TPC-H 2.18.0 on AnalyticDB MySQL

今回はTPC-Hのクエリをご紹介、テスト対象はAnalyticDB MySQLです

概要

本文章はTPC-H 2.18.0のHologresでAnalyticDB MySQLをご紹介します。

1 TPC-H 2.18.0環境を準備する

2 データセットを初期化する

3 データをADB-Mysqlにロードする

4 SQLクエリを実行して性能計測

1 TPC-H 2.18.0環境を準備する

TPC-H2.18.0とは

TPC-Hは複数のテーブルからなるデータベースで22種類のクエリからなるベンチマークスイートです，データ分析に要する処理の性能評価に利用される

インストール

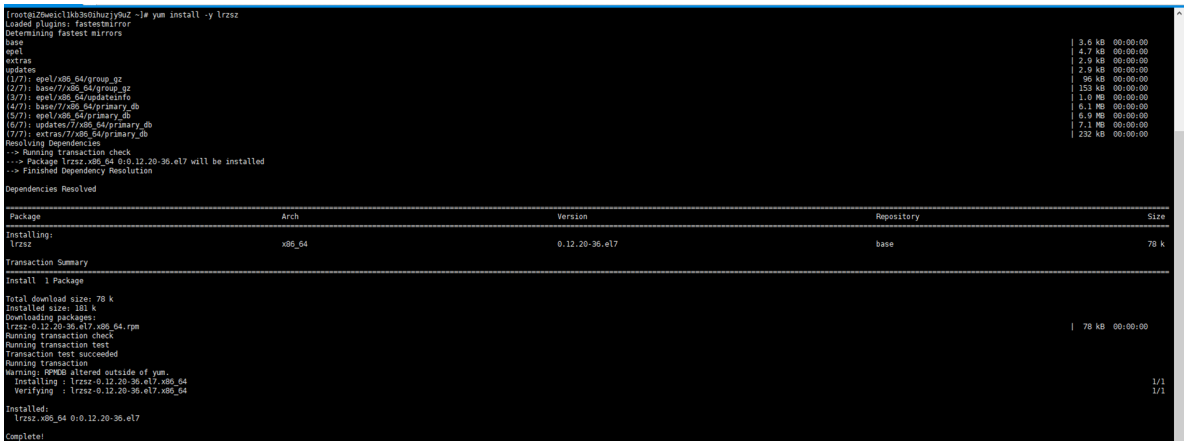
1) ECSインスタンスを作成する

```
ECS:
Specifications: 64 vCPU 512 GiB ecs.hfr6.16xlarge
Disk:140GB
OS: CentOS  7.7 64-bit
```

2) TPC-H 2.18.0環境を準備する

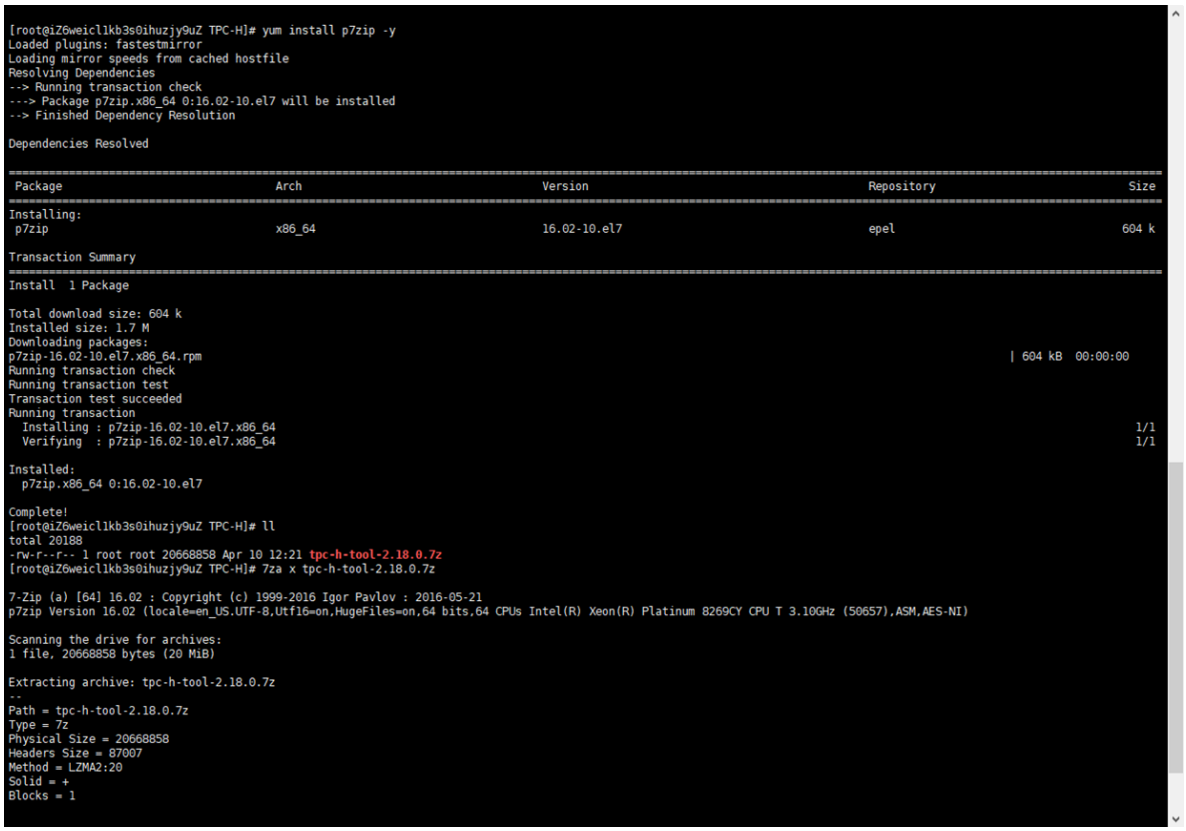
以下の手順でTPC-H 2.18.0環境を準備する。
①TPCHツールをダウンロードする<tpc-h-tool-2.18.0.7z>
②lrszをインストールする

```
# yum install -y lrzsz
```



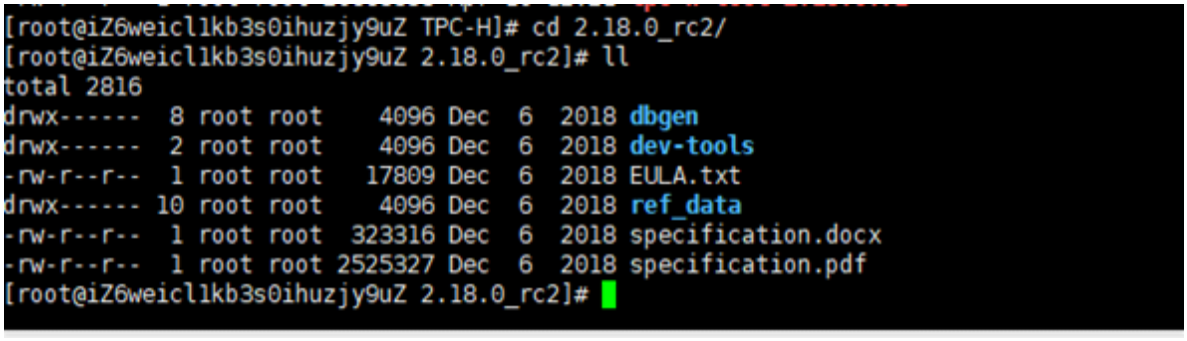
③p7zipをインストールする

```
# yum install p7zip -y
# 7za x tpc-h-tool-2.18.0.7z
```



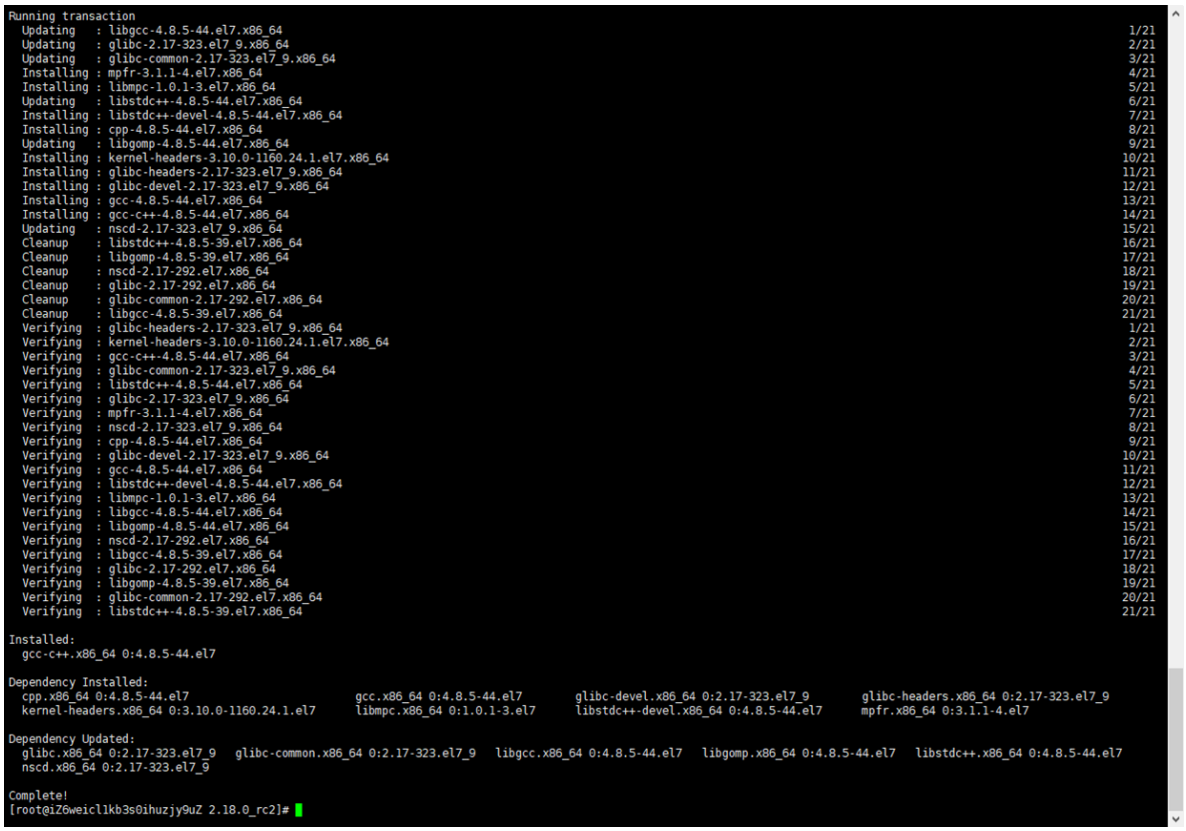
④TPCHファイルを確認する

```
# cd 2.18.0_rc2
# ll
```



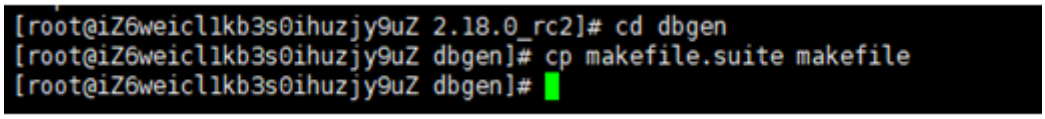
⑤gccをインストールする

```
# yum install gcc-c++
```



⑥tpch環境を設定する

```
# cd dbgen
# cp makefile.suite makefile
```




```
# vim makefile
  #################
   ## CHANGE NAME OF ANSI COMPILER HERE
   #################
   CC      = gcc
   # Current values for DATABASE are: INFORMIX, DB2, ORACLE,
   #                                  SQLSERVER, SYBASE, TDAT (Teradata)
   # Current values for MACHINE are:  ATT, DOS, HP, IBM, ICL, MVS,
   #                                  SGI, SUN, U2200, VMS, LINUX, WIN32
   # Current values for WORKLOAD are:  TPCH
   DATABASE= MYSQL
   MACHINE = LINUX
   WORKLOAD = TPCH
```

```
#
# Revision 1.7  2006/04/12 18:13:58  jms
# release 2.3.3
#
# Revision 1.6  2006/03/09 18:59:19  jms
# move to version 2.3.2
#
# Revision 1.5  2006/01/28 23:54:32  jms
# add reference data to release
#
# Revision 1.4  2005/10/28 03:00:32  jms
# fix release target
#
# Revision 1.3  2005/10/28 02:54:14  jms
# increment build count with each release creation
#
# Revision 1.2  2005/01/03 20:08:58  jms
# change line terminations
#
# Revision 1.1.1.1  2004/11/24 23:31:47  jms
# re-establish external server
#
# Revision 1.5  2004/03/26 20:39:23  jms
# add tpch tag to release files
#
# Revision 1.4  2004/03/16 14:45:57  jms
# correct release target in makefile
#
# Revision 1.3  2004/03/02 20:49:01  jms
# simplify distributions, add Windows IDE files
# releases should use make release from now on
#
# Revision 1.2  2004/02/18 14:05:53  jms
# porting changes for LINUX and 64 bit RNG
#
# Revision 1.1.1.1  2003/04/03 18:54:21  jms
# recreation after CVS crash
#
# Revision 1.1.1.1  2003/04/03 18:54:21  jms
# initial checkin
#
#
#
###############
## CHANGE NAME OF ANSI COMPILER HERE
###############
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= MYSQL
MACHINE = LINUX
WORKLOAD = TPCH
#
-- INSERT --                                                    110,16        39%
```

```
# vim tpcd.h
  #ifdef MYSQL
  #define GEN_QUERY_PLAN ""
  #define START_TRAN "START TRANSACTION"
  #define END_TRAN "COMMIT"
  #define SET_OUTPUT ""
  #define SET_ROWCOUNT "limit %d;\n"
  #define SET_DBASE "use %s;\n"
  #endif
```

```
#define START_TRAN ""
#define END_TRAN ""
#define SET_OUTPUT ""
#define SET_ROWCOUNT "where rownum <= %d;\n"
#define SET_DBASE ""
#endif

#ifdef  SQLSERVER
#define GEN_QUERY_PLAN  "set showplan on\nset noexec on\ngo\n"
#define START_TRAN      "begin transaction\ngo\n"
#define END_TRAN        "commit transaction\ngo\n"
#define SET_OUTPUT      ""
#define SET_ROWCOUNT    "set rowcount %d\ngo\n\n"
#define SET_DBASE       "use %s\ngo\n"
#endif

#ifdef  SYBASE
#define GEN_QUERY_PLAN  "set showplan on\nset noexec on\ngo\n"
#define START_TRAN      "begin transaction\ngo\n"
#define END_TRAN        "commit transaction\ngo\n"
#define SET_OUTPUT      ""
#define SET_ROWCOUNT    "set rowcount %d\ngo\n\n"
#define SET_DBASE       "use %s\ngo\n"
#endif

#ifdef TDAT
#define GEN_QUERY_PLAN  "EXPLAIN"
#define START_TRAN      "BEGIN TRANSACTION"
#define END_TRAN        "END TRANSACTION"
#define SET_OUTPUT      ".SET FORMAT OFF\n.EXPORT REPORT file="
#define SET_ROWCOUNT    ".SET RETCANCEL ON\n.SET RETLIMIT %d\n"
#define SET_DBASE       ".LOGON %s\n"
#endif

#ifdef MYSQL
#define GEN_QUERY_PLAN ""
#define START_TRAN "START TRANSACTION"
#define END_TRAN "COMMIT"
#define SET_OUTPUT ""
#define SET_ROWCOUNT "limit %d;\n"
#define SET_DBASE "use %s;\n"
#endif

#define MAX_VARS     8 /* max number of host vars in any query */
#define QLEN_MAX   2048 /* max length of any query */
#define QUERIES_PER_SET 22

EXTERN int flags;
EXTERN int s_cnt;
EXTERN char *osuff;
EXTERN int stream;
EXTERN char *lfile;
EXTERN char *ifile;
EXTERN char *tfile;

#define MAX_PERMUTE     41
-- INSERT --                                                    122,7         89%
```

```
#make
```

```
  Verifying  : glibc-headers-2.17-323.el7_9.x86_64                                                                    1/21
  Verifying  : kernel-headers-3.10.0-1160.24.1.el7.x86_64                                                             2/21
  Verifying  : gcc-c++-4.8.5-44.el7.x86_64                                                                            3/21
  Verifying  : glibc-common-2.17-323.el7_9.x86_64                                                                     4/21
  Verifying  : libstdc++-4.8.5-44.el7.x86_64                                                                          5/21
  Verifying  : glibc-2.17-323.el7_9.x86_64                                                                            6/21
  Verifying  : mpfr-3.1.1-4.el7.x86_64                                                                                7/21
  Verifying  : nscd-2.17-323.el7_9.x86_64                                                                             8/21
  Verifying  : cpp-4.8.5-44.el7.x86_64                                                                                9/21
  Verifying  : glibc-devel-2.17-323.el7_9.x86_64                                                                     10/21
  Verifying  : gcc-4.8.5-44.el7.x86_64                                                                               11/21
  Verifying  : libstdc++-devel-4.8.5-44.el7.x86_64                                                                   12/21
  Verifying  : libmpc-1.0.1-3.el7.x86_64                                                                             13/21
  Verifying  : libgcc-4.8.5-44.el7.x86_64                                                                            14/21
  Verifying  : libgomp-4.8.5-44.el7.x86_64                                                                           15/21
  Verifying  : nscd-2.17-292.el7.x86_64                                                                              16/21
  Verifying  : libgcc-4.8.5-39.el7.x86_64                                                                            17/21
  Verifying  : glibc-2.17-292.el7.x86_64                                                                             18/21
  Verifying  : libgomp-4.8.5-39.el7.x86_64                                                                           19/21
  Verifying  : glibc-common-2.17-292.el7.x86_64                                                                      20/21
  Verifying  : libstdc++-4.8.5-39.el7.x86_64                                                                         21/21

Installed:
  gcc-c++.x86_64 0:4.8.5-44.el7

Dependency Installed:
  cpp.x86_64 0:4.8.5-44.el7                      gcc.x86_64 0:4.8.5-44.el7       glibc-devel.x86_64 0:2.17-323.el7_9       glibc-headers.x86_64 0:2.17-323.el7_9
  kernel-headers.x86_64 0:3.10.0-1160.24.1.el7   libmpc.x86_64 0:1.0.1-3.el7     libstdc++-devel.x86_64 0:4.8.5-44.el7     mpfr.x86_64 0:3.1.1-4.el7

Dependency Updated:
  glibc.x86_64 0:2.17-323.el7_9   glibc-common.x86_64 0:2.17-323.el7_9   libgcc.x86_64 0:4.8.5-44.el7   libgomp.x86_64 0:4.8.5-44.el7   libstdc++.x86_64 0:4.8.5-44.el7
  nscd.x86_64 0:2.17-323.el7_9

Complete!
[root@iZ6weiclkb3s0ihuzjy9uZ 2.18.0_rc2]# cd dbgen
[root@iZ6weiclkb3s0ihuzjy9uZ dbgen]# cp makefile.suite makefile
[root@iZ6weiclkb3s0ihuzjy9uZ dbgen]# vim makefile
[root@iZ6weiclkb3s0ihuzjy9uZ dbgen]# vim tpcd.h
[root@iZ6weiclkb3s0ihuzjy9uZ dbgen]# make
gcc -g -DDBNAME=\"dss\" -DLINUX -DMYSQL -DTPCH -DRNG_TEST -D_FILE_OFFSET_BITS=64    -c -o build.o build.c
gcc -g -DDBNAME=\"dss\" -DLINUX -DMYSQL -DTPCH -DRNG_TEST -D_FILE_OFFSET_BITS=64    -c -o driver.o driver.c
gcc -g -DDBNAME=\"dss\" -DLINUX -DMYSQL -DTPCH -DRNG_TEST -D_FILE_OFFSET_BITS=64    -c -o bm_utils.o bm_utils.c
gcc -g -DDBNAME=\"dss\" -DLINUX -DMYSQL -DTPCH -DRNG_TEST -D_FILE_OFFSET_BITS=64    -c -o rnd.o rnd.c
gcc -g -DDBNAME=\"dss\" -DLINUX -DMYSQL -DTPCH -DRNG_TEST -D_FILE_OFFSET_BITS=64    -c -o print.o print.c
gcc -g -DDBNAME=\"dss\" -DLINUX -DMYSQL -DTPCH -DRNG_TEST -D_FILE_OFFSET_BITS=64    -c -o load_stub.o load_stub.c
gcc -g -DDBNAME=\"dss\" -DLINUX -DMYSQL -DTPCH -DRNG_TEST -D_FILE_OFFSET_BITS=64    -c -o bcd2.o bcd2.c
gcc -g -DDBNAME=\"dss\" -DLINUX -DMYSQL -DTPCH -DRNG_TEST -D_FILE_OFFSET_BITS=64    -c -o speed_seed.o speed_seed.c
gcc -g -DDBNAME=\"dss\" -DLINUX -DMYSQL -DTPCH -DRNG_TEST -D_FILE_OFFSET_BITS=64    -c -o text.o text.c
gcc -g -DDBNAME=\"dss\" -DLINUX -DMYSQL -DTPCH -DRNG_TEST -D_FILE_OFFSET_BITS=64    -c -o permute.o permute.c
gcc -g -DDBNAME=\"dss\" -DLINUX -DMYSQL -DTPCH -DRNG_TEST -D_FILE_OFFSET_BITS=64    -c -o rng64.o rng64.c
gcc -g -DDBNAME=\"dss\" -DLINUX -DMYSQL -DTPCH -DRNG_TEST -D_FILE_OFFSET_BITS=64  -O -o dbgen build.o driver.o bm_utils.o rnd.o print.o load_stub.o bcd2.o speed_seed.o text.
o permute.o rng64.o -lm
gcc -g -DDBNAME=\"dss\" -DLINUX -DMYSQL -DTPCH -DRNG_TEST -D_FILE_OFFSET_BITS=64    -c -o qgen.o qgen.c
gcc -g -DDBNAME=\"dss\" -DLINUX -DMYSQL -DTPCH -DRNG_TEST -D_FILE_OFFSET_BITS=64    -c -o varsub.o varsub.c
gcc -g -DDBNAME=\"dss\" -DLINUX -DMYSQL -DTPCH -DRNG_TEST -D_FILE_OFFSET_BITS=64  -O -o qgen build.o bm_utils.o qgen.o rnd.o varsub.o text.o bcd2.o permute.o speed_seed.o rn
g64.o -lm
[root@iZ6weiclkb3s0ihuzjy9uZ dbgen]#
```

