time_attr, interval, interval) SESSION_END(time_attr, interval)	Returns the timestamp of the **exclusive** upper bound of the corresponding tumbling, hopping, or session window. Note: The exclusive upper bound timestamp **cannot** be used as a rowtime attribute in subsequent time-based operations, such as interval joins and group window or over window aggregations.
TUMBLE_ROWTIME(time_attr, interval) HOP_ROWTIME(time_attr, interval, interval) SESSION_ROWTIME(time_attr, interval)	Returns the timestamp of the inclusive upper bound of the corresponding tumbling, hopping, or session window. The resulting attribute is a rowtime attribute that can be used in subsequent time-based operations such as interval joins and group window or over window aggregations.

Auxiliary Function	Description
TUMBLE_PROCTIME(time_attr, interval) HOP_PROCTIME(time_attr, interval, interval) SESSION_PROCTIME(time_attr, interval)	Returns a proctime attribute that can be used in subsequent time-based operations such as interval joins and group window or over window aggregations.

Note: Auxiliary functions must be called with exactly same arguments as the group window function in the GROUP BY clause.

Example

```
// Calculate the SUM every day (event time).
insert into temp SELECT name,
   TUMBLE_START(ts, INTERVAL '1' DAY) as wStart,
   SUM(amount)
   FROM Orders
   GROUP BY TUMBLE(ts, INTERVAL '1' DAY), name;

// Calculate the SUM every day (processing time).
insert into temp SELECT name,
   SUM(amount)
   FROM Orders
   GROUP BY TUMBLE(proctime, INTERVAL '1' DAY), name;

// Calculate the SUM over the recent 24 hours every hour (event time).
insert into temp SELECT product,
   SUM(amount)
   FROM Orders
   GROUP BY HOP(ts, INTERVAL '1' HOUR, INTERVAL '1' DAY), product;

// Calculate the SUM of each session and an inactive interval every 12 hours (event time).
insert into temp SELECT name,
   SESSION_START(ts, INTERVAL '12' HOUR) AS sStart,
   SESSION_END(ts, INTERVAL '12' HOUR) AS sEnd,
   SUM(amount)
   FROM Orders
   GROUP BY SESSION(ts, INTERVAL '12' HOUR), name;
```

TUMBLE WINDOW Extension

Function

The extension functions of the DLI tumbling window are as follows:

- A tumbling window is triggered periodically to reduce latency.

  Before the tumbling window ends, the window can be periodically triggered based on the configured frequency. The compute result from the start to the current time is output, which does not affect the final output. The latest result can be viewed in each period before the window ends.

- Data accuracy is improved.

  You can set a latency for the end of the window. The output of the window is updated according to the configured latency each time a piece of late data reaches.

Precautions

- If you use the INSERT statement to write results to a sink, it must support the upsert mode. Ensure that the result table supports upsert operations and the primary key is defined.
- Latency settings only take effect for event time and not for proctime.
- Auxiliary functions must be called with the same parameters as the grouping window functions in the GROUP BY clause.
- If event time is used, watermark must be used. The code is as follows (**order_time** is identified as the event time column and watermark is set to 3 seconds):

```
CREATE TABLE orders (
  order_id string,
  order_channel string,
  order_time timestamp(3),
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string,
  watermark for order_time as order_time - INTERVAL '3' SECOND
) WITH (
  'connector' = 'kafka',
  'topic' = '<yourTopic>',
  'properties.bootstrap.servers' = '<yourKafka>:<port>',
  'properties.group.id' = '<yourGroupId>',
  'scan.startup.mode' = 'latest-offset',
  'format' = 'json'
);
```

- If the proctime is used, you need to use the computed column. The code is as follows (**proc** is the processing time column):

```
CREATE TABLE orders (
  order_id string,
  order_channel string,
  order_time timestamp(3),
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string,
  proc as proctime()
) WITH (
  'connector' = 'kafka',
  'topic' = '<yourTopic>',
  'properties.bootstrap.servers' = '<yourKafka>:<port>',
  'properties.group.id' = '<yourGroupId>',
  'scan.startup.mode' = 'latest-offset',
  'format' = 'json'
);
```

Syntax

```
TUMBLE(time_attr, window_interval, period_interval, lateness_interval)
```

Example

The current time attribute column is **testtime**, the window interval is 10 seconds, and the latency is 10 seconds.

```
TUMBLE(testtime, INTERVAL '10' SECOND, INTERVAL '10' SECOND, INTERVAL '10' SECOND)
```

Description

Table 3-43 Parameters

Parameter	Description	Format
time_attr	Event time or processing time attribute column • **event-time**: The type is timestamp(3). • **processing-time**: No need to specify the type.	-
window_interval	Duration of the window	• Format 1: **INTERVAL** '10' **SECOND** The window interval is 10 seconds. You can change the value as needed. • Format 2: **INTERVAL** '10' **MINUTE** The window interval is 10 minutes. You can change the value as needed. • Format 3: **INTERVAL** '10' **DAY** The window interval is 10 days. You can change the value as needed.
period_interval	Frequency of periodic triggering within the window range. That is, before the window ends, the output result is updated at an interval specified by **period_interval** from the time when the window starts. If this parameter is not set, the periodic triggering policy is not used by default.	
lateness_interval	Time to postpone the end of the window. The system continues to collect the data that reaches the window within **lateness_interval** after the window ends. The output is updated for each data that reaches the window within **lateness_interval**. **NOTE** If the time window is for processing time, **lateness_interval** does not take effect.	

NOTE

Values of **period_interval** and **lateness_interval** cannot be negative numbers.

- If **period_interval** is set to **0**, periodic triggering is disabled for the window.
- If **lateness_interval** is set to **0**, the latency after the window ends is disabled.
- If neither of the two parameters is set, both periodic triggering and latency are disabled and only the regular tumbling window functions are available .
- If only the latency function needs to be used, set period_interval **INTERVAL '0' SECOND**.

Auxiliary Functions

Table 3-44 Auxiliary function

Auxiliary Function	Description
TUMBLE_START(time_attr, window_interval, period_interval, lateness_interval)	Returns the timestamp of the inclusive lower bound of the corresponding tumbling window.
TUMBLE_END(time_attr, window_interval, period_interval, lateness_interval)	Returns the timestamp of the exclusive upper bound of the corresponding tumbling window.

Example

1. The Kafka is used as the data source table containing the order information, and the JDBC is used as the data result table for statistics on the number of orders settled by a user within 30 seconds. The order ID and window opening time are used as primary keys to collect result statistics in real time to JDBC.

Step 1 Create a datasource connection for the communication with the VPC and subnet where MySQL and Kafka locate and bind the connection to the queue. Set an inbound rule for the security group to allow access of the queue, and test the connectivity of the queue using the MySQL and Kafka addresses. If the connection is successful, the datasource is bound to the queue. Otherwise, the binding fails.

Step 2 Run the following statement to create the **order_count** table in the MySQL Flink database:

```
CREATE TABLE `flink`.`order_count` (
    `user_id` VARCHAR(32) NOT NULL,
    `window_start` TIMESTAMP NOT NULL,
    `window_end` TIMESTAMP NULL,
    `total_num` BIGINT UNSIGNED NULL,
    PRIMARY KEY (`user_id`, `window_start`)
)   ENGINE = InnoDB
    DEFAULT CHARACTER SET = utf8mb4
    COLLATE = utf8mb4_general_ci;
```

Step 3 Create a Flink OpenSource SQL job and submit the job. In this example, the window size is 30 seconds, the triggering period is 10 seconds, and the latency is 5 seconds. That is, if the result is updated before the window ends, the intermediate result will be output every 10 seconds. After the watermark is reached and the window ends, the data whose event time is within 5 seconds of the watermark will still be processed and counted in the current window. If the event time exceeds 5 seconds of the watermark, the data will be discarded.

```
CREATE TABLE orders (
  order_id string,
  order_channel string,
  order_time timestamp(3),
  pay_amount double,
  real_pay double,
  pay_time string,
  user_id string,
  user_name string,
  area_id string,
  watermark for order_time as order_time - INTERVAL '3' SECOND
) WITH (
  'connector' = 'kafka',
  'topic' = '<yourTopic>',
  'properties.bootstrap.servers' = '<yourKafka>:<port>',
```



```
  'properties.group.id' = '<yourGroupId>',
  'scan.startup.mode' = 'latest-offset',
  'format' = 'json'
);

CREATE TABLE jdbcSink (
  user_id string,
  window_start timestamp(3),
  window_end timestamp(3),
  total_num BIGINT,
  primary key (user_id, window_start) not enforced
) WITH (
  'connector' = 'jdbc',
  'url' = 'jdbc:mysql://<yourMySQL>:3306/flink',
  'table-name' = 'order_count',
  'username' = '<yourUserName>',
  'password' = '<yourPassword>',
  'sink.buffer-flush.max-rows' = '1'
);

insert into jdbcSink select
    order_id,
    TUMBLE_START(order_time, INTERVAL '30' SECOND, INTERVAL '10' SECOND, INTERVAL '5' SECOND),
    TUMBLE_END(order_time, INTERVAL '30' SECOND, INTERVAL '10' SECOND, INTERVAL '5' SECOND),
    COUNT(*) from orders
    GROUP BY user_id, TUMBLE(order_time, INTERVAL '30' SECOND, INTERVAL '10' SECOND, INTERVAL '5'
SECOND);
```

Step 4 Insert data to Kafka. Assume that orders are settled at different time and the order data at 10:00:13 arrives late.

```
{"order_id":"202103241000000001", "order_channel":"webShop", "order_time":"2021-03-24 10:00:00",
"pay_amount":"100.00", "real_pay":"100.00", "pay_time":"2021-03-24 10:02:03", "user_id":"0001",
"user_name":"Alice", "area_id":"330106"}

{"order_id":"202103241000000002", "order_channel":"webShop", "order_time":"2021-03-24 10:00:20",
"pay_amount":"100.00", "real_pay":"100.00", "pay_time":"2021-03-24 10:02:03", "user_id":"0001",
"user_name":"Alice", "area_id":"330106"}

{"order_id":"202103241000000003", "order_channel":"webShop", "order_time":"2021-03-24 10:00:33",
"pay_amount":"100.00", "real_pay":"100.00", "pay_time":"2021-03-24 10:02:03", "user_id":"0001",
"user_name":"Alice", "area_id":"330106"}

{"order_id":"202103241000000004", "order_channel":"webShop", "order_time":"2021-03-24 10:00:13",
"pay_amount":"100.00", "real_pay":"100.00", "pay_time":"2021-03-24 10:02:03", "user_id":"0001",
"user_name":"Alice", "area_id":"330106"}
```

Step 5 Run the following statement in the MySQL database to view the output result. The final result is displayed as follows because the periodic output result cannot be collected:

```
select * from order_count
user_id     window_start        window_end        total_num
0001     2021-03-24 10:00:00  2021-03-24 10:00:30    3
0001     2021-03-24 10:00:30  2021-03-24 10:01:00    1
```

----End

OVER WINDOW

The difference between Over Window and Group Window is that one record is generated from one row in Over Window.

Syntax

```
SELECT agg1(attr1) OVER (
  [PARTITION BY partition_name]
  ORDER BY proctime|rowtime
```



```
 ROWS
 BETWEEN (UNBOUNDED|rowCOUNT) PRECEDING AND CURRENT ROW FROM TABLENAME

SELECT agg1(attr1) OVER (
  [PARTITION BY partition_name]
  ORDER BY proctime|rowtime
  RANGE
  BETWEEN (UNBOUNDED|timeInterval) PRECEDING AND CURRENT ROW FROM TABLENAME
```

Description

Table 3-45 Parameter description

Parameter	Description
PARTITION BY	Indicates the primary key of the specified group. Each group separately performs calculation.
ORDER BY	Indicates the processing time or event time as the timestamp for data.
ROWS	Indicates the count window.
RANGE	Indicates the time window.

Precautions

- All aggregates must be defined in the same window, that is, in the same partition, sort, and range.
- Currently, only windows from PRECEDING (unbounded or bounded) to CURRENT ROW are supported. The range described by FOLLOWING is not supported.
- ORDER BY must be specified for a single time attribute.

Example

```
// Calculate the count and total number from syntax rules enabled to now (in proctime).
insert into temp SELECT name,
   count(amount) OVER (PARTITION BY name ORDER BY proctime RANGE UNBOUNDED preceding) as
cnt1,
   sum(amount) OVER (PARTITION BY name ORDER BY proctime RANGE UNBOUNDED preceding) as cnt2
   FROM Orders;

// Calculate the count and total number of the recent four records (in proctime).
insert into temp SELECT name,
   count(amount) OVER (PARTITION BY name ORDER BY proctime ROWS BETWEEN 4 PRECEDING AND
CURRENT ROW) as cnt1,
   sum(amount) OVER (PARTITION BY name ORDER BY proctime ROWS BETWEEN 4 PRECEDING AND
CURRENT ROW) as cnt2
   FROM Orders;

// Calculate the count and total number last 60s (in eventtime). Process the events based on event time,
which is the timeattr field in Orders.
insert into temp SELECT name,
   count(amount) OVER (PARTITION BY name ORDER BY timeattr RANGE BETWEEN INTERVAL '60'
SECOND PRECEDING AND CURRENT ROW) as cnt1,
   sum(amount) OVER (PARTITION BY name ORDER BY timeattr RANGE BETWEEN INTERVAL '60' SECOND
PRECEDING AND CURRENT ROW) as cnt2
   FROM Orders;
```


3.4.4 JOIN

Equi-join

Syntax

```
FROM tableExpression INNER | LEFT | RIGHT | FULL JOIN tableExpression
  ON value11 = value21 [ AND value12 = value22]
```

Precautions

- Currently, only equi-joins are supported, for example, joins that have at least one conjunctive condition with an equality predicate. Arbitrary cross or theta joins are not supported.
- Tables are joined in the order in which they are specified in the FROM clause. Make sure to specify tables in an order that does not yield a cross join (Cartesian product), which are not supported and would cause a query to fail.
- For streaming queries the required state to compute the query result might grow infinitely depending on the type of aggregation and the number of distinct grouping keys. Provide a query configuration with valid retention interval to prevent excessive state size.

Example

```
SELECT *
FROM Orders INNER JOIN Product ON Orders.productId = Product.id;

SELECT *
FROM Orders LEFT JOIN Product ON Orders.productId = Product.id;

SELECT *
FROM Orders RIGHT JOIN Product ON Orders.productId = Product.id;

SELECT *
FROM Orders FULL OUTER JOIN Product ON Orders.productId = Product.id;
```

Time-windowed Join

Function

Each piece of data in a stream is joined with data in different time zones in another stream.

Syntax

```
from t1 JOIN t2 ON t1.key = t2.key AND TIMEBOUND_EXPRESSIO
```

Description

TIMEBOUND_EXPRESSION can be in either of the following formats:

- L.time between LowerBound(R.time) and UpperBound(R.time)
- R.time between LowerBound(L.time) and UpperBound(L.time)
- Comparison expression with the time attributes (L.time/R.time)

Precautions

A time window join requires at least one equi join predicate and a join condition that limits the time of both streams.

For example, use two range predicates (<, <=, >=, or >), a BETWEEN predicate, or an equal predicate that compares the same type of time attributes (such as processing time and event time) in two input tables.

For example, the following predicate is a valid window join condition:

- ltime = rtime
- ltime >= rtime AND ltime < rtime + INTERVAL '10' MINUTE
- ltime BETWEEN rtime - INTERVAL '10' SECOND AND rtime + INTERVAL '5' SECOND

Example

Join all orders shipped within 4 hours with their associated shipments.

```
SELECT *
FROM Orders o, Shipments s
WHERE o.id = s.orderId AND
    o.ordertime BETWEEN s.shiptime - INTERVAL '4' HOUR AND s.shiptime;
```

Expanding arrays into a relation

Precautions

This clause is used to return a new row for each element in the given array. Unnesting WITH ORDINALITY is not yet supported.

Example

```
SELECT users, tag
FROM Orders CROSS JOIN UNNEST(tags) AS t (tag);
```

User-Defined Table Functions

Function

This clause is used to join a table with the results of a table function. ach row of the left (outer) table is joined with all rows produced by the corresponding call of the table function.

Precautions

A left outer join against a lateral table requires a TRUE literal in the ON clause.

Example

The row of the left (outer) table is dropped, if its table function call returns an empty result.

```
SELECT users, tag
FROM Orders, LATERAL TABLE(unnest_udtf(tags)) t AS tag;
```

If a table function call returns an empty result, the corresponding outer row is preserved, and the result padded with null values.

```
SELECT users, tag
FROM Orders LEFT JOIN LATERAL TABLE(unnest_udtf(tags)) t AS tag ON TRUE;
```

Join Temporal Table Function

Function

Precautions

Currently only inner join and left outer join with temporal tables are supported.

Example

Assuming Rates is a temporal table function, the join can be expressed in SQL as follows:

```
SELECT
  o_amount, r_rate
FROM
  Orders,
  LATERAL TABLE (Rates(o_proctime))
WHERE
  r_currency = o_currency;
```

Join Temporal Tables

Function

This clause is used to join the Temporal table.

Syntax

```
SELECT column-names
FROM table1  [AS <alias1>]
[LEFT] JOIN table2 FOR SYSTEM_TIME AS OF table1.proctime [AS <alias2>]
ON table1.column-name1 = table2.key-name1
```

Description

- **table1.proctime** indicates the processing time attribute (computed column) of **table1**.
- **FOR SYSTEM_TIME AS OF table1.proctime** indicates that when the records in the left table are joined with the dimension table on the right, only the snapshot data is used for matching the current processing time dimension table.

Precautions

Only inner and left joins are supported for temporal tables with processing time attributes.

Example

LatestRates is a dimension table (such as HBase table) that is materialized with the latest rate.

```
SELECT
  o.amout, o.currency, r.rate, o.amount * r.rate
FROM
  Orders AS o
  JOIN LatestRates FOR SYSTEM_TIME AS OF o.proctime AS r
  ON r.currency = o.currency;
```

3.4.5 OrderBy & Limit

OrderBy

Function

This clause is used to sort data in ascending order on a time attribute.

Precautions

Currently, only sorting by time attribute is supported.

Example

Sort data in ascending order on the time attribute.

```
SELECT *
FROM Orders
ORDER BY orderTime;
```

Limit

Function

This clause is used to constrain the number of rows returned.

Precautions

This clause is used in conjunction with ORDER BY to ensure that the results are deterministic.

Example

```
SELECT *
FROM Orders
ORDER BY orderTime
LIMIT 3;
```

3.4.6 Top-N

Function

Top-N queries ask for the N smallest or largest values ordered by columns. Both smallest and largest values sets are considered Top-N queries. Top-N queries are useful in cases where the need is to display only the N bottom-most or the N top-most records from batch/streaming table on a condition.

Syntax

```
SELECT [column_list]
FROM (
   SELECT [column_list],
     ROW_NUMBER() OVER ([PARTITION BY col1[, col2...]]
       ORDER BY col1 [asc|desc][, col2 [asc|desc]...]) AS rownum
   FROM table_name)
WHERE rownum <= N [AND conditions]
```

Description

- ROW_NUMBER(): Allocate a unique and consecutive number to each line starting from the first line in the current partition. Currently, we only support ROW_NUMBER as the over window function. In the future, we will support RANK() and DENSE_RANK().
- PARTITION BY col1[, col2...]: Specifies the partition columns. Each partition will have a Top-N result.

- ORDER BY col1 [asc|desc][, col2 [asc|desc]...]: Specifies the ordering columns. The ordering directions can be different on different columns.
- WHERE rownum <= N: The rownum <= N is required for Flink to recognize this query is a Top-N query. The N represents the N smallest or largest records will be retained.
- [AND conditions]: It is free to add other conditions in the where clause, but the other conditions can only be combined with rownum <= N using AND conjunction.

Precautions

- The TopN query is Result Updating.
- Flink SQL will sort the input data stream according to the order key,
- so if the top N records have been changed, the changed ones will be sent as retraction/update records to downstream.
- If the top N records need to be stored in external storage, the result table should have the same unique key with the Top-N query.

Example

This is an example to get the top five products per category that have the maximum sales in realtime.

```
SELECT *
  FROM (
    SELECT *,
        ROW_NUMBER() OVER (PARTITION BY category ORDER BY sales DESC) as row_num
    FROM ShopSales)
  WHERE row_num <= 5;
```

3.4.7 Deduplication

Function

Deduplication removes rows that duplicate over a set of columns, keeping only the first one or the last one.

Syntax

```
SELECT [column_list]
FROM (
   SELECT [column_list],
     ROW_NUMBER() OVER ([PARTITION BY col1[, col2...]]
       ORDER BY time_attr [asc|desc]) AS rownum
   FROM table_name)
WHERE rownum = 1
```

Description

- ROW_NUMBER(): Assigns a unique, sequential number to each row, starting with one.
- PARTITION BY col1[, col2...]: Specifies the partition columns, i.e. the deduplicate key.

- ORDER BY time_attr [asc|desc]: Specifies the ordering column, it must be a time attribute. Currently Flink supports proctime only. Ordering by ASC means keeping the first row, ordering by DESC means keeping the last row.
- WHERE rownum = 1: The rownum = 1 is required for Flink to recognize this query is deduplication.

Precautions

None

Example

The following examples show how to remove duplicate rows on **order_id**. The proctime is an event time attribute.

```
SELECT order_id, user, product, number
  FROM (
    SELECT *,
        ROW_NUMBER() OVER (PARTITION BY order_id ORDER BY proctime ASC) as row_num
    FROM Orders)
  WHERE row_num = 1;
```

3.5 Functions

3.5.1 User-Defined Functions (UDFs)

Overview

DLI supports the following three types of user-defined functions (UDFs):

- Regular UDF: takes in one or more input parameters and returns a single result.
- User-defined table-generating function (UDTF): takes in one or more input parameters and returns multiple rows or columns.
- User-defined aggregate function (UDAF): aggregates multiple records into one value.

NOTE

- UDFs can only be used in dedicated queues.
- **Currently, Python is not supported for programming UDFs, UDTFs, and UDAFs.**

POM Dependency

```
<dependency>
      <groupId>org.apache.flink</groupId>
      <artifactId>flink-table-common</artifactId>
      <version>1.10.0</version>
      <scope>provided</scope>
</dependency>
```

Using UDFs

1. Encapsulate the implemented UDFs into a JAR package and upload the package to OBS.

2. In the navigation pane of the DLI management console, choose **Data Management** > **Package Management**. On the displayed page, click **Create** and use the JAR package uploaded to OBS to create a package.
3. In the left navigation, choose **Job Management** and click **Flink Jobs**. Locate the row where the target resides and click **Edit** in the **Operation** column to switch to the page where you can edit the job.
4. Click the **Running Parameters** tab of your job, select the UDF JAR and click **Save**.
5. Add the following statement to the SQL statements to use the functions:
   ```
   CREATE FUNCTION udf_test AS 'com.huaweicompany.udf.UdfScalarFunction';
   ```

UDF

The regular UDF must inherit the ScalarFunction function and implement the eval method. The open and close functions are optional.

Example code

```
import org.apache.flink.table.functions.FunctionContext;
import org.apache.flink.table.functions.ScalarFunction;
public class UdfScalarFunction extends ScalarFunction {
  private int factor = 12;
  public UdfScalarFunction() {
    this.factor = 12;
  }
  /**
   * (optional) Initialization
   * @param context
   */
  @Override
  public void open(FunctionContext context) {}
  /**
   * Custom logic
   * @param s
   * @return
   */
  public int eval(String s) {
    return s.hashCode() * factor;
  }
  /**
   * Optional
   */
  @Override
  public void close() {}
}
```

Example

```
CREATE FUNCTION udf_test AS 'com.huaweicompany.udf.UdfScalarFunction';
INSERT INTO sink_stream select udf_test(attr) FROM source_stream;
```

UDTF

The UDTF must inherit the TableFunction function and implement the eval method. The open and close functions are optional. If the UDTF needs to return multiple columns, you only need to declare the returned value as **Tuple** or **Row**. If **Row** is used, you need to overload the getResultType method to declare the returned field type.

Example code

```
import org.apache.flink.api.common.typeinfo.TypeInformation;
import org.apache.flink.api.common.typeinfo.Types;
```



```
import org.apache.flink.table.functions.FunctionContext;
import org.apache.flink.table.functions.TableFunction;
import org.apache.flink.types.Row;
import org.slf4j.Logger;
import org.slf4j.LoggerFactory;
public class UdfTableFunction extends TableFunction<Row> {
  private Logger log = LoggerFactory.getLogger(TableFunction.class);
  /**
   * (optional) Initialization
   * @param context
   */
  @Override
  public void open(FunctionContext context) {}
  public void eval(String str, String split) {
    for (String s : str.split(split)) {
      Row row = new Row(2);
      row.setField(0, s);
      row.setField(1, s.length());
      collect(row);
    }
  }
  /**
   * Declare the type returned by the function
   * @return
   */
  @Override
  public TypeInformation<Row> getResultType() {
  return Types.ROW(Types.STRING, Types.INT);
  }
  /**
    * Optional
   */
  @Override
  public void close() {}
}
```

Example

The UDTF supports CROSS JOIN and LEFT JOIN. When the UDTF is used, the **LATERAL** and **TABLE** keywords must be included.

- CROSS JOIN: does not output the data of a row in the left table if the UDTF does not output the result for the data of the row.
- LEFT JOIN: outputs the data of a row in the left table even if the UDTF does not output the result for the data of the row, but pads null with UDTF-related fields.

```
CREATE FUNCTION udtf_test AS 'com.huaweicompany.udf.TableFunction';
// CROSS JOIN
INSERT INTO sink_stream select subValue, length FROM source_stream, LATERAL
TABLE(udtf_test(attr, ',')) as T(subValue, length);
// LEFT JOIN
INSERT INTO sink_stream select subValue, length FROM source_stream LEFT JOIN LATERAL
TABLE(udtf_test(attr, ',')) as T(subValue, length) ON TRUE;
```

UDAF

The UDAF must inherit the AggregateFunction function. You need to create an accumulator for storing the computing result, for example, **WeightedAvgAccum** in the following example code.

Example code

```
public class WeightedAvgAccum {
public long sum = 0;
public int count = 0;
}
```



```
import org.apache.flink.table.functions.AggregateFunction;
import java.util.Iterator;
/**
* The first type variable is the type returned by the aggregation function, and the second type variable is of
the Accumulator type.
* Weighted Average user-defined aggregate function.
*/
public class UdfAggFunction extends AggregateFunction<Long, WeightedAvgAccum> {
// Initialize the accumulator.
  @Override
  public WeightedAvgAccum createAccumulator() {
    return new WeightedAvgAccum();
  }
// Return the intermediate computing value stored in the accumulator.
  @Override
  public Long getValue(WeightedAvgAccum acc) {
    if (acc.count == 0) {
      return null;
    } else {
      return acc.sum / acc.count;
 }
}
// Update the intermediate computing value according to the input.
public void accumulate(WeightedAvgAccum acc, long iValue) {
acc.sum += iValue;
acc.count += 1;
}
// Perform the retraction operation, which is opposite to the accumulate operation.
public void retract(WeightedAvgAccum acc, long iValue) {
acc.sum -= iValue;
acc.count -= 1;
}
// Combine multiple accumulator values.
public void merge(WeightedAvgAccum acc, Iterable<WeightedAvgAccum> it) {
Iterator<WeightedAvgAccum> iter = it.iterator();
while (iter.hasNext()) {
WeightedAvgAccum a = iter.next();
acc.count += a.count;
acc.sum += a.sum;
}
}
// Reset the intermediate computing value.
public void resetAccumulator(WeightedAvgAccum acc) {
acc.count = 0;
acc.sum = 0L;
}
}
```

Example

```
CREATE FUNCTION udaf_test AS 'com.huaweicompany.udf.UdfAggFunction';
INSERT INTO sink_stream SELECT udaf_test(attr2) FROM source_stream GROUP BY attr1;
```

3.5.2 Built-In Functions

3.5.2.1 Mathematical Operation Functions

Relational Operators

All data types can be compared by using relational operators and the result is returned as a BOOLEAN value.

Relationship operators are binary operators. Two compared data types must be of the same type or they must support implicit conversion.

Table 3-46 lists all relational operators supported by Flink SQL.

Table 3-46 Relational Operators

Operator	Returned Data Type	Description
A = B	BOOLEAN	If A is equal to B, then **TRUE** is returned. Otherwise, **FALSE** is returned. This operator is used for value assignment.
A <> B	BOOLEAN	If A is not equal to B, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned. This operator follows the standard SQL syntax.
A < B	BOOLEAN	If A is less than B, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned.
A <= B	BOOLEAN	If A is less than or equal to B, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned.
A > B	BOOLEAN	If A is greater than B, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned.
A >= B	BOOLEAN	If A is greater than or equal to B, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned.
A IS NULL	BOOLEAN	If A is **NULL**, then **TRUE** is returned. Otherwise, **FALSE** is returned.
A IS NOT NULL	BOOLEAN	If A is not **NULL**, then **TRUE** is returned. Otherwise, **FALSE** is returned.
A IS DISTINCT FROM B	BOOLEAN	If A is not equal to B, **TRUE** is returned. **NULL** indicates A equals B.
A IS NOT DISTINCT FROM B	BOOLEAN	If A is equal to B, **TRUE** is returned. **NULL** indicates A equals B.

Operator	Returned Data Type	Description
A BETWEEN [ASYMMETRIC | SYMMETRIC] B AND C	BOOLEAN	If A is greater than or equal to B but less than or equal to C, **TRUE** is returned. • ASYMMETRIC: indicates that B and C are location-related. For example, "A BETWEEN ASYMMETRIC B AND C" is equivalent to "A BETWEEN B AND C". • SYMMETRIC: indicates that B and C are not location-related. For example, "A BETWEEN SYMMETRIC B AND C" is equivalent to "A BETWEEN B AND C) OR (A BETWEEN C AND B".
A NOT BETWEEN B [ASYMMETRIC | SYMMETRIC]AND C	BOOLEAN	If A is less than B or greater than C, **TRUE** is returned. • ASYMMETRIC: indicates that B and C are location-related. For example, "A NOT BETWEEN ASYMMETRIC B AND C" is equivalent to "A NOT BETWEEN B AND C". • SYMMETRIC: indicates that B and C are not location-related. For example, "A NOT BETWEEN SYMMETRIC B AND C" is equivalent to "(A NOT BETWEEN B AND C) OR (A NOT BETWEEN C AND B)".
A LIKE B [ESCAPE C]	BOOLEAN	If A matches pattern B, **TRUE** is returned. The escape character C can be defined as required.
A NOT LIKE B [ESCAPE C]	BOOLEAN	If A does not match pattern B, **TRUE** is returned. The escape character C can be defined as required.
A SIMILAR TO B [ESCAPE C]	BOOLEAN	If A matches regular expression B, **TRUE** is returned. The escape character C can be defined as required.
A NOT SIMILAR TO B [ESCAPE C]	BOOLEAN	If A does not match regular expression B, **TRUE** is returned. The escape character C can be defined as required.
value IN (value [, value]*)	BOOLEAN	If the value is equal to any value in the list, **TRUE** is returned.
value NOT IN (value [, value]*)	BOOLEAN	If the value is not equal to any value in the list, **TRUE** is returned.
EXISTS (sub-query)	BOOLEAN	If sub-query returns at least one row, **TRUE** is returned.

Operator	Returned Data Type	Description
value IN (sub-query)	BOOLEAN	If value is equal to a row returned by subquery, **TRUE** is returned.
value NOT IN (sub-query)	BOOLEAN	If value is not equal to a row returned by subquery, **TRUE** is returned.

Precautions

- Values of the double, real, and float types may be different in precision. The equal sign (=) is not recommended for comparing two values of the double type. You are advised to obtain the absolute value by subtracting these two values of the double type and determine whether they are the same based on the absolute value. If the absolute value is small enough, the two values of the double data type are regarded equal. For example:
  ```
  abs(0.9999999999 - 1.0000000000) < 0.000000001 //The precision decimal places of 0.9999999999 and 1.0000000000 are 10, while the precision decimal place of 0.000000001 is 9. Therefore, 0.9999999999 can be regarded equal to 1.0000000000.
  ```
- Comparison between data of the numeric type and character strings is allowed. During comparison using relational operators, including >, <, ≤, and ≥, data of the string type is converted to numeric type by default. No characters other than numeric characters are allowed.
- Character strings can be compared using relational operators.

Logical Operators

Common logical operators are AND, OR, and NOT. Their priority order is NOT > AND > OR.

Table 3-47 lists the calculation rules. A and B indicate logical expressions.

Table 3-47 Logical Operators

Operator	Returned Data Type	Description
A OR B	BOOLEAN	If A or B is TRUE, **TRUE** is returned. Three-valued logic is supported.
A AND B	BOOLEAN	If both A and B are TRUE, **TRUE** is returned. Three-valued logic is supported.
NOT A	BOOLEAN	If A is not TRUE, **TRUE** is returned. If A is UNKNOWN, **UNKNOWN** is returned.
A IS FALSE	BOOLEAN	If A is TRUE, **TRUE** is returned. If A is UNKNOWN, **FALSE** is returned.
A IS NOT FALSE	BOOLEAN	If A is not FALSE, **TRUE** is returned. If A is UNKNOWN, **TRUE** is returned.

Operator	Returned Data Type	Description
A IS TRUE	BOOLEAN	If A is TRUE, **TRUE** is returned. If A is UNKNOWN, **FALSE** is returned.
A IS NOT TRUE	BOOLEAN	If A is not TRUE, **TRUE** is returned. If A is UNKNOWN, **TRUE** is returned.
A IS UNKNOWN	BOOLEAN	If A is UNKNOWN, **TRUE** is returned.
A IS NOT UNKNOWN	BOOLEAN	If A is not UNKNOWN, **TRUE** is returned.

Precautions

Only data of the Boolean type can be used for calculation using logical operators. Implicit type conversion is not supported.

Arithmetic Operators

Arithmetic operators include binary operators and unary operators, for all of which, the returned results are of the numeric type. **Table 3-48** lists arithmetic operators supported by Flink SQL.

Table 3-48 Arithmetic Operators

Operator	Returned Data Type	Description
+ numeric	All numeric types	Returns numbers.
- numeric	All numeric types	Returns negative numbers.
A + B	All numeric types	A plus B. The result type is associated with the operation data type. For example, if floating-point number is added to an integer, the result will be a floating-point number.

Operator	Returned Data Type	Description
A - B	All numeric types	A minus B. The result type is associated with the operation data type.
A * B	All numeric types	Multiply A and B. The result type is associated with the operation data type.
A / B	All numeric types	Divide A by B. The result is a number of the double type (double-precision number).
POWER(A, B)	All numeric types	Returns the value of A raised to the power B.
ABS(numeric)	All numeric types	Returns the absolute value of a specified value.
MOD(A, B)	All numeric types	Returns the remainder (modulus) of A divided by B. A negative value is returned only when A is a negative value.
SQRT(A)	All numeric types	Returns the square root of A.
LN(A)	All numeric types	Returns the nature logarithm of A (base e).
LOG10(A)	All numeric types	Returns the base 10 logarithms of A.
LOG2(A)	All numeric types	Returns the base 2 logarithm of A.

Operator	Returned Data Type	Description
LOG(B) LOG(A, B)	All numeric types	When called with one argument, returns the natural logarithm of B. When called with two arguments, this function returns the logarithm of B to the base A. B must be greater than 0 and A must be greater than 1.
EXP(A)	All numeric types	Return the value of e raised to the power of **a**.
CEIL(A) CEILING(A)	All numeric types	Return the smallest integer that is greater than or equal to **a**. For example: ceil(21.2) = 22.
FLOOR(A)	All numeric types	Return the largest integer that is less than or equal to **a**. For example: floor(21.2) = 21.
SIN(A)	All numeric types	Returns the sine value of A.
COS(A)	All numeric types	Returns the cosine value of A.
TAN(A)	All numeric types	Returns the tangent value of A.
COT(A)	All numeric types	Returns the cotangent value of A.
ASIN(A)	All numeric types	Returns the arc sine value of A.

Operator	Returned Data Type	Description
ACOS(A)	All numeric types	Returns the arc cosine value of A.
ATAN(A)	All numeric types	Returns the arc tangent value of A.
ATAN2(A, B)	All numeric types	Returns the arc tangent of a coordinate (A, B).
COSH(A)	All numeric types	Returns the hyperbolic cosine of A. Return value type is DOUBLE.
DEGREES(A)	All numeric types	Convert the value of **a** from radians to degrees.
RADIANS(A)	All numeric types	Convert the value of **a** from degrees to radians.
SIGN(A)	All numeric types	Returns the sign of A. **1** is returned if A is positive. **–1** is returned if A is negative. Otherwise, **0** is returned.
ROUND(A, d)	All numeric types	Returns a number rounded to **d** decimal places for A. For example: round(21.263,2) = 21.26.
PI	All numeric types	Returns the value of **pi**.
E()	All numeric types	Returns the value of **e**.

Operator	Returned Data Type	Description
RAND()	All numeric types	Returns a pseudorandom double value in the range [0.0, 1.0)
RAND(A)	All numeric types	Returns a pseudorandom double value in the range [0.0, 1.0) with an initial seed A. Two RAND functions will return identical sequences of numbers if they have the same initial seed.
RAND_INTEGER(A)	All numeric types	Returns a pseudorandom double value in the range [0.0, A)
RAND_INTEGER(A, B)	All numeric types	Returns a pseudorandom double value in the range [0.0, B) with an initial seed A.
UUID()	All numeric types	Returns a UUID string.
BIN(A)	All numeric types	Returns a string representation of integer A in binary format. Returns NULL if A is NULL.
HEX(A) HEX(B)	All numeric types	Returns a string representation of an integer A value or a string B in hex format. Returns NULL if the argument is NULL.
TRUNCATE(A, d)	All numeric types	Returns a number of truncated to **d** decimal places. Returns NULL if A or **d** is NULL. Example: truncate (42.345, 2) = 42.340 truncate(42.345) = 42.000
PI()	All numeric types	Returns the value of **pi**.

Precautions

Data of the string type is not allowed in arithmetic operations.

3.5.2.2 String Functions

Table 3-49 String Functions

Function	Return Type	Description
string1 || string2	STRING	Returns the concatenation of string1 and string2.
CHAR_LENGTH(string) CHARACTER_LENGTH(string)	INT	Returns the number of characters in the string.
UPPER(string)	STRING	Returns the string in uppercase.
LOWER(string)	STRING	Returns the string in lowercase.
POSITION(string1 IN string2)	INT	Returns the position (start from **1**) of the first occurrence of string1 in string2; returns **0** if string1 cannot be found in string2.
TRIM([BOTH | LEADING | TRAILING] string1 FROM string2)	STRING	Returns a string that removes leading and/or trailing characters string2 from string1.
LTRIM(string)	STRING	Returns a string that removes the left whitespaces from the specified string. For example, **LTRIM(' This is a test String.')** returns **"This is a test String."**.
RTRIM(string)	STRING	Returns a string that removes the right whitespaces from the specified string. For example, **RTRIM('This is a test String. ')** returns **"This is a test String."**.
REPEAT(string, integer)	STRING	Returns a string that repeats the base string integer times. For example, **REPEAT('This is a test String.', 2)** returns **"This is a test String.This is a test String."**.
REGEXP_REPLACE(string1, string2, string3)	STRING	Returns a string from string1 with all the substrings that match a regular expression string2 consecutively being replaced with string3. For example, **REGEXP_REPLACE('foobar', 'oo|ar', '')** returns **"fb"**. **REGEXP_REPLACE('ab\ab', '\\', 'e')** returns **"abeab"**.

Function	Return Type	Description
OVERLAY(string1 PLACING string2 FROM integer1 [FOR integer2])	STRING	Returns a string that replaces integer2 characters of STRING1 with STRING2 from position integer1. The default value of integer2 is the length of string2. For example, **OVERLAY('This is an old string' PLACING ' new' FROM 10 FOR 5)** returns **"This is a new string"**.
SUBSTRING(string FROM integer1 [FOR integer2])	STRING	Returns a substring of the specified string starting from position integer1 with length integer2 (to the end by default). If integer2 is not configured, the substring from integer1 to the end is returned by default.
REPLACE(string1, string2, string3)	STRING	Returns a new string which replaces all the occurrences of string2 with string3 (non-overlapping) from string1. For example, **REPLACE('hello world', 'world', 'flink')** returns **"hello flink"**; **REPLACE('abababab', 'abab', 'z')** returns **"zab"**. **REPLACE('ab\\ab', '\\', 'e')** returns **"abeab"**.
REGEXP_EXTRACT(string1, string2[, integer])	STRING	Returns a string from string1 which extracted with a specified regular expression string2 and a regex match group index integer. Returns NULL, if the parameter is NULL or the regular expression is invalid. For example, **REGEXP_EXTRACT('foothebar', 'foo(.*?)(bar)', 2)"** returns **"bar"**.
INITCAP(string)	STRING	Returns a new form of STRING with the first character of each word converted to uppercase and the rest characters to lowercase.
CONCAT(string1, string2,...)	STRING	Returns a string that concatenates string1, string2, …. For example, **CONCAT('AA', 'BB', 'CC')** returns **"AABBCC"**.
CONCAT_WS(string1, string2, string3,...)	STRING	Returns a string that concatenates string2, string3, … with a separator string1. The separator is added between the strings to be concatenated. Returns NULL if string1 is NULL. If other arguments are NULL, this function automatically skips NULL arguments. For example, **CONCAT_WS('~', 'AA', NULL, 'BB', '', 'CC')** returns **"AA~BB~~CC"**.

Function	Return Type	Description
LPAD(string1, integer, string2)	STRING	Returns a new string from string1 left-padded with string2 to a length of integer characters. If any argument is NULL, NULL is returned. If integer is negative, NULL is returned. If the length of string1 is shorter than integer, returns string1 shortened to integer characters. For example, **LPAD(Symbol,4,Symbol)** returns **"Symbol hi"**. **LPAD('hi',1,'??')** returns **"h"**.
RPAD(string1, integer, string2)	STRING	Returns a new string from string1 right-padded with string2 to a length of integer characters. If any argument is NULL, NULL is returned. If integer is negative, NULL is returned. If the length of string1 is shorter than integer, returns string1 shortened to integer characters. For example, **RPAD('hi',4,'??')** returns **"hi??"**. **RPAD('hi',1,'??')** returns **"h"**.
FROM_BASE64(string)	STRING	Returns the base64-decoded result from string. Returns NULL if string is NULL. For example, **FROM_BASE64('aGVsbG8gd29ybGQ=')** returns **"hello world"**.
TO_BASE64(string)	STRING	Returns the base64-encoded result from string; f string is NULL. Returns NULL if string is NULL. For example, **TO_BASE64(hello world)** returns **"aGVsbG8gd29ybGQ="**.
ASCII(string)	INT	Returns the numeric value of the first character of string. Returns NULL if string is NULL. For example, **ascii('abc')** returns **97.** **ascii(CAST(NULL AS VARCHAR))** returns **NULL**.

Function	Return Type	Description
CHR(integer)	STRING	Returns the ASCII character having the binary equivalent to integer. If integer is larger than 255, we will get the modulus of integer divided by 255 first, and returns CHR of the modulus. Returns NULL if integer is NULL. **chr(97)** returns **a**. **chr(353)** Return **a**.
DECODE(binary, string)	STRING	Decodes the first argument into a String using the provided character set (one of 'US-ASCII', 'ISO-8859-1', 'UTF-8', 'UTF-16BE', 'UTF-16LE', 'UTF-16'). If either argument is NULL, the result will also be NULL.
ENCODE(strinh1, string2)	STRING	Encodes the string1 into a BINARY using the provided string2 character set (one of 'US-ASCII', 'ISO-8859-1', 'UTF-8', 'UTF-16BE', 'UTF-16LE', 'UTF-16'). If either argument is NULL, the result will also be NULL.
INSTR(string1, string2)	INT	Returns the position of the first occurrence of string2 in string1. Returns NULL if any argument is NULL.
LEFT(string, integer)	STRING	Returns the leftmost integer characters from the string. Returns EMPTY String if integer is negative. Returns NULL if any argument is NULL.
RIGHT(string, integer)	STRING	Returns the rightmost integer characters from the string. Returns EMPTY String if integer is negative. Returns NULL if any argument is NULL.
LOCATE(string1, string2[, integer])	INT	Returns the position of the first occurrence of string1 in string2 after position integer. Returns 0 if not found. The value of **integer** defaults to **0**. Returns NULL if any argument is NULL.

Function	Return Type	Description
PARSE_URL(string1, string2[, string3])	STRING	Returns the specified part from the URL. Valid values for string2 include 'HOST', 'PATH', 'QUERY', 'REF', 'PROTOCOL', 'AUTHORITY', 'FILE', and 'USERINFO'. Returns NULL if any argument is NULL. If string2 is QUERY, the key in QUERY can be specified as string3. Example: The **parse_url('http://facebook.com/path1/p.php?k1=v1&k2=v2#Ref1', 'HOST')** returns **'facebook.com'**. **parse_url('http://facebook.com/path1/p.php?k1=v1&k2=v2#Ref1', 'QUERY', 'k1') returns 'v1'**.
REGEXP(string1, string2)	BOOLEAN	Performs a regular expression search on the specified string and returns a BOOLEAN value indicating whether the specified match pattern is found. If it is found, TRUE is returned. string1 indicates the specified string, and string2 indicates the regular expression. Returns NULL if any argument is NULL.
REVERSE(string)	STRING	Returns the reversed string. Returns NULL if any argument is NULL. **NOTE** Note that backquotes must be added to this function, for example, `REVERSE`.
SPLIT_INDEX(string1, string2, integer1)	STRING	Splits string1 by the delimiter string2, returns the integerth (zero-based) string of the split strings. Returns NULL if integer is negative. Returns NULL if integer is negative. Returns NULL if any argument is NULL.
STR_TO_MAP(string1[, string2, string3]])	MAP	Returns a map after splitting the string1 into key/value pairs using delimiters. The default value of string2 is **','**. The default value of string3 is **'='**.
SUBSTR(string[, integer1[, integer2]])	STRING	Returns a substring of string starting from position integer1 with length integer2. If integer2 is not specified, the string is truncated to the end.

Function	Return Type	Description
JSON_VAL(STRING json_string, STRING json_path)	STRING	Returns the value of the specified **json_path** from the **json_string**. For details about how to use the functions, see **JSON_VAL Function**. **NOTE** The following rules are listed in descending order of priority. 1. The two arguments **json_string** and **json_path** cannot be **NULL**. 2. The value of **json_string** must be a valid JSON string. Otherwise, the function returns **NULL**. 3. If **json_string** is an empty string, the function returns an empty string. 4. If **json_path** is an empty string or the path does not exist, the function returns **NULL**.

JSON_VAL Function

- Syntax

```
STRING JSON_VAL(STRING json_string, STRING json_path)
```

Table 3-50 Parameters

Parameter	Data Types	Description
json_string	STRING	JSON object to be parsed
json_path	STRING	Path expression for parsing the JSON string For the supported expressions, see **Table 3-51**.

Table 3-51 Expressions supported

Expression	Description
$	Root node in the path
[]	Access array elements
*	Array wildcard
.	Access child elements

- Example

  a. Test input data.

  Test the data source kafka. The message content is as follows:


```
{name:James,age:24,sex:male,grade:{math:95,science:[80,85],english:100}}
{name:James,age:24,sex:male,grade:{math:95,science:[80,85],english:100}]
```

b. Use JSON_VAL in SQL statements.

```
CREATE TABLE kafkaSource (
  `message` string
) WITH (
  'connector' = 'kafka',
  'topic' = '<yourSourceTopic>',
  'properties.bootstrap.servers' =
'<yourKafkaAddress1>:<yourKafkaPort>,<yourKafkaAddress2>:<yourKafkaPort>',
  'properties.group.id' = '<yourGroupId>',
  'scan.startup.mode' = 'latest-offset',
  "format" = "csv",
  "csv.field-delimiter" = "\u0001",
  "csv.quote-character" = """
);

CREATE TABLE kafkaSink(
  message1 STRING,
  message2 STRING,
  message3 STRING,
  message4 STRING,
  message5 STRING,
  message6 STRING
) WITH (
  'connector' = 'kafka',
  'topic' = '<yourSinkTopic>',
  'properties.bootstrap.servers' =
'<yourKafkaAddress1>:<yourKafkaPort>,<yourKafkaAddress2>:<yourKafkaPort>',
  "format" = "json"
);

insert into kafkaSink select
JSON_VAL(message,""),
JSON_VAL(message,"$.name"),
JSON_VAL(message,"$.grade.science"),
JSON_VAL(message,"$.grade.science[*]"),
JSON_VAL(message,"$.grade.science[1]"),JSON_VAL(message,"$.grade.dddd")
from kafkaSource;
```

c. Check the output result of the Kafka topic in the sink.

```
{"message1":null,"message2":"swq","message3":"[80,85]","message4":"[80,85]","message5":"85"
,"message6":null}
{"message1":null,"message2":null,"message3":null,"message4":null,"message5":null,"message6":
null}
```

3.5.2.3 Temporal Functions

Table 3-52 lists the time functions supported by Flink OpenSource SQL.

Description

Table 3-52 Temporal Functions

Function	Return Type	Description
DATE string	DATE	Parse the date string (**yyyy-MM-dd**) to a SQL date.
TIME string	TIME	Parse the time string (**HH:mm:ss[.fff]**) to a SQL time.

Function	Return Type	Description
TIMESTAMP string	TIMESTAMP	Convert the time string into a timestamp. The time string format is **yyyy-MM-dd HH:mm:ss[.fff]**.
INTERVAL string range	INTERVAL	interval indicates the interval. There are two forms: • **yyyy-MM** for SQL intervals of months. An interval range might be **YEAR** or **YEAR TO MONTH** for intervals of months. • **dd hh:mm:ss.fff** for SQL intervals of milliseconds. An interval range might be **DAY**, **MINUTE**, **DAY TO HOUR**, or **DAY TO SECOND**. Example: INTERVAL '10 00:00:00.004' DAY TO second indicates that the interval is 10 days and 4 milliseconds. INTERVA**L '10' DAY**: indicates that the interval is 10 days. **INTERVAL '2-10' YEAR TO MONTH** indicates that the interval is two years and ten months.
CURRENT_DATE	DATE	Return the SQL date of UTC time zone.
CURRENT_TIME	TIME	Return the SQL time of UTC time zone.
CURRENT_TIMESTAMP	TIMESTAMP	Return the SQL timestamp of UTC time zone.
LOCALTIME	TIME	Return the SQL time of the current time zone.
LOCALTIMESTAMP	TIMESTAMP	Return the SQL timestamp of the current time zone.
EXTRACT(timeintervalunit FROM temporal)	BIGINT	Extract part of the time point or interval. Return the part in the int type. For example, extract the date **2006-06-05** and return 5. **EXTRACT(DAY FROM DATE '2006-06-05')** returns **5**.
YEAR(date)	BIGINT	Return the year from SQL date. For example, **YEAR(DATE'1994-09-27')** returns **1994**.

Function	Return Type	Description
QUARTER(date)	BIGINT	Return the quarter of a year (an integer between 1 and 4) from SQL date.
MONTH(date)	BIGINT	Return the month of a year (an integer between 1 and 12) from SQL date. For example, **MONTH(DATE '1994-09-27')** returns **9**.
WEEK(date)	BIGINT	Return the week of a year (an integer between 1 and 53) from SQL date. For example, **WEEK(DATE'1994-09-27')** returns **39**.
DAYOFYEAR(date)	BIGINT	Returns the day of a year (an integer between 1 and 366) from SQL date. For example, **DAYOFYEAR(DATE '1994-09-27')** is **270**.
DAYOFMONTH(date)	BIGINT	Return the day of a month (an integer between 1 and 31) from SQL date. For example, **DAYOFMONTH(DATE'1994-09-27')** returns **27**.
DAYOFWEEK(date)	BIGINT	Return the day of a week (an integer between 1 and 7) from SQL date. Sunday is set to **1**. For example, **DAYOFWEEK(DATE'1994-09-27')** returns **3**.
HOUR(timestamp)	BIGINT	Returns the hour of a day (an integer between 0 and 23) from SQL timestamp. For example, **HOUR(TIMESTAMP '1994-09-27 13:14:15')** returns **13**.
MINUTE(timestamp)	BIGINT	Returns the minute of an hour (an integer between 0 and 59) from SQL timestamp. For example, **MINUTE(TIMESTAMP '1994-09-27 13:14:15')** returns **14**.
SECOND(timestamp)	BIGINT	Returns the second of a minute (an integer between 0 and 59) from SQL timestamp. For example, **SECOND(TIMESTAMP '1994-09-27 13:14:15')** returns **15**.
FLOOR(timepoint TO timeintervalunit)	TIME	Round a time point down to the given unit. For example, **12:44:00** is returned from **FLOOR(TIME '12:44:31' TO MINUTE)**.

Function	Return Type	Description
CEIL(timepoint TO timeintervalunit)	TIME	Round a time point up to the given unit. For example, **CEIL(TIME '12:44:31' TO MINUTE)** returns **12:45:00**.
(timepoint1, temporal1) OVERLAPS (timepoint2, temporal2)	BOOLEAN	Return **TRUE** if two time intervals defined by (timepoint1, temporal1) and (timepoint2, temporal2) overlap. Example: **(TIME '2:55:00', INTERVAL '1' HOUR) OVERLAPS (TIME '3:30:00', INTERVAL '2' HOUR)** returns **TRUE**. **(TIME '9:00:00', TIME '10:00:00') OVERLAPS (TIME '10:15:00', INTERVAL '3' HOUR)** returns **FALSE**.
DATE_FORMAT(timestamp, string)	STRING	Convert timestamp to a value of string in the format specified by the date format string.
TIMESTAMPADD(timeintervalunit, interval, timepoint)	TIMESTAMP/ DATE/ TIME	Return the date and time added to **timepoint** based on the result of **interval** and **timeintervalunit**. For example, **TIMESTAMPADD(WEEK, 1, DATE '2003-01-02')** returns **2003-01-09**.
TIMESTAMPDIFF(timepointunit, timepoint1, timepoint2)	INT	Return the (signed) number of timepointunit between **timepoint1** and **timepoint2**. The unit for the interval is given by the first argument, which should be one of the following values: SECOND, MINUTE, HOUR, DAY, MONTH, or YEAR. For example, **TIMESTAMPDIFF(DAY, TIMESTAMP '2003-01-02 10:00:00', TIMESTAMP '2003-01-03 10:00:00')** returns **1**.
CONVERT_TZ(string1, string2, string3)	TIMESTAMP	Convert a datetime **string1** from time zone **string2** to time zone **string3**. For example, **CONVERT_TZ('1970-01-01 00:00:00', 'UTC', 'America/Los_Angeles')** returns '**1969-12-31 16:00:00**'.

Function	Return Type	Description
FROM_UNIXTIME(numeric[, string])	STRING	Return a string representation of the **numeric** argument (in seconds) in the current time zone. The default string format is YYYY-MM-DD hh:mm:ss. For example, **FROM_UNIXTIME(44)** returns **1970-01-01 09:00:44**.
UNIX_TIMESTAMP()	BIGINT	Get current Unix timestamp in seconds.
UNIX_TIMESTAMP(string1[, string2])	BIGINT	Convert date time string **string1** in format **string2** to Unix timestamp (in seconds), using the specified timezone in table config. The default format of **string2** is yyyy-MM-dd HH:mm:ss.
TO_DATE(string1[, string2])	DATE	Convert a date string **string1** with format **string2** to a date. The default format of **string2** is yyyy-MM-dd.
TO_TIMESTAMP(string1[, string2])	TIMESTAMP	Converts date time string string1 with format string2 under the 'UTC+0' time zone to a timestamp. The default format of **string2** is yyyy-MM-dd HH:mm:ss.

DATE

- **Function**

  Returns a SQL date parsed from string in form of **yyyy-MM-dd**.

- **Description**

  DATE **DATE** string

- **Input parameters**

Parameter	Data Types	Parameters
string	STRING	String in the SQL date format. Note that the string must be in the **yyyy-MM-dd** format. Otherwise, an error will be reported.

- **Example**

  - Test statement

```
SELECT
  DATE "2021-08-19" AS `result`
FROM
  testtable;
```

  - Test Result

result
2021-08-19

TIME

- **Function**

  Returns a SQL time parsed from string in form of **HH:mm:ss[.fff]**.

- **Description**

```
TIME TIME string
```

- **Input parameters**

Parameter	Data Types	Parameters
string	STRING	Time Note that the string must be in the format of **HH:mm:ss[.fff]**. Otherwise, an error will be reported.

- **Example**

  - Test statement

```
SELECT
  TIME "10:11:12" AS `result`,
    TIME "10:11:12.032" AS `result2`
FROM
  testtable;
```

  - Test result

result	result2
10:11:12	10:11:12.032

TIMESTAMP

- **Function**

  Converts the time string into timestamp. The time string format is **yyyy-MM-dd HH:mm:ss[.fff]**. The return value is of the **TIMESTAMP(3)** type.

- **Description**

```
TIMESTAMP(3) TIMESTAMP string
```

- **Input parameters**

Parameter	Data Types	Parameters
string	STRING	Time Note that the string must be in the format of **yyyy-MM-dd HH:mm:ss[.fff]**. Otherwise, an error will be reported.

- **Example**
  - Test statement

```
SELECT
   TIMESTAMP "1997-04-25 13:14:15" AS `result`,
      TIMESTAMP "1997-04-25 13:14:15.032" AS `result2`
FROM
   testtable;
```

  - Test result

result	result2
1997-04-25 13:14:15	1997-04-25 13:14:15.032

INTERVAL

- **Function**

  Parses an interval string.

- **Description**

```
INTERVAL INTERVAL string range
```

- **Input parameters**

Parameter	Data Types	Parameters
string	STRING	Timestamp string used together with the **range** parameter. The string is in either of the following two formats: • **yyyy-MM** for SQL intervals of months. An interval range might be **YEAR** or **YEAR TO MONTH** for intervals of months. • **dd hh:mm:ss.fff** for SQL intervals of milliseconds. An interval range might be **DAY**, **MINUTE**, **DAY TO HOUR**, or **DAY TO SECOND**.
range	INTERVAL	Interval range. This parameter is used together with the **string** parameter. Available values are as follows: **YEAR, YEAR To Month, DAY, MINUTE, DAY TO HOUR and DAY TO SECOND**.

- **Example**

Test statement

```
-- indicates that the interval is 10 days and 4 milliseconds.
INTERVAL '10 00:00:00.004' DAY TO second
-- The interval is 10 days.
INTERVAL '10'
-- The interval is 2 years and 10 months.
INTERVAL '2-10' YEAR TO MONTH
```

CURRENT_DATE

- **Function**

  Returns the current SQL time (**yyyy-MM-dd**) in the local time zone. The return value is of the **DATE** type.

- **Description**

  ```
  DATE CURRENT_DATE
  ```

- **Input parameters**

  None

- **Example**

  – Test statement

  ```
  SELECT
    CURRENT_DATE AS `result`
  FROM
    testtable;
  ```

  – Test result

result
2021-10-28

CURRENT_TIME

- **Function**

  Returns the current SQL time (**HH:mm:sss.fff**) in the local time zone. The return value is of the **TIME** type.

- **Description**

  ```
  TIME CURRENT_TIME
  ```

- **Input parameters**

  None

- **Example**

  – Test statement

  ```
  SELECT
    CURRENT_TIME AS `result`
  FROM
    testtable;
  ```

  – Test Result

result
08:29:19.289

CURRENT_TIMESTAMP

- **Function**

  Returns the current SQL timestamp in the local time zone. The return value is of the **TIMESTAMP(3)** type.

- **Description**

  ```
  TIMESTAMP(3) CURRENT_TIMESTAMP
  ```

- **Input parameters**

  None

- **Example**

  – Test statement

  ```
  SELECT
    CURRENT_TIMESTAMP AS `result`
  FROM
    testtable;
  ```

  – Test Result

result
2021-10-28 08:33:51.606

LOCALTIME

- **Function**

  Returns the current SQL time in the local time zone. The return value is of the **TIME** type.

- **Description**

  ```
  TIME LOCALTIME
  ```

- **Input parameters**

  None

- **Example**

  – Test statement

  ```
  SELECT
    LOCALTIME AS `result`
  FROM
    testtable;
  ```

  – Test Result

result
16:39:37.706

LOCALTIMESTAMP

- **Function**

  Returns the current SQL timestamp in the local time zone. The return value is of the **TIMESTAMP(3)** type.

- **Description**

  ```
  TIMESTAMP(3) LOCALTIMESTAMP
  ```


- **Input parameters**

  None

- **Example**

  – Test statement

  ```
  SELECT
    LOCALTIMESTAMP AS `result`
  FROM
    testtable;
  ```

  – Test Result

result
2021-10-28 16:43:17.625

EXTRACT

- **Function**

  Returns a value extracted from the **timeintervalunit** part of temporal. The return value is of the **BIGINT** type.

- **Description**

  ```
  BIGINT EXTRACT(timeinteravlunit FROM temporal)
  ```

- **Input parameters**

Parameter	Data Types	Parameters
timeinteravlunit	TIMEUNIT	Time unit to be extracted from a time point or interval. The value can be **YEAR**, **QUARTER**, **MONTH**, **WEEK**, **DAY**, **DOY**, **HOUR**, **MINUTE**, **SECOND**.
temporal	DATE/TIME/ TIMESTAMP/ INTERVAL	Time point or interval

CAUTION

Do not specify a time unit that is not of any time points or intervals. Otherwise, the job fails to be submitted.

For example, an error message is displayed when the following statement is executed because **YEAR** cannot be extracted from **TIME**.

```
SELECT
  EXTRACT(YEAR FROM TIME '12:44:31' ) AS `result`
FROM
  testtable;
```

- **Example**

  – Test statement

  ```
  SELECT
    EXTRACT(YEAR FROM DATE '1997-04-25' ) AS `result`,
      EXTRACT(MINUTE FROM TIME '12:44:31') AS `result2`,
      EXTRACT(SECOND FROM TIMESTAMP '1997-04-25 13:14:15') AS `result3`,
  ```



```
    EXTRACT(YEAR FROM INTERVAL '2-10' YEAR TO MONTH) AS `result4`,
FROM
  testtable;
```

– Test result

result	result2	result3	result4
1997	44	15	2

YEAR

- **Function**

  Returns the year from a SQL date date. The return value is of the **BIGINT** type.

- **Description**

```
BIGINT YEAR(date)
```

- **Input parameters**

Parameter	Data Types	Parameters
date	DATE	SQL date

- **Example**

  – Test statement

```
SELECT
  YEAR(DATE '1997-04-25' ) AS `result`
FROM
  testtable;
```

  – Test result

result
1997

QUARTER

- **Function**

  Returns the quarter of a year (an integer between 1 and 4) from a SQL date date. The return value is of the **BIGINT** type.

- **Description**

```
BIGINT QUARTER(date)
```

- **Input parameters**

Parameter	Data Types	Parameters
date	DATE	SQL date

- **Example**

  – Test statement

```
SELECT
  QUARTER(DATE '1997-04-25' ) AS `result`
```



```
FROM
  testtable;
```

– Test result

result
2

MONTH

- **Function**

  Returns the month of a year (an integer between 1 and 12) from a SQL date date. The return value is of the **BIGINT** type.

- **Description**

```
BIGINT MONTH(date)
```

- **Input parameters**

Parameter	Data Types	Parameters
date	DATE	SQL date

- **Example**

  – Test statement

```
SELECT
  MONTH(DATE '1997-04-25' ) AS `result`
FROM
  testtable;
```

  – Test result

result
4

WEEK

- **Function**

  Returns the week of a year from a SQL date date. The return value is of the **BIGINT** type.

- **Description**

```
BIGINT WEEK(date)
```

- **Input parameters**

Parameter	Data Types	Parameters
date	DATE	SQL date

- **Example**

  – Test statement

```
SELECT
  WEEK(DATE '1997-04-25' ) AS `result`
```



```
FROM
  testtable;
```

– Test result

result
17

DAYOFYEAR

- **Function**

  Returns the day of a year (an integer between 1 and 366) from SQL date date. The return value is of the **BIGINT** type.

- **Description**

```
BIGINT DAYOFYEAR(date)
```

- **Input parameters**

Parameter	Data Types	Parameters
date	DATE	SQL date

- **Example**

  – Test statement

```
SELECT
  DAYOFYEAR(DATE '1997-04-25' ) AS `result`
FROM
  testtable;
```

  – Test Result

result
115

DAYOFMONTH

- **Function**

  Returns the day of a month (an integer between 1 and 31) from a SQL date date. The return value is of the **BIGINT** type.

- **Description**

```
BIGINT DAYOFMONTH(date)
```

- **Input parameters**

Parameter	Data Types	Parameters
date	DATE	SQL date

- **Example**

  – Test statement

```
SELECT
  DAYOFMONTH(DATE '1997-04-25' ) AS `result`
```



```
FROM
  testtable;
```

– Test Result

result
25

DAYOFWEEK

- **Function**

  Returns the day of a week (an integer between 1 and 7) from a SQL date date. The return value is of the **BIGINT** type.

  NOTE

  Note that the start day of a week is Sunday.

- **Description**

```
BIGINT DAYOFWEEK(date)
```

- **Input parameters**

Parameter	Data Types	Parameters
date	DATE	SQL date

- **Example**

  – Test statement

```
SELECT
  DAYOFWEEK(DATE '1997-04-25') AS `result`
FROM
  testtable;
```

  – Test Result

result
6

HOUR

- **Function**

  Returns the hour of a day (an integer between 0 and 23) from SQL timestamp timestamp. The return value is of the **BIGINT** type.

- **Description**

```
BIGINT HOUR(timestamp)
```

- **Input parameters**

Parameter	Data Types	Parameters
timestamp	TIMESTAMP	SQL timestamp

- **Example**
  - Test statement

```
SELECT
    HOUR(TIMESTAMP '1997-04-25 10:11:12') AS `result`
FROM
    testtable;
```

  - Test Result

result
10

MINUTE

- **Function**

  Returns the minute of an hour (an integer between 0 and 59) from a SQL timestamp. The return value is of the **BIGINT** type.

- **Description**

```
BIGINT MINUTE(timestamp)
```

- **Input parameters**

Parameter	Data Types	Parameters
timestamp	TIMESTAMP	SQL timestamp

- **Example**
  - Test statement

```
SELECT
    MINUTE(TIMESTAMP '1997-04-25 10:11:12') AS `result`
FROM
    testtable;
```

  - Test Result

result
11

SECOND

- **Function**

  Returns the second of an hour (an integer between 0 and 59) from a SQL timestamp. The return value is of the **BIGINT** type.

- **Description**

```
BIGINT SECOND(timestamp)
```

- **Input parameters**

Parameter	Data Types	Parameters
timestamp	TIMESTAMP	SQL timestamp

- **Example**
  - Test statement

```
SELECT
   SECOND(TIMESTAMP '1997-04-25 10:11:12') AS `result`
FROM
   testtable;
```

  - Test result

result
12

FLOOR

- **Function**

  Returns a value that rounds **timepoint** down to the time unit **timeintervalunit**.

- **Description**

```
TIME/TIMESTAMP(3) FLOOR(timepoint TO timeintervalunit)
```

- **Input parameters**

Parameter	Data Types	Parameters
timepoint	TIMESTAMP /TIME	SQL time or SQL timestamp
timeintervalunit	TIMEUNIT	Time unit. The value can be **YEAR**, **QUARTER**, **MONTH**, **WEEK**, **DAY**, **DOY**, **HOUR**, **MINUTE**, or **SECOND**.

