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云原生数据仓库 AnalyticDB PostgreSQL 版

性能指标

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格式	说明	样例
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注意	用于警示信息、补充说明等，是用户必须了解的内容。	注意 权重设置为0，该服务器不会再接受新请求。
说明	用于补充说明、最佳实践、窍门等，不是用户必须了解的内容。	说明 您也可以通过按Ctrl+A选中全部文件。
>	多级菜单递进。	单击**设置**> **网络**> **设置网络类型**。
粗体	表示按键、菜单、页面名称等UI元素。	在**结果确认**页面，单击**确定**。
Courier字体	命令或代码。	执行 `cd /d C:/window` 命令，进入Windows系统文件夹。
斜体	表示参数、变量。	`bae log list --instanceid` *Instance_ID*
[] 或者 [a|b]	表示可选项，至多选择一个。	`ipconfig [-all|-t]`
{} 或者 {a|b}	表示必选项，至多选择一个。	`switch {active|stand}`

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1.TPC-H

AnalyticDB PostgreSQL 6.0版在支持ACID和分布式事务的同时，提供了优秀的大数据MPP分析性能。本文讲述如何运行TPC-H进行测试。

TPC-H简介

以下文字描述引用自TPC Benchmark™ H (TPC-H)规范：

“TPC-H是一个决策支持基准，由一套面向业务的临时查询和并发数据修改组成。选择的查询和填充数据库的数据具有广泛的行业相关性。该基准测试说明了决策支持系统可以检查大量数据，执行高度复杂的查询，并解答关键的业务问题。”

详情请参见TPCH Specification。

> **说明**
>
> 本文的TPC-H的实现基于TPC-H的基准测试，并不能与已发布的TPC-H基准测试结果相比较，本文中的测试并不符合TPC-H基准测试的所有要求。

前提条件

- 已注册阿里云账号。
- 已创建用于测试的AnalyticDB PostgreSQL实例。创建实例具体操作，请参见创建实例。

  本文测试的AnalyticDB PostgreSQL实例规格如下：
  - 引擎版本：6.0标准版
  - 节点规格（segment）：2C16G
  - 节点数量（segment）：32
  - 存储磁盘类型：ESSD云盘
  - 节点存储容量（segment）：200 GB
- 已创建用于测试的ECS实例。创建实例具体操作，请参见创建实例。

  本文测试的ECS实例规格如下：
  - 实例规格：ecs.g6e.4xlarge
  - 操作系统：CentOS 7.x
  - 系统盘：磁盘类型为ESSD云盘、容量为40 GiB、性能级别为PL1。
  - 数据盘：磁盘类型为ESSD云盘、容量为2048 GiB、性能级别为PL3。

    > **说明**
    >
    > ECS实例创建完成后需要挂载数据库，具体操作，请参见分区格式化数据盘（Linux）。
- 已开通OSS并创建存储空间。
- 已将ECS实例的IP地址添加到AnalyticDB PostgreSQL实例的白名单中，操作方式，请参见设置白名单。
- 已在ECS上安装psql，安装方式，请参见psql。

生成测试数据

1. 登录ECS实例，登录方式，请参见连接ECS实例。
2. 在ECS上执行以下命令，下载TPC-H dbgen代码到数据盘并编译。

   本文中数据盘的路径为 `/mnt` 。

```
wget https://github.com/electrum/tpch-dbgen/archive/refs/heads/master.zip
yum install -y unzip zip
unzip master.zip
cd tpch-dbgen-master/
echo "#define EOL_HANDLING 1" >> config.h # 消除生成数据末尾的'|'
make
./dbgen --help
```

3. 在ECS上执行如下命令，生成1 TB测试数据集。建议使用分片文件，分片数量与AnalyticDB PostgreSQL版实例节点数量一致，例如本文中示例AnalyticDB PostgreSQL实例有32个计算节点，以下示例中将创建32个分片文件。

```
for((i=1;i<=32;i++));
do
  ./dbgen -s 1000 -S $i -C 32 -f &
done
```

