

数据仓库服务
9.1.0.100

性能白皮书

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1 9.1.0 版本性能测试概述

目的

GaussDB(DWS)是云端托管的PB级高并发实时数据仓库，专注于服务OLAP领域，提供按量付费和包年包月两种付费方式。

本次性能测试基于华为云基础环境，分别在同等硬件配置和同等数据规模下，基于TPC-H、TPC-DS标准测试集，对DWS 9.1.0版本和8.3.0版本进行性能对比测试。基于SSB-Flat测试集，对DWS 9.1.0版本和开源OLAP产品ClickHouse进行对比测试。本次性能测试时间为2024年11月。

TPC-H

TPC-H由国际事务处理性能委员会（Transaction Processing Performance Council）制定发布，用于评测数据库的分析查询能力。TPC-H查询包含8张数据表和22条复杂SQL查询，大多数查询包含多表Join、子查询和Group By等。

TPC-DS

TPC-DS由国际事务处理性能委员会（Transaction Processing Performance Council）制定发布，用于决策支持系统测试基准，主要用于衡量大数据产品的分析性能。TPC-DS查询共包含24张表，99个查询测试语句。

SSB

SSB（Star Schema Benchmark）是一种在学术界和工业界广泛应用的数据库系统性能评估基准测试方法。它能够对比不同数据仓库在处理星型模型查询时的性能，帮助数据库管理员和决策者选择最符合需求的数据库系统。此外，参考OLAP行业的做法，将SSB中的星型模型展平转化为宽表，还可以改造成单一表测试Benchmark（SSB Flat）。

2 9.1.0 版本测试结论

2.1 性能总览

在9.1.0版本，我们实现了很多性能优化特性，提升整体开箱的SQL查询性能。以TPC-H、TPC-DS 1TB作为性能测试对比的基准，重点对比最新9.1.0版本与8.3.0版本的性能提升。集群规模为6节点，其中各节点的规格为16U 64G，累计96U 384G。从以下测试结果可以看到：

- 9.1.0版本存算一体架构TPC-H总查询耗时为170.08秒，相较8.3.0版本的533.05秒，性能提升208%。
- 9.1.0版本存算分离架构与存算一体架构性能劣化在10%以内。
- TPC-H 1000x测试基准22个SQL中，9.1.0.200版本相比8.3.0版本，所有SQL查询性能提升达到1.5~5倍，特别是Q19提升达16倍。
- TPC-DS 1000x测试基准99个SQL中，9.1.0.200版本相比8.3.0版本，87个SQL有明显提升，其中15个SQL性能提升有2~10倍。
- 不论是简单的过滤、排序、聚集，还是复杂的多表关联、窗口计算、CTE查询，9.1.0版本都有明显性能优势。

表 2-1 TPC-H 和 TPC-DS 性能总览

1000x	DWS开箱性能		
版本	8.3.0	9.1.0.200	
-	存算一体 (s)	存算一体 (s)	存算分离 (s)
TPC-H	533.05	170.08	172.62
TPC-DS	1321.76	645.424	622.214

在9.1.0版本，我们使用存算分离架构指定二级分区，基于ssb-flat 100 GB测试基准，对比DWS和ClickHouse的性能表现。从以下测试结果可以看到：

- 开箱性能相比开源厂商ClickHouse有200%性能优势。

- 开箱性能相比9.1.0.100版本提升了133%。

表 2-2 SSB 性能总览

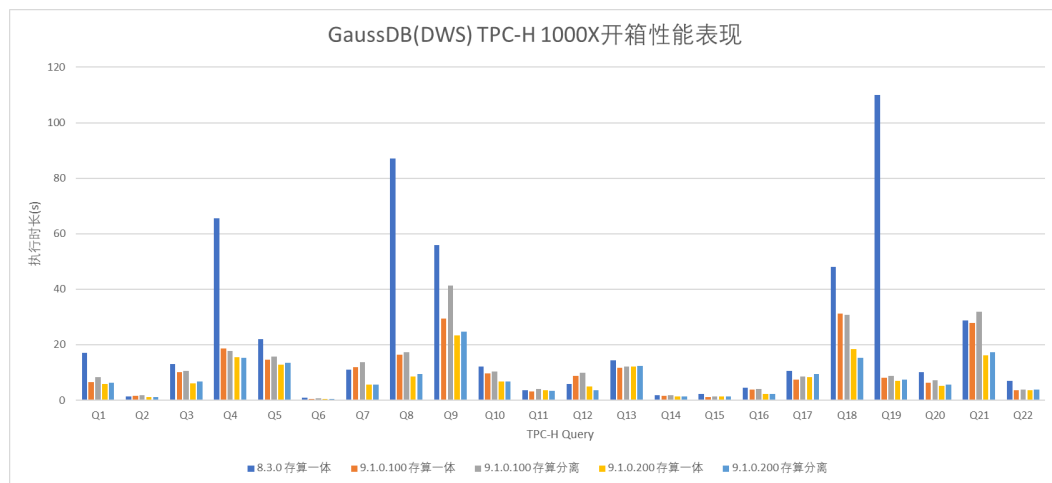
100x	DWS	ClickHouse
ssb-flat	0.91	2.73

3 TPC-H 性能测试

3.1 TPC-H 测试结果

DWS测试了使用存算一体和存算分离两种部署架构下，TPC-H 1T规模数据集的开箱查询性能，共22个查询。存算一体查询总耗时为170.08s，存算分离查询总耗时为172.62s。

图 3-1 TPC-H 1000X 开箱性能



详细性能数据见下表。

表 3-1 TPC-H 测试结果

TPC-H查询	8.3.0	9.1.0.200	
	存算一体	存算一体	存算分离
Q1	16.97	5.82	6.25
Q2	1.44	1.11	1.15
Q3	13.02	6.17	6.64

TPC-H查询	8.3.0	9.1.0.200	
Q4	65.56	15.39	15.26
Q5	21.90	12.72	13.40
Q6	0.84	0.42	0.46
Q7	11.08	5.55	5.65
Q8	87.18	8.62	9.37
Q9	55.98	23.46	24.69
Q10	12.20	6.75	6.76
Q11	3.57	3.52	3.41
Q12	5.92	5.05	3.60
Q13	14.28	12.16	12.31
Q14	1.87	1.29	1.26
Q15	2.24	1.25	1.44
Q16	4.52	2.19	2.14
Q17	10.54	8.40	9.42
Q18	47.97	18.34	15.16
Q19	110.03	6.88	7.50
Q20	10.07	5.19	5.60
Q21	28.82	16.25	17.37
Q22	7.04	3.53	3.76
总时长 (s)	533.05	170.08	172.62

3.2 TPC-H 测试环境

硬件环境

每个测试环境6个节点，配置如下：

- CPU 16核：Intel Ice Lake
- 内存：64GB
- 网络带宽：9Gbit/s
- 磁盘：SSD云盘，每块600GB，共2块

软件环境

- 内核版本：Linux 3.10.0-862.14.1.5.h757.eulerosv2r7.x86_64
- 操作系统：EulerOS release 2.0 (SP5)
- 数据库版本：DWS 3.0

3.3 TPC-H 测试过程

3.3.1 TPC-H 测试数据

表 3-2 TPC-H 测试数据

序号	表名	行数	表大小
1	region	5	294KB
2	nation	25	298KB
3	supplier	10,000,000	1020MB
4	customer	150,000,000	8226MB
5	part	200,000,000	5216MB
6	partsupp	800,000,000	29GB
7	orders	1,500,000,000	43GB
8	lineitem	5,999,989,709	171GB

3.3.2 TPC-H 数据生成

步骤1 从[官网](#)获取TPC-H工具。

步骤2 登录ECS云服务器，执行如下命令创建TPC-H存放目录。

```
mkdir -p /data1/script/tpch-kit/tpch1000X  
mkdir -p /data2/script/tpch-kit/tpch1000X
```

步骤3 将获取的TPC-H工具上传到ECS的/data1/script/tpch-kit目录执行以下命令解压。

“tpch_3.0.1.zip”替换为实际的软件包名。

```
cd /data1/script/tpch-kit && unzip tpch_v3.0.1.zip
```

步骤4 执行如下命令编译生成数据构建工具dbgen。

须知

编译之前需要修改dbgen目录下的两个文件：makefile.suite和tpcd.h

1. 修改makefile.suite文件。

```
#makefile.suite的更改参数如下 ( 103行-111行) :  
CC = gcc  
# Current values for DATABASE are: INFORMIX, DB2, TDAT (Teradata)  
#                               SQLSERVER, SYBASE, ORACLE, VECTORWISE  
# Current values for MACHINE are: ATT, DOS, HP, IBM, ICL, MVS,  
#                               SGI, SUN, U2200, VMS, LINUX, WIN32  
# Current values for WORKLOAD are: TPCH  
DATABASE = POSTGRESQL #程序给定参数没有postgresql , 修改tpcd.h 添加POSTGRESQL脚本  
MACHINE = LINUX  
WORKLOAD = TPCH
```

2. 修改tpcd.h文件。

```
//在tpcd.h文件增加如下语句:  
#ifdef POSTGRESQL  
#define GEN_QUERY_PLAN "EXPLAIN"  
#define START_TRAN "BEGIN TRANSACTION"  
#define END_TRAN "COMMIT;"  
#define SET_OUTPUT ""  
#define SET_ROWCOUNT "LIMIT %d\n"  
#define SET_DBASE ""  
#endif /* POSTGRESQL */  
$ cd TPC-H_Tools_v3.0.1/dbgen  
$ cp makefile.suite makefile  
$ make -f makefile  
$ cp -R /data1/script/tpch-kit/TPC-H_Tools_v3.0.1/ /data2/script/tpch-kit/
```

步骤5 登录ECS，执行如下命令生成TPC-H 1000X数据，本示例分两个数据盘同步生成TPC-H 1000X数据。

须知

TPC-H 1000X数据文件总大小约1100GB，请确认ECS的磁盘空间足够。

1. 进入/data1/script/tpch-kit/TPC-H_Tools_v3.0.1/dbgen目录后，执行如下命令。

```
for c in {1..5};do ./dbgen -s 1000 -C 10 -S ${c} -f > /dev/null 2>&1 &;done
```

2. 进入/data2/script/tpch-kit/ TPC-H_Tools_v3.0.1/dbgen目录后，执行如下命令。

```
for c in {6..10};do ./dbgen -s 1000 -C 10 -S ${c} -f > /dev/null 2>&1 &;done
```

其中：

- s 指定数据规模，本例为1000。
- C 指定分成几个chunk，本例为10。
- S 指定当前是第几个chunk，此处不需修改。

步骤6 执行以下命令，判断数据文件的生成进度。也可以通过`ps ux|grep dbgen`，查看生成数据文件的进程是否退出。

```
du -sh /data1/script/tpch-kit/TPC-H_Tools_v3.0.1/dbgen/*.tbl*  
du -sh /data2/script/tpch-kit/TPC-H_Tools_v3.0.1/dbgen/*.tbl*
```

步骤7 将TPC-H 1000X数据转移至指定目录。

```
mv /data1/script/tpch-kit/TPC-H_Tools_v3.0.1/dbgen/*.tbl* /data1/script/tpch-kit/tpch1000X  
mv /data2/script/tpch-kit/TPC-H_Tools_v3.0.1/dbgen/*.tbl* /data2/script/tpch-kit/tpch1000X
```

---结束

3.3.3 建表与导入 TPC-H 数据

创建 TPC-H 目标表

连接DWS数据库后执行以下命令创建目标表。

```
CREATE TABLE REGION
(
  R_REGIONKEY INT NOT NULL
, R_NAME VARCHAR(25) NOT NULL
, R_COMMENT VARCHAR(152)
) WITH (orientation=column, colversion=2.0, enable_hstore=true,
enable_hstore_opt=true,bucketnums=16384)
DISTRIBUTE BY replication;

CREATE TABLE NATION
(
  N_NATIONKEY INT NOT NULL
, N_NAME VARCHAR(25) NOT NULL
, N_REGIONKEY INT NOT NULL
, N_COMMENT VARCHAR(152)
) WITH (orientation=column, colversion=2.0, enable_hstore=true,
enable_hstore_opt=true,bucketnums=16384)
DISTRIBUTE BY replication;

CREATE TABLE SUPPLIER
(
  S_SUPPKEY BIGINT NOT NULL
, S_NAME VARCHAR(25) NOT NULL
, S_ADDRESS VARCHAR(40) NOT NULL
, S_NATIONKEY INT NOT NULL
, S_PHONE VARCHAR(15) NOT NULL
, S_ACCTBAL DECIMAL(15,2) NOT NULL
, S_COMMENT VARCHAR(101) NOT NULL
) WITH (orientation=column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384,secondary_part_column='s_su
ppkey',secondary_part_num=72)
DISTRIBUTE BY hash(S_SUPPKEY)
PARTITION BY RANGE(S_NATIONKEY)
(
  PARTITION S_NATIONKEY_1 VALUES LESS THAN(1),
  PARTITION S_NATIONKEY_2 VALUES LESS THAN(2),
  PARTITION S_NATIONKEY_3 VALUES LESS THAN(3),
  PARTITION S_NATIONKEY_4 VALUES LESS THAN(4),
  PARTITION S_NATIONKEY_5 VALUES LESS THAN(5),
  PARTITION S_NATIONKEY_6 VALUES LESS THAN(6),
  PARTITION S_NATIONKEY_7 VALUES LESS THAN(7),
  PARTITION S_NATIONKEY_8 VALUES LESS THAN(8),
  PARTITION S_NATIONKEY_9 VALUES LESS THAN(9),
  PARTITION S_NATIONKEY_10 VALUES LESS THAN(10),
  PARTITION S_NATIONKEY_11 VALUES LESS THAN(11),
  PARTITION S_NATIONKEY_12 VALUES LESS THAN(12),
  PARTITION S_NATIONKEY_13 VALUES LESS THAN(13),
  PARTITION S_NATIONKEY_14 VALUES LESS THAN(14),
  PARTITION S_NATIONKEY_15 VALUES LESS THAN(15),
  PARTITION S_NATIONKEY_16 VALUES LESS THAN(16),
  PARTITION S_NATIONKEY_17 VALUES LESS THAN(17),
  PARTITION S_NATIONKEY_18 VALUES LESS THAN(18),
  PARTITION S_NATIONKEY_19 VALUES LESS THAN(19),
  PARTITION S_NATIONKEY_20 VALUES LESS THAN(20),
  PARTITION S_NATIONKEY_21 VALUES LESS THAN(21),
  PARTITION S_NATIONKEY_22 VALUES LESS THAN(22),
  PARTITION S_NATIONKEY_23 VALUES LESS THAN(23),
  PARTITION S_NATIONKEY_24 VALUES LESS THAN(24),
  PARTITION S_NATIONKEY_25 VALUES LESS THAN(25)
);

CREATE TABLE CUSTOMER
```

```
(
  C_CUSTKEY BIGINT NOT NULL
, C_NAME VARCHAR(25) NOT NULL
, C_ADDRESS VARCHAR(40) NOT NULL
, C_NATIONKEY INT NOT NULL
, C_PHONE VARCHAR(15) NOT NULL
, C_ACCTBAL DECIMAL(15,2) NOT NULL
, C_MKTSEGMENT VARCHAR(10) NOT NULL
, C_COMMENT VARCHAR(117) NOT NULL
) WITH (orientation=column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384,secondary_part_column='c_custkey',secondary_part_num=72)
DISTRIBUTE BY hash(C_CUSTKEY)
PARTITION BY RANGE(C_NATIONKEY)
(
  PARTITION C_NATIONKEY_1 VALUES LESS THAN(1),
  PARTITION C_NATIONKEY_2 VALUES LESS THAN(2),
  PARTITION C_NATIONKEY_3 VALUES LESS THAN(3),
  PARTITION C_NATIONKEY_4 VALUES LESS THAN(4),
  PARTITION C_NATIONKEY_5 VALUES LESS THAN(5),
  PARTITION C_NATIONKEY_6 VALUES LESS THAN(6),
  PARTITION C_NATIONKEY_7 VALUES LESS THAN(7),
  PARTITION C_NATIONKEY_8 VALUES LESS THAN(8),
  PARTITION C_NATIONKEY_9 VALUES LESS THAN(9),
  PARTITION C_NATIONKEY_10 VALUES LESS THAN(10),
  PARTITION C_NATIONKEY_11 VALUES LESS THAN(11),
  PARTITION C_NATIONKEY_12 VALUES LESS THAN(12),
  PARTITION C_NATIONKEY_13 VALUES LESS THAN(13),
  PARTITION C_NATIONKEY_14 VALUES LESS THAN(14),
  PARTITION C_NATIONKEY_15 VALUES LESS THAN(15),
  PARTITION C_NATIONKEY_16 VALUES LESS THAN(16),
  PARTITION C_NATIONKEY_17 VALUES LESS THAN(17),
  PARTITION C_NATIONKEY_18 VALUES LESS THAN(18),
  PARTITION C_NATIONKEY_19 VALUES LESS THAN(19),
  PARTITION C_NATIONKEY_20 VALUES LESS THAN(20),
  PARTITION C_NATIONKEY_21 VALUES LESS THAN(21),
  PARTITION C_NATIONKEY_22 VALUES LESS THAN(22),
  PARTITION C_NATIONKEY_23 VALUES LESS THAN(23),
  PARTITION C_NATIONKEY_24 VALUES LESS THAN(24),
  PARTITION C_NATIONKEY_25 VALUES LESS THAN(25)
);

CREATE TABLE PART
(
  P_PARTKEY BIGINT NOT NULL
, P_NAME VARCHAR(55) NOT NULL
, P_MFGR VARCHAR(25) NOT NULL
, P_BRAND VARCHAR(10) NOT NULL
, P_TYPE VARCHAR(25) NOT NULL
, P_SIZE BIGINT NOT NULL
, P_CONTAINER VARCHAR(10) NOT NULL
, P_RETAILPRICE DECIMAL(15,2) NOT NULL
, P_COMMENT VARCHAR(23) NOT NULL
) WITH (orientation=column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384,secondary_part_column='p_partkey',secondary_part_num=72)
DISTRIBUTE BY hash(P_PARTKEY)
PARTITION BY RANGE(P_SIZE)
(
  PARTITION P_SIZE_1 VALUES LESS THAN(11),
  PARTITION P_SIZE_2 VALUES LESS THAN(21),
  PARTITION P_SIZE_3 VALUES LESS THAN(31),
  PARTITION P_SIZE_4 VALUES LESS THAN(41),
  PARTITION P_SIZE_5 VALUES LESS THAN(51)
);

CREATE TABLE PARTSUPP
(
```

```

PS_PARTKEY BIGINT NOT NULL
, PS_SUPPKEY BIGINT NOT NULL
, PS_AVAILQTY BIGINT NOT NULL
, PS_SUPPLYCOST DECIMAL(15,2) NOT NULL
, PS_COMMENT VARCHAR(199) NOT NULL
) WITH (orientation=column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384,secondary_part_column='ps_p
artkey',secondary_part_num=72)
DISTRIBUTE BY hash(PS_PARTKEY)
PARTITION BY RANGE(PS_AVAILQTY)
(
PARTITION PS_AVAILQTY_1 VALUES LESS THAN(1000),
PARTITION PS_AVAILQTY_2 VALUES LESS THAN(2000),
PARTITION PS_AVAILQTY_3 VALUES LESS THAN(3000),
PARTITION PS_AVAILQTY_4 VALUES LESS THAN(4000),
PARTITION PS_AVAILQTY_5 VALUES LESS THAN(5000),
PARTITION PS_AVAILQTY_6 VALUES LESS THAN(6000),
PARTITION PS_AVAILQTY_7 VALUES LESS THAN(7000),
PARTITION PS_AVAILQTY_8 VALUES LESS THAN(8000),
PARTITION PS_AVAILQTY_9 VALUES LESS THAN(9000),
PARTITION PS_AVAILQTY_10 VALUES LESS THAN(10000)
);

CREATE TABLE ORDERS
(
O_ORDERKEY BIGINT NOT NULL
, O_CUSTKEY BIGINT NOT NULL
, O_ORDERSTATUS VARCHAR(1) NOT NULL
, O_TOTALPRICE DECIMAL(15,2) NOT NULL
, O_ORDERDATE DATE NOT NULL
, O_ORDERPRIORITY VARCHAR(15) NOT NULL
, O_CLERK VARCHAR(15) NOT NULL
, O_SHIPPRIORITY BIGINT NOT NULL
, O_COMMENT VARCHAR(79) NOT NULL
) WITH (orientation=column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384,secondary_part_column='o_or
derkey',secondary_part_num=72)
DISTRIBUTE BY hash(O_ORDERKEY)
PARTITION BY RANGE(O_ORDERDATE)
(
PARTITION O_ORDERDATE_1 VALUES LESS THAN('1993-01-01 00:00:00'),
PARTITION O_ORDERDATE_2 VALUES LESS THAN('1994-01-01 00:00:00'),
PARTITION O_ORDERDATE_3 VALUES LESS THAN('1995-01-01 00:00:00'),
PARTITION O_ORDERDATE_4 VALUES LESS THAN('1996-01-01 00:00:00'),
PARTITION O_ORDERDATE_5 VALUES LESS THAN('1997-01-01 00:00:00'),
PARTITION O_ORDERDATE_6 VALUES LESS THAN('1998-01-01 00:00:00'),
PARTITION O_ORDERDATE_7 VALUES LESS THAN('1999-01-01 00:00:00')
);

CREATE TABLE LINEITEM
(
L_ORDERKEY BIGINT NOT NULL
, L_PARTKEY BIGINT NOT NULL
, L_SUPPKEY BIGINT NOT NULL
, L_LINENUMBER BIGINT NOT NULL
, L_QUANTITY DECIMAL(15,2) NOT NULL
, L_EXTENDEDPRICE DECIMAL(15,2) NOT NULL
, L_DISCOUNT DECIMAL(15,2) NOT NULL
, L_TAX DECIMAL(15,2) NOT NULL
, L_RETURNFLAG VARCHAR(1) NOT NULL
, L_LINestatus VARCHAR(1) NOT NULL
, L_SHIPDATE DATE NOT NULL
, L_COMMITDATE DATE NOT NULL
, L_RECEIPTDATE DATE NOT NULL
, L_SHIPINSTRUCT VARCHAR(25) NOT NULL
, L_SHIPMODE VARCHAR(10) NOT NULL
, L_COMMENT VARCHAR(44) NOT NULL
) WITH (orientation=column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384,secondary_part_column='l_ord