- **Example**
  - Test statement

```
SELECT
   FLOOR(TIME '13:14:15' TO MINUTE) AS `result`
      FLOOR(TIMESTAMP '1997-04-25 13:14:15' TO MINUTE) AS `result2`,
      FLOOR(TIMESTAMP '1997-04-25 13:14:15' TO MINUTE) AS `result3`
FROM    testtable;
```

  - Test result

message	message2	message3
13:14	13:14	1997-04-25T13:14

CEIL

- **Function**

  Returns a value that rounds **timepoint** up to the time unit **timeintervalunit**.

- **Description**

```
TIME/TIMESTAMP(3) CEIL(timepoint TO timeintervalunit)
```

- **Input parameters**

Parameter	Data Types	Parameters
timepoint	TIMESTAMP /TIME	SQL time or SQL timestamp
timeintervalunit	TIMEUNIT	Time unit. The value can be **YEAR**, **QUARTER**, **MONTH**, **WEEK**, **DAY**, **DOY**, **HOUR**, **MINUTE**, or **SECOND**.

- **Example**
  - Test statement

```
SELECT
   CEIL(TIME '13:14:15' TO MINUTE) AS `result`
      CEIL(TIMESTAMP '1997-04-25 13:14:15' TO MINUTE) AS `result2`,
      CEIL(TIMESTAMP '1997-04-25 13:14:15' TO MINUTE) AS `result3`
FROM    testtable;
```

  - Test Result

result	result2	result3
13:15	13:15	1997-04-25T13:15

OVERLAPS

- **Function**

  Returns **TRUE** if two time intervals overlap; returns **FALSE** otherwise.

- **Description**

```
BOOLEAN (timepoint1, temporal1) OVERLAPS (timepoint2, temporal2)
```

- **Input parameters**

Parameter	Data Types	Parameters
timepoint1/ timepoint2	DATE/TIME/ TIMESTAMP	Time point
temporal1/ temporal2	DATE/TIME/ TIMESTAMP/ INTERVAL	Time point or interval

NOTE

- **(timepoint, temporal)** is a closed interval.
- The temporal can be of the **DATE**, **TIME**, **TIMESTAMP**, or **INTERVAL** type.
  - When th temporal is **DATE**, **TIME**, or **TIMESTAMP**, **(timepoint, temporal)** indicates an interval between **timepoint** and **temporal**. The temporal can be earlier than the value of **timepoint**, for example, **(DATE '1997-04-25', DATE '1997-04-23')**.
  - When the temporal is **INTERVAL**, **(timepoint, temporal)** indicates an interval between **timepoint** and **timepoint + temporal**.
- Ensure that **(timepoint1, temporal1)** and **(timepoint2, temporal2)** are intervals of the same data type.

- **Example**
  - Test statement

```
SELECT
    (TIME '2:55:00', INTERVAL '1' HOUR) OVERLAPS (TIME '3:30:00', INTERVAL '2' HOUR) AS
`result`,
        (TIME '2:30:00', INTERVAL '1' HOUR) OVERLAPS (TIME '3:30:00', INTERVAL '2' HOUR) AS
`result2`,
    (TIME '2:30:00', INTERVAL '1' HOUR) OVERLAPS (TIME '3:31:00', INTERVAL '2' HOUR) AS
`result3`,
    (TIME '9:00:00', TIME '10:00:00') OVERLAPS (TIME '10:00:00', INTERVAL '3' HOUR) AS
`result4`,
    (TIMESTAMP '1997-04-25 12:00:00', TIMESTAMP '1997-04-25 12:20:00') OVERLAPS
(TIMESTAMP '1997-04-25 13:00:00', INTERVAL '2' HOUR) AS `result5`,
    (DATE '1997-04-23', INTERVAL '2' DAY) OVERLAPS (DATE '1997-04-25', INTERVAL '2' DAY)
AS `result6`,
    (DATE '1997-04-25', DATE '1997-04-23') OVERLAPS (DATE '1997-04-25', INTERVAL '2' DAY)
AS `result7`
FROM
    testtable;
```

  - Test Result

result	result2	result3	result4	result5	result6	result7
true	true	false	true	false	true	true

DATE_FORMAT

- **Function**

  Converts a timestamp to a value of string in the format specified by the date format string.

- **Description**

```
STRING DATE_FORMAT(timestamp, dateformat)
```

- **Input parameters**

Parameter	Data Types	Parameters
timestamp	TIMESTAMP/ STRING	Time point
dateformat	STRING	String in the date format

- **Example**
  - Test statement

```
SELECT
    DATE_FORMAT(TIMESTAMP '1997-04-25 10:11:12', 'yyyy-MM-dd HH:mm:ss') AS `result`,
        DATE_FORMAT(TIMESTAMP '1997-04-25 10:11:12', 'yyyy-MM-dd') AS `result2`,
    DATE_FORMAT(TIMESTAMP '1997-04-25 10:11:12', 'yy/MM/dd HH:mm') AS `result3`,
        DATE_FORMAT('1997-04-25 10:11:12', 'yyyy-MM-dd') AS `result4`
FROM    testtable;
```

  - Test Result

result	result2	result3	result4
1997-04-25 10:11:12	1997-04-25	97/04/25 10:11	1997-04-25

TIMESTAMPADD

- **Function**

  Returns the date and time by combining **interval** and **timeintervalunit** and adding the combination to **timepoint**.

  NOTE

  The return value of **TIMESTAMPADD** is the value of **timepoint**. An exception is that if the input **timepoint** is of the **TIMESTAMP** type, the return value can be inserted into a table field of the **DATE** type.

- **Description**

  TIMESTAMP(3)/DATE/TIME **TIMESTAMPADD**(timeintervalunit, interval, timepoint)

- **Input parameters**

Parameter	Data Types	Parameters
timeintervalunit	TIMEUNIT	Time unit.
interval	INT	Interval
timepoint	TIMESTAMP/ DATE/TIME	Time point

- **Example**

  – Test statement

  ```
  SELECT
     TIMESTAMPADD(WEEK, 1, DATE '1997-04-25') AS `result`,
        TIMESTAMPADD(QUARTER, 1, TIMESTAMP '1997-04-25 10:11:12') AS `result2`,
     TIMESTAMPADD(SECOND, 2, TIME '10:11:12') AS `result3`
  FROM    testtable;
  ```

  – Test Result

result	result2	result3
1997-05-02	• If this field is inserted into a table field of the **TIMESTAMP** type, **1997-07-25T10:11:12** is returned. • If this field is inserted into a table field of the TIMESTAMP type, 1997-07-25 is returned.	10:11:14

TIMESTAMPDIFF

- **Function**

  Returns the (signed) number of **timepointunit** between **timepoint1** and **timepoint2**. The unit for the interval is given by the first argument.

- **Description**

  INT **TIMESTAMPDIFF**(timepointunit, timepoint1, timepoint2)

- **Input parameters**

Parameter	Data Types	Parameters
timepointunit	TIMEUNIT	Time unit. The value can be **SECOND**, **MINUTE**, **HOUR**, **DAY**, **MONTH** or **YEAR**.
timepoint1/ timepoint2	TIMESTAMP/ DATE	Time point

- **Example**

  – Test statement

```
SELECT
   TIMESTAMPDIFF(DAY, TIMESTAMP '1997-04-25 10:00:00', TIMESTAMP '1997-04-28 10:00:00')
AS `result`,
       TIMESTAMPDIFF(DAY, DATE '1997-04-25', DATE '1997-04-28') AS `result2`,
   TIMESTAMPDIFF(DAY, TIMESTAMP '1997-04-27 10:00:20', TIMESTAMP '1997-04-25 10:00:00')
AS `result3`
FROM    testtable;
```

  – Test result

result	result2	result3
3	3	-2

CONVERT_TZ

- **Function**

  Converts a datetime **string1** (with default ISO timestamp format **'yyyy-MM-dd HH:mm:ss'**) from time zone **string2** to time zone **string3**.

- **Description**

  STRING **CONVERT_TZ**(string1, string2, string3)

- **Input parameters**

Parameter	Data Types	Parameters
string1	STRING	SQL timestamp. If the value does not meet the format requirements, **NULL** is returned.

Parameter	Data Types	Parameters
string2	STRING	Time zone before conversion. The format of time zone should be either an abbreviation such as **PST**, a full name such as **America/Los_Angeles**, or a custom ID such as **GMT-08:00**.
string3	STRING	Time zone after conversion. The format of time zone should be either an abbreviation such as **PST**, a full name such as **America/Los_Angeles**, or a custom ID such as **GMT-08:00**.

- **Example**
  - Test statement

```
SELECT
   CONVERT_TZ(1970-01-01 00:00:00, UTC, America/Los_Angeles) AS `result`,
      CONVERT_TZ(1997-04-25 10:00:00, UTC, GMT-08:00) AS `result2`
FROM    testtable;
```

  - Test Result

result	result2
1969-12-31 16:00:00	1997-04-25 02:00:00

FROM_UNIXTIME

- **Function**

  Returns a representation of the **numeric** argument as a value in string format.

- **Description**

```
STRING FROM_UNIXTIME(numeric[, string])
```

- **Input parameters**

Parameter	Data Types	Parameters
numeric	BIGINT	An internal timestamp representing the number of seconds since 1970-01-01 00:00:00 UTC. The value can be generated by the **UNIX_TIMESTAMP()** function.
string	STRING	Time. If this parameter is not specified, the default time format is **yyyy-MM-dd HH:mm:ss** format.

- **Example**
  - Test statement

```
SELECT
   FROM_UNIXTIME(44) AS `result`,
      FROM_UNIXTIME(44, 'yyyy:MM:dd') AS `result2`
FROM    testtable;
```


– Test Result

result	result2
1970-01-01 08:00:44	1970:01:01

UNIX_TIMESTAMP

- **Function**

  Gets current Unix timestamp in seconds. The return value is of the **BIGINT** type.

- **Description**

```
BIGINT UNIX_TIMESTAMP()
```

- **Input parameters**

  None

- **Example**

  – Test statement

```
SELECT
  UNIX_TIMESTAMP() AS `result`
FROM
  table;
```

  – Test result

result
1635401982

UNIX_TIMESTAMP(string1[, string2])

- **Function**

  Converts date time **string1** in format **string2** to Unix timestamp (in seconds). The return value is of the **BIGINT** type.

- **Description**

```
BIGINT UNIX_TIMESTAMP(string1[, string2])
```

- **Input parameters**

Parameter	Data Types	Parameters
string1	STRING	SQL timestamp string. An error is reported if the value does not comply with the **string2** format.
string2	STRING	Time. If this parameter is not specified, the default time format is **yyyy-MM-dd HH:mm:ss**.

- **Example**

  – Test statement

```
SELECT
  UNIX_TIMESTAMP('1997-04-25', 'yyyy-MM-dd') AS `result`,
```



```
    UNIX_TIMESTAMP('1997-04-25 00:00:10', 'yyyy-MM-dd HH:mm:ss') AS `result2`,
    UNIX_TIMESTAMP('1997-04-25 00:00:00') AS `result3`
FROM
  testtable;
```

- Test result

result	result2	result3
861897600	861897610	861897600

TO_DATE

- **Function**

  Converts a date **string1** with format **string2** to a date.

- **Description**

```
DATE TO_DATE(string1[, string2])
```

- **Input parameters**

Parameter	Data Types	Parameters
string1	STRING	SQL timestamp string. If the value is not in the required format, an error is reported.
string2	STRING	Format. If this parameter is not specified, the default time format is **yyyy-MM-dd**.

- **Example**
  - Test statement

```
SELECT
  TO_DATE('1997-04-25') AS `result`,
    TO_DATE('1997:04:25', 'yyyy-MM-dd') AS `result2`,
    TO_DATE('1997-04-25 00:00:00', 'yyyy-MM-dd HH:mm:ss') AS `result3`
FROM
  testtable;
```

  - Test result

result	result2	result3
1997-04-25	1997-04-25	1997-04-25

TO_TIMESTAMP

- **Function**

  Converts date time **string1** with format **string2** to a timestamp.

- **Description**

```
TIMESTAMP TO_TIMESTAMP(string1[, string2])
```

- **Input parameters**

Parameter	Data Types	Parameters
string1	STRING	SQL timestamp string. If the value is not in the required format, **NULL** is returned.
string2	STRING	Date format. If this parameter is not specified, the default format is **yyyy-MM-dd HH:mm:ss**.

- **Example**
  - Test statement

```
SELECT
    TO_TIMESTAMP('1997-04-25', 'yyyy-MM-dd') AS `result`,
        TO_TIMESTAMP('1997-04-25 00:00:00') AS `result2`,
        TO_TIMESTAMP('1997-04-25 00:00:00', 'yyyy-MM-dd HH:mm:ss') AS `result3`
FROM
    testtable;
```

  - Test result

result	result2	result3
1997-04-25 00:00	1997-04-25 00:00	1997-04-25 00:00

3.5.2.4 Conditional Functions

Description

Table 3-53 Conditional Functions

Conditional Functions	Description
CASE value WHEN value1_1 [, value1_2]* THEN result1 [WHEN value2_1 [, value2_2]* THEN result2]* [ELSE resultZ] END	Returns **resultX** when the value is contained in (valueX_1, valueX_2, …). Only the first matched value is returned. When no value matches, returns **result_z** if it is provided and returns **NULL** otherwise.
CASE WHEN condition1 THEN result1 [WHEN condition2 THEN result2]* [ELSE resultZ] END	Returns **resultX** when the first **conditionX** is met. Only the first matched value is returned. When no condition is met, returns **result_z** if it is provided and returns **NULL** otherwise.

Conditional Functions	Description
NULLIF(value1, value2)	Returns NULL if value1 is equal to value2; returns value1 otherwise. For example, **NullIF (5, 5)** returns **NULL**. **NULLIF(5, 0)** returns **5**.
COALESCE(value1, value2 [, value3]*)	Returns the first value (from left to right) that is not NULL from value1, value2, …. For example, **COALESCE(NULL, 5)** returns **5**.
IF(condition, true_value, false_value)	Returns the **true_value** if condition is met, otherwise **false_value**. For example, **IF(5 > 3, 5, 3)** returns **5**.
IS_ALPHA(string)	Returns **TRUE** if all characters in the string are letters, otherwise **FALSE**.
IS_DECIMAL(string)	Returns **TRUE** if string can be parsed to a valid numeric, otherwise **FALSE**.
IS_DIGIT(string)	Returns **TRUE** if all characters in string are digits, otherwise **FALSE**. Otherwise, FALSE is returned.

3.5.2.5 Type Conversion Functions

Syntax

```
CAST(value AS type)
```

Description

This function is used to forcibly convert types.

Precautions

- If the input is **NULL**, **NULL** is returned.
- The **cast** function does not support converting a string to the JSON format.

Example 1: Convert the amount value to an integer.

The following example converts the **amount** value to an integer.

```
insert into temp select cast(amount as INT) from source_stream;
```


Table 3-54 Examples of type conversion functions

Example	Description	Example

cast(v1 as string)	Converts **v1** to a string. The value of **v1** can be of the numeric type or of the timestamp, date, or time type.	Table T1:
		`| content (INT) |`
		`| ---------- |`
		`| 5 |`
		Statement:
		`SELECT`
		`  cast(content as varchar)`
		`FROM`
		`  T1;`
		Result:
		`"5"`

cast (v1 as int)	Converts **v1** to the **int** type. The value of **v1** can be a number or a character.	Table T1:
		`| content (STRING) |`
		`| ---------- |`
		`| "5" |`
		Statement:
		`SELECT`
		`  cast(content as int)`
		`FROM`
		`  T1;`
		Result:
		`5`

cast(v1 as timestamp)	Converts **v1** to the **timestamp** type. The value of **v1** can be of the **string**, **date**, or **time** type.	Table T1:
		`| content (STRING) |`
		`| ---------- |`
		`| "2018-01-01 00:00:01" |`
		Statement:
		`SELECT`
		`  cast(content as timestamp)`
		`FROM`
		`  T1;`
		Result:
		`1514736001000`

cast(v1 as date)	Converts **v1** to the **date** type. The value of **v1** can be of the **string** or **timestamp** type.	Table T1:
		`| content (TIMESTAMP) |`
		`| ---------- |`
		`| 1514736001000 |`
		Statement:
		`SELECT`
		`  cast(content as date)`
		`FROM`
		`  T1;`
		Result:
		`"2018-01-01"`

NOTE

Flink jobs do not support the conversion of **bigint** to **timestamp** using CAST. You can convert it using **to_timestamp**.

Example 2:

1. Create a Flink opensource SQL job by referring to **Kafka Source Table** and **Print Result Table**, enter the following job running script, and submit the job.

   Note: When creating a job, set Flink Version to 1.12 in the Running Parameters area on the job editing page, select Save Job Log, and set the OBS bucket for saving job logs to facilitate subsequent job log viewing. Change the values of the parameters in bold in the following script according to the actual situation.

```
CREATE TABLE kafkaSource (
  cast_int_to_string int,
  cast_String_to_int string,
  case_string_to_timestamp string,
  case_timestamp_to_date timestamp
) WITH (
  'connector' = 'kafka',
  'topic' = '***KafkaTopic***',
  'properties.bootstrap.servers' = '***KafkaAddress1:KafkaPort,KafkaAddress2:KafkaPort***',
  'properties.group.id' = '***GroupId***',
  'scan.startup.mode' = 'latest-offset',
  "format" = "json"
);

CREATE TABLE printSink (
  cast_int_to_string string,
  cast_String_to_int int,
  case_string_to_timestamp timestamp,
  case_timestamp_to_date date
) WITH (
  'connector' = 'print'
);

insert into printSink select
  cast(cast_int_to_string as string),
  cast(cast_String_to_int as int),
  cast(case_string_to_timestamp as timestamp),
  cast(case_timestamp_to_date as date)
from kafkaSource;
```

2. Connect to the Kafka cluster and send the following test data to the Kafka topic:

```
{"cast_int_to_string":"1", "cast_String_to_int": "1", "case_string_to_timestamp": "2022-04-02 15:00:00",
"case_timestamp_to_date": "2022-04-02 15:00:00"}
```

3. View output.
   - Method 1:
     i. Log in to the DLI management console and choose Job Management > Flink Streaming Jobs.
     ii. Locate the row that contains the target Flink job, and choose More & > FlinkUI in the Operation column.
     iii. On the Flink UI, choose Task Managers, click the task name, and select Stdout to view the job run logs.
   - Method 2: If you select Save Job Log for Running Parameters before submitting the job, perform the following operations:
     i. Log in to the DLI management console and choose Job Management > Flink Streaming Jobs.
     ii. Click the name of the corresponding Flink job, choose Run Log, click OBS Bucket, and locate the folder of the corresponding log based on the job running date.

iii. Go to the folder of the corresponding date, find the folder whose name contains taskmanager, download the taskmanager.out file, and view the result log.

The query result is as follows:

```
+I(1,1,2022-04-02T15:00,2022-04-02)
```

3.5.2.6 Collection Functions

Description

Table 3-55 Collection functions

Collection Functions	Description
CARDINALITY(array)	Returns the number of elements in array.
array '[' integer ']'	Returns the element at position INT in array. The index starts from 1.
ELEMENT(array)	Returns the sole element of array (whose cardinality should be one) Returns **NULL** if array is empty. Throws an exception if array has more than one element.
CARDINALITY(map)	Returns the number of entries in map.
map '[' key ']'	Returns the value specified by key value in map.

3.5.2.7 Value Construction Functions

Description

Table 3-56 Value construction functions

Value Construction Functions	Description
ROW(value1, [, value2]*) (value1, [, value2]*)	Returns a row created from a list of values (value1, value2,…).
ARRAY '[' value1 [, value2]* ']'	Returns an array created from a list of values (value1, value2, …).
MAP '[' key1, value1 [, key2, value2]* ']'	Returns a map created from a list of key-value pairs ((value1, value2), (value3, value4), …). The key-value pair is (key1, value1), (key2, value2).

3.5.2.8 Value Access Functions

Description

Table 3-57 Value access functions

Function	Description
tableName.compositeType.field	Returns the value of a field from a Flink composite type (e.g., Tuple, POJO) by name.
tableName.compositeType.*	Returns a flat representation of a Flink composite type (e.g., Tuple, POJO) that converts each of its direct subtype into a separate field.

3.5.2.9 Hash Functions

Description

Table 3-58 Hash functions

Hash Functions	Description
MD5(string)	Returns the MD5 hash of string as a string of 32 hexadecimal digits. Returns **NULL** if **string** is **NULL**.
SHA1(string)	Returns the SHA-1 hash of string as a string of 40 hexadecimal digits. Returns **NULL** if **string** is **NULL**.
SHA224(string)	Returns the SHA-224 hash of string as a string of 56 hexadecimal digits. Returns **NULL** if **string** is **NULL**.
SHA256(string)	Returns the SHA-256 hash of string as a string of 64 hexadecimal digits. Returns **NULL** if **string** is **NULL**.
SHA384(string)	Returns the SHA-384 hash of string as a string of 96 hexadecimal digits. Returns **NULL** if **string** is **NULL**.
SHA512(string)	Returns the SHA-512 hash of string as a string of 128 hexadecimal digits. Returns **NULL** if **string** is **NULL**.

Hash Functions	Description
SHA2(string, hashLength)	Returns the hash using the SHA-2 family of hash functions (SHA-224, SHA-256, SHA-384, or SHA-512). The first argument string is the string to be hashed and the second argument hashLength is the bit length of the result (224, 256, 384, or 512). If either argument is NULL, the result will also be NULL.

3.5.2.10 Aggregate Functions

An aggregate function performs a calculation operation on a set of input values and returns a value. For example, the COUNT function counts the number of rows retrieved by an SQL statement. **Table 3-59** lists aggregate functions.

Table 3-59 Aggregate functions

Function	Return Type	Description
COUNT([ALL] expression | DISTINCT expression1 [, expression2]*)	BIGINT	Returns the number of input rows for which the expression is not NULL. Use DISTINCT for one unique instance of each value.
COUNT(*) COUNT(1)	BIGINT	Returns the number of input rows.
AVG([ALL | DISTINCT] expression)	DOUBLE	Returns the average (arithmetic mean) of expression across all input rows. Use DISTINCT for one unique instance of each value.
SUM([ALL | DISTINCT] expression)	DOUBLE	Returns the sum of expression across all input rows. Use DISTINCT for one unique instance of each value.
MAX([ALL | DISTINCT] expression)	DOUBLE	Returns the maximum value of expression across all input rows.
MIN([ALL | DISTINCT] expression)	DOUBLE	Returns the minimum value of expression across all input rows.
STDDEV_POP([ALL | DISTINCT] expression)	DOUBLE	Returns the population standard deviation of expression across all input rows.
STDDEV_SAMP([ALL | DISTINCT] expression)	DOUBLE	Returns the sample standard deviation of expression across all input rows.

Function	Return Type	Description
VAR_POP([ALL | DISTINCT] expression)	DOUBLE	Returns the population variance (square of the population standard deviation) of expression across all input rows.
VAR_SAMP([ALL | DISTINCT] expression)	DOUBLE	Returns the sample variance (square of the sample standard deviation) of expression across all input rows.
COLLECT([ALL | DISTINCT] expression)	MULTISET	Returns a multiset of expression across all input rows.
VARIANCE([ALL | DISTINCT] expression)	DOUBLE	Returns the sample variance (square of the sample standard deviation) of expression across all input rows.
FIRST_VALUE(expression)	Actual type	Returns the first value in an ordered set of values.
LAST_VALUE(expression)	Actual type	Returns the last value in an ordered set of values.

3.5.2.11 Table-Valued Functions

3.5.2.11.1 string_split

The **string_split** function splits a target string into substrings based on the specified separator and returns a substring list.

Description

```
string_split(target, separator)
```

Table 3-60 string_split parameters

Parameter	Data Types	Description
target	STRING	Target string to be processed **NOTE** • If **target** is **NULL**, an empty line is returned. • If **target** contains two or more consecutive separators, an empty substring is returned. • If **target** does not contain a specified separator, the original string passed to **target** is returned.

Parameter	Data Types	Description
separator	VARCHAR	Separator. Currently, only single-character separators are supported.

Example

1. Create a Flink OpenSource SQL job by referring to **Kafka Source Table** and **Print Result Table**, enter the following job running script, and submit the job.

   When you create a job, set **Flink Version** to **1.12** in the **Running Parameters** tab. Select **Save Job Log**, and specify the OBS bucket for saving job logs.
   Change the values of the parameters in bold as needed in the following script.

```
CREATE TABLE kafkaSource (
  target STRING,
  separator  VARCHAR
) WITH (
  'connector' = 'kafka',
  'topic' = '***KafkaTopic***',
  'properties.bootstrap.servers' = '***KafkaAddress1:KafkaPort,KafkaAddress2:KafkaPort***',
  'properties.group.id' = '***GroupId***',
  'scan.startup.mode' = 'latest-offset',
  "format" = "json"
);

CREATE TABLE printSink (
  target STRING,
  item STRING
) WITH (
  'connector' = 'print'
);

insert into printSink
  select target,
  item from
  kafkaSource,
  lateral table(string_split(target, separator)) as T(item);
```

2. Connect to the Kafka cluster and send the following test data to the Kafka topic:

```
{"target":"test-flink","separator":"-"}
{"target":"flink","separator":"-"}
{"target":"one-two-ww-three","separator":"-"}
```

   The data is as follows:

   Table 3-61 Test table data

target (STRING)	separator (VARCHAR)
test-flink	-
flink	-
one-two-ww-three	-

3. View output.

- Method 1:
  i. Log in to the DLI console. In the navigation pane, choose **Job Management** > **Flink Jobs**.
  ii. Locate the row that contains the target Flink job, and choose **More** > **FlinkUI** in the **Operation** column.
  iii. On the Flink UI, choose **Task Managers**, click the task name, and select **Stdout** to view job logs.
- Method 2: If you select **Save Job Log** on the **Running Parameters** tab before submitting the job, perform the following operations:
  i. Log in to the DLI console. In the navigation pane, choose **Job Management** > **Flink Jobs**.
  ii. Click the name of the corresponding Flink job, choose **Run Log**, click **OBS Bucket**, and locate the folder of the log you want to view according to the date.
  iii. Go to the folder of the date, find the folder whose name contains **taskmanager**, download the **taskmanager.out** file, and view result logs.

The query result is as follows:

```
+I(test-flink,test)
+I(test-flink,flink)
+I(flink,flink)
+I(one-two-ww-three,one)
+I(one-two-ww-three,two)
+I(one-two-ww-three,ww)
+I(one-two-ww-three,three)
```

The output data is as follows:

Table 3-62 Result table data

target (STRING)	item (STRING)
test-flink	test
test-flink	flink
flink	flink
one-two-ww-three	one
one-two-ww-three	two
one-two-ww-three	ww
one-two-ww-three	three

4 Flink Opensource SQL 1.10 Syntax Reference

4.1 Constraints and Definitions

4.1.1 Supported Data Types

STRING, BOOLEAN, BYTES, DECIMAL, TINYINT, SMALLINT, INTEGER, BIGINT, FLOAT, DOUBLE, DATE, TIME, TIMESTAMP, TIMESTAMP WITH LOCAL TIME ZONE, INTERVAL, ARRAY, MULTISET, MAP, ROW

4.1.2 Syntax Definition

4.1.2.1 Data Definition Language (DDL)

4.1.2.1.1 CREATE TABLE

Syntax

```
CREATE TABLE table_name
  (
    { <column_definition> | <computed_column_definition> }[ , ...n]
    [ <watermark_definition> ]
    [ <table_constraint> ][ , ...n]
  )
  [COMMENT table_comment]
  [PARTITIONED BY (partition_column_name1, partition_column_name2, ...)]
  WITH (key1=val1, key2=val2, ...)

<column_definition>:
  column_name column_type [ <column_constraint> ] [COMMENT column_comment]

<column_constraint>:
  [CONSTRAINT constraint_name] PRIMARY KEY NOT ENFORCED

<table_constraint>:
  [CONSTRAINT constraint_name] PRIMARY KEY (column_name, ...) NOT ENFORCED

<computed_column_definition>:
```



```
  column_name AS computed_column_expression [COMMENT column_comment]

<watermark_definition>:
  WATERMARK FOR rowtime_column_name AS watermark_strategy_expression

<source_table>:
  [catalog_name.][db_name.]table_name
```

Function

This clause is used to create a table with a specified name.

Description

COMPUTED COLUMN

A computed column is a virtual column generated using **column_name AS computed_column_expression**. A computed column evaluates an expression that can reference other columns declared in the same table. The column itself is not physically stored within the table. A computed column could be defined using **cost AS price * quantity**. This expression can contain any combination of physical columns, constants, functions, or variables, but cannot contain any subquery.

In Flink, a computed column is used to define the time attribute in **CREATE TABLE** statements. A processing time attribute can be defined easily via **proc AS PROCTIME()** using the system's **PROCTIME()** function. The event time column may be obtained from an existing field. In this case, you can use the computed column to obtain event time. For example, if the original field is not of the **TIMESTAMP(3)** type or is nested in a JSON string, you can use computed columns.

Notes:

- An expression that define a computed column in a source table is calculated after data is read from the data source. The column can be used in the **SELECT** statement.
- A computed column cannot be the target of an **INSERT** statement. In an **INSERT** statement, the schema of the **SELECT** statement must be the same as that of the target table that does not have a computed column.

WATERMARK

The **WATERMARK** clause defines the event time attribute of a table and takes the form **WATERMARK FOR rowtime_column_name AS watermark_strategy_expression**.

rowtime_column_name defines an existing column that is marked as the event time attribute of the table. The column must be of the **TIMESTAMP(3)** type and must be the top-level column in the schema. It can also be a computed column.

watermark_strategy_expression defines the watermark generation strategy. It allows arbitrary non-query expression, including computed columns, to calculate the watermark. The expression return type must be **TIMESTAMP(3)**, which represents the timestamp since the Epoch. The returned watermark will be emitted only if it is non-null and its value is larger than the previously emitted local watermark (to preserve the contract of ascending watermarks). The watermark generation expression is evaluated by the framework for every record.

The framework will periodically emit the largest generated watermark. If the current watermark is still identical to the previous one, or is null, or the value of the returned watermark is smaller than that of the last emitted one, then no new watermark will be emitted. Watermark is emitted in an interval defined by **pipeline.auto-watermark-interval** configuration. If watermark interval is 0 ms, the generated watermarks will be emitted per-record if it is not null and greater than the last emitted one.

When using event time semantics, tables must contain an event time attribute and watermarking strategy.

Flink provides several commonly used watermark strategies.

- Strictly ascending timestamps: **WATERMARK FOR rowtime_column AS rowtime_column**.

  Emits a watermark of the maximum observed timestamp so far. Rows that have a timestamp bigger to the max timestamp are not late.

- Ascending timestamps: **WATERMARK FOR rowtime_column AS rowtime_column - INTERVAL '0.001' SECOND**.

  Emits a watermark of the maximum observed timestamp so far minus 1. Rows that have a timestamp bigger or equal to the max timestamp are not late.

- Bounded out of orderness timestamps: **WATERMARK FOR rowtime_column AS rowtime_column - INTERVAL 'string' timeUnit**.

  Emits watermarks, which are the maximum observed timestamp minus the specified delay, for example, **WATERMARK FOR rowtime_column AS rowtime_column - INTERVAL '5' SECOND** is a 5 seconds delayed watermark strategy.

  ```
  CREATE TABLE Orders (
      user BIGINT,
      product STRING,
      order_time TIMESTAMP(3),
      WATERMARK FOR order_time AS order_time - INTERVAL '5' SECOND
  ) WITH ( . . . );
  ```

PRIMARY KEY

Primary key constraint is a hint for Flink to leverage for optimizations. It tells that a column or a set of columns of a table or a view are unique and they do not contain null. Neither of columns in a primary can be nullable. The primary key therefore uniquely identifies a row in a table.

Primary key constraint can be either declared along with a column definition (a column constraint) or as a single line (a table constraint). For both cases, it should only be declared as a singleton. If you define multiple primary key constraints at the same time, an exception would be thrown.

Validity Check

SQL standard specifies that a constraint can either be **ENFORCED** or **NOT ENFORCED**. This controls if the constraint checks are performed on the incoming/outgoing data. Flink does not own the data therefore the only mode we want to support is the **NOT ENFORCED** mode. It is up to the user to ensure that the query enforces key integrity.

Flink will assume correctness of the primary key by assuming that the columns nullability is aligned with the columns in primary key. Connectors should ensure those are aligned.

Notes: In a **CREATE TABLE** statement, creating a primary key constraint will alter the columns nullability, that means, a column with primary key constraint is not nullable.

PARTITIONED BY

Partition the created table by the specified columns. A directory is created for each partition if this table is used as a filesystem sink.

WITH OPTIONS

Table properties used to create a table source/sink. The properties are usually used to find and create the underlying connector.

The key and value of expression key1=val1 should both be string literal.

Notes: The table registered with CREATE TABLE statement can be used as both table source and table sink. We cannot decide if it is used as a source or sink until it is referenced in the DMLs.

4.1.2.1.2 CREATE VIEW

Syntax

```
CREATE VIEW [IF NOT EXISTS] view_name
  [{columnName [, columnName ]* }] [COMMENT view_comment]
  AS query_expression
```

Function

Create a view with multiple layers nested in it to simplify the development process.

Description

IF NOT EXISTS

If the view already exists, nothing happens.

Example

Create a view named **viewName**.

```
create view viewName as select * from dataSource
```

4.1.2.1.3 CREATE FUNCTION

Syntax

```
CREATE FUNCTION
  [IF NOT EXISTS] function_name
  AS identifier [LANGUAGE JAVA|SCALA]
```


Function

Create a user-defined function.

Description

IF NOT EXISTS

If the function already exists, nothing happens.

LANGUAGE JAVA|SCALA

Language tag is used to instruct Flink runtime how to execute the function. Currently only **JAVA** and **SCALA** are supported, the default language for a function is **JAVA**.

Example

Create a function named **STRINGBACK**.

```
create function STRINGBACK as 'com.dli.StringBack'
```

4.1.2.2 Data Manipulation Language (DML)

Statements

Syntax

```
INSERT INTO table_name [PARTITION part_spec] query

part_spec:  (part_col_name1=val1 [, part_col_name2=val2, ...])

query:
  values
  | {
      select
      | selectWithoutFrom
      | query UNION [ ALL ] query
      | query EXCEPT query
      | query INTERSECT query
    }
    [ ORDER BY orderItem [, orderItem ]* ]
    [ LIMIT { count | ALL } ]
    [ OFFSET start { ROW | ROWS } ]
    [ FETCH { FIRST | NEXT } [ count ] { ROW | ROWS } ONLY]

orderItem:
  expression [ ASC | DESC ]

select:
  SELECT [ ALL | DISTINCT ]
  { * | projectItem [, projectItem ]* }
  FROM tableExpression
  [ WHERE booleanExpression ]
  [ GROUP BY { groupItem [, groupItem ]* } ]
  [ HAVING booleanExpression ]
  [ WINDOW windowName AS windowSpec [, windowName AS windowSpec ]* ]

selectWithoutFrom:
  SELECT [ ALL | DISTINCT ]
  { * | projectItem [, projectItem ]* }

projectItem:
```



```
  expression [ [ AS ] columnAlias ]
  | tableAlias . *

tableExpression:
  tableReference [, tableReference ]*
  | tableExpression [ NATURAL ] [ LEFT | RIGHT | FULL ] JOIN tableExpression [ joinCondition ]

joinCondition:
  ON booleanExpression
  | USING '(' column [, column ]* ')'

tableReference:
  tablePrimary
  [ matchRecognize ]
  [ [ AS ] alias [ '(' columnAlias [, columnAlias ]* ')' ] ]

tablePrimary:
  [ TABLE ] [ [ catalogName . ] schemaName . ] tableName
  | LATERAL TABLE '(' functionName '(' expression [, expression ]* ')' ')'
  | UNNEST '(' expression ')'

values:
  VALUES expression [, expression ]*

groupItem:
  expression
  | '(' ')'
  | '(' expression [, expression ]* ')'
  | CUBE '(' expression [, expression ]* ')'
  | ROLLUP '(' expression [, expression ]* ')'
  | GROUPING SETS '(' groupItem [, groupItem ]* ')'

windowRef:
    windowName
  | windowSpec

windowSpec:
    [ windowName ]
    '('
    [ ORDER BY orderItem [, orderItem ]* ]
    [ PARTITION BY expression [, expression ]* ]
    [
        RANGE numericOrIntervalExpression {PRECEDING}
      | ROWS numericExpression {PRECEDING}
    ]
    ')'

matchRecognize:
      MATCH_RECOGNIZE '('
      [ PARTITION BY expression [, expression ]* ]
      [ ORDER BY orderItem [, orderItem ]* ]
      [ MEASURES measureColumn [, measureColumn ]* ]
      [ ONE ROW PER MATCH ]
      [ AFTER MATCH
            ( SKIP TO NEXT ROW
            | SKIP PAST LAST ROW
            | SKIP TO FIRST variable
            | SKIP TO LAST variable
            | SKIP TO variable )
      ]
      PATTERN '(' pattern ')'
      [ WITHIN intervalLiteral ]
      DEFINE variable AS condition [, variable AS condition ]*
      ')'

measureColumn:
      expression AS alias

pattern:
```



```
    patternTerm [ '|' patternTerm ]*

patternTerm:
    patternFactor [ patternFactor ]*

patternFactor:
    variable [ patternQuantifier ]

patternQuantifier:
      '*'
  |   '*?'
  |   '+'
  |   '+?'
  |   '?'
  |   '??'
  |   '{' { [ minRepeat ], [ maxRepeat ] } '}' ['?']
  |   '{' repeat '}'
```

Precautions

Flink SQL uses a lexical policy for identifier (table, attribute, function names) similar to Java:

- The case of identifiers is preserved whether they are quoted.
- Identifiers are matched case-sensitively.
- Unlike Java, back-ticks allow identifiers to contain non-alphanumeric characters (for example **SELECT a AS `my field` FROM t**).

String literals must be enclosed in single quotes (for example, **SELECT'Hello World'**). Two single quotation marks are used for escaping (for example, **SELECT'It''s me.'**). Unicode characters are supported in string literals. If explicit Unicode points are required, use the following syntax:

- Use the backslash (\) as escaping character (default): **SELECT U&'\263A'**
- Use a custom escaping character: **SELECT U&'#263A' UESCAPE '#'**

4.2 Flink OpenSource SQL 1.10 Syntax

This section describes the Flink OpenSource SQL syntax supported by DLI. For details about the parameters and examples, see the syntax description.

Creating Tables

Table 4-1 Syntax for creating tables

Classification	Function
Creating a Source Table	Kafka Source Table
	DIS Source Table
	JDBC Source Table
	GaussDB(DWS) Source Table
	Redis Source Table
	HBase Source Table

Classification	Function
	userDefined Source Table
Creating a Result Table	ClickHouse Result Table
	Kafka Result Table
	Upsert Kafka Result Table
	DIS Result Table
	JDBC Result Table
	GaussDB(DWS) Result Table
	Redis Result Table
	SMN Result Table
	HBase Result Table
	Elasticsearch Result Table
	User-defined Result Table
Creating a Dimension Table	JDBC Dimension Table
	GaussDB(DWS) Dimension Table
	HBase Dimension Table

4.3 Data Definition Language (DDL)

4.3.1 Creating a Source Table

4.3.1.1 Kafka Source Table

Function

Create a source stream to obtain data from Kafka as input data for jobs.

Apache Kafka is a fast, scalable, and fault-tolerant distributed message publishing and subscription system. It delivers high throughput and built-in partitions and provides data replicas and fault tolerance. Apache Kafka is applicable to scenarios of handling massive messages.

Prerequisites

Kafka is an offline cluster. You have built an enhanced datasource connection to connect Flink jobs to Kafka. You have set security group rules as required.

Precautions

SASL_SSL cannot be enabled for the interconnected Kafka cluster.

Syntax

```
create table kafkaSource(
  attr_name attr_type
  (',' attr_name attr_type)*
  (',PRIMARY KEY (attr_name, ...) NOT ENFORCED)
  (',' WATERMARK FOR rowtime_column_name AS watermark-strategy_expression)
)
with (
  'connector.type' = 'kafka',
  'connector.version' = '',
  'connector.topic' = '',
  'connector.properties.bootstrap.servers' = '',
  'connector.properties.group.id' = '',
  'connector.startup-mode' = '',
  'format.type' = ''
);
```

Parameters

Table 4-2 Parameter description

Parameter	Mandatory	Description
connector.type	Yes	Connector type. Set this parameter to **kafka**.
connector.version	Yes	Kafka version. The value can be '**0.10**' or '**0.11**', which corresponds to Kafka 2.11 to 2.4.0 and other historical versions, respectively.
format.type	Yes	Data deserialization format. The value can be **csv**, **json**, or **avro**.
format.field-delimiter	No	Attribute delimiter. You can customize the attribute delimiter only when the encoding format is CSV. The default delimiter is a comma (,).
connector.topic	Yes	Kafka topic name. Either this parameter or **connector.topic-pattern** is used.
connector.topic-pattern	No	Regular expression for matching the Kafka topic name. Either this parameter or **connector.topic** is used. Example: 'topic.*' '(topic-c|topic-d)' '(topic-a|topic-b|topic-\\d*)' '(topic-a|topic-b|topic-[0-9]*)'

Parameter	Mandatory	Description
connector.properties.bootstrap.servers	Yes	Kafka broker addresses. Use commas (,) to separated them.
connector.properties.group.id	No	Consumer group name
connector.startup-mode	No	Consumer startup mode. The value can be **earliest-offset**, **latest-offset**, **group-offsets**, **specific-offsets** or **timestamp**. The default value is **group-offsets**.
connector.specific-offsets	No	Consumption offset. This parameter is mandatory when **startup-mode** is **specific-offsets**. The value is in the 'partition:0,offset:42;partition:1,offset:300' format.
connector.startup-timestamp-millis	No	Consumption start timestamp. This parameter is mandatory when **startup-mode** is **timestamp**.
connector.properties.*	No	Native Kafka property

Example

- Create table **kafkaSource** and read data encoded in CSV format from Kafka.

```
create table kafkaSource(
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_speed INT)
with (
  'connector.type' = 'kafka',
  'connector.version' = '0.11',
  'connector.topic' = 'test-topic',
  'connector.properties.bootstrap.servers' = 'xx.xx.xx.xx:9092',
  'connector.properties.group.id' = 'test-group',
  'connector.startup-mode' = 'latest-offset',
  'format.type' = 'csv'
);
```

- Create table **kafkaSource** and read data in non-nested JSON strings from Kafka.

  Assume that the non-nested JSON strings are as follows:

```
{"car_id": 312, "car_owner": "wang", "car_brand": "tang"}
{"car_id": 313, "car_owner": "li", "car_brand": "lin"}
{"car_id": 314, "car_owner": "zhao", "car_brand": "han"}
```

  You can create the table as follows:

```
create table kafkaSource(
  car_id STRING,
  car_owner STRING,
  car_brand STRING
)
with (
  'connector.type' = 'kafka',
  'connector.version' = '0.11',
```



```
  'connector.topic' = 'test-topic',
  'connector.properties.bootstrap.servers' = 'xx.xx.xx.xx:9092',
  'connector.properties.group.id' = 'test-group',
  'connector.startup-mode' = 'latest-offset',
  'format.type' = 'json'
);
```

- Create table **kafkaSource** and read the nested JSON data from Kafka.

  Assume that the JSON data is as follows:

  ```
  {
      "id":"1",
      "type":"online",
      "data":{
          "patient_id":1234,
          "name":"bob1234",
          "age":"Bob",
          "gmt_create":"Bob",
          "gmt_modify":"Bob"
      }
  }
  ```

  You can create the table as follows:

  ```
  CREATE table kafkaSource(
    id STRING,
    type STRING,
    data ROW(
      patient_id STRING,
      name STRING,
      age STRING,
      gmt_create STRING,
      gmt_modify STRING)
  )
  with (
    'connector.type' = 'kafka',
    'connector.version' = '0.11',
    'connector.topic' = 'test-topic',
    'connector.properties.bootstrap.servers' = 'xx.xx.xx.xx:9092',
    'connector.properties.group.id' = 'test-group',
    'connector.startup-mode' = 'latest-offset',
    'format.type' = 'json'
  );
  ```

4.3.1.2 DIS Source Table

Function

Create a source stream to read data from DIS. DIS accesses user data and Flink job reads data from the DIS stream as input data for jobs. Flink jobs can quickly remove data from producers using DIS source sources for continuous processing. Flink jobs are applicable to scenarios where data outside the cloud service is imported to the cloud service for filtering, real-time analysis, monitoring reports, and dumping.

DIS addresses the challenge of transmitting data outside cloud services to cloud services. DIS builds data intake streams for custom applications capable of processing or analyzing streaming data. DIS continuously captures, transmits, and stores terabytes of data from hundreds of thousands of sources every hour, such as logs, Internet of Things (IoT) data, social media feeds, website clickstreams, and location-tracking events. For more information about DIS, see the .

Syntax

```
create table disSource (
  attr_name attr_type
```



```
  (',' attr_name attr_type)*
  (','PRIMARY KEY (attr_name, ...) NOT ENFORCED)
  (',' watermark for rowtime_column_name as watermark-strategy_expression)
)
with (
  'connector.type' = 'dis',
  'connector.region' = '',
  'connector.channel' = '',
  'format-type' = ''
);
```

Parameters

Table 4-3 Parameter description

Parameter	Mandatory	Description
connector.type	Yes	Data source type. Set this parameter to **dis**.
connector.region	Yes	Region where DIS for storing the data locates.
connector.ak	No	Access key ID. This parameter must be set in pair with **sk**.
connector.sk	No	Secret access key. This parameter must be set in pair with **ak**.
connector.channel	Yes	Name of the DIS stream where data is located.
connector.partition-count	No	Number of partitions where data will be read. Data in partition 0 to **partition-count** will be read. Neither this parameter or **partition-range** can be configured. If neither of the two parameters is set, all partition data will be read by default.
connector.partition-range	No	Range of partitions where data will be read. Neither this parameter or **partition-count** can be configured. If neither of the two parameters is set, all partition data will be read by default. For example, if you set **partition-range** to **[0:2]**, data in partitions 1, 2, and 3 will be read. The range must be within the DIS stream.
connector.offset	No	Start position from which data will be read. Either this parameter or **start-time** can be configured.

Parameter	Mandatory	Description
connector.start-time	No	Time from which DLI reads data If this parameter is specified, DLI reads data read from the specified time. The format is **yyyy-MM-dd HH:mm:ss**. If neither **start-time** nor **offset** is specified, the latest data is read.
connector. enable-checkpoint	No	Whether to enable the checkpoint function. The value can be **true** (enabled) or **false** (disabled). The default value is **false**. Do not set this parameter when **offset** or **start-time** is set. If this parameter is set to **true**, **checkpoint-app-name** must be configured.
connector. checkpoint-app-name	No	ID of a DIS consumer. If a DIS stream is consumed by different jobs, you need to configure the consumer ID for each job to avoid checkpoint confusion. Do not set this parameter when **offset** or **start-time** is set. If **checkpoint-app-name** is set to **true**, this parameter is mandatory.
connector. checkpoint-interval	No	Interval of checkpoint operations on the DIS source operator. The default value is **60s**. Available value units: d, day/h, hour/min, minute/s, sec, second Do not set this parameter when **offset** or **start-time** is configured.
format.type	Yes	Data coding format. The value can be **csv** or **json**.
format.field-delimiter	No	Attribute delimiter. You can customize the attribute delimiter only when the encoding format is CSV. The default delimiter is a comma (,).

Precautions

None

Example

```
create table disCsvSource (
  car_id STRING,
  car_owner STRING,
  car_age INT,
  average_speed INT,
  total_miles INT)
with (
```



```
  'connector.type' = 'dis',
  'connector.region' = '',
  'connector.channel' = 'disInput',
  'format.type' = 'csv'
);
```

4.3.1.3 JDBC Source Table

Function

The JDBC connector is a Flink's built-in connector to read data from a database.

Prerequisites

- An enhanced datasource connection with the database has been established, so that you can configure security group rules as required.

Syntax

```
create table jbdcSource (
  attr_name attr_type
  (',' attr_name attr_type)*
  (','PRIMARY KEY (attr_name, ...) NOT ENFORCED)
  (',' watermark for rowtime_column_name as watermark-strategy_expression)
)
with (
  'connector.type' = 'jdbc',
  'connector.url' = '',
  'connector.table' = '',
  'connector.username' = '',
  'connector.password' = ''
);
```

Parameters

Table 4-4 Parameter description

Parameter	Mandatory	Description
connector.type	Yes	Data source type. Set this parameter to **jdbc**.
connector.url	Yes	Database URL
connector.table	Yes	Name of the table where the data to be read from the database is located
connector.driver	No	Driver required for connecting to the database If you do not set this parameter, the automatically extracted URL will be used.
connector.username	No	Database authentication username. This parameter must be configured in pair with **connector.password**.

Parameter	Mandatory	Description
connector.password	No	Database authentication password. This parameter must be configured in pair with **connector.username**.
connector.read.partition.column	No	Name of the column used to partition the input This parameter is mandatory if **connector.read.partition.lower-bound**, **connector.read.partition.upper-bound**, and **connector.read.partition.num** are configured.
connector.read.partition.lower-bound	No	Lower bound of values to be fetched for the first partition This parameter is mandatory if **connector.read.partition.column**, **connector.read.partition.upper-bound**, and **connector.read.partition.num** are configured.
connector.read.partition.upper-bound	No	Upper bound of values to be fetched for the last partition This parameter is mandatory if **connector.read.partition.column**, **connector.read.partition.lower-bound**, and **connector.read.partition.num** are configured.
connector.read.partition.num	No	Number of partitions to be created This parameter is mandatory if **connector.read.partition.column**, **connector.read.partition.upper-bound**, and **connector.read.partition.upper-bound** are configured.
connector.read.fetch-size	No	Number of rows fetched from the database each time The default value is **0**, indicating the hint is ignored.

Precautions

None

Example

```
create table jdbcSource (
  car_id STRING,
  car_owner STRING,
  car_age INT,
  average_speed INT,
```



```
  total_miles INT)
with (
  'connector.type' = 'jdbc',
  'connector.url' = 'jdbc:mysql://xx.xx.xx.xx:3306/xx',
  'connector.table' = 'jdbc_table_name',
  'connector.driver' = 'com.mysql.jdbc.Driver',
  'connector.username' = 'xxx',
  'connector.password' = 'xxxxxx'
);
```

4.3.1.4 GaussDB(DWS) Source Table

Function

DLI reads data of Flink jobs from GaussDB(DWS). GaussDB(DWS) database kernel is compliant with PostgreSQL. The PostgreSQL database can store data of more complex types and delivers space information services, multi-version concurrent control (MVCC), and high concurrency. It applies to location applications, financial insurance, and e-commerce.

GaussDB(DWS) is an online data processing database based on the cloud infrastructure and platform and helps you mine and analyze massive sets of data.

Prerequisites

- Ensure that you have created a GaussDB(DWS) cluster using your account.

  For details about how to create a GaussDB(DWS) cluster, see "Creating a Cluster" in *Data Warehouse Service Management Guide*.
- A GaussDB(DWS) database table has been created.
- An enhanced datasource connection has been created for DLI to connect to GaussDB(DWS) clusters, so that jobs can run on the dedicated queue of DLI and you can set the security group rules as required.

Syntax

```
create table dwsSource (
  attr_name attr_type
  (',' attr_name attr_type)*
  (','PRIMARY KEY (attr_name, ...) NOT ENFORCED)
  (',' watermark for rowtime_column_name as watermark-strategy_expression)
)
with (
  'connector.type' = 'gaussdb',
  'connector.url' = '',
  'connector.table' = '',
  'connector.username' = '',
  'connector.password' = ''
);
```


Parameters

Table 4-5 Parameter description

Parameter	Mandatory	Description
connector.type	Yes	Connector type. Set this parameter to **gaussdb**.
connector.url	Yes	JDBC connection address. The format is jdbc:postgresql://${ip}:${port}/${dbName}. If the database version is later than 8.1.0, the value format is jdbc:gaussdb://${ip}:${port}/${dbName}.
connector.table	Yes	Name of the table to be operated. If the GaussDB(DWS) table is in a schema, the format is **schema\".\"***Table name*. For details, see the **Example**.
connector.driver	No	JDBC connection driver. The default value is **org.postgresql.Driver**. If the database version is later than 8.1.0, the value is **com.huawei.gauss200.jdbc.Driver**.
connector.username	No	Database authentication user name. This parameter must be configured in pair with **connector.password**.
connector.password	No	Database authentication password. This parameter must be configured in pair with **connector.username**.
connector.read.partition.column	No	Name of the column used to partition the input This parameter is mandatory if **connector.read.partition.lower-bound**, **connector.read.partition.upper-bound**, and **connector.read.partition.num** are configured.
connector.read.partition.lower-bound	No	Lower bound of values to be fetched for the first partition This parameter is mandatory if **connector.read.partition.column**, **connector.read.partition.upper-bound**, and **connector.read.partition.num** are configured.
connector.read.partition.upper-bound	No	Upper bound of values to be fetched for the last partition This parameter is mandatory if **connector.read.partition.column**, **connector.read.partition.lower-bound**, and **connector.read.partition.num** are configured.

Parameter	Mandatory	Description
connector.read.partition.num	No	Number of partitions to be created This parameter is mandatory if **connector.read.partition.column**, **connector.read.partition.upper-bound**, and **connector.read.partition.upper-bound** are configured.
connector.read.fetch-size	No	Number of rows fetched from the database each time The default value is **0**, indicating the hint is ignored.

Example

- If you use the gsjdbc4 driver for connection, set **connector.driver** to **org.postgresql.Driver**. You can omit this parameter because the gsjdbc4 driver is the default one.

  Create table **dwsSource** with data fetched from the **car_info** table that is not in a schema:

  ```
  create table dwsSource(
    car_id STRING,
    car_owner STRING,
    car_brand STRING,
    car_speed INT
  ) with (
    'connector.type' = 'gaussdb',
    'connector.url' = 'jdbc:postgresql://xx.xx.xx.xx:8000/xx',
    'connector.table' = 'car_info',
    'connector.username' = 'xx',
    'connector.password' = 'xx'
  );
  ```

  Create table **dwsSource** with data fetched from GaussDB(DWS) table **test** that is in a schema named **test_schema**:

  ```
  create table dwsSource(
    car_id STRING,
    car_owner STRING,
    car_brand STRING,
    car_speed INT
  ) with (
    'connector.type' = 'gaussdb',
    'connector.url' = 'jdbc:postgresql://xx.xx.xx.xx:8000/xx',
    'connector.table' = 'test_schema\".\"test',
    'connector.username' = 'xx',
    'connector.password' = 'xx'
  );
  ```

- If you use the gsjdbc200 driver for connection, set **connector.driver** to **com.huawei.gauss200.jdbc.Driver**.

  Create table **dwsSource** with data fetched from GaussDB(DWS) table **test** that is in a schema named **ads_game_sdk_base**:

  ```
  create table dwsSource(
    car_id STRING,
    car_owner STRING,
    car_brand STRING,
    car_speed INT
  ) with (
  ```



```
  'connector.type' = 'gaussdb',
  'connector.table' = 'ads_game_sdk_base\".\"test',
  'connector.driver' = 'com.huawei.gauss200.jdbc.Driver',
  'connector.url' = 'jdbc:gaussdb://xx.xx.xx.xx:8000/xx',
  'connector.username' = 'xx',
  'connector.password' = 'xx'
);
```

4.3.1.5 Redis Source Table

Function

Create a source stream to obtain data from Redis as input for jobs.

Prerequisites

An enhanced datasource connection with Redis has been established, so that you can configure security group rules as required.

Syntax

```
create table dwsSource (
  attr_name attr_type
  (',' attr_name attr_type)*
  (',' watermark for rowtime_column_name as watermark-strategy_expression)
)
with (
  'connector.type' = 'redis',
  'connector.host' = '',
  'connector.port' = ''
);
```

Parameters

Table 4-6 Parameter description

Parameter	Mandatory	Description
connector.type	Yes	Connector type. Set this parameter to **redis**.
connector.host	Yes	Redis connector address
connector.port	Yes	Redis connector port
connector.password	No	Redis authentication password
connector.deploy-mode	No	Redis deployment mode. The value can be **standalone** or **cluster**. The default value is **standalone**.

Parameter	Mandatory	Description
connector.table-name	No	Name of the table stored in the Redis. This parameter is mandatory in the Redis Hashmap storage pattern. In this pattern, data is stored to Redis in hashmaps. The hash key is **${table-name}:${ext-key}**, and the field name is the column name. **NOTE** Table storage pattern: **connector.table-name** and **connector.key-column** are used as Redis keys. For the Redis hash type, each key corresponds to a hashmap. A hash key is a field name of the source table, and a hash value is a field value of the source table.
connector.use-internal-schema	No	Whether to use the existing schema in the Redis. This parameter is optional in the Redis Hashmap storage pattern. The default value is **false**.
connector.key-column	No	This parameter is optional in table storage pattern. The value is used as the value of ext-key in the Redis. If this parameter is not set, the value of ext-key is the generated UUID.

Example

Reads data from Redis.

```
create table redisSource(
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_speed INT
) with (
 'connector.type' = 'redis',
  'connector.host' = 'xx.xx.xx.xx',
  'connector.port' = '6379',
  'connector.password' = 'xx',
  'connector.table-name' = 'car_info'
);
```

4.3.1.6 HBase Source Table

Function

Create a source stream to obtain data from HBase as input for jobs. HBase is a column-oriented distributed cloud storage system that features enhanced reliability, excellent performance, and elastic scalability. It applies to the storage of massive amounts of data and distributed computing. You can use HBase to build a storage system capable of storing TB- or even PB-level data. With HBase, you can filter and analyze data with ease and get responses in milliseconds, rapidly mining data value. DLI can read data from HBase for filtering, analysis, and data dumping.

Prerequisites

- An enhanced datasource connection has been created for DLI to connect to HBase, so that jobs can run on the dedicated queue of DLI and you can set the security group rules as required.
- **If MRS HBase is used, IP addresses of all hosts in the MRS cluster have been added to host information of the enhanced datasource connection.**

  .

Syntax

```
create table hbaseSource (
  attr_name attr_type
  (',' attr_name attr_type)*
  (',' watermark for rowtime_column_name as watermark-strategy_expression)
)
with (
  'connector.type' = 'hbase',
  'connector.version' = '1.4.3',
  'connector.table-name' = '',
  'connector.zookeeper.quorum' = ''
);
```

Parameters

Table 4-7 Parameter description

Parameter	Mandatory	Description
connector.type	Yes	Connector type. Set this parameter to **hbase**.
connector.version	Yes	The value must be **1.4.3**.
connector.table-name	Yes	HBase table name
connector.zookeeper.quorum	Yes	ZooKeeper address
connector.zookeeper.znode.parent	No	Root directory for ZooKeeper. The default value is **/hbase**.

Parameter	Mandatory	Description
connector.rowkey	No	Content of a compound rowkey to be assigned. The content is assigned to a new field based on the configuration. Example: rowkey1:3,rowkey2:3,... The value 3 indicates the first three bytes of the field. The number cannot be greater than the byte size of the field and cannot be less than 1. **rowkey1:3,rowkey2:3** indicates that the first three bytes of the compound rowkey are assigned to **rowkey1**, and the last three bytes are assigned to **rowkey2**.

Example

```
create table hbaseSource(
  rowkey1 string,
  rowkey2 string,
  info Row<owner string>,
  car ROW<miles string, speed string>
 ) with (
  'connector.type' = 'hbase',
  'connector.version' = '1.4.3',
  'connector.table-name' = 'carinfo',
  'connector.rowkey' = 'rowkey1:1,rowkey2:3',
  'connector.zookeeper.quorum' = 'xxxx:2181'
 );
```

4.3.1.7 userDefined Source Table

Function

You can call APIs to obtain data from the cloud ecosystem or an open source ecosystem and use the obtained data as input of Flink jobs.

Prerequisites

The customized source class needs to inherit the **RichParallelSourceFunction** class and specify the data type as Row.

For example, run **public class MySource extends RichParallelSourceFunction<Row>{}** to declare custom class **MySource**. You need to implement the **open**, **run**, **close**, and **cancel** functions. Encapsulate the class into a JAR file and upload the file through the UDF JAR on the SQL editing page.

Content of the dependent pom configuration file is as follows:

```
<dependency>
   <groupId>org.apache.flink</groupId>
   <artifactId>flink-streaming-java_2.11</artifactId>
   <version>${flink.version}</version>
   <scope>provided</scope>
```



```
</dependency>

<dependency>
    <groupId>org.apache.flink</groupId>
    <artifactId>flink-core</artifactId>
    <version>${flink.version}</version>
    <scope>provided</scope>
</dependency>
```

Syntax

```
create table userDefinedSource (
  attr_name attr_type
  (',' attr_name attr_type)*
)
with (
  'connector.type' = 'user-defined',
  'connector.class-name' = ''
);
```

Parameters

Table 4-8 Parameter description

Parameter	Mandatory	Description
connector.type	Yes	Source type. The value can only be **user-defined**, indicating a custom source.
connector.class-name	Yes	Fully qualified class name of the source class
connector.class-parameter	No	Parameter of the constructor of the source class. Only one parameter of the string type is supported.

Precautions

connector.class-name must be a fully qualified class name.

Example

```
create table userDefinedSource (
  attr1 int,
  attr2 int
)
with (
  'connector.type' = 'user-defined',
  'connector.class-name' = 'xx.xx.MySource'
);
```

4.3.2 Creating a Result Table

4.3.2.1 ClickHouse Result Table

Function

DLI exports Flink job data to ClickHouse result tables.

ClickHouse is a column-based database oriented to online analysis and processing. It supports SQL query and provides good query performance. The aggregation analysis and query performance based on large and wide tables is excellent, which is one order of magnitude faster than other analytical databases.

Prerequisites

- Ensure your jobs run on an exclusive queue (non-shared queue) of DLI.
- You have established an enhanced datasource connection to ClickHouse and set the port in the security group rule of the ClickHouse cluster as needed.

  For details about how to set up an enhanced datasource connection. For details, see "Enhanced Datasource Connection" in the *Data Lake Insight User Guide*.

Precautions

- When you create a ClickHouse cluster for MRS, set the cluster version to MRS 3.1.0 and do not enable Kerberos authentication.
- Do not define a primary key in Flink SQL statements. Do not use any syntax that generates primary keys, such as **insert into clickhouseSink select id, cout(*) from sourceName group by id**.
- Flink supports the following data types: string, tinyint, smallint, int, long, float, double, date, timestamp, decimal, and Array.

  The array supports only the int, bigint, string, float, and double data types.

Syntax

```
create table clickhouseSink (
  attr_name attr_type
  (',' attr_name attr_type)*
)
with (
  'connector.type' = 'clickhouse',
  'connector.url' = '',
  'connector.table' = ''
);
```

Parameters

Table 4-9 Parameter description

Parameter	Mandatory	Description
connector.type	Yes	Result table type. Set this parameter to **clickhouse**.

Parameter	Mandatory	Description
connector.url	Yes	ClickHouse URL. Parameter format: **jdbc:clickhouse://** *ClickHouseBalancer instance IP address*:*HTTP port number for ClickHouseBalancer instances*/*Database name* • IP address of a ClickHouseBalancer instance: Log in to the MRS management console, click a cluster name, and choose **Components** > **ClickHouse** > **Instance** to obtain the service IP address of the ClickHouseBalancer instance. • HTTP port of a ClickHouseBalancer instance: Log in to the MRS management console, click the target cluster name. On the displayed page, choose **Components** > **ClickHouse**. In the **Service Configuration** tab, choose **ClickHouseBalancer** from the **All Roles** dropdown list and search for **lb_http_port** to configure the parameter. The default value is **21425**. • The database name is the name of the database created for the ClickHouse cluster.
connector.table	Yes	Name of the ClickHouse table to be created
connector.driver	No	Driver required for connecting to the database • If this parameter is not specified during table creation, the driver automatically extracts the value from the ClickHouse URL. • If this parameter is specified during table creation, the value must be **ru.yandex.clickhouse.ClickHouseDriver**.
connector.username	No	Account for connecting the ClickHouse database
connector.password	No	Password for accessing the ClickHouse database
connector.write.flush.max-rows	No	Maximum number of rows to be updated when data is written. The default value is **5000**.
connector.write.flush.interval	No	Interval for data update. The unit can be ms, milli, millisecond/s, sec, second/min or minute.
connector.write.max-retries	No	Maximum number of attempts to write data if failed. The default value is **3**.

Example

Read data from a DIS table and insert the data into the **test** table of ClickHouse database **flinktest**.

1. Create a DIS source table **disSource**.

```
create table disSource(
  attr0 string,
  attr1 TINYINT,
  attr2 smallint,
  attr3 int,
  attr4 bigint,
  attr5 float,
  attr6 double,
  attr7 String,
  attr8 string,
  attr9 timestamp(3),
  attr10 timestamp(3),
  attr11 date,
  attr12 decimal(38, 18),
  attr13 decimal(38, 18)
) with (
  "connector.type" = "dis",
  "connector.region" = "cn-xxxx-x",
  "connector.channel" = "xxxx",
  "format.type" = 'csv'
);
```

2. Create ClickHouse result table **clickhouse** and insert the data from the **disSource** table to the result table.

```
create table clickhouse(
  attr0 string,
  attr1 TINYINT,
  attr2 smallint,
  attr3 int,
  attr4 bigint,
  attr5 float,
  attr6 double,
  attr7 String,
  attr8 string,
  attr9 timestamp(3),
  attr10 timestamp(3),
  attr11 date,
  attr12 decimal(38, 18),
  attr13 decimal(38, 18),
  attr14 array < int >,
  attr15 array < bigint >,
  attr16 array < float >,
  attr17 array < double >,
  attr18 array < varchar >,
  attr19 array < String >
) with (
  'connector.type' = 'clickhouse',
  'connector.url' = 'jdbc:clickhouse://xx.xx.xx.xx:xx/flinktest',
  'connector.table' = 'test'
);

insert into
  clickhouse
select
  attr0,
  attr1,
  attr2,
  attr3,
  attr4,
  attr5,
  attr6,
  attr7,
  attr8,
```



```
  attr9,
  attr10,
  attr11,
  attr12,
  attr13,
  array [attr3, attr3+1],
  array [cast(attr4 as bigint), cast(attr4+1 as bigint)],
  array [cast(attr12 as float), cast(attr12+1 as float)],
  array [cast(attr13 as double), cast(attr13+1 as double)],
  array ['TEST1', 'TEST2'],
  array [attr7, attr7]
from
  disSource;
```

4.3.2.2 Kafka Result Table

Function

DLI exports the output data of the Flink job to Kafka.

Apache Kafka is a fast, scalable, and fault-tolerant distributed message publishing and subscription system. It delivers high throughput and built-in partitions and provides data replicas and fault tolerance. Apache Kafka is applicable to scenarios of handling massive messages.

Prerequisites

Kafka is an offline cluster. You have built an enhanced datasource connection to connect Flink jobs to Kafka. You have set security group rules as required.

Precautions

SASL_SSL cannot be enabled for the interconnected Kafka cluster.

Syntax

```
create table kafkaSource(
  attr_name attr_type
  (',' attr_name attr_type)*
  (',PRIMARY KEY (attr_name, ...) NOT ENFORCED)
)
with (
  'connector.type' = 'kafka',
  'connector.version' = '',
  'connector.topic' = '',
  'connector.properties.bootstrap.servers' = '',
  'format.type' = ''
);
```

Parameters

Table 4-10 Parameter description

Parameter	Mandatory	Description
connector.type	Yes	Connector type. Set this parameter to **kafka**.