> **说明**
>
> - 数据量的大小对查询速度有直接的影响，TPC-H中使用SF描述数据量，1SF对应1 GB单位。1000SF，即1 TB。1SF对应的数据量只是8个表的总数据量不包括索引等空间占用，准备数据时需预留更多空间。
> - 后台运行dbgen程序时间较长，您可以通过 `ps- fHU $USER | grep dbgen` 命令查看进度，确保dbgen程序运行完成。

创建测试表

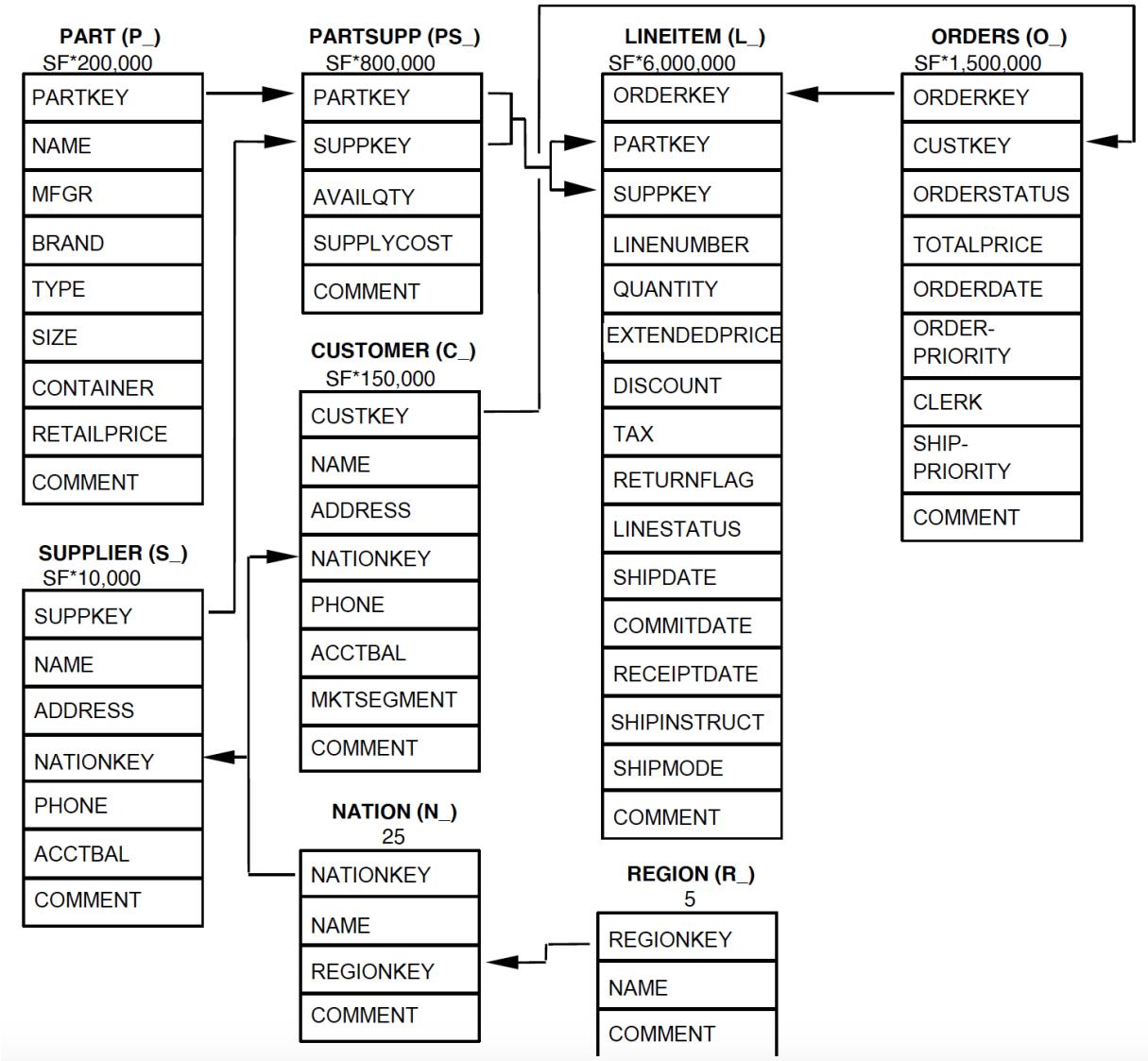
1. 使用psql连接AnalyticDB PostgreSQL，连接方式，请参见psql。
2. 执行如下语句创建用于测试的8张表。

```
CREATE TABLE NATION (
  N_NATIONKEY  INTEGER NOT NULL,
  N_NAME       CHAR(25) NOT NULL,
  N_REGIONKEY  INTEGER NOT NULL,
  N_COMMENT    VARCHAR(152)
)
WITH (APPENDONLY=TRUE, ORIENTATION=COLUMN, COMPRESSTYPE=LZ4, COMPRESSLEVEL=9)
DISTRIBUTED Replicated
;

CREATE TABLE REGION (
  R_REGIONKEY  INTEGER NOT NULL,
  R_NAME       CHAR(25) NOT NULL,
  R_COMMENT    VARCHAR(152)
```

```
)
WITH (APPENDONLY=TRUE, ORIENTATION=COLUMN, COMPRESSTYPE=LZ4, COMPRESSLEVEL=9)
DISTRIBUTED Replicated
;

CREATE TABLE PART (
  P_PARTKEY    INTEGER NOT NULL,
  P_NAME       VARCHAR(55) NOT NULL,
  P_MFGR       CHAR(25) NOT NULL,
  P_BRAND      CHAR(10) NOT NULL,
  P_TYPE       VARCHAR(25) NOT NULL,
  P_SIZE       INTEGER NOT NULL,
  P_CONTAINER  CHAR(10) NOT NULL,
  P_RETAILPRICE DECIMAL(15,2) NOT NULL,
  P_COMMENT    VARCHAR(23) NOT NULL
)
WITH (APPENDONLY=TRUE, ORIENTATION=COLUMN, COMPRESSTYPE=LZ4, COMPRESSLEVEL=9)
DISTRIBUTED BY (P_PARTKEY)
;

CREATE TABLE SUPPLIER (
  S_SUPPKEY    INTEGER NOT NULL,
  S_NAME       CHAR(25) NOT NULL,
  S_ADDRESS    VARCHAR(40) NOT NULL,
  S_NATIONKEY  INTEGER NOT NULL,
  S_PHONE      CHAR(15) NOT NULL,
  S_ACCTBAL    DECIMAL(15,2) NOT NULL,
  S_COMMENT    VARCHAR(101) NOT NULL
)
WITH (APPENDONLY=TRUE, ORIENTATION=COLUMN, COMPRESSTYPE=LZ4, COMPRESSLEVEL=9)
DISTRIBUTED BY (S_SUPPKEY)
;

CREATE TABLE PARTSUPP (
  PS_PARTKEY    INTEGER NOT NULL,
  PS_SUPPKEY    INTEGER NOT NULL,