make後二つexeファイルが生成される
dbgen：データ生成ツール。InfiniDB公式サイトのテストスクリプトでテストする際に、このツールを使ってtpch関連テーブルを生成する。
qgen：SQL生成ツール。初期化テストクエリを生成する、違うseedで生成されたクエリが異なるため、AlibabaCloudサイトで提供された22個クエリを使う

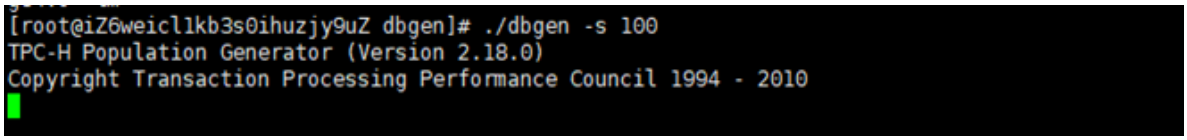
```
drwx------ 2 root root       4096 Dec  6  2018 answers
-rw-r--r-- 1 root root       6072 Dec  6  2018 bcd2.c
-rw-r--r-- 1 root root        859 Dec  6  2018 bcd2.h
-rw-r--r-- 1 root root      18368 Apr 12 11:17 bcd2.o
-rw-r--r-- 1 root root      13632 Dec  6  2018 bm_utils.c
-rw-r--r-- 1 root root      22584 Apr 12 11:17 bm_utils.o
-rw-r--r-- 1 root root      27872 Dec  6  2018 BUGS
-rw-r--r-- 1 root root      11413 Dec  6  2018 build.c
-rw-r--r-- 1 root root      26880 Apr 12 11:17 build.o
drwx------ 2 root root       4096 Dec  6  2018 check_answers
-rwxr-xr-x 1 root root        166 Dec  6  2018 column_split.sh
-rw-r--r-- 1 root root       6358 Dec  6  2018 config.h
-rw-r--r-- 1 root root       3805 Apr 15 18:27 createtable.dll
-rw-r--r-- 1 root root 2463490271 Apr 12 11:40 customer.tbl
-rwxr-xr-x 1 root root     106504 Apr 12 11:17 dbgen
-rw-r--r-- 1 root root       5154 Dec  6  2018 dbgen.dsp
-rw-r--r-- 1 root root      11815 Dec  6  2018 dists.dss
-rw-r--r-- 1 root root      20158 Dec  6  2018 driver.c
-rw-r--r-- 1 root root      40904 Apr 12 11:17 driver.o
-rw-r--r-- 1 root root       3779 Apr 14 10:19 dss.ddl
-rw-r--r-- 1 root root      15399 Dec  6  2018 dss.h
-rw-r--r-- 1 root root       2324 Apr 15 16:07 dss.ri
-rw-r--r-- 1 root root       2072 Dec  6  2018 dss.ri.bk
-rw-r--r-- 1 root root       5127 Dec  6  2018 dsstypes.h
-rw-r--r-- 1 root root      23726 Dec  6  2018 HISTORY
-rw-r--r-- 1 root root        111 Apr 14 19:14 index.log
-rw-r--r-- 1 root root       1351 Apr 14 19:14 index.sh
-rw-r--r-- 1 root root 7957960494506 Apr 12 11:40 lineitem.tbl
-rw-r--r-- 1 root root        658 Apr 17 15:12 load.ddl
-rw-r--r-- 1 root root         83 Apr 18 06:06 load-line.ddl
-rw-r--r-- 1 root root        658 Apr 16 17:55 loadpr.dll
-rw-r--r-- 1 root root       4377 Dec  6  2018 load_stub.c
-rw-r--r-- 1 root root      19400 Apr 12 11:17 load_stub.o
-rw-r--r-- 1 root root       6377 Apr 12 11:12 makefile
-rw-r--r-- 1 root root       6360 Dec  6  2018 makefile.suite
-rw-r--r-- 1 root root       2224 Apr 12 11:40 nation.tbl
-rw------- 1 root root        205 Apr 17 10:43 nohup.out
-rw-r--r-- 1 root root 17793116301 Apr 12 11:40 orders.tbl
-rw-r--r-- 1 root root 12209211160 Apr 12 11:40 partsupp.tbl
-rw-r--r-- 1 root root 2453234158 Apr 12 11:40 part.tbl
-rw-r--r-- 1 root root       3685 Dec  6  2018 permute.c
-rw-r--r-- 1 root root       3357 Dec  6  2018 permute.h
-rw-r--r-- 1 root root       8224 Apr 12 11:17 permute.o
-rw-r--r-- 1 root root       9176 Dec  6  2018 PORTING.NOTES
-rw-r--r-- 1 root root       9582 Dec  6  2018 print.c
-rw-r--r-- 1 root root      29192 Apr 12 11:17 print.o
-rwxr-xr-x 1 root root      98592 Apr 12 11:17 qgen
-rw-r--r-- 1 root root      14404 Dec  6  2018 qgen.c
-rw-r--r-- 1 root root      45992 Apr 12 11:17 qgen.o
-rw-r--r-- 1 root root       4916 Dec  6  2018 qgen.vcproj
drwx------ 2 root root       4096 Apr 15 15:55 queries
-rw-r--r-- 1 root root      17617 Dec  6  2018 README
drwx------ 2 root root       4096 Dec  6  2018 reference
-rw-r--r-- 1 root root        389 Apr 12 11:40 region.tbl
-rw-r--r-- 1 root root         96 Dec  6  2018 release.h
-rw-r--r-- 1 root root       5243 Dec  6  2018 rnd.c
-rw-r--r-- 1 root root       4612 Dec  6  2018 rnd.h
```

ここまでTPCH2.18.0環境を準備完了しました。

2 データセットを初期化する

①データセットを初期化する(ここの手順は何時間ほどかかります。)

```
# ./dbgen -s 100
```



備考：下記のようにchunkパラメータも指定できる。本テストは./dbgen -s 100でデータを生成する
https://help.aliyun.com/document_detail/156328.html?spm=a2c4g.11186623.6.938.61722994H2iWPQ

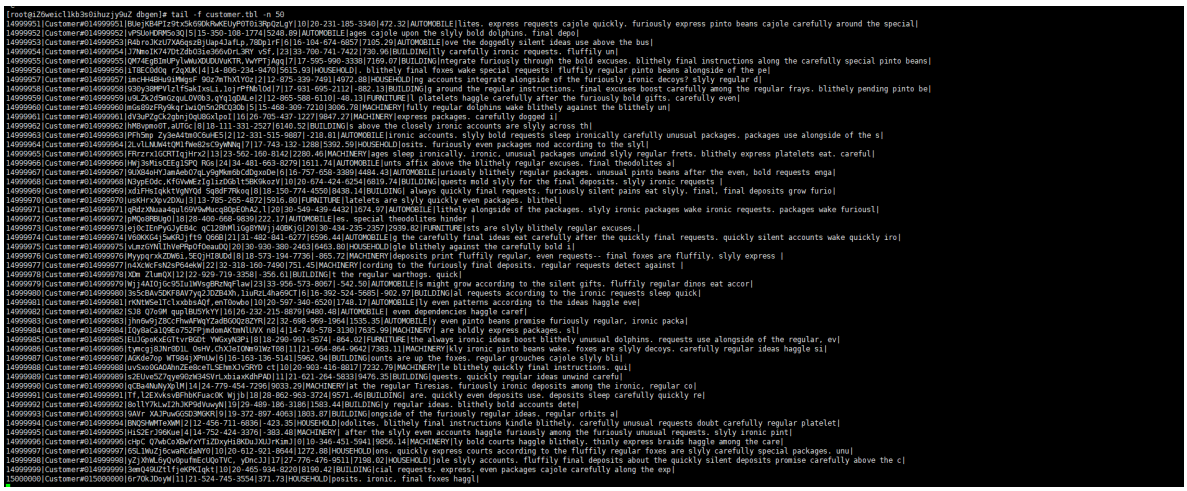
```
# ./dbgen -s $scale -C $chunks -S $i -f
-s：scale値を指定，例100GBの際にscale値は100、1TBの際にscale値は1000
-C：トータルchunkを指定
-S：現在何個目のchunkを生成する
```

②初期化されたテーブルファイルを確認する

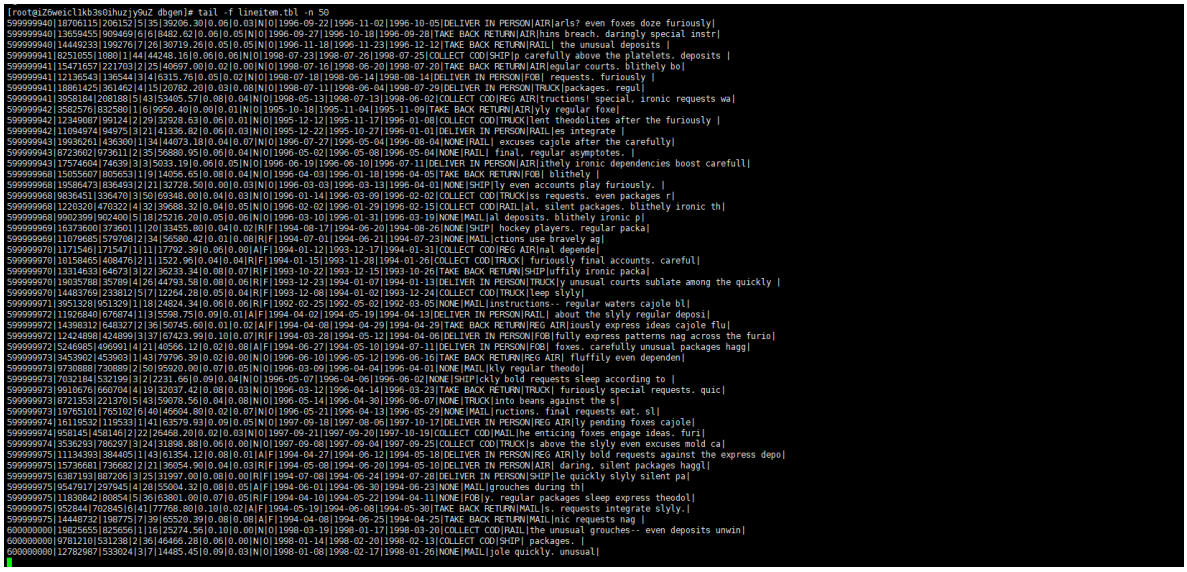
```
# ls -lh *tbl
-rw-r--r-- 1 root root 2.3G Apr 12 11:40 customer.tbl
-rw-r--r-- 1 root root  75G Apr 12 11:40 lineitem.tbl
-rw-r--r-- 1 root root 2.2K Apr 12 11:40 nation.tbl
-rw-r--r-- 1 root root  17G Apr 12 11:40 orders.tbl
-rw-r--r-- 1 root root  12G Apr 12 11:40 partsupp.tbl
-rw-r--r-- 1 root root 2.3G Apr 12 11:40 part.tbl
-rw-r--r-- 1 root root  389 Apr 12 11:40 region.tbl
-rw-r--r-- 1 root root 137M Apr 12 11:40 supplier.tbl
```