```

```
erkey',secondary_part_num=72)
DISTRIBUTE BY hash(L_ORDERKEY)
PARTITION BY RANGE(L_SHIPDATE)
(
PARTITION L_SHIPDATE_1 VALUES LESS THAN('1993-01-01 00:00:00'),
PARTITION L_SHIPDATE_2 VALUES LESS THAN('1994-01-01 00:00:00'),
PARTITION L_SHIPDATE_3 VALUES LESS THAN('1995-01-01 00:00:00'),
PARTITION L_SHIPDATE_4 VALUES LESS THAN('1996-01-01 00:00:00'),
PARTITION L_SHIPDATE_5 VALUES LESS THAN('1997-01-01 00:00:00'),
PARTITION L_SHIPDATE_6 VALUES LESS THAN('1998-01-01 00:00:00'),
PARTITION L_SHIPDATE_7 VALUES LESS THAN('1999-01-01 00:00:00')
);
```

安装和启动 GDS

步骤1 参见[工具下载](#)下载GDS客户端（与gsql客户端在一个包）。

步骤2 将GDS工具包上传至ECS的/opt目录中，本例以上传Euler Kunpeng版本的工具包为例。

步骤3 在工具包所在目录下，解压工具包。

```
cd /opt/
unzip dws_client_8.1.x_euler_kunpeng_x64.zip
```

步骤4 创建用户gds_user及其所属的用户组gdsgrp。此用户用于启动GDS，且需要拥有读取数据源文件目录的权限。

```
groupadd gdsgrp
useradd -g gdsgrp gds_user
```

步骤5 修改工具包以及数据源文件目录属主为创建的用户gds_user及其所属的用户组gdsgrp。

```
chown -R gds_user:gdsgrp /opt/
chown -R gds_user:gdsgrp /data1
chown -R gds_user:gdsgrp /data2
```

步骤6 切换到gds_user用户。

```
su - gds_user
```

步骤7 执行环境依赖脚本（仅8.1.x版本适用）。

```
cd /opt/gds/bin
source gds_env
```

步骤8 启动GDS。

```
/opt/gds/bin/gds -d /data1/script/tpch-kit/tpch1000X -p 192.168.0.90:5000 -H 192.168.0.0/24 -l /opt/gds/gds01_log.txt -D #TPC-H使用
/opt/gds/bin/gds -d /data2/script/tpch-kit/tpch1000X -p 192.168.0.90:5001 -H 192.168.0.0/24 -l /opt/gds/gds02_log.txt -D #TPC-H使用
/opt/gds/bin/gds -d /data1/script/tpcds-kit/tpcds1000X/ -p 192.168.0.90:5002 -H 192.168.0.0/24 -l /opt/gds/gds03_log.txt -D #TPC-DS使用
/opt/gds/bin/gds -d /data2/script/tpcds-kit/tpcds1000X/ -p 192.168.0.90:5003 -H 192.168.0.0/24 -l /opt/gds/gds04_log.txt -D #TPC-DS使用
/opt/gds/bin/gds -d /data1/script/ssb-kit/ssb100X/ -p 192.168.0.90:5004 -H 192.168.0.0/24 -l /opt/gds/gds05_log.txt -D #SSB使用
```

须知

- 命令中的斜体部分请根据实际填写，如果数据分片存放至多个数据盘目录，需要启动对应目录数量的GDS。
- 如果TPC-H和TPC-DS数据同时测试，需要启动以上4个GDS，如果只测试TPC-DS或TPC-H数据，请根据后面的“#xxx”备注启动对应的GDS服务即可。
- -d dir: 保存有待导入数据的数据文件所在目录。
- -p ip:port: GDS监听IP和监听端口。IP替换为ECS的内网IP，确保GaussDB(DWS)能通过此IP与GDS的通讯；端口对于TPC-H取5000、5001，对于TPC-DS取5002、5003。
- -H address_string: 允许哪些主机连接和使用GDS服务。参数需为CIDR格式。此地址配置成GaussDB(DWS)的集群内网网段（即GDS所在的ECS与GaussDB(DWS)在同一个VPC下，以内网通讯即可），例如192.168.0.0/24。
- -l log_file: 存放GDS的日志文件路径及文件名。
- -D: 后台运行GDS。仅支持Linux操作系统下使用。

----结束

创建 TPC-H 数据集的 GDS 外表

连接DWS数据库后执行以下SQL语句创建。

须知

以下每个外表的“**gsfs://192.168.0.90:500x/xxx | gsfs://192.168.0.90:500x/xxx**”中的IP地址和端口，请替换成安装和启动GDS中的对应的GDS的监听IP和端口。如启动两个GDS，则使用“|”区分。如果启动多个GDS，需要将所有GDS的监听IP和端口配置到外表中。

```
DROP FOREIGN TABLE IF EXISTS region_load;
CREATE FOREIGN TABLE region_load
(
  R_REGIONKEY INT,
  R_NAME CHAR(25),
  R_COMMENT VARCHAR(152)
) SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5000/region.tbl* | gsfs://192.168.0.90:5001/region.tbl*',
format 'text',
deLIMITer '|',
encoding 'utf8',
mode 'Normal'
);
DROP FOREIGN TABLE IF EXISTS nation_load;
CREATE FOREIGN TABLE nation_load
(
  N_NATIONKEY INT,
  N_NAME CHAR(25),
  N_REGIONKEY INT,
  N_COMMENT VARCHAR(152)
) SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5000/nation.tbl* | gsfs://192.168.0.90:5001/nation.tbl*',
format 'text',
deLIMITer '|',
encoding 'utf8',
mode 'Normal'
```

```

);
DROP FOREIGN TABLE IF EXISTS supplier_load;
CREATE FOREIGN TABLE supplier_load
(
S_SUPPKEY INT,
S_NAME CHAR(25),
S_ADDRESS VARCHAR(40),
S_NATIONKEY INT,
S_PHONE CHAR(15),
S_ACCTBAL DECIMAL(15,2),
S_COMMENT VARCHAR(101)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5000/supplier.tbl*' | gsfs://192.168.0.90:5001/supplier.tbl*',
format 'text',
deLIMITer '|',
encoding 'utf8',
mode 'Normal'
);
DROP FOREIGN TABLE IF EXISTS customer_load;
CREATE FOREIGN TABLE customer_load
(
C_CUSTKEY INT,
C_NAME VARCHAR(25),
C_ADDRESS VARCHAR(40),
C_NATIONKEY INT,
C_PHONE CHAR(15),
C_ACCTBAL DECIMAL(15,2),
C_MKTSEGMENT CHAR(10),
C_COMMENT VARCHAR(117)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5000/customer.tbl*' | gsfs://192.168.0.90:5001/customer.tbl*',
format 'text',
deLIMITer '|',
encoding 'utf8',
mode 'Normal'
);
DROP FOREIGN TABLE IF EXISTS part_load;
CREATE FOREIGN TABLE part_load
(
P_PARTKEY INT,
P_NAME VARCHAR(55),
P_MFGR CHAR(25),
P_BRAND CHAR(10),
P_TYPE VARCHAR(25),
P_SIZE INT,
P_CONTAINER CHAR(10),
P_RETAILPRICE DECIMAL(15,2),
P_COMMENT VARCHAR(23)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5000/part.tbl*' | gsfs://192.168.0.90:5001/part.tbl*',
format 'text',
deLIMITer '|',
encoding 'utf8',
mode 'Normal'
);
DROP FOREIGN TABLE IF EXISTS partsupp_load;
CREATE FOREIGN TABLE partsupp_load
(
PS_PARTKEY INT,
PS_SUPPKEY INT,
PS_AVAILQTY INT,
PS_SUPPLYCOST DECIMAL(15,2),
PS_COMMENT VARCHAR(199)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5000/partsupp.tbl*' | gsfs://192.168.0.90:5001/partsupp.tbl*',

```



```
format 'text',
deLIMITer '|',
encoding 'utf8',
mode 'Normal'
);
DROP FOREIGN TABLE IF EXISTS orders_load;
CREATE FOREIGN TABLE orders_load
(
O_ORDERKEY    BIGINT,
O_CUSTKEY     INT,
O_ORDERSTATUS CHAR(1),
O_TOTALPRICE  DECIMAL(15,2),
O_ORDERDATE   DATE,
O_ORDERPRIORITY CHAR(15),
O_CLERK       CHAR(15),
O_SHIPPRIORITY INT,
O_COMMENT     VARCHAR(79)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5000/orders.tbl* | gsfs://192.168.0.90:5001/orders.tbl*',
format 'text',
deLIMITer '|',
encoding 'utf8',
mode 'Normal'
);
DROP FOREIGN TABLE IF EXISTS lineitem_load;
CREATE FOREIGN TABLE lineitem_load
(
L_ORDERKEY    BIGINT,
L_PARTKEY     INT,
L_SUPPKEY     INT,
L_LINENUMBER  INT,
L_QUANTITY    DECIMAL(15,2),
L_EXTENDEDPRICE DECIMAL(15,2),
L_DISCOUNT   DECIMAL(15,2),
L_TAX         DECIMAL(15,2),
L_RETURNFLAG  CHAR(1),
L_LINESTATUS  CHAR(1),
L_SHIPDATE    DATE,
L_COMMITDATE  DATE,
L_RECEIPTDATE DATE,
L_SHIPINSTRUCT CHAR(25),
L_SHIPMODE    CHAR(10),
L_COMMENT     VARCHAR(44)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5000/lineitem.tbl* | gsfs://192.168.0.90:5001/lineitem.tbl*',
format 'text',
deLIMITer '|',
encoding 'utf8',
mode 'Normal'
);
```

导入 TPC-H 数据

执行以下SQL语句导入数据。

```
INSERT INTO region SELECT * FROM region_load;
INSERT INTO nation SELECT * FROM nation_load;
INSERT INTO supplier SELECT * FROM supplier_load;
INSERT INTO customer SELECT * FROM customer_load;
INSERT INTO part SELECT * FROM part_load;
INSERT INTO partsupp SELECT * FROM partsupp_load;
INSERT INTO orders SELECT * FROM orders_load;
INSERT INTO lineitem SELECT * FROM lineitem_load;
```

设置 GUC 参数

在执行测试之前，可以设置如下几个参数，这将给性能带来5-10%的提升。

```
cpu_tuple_cost=0.0058401054702699184
cpu_operator_cost=0.002450424712151289
cpu_index_tuple_cost=0.004948411136865616
seq_page_cost=0.3447857201099396
random_page_cost=2.3901453018188477
allocate_mem_cost=0.5275554060935974
effective_cache_size=502
smp_thread_cost=278.525634765625
stream_multiple=0.5654585361480713
```

3.3.4 TPC-H 查询测试

TPC-H由国际事务处理性能委员会（Transaction Processing Performance Council）制定发布，用于评测数据库的分析查询能力。TPC-H查询包含8张数据表和22条复杂SQL查询，大多数查询包含多表Join、子查询和Group By等。

包含Q1~Q22共22个查询，具体的查询SQL代码如下显示，仅供参考。

了解更多内容，请访问TPC-H官网。

Q1

```
SELECT
  L_returnflag,
  L_linestatus,
  sum(L_quantity) as sum_qty,
  sum(L_extendedprice) as sum_base_price,
  sum(L_extendedprice * (1 - L_discount)) as sum_disc_price,
  sum(L_extendedprice * (1 - L_discount) * (1 + L_tax)) as sum_charge,
  avg(L_quantity) as avg_qty,
  avg(L_extendedprice) as avg_price,
  avg(L_discount) as avg_disc,
  count(*) as count_order
FROM
  lineitem
WHERE
  L_shipdate <= date '1998-12-01' - interval '90' day (3)
GROUP BY
  L_returnflag,
  L_linestatus
ORDER BY
  L_returnflag,
  L_linestatus;
```

Q2

```
SELECT
  s_acctbal,
  s_name,
  n_name,
  p_partkey,
  p_mfgr,
  s_address,
  s_phone,
  s_comment
FROM
  part,
  supplier,
  partsupp,
  nation,
  region
```

```

WHERE
p_partkey = ps_partkey
and s_suppkey = ps_suppkey
and p_size = 15
and p_type like '%BRASS'
and s_nationkey = n_nationkey
and n_regionkey = r_regionkey
and r_name = 'EUROPE'
and ps_supplycost = (
SELECT
min(ps_supplycost)
FROM
partsupp,
supplier,
nation,
region
WHERE
p_partkey = ps_partkey
and s_suppkey = ps_suppkey
and s_nationkey = n_nationkey
and n_regionkey = r_regionkey
and r_name = 'EUROPE'
)
ORDER BY
s_acctbal desc,
n_name,
s_name,
p_partkey
LIMIT 100;

```

Q3

```

SELECT
l_orderkey,
sum(l_extendedprice * (1 - l_discount)) as revenue,
o_orderdate,
o_shippriority
FROM
customer,
orders,
lineitem
WHERE
c_mktsegment = 'BUILDING'
and c_custkey = o_custkey
and l_orderkey = o_orderkey
and o_orderdate < date '1995-03-15'
and l_shipdate > date '1995-03-15'
GROUP BY
l_orderkey,
o_orderdate,
o_shippriority
ORDER BY
revenue desc,
o_orderdate
LIMIT 10;

```

Q4

```

SELECT
o_orderpriority,
count(*) as order_count
FROM
orders
WHERE
o_orderdate >= date '1993-07-01'
and o_orderdate < date '1993-07-01' + interval '3' month
and exists (
SELECT
*

```

```
FROM
lineitem
WHERE
L_orderkey = o_orderkey
and L_commitdate < L_receiptdate
)
GROUP BY
o_orderpriority
ORDER BY
o_orderpriority;
```

Q5

```
SELECT
n_name,
sum(L_extendedprice * (1 - L_discount)) as revenue
FROM
customer,
orders,
lineitem,
supplier,
nation,
region
WHERE
c_custkey = o_custkey
and L_orderkey = o_orderkey
and L_suppkey = s_suppkey
and c_nationkey = s_nationkey
and s_nationkey = n_nationkey
and n_regionkey = r_regionkey
and r_name = 'ASIA'
and o_orderdate >= date '1994-01-01'
and o_orderdate < date '1994-01-01' + interval '1' year
GROUP BY
n_name
ORDER BY
revenue desc;
```

Q6

```
SELECT
sum(L_extendedprice * L_discount) as revenue
FROM
lineitem
WHERE
L_shipdate >= date '1994-01-01'
and L_shipdate < date '1994-01-01' + interval '1' year
and L_discount between .06 - 0.01 and .06 + 0.01
and L_quantity < 24;
```

Q7

```
SELECT
supp_nation,
cust_nation,
L_year,
sum(volume) as revenue
FROM
(
SELECT
n1.n_name as supp_nation,
n2.n_name as cust_nation,
extract(year FROM L_shipdate) as L_year,
L_extendedprice * (1 - L_discount) as volume
FROM
supplier,
lineitem,
orders,
```

```
customer,
nation n1,
nation n2
WHERE
s_suppkey = l_suppkey
and o_orderkey = l_orderkey
and c_custkey = o_custkey
and s_nationkey = n1.n_nationkey
and c_nationkey = n2.n_nationkey
and (
(n1.n_name = 'FRANCE' and n2.n_name = 'GERMANY')
or (n1.n_name = 'GERMANY' and n2.n_name = 'FRANCE')
)
and l_shipdate between date '1995-01-01' and date '1996-12-31'
) as shipping
GROUP BY
supp_nation,
cust_nation,
l_year
ORDER BY
supp_nation,
cust_nation,
l_year;
```

Q8

```
SELECT
o_year,
sum(case
when nation = 'BRAZIL' then volume
else 0
end) / sum(volume) as mkt_share
FROM
(
SELECT
extract(year FROM o_orderdate) as o_year,
l_extendedprice * (1 - l_discount) as volume,
n2.n_name as nation
FROM
part,
supplier,
lineitem,
orders,
customer,
nation n1,
nation n2,
region
WHERE
p_partkey = l_partkey
and s_suppkey = l_suppkey
and l_orderkey = o_orderkey
and o_custkey = c_custkey
and c_nationkey = n1.n_nationkey
and n1.n_regionkey = r_regionkey
and r_name = 'AMERICA'
and s_nationkey = n2.n_nationkey
and o_orderdate between date '1995-01-01' and date '1996-12-31'
and p_type = 'ECONOMY ANODIZED STEEL'
) as all_nations
GROUP BY
o_year
ORDER BY
o_year;
```

Q9

```
SELECT
nation,
o_year,
```

```

sum(amount) as sum_profit
FROM
(
SELECT
n_name as nation,
extract(year FROM o_orderdate) as o_year,
L_extendedprice * (1 - L_discount) - ps_supplycost * L_quantity as amount
FROM
part,
supplier,
lineitem,
partsupp,
orders,
nation
WHERE
s_suppkey = L_suppkey
and ps_suppkey = L_suppkey
and ps_partkey = L_partkey
and p_partkey = L_partkey
and o_orderkey = L_orderkey
and s_nationkey = n_nationkey
and p_name like '%green%'
) as profit
GROUP BY
nation,
o_year
ORDER BY
nation,
o_year desc;

```

Q10

```

SELECT
c_custkey,
c_name,
sum(L_extendedprice * (1 - L_discount)) as revenue,
c_acctbal,
n_name,
c_address,
c_phone,
c_comment
FROM
customer,
orders,
lineitem,
nation
WHERE
c_custkey = o_custkey
and l_orderkey = o_orderkey
and o_orderdate >= date '1993-10-01'
and o_orderdate < date '1993-10-01' + interval '3' month
and l_returnflag = 'R'
and c_nationkey = n_nationkey
GROUP BY
c_custkey,
c_name,
c_acctbal,
c_phone,
n_name,
c_address,
c_comment
ORDER BY
revenue desc
LIMIT 20;

```

Q11

```

SELECT
ps_partkey,

```

```

sum(ps_supplycost * ps_availqty) as value
FROM
partsupp,
supplier,
nation
WHERE
ps_suppkey = s_suppkey
and s_nationkey = n_nationkey
and n_name = 'GERMANY'
GROUP BY
ps_partkey having
sum(ps_supplycost * ps_availqty) > (
SELECT
sum(ps_supplycost * ps_availqty) * 0.0000001000
FROM
partsupp,
supplier,
nation
WHERE
ps_suppkey = s_suppkey
and s_nationkey = n_nationkey
and n_name = 'GERMANY'
)
ORDER BY
value desc;

```

Q12

```

SELECT
l_shipmode,
sum(case
when o_orderpriority = '1-URGENT'
or o_orderpriority = '2-HIGH'
then 1
else 0
end) as high_line_count,
sum(case
when o_orderpriority <> '1-URGENT'
and o_orderpriority <> '2-HIGH'
then 1
else 0
end) as low_line_count
FROM
orders,
lineitem
WHERE
o_orderkey = l_orderkey
and l_shipmode in ('MAIL', 'SHIP')
and l_commitdate < l_receiptdate
and l_shipdate < l_commitdate
and l_receiptdate >= date '1994-01-01'
and l_receiptdate < date '1994-01-01' + interval '1' year
GROUP BY
l_shipmode
ORDER BY
l_shipmode;

```

Q13

```

SELECT
c_count,
count(*) as custdist
FROM
(
SELECT
c_custkey,
count(o_orderkey)
FROM
customer left outer join orders on

```

```
c_custkey = o_custkey
and o_comment not like '%special%requests%'
GROUP BY
c_custkey
) as c_orders (c_custkey, c_count)
GROUP BY
c_count
ORDER BY
custdist desc,
c_count desc;
```

Q14

```
SELECT
100.00 * sum(case
when p_type like 'PROMO%'
then l_extendedprice * (1 - l_discount)
else 0
end) / sum(l_extendedprice * (1 - l_discount)) as promo_revenue
FROM
lineitem,
part
WHERE
l_partkey = p_partkey
and l_shipdate >= date '1995-09-01'
and l_shipdate < date '1995-09-01' + interval '1' month;
```

Q15

```
WITH revenue (supplier_no, total_revenue) as
(
SELECT
l_suppkey,
sum(l_extendedprice * (1 - l_discount))
FROM
lineitem
WHERE
l_shipdate >= date '1996-01-01'
and l_shipdate < date '1996-01-01' + interval '3 month'
GROUP BY
l_suppkey
)
SELECT
s_suppkey,
s_name,
s_address,
s_phone,
total_revenue
FROM
supplier,
revenue
WHERE
s_suppkey = supplier_no
and total_revenue = (
SELECT
max(total_revenue)
FROM
revenue
)
ORDER BY
s_suppkey;
```

Q16

```
SELECT
p_brand,
p_type,
p_size,
```



```

count(distinct ps_suppkey) as supplier_cnt
FROM
partsupp,
part
WHERE
p_partkey = ps_partkey
and p_brand <> 'Brand#45'
and p_type not like 'MEDIUM POLISHED%'
and p_size in (49, 14, 23, 45, 19, 3, 36, 9)
and ps_suppkey not in (
SELECT
s_suppkey
FROM
supplier
WHERE
s_comment like '%Customer%Complaints%'
)
GROUP BY
p_brand,
p_type,
p_size
ORDER BY
supplier_cnt desc,
p_brand,
p_type,
p_size
LIMIT 100;

```

Q17

```

SELECT
sum(L_extendedprice) / 7.0 as avg_yearly
FROM
lineitem,
part
WHERE
p_partkey = l_partkey
and p_brand = 'Brand#23'
and p_container = 'MED BOX'
and l_quantity < (
SELECT
0.2 * avg(L_quantity)
FROM
lineitem
WHERE
l_partkey = p_partkey
);

```

Q18

```

SELECT
c_name,
c_custkey,
o_orderkey,
o_orderdate,
o_totalprice,
sum(l_quantity)
FROM
customer,
orders,
lineitem
WHERE
o_orderkey in (
SELECT
l_orderkey
FROM
lineitem
GROUP BY
l_orderkey having

```

```

sum(L_quantity) > 300
)
and c_custkey = o_custkey
and o_orderkey = L_orderkey
GROUP BY
c_name,
c_custkey,
o_orderkey,
o_orderdate,
o_totalprice
ORDER BY
o_totalprice desc,
o_orderdate
LIMIT 100;

```

Q19

```

SELECT
sum(L_extendedprice* (1 - L_discount)) as revenue
FROM
lineitem,
part
WHERE
(
p_partkey = L_partkey
and p_brand = 'Brand#12'
and p_container in ('SM CASE', 'SM BOX', 'SM PACK', 'SM PKG')
and L_quantity >= 1 and L_quantity <= 1 + 10
and p_size between 1 and 5
and L_shipmode in ('AIR', 'AIR REG')
and L_shipinstruct = 'DELIVER IN PERSON'
)
or
(
p_partkey = L_partkey
and p_brand = 'Brand#23'
and p_container in ('MED BAG', 'MED BOX', 'MED PKG', 'MED PACK')
and L_quantity >= 10 and L_quantity <= 10 + 10
and p_size between 1 and 10
and L_shipmode in ('AIR', 'AIR REG')
and L_shipinstruct = 'DELIVER IN PERSON'
)
or
(
p_partkey = L_partkey
and p_brand = 'Brand#34'
and p_container in ('LG CASE', 'LG BOX', 'LG PACK', 'LG PKG')
and L_quantity >= 20 and L_quantity <= 20 + 10
and p_size between 1 and 15
and L_shipmode in ('AIR', 'AIR REG')
and L_shipinstruct = 'DELIVER IN PERSON'
);