  PS_AVAILQTY   INTEGER NOT NULL,
  PS_SUPPLYCOST  DECIMAL(15,2)  NOT NULL,
  PS_COMMENT    VARCHAR(199) NOT NULL
)
WITH (APPENDONLY=TRUE, ORIENTATION=COLUMN, COMPRESSTYPE=LZ4, COMPRESSLEVEL=9)
DISTRIBUTED BY (PS_PARTKEY)
;

CREATE TABLE CUSTOMER (
  C_CUSTKEY    INTEGER NOT NULL,
  C_NAME       VARCHAR(25) NOT NULL,
  C_ADDRESS    VARCHAR(40) NOT NULL,
  C_NATIONKEY  INTEGER NOT NULL,
  C_PHONE      CHAR(15) NOT NULL,
  C_ACCTBAL    DECIMAL(15,2)   NOT NULL,
  C_MKTSEGMENT  CHAR(10) NOT NULL,
  C_COMMENT    VARCHAR(117) NOT NULL
)
```

```
WITH (APPENDONLY=TRUE, ORIENTATION=COLUMN, COMPRESSTYPE=LZ4, COMPRESSLEVEL=9)
DISTRIBUTED BY (C_CUSTKEY)
;

CREATE TABLE ORDERS (
  O_ORDERKEY     BIGINT NOT NULL,
  O_CUSTKEY      INTEGER NOT NULL,
  O_ORDERSTATUS   "char" NOT NULL,
  O_TOTALPRICE    DECIMAL(15,2) NOT NULL,
  O_ORDERDATE     DATE NOT NULL,
  O_ORDERPRIORITY  CHAR(15) NOT NULL,
  O_CLERK       CHAR(15) NOT NULL,
  O_SHIPPRIORITY   INTEGER NOT NULL,
  O_COMMENT      VARCHAR(79) NOT NULL
)
WITH (APPENDONLY=TRUE, ORIENTATION=COLUMN, COMPRESSTYPE=LZ4, COMPRESSLEVEL=9)
DISTRIBUTED BY (O_ORDERKEY)
ORDER BY(O_ORDERDATE)
;

CREATE TABLE LINEITEM (
  L_ORDERKEY    BIGINT NOT NULL,
  L_PARTKEY    INTEGER NOT NULL,
  L_SUPPKEY    INTEGER NOT NULL,
  L_LINENUMBER  INTEGER 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  "char" NOT NULL,
  L_LINESTATUS  "char" NOT NULL,
  L_SHIPDATE    DATE NOT NULL,
  L_COMMITDATE  DATE NOT NULL,
  L_RECEIPTDATE DATE NOT NULL,
  L_SHIPINSTRUCT CHAR(25) NOT NULL,
  L_SHIPMODE    CHAR(10) NOT NULL,
  L_COMMENT     VARCHAR(44) NOT NULL
)
WITH (APPENDONLY=TRUE, ORIENTATION=COLUMN, COMPRESSTYPE=LZ4, COMPRESSLEVEL=9)
DISTRIBUTED BY (L_ORDERKEY)
ORDER BY(L_SHIPDATE)
;
```