③テーブル詳細を確認する

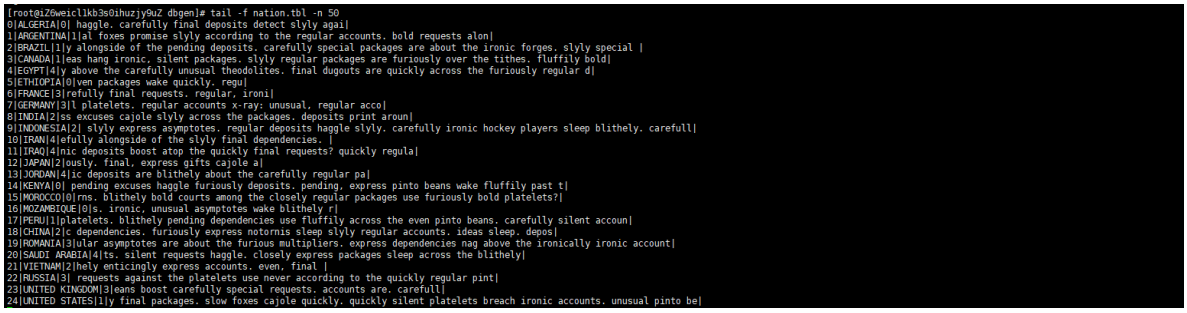
```
# tail -f customer.tbl -n 50
```



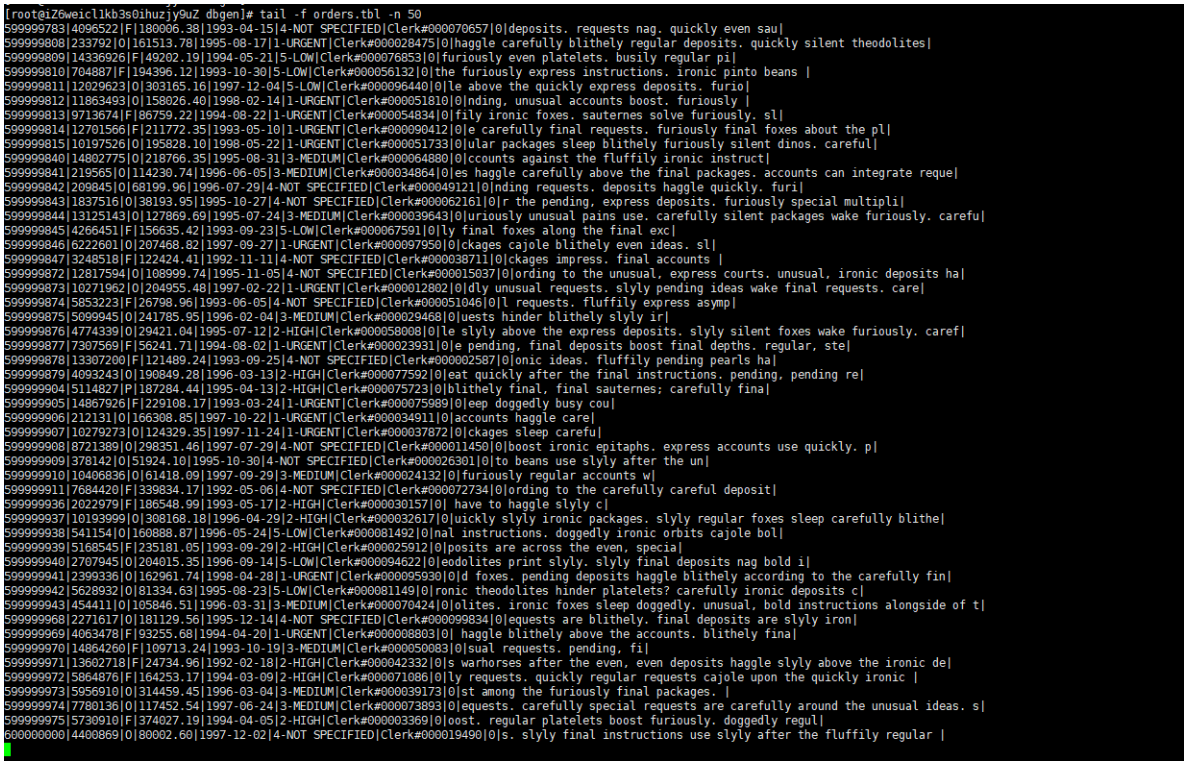

```
# tail -f lineitem.tbl -n 50
```




```
# tail -f nation.tbl -n 50
```

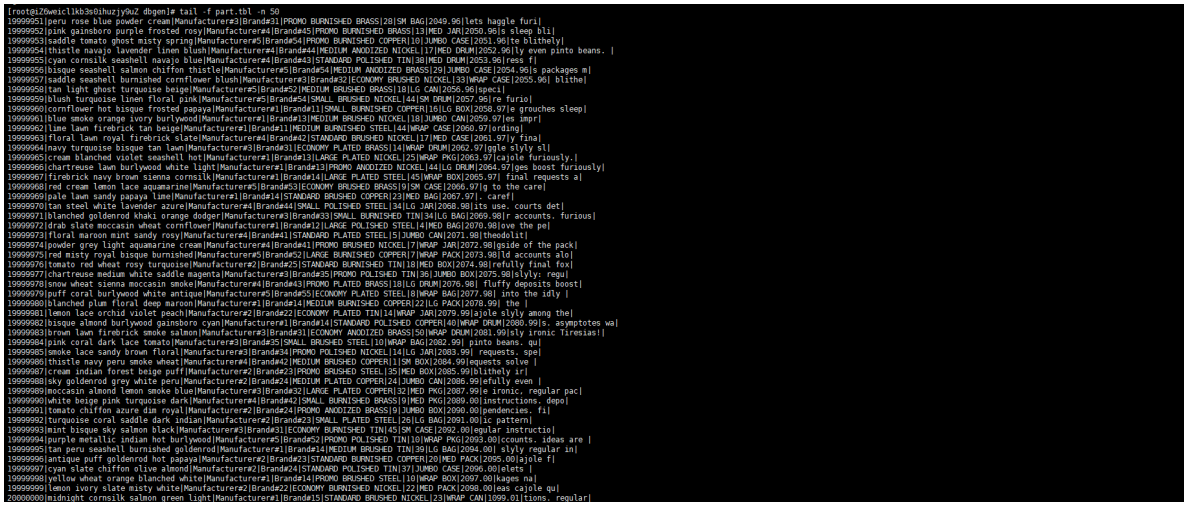



```
# tail -f orders.tbl -n 50
```

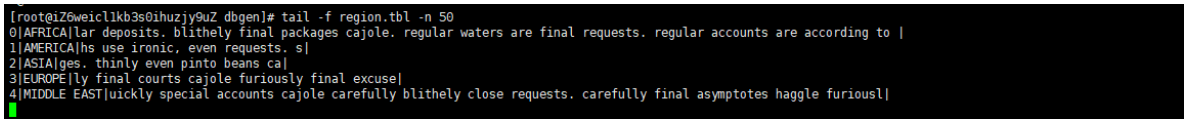



```
# tail -f partsupp.tbl -n 50
```

```
# tail -f part.tbl -n 50
```



```
# tail -f region.tbl -n 50
```



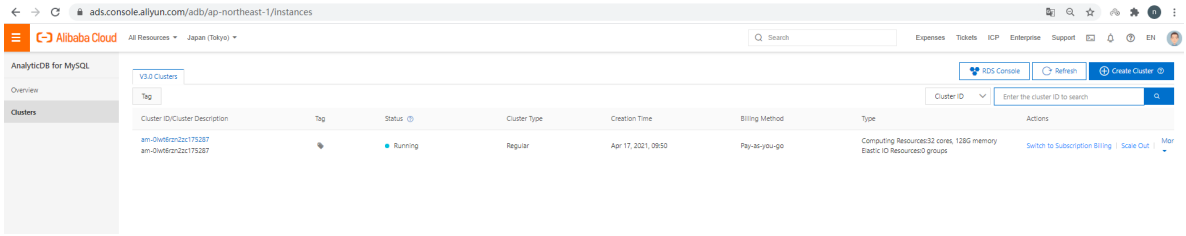
```
# tail -f supplier.tbl -n 50
```

ここまで100GBのデータセットが準備完了しました

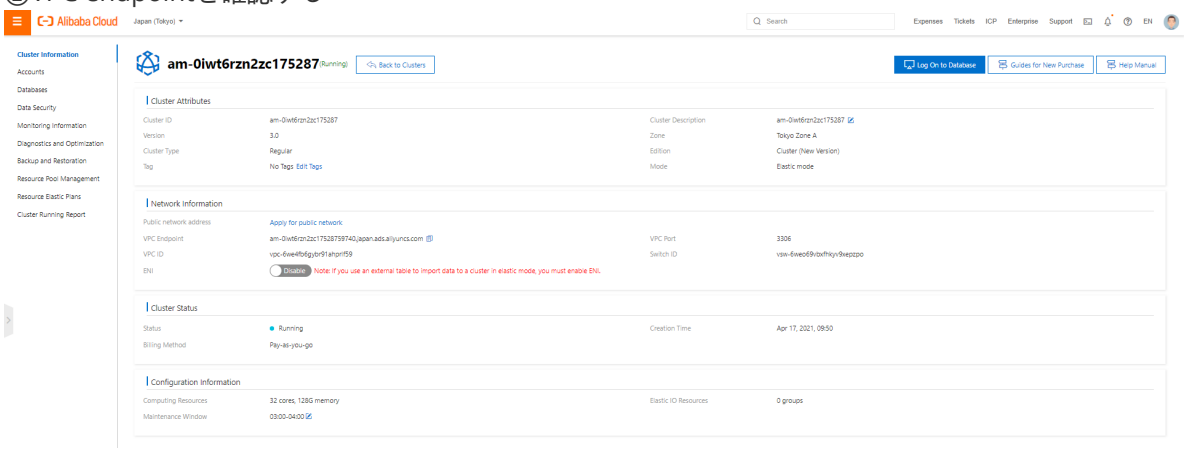
3 データをADB-Mysqlにロードする

1) AnalyticDB MySQLインスタンスを作成する

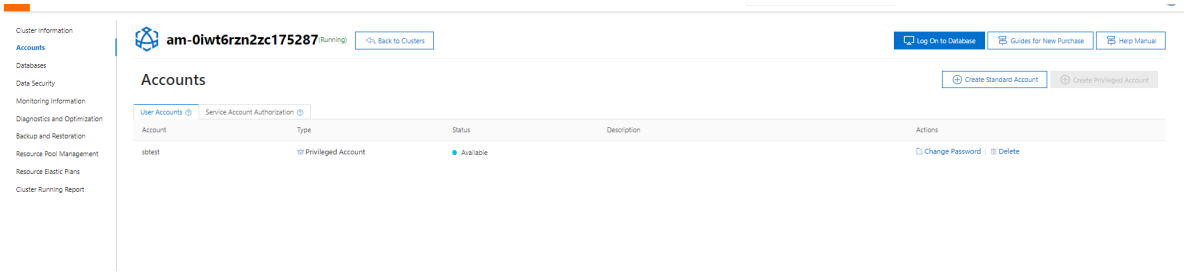
① AnalyticDB MySQLインスタンスを作成する（ECSのVPCと同じVPCで作成する）
AnalyticDB MySQL: 32Core128GB



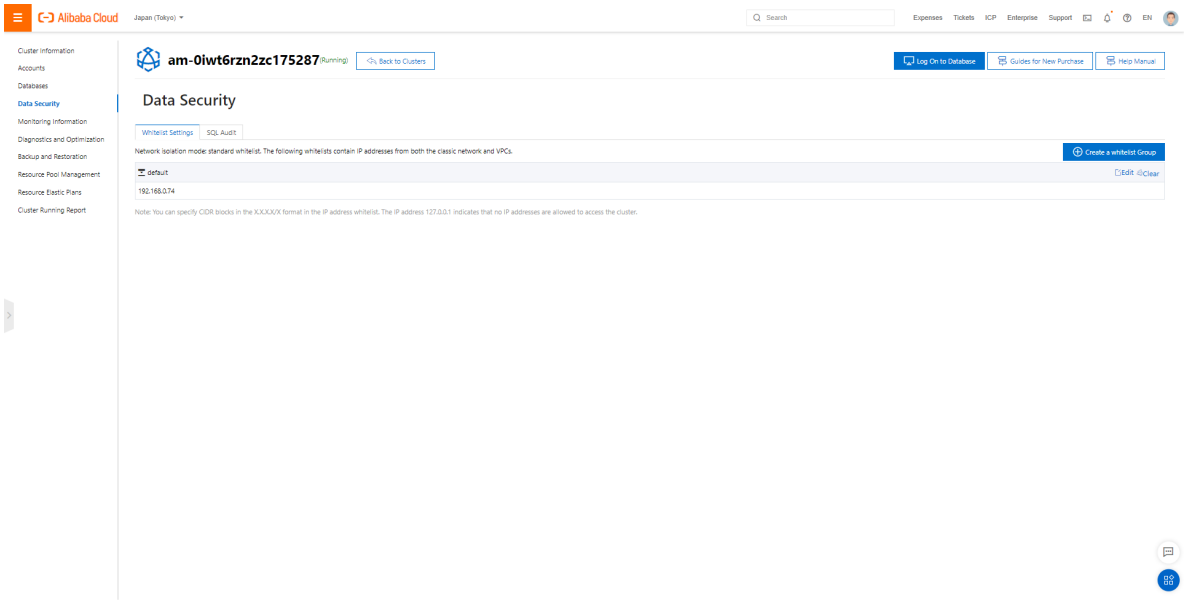
②VPC endpointを確認する



③アカウントを作成する



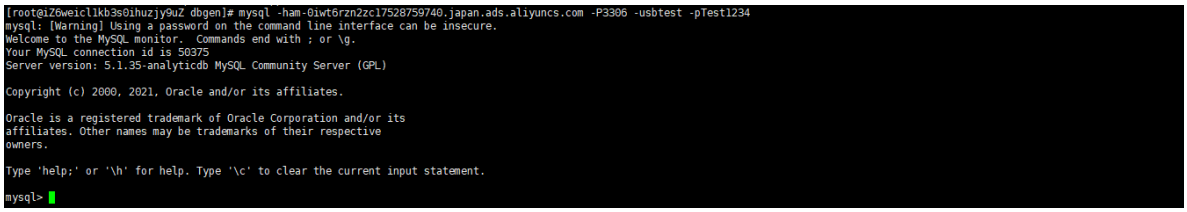
④ECSのプライベートIPをホワイトリストに追加する



2)　AnalyticDB MySQLテーブルを作成する

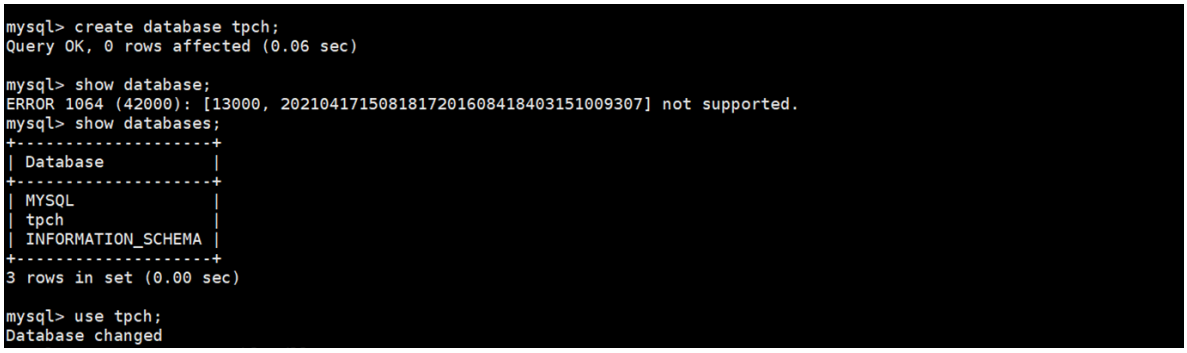
①ECSでADBに接続する

```
mysql -ham-0iwt6rzn2zc17528759740.japan.ads.aliyuncs.com -P3306 -usbtest -
pTest1234
```



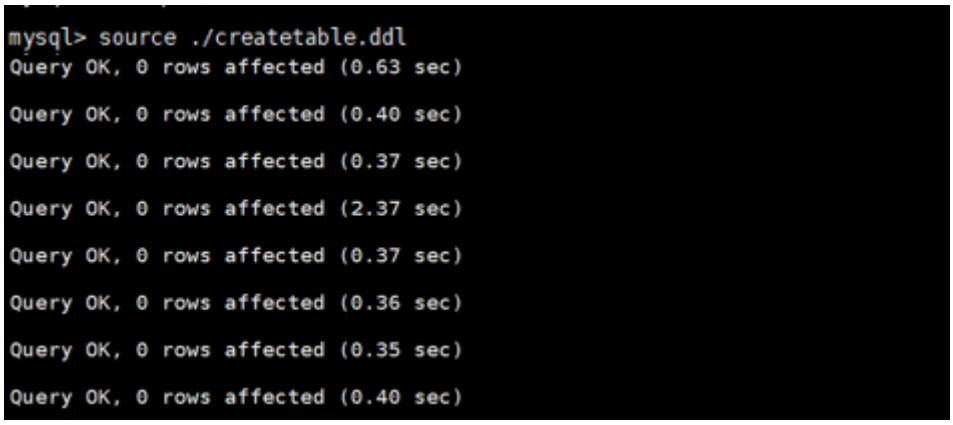
②ADBにDBを作成する

```
mysql> create database tpch;
mysql> show databases;
mysql> use tpch;
```