```

Q20

```

SELECT
s_name,
s_address
FROM
supplier,
nation
WHERE
s_suppkey in (
SELECT
ps_suppkey
FROM
partsupp
WHERE
ps_partkey in (

```

```
SELECT
p_partkey
FROM
part
WHERE
p_name like 'forest%'
)
and ps_availqty > (
SELECT
0.5 * sum(L_quantity)
FROM
lineitem
WHERE
L_partkey = ps_partkey
and L_suppkey = ps_suppkey
and L_shipdate >= date '1994-01-01'
and L_shipdate < date '1994-01-01' + interval '1' year
)
)
and s_nationkey = n_nationkey
and n_name = 'CANADA'
ORDER BY
s_name;
```

Q21

```
SELECT
s_name,
count(*) as numwait
FROM
supplier,
lineitem l1,
orders,
nation
WHERE
s_suppkey = l1.l_suppkey
and o_orderkey = l1.l_orderkey
and o_orderstatus = 'F'
and l1.l_receiptdate > l1.l_commitdate
and exists (
SELECT
*
FROM
lineitem l2
WHERE
l2.l_orderkey = l1.l_orderkey
and l2.l_suppkey <> l1.l_suppkey
)
AND NOT EXISTS(
SELECT
*
FROM
lineitem l3
WHERE
l3.l_orderkey = l1.l_orderkey
and l3.l_suppkey <> l1.l_suppkey
and l3.l_receiptdate > l3.l_commitdate
)
and s_nationkey = n_nationkey
and n_name = 'SAUDI ARABIA'
GROUP BY
s_name
ORDER BY
numwait desc,
s_name
LIMIT 100;
```

Q22

```
SELECT
  cntrycode,
  count(*) as numcust,
  sum(c_acctbal) as totacctbal
FROM
  (
    SELECT
      substring(c_phone FROM 1 for 2) as cntrycode,
      c_acctbal
    FROM
      customer
    WHERE
      substring(c_phone FROM 1 for 2) in
      ('13', '31', '23', '29', '30', '18', '17')
      and c_acctbal > (
        SELECT
          avg(c_acctbal)
        FROM
          customer
        WHERE
          c_acctbal > 0.00
          and substring(c_phone FROM 1 for 2) in
          ('13', '31', '23', '29', '30', '18', '17')
        )
    AND NOT EXISTS(
      SELECT
        *
      FROM
        orders
      WHERE
        o_custkey = c_custkey
    )
  ) as custsale
GROUP BY
  cntrycode
ORDER BY
  cntrycode;
```

4 TPC-DS 性能测试

4.1 TPC-DS 测试结果

本测试主要包括使用存算一体和存算分离两种部署架构下，TPC-DS 1T规模数据集的開箱查询性能，共99个查询。存算一体查询总耗时为622.21s，存算分离查询总耗时为645.42s。详细结果见下表。

表 4-1 TPC-DS 测试结果

TPC-DS查询	8.3.0	9.1.0.210	
	存算一体 (s)	存算一体 (s)	存算分离 (s)
-			
Q1	2.03	0.513	0.546
Q2	9.14	4.036	4.286
Q3	1.52	1.228	1.426
Q4	200.44	125.877	122.118
Q5	3.11	1.403	1.509
Q6	0.39	0.399	0.366
Q7	1.85	1.665	2.227
Q8	0.72	0.481	0.483
Q9	11.14	13.604	12.354
Q10	1.08	0.711	0.876
Q11	92.20	62.143	63.736
Q12	0.20	0.131	0.132
Q13	2.50	3.502	3.853
Q14	74.98	17.622	18.407

TPC-DS查询	8.3.0	9.1.0.210	
Q15	2.11	0.412	0.434
Q16	6.51	3.148	3.256
Q17	2.93	1.168	2.618
Q18	2.16	1.191	1.443
Q19	0.70	0.665	0.771
Q20	0.18	0.108	0.086
Q21	0.18	0.084	0.084
Q22	5.84	1.089	1.286
Q23	144.71	85.005	90.962
Q24	8.55	9.033	9.438
Q25	3.10	1.262	2.580
Q26	0.63	0.449	0.516
Q27	2.03	1.739	2.219
Q28	13.32	6.293	6.623
Q29	2.50	2.049	2.364
Q30	0.73	0.404	0.402
Q31	3.73	3.045	2.902
Q32	0.18	0.089	0.096
Q33	1.28	0.821	0.815
Q34	2.13	2.653	3.011
Q35	3.00	2.132	1.743
Q36	6.21	1.766	1.971
Q37	0.34	0.231	0.268
Q38	52.24	10.150	11.110
Q39	5.57	5.057	5.475
Q40	0.66	0.128	0.126
Q41	0.04	0.036	0.033
Q42	0.70	0.389	0.436
Q43	1.99	1.256	1.410
Q44	3.25	2.218	2.381

TPC-DS查询	8.3.0	9.1.0.210	
Q45	0.82	0.399	0.404
Q46	4.63	3.569	4.154
Q47	6.91	4.542	5.156
Q48	2.37	3.129	3.508
Q49	3.01	2.291	2.478
Q50	5.82	3.694	4.204
Q51	10.67	4.368	4.630
Q52	0.70	0.384	0.457
Q53	0.88	0.715	0.794
Q54	3.96	0.609	4.123
Q55	0.66	0.402	0.421
Q56	0.84	0.751	0.707
Q57	3.12	1.643	1.826
Q58	0.76	0.548	0.449
Q59	17.30	8.824	9.302
Q60	1.75	0.920	0.988
Q61	1.10	0.980	1.013
Q62	1.29	0.813	0.779
Q63	0.86	0.697	0.799
Q64	14.20	6.504	7.643
Q65	6.92	3.988	3.630
Q66	1.50	1.018	1.077
Q67	153.90	54.645	56.221
Q68	3.65	2.764	3.395
Q69	0.93	0.720	0.689
Q70	23.13	3.016	3.255
Q71	2.33	2.211	2.196
Q72	3.69	2.270	2.521
Q73	1.40	1.743	2.068
Q74	37.27	34.956	29.475

TPC-DS查询	8.3.0	9.1.0.210	
Q75	11.85	5.517	5.769
Q76	3.37	2.364	2.730
Q77	1.30	1.112	1.141
Q78	152.21	12.058	14.874
Q79	4.49	3.766	4.449
Q80	3.56	1.696	1.770
Q81	0.64	0.390	0.409
Q82	0.75	0.655	0.735
Q83	0.15	0.085	0.216
Q84	0.24	0.221	0.234
Q85	2.78	1.151	1.512
Q86	2.59	0.345	0.364
Q87	78.17	10.557	11.300
Q88	6.90	9.081	9.688
Q89	2.61	0.918	1.058
Q90	0.64	0.569	0.787
Q91	0.15	0.135	0.114
Q92	0.20	0.118	0.127
Q93	7.53	3.977	4.413
Q94	3.49	1.746	2.109
Q95	29.57	27.629	25.971
Q96	1.49	1.844	2.062
Q97	8.49	3.341	3.674
Q98	1.09	0.938	0.865
Q99	2.37	1.503	1.516
SUM	1321.757	645.424	622.214

4.2 TPC-DS 测试环境

硬件环境

每个测试环境6个节点，配置如下：

- CPU 16核：Intel Ice Lake
- 内存：64GB
- 网络带宽：9Gbit/s
- 磁盘：SSD云盘，每块600GB，共2块

软件环境

- 内核版本：Linux 3.10.0-862.14.1.5.h757.eulerosv2r7.x86_64
- 操作系统：EulerOS release 2.0 (SP5)
- 数据库版本：DWS 3.0

4.3 TPC-DS 测试过程

4.3.1 TPC-DS 测试数据

表 4-2 TPC-DS 测试数据

序号	表名	行数	表大小
1	customer_address	6,000,000	126MB
2	customer_demographics	1,920,800	11MB
3	date_dim	73,049	11MB
4	warehouse	20	1200KB
5	ship_mode	20	864KB
6	time_dim	86,400	1520KB
7	reason	65	720KB
8	income_band	20	720KB
9	item	300,000	23MB
10	store	1,002	2400KB
11	call_center	42	1968KB
12	customer	12,000,000	519MB

序号	表名	行数	表大小
13	web_site	54	1824KB
14	household_demographics	7,200	1208KB
15	web_page	3,000	2208KB
16	promotion	1,500	2112KB
17	catalog_page	30,000	3536KB
18	inventory	783,000,000	2499MB
19	catalog_returns	143,996,756	8454MB
20	web_returns	71,997,522	3990MB
21	store_returns	287,999,764	13GB
22	web_sales	720,000,376	54GB
23	catalog_sales	1,439,980,416	104GB
24	store_sales	2,879,987,999	142GB

4.3.2 TPC-DS 数据生成

步骤1 登录ECS云服务器，执行如下命令创建TPC-DS存放目录。

```
mkdir -p /data1/script/tpcds-kit/tpcds1000X
mkdir -p /data2/script/tpcds-kit/tpcds1000X
```

步骤2 从[官网](#)获取TPC-DS数据构建工具dsdgen最新版本，并通过SFTP工具上传到ECS的/data1/script/tpcds-kit目录。

步骤3 执行如下命令解压tpcds的包并编译生成数据构建工具dsdgen。

“tpcds_3.2.0.zip” 替换为实际的软件包名。

“DSGen-software-code-3.2.0rc1” 替换为实际解压的文件夹名。

```
cd /data1/script/tpcds-kit && unzip tpcds_3.2.0.zip
cd DSGen-software-code-3.2.0rc1/tools && make
```

步骤4 进入/data1/script/tpcds-kit/DSGen-software-code-3.2.0rc1/tools目录后，执行以下命令生成数据。

```
for c in {1..5};do (./dsdgen -scale 1000 -dir /data1/script/tpcds-kit/tpcds1000X -TERMINATE N -parallel 10 -child ${c} -force Y > /dev/null 2>&1 &);done
for c in {6..10};do (./dsdgen -scale 1000 -dir /data2/script/tpcds-kit/tpcds1000X -TERMINATE N -parallel 10 -child ${c} -force Y > /dev/null 2>&1 &);done
```

其中：

- -scale 指定数据规模，本例为1000。
- -dir 指定生成数据文件存放的目录，本例为/data1/script/tpcds-kit/tpcds1000X/data2/script/tpcds-kit/tpcds1000X。

- -TERMINATE 控制每行记录的末尾是否需要分隔符。
- -parallel 指定分片数，本例为10片。
- -child 指定当前是生成分片中的第几片，本例不需修改。

步骤5 执行以下命令，判断数据文件的生成进度。也可以通过`ps ux|grep dsdgen`，查看生成数据文件的进程是否退出。

```
du -sh /data1/script/tpcds-kit/tpcds1000X/*.dat
du -sh /data2/script/tpcds-kit/tpcds1000X/*.dat
```

----结束

4.3.3 建表与导入 TPC-DS 数据

创建 TPC-DS 目标表

连接DWS数据库后执行以下SQL语句。

```
CREATE TABLE customer_address
(
  ca_address_sk      integer      not null,
  ca_address_id     varchar(16)   not null,
  ca_street_number  varchar(10)   ,
  ca_street_name    varchar(60)   ,
  ca_street_type    varchar(15)   ,
  ca_suite_number   varchar(10)   ,
  ca_city           varchar(60)   ,
  ca_county         varchar(30)   ,
  ca_state          varchar(2)    ,
  ca_zip            varchar(10)   ,
  ca_country        varchar(20)   ,
  ca_gmt_offset     decimal(5,2)  ,
  ca_location_type  varchar(20)
) WITH (orientation = column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384,secondary_part_column='ca_address_sk',secondary_part_num=72)
DISTRIBUTE BY hash (ca_address_sk);

CREATE TABLE customer_demographics
(
  cd_demo_sk        integer      not null,
  cd_gender         varchar(1)    ,
  cd_marital_status varchar(1)    ,
  cd_education_status varchar(20) ,
  cd_purchase_estimate integer    ,
  cd_credit_rating  varchar(10)   ,
  cd_dep_count      integer      ,
  cd_dep_employed_count integer    ,
  cd_dep_college_count integer
) WITH (orientation = column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384,secondary_part_column='cd_demo_sk',secondary_part_num=72)
DISTRIBUTE BY hash (cd_demo_sk);

CREATE TABLE date_dim
(
  d_date_sk      integer      not null,
  d_date_id     varchar(16)   not null,
  d_date        date          ,
  d_month_seq   integer      ,
  d_week_seq    integer      ,
  d_quarter_seq integer      ,
  d_year        integer      ,
  d_dow         integer      ,
  d_moy         integer      ,
  d_dom         integer      ,
```

```

d_qoy          integer          ,
d_fy_year      integer          ,
d_fy_quarter_seq integer        ,
d_fy_week_seq integer          ,
d_day_name     varchar(9)       ,
d_quarter_name varchar(6)       ,
d_holiday     varchar(1)        ,
d_weekend     varchar(1)        ,
d_following_holiday varchar(1)  ,
d_first_dom   integer          ,
d_last_dom    integer          ,
d_same_day_ly integer          ,
d_same_day_lq integer          ,
d_current_day varchar(1)        ,
d_current_week varchar(1)       ,
d_current_month varchar(1)      ,
d_current_quarter varchar(1)   ,
d_current_year varchar(1)      ,
) WITH (orientation = column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384,secondary_part_column='d_date_sk',secondary_part_num=72)
DISTRIBUTE BY hash (d_date_sk)
PARTITION BY Range(d_year) (
partition p1 values less than(1950),
partition p2 values less than(2000),
partition p3 values less than(2050),
partition p4 values less than(2100),
partition p5 values less than(3000),
partition p6 values less than(maxvalue)
);

CREATE TABLE warehouse
(
w_warehouse_sk integer          not null,
w_warehouse_id varchar(16)      not null,
w_warehouse_name varchar(20)    ,
w_warehouse_sq_ft integer        ,
w_street_number varchar(10)     ,
w_street_name varchar(60)       ,
w_street_type varchar(15)       ,
w_suite_number varchar(10)      ,
w_city varchar(60)              ,
w_county varchar(30)            ,
w_state varchar(2)              ,
w_zip varchar(10)               ,
w_country varchar(20)           ,
w_gmt_offset decimal(5,2)
)
WITH (orientation = column, colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384)
DISTRIBUTE BY replication;

CREATE TABLE ship_mode
(
sm_ship_mode_sk integer          not null,
sm_ship_mode_id varchar(16)      not null,
sm_type varchar(30)              ,
sm_code varchar(10)              ,
sm_carrier varchar(20)           ,
sm_contract varchar(20)
)
WITH (orientation = column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384)
DISTRIBUTE BY replication;

CREATE TABLE time_dim
(
t_time_sk integer          not null,
t_time_id varchar(16)      not null,
t_time integer

```

```

t_hour          integer          ,
t_minute        integer          ,
t_second        integer          ,
t_am_pm         varchar(2)       ,
t_shift         varchar(20)      ,
t_sub_shift     varchar(20)      ,
t_meal_time     varchar(20)
)
WITH (orientation = column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384,secondary_part_column='t_time_sk',secondary_part_num=72)
DISTRIBUTE BY hash (t_time_sk);

CREATE TABLE reason
(
r_reason_sk     integer          not null,
r_reason_id     varchar(16)      not null,
r_reason_desc   varchar(100)
)
WITH (orientation = column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384)
DISTRIBUTE BY replication;

CREATE TABLE income_band
(
ib_income_band_sk integer      not null,
ib_lower_bound   integer
,
ib_upper_bound   integer
)
WITH (orientation = column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384)
DISTRIBUTE BY replication;

CREATE TABLE item
(
i_item_sk       integer          not null,
i_item_id       varchar(16)      not null,
i_rec_start_date date            ,
i_rec_end_date  date            ,
i_item_desc     varchar(200)    ,
i_current_price decimal(7,2)    ,
i_wholesale_cost decimal(7,2)   ,
i_brand_id     integer          ,
i_brand         varchar(50)     ,
i_class_id     integer          ,
i_class        varchar(50)     ,
i_category_id  integer          ,
i_category     varchar(50)     ,
i_manufact_id  integer          ,
i_manufact     varchar(50)     ,
i_size         varchar(20)     ,
i_formulation  varchar(20)     ,
i_color        varchar(20)     ,
i_units        varchar(10)     ,
i_container    varchar(10)     ,
i_manager_id   integer          ,
i_product_name varchar(50)
)
WITH (orientation = column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384,secondary_part_column='i_item_sk',secondary_part_num=72)
DISTRIBUTE BY hash (i_item_sk);

CREATE TABLE store
(
s_store_sk      integer          not null,
s_store_id     varchar(16)      not null,
s_rec_start_date date            ,
s_rec_end_date  date            ,

```

```

s_closed_date_sk      integer      ,
s_store_name          varchar(50)    ,
s_number_employees   integer      ,
s_floor_space         integer      ,
s_hours              varchar(20)   ,
s_manager            varchar(40)   ,
s_market_id          integer      ,
s_geography_class    varchar(100)  ,
s_market_desc        varchar(100)  ,
s_market_manager     varchar(40)   ,
s_division_id        integer      ,
s_division_name      varchar(50)   ,
s_company_id         integer      ,
s_company_name       varchar(50)   ,
s_street_number      varchar(10)   ,
s_street_name        varchar(60)   ,
s_street_type        varchar(15)   ,
s_suite_number       varchar(10)   ,
s_city               varchar(60)   ,
s_county             varchar(30)   ,
s_state              varchar(2)    ,
s_zip                varchar(10)   ,
s_country            varchar(20)   ,
s_gmt_offset         decimal(5,2)  ,
s_tax_percentage     decimal(5,2)  ,
)
WITH (orientation = column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384)
DISTRIBUTE BY replication;

CREATE TABLE call_center
(
cc_call_center_sk     integer      not null,
cc_call_center_id    varchar(16)   not null,
cc_rec_start_date     date          ,
cc_rec_end_date       date          ,
cc_closed_date_sk    integer      ,
cc_open_date_sk       integer      ,
cc_name              varchar(50)   ,
cc_class             varchar(50)   ,
cc_employees         integer      ,
cc_sq_ft             integer      ,
cc_hours             varchar(20)   ,
cc_manager           varchar(40)   ,
cc_mkt_id            integer      ,
cc_mkt_class         varchar(50)   ,
cc_mkt_desc          varchar(100)  ,
cc_market_manager    varchar(40)   ,
cc_division          integer      ,
cc_division_name     varchar(50)   ,
cc_company           integer      ,
cc_company_name      varchar(50)   ,
cc_street_number     varchar(10)   ,
cc_street_name       varchar(60)   ,
cc_street_type       varchar(15)   ,
cc_suite_number      varchar(10)   ,
cc_city              varchar(60)   ,
cc_county            varchar(30)   ,
cc_state             varchar(2)    ,
cc_zip              varchar(10)   ,
cc_country           varchar(20)   ,
cc_gmt_offset        decimal(5,2)  ,
cc_tax_percentage    decimal(5,2)  ,
)
WITH (orientation = column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384)
DISTRIBUTE BY replication;

CREATE TABLE customer

```

```
(
  c_customer_sk      integer      not null,
  c_customer_id      varchar(16)    not null,
  c_current_cdemo_sk integer          ,
  c_current_hdemo_sk integer        ,
  c_current_addr_sk  integer        ,
  c_first_shipto_date_sk integer     ,
  c_first_sales_date_sk integer     ,
  c_salutation       varchar(10)    ,
  c_first_name       varchar(20)    ,
  c_last_name        varchar(30)    ,
  c_preferred_cust_flag varchar(1)  ,
  c_birth_day        integer        ,
  c_birth_month      integer        ,
  c_birth_year       integer        ,
  c_birth_country    varchar(20)    ,
  c_login            varchar(13)    ,
  c_email_address    varchar(50)    ,
  c_last_review_date varchar(10)
)
WITH (orientation = column,
      colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384,secondary_part_column='c_customer_sk',secondary_part_num=72)
DISTRIBUTE BY hash (c_customer_sk);

CREATE TABLE web_site
(
  web_site_sk      integer      not null,
  web_site_id      varchar(16)    not null,
  web_rec_start_date date        ,
  web_rec_end_date date        ,
  web_name         varchar(50)    ,
  web_open_date_sk integer        ,
  web_close_date_sk integer      ,
  web_class        varchar(50)    ,
  web_manager      varchar(40)    ,
  web_mkt_id       integer        ,
  web_mkt_class    varchar(50)    ,
  web_mkt_desc     varchar(100)   ,
  web_market_manager varchar(40)  ,
  web_company_id   integer        ,
  web_company_name varchar(50)    ,
  web_street_number varchar(10)   ,
  web_street_name  varchar(60)    ,
  web_street_type  varchar(15)    ,
  web_suite_number varchar(10)    ,
  web_city         varchar(60)    ,
  web_county       varchar(30)    ,
  web_state        varchar(2)     ,
  web_zip          varchar(10)    ,
  web_country      varchar(20)    ,
  web_gmt_offset   decimal(5,2)   ,
  web_tax_percentage decimal(5,2)
)
WITH (orientation = column,
      colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384)
DISTRIBUTE BY replication;

CREATE TABLE household_demographics
(
  hd_demo_sk      integer      not null,
  hd_income_band_sk integer      ,
  hd_buy_potential varchar(15)   ,
  hd_dep_count    integer      ,
  hd_vehicle_count integer
)
WITH (orientation = column,
      colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384,secondary_part_column='hd_demo_sk',secondary_part_num=72)
```

```

DISTRIBUTE BY hash (hd_demo_sk);

CREATE TABLE web_page
(
  wp_web_page_sk      integer      not null,
  wp_web_page_id     varchar(16)   not null,
  wp_rec_start_date  date          ,
  wp_rec_end_date    date          ,
  wp_creation_date_sk integer      ,
  wp_access_date_sk  integer      ,
  wp_autogen_flag    varchar(1)   ,
  wp_customer_sk     integer      ,
  wp_url             varchar(100)  ,
  wp_type            varchar(50)   ,
  wp_char_count      integer      ,
  wp_link_count      integer      ,
  wp_image_count     integer      ,
  wp_max_ad_count    integer
)
WITH (orientation = column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384)
DISTRIBUTE BY replication;

CREATE TABLE promotion
(
  p_promo_sk         integer      not null,
  p_promo_id        varchar(16)   not null,
  p_start_date_sk   integer      ,
  p_end_date_sk     integer      ,
  p_item_sk         integer      ,
  p_cost            decimal(15,2) ,
  p_response_target integer      ,
  p_promo_name      varchar(50)   ,
  p_channel_dmail   varchar(1)   ,
  p_channel_email   varchar(1)   ,
  p_channel_catalog varchar(1)   ,
  p_channel_tv      varchar(1)   ,
  p_channel_radio   varchar(1)   ,
  p_channel_press   varchar(1)   ,
  p_channel_event   varchar(1)   ,
  p_channel_demo    varchar(1)   ,
  p_channel_details varchar(100)  ,
  p_purpose           varchar(15)   ,
  p_discount_active varchar(1)
)
WITH (orientation = column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384)
DISTRIBUTE BY replication;

CREATE TABLE catalog_page
(
  cp_catalog_page_sk integer      not null,
  cp_catalog_page_id varchar(16)   not null,
  cp_start_date_sk   integer      ,
  cp_end_date_sk     integer      ,
  cp_department      varchar(50)   ,
  cp_catalog_number  integer      ,
  cp_catalog_page_number integer    ,
  cp_description     varchar(100)  ,
  cp_type            varchar(100)
)
WITH (orientation = column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384,secondary_part_column='cp_c
atalog_page_sk',secondary_part_num=72)
DISTRIBUTE BY hash (cp_catalog_page_sk);

CREATE TABLE inventory
(
  inv_date_sk      integer      not null,