Parameter	Mandatory	Description
connector.version	No	Kafka version. The value can be '**0.10**' or '**0.11**', which corresponds to Kafka 2.11 to 2.4.0 and other historical versions, respectively.
format.type	Yes	Data serialization format. The value can be **csv**, **json**, or **avro**.
format.field-delimiter	No	Attribute delimiter. You can customize the attribute delimiter only when the encoding format is CSV. The default delimiter is a comma (,).
connector.topic	Yes	Kafka topic name.
connector.properties.bootstrap.servers	Yes	Kafka broker addresses. Use commas (,) to separated them.
connector.sink-partitioner	No	Partitioner type. The value can be **fixed**, **round-robin**, or **custom**.
connector.sink-partitioner-class	No	Custom partitioner. This parameter is mandatory when **sink-partitioner** is **custom**, for example, **org.mycompany.MyPartitioner**.
update-mode	No	Data update mode. Three write modes are supported: **append**, **retract**, and **upsert**.
connector.properties.*	No	Native properties of Kafka

Example

Output the data in **kafkaSink** to Kafka.

```
create table kafkaSink(
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_speed INT)
with (
  'connector.type' = 'kafka',
  'connector.version' = '0.10',
  'connector.topic' = 'test-topic',
  'connector.properties.bootstrap.servers' = 'xx.xx.xx.xx:9092',
  'connector.sink-partitioner' = 'round-robin',
  'format.type' = 'csv'
);
```

4.3.2.3 Upsert Kafka Result Table

Function

DLI exports the output data of the Flink job to Kafka in upsert mode.

Apache Kafka is a fast, scalable, and fault-tolerant distributed message publishing and subscription system. It delivers high throughput and built-in partitions and

provides data replicas and fault tolerance. Apache Kafka is applicable to scenarios of handling massive messages.

Prerequisites

Kafka is an offline cluster. You have built an enhanced datasource connection to connect Flink jobs to Kafka. You have set security group rules as required.

Precautions

SASL_SSL cannot be enabled for the interconnected Kafka cluster.

Syntax

```
create table kafkaSource(
  attr_name attr_type
  (',' attr_name attr_type)*
  (','PRIMARY KEY (attr_name, ...) NOT ENFORCED)
)
with (
  'connector.type' = 'upsert-kafka',
  'connector.version' = '',
  'connector.topic' = '',
  'connector.properties.bootstrap.servers' = '',
   'format.type' = ''
);
```

Parameters

Table 4-11 Parameter description

Parameter	Mandatory	Description
connector.type	Yes	Connector type. Set this parameter to **upsert-kafka**.
connector.version	No	Kafka version. The value can only be **0.11**.
format.type	Yes	Data serialization format. The value can be **csv**, **json**, or **avro**.
connector.topic	Yes	Kafka topic name
connector.properties.bootstrap.servers	Yes	Kafka broker addresses. Use commas (,) to separated them.
connector.sink-partitioner	No	Partitioner type. The value can be **fixed**, **round-robin**, or **custom**.

Parameter	Mandatory	Description
connector.sink-partitioner-class	No	Custom partitioner. This parameter is mandatory when **sink-partitioner** is **custom**, for example, **org.mycompany.MyPartitioner**.
connector.sink.ignore-retraction	No	Whether to ignore the retraction message. The default value is **false**, indicating that the retraction message is written to Kafka as **null**.
update-mode	No	Data update mode. Three write modes are supported: **append**, **retract**, and **upsert**.
connector.properties.*	No	Native properties of Kafka

Example

```
create table upsertKafkaSink(
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_speed INT,
  primary key (car_id) not enforced
)
with (
  'connector.type' = 'upsert-kafka',
  'connector.version' = '0.11',
  'connector.topic' = 'test-topic',
  'connector.properties.bootstrap.servers' = 'xx.xx.xx.xx:9092',
  'format.type' = 'csv'
);
```

4.3.2.4 DIS Result Table

Function

DLI writes the Flink job output data into DIS. The data is filtered and imported to the DIS stream for future processing.

DIS addresses the challenge of transmitting data outside cloud services to cloud services. DIS builds data intake streams for custom applications capable of processing or analyzing streaming data. DIS continuously captures, transmits, and stores terabytes of data from hundreds of thousands of sources every hour, such as logs, Internet of Things (IoT) data, social media feeds, website clickstreams, and location-tracking events. For more information about DIS, see the *Data Ingestion Service User Guide*.

Syntax

```
create table disSink (
  attr_name attr_type
  (',' attr_name attr_type)*
```



```
  (','PRIMARY KEY (attr_name, ...) NOT ENFORCED)
)
with (
  'connector.type' = 'dis',
  'connector.region' = '',
  'connector.channel' = '',
  'format.type' = ''
);
```

Parameters

Table 4-12 Parameter description

Parameter	Mandatory	Description
connector.type	Yes	Data source type. Set this parameter to **dis**.
connector.region	Yes	Region where DIS for storing the data locates.
connector.ak	No	Access key ID. This parameter must be set in pair with **sk**.
connector.sk	No	Secret access key. This parameter must be set in pair with **ak**.
connector.channel	Yes	Name of the DIS stream where data is located.
format.type	Yes	Data coding format. The value can be **csv** or **json**.
format.field-delimiter	No	Attribute delimiter. You can customize the attribute delimiter only when the encoding format is CSV. The default delimiter is a comma (,).
connector.partition-key	No	Group primary key. Multiple primary keys are separated by commas (,). If this parameter is not specified, data is randomly written to DIS partitions.

Precautions

None

Example

Output the data in the **disSink** stream to DIS.

```
create table disSink(
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_speed INT
)
with (
  'connector.type' = 'dis',
  'connector.region' = '',
```



```
  'connector.channel' = 'disOutput',
  'connector.partition-key' = 'car_id,car_owner',
  'format.type' = 'csv'
);
```

4.3.2.5 JDBC Result Table

Function

DLI exports the output data of the Flink job to RDS.

Prerequisites

- An enhanced datasource connection with the database has been established, so that you can configure security group rules as required.

Syntax

```
create table jdbcSink (
  attr_name attr_type
  (',' attr_name attr_type)*
  (','PRIMARY KEY (attr_name, ...) NOT ENFORCED)
)
with (
  'connector.type' = 'jdbc',
  'connector.url' = '',
  'connector.table' = '',
  'connector.driver' = '',
  'connector.username' = '',
  'connector.password' = ''
);
```

Parameters

Table 4-13 Parameter description

Parameter	Mandatory	Description
connector.type	Yes	Data source type. Set this parameter to **jdbc**.
connector.url	Yes	Database URL
connector.table	Yes	Name of the table where the data to be read from the database is located
connector.driver	No	Driver required for connecting to the database If you do not set this parameter, the automatically extracted URL will be used.
connector.username	No	Username for accessing the database
connector.password	No	Password for accessing the database

Parameter	Mandatory	Description
connector.write.flush.max-rows	No	Maximum number of rows to be updated when data is written. The default value is **5000**.
connector.write.flush.interval	No	Interval for data update. The unit can be ms, milli, millisecond/s, sec, second/min or minute. If this parameter is not set, the value is not updated based on the interval by default.
connector.write.max-retries	No	Maximum number of attempts to write data if failed. The default value is **3**.
connector.write.exclude-update-columns	No	Columns excluded for data update. The default value is empty, indicating that when data with the same primary key is updated, the update of the specified field is ignored. The primary key column is ignored by default.

Precautions

None

Example

Output data from stream **jdbcSink** to the MySQL database.

```
create table jdbcSink(
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_speed INT
)
with (
  'connector.type' = 'jdbc',
  'connector.url' = 'jdbc:mysql://xx.xx.xx.xx:3306/xx',
  'connector.table' = 'jdbc_table_name',
  'connector.driver' = 'com.mysql.jdbc.Driver',
  'connector.username' = 'xxx',
  'connector.password' = 'xxxxxx'
);
```

4.3.2.6 GaussDB(DWS) Result Table

Function

DLI outputs the Flink job output data to GaussDB(DWS). GaussDB(DWS) database kernel is compliant with PostgreSQL. The PostgreSQL database can store data of more complex types and delivers space information services, multi-version concurrent control (MVCC), and high concurrency. It applies to location applications, financial insurance, and e-commerce.

GaussDB(DWS) is an online data processing database based on the cloud infrastructure and platform and helps you mine and analyze massive sets of data.

Prerequisites

- Ensure that you have created a GaussDB(DWS) cluster using your account.

  For details about how to create a GaussDB(DWS) cluster, see "Creating a Cluster" in *Data Warehouse Service Management Guide*.
- A GaussDB(DWS) database table has been created.
- An enhanced datasource connection has been created for DLI to connect to GaussDB(DWS) clusters, so that jobs can run on the dedicated queue of DLI and you can set the security group rules as required.

Syntax

```
create table dwsSink (
  attr_name attr_type
  (',' attr_name attr_type)*
  (',PRIMARY KEY (attr_name, ...) NOT ENFORCED)
)
with (
  'connector.type' = 'gaussdb',
  'connector.url' = '',
  'connector.table' = '',
  'connector.driver' = '',
  'connector.username' = '',
  'connector.password' = ''
);
```

Parameters

Table 4-14 Parameter description

Parameter	Mandatory	Description
connector.type	Yes	Connector type. Set this parameter to **gaussdb**.
connector.url	Yes	JDBC connection address. The format is jdbc:postgresql://${ip}:${port}/${dbName}.
connector.table	Yes	Name of the table to be operated. If the GaussDB(DWS) table is in a schema, the format is **schema\".\"***Table name*. For details, see the **Example**.
connector.driver	No	JDBC connection driver. The default value is **org.postgresql.Driver**.
connector.username	No	Database authentication user name. This parameter must be configured in pair with **connector.password**.
connector.password	No	Database authentication password. This parameter must be configured in pair with **connector.username**.

Parameter	Mandatory	Description
connector.write.mode	No	Data write mode. The value can be **copy**, **insert**, or **upsert**. The default value is **upsert**. This parameter must be configured depending on **primary key**. • If **primary key** is not configured, data can be appended in **copy** and **insert** modes. • If **primary key** is configured, all the three modes are available. Note: GaussDB(DWS) does not support the update of distribution columns. The primary keys of columns to be updated must cover all distribution columns defined in the GaussDB(DWS) table.
connector.write.flush.max-rows	No	Maximum rows allowed for data flush. If the data size exceeds the value, data flush is triggered. The default value is **5000**.
connector.write.flush.interval	No	Data flush period. Data flush is triggered periodically. The format is {length value}{time unit label}, for example, **123ms, 321s**. The supported time units include d, h, min, s, and ms (default unit). If this parameter is not set, the value is not updated based on the interval by default.
connector.write.max-retries	No	Maximum number of attempts to write data. The default value is **3**.
connector.write.merge.filter-key	No	Column to be merged. This parameter takes effects only when PRIMARY KEY is configured and **connector.write.mode** is set to **copy**.
connector.write.escape-string-value	No	Whether to escape values of the string type. The default value is **false**.

Precautions

None

Example

- If you use the gsjdbc4 driver for connection, set **connector.driver** to **org.postgresql.Driver**. You can omit this parameter because the gsjdbc4 driver is the default one.
  - Write data to GaussDB(DWS) in **upsert** mode.

```
create table dwsSink(
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_speed INT
```



```
) with (
  'connector.type' = 'gaussdb',
  'connector.url' = 'jdbc:postgresql://xx.xx.xx.xx:8000/xx',
  'connector.table' = 'car_info',
  'connector.username' = 'xx',
  'connector.password' = 'xx',
  'connector.write.mode' = 'upsert',
  'connector.write.flush.interval' = '30s'
);
```

Create table **dwsSource** with data fetched from GaussDB(DWS) table **test** that is in a schema named **ads_game_sdk_base**:

```
CREATE TABLE ads_rpt_game_sdk_realtime_ada_reg_user_pay_mm (
  ddate DATE,
  dmin TIMESTAMP(3),
  game_appkey VARCHAR,
  channel_id VARCHAR,
  pay_user_num_1m bigint,
  pay_amt_1m bigint,
  PRIMARY KEY (ddate, dmin, game_appkey, channel_id) NOT ENFORCED
) WITH (
  'connector.type' = 'gaussdb',
  'connector.url' = 'jdbc:postgresql://xx.xx.xx.xx:8000/dws_bigdata_db',
  'connector.table' = 'ads_game_sdk_base\".\"test',
  'connector.username' = 'xxxx',
  'connector.password' = 'xxxxx',
  'connector.write.mode' = 'upsert',
  'connector.write.flush.interval' = '30s'
);
```

- If you use the gsjdbc200 driver for connection, set **connector.driver** to **com.huawei.gauss200.jdbc.Driver**.

  Create table **dwsSource** with data fetched from GaussDB(DWS) table **test** that is in a schema named **ads_game_sdk_base**:

```
create table dwsSink(
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_speed INT
) with (
  'connector.type' = 'gaussdb',
  'connector.table' = 'ads_game_sdk_base\".\"test',
  'connector.driver' = 'com.huawei.gauss200.jdbc.Driver',
  'connector.url' = 'jdbc:gaussdb://xx.xx.xx.xx:8000/xx',
  'connector.username' = 'xx',
  'connector.password' = 'xx',
  'connector.write.mode' = 'upsert',
  'connector.write.flush.interval' = '30s'
);
```

4.3.2.7 Redis Result Table

Function

DLI exports the output data of the Flink job to Redis. Redis is a storage system that supports multiple types of data structures such as key-value. It can be used in scenarios such as caching, event pub/sub, and high-speed queuing. Redis supports direct read/write of strings, hashes, lists, queues, and sets. Redis works with in-memory dataset and provides persistence. For more information about Redis, visit **https://redis.io/**.

Prerequisites

An enhanced datasource connection with Redis has been established, so that you can configure security group rules as required.

Syntax

```
create table dwsSink (
  attr_name attr_type
  (',' attr_name attr_type)*
  (',PRIMARY KEY (attr_name, ...) NOT ENFORCED)
)
with (
'connector.type' = 'redis',
  'connector.host' = '',
  'connector.port' = '',
  'connector.password' = '',
  'connector.table-name' = '',
  'connector.key-column' = ''
);
```

Parameters

Table 4-15 Parameter description

Parameter	Mandatory	Description
connector.type	Yes	Connector type. Set this parameter to **redis**.
connector.host	Yes	Redis connector address
connector.port	Yes	Redis connector port
connector.password	No	Redis authentication password
connector.deploy-mode	No	Redis deployment mode. The value can be **standalone** or **cluster**. The default value is **standalone**.
connector.table-name	No	Name of the table stored in the Redis. This parameter is mandatory in the Redis Hashmap storage pattern. In this pattern, data is stored to Redis in hashmaps. The hash key is **${table-name}:${ext-key}**, and the field name is the column name. **NOTE** Table storage pattern: **connector.table-name** and **connector.key-column** are used as Redis keys. For the Redis hash type, each key corresponds to a hashmap. A hash key is a field name of the source table, and a hash value is a field value of the source table.

Parameter	Mandatory	Description
connector.key-column	No	This parameter is optional in table storage pattern. The value is used as the value of ext-key in the Redis. If this parameter is not set, the value of ext-key is the generated UUID.
connector.write-schema	No	Whether to write the current schema to the Redis. This parameter is available in table storage pattern. The default value is **false**.
connector.data-type	No	Data types for storage. This parameter is mandatory for a custom storage pattern. Supported values include string, list, hash, and set. In a string, list or set, the number of schema fields must be 2, and the number of hash fields must be 3.
connector.ignore-retraction	No	Whether to ignore the retraction message. The default value is **false**.

Precautions

Either **connector.table-name** or **connector.data-type** must be set.

Example

- Configure the table storage pattern when you configure **connector.table-name**.

  In table storage pattern, data is stored in hash mode, which is different from the basic hash pattern in which the three fields of a table are used as the **key**, **hash_key**, and **hash_value**. The key in table pattern can be specified by **connector.table-name** and **connector.key-column** parameters, all field names in the table are used as **hash_key**, and the field values are written to the hash table as **hash_value**.

```
create table redisSink(
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_speed INT
) with (
  'connector.type' = 'redis',
  'connector.host' = 'xx.xx.xx.xx',
  'connector.port' = '6379',
  'connector.password' = 'xx',
  'connector.table-name'='car_info',
  'connector.key-column'='car_id'
);

insert into redisSink
  (car_id,car_owner,car_brand,car_speed)
  VALUES
  ("A1234","OwnA","A1234",30);
```


- The following example shows how to create a table when **connector.data-type** is set to **string**, **list**, **hash**, or **set**, respectively.
  - String type

    The table contains two columns: key and value.

    ```
    create table redisSink(
      attr1 STRING,
      attr2 STRING
    ) with (
      'connector.type' = 'redis',
      'connector.host' = 'xx.xx.xx.xx',
      'connector.port' = '6379',
      'connector.password' = 'xx',
      'connector.data-type' = 'string'
    );

    insert into redisSink
      (attr1,attr2)
      VALUES
      ("car_id","A1234");
    ```

  - List type

    The table contains two columns: key and value.

    ```
    create table redisSink(
      attr1 STRING,
      attr2 STRING
    ) with (
      'connector.type' = 'redis',
      'connector.host' = 'xx.xx.xx.xx',
      'connector.port' = '6379',
      'connector.password' = 'xx',
      'connector.data-type' = 'list'
    );

    insert into redisSink
      (attr1,attr2)
      VALUES
      ("car_id","A1234");
    ```

  - Set type

    The table contains two columns: key and value.

    ```
    create table redisSink(
      attr1 STRING,
      attr2 STRING
    ) with (
      'connector.type' = 'redis',
      'connector.host' = 'xx.xx.xx.xx',
      'connector.port' = '6379',
      'connector.password' = 'xx',
      'connector.data-type' = 'set'
    );

    insert into redisSink
      (attr1,attr2)
      VALUES
      ("car_id","A1234");
    ```

  - Hash type

    The table contains three columns: key, hash_key, and hash_value.

    ```
    create table redisSink(
      attr1 STRING,
      attr2 STRING,
      attr3 STRING
    ) with (
      'connector.type' = 'redis',
      'connector.host' = 'xx.xx.xx.xx',
      'connector.port' = '6379',
      'connector.password' = 'xx',
    ```



```
  'connector.data-type' = 'hash'
);

insert into redisSink
  (attr1,attr2,attr3)
  VALUES
  ("car_info","car_id","A1234");
```

4.3.2.8 SMN Result Table

Function

DLI exports Flink job output data to SMN.

SMN provides reliable and flexible large-scale message notification services to DLI. It significantly simplifies system coupling and pushes messages to subscription endpoints based on requirements. SMN can be connected to other cloud services or integrated with any application that uses or generates message notifications to push messages over multiple protocols.

Syntax

```
create table smnSink (
  attr_name attr_type
  (',' attr_name attr_type)*
  (','PRIMARY KEY (attr_name, ...) NOT ENFORCED)
)
with (
  'connector.type' = 'smn',
  'connector.region' = '',
  'connector.topic-urn' = '',
  'connector.message-subject' = '',
  'connector.message-column' = ''
);
```

Parameters

Table 4-16 Parameter description

Parameter	Mandatory	Description
connector.type	Yes	Sink data type. Set this parameter to **smn**, which means that data is stored to SMN.
connector.region	Yes	Region where SMN belongs
connector.topic-urn	No	URN of an SMN topic, which is used for the static topic URN configuration. The SMN topic serves as the destination for short message notification and needs to be created in SMN. Either of **topic_urn** and **urn_column** must be configured. If both of them are configured, the **topic_urn** setting takes precedence.

Parameter	Mandatory	Description
connector.urn-column	No	Field name of the topic URN content, which is used for the dynamic topic URN configuration. One of **topic_urn** and **urn_column** must be configured. If both of them are configured, the **topic_urn** setting takes precedence.
connector.message-subject	Yes	Message subject sent by SMN. This parameter can be customized.
connector.message-column	Yes	Column name in the current table. Data in this column is the message content and is customized. Currently, only text messages are supported.

Precautions

None

Example

Write the data to the target of SMN topic. The topic of the message sent by SMN is **test**, and the message content is the data in the **attr1** column.

```
create table smnSink (
  attr1 STRING,
  attr2 STRING
)
with (
  'connector.type' = 'smn',
  'connector.region' = '',
  'connector.topic-urn' = 'xxxxxx',
  'connector.message-subject' = 'test',
  'connector.message-column' = 'attr1'
);
```

4.3.2.9 HBase Result Table

Function

DLI outputs the job data to HBase. HBase is a column-oriented distributed cloud storage system that features enhanced reliability, excellent performance, and elastic scalability. It applies to the storage of massive amounts of data and distributed computing. You can use HBase to build a storage system capable of storing TB- or even PB-level data. With HBase, you can filter and analyze data with ease and get responses in milliseconds, rapidly mining data value. Structured and semi-structured key-value data can be stored, including messages, reports, recommendation data, risk control data, logs, and orders. With DLI, you can write massive volumes of data to HBase at a high speed and with low latency.

Prerequisites

An enhanced datasource connection has been created for DLI to connect to HBase, so that jobs can run on the dedicated queue of DLI and you can set the security group rules as required.

- **If MRS HBase is used, IP addresses of all hosts in the MRS cluster have been added to host information of the enhanced datasource connection.**

  .

Syntax

```
create table hbaseSink (
  attr_name attr_type
  (',' attr_name attr_type)*
)
with (
  'connector.type' = 'hbase',
  'connector.version' = '1.4.3',
  'connector.table-name' = '',
  'connector.zookeeper.quorum' = ''
);
```

Parameters

Table 4-17 Parameter description

Parameter	Mandatory	Description
connector.type	Yes	Connector type. Set this parameter to **hbase**.
connector.version	Yes	The value must be **1.4.3**.
connector.table-name	Yes	HBase table name
connector.zookeeper.quorum	Yes	ZooKeeper address
connector.zookeeper.znode.parent	No	Root directory for ZooKeeper. The default value is **/hbase**.
connector.write.buffer-flush.max-size	No	Maximum buffer size for each data write. The default value is 2 MB. The unit is MB.
connector.write.buffer-flush.max-rows	No	Maximum number of data records that can be updated each time

Parameter	Mandatory	Description
connector.write.buffer-flush.interval	No	Update time. The default value is **0s**. Example value: **2s**.
connector.rowkey	No	Content of a compound rowkey to be assigned. The content is assigned to a new field based on the configuration. Example: rowkey1:3,rowkey2:3, ... The value 3 indicates the first three bytes of the field. The number cannot be greater than the byte size of the field and cannot be less than 1.

Example

```
create table hbaseSink(
 rowkey string,
 name string,
 i Row<geneder string, age int>,
 j Row<address string>
) with (
  'connector.type' = 'hbase',
  'connector.version' = '1.4.3',
  'connector.table-name' = 'sink',
  'connector.rowkey' = 'rowkey:1,name:3',
  'connector.write.buffer-flush.max-rows' = '5',
  'connector.zookeeper.quorum' = 'xxxx:2181'
);
```

4.3.2.10 Elasticsearch Result Table

Function

DLI exports Flink job output data to Elasticsearch of Cloud Search Service (CSS). Elasticsearch is a popular enterprise-class Lucene-powered search server and provides the distributed multi-user capabilities. It delivers multiple functions, including full-text retrieval, structured search, analytics, aggregation, and highlighting. With Elasticsearch, you can achieve stable, reliable, real-time search. Elasticsearch applies to diversified scenarios, such as log analysis and site search.

CSS is a fully managed, distributed search service. It is fully compatible with open-source Elasticsearch and provides DLI with structured and unstructured data search, statistics, and report capabilities. For more information about CSS, see .

Prerequisites

- Ensure that you have created a cluster on CSS using your account.

  If you need to access Elasticsearch using the cluster username and password, enable the security mode and disable HTTPS for the created CSS cluster.

- In this scenario, jobs must run on the dedicated queue of DLI. Therefore, DLI must interconnect with the enhanced datasource connection that has been connected with CSS. You can also set the security group rules as required.

Precautions

- Currently, only CSS 7.X and later versions are supported. Version 7.6.2 is recommended.
- Do not enable the security mode for the CSS cluster if **connector.username** and **connector.password** are not configured.
- ICMP must be enabled for the security group inbound rule of the CSS cluster.

Syntax

```
create table esSink (
  attr_name attr_type
  (',' attr_name attr_type)*
  (',PRIMARY KEY (attr_name, ...) NOT ENFORCED)
)
with (
  'connector.type' = 'elasticsearch',
  'connector.version' = '7',
  'connector.hosts' = 'http://xxxx:9200',
  'connector.index' = '',
  'connector.document-type' = '',
  'update-mode' = '',
  'format.type' = 'json'
);
```

Parameters

Table 4-18 Parameter description

Parameter	Mandatory	Description
connector.type	Yes	Connector type. Set this parameter to **elasticsearch**.
connector.version	Yes	Elasticsearch version Currently, only version 7 can be used. That is, the value of this parameter can only be **7**.
connector.hosts	Yes	Host name of the cluster where Elasticsearch locates. Use semicolons (;) to separate multiple host names. Ensure that the host name starts with **http**, for example, **http://**x.x.x.x**:9200**.
connector.index	Yes	Elasticsearch index name
connector.document-type	Yes	Elasticsearch type name This attribute is invalid because Elasticsearch 7 uses the default **_doc** type.
update-mode	Yes	Data update mode of the sink. The value can be **append** or **upsert**.

Parameter	Mandatory	Description
connector.key-delimiter	No	Delimiter of compound primary keys. The default value is _.
connector.key-null-literal	No	Character used to replace **null** in keys.
connector.failure-handler	No	Policy used when an Elasticsearch request fails. The default value is **fail**. **fail**: An exception is thrown when the request fails and the job fails. **ignore**: The failed request is ignored. **retry-rejected**: If the request fails because the queue running the Elasticsearch node is full, the request is resent and no failure is reported. **custom**: A custom policy is used.
connector.failure-handler-class	No	Custom processing mode used to handle a failure
connector.flush-on-checkpoint	No	Whether the connector waits for all pending action requests to be acknowledged by Elasticsearch on checkpoints. The default value **true** indicates that wait for all pending action requests on checkpoints. If you set this parameter to false, the connector will not wait for the requests.
connector.bulk-flush.max-actions	No	Maximum number of records that can be written in a batch
connector.bulk-flush.max-size	No	Maximum total amount of data to be written in batches. Specify the unit when you configure this parameter. The unit is MB.
connector.bulk-flush.interval	No	Update interval for batch writing. The unit is milliseconds and is not required.
format.type	Yes	Data format. Currently, only JSON is supported.
connector.username	No	Account of the cluster where Elasticsearch locates. This parameter and must be configured in pair with **connector.password**. If the account and password are used, the security mode must be enabled and HTTPS must be disabled for the created CSS cluster.
connector.password	No	Password of the cluster where Elasticsearch locates. This parameter must be configured in pair with **connector.username**.

Example

```
create table sink1(
  attr1 string,
  attr2 int
) with (
  'connector.type' = 'elasticsearch',
  'connector.version' = '7',
  'connector.hosts' = 'http://xxxx:9200',
  'connector.index' = 'es',
  'connector.document-type' = 'one',
  'update-mode' = 'append',
  'format.type' = 'json'
);
```

4.3.2.11 OpenTSDB Result Table

Function

OpenTSDB is a distributed, scalable time series database based on HBase. OpenTSDB is designed to collect monitoring information of a large-scale cluster and query data in seconds, facilitating querying and storing massive amounts of monitoring data in common databases. OpenTSDB can be used for system monitoring and measurement as well as collection and monitoring of IoT data, financial data, and scientific experimental results.

DLI uses enhanced datasource connections to write the output of Flink jobs to OpenTSDB.

Prerequisites

- The OpenTSDB service has been enabled.
- An enhanced datasource connection has been created for DLI to connect to OpenTSDB, so that jobs can run on the dedicated queue of DLI and you can set the security group rules as required.

Syntax

```
create table tsdbSink (
  attr_name attr_type
  (',' attr_name attr_type)*
)
with (
  'connector.type' = 'opentsdb',
  'connector.region' = '',
  'connector.tsdb-metrics' = '',
  'connector.tsdb-timestamps' = '',
  'connector.tsdb-values' = '',
  'connector.tsdb-tags' = '',
  'connector.tsdb-link-address' = ''
);
```


Parameters

Table 4-19 Parameter description

Parameter	Mandatory	Description
connector.type	Yes	Connector type. Set this parameter to **opentsdb**.
connector.region	Yes	Region where OpenTSDB locates
connector.tsdb-metrics	Yes	Metrics of data points, which can be specified through parameter configurations. The number of metrics must be 1 or the same as the number of **connector.tsdb-values**. Use semicolons (;) to separate multiple metrics.
connector.tsdb-timestamps	Yes	Timestamps of data points. Only dynamic columns are supported. The data type can be int, bigint, or string. Only numbers are supported. The number of metrics must be 1 or the same as the number of **connector.tsdb-values**. Use semicolons (;) to separate multiple timestamps.
connector.tsdb-values	Yes	Values of data points. You can specify dynamic columns or constant values. Separate multiple values with semicolons (;).
connector.tsdb-tags	Yes	Tags of data points. Each tag contains at least one tag value and a maximum of eight tag values. Separate multiple tags by commas (,). You can specify the tags by parameters. The number of metrics must be 1 or the same as the number of **connector.tsdb-values**. Separate multiple tags with semicolons (;).
connector.batch-insert-data-num	No	Number of data records to be written in batches at a time. The value must be a positive integer. The default value is **8**.
connector.tsdb-link-address	Yes	OpenTSDB address for connecting to the cluster where the data to be inserted belongs.

Precautions

- If your OpenTSDB runs in an MRS cluster, ensure that:

a. The IP address and port number of OpenTSDB must be obtained from **tsd.network.bind** and **tsd.network.port** in the OpenTSDB service configuration.
b. If **tsd.https.enabled** is set to **true**, the value format of **connector.tsdb-link-address** in the SQL statement is **https://***ip:port*. If **tsd.https.enabled** is set to **false**, the value of **connector.tsdb-link-address** can be in the format of **http://***ip:port* or *ip:port*.
c. When establishing an enhanced datasource connection, you need to add the mapping between MRS cluster hosts and IP addresses in **/etc/hosts** to the Host Information parameter.

- If a configuration item can be specified through parameter configurations, one or more columns in the record can be used as part of the configuration item. For example, if the configuration item is set to **car_$ {car_brand}** and the value of **car_brand** in a record is **BMW**, the value of this configuration item is **car_BMW** in the record.
- If dynamic columns are supported, the format must be ${columnName}, where **columnName** indicates a field name.

Example

```
create table sink1(
  attr1 bigint,
  attr2 int,
  attr3 int
) with (
  'connector.type' = 'opentsdb',
  'connector.region' = '',
  'connector.tsdb-metrics' = '',
  'connector.tsdb-timestamps' = '${attr1}',
  'connector.tsdb-values' = '${attr2};10',
  'connector.tsdb-tags' = 'key1:value1,key2:value2;key3:value3',
  'connector.tsdb-link-address' = ''
);
```

4.3.2.12 User-defined Result Table

Function

Write your Java code to insert the processed data into a specified database supported by your cloud service.

Prerequisites

Implement the custom sink class :

The custom sink class is inherited from Flink open-source class **RichSinkFunction**. The data type is **Tuple2<Boolean, Row**>.

For example, define the **MySink** class by **public class MySink extends RichSinkFunction< Tuple2<Boolean, Row>>{}**, and implement the **open**, **invoke**, and **close** functions. A code example is as follows:

```
public class MySink extends RichSinkFunction<Tuple2<Boolean, Row>> {
   // Initialize the object.
   @Override
   public void open(Configuration parameters) throws Exception {}

   @Override
```



```
    // Implement the data processing logic.
    /* The in parameter contains two values. The first value is of the Boolean type. The value true indicates the insert or update operation, and the value false indicates the delete operation. If the interconnected sink does not support the delete operation, the deletion will not be executed. The second value indicates the data to be operated.*/
    public void invoke(Tuple2<Boolean, Row> in, Context context) throws Exception {}

    @Override
    public void close() throws Exception {}
}
```

Content of the dependent pom configuration file is as follows:

```
<dependency>
    <groupId>org.apache.flink</groupId>
    <artifactId>flink-streaming-java_2.11</artifactId>
    <version>${flink.version}</version>
    <scope>provided</scope>
</dependency>

<dependency>
    <groupId>org.apache.flink</groupId>
    <artifactId>flink-core</artifactId>
    <version>${flink.version}</version>
    <scope>provided</scope>
</dependency>
```

Pack the implemented class and compile it in a JAR file, and upload it using the UDF Jar parameter on the editing page of your Flink OpenSource SQL job.

Syntax

```
create table userDefinedSink (
  attr_name attr_type
  (',' attr_name attr_type)*
)
with (
  'connector.type' = 'user-defined',
  'connector.class-name' = ''
);
```

Parameters

Table 4-20 Parameter description

Parameter	Mandatory	Description
connector.type	Yes	Connector type. The value can only be a user-defined sink.
connector.class-name	Yes	Fully qualified class name of the sink class. For details about the implementation of the sink class, see **Prerequisites**.
connector.class-parameter	No	Parameter of the constructor of the sink class. Only one parameter of the string type is supported.

Precautions

connector.class-name must be a fully qualified class name.

Example

```
create table userDefinedSink (
  attr1 int,
  attr2 int
)
with (
  'connector.type' = 'user-defined',
  'connector.class-name' = 'xx.xx.MySink'
);
```

4.3.2.13 Print Result Table

Function

The print connector exports your data output to the **error** file or the **out** file of TaskManager. It is mainly used for code debugging and output viewing.

Syntax

```
create table printSink (
  attr_name attr_type (',' attr_name attr_type) * (',' PRIMARY KEY (attr_name,...) NOT ENFORCED)
) with (
  'connector' = 'print',
  'print-identifier' = '',
  'standard-error' = ''
);
```

Parameters

Table 4-21 Parameter description

Parameter	Mandatory	Description
connector	Yes	The value is fixed to **print**.
print-identifier	No	Message that identifies print and is prefixed to the output of the value.
standard-error	No	The value can be only **true** or **false**. The default value is **false**. • If the value is **true**, data is output to the error file of the TaskManager. • If the value is **false**, data is output to the **out** file of the TaskManager.

Example

Read data from Kafka and export the data to the **out** file of TaskManager. You can view the output in the exported file.

```
create table kafkaSource(
  attr0 string,
  attr1 boolean,
  attr3 decimal(38, 18),
  attr4 TINYINT,
  attr5 smallint,
  attr6 int,
  attr7 bigint,
  attr8 float,
  attr9 double,
  attr10 date,
  attr11 time,
  attr12 timestamp(3)
) with (
  'connector.type' = 'kafka',
  'connector.version' = '0.11',
  'connector.topic' = 'test_json',
  'connector.properties.bootstrap.servers' = 'xx.xx.xx.xx:9092',
  'connector.properties.group.id' = 'test_print',
  'connector.startup-mode' = 'latest-offset',
  'format.type' = 'csv'
);

create table printTable(
  attr0 string,
  attr1 boolean,
  attr3 decimal(38,18),
  attr4 TINYINT,
  attr5 smallint,
  attr6 int,
  attr7 bigint,
  attr8 float,
  attr9 double,
  attr10 date,
  attr11 time,
  attr12 timestamp(3),
  attr13 array<string>,
  attr14 row<attr15 float, attr16 timestamp(3)>,
  attr17 map<int, bigint>
) with (
  "connector" = "print"
);

insert into
  printTable
select
  attr0,
  attr1,
  attr3,
  attr4,
  attr5,
  attr6,
  attr7,
  attr8,
  attr9,
  attr10,
  attr11,
  attr12,
  array [cast(attr0 as string), cast(attr0 as string)],
  row(
    cast(attr8 as float),
    cast(attr12 as timestamp(3))
  ),
  map [cast(attr6 as int), cast(attr7 as bigint)]
```



```
from
  kafkaSource;
```

4.3.2.14 File System Result Table

Function

You can create a file system result table to export data to a file system such as HDFS or OBS. After the data is generated, a non-DLI table can be created directly according to the generated directory. The table can be processed through DLI SQL, and the output data directory can be stored in partition tables. It is applicable to scenarios such as data dumping, big data analysis, data backup, and active, deep, or cold archiving.

Syntax

```
create table filesystemSink (
  attr_name attr_type (',' attr_name attr_type) *
) with (
  'connector.type' = 'filesystem',
  'connector.file-path' = '',
  'format.type' = ''
);
```

Important Notes

- If the data output directory in the table creation syntax is OBS, the directory must be a parallel file system and cannot be an OBS bucket.
- When using a file system table, you must enable checkpointing to ensure job consistency.
- When **format.type** is **parquet**, the supported data type is string, boolean, tinyint, smallint, int, bigint, float, double, map<string, string>, timestamp(3), and time.
- To avoid data loss or data coverage, you need to enable automatic restart upon job exceptions. Enable the **Restore Job from Checkpoint**.
- Set the checkpoint interval after weighing between real-time output file, file size, and recovery time, such as 10 minutes.
- When using HDFS, you need to bind the data source and enter the host information.
- When using HDFS, you need to configure information about the node where the active NameNode locates.

Parameter

Table 4-22 Parameter description

Parameter	Mandatory	Description
connector.type	Yes	The value is fixed to **filesystem**.
connector.file-path	Yes	Data output directory. The format is *schema*://*file.path*. **NOTE** Currently, Schema supports only OBS and HDFS. • If **schema** is set to **obs**, data is stored to OBS. **Note that OBS directory must be a parallel file system and must not be an OBS bucket.** For example, **obs://***bucketName*/*fileName* indicates that data is exported to the **fileName** directory in the **bucketName** bucket. • If **schema** is set to **hdfs**, data is exported to HDFS. Example: **hdfs://node-master1sYAx:9820/user/car_infos**, where **node-master1sYAx:9820** is the name of the node where the NameNode locates.
format.type	Yes	Output data encoding format. Only **parquet** and **csv** are supported. • When **schema** is set to **obs**, the encoding format of the output data can only be **parquet**. • When **schema** is set to **hdfs**, the output data can be encoded in **Parquet** or **CSV** format.
format.field-delimiter	No	Delimiter used to separate every two attributes. This parameter needs to be configured if the CSV encoding format is adopted. It can be user-defined, for example, a comma (,).
connector.ak	No	Access key for accessing OBS This parameter is mandatory when data is written to OBS.
connector.sk	No	Secret key for accessing OBS This parameter is mandatory when data is written to OBS.
connector.partitioned-by	No	Partitioning field. Use commas (,) to separate multiple fields.

Example

Read data from Kafka and write the data in Parquet format to the **fileName** directory in the **bucketName** bucket.

```
create table kafkaSource(
  attr0 string,
  attr1 boolean,
  attr2 TINYINT,
  attr3 smallint,
  attr4 int,
  attr5 bigint,
  attr6 float,
  attr7 double,
  attr8 timestamp(3),
  attr9 time
) with (
  'connector.type' = 'kafka',
  'connector.version' = '0.11',
  'connector.topic' = 'test_json',
  'connector.properties.bootstrap.servers' = 'xx.xx.xx.xx:9092',
  'connector.properties.group.id' = 'test_filesystem',
  'connector.startup-mode' = 'latest-offset',
  'format.type' = 'csv'
);

create table filesystemSink(
  attr0 string,
  attr1 boolean,
  attr2 TINYINT,
  attr3 smallint,
  attr4 int,
  attr5 bigint,
  attr6 float,
  attr7 double,
  attr8 map < string,  string >,
  attr9 timestamp(3),
  attr10 time
) with (
  "connector.type" = "filesystem",
  "connector.file-path" = "obs://bucketName/fileName",
  "format.type" = "parquet",
  "connector.ak" = "xxxx",
  "connector.sk" = "xxxxxx"
);

insert into
  filesystemSink
select
  attr0,
  attr1,
  attr2,
  attr3,
  attr4,
  attr5,
  attr6,
  attr7,
  map [attr0,attr0],
  attr8,
  attr9
from
  kafkaSource;
```

4.3.3 Creating a Dimension Table

4.3.3.1 JDBC Dimension Table

Create a JDBC dimension table to connect to the source stream.

Prerequisites

- You have created a JDBC instance for your account.

Syntax

```
CREATE TABLE  table_id (
  attr_name attr_type
  (',' attr_name attr_type)*
)
  WITH (
  'connector.type' = 'jdbc',
  'connector.url' = '',
  'connector.table' = '',
  'connector.username' = '',
  'connector.password' = ''
);
```

Parameters

Table 4-23 Parameter description

Parameter	Mandatory	Description
connector.type	Yes	Data source type. Set this parameter to **jdbc**.
connector.url	Yes	Database URL
connector.table	Yes	Name of the table where the data to be read from the database is located
connector.driver	No	Driver required for connecting to the database If you do not set this parameter, the automatically extracted URL will be used.
connector.username	No	Database authentication user name. This parameter must be configured in pair with **connector.password**.
connector.password	No	Database authentication password. This parameter must be configured in pair with **connector.username**.
connector.read.partition.column	No	Name of the column used to partition the input This parameter is mandatory if **connector.read.partition.lower-bound**, **connector.read.partition.upper-bound**, and **connector.read.partition.num** are configured.

Parameter	Mandatory	Description
connector.read.partition.lower-bound	No	Lower bound of values to be fetched for the first partition This parameter is mandatory if **connector.read.partition.column**, **connector.read.partition.upper-bound**, and **connector.read.partition.num** are configured.
connector.read.partition.upper-bound	No	Upper bound of values to be fetched for the last partition This parameter is mandatory if **connector.read.partition.column**, **connector.read.partition.lower-bound**, and **connector.read.partition.num** are configured.
connector.read.partition.num	No	Number of partitions This parameter is mandatory if **connector.read.partition.column**, **connector.read.partition.upper-bound**, and **connector.read.partition.upper-bound** are configured.
connector.read.fetch-size	No	Number of rows fetched from the database each time. The default value is **0**, indicating the hint is ignored.
connector.lookup.cache.max-rows	No	Maximum number of cached rows in a dimension table. If the number of cached rows exceeds the value , old data will be deleted. The value **-1** indicates that data cache disabled.
connector.lookup.cache.ttl	No	Time To Live (TTL) of dimension table cache. Caches exceeding the TTL will be deleted. The format is {length value}{time unit label}, for example, **123ms, 321s**. The supported time units include d, h, min, s, and ms (default unit).
connector.lookup.max-retries	No	Maximum number of attempts to obtain data from the dimension table. The default value is **3**.

Example

The RDS table is used to connect to the source stream.

```
CREATE TABLE car_infos (
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_price INT,
```



```
  proctime as PROCTIME()
)
  WITH (
  'connector.type' = 'dis',
  'connector.region' = '',
  'connector.channel' = 'disInput',
  'format.type' = 'csv'
  );

CREATE TABLE  db_info (
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_price INT
)
  WITH (
  'connector.type' = 'jdbc',
  'connector.url' = 'jdbc:mysql://xx.xx.xx.xx:3306/xx',
  'connector.table' = 'jdbc_table_name',
  'connector.driver' = 'com.mysql.jdbc.Driver',
  'connector.username' = 'xxx',
  'connector.password' = 'xxxxx'
);

CREATE TABLE audi_cheaper_than_30w (
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_price INT
)
  WITH (
  'connector.type' = 'dis',
  'connector.region' = '',
  'connector.channel' = 'disOutput',
  'connector.partition-key' = 'car_id,car_owner',
  'format.type' = 'csv'
  );

INSERT INTO audi_cheaper_than_30w
SELECT a.car_id, b.car_owner, b.car_brand, b.car_price
FROM car_infos as a join db_info FOR SYSTEM_TIME AS OF a.proctime AS b on a.car_id = b.car_id;
```

4.3.3.2 GaussDB(DWS) Dimension Table

Create a GaussDB(DWS) dimension table to connect to the input stream.

Prerequisites

- You have created a GaussDB(DWS) instance for your account.

Syntax

```
create table dwsSource (
  attr_name attr_type
  (',' attr_name attr_type)*
)
with (
  'connector.type' = 'gaussdb',
  'connector.url' = '',
  'connector.table' = '',
  'connector.username' = '',
  'connector.password' = ''
);
```


Parameters

Table 4-24 Parameter description

Parameter	Mandatory	Description
connector.type	Yes	Connector type. Set this parameter to **gaussdb**.
connector.url	Yes	JDBC connection address. The format is **jdbc:postgresql://${**ip**}:${**port**}/${**dbName**}**.
connector.table	Yes	Name of the table where the data to be read from the database is located
connector.driver	No	JDBC connection driver. The default value is **org.postgresql.Driver**.
connector.username	No	Database authentication user name. This parameter must be configured in pair with **connector.password**.
connector.password	No	Database authentication password. This parameter must be configured in pair with **connector.username**.
connector.read.partition.column	No	Name of the column used to partition the input This parameter is mandatory if **connector.read.partition.lower-bound**, **connector.read.partition.upper-bound**, and **connector.read.partition.num** are configured.
connector.read.partition.lower-bound	No	Lower bound of values to be fetched for the first partition This parameter is mandatory if **connector.read.partition.column**, **connector.read.partition.upper-bound**, and **connector.read.partition.num** are configured.
connector.read.partition.upper-bound	No	Upper bound of values to be fetched for the last partition This parameter is mandatory if **connector.read.partition.column**, **connector.read.partition.lower-bound**, and **connector.read.partition.num** are configured.
connector.read.partition.num	No	Number of partitions This parameter is mandatory if **connector.read.partition.column**, **connector.read.partition.upper-bound**, and **connector.read.partition.upper-bound** are configured.

Parameter	Mandatory	Description
connector.read.fetch-size	No	Number of rows fetched from the database each time. The default value is **0**, indicating the hint is ignored.
connector.lookup.cache.max-rows	No	Maximum number of cached rows in a dimension table. If the number of cached rows exceeds the value , old data will be deleted. The value **-1** indicates that data cache disabled.
connector.lookup.cache.ttl	No	Time To Live (TTL) of dimension table cache. Caches exceeding the TTL will be deleted. The format is {length value}{time unit label}, for example, **123ms, 321s**. The supported time units include d, h, min, s, and ms (default unit).
connector.lookup.max-retries	No	Maximum number of attempts to obtain data from the dimension table. The default value is **3**.

Example

Use an RDS table to connect to the source stream.

```
CREATE TABLE car_infos (
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_price INT,
  proctime as PROCTIME()
)
  WITH (
  'connector.type' = 'dis',
  'connector.region' = '',
  'connector.channel' = 'disInput',
  'format.type' = 'csv'
  );

CREATE TABLE  db_info (
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_price INT
)
  WITH (
  'connector.type' = 'gaussdb',
  'connector.driver' = 'org.postgresql.Driver',
  'connector.url' = 'jdbc:gaussdb://xx.xx.xx.xx:8000/xx',
  'connector.table' = 'car_info',
  'connector.username' = 'xx',
  'connector.password' = 'xx',
  'connector.lookup.cache.max-rows' = '10000',
  'connector.lookup.cache.ttl' = '24h'
);

CREATE TABLE audi_cheaper_than_30w (
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
```



```
  car_price INT
)
  WITH (
  'connector.type' = 'dis',
  'connector.region' = '',
  'connector.channel' = 'disOutput',
  'connector.partition-key' = 'car_id,car_owner',
  'format.type' = 'csv'
  );

INSERT INTO audi_cheaper_than_30w
SELECT a.car_id, b.car_owner, b.car_brand, b.car_price
FROM car_infos as a join db_info FOR SYSTEM_TIME AS OF a.proctime AS b on a.car_id = b.car_id;
```

4.3.3.3 HBase Dimension Table

Function

Create a Hbase dimension table to connect to the source stream.

Prerequisites

- An enhanced datasource connection has been created for DLI to connect to HBase, so that jobs can run on the dedicated queue of DLI and you can set the security group rules as required.
- **If MRS HBase is used, IP addresses of all hosts in the MRS cluster have been added to host information of the enhanced datasource connection.**

  .

Syntax

```
create table hbaseSource (
  attr_name attr_type
  (',' attr_name attr_type)*
 )
with (
  'connector.type' = 'hbase',
  'connector.version' = '1.4.3',
  'connector.table-name' = '',
  'connector.zookeeper.quorum' = ''
);
```

Parameters

Table 4-25 Parameter description

Parameter	Mandatory	Description
connector.type	Yes	Connector type. Set this parameter to **hbase**.
connector.version	Yes	The value must be **1.4.3**.
connector. table-name	Yes	Table name in HBase

Parameter	Mandatory	Description
connector.zookeeper.quorum	Yes	ZooKeeper address
connector.zookeeper.znode.parent	No	Root directory for ZooKeeper. The default value is **/hbase**.

Example

```
create table hbaseSource(
  id string,
  i Row<score string>
 ) with (
   'connector.type' = 'hbase',
   'connector.version' = '1.4.3',
   'connector.table-name' = 'user',
   'connector.zookeeper.quorum' = 'xxxx:2181'
 );
create table source1(
  id string,
  name string,
  geneder string,
  age int,
  address string,
  proctime as PROCTIME()
) with (
  "connector.type" = "dis",
  "connector.region" = "",
  "connector.channel" = "read",
  "connector.ak" = "xxxxxx",
  "connector.sk" = "xxxxxx",
  "format.type" = 'csv'
);

 create table hbaseSink(
  rowkey string,
  i Row<name string, geneder string, age int, address string>,
  j ROW<score string>
 ) with (
   'connector.type' = 'hbase',
   'connector.version' = '1.4.3',
   'connector.table-name' = 'score',
   'connector.write.buffer-flush.max-rows' = '1',
   'connector.zookeeper.quorum' = 'xxxx:2181'
 );
 insert into hbaseSink select d.id, ROW(name, geneder,age,address), ROW(score) from source1 as d join
hbaseSource for system_time as of d.proctime as h on d.id = h.id;
```

4.4 Data Manipulation Language (DML)

4.4.1 SELECT

SELECT

Syntax


```
SELECT [ ALL | DISTINCT ]
  { * | projectItem [, projectItem ]* }
  FROM tableExpression
  [ WHERE booleanExpression ]
  [ GROUP BY { groupItem [, groupItem ]* } ]
  [ HAVING booleanExpression ]
```

Description

This clause is used to select data from a table.

ALL indicates that all results are returned.

DISTINCT indicates that the duplicated results are removed.

Precautions

- The to-be-queried table must exist. Otherwise, an error is reported.
- WHERE is used to specify the filtering condition, which can be the arithmetic operator, relational operator, or logical operator.
- GROUP BY is used to specify the grouping field, which can be one or more multiple fields.

Example

Select the order which contains more than 3 pieces of data.

```
insert into temp SELECT  * FROM Orders WHERE units > 3;
```

Insert a group of constant data.

```
insert into temp select 'Lily', 'male', 'student', 17;
```

WHERE Filtering Clause

Syntax

```
SELECT   { * | projectItem [, projectItem ]* }
  FROM tableExpression
  [ WHERE booleanExpression ]
```

Description

This clause is used to filter the query results using the WHERE clause.

Precautions

- The to-be-queried table must exist.
- WHERE filters the records that do not meet the requirements.

Example

Filter orders which contain more than 3 pieces and fewer than 10 pieces of data.

```
insert into temp SELECT  * FROM Orders
  WHERE units > 3 and units < 10;
```

HAVING Filtering Clause

Function

This clause is used to filter the query results using the HAVING clause.

Syntax

```
SELECT [ ALL | DISTINCT ]  { * | projectItem [, projectItem ]* }
  FROM tableExpression
  [ WHERE booleanExpression ]
  [ GROUP BY { groupItem [, groupItem ]* } ]
  [ HAVING booleanExpression ]
```

Description

Generally, HAVING and GROUP BY are used together. GROUP BY applies first for grouping and HAVING then applies for filtering. The arithmetic operation and aggregate function are supported by the HAVING clause.

Precautions

If the filtering condition is subject to the query results of GROUP BY, the HAVING clause, rather than the WHERE clause, must be used for filtering.

Example

Group the **student** table according to the **name** field and filter the records in which the maximum score is higher than 95 based on groups.

```
insert into temp SELECT name, max(score) FROM student
  GROUP BY name
  HAVING max(score) >95;
```

Column-Based GROUP BY

Function

This clause is used to group a table based on columns.

Syntax

```
SELECT [ ALL | DISTINCT ]  { * | projectItem [, projectItem ]* }
  FROM tableExpression
  [ WHERE booleanExpression ]
  [ GROUP BY { groupItem [, groupItem ]* } ]
```

Description

Column-based GROUP BY can be categorized into single-column GROUP BY and multi-column GROUP BY.

- Single-column GROUP BY indicates that the GROUP BY clause contains only one column.
- Multi-column GROUP BY indicates that the GROUP BY clause contains multiple columns. The table will be grouped according to all fields in the GROUP BY clause. The records whose fields are the same are grouped into one group.

Precautions

GroupBy generates update results in the stream processing table.

Example

Group the **student** table according to the score and name fields and return the grouping results.


```
insert into temp SELECT name,score, max(score) FROM student
  GROUP BY name,score;
```

Expression-Based GROUP BY

Function

This clause is used to group a table according to expressions.

Syntax

```
SELECT [ ALL | DISTINCT ]   { * | projectItem [, projectItem ]* }
  FROM tableExpression
  [ WHERE booleanExpression ]
  [ GROUP BY { groupItem [, groupItem ]* } ]
```

Description

groupItem can have one or more fields. The fields can be called by string functions, but cannot be called by aggregate functions.

Precautions

None

Example

Use the substring function to obtain the character string from the name field, group the **student** table according to the obtained character string, and return each sub string and the number of records.

```
insert into temp SELECT substring(name,6),count(name) FROM student
  GROUP BY substring(name,6);
```

Grouping sets, Rollup, Cube

Function

- The GROUP BY GROUPING SETS generates a result set equivalent to that generated by multiple simple GROUP BY UNION ALL statements. Using GROUPING SETS is more efficient.
- The ROLLUP and CUBE generate multiple groups based on certain rules and then collect statistics by group.
- The result set generated by CUBE contains all the combinations of values in the selected columns.
- The result set generated by ROLLUP contains the combinations of a certain layer structure in the selected columns.

Syntax

```
SELECT [ ALL | DISTINCT ]   { * | projectItem [, projectItem ]* }
  FROM tableExpression
  [ WHERE booleanExpression ]
  [ GROUP BY groupingItem]
```

Description

Values of **groupingItem** can be **Grouping sets(columnName [, columnName]*)**, **Rollup(columnName [, columnName]*)**, and **Cube(columnName [, columnName]*)**.

Precautions

None

Example

Return the results generated based on **user** and **product**.

```
INSERT INTO temp SELECT SUM(amount)
FROM Orders
GROUP BY GROUPING SETS ((user), (product));
```

GROUP BY Using HAVING

Function

This statement filters a table after grouping it using the HAVING clause.

Syntax

```
SELECT [ ALL | DISTINCT ]   { * | projectItem [, projectItem ]* }
  FROM tableExpression
  [ WHERE booleanExpression ]
  [ GROUP BY { groupItem [, groupItem ]* } ]
  [ HAVING booleanExpression ]
```

Description

Generally, HAVING and GROUP BY are used together. GROUP BY applies first for grouping and HAVING then applies for filtering.

Precautions

- If the filtering condition is subject to the query results of GROUP BY, the HAVING clause, rather than the WHERE clause, must be used for filtering. HAVING and GROUP BY are used together. GROUP BY applies first for grouping and HAVING then applies for filtering.
- Fields used in HAVING, except for those used for aggregate functions, must exist in GROUP BY.
- The arithmetic operation and aggregate function are supported by the HAVING clause.

Example

Group the **transactions** according to **num**, use the HAVING clause to filter the records in which the maximum value derived from multiplying **price** with **amount** is higher than 5000, and return the filtered results.

```
insert into temp SELECT num, max(price*amount) FROM transactions
  WHERE time > '2016-06-01'
  GROUP BY num
  HAVING max(price*amount)>5000;
```

4.4.2 Set Operations

UNION/UNION ALL/INTERSECT/EXCEPT

Syntax

```
query UNION [ ALL ] | Intersect | Except query
```

Description

- UNION is used to return the union set of multiple query results.
- INTERSECT is used to return the intersection of multiple query results.
- EXCEPT is used to return the difference set of multiple query results.

Precautions

- Set operation is to join tables from head to tail under certain conditions. The quantity of columns returned by each SELECT statement must be the same. Column types must be the same. Column names can be different.
- By default, the duplicate records returned by UNION are removed. The duplicate records returned by UNION ALL are not removed.

Example

Output the union set of Orders1 and Orders2 without duplicate records.

```
insert into temp SELECT  * FROM Orders1
  UNION SELECT  * FROM Orders2;
```

IN

Syntax

```
SELECT [ ALL | DISTINCT ]   { * | projectItem [, projectItem ]* }
  FROM tableExpression
  WHERE column_name IN (value (, value)* ) | query
```

Description

The IN operator allows multiple values to be specified in the WHERE clause. It returns true if the expression exists in the given table subquery.

Precautions

The subquery table must consist of a single column, and the data type of the column must be the same as that of the expression.

Example

Return **user** and **amount** information of the products in **NewProducts** of the **Orders** table.

```
insert into temp SELECT user, amount
FROM Orders
WHERE product IN (
    SELECT product FROM NewProducts
);
```

4.4.3 Window

GROUP WINDOW

Description

Group Window is defined in GROUP BY. One record is generated from each group. Group Window involves the following functions:

- Array functions

Table 4-26 Array functions

Grouping Window Function	Description
TUMBLE(time_attr, interval)	Defines a tumbling time window. A tumbling time window assigns rows to non-overlapping, continuous windows with a fixed duration (interval). For example, a tumbling window of 5 minutes groups rows in 5 minutes intervals. Tumbling windows can be defined on event-time (stream + batch) or processing-time (stream).
HOP(time_attr, interval, interval)	Defines a hopping time window (called sliding window in the Table API). A hopping time window has a fixed duration (second interval parameter) and hops by a specified hop interval (first interval parameter). If the hop interval is smaller than the window size, hopping windows are overlapping. Thus, rows can be assigned to multiple windows. For example, a hopping window of 15 minutes size and 5 minute hop interval assigns each row to 3 different windows of 15 minute size, which are evaluated in an interval of 5 minutes. Hopping windows can be defined on event-time (stream + batch) or processing-time (stream).
SESSION(time_attr, interval)	Defines a session time window. Session time windows do not have a fixed duration but their bounds are defined by a time interval of inactivity, i.e., a session window is closed if no event appears for a defined gap period. For example a session window with a 30 minute gap starts when a row is observed after 30 minutes inactivity (otherwise the row would be added to an existing window) and is closed if no row is added within 30 minutes. Session windows can work on event-time (stream + batch) or processing-time (stream).

Notes:

In streaming mode, the **time_attr** argument of the group window function must refer to a valid time attribute that specifies the processing time or event time of rows.

In batch mode, the **time_attr** argument of the group window function must be an attribute of type TIMESTAMP.

- Window auxiliary functions

  The start and end timestamps of group windows as well as time attributes can be selected with the following auxiliary functions.

Table 4-27 Window auxiliary functions

Auxiliary Function	Description
TUMBLE_START(time_attr, interval) HOP_START(time_attr, interval, interval) SESSION_START(time_attr, interval)	Returns the timestamp of the inclusive lower bound of the corresponding tumbling, hopping, or session window.
TUMBLE_END(time_attr, interval) HOP_END(time_attr, interval, interval) SESSION_END(time_attr, interval)	Returns the timestamp of the **exclusive** upper bound of the corresponding tumbling, hopping, or session window. Note: The exclusive upper bound timestamp **cannot** be used as a rowtime attribute in subsequent time-based operations, such as interval joins and group window or over window aggregations.
TUMBLE_ROWTIME(time_attr, interval) HOP_ROWTIME(time_attr, interval, interval) SESSION_ROWTIME(time_attr, interval)	Returns the timestamp of the inclusive upper bound of the corresponding tumbling, hopping, or session window. The resulting attribute is a rowtime attribute that can be used in subsequent time-based operations such as interval joins and group window or over window aggregations.
TUMBLE_PROCTIME(time_attr, interval) HOP_PROCTIME(time_attr, interval, interval) SESSION_PROCTIME(time_attr, interval)	Returns a proctime attribute that can be used in subsequent time-based operations such as interval joins and group window or over window aggregations.

Note: Auxiliary functions must be called with exactly same arguments as the group window function in the GROUP BY clause.

Example

```
// Calculate the SUM every day (event time).
insert into temp SELECT name,
   TUMBLE_START(ts, INTERVAL '1' DAY) as wStart,
   SUM(amount)
   FROM Orders
   GROUP BY TUMBLE(ts, INTERVAL '1' DAY), name;

//Calculate the SUM every day (processing time).
insert into temp SELECT name,
   SUM(amount)
   FROM Orders
   GROUP BY TUMBLE(proctime, INTERVAL '1' DAY), name;
```

```
//Calculate the SUM over the recent 24 hours every hour (event time).
insert into temp SELECT product,
   SUM(amount)
   FROM Orders
   GROUP BY HOP(ts, INTERVAL '1' HOUR, INTERVAL '1' DAY), product;

//Calculate the SUM of each session and an inactive interval every 12 hours (event time).
insert into temp SELECT name,
   SESSION_START(ts, INTERVAL '12' HOUR) AS sStart,
   SESSION_END(ts, INTERVAL '12' HOUR) AS sEnd,
   SUM(amount)
   FROM Orders
   GROUP BY SESSION(ts, INTERVAL '12' HOUR), name;
```

TUMBLE WINDOW Extension

Function

The extension functions of the DLI tumbling window are as follows:

- Periodical tumbling windows for lower latency

  Before the tumbling window ends, the window can be periodically triggered based on the configured frequency. The compute result from the start to the current time is output, which does not affect the final output. The latest result can be viewed in each period before the window ends.

- Custom latency for higher data accuracy

  You can set a latency for the end of the window. The output of the window is updated according to the configured latency each time a piece of late data reaches.

Precautions

If you use **insert** to write results into the sink, the sink must support the upsert mode.

Syntax

```
TUMBLE(time_attr, window_interval, period_interval, lateness_interval)
```

Example

If the current **time_attr** attribute column is **testtime** and the window interval is 10 seconds, the statement is as follows:

```
TUMBLE(testtime, INTERVAL '10' SECOND, INTERVAL '10' SECOND, INTERVAL '10' SECOND)
```

Description

Table 4-28 Parameter description

Parameter	Description	Format
time_attr	Event time or processing time attribute column	-

Parameter	Description	Format
window_interval	Duration of the window	• Format 1: **INTERVAL** '10' **SECOND** The window interval is 10 seconds. You can change the value as needed. • Format 2: **INTERVAL** '10' **MINUTE** The window interval is 10 minutes. You can change the value as needed. • Format 3: **INTERVAL** '10' **DAY** The window interval is 10 days. You can change the value as needed.
period_interval	Frequency of periodic triggering within the window range. That is, before the window ends, the output result is updated at an interval specified by **period_interval** from the time when the window starts. If this parameter is not set, the periodic triggering policy is not used by default.	
lateness_interval	Time to postpone the end of the window. The system continues to collect the data that reaches the window within **lateness_interval** after the window ends. The output is updated for each data that reaches the window within **lateness_interval**. **NOTE** If the time window is for processing time, **lateness_interval** does not take effect.	

NOTE

Values of **period_interval** and **lateness_interval** cannot be negative numbers.

- If **period_interval** is set to **0**, periodic triggering is disabled for the window.
- If **lateness_interval** is set to **0**, the latency after the window ends is disabled.
- If neither of the two parameters is set, both periodic triggering and latency are disabled and only the regular tumbling window functions are available .
- If only the latency function needs to be used, set period_interval **INTERVAL '0' SECOND**.

OVER WINDOW

The difference between Over Window and Group Window is that one record is generated from one row in Over Window.

Syntax

```
SELECT agg1(attr1) OVER (
  [PARTITION BY partition_name]
  ORDER BY proctime|rowtime
  ROWS
 BETWEEN (UNBOUNDED|rowCOUNT) PRECEDING AND CURRENT ROW FROM TABLENAME

SELECT agg1(attr1) OVER (
  [PARTITION BY partition_name]
  ORDER BY proctime|rowtime
  RANGE
  BETWEEN (UNBOUNDED|timeInterval) PRECEDING AND CURRENT ROW FROM TABLENAME
```


Description

Table 4-29 Parameter description

Parameter	Parameter Description
PARTITION BY	Indicates the primary key of the specified group. Each group separately performs calculation.
ORDER BY	Indicates the processing time or event time as the timestamp for data.
ROWS	Indicates the count window.
RANGE	Indicates the time window.

Precautions

- All aggregates must be defined in the same window, that is, in the same partition, sort, and range.
- Currently, only windows from PRECEDING (unbounded or bounded) to CURRENT ROW are supported. The range described by FOLLOWING is not supported.
- ORDER BY must be specified for a single time attribute.

Example

```
// Calculate the count and total number from syntax rules enabled to now (in proctime).
insert into temp SELECT name,
   count(amount) OVER (PARTITION BY name ORDER BY proctime RANGE UNBOUNDED preceding) as
cnt1,
   sum(amount) OVER (PARTITION BY name ORDER BY proctime RANGE UNBOUNDED preceding) as cnt2
   FROM Orders;

//Calculate the count and total number of the recent four records (in proctime).
insert into temp SELECT name,
   count(amount) OVER (PARTITION BY name ORDER BY proctime ROWS BETWEEN 4 PRECEDING AND
CURRENT ROW) as cnt1,
   sum(amount) OVER (PARTITION BY name ORDER BY proctime ROWS BETWEEN 4 PRECEDING AND
CURRENT ROW) as cnt2
   FROM Orders;

//Calculate the count and total number last 60s (in eventtime). Process the events based on event time,
which is the timeattr field in Orders.
insert into temp SELECT name,
   count(amount) OVER (PARTITION BY name ORDER BY timeattr RANGE BETWEEN INTERVAL '60'
SECOND PRECEDING AND CURRENT ROW) as cnt1,
   sum(amount) OVER (PARTITION BY name ORDER BY timeattr RANGE BETWEEN INTERVAL '60' SECOND
PRECEDING AND CURRENT ROW) as cnt2
   FROM Orders;
```

4.4.4 JOIN

Equi-join

Syntax

```
FROM tableExpression INNER | LEFT | RIGHT | FULL JOIN tableExpression
  ON value11 = value21 [ AND value12 = value22]
```

Precautions

- Currently, only equi-joins are supported, for example, joins that have at least one conjunctive condition with an equality predicate. Arbitrary cross or theta joins are not supported.
- Tables are joined in the order in which they are specified in the FROM clause. Make sure to specify tables in an order that does not yield a cross join (Cartesian product), which are not supported and would cause a query to fail.
- For streaming queries the required state to compute the query result might grow infinitely depending on the type of aggregation and the number of distinct grouping keys. Provide a query configuration with valid retention interval to prevent excessive state size.

Example

```
SELECT *
FROM Orders INNER JOIN Product ON Orders.productId = Product.id;

SELECT *
FROM Orders LEFT JOIN Product ON Orders.productId = Product.id;

SELECT *
FROM Orders RIGHT JOIN Product ON Orders.productId = Product.id;

SELECT *
FROM Orders FULL OUTER JOIN Product ON Orders.productId = Product.id;
```

Time-Windowed Join

Function

Each piece of data in a stream is joined with data in different time zones in another stream.