③ADBにテーブルを作成する
createtable.ddlはdbgenのフォルダにアップロードする

```
mysql> source ./createtable.ddl
```



createtable.ddl内容は下記の通りです

```
CREATE TABLE `CUSTOMER` (
  `C_CUSTKEY` int NOT NULL,
  `C_NAME` varchar NOT NULL,
  `C_ADDRESS` varchar NOT NULL,
  `C_NATIONKEY` int NOT NULL,
  `C_PHONE` varchar NOT NULL,
  `C_ACCTBAL` decimal(12, 2) NOT NULL,
  `C_MKTSEGMENT` varchar NOT NULL,
  `C_COMMENT` varchar NOT NULL,
```

```
 primary key (c_custkey)
)
DISTRIBUTE BY HASH(`c_custkey`)
INDEX_ALL='Y';

CREATE TABLE `LINEITEM` (
 `L_ORDERKEY` bigint NOT NULL,
 `L_PARTKEY` int NOT NULL,
 `L_SUPPKEY` int NOT NULL,
 `L_LINENUMBER` bigint NOT NULL,
 `L_QUANTITY` decimal(12, 2) NOT NULL,
 `L_EXTENDEDPRICE` decimal(12, 2) NOT NULL,
 `L_DISCOUNT` decimal(12, 2) NOT NULL,
 `L_TAX` decimal(12, 2) NOT NULL,
 `L_RETURNFLAG` varchar NOT NULL,
 `L_LINESTATUS` varchar NOT NULL,
 `L_SHIPDATE` date NOT NULL,
 `L_COMMITDATE` date NOT NULL,
 `L_RECEIPTDATE` date NOT NULL,
 `L_SHIPINSTRUCT` varchar NOT NULL,
 `L_SHIPMODE` varchar NOT NULL,
 `L_COMMENT` varchar NOT NULL,
 primary key (l_orderkey,l_linenumber,l_shipdate)
)
DISTRIBUTE BY HASH(`l_orderkey`)
PARTITION BY VALUE(`date_format(l_shipdate, '%Y%m')`)
LIFECYCLE 90
INDEX_ALL='Y';

CREATE TABLE `NATION` (
 `N_NATIONKEY` int NOT NULL,
 `N_NAME` varchar NOT NULL,
 `N_REGIONKEY` int NOT NULL,
 `N_COMMENT` varchar,
 primary key (n_nationkey)
) DISTRIBUTE BY BROADCAST INDEX_ALL='Y';


CREATE TABLE `ORDERS` (
 `O_ORDERKEY` bigint NOT NULL,
 `O_CUSTKEY` int NOT NULL,
 `O_ORDERSTATUS` varchar NOT NULL,
 `O_TOTALPRICE` decimal(12, 2) NOT NULL,
 `O_ORDERDATE` date NOT NULL,
 `O_ORDERPRIORITY` varchar NOT NULL,
 `O_CLERK` varchar NOT NULL,
 `O_SHIPPRIORITY` int NOT NULL,
 `O_COMMENT` varchar NOT NULL,
 primary key (o_orderkey,o_orderdate)
)
DISTRIBUTE BY HASH(`o_orderkey`)
PARTITION BY VALUE(`date_format(O_ORDERDATE, '%Y%m')`)
LIFECYCLE 90
INDEX_ALL='Y';


CREATE TABLE `PART` (
 `P_PARTKEY` int NOT NULL,
```

```
 `P_NAME` varchar NOT NULL,
 `P_MFGR` varchar NOT NULL,
 `P_BRAND` varchar NOT NULL,
 `P_TYPE` varchar NOT NULL,
 `P_SIZE` int NOT NULL,
 `P_CONTAINER` varchar NOT NULL,
 `P_RETAILPRICE` decimal(12, 2) NOT NULL,
 `P_COMMENT` varchar NOT NULL,
 primary key (p_partkey)
)
DISTRIBUTE BY HASH(`p_partkey`)
INDEX_ALL='Y';

CREATE TABLE `PARTSUPP` (
 `PS_PARTKEY` int NOT NULL,
 `PS_SUPPKEY` int NOT NULL,
 `PS_AVAILQTY` int NOT NULL,
 `PS_SUPPLYCOST` decimal(12, 2) NOT NULL,
 `PS_COMMENT` varchar NOT NULL,
 primary key (ps_partkey,ps_suppkey)
)
DISTRIBUTE BY HASH(`ps_partkey`)
INDEX_ALL='Y';

CREATE TABLE `REGION` (
 `R_REGIONKEY` int NOT NULL,
 `R_NAME` varchar NOT NULL,
 `R_COMMENT` varchar,
 primary key (r_regionkey)
)
DISTRIBUTE BY BROADCAST
INDEX_ALL='Y';

CREATE TABLE `SUPPLIER` (
 `S_SUPPKEY` int NOT NULL,
 `S_NAME` varchar NOT NULL,
 `S_ADDRESS` varchar NOT NULL,
 `S_NATIONKEY` int NOT NULL,
 `S_PHONE` varchar NOT NULL,
 `S_ACCTBAL` decimal(12, 2) NOT NULL,
 `S_COMMENT` varchar NOT NULL,
 primary key (s_suppkey)
)
DISTRIBUTE BY HASH(`s_suppkey`)
INDEX_ALL='Y';
```

下記のリンクご参照:
https://help.aliyun.com/document_detail/156322.html?spm=a2c4g.11186623.6.943.511629947h9OkB

④ADBにテーブルを確認する

```
mysql> show tables;
```

```
mysql> show tables;
+----------------+
| Tables_in_tpch |
+----------------+
| CUSTOMER       |
| LINEITEM       |
| NATION         |
| ORDERS         |
| PART           |
| PARTSUPP       |
| REGION         |
| SUPPLIER       |
+----------------+
8 rows in set (0.00 sec)
```

3) テーブルをAnalyticDB MySQLにロードする

①ADBテーブルにデータをロードする
load.ddlはdbgenフォルダにアップロードする

```
mysql> source ./load.ddl
```

```
-rw-r--r-- 1 root root        4929 Dec  6  2018 tpch.vcproj
-rw-r--r-- 1 root root         430 Dec  6  2018 update_release.sh
drwx------ 2 root root        4096 Dec  6  2018 variants
-rw-r--r-- 1 root root       12160 Dec  6  2018 varsub.c
-rw-r--r-- 1 root root       26400 Apr 12 11:17 varsub.o
[root@iZ6weicl1kb3s0ihuzjy9uZ dbgen]# mysql -ham-0iwt6rzn2zc17528759740.japan.ads.aliyuncs.com -P3306 -usbtest -pTest1234
mysql: [Warning] Using a password on the command line interface can be insecure.
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 25183
Server version: 5.1.35-analyticdb MySQL Community Server (GPL)

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affiliates. Other names may be trademarks of their respective
owners.

Type 'help;' or '\h' for help. Type '\c' to clear the current input statement.

mysql> show databases;
+--------------------+
| Database           |
+--------------------+
| MYSQL              |
| tpch               |
| INFORMATION_SCHEMA |
+--------------------+
3 rows in set (0.00 sec)

mysql> use tpch;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> source ./load.ddl
```

load.ddlファイル詳細:

```
load data local INFILE 'customer.tbl' INTO TABLE customer FIELDS TERMINATED BY
'|';
load data local INFILE 'region.tbl' INTO TABLE region FIELDS TERMINATED BY '|';
load data local INFILE 'nation.tbl' INTO TABLE nation FIELDS TERMINATED BY '|';
load data local INFILE 'supplier.tbl' INTO TABLE supplier FIELDS TERMINATED BY
'|';
load data local INFILE 'part.tbl' INTO TABLE part FIELDS TERMINATED BY '|';
load data local INFILE 'partsupp.tbl' INTO TABLE partsupp FIELDS TERMINATED BY
'|';
load data local INFILE 'orders.tbl' INTO TABLE orders FIELDS TERMINATED BY '|';
load data local INFILE 'lineitem.tbl' INTO TABLE lineitem FIELDS TERMINATED BY
'|';
```

```
Database changed
mysql> source ./load.ddl
Query OK, 15000000 rows affected (3 min 15.58 sec)

Query OK, 5 rows affected (0.03 sec)

Query OK, 25 rows affected (0.03 sec)

Query OK, 1000000 rows affected (12.27 sec)

Query OK, 20000000 rows affected (4 min 16.47 sec)

Query OK, 80000000 rows affected (13 min 49.55 sec)

Query OK, 150000000 rows affected (7 hours 12 min 48.15 sec)


Connection closed by foreign host.

Disconnected from remote host(ADB-TPH-C) at 06:05:19.
```

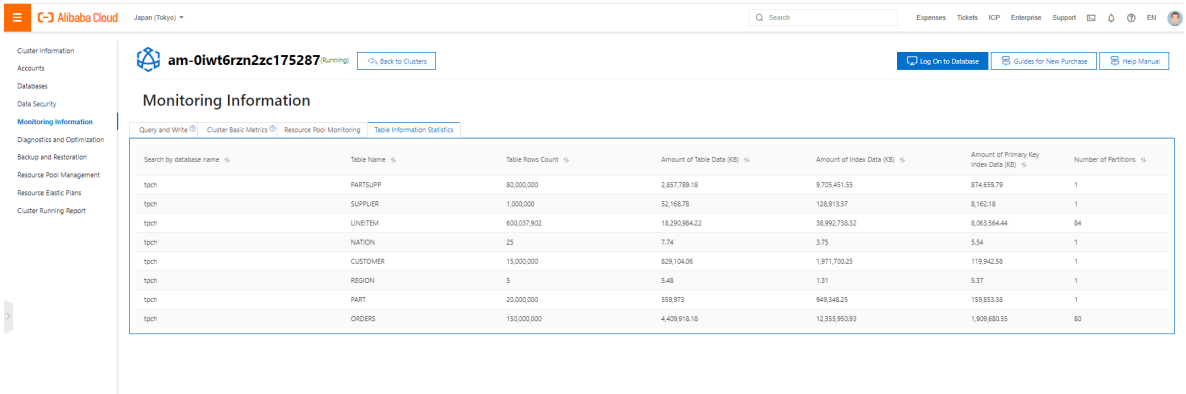
データロードがタイムアウトのため、途切れてしまった場合、中断されたテーブルのみで再度ロードする
load-line.ddlはdbgenフォルダにアップロードする

```
mysql> source ./load-line.ddl
```

load-line.ddlファイル詳細:

```
load data local INFILE 'lineitem.tbl' INTO TABLE lineitem FIELDS TERMINATED BY
'|';
```

```
mysql> show databases;
+--------------------+
| Database           |
+--------------------+
| MYSQL              |
| tpch               |
| INFORMATION_SCHEMA |
+--------------------+
3 rows in set (0.00 sec)

mysql> use tpch;
Reading table information for completion of table and column names
You can turn off this feature to get a quicker startup with -A

Database changed
mysql> source ./load-line.ddl
Query OK, 600037902 rows affected (1 day 3 hours 3 min 17.35 sec)

mysql>
```

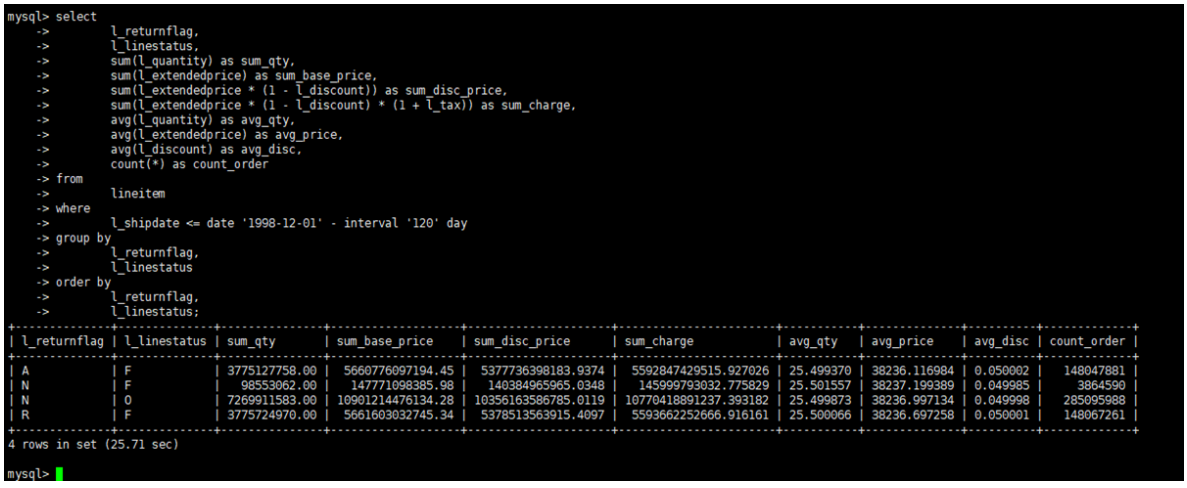


4 SQLクエリを実行して性能計測

①ECSで実行クエリの生成
違うseedで生成されたクエリが異なるため、AlibabaCloudサイトで提供された22個クエリを使う
クエリは下記のリンクを参照ください
https://help.aliyun.com/document_detail/156330.html?spm=a2c4g.11186623.6.948.14ce73c93KjI4G

1) SQL1:25.71 sec

```
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 '120' day
group by
        l_returnflag,
        l_linestatus
order by
        l_returnflag,
        l_linestatus;
```

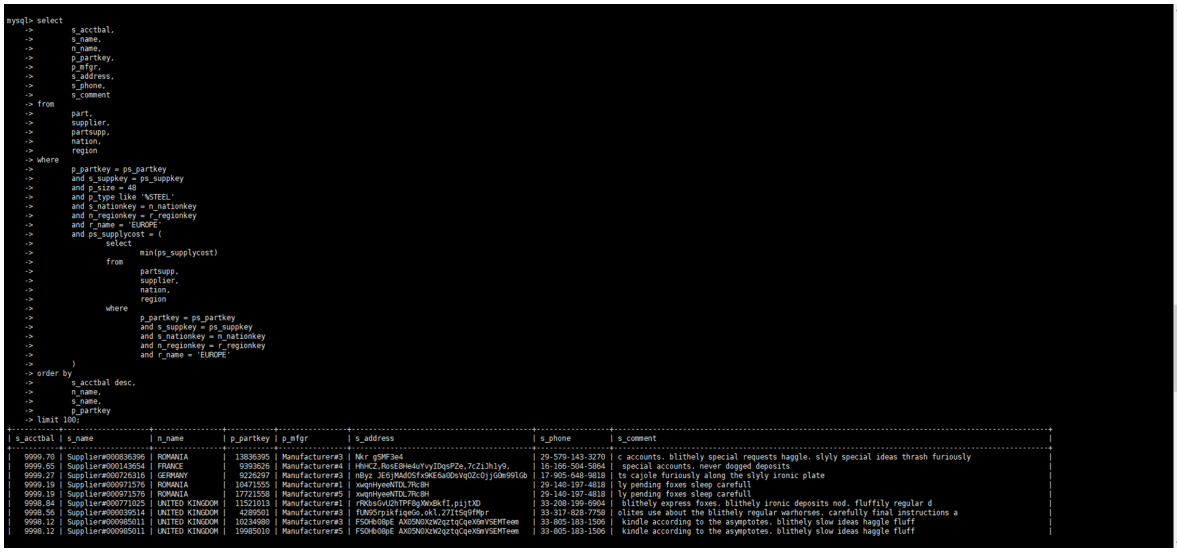


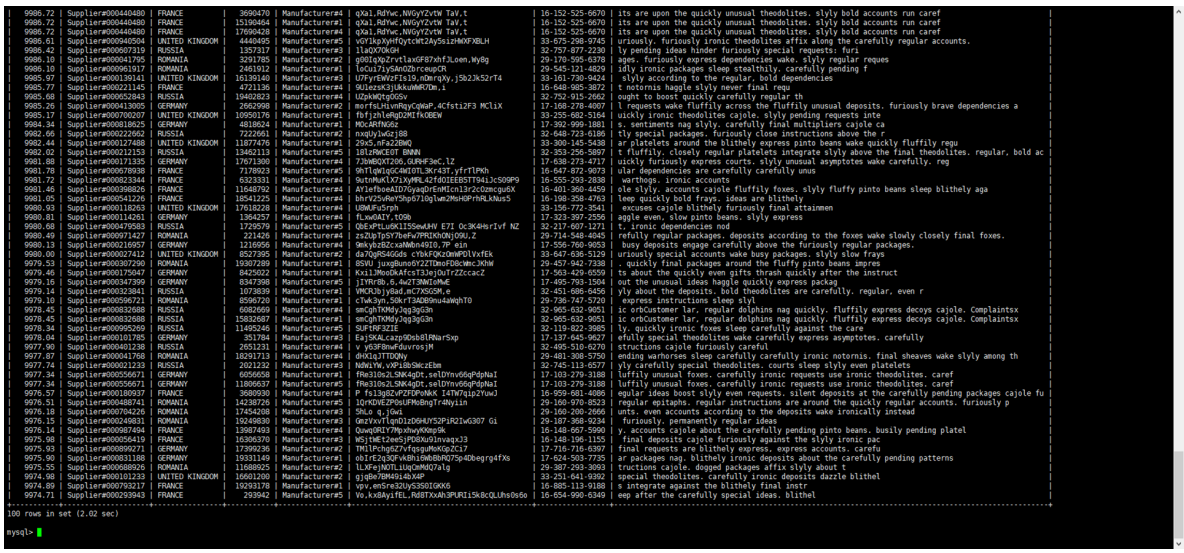
```
mysql> select
    ->         l_returnflag,
    ->         l_linestatus,
    ->         sum(l_quantity) as sum_qty,
    ->         sum(l_extendedprice) as sum_base_price,
    ->         sum(l_extendedprice * (1 - l_discount)) as sum_disc_price,
    ->         sum(l_extendedprice * (1 - l_discount) * (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 '120' day
    -> group by
    ->         l_returnflag,
    ->         l_linestatus
    -> order by
    ->         l_returnflag,
    ->         l_linestatus;
+--------------+-------------+--------------+-------------------+--------------------+----------------------+----------+-------------+----------+-------------+
| l_returnflag | l_linestatus | sum_qty      | sum_base_price    | sum_disc_price     | sum_charge           | avg_qty  | avg_price   | avg_disc | count_order |
+--------------+-------------+--------------+-------------------+--------------------+----------------------+----------+-------------+----------+-------------+
| A            | F           | 3775127758.00 |  5660776097194.45 |  5377736398183.9374 |  5592847429515.927026 | 25.499370 | 38236.116984 | 0.050002 |   148047881 |
| N            | F           |   98553062.00 |   147771098385.98 |   140384965965.0348 |   145999793032.775829 | 25.501557 | 38237.199389 | 0.049985 |     3864590 |
| N            | O           | 7269911583.00 | 10901214476134.28 | 10356163586785.0119 | 10770418891237.393182 | 25.499873 | 38236.997134 | 0.049998 |   285095988 |
| R            | F           | 3775724970.00 |  5661603032745.34 |  5378513563915.4097 |  5593662252666.916161 | 25.500066 | 38236.697258 | 0.050001 |   148067261 |
+--------------+-------------+--------------+-------------------+--------------------+----------------------+----------+-------------+----------+-------------+
4 rows in set (25.71 sec)

mysql>
```