```



```

    inv_item_sk      integer      not null,
    inv_warehouse_sk integer      not null,
    inv_quantity_on_hand integer
)
WITH (orientation = column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384,secondary_part_column='inv_i
tem_sk',secondary_part_num=72)
DISTRIBUTE BY hash (inv_item_sk)
partition by range(inv_date_sk)
(
    partition p1 values less than(2451179),
    partition p2 values less than(2451544),
    partition p3 values less than(2451910),
    partition p4 values less than(2452275),
    partition p5 values less than(2452640),
    partition p6 values less than(2453005),
    partition p7 values less than(maxvalue)
)
);

CREATE TABLE catalog_returns
(
    cr_returned_date_sk      integer      ,
    cr_returned_time_sk     integer      ,
    cr_item_sk              integer      not null,
    cr_refunded_customer_sk integer      ,
    cr_refunded_cdemo_sk    integer      ,
    cr_refunded_hdemo_sk    integer      ,
    cr_refunded_addr_sk     integer      ,
    cr_returning_customer_sk integer      ,
    cr_returning_cdemo_sk   integer      ,
    cr_returning_hdemo_sk   integer      ,
    cr_returning_addr_sk    integer      ,
    cr_call_center_sk       integer      ,
    cr_catalog_page_sk      integer      ,
    cr_ship_mode_sk         integer      ,
    cr_warehouse_sk         integer      ,
    cr_reason_sk            integer      ,
    cr_order_number         bigint      not null,
    cr_return_quantity      integer      ,
    cr_return_amount        decimal(7,2) ,
    cr_return_tax           decimal(7,2) ,
    cr_return_amt_inc_tax   decimal(7,2) ,
    cr_fee                  decimal(7,2) ,
    cr_return_ship_cost     decimal(7,2) ,
    cr_refunded_cash        decimal(7,2) ,
    cr_reversed_charge      decimal(7,2) ,
    cr_store_credit         decimal(7,2) ,
    cr_net_loss             decimal(7,2)
)
WITH (orientation = column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384,secondary_part_column='cr_it
em_sk',secondary_part_num=72)
DISTRIBUTE BY hash (cr_item_sk)
partition by range(cr_returned_date_sk)
(
    partition p1 values less than(2450815),
    partition p2 values less than(2451179),
    partition p3 values less than(2451544),
    partition p4 values less than(2451910),
    partition p5 values less than(2452275),
    partition p6 values less than(2452640),
    partition p7 values less than(2453005),
    partition p8 values less than(maxvalue)
)
);

CREATE TABLE web_returns
(

```

```

wr_returned_date_sk integer ,
wr_returned_time_sk integer ,
wr_item_sk integer not null,
wr_refunded_customer_sk integer ,
wr_refunded_cdemo_sk integer ,
wr_refunded_hdemo_sk integer ,
wr_refunded_addr_sk integer ,
wr_returning_customer_sk integer ,
wr_returning_cdemo_sk integer ,
wr_returning_hdemo_sk integer ,
wr_returning_addr_sk integer ,
wr_web_page_sk integer ,
wr_reason_sk integer ,
wr_order_number bigint not null,
wr_return_quantity integer ,
wr_return_amt decimal(7,2) ,
wr_return_tax decimal(7,2) ,
wr_return_amt_inc_tax decimal(7,2) ,
wr_fee decimal(7,2) ,
wr_return_ship_cost decimal(7,2) ,
wr_refunded_cash decimal(7,2) ,
wr_reversed_charge decimal(7,2) ,
wr_account_credit decimal(7,2) ,
wr_net_loss decimal(7,2)
)
WITH (orientation = column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384,secondary_part_column='wr_item_sk',secondary_part_num=72)
DISTRIBUTE BY hash (wr_item_sk)
partition by range(wr_returned_date_sk)
(
partition p1 values less than(2450815),
partition p2 values less than(2451179),
partition p3 values less than(2451544),
partition p4 values less than(2451910),
partition p5 values less than(2452275),
partition p6 values less than(2452640),
partition p7 values less than(2453005),
partition p8 values less than(maxvalue)
)
);

CREATE TABLE store_returns
(
sr_returned_date_sk integer ,
sr_return_time_sk integer ,
sr_item_sk integer not null,
sr_customer_sk integer ,
sr_cdemo_sk integer ,
sr_hdemo_sk integer ,
sr_addr_sk integer ,
sr_store_sk integer ,
sr_reason_sk integer ,
sr_ticket_number bigint not null,
sr_return_quantity integer ,
sr_return_amt decimal(7,2) ,
sr_return_tax decimal(7,2) ,
sr_return_amt_inc_tax decimal(7,2) ,
sr_fee decimal(7,2) ,
sr_return_ship_cost decimal(7,2) ,
sr_refunded_cash decimal(7,2) ,
sr_reversed_charge decimal(7,2) ,
sr_store_credit decimal(7,2) ,
sr_net_loss decimal(7,2)
)
WITH (orientation = column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384,secondary_part_column='sr_item_sk',secondary_part_num=72)
DISTRIBUTE BY hash (sr_item_sk)

```

```

partition by range(sr_returned_date_sk)
(
  partition p1 values less than (2451179) ,
  partition p2 values less than (2451544) ,
  partition p3 values less than (2451910) ,
  partition p4 values less than (2452275) ,
  partition p5 values less than (2452640) ,
  partition p6 values less than (2453005) ,
  partition p7 values less than (maxvalue)
)
);

CREATE TABLE web_sales
(
  ws_sold_date_sk      integer      ,
  ws_sold_time_sk     integer      ,
  ws_ship_date_sk     integer      ,
  ws_item_sk          integer      not null,
  ws_bill_customer_sk integer      ,
  ws_bill_cdemo_sk    integer      ,
  ws_bill_hdemo_sk    integer      ,
  ws_bill_addr_sk     integer      ,
  ws_ship_customer_sk integer      ,
  ws_ship_cdemo_sk    integer      ,
  ws_ship_hdemo_sk    integer      ,
  ws_ship_addr_sk     integer      ,
  ws_web_page_sk      integer      ,
  ws_web_site_sk      integer      ,
  ws_ship_mode_sk     integer      ,
  ws_warehouse_sk    integer      ,
  ws_promo_sk         integer      ,
  ws_order_number     bigint      not null,
  ws_quantity         integer      ,
  ws_wholesale_cost   decimal(7,2) ,
  ws_list_price       decimal(7,2) ,
  ws_sales_price      decimal(7,2) ,
  ws_ext_discount_amt decimal(7,2) ,
  ws_ext_sales_price  decimal(7,2) ,
  ws_ext_wholesale_cost decimal(7,2) ,
  ws_ext_list_price   decimal(7,2) ,
  ws_ext_tax          decimal(7,2) ,
  ws_coupon_amt       decimal(7,2) ,
  ws_ext_ship_cost    decimal(7,2) ,
  ws_net_paid         decimal(7,2) ,
  ws_net_paid_inc_tax decimal(7,2) ,
  ws_net_paid_inc_ship decimal(7,2) ,
  ws_net_paid_inc_ship_tax decimal(7,2) ,
  ws_net_profit       decimal(7,2)
)
WITH (orientation = column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384,secondary_part_column='ws_i
tem_sk',secondary_part_num=72)
DISTRIBUTE BY hash (ws_item_sk)
partition by range(ws_sold_date_sk)
(
  partition p1 values less than(2451179),
  partition p2 values less than(2451544),
  partition p3 values less than(2451910),
  partition p4 values less than(2452275),
  partition p5 values less than(2452640),
  partition p6 values less than(2453005),
  partition p7 values less than(maxvalue)
)
);

CREATE TABLE catalog_sales
(
  cs_sold_date_sk      integer      ,
  cs_sold_time_sk     integer      ,

```

```

cs_ship_date_sk      integer      ,
cs_bill_customer_sk integer      ,
cs_bill_cdemo_sk    integer      ,
cs_bill_hdemo_sk    integer      ,
cs_bill_addr_sk     integer      ,
cs_ship_customer_sk integer      ,
cs_ship_cdemo_sk    integer      ,
cs_ship_hdemo_sk    integer      ,
cs_ship_addr_sk     integer      ,
cs_call_center_sk   integer      ,
cs_catalog_page_sk  integer      ,
cs_ship_mode_sk     integer      ,
cs_warehouse_sk     integer      ,
cs_item_sk          integer      not null,
cs_promo_sk         integer      ,
cs_order_number     bigint      not null,
cs_quantity         integer      ,
cs_wholesale_cost   decimal(7,2) ,
cs_list_price       decimal(7,2) ,
cs_sales_price      decimal(7,2) ,
cs_ext_discount_amt decimal(7,2) ,
cs_ext_sales_price  decimal(7,2) ,
cs_ext_wholesale_cost decimal(7,2) ,
cs_ext_list_price   decimal(7,2) ,
cs_ext_tax          decimal(7,2) ,
cs_coupon_amt       decimal(7,2) ,
cs_ext_ship_cost    decimal(7,2) ,
cs_net_paid         decimal(7,2) ,
cs_net_paid_inc_tax decimal(7,2) ,
cs_net_paid_inc_ship decimal(7,2) ,
cs_net_paid_inc_ship_tax decimal(7,2) ,
cs_net_profit       decimal(7,2)
)
WITH (orientation = column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384,secondary_part_column='cs_item_sk',secondary_part_num=72)
DISTRIBUTE BY hash (cs_item_sk)
partition by range(cs_sold_date_sk)
(
partition p1 values less than(2451179),
partition p2 values less than(2451544),
partition p3 values less than(2451910),
partition p4 values less than(2452275),
partition p5 values less than(2452640),
partition p6 values less than(2453005),
partition p7 values less than(maxvalue)
)
);

CREATE TABLE store_sales
(
ss_sold_date_sk      integer      ,
ss_sold_time_sk     integer      ,
ss_item_sk          integer      not null,
ss_customer_sk      integer      ,
ss_cdemo_sk         integer      ,
ss_hdemo_sk        integer      ,
ss_addr_sk         integer      ,
ss_store_sk         integer      ,
ss_promo_sk         integer      ,
ss_ticket_number     bigint      not null,
ss_quantity         integer      ,
ss_wholesale_cost   decimal(7,2) ,
ss_list_price       decimal(7,2) ,
ss_sales_price      decimal(7,2) ,
ss_ext_discount_amt decimal(7,2) ,
ss_ext_sales_price  decimal(7,2) ,
ss_ext_wholesale_cost decimal(7,2) ,
ss_ext_list_price   decimal(7,2) ,

```

```

    ss_ext_tax          decimal(7,2)      ,
    ss_coupon_amt      decimal(7,2)      ,
    ss_net_paid        decimal(7,2)      ,
    ss_net_paid_inc_tax decimal(7,2)      ,
    ss_net_profit      decimal(7,2)
)
WITH (orientation = column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,bucketnums=16384,secondary_part_column='ss_item_sk',secondary_part_num=72)
DISTRIBUTE BY hash (ss_item_sk)
partition by range(ss_sold_date_sk)
(
    partition p1 values less than(2451179),
    partition p2 values less than(2451544),
    partition p3 values less than(2451910),
    partition p4 values less than(2452275),
    partition p5 values less than(2452640),
    partition p6 values less than(2453005),
    partition p7 values less than(maxvalue)
)
;

```

创建 TPC-DS 数据集的 GDS 外表

连接DWS数据库后执行以下SQL语句。

须知

以下每个外表的“**gsfs://192.168.0.90:500x/xxx | gsfs://192.168.0.90:500x/xxx**”中的IP地址和端口，请替换成安装和启动GDS中的对应的GDS的监听IP和端口。如启动两个GDS，则使用“|”区分。如果启动多个GDS，需要将所有GDS的监听IP和端口配置到外表中。

```

DROP FOREIGN TABLE IF EXISTS customer_address_ext;
CREATE FOREIGN TABLE customer_address_ext
(
    ca_address_sk          bigint          ,
    ca_address_id         char(16)         ,
    ca_street_number      char(10)         ,
    ca_street_name        varchar(60)      ,
    ca_street_type        char(15)         ,
    ca_suite_number       char(10)         ,
    ca_city               varchar(60)      ,
    ca_county             varchar(30)      ,
    ca_state              char(2)          ,
    ca_zip                char(10)         ,
    ca_country            varchar(20)      ,
    ca_gmt_offset         decimal(5,2)     ,
    ca_location_type      char(20)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/customer_address.dat* | gsfs://192.168.0.90:5003/customer_address.dat*',
FORMAT 'TEXT',
DELIMITER '|',
encoding 'utf8',
mode 'Normal')
)WITH customer_address_err;
DROP FOREIGN TABLE IF EXISTS customer_demographics_ext;
CREATE FOREIGN TABLE customer_demographics_ext
(
    cd_demo_sk           bigint          ,
    cd_gender            char(1)          ,
    cd_marital_status    char(1)
)

```

```

cd_education_status char(20)
cd_purchase_estimate bigint
cd_credit_rating char(10)
cd_dep_count bigint
cd_dep_employed_count bigint
cd_dep_college_count bigint
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/customer_demographics.dat* | gsfs://192.168.0.90:5003/
customer_demographics.dat*',
FORMAT 'TEXT',
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
WITH customer_demographics_err
;
DROP FOREIGN TABLE IF EXISTS date_dim_ext;
CREATE FOREIGN TABLE date_dim_ext
(
d_date_sk bigint
d_date_id char(16)
d_date date
d_month_seq bigint
d_week_seq bigint
d_quarter_seq bigint
d_year bigint
d_dow bigint
d_moy bigint
d_dom bigint
d_qoy bigint
d_fy_year bigint
d_fy_quarter_seq bigint
d_fy_week_seq bigint
d_day_name char(9)
d_quarter_name char(6)
d_holiday char(1)
d_weekend char(1)
d_following_holiday char(1)
d_first_dom bigint
d_last_dom bigint
d_same_day_ly bigint
d_same_day_lq bigint
d_current_day char(1)
d_current_week char(1)
d_current_month char(1)
d_current_quarter char(1)
d_current_year char(1)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/date_dim.dat* | gsfs://192.168.0.90:5003/date_dim.dat*',
FORMAT 'TEXT',
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
WITH date_dim_err
;
DROP FOREIGN TABLE IF EXISTS warehouse_ext;
CREATE FOREIGN TABLE warehouse_ext
(
w_warehouse_sk bigint
w_warehouse_id char(16)
w_warehouse_name varchar(20)
w_warehouse_sq_ft bigint
w_street_number char(10)
w_street_name varchar(60)
w_street_type char(15)
w_suite_number char(10)
)

```

```

w_city          varchar(60)          ,
w_county        varchar(30)        ,
w_state         char(2)             ,
w_zip           char(10)            ,
w_country       varchar(20)         ,
w_gmt_offset    decimal(5,2)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/warehouse.dat* | gsfs://192.168.0.90:5003/warehouse.dat*',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
WITH warehouse_err
;
DROP FOREIGN TABLE IF EXISTS ship_mode_ext;
CREATE FOREIGN TABLE ship_mode_ext
(
sm_ship_mode_sk    bigint          ,
sm_ship_mode_id    char(16)         ,
sm_type            char(30)         ,
sm_code            char(10)         ,
sm_carrier         char(20)         ,
sm_contract        char(20)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/ship_mode.dat* | gsfs://192.168.0.90:5003/ship_mode.dat*',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
WITH ship_mode_err
;
DROP FOREIGN TABLE IF EXISTS time_dim_ext;
CREATE FOREIGN TABLE time_dim_ext
(
t_time_sk          bigint          ,
t_time_id          char(16)         ,
t_time             bigint          ,
t_hour             bigint          ,
t_minute           bigint          ,
t_second           bigint          ,
t_am_pm            char(2)          ,
t_shift            char(20)         ,
t_sub_shift        char(20)         ,
t_meal_time        char(20)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/time_dim.dat* | gsfs://192.168.0.90:5003/time_dim.dat*',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
WITH time_dim_err
;
DROP FOREIGN TABLE IF EXISTS reason_ext;
CREATE FOREIGN TABLE reason_ext
(
r_reason_sk        bigint          ,
r_reason_id        char(16)         ,
r_reason_desc      char(100)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/reason.dat* | gsfs://192.168.0.90:5003/reason.dat*',
FORMAT 'TEXT' ,
DELIMITER '|',

```

```

encoding 'utf8',
mode 'Normal'
)
)
WITH reason_err
;
DROP FOREIGN TABLE IF EXISTS income_band_ext;
CREATE FOREIGN TABLE income_band_ext
(
ib_income_band_sk      bigint      ,
ib_lower_bound         bigint      ,
ib_upper_bound         bigint
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/income_band.dat* | gsfs://192.168.0.90:5003/income_band.dat*',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
WITH income_band_err
;
DROP FOREIGN TABLE IF EXISTS item_ext;
CREATE FOREIGN TABLE item_ext
(
i_item_sk              bigint      ,
i_item_id              char(16)    ,
i_rec_start_date       date        ,
i_rec_end_date         date        ,
i_item_desc            varchar(200),
i_current_price        decimal(7,2),
i_wholesale_cost       decimal(7,2),
i_brand_id             bigint      ,
i_brand                char(50)    ,
i_class_id             bigint      ,
i_class                char(50)    ,
i_category_id          bigint      ,
i_category             char(50)    ,
i_manufact_id          bigint      ,
i_manufact             char(50)    ,
i_size                 char(20)    ,
i_formulation          char(20)    ,
i_color                char(20)    ,
i_units                char(10)    ,
i_container            char(10)    ,
i_manager_id           bigint      ,
i_product_name         char(50)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/item.dat* | gsfs://192.168.0.90:5003/item.dat*',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
WITH item_err
;
DROP FOREIGN TABLE IF EXISTS store_ext;
CREATE FOREIGN TABLE store_ext
(
s_store_sk             bigint      ,
s_store_id             char(16)    ,
s_rec_start_date       date        ,
s_rec_end_date         date        ,
s_closed_date_sk       bigint      ,
s_store_name           varchar(50) ,
s_number_employees     bigint      ,
s_floor_space          bigint      ,
s_hours                char(20)    ,
s_manager              varchar(40)
)

```



```

s_market_id      bigint
s_geography_class varchar(100)
s_market_desc    varchar(100)
s_market_manager varchar(40)
s_division_id    bigint
s_division_name  varchar(50)
s_company_id     bigint
s_company_name   varchar(50)
s_street_number  varchar(10)
s_street_name    varchar(60)
s_street_type    char(15)
s_suite_number   char(10)
s_city           varchar(60)
s_county         varchar(30)
s_state          char(2)
s_zip            char(10)
s_country        varchar(20)
s_gmt_offset     decimal(5,2)
s_tax_precentage decimal(5,2)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/store_[^rs]* | gsfs://192.168.0.90:5003/store_[^rs]*',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
WITH store_err
;
DROP FOREIGN TABLE IF EXISTS call_center_ext;
CREATE FOREIGN TABLE call_center_ext
(
cc_call_center_sk      bigint
cc_call_center_id     char(16)
cc_rec_start_date     date
cc_rec_end_date       date
cc_closed_date_sk     bigint
cc_open_date_sk       bigint
cc_name               varchar(50)
cc_class              varchar(50)
cc_employees          bigint
cc_sq_ft              bigint
cc_hours              char(20)
cc_manager            varchar(40)
cc_mkt_id             bigint
cc_mkt_class          char(50)
cc_mkt_desc           varchar(100)
cc_market_manager     varchar(40)
cc_division           bigint
cc_division_name      varchar(50)
cc_company            bigint
cc_company_name       char(50)
cc_street_number      char(10)
cc_street_name        varchar(60)
cc_street_type        char(15)
cc_suite_number       char(10)
cc_city               varchar(60)
cc_county             varchar(30)
cc_state              char(2)
cc_zip                char(10)
cc_country            varchar(20)
cc_gmt_offset         decimal(5,2)
cc_tax_percentage     decimal(5,2)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/call_center.dat* | gsfs://192.168.0.90:5003/call_center.dat*',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',

```

```

mode 'Normal'
)
WITH call_center_err
;
DROP FOREIGN TABLE IF EXISTS customer_ext;
CREATE FOREIGN TABLE customer_ext
(
c_customer_sk          bigint          ,
c_customer_id         char(16)         ,
c_current_cdemo_sk    bigint          ,
c_current_hdemo_sk    bigint          ,
c_current_addr_sk     bigint          ,
c_first_shipto_date_sk bigint          ,
c_first_sales_date_sk bigint          ,
c_salutation          char(10)         ,
c_first_name          char(20)         ,
c_last_name           char(30)         ,
c_preferred_cust_flag char(1)         ,
c_birth_day           bigint          ,
c_birth_month         bigint          ,
c_birth_year          bigint          ,
c_birth_country       varchar(20)      ,
c_login               char(13)        ,
c_email_address       char(50)        ,
c_last_review_date_sk char(10)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/customer_[^ad]* | gsfs://192.168.0.90:5003/customer_[^ad]*',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'GBK',
mode 'Normal'
)
WITH customer_err
;
DROP FOREIGN TABLE IF EXISTS web_site_ext;
CREATE FOREIGN TABLE web_site_ext
(
web_site_sk          bigint          ,
web_site_id         char(16)         ,
web_rec_start_date   date            ,
web_rec_end_date     date            ,
web_name             varchar(50)      ,
web_open_date_sk    bigint          ,
web_close_date_sk   bigint          ,
web_class            varchar(50)      ,
web_manager         varchar(40)      ,
web_mkt_id          bigint          ,
web_mkt_class        varchar(50)      ,
web_mkt_desc         varchar(100)     ,
web_market_manager   varchar(40)      ,
web_company_id      bigint          ,
web_company_name     char(50)        ,
web_street_number    char(10)        ,
web_street_name      varchar(60)     ,
web_street_type      char(15)        ,
web_suite_number     char(10)        ,
web_city             varchar(60)     ,
web_county           varchar(30)     ,
web_state            char(2)         ,
web_zip              char(10)        ,
web_country          varchar(20)     ,
web_gmt_offset       decimal(5,2)    ,
web_tax_percentage   decimal(5,2)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/web_site.dat* | gsfs://192.168.0.90:5003/web_site.dat*',
FORMAT 'TEXT' ,
DELIMITER '|',