Syntax

```
from t1 JOIN t2 ON t1.key = t2.key AND TIMEBOUND_EXPRESSIO
```

Description

TIMEBOUND_EXPRESSION can be in either of the following formats:

- L.time between LowerBound(R.time) and UpperBound(R.time)
- R.time between LowerBound(L.time) and UpperBound(L.time)
- Comparison expression with the time attributes (L.time/R.time)

Precautions

A time window join requires at least one equi join predicate and a join condition that limits the time of both streams.

For example, use two range predicates (<, <=, >=, or >), a BETWEEN predicate, or an equal predicate that compares the same type of time attributes (such as processing time and event time) in two input tables.

For example, the following predicate is a valid window join condition:

- ltime = rtime
- ltime >= rtime AND ltime < rtime + INTERVAL '10' MINUTE

- ltime BETWEEN rtime - INTERVAL '10' SECOND AND rtime + INTERVAL '5' SECOND

Example

Join all orders shipped within 4 hours with their associated shipments.

```
SELECT *
FROM Orders o, Shipments s
WHERE o.id = s.orderId AND
    o.ordertime BETWEEN s.shiptime - INTERVAL '4' HOUR AND s.shiptime;
```

Array Expansion

Precautions

This clause is used to return a new row for each element in the given array. Unnesting WITH ORDINALITY is not yet supported.

Example

```
SELECT users, tag
FROM Orders CROSS JOIN UNNEST(tags) AS t (tag);
```

User-Defined Table Functions

Function

This clause is used to join a table with the results of a table function. ach row of the left (outer) table is joined with all rows produced by the corresponding call of the table function.

Precautions

A left outer join against a lateral table requires a TRUE literal in the ON clause.

Example

The row of the left (outer) table is dropped, if its table function call returns an empty result.

```
SELECT users, tag
FROM Orders, LATERAL TABLE(unnest_udtf(tags)) t AS tag;
```

If a table function call returns an empty result, the corresponding outer row is preserved, and the result padded with null values.

```
SELECT users, tag
FROM Orders LEFT JOIN LATERAL TABLE(unnest_udtf(tags)) t AS tag ON TRUE;
```

Temporal Table Function Join

Function

Precautions

Currently only inner join and left outer join with temporal tables are supported.

Example

Assuming Rates is a temporal table function, the join can be expressed in SQL as follows:


```
SELECT
  o_amount, r_rate
FROM
  Orders,
  LATERAL TABLE (Rates(o_proctime))
WHERE
  r_currency = o_currency;
```

Join Temporal Tables

Function

This clause is used to join the Temporal table.

Syntax

```
SELECT column-names
FROM table1  [AS <alias1>]
[LEFT] JOIN table2 FOR SYSTEM_TIME AS OF table1.proctime [AS <alias2>]
ON table1.column-name1 = table2.key-name1
```

Description

- **table1.proctime** indicates the processing time attribute (computed column) of **table1**.
- **FOR SYSTEM_TIME AS OF table1.proctime** indicates that when the records in the left table are joined with the dimension table on the right, only the snapshot data is used for matching the current processing time dimension table.

Precautions

Only inner and left joins are supported for temporal tables with processing time attributes.

Example

LatestRates is a temporal table that is materialized with the latest rate.

```
SELECT
  o.amout, o.currency, r.rate, o.amount * r.rate
FROM
  Orders AS o
  JOIN LatestRates FOR SYSTEM_TIME AS OF o.proctime AS r
  ON r.currency = o.currency;
```

4.4.5 OrderBy & Limit

OrderBy

Function

This clause is used to sort data in ascending order on a time attribute.

Precautions

Currently, only sorting by time attribute is supported.

Example

Sort data in ascending order on the time attribute.


```
SELECT *
FROM Orders
ORDER BY orderTime;
```

Limit

Function

This clause is used to constrain the number of rows returned.

Precautions

This clause is used in conjunction with ORDER BY to ensure that the results are deterministic.

Example

```
SELECT *
FROM Orders
ORDER BY orderTime
LIMIT 3;
```

4.4.6 Top-N

Function

Top-N queries ask for the N smallest or largest values ordered by columns. Both smallest and largest values sets are considered Top-N queries. Top-N queries are useful in cases where the need is to display only the N bottom-most or the N top-most records from batch/streaming table on a condition.

Syntax

```
SELECT [column_list]
FROM (
  SELECT [column_list],
    ROW_NUMBER() OVER ([PARTITION BY col1[, col2...]]
      ORDER BY col1 [asc|desc][, col2 [asc|desc]...]) AS rownum
  FROM table_name)
WHERE rownum <= N [AND conditions]
```

Description

- ROW_NUMBER(): Allocate a unique and consecutive number to each line starting from the first line in the current partition. Currently, we only support ROW_NUMBER as the over window function. In the future, we will support RANK() and DENSE_RANK().
- PARTITION BY col1[, col2...]: Specifies the partition columns. Each partition will have a Top-N result.
- ORDER BY col1 [asc|desc][, col2 [asc|desc]...]: Specifies the ordering columns. The ordering directions can be different on different columns.
- WHERE rownum <= N: The rownum <= N is required for Flink to recognize this query is a Top-N query. The N represents the N smallest or largest records will be retained.
- [AND conditions]: It is free to add other conditions in the where clause, but the other conditions can only be combined with rownum <= N using AND conjunction.

Important Notes

- The TopN query is Result Updating.
- Flink SQL will sort the input data stream according to the order key,
- so if the top N records have been changed, the changed ones will be sent as retraction/update records to downstream.
- If the top N records need to be stored in external storage, the result table should have the same unique key with the Top-N query.

Example

This is an example to get the top five products per category that have the maximum sales in realtime.

```
SELECT *
  FROM (
     SELECT *,
         ROW_NUMBER() OVER (PARTITION BY category ORDER BY sales DESC) as row_num
     FROM ShopSales)
  WHERE row_num <= 5;
```

4.4.7 Deduplication

Function

Deduplication removes rows that duplicate over a set of columns, keeping only the first one or the last one.

Syntax

```
SELECT [column_list]
FROM (
   SELECT [column_list],
     ROW_NUMBER() OVER ([PARTITION BY col1[, col2...]]
       ORDER BY time_attr [asc|desc]) AS rownum
   FROM table_name)
WHERE rownum = 1
```

Description

- ROW_NUMBER(): Assigns a unique, sequential number to each row, starting with one.
- PARTITION BY col1[, col2...]: Specifies the partition columns, for example, the deduplicate key.
- ORDER BY time_attr [asc|desc]: Specifies the ordering column, it must be a time attribute. Currently Flink supports proctime only. Ordering by ASC means to keep the first row, ordering by DESC means to keep the last row.
- WHERE rownum = 1: The rownum = 1 is required for Flink to recognize this query is deduplication.

Precautions

None

Example

The following examples show how to remove duplicate rows on **order_id**. The proctime is an event time attribute.

```
SELECT order_id, user, product, number
  FROM (
    SELECT *,
        ROW_NUMBER() OVER (PARTITION BY order_id ORDER BY proctime ASC) as row_num
    FROM Orders)
  WHERE row_num = 1;
```

4.5 Functions

4.5.1 User-Defined Functions

Overview

DLI supports the following three types of user-defined functions (UDFs):

- Regular UDF: takes in one or more input parameters and returns a single result.
- User-defined table-generating function (UDTF): takes in one or more input parameters and returns multiple rows or columns.
- User-defined aggregate function (UDAF): aggregates multiple records into one value.

NOTE

UDFs can only be used in dedicated queues.

POM Dependency

```
<dependency>
      <groupId>org.apache.flink</groupId>
      <artifactId>flink-table-common</artifactId>
      <version>1.10.0</version>
      <scope>provided</scope>
</dependency>
```

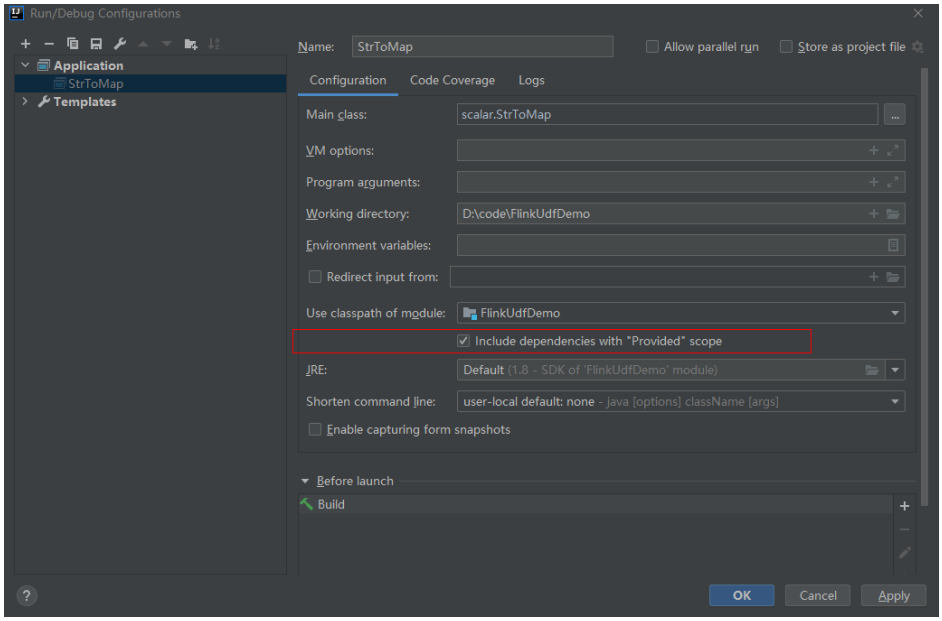
Important Notes

- Currently, Python is not supported for programming UDFs, UDTFs, and UDAFs.
- If you use IntelliJ IDEA to debug the created UDF, select **include dependencies with "Provided" scope**. Otherwise, the dependency packages in the POM file cannot be loaded for local debugging.

  The following uses IntelliJ IDEA 2020.2 as an example:

  a. On the IntelliJ IDEA page, select the configuration file you need to debug and click **Edit Configurations**.

b. On the **Run/Debug Configurations** page, select **include dependencies with "Provided" scope**.



c. Click **OK**.

Using UDFs

1. Encapsulate the implemented UDFs into a JAR package and upload the package to OBS.
2. In the navigation pane of the DLI management console, choose **Data Management** > **Package Management**. On the displayed page, click **Create** and use the JAR package uploaded to OBS to create a package.
3. In the left navigation, choose **Job Management** and click **Flink Jobs**. Locate the row where the target resides and click **Edit** in the **Operation** column to switch to the page where you can edit the job.
4. Click the **Running Parameters** tab of your job, select the UDF JAR and click **Save**.
5. Add the following statement to the SQL statements to use the functions:

UDF

The regular UDF must inherit the ScalarFunction function and implement the eval method. The open and close functions are optional.

Example code

```
import org.apache.flink.table.functions.FunctionContext;
import org.apache.flink.table.functions.ScalarFunction;
public class UdfScalarFunction extends ScalarFunction {
  private int factor = 12;
  public UdfScalarFunction() {
    this.factor = 12;
  }
  /**
   * (optional) Initialization
   * @param context
   */
  @Override
  public void open(FunctionContext context) {}
  /**
   * Custom logic
   * @param s
   * @return
   */
   public int eval(String s) {
     return s.hashCode() * factor;
   }
   /**
    * Optional
    */
   @Override
   public void close() {}
}
```

Example

```
CREATE FUNCTION udf_test AS 'com.company.udf.UdfScalarFunction';
INSERT INTO sink_stream select udf_test(attr) FROM source_stream;
```

UDTF

The UDTF must inherit the TableFunction function and implement the eval method. The open and close functions are optional. If the UDTF needs to return multiple columns, you only need to declare the returned value as **Tuple** or **Row**. If **Row** is used, you need to overload the getResultType method to declare the returned field type.

Example code

```
import org.apache.flink.api.common.typeinfo.TypeInformation;
import org.apache.flink.api.common.typeinfo.Types;
import org.apache.flink.table.functions.FunctionContext;
import org.apache.flink.table.functions.TableFunction;
import org.apache.flink.types.Row;
import org.slf4j.Logger;
import org.slf4j.LoggerFactory;
public class UdfTableFunction extends TableFunction<Row> {
  private Logger log = LoggerFactory.getLogger(TableFunction.class);
  /**
   * (optional) Initialization
   * @param context
   */
  @Override
  public void open(FunctionContext context) {}
  public void eval(String str, String split) {
    for (String s : str.split(split)) {
      Row row = new Row(2);
      row.setField(0, s);
      row.setField(1, s.length());
      collect(row);
    }
```



```
}
/**
 * Declare the type returned by the function
 * @return
 */
@Override
public TypeInformation<Row> getResultType() {
return Types.ROW(Types.STRING, Types.INT);
}
/**
  * Optional
 */
@Override
public void close() {}
}
```

Example

The UDTF supports CROSS JOIN and LEFT JOIN. When the UDTF is used, the **LATERAL** and **TABLE** keywords must be included.

- CROSS JOIN: does not output the data of a row in the left table if the UDTF does not output the result for the data of the row.
- LEFT JOIN: outputs the data of a row in the left table even if the UDTF does not output the result for the data of the row, but pads null with UDTF-related fields.

```
CREATE FUNCTION udtf_test AS 'com.company.udf.TableFunction';
// CROSS JOIN
INSERT INTO sink_stream select subValue, length FROM source_stream, LATERAL
TABLE(udtf_test(attr, ',')) as T(subValue, length);
// LEFT JOIN
INSERT INTO sink_stream select subValue, length FROM source_stream LEFT JOIN LATERAL
TABLE(udtf_test(attr, ',')) as T(subValue, length) ON TRUE;
```

UDAF

The UDAF must inherit the AggregateFunction function. You need to create an accumulator for storing the computing result, for example, **WeightedAvgAccum** in the following example code.

Example code

```
public class WeightedAvgAccum {
public long sum = 0;
public int count = 0;
}
```

```
import org.apache.flink.table.functions.AggregateFunction;
import java.util.Iterator;
/**
* The first type variable is the type returned by the aggregation function, and the second type variable is of
the Accumulator type.
* Weighted Average user-defined aggregate function.
*/
public class UdfAggFunction extends AggregateFunction<Long, WeightedAvgAccum> {
// Initialize the accumulator.
  @Override
  public WeightedAvgAccum createAccumulator() {
    return new WeightedAvgAccum();
  }
// Return the intermediate computing value stored in the accumulator.
  @Override
  public Long getValue(WeightedAvgAccum acc) {
    if (acc.count == 0) {
      return null;
```



```
   } else {
     return acc.sum / acc.count;
 }
}
// Update the intermediate computing value according to the input.
public void accumulate(WeightedAvgAccum acc, long iValue) {
acc.sum += iValue;
acc.count += 1;
}
// Perform the retraction operation, which is opposite to the accumulate operation.
public void retract(WeightedAvgAccum acc, long iValue) {
acc.sum -= iValue;
acc.count -= 1;
}
// Combine multiple accumulator values.
public void merge(WeightedAvgAccum acc, Iterable<WeightedAvgAccum> it) {
Iterator<WeightedAvgAccum> iter = it.iterator();
while (iter.hasNext()) {
WeightedAvgAccum a = iter.next();
acc.count += a.count;
acc.sum += a.sum;
}
}
// Reset the intermediate computing value.
public void resetAccumulator(WeightedAvgAccum acc) {
acc.count = 0;
acc.sum = 0L;
}
}
```

Example

```
CREATE FUNCTION udaf_test AS 'com.company.udf.UdfAggFunction';
INSERT INTO sink_stream SELECT udaf_test(attr2) FROM source_stream GROUP BY attr1;
```

4.5.2 Built-In Functions

4.5.2.1 Mathematical Operation Functions

Relational Operators

All data types can be compared by using relational operators and the result is returned as a BOOLEAN value.

Relationship operators are binary operators. Two compared data types must be of the same type or they must support implicit conversion.

Table 4-30 lists all relational operators supported by Flink SQL.

Table 4-30 Relational Operators

Operator	Returned Data Type	Description
A = B	BOOLEAN	If A is equal to B, then **TRUE** is returned. Otherwise, **FALSE** is returned. This operator is used for value assignment.

Operator	Returned Data Type	Description
A <> B	BOOLEAN	If A is not equal to B, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned. This operator follows the standard SQL syntax.
A < B	BOOLEAN	If A is less than B, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned.
A <= B	BOOLEAN	If A is less than or equal to B, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned.
A > B	BOOLEAN	If A is greater than B, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned.
A >= B	BOOLEAN	If A is greater than or equal to B, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned.
A IS NULL	BOOLEAN	If A is **NULL**, then **TRUE** is returned. Otherwise, **FALSE** is returned.
A IS NOT NULL	BOOLEAN	If A is not **NULL**, then **TRUE** is returned. Otherwise, **FALSE** is returned.
A IS DISTINCT FROM B	BOOLEAN	If A is not equal to B, **TRUE** is returned. **NULL** indicates A equals B.
A IS NOT DISTINCT FROM B	BOOLEAN	If A is equal to B, **TRUE** is returned. **NULL** indicates A equals B.
A BETWEEN [ASYMMETRIC | SYMMETRIC] B AND C	BOOLEAN	If A is greater than or equal to B but less than or equal to C, **TRUE** is returned. • ASYMMETRIC: indicates that B and C are location-related. For example, "A BETWEEN ASYMMETRIC B AND C" is equivalent to "A BETWEEN B AND C". • SYMMETRIC: indicates that B and C are not location-related. For example, "A BETWEEN SYMMETRIC B AND C" is equivalent to "A BETWEEN B AND C) OR (A BETWEEN C AND B".

Operator	Returned Data Type	Description
A NOT BETWEEN B [ASYMMETRIC | SYMMETRIC]AND C	BOOLEAN	If A is less than B or greater than C, **TRUE** is returned. ● ASYMMETRIC: indicates that B and C are location-related. For example, "A NOT BETWEEN ASYMMETRIC B AND C" is equivalent to "A NOT BETWEEN B AND C". ● SYMMETRIC: indicates that B and C are not location-related. For example, "A NOT BETWEEN SYMMETRIC B AND C" is equivalent to "(A NOT BETWEEN B AND C) OR (A NOT BETWEEN C AND B)".
A LIKE B [ESCAPE C]	BOOLEAN	If A matches pattern B, **TRUE** is returned. The escape character C can be defined as required.
A NOT LIKE B [ESCAPE C]	BOOLEAN	If A does not match pattern B, **TRUE** is returned. The escape character C can be defined as required.
A SIMILAR TO B [ESCAPE C]	BOOLEAN	If A matches regular expression B, **TRUE** is returned. The escape character C can be defined as required.
A NOT SIMILAR TO B [ESCAPE C]	BOOLEAN	If A does not match regular expression B, **TRUE** is returned. The escape character C can be defined as required.
value IN (value [, value]*)	BOOLEAN	If the value is equal to any value in the list, **TRUE** is returned.
value NOT IN (value [, value]*)	BOOLEAN	If the value is not equal to any value in the list, **TRUE** is returned.
EXISTS (sub-query)	BOOLEAN	If sub-query returns at least one row, **TRUE** is returned.
value IN (sub-query)	BOOLEAN	If value is equal to a row returned by subquery, **TRUE** is returned.
value NOT IN (sub-query)	BOOLEAN	If value is not equal to a row returned by subquery, **TRUE** is returned.

Precautions

- Values of the double, real, and float types may be different in precision. The equal sign (=) is not recommended for comparing two values of the double type. You are advised to obtain the absolute value by subtracting these two values of the double type and determine whether they are the same based on

the absolute value. If the absolute value is small enough, the two values of the double data type are regarded equal. For example:

```
abs(0.9999999999 - 1.0000000000) < 0.000000001 //The precision decimal places of 0.9999999999 and 1.0000000000 are 10, while the precision decimal place of 0.000000001 is 9. Therefore, 0.9999999999 can be regarded equal to 1.0000000000.
```

- Comparison between data of the numeric type and character strings is allowed. During comparison using relational operators, including >, <, ≤, and ≥, data of the string type is converted to numeric type by default. No characters other than numeric characters are allowed.
- Character strings can be compared using relational operators.

Logical Operators

Common logical operators are AND, OR, and NOT. Their priority order is NOT > AND > OR.

Table 4-31 lists the calculation rules. A and B indicate logical expressions.

Table 4-31 Logical Operators

Operator	Result Type	Description
A OR B	BOOLEAN	If A or B is TRUE, **TRUE** is returned. Three-valued logic is supported.
A AND B	BOOLEAN	If both A and B are TRUE, **TRUE** is returned. Three-valued logic is supported.
NOT A	BOOLEAN	If A is not TRUE, **TRUE** is returned. If A is UNKNOWN, **UNKNOWN** is returned.
A IS FALSE	BOOLEAN	If A is TRUE, **TRUE** is returned. If A is UNKNOWN, **FALSE** is returned.
A IS NOT FALSE	BOOLEAN	If A is not FALSE, **TRUE** is returned. If A is UNKNOWN, **TRUE** is returned.
A IS TRUE	BOOLEAN	If A is TRUE, **TRUE** is returned. If A is UNKNOWN, **FALSE** is returned.
A IS NOT TRUE	BOOLEAN	If A is not TRUE, **TRUE** is returned. If A is UNKNOWN, **TRUE** is returned.
A IS UNKNOWN	BOOLEAN	If A is UNKNOWN, **TRUE** is returned.
A IS NOT UNKNOWN	BOOLEAN	If A is not UNKNOWN, **TRUE** is returned.

Precautions

Only data of the Boolean type can be used for calculation using logical operators. Implicit type conversion is not supported.

Arithmetic Operators

Arithmetic operators include binary operators and unary operators, for all of which, the returned results are of the numeric type. **Table 4-32** lists arithmetic operators supported by Flink SQL.

Table 4-32 Arithmetic Operators

Operator	Result Type	Description
+ numeric	All numeric types	Returns numbers.
- numeric	All numeric types	Returns negative numbers.
A + B	All numeric types	A plus B. The result type is associated with the operation data type. For example, if floating-point number is added to an integer, the result will be a floating-point number.
A - B	All numeric types	A minus B. The result type is associated with the operation data type.
A * B	All numeric types	Multiply A and B. The result type is associated with the operation data type.
A / B	All numeric types	Divide A by B. The result is a double-precision number.
POWER(A, B)	All numeric types	Returns the value of A raised to the power B.
ABS(numeric)	All numeric types	Returns the absolute value of a specified value.

Operator	Result Type	Description
MOD(A, B)	All numeric types	Returns the remainder (modulus) of A divided by B. A negative value is returned only when A is a negative value.
SQRT(A)	All numeric types	Returns the square root of A.
LN(A)	All numeric types	Returns the nature logarithm of A (base e).
LOG10(A)	All numeric types	Returns the base 10 logarithms of A.
LOG2(A)	All numeric types	Returns the base 2 logarithm of A.
LOG(B) LOG(A, B)	All numeric types	When called with one argument, returns the natural logarithm of B. When called with two arguments, this function returns the logarithm of B to the base A. B must be greater than 0 and A must be greater than 1.
EXP(A)	All numeric types	Return the value of e raised to the power of **a**.
CEIL(A) CEILING(A)	All numeric types	Return the smallest integer that is greater than or equal to **a**. For example: ceil(21.2) = 22.
FLOOR(A)	All numeric types	Return the largest integer that is less than or equal to **a**. For example: floor(21.2) = 21.
SIN(A)	All numeric types	Returns the sine value of A.

Operator	Result Type	Description
COS(A)	All numeric types	Returns the cosine value of A.
TAN(A)	All numeric types	Returns the tangent value of A.
COT(A)	All numeric types	Returns the cotangent value of A.
ASIN(A)	All numeric types	Returns the arc sine value of A.
ACOS(A)	All numeric types	Returns the arc cosine value of A.
ATAN(A)	All numeric types	Returns the arc tangent value of A.
ATAN2(A, B)	All numeric types	Returns the arc tangent of a coordinate (A, B).
COSH(A)	All numeric types	Returns the hyperbolic cosine of A. Return value type is DOUBLE.
DEGREES(A)	All numeric types	Convert the value of **a** from radians to degrees.
RADIANS(A)	All numeric types	Convert the value of **a** from degrees to radians.

Operator	Result Type	Description
SIGN(A)	All numeric types	Returns the sign of A. **1** is returned if A is positive. **–1** is returned if A is negative. Otherwise, **0** is returned.
ROUND(A, d)	All numeric types	Returns a number rounded to **d** decimal places for A. For example: round(21.263,2) = 21.26.
PI	All numeric types	Returns the value of **pi**.
E()	All numeric types	Returns the value of **e**.
RAND()	All numeric types	Returns a pseudorandom double value in the range [0.0, 1.0)
RAND(A)	All numeric types	Returns a pseudorandom double value in the range [0.0, 1.0) with an initial seed A. Two RAND functions will return identical sequences of numbers if they have the same initial seed.
RAND_INTEGER(A)	All numeric types	Returns a pseudorandom double value in the range [0.0, A)
RAND_INTEGER(A, B)	All numeric types	Returns a pseudorandom double value in the range [0.0, B) with an initial seed A.
UUID()	All numeric types	Returns a UUID string.
BIN(A)	All numeric types	Returns a string representation of integer A in binary format. Returns NULL if A is NULL.

Operator	Result Type	Description
HEX(A) HEX(B)	All numeric types	Returns a string representation of an integer A value or a string B in hex format. Returns NULL if the A or B is NULL.
TRUNCATE(A, d)	All numeric types	Returns a number of truncated to **d** decimal places. Returns NULL if A or **d** is NULL. Example: truncate (42.345, 2) = 42.340 truncate(42.345) = 42.000
PI()	All numeric types	Returns the value of **pi**.

Precautions

Data of the string type is not allowed in arithmetic operations.

4.5.2.2 String Functions

Table 4-33 String functions

SQL Function	Return Type	Description
string1 || string2	STRING	Returns the concatenation of string1 and string2.
CHAR_LENGTH(string) CHARACTER_LENGTH(string)	INT	Returns the number of characters in the string.
UPPER(string)	STRING	Returns the string in uppercase.
LOWER(string)	STRING	Returns the string in lowercase.
POSITION(string1 IN string2)	INT	Returns the position (start from **1**) of the first occurrence of string1 in string2; returns **0** if string1 cannot be found in string2.

SQL Function	Return Type	Description
TRIM([BOTH | LEADING | TRAILING] string1 FROM string2)	STRING	Returns a string that removes leading and/or trailing characters string2 from string1.
LTRIM(string)	STRING	Returns a string that removes the left whitespaces from the specified string. For example, **LTRIM(' This is a test String.')** returns **"This is a test String."**.
RTRIM(string)	STRING	Returns a string that removes the right whitespaces from the specified string. For example, **RTRIM('This is a test String. ')** returns **"This is a test String."**.
REPEAT(string, integer)	STRING	Returns a string that repeats the base string integer times. For example, **REPEAT('This is a test String.', 2)** returns **"This is a test String.This is a test String."**.
REGEXP_REPLACE(string1, string2, string3)	STRING	Returns a string from string1 with all the substrings that match a regular expression string2 consecutively being replaced with string3. For example, **REGEXP_REPLACE('foobar', 'oo|ar', '')** returns **"fb"**. **REGEXP_REPLACE('ab\ab', '\\', 'e')** returns **"abeab"**.
OVERLAY(string1 PLACING string2 FROM integer1 [FOR integer2])	STRING	Returns a string that replaces integer2 characters of STRING1 with STRING2 from position integer1. The default value of integer2 is the length of string2. For example, **OVERLAY('This is an old string' PLACING ' new' FROM 10 FOR 5)** returns **"This is a new string"**.
SUBSTRING(string FROM integer1 [FOR integer2])	STRING	Returns a substring of the specified string starting from position integer1 with length integer2 (to the end by default). If integer2 is not configured, the substring from integer1 to the end is returned by default.

SQL Function	Return Type	Description
REPLACE(string1, string2, string3)	STRING	Returns a new string which replaces all the occurrences of string2 with string3 (non-overlapping) from string1. For example, **REPLACE('hello world', 'world', 'flink')** returns **"hello flink"**; **REPLACE('ababab', 'abab', 'z')** returns **"zab"**. **REPLACE('ab\\ab', '\\', 'e')** returns **"abeab"**.
REGEXP_EXTRACT(string1, string2[, integer])	STRING	Returns a string from string1 which extracted with a specified regular expression string2 and a regex match group index integer. Returns NULL, if the parameter is NULL or the regular expression is invalid. For example, **REGEXP_EXTRACT('foothebar', 'foo(.*?)(bar)', 2)"** returns **"bar"**.
INITCAP(string)	STRING	Returns a new form of STRING with the first character of each word converted to uppercase and the rest characters to lowercase.
CONCAT(string1, string2,...)	STRING	Returns a string that concatenates string1, string2, …. For example, **CONCAT('AA', 'BB', 'CC')** returns **"AABBCC"**.
CONCAT_WS(string1, string2, string3,...)	STRING	Returns a string that concatenates string2, string3, … with a separator string1. The separator is added between the strings to be concatenated. Returns NULL if string1 is NULL. If other arguments are NULL, this function automatically skips NULL arguments. For example, **CONCAT_WS('~', 'AA', NULL, 'BB', '', 'CC')** returns **"AA~BB~~CC"**.
LPAD(string1, integer, string2)	STRING	Returns a new string from string1 left-padded with string2 to a length of integer characters. If any argument is NULL, NULL is returned. If integer is negative, NULL is returned. If the length of string1 is shorter than integer, returns string1 shortened to integer characters. For example, **LPAD(Symbol,4,Symbol)** returns **"Symbol hi"**. **LPAD('hi',1,'??')** returns **"h"**.

SQL Function	Return Type	Description
RPAD(string1, integer, string2)	STRING	Returns a new string from string1 right-padded with string2 to a length of integer characters. If any argument is NULL, NULL is returned. If integer is negative, NULL is returned. If the length of string1 is shorter than integer, returns string1 shortened to integer characters. For example, **RPAD('hi',4,'??')** returns **"hi??"**. **RPAD('hi',1,'??')** returns **"h"**.
FROM_BASE64(string)	STRING	Returns the base64-decoded result from string. Returns NULL if string is NULL. For example, **FROM_BASE64('aGVsbG8gd29ybGQ=')** returns **"hello world"**.
TO_BASE64(string)	STRING	Returns the base64-encoded result from string; f string is NULL. Returns NULL if string is NULL. For example, **TO_BASE64(hello world)** returns **"aGVsbG8gd29ybGQ="**.
ASCII(string)	INT	Returns the numeric value of the first character of string. Returns NULL if string is NULL. For example, **ascii('abc')** returns **97.** **ascii(CAST(NULL AS VARCHAR))** returns **NULL**.
CHR(integer)	STRING	Returns the ASCII character having the binary equivalent to integer. If integer is larger than 255, we will get the modulus of integer divided by 255 first, and returns CHR of the modulus. Returns NULL if integer is NULL. **chr(97)** returns **a**. **chr(353)** Return **a**.
DECODE(binary, string)	STRING	Decodes the first argument into a String using the provided character set (one of 'US-ASCII', 'ISO-8859-1', 'UTF-8', 'UTF-16BE', 'UTF-16LE', 'UTF-16'). If either argument is NULL, the result will also be NULL.

SQL Function	Return Type	Description
ENCODE(strinh1, string2)	STRING	Encodes the string1 into a BINARY using the provided string2 character set (one of 'US-ASCII', 'ISO-8859-1', 'UTF-8', 'UTF-16BE', 'UTF-16LE', 'UTF-16'). If either argument is NULL, the result will also be NULL.
INSTR(string1, string2)	INT	Returns the position of the first occurrence of string2 in string1. Returns NULL if any argument is NULL.
LEFT(string, integer)	STRING	Returns the leftmost integer characters from the string. Returns EMPTY String if integer is negative. Returns NULL if any argument is NULL.
RIGHT(string, integer)	STRING	Returns the rightmost integer characters from the string. Returns EMPTY String if integer is negative. Returns NULL if any argument is NULL.
LOCATE(string1, string2[, integer])	INT	Returns the position of the first occurrence of string1 in string2 after position integer. Returns 0 if not found. The value of **integer** defaults to **0**. Returns NULL if any argument is NULL.
PARSE_URL(string1, string2[, string3])	STRING	Returns the specified part from the URL. Valid values for string2 include 'HOST', 'PATH', 'QUERY', 'REF', 'PROTOCOL', 'AUTHORITY', 'FILE', and 'USERINFO'. Returns NULL if any argument is NULL. If string2 is QUERY, the key in QUERY can be specified as string3. Example: The **parse_url('http://facebook.com/path1/p.php?k1=v1&k2=v2#Ref1', 'HOST')** returns **'facebook.com'**. **parse_url('http://facebook.com/path1/p.php?k1=v1&k2=v2#Ref1', 'QUERY', 'k1') returns 'v1'**.

SQL Function	Return Type	Description
REGEXP(string1, string2)	BOOLEAN	Returns TRUE if any (possibly empty) substring of string1 matches the regular expression string2, otherwise FALSE. If the information is found, TRUE is returned. string1 indicates the specified string, and string2 indicates the regular expression. Returns NULL if any argument is NULL.
REVERSE(string)	STRING	Returns the reversed string. Returns NULL if string is NULL.
SPLIT_INDEX(string1, string2, integer1)	STRING	Splits string1 by the delimiter string2, returns the integer1-th (zero-based) string of the split strings. Returns NULL if integer is negative. Returns NULL if any argument is NULL.
STR_TO_MAP(string1[, string2, string3]])	MAP	Returns a map after splitting the string1 into key/value pairs using delimiters. The default value of string2 is **','**. The default value of string3 is **'='**.
SUBSTR(string[, integer1[, integer2]])	STRING	Returns a substring of string starting from position integer1 with length integer2. If integer2 is not specified, the string is truncated to the end.
JSON_VAL(STRING json_string, STRING json_path)	STRING	Returns the value of the specified **json_path** from the **json_string**. For details about how to use the functions, see **JSON_VAL Function**. **NOTE** The following rules are listed in descending order of priority. 1. The two arguments **json_string** and **json_path** cannot be **NULL**. 2. The value of **json_string** must be a valid JSON string. Otherwise, the function returns **NULL**. 3. If **json_string** is an empty string, the function returns an empty string. 4. If **json_path** is an empty string or the path does not exist, the function returns **NULL**.

JSON_VAL Function

- Syntax

```
STRING JSON_VAL(STRING json_string, STRING json_path)
```


Table 4-34 Parameter description

Parameter	Type	Description
json_string	STRING	JSON object to be parsed
json_path	STRING	Path expression for parsing the JSON string For the supported expressions, see **Table 4-35**.

Table 4-35 Expressions supported

Expression	Description
$	Root node in the path
[]	Access array elements
*	Array wildcard
.	Access child elements

- Example
  a. Test input data.

     Test the data source kafka. The message content is as follows:

     ```
     "{name:James,age:24,sex:male,grade:{math:95,science:[80,85],english:100}}"
     "{name:James,age:24,sex:male,grade:{math:95,science:[80,85],english:100}]"
     ```

  b. Use JSON_VAL in SQL statements.

     ```
     create table kafkaSource(
       message STRING
     )
     with (
       'connector.type' = 'kafka',
       'connector.version' = '0.11',
       'connector.topic' = '<i>topic-swq</i>',
       'connector.properties.bootstrap.servers' =
     'xxx.xxx.xxx.xxx:9092,yyy.yyy.yyy:9092,zzz.zzz.zzz.zzz:9092',
       'connector.startup-mode' = 'earliest-offset',
       'format.field-delimiter' = '|',
       'format.type' = 'csv'
     );

     create table kafkaSink(
       message1 STRING,
       message2 STRING,
       message3 STRING,
       message4 STRING,
       message5 STRING,
       message6 STRING
     )
     with (
       'connector.type' = 'kafka',
       'connector.version' = '0.11',
       'connector.topic' = '<i>topic-swq-out</i>',
       'connector.properties.bootstrap.servers' =
     'xxx.xxx.xxx.xxx:9092,yyy.yyy.yyy:9092,zzz.zzz.zzz.zzz:9092',
       'format.type' = 'json'
     );
     ```



```
INSERT INTO kafkaSink
SELECT
JSON_VAL(message,""),
JSON_VAL(message,"$.name"),
JSON_VAL(message,"$.grade.science"),
JSON_VAL(message,"$.grade.science[*]"),
JSON_VAL(message,"$.grade.science[1]"),
JSON_VAL(message,"$.grade.dddd")
FROM kafkaSource;
```

c. View output.

```
{"message1":null,"message2":"swq","message3":"[80,85]","message4":"[80,85]","message5":"85"
,"message6":null}
{"message1":null,"message2":null,"message3":null,"message4":null,"message5":null,"message6":
null}
```

4.5.2.3 Temporal Functions

Table 4-36 lists the temporal functions supported by Flink OpenSource SQL.

Function Description

Table 4-36 Temporal functions

Function	Return Type	Description
DATE string	DATE	Parse the date string (**yyyy-MM-dd**) to a SQL date.
TIME string	TIME	Parse the time string (**HH:mm:ss[.fff]**) to a SQL time.
TIMESTAMP string	TIMESTAMP	Convert the time string into a timestamp. The time string format is **yyyy-MM-dd HH:mm:ss[.fff]**.

Function	Return Type	Description
INTERVAL string range	INTERVAL	Parse an interval string in the following two forms: • **yyyy-MM** for SQL intervals of months. An interval range might be **YEAR** or **YEAR TO MONTH**. • **dd hh:mm:ss.fff** for SQL intervals of milliseconds. An interval range might be **DAY**, **MINUTE**, **DAY TO HOUR**, or **DAY TO SECOND**. Example: **INTERVAL '10 00:00:00.004' DAY TO second** indicates that the interval is 10 days and 4 milliseconds. **INTERVAL '10' DAY**: indicates that the interval is 10 days. **INTERVAL '2-10' YEAR TO MONTH** indicates that the interval is two years and ten months.
CURRENT_DATE	DATE	Return the SQL date of UTC time zone.
CURRENT_TIME	TIME	Return the SQL time of UTC time zone.
CURRENT_TIMESTAMP	TIMESTAMP	Return the SQL timestamp of UTC time zone.
LOCALTIME	TIME	Return the SQL time of the local time zone.
LOCALTIMESTAMP	TIMESTAMP	Return the SQL timestamp of the local time zone.
EXTRACT(timeintervalunit FROM temporal)	BIGINT	Extract part of the time point or interval. Return the part in the int type. For example, extract the date **2006-06-05** and return **5**. **EXTRACT(DAY FROM DATE '2006-06-05')** returns **5**.
YEAR(date)	BIGINT	Return the year from a SQL date. For example, **YEAR(DATE'1994-09-27')** returns **1994**.
QUARTER(date)	BIGINT	Return the quarter of a year from a SQL date.
MONTH(date)	BIGINT	Return the month of a year from a SQL date. For example, **MONTH(DATE '1994-09-27')** returns **9**.

Function	Return Type	Description
WEEK(date)	BIGINT	Return the week of a year from a SQL date. For example, **WEEK(DATE'1994-09-27')** returns **39**.
DAYOFYEAR(date)	BIGINT	Return the day of a year from a SQL date. For example, **DAYOFYEAR(DATE '1994-09-27')** is **270**.
DAYOFMONTH(date)	BIGINT	Return the day of a month from a SQL date. For example, **DAYOFMONTH(DATE'1994-09-27')** returns **27**.
DAYOFWEEK(date)	BIGINT	Return the day of a week from a SQL date. Sunday is set to **1**. For example, **DAYOFWEEK(DATE'1994-09-27')** returns **3**.
HOUR(timestamp)	BIGINT	Return the hour of a day (an integer between 0 and 23) from a SQL timestamp. For example, **HOUR(TIMESTAMP '1994-09-27 13:14:15')** returns **13**.
MINUTE(timestamp)	BIGINT	Return the minute of an hour (an integer between 0 and 59) from a SQL timestamp. For example, **MINUTE(TIMESTAMP '1994-09-27 13:14:15')** returns **14**.
SECOND(timestamp)	BIGINT	Returns the second of a minute (an integer between 0 and 59) from a SQL timestamp. For example, **SECOND(TIMESTAMP '1994-09-27 13:14:15')** returns **15**.
FLOOR(timepoint TO timeintervalunit)	TIME	Round a time point down to the given unit. For example, **12:44:00** is returned from **FLOOR(TIME '12:44:31' TO MINUTE)**.
CEIL(timepoint TO timeintervalunit)	TIME	Round a time point up to the given unit. For example, **CEIL(TIME '12:44:31' TO MINUTE)** returns **12:45:00**.

Function	Return Type	Description
(timepoint1, temporal1) OVERLAPS (timepoint2, temporal2)	BOOLEAN	Return **TRUE** if two time intervals overlap. Example: **(TIME '2:55:00', INTERVAL '1' HOUR) OVERLAPS (TIME '3:30:00', INTERVAL '2' HOUR)** returns **TRUE**. **(TIME '9:00:00', TIME '10:00:00') OVERLAPS (TIME '10:15:00', INTERVAL '3' HOUR)** returns **FALSE**.
DATE_FORMAT(timestamp, string)	STRING	Convert a timestamp to a value of string in the format specified by the date format string.
TIMESTAMPADD(timeintervalunit, interval, timepoint)	TIMESTAMP/ DATE/ TIME	Return the date and time added to **timepoint** based on the result of **interval** and **timeintervalunit**. For example, **TIMESTAMPADD(WEEK, 1, DATE '2003-01-02')** returns **2003-01-09**.
TIMESTAMPDIFF(timepointunit, timepoint1, timepoint2)	INT	Return the (signed) number of timepointunit between **timepoint1** and **timepoint2**. The unit for the interval is given by the first argument, which should be one of the following values: **SECOND**, **MINUTE**, **HOUR**, **DAY**, **MONTH**, and **YEAR**. For example, **TIMESTAMPDIFF(DAY, TIMESTAMP '2003-01-02 10:00:00', TIMESTAMP '2003-01-03 10:00:00')** returns **1**.
CONVERT_TZ(string1, string2, string3)	TIMESTAMP	Convert a datetime **string1** from time zone **string2** to time zone **string3**. For example, **CONVERT_TZ('1970-01-01 00:00:00', 'UTC', 'America/Los_Angeles')** returns **'1969-12-31 16:00:00'**.
FROM_UNIXTIME(numeric[, string])	STRING	Return a representation of the numeric argument as a value in string format. The default string format is YYYY-MM-DD hh:mm:ss. For example, **FROM_UNIXTIME(44)** returns **1970-01-01 09:00:44**.
UNIX_TIMESTAMP()	BIGINT	Get current Unix timestamp in seconds.

Function	Return Type	Description
UNIX_TIMESTAMP(string1[, string2])	BIGINT	Convert date time string **string1** in format **string2** to Unix timestamp (in seconds), using the specified timezone in table config. The default format of **string2** is yyyy-MM-dd HH:mm:ss.
TO_DATE(string1[, string2])	DATE	Convert a date string **string1** with format **string2** to a date. The default format of **string2** is yyyy-MM-dd.
TO_TIMESTAMP(string1[, string2])	TIMESTAMP	Convert date time string **string1** with format **string2** to a timestamp. The default format of **string2** is yyyy-MM-dd HH:mm:ss.

DATE

- **Function**

  Returns a date parsed from string in form of **yyyy-MM-dd**.

- **Description**

  ```
  DATE DATE string
  ```

- **Input parameters**

Parameter	Type	Description
string	STRING	String in the SQL date format. Note that the string must be in the **yyyy-MM-dd** format. Otherwise, an error will be reported.

- **Example**

  - Test statement

    ```
    SELECT
      DATE "2021-08-19" AS `result`
    FROM
      testtable;
    ```

  - Test result

result
2021-08-19

TIME

- **Function**

  Returns a SQL time parsed from string in form of **HH:mm:ss[.fff]**.

- **Description**

  TIME **TIME** string

- **Input parameters**

Parameter	Type	Description
string	STRING	Time Note that the string must be in the format of **HH:mm:ss[.fff]**. Otherwise, an error will be reported.

- **Example**

  – Test statement

  ```
  SELECT
    TIME "10:11:12" AS `result`,
      TIME "10:11:12.032" AS `result2`
  FROM
    testtable;
  ```

  – Test result

result	result2
10:11:12	10:11:12.032

TIMESTAMP

- **Function**

  Converts the time string into timestamp. The time string format is **yyyy-MM-dd HH:mm:ss[.fff]**. The return value is of the **TIMESTAMP(3)** type.

- **Description**

  TIMESTAMP(3) **TIMESTAMP** string

- **Input parameters**

Parameter	Type	Description
string	STRING	Time Note that the string must be in the format of **yyyy-MM-dd HH:mm:ss[.fff]**. Otherwise, an error will be reported.

- **Example**

  – Test statement

  ```
  SELECT
    TIMESTAMP "1997-04-25 13:14:15" AS `result`,
  ```



```
    TIMESTAMP "1997-04-25 13:14:15.032" AS `result2`
FROM
  testtable;
```

– Test result

result	result2
1997-04-25 13:14:15	1997-04-25 13:14:15.032

INTERVAL

- **Function**

  Parses an interval string.

- **Description**

  ```
  INTERVAL INTERVAL string range
  ```

- **Input parameters**

Parameter	Type	Description
string	STRING	Timestamp string used together with the **range** parameter. The string is in either of the following two formats: • **yyyy-MM** for SQL intervals of months. An interval range might be **YEAR** or **YEAR TO MONTH** for intervals of months. • **dd hh:mm:ss.fff** for SQL intervals of milliseconds. An interval range might be **DAY**, **MINUTE**, **DAY TO HOUR**, or **DAY TO SECOND**.
range	INTERVAL	Interval range. This parameter is used together with the **string** parameter. Available values are as follows: **YEAR, YEAR To Month, DAY, MINUTE, DAY TO HOUR and DAY TO SECOND**.

- **Example**

  Test statement

  ```
  -- The interval is 10 days and 4 milliseconds.
  INTERVAL '10 00:00:00.004' DAY TO second
  -- The interval is 10 days.
  INTERVAL '10'
  -- The interval is 2 years and 10 months.
  INTERVAL '2-10' YEAR TO MONTH
  ```

CURRENT_DATE

- **Function**

  Returns the current SQL time (**yyyy-MM-dd**) in the local time zone. The return value is of the **DATE** type.

- **Description**
  DATE **CURRENT_DATE**
- **Input parameters**

  N/A
- **Example**
  - Test statement
    ```
    SELECT
      CURRENT_DATE AS `result`
    FROM
      testtable;
    ```
  - Test result

result
2021-10-28

CURRENT_TIME

- **Function**

  Returns the current SQL time (**HH:mm:sss.fff**) in the local time zone. The return value is of the **TIME** type.
- **Description**
  TIME **CURRENT_TIME**
- **Input parameters**

  N/A
- **Example**
  - Test statement
    ```
    SELECT
      CURRENT_TIME AS `result`
    FROM
      testtable;
    ```
  - Test result

result
08:29:19.289

CURRENT_TIMESTAMP

- **Function**

  Returns the current SQL timestamp in the local time zone. The return value is of the **TIMESTAMP(3)** type.
- **Description**
  TIMESTAMP(3) **CURRENT_TIMESTAMP**
- **Input parameters**

  N/A
- **Example**
  - Test statement


```
SELECT
   CURRENT_TIMESTAMP AS `result`
FROM
   testtable;
```

– Test result

result
2021-10-28 08:33:51.606

LOCALTIME

- **Function**

  Returns the current SQL time in the local time zone. The return value is of the **TIME** type.

- **Description**

  ```
  TIME LOCALTIME
  ```

- **Input parameters**

  N/A

- **Example**

  – Test statement

  ```
  SELECT
     LOCALTIME AS `result`
  FROM
     testtable;
  ```

  – Test result

result
16:39:37.706

LOCALTIMESTAMP

- **Function**

  Returns the current SQL timestamp in the local time zone. The return value is of the **TIMESTAMP(3)** type.

- **Description**

  ```
  TIMESTAMP(3) LOCALTIMESTAMP
  ```

- **Input parameters**

  N/A

- **Example**

  – Test statement

  ```
  SELECT
     LOCALTIMESTAMP AS `result`
  FROM
     testtable;
  ```

  – Test result

result
2021-10-28 16:43:17.625

EXTRACT

- **Function**

  Returns a value extracted from the **timeintervalunit** part of temporal. The return value is of the **BIGINT** type.

- **Description**

  BIGINT **EXTRACT**(timeinteravlunit **FROM** temporal)

- **Input parameters**

Parameter	Type	Description
timeinteravlunit	TIMEUNIT	Time unit to be extracted from a time point or interval. The value can be **YEAR**, **QUARTER**, **MONTH**, **WEEK**, **DAY**, **DOY**, **HOUR**, **MINUTE**, **SECOND**.
temporal	DATE/TIME/ TIMESTAMP/ INTERVAL	Time point or interval.

CAUTION

Do not specify a time unit that is not of any time points or intervals. Otherwise, the job fails to be submitted.

For example, an error message is displayed when the following statement is executed because **YEAR** cannot be extracted from **TIME**.

```
SELECT
   EXTRACT(YEAR FROM TIME '12:44:31' ) AS `result`
FROM
   testtable;
```

- **Example**

  - Test statement

    ```
    SELECT
       EXTRACT(YEAR FROM DATE '1997-04-25' ) AS `result`,
          EXTRACT(MINUTE FROM TIME '12:44:31') AS `result2`,
          EXTRACT(SECOND FROM TIMESTAMP '1997-04-25 13:14:15') AS `result3`,
          EXTRACT(YEAR FROM INTERVAL '2-10' YEAR TO MONTH) AS `result4`,
    FROM
       testtable;
    ```

  - Test result

result	result2	result3	result4
1997	44	15	2

YEAR

- **Function**

  Returns the year from a SQL date. The return value is of the **BIGINT** type.

- **Description**

```
BIGINT YEAR(date)
```

- **Input parameters**

Parameter	Type	Description
date	DATE	SQL date

- **Example**
  - Test statement

```
SELECT
    YEAR(DATE '1997-04-25' ) AS `result`
FROM
    testtable;
```

  - Test result

result
1997

QUARTER

- **Function**

  Returns the quarter of a year (an integer between 1 and 4) from a SQL date. The return value is of the **BIGINT** type.

- **Description**

```
BIGINT QUARTER(date)
```

- **Input parameters**

Parameter	Type	Description
date	DATE	SQL date

- **Example**
  - Test statement

```
SELECT
    QUARTER(DATE '1997-04-25' ) AS `result`
FROM
    testtable;
```

  - Test result

Result
2

MONTH

- **Function**

  Returns the month of a year (an integer between 1 and 12) from a SQL date. The return value is of the **BIGINT** type.

- **Description**

```
BIGINT MONTH(date)
```

- **Input parameters**

Parameter	Type	Description
date	DATE	SQL date

- **Example**
  - Test statement

```
SELECT
  MONTH(DATE '1997-04-25' ) AS `result`
FROM
  testtable;
```

  - Test result

result
4

WEEK

- **Function**

  Returns the week of a year from a SQL date. The return value is of the **BIGINT** type.

- **Description**

```
BIGINT WEEK(date)
```

- **Input parameters**

Parameter	Type	Description
date	DATE	SQL date

- **Example**
  - Test statement

```
SELECT
  WEEK(DATE '1997-04-25' ) AS `result`
FROM
  testtable;
```

  - Test result

result
17

DAYOFYEAR

- **Function**

  Returns the day of a year (an integer between 1 and 366) from SQL date. The return value is of the **BIGINT** type.

- **Description**

```
BIGINT DAYOFYEAR(date)
```

- **Input parameters**

Parameter	Type	Description
date	DATE	SQL date

- **Example**
  - Test statement

```
SELECT
  DAYOFYEAR(DATE '1997-04-25' ) AS `result`
FROM
  testtable;
```

  - Test result

result
115

DAYOFMONTH

- **Function**

  Returns the day of a month (an integer between 1 and 31) from a SQL date. The return value is of the **BIGINT** type.

- **Description**

```
BIGINT DAYOFMONTH(date)
```

- **Input parameters**

Parameter	Type	Description
date	DATE	SQL date

- **Example**
  - Test statement

```
SELECT
  DAYOFMONTH(DATE '1997-04-25' ) AS `result`
FROM
  testtable;
```

  - Test result

Result
25

DAYOFWEEK

- **Function**

  Returns the day of a week (an integer between 1 and 7) from a SQL date. The return value is of the **BIGINT** type.

  NOTE

  Note that the start day of a week is Sunday.

- **Description**

  BIGINT **DAYOFWEEK**(date)

- **Input parameters**

Parameter	Type	Description
date	DATE	SQL date

- **Example**
  - Test statement

    ```
    SELECT
      DAYOFWEEK(DATE '1997-04-25') AS `result`
    FROM
      testtable;
    ```

  - Test result

result
6

HOUR

- **Function**

  Returns the hour of a day (an integer between 0 and 23) from SQL timestamp. The return value is of the **BIGINT** type.

- **Description**

  BIGINT **HOUR**(timestamp)

- **Input parameters**

Parameter	Type	Description
timestamp	TIMESTAMP	SQL timestamp

- **Example**
  - Test statement

    ```
    SELECT
      HOUR(TIMESTAMP '1997-04-25 10:11:12') AS `result`
    FROM
      testtable;
    ```

  - Test result

result
10

MINUTE

- **Function**

  Returns the minute of an hour (an integer between 0 and 59) from a SQL timestamp. The return value is of the **BIGINT** type.

- **Description**

  BIGINT **MINUTE**(timestamp)

- **Input parameters**

Parameter	Type	Description
timestamp	TIMESTAMP	SQL timestamp

- **Example**
  - Test statement

    ```
    SELECT
      MINUTE(TIMESTAMP '1997-04-25 10:11:12') AS `result`
    FROM
      testtable;
    ```

  - Test result

result
11

SECOND

- **Function**

  Returns the second of an hour (an integer between 0 and 59) from a SQL timestamp. The return value is of the **BIGINT** type.

- **Description**

  BIGINT **SECOND**(timestamp)

- **Input parameters**

Parameter	Type	Description
timestamp	TIMESTAMP	SQL timestamp

- **Example**
  - Test statement

    ```
    SELECT
      SECOND(TIMESTAMP '1997-04-25 10:11:12') AS `result`
    FROM
      testtable;
    ```

  - Test result

result
12

FLOOR

- **Function**

  Returns a value that rounds **timepoint** down to the time unit **timeintervalunit**.

- **Description**

  ```
  TIME/TIMESTAMP(3) FLOOR(timepoint TO timeintervalunit)
  ```

- **Input parameters**

Parameter	Type	Description
timepoint	TIMESTAMP /TIME	SQL time or SQL timestamp
timeintervalunit	TIMEUNIT	Time unit. The value can be **YEAR**, **QUARTER**, **MONTH**, **WEEK**, **DAY**, **DOY**, **HOUR**, **MINUTE**, or **SECOND**.

- **Example**

  – Test statement For details about the syntax of the userDefined result table, see **User-defined Result Table**.

  ```
  create table PrintSink (
    message TIME,
    message2 TIME,
    message3 TIMESTAMP(3)
  )
  with (
    'connector.type' = 'user-defined',
    'connector.class-name' = 'com.swqtest.flink.sink.PrintSink'--Replace the class with a user-defined class. For details, see the syntax description in the userDefined result table.
  );

  INSERT INTO
      PrintSink
  SELECT
      FLOOR(TIME '13:14:15' TO MINUTE) AS `result`
          FLOOR(TIMESTAMP '1997-04-25 13:14:15' TO MINUTE) AS `result2`,
          FLOOR(TIMESTAMP '1997-04-25 13:14:15' TO MINUTE) AS `result3`;
  ```

  – Test result

  The values of the fields in the PrintSink table are as follows:

Message	Message 2	Message 3
13:14	13:14	1997-04-25T13:14

CEIL

- **Function**

  Returns a value that rounds **timepoint** up to the time unit **timeintervalunit**.

- **Description**
  TIME/TIMESTAMP(3) **CEIL**(timepoint **TO** timeintervalunit)
- **Input parameters**

Parameter	Type	Description
timepoint	TIMESTAMP /TIME	SQL time or SQL timestamp
timeintervalunit	TIMEUNIT	Time unit. The value can be **YEAR**, **QUARTER**, **MONTH**, **WEEK**, **DAY**, **DOY**, **HOUR**, **MINUTE**, or **SECOND**.

- **Example**
  - Test statement For details about the syntax of the userDefined result table, see **User-defined Result Table**.

```
create table PrintSink (
  message TIME,
  message2 TIME,
  message3 TIMESTAMP(3)
)
with (
  'connector.type' = 'user-defined',
  'connector.class-name' = 'com.swqtest.flink.sink.PrintSink'--Replace the class with a user-defined class. For details, see the syntax description in the userDefined result table.
);

INSERT INTO
    PrintSink
SELECT
    CEIL(TIME '13:14:15' TO MINUTE) AS `result`
        CEIL(TIMESTAMP '1997-04-25 13:14:15' TO MINUTE) AS `result2`,
        CEIL(TIMESTAMP '1997-04-25 13:14:15' TO MINUTE) AS `result3`;
```

  - Test result

result	result2	result3
13:15	13:15	1997-04-25T13:15

OVERLAPS

- **Function**
  Returns **TRUE** if two time intervals overlap; returns **FALSE** otherwise.
- **Description**
  BOOLEAN (timepoint1, temporal1) **OVERLAPS** (timepoint2, temporal2)
- **Input parameters**

Parameter	Type	Description
timepoint1/ timepoint2	DATE/TIME/ TIMESTAMP	Time point
temporal1/ temporal2	DATE/TIME/ TIMESTAMP/ INTERVAL	Time point or interval

NOTE

- **(timepoint, temporal)** is a closed interval.
- The temporal can be of the **DATE**, **TIME**, **TIMESTAMP**, or **INTERVAL** type.
  - When th temporal is **DATE**, **TIME**, or **TIMESTAMP**, **(timepoint, temporal)** indicates an interval between **timepoint** and **temporal**. The temporal can be earlier than the value of **timepoint**, for example, **(DATE '1997-04-25', DATE '1997-04-23')**.
  - When the temporal is **INTERVAL**, **(timepoint, temporal)** indicates an interval between **timepoint** and **timepoint + temporal**.
- Ensure that **(timepoint1, temporal1)** and **(timepoint2, temporal2)** are intervals of the same data type.

- **Example**
  - Test statement

```
SELECT
   (TIME '2:55:00', INTERVAL '1' HOUR) OVERLAPS (TIME '3:30:00', INTERVAL '2' HOUR) AS `result`,
      (TIME '2:30:00', INTERVAL '1' HOUR) OVERLAPS (TIME '3:30:00', INTERVAL '2' HOUR) AS `result2`,
   (TIME '2:30:00', INTERVAL '1' HOUR) OVERLAPS (TIME '3:31:00', INTERVAL '2' HOUR) AS `result3`,
   (TIME '9:00:00', TIME '10:00:00') OVERLAPS (TIME '10:00:00', INTERVAL '3' HOUR) AS `result4`,
   (TIMESTAMP '1997-04-25 12:00:00', TIMESTAMP '1997-04-25 12:20:00') OVERLAPS (TIMESTAMP '1997-04-25 13:00:00', INTERVAL '2' HOUR) AS `result5`,
   (DATE '1997-04-23', INTERVAL '2' DAY) OVERLAPS (DATE '1997-04-25', INTERVAL '2' DAY) AS `result6`,
   (DATE '1997-04-25', DATE '1997-04-23') OVERLAPS (DATE '1997-04-25', INTERVAL '2' DAY) AS `result7`
FROM
   testtable;
```

  - Test result

result	result2	result3	result4	result5	result6	result7
true	true	false	true	false	true	true

DATE_FORMAT

- **Function**

  Converts a timestamp to a value of string in the format specified by the date format string.

- **Description**

```
STRING DATE_FORMAT(timestamp, dateformat)
```

- **Input parameters**

Parameter	Type	Description
timestamp	TIMESTAMP/ STRING	Time point
dateformat	STRING	String in the date format

- **Example**
  - Test statement

```
SELECT
    DATE_FORMAT(TIMESTAMP '1997-04-25 10:11:12', 'yyyy-MM-dd HH:mm:ss') AS `result`,
        DATE_FORMAT(TIMESTAMP '1997-04-25 10:11:12', 'yyyy-MM-dd') AS `result2`,
    DATE_FORMAT(TIMESTAMP '1997-04-25 10:11:12', 'yy/MM/dd HH:mm') AS `result3`,
        DATE_FORMAT('1997-04-25 10:11:12', 'yyyy-MM-dd') AS `result4`
FROM    testtable;
```

  - Test result

result	result2	result3	result4
1997-04-25 10:11:12	1997-04-25	97/04/25 10:11	1997-04-25

TIMESTAMPADD

- **Function**

  Returns the date and time by combining **interval** and **timeintervalunit** and adding the combination to **timepoint**.

  NOTE

  The return value of **TIMESTAMPADD** is the value of **timepoint**. An exception is that if the input **timepoint** is of the **TIMESTAMP** type, the return value can be inserted into a table field of the **DATE** type.

- **Description**

```
TIMESTAMP(3)/DATE/TIME TIMESTAMPADD(timeintervalunit, interval, timepoint)
```

- **Input parameters**

Parameter	Type	Description
timeintervalunit	TIMEUNIT	Time unit
interval	INT	Interval
timepoint	TIMESTAMP/ DATE/TIME	Time point

- **Example**
  - Test statement

```
SELECT
    TIMESTAMPADD(WEEK, 1, DATE '1997-04-25') AS `result`,
        TIMESTAMPADD(QUARTER, 1, TIMESTAMP '1997-04-25 10:11:12') AS `result2`,
    TIMESTAMPADD(SECOND, 2, TIME '10:11:12') AS `result3`
FROM    testtable;
```

  - Test result

result	result2	result3
1997-05-02	• If this field is inserted into a table field of the **TIMESTAMP** type, **1997-07-25T10:11:12** is returned. • If this field is inserted into a table field of the **DATE** type, **1997-07-25** is returned.	10:11:14

TIMESTAMPDIFF

- **Function**

  Returns the (signed) number of **timepointunit** between **timepoint1** and **timepoint2**. The unit for the interval is given by the first argument.

- **Description**

  INT **TIMESTAMPDIFF**(timepointunit, timepoint1, timepoint2)

- **Input parameters**

Parameter	Type	Description
timepointunit	TIMEUNIT	Time unit. The value can be **SECOND**, **MINUTE**, **HOUR**, **DAY**, **MONTH** or **YEAR**.
timepoint1/ timepoint2	TIMESTAMP/ DATE	Time point

- **Example**
  - Test statement

```
SELECT
    TIMESTAMPDIFF(DAY, TIMESTAMP '1997-04-25 10:00:00', TIMESTAMP '1997-04-28 10:00:00')
AS `result`,
        TIMESTAMPDIFF(DAY, DATE '1997-04-25', DATE '1997-04-28') AS `result2`,
    TIMESTAMPDIFF(DAY, TIMESTAMP '1997-04-27 10:00:20', TIMESTAMP '1997-04-25 10:00:00')
AS `result3`
FROM     testtable;
```

  - Test result

result	result2	result3
3	3	-2

CONVERT_TZ

- **Function**

  Converts a datetime **string1** (with default ISO timestamp format **'yyyy-MM-dd HH:mm:ss'**) from time zone **string2** to time zone **string3**.

- **Description**
  STRING **CONVERT_TZ**(string1, string2, string3)
- **Input parameters**

Parameter	Type	Description
string1	STRING	SQL timestamp. If the value does not meet the format requirements, **NULL** is returned.
string2	STRING	Time zone before conversion. The format of time zone should be either an abbreviation such as **PST**, a full name such as **America/Los_Angeles**, or a custom ID such as **GMT-08:00**.
string3	STRING	Time zone after conversion. The format of time zone should be either an abbreviation such as **PST**, a full name such as **America/Los_Angeles**, or a custom ID such as **GMT-08:00**.

- **Example**
  - Test statement

```
SELECT
   CONVERT_TZ(1970-01-01 00:00:00, UTC, America/Los_Angeles) AS `result`,
      CONVERT_TZ(1997-04-25 10:00:00, UTC, GMT-08:00) AS `result2`
FROM    testtable;
```

  - Test result

result	result2
1969-12-31 16:00:00	1997-04-25 02:00:00

FROM_UNIXTIME

- **Function**

  Returns a representation of the **numeric** argument as a value in string format.
- **Description**
  STRING **FROM_UNIXTIME**(numeric[, string])
- **Input parameters**

Parameter	Type	Description
numeric	BIGINT	An internal timestamp representing the number of seconds since 1970-01-01 00:00:00 UTC. The value can be generated by the **UNIX_TIMESTAMP()** function.

Parameter	Type	Description
string	STRING	Time. If this parameter is not specified, the default time format is **yyyy-MM-dd HH:mm:ss** format.

- **Example**
  - Test statement

```
SELECT
    FROM_UNIXTIME(44) AS `result`,
        FROM_UNIXTIME(44, 'yyyy:MM:dd') AS `result2`
FROM    testtable;
```

  - Test result

result	result2
1970-01-01 08:00:44	1970:01:01

UNIX_TIMESTAMP

- **Function**

  Gets current Unix timestamp in seconds. The return value is of the **BIGINT** type.

- **Description**

```
BIGINT UNIX_TIMESTAMP()
```

- **Input parameters**

  N/A

- **Example**
  - Test statement

```
SELECT
    UNIX_TIMESTAMP() AS `result`
FROM
    table;
```

  - Test result

result
1635401982

UNIX_TIMESTAMP(string1[, string2])

- **Function**

  Converts date time **string1** in format **string2** to Unix timestamp (in seconds). The return value is of the **BIGINT** type.

- **Description**

```
BIGINT UNIX_TIMESTAMP(string1[, string2])
```

- **Input parameters**

Parameter	Type	Description
string1	STRING	SQL timestamp string. An error is reported if the value does not comply with the **string2** format.
string2	STRING	Time. If this parameter is not specified, the default time format is **yyyy-MM-dd HH:mm:ss**.

- **Example**
  - Test statement

```
SELECT
   UNIX_TIMESTAMP('1997-04-25', 'yyyy-MM-dd') AS `result`,
      UNIX_TIMESTAMP('1997-04-25 00:00:10', 'yyyy-MM-dd HH:mm:ss') AS `result2`,
      UNIX_TIMESTAMP('1997-04-25 00:00:00') AS `result3`
FROM
   testtable;
```

  - Test result

result	result2	result3
861897600	861897610	861897600

TO_DATE

- **Function**

  Converts a date **string1** with format **string2** to a date.

- **Description**

```
DATE TO_DATE(string1[, string2])
```

- **Input parameters**

Parameter	Type	Description
string1	STRING	SQL timestamp string. If the value is not in the required format, an error is reported.
string2	STRING	Format. If this parameter is not specified, the default time format is **yyyy-MM-dd**.

- **Example**
  - Test statement

```
SELECT
   TO_DATE('1997-04-25') AS `result`,
      TO_DATE('1997:04:25', 'yyyy-MM-dd') AS `result2`,
      TO_DATE('1997-04-25 00:00:00', 'yyyy-MM-dd HH:mm:ss') AS `result3`
FROM
   testtable;
```

  - Test result

result	result2	result3
1997-04-25	1997-04-25	1997-04-25

TO_TIMESTAMP

- **Function**

  Converts date time **string1** with format **string2** to a timestamp.

- **Description**

  ```
  TIMESTAMP TO_TIMESTAMP(string1[, string2])
  ```

- **Input parameters**

Parameter	Type	Description
string1	STRING	SQL timestamp string. If the value is not in the required format, **NULL** is returned.
string2	STRING	Date format. If this parameter is not specified, the default format is **yyyy-MM-dd HH:mm:ss**.