8张表的逻辑关系如下图所示。



（图片来源于：TPC Benchmark H Standard Specification）

导入数据

以下内容为您介绍如何导入数据到AnalyticDB PostgreSQL数据库中。

1. 在AnalyticDB PostgreSQL数据库中使用COPY命令导入nation和region两张小表，命令如下：

```
\copy nation from '/mnt/tpch-dbgen-master/nation.tbl' DELIMITER '|';
\copy region from '/mnt/tpch-dbgen-master/region.tbl' DELIMITER '|';
```

> **说明**
>
> 上述示例中的 `/mnt/tpch-dbgen-master` 为示例路径，测试过程中请替换成 `nation.tbl` 和 `region.tbl` 文件的实际路径。

2. 将其余的6张大表通过ossutil上传到OSS。更多关于ossutil的使用方法，请参见概述。

> **说明**
>
> 由于\COPY命令需要通过Master节点进行串行数据写入处理，无法实现并行写入大批量数据，因此需要通过OSS进行数据导入。

i. 在ECS上下载ossutil，命令如下：

```
wget http://gosspublic.alicdn.com/ossutil/1.7.3/ossutil64
```

ii. 修改文件的执行权限，命令如下：

```
chmod 755 ossutil64
```

iii. 执行如下语句，依次将其余6张表的 `.tbl` 文件通过ossutil上传到OSS。

```
ls <table_name>.tbl* | while read line;
do
~/ossutil64 -e <EndPoint> -i <AccessKey ID> -k <Access Key Secret> cp $line oss://<oss bucket>/<目录>/ &
done
```