```

```

encoding 'utf8',
mode 'Normal'
)
)
WITH web_site_err
;
DROP FOREIGN TABLE IF EXISTS store_returns_ext;
CREATE FOREIGN TABLE store_returns_ext
(
sr_returned_date_sk    bigint           ,
sr_return_time_sk     bigint           ,
sr_item_sk            bigint           ,
sr_customer_sk        bigint           ,
sr_cdemo_sk           bigint           ,
sr_hdemo_sk           bigint           ,
sr_addr_sk            bigint           ,
sr_store_sk           bigint           ,
sr_reason_sk          bigint           ,
sr_ticket_number      bigint           ,
sr_return_quantity    bigint           ,
sr_return_amt         decimal(7,2)    ,
sr_return_tax         decimal(7,2)    ,
sr_return_amt_inc_tax decimal(7,2)    ,
sr_fee                decimal(7,2)    ,
sr_return_ship_cost   decimal(7,2)    ,
sr_refunded_cash     decimal(7,2)    ,
sr_reversed_charge    decimal(7,2)    ,
sr_store_credit       decimal(7,2)    ,
sr_net_loss          decimal(7,2)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/store_returns.dat* | gsfs://192.168.0.90:5003/store_returns.dat*',
FORMAT 'TEXT',
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
WITH store_returns_err
;
DROP FOREIGN TABLE IF EXISTS household_demographics_ext;
CREATE FOREIGN TABLE household_demographics_ext
(
hd_demo_sk            bigint           ,
hd_income_band_sk    bigint           ,
hd_buy_potential      char(15)        ,
hd_dep_count          bigint           ,
hd_vehicle_count      bigint
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/household_demographics.dat* | gsfs://192.168.0.90:5003/
household_demographics.dat*',
FORMAT 'TEXT',
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
WITH household_demographics_err
;
DROP FOREIGN TABLE IF EXISTS web_page_ext;
CREATE FOREIGN TABLE web_page_ext
(
wp_web_page_sk        bigint           ,
wp_web_page_id        char(16)        ,
wp_rec_start_date     date             ,
wp_rec_end_date       date             ,
wp_creation_date_sk   bigint           ,
wp_access_date_sk     bigint           ,
wp_autogen_flag       char(1)         ,
wp_customer_sk        bigint           ,
wp_url                varchar(100)
)

```

```

wp_type          char(50)          ,
wp_char_count    bigint          ,
wp_link_count    bigint          ,
wp_image_count   bigint          ,
wp_max_ad_count  bigint          ,
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/web_page.dat* | gsfs://192.168.0.90:5003/web_page.dat*',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
)
WITH web_page_err
;
DROP FOREIGN TABLE IF EXISTS promotion_ext;
CREATE FOREIGN TABLE promotion_ext
(
p_promo_sk       bigint          ,
p_promo_id       char(16)         ,
p_start_date_sk  bigint          ,
p_end_date_sk    bigint          ,
p_item_sk        bigint          ,
p_cost           decimal(15,2)    ,
p_response_target bigint          ,
p_promo_name     char(50)         ,
p_channel_dmail  char(1)         ,
p_channel_email  char(1)         ,
p_channel_catalog char(1)       ,
p_channel_tv     char(1)         ,
p_channel_radio  char(1)         ,
p_channel_press  char(1)         ,
p_channel_event  char(1)         ,
p_channel_demo   char(1)         ,
p_channel_details varchar(100)    ,
p_purpose          char(15)        ,
p_discount_active char(1)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/promotion.dat* | gsfs://192.168.0.90:5003/promotion.dat*',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
)
WITH promotion_err
;
DROP FOREIGN TABLE IF EXISTS catalog_page_ext;
CREATE FOREIGN TABLE catalog_page_ext
(
cp_catalog_page_sk  bigint          ,
cp_catalog_page_id  char(16)         ,
cp_start_date_sk    bigint          ,
cp_end_date_sk      bigint          ,
cp_department       varchar(50)     ,
cp_catalog_number   bigint          ,
cp_catalog_page_number bigint      ,
cp_description      varchar(100)    ,
cp_type            varchar(100)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/catalog_page.dat* | gsfs://192.168.0.90:5003/catalog_page.dat*',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
)
WITH catalog_page_err
;

```

```

DROP FOREIGN TABLE IF EXISTS inventory_ext;
CREATE FOREIGN TABLE inventory_ext
(
  inv_date_sk          bigint          ,
  inv_item_sk         bigint          ,
  inv_warehouse_sk    bigint          ,
  inv_quantity_on_hand integer
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/inventory.dat* | gsfs://192.168.0.90:5003/inventory.dat*',
FORMAT 'TEXT',
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
WITH inventory_err
;
DROP FOREIGN TABLE IF EXISTS catalog_returns_ext;
CREATE FOREIGN TABLE catalog_returns_ext
(
  cr_returned_date_sk  bigint          ,
  cr_returned_time_sk  bigint          ,
  cr_item_sk           bigint          ,
  cr_refunded_customer_sk  bigint          ,
  cr_refunded_cdemo_sk   bigint          ,
  cr_refunded_hdemo_sk   bigint          ,
  cr_refunded_addr_sk    bigint          ,
  cr_returning_customer_sk  bigint          ,
  cr_returning_cdemo_sk   bigint          ,
  cr_returning_hdemo_sk   bigint          ,
  cr_returning_addr_sk    bigint          ,
  cr_call_center_sk     bigint          ,
  cr_catalog_page_sk    bigint          ,
  cr_ship_mode_sk       bigint          ,
  cr_warehouse_sk       bigint          ,
  cr_reason_sk          bigint          ,
  cr_order_number       bigint          ,
  cr_return_quantity    bigint          ,
  cr_return_amount      decimal(7,2)    ,
  cr_return_tax          decimal(7,2)    ,
  cr_return_amt_inc_tax decimal(7,2)    ,
  cr_fee                 decimal(7,2)    ,
  cr_return_ship_cost   decimal(7,2)    ,
  cr_refunded_cash      decimal(7,2)    ,
  cr_reversed_charge    decimal(7,2)    ,
  cr_store_credit        decimal(7,2)    ,
  cr_net_loss            decimal(7,2)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/catalog_returns.dat* | gsfs://192.168.0.90:5003/
catalog_returns.dat*',
FORMAT 'TEXT',
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
WITH catalog_returns_err
;
DROP FOREIGN TABLE IF EXISTS web_returns_ext;
CREATE FOREIGN TABLE web_returns_ext
(
  wr_returned_date_sk  bigint          ,
  wr_returned_time_sk  bigint          ,
  wr_item_sk           bigint          ,
  wr_refunded_customer_sk  bigint          ,
  wr_refunded_cdemo_sk   bigint          ,
  wr_refunded_hdemo_sk   bigint          ,
  wr_refunded_addr_sk    bigint          ,
  wr_returning_customer_sk  bigint
)

```

```

wr_returning_cdemo_sk    bigint    ,
wr_returning_hdemo_sk   bigint    ,
wr_returning_addr_sk    bigint    ,
wr_web_page_sk          bigint    ,
wr_reason_sk            bigint    ,
wr_order_number         bigint    ,
wr_return_quantity      bigint    ,
wr_return_amt           decimal(7,2) ,
wr_return_tax           decimal(7,2) ,
wr_return_amt_inc_tax   decimal(7,2) ,
wr_fee                  decimal(7,2) ,
wr_return_ship_cost     decimal(7,2) ,
wr_refunded_cash       decimal(7,2) ,
wr_reversed_charge      decimal(7,2) ,
wr_account_credit       decimal(7,2) ,
wr_net_loss             decimal(7,2)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/web_returns.dat* | gsfs://192.168.0.90:5003/web_returns.dat*',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
)
WITH web_returns_err
;
DROP FOREIGN TABLE IF EXISTS web_sales_ext;
CREATE FOREIGN TABLE web_sales_ext
(
ws_sold_date_sk    bigint    ,
ws_sold_time_sk    bigint    ,
ws_ship_date_sk    bigint    ,
ws_item_sk         bigint    ,
ws_bill_customer_sk  bigint    ,
ws_bill_cdemo_sk   bigint    ,
ws_bill_hdemo_sk   bigint    ,
ws_bill_addr_sk    bigint    ,
ws_ship_customer_sk  bigint    ,
ws_ship_cdemo_sk   bigint    ,
ws_ship_hdemo_sk   bigint    ,
ws_ship_addr_sk    bigint    ,
ws_web_page_sk     bigint    ,
ws_web_site_sk     bigint    ,
ws_ship_mode_sk    bigint    ,
ws_warehouse_sk    bigint    ,
ws_promo_sk        bigint    ,
ws_order_number    bigint    ,
ws_quantity        bigint    ,
ws_wholesale_cost  decimal(7,2) ,
ws_list_price      decimal(7,2) ,
ws_sales_price     decimal(7,2) ,
ws_ext_discount_amt decimal(7,2) ,
ws_ext_sales_price decimal(7,2) ,
ws_ext_wholesale_cost decimal(7,2) ,
ws_ext_list_price  decimal(7,2) ,
ws_ext_tax         decimal(7,2) ,
ws_coupon_amt      decimal(7,2) ,
ws_ext_ship_cost   decimal(7,2) ,
ws_net_paid        decimal(7,2) ,
ws_net_paid_inc_tax decimal(7,2) ,
ws_net_paid_inc_ship decimal(7,2) ,
ws_net_paid_inc_ship_tax decimal(7,2) ,
ws_net_profit      decimal(7,2)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/web_sales.dat* | gsfs://192.168.0.90:5003/web_sales.dat*',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',

```

```

mode 'Normal'
) WITH web_sales_err ;
DROP FOREIGN TABLE IF EXISTS catalog_sales_ext;
CREATE FOREIGN TABLE catalog_sales_ext
(
cs_sold_date_sk      bigint      ,
cs_sold_time_sk     bigint      ,
cs_ship_date_sk     bigint      ,
cs_bill_customer_sk bigint      ,
cs_bill_cdemo_sk    bigint      ,
cs_bill_hdemo_sk    bigint      ,
cs_bill_addr_sk     bigint      ,
cs_ship_customer_sk bigint      ,
cs_ship_cdemo_sk    bigint      ,
cs_ship_hdemo_sk    bigint      ,
cs_ship_addr_sk     bigint      ,
cs_call_center_sk   bigint      ,
cs_catalog_page_sk  bigint      ,
cs_ship_mode_sk     bigint      ,
cs_warehouse_sk     bigint      ,
cs_item_sk          bigint      ,
cs_promo_sk         bigint      ,
cs_order_number     bigint      ,
cs_quantity         bigint      ,
cs_wholesale_cost   decimal(7,2) ,
cs_list_price       decimal(7,2) ,
cs_sales_price      decimal(7,2) ,
cs_ext_discount_amt decimal(7,2) ,
cs_ext_sales_price  decimal(7,2) ,
cs_ext_wholesale_cost decimal(7,2) ,
cs_ext_list_price   decimal(7,2) ,
cs_ext_tax          decimal(7,2) ,
cs_coupon_amt       decimal(7,2) ,
cs_ext_ship_cost    decimal(7,2) ,
cs_net_paid         decimal(7,2) ,
cs_net_paid_inc_tax decimal(7,2) ,
cs_net_paid_inc_ship decimal(7,2) ,
cs_net_paid_inc_ship_tax decimal(7,2) ,
cs_net_profit       decimal(7,2)
)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/catalog_sales.dat*' | gsfs://192.168.0.90:5003/catalog_sales.dat*',
FORMAT 'TEXT' ,
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
) WITH catalog_sales_err ;
DROP FOREIGN TABLE IF EXISTS store_sales_ext;
CREATE FOREIGN TABLE store_sales_ext
(
ss_sold_date_sk      bigint      ,
ss_sold_time_sk     bigint      ,
ss_item_sk          bigint      ,
ss_customer_sk      bigint      ,
ss_cdemo_sk         bigint      ,
ss_hdemo_sk         bigint      ,
ss_addr_sk          bigint      ,
ss_store_sk         bigint      ,
ss_promo_sk         bigint      ,
ss_ticket_number     bigint      ,
ss_quantity         bigint      ,
ss_wholesale_cost   decimal(7,2) ,
ss_list_price       decimal(7,2) ,
ss_sales_price      decimal(7,2) ,
ss_ext_discount_amt decimal(7,2) ,
ss_ext_sales_price  decimal(7,2) ,
ss_ext_wholesale_cost decimal(7,2) ,
ss_ext_list_price   decimal(7,2) ,
ss_ext_tax          decimal(7,2)
)

```

```
ss_coupon_amt      decimal(7,2)      ,
ss_net_paid        decimal(7,2)      ,
ss_net_paid_inc_tax decimal(7,2)      ,
ss_net_profit      decimal(7,2)
) SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5002/store_sales.dat* | gsfs://192.168.0.90:5003/store_sales.dat*',
FORMAT 'TEXT',
DELIMITER '|',
encoding 'utf8',
mode 'Normal'
) WITH store_sales_err;
```

导入 TPC-DS 数据

执行以下命令导入数据。

```
INSERT INTO customer_address SELECT * FROM customer_address_ext;
INSERT INTO customer_demographics SELECT * FROM customer_demographics_ext;
INSERT INTO date_dim SELECT * FROM date_dim_ext;
INSERT INTO warehouse SELECT * FROM warehouse_ext;
INSERT INTO ship_mode SELECT * FROM ship_mode_ext;
INSERT INTO time_dim SELECT * FROM time_dim_ext;
INSERT INTO reason SELECT * FROM reason_ext;
INSERT INTO income_band SELECT * FROM income_band_ext;
INSERT INTO item SELECT * FROM item_ext;
INSERT INTO store SELECT * FROM store_ext;
INSERT INTO call_center SELECT * FROM call_center_ext;
INSERT INTO customer SELECT * FROM customer_ext;
INSERT INTO web_site SELECT * FROM web_site_ext;
INSERT INTO household_demographics SELECT * FROM household_demographics_ext;
INSERT INTO web_page SELECT * FROM web_page_ext;
INSERT INTO promotion SELECT * FROM promotion_ext;
INSERT INTO catalog_page SELECT * FROM catalog_page_ext;
INSERT INTO inventory SELECT * FROM inventory_ext;
INSERT INTO catalog_returns SELECT * FROM catalog_returns_ext;
INSERT INTO web_returns SELECT * FROM web_returns_ext;
INSERT INTO store_returns SELECT * FROM store_returns_ext;
INSERT INTO web_sales SELECT * FROM web_sales_ext;
INSERT INTO catalog_sales SELECT * FROM catalog_sales_ext;
INSERT INTO store_sales SELECT * FROM store_sales_ext;
```

4.3.4 TPC-DS 查询测试

您可以通过[命令生成方法](#)生成 TPC-DS 测试集，也可以直接通过[脚本生成方法](#)生成，另我们已经给出前面 20 个的 TPC-DS [测试集](#) 供您参考。

命令生成方法

TPC-DS 标准 99 个 SQL 查询语句可用如下方法生成：

步骤 1 准备工作。生成 TPC-DS 查询语句前需要修改 query_templates 目录下的文件：

1. 登录测试过程申请的 ECS，进入 /data1/script/tpcds-kit/DSGen-software-code-3.2.0rc1/query_templates 目录：
`cd /data1/script/tpcds-kit/DSGen-software-code-3.2.0rc1/query_templates`
2. 新建文件 hwdws.tpl，内容为：

```
define __LIMITA = "";  
define __LIMITB = "";  
define __LIMITC = "limit %d";  
define __BEGIN = "-- begin query " + [_QUERY] + " in stream " + [_STREAM] + " using template " +  
[_TEMPLATE];  
define __END = "-- end query " + [_QUERY] + " in stream " + [_STREAM] + " using template " +  
[_TEMPLATE];
```
3. 因 TPC-DS 工具中 SQL 语句生成模板有语法错误，需修改 query77.tpl，将 135 行的
' , coalesce(returns, 0) returns' 改为 '**, coalesce(returns, 0) as returns**'。

步骤2 执行以下命令生成查询语句：

```
cd /data1/script/tpcds-kit/DGen-software-code-3.2.0rc1/tools
./dsqgen -input ../query_templates/templates.lst -directory ../query_templates/ -scale 1000 -dialect hwdws
```

执行后会生成query_0.sql文件，里面放着99个标准SQL语句，需要手动去切分成99个文件。

步骤3 生成的标准查询中如下日期函数语法在GaussDB(DWS)暂不支持，需要手动进行修改：

```
Q5: and (cast('2001-08-19' as date) + 14 days)
修改为
and (cast('2001-08-19' as date) + 14)
```

```
Q12:and (cast('1999-02-28' as date) + 30 days)
修改为
and (cast('1999-02-28' as date) + 30)
```

```
Q16:(cast('1999-4-01' as date) + 60 days)
修改为
(cast('1999-4-01' as date) + 60)
```

```
Q20:and (cast('1998-05-05' as date) + 30 days)
修改为
and (cast('1998-05-05' as date) + 30)
```

```
Q21:and d_date between (cast ('2000-05-19' as date) - 30 days)
修改为
and d_date between (cast ('2000-05-19' as date) - 30)
```

```
and (cast ('2000-05-19' as date) + 30 days)
修改为
and (cast ('2000-05-19' as date) + 30)
```

```
Q32:(cast('1999-02-22' as date) + 90 days)
修改为
(cast('1999-02-22' as date) + 90)
```

```
Q37:and d_date between cast('1998-04-29' as date) and (cast('1998-04-29' as date) + 60 days)
修改为
and d_date between cast('1998-04-29' as date) and (cast('1998-04-29' as date) + 60)
```

```
Q40:and d_date between (cast ('2002-05-10' as date) - 30 days)
修改为
and d_date between (cast ('2002-05-10' as date) - 30)
```

```
and (cast ('2002-05-10' as date) + 30 days)
修改为
and (cast ('2002-05-10' as date) + 30)
```

```
Q77:and (cast('1999-08-29' as date) + 30 days)
修改为
and (cast('1999-08-29' as date) + 30)
```

```
Q80:and (cast('2002-08-04' as date) + 30 days)
修改为
and (cast('2002-08-04' as date) + 30)
```

```
Q82:and d_date between cast('1998-01-18' as date) and (cast('1998-01-18' as date) + 60 days)
修改为
and d_date between cast('1998-01-18' as date) and (cast('1998-01-18' as date) + 60)
```

```
Q92:(cast('2001-01-26' as date) + 90 days)
修改为
(cast('2001-01-26' as date) + 90)
```

```
Q94:(cast('1999-5-01' as date) + 60 days)
修改为
```

```
(cast('1999-5-01' as date) + 60)
```

```
Q95:(cast('1999-4-01' as date) + 60 days)
```

修改为

```
(cast('1999-4-01' as date) + 60)
```

```
Q98:and (cast('2002-04-01' as date) + 30 days)
```

修改为

```
and (cast('2002-04-01' as date) + 30)
```

----结束

脚本生成方法

建议使用如下脚本直接生成GaussDB(DWS)可用的SQL语句:

```
# -*- coding: utf-8 -*-
import os
import sys
import re
import stat

def gen_thp_seq(dsqgen_file, scale, query_dir):
    flags = os.O_WRONLY | os.O_CREAT | os.O_EXCL
    modes = stat.S_IWUSR | stat.S_IRUSR
    if not os.path.exists(query_dir):
        os.mkdir(query_dir)

    cmd = dsqgen_file + ' -input ../query_templates/templates.lst -directory ../query_templates/ -scale ' +
    str(scale) + ' -dialect hwdws'
    os.system(cmd)
    with open('query_0.sql', 'r') as f1:
        line = f1.readline()
        queryname = ""
        while line:
            if '-- begin' in line.strip():
                #line:-- begin query 1 in stream 0 using template query96.tpl\n'
                queryname = line.split(' ')[-1][5:-5]
                fquery = os.fdopen(os.open(query_dir + '/Q' + queryname, flags, modes), 'w+')
                line = f1.readline()
                continue

            if not queryname or line == '\n':
                line = f1.readline()
                continue

            if '-- end' in line.strip():
                fquery.close()
                line = f1.readline()
                continue

            if 'days' in line:
                line = line.replace('days', "")
                fquery.write(line)
                line = f1.readline()

    print("TPCDS Q1-Q99 query store at " + query_dir)
    os.system('rm -rf query_0.sql')

if __name__ == '__main__':
    if len(sys.argv) != 4:
        print('Wrong number of parameters! ')
        print('Usage: python3 gen_tpcds_thpseq.py dsqgen_file_path scale query_dir')
        print('Parameter:
        qgen_file_path: tpcds dsqgen文件路径
        scale: 生成查询对应的数据规模')
```

```
query_dir: 生成文件的存放路径""")
print("""Example:
python3 gen_tpcds_thpseq.py ./dsqgen 1000 tpcds_query1000x""")
sys.exit(1)

dsqgen_file_path = sys.argv[1]
scale = sys.argv[2]
query_dir = sys.argv[3]
try:
    if not re.match(r'^\.\?(\w+\/?)+$', dsqgen_file_path):
        print("error param qgenfilepath:", dsqgen_file_path)
    if not re.match(r'\d+', scale):
        print('error param scale:', scale)
    if not re.match(r'^\.\?(\w+\/?)+$', query_dir):
        print('error param query_dir:', query_dir)
except Exception as ex:
    print('exception: invalid param!')

if not os.path.isfile(dsqgen_file_path):
    print("The file %s is not exist!" % dsqgen_file_path)
    sys.exit(1)

gen_thp_seq(dsqgen_file_path, int(scale), query_dir)
```

将以上脚本保存在/data1/script/tpcds-kit/DSGen-software-code-3.2.0rc1/tools/gen_tpcds_thpseq.py，执行如下命令可获得99个SQL语句，其中1000为数据规模，代表TPCDS 1000x，tpcds_query1000x为生成的SQL语句存放的位置：

```
cd /data1/script/tpcds-kit/DSGen-software-code-3.2.0rc1/tools/
python3 gen_tpcds_thpseq.py ./dsqgen 1000 tpcds_query1000x
```