2) SQL2: 2.02 sec

```
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 = 48
        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;
```

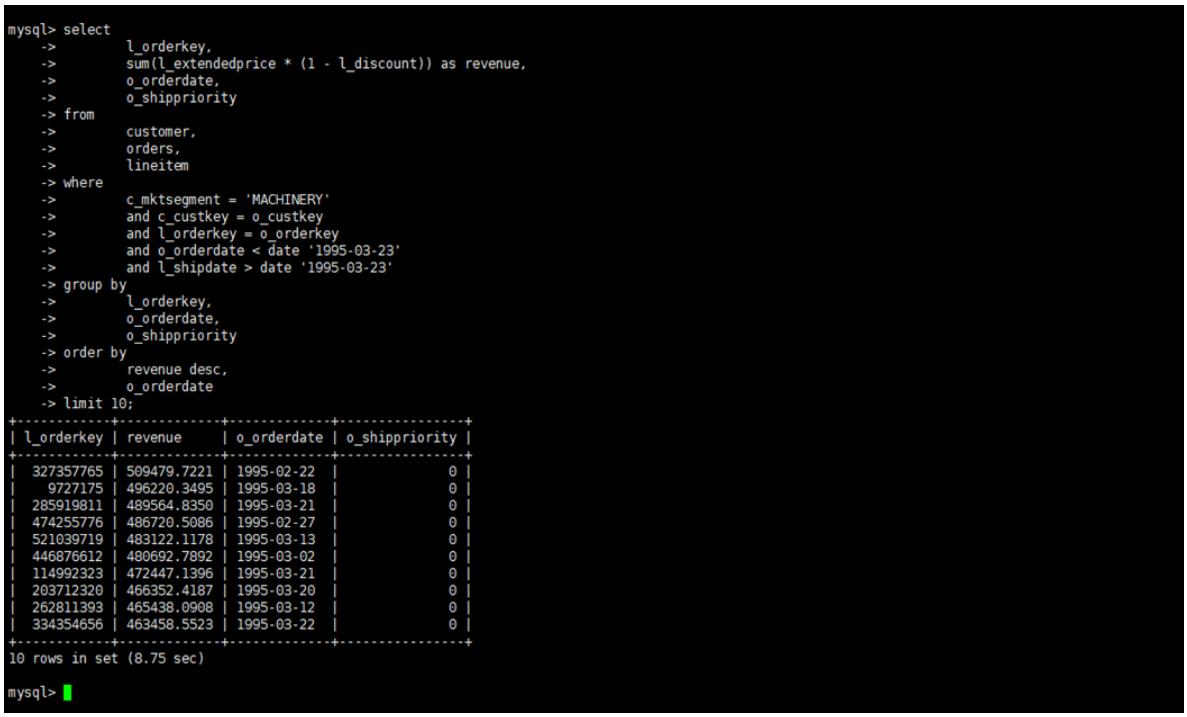




```
|  9986.72 | Supplier#000440480 | FRANCE         |  3690470 | Manufacturer#4 | qXaL.RdYwc,NVGyYZvtW TaV,t                | 16-152-525-6670 | its are upon the quickly unusual theodolites. slyly bold accounts run caref                |
|  9986.72 | Supplier#000440480 | FRANCE         | 15190464 | Manufacturer#1 | qXaL.RdYwc,NVGyYZvtW TaV,t                | 16-152-525-6670 | its are upon the quickly unusual theodolites. slyly bold accounts run caref                |
|  9986.72 | Supplier#000440480 | FRANCE         | 17690428 | Manufacturer#4 | qXaL.RdYwc,NVGyYZvtW TaV,t                | 16-152-525-6670 | its are upon the quickly unusual theodolites. slyly bold accounts run caref                |
|  9986.61 | Supplier#000940594 | UNITED KINGDOM |  4440405 | Manufacturer#5 | vGY1kpXyHfGytcWt2AySsizHKKFXBLH           | 33-675-298-9745 | uriously. furiously ironic theodolites affix along the carefully regular accounts.         |
|  9986.42 | Supplier#000607319 | RUSSIA         |  1357317 | Manufacturer#3 | 1laQX7OKGH                                | 32-757-877-2230 | ly pending ideas hinder furiously special requests: furi                                   |
|  9986.10 | Supplier#000041795 | ROMANIA        |  3291785 | Manufacturer#2 | g00IqXpZrvrlaxGF87xhfJLoen,Wy8g           | 29-170-595-6378 | ages. furiously express dependencies wake. slyly regular reques                            |
|  9986.10 | Supplier#000901017 | ROMANIA        |  2461012 | Manufacturer#1 | leCui7ly5AnOZbrceqvrCh                    | 29-545-121-4829 | idly ironic packages sleep stealthily. carefully pending f                                 |
|  9985.97 | Supplier#000139141 | UNITED KINGDOM | 16139140 | Manufacturer#3 | UfFyrEWzFIs19,nDmrqKy,j5b2Jk52rT4         | 33-161-730-9424 |  slyly according to the regular, bold dependencies                                          |
|  9985.77 | Supplier#000221145 | FRANCE         |  4721136 | Manufacturer#4 | QUlezsK3jiJkkuWWRZDm,i                    | 16-648-985-3872 | t notornis haggle slyly never final requ                                                   |
|  9985.68 | Supplier#000052043 | RUSSIA         | 19402023 | Manufacturer#4 | UZpkWEtgCGSy                              | 32-752-915-2682 | ought to boost quickly carefully regular th                                                |
|  9985.26 | Supplier#000413005 | GERMANY        |  2662998 | Manufacturer#4 | morfsLHLvnMqyCqWaP,4Cfsti2F3 MCliX        | 17-168-278-4007 | l requests wake fluffily across the fluffily unusual deposits. furiously brave dependencies a |
|  9985.17 | Supplier#000700207 | UNITED KINGDOM | 10950176 | Manufacturer#1 | fbfjzhleRqD2MIfkOBEW                      | 33-255-682-5164 | uickly ironic theodolites cajole. slyly pending requests inte                              |
|  9984.34 | Supplier#000018025 | GERMANY        |  4818024 | Manufacturer#1 | MOcARfNbGo                                | 17-992-990-1881 | e, sentiments nag slyly. carefully final multipliers cajole ca                             |
|  9982.66 | Supplier#000222662 | RUSSIA         |  7222661 | Manufacturer#3 | nxqlylwGzj88                              | 32-648-723-6186 | tly special packages. furiously close instructions above the r                             |
|  9982.44 | Supplier#000127488 | UNITED KINGDOM | 11877476 | Manufacturer#1 | 29xS.nFa2Z0WQ                             | 33-300-145-5438 | ar platelets around the blithely express pinto beans wake quickly fluffily regu            |
|  9982.02 | Supplier#000212153 | RUSSIA         | 13462113 | Manufacturer#5 | 18lzNKCEOT 6NNN                           | 32-353-256-5897 | t fluffily. closely regular platelets integrate slyly above the final theodolites. regular, bold ac |
|  9981.88 | Supplier#000171335 | GERMANY        | 17671300 | Manufacturer#4 | 7JbWBQXT2O6,GURHF3eC,lZ                   | 17-638-273-4717 | uickly furiously express courts. slyly unusual asymptotes wake carefully. reg              |
|  9981.78 | Supplier#000078938 | FRANCE         |  7178923 | Manufacturer#5 | 9hTlqWlqGC4WI0TL3Kr43T,yfrTlPKh           | 16-647-872-9073 | ular dependencies are carefully carefully unus                                             |
|  9981.72 | Supplier#000823344 | FRANCE         |  6323331 | Manufacturer#5 | OutoMuKlV7lkyMRL42fdOIEE8STT94lJcSO9P9    | 16-555-293-2838 |  warthogs, ironic accounts                                                                 |
|  9981.46 | Supplier#000398826 | FRANCE         | 11648792 | Manufacturer#4 | AYlefbeeAID7GyaqDrEnMIcni3r2cOzmcgu6X     | 16-401-360-4459 | ole slyly. accounts cajole fluffily foxes. slyly fluffy pinto beans sleep blithely aga      |
|  9981.05 | Supplier#000541226 | FRANCE         | 18541225 | Manufacturer#4 | bhrV25vReYShp6710glwm2MsH0PfhRLkNus5      | 16-198-358-4763 | leep quickly bold frays, ideas are blithely                                                |
|  9980.93 | Supplier#000118263 | UNITED KINGDOM | 17618228 | Manufacturer#4 | UBWkFu5rph                                | 33-156-772-3541 |  encuses cajole blithely furiously final attainmen                                         |
|  9980.81 | Supplier#000114261 | GERMANY        |  1364257 | Manufacturer#4 | fLxw0AIY,tO9b                             | 17-323-397-2556 | aggle even, slow pinto beans. slyly express                                                |
|  9980.68 | Supplier#000479583 | RUSSIA         |  1729579 | Manufacturer#5 | QbExPtLu0KiI5SewkHV E7I Oc3K4Hsr1vf NZ    | 32-217-607-1271 | t, ironic dependencies nod                                                                 |
|  9980.49 | Supplier#000971427 | ROMANIA        |   221429 | Manufacturer#4 | zsZUpTp5Y7kefv7PMIKhONjO9U,Z              | 29-714-548-4045 | refully regular packages. deposits according to the foxes wake slowly closely final foxes. |
|  9980.13 | Supplier#000216957 | GERMANY        |  1216956 | Manufacturer#4 | QmkybzBZcxaNWbn49I0,7P ein                | 17-556-760-9053 |  busy deposits engage carefully above the furiously regular packages.                       |
|  9980.00 | Supplier#000027412 | UNITED KINGDOM |  8527395 | Manufacturer#2 | da7QgRSdGGds cYbkFQKzOmWPDlVxfEk          | 33-647-636-5129 | uriously special accounts wake busy packages. slyly slow frays                             |
|  9979.53 | Supplier#000307290 | ROMANIA        | 19307289 | Manufacturer#1 | dSVU jugBunoOY2ZTDmFIBcWmcJKhW            | 29-457-942-7338 | . quickly final packages around the fluffy pinto beans impres                              |
|  9979.46 | Supplier#000175047 | GERMANY        |  8425022 | Manufacturer#1 | KxiiJMeoDkAfcsT3iejOuTrZZccacZ            | 17-563-429-6559 | ts about the quickly even gifts thrash quickly after the instruct                          |
|  9979.16 | Supplier#000347399 | GERMANY        |  8347398 | Manufacturer#5 | jIYRrBb,6,4w2T3NNIoMwE                    | 17-495-793-1504 | out the unusual ideas haggle quickly express packag                                        |
|  9979.14 | Supplier#000323841 | RUSSIA         | 10238839 | Manufacturer#1 | VMCRJbjyBaeLmC7XSSM,e                     | 32-451-686-6456 | yly about the deposits. bold theodolites are carefully. regular, even r                    |
|  9979.10 | Supplier#000596721 | ROMANIA        |  8596720 | Manufacturer#1 | cTwk3yn,.50krT3ADB9nu4aWqhT0              | 29-736-747-5720 |  express instructions sleep slyl                                                           |
|  9978.45 | Supplier#000832688 | RUSSIA         |  6082669 | Manufacturer#4 | smCghTKMdyJqg3gG3n                        | 32-965-632-9051 | ic orbCustomer lar, regular dolphins nag quickly. fluffily express decoys cajole. Complaintsx |
|  9978.45 | Supplier#000832688 | RUSSIA         | 15832687 | Manufacturer#1 | smCghTKMdyJqg3gG3n                        | 32-965-632-9051 | ic orbCustomer lar, regular dolphins nag quickly. fluffily express decoys cajole. Complaintsx |
|  9978.34 | Supplier#000995269 | RUSSIA         | 11495246 | Manufacturer#5 | SUFfRF3ZIE                                | 32-119-822-3985 | ly. quickly ironic foxes sleep carefully against the care                                  |
|  9978.04 | Supplier#000101785 | GERMANY        |   351784 | Manufacturer#3 | EajSKALcazp9Dsb8lRNarSxp                  | 17-137-645-9627 | efully special theodolites wake carefully express asymptotes. carefully                    |
|  9977.90 | Supplier#000401238 | ROMANIA        |  2651231 | Manufacturer#4 | v y65FBnwf4uvrosjM                        | 32-495-510-9270 | structions cajole furiously careful                                                        |
|  9977.87 | Supplier#000041768 | ROMANIA        | 18291713 | Manufacturer#4 | dHXiqJTTDQNy                              | 29-481-308-5750 | ending warhorses sleep carefully carefully ironic notornis. final sheaves wake slyly among th |
|  9977.74 | Supplier#000021233 | RUSSIA         |  2021232 | Manufacturer#3 | NdWaYW,vXPi8bSWczEbm                      | 32-745-113-6577 | yly carefully special theodolites. courts sleep slyly even platelets                       |
|  9977.34 | Supplier#000556671 | GERMANY        |  6656658 | Manufacturer#4 | fRe310s2L5NK4gDt,selDYnv66qPdpNaI         | 17-103-279-3188 | luffily unusual foxes. carefully ironic requests use ironic theodolites. caref             |
|  9977.34 | Supplier#000556671 | GERMANY        | 11806637 | Manufacturer#5 | fRe310s2L5NK4gDt,selDYnv66qPdpNaI         | 17-103-279-3188 | luffily unusual foxes. carefully ironic requests use ironic theodolites. caref             |
|  9976.57 | Supplier#000180937 | FRANCE         |  3680930 | Manufacturer#4 | P fs13g0ZvPZFDPoNkK I4TW7qip2YuwJ         | 16-959-681-4086 | egular ideas boost slyly even requests. silent deposits at the carefully pending packages cajole fu |
|  9976.51 | Supplier#000488741 | ROMANIA        | 14238726 | Manufacturer#5 | 1QrK0VE2P0kiPNsBngTr4Nyiin                | 29-160-970-8523 | regular epitaphs. regular instructions are around the quickly regular accounts. furiously p |
|  9976.18 | Supplier#000704226 | ROMANIA        | 17454208 | Manufacturer#3 | 5hLo q,jGwi                               | 29-160-200-2666 | unts. even accounts according to the deposits wake ironically instead                      |
|  9976.15 | Supplier#000249831 | ROMANIA        | 19249830 | Manufacturer#3 | QmzVxvTlqnDlzD6HJY52PiR2IwG307 Gi         | 29-187-368-9234 |  furiously. permanently regular ideas                                                       |
|  9976.14 | Supplier#000987494 | FRANCE         | 13987493 | Manufacturer#4 | QuwqXMIY7MxxhwyKVqg9K                     | 16-148-607-5990 | y, accounts cajole about the carefully pending pinto beans. busily pending platel          |
|  9975.98 | Supplier#000056419 | FRANCE         | 16306370 | Manufacturer#3 | WSjtWEt2eeSjPD8Xu9InvaqxJ3                | 16-148-196-1155 |  final deposits cajole furiously against the slyly ironic pac                              |
|  9975.93 | Supplier#000899271 | GERMANY        | 17399236 | Manufacturer#2 | TMllPchgSZ7vfqsguMoKGpZCi7                | 17-716-716-6397 | final requests are blithely express, express accounts. carefu                              |
|  9975.90 | Supplier#000831188 | GERMANY        | 19331149 | Manufacturer#1 | ob1rE2q3QFvAQb1eNkBBdRQ75p4Dbegrg4fXs     | 17-624-503-7735 | ar packages nag. blithely ironic deposits about the carefully pending patterns             |
|  9975.55 | Supplier#000688926 | ROMANIA        | 11688925 | Manufacturer#2 | lLXFejNOTLiUqOmMdQ7alg                    | 29-387-293-3093 | tructions cajole. dogged packages affix slyly about t                                      |
|  9974.98 | Supplier#000101233 | UNITED KINGDOM | 16601200 | Manufacturer#2 | gjqBe7BM491q4bJxAP                        | 33-251-641-9392 | special theodolites. carefully ironic deposits dazzle blithel                              |
|  9974.89 | Supplier#000793217 | FRANCE         | 19293178 | Manufacturer#1 | vpv,mSra3UlySSBGIGKK6                     | 16-885-113-9188 | s integrate against the blithely final instr                                               |
|  9974.71 | Supplier#000293943 | FRANCE         |   293942 | Manufacturer#5 | Vo,kx8AyifEL,Rd8TXxAh3PURIi5k8cQLUhs0s6o  | 16-654-990-6349 | eep after the carefully special ideas. blithel                                             |
+----------+--------------------+----------------+----------+----------------+-------------------------------------------+-----------------+--------------------------------------------------------------------------------------------+
100 rows in set (2.02 sec)

mysql>
```