3. 待所有表上传到OSS后，在AnalyticDB PostgreSQL数据库中执行如下语句将数据从OSS导入表。具体信息，请参见使用COPY/UNLOAD导入/导出数据到OSS。

```
COPY customer
FROM 'oss://<oss bucket>/<目录>/customer.tbl'
ACCESS_KEY_ID '<AccessKey ID>'
SECRET_ACCESS_KEY '<Access Key Secret>'
FORMAT AS text
"delimiter" '|'
"null" ''
ENDPOINT '<EndPoint>'
FDW 'oss_fdw'
;

COPY lineitem
FROM 'oss://<oss bucket>/<目录>/lineitem.tbl'
ACCESS_KEY_ID '<AccessKey ID>'
SECRET_ACCESS_KEY '<Access Key Secret>'
FORMAT AS text
"delimiter" '|'
"null" ''
ENDPOINT '<EndPoint>'
FDW 'oss_fdw'
;

-- lineitem表定义了排序列，数据导入完成后可对数据进行聚簇排序
sort lineitem;

COPY orders
FROM 'oss://<oss bucket>/<目录>/orders.tbl'
ACCESS_KEY_ID '<AccessKey ID>'
SECRET_ACCESS_KEY '<Access Key Secret>'
```

```
FORMAT AS text
"delimiter" '|'
"null" ''
ENDPOINT '<EndPoint>'
FDW 'oss_fdw'
;

-- orders表定义了排序列，数据导入完成后可对数据进行聚簇排序
sort orders;

COPY part
FROM 'oss://<oss bucket>/<目录>/part.tbl'
ACCESS_KEY_ID '<AccessKey ID>'
SECRET_ACCESS_KEY '<Access Key Secret>'
FORMAT AS text
"delimiter" '|'
"null" ''
ENDPOINT '<EndPoint>'
FDW 'oss_fdw'
;

COPY supplier
FROM 'oss://<oss bucket>/<目录>/supplier.tbl'
ACCESS_KEY_ID '<AccessKey ID>'
SECRET_ACCESS_KEY '<Access Key Secret>'
FORMAT AS text
"delimiter" '|'
"null" ''
ENDPOINT '<EndPoint>'
FDW 'oss_fdw'
;

COPY partsupp
FROM 'oss://<oss bucket>/<目录>/partsupp.tbl'
ACCESS_KEY_ID '<AccessKey ID>'
SECRET_ACCESS_KEY '<Access Key Secret>'
FORMAT AS text
"delimiter" '|'
ENDPOINT '<EndPoint>'
FDW 'oss_fdw'
;
```

执行查询

您可以通过Shell脚本进行测试，也可以通过psql等客户端工具逐条执行查询SQL，以下内容将分别介绍两种执行查询的方法。

Shell脚本

1. 下载tpch_query.tar.gz文件并解压到 `~/tpch_query` 目录。
2. 创建一个名为 `query.sh` 的Shell脚本，用于执行全部查询，并记录每条耗时和总耗时。

   Shell脚本内容如下：

```
#!/bin/bash

total_cost=0

for i in {1..22}
do
    echo "begin run Q${i}, tpch_query/q$i.sql , `date` "
    begin_time=`date +%s.%N`
    ./psql ${实例连接地址} -p ${端口号} -U ${数据库用户} -f ~/tpch_query/q${i}.sql > ~/log/log_q${i}.out
    rc=$?
    end_time=`date +%s.%N`
    cost=`echo "$end_time-$begin_time"|bc`
    total_cost=`echo "$total_cost+$cost"|bc`
    if [ $rc -ne 0 ] ; then
       printf "run Q%s fail, cost: %.2f, totalCost: %.2f, `date`\n" $i $cost $total_cost
    else
       printf "run Q%s succ, cost: %.2f, totalCost: %.2f, `date`\n" $i $cost $total_cost
    fi
done
```