测试集

TPC-DS测试集共包括99个SQL查询，本章节仅体现前20个SQL。其他请根据以上方法生成。

SQL1

```
with customer_total_return as
(select sr_customer_sk as ctr_customer_sk
,sr_store_sk as ctr_store_sk
,sum(SR_RETURN_AMT_INC_TAX) as ctr_total_return
from store_returns
,date_dim
where sr_returned_date_sk = d_date_sk
and d_year =2001
group by sr_customer_sk
,sr_store_sk)
select c_customer_id
from customer_total_return ctr1
,store
,customer
where ctr1.ctr_total_return > (select avg(ctr_total_return)*1.2
from customer_total_return ctr2
where ctr1.ctr_store_sk = ctr2.ctr_store_sk)
and s_store_sk = ctr1.ctr_store_sk
and s_state = 'PA'
and ctr1.ctr_customer_sk = c_customer_sk
order by c_customer_id
limit 100;
```

SQL2

```
with wscs as
(select sold_date_sk
,sales_price
from (select ws_sold_date_sk sold_date_sk
```

```

        ,ws_ext_sales_price sales_price
    from web_sales
    union all
    select cs_sold_date_sk sold_date_sk
        ,cs_ext_sales_price sales_price
    from catalog_sales)),
wswscs as
(select d_week_seq,
    sum(case when (d_day_name='Sunday') then sales_price else null end) sun_sales,
    sum(case when (d_day_name='Monday') then sales_price else null end) mon_sales,
    sum(case when (d_day_name='Tuesday') then sales_price else null end) tue_sales,
    sum(case when (d_day_name='Wednesday') then sales_price else null end) wed_sales,
    sum(case when (d_day_name='Thursday') then sales_price else null end) thu_sales,
    sum(case when (d_day_name='Friday') then sales_price else null end) fri_sales,
    sum(case when (d_day_name='Saturday') then sales_price else null end) sat_sales
from wscs
    ,date_dim
where d_date_sk = sold_date_sk
group by d_week_seq)
select d_week_seq1
    ,round(sun_sales1/sun_sales2,2)
    ,round(mon_sales1/mon_sales2,2)
    ,round(tue_sales1/tue_sales2,2)
    ,round(wed_sales1/wed_sales2,2)
    ,round(thu_sales1/thu_sales2,2)
    ,round(fri_sales1/fri_sales2,2)
    ,round(sat_sales1/sat_sales2,2)
from
(select wswscs.d_week_seq d_week_seq1
    ,sun_sales sun_sales1
    ,mon_sales mon_sales1
    ,tue_sales tue_sales1
    ,wed_sales wed_sales1
    ,thu_sales thu_sales1
    ,fri_sales fri_sales1
    ,sat_sales sat_sales1
from wswscs,date_dim
where date_dim.d_week_seq = wswscs.d_week_seq and
    d_year = 1999) y,
(select wswscs.d_week_seq d_week_seq2
    ,sun_sales sun_sales2
    ,mon_sales mon_sales2
    ,tue_sales tue_sales2
    ,wed_sales wed_sales2
    ,thu_sales thu_sales2
    ,fri_sales fri_sales2
    ,sat_sales sat_sales2
from wswscs
    ,date_dim
where date_dim.d_week_seq = wswscs.d_week_seq and
    d_year = 1999+1) z
where d_week_seq1=d_week_seq2-53
order by d_week_seq1;

```

SQL3

```

select dt.d_year
    ,item.i_brand_id brand_id
    ,item.i_brand brand
    ,sum(ss_ext_sales_price) sum_agg
from date_dim dt
    ,store_sales
    ,item
where dt.d_date_sk = store_sales.ss_sold_date_sk
    and store_sales.ss_item_sk = item.i_item_sk
    and item.i_manufact_id = 125
    and dt.d_moy=11
group by dt.d_year
    ,item.i_brand

```

```
,item.i_brand_id
order by dt.d_year
      ,sum_agg desc
      ,brand_id
limit 100;
```

SQL4

```
with year_total as (
select c_customer_id customer_id
      ,c_first_name customer_first_name
      ,c_last_name customer_last_name
      ,c_preferred_cust_flag customer_preferred_cust_flag
      ,c_birth_country customer_birth_country
      ,c_login customer_login
      ,c_email_address customer_email_address
      ,d_year dyear
      ,sum(((ss_ext_list_price-ss_ext_wholesale_cost-ss_ext_discount_amt)+ss_ext_sales_price)/2) year_total
      ,'s' sale_type
from customer
      ,store_sales
      ,date_dim
where c_customer_sk = ss_customer_sk
      and ss_sold_date_sk = d_date_sk
group by c_customer_id
      ,c_first_name
      ,c_last_name
      ,c_preferred_cust_flag
      ,c_birth_country
      ,c_login
      ,c_email_address
      ,d_year
union all
select c_customer_id customer_id
      ,c_first_name customer_first_name
      ,c_last_name customer_last_name
      ,c_preferred_cust_flag customer_preferred_cust_flag
      ,c_birth_country customer_birth_country
      ,c_login customer_login
      ,c_email_address customer_email_address
      ,d_year dyear
      ,sum((((cs_ext_list_price-cs_ext_wholesale_cost-cs_ext_discount_amt)+cs_ext_sales_price)/2) ) year_total
      ,'c' sale_type
from customer
      ,catalog_sales
      ,date_dim
where c_customer_sk = cs_bill_customer_sk
      and cs_sold_date_sk = d_date_sk
group by c_customer_id
      ,c_first_name
      ,c_last_name
      ,c_preferred_cust_flag
      ,c_birth_country
      ,c_login
      ,c_email_address
      ,d_year
union all
select c_customer_id customer_id
      ,c_first_name customer_first_name
      ,c_last_name customer_last_name
      ,c_preferred_cust_flag customer_preferred_cust_flag
      ,c_birth_country customer_birth_country
      ,c_login customer_login
      ,c_email_address customer_email_address
      ,d_year dyear
      ,sum((((ws_ext_list_price-ws_ext_wholesale_cost-ws_ext_discount_amt)+ws_ext_sales_price)/2) )
year_total
      ,'w' sale_type
from customer
```

```

,web_sales
,date_dim
where c_customer_sk = ws_bill_customer_sk
and ws_sold_date_sk = d_date_sk
group by c_customer_id
,c_first_name
,c_last_name
,c_preferred_cust_flag
,c_birth_country
,c_login
,c_email_address
,d_year
)
select
    t_s_secyear.customer_id
    ,t_s_secyear.customer_first_name
    ,t_s_secyear.customer_last_name
    ,t_s_secyear.customer_preferred_cust_flag
from year_total t_s_firstyear
    ,year_total t_s_secyear
    ,year_total t_c_firstyear
    ,year_total t_c_secyear
    ,year_total t_w_firstyear
    ,year_total t_w_secyear
where t_s_secyear.customer_id = t_s_firstyear.customer_id
and t_s_firstyear.customer_id = t_c_secyear.customer_id
and t_s_firstyear.customer_id = t_c_firstyear.customer_id
and t_s_firstyear.customer_id = t_w_firstyear.customer_id
and t_s_firstyear.customer_id = t_w_secyear.customer_id
and t_s_firstyear.sale_type = 's'
and t_c_firstyear.sale_type = 'c'
and t_w_firstyear.sale_type = 'w'
and t_s_secyear.sale_type = 's'
and t_c_secyear.sale_type = 'c'
and t_w_secyear.sale_type = 'w'
and t_s_firstyear.dyear = 2000
and t_s_secyear.dyear = 2000+1
and t_c_firstyear.dyear = 2000
and t_c_secyear.dyear = 2000+1
and t_w_firstyear.dyear = 2000
and t_w_secyear.dyear = 2000+1
and t_s_firstyear.year_total > 0
and t_c_firstyear.year_total > 0
and t_w_firstyear.year_total > 0
and case when t_c_firstyear.year_total > 0 then t_c_secyear.year_total / t_c_firstyear.year_total else null
end
    > case when t_s_firstyear.year_total > 0 then t_s_secyear.year_total / t_s_firstyear.year_total else null
end
and case when t_c_firstyear.year_total > 0 then t_c_secyear.year_total / t_c_firstyear.year_total else null
end
    > case when t_w_firstyear.year_total > 0 then t_w_secyear.year_total / t_w_firstyear.year_total else
null end
order by t_s_secyear.customer_id
    ,t_s_secyear.customer_first_name
    ,t_s_secyear.customer_last_name
    ,t_s_secyear.customer_preferred_cust_flag
limit 100;

```

SQL5

```

with ssr as
(select s_store_id,
    sum(sales_price) as sales,
    sum(profit) as profit,
    sum(return_amt) as returns,
    sum(net_loss) as profit_loss
from
    ( select ss_store_sk as store_sk,
        ss_sold_date_sk as date_sk,

```

```

        ss_ext_sales_price as sales_price,
        ss_net_profit as profit,
        cast(0 as decimal(7,2)) as return_amt,
        cast(0 as decimal(7,2)) as net_loss
    from store_sales
    union all
    select sr_store_sk as store_sk,
        sr_returned_date_sk as date_sk,
        cast(0 as decimal(7,2)) as sales_price,
        cast(0 as decimal(7,2)) as profit,
        sr_return_amt as return_amt,
        sr_net_loss as net_loss
    from store_returns
) salesreturns,
date_dim,
store
where date_sk = d_date_sk
    and d_date between cast('2002-08-05' as date)
        and (cast('2002-08-05' as date) + 14 )
    and store_sk = s_store_sk
group by s_store_id)
,
csr as
(select cp_catalog_page_id,
    sum(sales_price) as sales,
    sum(profit) as profit,
    sum(return_amt) as returns,
    sum(net_loss) as profit_loss
from
( select cs_catalog_page_sk as page_sk,
    cs_sold_date_sk as date_sk,
    cs_ext_sales_price as sales_price,
    cs_net_profit as profit,
    cast(0 as decimal(7,2)) as return_amt,
    cast(0 as decimal(7,2)) as net_loss
from catalog_sales
union all
select cr_catalog_page_sk as page_sk,
    cr_returned_date_sk as date_sk,
    cast(0 as decimal(7,2)) as sales_price,
    cast(0 as decimal(7,2)) as profit,
    cr_return_amount as return_amt,
    cr_net_loss as net_loss
from catalog_returns
) salesreturns,
date_dim,
catalog_page
where date_sk = d_date_sk
    and d_date between cast('2002-08-05' as date)
        and (cast('2002-08-05' as date) + 14 )
    and page_sk = cp_catalog_page_sk
group by cp_catalog_page_id)
,
wsr as
(select web_site_id,
    sum(sales_price) as sales,
    sum(profit) as profit,
    sum(return_amt) as returns,
    sum(net_loss) as profit_loss
from
( select ws_web_site_sk as wsr_web_site_sk,
    ws_sold_date_sk as date_sk,
    ws_ext_sales_price as sales_price,
    ws_net_profit as profit,
    cast(0 as decimal(7,2)) as return_amt,
    cast(0 as decimal(7,2)) as net_loss
from web_sales
union all
select ws_web_site_sk as wsr_web_site_sk,

```

```

        wr_returned_date_sk as date_sk,
        cast(0 as decimal(7,2)) as sales_price,
        cast(0 as decimal(7,2)) as profit,
        wr_return_amt as return_amt,
        wr_net_loss as net_loss
    from web_returns left outer join web_sales on
        ( wr_item_sk = ws_item_sk
          and wr_order_number = ws_order_number)
    ) salesreturns,
    date_dim,
    web_site
where date_sk = d_date_sk
      and d_date between cast('2002-08-05' as date)
                        and (cast('2002-08-05' as date) + 14 )
      and wsr_web_site_sk = web_site_sk
group by web_site_id)
select channel
       , id
       , sum(sales) as sales
       , sum(returns) as returns
       , sum(profit) as profit
from
(select 'store channel' as channel
       , 'store' || s_store_id as id
       , sales
       , returns
       , (profit - profit_loss) as profit
 from   ssr
 union all
 select 'catalog channel' as channel
       , 'catalog_page' || cp_catalog_page_id as id
       , sales
       , returns
       , (profit - profit_loss) as profit
 from   csr
 union all
 select 'web channel' as channel
       , 'web_site' || web_site_id as id
       , sales
       , returns
       , (profit - profit_loss) as profit
 from   wsr
 ) x
group by rollup (channel, id)
order by channel
       ,id
limit 100;

```

SQL6

```

select a.ca_state state, count(*) cnt
from customer_address a
     ,customer c
     ,store_sales s
     ,date_dim d
     ,item i
where   a.ca_address_sk = c.c_current_addr_sk
and c.c_customer_sk = s.ss_customer_sk
and s.ss_sold_date_sk = d.d_date_sk
and s.ss_item_sk = i.i_item_sk
and d.d_month_seq =
    (select distinct (d_month_seq)
     from date_dim
      where d_year = 1998
            and d_moy = 7 )
and i.i_current_price > 1.2 *
    (select avg(j.i_current_price)
     from item j
      where j.i_category = i.i_category)

```



```
group by a.ca_state
having count(*) >= 10
order by cnt, a.ca_state
limit 100;
```

SQL7

```
select i_item_id,
       avg(ss_quantity) agg1,
       avg(ss_list_price) agg2,
       avg(ss_coupon_amt) agg3,
       avg(ss_sales_price) agg4
from store_sales, customer_demographics, date_dim, item, promotion
where ss_sold_date_sk = d_date_sk and
      ss_item_sk = i_item_sk and
      ss_cdemo_sk = cd_demo_sk and
      ss_promo_sk = p_promo_sk and
      cd_gender = 'M' and
      cd_marital_status = 'U' and
      cd_education_status = 'College' and
      (p_channel_email = 'N' or p_channel_event = 'N') and
      d_year = 1999
group by i_item_id
order by i_item_id
limit 100;
```

SQL8

```
select s_store_name
       ,sum(ss_net_profit)
from store_sales
   ,date_dim
   ,store
   ,(select ca_zip
      from (
        SELECT substr(ca_zip,1,5) ca_zip
        FROM customer_address
        WHERE substr(ca_zip,1,5) IN (
          '74804','87276','13428','49436','56281','79805',
          '46826','68570','20368','28846','41886',
          '68164','68097','16113','18727','96789',
          '63317','57937','19554','69911','83554',
          '84246','61336','46999','25229','15960',
          '61657','28058','64558','39712','74928',
          '34018','87826','69733','26479','73630',
          '88683','61704','81441','42706','54175',
          '45152','49049','30850','63980','40484',
          '71665','63755','23769','79855','24308',
          '28241','16343','25663','85999','46359',
          '93691','34706','99973','74947','60316',
          '58637','48063','81363','19268','66228',
          '78136','16368','99907','58139','17043',
          '89764','14834','25152','70158','76080',
          '81251','83972','48635','54671','35602',
          '10788','57325','46354','92707','41103',
          '89761','31840','69225','76139','18826',
          '12556','51692','20579','50965','32136',
          '71357','16309','82922','59273','40999',
          '73273','93217','65679','12653','16978',
          '27319','41973','65580','56237','17799',
          '53192','63632','37089','65994','58048',
          '14388','58085','80614','40042','79194',
          '42268','61913','97332','37349','72146',
          '52681','18176','39332','89283','69023',
          '84175','11520','33483','60169','93562',
          '10097','14536','70276','64042','22822',
          '87229','51528','70269','44519','48044',
          '78170','81440','60315','14543','30719',
          '13240','62325','35517','51529','98085',
```

```
'79007','16582','95187','15625','88780',
'38656','74607','75117','62819','31929',
'27665','88890','98611','53527','48652',
'10324','62273','17726','36232','38526',
'50705','61179','30363','54408','58631',
'23622','50319','33299','78829','91267',
'25571','60347','44750','62797','10713',
'46494','91163','20973','42007','54724',
'89203','12561','71116','60404','70589',
'66744','46074','69138','34737','25092',
'59246','74778','40140','89476','71030',
'89861','93207','44996','34850','48752',
'79574','29570','76507','79728','43195',
'47596','46415','42514','68144','14169',
'17041','75747','33630','19378','32618',
'78704','75807','76800','80916','87272',
'37109','21714','14867','83806','33895',
'80637','20658','75224','92772','55791',
'58603','31681','38788','91922','42465',
'74371','72854','75746','80383','75909',
'37151','82077','80604','66771','46075',
'58723','15380','83174','53615','50347',
'98340','68957','63361','18705','47629',
'76013','68572','50588','31168','41563',
'38936','88746','19052','75648','46403',
'24332','54711','28218','80432','53870',
'25049','32562','94211','99803','49133',
'21202','50005','17953','14324','85525',
'51984','37304','69870','64321','66962',
'66453','40619','91199','54400','28804',
'65544','27059','31143','20303','52429',
'24476','91458','52514','55145','99015',
'51657','10001','96434','38325','39628',
'83338','62381','67697','61542','86076',
'89833','32657','56881','93983','85031',
'57530','56318','46934','34740','79458',
'88443','15861','56034','24808','32336',
'34312','96450','12923','91876','53509',
'30241','35816','52377','23946','23644',
'16413','35796','59100','21689','49199',
'40062','82510','14072','78823','49158',
'99933','75399','11365','44799','77549',
'19569','39186','78909','68143','70468',
'14944','33047','98329','42262','68647',
'65754','27357','56372','18073','12363',
'64467','26221','32914','70431','42436',
'55316','33335','27701','44687','22360',
'76124','44007','59525','51574','71555',
'43130','64199','19616','94285')
intersect
select ca_zip
from (SELECT substr(ca_zip,1,5) ca_zip,count(*) cnt
FROM customer_address, customer
WHERE ca_address_sk = c_current_addr_sk and
c_preferred_cust_flag='Y'
group by ca_zip
having count(*) > 10)A1)A2) V1
where ss_store_sk = s_store_sk
and ss_sold_date_sk = d_date_sk
and d_qoy = 1 and d_year = 1999
and (substr(s_zip,1,2) = substr(V1.ca_zip,1,2))
group by s_store_name
order by s_store_name
limit 100;
```

SQL9

```
select case when (select count(*)
from store_sales
```

```

        where ss_quantity between 1 and 20) > 40845849
    then (select avg(ss_ext_tax)
         from store_sales
         where ss_quantity between 1 and 20)
    else (select avg(ss_net_paid)
         from store_sales
         where ss_quantity between 1 and 20) end bucket1 ,
case when (select count(*)
           from store_sales
           where ss_quantity between 21 and 40) > 5712087
    then (select avg(ss_ext_tax)
         from store_sales
         where ss_quantity between 21 and 40)
    else (select avg(ss_net_paid)
         from store_sales
         where ss_quantity between 21 and 40) end bucket2,
case when (select count(*)
           from store_sales
           where ss_quantity between 41 and 60) > 30393328
    then (select avg(ss_ext_tax)
         from store_sales
         where ss_quantity between 41 and 60)
    else (select avg(ss_net_paid)
         from store_sales
         where ss_quantity between 41 and 60) end bucket3,
case when (select count(*)
           from store_sales
           where ss_quantity between 61 and 80) > 46385791
    then (select avg(ss_ext_tax)
         from store_sales
         where ss_quantity between 61 and 80)
    else (select avg(ss_net_paid)
         from store_sales
         where ss_quantity between 61 and 80) end bucket4,
case when (select count(*)
           from store_sales
           where ss_quantity between 81 and 100) > 29981928
    then (select avg(ss_ext_tax)
         from store_sales
         where ss_quantity between 81 and 100)
    else (select avg(ss_net_paid)
         from store_sales
         where ss_quantity between 81 and 100) end bucket5
from reason
where r_reason_sk = 1
;

```

SQL10

```

select
  cd_gender,
  cd_marital_status,
  cd_education_status,
  count(*) cnt1,
  cd_purchase_estimate,
  count(*) cnt2,
  cd_credit_rating,
  count(*) cnt3,
  cd_dep_count,
  count(*) cnt4,
  cd_dep_employed_count,
  count(*) cnt5,
  cd_dep_college_count,
  count(*) cnt6
from
  customer c, customer_address ca, customer_demographics
where
  c.c_current_addr_sk = ca.ca_address_sk and
  ca_county in ('Clark County','Richardson County','Tom Green County','Sullivan County','Cass County') and

```

```

cd_demo_sk = c.c_current_cdemo_sk and
exists (select *
        from store_sales,date_dim
        where c.c_customer_sk = ss_customer_sk and
              ss_sold_date_sk = d_date_sk and
              d_year = 2000 and
              d_moy between 1 and 1+3) and
(exists (select *
        from web_sales,date_dim
        where c.c_customer_sk = ws_bill_customer_sk and
              ws_sold_date_sk = d_date_sk and
              d_year = 2000 and
              d_moy between 1 AND 1+3) or
exists (select *
        from catalog_sales,date_dim
        where c.c_customer_sk = cs_ship_customer_sk and
              cs_sold_date_sk = d_date_sk and
              d_year = 2000 and
              d_moy between 1 and 1+3))
group by cd_gender,
         cd_marital_status,
         cd_education_status,
         cd_purchase_estimate,
         cd_credit_rating,
         cd_dep_count,
         cd_dep_employed_count,
         cd_dep_college_count
order by cd_gender,
         cd_marital_status,
         cd_education_status,
         cd_purchase_estimate,
         cd_credit_rating,
         cd_dep_count,
         cd_dep_employed_count,
         cd_dep_college_count
limit 100;

```

SQL11

```

with year_total as (
select c_customer_id customer_id
      ,c_first_name customer_first_name
      ,c_last_name customer_last_name
      ,c_preferred_cust_flag customer_preferred_cust_flag
      ,c_birth_country customer_birth_country
      ,c_login customer_login
      ,c_email_address customer_email_address
      ,d_year dyear
      ,sum(ss_ext_list_price-ss_ext_discount_amt) year_total
      ,'s' sale_type
from customer
      ,store_sales
      ,date_dim
where c_customer_sk = ss_customer_sk
     and ss_sold_date_sk = d_date_sk
group by c_customer_id
        ,c_first_name
        ,c_last_name
        ,c_preferred_cust_flag
        ,c_birth_country
        ,c_login
        ,c_email_address
        ,d_year
union all
select c_customer_id customer_id
      ,c_first_name customer_first_name
      ,c_last_name customer_last_name
      ,c_preferred_cust_flag customer_preferred_cust_flag
      ,c_birth_country customer_birth_country