- **Example**
  - Test statement

    ```
    SELECT
      TO_TIMESTAMP('1997-04-25', 'yyyy-MM-dd') AS `result`,
          TO_TIMESTAMP('1997-04-25 00:00:00') AS `result2`,
          TO_TIMESTAMP('1997-04-25 00:00:00', 'yyyy-MM-dd HH:mm:ss') AS `result3`
    FROM
      testtable;
    ```

  - Test result

result	result2	result3
1997-04-25 00:00	1997-04-25 00:00	1997-04-25 00:00

4.5.2.4 Conditional Functions

Description

Table 4-37 Conditional functions

Function	Description
CASE value WHEN value1_1 [, value1_2]* THEN result1 [WHEN value2_1 [, value2_2]* THEN result2]* [ELSE resultZ] END	Returns **resultX** when the value is contained in (valueX_1, valueX_2, …). Only the first matched value is returned. When no value matches, returns **resultZ** if it is provided and returns **NULL** otherwise.
CASE WHEN condition1 THEN result1 [WHEN condition2 THEN result2]* [ELSE resultZ] END	Returns **resultX** when the first **conditionX** is met. Only the first matched value is returned. When no condition is met, returns **resultZ** if it is provided and returns **NULL** otherwise.
NULLIF(value1, value2)	Returns NULL if value1 is equal to value2; returns value1 otherwise. For example, **NullIF (5, 5)** returns **NULL**. **NULLIF(5, 0)** returns **5**.
COALESCE(value1, value2 [, value3]*)	Returns the first value (from left to right) that is not NULL from value1, value2, …. For example, **COALESCE(NULL, 5)** returns **5**.
IF(condition, true_value, false_value)	Returns the **true_value** if condition is met, otherwise **false_value**. For example, **IF(5 > 3, 5, 3)** returns **5**.
IS_ALPHA(string)	Returns **TRUE** if all characters in the string are letters, otherwise **FALSE**.
IS_DECIMAL(string)	Returns **TRUE** if string can be parsed to a valid numeric, otherwise **FALSE**.
IS_DIGIT(string)	Returns **TRUE** if all characters in the string are digits, otherwise **FALSE**.

4.5.2.5 Type Conversion Function

Syntax

```
CAST(value AS type)
```

Syntax Description

This function is used to forcibly convert types.

Precautions

If the input is **NULL**, **NULL** is returned.

Example

The following example converts the **amount** value to an integer.

```
insert into temp select cast(amount as INT) from source_stream;
```

Table 4-38 Examples of type conversion functions

Example	Description	Example
cast(v1 as string)	Converts **v1** to a string. The value of **v1** can be of the numeric type or of the timestamp, date, or time type.	Table T1: | content (INT)

5	 Statement: SELECT cast(content as varchar) FROM T1; Result: "5"
cast (v1 as int)	Converts **v1** to the **int** type. The value of **v1** can be a number or a character.	Table T1: | content (STRING)

"5"	 Statement: SELECT cast(content as int) FROM T1; Result: 5

Example	Description	Example
cast(v1 as timestamp)	Converts **v1** to the **timestamp** type. The value of **v1** can be of the **string**, **date**, or **time** type.	Table T1: | content (STRING)

"2018-01-01 00:00:01"	 Statement: SELECT cast(content as timestamp) FROM T1; Result: 1514736001000
cast(v1 as date)	Converts **v1** to the **date** type. The value of **v1** can be of the **string** or **timestamp** type.	Table T1: | content (TIMESTAMP)

1514736001000	 Statement: SELECT cast(content as date) FROM T1; Result: "2018-01-01"

NOTE

Flink jobs do not support the conversion of **bigint** to **timestamp** using CAST. You can convert it using **to_timestamp**.

Detailed Sample Code

```
/** source **/
CREATE
TABLE car_infos (cast_int_to_string int, cast_String_to_int string,
case_string_to_timestamp string, case_timestamp_to_date timestamp(3)) WITH (
  'connector.type' = 'dis',
  'connector.region' = 'xxxxx',
  'connector.channel' = 'dis-input',
  'format.type' = 'json'
);
/** sink **/
CREATE
TABLE cars_infos_out (cast_int_to_string string, cast_String_to_int
int, case_string_to_timestamp timestamp(3), case_timestamp_to_date date) WITH (
  'connector.type' = 'dis',
  'connector.region' = 'xxxxx',
  'connector.channel' = 'dis-output',
  'format.type' = 'json'
);
/** Statistics on static car information**/
INSERT
INTO
  cars_infos_out
SELECT
  cast(cast_int_to_string as string),
  cast(cast_String_to_int as int),
  cast(case_string_to_timestamp as timestamp),
  cast(case_timestamp_to_date as date)
FROM
  car_infos;
```


4.5.2.6 Collection Functions

Description

Table 4-39 Collection functions

Function	Description
CARDINALITY(array)	Returns the number of elements in array.
array '[' integer ']'	Returns the element at position INT in array. The index starts from 1.
ELEMENT(array)	Returns the sole element of array (whose cardinality should be one) Returns **NULL** if array is empty. Throws an exception if array has more than one element.
CARDINALITY(map)	Returns the number of entries in map.
map '[' key ']'	Returns the value specified by key value in map.

4.5.2.7 Value Construction Functions

Description

Table 4-40 Value construction functions

Function	Description
ROW(value1, [, value2]*) (value1, [, value2]*)	Returns a row created from a list of values (value1, value2,…).
ARRAY '[' value1 [, value2]* ']'	Returns an array created from a list of values (value1, value2, …).
MAP '[' key1, value1 [, key2, value2]* ']'	Returns a map created from a list of key-value pairs ((value1, value2), (value3, value4), …). The key-value pair is (key1, value1), (key2, value2).

4.5.2.8 Value Access Functions

Description

Table 4-41 Value access functions

Function	Description
tableName.compositeType.field	Returns the value of a field from a Flink composite type (e.g., Tuple, POJO) by name.
tableName.compositeType.*	Returns a flat representation of a Flink composite type (e.g., Tuple, POJO) that converts each of its direct subtype into a separate field.

4.5.2.9 Hash Functions

Description

Table 4-42 Hash functions

Function	Description
MD5(string)	Returns the MD5 hash as a string that contains 32 hexadecimal digits. Returns **NULL** if **string** is **NULL**.
SHA1(string)	Returns the SHA-1 hash as a string that contains 40 hexadecimal digits. Returns **NULL** if **string** is **NULL**.
SHA224(string)	Returns the SHA-224 hash as a string that contains 56 hexadecimal digits. Returns **NULL** if **string** is **NULL**.
SHA256(string)	Returns the SHA-256 hash as a string that contains 64 hexadecimal digits. Returns **NULL** if **string** is **NULL**.
SHA384(string)	Returns the SHA-384 hash as a string that contains 96 hexadecimal digits. Returns **NULL** if **string** is **NULL**.
SHA512(string)	Returns the SHA-512 hash as a string that contains 128 hexadecimal digits. Returns **NULL** if **string** is **NULL**.

Function	Description
SHA2(string, hashLength)	Returns the hash using the SHA-2 family of hash functions (SHA-224, SHA-256, SHA-384, or SHA-512). The first argument string is the string to be hashed and the second argument hashLength is the bit length of the result (224, 256, 384, or 512). Returns **NULL** if **string** or hashLength is **NULL**.

4.5.2.10 Aggregate Function

An aggregate function performs a calculation operation on a set of input values and returns a value. For example, the COUNT function counts the number of rows retrieved by an SQL statement. **Table 4-43** lists aggregate functions.

Table 4-43 Aggregate functions

Function	Return Data Type	Description
COUNT([ALL] expression | DISTINCT expression1 [, expression2]*)	BIGINT	Returns the number of input rows for which the expression is not NULL. Use DISTINCT for one unique instance of each value.
COUNT(*) COUNT(1)	BIGINT	Returns the number of input rows.
AVG([ALL | DISTINCT] expression)	DOUBLE	Returns the average (arithmetic mean) of expression across all input rows. Use DISTINCT for one unique instance of each value.
SUM([ALL | DISTINCT] expression)	DOUBLE	Returns the sum of expression across all input rows. Use DISTINCT for one unique instance of each value.
MAX([ALL | DISTINCT] expression)	DOUBLE	Returns the maximum value of expression across all input rows.
MIN([ALL | DISTINCT] expression)	DOUBLE	Returns the minimum value of expression across all input rows.
STDDEV_POP([ALL | DISTINCT] expression)	DOUBLE	Returns the population standard deviation of expression across all input rows.
STDDEV_SAMP([ALL | DISTINCT] expression)	DOUBLE	Returns the sample standard deviation of expression across all input rows.

Function	Return Data Type	Description
VAR_POP([ALL | DISTINCT] expression)	DOUBLE	Returns the population variance (square of the population standard deviation) of expression across all input rows.
VAR_SAMP([ALL | DISTINCT] expression)	DOUBLE	Returns the sample variance (square of the sample standard deviation) of expression across all input rows.
COLLECT([ALL | DISTINCT] expression)	MULTISET	Returns a multiset of expression across all input rows.
VARIANCE([ALL | DISTINCT] expression)	DOUBLE	Returns the sample variance (square of the sample standard deviation) of expression across all input rows.
FIRST_VALUE(expression)	Actual type	Returns the first value in an ordered set of values.
LAST_VALUE(expression)	Actual type	Returns the last value in an ordered set of values.

4.5.2.11 Table-Valued Functions

4.5.2.11.1 split_cursor

The **split_cursor** function can convert one row of records into multiple rows or convert one column of records into multiple columns. Table-valued functions can only be used in JOIN LATERAL TABLE.

Table 4-44 split_cursor function

Function	Return Type	Description
split_cursor(value, delimiter)	cursor	Separates the "value" string into multiple rows of strings by using the delimiter.

Example

Input one record ("student1", "student2, student3") and output two records ("student1", "student2") and ("student1", "student3").

```
create table s1(attr1 string, attr2 string) with (.....);
insert into s2 select  attr1, b1 from s1 left join lateral table(split_cursor(attr2, ',')) as T(b1) on true;
```

4.5.2.11.2 string_split

The **string_split** function splits a target string into substrings based on the specified separator and returns a substring list.

Description

```
string_split(target, separator)
```

Table 4-45 string_split parameters

Parameter	Type	Description
target	STRING	Target string to be processed **NOTE** • If **target** is **NULL**, an empty line is returned. • If **target** contains two or more consecutive separators, an empty substring is returned. • If **target** does not contain a specified separator, the original string passed to **target** is returned.
separator	VARCHAR	Delimiter. Currently, only single-character delimiters are supported.

Example

1. Prepare test input data.

   Table 4-46 Source table disSource

target (STRING)	separator (VARCHAR)
test-flink	-
flink	-
one-two-ww-three	-

2. Write test SQL statements.

```
create table disSource(
  target STRING,
  separator  VARCHAR
) with (
  "connector.type" = "dis",
  "connector.region" = "xxx",
  "connector.channel" = "ygj-dis-in",
  "format.type" = 'csv'
```

```
);

create table disSink(
  target STRING,
  item STRING
) with (
  'connector.type' = 'dis',
  'connector.region' = 'xxx',
  'connector.channel' = 'ygj-dis-out',
  'format.type' = 'csv'
);

insert into
  disSink
select
  target,
  item
from
  disSource,
lateral table(string_split(target, separator)) as T(item);
```

3. Check test results.

Table 4-47 disSink result table

target (STRING)	item (STRING)
test-flink	test
test-flink	flink
flink	flink
one-two-ww-three	one
one-two-ww-three	two
one-two-ww-three	ww
one-two-ww-three	three

5 Historical Versions (Unavailable Soon)

5.1 Flink SQL Syntax

5.1.1 SQL Syntax Constraints and Definitions

Syntax Constraints

- Currently, Flink SQL only supports the following operations: SELECT, FROM, WHERE, UNION, aggregation, window, JOIN between stream and table data, and JOIN between streams.
- Data cannot be inserted into the source stream.
- The sink stream cannot be used to perform query operations.

Data Types Supported by Syntax

- Basic data types: VARCHAR, STRING, BOOLEAN, TINYINT, SMALLINT, INTEGER/INT, BIGINT, REAL/FLOAT, DOUBLE, DECIMAL, DATE, TIME, and TIMESTAMP
- Array: Square brackets ([]) are used to quote fields. The following is an example:
  ```
  insert into temp select CARDINALITY(ARRAY[1,2,3]) FROM OrderA;
  ```

Syntax Definition

```
INSERT INTO stream_name query;
query:
  values
  | {
      select
      | selectWithoutFrom
      | query UNION [ ALL ] query
    }

orderItem:
  expression [ ASC | DESC ]

select:
  SELECT
  { * | projectItem [, projectItem ]* }
```



```
  FROM tableExpression [ JOIN tableExpression ]
  [ WHERE booleanExpression ]
  [ GROUP BY { groupItem [, groupItem ]* } ]
  [ HAVING booleanExpression ]

selectWithoutFrom:
  SELECT [ ALL | DISTINCT ]
  { * | projectItem [, projectItem ]* }

projectItem:
  expression [ [ AS ] columnAlias ]
  | tableAlias . *

tableExpression:
  tableReference

tableReference:
  tablePrimary
  [ [ AS ] alias [ '(' columnAlias [, columnAlias ]* ')' ] ]

tablePrimary:
  [ TABLE ] [ [ catalogName . ] schemaName . ] tableName
  | LATERAL TABLE '(' functionName '(' expression [, expression ]* ')' ')'
  | UNNEST '(' expression ')'

values:
  VALUES expression [, expression ]*

groupItem:
  expression
  | '(' ')'
  | '(' expression [, expression ]* ')'
  | CUBE '(' expression [, expression ]* ')'
  | ROLLUP '(' expression [, expression ]* ')'
  | GROUPING SETS '(' groupItem [, groupItem ]* ')'
```

5.1.2 SQL Syntax Overview of Stream Jobs

This section describes the Flink SQL syntax list provided by DLI. For details about the parameters and examples, see the syntax description.

Table 5-1 SQL Syntax of stream jobs

Classification	Function
Creating a Source Stream	**CloudTable HBase Source Stream**
Creating a Source Stream	**DIS Source Stream**
	DMS Source Stream
Creating a Source Stream	**MRS Kafka Source Stream**
	Open-Source Kafka Source Stream
	OBS Source Stream
Creating a Sink Stream	**CloudTable HBase Sink Stream**
Creating a Sink Stream	**CloudTable OpenTSDB Sink Stream**
Creating a Sink Stream	**CSS Elasticsearch Sink Stream**
	DCS Sink Stream

Classification	Function
	DDS Sink Stream
	DIS Sink Stream
	DMS Sink Stream
	DWS Sink Stream (JDBC Mode)
	DWS Sink Stream (OBS-based Dumping)
Creating a Sink Stream	MRS HBase Sink Stream
	MRS Kafka Sink Stream
	Open-Source Kafka Sink Stream
	OBS Sink Stream
	RDS Sink Stream
Creating a Sink Stream	SMN Sink Stream
	File System Sink Stream (Recommended)
Creating a Temporary Stream	Creating a Temporary Stream
Creating a Dimension Table	Creating a Redis Table
	Creating an RDS Table
Custom Stream Ecosystem	Custom Source Stream
	Custom Sink Stream

5.1.3 Creating a Source Stream

5.1.3.1 CloudTable HBase Source Stream

Function

Create a source stream to obtain data from HBase of CloudTable as input data of the job. HBase is a column-oriented distributed cloud storage system that features enhanced reliability, excellent performance, and elastic scalability. It applies to the storage of massive amounts of data and distributed computing. You can use HBase to build a storage system capable of storing TB- or even PB-level data. With HBase, you can filter and analyze data with ease and get responses in milliseconds, rapidly mining data value. DLI can read data from HBase for filtering, analysis, and data dumping.

CloudTable is a distributed, scalable, and fully-hosted key-value data storage service based on Apache HBase. It provides DLI with high-performance random read and write capabilities, which are helpful when applications need to store and

query a massive amount of structured data, semi-structured data, and time series data. CloudTable applies to IoT scenarios and storage and query of massive volumes of key-value data. For more information about CloudTable, see the *CloudTable Service User Guide*.

Prerequisites

In this scenario, jobs must run on the dedicated queue of DLI. Therefore, DLI must interconnect with the enhanced datasource connection that has been connected with CloudTable HBase. You can also set the security group rules as required.

For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.

For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.

Syntax

```
CREATE SOURCE STREAM stream_id (attr_name attr_type (',' attr_name attr_type)* )
  WITH (
    type = "cloudtable",
    region = "",
    cluster_id = "",
    table_name = "",
    table_columns = ""
  );
```

Keyword

Table 5-2 Keyword description

Parameter	Mandatory	Description
type	Yes	Data source type. **CloudTable** indicates that the data source is CloudTable.
region	Yes	Region to which CloudTable belongs.
cluster_id	Yes	ID of the cluster to which the data table to be read belongs. For details about how to view the ID of the CloudTable cluster, see section "**Viewing Basic Cluster Information**" in the .
table_name	Yes	Name of the table from which data is to be read. If a namespace needs to be specified, set it to **namespace_name:table_name**.
table_columns	Yes	Column to be read. The format is **rowKey,f1:c1,f1:c2,f2:c1**. The number of columns must be the same as the number of attributes specified in the source stream.

Precautions

When creating a source stream, you can specify a time model for subsequent calculation. Currently, DLI supports two time models: Processing Time and Event Time. For details about the syntax, see **Configuring Time Models**.

Example

Read the **car_infos** table from HBase of CloudTable.

```
CREATE SOURCE STREAM car_infos (
  car_id STRING,
  car_owner STRING,
  car_age INT,
  average_speed INT,
  total_miles INT
)
  WITH (
    type = "cloudtable",
    region = "xxx",
    cluster_id = "209ab1b6-de25-4c48-8e1e-29e09d02de28",
    table_name = "carinfo",
    table_columns = "rowKey,info:owner,info:age,car:speed,car:miles"
);
```

5.1.3.2 DIS Source Stream

Function

Create a source stream to read data from DIS. DIS accesses user data and Flink job reads data from the DIS stream as input data for jobs. Flink jobs can quickly remove data from producers using DIS source sources for continuous processing. Flink jobs are applicable to scenarios where data outside the cloud service is imported to the cloud service for filtering, real-time analysis, monitoring reports, and dumping.

DIS addresses the challenge of transmitting data outside cloud services to cloud services. DIS builds data intake streams for custom applications capable of processing or analyzing streaming data. DIS continuously captures, transmits, and stores terabytes of data from hundreds of thousands of sources every hour, such as logs, Internet of Things (IoT) data, social media feeds, website clickstreams, and location-tracking events. For more information about DIS, see the *Data Ingestion Service User Guide*.

Syntax

```
CREATE SOURCE STREAM stream_id (attr_name attr_type (',' attr_name attr_type)* )
  WITH (
    type = "dis",
    region = "",
    channel = "",
    partition_count = "",
    encode = "",
    field_delimiter = "",
    offset= "");
```


Keyword

Table 5-3 Keyword description

Parameter	Mandatory	Description
type	Yes	Data source type. **dis** indicates that the data source is DIS.
region	Yes	Region where DIS for storing the data is located.
ak	No	Access Key ID (AK). For details about how to obtain the access key, see **My Credentials**.
sk	No	Specifies the secret access key used together with the ID of the access key. For details about how to obtain the access key, see **My Credentials**.
channel	Yes	Name of the DIS stream where data is located.
partition_count	No	Number of partitions of the DIS stream where data is located. This parameter and **partition_range** cannot be configured at the same time. If this parameter is not specified, data of all partitions is read by default.
partition_range	No	Range of partitions of a DIS stream, data in which is ingested by the DLI job. This parameter and **partition_count** cannot be configured at the same time. If this parameter is not specified, data of all partitions is read by default. If you set this parameter to **[0:2]**, data will be read from partitions 1, 2, and 3.
encode	Yes	Data encoding format. The value can be **csv**, **json**, **xml**, **email**, **blob**, or **user_defined**. • **field_delimiter** must be specified if this parameter is set to **csv**. • **json_config** must be specified if this parameter is set to **json**. • **xml_config** must be specified if this parameter is set to **xml**. • **email_key** must be specified if this parameter is set to **email**. • If this parameter is set to **blob**, the received data is not parsed, only one stream attribute exists, and the data format is ARRAY[TINYINT]. • **encode_class_name** and **encode_class_parameter** must be specified if this parameter is set to **user_defined**.
field_delimiter	No	Attribute delimiter. This parameter is mandatory only when the CSV encoding format is used. You can set this parameter, for example, to a comma (,).

Parameter	Mandatory	Description
quote	No	Quoted symbol in a data format. The attribute delimiters between two quoted symbols are treated as common characters. ● If double quotation marks are used as the quoted symbol, set this parameter to **\u005c\u0022** for character conversion. ● If a single quotation mark is used as the quoted symbol, set this parameter to a single quotation mark ('). **NOTE** ● Currently, only the CSV format is supported. ● After this parameter is specified, ensure that each field does not contain quoted symbols or contains an even number of quoted symbols. Otherwise, parsing will fail.
json_config	No	When the encoding format is JSON, you need to use this parameter to specify the mapping between JSON fields and stream definition fields. The format is **field1=data_json.field1; field2=data_json.field2; field3=$**, where **field3=$** indicates that the content of field3 is the entire JSON string.
xml_config	No	If **encode** is set to **xml**, you need to set this parameter to specify the mapping between the xml field and the stream definition field. An example of the format is as follows: field1=data_xml.field1; field2=data_xml.field2.
email_key	No	If **encode** is set to **email**, you need to set the parameter to specify the information to be extracted. You need to list the key values that correspond to stream definition fields. Multiple key values are separated by commas (,), for example, "Message-ID, Date, Subject, body". There is no keyword in the email body and DLI specifies "body" as the keyword.
encode_class_name	No	If **encode** is set to **user_defined**, you need to set this parameter to the name of the user-defined decoding class (including the complete package path). The class must inherit the **DeserializationSchema** class.
encode_class_parameter	No	If **encode** is set to **user_defined**, you can set this parameter to specify the input parameter of the user-defined decoding class. Only one parameter of the string type is supported.
offset	No	● If data is imported to the DIS stream after the job is started, this parameter will become invalid. ● If the job is started after data is imported to the DIS stream, you can set the parameter as required. For example, if **offset** is set to **100**, DLI starts from the 100th data record in DIS.

Parameter	Mandatory	Description
start_time	No	Start time for reading DIS data. • If this parameter is specified, DLI reads data read from the specified time. The format is **yyyy-MM-dd HH:mm:ss**. • If neither **start_time** nor **offset** is specified, DLI reads the latest data. • If **start_time** is not specified but **offset** is specified, DLI reads data from the data record specified by **offset**.
enable_checkpoint	No	Whether to enable the checkpoint function. The value can be **true** (enabled) or **false** (disabled). The default value is **false**.
checkpoint_app_name	No	ID of a DIS consumer. If a DIS stream is consumed by different jobs, you need to configure the consumer ID for each job to avoid checkpoint confusion.
checkpoint_interval	No	Interval of checkpoint operations on the DIS source operator. The value is in the unit of seconds. The default value is **60**.

Precautions

When creating a source stream, you can specify a time model for subsequent calculation. Currently, DLI supports two time models: Processing Time and Event Time. For details about the syntax, see **Configuring Time Models**.

Example

- In CSV encoding format, DLI reads data from the DIS stream and records it as codes in CSV format. The codes are separated by commas (,).

```
CREATE SOURCE STREAM car_infos (
  car_id STRING,
  car_owner STRING,
  car_age INT,
  average_speed INT,
  total_miles INT,
  car_timestamp LONG
)
  WITH (
    type = "dis",
    region = "xxx",
    channel = "dliinput",
    encode = "csv",
    field_delimiter = ","
);
```

- In JSON encoding format, DLI reads data from the DIS stream and records it as codes in JSON format. For example, {"car":{"car_id":"ZJA710XC", "car_owner":"coco", "car_age":5, "average_speed":80, "total_miles":15000, "car_timestamp":1526438880}}

```
CREATE SOURCE STREAM car_infos (
  car_id STRING,
```



```
  car_owner STRING,
  car_age INT,
  average_speed INT,
  total_miles INT,
  car_timestamp LONG
)
  WITH (
    type = "dis",
    region = "xxx",
    channel = "dliinput",
    encode = "json",
    json_config = "car_id=car.car_id;car_owner =car.car_owner;car_age=car.car_age;average_speed
=car.average_speed ;total_miles=car.total_miles;"
);
```

- In XML encoding format, DLI reads data from the DIS stream and records it as codes in XML format.

```
CREATE SOURCE STREAM person_infos (
    pid BIGINT,
    pname STRING,
    page int,
    plocation STRING,
    pbir DATE,
    phealthy BOOLEAN,
    pgrade ARRAY[STRING]
)
  WITH (
    type = "dis",
    region = "xxx",
    channel = "dis-dli-input",
    encode = "xml",
    field_delimiter = ",",
    xml_config =
"pid=person.pid;page=person.page;pname=person.pname;plocation=person.plocation;pbir=person.pbir;
pgrade=person.pgrade;phealthy=person.phealthy"
);
```

  An example of XML data is as follows:

```
<?xml version="1.0" encoding="utf-8"?>

<root>
  <person>
    <pid>362305199010025042</pid>
    <pname>xiaoming</pname>
    <page>28</page>
    <plocation>xxx</plocation>
    <pbir>1990-10-02</pbir>
    <phealthy>true</phealthy>
    <pgrade>[A,B,C]</pgrade>
  </person>
</root>
```

- In EMAIL encoding format, DLI reads data from the DIS stream and records it as a complete Email.

```
CREATE SOURCE STREAM email_infos (
  Event_ID String,
  Event_Time Date,
  Subject String,
  From_Email String,
  To_EMAIL String,
  CC_EMAIL Array[String],
  BCC_EMAIL String,
  MessageBody String,
  Mime_Version String,
  Content_Type String,
  charset String,
  Content_Transfer_Encoding String
)
  WITH (
    type = "dis",
```



```
    region = "xxx",
    channel = "dliinput",
    encode = "email",
    email_key = "Message-ID, Date, Subject, From, To, CC, BCC, Body, Mime-Version, Content-Type,
charset, Content_Transfer_Encoding"
);
```

An example of email data is as follows:

```
Message-ID: <20090629183903250425 4@sample.com>
Date: Fri, 11 May 2001 09:54:00 -0700 (PDT)
From: zhangsan@sample.com
To: lisi@sample.com, wangwu@sample.com
Subject:  "Hello World"
Cc: lilei@sample.com, hanmei@sample.com
Mime-Version: 1.0
Content-Type: text/plain; charset=us-ascii
Content-Transfer-Encoding: 7bit
Bcc: jack@sample.com, lily@sample.com
X-From: Zhang San
X-To: Li Si, Wang Wu
X-cc: Li Lei, Han Mei
X-bcc:
X-Folder: \Li_Si_June2001\Notes Folders\Notes inbox
X-Origin: Lucy
X-FileName: sample.nsf

Dear Associate / Analyst Committee:

Hello World!

Thank you,

Associate / Analyst Program
zhangsan
```

5.1.3.3 DMS Source Stream

DMS (Distributed Message Service) is a message middleware service based on distributed, high-availability clustering technology. It provides reliable, scalable, fully managed queues for sending, receiving, and storing messages. DMS for Kafka is a message queuing service based on Apache Kafka. This service provides Kafka premium instances.

The source stream can read data from a Kafka instance as the input data of jobs. The syntax for creating a Kafka source stream is the same as that for creating an open source Apache Kafka source stream. For details, see **Open-Source Kafka Source Stream**.

5.1.3.4 MRS Kafka Source Stream

Function

Create a source stream to obtain data from Kafka as input data for jobs.

Apache Kafka is a fast, scalable, and fault-tolerant distributed message publishing and subscription system. It delivers high throughput and built-in partitions and provides data replicas and fault tolerance. Apache Kafka is applicable to scenarios of handling massive messages. Kafka clusters are deployed and hosted on MRS that is powered on Apache Kafka.

Prerequisites

- If the Kafka server listens on the port using hostname, you need to add the mapping between the hostname and IP address of the Kafka Broker node to the DLI queue. Contact the Kafka service deployment personnel to obtain the hostname and IP address of the Kafka Broker node. For details about how to add an IP-domain mapping, see **Modifying the Host Information** in the *Data Lake Insight User Guide*.
- Kafka is an offline cluster. You need to use the enhanced datasource connection function to connect Flink jobs to Kafka. You can also set security group rules as required.

  For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.

  For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.

Syntax

```
CREATE SOURCE STREAM stream_id (attr_name attr_type (',' attr_name attr_type)* )
  WITH (
    type = "kafka",
    kafka_bootstrap_servers = "",
    kafka_group_id = "",
    kafka_topic = "",
    encode = "json"
  );
```

Keyword

Table 5-4 Keyword description

Parameter	Mandatory	Description
type	Yes	Data source type. **Kafka** indicates that the data source is Kafka.
kafka_bootstrap_servers	Yes	Port that connects DLI to Kafka. Use enhanced datasource connections to connect DLI queues with Kafka clusters.
kafka_group_id	No	Group ID
kafka_topic	Yes	Kafka topic to be read. Currently, only one topic can be read at a time.

Parameter	Mandatory	Description
encode	Yes	Data encoding format. The value can be **csv**, **json**, **blob**, or **user_defined**. • **field_delimiter** must be specified if this parameter is set to **csv**. • **json_config** must be specified if this parameter is set to **json**. • If this parameter is set to **blob**, the received data is not parsed, only one stream attribute exists, and the stream attribute is of the Array[TINYINT] type. • **encode_class_name** and **encode_class_parameter** must be specified if this parameter is set to **user_defined**.
encode_class_name	No	If **encode** is set to **user_defined**, you need to set this parameter to the name of the user-defined decoding class (including the complete package path). The class must inherit the **DeserializationSchema** class.
encode_class_parameter	No	If **encode** is set to **user_defined**, you can set this parameter to specify the input parameter of the user-defined decoding class. Only one parameter of the string type is supported.
krb_auth	No	The authentication name for creating a datasource connection authentication. This parameter is mandatory when Kerberos authentication is enabled. **NOTE** Ensure that the **/etc/hosts** information of the master node in the MRS cluster is added to the host file of the DLI queue.
json_config	No	If **encode** is set to **json**, you can use this parameter to specify the mapping between JSON fields and stream attributes. The format is field1=json_field1;field2=json_field2. **field1** and **field2** indicate the names of the created table fields. **json_field1** and **json_field2** are key fields of the JSON strings in the Kafka input data. For details, see the **example**.
field_delimiter	No	If **encode** is set to **csv**, you can use this parameter to specify the separator between CSV fields. By default, the comma (,) is used.

Parameter	Mandatory	Description
quote	No	Quoted symbol in a data format. The attribute delimiters between two quoted symbols are treated as common characters. • If double quotation marks are used as the quoted symbol, set this parameter to **\u005c \u0022** for character conversion. • If a single quotation mark is used as the quoted symbol, set this parameter to a single quotation mark ('). **NOTE** • Currently, only the CSV format is supported. • After this parameter is specified, ensure that each field does not contain quoted symbols or contains an even number of quoted symbols. Otherwise, parsing will fail.
start_time	No	Start time when Kafka data is ingested. If this parameter is specified, DLI reads data read from the specified time. The format is **yyyy-MM-dd HH:mm:ss**. Ensure that the value of **start_time** is not later than the current time. Otherwise, no data will be obtained.
kafka_properties	No	This parameter is used to configure the native attributes of Kafka. The format is **key1=value1;key2=value2**.
kafka_certificate_name	No	Specifies the name of the datasource authentication information. This parameter is valid only when the datasource authentication type is set to **Kafka_SSL**. **NOTE** • If this parameter is specified, the service loads only the specified file and password under the authentication. The system automatically sets this parameter to **kafka_properties**. • Other configuration information required for Kafka SSL authentication needs to be manually configured in the **kafka_properties** attribute.

Precautions

When creating a source stream, you can specify a time model for subsequent calculation. Currently, DLI supports two time models: Processing Time and Event Time. For details about the syntax, see **Configuring Time Models**.

Example

- Read data from the Kafka topic **test**.

```
CREATE SOURCE STREAM kafka_source (
  name STRING,
  age int
 )
  WITH (
    type = "kafka",
    kafka_bootstrap_servers = "ip1:port1,ip2:port2",
    kafka_group_id = "sourcegroup1",
    kafka_topic = "test",
    encode = "json"
);
```

- Read the topic whose object is **test** from Kafka and use **json_config** to map JSON data to table fields.

  The data encoding format is non-nested JSON.

```
{"attr1": "lilei", "attr2": 18}
```

  The table creation statement is as follows:

```
CREATE SOURCE STREAM kafka_source (name STRING, age int)
WITH (
  type = "kafka",
  kafka_bootstrap_servers = "ip1:port1,ip2:port2",
  kafka_group_id = "sourcegroup1",
  kafka_topic = "test",
  encode = "json",
  json_config = "name=attr1;age=attr2"
);
```

5.1.3.5 Open-Source Kafka Source Stream

Function

Create a source stream to obtain data from Kafka as input data for jobs.

Apache Kafka is a fast, scalable, and fault-tolerant distributed message publishing and subscription system. It delivers high throughput and built-in partitions and provides data replicas and fault tolerance. Apache Kafka is applicable to scenarios of handling massive messages.

Prerequisites

- If the Kafka server listens on the port using hostname, you need to add the mapping between the hostname and IP address of the Kafka Broker node to the DLI queue. Contact the Kafka service deployment personnel to obtain the hostname and IP address of the Kafka Broker node. For details about how to add an IP-domain mapping, see **Modifying the Host Information** in the *Data Lake Insight User Guide*.
- Kafka is an offline cluster. You need to use the enhanced datasource connection function to connect Flink jobs to Kafka. You can also set security group rules as required.

  For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.

  For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.

Syntax

```
CREATE SOURCE STREAM stream_id (attr_name attr_type (',' attr_name attr_type)* )
  WITH (
    type = "kafka",
    kafka_bootstrap_servers = "",
    kafka_group_id = "",
    kafka_topic = "",
    encode = "json",
    json_config=""
  );
```

Keyword

Table 5-5 Keyword description

Parameter	Mandatory	Description
type	Yes	Data source type. **Kafka** indicates that the data source is Kafka.
kafka_bootstrap_servers	Yes	Port that connects DLI to Kafka. Use enhanced datasource connections to connect DLI queues with Kafka clusters.
kafka_group_id	No	Group ID.
kafka_topic	Yes	Kafka topic to be read. Currently, only one topic can be read at a time.
encode	Yes	Data encoding format. The value can be **csv**, **json**, **blob**, or **user_defined**. • **field_delimiter** must be specified if this parameter is set to **csv**. • **json_config** must be specified if this parameter is set to **json**. • If this parameter is set to **blob**, the received data will not be parsed, and only one Array[TINYINT] field exists in the table. • **encode_class_name** and **encode_class_parameter** must be specified if this parameter is set to **user_defined**.
encode_class_name	No	If **encode** is set to **user_defined**, you need to set this parameter to the name of the user-defined decoding class (including the complete package path). The class must inherit the **DeserializationSchema** class.
encode_class_parameter	No	If **encode** is set to **user_defined**, you can set this parameter to specify the input parameter of the user-defined decoding class. Only one parameter of the string type is supported.

Parameter	Mandatory	Description
json_config	No	If **encode** is set to **json**, you can use this parameter to specify the mapping between JSON fields and stream attributes. The format is field1=json_field1;field2=json_field2. **field1** and **field2** indicate the names of the created table fields. **json_field1** and **json_field2** are key fields of the JSON strings in the Kafka input data. For details, see **Example**. **NOTE** If the attribute names in the source stream are the same as those in JSON fields, you do not need to set this parameter.
field_delimiter	No	If **encode** is set to **csv**, you can use this parameter to specify the separator between CSV fields. By default, the comma (,) is used.
quote	No	Quoted symbol in a data format. The attribute delimiters between two quoted symbols are treated as common characters. • If double quotation marks are used as the quoted symbol, set this parameter to **\u005c \u0022** for character conversion. • If a single quotation mark is used as the quoted symbol, set this parameter to a single quotation mark ('). **NOTE** • Currently, only the CSV format is supported. • After this parameter is specified, ensure that each field does not contain quoted symbols or contains an even number of quoted symbols. Otherwise, parsing will fail.
start_time	No	Start time when Kafka data is ingested. If this parameter is specified, DLI reads data read from the specified time. The format is **yyyy-MM-dd HH:mm:ss**. Ensure that the value of **start_time** is not later than the current time. Otherwise, no data will be obtained. If you set this parameter, only the data generated after the specified time for the Kafka topic will be read.
kafka_properties	No	Native properties of Kafka. The format is **key1=value1;key2=value2**. For details about the property values, see the description in **Apache Kafka**.

Parameter	Mandatory	Description
kafka_certificate_name	No	Name of the datasource authentication information. This parameter is valid only when the datasource authentication type is set to **Kafka_SSL**. **NOTE** • If this parameter is specified, the service loads only the specified file and password under the authentication. The system automatically sets this parameter to **kafka_properties**. • Other configuration information required for Kafka SSL authentication needs to be manually configured in the **kafka_properties** attribute.

Precautions

When creating a source stream, you can specify a time model for subsequent calculation. Currently, DLI supports two time models: Processing Time and Event Time. For details about the syntax, see **Configuring Time Models**.

Example

- Read Kafka topic **test**. The data encoding format is non-nested JSON, for example, {"attr1": "lilei", "attr2": 18}.

```
CREATE SOURCE STREAM kafka_source (name STRING, age int)
WITH (
  type = "kafka",
  kafka_bootstrap_servers = "ip1:port1,ip2:port2",
  kafka_group_id = "sourcegroup1",
  kafka_topic = "test",
  encode = "json",
  json_config = "name=attr1;age=attr2"
);
```

- Read Kafka topic **test**. The data is encoded in JSON format and nested. This example uses the complex data type ROW. For details about the syntax of ROW, see **Data Type**.

  The test data is as follows:

```
{
    "id":"1",
    "type2":"online",
    "data":{
        "patient_id":1234,
        "name":"bob1234"
    }
}
```

  An example of the table creation statements is as follows:

```
CREATE SOURCE STREAM kafka_source
(
  id STRING,
  type2 STRING,
  data ROW<
    patient_id STRING,
    name STRING>
)
WITH (
  type = "kafka",
```



```
  kafka_bootstrap_servers = "ip1:port1,ip2:port2",
  kafka_group_id = "sourcegroup1",
  kafka_topic = "test",
  encode = "json"
);

CREATE SINK STREAM kafka_sink
(
  id STRING,
  type2 STRING,
  patient_id STRING,
  name STRING
)
  WITH (
    type="kafka",
    kafka_bootstrap_servers =  "ip1:port1,ip2:port2",
    kafka_topic = "testsink",
    encode = "csv"
  );

INSERT INTO kafka_sink select id, type2, data.patient_id, data.name from kafka_source;
```

5.1.3.6 OBS Source Stream

Function

Create a source stream to obtain data from OBS. DLI reads data stored by users in OBS as input data for jobs. OBS applies to various scenarios, such as big data analysis, cloud-native application program data, static website hosting, backup/active archive, and deep/cold archive.

OBS is an object-based storage service. It provides massive, secure, highly reliable, and low-cost data storage capabilities. For more information about OBS, see the .**Object Storage Service Console Operation Guide**

Syntax

```
CREATE SOURCE STREAM stream_id (attr_name attr_type (',' attr_name attr_type)* )
  WITH (
    type = "obs",
    region = "",
    bucket = "",
    object_name = "",
    row_delimiter = "\n",
    field_delimiter = '',
    version_id = ""
  );
```

Keyword

Table 5-6 Keyword description

Parameter	Mandatory	Description
type	Yes	Data source type. **obs** indicates that the data source is OBS.
region	Yes	Region to which OBS belongs.

Parameter	Mandatory	Description
encode	No	Data encoding format. The value can be **csv** or **json**. The default value is **csv**.
ak	No	Access Key ID (AK). For details about how to obtain the access key, see **My Credentials**.
sk	No	Secret access key used together with the ID of the access key. For details about how to obtain the access key, see **My Credentials**.
bucket	Yes	Name of the OBS bucket where data is located.
object_name	Yes	Name of the object stored in the OBS bucket where data is located. If the object is not in the OBS root directory, you need to specify the folder name, for example, **test/test.csv**. For the object file format, see the **encode** parameter.
row_delimiter	Yes	Separator used to separate every two rows.
field_delimiter	No	Separator used to separate every two attributes. • This parameter is mandatory when **encode** is **csv**. You use custom attribute separators. • If **encode** is **json**, you do not need to set this parameter.
quote	No	Quoted symbol in a data format. The attribute delimiters between two quoted symbols are treated as common characters. • If double quotation marks are used as the quoted symbol, set this parameter to **\u005c\u0022** for character conversion. • If a single quotation mark is used as the quoted symbol, set this parameter to a single quotation mark ('). **NOTE** • Currently, only the CSV format is supported. • After this parameter is specified, ensure that each field does not contain quoted symbols or contains an even number of quoted symbols. Otherwise, parsing will fail.
version_id	No	Version number. This parameter is optional and required only when the OBS bucket or object has version settings.

Precautions

When creating a source stream, you can specify a time model for subsequent calculation. Currently, DLI supports two time models: Processing Time and Event Time. For details about the syntax, see **Configuring Time Models**.

Example

- The **input.csv** file is read from the OBS bucket. Rows are separated by **'\n'** and columns are separated by **','**.

  To use the test data, create an **input.txt** file, copy and paste the following text data, and save the file as **input.csv**. Upload the **input.csv** file to the target OBS bucket directory. For example, upload the file to the **dli-test-obs01** bucket directory.

  ```
  1,2,3,4,1403149534
  5,6,7,8,1403149535
  ```

  The following is an example for creating the table:

  ```
  CREATE SOURCE STREAM car_infos (
    car_id STRING,
    car_owner STRING,
    car_brand STRING,
    car_price INT,
    car_timestamp LONG
  )
    WITH (
      type = "obs",
      bucket = "dli-test-obs01",
      region = "xxx",
      object_name = "input.csv",
      row_delimiter = "\n",
      field_delimiter = ","
  );
  ```

- The **input.json** file is read from the OBS bucket. Rows are separated by **'\n'**.

  ```
  CREATE SOURCE STREAM obs_source (
    str STRING
  )
    WITH (
      type = "obs",
      bucket = "obssource",
      region = "xxx",
      encode = "json",
      row_delimiter = "\n",
      object_name = "input.json"
  );
  ```

5.1.4 Creating a Sink Stream

5.1.4.1 CloudTable HBase Sink Stream

Function

DLI exports the job output data to HBase of CloudTable. HBase is a column-oriented distributed cloud storage system that features enhanced reliability, excellent performance, and elastic scalability. It applies to the storage of massive amounts of data and distributed computing. You can use HBase to build a storage system capable of storing TB- or even PB-level data. With HBase, you can filter and analyze data with ease and get responses in milliseconds, rapidly mining data value. Structured and semi-structured key-value data can be stored, including messages, reports, recommendation data, risk control data, logs, and orders. With DLI, you can write massive volumes of data to HBase at a high speed and with low latency.

CloudTable is a distributed, scalable, and fully-hosted key-value data storage service based on Apache HBase. It provides DLI with high-performance random

read and write capabilities, which are helpful when applications need to store and query a massive amount of structured data, semi-structured data, and time series data. CloudTable applies to IoT scenarios and storage and query of massive volumes of key-value data. For more information about CloudTable, see the *CloudTable Service User Guide*.

Prerequisites

In this scenario, jobs must run on the dedicated queue of DLI. Therefore, DLI must interconnect with the enhanced datasource connection that has been connected with CloudTable HBase. You can also set the security group rules as required.

For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.

For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.

Syntax

```
CREATE SINK STREAM stream_id (attr_name attr_type (',' attr_name attr_type)* )
  WITH (
    type = "cloudtable",
    region = "",
    cluster_id = "",
    table_name = "",
    table_columns = "",
    create_if_not_exist = ""
  )
```

Keyword

Table 5-7 Keyword description

Parameter	Mandatory	Description
type	Yes	Output channel type. **cloudtable** indicates that data is exported to CloudTable (HBase).
region	Yes	Region to which CloudTable belongs.
cluster_id	Yes	ID of the cluster to which the data you want to insert belongs.
table_name	Yes	Name of the table, into which data is to be inserted. It can be specified through parameter configurations. For example, if you want one or more certain columns as part of the table name, use **car_pass_inspect_with_age_${car_age}**, where **car_age** is the column name.
table_columns	Yes	Columns to be inserted. The format is **rowKey, f1:c1, f1:c2, f2:c1**, where **rowKey** must be specified. If you do not want to add a column (for example, the third column) to the database, set this parameter to **rowKey,f1:c1,,f2:c1**.

Parameter	Mandatory	Description
illegal_data_table	No	If this parameter is specified, abnormal data (for example, **rowKey** does not exist) will be written into the table. If not specified, abnormal data will be discarded. The rowKey value is a timestamp followed by six random digits, and the schema is info:data, info:reason.
create_if_not_exist	No	Whether to create a table or column into which the data is written when this table or column does not exist. The value can be **true** or **false**. The default value is **false**.
batch_insert_data_num	No	Number of data records to be written in batches at a time. The value must be a positive integer. The upper limit is **100**. The default value is **10**.

Precautions

- If a configuration item can be specified through parameter configurations, one or more columns in the record can be used as part of the configuration item. For example, if the configuration item is set to **car_$ {car_brand}** and the value of **car_brand** in a record is **BMW**, the value of this configuration item is **car_BMW** in the record.
- In this way, data is written to HBase of CloudTable. The speed is limited. The dedicated resource mode is recommended.

  For details about how to create a dedicated resource mode, see **Creating a Queue** in the *Data Lake Insight User Guide*.

Example

Output data of stream **qualified_cars** to CloudTable (HBase).

```
CREATE SINK STREAM qualified_cars (
  car_id STRING,
  car_owner STRING,
  car_age INT,
  average_speed INT,
  total_miles INT
)
  WITH (
    type = "cloudtable",
    region = "xxx",
    cluster_id = "209ab1b6-de25-4c48-8e1e-29e09d02de28",
    table_name = "car_pass_inspect_with_age_${car_age}",
    table_columns = "rowKey,info:owner,,car:speed,car:miles",
    illegal_data_table = "illegal_data",
    create_if_not_exist = "true",
    batch_insert_data_num = "20"
);
```

5.1.4.2 CloudTable OpenTSDB Sink Stream

Function

DLI exports the job output data to OpenTSDB of CloudTable. OpenTSDB is a distributed, scalable time series database based on HBase. It stores time series data. Time series data refers to the data collected at different time points. This type of data reflects the change status or degree of an object over time. OpenTSDB supports data collection and monitoring in seconds, permanent storage, index, and queries. It can be used for system monitoring and measurement as well as collection and monitoring of IoT data, financial data, and scientific experimental results.

CloudTable is a distributed, scalable, and fully-hosted key-value data storage service based on Apache HBase. It provides DLI with high-performance random read and write capabilities, which are helpful when applications need to store and query a massive amount of structured data, semi-structured data, and time series data. CloudTable applies to IoT scenarios and storage and query of massive volumes of key-value data. For more information about CloudTable, see the *CloudTable Service User Guide*.

Prerequisites

- In this scenario, jobs must run on the dedicated queue of DLI. Therefore, DLI must interconnect with the enhanced datasource connection that has been connected with CloudTable HBase. You can also set the security group rules as required.

  For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.

  For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.

Syntax

```
CREATE SINK STREAM stream_id (attr_name attr_type (',' attr_name attr_type)* )
  WITH (
    type = "opentsdb",
    region = "",
    cluster_id = "",
    tsdb_metrics = "",
    tsdb_timestamps = "",
    tsdb_values = "",
    tsdb_tags = "",
    batch_insert_data_num = ""
  )
```

Keyword

Table 5-8 Keyword description

Parameter	Mandatory	Description
type	Yes	Output channel type. **opentsdb** indicates that data is exported to CloudTable (OpenTSDB).

Parameter	Mandatory	Description
region	Yes	Region to which CloudTable belongs.
cluster_id	No	ID of the cluster to which the data to be inserted belongs. Either this parameter or **tsdb_link_address** must be specified.
tsdb_metrics	Yes	Metric of a data point, which can be specified through parameter configurations.
tsdb_timestamps	Yes	Timestamp of a data point. The data type can be LONG, INT, SHORT, or STRING. Only dynamic columns are supported.
tsdb_values	Yes	Value of a data point. The data type can be SHORT, INT, LONG, FLOAT, DOUBLE, or STRING. Dynamic columns or constant values are supported.
tsdb_tags	Yes	Tags of a data point. Each of tags contains at least one tag value and up to eight tag values. Tags of the data point can be specified through parameter configurations.
batch_insert_data_num	No	Number of data records to be written in batches at a time. The value must be a positive integer. The upper limit is **65536**. The default value is **8**.
tsdb_link_address	No	OpenTSDB link of the cluster to which the data to be inserted belongs. If this parameter is used, the job must run in a dedicated DLI queue, and the DLI queue must be connected to the CloudTable cluster through an enhanced datasource connection. Either this parameter or **cluster_id** must be specified. **NOTE** For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.

Precautions

If a configuration item can be specified through parameter configurations, one or more columns in the record can be used as part of the configuration item. For example, if the configuration item is set to **car_$ {car_brand}** and the value of **car_brand** in a record is **BMW**, the value of this configuration item is **car_BMW** in the record.

Example

Output data of stream **weather_out** to CloudTable (OpenTSDB).

```
CREATE SINK STREAM weather_out (
  timestamp_value LONG, /* Time */
  temperature FLOAT, /* Temperature value */
  humidity FLOAT, /* Humidity */
```



```
  location STRING /* Location */
)
  WITH (
    type = "opentsdb",
    region = "xxx",
    cluster_id = "e05649d6-00e2-44b4-b0ff-7194adaeab3f",
    tsdb_metrics = "weather",
    tsdb_timestamps = "${timestamp_value}",
    tsdb_values = "${temperature}; ${humidity}",
    tsdb_tags = "location:${location},signify:temperature; location:${location},signify:humidity",
    batch_insert_data_num = "10"
);
```

5.1.4.3 MRS OpenTSDB Sink Stream

Function

DLI exports the output data of the Flink job to OpenTSDB of MRS.

Prerequisites

- OpenTSDB has been installed in the MRS cluster.
- In this scenario, jobs must run on the dedicated queue of DLI. Therefore, DLI must interconnect with the enhanced datasource connection that has been connected with MRS clusters. You can also set the security group rules as required.

  For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.

  For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.

Syntax

```
CREATE SINK STREAM stream_id (attr_name attr_type (',' attr_name attr_type)* )
  WITH (
    type = "opentsdb",
    region = "",
    tsdb_metrics = "",
    tsdb_timestamps = "",
    tsdb_values = "",
    tsdb_tags = "",
    batch_insert_data_num = ""
  )
```

Keyword

Table 5-9 Keyword description

Parameter	Mandatory	Description
type	Yes	Sink channel type. **opentsdb** indicates that data is exported to OpenTSDB of MRS.
region	Yes	Region where MRS resides.

Parameter	Mandatory	Description
tsdb_link_address	Yes	Service address of the OpenTSDB instance in MRS. The format is **http://ip:port** or **https://ip:port**. **NOTE** If **tsd.https.enabled** is set to **true**, HTTPS must be used. Note that HTTPS does not support certificate authentication.
tsdb_metrics	Yes	Metric of a data point, which can be specified through parameter configurations.
tsdb_timestamps	Yes	Timestamp of a data point. The data type can be LONG, INT, SHORT, or STRING. Only dynamic columns are supported.
tsdb_values	Yes	Value of a data point. The data type can be SHORT, INT, LONG, FLOAT, DOUBLE, or STRING. Dynamic columns or constant values are supported.
tsdb_tags	Yes	Tags of a data point. Each of tags contains at least one tag value and up to eight tag values. Tags of the data point can be specified through parameter configurations.
batch_insert_data_num	No	Number of data records to be written in batches at a time. The value must be a positive integer. The upper limit is **65536**. The default value is **8**.

Precautions

If a configuration item can be specified through parameter configurations, one or more columns in the record can be used as part of the configuration item. For example, if the configuration item is set to **car_$ {car_brand}** and the value of **car_brand** in a record is **BMW**, the value of this configuration item is **car_BMW** in the record.

Example

Output data of stream **weather_out** to OpenTSDB of MRS.

```
CREATE SINK STREAM weather_out (
  timestamp_value LONG, /* Time */
  temperature FLOAT, /* Temperature value */
  humidity FLOAT, /* Humidity */
  location STRING /* Location */
)
  WITH (
    type = "opentsdb",
    region = "xxx",
    tsdb_link_address = "https://x.x.x.x:4242",
    tsdb_metrics = "weather",
    tsdb_timestamps = "${timestamp_value}",
    tsdb_values = "${temperature}; ${humidity}",
    tsdb_tags = "location:${location},signify:temperature; location:${location},signify:humidity",
    batch_insert_data_num = "10"
);
```


5.1.4.4 CSS Elasticsearch Sink Stream

Function

DLI exports Flink job output data to Elasticsearch of Cloud Search Service (CSS). Elasticsearch is a popular enterprise-class Lucene-powered search server and provides the distributed multi-user capabilities. It delivers multiple functions, including full-text retrieval, structured search, analytics, aggregation, and highlighting. With Elasticsearch, you can achieve stable, reliable, real-time search. Elasticsearch applies to diversified scenarios, such as log analysis and site search.

CSS is a fully managed, distributed search service. It is fully compatible with open-source Elasticsearch and provides DLI with structured and unstructured data search, statistics, and report capabilities.

For more information about CSS, see the *Cloud Search Service User Guide*.

NOTE

If the security mode is enabled when you create a CSS cluster, it cannot be undone.

Prerequisites

- Ensure that you have created a cluster on CSS using your account. For details about how to create a cluster on CSS, see **Creating a Cluster** in the *Cloud Search Service User Guide*.
- In this scenario, jobs must run on the dedicated queue of DLI. Therefore, DLI must interconnect with the enhanced datasource connection that has been connected with CSS. You can also set the security group rules as required.

  For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.

  For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.

Syntax

```
CREATE SINK STREAM stream_id (attr_name attr_type (',' attr_name attr_type)* )
  WITH (
    type = "es",
    region = "",
    cluster_address = "",
    es_index = "",
    es_type= "",
    es_fields= "",
    batch_insert_data_num= ""
  );
```

Keyword

Table 5-10 Keyword description

Parameter	Mandatory	Description
type	Yes	Output channel type. **es** indicates that data is exported to CSS.
region	Yes	Region where CSS is located.
cluster_address	Yes	Private access address of the CSS cluster, for example: **x.x.x.x:x**. Use commas (,) to separate multiple addresses.
es_index	Yes	Index of the data to be inserted. This parameter corresponds to CSS index. For details, see **Cloud Search Service Overview**.
es_type	Yes	Type of the document to which data is to be inserted. This parameter corresponds to the CSS type. For details, see **Cloud Search Service Overview**. If the Elasticsearch version is 6.x, the value cannot start with an underscore (_). If the Elasticsearch version is 7.x and the type of CSS is preset, the value must be **_doc**. Otherwise, the value must comply with CSS specifications.
es_fields	Yes	Key of the data field to be inserted. The format is **id,f1,f2,f3,f4**. Ensure that the key corresponds to the data column in the sink. If a random attribute field instead of a key is used, the keyword **id** does not need to be used, for example, **f1,f2,f3,f4,f5**. This parameter corresponds to the CSS filed. For details, see **Cloud Search Service Overview**.
batch_insert_data_num	Yes	Amount of data to be written in batches at a time. The value must be a positive integer. The unit is 10 records. The maximum value allowed is **65536**, and the default value is **10**.
action	No	If the value is **add**, data is forcibly overwritten when the same ID is encountered. If the value is **upsert**, data is updated when the same ID is encountered. (If **upsert** is selected, **id** in the **es_fields** field must be specified.) The default value is **add**.
enable_output_null	No	This parameter is used to configure whether to generate an empty field. If this parameter is set to **true**, an empty field (the value is **null**) is generated. If set to **false**, no empty field is generated. The default value is **false**.

Parameter	Mandatory	Description
max_record_num_cache	No	Maximum number of records that can be cached.
es_certificate_name	No	Name of the datasource authentication information For details about how to create cross-source authentication, see **Creating and Managing Datasource Authentication**. If the security mode is enabled and HTTPS is used by the Elasticsearch cluster, the certificate is required for access. In this case, set the datasource authentication type to **CSS**. If the security mode is enabled for the Elasticsearch cluster but HTTPS is disabled, the certificate and username and password are required for access. In this case, set the datasource authentication type to **Password**.

Precautions

If a configuration item can be specified through parameter configurations, one or more columns in the record can be used as part of the configuration item. For example, if the configuration item is set to **car_$ {car_brand}** and the value of **car_brand** in a record is **BMW**, the value of this configuration item is **car_BMW** in the record.

Example

Data of stream **qualified_cars** is exported to the cluster on CSS.

```
CREATE SINK STREAM qualified_cars (
  car_id STRING,
  car_owner STRING,
  car_age INT,
  average_speed INT,
  total_miles INT
)
  WITH (
    type = "es",
    region = "xxx",
    cluster_address = "192.168.0.212:9200",
    es_index = "car",
    es_type = "information",
    es_fields = "id,owner,age,speed,miles",
    batch_insert_data_num = "10"
);
```

5.1.4.5 DCS Sink Stream

Function

DLI exports the Flink job output data to Redis of DCS. Redis is a storage system that supports multiple types of data structures such as key-value. It can be used in

scenarios such as caching, event pub/sub, and high-speed queuing. Redis supports direct read/write of strings, hashes, lists, queues, and sets. Redis works with in-memory dataset and provides persistence. For more information about Redis, visit **https://redis.io/**.

DCS provides Redis-compatible, secure, reliable, out-of-the-box, distributed cache capabilities allowing elastic scaling and convenient management. It meets users' requirements for high concurrency and fast data access.

For more information about DCS, see the **Distributed Cache Service User Guide**.

Prerequisites

- Ensure that You have created a Redis cache instance on DCS using your account.

  For details about how to create a Redis cache instance, see **Creating a DCS Instance** in the **Distributed Cache Service User Guide**.
- In this scenario, jobs must run on the dedicated queue of DLI. Therefore, DLI must be interconnected with the DCS clusters. You can also set the security group rules as required.

  For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.

  For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.
- If you use a VPC peering connection to access a DCS instance, the following restrictions also apply:
  - If network segment 172.16.0.0/12~24 is used during DCS instance creation, the DLI queue cannot be in any of the following network segments: 192.168.1.0/24, 192.168.2.0/24, and 192.168.3.0/24.
  - If network segment 192.168.0.0/16~24 is used during DCS instance creation, the DLI queue cannot be in any of the following network segments: 172.31.1.0/24, 172.31.2.0/24, and 172.31.3.0/24.
  - If network segment 10.0.0.0/8~24 is used during DCS instance creation, the DLI queue cannot be in any of the following network segments: 172.31.1.0/24, 172.31.2.0/24, and 172.31.3.0/24.

Syntax

```
CREATE SINK STREAM stream_id (attr_name attr_type (',' attr_name attr_type)* )
  WITH (
    type = "dcs_redis",
    region = "",
    cluster_address = "",
    password = "",
    value_type= "",key_value= ""
  );
```


Keyword

Table 5-11 Keyword description

Parameter	Mandatory	Description
type	Yes	Output channel type. **dcs_redis** indicates that data is exported to DCS Redis.
region	Yes	Region where DCS for storing the data is located.
cluster_address	Yes	Redis instance connection address.
password	No	Redis instance connection password. This parameter is not required if password-free access is used.
value_type	Yes	This parameter can be set to any or the combination of the following options: ● Data types, including **string**, **list**, **hash**, **set**, and **zset** ● Commands used to set the expiration time of a key, including **expire**, **pexpire**, **expireAt**, and **pexpireAt** ● Commands used to delete a key, including **del** and **hdel** Use commas (,) to separate multiple commands.
key_value	Yes	Key and value. The number of key_value pairs must be the same as the number of types specified by value_type, and key_value pairs are separated by semicolons (;). Both key and value can be specified through parameter configurations. The dynamic column name is represented by ${column name}.

Precautions

- If a configuration item can be specified through parameter configurations, one or more columns in the record can be used as part of the configuration item. For example, if the configuration item is set to **car_$ {car_brand}** and the value of **car_brand** in a record is **BMW**, the value of this configuration item is **car_BMW** in the record.
- Characters ":", ",", ";", "$", "{", and "}" have been used as special separators without the escape function. These characters cannot be used in key and value as common characters. Otherwise, parsing will be affected and the program exceptions will occur.

Example

Data of stream **qualified_cars** is exported to the Redis cache instance on DCS.

```
CREATE SINK STREAM qualified_cars (
  car_id STRING,
  car_owner STRING,
  car_age INT,
```



```
  average_speed DOUBLE,
  total_miles DOUBLE
)
  WITH (
    type = "dcs_redis",
    cluster_address = "192.168.0.34:6379",
    password = "xxxxxxxx",
    value_type = "string; list; hash; set; zset",
    key_value = "${car_id}_str: ${car_owner}; name_list: ${car_owner}; ${car_id}_hash: {name:${car_owner},
age: ${car_age}}; name_set:    ${car_owner}; math_zset: {${car_owner}:${average_speed}}"
  );
```

5.1.4.6 DDS Sink Stream

Function

DLI outputs the job output data to Document Database Service (DDS).

DDS is compatible with the MongoDB protocol and is secure, highly available, reliable, scalable, and easy to use. It provides DB instance creation, scaling, redundancy, backup, restoration, monitoring, and alarm reporting functions with just a few clicks on the DDS console.

Prerequisites

- Ensure that you have created a DDS instance on DDS using your account.

  For details about how to create a DDS instance, see **Buying a DDS DB Instance** in the *Document Database Service Getting Started*.
- Currently, only cluster instances with SSL authentication disabled are supported. Replica set and single node instances are not supported.
- In this scenario, jobs must run on the dedicated queue of DLI. Ensure that the dedicated queue of DLI has been created.

  To create a dedicated DLI queue, select **Pay-per-use** for **Billing Mode** and click **Dedicated Resource Mode** for **Queue Type** when creating a queue. For details, see **Creating a Queue** in the *Data Lake Insight User Guide*.
- Ensure that a datasource connection has been set up between the DLI dedicated queue and the DDS cluster, and security group rules have been configured based on the site requirements.

  For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.

  For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.

Syntax

```
CREATE SINK STREAM stream_id (attr_name attr_type (',' attr_name attr_type)* )
  WITH (
    type = "dds",
    username = "",
    password = "",
    db_url = "",
    field_names = ""
  );
```


Keyword

Table 5-12 Keyword description

Parameter	Mandatory	Description
type	Yes	Output channel type. **dds** indicates that data is exported to DDS.
username	Yes	Username for connecting to a database.
password	Yes	Password for connecting to a database.
db_url	Yes	DDS instance access address, for example, **ip1:port,ip2:port/database/collection**.
field_names	Yes	Key of the data field to be inserted. The format is **f1,f2,f3**. Ensure that the key corresponds to the data column in the sink stream.
batch_insert_data_num	No	Amount of data to be written in batches at a time. The value must be a positive integer. The default value is **10**.

Example

Output data in the **qualified_cars** stream to the **collectionTest** DDS DB.

```
CREATE SINK STREAM qualified_cars (
  car_id STRING,
  car_owner STRING,
  car_age INT,
  average_speed INT,
  total_miles INT
)
  WITH (
    type = "dds",
    region = "xxx",
    db_url = "192.168.0.8:8635,192.168.0.130:8635/dbtest/collectionTest",
    username = "xxxxxxxxxx",
    password =  "xxxxxxxxxx",
    field_names = "car_id,car_owner,car_age,average_speed,total_miles",
    batch_insert_data_num = "10"
  );
```

5.1.4.7 DIS Sink Stream

Function

DLI writes the Flink job output data into DIS. This cloud ecosystem is applicable to scenarios where data is filtered and imported to the DIS stream for future processing.

DIS addresses the challenge of transmitting data outside cloud services to cloud services. DIS builds data intake streams for custom applications capable of

processing or analyzing streaming data. DIS continuously captures, transmits, and stores terabytes of data from hundreds of thousands of sources every hour, such as logs, Internet of Things (IoT) data, social media feeds, website clickstreams, and location-tracking events. For more information about DIS, see the *Data Ingestion Service User Guide*.

Syntax

```
CREATE SINK STREAM stream_id (attr_name attr_type (',' attr_name attr_type)* )
  WITH (
    type = "dis",
    region = "",
    channel = "",
    partition_key = "",
    encode= "",
    field_delimiter= ""
  );
```

Keyword

Table 5-13 Keyword description

Parameter	Mandatory	Description
type	Yes	Output channel type. **dis** indicates that data is exported to DIS.
region	Yes	Region where DIS for storing the data is located.
ak	No	Access Key ID (AK).
sk	No	Specifies the secret access key used together with the ID of the access key.
channel	Yes	DIS stream.
partition_key	No	Group primary key. Multiple primary keys are separated by commas (,). If this parameter is not specified, data is randomly written to DIS partitions.
encode	Yes	Data encoding format. The value can be **csv**, **json**, or **user_defined**. **NOTE** • **field_delimiter** must be specified if this parameter is set to **csv**. • If the encoding format is **json**, you need to configure **enable_output_null** to determine whether to generate an empty field. For details, see the examples. • **encode_class_name** and **encode_class_parameter** must be specified if this parameter is set to **user_defined**.

Parameter	Mandatory	Description
field_delimiter	Yes	Separator used to separate every two attributes. ● This parameter needs to be configured if the CSV encoding format is adopted. It can be user-defined, for example, a comma (**,**). ● This parameter is not required if the JSON encoding format is adopted.
json_config	No	If **encode** is set to **json**, you can set this parameter to specify the mapping between the JSON field and the stream definition field. An example of the format is as follows: field1=data_json.field1; field2=data_json.field2.
enable_output_null	No	If **encode** is set to **json**, you need to specify this parameter to determine whether to generate an empty field. If this parameter is set to **true**, an empty field (the value is **null**) is generated. If set to **false**, no empty field is generated. The default value is **true**.
encode_class_name	No	If **encode** is set to **user_defined**, you need to set this parameter to the name of the user-defined decoding class (including the complete package path). The class must inherit the **DeserializationSchema** class.
encode_class_parameter	No	If **encode** is set to **user_defined**, you can set this parameter to specify the input parameter of the user-defined decoding class. Only one parameter of the string type is supported.

Precautions

None

Example

- CSV: Data is written to the DIS stream and encoded using CSV. CSV fields are separated by commas (,). If there are multiple partitions, car_owner is used as the key to distribute data to different partitions. An example is as follows: "ZJA710XC", "lilei", "BMW", 700000.

```
CREATE SINK STREAM audi_cheaper_than_30w (
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_price INT
)
  WITH (
    type = "dis",
    region = "xxx",
    channel = "dlioutput",
```

```
  encode = "csv",
  field_delimiter = ","
);
```

- JSON: Data is written to the DIS stream and encoded using JSON. If there are multiple partitions, car_owner and car_brand are used as the keys to distribute data to different partitions. If **enableOutputNull** is set to **true**, an empty field (the value is **null**) is generated. If set to **false**, no empty field is generated. An example is as follows: "car_id ":"ZJA710XC", "car_owner ":"lilei", "car_brand ":"BMW", "car_price ":700000.

```
CREATE SINK STREAM audi_cheaper_than_30w (
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_price INT
)
  WITH (
    type = "dis",
    channel = "dlioutput",
    region = "xxx",
    partition_key = "car_owner,car_brand",
    encode = "json",
    enable_output_null = "false"
);
```

5.1.4.8 DMS Sink Stream

DMS (Distributed Message Service) is a message middleware service based on distributed, high-availability clustering technology. It provides reliable, scalable, fully managed queues for sending, receiving, and storing messages. DMS for Kafka is a message queuing service based on Apache Kafka. This service provides Kafka premium instances.