3) SQL3: 8.75 sec

```
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 '1995-03-23'
        and l_shipdate > date '1995-03-23'
group by
        l_orderkey,
        o_orderdate,
        o_shippriority
order by
        revenue desc,
        o_orderdate
limit 10;
```



```
mysql> 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 '1995-03-23'
    ->         and l_shipdate > date '1995-03-23'
    -> group by
    ->         l_orderkey,
    ->         o_orderdate,
    ->         o_shippriority
    -> order by
    ->         revenue desc,
    ->         o_orderdate
    -> limit 10;
+------------+------------+-------------+---------------+
| l_orderkey | revenue    | o_orderdate | o_shippriority |
+------------+------------+-------------+---------------+
|  327357765 | 509479.7221 | 1995-02-22  |             0 |
|    9727175 | 496220.3495 | 1995-03-18  |             0 |
|  285919811 | 489564.8350 | 1995-03-21  |             0 |
|  474255776 | 486720.5086 | 1995-02-27  |             0 |
|  521039719 | 483122.1178 | 1995-03-13  |             0 |
|  446876612 | 480692.7892 | 1995-03-02  |             0 |
|  114992323 | 472447.1396 | 1995-03-21  |             0 |
|  203712320 | 466352.4187 | 1995-03-20  |             0 |
|  262811393 | 465438.0908 | 1995-03-12  |             0 |
|  334354656 | 463458.5523 | 1995-03-22  |             0 |
+------------+------------+-------------+---------------+
10 rows in set (8.75 sec)

mysql>
```

4) SQL4: 12.22 sec

```
select
        o_orderpriority,
        count(*) as order_count
from
        orders
where
        o_orderdate >= date '1996-07-01'
        and o_orderdate < date '1996-07-01' + 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;
```

```
mysql> select
    ->         o_orderpriority,
    ->         count(*) as order_count
    -> from
    ->         orders
    -> where
    ->         o_orderdate >= date '1996-07-01'
    ->         and o_orderdate < date '1996-07-01' + 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;
+-----------------+-------------+
| o_orderpriority | order_count |
+-----------------+-------------+
| 1-URGENT        |     1051317 |
| 2-HIGH          |     1050579 |
| 3-MEDIUM        |     1052816 |
| 4-NOT SPECIFIED |     1051475 |
| 5-LOW           |     1051313 |
+-----------------+-------------+
5 rows in set (12.22 sec)

mysql>
```

5) SQL5: 10.55 sec

```
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 = 'EUROPE'
        and o_orderdate >= date '1996-01-01'
        and o_orderdate < date '1996-01-01' + interval '1' year
group by
        n_name
order by
        revenue desc;
```

```
mysql> 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 = 'EUROPE'
    ->         and o_orderdate >= date '1996-01-01'
    ->         and o_orderdate < date '1996-01-01' + interval '1' year
    -> group by
    ->         n_name
    -> order by
    ->         revenue desc;
+---------------+----------------+
| n_name        | revenue        |
+---------------+----------------+
| ROMANIA       | 5363192622.1422 |
| FRANCE        | 5333474646.0198 |
| GERMANY       | 5316834062.6974 |
| RUSSIA        | 5306447392.3465 |
| UNITED KINGDOM | 5295232410.8591 |
+---------------+----------------+
5 rows in set (10.55 sec)
```

6) SQL6: 0.67 sec

```
select
        sum(l_extendedprice * l_discount) as revenue
from
        lineitem
where
        l_shipdate >= date '1996-01-01'
        and l_shipdate < date '1996-01-01' + interval '1' year
        and l_discount between 0.02 - 0.01 and 0.02 + 0.01
        and l_quantity < 24;
```

```
mysql> select
    ->         sum(l_extendedprice * l_discount) as revenue
    -> from
    ->         lineitem
    -> where
    ->         l_shipdate >= date '1996-01-01'
    ->         and l_shipdate < date '1996-01-01' + interval '1' year
    ->         and l_discount between 0.02 - 0.01 and 0.02 + 0.01
    ->         and l_quantity < 24;
+----------------+
| revenue        |
+----------------+
| 4121680370.4060 |
+----------------+
1 row in set (0.67 sec)

mysql>
```

7) SQL7: 6.41 sec

```
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 = 'CANADA' and n2.n_name = 'BRAZIL')
                                or (n1.n_name = 'BRAZIL' and n2.n_name =
'CANADA')
                        )
                        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;
```

```
mysql> 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 = 'CANADA' and n2.n_name = 'BRAZIL')
    ->                                 or (n1.n_name = 'BRAZIL' and n2.n_name = 'CANADA')
    ->                         )
    ->                         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;
+-------------+-------------+--------+----------------+
| supp_nation | cust_nation | l_year | revenue        |
+-------------+-------------+--------+----------------+
| BRAZIL      | CANADA      |   1995 | 5310686773.2602 |
| BRAZIL      | CANADA      |   1996 | 5319569321.1307 |
| CANADA      | BRAZIL      |   1995 | 5301846186.6888 |
| CANADA      | BRAZIL      |   1996 | 5319032885.0106 |
+-------------+-------------+--------+----------------+
4 rows in set (6.41 sec)
```

8) SQL8: 17.09 sec

```
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 = 'LARGE ANODIZED COPPER'
        ) as all_nations
group by
        o_year
order by
        o_year;
```

```
mysql> 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 = 'LARGE ANODIZED COPPER'
    ->         ) as all_nations
    -> group by
    ->         o_year
    -> order by
    ->         o_year;
+--------+----------+
| o_year | mkt_share |
+--------+----------+
|   1995 |  0.039226 |
|   1996 |  0.039146 |
+--------+----------+
2 rows in set (17.09 sec)
```

9) SQL9: 36.88 sec

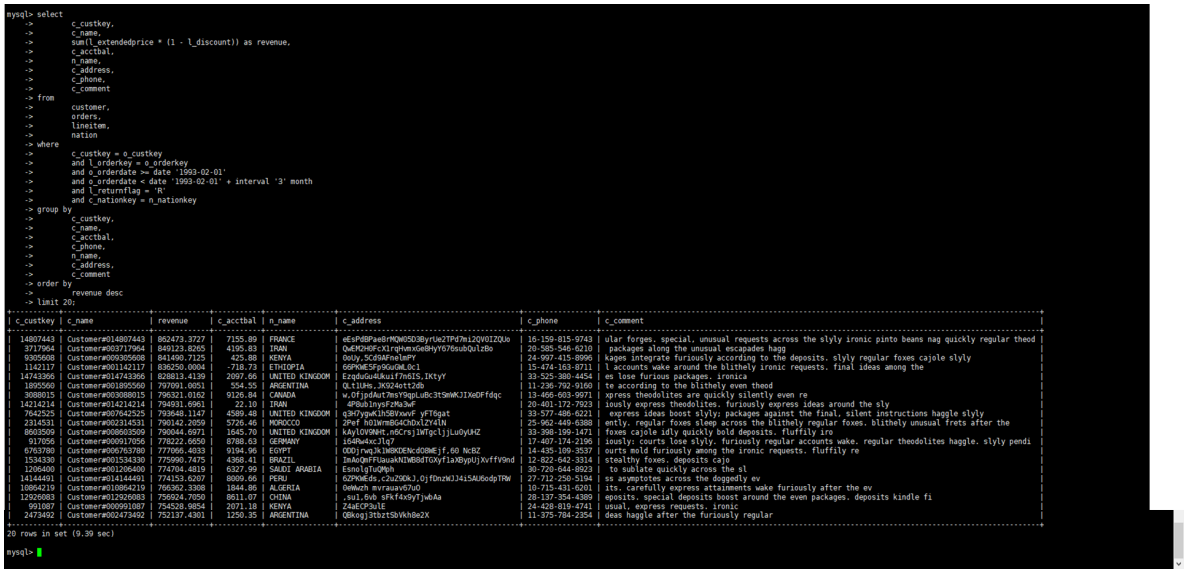
```
select
        nation,
        o_year,
        sum(amount) as sum_profit
from
        (
```

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

```
mysql> 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 '%maroon%'
    ->         ) as profit
    -> group by
    ->         nation,
    ->         o_year
    -> order by
    ->         nation,
    ->         o_year desc;
+---------------+--------+---------------+
| nation        | o_year | sum_profit    |
+---------------+--------+---------------+
| ALGERIA       |   1998 | 2720594230.1803 |
| ALGERIA       |   1997 | 4654961873.9242 |
| ALGERIA       |   1996 | 4680012407.4261 |
| ALGERIA       |   1995 | 4659697270.6760 |
| ALGERIA       |   1994 | 4635157949.3008 |
| ALGERIA       |   1993 | 4649704017.4265 |
| ALGERIA       |   1992 | 4643100777.0422 |
| ARGENTINA     |   1998 | 2698914879.7325 |
| ARGENTINA     |   1997 | 4637343262.8659 |
| ARGENTINA     |   1996 | 4651780956.7261 |
| ARGENTINA     |   1995 | 4611704865.0426 |
| ARGENTINA     |   1994 | 4633320578.1357 |
| ARGENTINA     |   1993 | 4633294188.6940 |
| ARGENTINA     |   1992 | 4642855705.9823 |
| BRAZIL        |   1998 | 2751163575.0700 |
| BRAZIL        |   1997 | 4637791296.6352 |
| BRAZIL        |   1996 | 4683733653.0234 |
| BRAZIL        |   1995 | 4657382145.9503 |
| BRAZIL        |   1994 | 4665068700.0852 |
| BRAZIL        |   1993 | 4651447017.3472 |
| BRAZIL        |   1992 | 4675697278.1436 |
```

10) SQL10: 9.39 sec

```
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 '1993-02-01'
        and o_orderdate < date '1993-02-01' + 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;
```



11) SQL11: 1.96 sec

```
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 = 'EGYPT'
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 = 'EGYPT'
                )
order by
        value desc;
```

```
mysql> 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 = 'EGYPT'
    -> 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 = 'EGYPT'
    ->                 )
    -> order by
    ->         value desc;
Empty set (1.96 sec)

mysql>
```

12) SQL12: 3.98 sec

```
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 ('FOB', 'AIR')
        and l_commitdate < l_receiptdate
        and l_shipdate < l_commitdate
        and l_receiptdate >= date '1997-01-01'
        and l_receiptdate < date '1997-01-01' + interval '1' year
group by
        l_shipmode
order by
        l_shipmode;
```

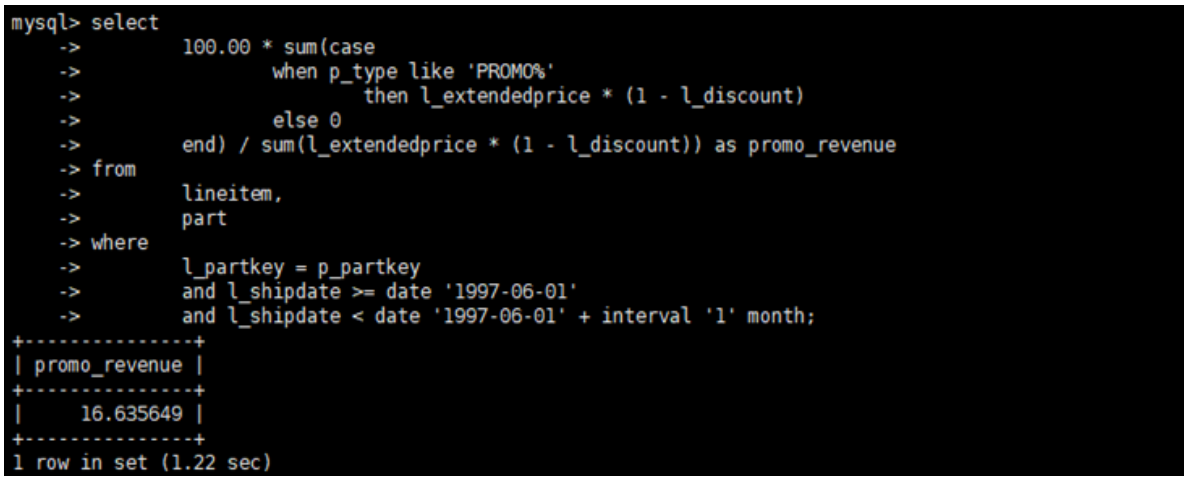
```
mysql> select
    ->         l_shipmode,
    ->         sum(case
    ->                 when o_orderpriority = '1-URGENT'
    ->                         or o_orderpriority = '2-HIGH'
    ->                         then 1
    ->                 else 0
    ->         end) as high_line_count,
    ->         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 ('FOB', 'AIR')
    ->         and l_commitdate < l_receiptdate
    ->         and l_shipdate < l_commitdate
    ->         and l_receiptdate >= date '1997-01-01'
    ->         and l_receiptdate < date '1997-01-01' + interval '1' year
    -> group by
    ->         l_shipmode
    -> order by
    ->         l_shipmode;
+------------+-----------------+---------------+
| l_shipmode | high_line_count | low_line_count |
+------------+-----------------+---------------+
| AIR        |          621795 |         934515 |
| FOB        |          623592 |         932898 |
+------------+-----------------+---------------+
2 rows in set (3.98 sec)

mysql>
```

13) SQL13: 12.65 sec

```
select
        c_count,
        count(*) as custdist
from
        (
                select
                        c_custkey,
                        count(o_orderkey) as c_count
                from
                        customer left outer join orders on
                                c_custkey = o_custkey
                                and o_comment not like '%special%deposits%'
                group by
                        c_custkey
        ) c_orders
group by
        c_count
order by
        custdist desc,
        c_count desc;
```

14) SQL14: 1.22 sec

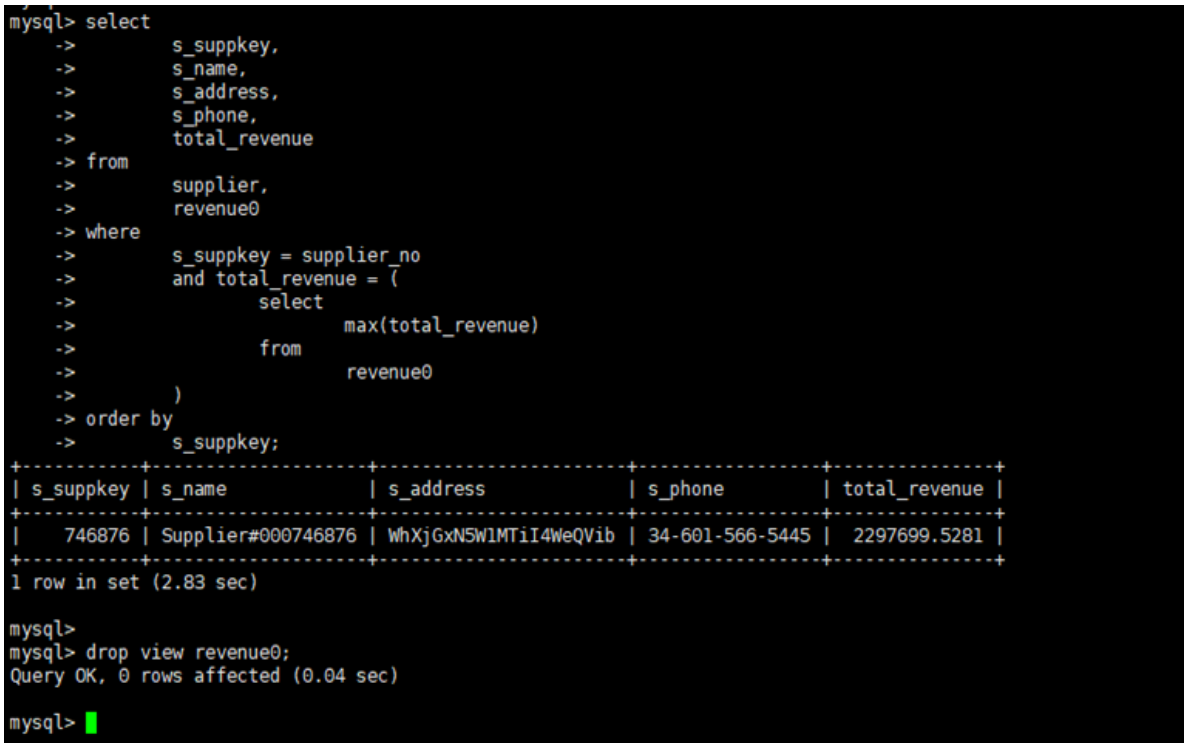
```
select
        100.00 * sum(case
                when p_type like 'PROMO%'
                        then l_extendedprice * (1 - l_discount)
                else 0
        end) / sum(l_extendedprice * (1 - l_discount)) as promo_revenue
from
        lineitem,
        part
where
        l_partkey = p_partkey
        and l_shipdate >= date '1997-06-01'
        and l_shipdate < date '1997-06-01' + interval '1' month;
```