```

```

,c_login customer_login
,c_email_address customer_email_address
,d_year dyear
,sum(ws_ext_list_price-ws_ext_discount_amt) year_total
,'w' sale_type
from customer
,web_sales
,date_dim
where c_customer_sk = ws_bill_customer_sk
and ws_sold_date_sk = d_date_sk
group by c_customer_id
,c_first_name
,c_last_name
,c_preferred_cust_flag
,c_birth_country
,c_login
,c_email_address
,d_year
)
select
t_s_secyear.customer_id
,t_s_secyear.customer_first_name
,t_s_secyear.customer_last_name
,t_s_secyear.customer_birth_country
from year_total t_s_firstyear
,year_total t_s_secyear
,year_total t_w_firstyear
,year_total t_w_secyear
where t_s_secyear.customer_id = t_s_firstyear.customer_id
and t_s_firstyear.customer_id = t_w_secyear.customer_id
and t_s_firstyear.customer_id = t_w_firstyear.customer_id
and t_s_firstyear.sale_type = 's'
and t_w_firstyear.sale_type = 'w'
and t_s_secyear.sale_type = 's'
and t_w_secyear.sale_type = 'w'
and t_s_firstyear.dyear = 2001
and t_s_secyear.dyear = 2001+1
and t_w_firstyear.dyear = 2001
and t_w_secyear.dyear = 2001+1
and t_s_firstyear.year_total > 0
and t_w_firstyear.year_total > 0
and case when t_w_firstyear.year_total > 0 then t_w_secyear.year_total / t_w_firstyear.year_total else
0.0 end
> case when t_s_firstyear.year_total > 0 then t_s_secyear.year_total / t_s_firstyear.year_total else 0.0
end
order by t_s_secyear.customer_id
,t_s_secyear.customer_first_name
,t_s_secyear.customer_last_name
,t_s_secyear.customer_birth_country
limit 100;

```

SQL12

```

select i_item_id
,i_item_desc
,i_category
,i_class
,i_current_price
,sum(ws_ext_sales_price) as itemrevenue
,sum(ws_ext_sales_price)*100/sum(sum(ws_ext_sales_price)) over
(partition by i_class) as renumeratio
from
web_sales
,item
,date_dim
where
ws_item_sk = i_item_sk
and i_category in ('Music', 'Shoes', 'Children')
and ws_sold_date_sk = d_date_sk

```

```

        and d_date between cast('2000-05-14' as date)
            and (cast('2000-05-14' as date) + 30 )
    group by
        i_item_id
        ,i_item_desc
        ,i_category
        ,i_class
        ,i_current_price
    order by
        i_category
        ,i_class
        ,i_item_id
        ,i_item_desc
        ,revenue_ratio
    limit 100;

```

SQL13

```

select avg(ss_quantity)
    ,avg(ss_ext_sales_price)
    ,avg(ss_ext_wholesale_cost)
    ,sum(ss_ext_wholesale_cost)
from store_sales
    ,store
    ,customer_demographics
    ,household_demographics
    ,customer_address
    ,date_dim
where s_store_sk = ss_store_sk
and ss_sold_date_sk = d_date_sk and d_year = 2001
and((ss_hdemo_sk=hd_demo_sk
and cd_demo_sk = ss_cdemo_sk
and cd_marital_status = 'U'
and cd_education_status = '4 yr Degree'
and ss_sales_price between 100.00 and 150.00
and hd_dep_count = 3
)or
(ss_hdemo_sk=hd_demo_sk
and cd_demo_sk = ss_cdemo_sk
and cd_marital_status = 'D'
and cd_education_status = '2 yr Degree'
and ss_sales_price between 50.00 and 100.00
and hd_dep_count = 1
) or
(ss_hdemo_sk=hd_demo_sk
and cd_demo_sk = ss_cdemo_sk
and cd_marital_status = 'S'
and cd_education_status = 'Advanced Degree'
and ss_sales_price between 150.00 and 200.00
and hd_dep_count = 1
))
and((ss_addr_sk = ca_address_sk
and ca_country = 'United States'
and ca_state in ('IL', 'WI', 'TN')
and ss_net_profit between 100 and 200
) or
(ss_addr_sk = ca_address_sk
and ca_country = 'United States'
and ca_state in ('MO', 'OK', 'WA')
and ss_net_profit between 150 and 300
) or
(ss_addr_sk = ca_address_sk
and ca_country = 'United States'
and ca_state in ('NE', 'VA', 'GA')
and ss_net_profit between 50 and 250
))
;

```

SQL14

```

with cross_items as
(select i_item_sk ss_item_sk
 from item,
(select iss.i_brand_id brand_id
 ,iss.i_class_id class_id
 ,iss.i_category_id category_id
 from store_sales
 ,item iss
 ,date_dim d1
 where ss_item_sk = iss.i_item_sk
 and ss_sold_date_sk = d1.d_date_sk
 and d1.d_year between 2000 AND 2000 + 2
 intersect
 select ics.i_brand_id
 ,ics.i_class_id
 ,ics.i_category_id
 from catalog_sales
 ,item ics
 ,date_dim d2
 where cs_item_sk = ics.i_item_sk
 and cs_sold_date_sk = d2.d_date_sk
 and d2.d_year between 2000 AND 2000 + 2
 intersect
 select iws.i_brand_id
 ,iws.i_class_id
 ,iws.i_category_id
 from web_sales
 ,item iws
 ,date_dim d3
 where ws_item_sk = iws.i_item_sk
 and ws_sold_date_sk = d3.d_date_sk
 and d3.d_year between 2000 AND 2000 + 2)
 where i_brand_id = brand_id
 and i_class_id = class_id
 and i_category_id = category_id
),
avg_sales as
(select avg(quantity*list_price) average_sales
 from (select ss_quantity quantity
 ,ss_list_price list_price
 from store_sales
 ,date_dim
 where ss_sold_date_sk = d_date_sk
 and d_year between 2000 and 2000 + 2
 union all
 select cs_quantity quantity
 ,cs_list_price list_price
 from catalog_sales
 ,date_dim
 where cs_sold_date_sk = d_date_sk
 and d_year between 2000 and 2000 + 2
 union all
 select ws_quantity quantity
 ,ws_list_price list_price
 from web_sales
 ,date_dim
 where ws_sold_date_sk = d_date_sk
 and d_year between 2000 and 2000 + 2) x)
select channel, i_brand_id,i_class_id,i_category_id,sum(sales), sum(number_sales)
from(
 select 'store' channel, i_brand_id,i_class_id
 ,i_category_id,sum(ss_quantity*ss_list_price) sales
 , count(*) number_sales
 from store_sales
 ,item
 ,date_dim
 where ss_item_sk in (select ss_item_sk from cross_items)
 and ss_item_sk = i_item_sk

```

```

        and ss_sold_date_sk = d_date_sk
        and d_year = 2000+2
        and d_moy = 11
    group by i_brand_id,i_class_id,i_category_id
    having sum(ss_quantity*ss_list_price) > (select average_sales from avg_sales)
    union all
    select 'catalog' channel, i_brand_id,i_class_id,i_category_id, sum(cs_quantity*cs_list_price) sales,
count(*) number_sales
    from catalog_sales
        ,item
        ,date_dim
    where cs_item_sk in (select ss_item_sk from cross_items)
        and cs_item_sk = i_item_sk
        and cs_sold_date_sk = d_date_sk
        and d_year = 2000+2
        and d_moy = 11
    group by i_brand_id,i_class_id,i_category_id
    having sum(cs_quantity*cs_list_price) > (select average_sales from avg_sales)
    union all
    select 'web' channel, i_brand_id,i_class_id,i_category_id, sum(ws_quantity*ws_list_price) sales , count(*)
number_sales
    from web_sales
        ,item
        ,date_dim
    where ws_item_sk in (select ss_item_sk from cross_items)
        and ws_item_sk = i_item_sk
        and ws_sold_date_sk = d_date_sk
        and d_year = 2000+2
        and d_moy = 11
    group by i_brand_id,i_class_id,i_category_id
    having sum(ws_quantity*ws_list_price) > (select average_sales from avg_sales)
) y
group by rollup (channel, i_brand_id,i_class_id,i_category_id)
order by channel,i_brand_id,i_class_id,i_category_id
limit 100;
with cross_items as
(select i_item_sk ss_item_sk
from item,
(select iss.i_brand_id brand_id
,iss.i_class_id class_id
,iss.i_category_id category_id
from store_sales
,item iss
,date_dim d1
where ss_item_sk = iss.i_item_sk
and ss_sold_date_sk = d1.d_date_sk
and d1.d_year between 2000 AND 2000 + 2
intersect
select ics.i_brand_id
,ics.i_class_id
,ics.i_category_id
from catalog_sales
,item ics
,date_dim d2
where cs_item_sk = ics.i_item_sk
and cs_sold_date_sk = d2.d_date_sk
and d2.d_year between 2000 AND 2000 + 2
intersect
select iws.i_brand_id
,iws.i_class_id
,iws.i_category_id
from web_sales
,item iws
,date_dim d3
where ws_item_sk = iws.i_item_sk
and ws_sold_date_sk = d3.d_date_sk
and d3.d_year between 2000 AND 2000 + 2) x
where i_brand_id = brand_id
and i_class_id = class_id

```



```

        and i_category_id = category_id
    ),
    avg_sales as
    (select avg(quantity*list_price) average_sales
     from (select ss_quantity quantity
              ,ss_list_price list_price
            from store_sales
              ,date_dim
            where ss_sold_date_sk = d_date_sk
              and d_year between 2000 and 2000 + 2
            union all
            select cs_quantity quantity
              ,cs_list_price list_price
            from catalog_sales
              ,date_dim
            where cs_sold_date_sk = d_date_sk
              and d_year between 2000 and 2000 + 2
            union all
            select ws_quantity quantity
              ,ws_list_price list_price
            from web_sales
              ,date_dim
            where ws_sold_date_sk = d_date_sk
              and d_year between 2000 and 2000 + 2) x)
    select this_year.channel ty_channel
           ,this_year.i_brand_id ty_brand
           ,this_year.i_class_id ty_class
           ,this_year.i_category_id ty_category
           ,this_year.sales ty_sales
           ,this_year.number_sales ty_number_sales
           ,last_year.channel ly_channel
           ,last_year.i_brand_id ly_brand
           ,last_year.i_class_id ly_class
           ,last_year.i_category_id ly_category
           ,last_year.sales ly_sales
           ,last_year.number_sales ly_number_sales
    from
    (select 'store' channel, i_brand_id,i_class_id,i_category_id
           ,sum(ss_quantity*ss_list_price) sales, count(*) number_sales
     from store_sales
           ,item
           ,date_dim
     where ss_item_sk in (select ss_item_sk from cross_items)
       and ss_item_sk = i_item_sk
       and ss_sold_date_sk = d_date_sk
       and d_week_seq = (select d_week_seq
                        from date_dim
                        where d_year = 2000 + 1
                          and d_moy = 12
                          and d_dom = 17)
     group by i_brand_id,i_class_id,i_category_id
     having sum(ss_quantity*ss_list_price) > (select average_sales from avg_sales)) this_year,
    (select 'store' channel, i_brand_id,i_class_id
           ,i_category_id, sum(ss_quantity*ss_list_price) sales, count(*) number_sales
     from store_sales
           ,item
           ,date_dim
     where ss_item_sk in (select ss_item_sk from cross_items)
       and ss_item_sk = i_item_sk
       and ss_sold_date_sk = d_date_sk
       and d_week_seq = (select d_week_seq
                        from date_dim
                        where d_year = 2000
                          and d_moy = 12
                          and d_dom = 17)
     group by i_brand_id,i_class_id,i_category_id
     having sum(ss_quantity*ss_list_price) > (select average_sales from avg_sales)) last_year
    where this_year.i_brand_id= last_year.i_brand_id
       and this_year.i_class_id = last_year.i_class_id

```

```
and this_year.i_category_id = last_year.i_category_id
order by this_year.channel, this_year.i_brand_id, this_year.i_class_id, this_year.i_category_id
limit 100;
```

SQL15

```
select ca_zip
      ,sum(cs_sales_price)
from catalog_sales
      ,customer
      ,customer_address
      ,date_dim
where cs_bill_customer_sk = c_customer_sk
      and c_current_addr_sk = ca_address_sk
      and ( substr(ca_zip,1,5) in ('85669', '86197','88274','83405','86475',
                                  '85392', '85460', '80348', '81792')
           or ca_state in ('CA','WA','GA')
           or cs_sales_price > 500)
      and cs_sold_date_sk = d_date_sk
      and d_qoy = 2 and d_year = 1999
group by ca_zip
order by ca_zip
limit 100;
```

SQL16

```
select
  count(distinct cs_order_number) as "order count"
  ,sum(cs_ext_ship_cost) as "total shipping cost"
  ,sum(cs_net_profit) as "total net profit"
from
  catalog_sales cs1
  ,date_dim
  ,customer_address
  ,call_center
where
  d_date between '1999-2-01' and
    (cast('1999-2-01' as date) + 60 )
and cs1.cs_ship_date_sk = d_date_sk
and cs1.cs_ship_addr_sk = ca_address_sk
and ca_state = 'TX'
and cs1.cs_call_center_sk = cc_call_center_sk
and cc_county in ('Barrow County','Luce County','Mobile County','Richland County',
                  'Wadena County'
)
and exists (select *
            from catalog_sales cs2
            where cs1.cs_order_number = cs2.cs_order_number
              and cs1.cs_warehouse_sk <> cs2.cs_warehouse_sk)
and not exists(select *
               from catalog_returns cr1
               where cs1.cs_order_number = cr1.cr_order_number)
order by count(distinct cs_order_number)
limit 100;
```

SQL17

```
select i_item_id
      ,i_item_desc
      ,s_state
      ,count(ss_quantity) as store_sales_quantitycount
      ,avg(ss_quantity) as store_sales_quantityave
      ,stddev_samp(ss_quantity) as store_sales_quantitystdev
      ,stddev_samp(ss_quantity)/avg(ss_quantity) as store_sales_quantitycov
      ,count(sr_return_quantity) as store_returns_quantitycount
      ,avg(sr_return_quantity) as store_returns_quantityave
      ,stddev_samp(sr_return_quantity) as store_returns_quantitystdev
      ,stddev_samp(sr_return_quantity)/avg(sr_return_quantity) as store_returns_quantitycov
```

```

, count(cs_quantity) as catalog_sales_quantitycount, avg(cs_quantity) as catalog_sales_quantityave
, stddev_samp(cs_quantity) as catalog_sales_quantitystdev
, stddev_samp(cs_quantity)/avg(cs_quantity) as catalog_sales_quantitycov
from store_sales
, store_returns
, catalog_sales
, date_dim d1
, date_dim d2
, date_dim d3
, store
, item
where d1.d_quarter_name = '2000Q1'
and d1.d_date_sk = ss_sold_date_sk
and i_item_sk = ss_item_sk
and s_store_sk = ss_store_sk
and ss_customer_sk = sr_customer_sk
and ss_item_sk = sr_item_sk
and ss_ticket_number = sr_ticket_number
and sr_returned_date_sk = d2.d_date_sk
and d2.d_quarter_name in ('2000Q1','2000Q2','2000Q3')
and sr_customer_sk = cs_bill_customer_sk
and sr_item_sk = cs_item_sk
and cs_sold_date_sk = d3.d_date_sk
and d3.d_quarter_name in ('2000Q1','2000Q2','2000Q3')
group by i_item_id
, i_item_desc
, s_state
order by i_item_id
, i_item_desc
, s_state
limit 100;

```

SQL18

```

select i_item_id,
ca_country,
ca_state,
ca_county,
avg( cast(cs_quantity as decimal(12,2))) agg1,
avg( cast(cs_list_price as decimal(12,2))) agg2,
avg( cast(cs_coupon_amt as decimal(12,2))) agg3,
avg( cast(cs_sales_price as decimal(12,2))) agg4,
avg( cast(cs_net_profit as decimal(12,2))) agg5,
avg( cast(c_birth_year as decimal(12,2))) agg6,
avg( cast(cd1.cd_dep_count as decimal(12,2))) agg7
from catalog_sales, customer_demographics cd1,
customer_demographics cd2, customer, customer_address, date_dim, item
where cs_sold_date_sk = d_date_sk and
cs_item_sk = i_item_sk and
cs_bill_cdemo_sk = cd1.cd_demo_sk and
cs_bill_customer_sk = c_customer_sk and
cd1.cd_gender = 'M' and
cd1.cd_education_status = 'Primary' and
c_current_cdemo_sk = cd2.cd_demo_sk and
c_current_addr_sk = ca_address_sk and
c_birth_month in (10,1,8,7,3,5) and
d_year = 1998 and
ca_state in ('NE','OK','NC',
, 'CO','ID','AR','MO')
group by rollup (i_item_id, ca_country, ca_state, ca_county)
order by ca_country,
ca_state,
ca_county,
i_item_id
limit 100;

```

SQL19

```
select i_brand_id brand_id, i_brand brand, i_manufact_id, i_manufact,
       sum(ss_ext_sales_price) ext_price
from date_dim, store_sales, item, customer, customer_address, store
where d_date_sk = ss_sold_date_sk
     and ss_item_sk = i_item_sk
     and i_manager_id=62
     and d_moy=11
     and d_year=2000
     and ss_customer_sk = c_customer_sk
     and c_current_addr_sk = ca_address_sk
     and substr(ca_zip,1,5) <> substr(s_zip,1,5)
     and ss_store_sk = s_store_sk
group by i_brand
       ,i_brand_id
       ,i_manufact_id
       ,i_manufact
order by ext_price desc
       ,i_brand
       ,i_brand_id
       ,i_manufact_id
       ,i_manufact
limit 100 ;
```

SQL20

```
select i_item_id
       ,i_item_desc
       ,i_category
       ,i_class
       ,i_current_price
       ,sum(cs_ext_sales_price) as itemrevenue
       ,sum(cs_ext_sales_price)*100/sum(sum(cs_ext_sales_price)) over
         (partition by i_class) as revenueratio
from catalog_sales
       ,item
       ,date_dim
where cs_item_sk = i_item_sk
     and i_category in ('Sports', 'Shoes', 'Women')
     and cs_sold_date_sk = d_date_sk
     and d_date between cast('2001-03-21' as date)
         and (cast('2001-03-21' as date) + 30)
group by i_item_id
       ,i_item_desc
       ,i_category
       ,i_class
       ,i_current_price
order by i_category
       ,i_class
       ,i_item_id
       ,i_item_desc
       ,revenueratio
limit 100;
```

5 SSB 性能测试

5.1 SSB 测试结果

经过针对SSB宽表场景对DWS和开源OLAP产品ClickHouse的对比测试发现：使用 hstore_opt表，配合turbo存储、turbo引擎，DWS查询性能整体优于开源产品 ClickHouse 2倍。

表 5-1 SSB 测试结果

SSB	DWS	ClickHouse
Q1.1	0.074	0.059
Q1.2	0.039	0.021
Q1.3	0.102	0.022
Q2.1	0.052	0.254
Q2.2	0.236	0.281
Q2.3	0.064	0.214
Q3.1	0.101	0.434
Q3.2	0.049	0.348
Q3.3	0.032	0.299
Q3.4	0.010	0.025
Q4.1	0.085	0.456
Q4.2	0.047	0.171
Q4.3	0.023	0.146
总时长 (s)	0.913	2.73

5.2 SSB 测试环境

硬件环境

每个测试环境6个节点，配置如下：

- CPU 16核：Intel Ice Lake
- 内存：64GB
- 网络带宽：9Gbit/s
- 磁盘：SSD云盘，每块600GB，共2块

软件环境

内核版本：Linux 3.10.0-862.14.1.5.h757.eulerosv2r7.x86_64

操作系统：EulerOS release 2.0 (SP5)

数据库版本：DWS 3.0

5.3 SSB 测试过程

5.3.1 SSB 测试数据

表 5-2 SSB 测试数据

序号	表名	行数	表大小
1	supplier	200000	-
2	customer	3000000	-
3	part	1400000	-
4	lineorder	60037902	-
5	lineorder_flat	60037902	-

5.3.2 SSB 数据生成

步骤1 下载ssb工具包并编译。

```
git clone http://github.com/vadimtk/ssb-dbgen.git  
cd ssb-dbgen && make
```

步骤2 生成数据。

📖 说明

文件生成路径最好符合[安装和启动GDS](#)中SSB所使用的路径，否则需要修改[安装和启动GDS](#)中GDS的启动路径。

```
./dbgen -s 100 -T c  
./dbgen -s 100 -T l  
./dbgen -s 100 -T p  
./dbgen -s 100 -T s  
./dbgen -s 100 -T d
```