DLI can write the job output data into the Kafka instance. The syntax for creating a Kafka sink stream is the same as that for creating an open source Apache Kafka sink stream. For details, see **MRS Kafka Sink Stream**.

5.1.4.9 DWS Sink Stream (JDBC Mode)

Function

DLI outputs the Flink job output data to Data Warehouse Service (DWS). DWS database kernel is compliant with PostgreSQL. The PostgreSQL database can store data of more complex types and delivers space information services, multi-version concurrent control (MVCC), and high concurrency. It applies to location applications, financial insurance, and e-commerce.

DWS is an online data processing database based on the cloud infrastructure and platform and helps you mine and analyze massive sets of data. For more information about DWS, see the *Data Warehouse Service Management Guide*.

Prerequisites

- Ensure that you have created a DWS cluster on DWS using your account.

  For details about how to create a DWS cluster, see **Creating a Cluster** in the *Data Warehouse Service Management Guide*.
- Ensure that a DWS database table has been created.

- In this scenario, jobs must run on the dedicated queue of DLI. Therefore, DLI must interconnect with the enhanced datasource connection that has been connected with DWS clusters. You can also set the security group rules as required.

  For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.

  For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.

Syntax

```
CREATE SINK STREAM stream_id (attr_name attr_type (',' attr_name attr_type)* )
  WITH (
    type = "rds",
    username = "",
    password = "",
    db_url = "",
    table_name = ""
  );
```

Keyword

Table 5-14 Keyword description

Parameter	Mandatory	Description
type	Yes	Output channel type. **rds** indicates that data is exported to RDS or DWS.
username	Yes	Username for connecting to a database.
password	Yes	Password for connecting to a database.
db_url	Yes	Database connection address, for example, **postgresql://ip:port/database**.
table_name	Yes	Name of the table where data will be inserted. You need to create the database table in advance.

Parameter	Mandatory	Description

db_columns	No	Mapping between attributes in the output stream and those in the database table. This parameter must be configured based on the sequence of attributes in the output stream.
		Example:
		`create sink stream a3(student_name  string, student_age int)`
		`  with (`
		`    type = "rds",`
		`    username = "root",`
		`    password = "xxxxxxxx",`
		`    db_url = "postgresql://192.168.0.102:8000/test1",`
		`    db_columns = "name,age",`
		`    table_name = "t1"`
		`  );`
		In the example, **student_name** corresponds to the name attribute in the database, and **student_age** corresponds to the age attribute in the database.
		NOTE
		• If **db_columns** is not configured, it is normal that the number of attributes in the output stream is less than that of attributes in the database table and the extra attributes in the database table are all nullable or have default values.

primary_key	No	To update data in the table in real time by using the primary key, add the **primary_key** configuration item (**c_timeminute** in the following example) when creating a table. During the data writing operation, data is updated if the specified **primary_key** exists. Otherwise, data is inserted.
		Example:
		`CREATE SINK STREAM test(c_timeminute LONG, c_cnt LONG)`
		`  WITH (`
		`    type = "rds",`
		`    username = "root",`
		`    password = "xxxxxxxx",`
		`    db_url = "postgresql://192.168.0.12:8000/test",`
		`    table_name = "test",`
		`    primary_key = "c_timeminute"`
		`  );`

Precautions

The stream format defined by **stream_id** must be the same as the table format.

Example

Data of stream **audi_cheaper_than_30w** is exported to the **audi_cheaper_than_30w** table in the **test** database.

```
CREATE SINK STREAM audi_cheaper_than_30w (
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_price INT
)
```

```
WITH (
  type = "rds",
  username = "root",
  password = "xxxxxx",
  db_url = "postgresql://192.168.1.1:8000/test",
  table_name = "audi_cheaper_than_30w"
);

insert into audi_cheaper_than_30w select "1","2","3",4;
```

5.1.4.10 DWS Sink Stream (OBS-based Dumping)

Function

Create a sink stream to export Flink job data to DWS through OBS-based dumping, specifically, output Flink job data to OBS and then import data from OBS to DWS. For details about how to import OBS data to DWS, see **Concurrently Importing Data from OBS** in the *Data Warehouse Service Development Guide*.

DWS is an online data processing database based on the cloud infrastructure and platform and helps you mine and analyze massive sets of data. For more information about DWS, see the *Data Warehouse Service Management Guide*.

Precautions

- OBS-based dumping supports intermediate files of the following two types:
  - ORC: The ORC format does not support array data type. If the ORC format is used, create a foreign server in DWS. For details, see **Creating a Foreign Server** in the *Data Warehouse Development Guide*.
  - CSV: By default, the line break is used as the record separator. If the line break is contained in the attribute content, you are advised to configure quote. For details, see **Table 5-15**.
- If the target table does not exist, a table is automatically created. DLI data of the SQL type does not support **text**. If a long text exists, you are advised to create a table in the database.
- When **encode** uses the ORC format to create a DWS table, if the field attribute of the SQL stream is defined as the **String** type, the field attribute of the DWS table cannot use the **varchar** type. Instead, a specific text type must be used. If the SQL stream field attribute is defined as the **Integer** type, the DWS table field must use the **Integer** type.

Prerequisites

- Ensure that OBS buckets and folders have been created.

  For details about how to create an OBS bucket, see **Creating a Bucket** in the **Object Storage Service Console Operation Guide**.

  For details about how to create a folder, see **Creating a Folder** in the **Object Storage Service Console Operation Guide**.
- In this scenario, jobs must run on the dedicated queue of DLI. Therefore, DLI must interconnect with the enhanced datasource connection that has been connected with DWS clusters. You can also set the security group rules as required.

  For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.

For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.

Syntax

```
CREATE SINK STREAM stream_id (attr_name attr_type (',' attr_name attr_type)* )
 WITH (
       type = "dws",
       region = "",
       ak = "",
       sk = "",
       encode = "",
       field_delimiter = "",
       quote = "",
       db_obs_server = "",
       obs_dir = "",
       username = "",
       password =  "",
       db_url = "",
       table_name = "",
       max_record_num_per_file = "",
       dump_interval = ""
 );
```

Keyword

Table 5-15 Keyword description

Parameter	Mandatory	Description
type	Yes	Output channel type. **dws** indicates that data is exported to DWS.
region	Yes	Region where DWS is located.
ak	Yes	Access Key ID (AK). For details about how to obtain the access key, see **My Credentials**.
sk	Yes	Secret access key used together with the ID of the AK. For details about how to obtain the access key, see **My Credentials**.
encode	Yes	Encoding format. Currently, CSV and ORC are supported.
field_delimiter	No	Separator used to separate every two attributes. This parameter needs to be configured if the CSV encoding mode is used. It is recommended that you use invisible characters as separators, for example, **\u0006\u0002**.
quote	No	Single byte. It is recommended that invisible characters be used, for example, **u0007**.

Parameter	Mandatory	Description
db_obs_server	No	Foreign server (for example, **obs_server**) that has been created in the database. For details about how to create a foreign server, see **Creating a Foreign Server** in the *Data Warehouse Service Database Development Guide*. You need to specify this parameter if the ORC encoding mode is adopted.
obs_dir	Yes	Directory for storing intermediate files. The directory is in the format of {Bucket name}/{Directory name}, for example, obs-a1/dir1/subdir.
username	Yes	Username for connecting to a database.
password	Yes	Password for connecting to a database.
db_url	Yes	Database connection address. The format is /ip:port/database, for example, **192.168.1.21:8000/test1**.
table_name	Yes	Data table name. If no table is available, a table is automatically created.
max_record_num_per_file	Yes	Maximum number of records that can be stored in a file. If the number of records in a file is less than the maximum value, the file will be dumped to OBS after one dumping period.
dump_interval	Yes	Dumping period. The unit is second.
delete_obs_temp_file	No	Whether to delete temporary files on OBS. The default value is **true**. If this parameter is set to **false**, files on OBS will not be deleted. You need to manually clear the files.
max_dump_file_num	No	Maximum number of files that can be dumped at a time. If the number of files to be dumped is less than the maximum value, the files will be dumped to OBS after one dumping period.

Example

- Dump files in CSV format.

```
CREATE SINK STREAM car_infos (
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_price INT,
  car_timestamp LONG
)
  WITH (
    type = "dws",
    region = "xxx",
```

```
  ak = "",
  sk = "",
  encode = "csv",
  field_delimiter = "\u0006\u0006\u0002",
  quote = "\u0007",
  obs_dir = "dli-append-2/dws",
  username = "",
  password =  "",
  db_url = "192.168.1.12:8000/test1",
  table_name = "table1",
  max_record_num_per_file = "100",
  dump_interval = "10"
 );
```

- Dump files in ORC format.

```
CREATE SINK STREAM car_infos (
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_price INT,
  car_timestamp LONG
)
  WITH (
    type = "dws",
    region = "xxx",
    ak = "",
    sk = "",
    encode = "orc",
    db_obs_server = "obs_server",
    obs_dir = "dli-append-2/dws",
    username = "",
    password =  "",
    db_url = "192.168.1.12:8000/test1",
    table_name = "table1",
    max_record_num_per_file = "100",
    dump_interval = "10"
  );
```

5.1.4.11 MRS HBase Sink Stream

Function

DLI exports the output data of the Flink job to HBase of MRS.

Prerequisites

- An MRS cluster has been created by using your account. DLI can interconnect with HBase clusters with Kerberos enabled.
- In this scenario, jobs must run on the dedicated queue of DLI. Ensure that the dedicated queue of DLI has been created.

  To create a dedicated DLI queue, select **Pay-per-use** for **Billing Mode** and click **Dedicated Resource Mode** for **Queue Type** when creating a queue. For details, see **Creating a Queue** in the *Data Lake Insight User Guide*.
- Ensure that a datasource connection has been set up between the DLI dedicated queue and the MRS cluster, and security group rules have been configured based on the site requirements.

  For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.

  For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.

- **If you use MRS HBase, ensure that you have added IP addresses of all hosts in the MRS cluster for the enhanced datasource connection.**

  For details about how to add an IP-domain mapping, see **Modifying the Host Information** in the *Data Lake Insight User Guide*.

Syntax

```
CREATE SINK STREAM stream_id (attr_name attr_type (',' attr_name attr_type)* )
  WITH (
    type = "mrs_hbase",
    region = "",
    cluster_address = "",
    table_name = "",
    table_columns = "",
    illegal_data_table = "",
    batch_insert_data_num = "",
    action = ""
)
```

Keyword

Table 5-16 Keyword description

Parameter	Mandatory	Description
type	Yes	Output channel type. **mrs_hbase** indicates that data is exported to HBase of MRS.
region	Yes	Region where MRS resides.
cluster_address	Yes	ZooKeeper address of the cluster to which the data table to be inserted belongs. The format is **ip1,ip2:port**.
table_name	Yes	Name of the table where data is to be inserted. It can be specified through parameter configurations. For example, if you want one or more certain columns as part of the table name, use **car_pass_inspect_with_age_${car_age}**, where **car_age** is the column name.
table_columns	Yes	Columns to be inserted. The format is **rowKey, f1:c1, f1:c2, f2:c1**, where **rowKey** must be specified. If you do not want to add a column (for example, the third column) to the database, set this parameter to **rowKey,f1:c1,,f2:c1**.
illegal_data_table	No	If this parameter is specified, abnormal data (for example, **rowKey** does not exist) will be written into the table. If not specified, abnormal data will be discarded. The **rowKey** value is **taskNo**_*Timestamp* followed by six random digits, and the schema is info:data, info:reason.

Parameter	Mandatory	Description
batch_insert_data_num	No	Number of data records to be written in batches at a time. The value must be a positive integer. The upper limit is **1000**. The default value is **10**.
action	No	Whether data is added or deleted. Available options include **add** and **delete**. The default value is **add**.
krb_auth	No	Authentication name for creating a datasource connection authentication. This parameter is mandatory when Kerberos authentication is enabled. Set this parameter to the corresponding cross-source authentication name. For details, see **Datasource Authentication**. **NOTE** Ensure that the **/etc/hosts** information of the master node in the MRS cluster is added to the host file of the DLI queue.

Precautions

None

Example

Output data to HBase of MRS.

```
CREATE SINK STREAM qualified_cars (
  car_id STRING,
  car_owner STRING,
  car_age INT,
  average_speed INT,
  total_miles INT
)
  WITH (
    type = "mrs_hbase",
    region = "xxx",
    cluster_address = "192.16.0.88,192.87.3.88:2181",
    table_name = "car_pass_inspect_with_age_${car_age}",
    table_columns = "rowKey,info:owner,,car:speed,car:miles",
    illegal_data_table = "illegal_data",
    batch_insert_data_num = "20",
    action = "add",
    krb_auth = "KRB_AUTH_NAME"
  );
```

5.1.4.12 MRS Kafka Sink Stream

Function

DLI exports the output data of the Flink job to Kafka.

Apache Kafka is a fast, scalable, and fault-tolerant distributed message publishing and subscription system. It delivers high throughput and built-in partitions and

provides data replicas and fault tolerance. Apache Kafka is applicable to scenarios of handling massive messages. Kafka clusters are deployed and hosted on MRS that is powered on Apache Kafka.

Prerequisites

- If the Kafka server listens on the port using hostname, you need to add the mapping between the hostname and IP address of the Kafka Broker node to the DLI queue. Contact the Kafka service deployment personnel to obtain the hostname and IP address of the Kafka Broker node. For details about how to add an IP-domain mapping, see **Modifying the Host Information** in the *Data Lake Insight User Guide*.
- Kafka is an offline cluster. You need to use the enhanced datasource connection function to connect Flink jobs to Kafka. You can also set security group rules as required.

  For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.

  For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.

Syntax

```
CREATE SINK STREAM stream_id (attr_name attr_type (',' attr_name attr_type)* )
  WITH(
    type = "kafka",
    kafka_bootstrap_servers = "",
    kafka_topic = "",
    encode = "json"
)
```

Keyword

Table 5-17 Keyword description

Parameter	Mandatory	Description
type	Yes	Output channel type. **kafka** indicates that data is exported to Kafka.
kafka_bootstrap_servers	Yes	Port that connects DLI to Kafka. Use enhanced datasource connections to connect DLI queues with Kafka clusters.
kafka_topic	Yes	Kafka topic into which DLI writes data.
encode	Yes	Encoding format. Currently, **json** and **user_defined** are supported. **encode_class_name** and **encode_class_parameter** must be specified if this parameter is set to **user_defined**.

Parameter	Mandatory	Description
encode_class_name	No	If **encode** is set to **user_defined**, you need to set this parameter to the name of the user-defined decoding class (including the complete package path). The class must inherit the **DeserializationSchema** class.
encode_class_parameter	No	If **encode** is set to **user_defined**, you can set this parameter to specify the input parameter of the user-defined decoding class. Only one parameter of the string type is supported.
krb_auth	No	Authentication name for creating a datasource connection authentication. This parameter is mandatory when Kerberos authentication is enabled. If Kerberos authentication is not enabled for the created MRS cluster, ensure that the **/etc/hosts** information of the master node in the MRS cluster is added to the host file of the DLI queue.
kafka_properties	No	This parameter is used to configure the native attributes of Kafka. The format is **key1=value1;key2=value2**.
kafka_certificate_name	No	Specifies the name of the datasource authentication information. This parameter is valid only when the datasource authentication type is set to **Kafka_SSL**. **NOTE** • If this parameter is specified, the service loads only the specified file and password under the authentication. The system automatically sets this parameter to **kafka_properties**. • Other configuration information required for Kafka SSL authentication needs to be manually configured in the **kafka_properties** attribute.

Precautions

None

Example

Output data to Kafka.

- Example 1:

```
CREATE SINK STREAM kafka_sink (name STRING)
  WITH (
    type="kafka",
    kafka_bootstrap_servers =  "ip1:port1,ip2:port2",
    kafka_topic = "testsink",
    encode = "json"
  );
```

- Example 2:


```
CREATE SINK STREAM kafka_sink (
  a1 string,
  a2 string,
  a3 string,
  a4 INT
  ) // Output Field
  WITH (
    type="kafka",
    kafka_bootstrap_servers =  "192.x.x.x:9093, 192.x.x.x:9093, 192.x.x.x:9093",
kafka_topic = "testflink", // Written topic
  encode = "csv", // Encoding format, which can be JSON or CSV.
    kafka_certificate_name = "Flink",
    kafka_properties_delimiter = ",",
    kafka_properties = "sasl.jaas.config=org.apache.kafka.common.security.plain.PlainLoginModule
required username=\"xxx\" password=\"xxx\";,sasl.mechanism=PLAIN,security.protocol=SASL_SSL"
  );
```

5.1.4.13 Open-Source Kafka Sink Stream

Function

DLI exports the output data of the Flink job to Kafka.

Apache Kafka is a fast, scalable, and fault-tolerant distributed message publishing and subscription system. It delivers high throughput and built-in partitions and provides data replicas and fault tolerance. Apache Kafka is applicable to scenarios of handling massive messages.

Prerequisites

- If the Kafka server listens on the port using hostname, you need to add the mapping between the hostname and IP address of the Kafka Broker node to the DLI queue. Contact the Kafka service deployment personnel to obtain the hostname and IP address of the Kafka Broker node. For details about how to add an IP-domain mapping, see **Modifying the Host Information** in the *Data Lake Insight User Guide*.
- Kafka is an offline cluster. You need to use the enhanced datasource connection function to connect Flink jobs to Kafka. You can also set security group rules as required.

  For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.

  For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.

Syntax

```
CREATE SINK STREAM stream_id (attr_name attr_type (',' attr_name attr_type)* )
  WITH(
    type = "kafka",
    kafka_bootstrap_servers = "",
    kafka_topic = "",
    encode = "json"
  )
```


Keyword

Table 5-18 Keyword description

Parameter	Mandatory	Description
type	Yes	Output channel type. **kafka** indicates that data is exported to Kafka.
kafka_bootstrap_servers	Yes	Port that connects DLI to Kafka. Use enhanced datasource connections to connect DLI queues with Kafka clusters.
kafka_topic	Yes	Kafka topic into which DLI writes data.
encode	Yes	Data encoding format. The value can be **csv**, **json**, or **user_defined**. • **field_delimiter** must be specified if this parameter is set to **csv**. • **encode_class_name** and **encode_class_parameter** must be specified if this parameter is set to **user_defined**.
filed_delimiter	No	If **encode** is set to **csv**, you can use this parameter to specify the separator between CSV fields. By default, the comma (,) is used.
encode_class_name	No	If **encode** is set to **user_defined**, you need to set this parameter to the name of the user-defined decoding class (including the complete package path). The class must inherit the **DeserializationSchema** class.
encode_class_parameter	No	If **encode** is set to **user_defined**, you can set this parameter to specify the input parameter of the user-defined decoding class. Only one parameter of the string type is supported.
kafka_properties	No	This parameter is used to configure the native attributes of Kafka. The format is **key1=value1;key2=value2**.
kafka_certificate_name	No	Name of the datasource authentication information. This parameter is valid only when the datasource authentication type is set to **Kafka_SSL**. **NOTE** • If this parameter is specified, the service loads only the specified file and password under the authentication. The system automatically sets this parameter to **kafka_properties**. • Other configuration information required for Kafka SSL authentication needs to be manually configured in the **kafka_properties** attribute.

Precautions

None

Example

Output the data in the kafka_sink stream to Kafka.

```
CREATE SINK STREAM kafka_sink (name STRING)
  WITH (
    type="kafka",
    kafka_bootstrap_servers =  "ip1:port1,ip2:port2",
    kafka_topic = "testsink",
    encode = "json"
  );
```

5.1.4.14 File System Sink Stream (Recommended)

Function

You can create a sink stream to export data to a file system such as HDFS or OBS. After the data is generated, a non-DLI table can be created directly according to the generated directory. The table can be processed through DLI SQL, and the output data directory can be stored in partitioned tables. It is applicable to scenarios such as data dumping, big data analysis, data backup, and active, deep, or cold archiving.

OBS is an object-based storage service. It provides massive, secure, highly reliable, and low-cost data storage capabilities.

For more information about OBS, see the **Object Storage Service Console Operation Guide**.

Syntax

```
CREATE SINK STREAM stream_id (attr_name attr_type (',' attr_name attr_type)* )
  [PARTITIONED BY (attr_name (',' attr_name)*]
  WITH (
    type = "filesystem",
    file.path = "obs://bucket/xx",
    encode = "parquet",
    ak = "",
    sk = ""
  );
```

Keyword

Table 5-19 Keyword description

Parameter	Mandatory	Description
type	Yes	Output stream type. If **type** is set to **filesystem**, data is exported to the file system.

Parameter	Mandatory	Description
file.path	Yes	Output directory in the form: **schema://file.path**. Currently, Schema supports only OBS and HDFS. • If **schema** is set to **obs**, data is stored to OBS. • If **schema** is set to **hdfs**, data is exported to HDFS. A proxy user needs to be configured for HDFS. For details, see **HDFS Proxy User Configuration**. Example: **hdfs://node-master1sYAx:9820/user/car_infos**, where **node-master1sYAx:9820** is the name of the node where the NameNode is located.
encode	Yes	Output data encoding format. Currently, only the **parquet** and **csv** formats are supported. • When **schema** is set to **obs**, the encoding format of the output data can only be **parquet**. • When **schema** is set to **hdfs**, the output data can be encoded in **Parquet** or **CSV** format.
ak	No	Access key. This parameter is mandatory when data is exported to OBS. Global variables can be used to mask the access key used for OBS authentication. For details about how to use global variables on the console, see the **Data Lake Insight User Guide**.
sk	No	Secret access key. This parameter is mandatory when data is exported to OBS. Secret key for accessing OBS authentication. Global variables can be used to mask sensitive information. For details about how to use global variables on the console, see the **Data Lake Insight User Guide**.
krb_auth	No	Authentication name for creating a datasource connection authentication. This parameter is mandatory when Kerberos authentication is enabled. If Kerberos authentication is not enabled for the created MRS cluster, ensure that the **/etc/hosts** information of the master node in the MRS cluster is added to the host file of the DLI queue.
field_delimiter	No	Separator used to separate every two attributes. This parameter needs to be configured if the CSV encoding format is adopted. It can be user-defined, for example, a comma (**,**).

Precautions

- To ensure job consistency, enable checkpointing if the Flink job uses the file system output stream.
- To avoid data loss or data coverage, you need to enable automatic or manual restart upon job exceptions. Enable the **Restore Job from Checkpoint**.

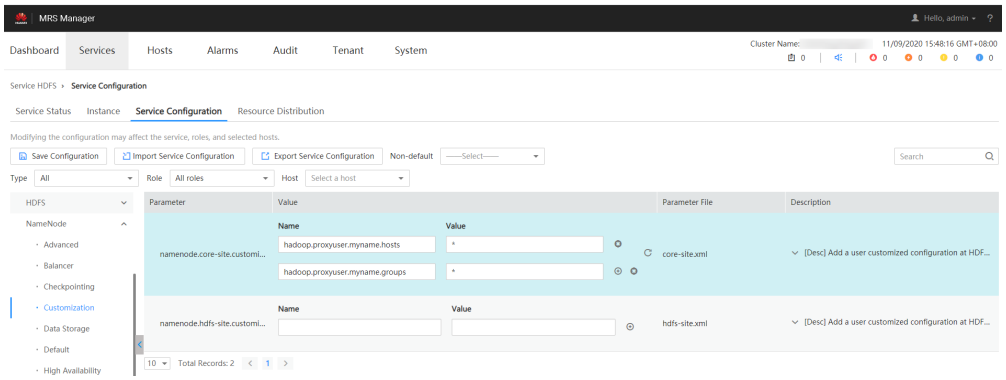
- Set the checkpoint interval after weighing between real-time output file, file size, and recovery time, such as 10 minutes.
- Two modes are supported.
  - **At least once**: Events are processed at least once.
  - **Exactly once**: Events are processed only once.
- When you use sink streams of a file system to write data into OBS, do not use multiple jobs for the same directory.
  - The default behavior of an OBS bucket is overwriting, which may cause data loss.
  - The default behavior of the OBS parallel file system bucket is appending, which may cause data confusion.

  You should carefully select the OBS bucket because of the preceding behavior differences. Data exceptions may occur after abnormal job restart.

HDFS Proxy User Configuration

1. Log in to the MRS management page.
2. Select the HDFS NameNode configuration of MRS and add configuration parameters in the **Customization** area.

   Figure 5-1 HDFS service configuration



   In the preceding information, **myname** in the **core-site** values **hadoop.proxyuser.myname.hosts** and **hadoop.proxyuser.myname.groups** is the name of the krb authentication user.

   NOTE

   Ensure that the permission on the HDFS data write path is **777**.

3. After the configuration is complete, click **Save**.

Example

- Example 1:

  The following example dumps the **car_info** data to OBS, with the **buyday** field as the partition field and **parquet** as the encoding format.

```
create sink stream car_infos (
  carId string,
  carOwner string,
  average_speed double,
```

```
 buyday string
 ) partitioned by (buyday)
 with (
   type = "filesystem",
   file.path = "obs://obs-sink/car_infos",
   encode = "parquet",
   ak = "{{myAk}}",
   sk = "{{mySk}}"
);
```

The data is ultimately stored in OBS. Directory: **obs://obs-sink/car_infos/buyday=xx/part-x-x**.

After the data is generated, the OBS partitioned table can be established for subsequent batch processing through the following SQL statements:

a. Create an OBS partitioned table.

```
create table car_infos (
  carId string,
  carOwner string,
  average_speed double
)
  partitioned by (buyday string)
  stored as parquet
  location 'obs://obs-sink/car_infos';
```

b. Restore partition information from the associated OBS path.

```
alter table car_infos recover partitions;
```

- Example 2:

  The following example dumps the **car_info** data to HDFS, with the **buyday** field as the partition field and **csv** as the encoding format.

```
create sink stream car_infos (
  carId string,
  carOwner string,
  average_speed double,
  buyday string
  ) partitioned by (buyday)
  with (
    type = "filesystem",
    file.path = "hdfs://node-master1sYAx:9820/user/car_infos",
    encode = "csv",
    field_delimiter = ","
);
```

The data is ultimately stored in HDFS. Directory: **/user/car_infos/buyday=xx/part-x-x**.

5.1.4.15 OBS Sink Stream

Function

Create a sink stream to export DLI data to OBS. DLI can export the job analysis results to OBS. OBS applies to various scenarios, such as big data analysis, cloud-native application program data, static website hosting, backup/active archive, and deep/cold archive.

OBS is an object-based storage service. It provides massive, secure, highly reliable, and low-cost data storage capabilities. For more information about OBS, see the .**Object Storage Service Console Operation Guide**

NOTE

You are advised to use the **File System Sink Stream (Recommended)**.

Prerequisites

Before data exporting, check the version of the OBS bucket. The OBS sink stream supports data exporting to an OBS bucket running OBS 3.0 or a later version.

Syntax

```
CREATE SINK STREAM stream_id (attr_name attr_type (',' attr_name attr_type)* )
 WITH (
        type = "obs",
        region = "",
        encode = "",
        field_delimiter = "",
        row_delimiter = "",
        obs_dir = "",
        file_prefix = "",
        rolling_size = "",
        rolling_interval = "",
        quote = "",
        array_bracket = "",
        append = "",
        max_record_num_per_file = "",
        dump_interval = "",
        dis_notice_channel = ""
 )
```

Keyword

Table 5-20 Keyword description

Parameter	Mandatory	Description
type	Yes	Output channel type. **obs** indicates that data is exported to OBS.
region	Yes	Region to which OBS belongs.
ak	No	Access Key ID (AK). For details about how to obtain the access key, see **My Credentials**.
sk	No	Secret access key used together with the ID of the access key. For details about how to obtain the access key, see **My Credentials**.
encode	Yes	Encoding format. Currently, formats CSV, JSON, ORC, Avro, Avro-Merge, and Parquet are supported.
field_delimiter	No	Separator used to separate every two attributes. This parameter is mandatory only when the CSV encoding format is adopted. If this parameter is not specified, the default separator comma (,) is used.
row_delimiter	No	Row delimiter. This parameter does not need to be configured if the CSV or JSON encoding format is adopted.

Parameter	Mandatory	Description
json_config	No	If **encode** is set to **json**, you can set this parameter to specify the mapping between the JSON field and the stream definition field. An example of the format is as follows: field1=data_json.field1;field2=data_json.field2.
obs_dir	Yes	Directory for storing files. The directory is in the format of {Bucket name}/{Directory name}, for example, obs-a1/dir1/subdir. If **encode** is set to **csv** (**append** is **false**), **json** (**append** is **false**), **avro_merge**, or **parquet**, parameterization is supported.
file_prefix	No	Prefix of the data export file name. The generated file is named in the format of file_prefix.*x*, for example, file_prefix.1 and file_prefix.2. If this parameter is not specified, the file prefix is **temp** by default.
rolling_size	No	Maximum size of a file. **NOTE** • One or both of **rolling_size** and **rolling_interval** must be configured. • When the size of a file exceeds the specified size, a new file is generated. • The unit can be KB, MB, or GB. If no unit is specified, the byte unit is used. • This parameter does not need to be configured if the ORC encoding format is adopted.
rolling_interval	No	Time mode, in which data is saved to the corresponding directory. **NOTE** • One or both of **rolling_size** and **rolling_interval** must be configured. • After this parameter is specified, data is written to the corresponding directories according to the output time. • The parameter value can be in the format of yyyy/MM/dd/HH/mm, which is case sensitive. The minimum unit is minute. If this parameter is set to **yyyy/MM/dd/HH**, data is written to the directory that is generated at the hour time. For example, data generated at 2018-09-10 16:00 will be written to the **{obs_dir}/2018-09-10_16** directory. • If both **rolling_size** and **rolling_interval** are set, a new file is generated when the size of a single file exceeds the specified size in the directory corresponding to each time point.
quote	No	Modifier, which is added before and after each attribute only when the CSV encoding format is adopted. You are advised to use invisible characters, such as **u0007**, as the parameter value.

Parameter	Mandatory	Description
array_bracket	No	Array bracket, which can be configured only when the CSV encoding format is adopted. The available options are **()**, **{}**, and **[]**. For example, if you set this parameter to **{}**, the array output format is {a1, a2}.
append	No	The value can be **true** or **false**. The default value is **true**. If OBS does not support the append mode and the encoding format is CSV or JSON, set this parameter to **false**. If **Append** is set to **false**, **max_record_num_per_file** and **dump_interval** must be set.
max_record_num_per_file	No	Maximum number of records in a file. This parameter needs to be set if **encode** is **csv** (**append** is **false**), **json** (**append** is **false**), **orc**, **avro**, **avro_merge**, or **parquet**. If the maximum number of records has been reached, a new file is generated.
dump_interval	No	Triggering period. This parameter needs to be configured when the ORC encoding format is adopted or notification to DIS is enabled. ● If the ORC encoding format is specified, this parameter indicates that files will be uploaded to OBS when the triggering period arrives even if the number of file records does not reach the maximum value. ● In notification to DIS is enabled, this parameter specifies that a notification is sent to DIS every period to indicate that no more files will be generated in the directory.
dis_notice_channel	No	DIS channel where DLI sends the record that contains the OBS directory DLI periodically sends the DIS channel a record, which contains the OBS directory, indicating that no more new files will be generated in the directory.
encoded_data	No	Data to be encoded. This parameter is set if **encode** is **json** (**append** is **false**), **avro_merge**, or **parquet**. The format is **${field_name}**, indicating that the stream field content is encoded as a complete record.

Precautions

If a configuration item can be specified through parameter configurations, one or more columns in the record can be used as part of the configuration item. For example, if the configuration item is set to **car_$ {car_brand}** and the value of

car_brand in a record is **BMW**, the value of this configuration item is **car_BMW** in the record.

Example

- Export the **car_infos** data to the **obs-sink** bucket in OBS. The output directory is **car_infos**. The output file uses **greater_30** as the file name prefix. The maximum size of a single file is 100 MB. If the data size exceeds 100 MB, another new file is generated. The data is encoded in CSV format, the comma (,) is used as the attribute delimiter, and the line break is used as the line separator.

```
CREATE SINK STREAM car_infos (
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_price INT,
  car_timestamp LONG
)
  WITH (
    type = "obs",
    encode = "csv",
    region = "xxx",
    field_delimiter = ",",
    row_delimiter = "\n",
    obs_dir = "obs-sink/car_infos",
    file_prefix = "greater_30",
    rolling_size = "100m"
);
```

- Example of the ORC encoding format

```
CREATE SINK STREAM car_infos (
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_price INT,
  car_timestamp LONG
)
  WITH (
    type = "obs",
    region = "xxx",
    encode = "orc",
    obs_dir = "dli-append-2/obsorc",
    FILE_PREFIX = "es_info",
    max_record_num_per_file = "100000",
    dump_interval = "60"
);
```

- For details about the parquet encoding example, see the example in **File System Sink Stream (Recommended)**.

5.1.4.16 RDS Sink Stream

Function

DLI outputs the Flink job output data to RDS. Currently, PostgreSQL and MySQL databases are supported. The PostgreSQL database can store data of more complex types and delivers space information services, multi-version concurrent control (MVCC), and high concurrency. It applies to location applications, financial insurance, and e-commerce. The MySQL database reduces IT deployment and maintenance costs in various scenarios, such as web applications, e-commerce, enterprise applications, and mobile applications.

RDS is a cloud-based web service.

For more information about RDS, see the **Relational Database Service User Guide**.

Prerequisites

- Ensure that you have created a PostgreSQL or MySQL RDS instance in RDS.

  For details about how to create an RDS instance, see **Buying an Instance** in the **Relational Database Service Getting Started**.

- In this scenario, jobs must run on the dedicated queue of DLI. Therefore, DLI must interconnect with the enhanced datasource connection that has been connected with RDS instance. You can also set the security group rules as required.

  For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.

  For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.

Syntax

```
CREATE SINK STREAM stream_id (attr_name attr_type (',' attr_name attr_type)* )
  WITH (
    type = "rds",
    username = "",
    password = "",
    db_url = "",
    table_name = ""
  );
```

Keyword

Table 5-21 Keyword description

Parameter	Mandatory	Description
type	Yes	Output channel type. **rds** indicates that data is exported to RDS.
username	Yes	Username for connecting to a database.
password	Yes	Password for connecting to a database.
db_url	Yes	Database connection address, for example, **{database_type}://ip:port/database**. Currently, two types of database connections are supported: MySQL and PostgreSQL. • MySQL: 'mysql://ip:port/database' • PostgreSQL: 'postgresql://ip:port/database'

Parameter	Mandatory	Description
table_name	Yes	Name of the table where data will be inserted.

db_columns	No	Mapping between attributes in the output stream and those in the database table. This parameter must be configured based on the sequence of attributes in the output stream.
		Example:
		`create sink stream a3(student_name  string, student_age int) with (`
		`type = "rds",`
		`username = "root",`
		`password = "xxxxxxxx",`
		`db_url = "mysql://192.168.0.102:8635/test1",`
		`db_columns = "name,age",`
		`table_name = "t1"`
		`);`
		In the example, **student_name** corresponds to the name attribute in the database, and **student_age** corresponds to the age attribute in the database.
		NOTE
		• If **db_columns** is not configured, it is normal that the number of attributes in the output stream is less than that of attributes in the database table and the extra attributes in the database table are all nullable or have default values.

primary_key	No	To update data in the table in real time by using the primary key, add the **primary_key** configuration item (**c_timeminute** in the following example) when creating a table. During the data writing operation, data is updated if the specified **primary_key** exists. Otherwise, data is inserted.
		Example:
		`CREATE SINK STREAM test(c_timeminute LONG, c_cnt LONG)`
		`WITH (`
		`type = "rds",`
		`username = "root",`
		`password = "xxxxxxxx",`
		`db_url = "mysql://192.168.0.12:8635/test",`
		`table_name = "test",`
		`primary_key = "c_timeminute");`

operation_field	No	Processing method of specified data in the format of ${field_name}. The value of **field_name** must be a string. If **field_name** indicates D or DELETE, this record is deleted from the database and data is inserted by default.

Precautions

The stream format defined by **stream_id** must be the same as the table format.

Example

Data of stream **audi_cheaper_than_30w** is exported to the **audi_cheaper_than_30w** table in the **test** database.

```
CREATE SINK STREAM audi_cheaper_than_30w (
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_price INT
)
  WITH (
    type = "rds",
    username = "root",
    password = "xxxxxx",
    db_url = "mysql://192.168.1.1:8635/test",
    table_name = "audi_cheaper_than_30w"
);
```

5.1.4.17 SMN Sink Stream

Function

DLI exports Flink job output data to SMN.

SMN provides reliable and flexible large-scale message notification services to DLI. It significantly simplifies system coupling and pushes messages to subscription endpoints based on requirements. SMN can be connected to other cloud services or integrated with any application that uses or generates message notifications to push messages over multiple protocols.

For more information about SMN, see the **Simple Message Notification User Guide**.

Syntax

```
CREATE SINK STREAM stream_id (attr_name attr_type (',' attr_name attr_type)* )
  WITH(
    type = "smn",
    region = "",
    topic_urn = "",
    urn_column = "",
    message_subject = "",
    message_column = ""
  )
```

Keyword

Table 5-22 Keyword description

Parameter	Mandatory	Description
type	Yes	Output channel type. **smn** indicates that data is exported to SMN.
region	Yes	Region to which SMN belongs.

Parameter	Mandatory	Description
topic_urn	No	URN of an SMN topic, which is used for the static topic URN configuration. The SMN topic serves as the destination for short message notification and needs to be created in SMN. One of **topic_urn** and **urn_column** must be configured. If both of them are configured, the **topic_urn** setting takes precedence.
urn_column	No	Field name of the topic URN content, which is used for the dynamic topic URN configuration. One of **topic_urn** and **urn_column** must be configured. If both of them are configured, the **topic_urn** setting takes precedence.
message_subject	Yes	Message subject sent to SMN. This parameter can be user-defined.
message_column	Yes	Field name in the sink stream. Contents of the field name serve as the message contents, which are user-defined. Currently, only text messages (default) are supported.

Precautions

None

Example

Data of stream **over_speed_warning** is exported to SMN.

```
//Static topic configuration
CREATE SINK STREAM over_speed_warning (
  over_speed_message STRING /* over speed message */
)
  WITH (
    type = "smn",
    region = "xxx",
    topic_Urn = "xxx",
    message_subject = "message title",
    message_column = "over_speed_message"
  );
//Dynamic topic configuration
CREATE SINK STREAM over_speed_warning2 (
    over_speed_message STRING, /* over speed message */
    over_speed_urn STRING
)
  WITH (
    type = "smn",
    region = "xxx",
    urn_column = "over_speed_urn",
    message_subject = "message title",
    message_column = "over_speed_message"
  );
```

5.1.5 Creating a Temporary Stream

Function

The temporary stream is used to simplify SQL logic. If complex SQL logic is followed, write SQL statements concatenated with temporary streams. The temporary stream is just a logical concept and does not generate any data.

Syntax

```
CREATE TEMP STREAM stream_id (attr_name attr_type (',' attr_name attr_type)* )
```

Example

```
create temp stream a2(attr1 int, attr2 string);
```

5.1.6 Creating a Dimension Table

5.1.6.1 Creating a Redis Table

Create a Redis table to connect to the source stream.

For more information about DCS, see the **Distributed Cache Service User Guide**.

For details about the JOIN syntax, see **JOIN Between Stream Data and Table Data**.

Syntax

```
CREATE TABLE table_id (key_attr_name STRING(, hash_key_attr_name STRING)?, value_attr_name STRING)
  WITH (
    type = "dcs_redis",
    cluster_address = ""(,password = "")?,
    value_type= "",
    key_column= ""(,hash_key_column="")?);
```

Keyword

Table 5-23 Keyword description

Parameter	Mandatory	Description
type	Yes	Output channel type. Value **dcs_redis** indicates that data is exported to DCS Redis.
cluster_address	Yes	Redis instance connection address.
password	No	Redis instance connection password. This parameter is not required if password-free access is used.
value_type	Yes	Indicates the field data type. Supported data types include string, list, hash, set, and zset.

Parameter	Mandatory	Description
key_column	Yes	Indicates the column name of the Redis key attribute.
hash_key_column	No	If **value_type** is set to **hash**, this field must be specified as the column name of the level-2 key attribute.
cache_max_num	No	Indicates the maximum number of cached query results. The default value is **32768**.
cache_time	No	Indicates the maximum duration for caching database query results in the memory. The unit is millisecond. The default value is **10000**. The value **0** indicates that caching is disabled.

Precautions

- Redis clusters are not supported.
- Ensure that You have created a Redis cache instance on DCS using your account.

  For details about how to create a Redis cache instance, see the **Distributed Cache Service User Guide**.
- In this scenario, jobs must run on the dedicated queue of DLI. Therefore, DLI must interconnect with the enhanced datasource connection that has been connected with DCS instance. You can also set the security group rules as required.

  For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.

  For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.

Example

The Redis table is used to connect to the source stream.

```
CREATE TABLE table_a (attr1 string, attr2 string, attr3 string)
  WITH (
    type = "dcs_redis",
    value_type = "hash",
    key_column = "attr1",
    hash_key_column = "attr2",
    cluster_address = "192.168.1.238:6379",
    password = "xxxxxxxx"
 );
```

5.1.6.2 Creating an RDS Table

Create an RDS/DWS table to connect to the source stream.

For details about the JOIN syntax, see **JOIN**.

Prerequisites

- Ensure that you have created a PostgreSQL or MySQL RDS instance in RDS.
- In this scenario, jobs must run on the dedicated queue of DLI. Therefore, DLI must interconnect with the enhanced datasource connection that has been connected with RDS instance. You can also set the security group rules as required.

  For details about how to create an enhanced datasource connection, see **Enhanced Datasource Connections** in the *Data Lake Insight User Guide*.

  For details about how to configure security group rules, see **Security Group** in the **Virtual Private Cloud User Guide**.

Syntax

```
CREATE TABLE  table_id (
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_price INT
)
  WITH (
    type = "rds",
    username = "",
    password = "",
    db_url = "",
    table_name = ""
  );
```

Keyword

Table 5-24 Keyword description

Parameter	Mandatory	Description
type	Yes	Output channel type. Value **rds** indicates that data is stored to RDS.
username	Yes	Username for connecting to a database.
password	Yes	Password for connecting to a database.
db_url	Yes	Database connection address, for example, **{database_type}://ip:port/database**. Currently, two types of database connections are supported: MySQL and PostgreSQL. • MySQL: 'mysql://ip:port/database' • PostgreSQL: 'postgresql://ip:port/database' **NOTE** To create a DWS dimension table, set the database connection address to a DWS database address. If the DWS database version is later than 8.1.0, the open-source PostgreSQL driver cannot be used for connection. You need to use the GaussDB driver for connection.

Parameter	Mandatory	Description
table_name	Yes	Indicates the name of the database table for data query.
db_columns	No	Indicates the mapping of stream attribute fields between the sink stream and database table. This parameter is mandatory when the stream attribute fields in the sink stream do not match those in the database table. The parameter value is in the format of dbtable_attr1,dbtable_attr2,dbtable_attr3.
cache_max_num	No	Indicates the maximum number of cached query results. The default value is **32768**.
cache_time	No	Indicates the maximum duration for caching database query results in the memory. The unit is millisecond. The default value is **10000**. The value **0** indicates that caching is disabled.

Example

The RDS table is used to connect to the source stream.

```
CREATE SOURCE STREAM car_infos (
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_price INT
)
  WITH (
    type = "dis",
    region = "",
    channel = "dliinput",
    encode = "csv",
    field_delimiter = ","
  );

CREATE TABLE  db_info (
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_price INT
)
  WITH (
    type = "rds",
    username = "root",
    password = "******",
    db_url = "postgresql://192.168.0.0:2000/test1",
    table_name = "car"
);

CREATE SINK STREAM audi_cheaper_than_30w (
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_price INT
)
  WITH (
    type = "dis",
    region = "",
```

```
  channel = "dlioutput",
  partition_key = "car_owner",
  encode = "csv",
  field_delimiter = ","
);

INSERT INTO audi_cheaper_than_30w
SELECT a.car_id, b.car_owner, b.car_brand, b.car_price
FROM car_infos as a join db_info as b on a.car_id = b.car_id;
```

NOTE

To create a DWS dimension table, set the database connection address to a DWS database address. If the DWS database version is later than 8.1.0, the open-source PostgreSQL driver cannot be used for connection. You need to use the GaussDB driver for connection.

5.1.7 Custom Stream Ecosystem

5.1.7.1 Custom Source Stream

Compile code to obtain data from the desired cloud ecosystem or open-source ecosystem as the input data of Flink jobs.

Syntax

```
CREATE SOURCE STREAM stream_id (attr_name attr_type (',' attr_name attr_type)* )
 WITH (
  type = "user_defined",
  type_class_name = "",
  type_class_parameter = ""
 )
 (TIMESTAMP BY timeindicator (',' timeindicator)?);timeindicator:PROCTIME '.' PROCTIME| ID '.' ROWTIME
```

Keyword

Table 5-25 Keyword description

Parameter	Mandatory	Description
type	Yes	Data source type. The value **user_defined** indicates that the data source is a user-defined data source.
type_class_name	Yes	Name of the source class for obtaining source data. The value must contain the complete package path.
type_class_parameter	Yes	Input parameter of the user-defined source class. Only one parameter of the string type is supported.

Precautions

The user-defined source class needs to inherit the **RichParallelSourceFunction** class and specify the data type as Row. For example, define MySource class: **public class MySource extends RichParallelSourceFunction<Row>{}**. It aims to implement the **open**, **run**, and **close** functions.

Dependency pom:

```
<dependency>
   <groupId>org.apache.flink</groupId>
   <artifactId>flink-streaming-java_2.11</artifactId>
   <version>${flink.version}</version>
   <scope>provided</scope>
</dependency>
<dependency>
   <groupId>org.apache.flink</groupId>
   <artifactId>flink-core</artifactId>
   <version>${flink.version}</version>
   <scope>provided</scope>
</dependency>
```

Example

A data record is generated in each period. The data record contains only one field of the INT type. The initial value is 1 and the period is 60 seconds. The period is specified by an input parameter.

```
CREATE SOURCE STREAM user_in_data (
   count INT
   )
 WITH (
   type = "user_defined",
   type_class_name = "mySourceSink.MySource",
   type_class_parameter = "60"
    )
    TIMESTAMP BY car_timestamp.rowtime;
```

NOTE

To customize the implementation of the source class, you need to pack the class in a JAR package and upload the UDF function on the SQL editing page.

5.1.7.2 Custom Sink Stream

Compile code to write the data processed by DLI to a specified cloud ecosystem or open-source ecosystem.

Syntax

```
CREATE SINK STREAM stream_id (attr_name attr_type (',' attr_name attr_type)* )
 WITH (
   type = "user_defined",
   type_class_name = "",
   type_class_parameter = ""
 );
```

Keyword

Table 5-26 Keyword description

Parameter	Mandatory	Description
type	Yes	Data source type. The value **user_defined** indicates that the data source is a user-defined data source.

Parameter	Mandatory	Description
type_class_name	Yes	Name of the sink class for obtaining source data. The value must contain the complete package path.
type_class_parameter	Yes	Input parameter of the user-defined sink class. Only one parameter of the string type is supported.

Precautions

The user-defined sink class needs to inherit the **RichSinkFunction** class and specify the data type as Row. For example, define MySink class: **public class MySink extends RichSinkFunction<Row>{}**. It aims to implement the **open**, **invoke**, and **close** functions.

Dependency pom:

```
<dependency>
   <groupId>org.apache.flink</groupId>
   <artifactId>flink-streaming-java_2.11</artifactId>
   <version>${flink.version}</version>
   <scope>provided</scope>
</dependency>
<dependency>
   <groupId>org.apache.flink</groupId>
   <artifactId>flink-core</artifactId>
   <version>${flink.version}</version>
   <scope>provided</scope>
</dependency>
```

Example

Writing data encoded in CSV format to a DIS stream is used as an example.

```
CREATE SINK STREAM user_out_data (
   count INT
)
 WITH (
   type = "user_defined",
   type_class_name = "mySourceSink.MySink",
   type_class_parameter = ""
    );
```

NOTE

To customize the implementation of the sink class, you need to pack the class in a JAR package and upload the UDF function on the SQL editing page.

5.1.8 Data Type

Overview

Data type is a basic attribute of data and used to distinguish different types of data. Different data types occupy different storage space and support different operations. Data is stored in data tables in the database. Each column of a data

table defines the data type. During storage, data must be stored according to data types.

Similar to the open source community, Flink SQL of the Huawei big data platform supports both native data types and complex data types.

Primitive Data Types

Table 5-27 lists native data types supported by Flink SQL.

Table 5-27 Primitive Data Types

Data Type	Description	Storage Space	Value Range
VARCHAR	Character with a variable length	-	-
BOOLEAN	Boolean	-	TRUE/FALSE
TINYINT	Signed integer	1 byte	-128-127
SMALLINT	Signed integer	2 bytes	-32768-32767
INT	Signed integer	4 bytes	–2147483648 to 2147483647
INTEGER	Signed integer	4 bytes	–2147483648 to 2147483647
BIGINT	Signed integer	8 bytes	–9223372036854775808 to 9223372036854775807
REAL	Single-precision floating point	4 bytes	-
FLOAT	Single-precision floating point	4 bytes	-
DOUBLE	Double-precision floating-point	8 bytes	-
DECIMAL	Data type of valid fixed places and decimal places	-	-
DATE	Date type in the format of yyyy-MM-dd, for example, 2014-05-29	-	**DATE** does not contain time information. Its value ranges from 0000-01-01 to 9999-12-31.
TIME	Time type in the format of HH:MM:SS For example, 20:17:40	-	-

Data Type	Description	Storage Space	Value Range
TIMESTAMP(3)	Timestamp of date and time For example, 1969-07-20 20:17:40	-	-
INTERVAL timeUnit [TO timeUnit]	Time interval For example, INTERVAL '1:5' YEAR TO MONTH, INTERVAL '45' DAY	-	-

Complex Data Types

Flink SQL supports complex data types and complex type nesting. **Table 5-28** describes complex data types.

Table 5-28 Complex Data Types

Data Type	Description	Declaration Method	Reference Method	Construction Method
ARRAY	Indicates a group of ordered fields that are of the same data type.	ARRAY[TYPE]	Variable name **[subscript]**. The subscript starts from 1, for example, **v1[1]**.	Array[value1, value2, ...] as v1
MAP	Indicates a group of unordered key/value pairs. The key must be native data type, but the value can be either native data type or complex data type. The type of the same MAP key, as well as the MAP value, must be the same.	**MAP [TYPE, TYPE]**	Variable name **[key]**, for example, **v1[key]**	Map[key, value, key2, value2, key3, value3.....] as v1
ROW	Indicates a group of named fields. The data types of the fields can be different.	ROW<a1 TYPE1, a2 TYPE2>	Variable name. Field name, for example, **v1.a1**.	Row('1',2) as v1

Here is a sample code:

```
CREATE SOURCE STREAM car_infos (
  car_id STRING,
  address ROW<city STRING, province STRING, country STRING>,
  average_speed MAP[STRING, LONG],
  speeds ARRAY[LONG]
)
  WITH (
    type = "dis",
    region = "xxx",
    channel = "dliinput",
    encode = "json"
);

CREATE temp STREAM car_speed_infos (
  car_id STRING,
  province STRING,
  average_speed LONG,
  start_speed LONG
);

INSERT INTO car_speed_infos SELECT
   car_id,
   address.province,
   average_speed[address.city],
   speeds[1]
FROM car_infos;
```

Complex Type Nesting

- JSON format enhancement

  The following uses Source as an example. The method of using Sink is the same.

  - **json_schema** can be configured.

    After **json_schema** is configured, fields in DDL can be automatically generated from **json_schema** without declaration. Here is a sample code:

    ```
    CREATE SOURCE STREAM data_with_schema WITH (
          type = "dis",
          region = "xxx",
          channel = "dis-in",
          encode = "json",
          json_schema = '{"definitions":{"address":{"type":"object","properties":{"street_address":
    {"type":"string"},"city":{"type":"string"},"state":{"type":"string"}},"required":
    ["street_address","city","state"]}},"type":"object","properties":{"billing_address":{"$ref":"#/
    definitions/address"},"shipping_address":{"$ref":"#/definitions/address"},"optional_address":
    {"oneOf":[{"type":"null"},{"$ref":"#/definitions/address"}]}}}'
        );

        CREATE SINK STREAM buy_infos (
          billing_address_city STRING,
          shipping_address_state string
        ) WITH (
          type = "obs",
          encode = "csv",
          region = "xxx" ,
          field_delimiter = ",",
          row_delimiter = "\n",
          obs_dir = "bucket/car_infos",
          file_prefix = "over",
          rolling_size = "100m"
        );

        insert into buy_infos select billing_address.city, shipping_address.state from
    data_with_schema;
    ```

    Example data


```
{
 "billing_address":
  {
   "street_address":"xxx",
   "city":"xxx",
   "state":"xxx"
   },
 "shipping_address":
  {
   "street_address":"xxx",
   "city":"xxx",
   "state":"xxx"
  }
}
```

- The **json_schema** and **json_config** parameters can be left empty. For details about how to use **json_config**, see the example in **Open-Source Kafka Source Stream**.

  In this case, the attribute name in the DDL is used as the JSON key for parsing by default.

  The following is example data. It contains nested JSON fields, such as **billing_address** and **shipping_address**, and non-nested fields **id** and **type2**.

  ```
  {
   "id":"1",
   "type2":"online",
   "billing_address":
   {
    "street_address":"xxx",
    "city":"xxx",
    "state":"xxx"
    },
   "shipping_address":
   {
    "street_address":"xxx",
    "city":"xxx",
    "state":"xxx"
   }
  }
  ```

  The table creation and usage examples are as follows:

  ```
  CREATE SOURCE STREAM car_info_data (
        id STRING,
        type2 STRING,
        billing_address Row<street_address string, city string, state string>,
        shipping_address Row<street_address string, city string, state string>,
        optional_address Row<street_address string, city string, state string>
      ) WITH (
        type = "dis",
        region = "xxx",
        channel = "dis-in",
        encode = "json"
      );

     CREATE SINK STREAM buy_infos (
        id STRING,
        type2 STRING,
        billing_address_city STRING,
        shipping_address_state string
      ) WITH (
        type = "obs",
        encode = "csv",
        region = "xxx",
        field_delimiter = ",",
        row_delimiter = "\n",
        obs_dir = "bucket/car_infos",
        file_prefix = "over",
  ```

```
    rolling_size = "100m"
  );

  insert into buy_infos select id, type2, billing_address.city, shipping_address.state from
car_info_data;
```

- Complex data types supported by sink serialization
  - Currently, only the CSV and JSON formats support complex data types.
  - For details about the JSON format, see **Json format enhancement**.
  - There is no standard format for CSV files. Therefore, only sink parsing is supported.
  - Output format: It is recommended that the output format be the same as that of the native Flink.

    Map: {key1=Value1, key2=Value2}

    Row: Attributes are separated by commas (,), for example, **Row(1,'2') => 1,'2'**.

5.1.9 Built-In Functions

5.1.9.1 Mathematical Operation Functions

Relational Operators

All data types can be compared by using relational operators and the result is returned as a BOOLEAN value.

Relationship operators are binary operators. Two compared data types must be of the same type or they must support implicit conversion.

Table 5-29 lists all relational operators supported by Flink SQL.

Table 5-29 Relational Operators

Operator	Returned Data Type	Description
A = B	BOOLEAN	If A is equal to B, then **TRUE** is returned. Otherwise, **FALSE** is returned. This operator is used for value assignment.
A <> B	BOOLEAN	If A is not equal to B, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned. This operator follows the standard SQL syntax.
A < B	BOOLEAN	If A is less than B, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned.
A <= B	BOOLEAN	If A is less than or equal to B, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned.

Operator	Returned Data Type	Description
A > B	BOOLEAN	If A is greater than B, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned.
A >= B	BOOLEAN	If A is greater than or equal to B, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned.
A IS NULL	BOOLEAN	If A is **NULL**, then **TRUE** is returned. Otherwise, **FALSE** is returned.
A IS NOT NULL	BOOLEAN	If A is not **NULL**, then **TRUE** is returned. Otherwise, **FALSE** is returned.
A IS DISTINCT FROM B	BOOLEAN	If A is not equal to B, **TRUE** is returned. **NULL** indicates A equals B.
A IS NOT DISTINCT FROM B	BOOLEAN	If A is equal to B, **TRUE** is returned. **NULL** indicates A equals B.
A BETWEEN [ASYMMETRIC | SYMMETRIC] B AND C	BOOLEAN	If A is greater than or equal to B but less than or equal to C, **TRUE** is returned. • ASYMMETRIC: indicates that B and C are location-related. For example, "A BETWEEN ASYMMETRIC B AND C" is equivalent to "A BETWEEN B AND C". • SYMMETRIC: indicates that B and C are not location-related. For example, "A BETWEEN SYMMETRIC B AND C" is equivalent to "A BETWEEN B AND C) OR (A BETWEEN C AND B".
A NOT BETWEEN B AND C	BOOLEAN	If A is less than B or greater than C, **TRUE** is returned.
A LIKE B [ESCAPE C]	BOOLEAN	If A matches pattern B, **TRUE** is returned. The escape character C can be defined as required.
A NOT LIKE B [ESCAPE C]	BOOLEAN	If A does not match pattern B, **TRUE** is returned. The escape character C can be defined as required.
A SIMILAR TO B [ESCAPE C]	BOOLEAN	If A matches regular expression B, **TRUE** is returned. The escape character C can be defined as required.

Operator	Returned Data Type	Description
A NOT SIMILAR TO B [ESCAPE C]	BOOLEAN	If A does not match regular expression B, **TRUE** is returned. The escape character C can be defined as required.
value IN (value [, value]*)	BOOLEAN	If the value is equal to any value in the list, **TRUE** is returned.
value NOT IN (value [, value]*)	BOOLEAN	If the value is not equal to any value in the list, **TRUE** is returned.

NOTE

- Values of the double, real, and float types may be different in precision. The equal sign (=) is not recommended for comparing two values of the double type. You are advised to obtain the absolute value by subtracting these two values of the double type and determine whether they are the same based on the absolute value. If the absolute value is small enough, the two values of the double data type are regarded equal. For example:
  abs(0.9999999999 - 1.0000000000) < 0.000000001 //The precision decimal places of 0.9999999999 and 1.0000000000 are 10, while the precision decimal place of 0.000000001 is 9. Therefore, 0.9999999999 can be regarded equal to 1.0000000000.
- Comparison between data of the numeric type and character strings is allowed. During comparison using relational operators, including >, <, ≤, and ≥, data of the string type is converted to numeric type by default. No characters other than numeric characters are allowed.
- Character strings can be compared using relational operators.

Logical Operators

Common logical operators are AND, OR, and NOT. Their priority order is NOT > AND > OR.

Table 5-30 lists the calculation rules. A and B indicate logical expressions.

Table 5-30 Logical Operators

Operator	Result Type	Description
A OR B	BOOLEAN	If A or B is TRUE, **TRUE** is returned. Three-valued logic is supported.
A AND B	BOOLEAN	If both A and B are TRUE, **TRUE** is returned. Three-valued logic is supported.
NOT A	BOOLEAN	If A is not TRUE, **TRUE** is returned. If A is UNKNOWN, **UNKNOWN** is returned.

Operator	Result Type	Description
A IS FALSE	BOOLEAN	If A is TRUE, **TRUE** is returned. If A is UNKNOWN, **FALSE** is returned.
A IS NOT FALSE	BOOLEAN	If A is not FALSE, **TRUE** is returned. If A is UNKNOWN, **TRUE** is returned.
A IS TRUE	BOOLEAN	If A is TRUE, **TRUE** is returned. If A is UNKNOWN, **FALSE** is returned.
A IS NOT TRUE	BOOLEAN	If A is not TRUE, **TRUE** is returned. If A is UNKNOWN, **TRUE** is returned.
A IS UNKNOWN	BOOLEAN	If A is UNKNOWN, **TRUE** is returned.
A IS NOT UNKNOWN	BOOLEAN	If A is not UNKNOWN, **TRUE** is returned.

NOTE

Only data of the Boolean type can be used for calculation using logical operators. Implicit type conversion is not supported.

Arithmetic Operators

Arithmetic operators include binary operators and unary operators, for all of which, the returned results are of the numeric type. **Table 5-31** lists arithmetic operators supported by Flink SQL.

Table 5-31 Arithmetic Operators

Operator	Result Type	Description
+ numeric	All numeric types	Returns numbers.
- numeric	All numeric types	Returns negative numbers.
A + B	All numeric types	A plus B. The result type is associated with the operation data type. For example, if floating-point number is added to an integer, the result will be a floating-point number.

Operator	Result Type	Description
A - B	All numeric types	A minus B. The result type is associated with the operation data type.
A * B	All numeric types	Multiply A and B. The result type is associated with the operation data type.
A / B	All numeric types	Divide A by B. The result is a number of the double type (double-precision number).
POWER(A, B)	All numeric types	Returns the value of A raised to the power B.
ABS(numeric)	All numeric types	Returns the absolute value of a specified value.
MOD(A, B)	All numeric types	Returns the remainder (modulus) of A divided by B. A negative value is returned only when A is a negative value.
SQRT(A)	All numeric types	Returns the square root of A.
LN(A)	All numeric types	Returns the nature logarithm of A (base e).
LOG10(A)	All numeric types	Returns the base 10 logarithms of A.
EXP(A)	All numeric types	Return the value of e raised to the power of **a**.
CEIL(A) CEILING(A)	All numeric types	Return the smallest integer that is greater than or equal to **a**. For example: ceil(21.2) = 22.
FLOOR(A)	All numeric types	Return the largest integer that is less than or equal to **a**. For example: floor(21.2) = 21.
SIN(A)	All numeric types	Returns the sine value of A.
COS(A)	All numeric types	Returns the cosine value of A.
TAN(A)	All numeric types	Returns the tangent value of A.
COT(A)	All numeric types	Returns the cotangent value of A.

Operator	Result Type	Description
ASIN(A)	All numeric types	Returns the arc sine value of A.
ACOS(A)	All numeric types	Returns the arc cosine value of A.
ATAN(A)	All numeric types	Returns the arc tangent value of A.
DEGREES(A)	All numeric types	Convert the value of **a** from radians to degrees.
RADIANS(A)	All numeric types	Convert the value of **a** from degrees to radians.
SIGN(A)	All numeric types	Returns the sign of A. **1** is returned if A is positive. **–1** is returned if A is negative. Otherwise, **0** is returned.
ROUND(A, d)	All numeric types	Round A to d places right to the decimal point. d is an int type. For example: round(21.263,2) = 21.26.
PI()	All numeric types	Return the value of **pi**.

NOTE

Data of the string type is not allowed in arithmetic operations.

5.1.9.2 String Functions

The common character string functions of DLI are as follows:

Table 5-32 String Operators

Operator	Returned Data Type	Description
||	VARCHAR	Concatenates two strings.
CHAR_LENGTH	INT	Returns the number of characters in a string.
CHARACTER_LENGTH	INT	Returns the number of characters in a string.
CONCAT	VARCHAR	Concatenates two or more string values to form a new string. If the value of any parameter is **NULL**, skip this parameter.

Operator	Returned Data Type	Description
CONCAT_WS	VARCHAR	Concatenates each parameter value and the separator specified by the first parameter separator to form a new string. The length and type of the new string depend on the input value.
HASH_CODE	INT	Returns the absolute value of **HASH_CODE()** of a string. In addition to **string**, **int**, **bigint**, **float**, and **double** are also supported.
INITCAP	VARCHAR	Returns a string whose first letter is in uppercase and the other letters in lowercase. Words are sequences of alphanumeric characters separated by non-alphanumeric characters.
IS_ALPHA	BOOLEAN	Checks whether a string contains only letters.
IS_DIGITS	BOOLEAN	Checks whether a string contains only digits.
IS_NUMBER	BOOLEAN	Checks whether a string is numeric.
IS_URL	BOOLEAN	Checks whether a string is a valid URL.
JSON_VALUE	VARCHAR	Obtains the value of a specified path in a JSON string.
KEY_VALUE	VARCHAR	Obtains the value of a key in a key-value pair string.
LOWER	VARCHAR	Returns a string of lowercase characters.
LPAD	VARCHAR	Concatenates the pad string to the left of the str string until the length of the new string reaches the specified length len.
MD5	VARCHAR	Returns the MD5 value of a string. If the parameter is an empty string (that is, the parameter is ''), an empty string is returned.
OVERLAY	VARCHAR	Replaces the substring of **x** with **y**. Replace length +1 characters starting from **start_position**.
POSITION	INT	Returns the position of the first occurrence of the target string **x** in the queried string **y**. If the target string **x** does not exist in the queried string **y**, **0** is returned.

Operator	Returned Data Type	Description
REPLACE	VARCHAR	Replaces all **str2** in the **str1** string with **str3**. • **str1**: original character. • **str2**: target character. • **str3**: replacement character.
RPAD	VARCHAR	Concatenates the pad string to the right of the str string until the length of the new string reaches the specified length len.
SHA1	STRING	Returns the SHA1 value of the **expr** string.
SHA256	STRING	Returns the SHA256 value of the **expr** string.
STRING_TO_ARRAY	ARRAY[STRING]	Separates the **value** string as string arrays by using the delimiter.
SUBSTRING	VARCHAR	Returns the substring starting from a fixed position of A. The start position starts from 1.
TRIM	STRING	Removes A at the start position, or end position, or both the start and end positions from B. By default, string expressions A at both the start and end positions are removed.
UPPER	VARCHAR	Returns a string converted to uppercase characters.

||

- Function

  Concatenates two character strings.
- Syntax

  ```
  VARCHAR VARCHAR a || VARCHAR b
  ```
- Parameter description
  - **a**: character string.
  - **b**: character string.
- Example
  - Test statement

    ```
    SELECT "hello" || "world";
    ```
  - Test result

    ```
    "helloworld"
    ```

CHAR_LENGTH

- Function

  Returns the number of characters in a string.

- Syntax
  ```
  INT CHAR_LENGTH(a)
  ```
- Parameter description
  - **a**: character string.
- Example
  - Test statement
    ```
    SELECT  CHAR_LENGTH(var1) as aa FROM T1;
    ```
  - Test data and result

    Table 5-33 Test data and result

Test Data (var1)	Test Result (aa)
abcde123	8

CHARACTER_LENGTH

- Function

  Returns the number of characters in a string.
- Syntax
  ```
  INT CHARACTER_LENGTH(a)
  ```
- Parameter description
  - **a**: character string.
- Example
  - Test statement
    ```
    SELECT  CHARACTER_LENGTH(var1) as aa FROM T1;
    ```
  - Test data and result

    Table 5-34 Test data and result

Test Data (var1)	Test Result (aa)
abcde123	8

CONCAT

- Function

  Concatenates two or more string values to form a new string. If the value of any parameter is NULL, skip this parameter.
- Syntax
  ```
  VARCHAR CONCAT(VARCHAR var1, VARCHAR var2, ...)
  ```
- Parameter description
  - **var1**: character string
  - **var2**: character string
- Example
  - Test statement
    ```
    SELECT CONCAT("abc", "def", "ghi", "jkl");
    ```


  - Test result
    ```
    "abcdefghijkl"
    ```

CONCAT_WS

- Function

  Concatenates each parameter value and the separator specified by the first parameter separator to form a new string. The length and type of the new string depend on the input value.