3. 在ECS上运行 query.sh 脚本。

```
nohup bash ~/query.sh > /tmp/tpch.log &
```

4. 执行如下命令查看结果。

```
cat /tmp/tpch.log
```

客户端工具

连接AnalyticDB PostgreSQL数据库后，逐条执行以下语句进行查询，并对比查询结果。

```
--创建向量化计算引擎Laser插件
create extension if not exists laser;

-- Q1
-- 开启向量加速引擎，并设置开关变量为on
set laser.enable = on;
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 '93 day'
group by
```

```
  l_returnflag,
  l_linestatus
order by
  l_returnflag,
  l_linestatus;

-- Q2
-- 开启向量加速引擎，并设置开关变量为on
set laser.enable = on;
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 = 23
  and p_type like '%STEEL'
  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
-- 开启向量加速引擎，并设置开关变量为on
set laser.enable = on;
select
  l_orderkey,
  sum(l_extendedprice * (1 - l_discount)) as revenue,
  o_orderdate,
  o_shippriority
from
  customer,
  orders,
  lineitem
where
  c_mktsegment = 'MACHINERY'
  and c_custkey = o_custkey
  and l_orderkey = o_orderkey
  and o_orderdate < date '1995-03-24'
  and l_shipdate > date '1995-03-24'
group by
  l_orderkey,
  o_orderdate,
  o_shippriority
order by
  revenue desc,
  o_orderdate
limit 10;

-- Q4
-- 开启向量加速引擎，并设置开关变量为on
set laser.enable = on;
select
  o_orderpriority,
  count(*) as order_count
from
  orders
where
  o_orderdate >= date '1996-08-01'
  and o_orderdate < date '1996-08-01' + 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;

-- Q6
-- 开启向量加速引擎，并设置开关变量为on
```

```
set laser.enable = on;
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 0.06 - 0.01 and 0.06 + 0.01
  and l_quantity < 24;

-- Q7
-- 开启向量加速引擎，并设置开关变量为on
set laser.enable = on;
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 = 'JORDAN' and n2.n_name = 'INDONESIA')
        or (n1.n_name = 'INDONESIA' and n2.n_name = 'JORDAN')
      )
      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
```

```
-- Q8
-- 开启向量加速引擎，并设置开关变量为on
set laser.enable = on;
select
  o_year,
  sum(case
    when nation = 'INDONESIA' 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 = 'ASIA'
      and s_nationkey = n2.n_nationkey
      and o_orderdate between date '1995-01-01' and date '1996-12-31'
      and p_type = 'STANDARD BRUSHED BRASS'
  ) as all_nations
group by
  o_year
order by
  o_year;

-- Q9
-- 开启向量加速引擎，并设置开关变量为on
set laser.enable = on;
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
```

```
    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 '%chartreuse%'
  ) as profit
group by
  nation,
  o_year
order by
  nation,
  o_year desc;

-- Q10
-- 开启向量加速引擎，并设置开关变量为on
set laser.enable = on;
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 '1994-08-01'
  and o_orderdate < date '1994-08-01' + 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
-- 开启向量加速引擎，并设置开关变量为on
set laser.enable = on;
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 = 'INDONESIA'
group by
  ps_partkey having
    sum(ps_supplycost * ps_availqty) > (
      select
        sum(ps_supplycost * ps_availqty) * 0.0001000000
      from
        partsupp,
        supplier,
        nation
      where
        ps_suppkey = s_suppkey
        and s_nationkey = n_nationkey
        and n_name = 'INDONESIA'
    )
order by
  value desc;

-- Q12
-- 开启向量加速引擎，并设置开关变量为on
set laser.enable = on;
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 ('REG AIR', 'TRUCK')
  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
-- 开启向量加速引擎，并设置开关变量为on
set laser.enable = on;