----结束

5.3.3 建表与导入 SSB 数据

创建 SSB 目标表

连接DWS数据库后执行以下SQL语句。

```
CREATE TABLE CUSTOMER  
(  
  C_CUSTKEY  BIGINT NOT NULL,  
  C_NAME     VARCHAR(25) NOT NULL,  
  C_ADDRESS  VARCHAR(40) NOT NULL,  
  C_CITY     VARCHAR(25) NOT NULL,  
  C_NATION   VARCHAR(25) NOT NULL,  
  C_REGION   VARCHAR(25) NOT NULL,  
  C_PHONE    VARCHAR(15) NOT NULL,  
  C_MKTSEGMENT VARCHAR(10) NOT NULL  
)  
WITH (orientation=column, colversion=2.0,enable_hstore=true,enable_hstore_opt=true)  
DISTRIBUTE BY hash(C_CUSTKEY);  
CREATE TABLE SUPPLIER  
(  
  S_SUPPKEY  BIGINT NOT NULL  
, S_NAME  VARCHAR(25) NOT NULL  
, S_ADDRESS VARCHAR(40) NOT NULL  
, S_CITY   VARCHAR(25) NOT NULL  
, S_NATION  VARCHAR(25) NOT NULL  
, S_REGION  VARCHAR(25) NOT NULL  
, S_PHONE  VARCHAR(15) NOT NULL  
)  
WITH (orientation=column, colversion=2.0,enable_hstore=true,enable_hstore_opt=true)  
DISTRIBUTE BY hash(S_SUPPKEY);  
CREATE TABLE PART  
(  
  P_PARTKEY  BIGINT NOT NULL  
, P_NAME  VARCHAR(55) NOT NULL  
, P_MFGR  VARCHAR(25) NOT NULL  
, P_CATEGORY VARCHAR(25) NOT NULL  
, P_BRAND  VARCHAR(10) NOT NULL  
, P_COLOR  VARCHAR(20) NOT NULL  
, P_TYPE  VARCHAR(25) NOT NULL  
, P_SIZE  BIGINT NOT NULL  
, P_CONTAINER  VARCHAR(10) NOT NULL  
)  
WITH (orientation=column, colversion=2.0,enable_hstore=true,enable_hstore_opt=true)  
DISTRIBUTE BY hash(P_PARTKEY);  
CREATE TABLE lineorder  
(  
  LO_ORDERKEY      BIGINT NOT NULL,  
  LO_LINENUMBER    BIGINT NOT NULL,  
  LO_CUSTKEY       BIGINT NOT NULL,  
  LO_PARTKEY       BIGINT NOT NULL,  
  LO_SUPPKEY       BIGINT NOT NULL,  
  LO_ORDERDATE     DATE NOT NULL,  
  LO_ORDERPRIORITY VARCHAR(15) NOT NULL,  
  LO_SHIPPRIORITY  BIGINT NOT NULL,  
  LO_QUANTITY      BIGINT NOT NULL,  
  LO_EXTENDEDPRICE BIGINT NOT NULL,  
  LO_ORDTOTALPRICE BIGINT NOT NULL,  
  LO_DISCOUNT     BIGINT NOT NULL,  
  LO_REVENUE       BIGINT NOT NULL,
```

```

LO_SUPPLYCOST      BIGINT NOT NULL,
LO_TAX             BIGINT NOT NULL,
LO_COMMITDATE     DATE NOT NULL,
LO_SHIPMODE       VARCHAR(10) NOT NULL
)
WITH (orientation=column, colversion=2.0,enable_hstore=true,enable_hstore_opt=true)
DISTRIBUTE BY hash(LO_ORDERKEY)
PARTITION BY RANGE(LO_ORDERDATE)
(
PARTITION LO_ORDERDATE_1 VALUES LESS THAN('1992-04-01 00:00:00'),
PARTITION LO_ORDERDATE_2 VALUES LESS THAN('1992-07-01 00:00:00'),
PARTITION LO_ORDERDATE_3 VALUES LESS THAN('1992-10-01 00:00:00'),
PARTITION LO_ORDERDATE_4 VALUES LESS THAN('1993-01-01 00:00:00'),
PARTITION LO_ORDERDATE_5 VALUES LESS THAN('1993-04-01 00:00:00'),
PARTITION LO_ORDERDATE_6 VALUES LESS THAN('1993-07-01 00:00:00'),
PARTITION LO_ORDERDATE_7 VALUES LESS THAN('1993-10-01 00:00:00'),
PARTITION LO_ORDERDATE_8 VALUES LESS THAN('1994-01-01 00:00:00'),
PARTITION LO_ORDERDATE_9 VALUES LESS THAN('1994-04-01 00:00:00'),
PARTITION LO_ORDERDATE_10 VALUES LESS THAN('1994-07-01 00:00:00'),
PARTITION LO_ORDERDATE_11 VALUES LESS THAN('1994-10-01 00:00:00'),
PARTITION LO_ORDERDATE_12 VALUES LESS THAN('1995-01-01 00:00:00'),
PARTITION LO_ORDERDATE_13 VALUES LESS THAN('1995-04-01 00:00:00'),
PARTITION LO_ORDERDATE_14 VALUES LESS THAN('1995-07-01 00:00:00'),
PARTITION LO_ORDERDATE_15 VALUES LESS THAN('1995-10-01 00:00:00'),
PARTITION LO_ORDERDATE_16 VALUES LESS THAN('1996-01-01 00:00:00'),
PARTITION LO_ORDERDATE_17 VALUES LESS THAN('1996-04-01 00:00:00'),
PARTITION LO_ORDERDATE_18 VALUES LESS THAN('1996-07-01 00:00:00'),
PARTITION LO_ORDERDATE_19 VALUES LESS THAN('1996-10-01 00:00:00'),
PARTITION LO_ORDERDATE_20 VALUES LESS THAN('1997-01-01 00:00:00'),
PARTITION LO_ORDERDATE_21 VALUES LESS THAN('1997-04-01 00:00:00'),
PARTITION LO_ORDERDATE_22 VALUES LESS THAN('1997-07-01 00:00:00'),
PARTITION LO_ORDERDATE_23 VALUES LESS THAN('1997-10-01 00:00:00'),
PARTITION LO_ORDERDATE_24 VALUES LESS THAN('1998-01-01 00:00:00'),
PARTITION LO_ORDERDATE_25 VALUES LESS THAN('1998-04-01 00:00:00'),
PARTITION LO_ORDERDATE_26 VALUES LESS THAN('1998-07-01 00:00:00'),
PARTITION LO_ORDERDATE_27 VALUES LESS THAN('1998-10-01 00:00:00'),
PARTITION LO_ORDERDATE_28 VALUES LESS THAN('1999-01-01 00:00:00')
);
SET enable_hstoreopt_auto_bitmap=true;
CREATE TABLE lineorder_flat
(
LO_ORDERKEY      BIGINT NOT NULL,
LO_LINENUMBER   BIGINT NOT NULL,
LO_CUSTKEY      BIGINT NOT NULL,
LO_PARTKEY      BIGINT NOT NULL,
LO_SUPPKEY      BIGINT NOT NULL,
LO_ORDERDATE    DATE NOT NULL,
LO_ORDERPRIORITY  VARCHAR(15) NOT NULL,
LO_SHIPPRIORITY  BIGINT NOT NULL,
LO_QUANTITY     BIGINT NOT NULL,
LO_EXTENDEDPRICE BIGINT NOT NULL,
LO_ORDTOTALPRICE BIGINT NOT NULL,
LO_DISCOUNT    BIGINT NOT NULL,
LO_REVENUE      BIGINT NOT NULL,
LO_SUPPLYCOST   BIGINT NOT NULL,
LO_TAX          BIGINT NOT NULL,
LO_COMMITDATE   DATE NOT NULL,
LO_SHIPMODE     VARCHAR(10) NOT NULL,
C_NAME         VARCHAR(25) NOT NULL
,C_ADDRESS     VARCHAR(40) NOT NULL
,C_CITY       VARCHAR(25) NOT NULL
,C_NATION     VARCHAR(25) NOT NULL
,C_REGION     VARCHAR(25) NOT NULL
,C_PHONE      VARCHAR(15) NOT NULL
,C_MKTSEGMENT VARCHAR(10) NOT NULL
,S_NAME       VARCHAR(25) NOT NULL
,S_ADDRESS    VARCHAR(40) NOT NULL
,S_CITY      VARCHAR(25) NOT NULL
,S_NATION     VARCHAR(25) NOT NULL

```



```
, S_REGION VARCHAR(25) NOT NULL
, S_PHONE VARCHAR(15) NOT NULL
, P_NAME VARCHAR(55) NOT NULL
, P_MFGR VARCHAR(25) NOT NULL
, P_CATEGORY VARCHAR(25) NOT NULL
, P_BRAND VARCHAR(10) NOT NULL
, P_COLOR VARCHAR(20) NOT NULL
, P_TYPE VARCHAR(25) NOT NULL
, P_SIZE BIGINT NOT NULL
, P_CONTAINER VARCHAR(10) NOT NULL
, Partial Cluster Key(s_region,s_nation,s_city)
) WITH (orientation=column,
colversion=2.0,enable_hstore=true,enable_hstore_opt=true,secondary_part_column='p_mfgr',
secondary_part_num=8)
DISTRIBUTE BY hash(LO_ORDERKEY)
PARTITION BY RANGE(LO_ORDERDATE)
(
PARTITION LO_ORDERDATE_1 VALUES LESS THAN('1992-04-01 00:00:00'),
PARTITION LO_ORDERDATE_2 VALUES LESS THAN('1992-07-01 00:00:00'),
PARTITION LO_ORDERDATE_3 VALUES LESS THAN('1992-10-01 00:00:00'),
PARTITION LO_ORDERDATE_4 VALUES LESS THAN('1993-01-01 00:00:00'),
PARTITION LO_ORDERDATE_5 VALUES LESS THAN('1993-04-01 00:00:00'),
PARTITION LO_ORDERDATE_6 VALUES LESS THAN('1993-07-01 00:00:00'),
PARTITION LO_ORDERDATE_7 VALUES LESS THAN('1993-10-01 00:00:00'),
PARTITION LO_ORDERDATE_8 VALUES LESS THAN('1994-01-01 00:00:00'),
PARTITION LO_ORDERDATE_9 VALUES LESS THAN('1994-04-01 00:00:00'),
PARTITION LO_ORDERDATE_10 VALUES LESS THAN('1994-07-01 00:00:00'),
PARTITION LO_ORDERDATE_11 VALUES LESS THAN('1994-10-01 00:00:00'),
PARTITION LO_ORDERDATE_12 VALUES LESS THAN('1995-01-01 00:00:00'),
PARTITION LO_ORDERDATE_13 VALUES LESS THAN('1995-04-01 00:00:00'),
PARTITION LO_ORDERDATE_14 VALUES LESS THAN('1995-07-01 00:00:00'),
PARTITION LO_ORDERDATE_15 VALUES LESS THAN('1995-10-01 00:00:00'),
PARTITION LO_ORDERDATE_16 VALUES LESS THAN('1996-01-01 00:00:00'),
PARTITION LO_ORDERDATE_17 VALUES LESS THAN('1996-04-01 00:00:00'),
PARTITION LO_ORDERDATE_18 VALUES LESS THAN('1996-07-01 00:00:00'),
PARTITION LO_ORDERDATE_19 VALUES LESS THAN('1996-10-01 00:00:00'),
PARTITION LO_ORDERDATE_20 VALUES LESS THAN('1997-01-01 00:00:00'),
PARTITION LO_ORDERDATE_21 VALUES LESS THAN('1997-04-01 00:00:00'),
PARTITION LO_ORDERDATE_22 VALUES LESS THAN('1997-07-01 00:00:00'),
PARTITION LO_ORDERDATE_23 VALUES LESS THAN('1997-10-01 00:00:00'),
PARTITION LO_ORDERDATE_24 VALUES LESS THAN('1998-01-01 00:00:00'),
PARTITION LO_ORDERDATE_25 VALUES LESS THAN('1998-04-01 00:00:00'),
PARTITION LO_ORDERDATE_26 VALUES LESS THAN('1998-07-01 00:00:00'),
PARTITION LO_ORDERDATE_27 VALUES LESS THAN('1998-10-01 00:00:00'),
PARTITION LO_ORDERDATE_28 VALUES LESS THAN('1999-01-01 00:00:00')
);
SET enable_hstoreopt_auto_bitmap=false;
```

创建 SSB 数据集的 GDS 外表

连接DWS数据库后执行以下SQL语句。

须知

以下每个外表的“**gsfs://192.168.0.90:500x/xxx | gsfs://192.168.0.90:500x/xxx**”中的IP地址和端口，请替换成安装和启动GDS中的对应的GDS的监听IP和端口。如启动两个GDS，则使用“|”区分。如果启动多个GDS，需要将所有GDS的监听IP和端口配置到外表中。

```
DROP FOREIGN TABLE IF EXISTS customer_load;
CREATE FOREIGN TABLE customer_load
(
C_CUSTKEY BIGINT NOT NULL
, C_NAME VARCHAR(25) NOT NULL
```

```

, C_ADDRESS  VARCHAR(40) NOT NULL
, C_CITY    VARCHAR(25) NOT NULL
, C_NATION  VARCHAR(25) NOT NULL
, C_REGION  VARCHAR(25) NOT NULL
, C_PHONE   VARCHAR(15) NOT NULL
, C_MKTSEGMENT VARCHAR(10) NOT NULL)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5004/customer.tbl*',
format 'text',
delimiter '|',
encoding 'utf8',
mode 'Normal'
);

DROP FOREIGN TABLE IF EXISTS supplier_load;
CREATE FOREIGN TABLE supplier_load
(
S_SUPPKEY BIGINT NOT NULL
, S_NAME VARCHAR(25) NOT NULL
, S_ADDRESS VARCHAR(40) NOT NULL
, S_CITY VARCHAR(25) NOT NULL
, S_NATION VARCHAR(25) NOT NULL
, S_REGION VARCHAR(25) NOT NULL
, S_PHONE VARCHAR(15) NOT NULL)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5004/supplier.tbl*',
format 'text',
delimiter '|',
encoding 'utf8',
mode 'Normal'
);

DROP FOREIGN TABLE IF EXISTS part_load;
CREATE FOREIGN TABLE part_load
(
P_PARTKEY BIGINT NOT NULL
, P_NAME VARCHAR(55) NOT NULL
, P_MFGR VARCHAR(25) NOT NULL
, P_CATEGORY VARCHAR(25) NOT NULL
, P_BRAND VARCHAR(10) NOT NULL
, P_COLOR VARCHAR(20) NOT NULL
, P_TYPE VARCHAR(25) NOT NULL
, P_SIZE BIGINT NOT NULL
, P_CONTAINER VARCHAR(10) NOT NULL)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5004/part.tbl*',
format 'text',
delimiter '|',
encoding 'utf8',
mode 'Normal'
);

DROP FOREIGN TABLE IF EXISTS lineorder_load;
CREATE FOREIGN TABLE lineorder_load
(
LO_ORDERKEY          BIGINT NOT NULL,
LO_LINENUMBER        BIGINT NOT NULL,
LO_CUSTKEY            BIGINT NOT NULL,
LO_PARTKEY            BIGINT NOT NULL,
LO_SUPPKEY            BIGINT NOT NULL,
LO_ORDERDATE          DATE NOT NULL,
LO_ORDERPRIORITY      VARCHAR(15) NOT NULL,
LO_SHIPPRIORITY        BIGINT NOT NULL,
LO_QUANTITY            BIGINT NOT NULL,
LO_EXTENDEDPRICE        BIGINT NOT NULL,
LO_ORDTOTALPRICE        BIGINT NOT NULL,
LO_DISCOUNT            BIGINT NOT NULL,
LO_REVENUE              BIGINT NOT NULL,
LO_SUPPLYCOST          BIGINT NOT NULL,

```

```

LO_TAX          BIGINT NOT NULL,
LO_COMMITDATE  DATE NOT NULL,
LO_SHIPMODE    VARCHAR(10) NOT NULL)
SERVER gsmpp_server
OPTIONS(location 'gsfs://192.168.0.90:5004/lineorder.tbl*',
format 'text',
delimiter '|',
encoding 'utf8',
mode 'Normal'
);

```

导入 SSB 数据

执行以下命令导入数据。

```

INSERT INTO customer SELECT * FROM customer_load;
INSERT INTO supplier SELECT * FROM supplier_load;
INSERT INTO part SELECT * FROM part_load;
INSERT INTO lineorder SELECT * FROM lineorder_load;

INSERT INTO lineorder_flat
SELECT
I.LO_ORDERKEY AS LO_ORDERKEY,
I.LO_LINENUMBER AS LO_LINENUMBER,
I.LO_CUSTKEY AS LO_CUSTKEY,
I.LO_PARTKEY AS LO_PARTKEY,
I.LO_SUPPKEY AS LO_SUPPKEY,
I.LO_ORDERDATE AS LO_ORDERDATE,
I.LO_ORDERPRIORITY AS LO_ORDERPRIORITY,
I.LO_SHIPPRIORITY AS LO_SHIPPRIORITY,
I.LO_QUANTITY AS LO_QUANTITY,
I.LO_EXTENDEDPRICE AS LO_EXTENDEDPRICE,
I.LO_ORDTOTALPRICE AS LO_ORDTOTALPRICE,
I.LO_DISCOUNT AS LO_DISCOUNT,
I.LO_REVENUE AS LO_REVENUE,
I.LO_SUPPLYCOST AS LO_SUPPLYCOST,
I.LO_TAX AS LO_TAX,
I.LO_COMMITDATE AS LO_COMMITDATE,
I.LO_SHIPMODE AS LO_SHIPMODE,
c.C_NAME AS C_NAME,
c.C_ADDRESS AS C_ADDRESS,
c.C_CITY AS C_CITY,
c.C_NATION AS C_NATION,
c.C_REGION AS C_REGION,
c.C_PHONE AS C_PHONE,
c.C_MKTSEGMENT AS C_MKTSEGMENT,
s.S_NAME AS S_NAME,
s.S_ADDRESS AS S_ADDRESS,
s.S_CITY AS S_CITY,
s.S_NATION AS S_NATION,
s.S_REGION AS S_REGION,
s.S_PHONE AS S_PHONE,
p.P_NAME AS P_NAME,
p.P_MFGR AS P_MFGR,
p.P_CATEGORY AS P_CATEGORY,
p.P_BRAND AS P_BRAND,
p.P_COLOR AS P_COLOR,
p.P_TYPE AS P_TYPE,
p.P_SIZE AS P_SIZE,
p.P_CONTAINER AS P_CONTAINER
FROM lineorder AS I
INNER JOIN customer AS c ON c.C_CUSTKEY = I.LO_CUSTKEY
INNER JOIN supplier AS s ON s.S_SUPPKEY = I.LO_SUPPKEY
INNER JOIN part AS p ON p.P_PARTKEY = I.LO_PARTKEY;

```

5.3.4 SSB 查询测试

SSB (Star Schema Benchmark) 是一种在学术界和工业界广泛应用的数据库系统性能评估基准测试方法。它能够对比不同数据仓库在处理星型模型查询时的性能，帮助数据库管理员和决策者选择最符合需求的数据库系统。此外，参考OLAP行业的做法，将SSB中的星型模型展平转化为宽表，还可以改造成单一表测试Benchmark (SSB Flat)。

共包含Q1.1~Q1.3、Q2.1~Q2.3、Q3.1~Q3.4、Q4.1~4.3的查询样例，以下为SQL查询语句，仅供参考。

了解更多SSB数据测试，请访问SSB官网。

Q1.1

```
SELECT SUM(LO_EXTENDEDPRICE * LO_DISCOUNT) AS revenue
FROM lineorder_flat
WHERE
LO_ORDERDATE >= date '19930101'
AND LO_ORDERDATE <= date '19931231'
AND LO_DISCOUNT BETWEEN 1 AND 3
AND LO_QUANTITY < 25;
```

Q1.2

```
SELECT SUM(LO_EXTENDEDPRICE * LO_DISCOUNT) AS revenue
FROM lineorder_flat
WHERE
LO_ORDERDATE >= 19940101
AND LO_ORDERDATE <= 19940131
AND LO_DISCOUNT BETWEEN 4 AND 6
AND LO_QUANTITY BETWEEN 26 AND 35;
```

Q1.3

```
SELECT SUM(LO_EXTENDEDPRICE * LO_DISCOUNT) AS revenue
FROM lineorder_flat
WHERE
weekofyear(to_date(LO_ORDERDATE)) = 6
AND LO_ORDERDATE >= 19940101
AND LO_ORDERDATE <= 19941231
AND LO_DISCOUNT BETWEEN 5 AND 7
AND LO_QUANTITY BETWEEN 26 AND 35;
```

Q2.1

```
SELECT
SUM(LO_REVENUE), div(LO_ORDERDATE,10000) AS YEAR,
P_BRAND
FROM lineorder_flat
WHERE P_CATEGORY = 'MFGR#12' AND S_REGION = 'AMERICA'
GROUP BY YEAR, P_BRAND
ORDER BY YEAR, P_BRAND;
```

Q2.2

```
SELECT
SUM(LO_REVENUE), div(LO_ORDERDATE,10000) AS YEAR,
P_BRAND
FROM lineorder_flat
WHERE
P_BRAND >= 'MFGR#2221'
AND P_BRAND <= 'MFGR#2228'
AND S_REGION = 'ASIA'
```

```
GROUP BY YEAR, P_BRAND  
ORDER BY YEAR, P_BRAND;
```

Q2.3

```
SELECT  
SUM(LO_REVENUE), div(LO_ORDERDATE,10000) AS YEAR,  
P_BRAND  
FROM lineorder_flat  
WHERE  
P_BRAND = 'MFGR#2239'  
AND S_REGION = 'EUROPE'  
GROUP BY YEAR, P_BRAND  
ORDER BY YEAR, P_BRAND;
```

Q3.1

```
SELECT  
C_NATION,  
S_NATION, div(LO_ORDERDATE,10000) AS YEAR,  
SUM(LO_REVENUE) AS revenue  
FROM lineorder_flat  
WHERE  
C_REGION = 'ASIA'  
AND S_REGION = 'ASIA'  
AND LO_ORDERDATE >= 19920101  
AND LO_ORDERDATE <= 19971231  
GROUP BY C_NATION, S_NATION, YEAR  
ORDER BY YEAR ASC, revenue DESC;
```

Q3.2

```
SELECT  
C_CITY,  
S_CITY, div(LO_ORDERDATE,10000) AS YEAR,  
SUM(LO_REVENUE) AS revenue  
FROM lineorder_flat  
WHERE  
C_NATION = 'UNITED STATES'  
AND S_NATION = 'UNITED STATES'  
AND LO_ORDERDATE >= 19920101  
AND LO_ORDERDATE <= 19971231  
GROUP BY C_CITY, S_CITY, YEAR  
ORDER BY YEAR ASC, revenue DESC;
```

Q3.3

```
SELECT  
C_CITY,  
S_CITY, div(LO_ORDERDATE,10000) AS YEAR,  
SUM(LO_REVENUE) AS revenue  
FROM lineorder_flat  
WHERE  
C_CITY IN ('UNITED K11', 'UNITED K15')  
AND S_CITY IN ('UNITED K11', 'UNITED K15')  
AND LO_ORDERDATE >= 19920101  
AND LO_ORDERDATE <= 19971231  
GROUP BY C_CITY, S_CITY, YEAR  
ORDER BY YEAR ASC, revenue DESC;
```

Q3.4

```
SELECT  
C_CITY,  
S_CITY, div(LO_ORDERDATE,10000) AS YEAR,  
SUM(LO_REVENUE) AS revenue  
FROM lineorder_flat
```

```
WHERE
C_CITY IN ('UNITED KI1', 'UNITED KI5')
AND S_CITY IN ('UNITED KI1', 'UNITED KI5')
AND LO_ORDERDATE >= 19971201
AND LO_ORDERDATE <= 19971231
GROUP BY C_CITY, S_CITY, YEAR
ORDER BY YEAR ASC, revenue DESC;
```

Q4.1

```
SELECT div(LO_ORDERDATE,10000) AS YEAR,
C_NATION,
SUM(LO_REVENUE - LO_SUPPLYCOST) AS profit
FROM lineorder_flat
WHERE
C_REGION = 'AMERICA'
AND S_REGION = 'AMERICA'
AND P_MFGR IN ('MFGR#1', 'MFGR#2')
GROUP BY YEAR, C_NATION
ORDER BY YEAR ASC, C_NATION ASC;
```

Q4.2

```
SELECT div(LO_ORDERDATE,10000) AS YEAR,
S_NATION,
P_CATEGORY,
SUM(LO_REVENUE - LO_SUPPLYCOST) AS profit
FROM lineorder_flat
WHERE
C_REGION = 'AMERICA'
AND S_REGION = 'AMERICA'
AND LO_ORDERDATE >= 19970101
AND LO_ORDERDATE <= 19981231
AND P_MFGR IN ('MFGR#1', 'MFGR#2')
GROUP BY YEAR, S_NATION, P_CATEGORY
ORDER BY
YEAR ASC,
S_NATION ASC,
P_CATEGORY ASC;
```

Q4.3

```
SELECT div(LO_ORDERDATE,10000) AS YEAR,
S_CITY,
P_BRAND,
SUM(LO_REVENUE - LO_SUPPLYCOST) AS profit
FROM lineorder_flat
WHERE
S_NATION = 'UNITED STATES'
AND LO_ORDERDATE >= 19970101
AND LO_ORDERDATE <= 19981231
AND P_CATEGORY = 'MFGR#14'
GROUP BY YEAR, S_CITY, P_BRAND
ORDER BY YEAR ASC, S_CITY ASC, P_BRAND ASC;
```