  NOTE

  If the value of **separator** is **null**, **separator** is combined with an empty string. If other parameters are set to null, the parameters whose values are null are skipped during combination.

- Syntax
  ```
  VARCHAR CONCAT_WS(VARCHAR separator, VARCHAR var1, VARCHAR var2, ...)
  ```
- Parameter description
  - **separator**: separator.
  - **var1**: character string
  - **var2**: character string
- Example
  - Test statement
    ```
    SELECT CONCAT_WS("-", "abc", "def", "ghi", "jkl");
    ```
  - Test result
    ```
    "abc-def-ghi-jkl"
    ```

HASH_CODE

- Function

  Returns the absolute value of **HASH_CODE()** of a string. In addition to **string**, **int**, **bigint**, **float**, and **double** are also supported.

- Syntax
  ```
  INT HASH_CODE(VARCHAR str)
  ```
- Parameter description
  - **str**: character string.
- Example
  - Test statement
    ```
    SELECT HASH_CODE("abc");
    ```
  - Test result
    ```
    96354
    ```

INITCAP

- Function

  Return the string whose first letter is in uppercase and the other letters in lowercase. Strings are sequences of alphanumeric characters separated by non-alphanumeric characters.

- Syntax
  ```
  VARCHAR INITCAP(a)
  ```
- Parameter description

  - **a**: character string.
- Example
  - Test statement
    ```
    SELECT INITCAP(var1)as aa FROM T1;
    ```
  - Test data and result

    Table 5-35 Test data and result

Test Data (var1)	Test Result (aa)
aBCde	Abcde

IS_ALPHA

- Function

  Checks whether a character string contains only letters.
- Syntax
  ```
  BOOLEAN IS_ALPHA(VARCHAR content)
  ```
- Parameter description
  - **content**: Enter a character string.
- Example
  - Test statement
    ```
    SELECT IS_ALPHA(content)  AS case_result FROM T1;
    ```
  - Test data and results

    Table 5-36 Test data and results

Test Data (content)	Test Result (case_result)
Abc	true
abc1#$	false
null	false
Empty string	false

IS_DIGITS

- Function

  Checks whether a character string contains only digits.
- Syntax
  ```
  BOOLEAN IS_DIGITS(VARCHAR content)
  ```
- Parameter description
  - **content**: Enter a character string.
- Example
  - Test statement
    ```
    SELECT IS_DIGITS(content) AS case_result FROM T1;
    ```


  - Test data and results

    Table 5-37 Test data and results

Test Data (content)	Test Result (case_result)
78	true
78.0	false
78a	false
null	false
Empty string	false

IS_NUMBER

- Function

  This function is used to check whether a character string is a numeric string.
- Syntax

  ```
  BOOLEAN IS_NUMBER(VARCHAR content)
  ```
- Parameter description
  - **content**: Enter a character string.
- Example
  - Test statement

    ```
    SELECT IS_NUMBER(content) AS case_result FROM T1;
    ```
  - Test data and results

    Table 5-38 Test data and results

Test Data (content)	Test Result (case_result)
78	true
78.0	true
78a	false
null	false
Empty string	false

IS_URL

- Function

  This function is used to check whether a character string is a valid URL.
- Syntax

  ```
  BOOLEAN IS_URL(VARCHAR content)
  ```
- Parameter description

  - **content**: Enter a character string.
- Example
  - Test statement
    ```
    SELECT IS_URL(content) AS case_result FROM T1;
    ```
  - Test data and results

    Table 5-39 Test data and results

Test Data (content)	Test Result (case_result)
https://www.testweb.com	true
https://www.testweb.com:443	true
www.testweb.com:443	false
null	false
Empty string	false

JSON_VALUE

- Function

  Obtains the value of a specified path in a JSON character string.
- Syntax
  ```
  VARCHAR JSON_VALUE(VARCHAR content, VARCHAR path)
  ```
- Parameter description
  - **content**: Enter a character string.
  - **path**: path to be obtained.
- Example
  - Test statement
    ```
    SELECT JSON_VALUE(content, path) AS case_result FROM T1;
    ```
  - Test data and results

    Table 5-40 Test data and results

Test Data (content and path)		Test Result (case_result)
{ "a1":"v1","a2":7,"a3":8.0,"a4": {"a41":"v41","a42": ["v1","v2"]}}	$	{ "a1":"v1","a2":7,"a3":8.0,"a4": {"a41":"v41","a42": ["v1","v2"]}}
{ "a1":"v1","a2":7,"a3":8.0,"a4": {"a41":"v41","a42": ["v1","v2"]}}	$.a1	v1
{ "a1":"v1","a2":7,"a3":8.0,"a4": {"a41":"v41","a42": ["v1","v2"]}}	$.a4	{"a41":"v41","a42": ["v1","v2"]}

Test Data (content and path)		Test Result (case_result)
{ "a1":"v1","a2":7,"a3":8.0,"a4" : {"a41":"v41","a42": ["v1","v2"]}}	$.a4.a42	["v1","v2"]
{ "a1":"v1","a2":7,"a3":8.0,"a4" : {"a41":"v41","a42": ["v1","v2"]}}	$.a4.a42[0]	v1

KEY_VALUE

- Function

  This function is used to obtain the value of a key in a key-value pair string.
- Syntax

  ```
  VARCHAR KEY_VALUE(VARCHAR content, VARCHAR split1, VARCHAR split2, VARCHAR key_name)
  ```
- Parameter description
  - **content**: Enter a character string.
  - **split1**: separator of multiple key-value pairs.
  - **split2**: separator between the key and value.
  - **key_name**: name of the key to be obtained.
- Example
  - Test statement

    ```
    SELECT KEY_VALUE(content, split1, split2, key_name)  AS case_result FROM T1;
    ```
  - Test data and results

    Table 5-41 Test data and results

Test Data (content, split1, split2, and key_name)				Test Result (case_result)
k1=v1;k2=v2	;	=	k1	v1
null	;	=	k1	null
k1=v1;k2=v2	null	=	k1	null

LOWER

- Function

  Returns a string of lowercase characters.
- Syntax

  ```
  VARCHAR LOWER(A)
  ```
- Parameter description
  - **A**: character string.
- Example

  - Test statement
    ```
    SELECT LOWER(var1) AS aa FROM T1;
    ```
  - Test data and result

    Table 5-42 Test data and result

Test Data (var1)	Test Result (aa)
ABc	abc

LPAD

- Function

  Concatenates the pad string to the left of the str string until the length of the new string reaches the specified length len.
- Syntax
  ```
  VARCHAR LPAD(VARCHAR str, INT len, VARCHAR pad)
  ```
- Parameter description
  - **str**: character string before concatenation.
  - **len**: length of the concatenated character string.
  - **pad**: character string to be concatenated.

  NOTE

  - If any parameter is null, **null** is returned.
  - If the value of len is a negative number, value **null** is returned.
  - If the value of **len** is less than the length of **str**, the first chunk of **str** characters in **len** length is returned.
- Example
  - Test statement
    ```
    SELECT
      LPAD("adc", 2, "hello"),
      LPAD("adc", -1, "hello"),
      LPAD("adc", 10, "hello");
    ```
  - Test result
    ```
    "ad",,"helloheadc"
    ```

MD5

- Function

  Returns the MD5 value of a string. If the parameter is an empty string (that is, the parameter is **''**), an empty string is returned.
- Syntax
  ```
  VARCHAR MD5(VARCHAR str)
  ```
- Parameter description
  - **str**: character string
- Example
  - Test statement
    ```
    SELECT MD5("abc");
    ```


  - Test result
    ```
    "900150983cd24fb0d6963f7d28e17f72"
    ```

OVERLAY

- Function

  Replaces the substring of **x** with **y**. Replaces length+1 characters starting from **start_position**.

- Syntax
  ```
  VARCHAR OVERLAY ( (VARCHAR x PLACING VARCHAR y FROM INT start_position [ FOR INT length ]) )
  ```
- Parameter description
  - **x**: character string
  - **y**: character string.
  - **start_position**: start position.
  - **length (optional)**: indicates the character length.
- Example
  - Test statement
    ```
    OVERLAY('abcdefg' PLACING 'xyz' FROM 2 FOR 2) AS result FROM T1;
    ```
  - Test result

    Table 5-43 Test result

result
axyzdefg

POSITION

- Function

  Returns the position of the first occurrence of the target string **x** in the queried string **y**. If the target character string **x** does not exist in the queried character string **y**, **0** is returned.

- Syntax
  ```
  INTEGER POSITION(x IN y)
  ```
- Parameter description
  - **x**: character string
  - **y**: character string.
- Example
  - Test statement
    ```
    POSITION('in' IN 'chin') AS result FROM T1;
    ```
  - Test result

    Table 5-44 Test result

result
3

REPLACE

- Function

  The character string replacement function is used to replace all **str2** in the **str1** string with **str3**.

- Syntax

```
VARCHAR REPLACE(VARCHAR str1, VARCHAR str2, VARCHAR str3)
```

- Parameter description
  - **str1**: original character.
  - **str2**: target character.
  - **str3**: replacement character.
- Example
  - Test statement

```
SELECT
  replace(
    "hello world hello world hello world",
    "world",
    "hello"
  );
```

  - Test result

```
"hello hello hello hello hello hello"
```

RPAD

- Function

  Concatenates the pad string to the right of the str string until the length of the new string reaches the specified length len.
  - If any parameter is null, **null** is returned.
  - If the value of len is a negative number, value **null** is returned.
  - The value of **pad** is an empty string. If the value of **len** is less than the length of **str**, the string whose length is the same as the length of **str** is returned.
- Syntax

```
VARCHAR RPAD(VARCHAR str, INT len, VARCHAR pad)
```

- Parameter description
  - **str**: start character string.
  - **len**: indicates the length of the new character string.
  - **pad**: character string that needs to be added repeatedly.
- Example
  - Test statement

```
SELECT
  RPAD("adc", 2, "hello"),
  RPAD("adc", -1, "hello"),
  RPAD("adc", 10, "hello");
```

  - Test result

```
"ad",,"adchellohe"
```


SHA1

- Function

  Returns the SHA1 value of the **expr** string.

- Syntax

  ```
  STRING SHA1(STRING expr)
  ```

- Parameter description
  - **expr**: character string.
- Example
  - Test statement

    ```
    SELECT SHA1("abc");
    ```

  - Test result

    ```
    "a9993e364706816aba3e25717850c26c9cd0d89d"
    ```

SHA256

- Function

  Returns the SHA256 value of the expr string.

- Syntax

  ```
  STRING SHA256(STRING expr)
  ```

- Parameter description
  - **expr**: character string.
- Example
  - Test statement

    ```
    SELECT SHA256("abc");
    ```

  - Test result

    ```
    "ba7816bf8f01cfea414140de5dae2223b00361a396177a9cb410ff61f20015ad"
    ```

STRING_TO_ARRAY

- Function

  Separates the **value** string as character string arrays by using the delimiter.

  NOTE

  delimiter uses the Java regular expression. If special characters are used, they need to be escaped.

- Syntax

  ```
  ARRAY[String] STRING_TO_ARRAY(STRING value, VARCHAR delimiter)
  ```

- Parameter description
  - **value**: character string.
  - **delimiter**: specifies the delimiter.
- Example
  - Test statement

    ```
    SELECT
      string_to_array("127.0.0.1", "\\."),
      string_to_array("red-black-white-blue", "-");
    ```

  - Test result

    ```
    [127,0,0,1],[red,black,white,blue]
    ```


SUBSTRING

- Function

  Returns the substring that starts from a fixed position of A. The start position starts from 1.

  - If **len** is not specified, the substring from the start position to the end of the string is truncated.
  - If **len** is specified, the substring starting from the position specified by **start** is truncated. The length is specified by **len**.

  NOTE

  The value of **start** starts from **1**. If the value is **0**, it is regarded as **1**. If the value of start is a negative number, the position is calculated from the end of the character string in reverse order.

- Syntax

  ```
  VARCHAR SUBSTRING(STRING A FROM INT start)
  ```

  Or

  ```
  VARCHAR SUBSTRING(STRING A FROM INT start FOR INT len)
  ```

- Parameter description
  - **A**: specified character string.
  - **start**: start position for truncating the character string **A**.
  - **len**: intercepted length.
- Example
  - Test statement 1

    ```
    SELECT SUBSTRING("123456" FROM 2);
    ```

  - Test result 1

    ```
    "23456"
    ```

  - Test statement 2

    ```
    SELECT SUBSTRING("123456" FROM 2 FOR 4);
    ```

  - Test result 2

    ```
    "2345"
    ```

TRIM

- Function

  Remove A at the start position, or end position, or both the start and end positions from B. By default, string expressions A at both the start and end positions are removed.

- Syntax

  ```
  STRING TRIM( { BOTH | LEADING | TRAILING } STRING a FROM STRING b)
  ```

- Parameter description
  - **a**: character string.
  - **b**: character string.
- Example
  - Test statement

    ```
    SELECT TRIM(BOTH " " FROM "  hello world  ");
    ```

  - Test result

    ```
    "hello world"
    ```


UPPER

- Function

  Returns a string converted to an uppercase character.
- Syntax

  ```
  VARCHAR UPPER(A)
  ```
- Parameter description
  - **A**: character string.
- Example
  - Test statement

    ```
    SELECT UPPER("hello world");
    ```
  - Test result

    ```
    "HELLO WORLD"
    ```

5.1.9.3 Temporal Functions

Table 5-45 lists the time functions supported by Flink SQL.

Function Description

Table 5-45 Time Function

Function	Return Type	Description
DATE string	DATE	Parse the date string (**yyyy-MM-dd**) to a SQL date.
TIME string	TIME	Parse the time string (**HH:mm:ss**) to the SQL time.
TIMESTAMP string	TIMESTAMP	Convert the time string into timestamp. The time string format is **yyyy-MM-dd HH:mm:ss.fff**.

Function	Return Type	Description
INTERVAL string range	INTERVAL	There are two types of intervals: **yyyy-MM** and **dd HH:mm:sss.fff'**. The range of yyyy-MM can be YEAR or YEAR TO MONTH, with the precision of month. The range of dd HH:mm:sss.fff' can be DAY TO HOUR, DAY TO MINUTE, DAY TO SECOND, or DAY TO MILLISECONDS, with the precision of millisecond. For example, if the range is DAY TO SECOND, the day, hour, minute, and second are all valid and the precision is second. DAY TO MINUTE indicates that the precision is minute. The following is an example: **INTERVAL '10 00:00:00.004' DAY TO milliseconds** indicates that the interval is 10 days and 4 milliseconds. **INTERVAL '10' DAY** indicates that the interval is 10 days and **INTERVAL '2-10' YEAR TO MONTH** indicates that the interval is 2 years and 10 months.
CURRENT_DATE	DATE	Return the SQL date of UTC time zone.
CURRENT_TIME	TIME	Return the SQL time of UTC time zone.
CURRENT_TIMESTAMP	TIMESTAMP	Return the SQL timestamp of UTC time zone.
LOCALTIME	TIME	Return the SQL time of the current time zone.
LOCALTIMESTAMP	TIMESTAMP	Return the SQL timestamp of the current time zone.
EXTRACT(timeintervalunit FROM temporal)	INT	Extract part of the time point or interval. Return the part in the int type. For example, **5** is returned from **EXTRACT(DAY FROM DATE "2006-06-05")**.
FLOOR(timepoint TO timeintervalunit)	TIME	Round a time point down to the given unit. For example, **12:44:00** is returned from **FLOOR(TIME '12:44:31' TO MINUTE)**.
CEIL(timepoint TO timeintervalunit)	TIME	Round a time point up to the given unit. For example, **12:45:00** is returned from CEIL(TIME '12:44:31' TO MINUTE).
QUARTER(date)	INT	Return the quarter from the SQL date.

Function	Return Type	Description
(timepoint, temporal) OVERLAPS (timepoint, temporal)	BOOLEAN	Check whether two intervals overlap. The time points and time are converted into a time range with a start point and an end point. The function is ***leftEnd >= rightStart && rightEnd >= leftStart***. If leftEnd is greater than or equal to rightStart and rightEnd is greater than or equal to leftStart, **true** is returned. Otherwise, **false** is returned. The following is an example: ● If leftEnd is **3:55:00** (2:55:00+1:00:00), rightStart is **3:30:00**, rightEnd is **5:30:00** (3:30:00+2:00:00), and leftStart is **2:55:00**, **true** will be returned. Specifically, **true** is returned from (TIME '2:55:00', INTERVAL '1' HOUR) OVERLAPS (TIME '3:30:00', INTERVAL '2' HOUR). ● If leftEnd is **10:00:00**, rightStart is **10:15:00**, rightEnd is **13:15:00** (10:15:00+3:00:00), and leftStart is **9:00:00**, **false** will be returned. Specifically, **false** is returned from (TIME '9:00:00', TIME '10:00:00') OVERLAPS (TIME '10:15:00', INTERVAL '3' HOUR).
TO_TIMESTAMP(long expr)	TIMESTAMP	Convert a timestamp to time. The input parameter this function must be of the BIGINT type. Other data types, such as VARCHAR and STRING, are not supported. For example, **TO_TIMESTAMP (1628765159000)** is converted to **2021-08-12 18:45:59**.

Function	Return Type	Description
UNIX_TIMESTAMP	BIGINT	Returns the timestamp of a specified parameter. The timestamp type is BIGINT and the unit is **second**. The following methods are supported: ● UNIX_TIMESTAMP(): returns the timestamp of the current time if no parameter is specified. ● UNIX_TIMESTAMP(STRING datestr): returns the timestamp indicated by the parameter if only one parameter is contained. The format of **datestr** must be yyyy-MM-dd HH:mm:ss. ● UNIX_TIMESTAMP(STRING datestr, STRING format): returns the timestamp indicated by the first parameter if two parameters are contained. The second parameter can specify the format of **datestr**.
UNIX_TIMESTAMP_MS	BIGINT	Returns the timestamp of a specified parameter. The timestamp type is BIGINT and the unit is **millisecond**. The following methods are supported: ● UNIX_TIMESTAMP_MS(): returns the timestamp of the current time if no parameter is specified. ● UNIX_TIMESTAMP_MS(STRING datestr): returns the timestamp indicated by the parameter if only one parameter is contained. The format of **datestr** must be yyyy-MM-dd HH:mm:ss.SSS. ● UNIX_TIMESTAMP_MS(STRING datestr, STRING format): returns the timestamp indicated by the first parameter if two parameters are contained. The second parameter can specify the format of **datestr**.

Precautions

None

Example

```
insert into temp SELECT Date '2015-10-11'  FROM  OrderA;//Date is returned
insert into temp1 SELECT Time '12:14:50'  FROM  OrderA;//Time is returned
insert into temp2 SELECT Timestamp '2015-10-11 12:14:50'  FROM  OrderA;//Timestamp is returned
```


5.1.9.4 Type Conversion Functions

Syntax

```
CAST(value AS type)
```

Syntax Description

This function is used to forcibly convert types.

Precautions

- If the input is **NULL**, **NULL** is returned.
- Flink jobs do not support the conversion of **bigint** to **timestamp** using CAST. You can convert it using **to_timestamp** or **to_localtimestamp**.

Example

Convert amount into a character string. The specified length of the string is invalid after the conversion.

```
insert into temp select cast(amount as VARCHAR(10)) from source_stream;
```

Common Type Conversion Functions

Table 5-46 Common type conversion functions

Function	Description
cast(v1 as varchar)	Converts **v1** to a string. The value of **v1** can be of the numeric type or of the timestamp, date, or time type.
cast (v1 as int)	Converts **v1** to the **int** type. The value of **v1** can be a number or a character.
cast(v1 as timestamp)	Converts **v1** to the **timestamp** type. The value of **v1** can be of the **string**, **date**, or **time** type.
cast(v1 as date)	Converts **v1** to the **date** type. The value of **v1** can be of the **string** or **timestamp** type.

- cast(v1 as varchar)
  - Test statement
    ```
    SELECT cast(content as varchar) FROM T1;
    ```
  - Test data and result

    Table 5-47 T1

content (INT)	varchar
5	"5"

- cast (v1 as int)
  - Test statement
    ```
    SELECT cast(content as int) FROM T1;
    ```
  - Test data and result

    Table 5-48 T1

content (STRING)	int
"5"	5

- cast(v1 as timestamp)
  - Test statement
    ```
    SELECT cast(content as timestamp) FROM T1;
    ```
  - Test data and result

    Table 5-49 T1

content (STRING)	timestamp
"2018-01-01 00:00:01"	1514736001000

- cast(v1 as date)
  - Test statement
    ```
    SELECT cast(content as date) FROM T1;
    ```
  - Test data and result

    Table 5-50 T1

content (TIMESTAMP)	date
1514736001000	"2018-01-01"

Detailed Sample Code

```
/** source **/
CREATE
SOURCE STREAM car_infos (cast_int_to_varchar int, cast_String_to_int string,
case_string_to_timestamp string, case_timestamp_to_date timestamp) WITH (
  type = "dis",
  region = "xxxxx",
  channel = "dis-input",
  partition_count = "1",
  encode = "json",
  offset = "13",
  json_config =
"cast_int_to_varchar=cast_int_to_varchar;cast_String_to_int=cast_String_to_int;case_string_to_timestamp=cas
e_string_to_timestamp;case_timestamp_to_date=case_timestamp_to_date"

);
/** sink **/
CREATE
SINK STREAM cars_infos_out (cast_int_to_varchar varchar, cast_String_to_int
```



```
int, case_string_to_timestamp timestamp, case_timestamp_to_date date) WITH (
  type = "dis",
  region = "xxxxx",
  channel = "dis-output",
  partition_count = "1",
  encode = "json",
  offset = "4",
  json_config =
"cast_int_to_varchar=cast_int_to_varchar;cast_String_to_int=cast_String_to_int;case_string_to_timestamp=cas
e_string_to_timestamp;case_timestamp_to_date=case_timestamp_to_date",
  enable_output_null="true"
);
/** Statistics on static car information**/
INSERT
INTO
  cars_infos_out
SELECT
  cast(cast_int_to_varchar as varchar),
  cast(cast_String_to_int as int),
  cast(case_string_to_timestamp as timestamp),
  cast(case_timestamp_to_date as date)
FROM
  car_infos;
```

Returned data

```
{"case_string_to_timestamp":1514736001000,"cast_int_to_varchar":"5","case_timestamp_to_date":"2018-01-
01","cast_String_to_int":100}
```

5.1.9.5 Aggregate Functions

An aggregate function performs a calculation operation on a set of input values and returns a value. For example, the COUNT function counts the number of rows retrieved by an SQL statement. **Table 5-51** lists aggregate functions.

Sample data: Table T1

```
|score|
|81   |
|100  |
|60   |
|95   |
|86   |
```

Common Aggregate Functions

Table 5-51 Common aggregation functions

Function	Return Data Type	Description
COUNT(*)	BIGINT	Return count of tuples.
COUNT([ALL] expression...	BIGINT	Returns the number of input rows for which the expression is not NULL. Use DISTINCT for a unique instance of each value.
AVG(numeric)	DOUBLE	Return average (arithmetic mean) of all input values.
SUM(numeric)	DOUBLE	Return the sum of all input numerical values.

Function	Return Data Type	Description
MAX(value)	DOUBLE	Return the maximum value of all input values.
MIN(value)	DOUBLE	Return the minimum value of all input values.
STDDEV_POP(value)	DOUBLE	Return the population standard deviation of all numeric fields of all input values.
STDDEV_SAMP(value)	DOUBLE	Return the sample standard deviation of all numeric fields of all input values.
VAR_POP(value)	DOUBLE	Return the population variance (square of population standard deviation) of numeral fields of all input values.
VAR_SAMP(value)	DOUBLE	Return the sample variance (square of the sample standard deviation) of numeric fields of all input values.

Example

- COUNT(*)
  - Test statement
    ```
    SELECT COUNT(score) FROM T1;
    ```
  - Test data and results

    Table 5-52 T1

Test Data (score)	Test Result
81	5
100	
60	
95	
86	

- COUNT([ALL] expression | DISTINCT expression1 [, expression2]*)
  - Test statement
    ```
    SELECT COUNT(DISTINCT content ) FROM T1;
    ```
  - Test data and results

Table 5-53 T1

content (STRING)	Test Result
"hello1 "	2
"hello2 "	
"hello2"	
null	
86	

- AVG(numeric)
  - Test statement
    ```
    SELECT AVG(score) FROM T1;
    ```
  - Test data and results

Table 5-54 T1

Test Data (score)	Test Result
81	84.0
100	
60	
95	
86	

- SUM(numeric)
  - Test statement
    ```
    SELECT SUM(score) FROM T1;
    ```
  - Test data and results

Table 5-55 T1

Test Data (score)	Test Result
81	422.0
100	
60	
95	
86	

- MAX(value)
  - Test statement


```
SELECT MAX(score) FROM T1;
```

  - Test data and results

Table 5-56 T1

Test Data (score)	Test Result
81	100.0
100	
60	
95	
86	

- MIN(value)
  - Test statement
    ```
    SELECT MIN(score) FROM T1;
    ```
  - Test data and results

Table 5-57 T1

Test Data (score)	Test Result
81	60.0
100	
60	
95	
86	

- STDDEV_POP(value)
  - Test statement
    ```
    SELECT STDDEV_POP(score) FROM T1;
    ```
  - Test data and results

Table 5-58 T1

Test Data (score)	Test Result
81	13.0
100	
60	
95	
86	

- STDDEV_SAMP(value)
  - Test statement
    ```
    SELECT STDDEV_SAMP(score) FROM T1;
    ```
  - Test data and results

    Table 5-59 T1

Test Data (score)	Test Result
81	15.0
100	
60	
95	
86	

- VAR_POP(value)
  - Test statement
    ```
    SELECT VAR_POP(score) FROM T1;
    ```
  - Test data and results

    Table 5-60 T1

Test Data (score)	Test Result
81	193.0
100	
60	
95	
86	

- VAR_SAMP(value)
  - Test statement
    ```
    SELECT VAR_SAMP(score) FROM T1;
    ```
  - Test data and results

    Table 5-61 T1

Test Data (score)	Test Result
81	241.0
100	
60	
95	

Test Data (score)	Test Result
86	

5.1.9.6 Table-Valued Functions

Table-valued functions can convert one row of records into multiple rows or convert one column of records into multiple columns. Table-valued functions can only be used in JOIN LATERAL TABLE.

Table 5-62 Table-valued functions

Function	Return Data Type	Description
split_cursor(value, delimiter)	cursor	Separates the "value" string into multiple rows of strings by using the delimiter.

Example

Input one record ("student1", "student2, student3") and output two records ("student1", "student2") and ("student1", "student3").

```
create source stream s1(attr1 string, attr2 string) with (.....);
insert into s2 select  attr1, b1 from s1 left join lateral table(split_cursor(attr2, ',')) as T(b1) on true;
```

5.1.9.7 Other Functions

Array Functions

Table 5-63 Array functions

Function	Return Data Type	Description
CARDINALITY(ARRAY)	INT	Return the element count of an array.
ELEMENT(ARRAY)	-	Return the sole element of an array with a single element. If the array contains no elements, **null** is returned. If the array contains multiple elements, an exception is reported.

Example:

The returned number of elements in the array is 3.

```
insert into temp select CARDINALITY(ARRAY[TRUE, TRUE, FALSE]) from source_stream;
```

HELLO WORLD is returned.

```
insert into temp select ELEMENT(ARRAY['HELLO WORLD']) from source_stream;
```

Attribute Access Functions

Table 5-64 Attribute access functions

Function	Return Data Type	Description
tableName.compositeType.field	-	Select a single field, use the name to access the field of Apache Flink composite types, such as Tuple and POJO, and return the value.
tableName.compositeType.*	-	Select all fields, and convert Apache Flink composite types, such as Tuple and POJO, and all their direct subtypes into a simple table. Each subtype is a separate field.

5.1.10 User-Defined Functions

Overview

DLI supports the following three types of user-defined functions (UDFs):

- Regular UDF: takes in one or more input parameters and returns a single result.
- User-defined table-generating function (UDTF): takes in one or more input parameters and returns multiple rows or columns.
- User-defined aggregate function (UDAF): aggregates multiple records into one value.

NOTE

UDFs can only be used in dedicated queues.

POM Dependency

```
<dependency>
  <groupId>org.apache.flink</groupId>
  <artifactId>flink-table_2.11</artifactId>
  <version>1.7.2</version>
  <scope>provided</scope>
</dependency>
<dependency>
      <groupId>org.apache.flink</groupId>
      <artifactId>flink-streaming-java_2.11</artifactId>
      <version>1.7.2</version>
      <scope>provided</scope>
</dependency>
```


Precautions

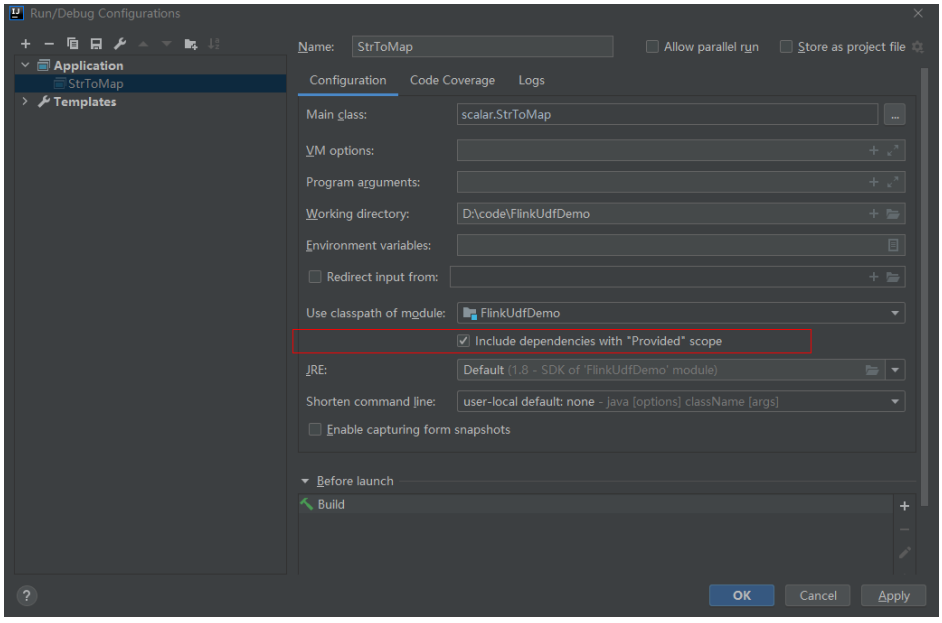
- **Currently, Python is not supported for programming UDFs, UDTFs, and UDAFs.**
- If you use IntelliJ IDEA to debug the created UDF, select **include dependencies with "Provided" scope**. Otherwise, the dependency packages in the POM file cannot be loaded for local debugging.

  The following uses IntelliJ IDEA 2020.2 as an example:

  a. On the IntelliJ IDEA page, select the configuration file you need to debug and click **Edit Configurations**.

  b. On the **Run/Debug Configurations** page, select **include dependencies with "Provided" scope**.

  c. Click **OK**.

Using UDFs

1. Write the code of custom functions. For details about the code examples, see **UDF**, **UDTF**, or **UDAF**.
2. Compile the UDF code, pack it into a JAR package, and upload the package to OBS.
3. In the left navigation pane of the DLI management console, click **Job Management** > **Flink Jobs**. Locate the row where the target resides and click

Edit in the **Operation** column to switch to the page where you can edit the job.

4. On the **Running Parameters** tab page, select an exclusive queue for **Queue**. The **UDF Jar** parameter is displayed. Select the JAR file stored on OBS and click **Save**.

   NOTE

   Before selecting a user-defined function JAR package, upload the JAR package to the created OBS bucket.

   After the JAR package is selected, add the UDF statement to the SQL statement. The following is an example:

   ```
   CREATE FUNCTION udf_test AS 'com.xxx.udf.UdfScalarFunction';
   ```

UDF

The regular UDF must inherit the ScalarFunction function and implement the eval method. The open and close functions are optional.

Example code

```
import org.apache.flink.table.functions.FunctionContext;
import org.apache.flink.table.functions.ScalarFunction;
public class UdfScalarFunction extends ScalarFunction {
  private int factor = 12;
  public UdfScalarFunction() {
    this.factor = 12;
  }
  /**
   * (optional) Initialization
   * @param context
   */
  @Override
  public void open(FunctionContext context) {}
  /**
   * Custom logic
   * @param s
   * @return
   */
  public int eval(String s) {
    return s.hashCode() * factor;
  }
  /**
   * Optional
   */
  @Override
  public void close() {}
}
```

Example

```
CREATE FUNCTION udf_test AS 'com.xxx.udf.UdfScalarFunction';
INSERT INTO sink_stream select udf_test(attr) FROM source_stream;
```

UDTF

The UDTF must inherit the TableFunction function and implement the eval method. The open and close functions are optional. If the UDTF needs to return multiple columns, you only need to declare the returned value as **Tuple** or **Row**. If **Row** is used, you need to overload the getResultType method to declare the returned field type.

Example code

```
import org.apache.flink.api.common.typeinfo.TypeInformation;
import org.apache.flink.api.common.typeinfo.Types;
import org.apache.flink.table.functions.FunctionContext;
import org.apache.flink.table.functions.TableFunction;
import org.apache.flink.types.Row;
import org.slf4j.Logger;
import org.slf4j.LoggerFactory;
public class UdfTableFunction extends TableFunction<Row> {
  private Logger log = LoggerFactory.getLogger(TableFunction.class);
  /**
   * (optional) Initialization
   * @param context
   */
  @Override
  public void open(FunctionContext context) {}
  public void eval(String str, String split) {
    for (String s : str.split(split)) {
      Row row = new Row(2);
      row.setField(0, s);
      row.setField(1, s.length());
      collect(row);
    }
  }
  /**
   * Declare the type returned by the function
   * @return
   */
  @Override
  public TypeInformation<Row> getResultType() {
  return Types.ROW(Types.STRING, Types.INT);
  }
  /**
    * Optional
   */
  @Override
  public void close() {}
}
```

Example

The UDTF supports CROSS JOIN and LEFT JOIN. When the UDTF is used, the **LATERAL** and **TABLE** keywords must be included.

- CROSS JOIN: does not output the data of a row in the left table if the UDTF does not output the result for the data of the row.
- LEFT JOIN: outputs the data of a row in the left table even if the UDTF does not output the result for the data of the row, but pads null with UDTF-related fields.

```
CREATE FUNCTION udtf_test AS 'com.xxx.udf.TableFunction';
// CROSS JOIN
INSERT INTO sink_stream select subValue, length FROM source_stream, LATERAL
TABLE(udtf_test(attr, ',')) as T(subValue, length);
// LEFT JOIN
INSERT INTO sink_stream select subValue, length FROM source_stream LEFT JOIN LATERAL
TABLE(udtf_test(attr, ',')) as T(subValue, length) ON TRUE;
```

UDAF

The UDAF must inherit the AggregateFunction function. You need to create an accumulator for storing the computing result, for example, **WeightedAvgAccum** in the following example code.

Example code

```
public class WeightedAvgAccum {
public long sum = 0;
public int count = 0;
}
```

```
import org.apache.flink.table.functions.AggregateFunction;
import java.util.Iterator;
/**
* The first type variable is the type returned by the aggregation function, and the second type variable is of the Accumulator type.
* Weighted Average user-defined aggregate function.
*/
public class UdfAggFunction extends AggregateFunction<Long, WeightedAvgAccum> {
// Initialize the accumulator.
  @Override
  public WeightedAvgAccum createAccumulator() {
    return new WeightedAvgAccum();
  }
// Return the intermediate computing value stored in the accumulator.
  @Override
  public Long getValue(WeightedAvgAccum acc) {
    if (acc.count == 0) {
      return null;
    } else {
      return acc.sum / acc.count;
 }
}
// Update the intermediate computing value according to the input.
public void accumulate(WeightedAvgAccum acc, long iValue) {
acc.sum += iValue;
acc.count += 1;
}
// Perform the retraction operation, which is opposite to the accumulate operation.
public void retract(WeightedAvgAccum acc, long iValue) {
acc.sum -= iValue;
acc.count -= 1;
}
// Combine multiple accumulator values.
public void merge(WeightedAvgAccum acc, Iterable<WeightedAvgAccum> it) {
Iterator<WeightedAvgAccum> iter = it.iterator();
while (iter.hasNext()) {
WeightedAvgAccum a = iter.next();
acc.count += a.count;
acc.sum += a.sum;
}
}
// Reset the intermediate computing value.
public void resetAccumulator(WeightedAvgAccum acc) {
acc.count = 0;
acc.sum = 0L;
}
}
```

Example

```
CREATE FUNCTION udaf_test AS 'com.xxx.udf.UdfAggFunction';
INSERT INTO sink_stream SELECT udaf_test(attr2) FROM source_stream GROUP BY attr1;
```

5.1.11 Geographical Functions

Function description

Table 5-65 describes the basic geospatial geometric elements.

Table 5-65 Basic geospatial geometric element table

Geospatial geometric elements	Description	Example Value
ST_POINT(latitude, longitude)	Indicates a geographical point, including the longitude and latitude.	ST_POINT(1.12012, 1.23401)
ST_LINE(array[point1... pointN])	Indicates a geographical line formed by connecting multiple geographical points (ST_POINT) in sequence. The line can be a polygonal line or a straight line.	ST_LINE(ARRAY[ST_POINT(1.12, 2.23), ST_POINT(1.13, 2.44), ST_POINT(1.13, 2.44)])
ST_POLYGON(array[point1...point1])	Indicates a geographical polygon, which is a closed polygon area formed by connecting multiple geographical points (ST_POINT) with the same start and end points in sequence.	ST_POLYGON(ARRAY[ST_POINT(1.0, 1.0), ST_POINT(2.0, 1.0), ST_POINT(2.0, 2.0), ST_POINT(1.0, 1.0)])
ST_CIRCLE(point, radius)	Indicates a geographical circle that consists of ST_POINT and a radius.	ST_CIRCLE(ST_POINT(1.0, 1.0), 1.234)

You can build complex geospatial geometries based on basic geospatial geometric elements. **Table 5-66** describes the related transformation methods.

Table 5-66 Transformation methods for building complex geometric elements based on basic geospatial geometric elements

Transformation Method	Description	Example Value
ST_BUFFER(geometry, distance)	Creates a polygon that surrounds the geospatial geometric elements at a given distance. Generally, this function is used to build the road area of a certain width for yaw detection.	ST_BUFFER(ST_LINE(ARRAY[ST_POINT(1.12, 2.23), ST_POINT(1.13, 2.44), ST_POINT(1.13, 2.44)]),1.0)
ST_INTERSECTION(geometry, geometry)	Creates a polygon that delimits the overlapping area of two given geospatial geometric elements.	ST_INTERSECTION(ST_CIRCLE(ST_POINT(1.0, 1.0), 2.0), ST_CIRCLE(ST_POINT(3.0, 1.0), 1.234))

Transformation Method	Description	Example Value
ST_ENVELOPE(geometry)	Creates the minimal rectangle polygon including the given geospatial geometric elements.	ST_ENVELOPE(ST_CIRCLE(ST_POINT(1.0, 1.0), 2.0))

DLI provides multiple functions used for performing operations on and determining locations of geospatial geometric elements. **Table 5-67** describes the SQL scalar functions.

Table 5-67 SQL scalar function table

Function	Return Type	Description
ST_DISTANCE(point_1, point_2)	DOUBLE	Calculates the Euclidean distance between the two geographical points. The following provides an example: Select ST_DISTANCE(ST_POINT(x1, y1), ST_POINT(x2, y2)) FROM input
ST_GEODESIC_DISTANCE(point_1, point_2)	DOUBLE	Calculates the shortest distance along the surface between two geographical points. The following provides an example: Select ST_GEODESIC_DISTANCE(ST_POINT(x1, y1), ST_POINT(x2, y2)) FROM input
ST_PERIMETER(polygon)	DOUBLE	Calculates the circumference of a polygon. The following provides an example: Select ST_PERIMETER(ST_POLYGON(ARRAY[ST_POINT(x11, y11), ST_POINT(x12, y12), ST_POINT(x11, y11)]) FROM input
ST_AREA(polygon)	DOUBLE	Calculates the area of a polygon. The following provides an example: Select ST_AREA(ST_POLYGON(ARRAY[ST_POINT(x11, y11), ST_POINT(x12, y12), ST_POINT(x11, y11)]) FROM input

Function	Return Type	Description
ST_OVERLAPS(polygon_1, polygon_2)	BOOLEAN	Checks whether one polygon overlaps with another. The following provides an example: SELECT ST_OVERLAPS(ST_POLYGON(ARRAY[ST_POINT(x11, y11), ST_POINT(x12, y12), ST_POINT(x11, y11)]), ST_POLYGON(ARRAY[ST_POINT(x21, y21), ST_POINT(x22, y22), ST_POINT(x23, y23), ST_POINT(x21, y21)])) FROM input
ST_INTERSECT(line1, line2)	BOOLEAN	Checks whether two line segments, rather than the two straight lines where the two line segments are located, intersect each other. The following provides an example: SELECT ST_INTERSECT(ST_LINE(ARRAY[ST_POINT(x11, y11), ST_POINT(x12, y12)]), ST_LINE(ARRAY[ST_POINT(x21, y21), ST_POINT(x22, y22), ST_POINT(x23, y23)])) FROM input
ST_WITHIN(point, polygon)	BOOLEAN	Checks whether one point is contained inside a geometry (polygon or circle). The following provides an example: SELECT ST_WITHIN(ST_POINT(x11, y11), ST_POLYGON(ARRAY[ST_POINT(x21, y21), ST_POINT(x22, y22), ST_POINT(x23, y23), ST_POINT(x21, y21)])) FROM input
ST_CONTAINS(polygon_1, polygon_2)	BOOLEAN	Checks whether the first geometry contains the second geometry. The following provides an example: SELECT ST_CONTAINS(ST_POLYGON(ARRAY[ST_POINT(x11, y11), ST_POINT(x12, y12), ST_POINT(x11, y11)]), ST_POLYGON(ARRAY[ST_POINT(x21, y21), ST_POINT(x22, y22), ST_POINT(x23, y23), ST_POINT(x21, y21)])) FROM input

Function	Return Type	Description
ST_COVERS(polygon_1, polygon_2)	BOOLEAN	Checks whether the first geometry covers the second geometry. This function is similar to ST_CONTAINS except the situation when judging the relationship between a polygon and the boundary line of polygon, for which ST_COVER returns TRUE and ST_CONTAINS returns FALSE. The following provides an example: SELECT ST_COVERS(ST_POLYGON(ARRAY[ST_POINT(x11, y11), ST_POINT(x12, y12), ST_POINT(x11, y11)]), ST_POLYGON([ST_POINT(x21, y21), ST_POINT(x22, y22), ST_POINT(x23, y23), ST_POINT(x21, y21)])) FROM input
ST_DISJOINT(polygon_1, polygon_2)	BOOLEAN	Checks whether one polygon is disjoint (not overlapped) with the other polygon. The following provides an example: SELECT ST_DISJOINT(ST_POLYGON(ARRAY[ST_POINT(x11, y11), ST_POINT(x12, y12), ST_POINT(x11, y11)]), ST_POLYGON(ARRAY[ST_POINT(x21, y21), ST_POINT(x22, y22), ST_POINT(x23, y23), ST_POINT(x21, y21)])) FROM input

The World Geodetic System 1984 (WGS84) is used as the reference coordinate system for geographical functions. Due to offsets, the GPS coordinates cannot be directly used in the Baidu Map (compliant with BD09) and the Google Map (compliant with GCJ02). To implement switchover between different geographical coordinate systems, DLI provides a series of functions related to coordinate system conversion as well as functions related to conversion between geographical distances and the unit meter. For details, see **Table 5-68**.

Table 5-68 Functions for geographical coordinate system conversion and distance-unit conversion

Function	Return Type	Description
WGS84_TO_BD09(geometry)	Geospatial geometric elements in the Baidu Map coordinate system	Converts the geospatial geometric elements in the GPS coordinate system into those in the Baidu Map coordinate system. The following provides an example: WGS84_TO_BD09(ST_CIRCLE(ST_POINT(x, y), r))
WGS84_TO_CJ02(geometry)	Geospatial geometric elements in the Google Map coordinate system	Converts the geospatial geometric elements in the GPS coordinate system into those in the Google Map coordinate system. The following provides an example: WGS84_TO_CJ02(ST_CIRCLE(ST_POINT(x, y), r))
BD09_TO_WGS84(geometry)	Geospatial geometric elements in the GPS coordinate system	Converts the geospatial geometric elements in the Baidu Map coordinate system into those in the GPS coordinate system. The following provides an example: BD09_TO_WGS84(ST_CIRCLE(ST_POINT(x, y), r))
BD09_TO_CJ02(geometry)	Geospatial geometric elements in the Google Map coordinate system	Converts the geospatial geometric elements in the Baidu Map coordinate system into those in the Google Map coordinate system. The following provides an example: BD09_TO_CJ02(ST_CIRCLE(ST_POINT(x, y), r))

Function	Return Type	Description
CJ02_TO_WGS84(geometry)	Geospatial geometric elements in the GPS coordinate system	Converts the geospatial geometric elements in the Google Map coordinate system into those in the GPS coordinate system. The following provides an example: CJ02_TO_WGS84(ST_CIRCLE(ST_POINT(x, y), r))
CJ02_TO_BD09(geometry)	Geospatial geometric elements in the Baidu Map coordinate system	Converts the geospatial geometric elements in the Google Map coordinate system into those in the Baidu Map coordinate system. The following provides an example: CJ02_TO_BD09(ST_CIRCLE(ST_POINT(x, y), r))
DEGREE_TO_METER(distance)	DOUBLE	Converts the distance value of the geographical function to a value in the unit of meter. In the following example, you calculate the circumference of a triangle in the unit of meter. DEGREE_TO_METER(ST_PERIMETER(ST_POLYGON(ARRAY[ST_POINT(x1,y1), ST_POINT(x2,y2), ST_POINT(x3,y3), ST_POINT(x1,y1)])))

Function	Return Type	Description
METER_TO_DEGREE(numerical_value)	DOUBLE	Convert the value in the unit of meter to the distance value that can be calculated using the geographical function. In the following example, you draw a circle which takes a specified geographical point as the center and has a radius of 1 km. ST_CIRCLE(ST_POINT(x,y), METER_TO_DEGREE(1000))

DLI also provides window-based SQL geographical aggregation functions specific for scenarios where SQL logic involves windows and aggregation. For details about the functions, see **Table 5-69**.

Table 5-69 Time-related SQL geographical aggregation function table

Function	Description	Example Value
AGG_DISTANCE(point)	Distance aggregation function, which is used to calculate the total distance of all adjacent geographical points in the window.	SELECT AGG_DISTANCE(ST_POINT(x,y)) FROM input GROUP BY HOP(rowtime, INTERVAL '1' HOUR, INTERVAL '1' DAY)
AVG_SPEED(point)	Average speed aggregation function, which is used to calculate the average speed of moving tracks formed by all geographical points in a window. The average speed is in the unit of m/s.	SELECT AVG_SPEED(ST_POINT(x,y)) FROM input GROUP BY TUMBLE(proctime, INTERVAL '1' DAY)

Precautions

None

Example

Example of yaw detection:

```
INSERT INTO yaw_warning
SELECT "The car is yawing"
FROM driver_behavior
WHERE NOT ST_WITHIN(ST_POINT(cast(Longitude as DOUBLE), cast(Latitude as DOUBLE)),
ST_BUFFER(ST_LINE(ARRAY[ST_POINT(34.585555,105.725221),ST_POINT(34.586729,105.735974),ST_POINT(
34.586492,105.740538),ST_POINT(34.586388,105.741651),ST_POINT(34.586135,105.748712),ST_POINT(34.5
88691,105.74997)]),0.001));
```

IP Functions

NOTE

Currently, only IPv4 addresses are supported.

Table 5-70 IP functions

Function	Return Type	Description
IP_TO_COUNTRY	STRING	Obtains the name of the country where the IP address is located.
IP_TO_PROVINCE	STRING	Obtains the province where the IP address is located. Usage: • IP_TO_PROVINCE(STRING ip): Determines the province where the IP address is located and returns the province name. • IP_TO_PROVINCE(STRING ip, STRING lang): Determines the province where the IP is located and returns the province name of the specified language. **NOTE** • If the province where the IP address is located cannot be obtained through IP address parsing, the country where the IP address is located is returned. If the IP address cannot be parsed, **Unknown** is returned. • The name returned by the function for the province is the short name.
IP_TO_CITY	STRING	Obtains the name of the city where the IP address is located. **NOTE** If the city where the IP address is located cannot be obtained through IP address parsing, the province or the country where the IP address is located is returned. If the IP address cannot be parsed, **Unknown** is returned.

Function	Return Type	Description
IP_TO_CITY_GEO	STRING	Obtains the longitude and latitude of the city where the IP address is located. The parameter value is in the following format: *Latitude*, *Longitude*. Usage: IP_TO_CITY_GEO(STRING ip): Returns the longitude and latitude of the city where the IP address is located.

5.1.12 SELECT

SELECT

Syntax

```
SELECT [ ALL | DISTINCT ]  { * | projectItem [, projectItem ]* }
  FROM tableExpression
  [ WHERE booleanExpression ]
  [ GROUP BY { groupItem [, groupItem ]* } ]
  [ HAVING booleanExpression ]
```

Description

The SELECT statement is used to select data from a table or insert constant data into a table.

Precautions

- The table to be queried must exist. Otherwise, an error is reported.
- WHERE is used to specify the filtering condition, which can be the arithmetic operator, relational operator, or logical operator.
- GROUP BY is used to specify the grouping field, which can be one or more multiple fields.

Example

Select the order which contains more than 3 pieces of data.

```
insert into temp SELECT  * FROM Orders WHERE units > 3;
```

Insert a group of constant data.

```
insert into temp select 'Lily', 'male', 'student', 17;
```

WHERE Filtering Clause

Syntax

```
SELECT   { * | projectItem [, projectItem ]* }
  FROM tableExpression
  [ WHERE booleanExpression ]
```

Description

This statement is used to filter the query results using the WHERE clause.

Precautions

- The to-be-queried table must exist.
- WHERE filters the records that do not meet the requirements.

Example

Filter orders which contain more than 3 pieces and fewer than 10 pieces of data.

```
insert into temp SELECT  * FROM Orders
  WHERE units > 3 and units < 10;
```

HAVING Filtering Clause

Function

This statement is used to filter the query results using the HAVING clause.

Syntax

```
SELECT [ ALL | DISTINCT ]   { * | projectItem [, projectItem ]* }
  FROM tableExpression
  [ WHERE booleanExpression ]
  [ GROUP BY { groupItem [, groupItem ]* } ]
  [ HAVING booleanExpression ]
```

Description

Generally, HAVING and GROUP BY are used together. GROUP BY applies first for grouping and HAVING then applies for filtering. The arithmetic operation and aggregate function are supported by the HAVING clause.

Precautions

If the filtering condition is subject to the query results of GROUP BY, the HAVING clause, rather than the WHERE clause, must be used for filtering.

Example

Group the **student** table according to the **name** field and filter the records in which the maximum score is higher than 95 based on groups.

```
insert into temp SELECT name, max(score) FROM student
  GROUP BY name
  HAVING max(score) >95
```

Column-Based GROUP BY

Function

This statement is used to group a table based on columns.

Syntax

```
SELECT [ ALL | DISTINCT ]   { * | projectItem [, projectItem ]* }
  FROM tableExpression
  [ WHERE booleanExpression ]
  [ GROUP BY { groupItem [, groupItem ]* } ]
```

Description

Column-based GROUP BY can be categorized into single-column GROUP BY and multi-column GROUP BY.

- Single-column GROUP BY indicates that the GROUP BY clause contains only one column.
- Multi-column GROUP BY indicates that the GROUP BY clause contains multiple columns. The table will be grouped according to all fields in the GROUP BY clause. The records whose fields are the same are grouped into one group.

Precautions

None

Example

Group the **student** table according to the score and name fields and return the grouping results.

```
insert into temp SELECT name,score, max(score) FROM student
  GROUP BY name,score;
```

Expression-Based GROUP BY

Function

This statement is used to group a table according to expressions.

Syntax

```
SELECT [ ALL | DISTINCT ]   { * | projectItem [, projectItem ]* }
  FROM tableExpression
  [ WHERE booleanExpression ]
  [ GROUP BY { groupItem [, groupItem ]* } ]
```

Description

groupItem can have one or more fields. The fields can be called by string functions, but cannot be called by aggregate functions.

Precautions

None

Example

Use the substring function to obtain the character string from the name field, group the **student** table according to the obtained character string, and return each sub character string and the number of records.

```
insert into temp SELECT substring(name,6),count(name) FROM student
  GROUP BY substring(name,6);
```

GROUP BY Using HAVING

Function

This statement filters a table after grouping it using the HAVING clause.

Syntax

```
SELECT [ ALL | DISTINCT ]   { * | projectItem [, projectItem ]* }
  FROM tableExpression
```



```
[ WHERE booleanExpression ]
[ GROUP BY { groupItem [, groupItem ]* } ]
[ HAVING booleanExpression ]
```

Description

Generally, HAVING and GROUP BY are used together. GROUP BY applies first for grouping and HAVING then applies for filtering.

Precautions

- If the filtering condition is subject to the query results of GROUP BY, the HAVING clause, rather than the WHERE clause, must be used for filtering. HAVING and GROUP BY are used together. GROUP BY applies first for grouping and HAVING then applies for filtering.
- Fields used in HAVING, except for those used for aggregate functions, must exist in GROUP BY.
- The arithmetic operation and aggregate function are supported by the HAVING clause.

Example

Group the **transactions** according to **num**, use the HAVING clause to filter the records in which the maximum value derived from multiplying **price** with **amount** is higher than 5000, and return the filtered results.

```
insert into temp SELECT num, max(price*amount) FROM transactions
  WHERE time > '2016-06-01'
  GROUP BY num
  HAVING max(price*amount)>5000;
```

UNION

Syntax

```
query UNION [ ALL ] query
```

Description

This statement is used to return the union set of multiple query results.

Precautions

- Set operation is to join tables from head to tail under certain conditions. The quantity of columns returned by each SELECT statement must be the same. Column types must be the same. Column names can be different.
- By default, the repeated records returned by UNION are removed. The repeated records returned by UNION ALL are not removed.

Example

Output the union set of Orders1 and Orders2 without duplicate records.

```
insert into temp SELECT  * FROM Orders1
  UNION SELECT  * FROM Orders2;
```


5.1.13 Condition Expression

CASE Expression

Syntax

```
CASE value WHEN value1 [, value11 ]* THEN result1
  [ WHEN valueN [, valueN1 ]* THEN resultN ]* [ ELSE resultZ ]
  END
```

or

```
CASE WHEN condition1 THEN result1
  [ WHEN conditionN THEN resultN ]* [ ELSE resultZ ]
  END
```

Description

- If the value of **value** is **value1**, **result1** is returned. If the value is not any of the values listed in the clause, **resultZ** is returned. If no else statement is specified, **null** is returned.
- If the value of **condition1** is **true**, **result1** is returned. If the value does not match any condition listed in the clause, **resultZ** is returned. If no else statement is specified, **null** is returned.

Precautions

- All results must be of the same type.
- All conditions must be of the Boolean type.
- If the value does not match any condition, the value of **ELSE** is returned when the else statement is specified, and **null** is returned when no else statement is specified.

Example

If the value of **units** equals **5**, **1** is returned. Otherwise, **0** is returned.

Example 1:

```
insert into temp SELECT  CASE units WHEN 5 THEN 1 ELSE 0 END FROM Orders;
```

Example 2:

```
insert into temp SELECT CASE WHEN units = 5 THEN 1 ELSE 0 END FROM Orders;
```

NULLIF Expression

Syntax

```
NULLIF(value, value)
```

Description

If the values are the same, **NULL** is returned. For example, **NULL** is returned from NULLIF (5,5) and **5** is returned from NULLIF (5,0).

Precautions

None

Example

If the value of **units** equals **3**, **null** is returned. Otherwise, the value of **units** is returned.

```
insert into temp SELECT  NULLIF(units, 3) FROM Orders;
```

COALESCE Expression

Syntax

```
COALESCE(value, value [, value ]* )
```

Description

Return the first value that is not **NULL**, counting from left to right.

Precautions

All values must be of the same type.

Example

5 is returned from the following example:

```
insert into temp SELECT  COALESCE(NULL, 5) FROM Orders;
```

5.1.14 Window

GROUP WINDOW

Description

Group Window is defined in GROUP BY. One record is generated from each group. Group Window involves the following functions:

NOTE

- **time_attr** can be **processing-time** or **event-time**.
  - **event-time**: Specify the data type to **bigint** or **timestamp**.
  - **processing-time**: No need to specify the type.
- **interval** specifies the window period.

- Array functions

Table 5-71 Array functions

Function Name	Description
TUMBLE(time_attr, interval)	Indicates the tumble window.
HOP(time_attr, interval, interval)	Indicates the extended tumble window (similar to the datastream sliding window). You can set the output triggering cycle and window period.

Function Name	Description
SESSION(time_attr, interval)	Indicates the session window. A session window will be closed if no response is returned within a duration specified by **interval**.

- Window functions

  Table 5-72 Window functions

Function Name	Description
TUMBLE_START(time_attr, interval)	Indicates the start time of returning to the tumble window. The parameter is a UTC time zone.
TUMBLE_END(time_attr, interval)	Indicates the end time of returning to the tumble window. The parameter is a UTC time zone.
HOP_START(time_attr, interval, interval)	Indicates the start time of returning to the extended tumble window. The parameter is a UTC time zone.
HOP_END(time_attr, interval, interval)	Indicates the end time of returning to the extended tumble window. The parameter is a UTC time zone.
SESSION_START(time_attr, interval)	Indicates the start time of returning to the session window. The parameter is a UTC time zone.
SESSION_END(time_attr, interval)	Indicates the end time of returning to the session window. The parameter is a UTC time zone.

Example

```
//Calculate the SUM every day (event time).
insert into temp SELECT name,
   TUMBLE_START(ts, INTERVAL '1' DAY) as wStart,
   SUM(amount)
   FROM Orders
   GROUP BY TUMBLE(ts, INTERVAL '1' DAY), name;

//Calculate the SUM every day (processing time).
insert into temp SELECT name,
   SUM(amount)
   FROM Orders
   GROUP BY TUMBLE(proctime, INTERVAL '1' DAY), name;

//Calculate the SUM over the recent 24 hours every hour (event time).
insert into temp SELECT product,
   SUM(amount)
   FROM Orders
   GROUP BY HOP(ts, INTERVAL '1' HOUR, INTERVAL '1' DAY), product;
```



```
//Calculate the SUM of each session and an inactive interval every 12 hours (event time).
insert into temp SELECT name,
    SESSION_START(ts, INTERVAL '12' HOUR) AS sStart,
    SESSION_END(ts, INTERVAL '12' HOUR) AS sEnd,
    SUM(amount)
    FROM Orders
    GROUP BY SESSION(ts, INTERVAL '12' HOUR), name;
```

OVER WINDOW

The difference between Over Window and Group Window is that one record is generated from one row in Over Window.

Syntax

```
OVER (
  [PARTITION BY partition_name]
  ORDER BY proctime|rowtime(ROWS number PRECEDING) |(RANGE (BETWEEN INTERVAL '1' SECOND
PRECEDING AND CURRENT ROW | UNBOUNDED preceding))
)
```

Description

Table 5-73 Parameter description

Parameter	Parameter Description
PARTITION BY	Indicates the primary key of the specified group. Each group separately performs calculation.
ORDER BY	Indicates the processing time or event time as the timestamp for data.
ROWS	Indicates the count window.
RANGE	Indicates the time window.

Precautions

- In the same SELECT statement, windows defined by aggregate functions must be the same.
- Currently, Over Window only supports forward calculation (preceding).
- The value of **ORDER BY** must be specified as **processing time** or **event time**.
- Constants do not support aggregation, such as sum(2).

Example

```
//Calculate the count and total number from syntax rules enabled to now (in proctime).
insert into temp SELECT name,
    count(amount) OVER (PARTITION BY name ORDER BY proctime RANGE UNBOUNDED preceding) as
cnt1,
    sum(amount) OVER (PARTITION BY name ORDER BY proctime RANGE UNBOUNDED preceding) as cnt2
    FROM Orders;

//Calculate the count and total number of the recent four records (in proctime).
insert into temp SELECT name,
    count(amount) OVER (PARTITION BY name ORDER BY proctime ROWS BETWEEN 4 PRECEDING AND
```



```
CURRENT ROW) as cnt1,
   sum(amount) OVER (PARTITION BY name ORDER BY proctime ROWS BETWEEN 4 PRECEDING AND
CURRENT ROW) as cnt2
   FROM Orders;

//Calculate the count and total number last 60s (in eventtime). Process the events based on event time,
which is the timeattr field in Orders.
insert into temp SELECT name,
   count(amount) OVER (PARTITION BY name ORDER BY timeattr RANGE BETWEEN INTERVAL '60'
SECOND PRECEDING AND CURRENT ROW) as cnt1,
   sum(amount) OVER (PARTITION BY name ORDER BY timeattr RANGE BETWEEN INTERVAL '60' SECOND
PRECEDING AND CURRENT ROW) as cnt2
   FROM Orders;
```

5.1.15 JOIN Between Stream Data and Table Data

The JOIN operation allows you to query data from a table and write the query result to the sink stream. Currently, only RDSs and DCS Redis tables are supported. The ON keyword describes the Key used for data query and then writes the **Value** field to the sink stream.

For details about the data definition statements of RDS tables, see **Creating an RDS Table**.

For details about the data definition statements of Redis tables, see **Creating a Redis Table**.

Syntax

```
FROM tableExpression JOIN tableExpression
  ON value11 = value21 [ AND value12 = value22]
```

Syntax Description

The ON keyword only supports equivalent query of table attributes. If level-2 keys exist (specifically, the Redis value type is HASH), the AND keyword needs to be used to express the equivalent query between Key and Hash Key.

Precautions

None

Example

Perform equivalent JOIN between the vehicle information source stream and the vehicle price table, get the vehicle price data, and write the price data into the vehicle information sink stream.

```
CREATE SOURCE STREAM car_infos (
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_detail_type STRING
)
WITH (
  type = "dis",
  region = "",
  channel = "dliinput",
  partition_count = "1",
  encode = "csv",
```



```
  field_delimiter = ","
);

/** Create a data dimension table to connect to the source stream to fulfill field backfill.
  *
  * Reconfigure the following options according to actual conditions:
  * value_type: indicates the value type of the Redis key value. The value can be STRING, HASH, SET, ZSET,
or LIST. For the HASH type, you need to specify hash_key_column as the layer-2 primary key. For the SET
type, you need to concatenate all queried values using commas (,).
  * key_column: indicates the column name corresponding to the primary key of the dimension table.
  * hash_key_column: indicates the column name corresponding to the KEY of the HASHMAP when
value_type is HASH. If value_type is not HASH, you do not need to set this option.
  * cluster_address: indicates the DCS Redis cluster address.
  * password: indicates the DCS Redis cluster password.
  **/
CREATE TABLE car_price_table (
  car_brand STRING,
  car_detail_type STRING,
  car_price STRING
)
WITH (
  type = "dcs_redis",
  value_type = "hash",
  key_column = "car_brand",
  hash_key_column = "car_detail_type",
  cluster_address = "192.168.1.238:6379",
  password = "xxxxxxxx"
);

CREATE SINK STREAM audi_car_owner_info (
  car_id STRING,
  car_owner STRING,
  car_brand STRING,
  car_detail_type STRING,
  car_price STRING
)
WITH (
  type = "dis",
  region = "",
  channel = "dlioutput",
  partition_key = "car_owner",
  encode = "csv",
  field_delimiter = ","
);

INSERT INTO audi_car_owner_info
SELECT t1.car_id, t1.car_owner, t2.car_brand, t1.car_detail_type, t2.car_price
FROM car_infos as t1 join car_price_table as t2
ON t2.car_brand = t1.car_brand and t2.car_detail_type = t1.car_detail_type
WHERE t1.car_brand = "audi";
```

5.1.16 Configuring Time Models

Flink provides two time models: processing time and event time.

DLI allows you to specify the time model during creation of the source stream and temporary stream.

Configuring Processing Time

Processing time refers to the system time, which is irrelevant to the data timestamp.

Syntax

```
CREATE SOURCE STREAM stream_name(...) WITH (...)
TIMESTAMP BY proctime.proctime;
```



```
CREATE TEMP STREAM stream_name(...)
TIMESTAMP BY proctime.proctime;
```

Description

To set the processing time, you only need to add proctime.proctime following TIMESTAMP BY. You can directly use the proctime field later.

Precautions

None

Example

```
CREATE SOURCE STREAM student_scores (
  student_number STRING, /* Student ID */
  student_name STRING, /* Name */
  subject STRING, /* Subject */
  score INT /* Score */
)
WITH (
  type = "dis",
  region = "",
  channel = "dliinput",
  partition_count = "1",
  encode = "csv",
  field_delimiter=","
)TIMESTAMP BY proctime.proctime;

INSERT INTO score_greate_90
SELECT student_name, sum(score) over (order by proctime RANGE UNBOUNDED PRECEDING)
FROM student_scores;
```

Configuring Event Time

Event Time refers to the time when an event is generated, that is, the timestamp generated during data generation.

Syntax

```
CREATE SOURCE STREAM stream_name(...) WITH (...)
TIMESTAMP BY {attr_name}.rowtime
SET WATERMARK (RANGE {time_interval} | ROWS {literal}, {time_interval});
```

Description

To set the event time, you need to select a certain attribute in the stream as the timestamp and set the watermark policy.

Out-of-order events or late events may occur due to network faults. The watermark must be configured to trigger the window for calculation after waiting for a certain period of time. Watermarks are mainly used to process out-of-order data before generated events are sent to DLI during stream processing.

The following two watermark policies are available:

- By time interval
  ```
  SET WATERMARK(range interval {time_unit}, interval {time_unit})
  ```
- By event quantity
  ```
  SET WATERMARK(rows literal, interval {time_unit})
  ```

NOTE

Parameters are separated by commas (,). The first parameter indicates the watermark sending interval and the second indicates the maximum event delay.

Precautions

None

Example

- Send a watermark every 10s the **time2** event is generated. The maximum event latency is 20s.

```
CREATE SOURCE STREAM student_scores (
  student_number STRING, /* Student ID */
  student_name STRING, /* Name */
  subject STRING, /* Subject */
  score INT, /* Score */
  time2 TIMESTAMP
)
WITH (
  type = "dis",
  region = "",
  channel = "dliinput",
  partition_count = "1",
  encode = "csv",
  field_delimiter=","
)
TIMESTAMP BY time2.rowtime
SET WATERMARK (RANGE interval 10 second, interval 20 second);

INSERT INTO score_greate_90
SELECT student_name, sum(score) over (order by time2 RANGE UNBOUNDED PRECEDING)
FROM student_scores;
```

- Send the watermark every time when 10 pieces of data are received, and the maximum event latency is 20s.

```
CREATE SOURCE STREAM student_scores (
  student_number STRING, /* Student ID */
  student_name STRING, /* Name */
  subject STRING, /* Subject */
  score INT, /* Score */
  time2 TIMESTAMP
)
WITH (
  type = "dis",
  region = "",
  channel = "dliinput",
  partition_count = "1",
  encode = "csv",
  field_delimiter=","
)
TIMESTAMP BY time2.rowtime
SET WATERMARK (ROWS 10, interval 20 second);

INSERT INTO score_greate_90
SELECT student_name, sum(score) over (order by time2 RANGE UNBOUNDED PRECEDING)
FROM student_scores;
```

5.1.17 Pattern Matching

Complex event processing (CEP) is used to detect complex patterns in endless data streams so as to identify and search patterns in various data rows. Pattern matching is a powerful aid to complex event handling.