15) SQL15: 2.83 sec

```
create view revenue0 (supplier_no, total_revenue) as
        select
                l_suppkey,
```

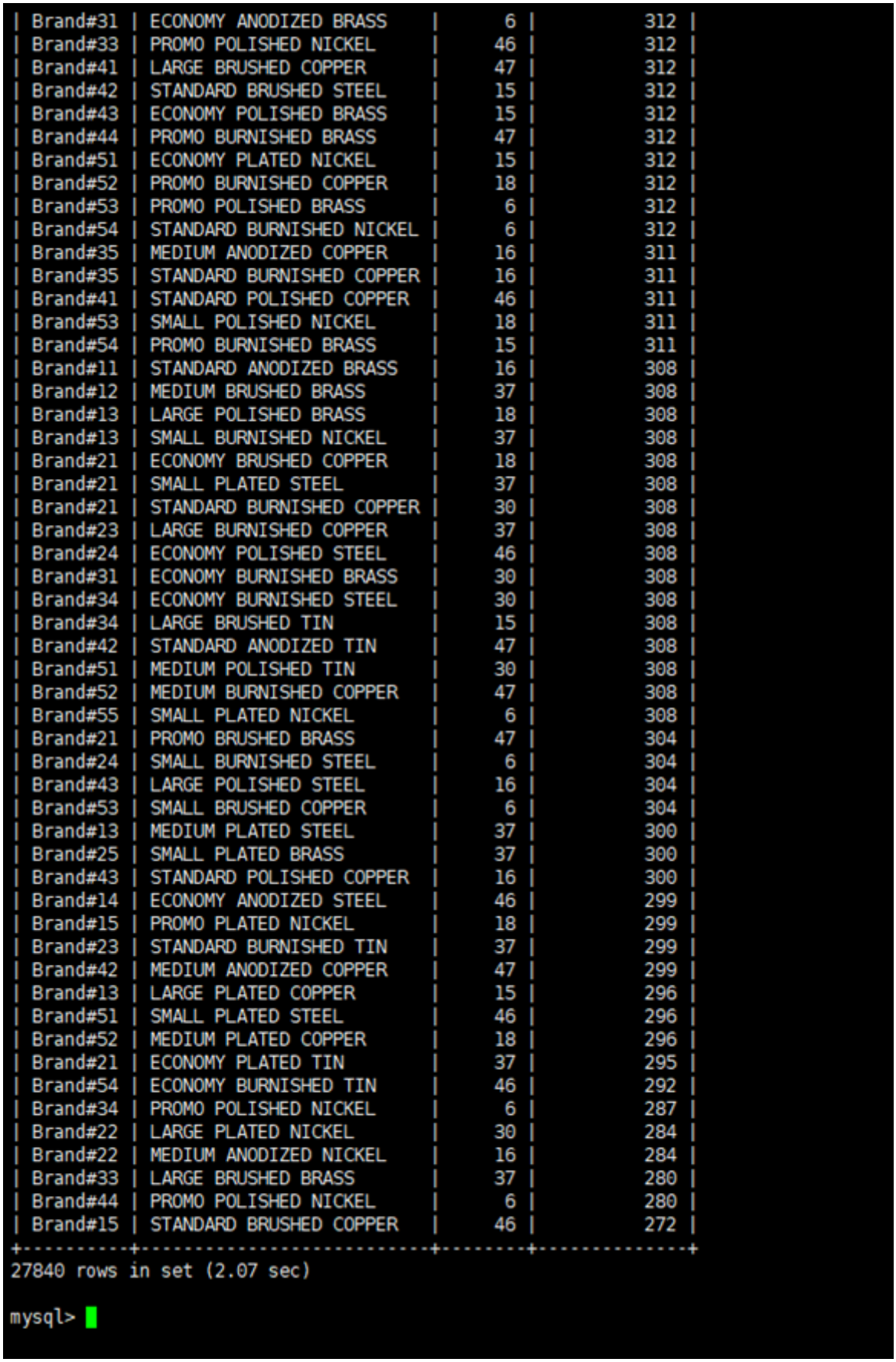
```
                sum(l_extendedprice * (1 - l_discount))
        from
                lineitem
        where
                l_shipdate >= date '1995-02-01'
                and l_shipdate < date '1995-02-01' + interval '3' month
        group by
                l_suppkey;


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;
```



16) SQL16: 2.07 sec

```
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 'SMALL ANODIZED%'
        and p_size in (47, 15, 37, 30, 46, 16, 18, 6)
        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;
```

```
mysql> 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 'SMALL ANODIZED%'
    ->         and p_size in (47, 15, 37, 30, 46, 16, 18, 6)
    ->         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;
```



```
| Brand#31 | ECONOMY ANODIZED BRASS    |      6 |          312 |
| Brand#33 | PROMO POLISHED NICKEL     |     46 |          312 |
| Brand#41 | LARGE BRUSHED COPPER      |     47 |          312 |
| Brand#42 | STANDARD BRUSHED STEEL    |     15 |          312 |
| Brand#43 | ECONOMY POLISHED BRASS    |     15 |          312 |
| Brand#44 | PROMO BURNISHED BRASS     |     47 |          312 |
| Brand#51 | ECONOMY PLATED NICKEL     |     15 |          312 |
| Brand#52 | PROMO BURNISHED COPPER    |     18 |          312 |
| Brand#53 | PROMO POLISHED BRASS      |      6 |          312 |
| Brand#54 | STANDARD BURNISHED NICKEL |      6 |          312 |
| Brand#35 | MEDIUM ANODIZED COPPER    |     16 |          311 |
| Brand#35 | STANDARD BURNISHED COPPER |     16 |          311 |
| Brand#41 | STANDARD POLISHED COPPER  |     46 |          311 |
| Brand#53 | SMALL POLISHED NICKEL     |     18 |          311 |
| Brand#54 | PROMO BURNISHED BRASS     |     15 |          311 |
| Brand#11 | STANDARD ANODIZED BRASS   |     16 |          308 |
| Brand#12 | MEDIUM BRUSHED BRASS      |     37 |          308 |
| Brand#13 | LARGE POLISHED BRASS      |     18 |          308 |
| Brand#13 | SMALL BURNISHED NICKEL    |     37 |          308 |
| Brand#21 | ECONOMY BRUSHED COPPER    |     18 |          308 |
| Brand#21 | SMALL PLATED STEEL        |     37 |          308 |
| Brand#21 | STANDARD BURNISHED COPPER |     30 |          308 |
| Brand#23 | LARGE BURNISHED COPPER    |     37 |          308 |
| Brand#24 | ECONOMY POLISHED STEEL    |     46 |          308 |
| Brand#31 | ECONOMY BURNISHED BRASS   |     30 |          308 |
| Brand#34 | ECONOMY BURNISHED STEEL   |     30 |          308 |
| Brand#34 | LARGE BRUSHED TIN         |     15 |          308 |
| Brand#42 | STANDARD ANODIZED TIN     |     47 |          308 |
| Brand#51 | MEDIUM POLISHED TIN       |     30 |          308 |
| Brand#52 | MEDIUM BURNISHED COPPER   |     47 |          308 |
| Brand#55 | SMALL PLATED NICKEL       |      6 |          308 |
| Brand#21 | PROMO BRUSHED BRASS       |     47 |          304 |
| Brand#24 | SMALL BURNISHED STEEL     |      6 |          304 |
| Brand#43 | LARGE POLISHED STEEL      |     16 |          304 |
| Brand#53 | SMALL BRUSHED COPPER      |      6 |          304 |
| Brand#13 | MEDIUM PLATED STEEL       |     37 |          300 |
| Brand#25 | SMALL PLATED BRASS        |     37 |          300 |
| Brand#43 | STANDARD POLISHED COPPER  |     16 |          300 |
| Brand#14 | ECONOMY ANODIZED STEEL    |     46 |          299 |
| Brand#15 | PROMO PLATED NICKEL       |     18 |          299 |
| Brand#23 | STANDARD BURNISHED TIN    |     37 |          299 |
| Brand#42 | MEDIUM ANODIZED COPPER    |     47 |          299 |
| Brand#13 | LARGE PLATED COPPER       |     15 |          296 |
| Brand#51 | SMALL PLATED STEEL        |     46 |          296 |
| Brand#52 | MEDIUM PLATED COPPER      |     18 |          296 |
| Brand#21 | ECONOMY PLATED TIN        |     37 |          295 |
| Brand#54 | ECONOMY BURNISHED TIN     |     46 |          292 |
| Brand#34 | PROMO POLISHED NICKEL     |      6 |          287 |
| Brand#22 | LARGE PLATED NICKEL       |     30 |          284 |
| Brand#22 | MEDIUM ANODIZED NICKEL    |     16 |          284 |
| Brand#33 | LARGE BRUSHED BRASS       |     37 |          280 |
| Brand#44 | PROMO POLISHED NICKEL     |      6 |          280 |
| Brand#15 | STANDARD BRUSHED COPPER   |     46 |          272 |
+----------+---------------------------+--------+--------------+
27840 rows in set (2.07 sec)

mysql>
```

17) SQL17: 5.74 sec

```
select
        sum(l_extendedprice) / 7.0 as avg_yearly
from
        lineitem,
        part
```

```
where
        p_partkey = l_partkey
        and p_brand = 'Brand#51'
        and p_container = 'WRAP PACK'
        and l_quantity < (
                select
                        0.2 * avg(l_quantity)
                from
                        lineitem
                where
                        l_partkey = p_partkey
        );
```

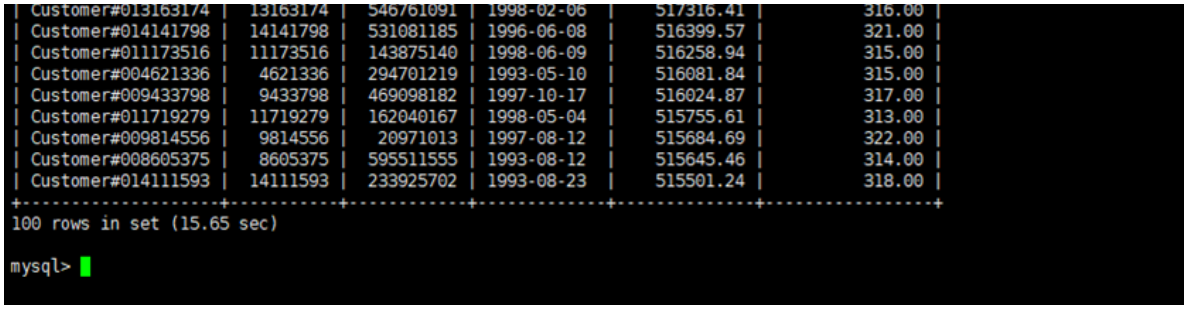
```
mysql> select
    ->         sum(l_extendedprice) / 7.0 as avg_yearly
    -> from
    ->         lineitem,
    ->         part
    -> where
    ->         p_partkey = l_partkey
    ->         and p_brand = 'Brand#51'
    ->         and p_container = 'WRAP PACK'
    ->         and l_quantity < (
    ->                 select
    ->                         0.2 * avg(l_quantity)
    ->                 from
    ->                         lineitem
    ->                 where
    ->                         l_partkey = p_partkey
    ->         );
+-----------------+
| avg_yearly      |
+-----------------+
| 31439346.442858 |
+-----------------+
1 row in set (5.74 sec)
```

18) SQL18: 15.65 sec

```
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) > 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;
```

```
mysql> 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) > 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;
+--------------------+-----------+------------+-------------+-------------+----------------+
| c_name             | c_custkey | o_orderkey | o_orderdate | o_totalprice | sum(l_quantity) |
+--------------------+-----------+------------+-------------+-------------+----------------+
| Customer#011472112 |  11472112 |  458304292 | 1998-02-05  |    591036.15 |          322.00 |
| Customer#012090925 |  12090925 |  501322081 | 1995-02-04  |    586945.44 |          319.00 |
| Customer#013458721 |  13458721 |  333307747 | 1997-12-19  |    572334.88 |          319.00 |
| Customer#008643083 |   8643083 |   84927619 | 1997-06-29  |    571417.48 |          316.00 |
| Customer#010543705 |  10543705 |  163142919 | 1996-06-10  |    569798.10 |          313.00 |
| Customer#005914657 |   5914657 |   55799200 | 1996-02-11  |    568754.48 |          327.00 |
| Customer#011461310 |  11461310 |   20662370 | 1992-07-22  |    566353.20 |          315.00 |
| Customer#007682894 |   7682894 |  532736640 | 1993-07-22  |    563532.16 |          316.00 |
| Customer#012070685 |  12070685 |   34201984 | 1997-06-18  |    563492.49 |          322.00 |
| Customer#012878113 |  12878113 |   42290181 | 1997-11-26  |    563479.57 |          318.00 |
| Customer#000506836 |    506836 |  116567399 | 1992-03-21  |    563342.71 |          319.00 |
| Customer#012848143 |  12848143 |  501771233 | 1994-12-06  |    562642.03 |          317.00 |
| Customer#003493022 |   3493022 |  182898470 | 1996-01-09  |    561296.06 |          318.00 |
| Customer#013083751 |  13083751 |   28077922 | 1996-10-27  |    560893.88 |          319.00 |
| Customer#006580315 |   6580315 |  343593507 | 1994-05-20  |    560058.60 |          321.00 |
| Customer#009427249 |   9427249 |   48881602 | 1993-09-19  |    559502.82 |          327.00 |
| Customer#012726752 |  12726752 |   92511430 | 1995-03-06  |    533441.05 |          318.00 |
| Customer#011219830 |  11219830 |  156065860 | 1996-07-03  |    533119.17 |          325.00 |
| Customer#014112568 |  14112568 |  280056096 | 1997-01-30  |    532881.87 |          313.00 |
| Customer#013477537 |  13477537 |  175859779 | 1997-04-14  |    532574.30 |          325.00 |
| Customer#003082444 |   3082444 |  319083271 | 1993-03-24  |    532223.76 |          315.00 |
| Customer#010716088 |  10716088 |  275341121 | 1994-07-15  |    532037.67 |          326.00 |
| Customer#009444602 |   9444602 |  177770599 | 1992-01-28  |    531961.40 |          337.00 |
| Customer#013616422 |  13616422 |  329431840 | 1995-09-05  |    531857.34 |          316.00 |
| Customer#000155713 |    155713 |  531652866 | 1996-06-18  |    531350.79 |          326.00 |
| Customer#004808569 |   4808569 |   12809282 | 1994-05-21  |    531002.73 |          314.00 |
| Customer#013300369 |  13300369 |  559711910 | 1993-03-25  |    530710.84 |          324.00 |
| Customer#003172843 |   3172843 |   44178691 | 1998-01-24  |    530083.88 |          316.00 |
| Customer#014675531 |  14675531 |  358712709 | 1996-01-15  |    529299.34 |          314.00 |
| Customer#007404905 |   7404905 |   87006309 | 1992-11-21  |    529089.99 |          320.00 |
| Customer#007773805 |   7773805 |  261498084 | 1993-12-24  |    528495.53 |          319.00 |
| Customer#014160562 |  14160562 |  525435843 | 1994-04-25  |    527900.25 |          313.00 |
| Customer#009668443 |   9668443 |  327357765 | 1995-02-22  |    527800.90 |          325.00 |
| Customer#006125536 |   6125536 |  532672775 | 1993-12-16  |    527552.58 |          326.00 |
| Customer#004041908 |   4041908 |   99667621 | 1992-10-25  |    526326.09 |          317.00 |
| Customer#006541660 |   6541660 |  130130438 | 1992-03-31  |    525783.23 |          324.00 |
| Customer#012270997 |  12270997 |   35542498 | 1993-10-12  |    525713.29 |          325.00 |
| Customer#007789483 |   7789483 |   40876003 | 1992-05-10  |    525433.70 |          314.00 |
| Customer#002620171 |   2620171 |  546228576 | 1994-11-28  |    524372.13 |          325.00 |
| Customer#011942315 |  11942315 |  137209030 | 1993-07-14  |    524187.78 |          323.00 |
| Customer#013455998 |  13455998 |  483724192 | 1997-03-04  |    523481.16 |          314.00 |
| Customer#007051187 |   7051187 |  138606375 | 1997-07-24  |    522926.52 |          318.00 |
| Customer#002021647 |   2021647 |  309781410 | 1995-04-12  |    521591.50 |          313.00 |
| Customer#005861503 |   5861503 |  395809221 | 1996-03-11  |    520971.04 |          314.00 |
| Customer#002667464 |   2667464 |   41274690 | 1992-08-10  |    520813.13 |          317.00 |
| Customer#007297621 |   7297621 |  442178406 | 1998-01-30  |    520565.56 |          318.00 |
| Customer#014874056 |  14874056 |  468303910 | 1998-01-29  |    519999.41 |          314.00 |
| Customer#012912623 |  12912623 |  187711367 | 1995-08-17  |    519950.45 |          325.00 |
| Customer#008050909 |   8050909 |  260432385 | 1994-09-13  |    519518.68 |          324.00 |
| Customer#007354688 |   7354688 |  584032992 | 1992-02-01  |    518933.52 |          316.00 |
| Customer#010930157 |  10930157 |  232919687 | 1997-05-21  |    518754.11 |          334.00 |
| Customer#006014731 |   6014731 |  161387302 | 1997-06-19  |    518719.77 |          314.00 |
| Customer#000280583 |    280583 |  224453441 | 1998-03-10  |    518616.51 |          318.00 |
| Customer#000040175 |     40175 |  507136258 | 1992-02-01  |    518497.04 |          317.00 |
| Customer#000358255 |    358255 |  396154496 | 1992-01-17  |    518095.13 |          317.00 |
| Customer#005907479 |   5907479 |  495435649 | 1992-05-07  |    517990.12 |          313.00 |
| Customer#008149051 |   8149051 |  127825121 | 1995-04-16  |    517895.56 |          320.00 |
| Customer#004261654 |   4261654 |  455281089 | 1997-09-08  |    517667.92 |          313.00 |
| Customer#004493219 |   4493219 |  146084455 | 1992-08-21  |    517549.01 |          313.00 |
| Customer#009049549 |   9049549 |  323219458 | 1994-04-02  |    517408.68 |          315.00 |
```