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 '%pending%requests%'
    group by
      c_custkey
  ) as c_orders (c_custkey, c_count)
group by
  c_count
order by
  custdist desc,
  c_count desc;

-- Q14
-- 开启向量加速引擎，并设置开关变量为on
set laser.enable = on;
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 '1994-11-01'
  and l_shipdate < date '1994-11-01' + interval '1' month;
```

```
-- Q15
-- 开启向量加速引擎，并设置开关变量为on
set laser.enable = on;
create view revenue0 (supplier_no, total_revenue) as
  select
    l_suppkey,
    sum(l_extendedprice * (1 - l_discount))
  from
    lineitem
  where
    l_shipdate >= date '1997-10-01'
    and l_shipdate < date '1997-10-01' + interval '3' month
  group by
    l_suppkey;
select
  s_suppkey,
  s_name,
  s_address,
  s_phone,
  total_revenue
from
  supplier,
  revenue0
where
  s_suppkey = supplier_no
  and total_revenue = (
    select
      max(total_revenue)
    from
      revenue0
  )
order by
  s_suppkey;
drop view revenue0;

-- Q16
-- 开启向量加速引擎，并设置开关变量为on
set laser.enable = on;
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#44'
  and p_type not like 'SMALL BURNISHED%'
  and p_size in (36, 27, 34, 45, 11, 6, 25, 16)
  and ps_suppkey not in (
    select
      s_suppkey
    from
```

```
    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;

-- Q17
-- 开启向量加速引擎，并设置开关变量为on
set laser.enable = on;
select
  sum(l_extendedprice) / 7.0 as avg_yearly
from
  lineitem,
  part
where
  p_partkey = l_partkey
  and p_brand = 'Brand#42'
  and p_container = 'JUMBO PACK'
  and l_quantity < (
    select
      0.2 * avg(l_quantity)
    from
      lineitem
    where
      l_partkey = p_partkey
  );

-- Q18
-- 开启向量加速引擎，并设置开关变量为on
set laser.enable = on;
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
```

```
    from
      lineitem
    group by
      l_orderkey having
        sum(l_quantity) > 312
  )
  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
-- 开启向量加速引擎，并设置开关变量为on
set laser.enable = on;
select
  sum(l_extendedprice* (1 - l_discount)) as revenue
from
  lineitem,
  part
where
  (
    p_partkey = l_partkey
    and p_brand = 'Brand#43'
    and p_container in ('SM CASE', 'SM BOX', 'SM PACK', 'SM PKG')
    and l_quantity >= 5 and l_quantity <= 5 + 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#45'
    and p_container in ('MED BAG', 'MED BOX', 'MED PKG', 'MED PACK')
    and l_quantity >= 12 and l_quantity <= 12 + 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#11'
    and p_container in ('LG CASE', 'LG BOX', 'LG PACK', 'LG PKG')
    and l_quantity >= 24 and l_quantity <= 24 + 10
    and p_size between 1 and 15
    and l_shipmode in ('AIR', 'AIR REG')
```

```
    and l_shipinstruct = 'DELIVER IN PERSON'
  );

-- Q20
-- 开启向量加速引擎，并设置开关变量为on
set laser.enable = on;
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 'magenta%'
      )
      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 '1996-01-01'
          and l_shipdate < date '1996-01-01' + interval '1' year
      )
  )
  and s_nationkey = n_nationkey
  and n_name = 'RUSSIA'
order by
  s_name;

-- Q21
-- 开启向量加速引擎，并设置开关变量为on
set laser.enable = on;
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 = 'MOZAMBIQUE'
group by
  s_name
order by
  numwait desc,
  s_name
limit 100;

-- Q22
-- 开启向量加速引擎，并设置开关变量为on
set laser.enable = on;
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;
```