CEP is used in a collection of event-driven business processes, such as abnormal behavior detection in secure applications and the pattern of searching for prices, transaction volume, and other behavior in financial applications. It also applies to fraud detection and sensor data analysis.

Syntax

```
MATCH_RECOGNIZE (
    [ PARTITION BY expression [, expression ]* ]
    [ ORDER BY orderItem [, orderItem ]* ]
    [ MEASURES measureColumn [, measureColumn ]* ]
    [ ONE ROW PER MATCH | ALL ROWS PER MATCH ]
    [ AFTER MATCH
        ( SKIP TO NEXT ROW
        | SKIP PAST LAST ROW
        | SKIP TO FIRST variable
        | SKIP TO LAST variable
        | SKIP TO variable )
    ]
    PATTERN ( pattern )
    [ WITHIN intervalLiteral ]
    DEFINE variable AS condition [, variable AS condition ]*
) MR
```

NOTE

Pattern matching in SQL is performed using the MATCH_RECOGNIZE clause. MATCH_RECOGNIZE enables you to do the following tasks:

- Logically partition and order the data that is used in the MATCH_RECOGNIZE clause with its PARTITION BY and ORDER BY clauses.
- Define patterns of rows to seek using the PATTERN clause of the MATCH_RECOGNIZE clause. These patterns use regular expression syntax.
- Specify the logical conditions required to map a row to a row pattern variable in the DEFINE clause.
- Define measures, which are expressions usable in other parts of the SQL query, in the MEASURES clause.

Syntax description

Table 5-74 Syntax description

Parameter	Mandatory	Description
PARTITION BY	No	Logically divides the rows into groups.
ORDER BY	No	Logically orders the rows in a partition.

Parameter	Mandatory	Description
[ONE ROW | ALL ROWS] PER MATCH	No	Chooses summaries or details for each match. • ONE ROW PER MATCH: Each match produces one summary row. • ALL ROWS PER MATCH: A match spanning multiple rows will produce one output row for each row in the match. The following provides an example: `SELECT * FROM MyTable MATCH_RECOGNIZE ( MEASURES AVG(B.id) as Bid ALL ROWS PER MATCH PATTERN (A B C) DEFINE A AS A.name = 'a', B AS B.name = 'b', C as C.name = 'c' ) MR` Example description Assume that the format of MyTable is (id, name) and there are three data records: (1, a), (2, b), and (3, c). ONE ROW PER MATCH outputs the average value 2 of B. ALL ROWS PER MATCH outputs each record and the average value of B, specifically, (1,a, null), (2,b,2), (3,c,2).
MEASURES	No	Defines calculations for export from the pattern matching.

Parameter	Mandatory	Description
PATTERN	Yes	Defines the row pattern that will be matched. • PATTERN (A B C) indicates to detect concatenated events A, B, and C. • PATTERN (A | B) indicates to detect A or B. • Modifiers – *: 0 or more iterations. For example, A* indicates to match A for 0 or more times. – +: 1 or more iterations. For example, A+ indicates to match A for 1 or more times. – ? : 0 or 1 iteration. For example, A? indicates to match A for 0 times or once. – {n}: *n* iterations (*n* > 0). For example, A{5} indicates to match A for five times. – {n,}: *n* or more iterations (*n* ≥ 0). For example, A{5,} indicates to match A for five or more times. – {n, m}: between *n* and *m* (inclusive) iterations (0 ≤ *n* ≤ *m*, 0 < *m*). For example, A{3,6} indicates to match A for 3 to 6 times. – {, m}: between 0 and *m* (inclusive) iterations (*m* > 0). For example, A{,4} indicates to match A for 0 to 4 times.
DEFINE	Yes	Defines primary pattern variables.
AFTER MATCH SKIP	No	Defines where to restart the matching process after a match is found. • SKIP TO NEXT ROW: Resumes pattern matching at the row after the first row of the current match. • SKIP PAST LAST ROW: Resumes pattern matching at the next row after the last row of the current match. • SKIP TO FIRST variable: Resumes pattern matching at the first row that is mapped to the pattern variable. • SKIP TO LAST variable: Resumes pattern matching at the last row that is mapped to the pattern variable. • SKIP TO variable: Same as SKIP TO LAST variable.

Functions Supported by CEP

Table 5-75 Function description

Function	Description
MATCH_NUMBER()	Finds which rows are in which match. It can be used in the MEASURES and DEFINE clauses.
CLASSIFIER()	Finds which pattern variable applies to which rows. It can be used in the MEASURES and DEFINE clauses.
FIRST()/LAST()	FIRST returns the value of an expression evaluated in the first row of the group of rows mapped to a pattern variable. LAST returns the value of an expression evaluated in the last row of the group of rows mapped to a pattern variable. In PATTERN (A B+ C), FIRST (B.id) indicates the ID of the first B in the match, and LAST (B.id) indicates the ID of the last B in the match.
NEXT()/PREV()	Relative offset, which can be used in DEFINE. For example, PATTERN (A B+) DEFINE B AS B.price > PREV(B.price)
RUNNING/ FINAL	RUNNING indicates to match the middle value, while FINAL indicates to match the final result value. Generally, RUNNING/ FINAL is valid only in ALL ROWS PER MATCH. For example, if there are three records (a, 2), (b, 6), and (c, 12), then the values of RUNNING AVG (A.price) and FINAL AVG (A.price) are (2,6), (4,6), (6,6).
Aggregate functions (COUNT, SUM, AVG, MAX, MIN)	Aggregation operations. These functions can be used in the MEASURES and DEFINE clauses. For details, see **Aggregate Functions**.

Example

- Fake plate vehicle detection

CEP conducts pattern matching based on license plate switchover features on the data of vehicles collected by cameras installed on urban roads or high-speed roads in different areas within 5 minutes.

```
INSERT INTO fake_licensed_car
SELECT * FROM camera_license_data MATCH_RECOGNIZE
(
  PARTITION BY car_license_number
  ORDER BY proctime
  MEASURES A.car_license_number as car_license_number, A.camera_zone_number as first_zone,
B.camera_zone_number as second_zone
  ONE ROW PER MATCH
  AFTER MATCH SKIP TO LAST C
  PATTERN (A B+ C)
  WITHIN interval '5' minute
  DEFINE
    B AS B.camera_zone_number <> A.camera_zone_number,
```

```
   C AS C.camera_zone_number = A.camera_zone_number
) MR;
```

According to this rule, if a vehicle of a license plate number drives from area A to area B but another vehicle of the same license plate number is detected in area A within 5 minutes, then the vehicle in area A is considered to carry a fake license plate.

Input data:

```
Zhejiang B88888, zone_A
Zhejiang AZ626M, zone_A
Zhejiang B88888, zone_A
Zhejiang AZ626M, zone_A
Zhejiang AZ626M, zone_A
Zhejiang B88888, zone_B
Zhejiang B88888, zone_B
Zhejiang AZ626M, zone_B
Zhejiang AZ626M, zone_B
Zhejiang AZ626M, zone_C
Zhejiang B88888, zone_A
Zhejiang B88888, zone_A
```

The output is as follows:

```
Zhejiang B88888, zone_A, zone_B
```

5.1.18 StreamingML

5.1.18.1 Anomaly Detection

Anomaly detection applies to various scenarios, including intrusion detection, financial fraud detection, sensor data monitoring, medical diagnosis, natural data detection, and more. The typical algorithms for anomaly detection include the statistical modeling method, distance-based calculation method, linear model, and nonlinear model.

DLI uses an anomaly detection method based on the random forest, which has the following characteristics:

- The one-pass algorithm is used with O(1) amortized time complexity and O(1) space complexity.
- The random forest structure is constructed only once. The model update operation only updates the node data distribution values.
- The node stores data distribution information of multiple windows, and the algorithm can detect data distribution changes.
- Anomaly detection and model updates are completed in the same code framework.

Syntax

```
SRF_UNSUP(ARRAY[Field 1, Field 2, ...], 'Optional parameter list')
```


NOTE

- The anomaly score returned by the function is a DOUBLE value in the range of [0, 1].
- The field names must be of the same type. If the field types are different, you can use the CAST function to escape the field names, for example, [a, CAST(b as DOUBLE)].
- The syntax of the optional parameter list is as follows: "key1=value,key2=value2,..."

Parameter Description

Table 5-76 Parameter Description

Parameter	Mandatory	Description	Default Value
transientThreshold	No	Threshold for which the histogram change is indicating a change in the data.	5
numTrees	No	Number of trees composing the random forest.	15
maxLeafCount	No	Maximum number of leaf nodes one tree can have.	15
maxTreeHeight	No	Maximum height of the tree.	12
seed	No	Random seed value used by the algorithm.	4010
numClusters	No	Number of types of data to be detected. By default, the following two data types are available: anomalous and normal data.	2
dataViewMode	No	Algorithm learning mode. • Value **history** indicates that all historical data is considered. • Value **horizon** indicates that only historical data of a recent time period (typically a size of 4 windows) is considered.	history

Example

Anomaly detection is conducted on the **c** field in data stream **MyTable**. If the anomaly score is greater than 0.8, then the detection result is considered to be anomaly.

```
SELECT c,
   CASE WHEN SRF_UNSUP(ARRAY[c], "numTrees=15,seed=4010") OVER (ORDER BY proctime RANGE
BETWEEN INTERVAL '99' SECOND PRECEDING AND CURRENT ROW) > 0.8
      THEN 'anomaly'
      ELSE 'not anomaly'
```



```
  END
FROM MyTable
```

5.1.18.2 Time Series Forecasting

Modeling and forecasting time series is a common task in many business verticals. Modeling is used to extract meaningful statistics and other characteristics of the data. Forecasting is the use of a model to predict future data. DLI provides a series of stochastic linear models to help users conduct online modeling and forecasting in real time.

ARIMA (Non-Seasonal)

Auto-Regressive Integrated Moving Average (ARIMA) is a classical model used for time series forecasting and is closely correlated with the AR, MA, and ARMA models.

- The AR, MA, and ARMA models are applicable to **stationary** sequences.
  - AR(p) is an autoregressive model. An AR(p) is a linear combination of p consecutive values from immediate past. The model can predict the next value by using the weight of linear combination.
  - MA(q) is a moving average model. An MA(q) is a linear combination of q white noise values from the past plus the average value. The model can also predict the next value by using the weight of linear combination.
  - ARMA(p, q) is an autoregressive moving average model, which integrates the advantages of both AR and MA models. In the ARMA model, the autoregressive process is responsible for quantizing the relationship between the current data and the previous data, and the moving average process is responsible for solving problems of random variables. Therefore, the ARMA model is more effective than AR/MA.
- ARIMA is suitable for **non-stationary** series. In ARIMA(p, q, d), **p** indicates the autoregressive order, **q** indicates the moving average order, and **d** indicates the difference order.

Syntax

```
AR_PRED(field, degree): Use the AR model to forecast new data.
AR_COEF(field, degree): Return the weight of the AR model.
ARMA_PRED(field, degree): Use the ARMA model to forecast new data.
ARMA_COEF(field, degree): Return the weight of the ARMA model.
ARIMA_PRED(field, degree, derivativeOrder): Use ARIMA to forecast new data.
```

Table 5-77 Parameter Description

Parameter	Mandatory	Description	Default Value
field	Yes	Name of the field, data in which is used for prediction, in the data stream.	-
degree	No	Defines how many steps in the past are going to be considered for the next prediction. Currently, only "p = q = degree" is allowed.	5

Parameter	Mandatory	Description	Default Value
derivativeOrder	No	Derivative order. Generally, this parameter is set to **1** or **2**.	1

Example

Separately use AR, ARMA, and ARIMA to forecast the time series ordered by rowtime.

```
SELECT b,
   AR_PRED(b) OVER (ORDER BY rowtime ROWS  BETWEEN 5 PRECEDING AND CURRENT ROW) AS ar,
   ARMA_PRED(b) OVER (ORDER BY rowtime ROWS  BETWEEN 5 PRECEDING AND CURRENT ROW) AS
arma,
   ARIMA_PRED(b) OVER (ORDER BY rowtime ROWS  BETWEEN 5 PRECEDING AND CURRENT ROW) AS
arima
FROM MyTable
```

Holt Winters

The Holt-Winters algorithm is one of the Exponential smoothing methods used to forecast **seasonal** data in time series.

Syntax

```
HOLT_WINTERS(field, seasonality, forecastOrder)
```

Table 5-78 Parameter Description

Parameter	Mandatory	Description
field	Yes	Name of the field, data in which is used for prediction, in the data stream.
seasonality	Yes	Seasonality space used to perform the prediction. For example, if data samples are collected daily, and the season space to consider is a week, then **seasonality** is **7**.
forecastOrder	No	Value to be forecast, specifically, the number of steps to be considered in the future for producing the forecast. If **forecastOrder** is set to **1**, the algorithm forecasts the next value. If **forecastOrder** is set to **2**, the algorithm forecasts the value of 2 steps ahead in the future. The default value is **1**. When using this parameter, ensure that the OVER window size is greater than the value of this parameter.

Example

Use Holt-Winters to forecast time series ordered by rowtime.

```
SELECT b,
   HOLT_WINTERS(b, 5) OVER (ORDER BY rowtime ROWS  BETWEEN 5 PRECEDING AND CURRENT ROW)
AS a1,
   HOLT_WINTERS(b, 5, 2) OVER (ORDER BY rowtime ROWS  BETWEEN 5 PRECEDING AND CURRENT
ROW) AS a2
FROM MyTable
```

5.1.18.3 Real-Time Clustering

Clustering algorithms belong to unsupervised algorithms. K-Means, a clustering algorithm, partitions data points into related clusters by calculating the distance between data points based on the predefined cluster quantity. For offline static datasets, we can determine the clusters based on field knowledge and run K-Means to achieve a better clustering effect. However, online real-time streaming data is always changing and evolving, and the cluster quantity is likely to change. To address clustering issues on online real-time streaming data, DLI provides a low-delay online clustering algorithm that does not require predefined cluster quantity.

The algorithm works as follows: Given a distance function, if the distance between two data points is less than a threshold, both data points will be partitioned into the same cluster. If the distances between a data point and the central data points in several cluster centers are less than the threshold, then related clusters will be merged. When data in a data stream arrives, the algorithm computes the distances between each data point and the central data points of all clusters to determine whether the data point can be partitioned into to an existing or new cluster.

Syntax

```
CENTROID(ARRAY[field_names], distance_threshold): Compute the centroid of the cluster where the
current data point is assigned.
CLUSTER_CENTROIDS(ARRAY[field_names], distance_threshold): Compute all centroids after the data point
is assigned.
ALL_POINTS_OF_CLUSTER(ARRAY[field_names], distance_threshold): Compute all data points in the cluster
where the current data point is assigned.
ALL_CLUSTERS_POINTS(ARRAY[field_names], distance_threshold): Computers all data points in each cluster
after the current data point is assigned.
```

NOTE

- Clustering algorithms can be applied in **unbounded streams**.

Parameter Description

Table 5-79 Parameter Description

Parameter	Mandatory	Description
field_names	Yes	Name of the field where the data is located in the data stream. Multiple fields are separated by commas (,). For example, **ARRAY[a, b, c]**.
distance_threshold	Yes	Distance threshold. When the distance between two data points is less than the threshold, both data points are placed in the same cluster.

Example

Use four functions to compute information related to clusters over windows.

```
SELECT
  CENTROID(ARRAY[c,e], 1.0) OVER (ORDER BY proctime RANGE UNBOUNDED PRECEDING) AS centroid,
  CLUSTER_CENTROIDS(ARRAY[c,e], 1.0) OVER (ORDER BY proctime RANGE UNBOUNDED PRECEDING) AS
centroids
FROM MyTable

SELECT
  CENTROID(ARRAY[c,e], 1.0) OVER (ORDER BY proctime RANGE BETWEEN INTERVAL '60' MINUTE
PRECEDING AND CURRENT ROW) AS centroidCE,
  ALL_POINTS_OF_CLUSTER(ARRAY[c,e], 1.0) OVER (ORDER BY proctime RANGE BETWEEN INTERVAL '60'
MINUTE PRECEDING AND CURRENT ROW) AS itemList,
  ALL_CLUSTERS_POINTS(ARRAY[c,e], 1.0) OVER (ORDER BY proctime RANGE  BETWEEN INTERVAL '60'
MINUTE PRECEDING AND CURRENT ROW) AS listoflistofpoints
FROM MyTable
```

5.1.18.4 Deep Learning Model Prediction

Deep learning has a wide range of applications in many industries, such as image classification, image recognition, and speech recognition. DLI provides several functions to load deep learning models for prediction.

Currently, models DeepLearning4j and Keras are supported. In Keras, TensorFlow, CNTK, or Theano can serve as the backend engine. With importing of the neural network model from Keras, models of mainstream learning frameworks such as Theano, TensorFlow, Caffe, and CNTK can be imported.

Syntax

```
-- Image classification: returns the predicted category IDs used for image classification.
DL_IMAGE_MAX_PREDICTION_INDEX(field_name, model_path, is_dl4j_model)
DL_IMAGE_MAX_PREDICTION_INDEX(field_name, keras_model_config_path, keras_weights_path) --
Suitable for the Keras model

--Text classification: returns the predicted category IDs used for text classification.
DL_TEXT_MAX_PREDICTION_INDEX(field_name, model_path, is_dl4j_model) -- Use the default word2vec
model.
DL_TEXT_MAX_PREDICTION_INDEX(field_name, word2vec_path, model_path, is_dl4j_model)
```


NOTE

Models and configuration files must be stored on OBS. The path format is obs://**your_ak**:**your_sk**@obs.**your_obs_region**.xxx.com:443/**your_model_path**. For example, if your model is stored on OBS, the bucket name is **dl_model**, and the file name is **model.h5**, set the path to obs://**your_ak**:**your_sk**@obs.xxx.com:443/dl_model/model.h5.

Parameter Description

Table 5-80 Parameter description

Parameter	Mandatory	Description
field_name	Yes	Name of the field, data in which is used for prediction, in the data stream. In image classification, this parameter needs to declare ARRAY[TINYINT]. In image classification, this parameter needs to declare String.
model_path	Yes	Complete save path of the model on OBS, including the model structure and model weight.
is_dl4j_model	Yes	Whether the model is a Deeplearning4j model Value **true** indicates that the model is a Deeplearning4j model, while value **false** indicates that the model is a Keras model.
keras_model_config_path	Yes	Complete save path of the model structure on OBS. In Keras, you can obtain the model structure by using **model.to_json()**.
keras_weights_path	Yes	Complete save path of the model weight on OBS. In Keras, you can obtain the model weight by using **model.save_weights(filepath)**.
word2vec_path	Yes	Complete save path of the word2vec model on OBS.

Example

For prediction in image classification, use the Mnist dataset as the input and load the pre-trained Deeplearning4j model or Keras model to predict the digit representing each image in real time.

```
CREATE SOURCE STREAM Mnist(
   image Array[TINYINT]
)
SELECT DL_IMAGE_MAX_PREDICTION_INDEX(image, 'your_dl4j_model_path', false) FROM Mnist
SELECT DL_IMAGE_MAX_PREDICTION_INDEX(image, 'your_keras_model_path', true) FROM Mnist
SELECT DL_IMAGE_MAX_PREDICTION_INDEX(image, 'your_keras_model_config_path', 'keras_weights_path')
FROM Mnist
```


For prediction in text classification, use data of a group of news titles as the input and load the pre-trained Deeplearning4j model or Keras model to predict the category of each news title in real time, such as economy, sports, and entertainment.

```
CREATE SOURCE STREAM News(
   title String
)
SELECT DL_TEXT_MAX_PREDICTION_INDEX(title, 'your_dl4j_word2vec_model_path','your_dl4j_model_path',
false) FROM News
SELECT DL_TEXT_MAX_PREDICTION_INDEX(title,
'your_keras_word2vec_model_path','your_keras_model_path', true) FROM News
SELECT DL_TEXT_MAX_PREDICTION_INDEX(title, 'your_dl4j_model_path', false) FROM New
SELECT DL_TEXT_MAX_PREDICTION_INDEX(title, 'your_keras_model_path', true) FROM New
```

5.1.19 Reserved Keywords

Flink SQL reserves some strings as keywords. If you want to use the following character strings as field names, ensure that they are enclosed by back quotes, for example, `value` and `count`.

A

- A
- ABS
- ABSOLUTE
- ACTION
- ADA
- ADD
- ADMIN
- AFTER
- AK
- ALL
- ALLOCATE
- ALLOW
- ALTER
- ALWAYS
- AND
- ANY
- APPEND
- APP_ID
- ARE
- ARRAY
- ARRAY_BRACKET
- AS
- ASC
- ASENSITIVE
- ASSERTION

- ASSIGNMENT
- ASYMMETRIC
- AT
- AT_LEAST_ONCE
- ATOMIC
- ATTRIBUTE
- ATTRIBUTES
- AUTHORIZATION
- AVG
- AVRO_CONFIG
- AVRO_DATA
- AVRO_SCHEMA

B

- BATCH_INSERT_DATA_NUM
- BEFORE
- BEGIN
- BERNOULLI
- BETWEEN
- BIGINT
- BINARY
- BIT
- BLOB
- BOOL
- BOOLEAN
- BOTH
- BREADTH
- BUCKET
- BY

C

- C
- CACHE_MAX_NUM
- CACHE_TIME
- CALL
- CALLED
- CARDINALITY
- CASCADE
- CASCADED
- CASE
- CAST

- CATALOG
- CATALOG_NAME
- CEIL
- CEILING
- CENTURY
- CHAIN
- CHANNEL
- CHAR
- CHARACTER
- CHARACTERISTICTS
- CHARACTERS
- CHARACTER_LENGTH
- CHARACTER_SET_CATALOG
- CHARACTER_SET_NAME
- CHARACTER_SET_SCHEMA
- CHAR_LENGTH
- CHECK
- CHECKPOINT_APP_NAME
- CHECKPOINT_INTERVAL
- CHECKPOINTINTERVAL
- CLASS_ORIGIN
- CLOB
- CLOSE
- CLUSTER_ADDRESS
- CLUSTER_ID
- CLUSTER_NAME
- COALESCE
- COBOL
- COLLATE
- COLLATION
- COLLATION_CATALOG
- COLLATION_NAME
- COLLATION_SCHEMA
- COLLECT
- COLUMN
- COLUMN_NAME
- COLUMN_NAME_MAP
- COMMAND_FUNCTION
- COMMAND_FUNCTION_CODE
- COMMIT

- COMMITTED
- CONDITION
- CONDITION_NUMBER
- CONFIGURATION
- CONFLUENT_CERTIFICATE_NAME
- CONFLUENT_PROPERTIES
- CONFLUENT_SCHEMA_FIELD
- CONFLUENT_URL
- CONNECT
- CONNECTION_NAME
- CONSTRAINT
- CONSTRAINTS
- CONSTRAINT_CATALOG
- CONSTRAINT_NAME
- CONSTRAINT_SCHEMA
- CONSTRUCTOR
- CONTAINS
- CONTINUE
- CONVERT
- CORR
- CORRESPONDING
- COUNT
- COVAR_POP
- COVAR_SAMP
- CREATE
- CREATE_IF_NOT_EXIST
- CROSS
- CUBE
- CUME_DIST
- CURRENT
- CURRENT_CATALOG
- CURRENT_DATE
- CURRENT_DEFAULT_TRANSFORM_GROUP
- CURRENT_PATH
- CURRENT_ROLE
- CURRENT_SCHEMA
- CURRENT_TIMESTAMP
- CURRENT_TRANSFORM_GROUP_FOR_TYPE
- CURRENT_USER
- CURSOR

- CURSOR_NAME
- CYCLE

D

- DATE
- DATABASE
- DATE
- DATETIME_INTERVAL_CODE
- DATETIME_INTERVAL_PRECISION
- DAY
- DB_COLUMNS
- DB_URL
- DB_OBS_SERVER
- DB_TYPE
- DEALLOCATE
- DEC
- DECADE
- DECIMAL
- DECLARE
- DEFAULTS
- DEFERRABLE
- DEFERRED
- DEFINER
- DEGREE
- DELETE
- DELETE_OBS_TEMP_FILE
- DENSE_RANK
- DEPTH
- DEREF
- DERIVED
- DESC
- DESCRIBE
- DESCRIPTION
- DESCRIPTOR
- DETERMINISTIC
- DIAGNOSTICS
- DISALLOW
- DISCONNECT
- DIS_NOTICE_CHANNEL
- DISPATCH

- DISTINCT
- DOMAIN
- DOUBLE
- DOW
- DOY
- DRIVER
- DROP
- DUMP_INTERVAL
- DYNAMIC
- DYNAMIC_FUNCTION
- DYNAMIC_FUNCTION_CODE

E

- EACH
- ELEMENT
- ELSE
- EMAIL_KEY
- ENABLECHECKPOINT
- ENABLE_CHECKPOINT
- ENABLE_OUTPUT_NULL
- ENCODE
- ENCODE_CLASS_NAME
- ENCODE_CLASS_PARAMETER
- ENCODED_DATA
- END
- ENDPOINT
- END_EXEC
- EPOCH
- EQUALS
- ESCAPE
- ES_FIELDS
- ES_INDEX
- ES_TYPE
- ESTIMATEMEM
- ESTIMATEPARALLELISM
- EXACTLY_ONCE
- EXCEPT
- EXCEPTION
- EXCLUDE
- EXCLUDING

- EXEC
- EXECUTE
- EXISTS
- EXP
- EXPLAIN
- EXTEND
- EXTERNAL
- EXTRACT
- EVERY

F

- FALSE
- FETCH
- FIELD_DELIMITER
- FIELD_NAMES
- FILE_PREFIX
- FILTER
- FINAL
- FIRST
- FIRST_VALUE
- FLOAT
- FLOOR
- FOLLOWING
- FOR
- FUNCTION
- FOREIGN
- FORTRAN
- FOUND
- FRAC_SECOND
- FREE
- FROM
- FULL
- FUSION

G

- G
- GENERAL
- GENERATED
- GET
- GLOBAL
- GO

- GOTO
- GRANT
- GRANTED
- GROUP
- GROUPING
- GW_URL

H

- HASH_KEY_COLUMN
- HAVING
- HIERARCHY
- HOLD
- HOUR
- HTTPS_PORT

I

- IDENTITY
- ILLEGAL_DATA_TABLE
- IMMEDIATE
- IMPLEMENTATION
- IMPORT
- IN
- INCLUDING
- INCREMENT
- INDICATOR
- INITIALLY
- INNER
- INOUT
- INPUT
- INSENSITIVE
- INSERT
- INSTANCE
- INSTANTIABLE
- INT
- INTEGER
- INTERSECT
- INTERSECTION
- INTERVAL
- INTO
- INVOKER
- IN_WITH_SCHEMA

- IS
- ISOLATION

J

- JAVA
- JOIN
- JSON_CONFIG
- JSON_SCHEMA

K

- K
- KAFKA_BOOTSTRAP_SERVERS
- KAFKA_CERTIFICATE_NAME
- KAFKA_GROUP_ID
- KAFKA_PROPERTIES
- KAFKA_PROPERTIES_DELIMITER
- KAFKA_TOPIC
- KEY
- KEY_COLUMN
- KEY_MEMBER
- KEY_TYPE
- KEY_VALUE
- KRB_AUTH

L

- LABEL
- LANGUAGE
- LARGE
- LAST
- LAST_VALUE
- LATERAL
- LEADING
- LEFT
- LENGTH
- LEVEL
- LIBRARY
- LIKE
- LIMIT
- LONG

M

- M
- MAP
- MATCH
- MATCHED
- MATCHING_COLUMNS
- MATCHING_REGEX
- MAX
- MAXALLOWEDCPU
- MAXALLOWEDMEM
- MAXALLOWEDPARALLELISM
- MAX_DUMP_FILE_NUM
- MAX_RECORD_NUM_CACHE
- MAX_RECORD_NUM_PER_FILE
- MAXVALUE
- MEMBER
- MERGE
- MESSAGE_COLUMN
- MESSAGE_LENGTH
- MESSAGE_OCTET_LENGTH
- MESSAGE_SUBJECT
- MESSAGE_TEXT
- METHOD
- MICROSECOND
- MILLENNIUM
- MIN
- MINUTE
- MINVALUE
- MOD
- MODIFIES
- MODULE
- MONTH
- MORE
- MS
- MULTISET
- MUMPS

N

- NAME
- NAMES

- NATIONAL
- NATURAL
- NCHAR
- NCLOB
- NESTING
- NEW
- NEXT
- NO
- NONE
- NORMALIZE
- NORMALIZED
- NOT
- NULL
- NULLABLE
- NULLIF
- NULLS
- NUMBER
- NUMERIC

O

- OBJECT
- OBJECT_NAME
- OBS_DIR
- OCTETS
- OCTET_LENGTH
- OF
- OFFSET
- OLD
- ON
- ONLY
- OPEN
- OPERATION_FIELD
- OPTION
- OPTIONS
- OR
- ORDER
- ORDERING
- ORDINALITY
- OTHERS
- OUT

- OUTER
- OUTPUT
- OVER
- OVERLAPS
- OVERLAY
- OVERRIDING

P

- PAD
- PARALLELISM
- PARAMETER
- PARAMETER_MODE
- PARAMETER_NAME
- PARAMETER_ORDINAL_POSITION
- PARAMETER_SPECIFIC_CATALOG
- PARAMETER_SPECIFIC_NAME
- PARAMETER_SPECIFIC_SCHEMA
- PARTIAL
- PARTITION
- PARTITION_COUNT
- PARTITION_KEY
- PARTITION_RANGE
- PASCAL
- PASSTHROUGH
- PASSWORD
- PATH
- PERCENTILE_CONT
- PERCENTILE_DISC
- PERCENT_RANK
- PERSIST_SCHEMA
- PIPELINE_ID
- PLACING
- PLAN
- PLI
- POSITION
- POWER
- PRECEDING
- PRECISION
- PREPARE
- PRESERVE

- PRIMARY
- PRIMARY_KEY
- PRIOR
- PRIVILEGES
- PROCEDURE
- PROCTIME
- PROJECT_ID
- PUBLIC

Q

- QUARTER
- QUOTE

R

- RANGE
- RANK
- RAW
- READ
- READS
- READ_ONCE
- REAL
- RECURSIVE
- REF
- REFERENCES
- REFERENCING
- REGION
- REGR_AVGX
- REGR_AVGY
- REGR_COUNT
- REGR_INTERCEPT
- REGR_R2
- REGR_SLOPE
- REGR_SXX
- REGR_SXY
- REGR_SYY
- RELATIVE
- RELEASE
- REPEATABLE
- RESET
- RESTART
- RESTRICT

- RESULT
- RETURN
- RETURNED_CARDINALITY
- RETURNED_LENGTH
- RETURNED_OCTET_LENGTH
- RETURNED_SQLSTATE
- RETURNS
- REVOKE
- RIGHT
- ROLE
- ROLLBACK
- ROLLING_INTERVAL
- ROLLING_SIZE
- ROLLUP
- ROUTINE
- ROUTINE_CATALOG
- ROUTINE_NAME
- ROUTINE_SCHEMA
- ROW
- ROW_COUNT
- ROW_DELIMITER
- ROW_NUMBER
- ROWS
- ROWTIME

S

- SAVEPOINT
- SCALE
- SCHEMA
- SCHEMA_CASE_SENSITIVE
- SCHEMA_NAME
- SCOPE
- SCOPE_CATALOGS
- SCOPE_NAME
- SCOPE_SCHEMA
- SCROLL
- SEARCH
- SECOND
- SECTION
- SECURITY

- SELECT
- SELF
- SENSITIVE
- SEQUENCE
- SERIALIZABLE
- SERVER
- SERVER_NAME
- SESSION
- SESSION_USER
- SET
- SETS
- SIMILAR
- SIMPLE
- SINK
- SIZE
- SK
- SMALLINT
- SOME
- SOURCE
- SPACE
- SPECIFIC
- SPECIFICTYPE
- SPECIFIC_NAME
- SQL
- SQLEXCEPTION
- SQLSTATE
- SQLWARNING
- SQL_TSI_DAY
- SQL_TSI_FRAC_SECOND
- SQL_TSI_HOUR
- SQL_TSI_MICROSECOND
- SQL_TSI_MINUTE
- SQL_TSI_MONTH
- SQL_TSI_QUARTER
- SQL_TSI_SECOND
- SQL_TSI_WEEK
- SQL_TSI_YEAR
- SQRT
- START
- START_TIME

- STATE
- STATEMENT
- STATIC
- STDDEV_POP
- STDDEV_SAMP
- STREAM
- STRING
- STRUCTURE
- STYLE
- SUBCLASS_ORIGIN
- SUBMULTISET
- SUBSTITUTE
- SUBSTRING
- SUM
- SYMMETRIC
- SYSTEM
- SYSTEM_USER

T

- TABLE
- TABLESAMPLE
- TABLE_COLUMNS
- TABLE_NAME
- TABLE_NAME_MAP
- TEMP
- TEMPORARY
- THEN
- TIES
- TIME
- TIMESTAMP
- TIMESTAMPADD
- TIMESTAMPDIFF
- TIMEZONE_HOUR
- TIMEZONE_MINUTE
- TINYINT
- TO
- TOP_LEVEL_COUNT
- TOPIC
- TOPIC_URN
- TRAILING

- TRANSACTION
- TRANSACTIONAL_TABLE
- TRANSACTIONS_ACTIVE
- TRANSACTIONS_COMMITTED
- TRANSACTIONS_ROLLED_BACK
- TRANSFORM
- TRANSFORMS
- TRANSLATE
- TRANSLATION
- TRANX_ID
- TREAT
- TRIGGER
- TRIGGER_CATALOG
- TRIGGER_NAME
- TRIGGER_SCHEMA
- TRIM
- TRUE
- TSDB_LINK_ADDRESS
- TSDB_METRICS
- TSDB_TIMESTAMPS
- TSDB_TAGS
- TSDB_VALUES
- TYPE
- TYPE_CLASS_NAME
- TYPE_CLASS_PARAMETER

U

- UESCAPE
- UNBOUNDED
- UNCOMMITTED
- UNDER
- UNION
- UNIQUE
- UNKNOWN
- UNNAMED
- UNNEST
- UPDATE
- UPPER
- UPSERT
- URN_COLUMN

- USAGE
- USER
- USER_DEFINED_TYPE_CATALOG
- USER_DEFINED_TYPE_CODE
- USER_DEFINED_TYPE_NAME
- USER_DEFINED_TYPE_SCHEMA
- USERNAME
- USING

V

- VALUE
- VALUES
- VALUE_TYPE
- VARBINARY
- VARCHAR
- VARYING
- VAR_POP
- VAR_SAMP
- VERSION
- VERSION_ID
- VIEW

W

- WATERMARK
- WEEK
- WHEN
- WHENEVER
- WHERE
- WIDTH_BUCKET
- WINDOW
- WITH
- WITHIN
- WITHOUT
- WORK
- WRAPPER
- WRITE

X

- XML
- XML_CONFIG

Y

- YEAR

Z

- ZONE

6 Identifiers

6.1 aggregate_func

Syntax

None.

Description

Aggregate function.

6.2 alias

Syntax

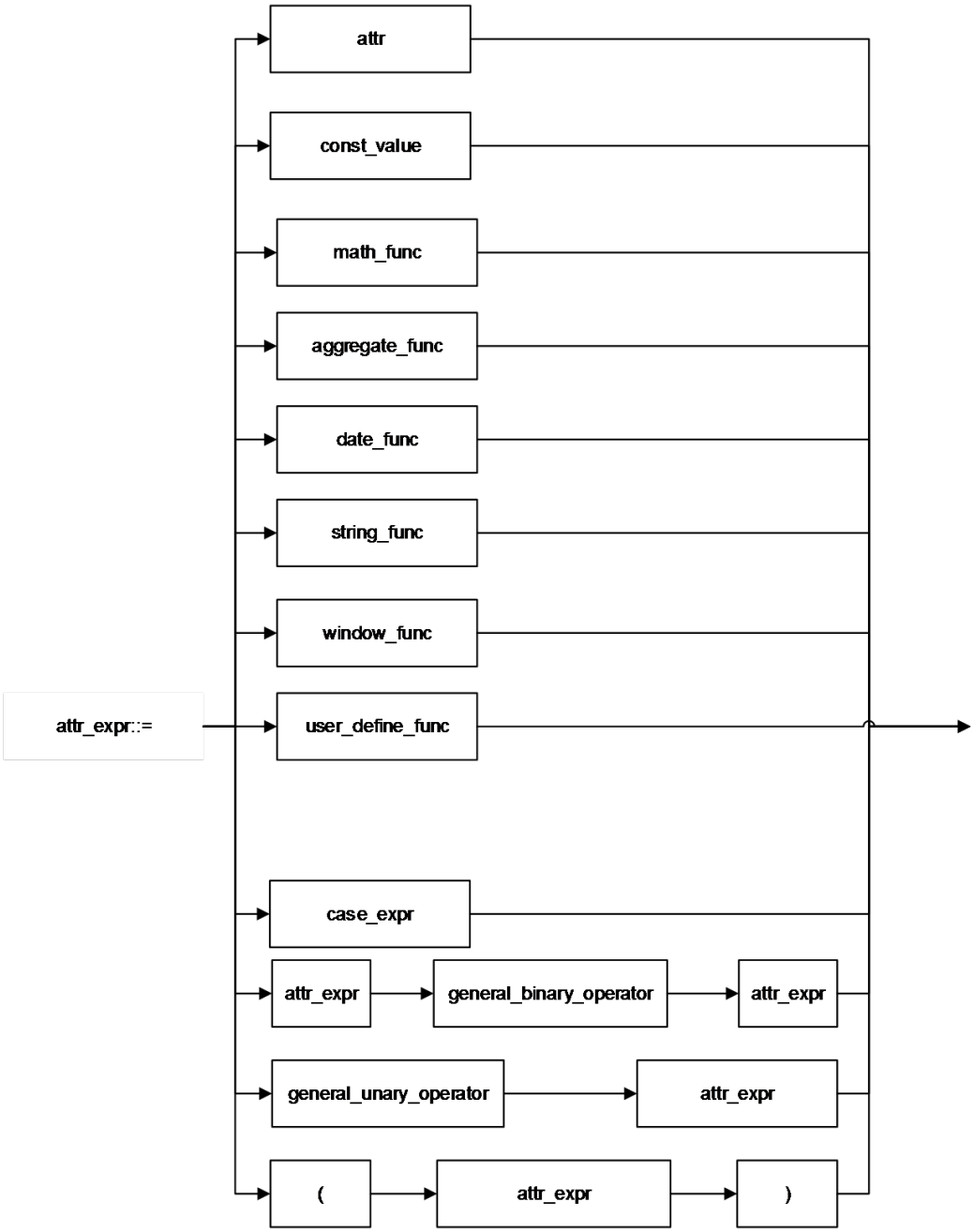
None.

Description

Alias, which must be STRING type. It can be assigned to a field, table, view, or subquery.

6.3 attr_expr

Syntax



Description

Syntax	Description
attr_expr	Attribute expression.

Syntax	Description
attr	Table field, which is the same as col_name.
const_value	Constant value.
case_expr	Case expression.
math_func	Mathematical function.
date_func	Date function.
string_func	String function.
aggregate_func	Aggregate function.
window_func	Analysis window function.
user_define_func	User-defined function.
general_binary_operator	General binary operator.
general_unary_operator	General unary operator.
(	Start of the specified subattribute expression.
)	End of the specified subattribute expression.

6.4 attr_expr_list

Syntax

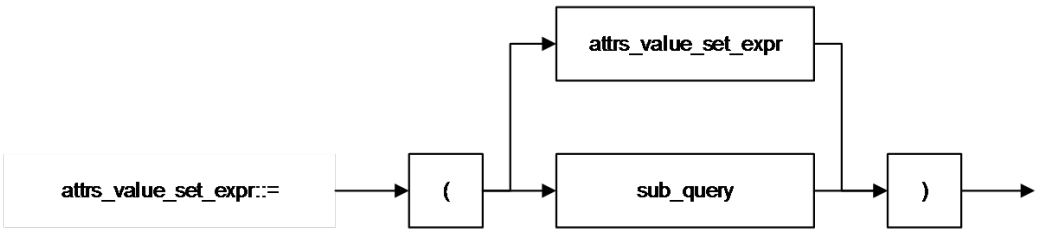
None.

Description

List of attr_expr, which is separated by commas (,).

6.5 attrs_value_set_expr

Syntax



Description

Syntax	Description
attrs_value_set_expr	Collection of attribute values.
sub_query	Subquery clause.
(	Start of the specified subquery expression.
)	End of the specified subquery expression.

6.6 boolean_expression

Syntax

None.

Description

Return a boolean expression.

6.7 col

Syntax

None.

Description

Formal parameter for function call. It is usually a field name, which is the same as **col_name**.

6.8 col_comment

Syntax

None.

Description

Column (field) description, which must be STRING type and cannot exceed 256 bytes.

6.9 col_name

Syntax

None.

Description

Column name, which must be STRING type and cannot exceed 128 bytes.

6.10 col_name_list

Syntax

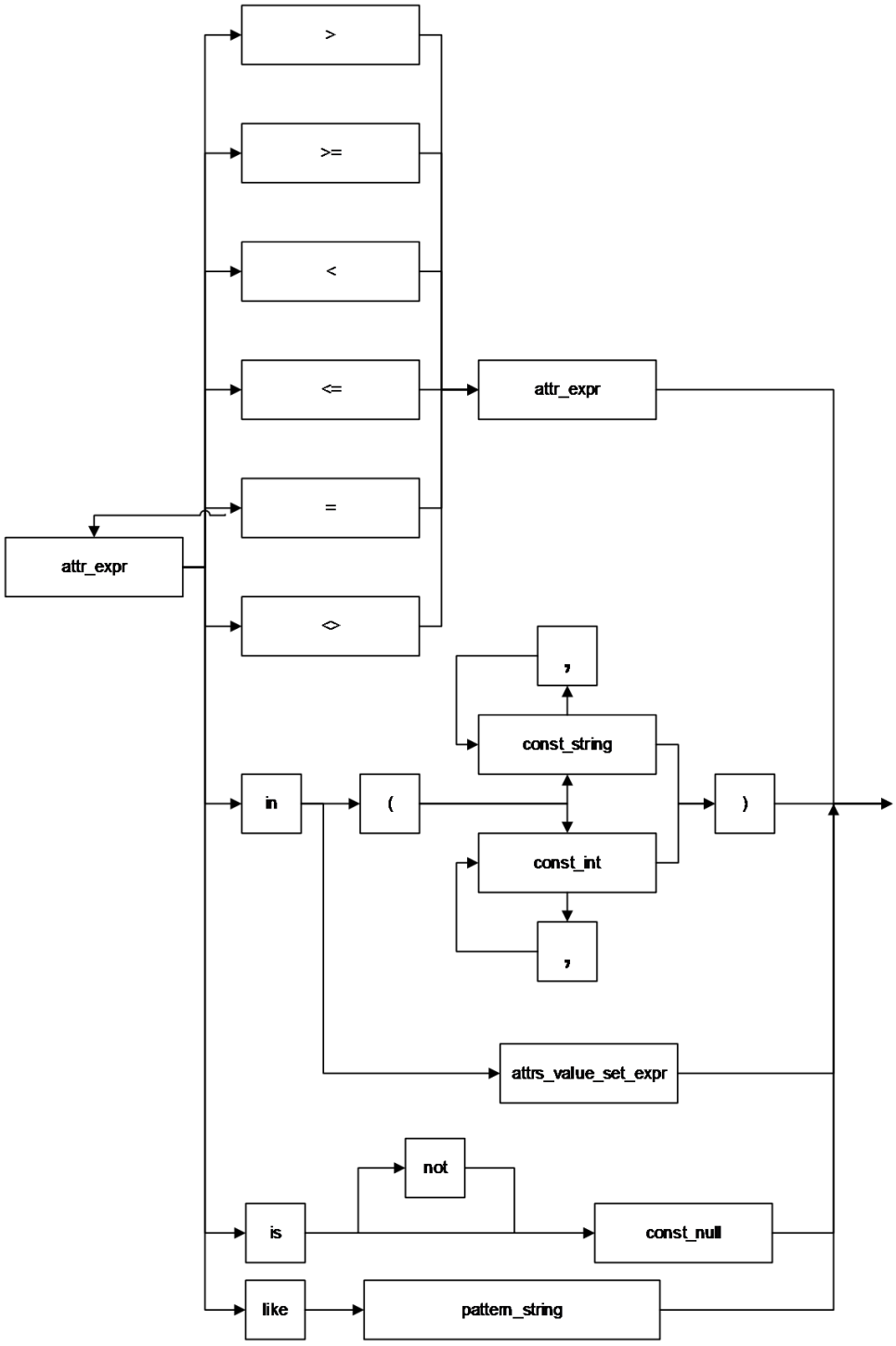
None.

Description

Field list, which consists of one **col_name** or more. If there is more than one **col_name**, separate them by using a comma (,).

6.11 condition

Syntax

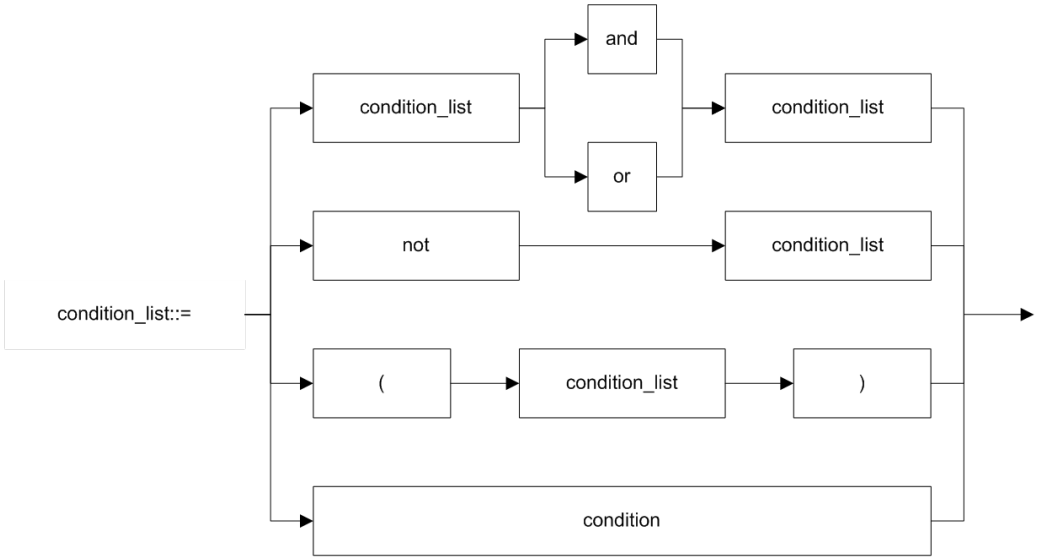


Description

Syntax	Description
condition	Judgment condition.
>	Relational operator: >
>=	Relational operator: ≥
<	Relational operator: <
<=	Relational operator: ≤
=	Relational operator: =
<>	Relational operator: <>
is	Relational operator: is
is not	Relational operator: is not
const_null	Constant value: null
like	Relational operator: used for wildcard matching.
pattern_string	Pattern matching string, which supports wildcard matching. In WHERE LIKE, SQL wildcard characters "**%**" and "_" are supported. "**%**" represents one or more characters. "_" represents only one character.
attr_expr	Attribute expression.
attrs_value_set_expr	Collection of attribute values.
in	Keyword used to determine whether attributes are in the same collection.
const_string	String constant.
const_int	Integer constant.
(	Start of the specified constant collection.
)	End of the specified constant collection.
,	Separator comma (,)

6.12 condition_list

Syntax



Description

Syntax	Description
condition_list	List of judgment conditions.
and	Logical operator: AND
or	Logical operator: OR
not	Logical operator: NOT
(	Start of the subjudgment condition.
)	End of the subjudgment condition.
condition	Judgment condition.

6.13 cte_name

Syntax

None.

Description

Common expression name.

6.14 data_type

Syntax

None.

Description

Data type. Currently, only the primitive data types are supported.

6.15 db_comment

Syntax

None.

Description

Database description, which must be STRING type and cannot exceed 256 characters.

6.16 db_name

Syntax

None.

Description

Database name, which must be STRING type and cannot exceed 128 bytes.

6.17 else_result_expression

Syntax

None.

Description

Returned result for the **ELSE** clause of the **CASE WHEN** statement.

6.18 file_format

Format

| AVRO

| CSV

| JSON

| ORC

| PARQUET

Description

- Currently, the preceding formats are supported.
- Both **USING** and **STORED AS** can be used for specifying the data format. You can specify the preceding data formats by **USING**, but only the **ORC** and **PARQUET** formats by **STORED AS**.
- **ORC** has optimized **RCFile** to provide an efficient method to store **Hive** data.
- **PARQUET** is an analytical service-oriented and column-based storage format.

6.19 file_path

Syntax

None.

Description

File path, which is the OBS path

6.20 function_name

Syntax

None.

Description

Function name, which must be STRING type.

6.21 groupby_expression

Syntax

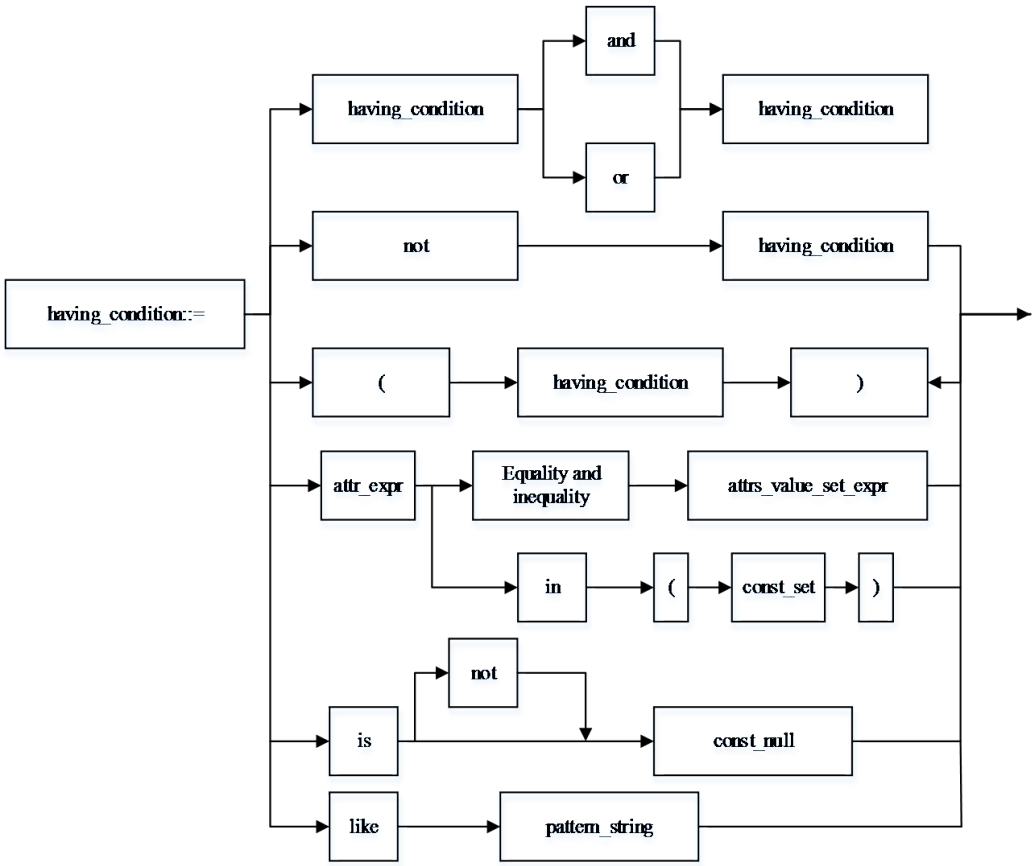
None.

Description

Expression that includes GROUP BY.

6.22 having_condition

Syntax



Description

Syntax	Description
having_condition	Judgment condition of **having**.
and	Logical operator: AND
or	Logical operator: OR
not	Logical operator: NOT
(	Start of the subjudgment condition.
)	End of the subjudgment condition.
condition	Judgment condition.
const_set	Collection of constants, which are separated by using comma (,).

Syntax	Description
in	Keyword used to determine whether attributes are in the same collection.
attrs_value_set_expr	Collection of attribute values.
attr_expr	Attribute expression.
Equality and inequality	Equation and inequality. For details, see **Relational Operators**.
pattern_string	Pattern matching string, which supports wildcard matching. In WHERE LIKE, SQL wildcard characters "**%**" and "_" are supported. "**%**" represents one or more characters. "_" represents only one character.
like	Relational operator: used for wildcard matching.

6.23 input_expression

Syntax

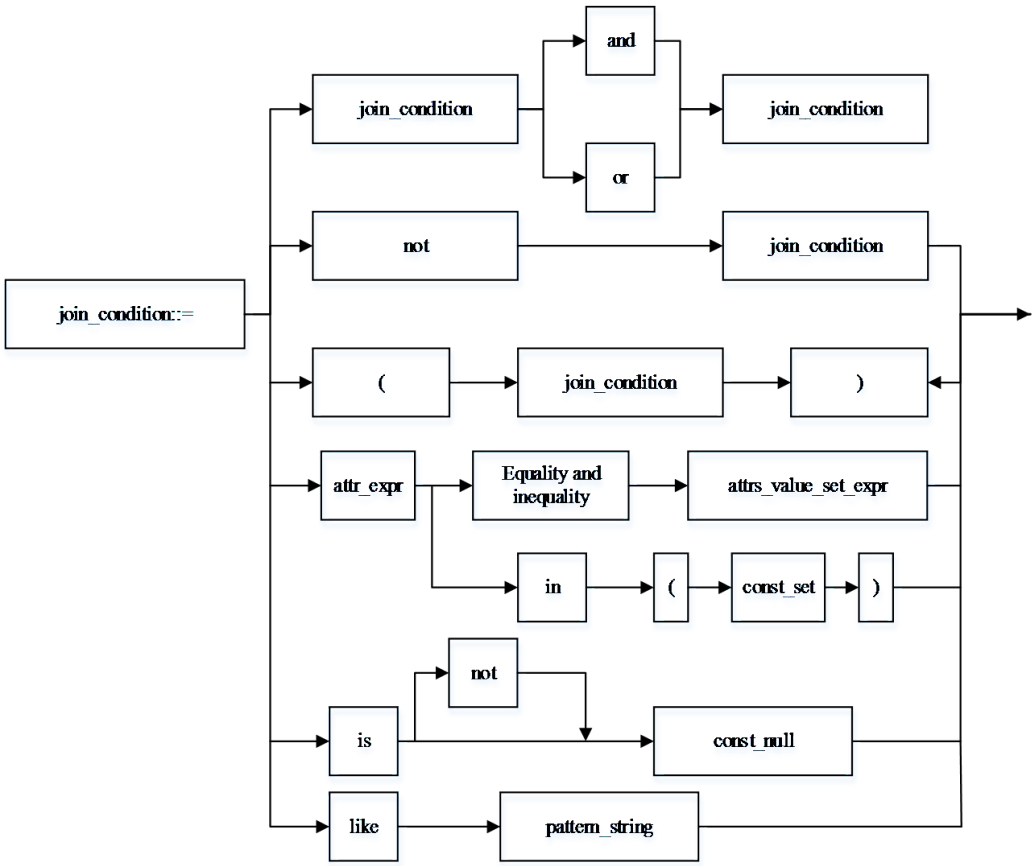
None.

Description

Input expression of the **CASE WHEN** statement.

6.24 join_condition

Syntax



Description

Syntax	Description
join_condition	Judgment condition of **join**.
and	Logical operator: AND
or	Logical operator: OR
not	Logical operator: NOT
(	Start of the subjudgment condition.
)	End of the subjudgment condition.
condition	Judgment condition.
const_set	Collection of constants, which are separated by using comma (,).

Syntax	Description
in	Keyword used to determine whether attributes are in the same collection.
atrrs_value_set_expr	Collection of attribute values.
attr_expr	Attribute expression.
Equality and inequality	Equation and inequality. For details, see **Relational Operators**.
pattern_string	Pattern matching string, which supports wildcard matching. In WHERE LIKE, SQL wildcard characters "**%**" and "_" are supported. "**%**" represents one or more characters. "_" represents only one character.

6.25 non_equi_join_condition

Syntax

None.

Description

The condition of an inequality join.

6.26 number

Syntax

None.

Description

Maximum number of output lines specified by **LIMIT**. Which must be INT type.

6.27 partition_col_name

Syntax

None.

Description

Partition column name, that is, partition field name, which must be STRING type.

6.28 partition_col_value

Syntax

None.

Description

Partition column value, that is, partition field value.

6.29 partition_specs

Syntax

partition_specs : (partition_col_name = partition_col_value, partition_col_name = partition_col_value, ...);

Description

Table partition list, which is expressed by using key=value pairs, in which **key** represents **partition_col_name**, and **value** represents **partition_col_value**. If there is more than one partition field, separate every two key=value pairs by using a comma (,).

6.30 property_name

Syntax

None.

Description

Property name, which must be STRING type.

6.31 property_value

Syntax

None.

Description

Property value, which must be STRING type.

6.32 regex_expression

Syntax

None.

Description

Pattern matching string, which supports wildcard matching.

6.33 result_expression

Syntax

None.

Description

Returned result for the **THEN** clause of the **CASE WHEN** statement.

6.34 select_statement

Syntax

None.

Description

Query clause for the basic **SELECT** statement.

6.35 separator

Syntax

None.

Description

Separator, which can be customized by users, for example, comma (,), semicolon (;), and colon (:). Which must be CHAR type.

6.36 sql_containing_cte_name

Syntax

None.

Description

SQL statement containing the common expression defined by cte_name.

6.37 sub_query

Syntax

None.

Description

Subquery.

6.38 table_comment

Syntax

None.

Description

Table description, which must be STRING type and cannot exceed 256 bytes.

6.39 table_name

Syntax

None

Description

Table name, which cannot exceed 128 bytes. The string type and "$" symbol are supported.

6.40 table_properties

Syntax

None.

Description

Table property list, which is expressed by using key=value pairs. key represents **property_name**, and value represents **property_value**. If there is more than one key=value pair, separate every two key=value pairs by using a comma (,).

6.41 table_reference

Syntax

None.

Description

Table or view name, which must be STRING type. It can also be a subquery. If it is subquery, an alias must also be provided.

6.42 when_expression

Syntax

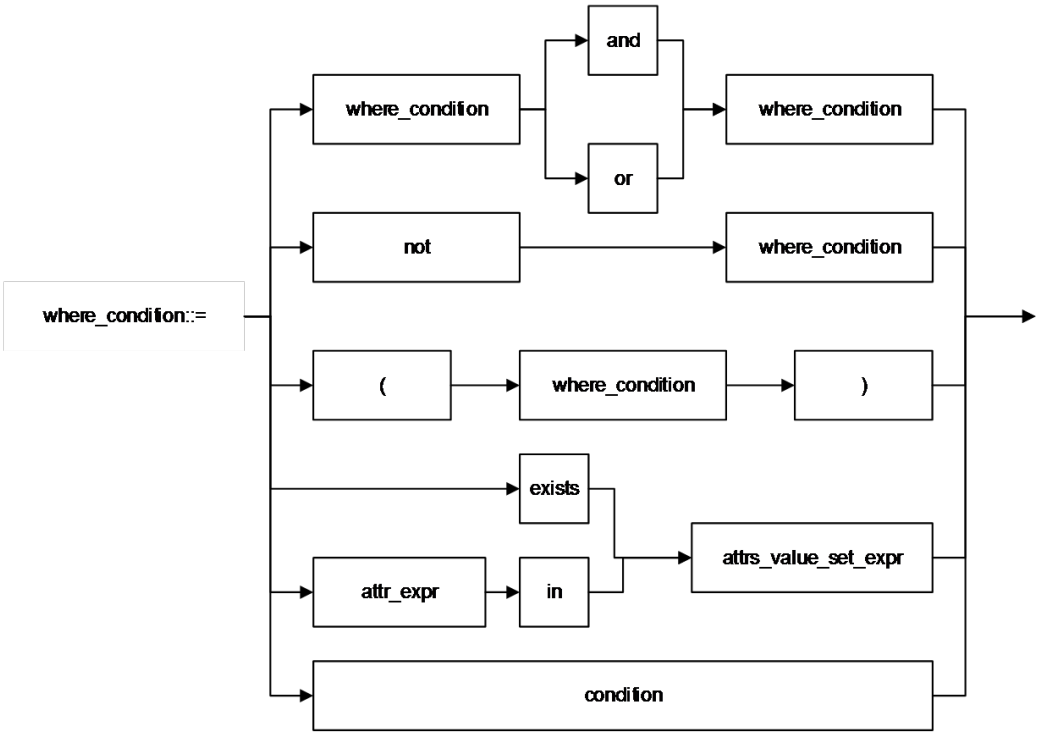
None.

Description

When expression of the **CASE WHEN** statement. It is used for matching with the input expression.

6.43 where_condition

Syntax



Description

Syntax	Description
where_condition	Judgment condition of **where**.
and	Logical operator: AND
or	Logical operator: OR
not	Logical operator: NOT
(	Start of the subjudgment condition.
)	End of the subjudgment condition.
condition	Judgment condition.
exists	Keyword used to determine whether a non-empty collection exists. If exists is followed by a subquery, then the subquery must contain a judgment condition.
in	Keyword used to determine whether attributes are in the same collection.
attrs_value_set_expr	Collection of attribute values.
attr_expr	Attribute expression.

6.44 window_function

Syntax

None

Description

Analysis window function.

7 Operators

7.1 Relational Operators

All data types can be compared by using relational operators and the result is returned as a BOOLEAN value.

Relationship operators are binary operators. Two compared data types must be of the same type or they must support implicit conversion.

Table 7-1 lists the relational operators provided by DLI.

Table 7-1 Relational operators

Operator	Result Type	Description
A = B	BOOLEAN	If A is equal to B, then **TRUE** is returned. Otherwise, **FALSE** is returned. This operator is used for value assignment.
A == B	BOOLEAN	If A is equal to B, then **TRUE** is returned. Otherwise, **FALSE** is returned. This operator cannot be used for value assignment.
A <=> B	BOOLEAN	If A is equal to B, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A and B are **NULL**, then **TRUE** is returned. If A or B is **NULL**, then **FALSE** is returned.
A <> B	BOOLEAN	If A is not equal to B, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned. This operator follows the standard SQL syntax.
A != B	BOOLEAN	This operator is the same as the <> logical operator. It follows the SQL Server syntax.

Operator	Result Type	Description
A < B	BOOLEAN	If A is less than B, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned.
A <= B	BOOLEAN	If A is less than or equal to B, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned.
A > B	BOOLEAN	If A is greater than B, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned.
A >= B	BOOLEAN	If A is greater than or equal to B, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned.
A BETWEEN B AND C	BOOLEAN	If A is greater than or equal to B and less than or equal to C, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A, B, or C is **NULL**, then **NULL** is returned.
A NOT BETWEEN B AND C	BOOLEAN	If A is less than B or greater than C, **TRUE** is returned; otherwise, **FALSE** is returned. If A, B, or C is **NULL**, then **NULL** is returned.
A IS NULL	BOOLEAN	If A is **NULL**, then **TRUE** is returned. Otherwise, **FALSE** is returned.
A IS NOT NULL	BOOLEAN	If A is not **NULL**, then **TRUE** is returned. Otherwise, **FALSE** is returned.
A LIKE B	BOOLEAN	If A matches B, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned.
A NOT LIKE B	BOOLEAN	If A does not match B, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned.
A RLIKE B	BOOLEAN	This operator is used for the LIKE operation of JAVA. If A or its substring matches B, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned.
A REGEXP B	BOOLEAN	The result is the same as A RLIKE B.

7.2 Arithmetic Operators

Arithmetic operators include binary operators and unary operators. For both types of operators, the returned results are numbers. **Table 7-2** lists the arithmetic operators supported by DLI.

Table 7-2 Arithmetic operators

Operator	Result Type	Description
A + B	All numeric types	A plus B. The result type is associated with the operation data type. For example, if floating-point number is added to an integer, the result will be a floating-point number.
A–B	All numeric types	A minus B. The result type is associated with the operation data type.
A * B	All numeric types	Multiply A and B. The result type is associated with the operation data type.
A / B	All numeric types	Divide A by B. The result is a number of the double type (double-precision number).
A % B	All numeric types	A on the B Modulo. The result type is associated with the operation data type.
A & B	All numeric types	Check the value of the two parameters in binary expressions and perform the AND operation by bit. If the same bit of both expressions are 1, then the bit is set to 1. Otherwise, the bit is 0.
A | B	All numeric types	Check the value of the two parameters in binary expressions and perform the OR operation by bit. If one bit of either expression is 1, then the bit is set to 1. Otherwise, the bit is set to 0.
A ^ B	All numeric types	Check the value of the two parameters in binary expressions and perform the XOR operation by bit. Only when one bit of either expression is 1, the bit is 1. Otherwise, the bit is 0.
~A	All numeric types	Perform the NOT operation on one expression by bit.

7.3 Logical Operators

Common logical operators include AND, OR, and NOT. The operation result can be TRUE, FALSE, or NULL (which means unknown). The priorities of the operators are as follows: NOT > AND > OR.

Table 7-3 lists the calculation rules, where A and B represent logical expressions.

Table 7-3 Logical operators

Operator	Result Type	Description
A AND B	BOOLEAN	If A and B are **TRUE**, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned.
A OR B	BOOLEAN	If A or B is **TRUE**, then **TRUE** is returned. Otherwise, **FALSE** is returned. If A or B is **NULL**, then **NULL** is returned. If one is **TRUE** and the other is **NULL**, then **TRUE** is returned.
NOT A	BOOLEAN	If A is **FALSE**, then **TRUE** is returned. If A is **NULL**, then **NULL** is returned. Otherwise, **FALSE** is returned.
! A	BOOLEAN	Same as NOT A.
A IN (val1, val2, ...)	BOOLEAN	If A is equal to any value in (val1, val2, ...), then **TRUE** is returned. Otherwise, **FALSE** is returned.
A NOT IN (val1, val2, ...)	BOOLEAN	If A is not equal to any value in (val1, val2, ...), then **TRUE** is returned. Otherwise, **FALSE** is returned.
EXISTS (subquery)	BOOLEAN	If the result of any subquery contains at least one line, then **TRUE** is returned. Otherwise, **FALSE** is returned.
NOT EXISTS (subquery)	BOOLEAN	If the subquery output does not contain any row, **TRUE** is returned; otherwise, **FALSE** is returned.

A Change History

Released On	Description
2023-08-01	Added the following section: **Creating a Datasource Connection with an Oracle Table**
2023-02-23	Modified the following sections: Updated descriptions about PERMISSIVE in **Creating an OBS Table Using the DataSource Syntax**.
2022-10-26	Added the unit of **FROM_UNIXTIME(numeric[, string])** in the description in **Temporal Functions**.
2022-09-15	This issue is the first official release.