19) SQL19: 3.88 sec

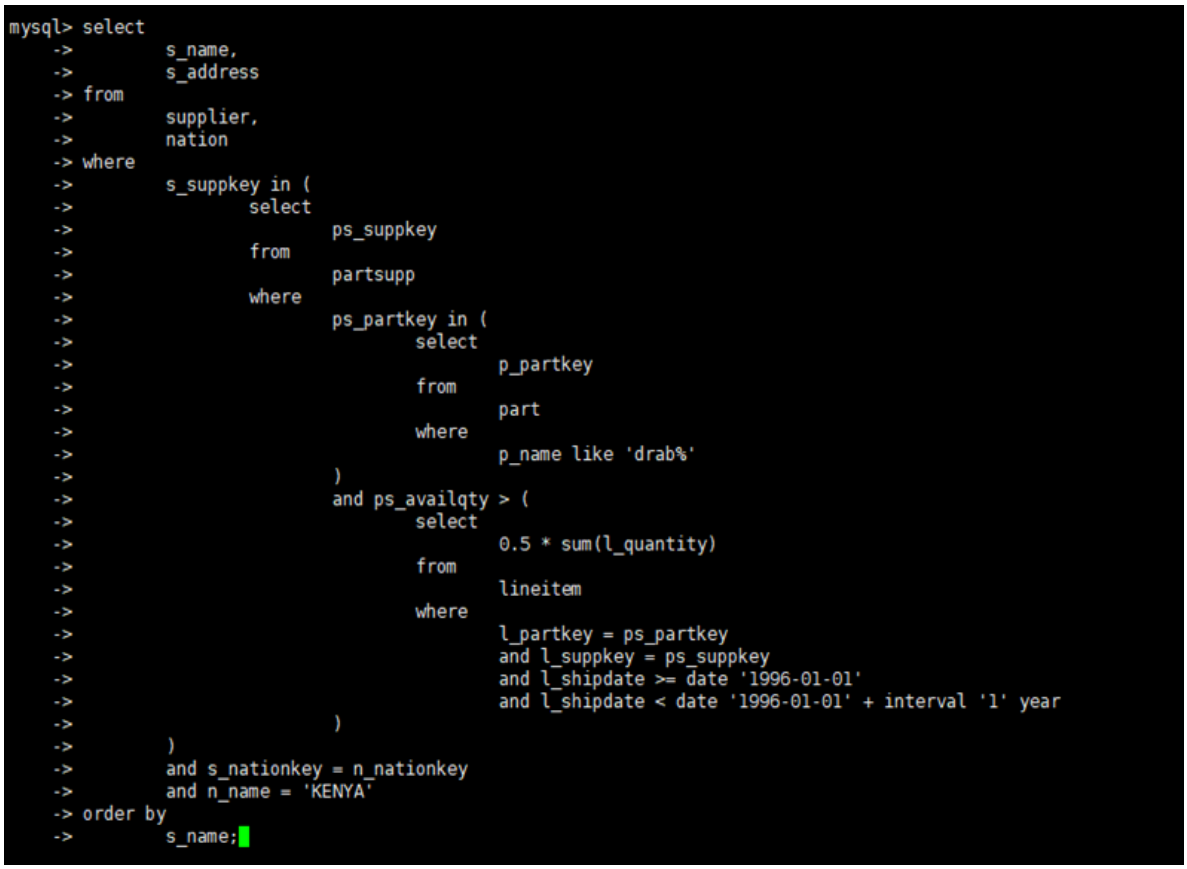
```
select
        sum(l_extendedprice* (1 - l_discount)) as revenue
from
        lineitem,
        part
where
        (
                p_partkey = l_partkey
                and p_brand = 'Brand#52'
                and p_container in ('SM CASE', 'SM BOX', 'SM PACK', 'SM PKG')
                and l_quantity >= 3 and l_quantity <= 3 + 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#43'
                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#52'
                and p_container in ('LG CASE', 'LG BOX', 'LG PACK', 'LG PKG')
                and l_quantity >= 21 and l_quantity <= 21 + 10
                and p_size between 1 and 15
                and l_shipmode in ('AIR', 'AIR REG')
                and l_shipinstruct = 'DELIVER IN PERSON'
        );
```

```
mysql> select
    ->         sum(l_extendedprice* (1 - l_discount)) as revenue
    -> from
    ->         lineitem,
    ->         part
    -> where
    ->         (
    ->                 p_partkey = l_partkey
    ->                 and p_brand = 'Brand#52'
    ->                 and p_container in ('SM CASE', 'SM BOX', 'SM PACK', 'SM PKG')
    ->                 and l_quantity >= 3 and l_quantity <= 3 + 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#43'
    ->                 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#52'
    ->                 and p_container in ('LG CASE', 'LG BOX', 'LG PACK', 'LG PKG')
    ->                 and l_quantity >= 21 and l_quantity <= 21 + 10
    ->                 and p_size between 1 and 15
    ->                 and l_shipmode in ('AIR', 'AIR REG')
    ->                 and l_shipinstruct = 'DELIVER IN PERSON'
    ->         );
+---------------+
| revenue       |
+---------------+
| 320514970.5068 |
+---------------+
1 row in set (3.88 sec)
```

20) SQL20: 6.24 sec

```
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 'drab%'
                        )
                        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 = 'KENYA'
order by
        s_name;
```

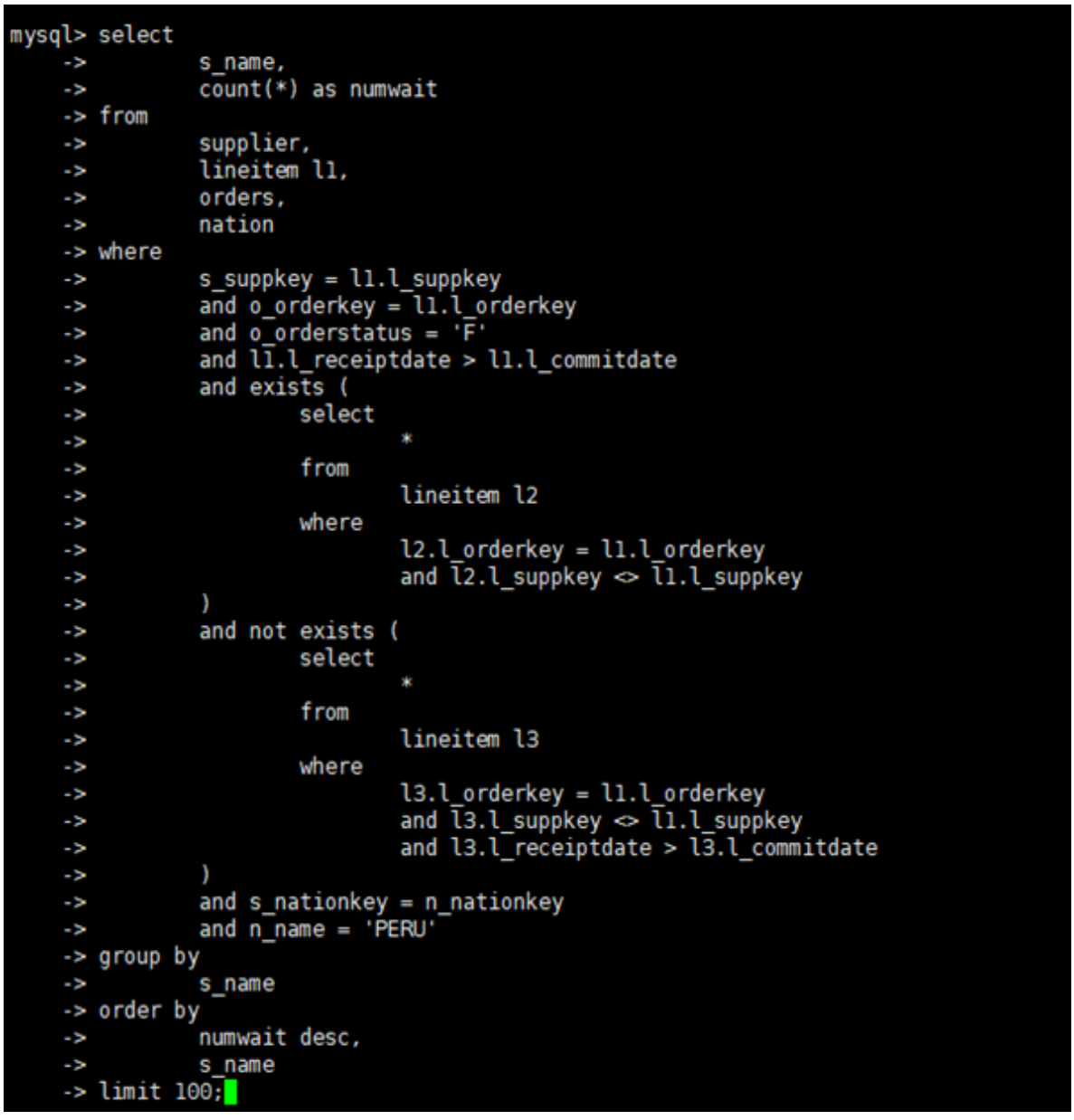


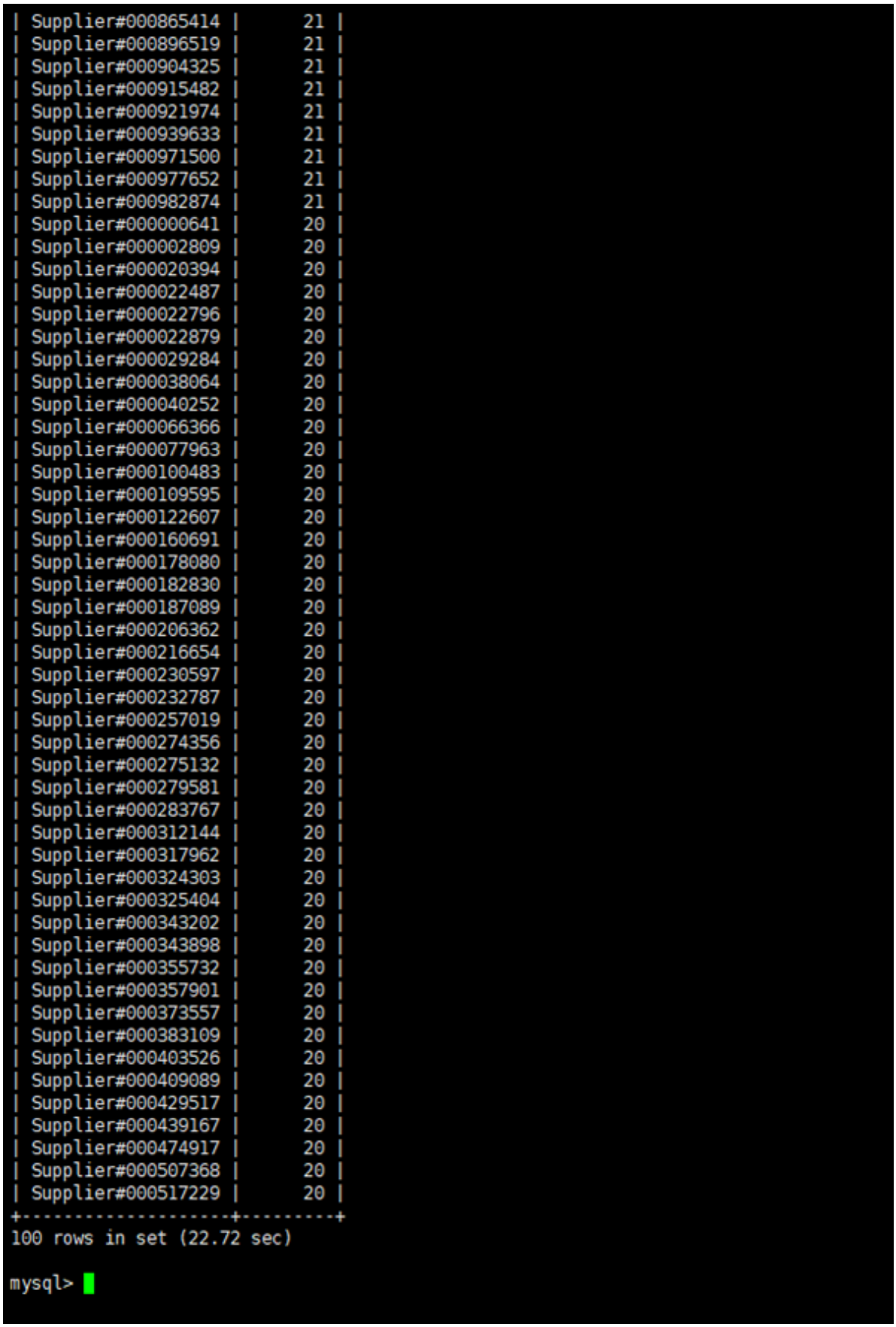
```
| Supplier#000996635 | Zqld95spPcLTo4k                          |
| Supplier#000996873 | 3PyVOKzfcjJKK9PrYppGcjg                  |
| Supplier#000996917 | q79SxJWPVnwnGypC5CFxf3                   |
| Supplier#000996946 | ar3ey0yfAo9tDhsUpUmqxVXXN3iDw 8moNPTSpnq |
| Supplier#000996983 | GRs9X0bnTlBm8d4vqzck2EZCHbx6ORyUJP       |
| Supplier#000997079 | SPpmrlc7ooxdQ8 FoIdb0ey9YSo8             |
| Supplier#000997114 | IrdBScQAhj 6                             |
| Supplier#000997152 | pCQEE6ATZEcqi                            |
| Supplier#000997195 | plc3uif2soPJUfFMEMlR7                    |
| Supplier#000997235 | KWYJXYHhaiQALJ8Vf                        |
| Supplier#000997253 | RlEliBIxYH                               |
| Supplier#000997278 | FBWGq3jzM6r3tHZN IlcR                    |
| Supplier#000997349 | 0wj9cDQRvvplUUBL                         |
| Supplier#000997401 | kUC3,YIUxgNchXRUbO8dpYQUl                |
| Supplier#000997404 | sFyoQi9RR,Hl,4sP8llyQiXxfS               |
| Supplier#000997460 | Ll8 ey74aNlij,LPA                        |
| Supplier#000997493 | iHfA6bQOWuTnfD                           |
| Supplier#000997598 | rWTELGcV 8wZjKkLH0CkfoBDgZE Rlk28kJVImaC |
| Supplier#000997704 | 5AbyL1xOewscyVfrF                        |
| Supplier#000997814 | CldswJLyNf8tB6yzyEsOiTHwDvbIEzsXvnt      |
| Supplier#000997870 | T6lFUQbZcrwXguGpd,Oo                     |
| Supplier#000997996 | kfIk,w8ePm1SoGG                          |
| Supplier#000998027 | yHa,dPFLh7l9U39NQXjtkmeeyOt2q5T3tY       |
| Supplier#000998065 | 9g4oI,1D4bwntHGRF5kDkqQsOt               |
| Supplier#000998181 | 9lqmlH7uaKZdN                            |
| Supplier#000998210 | 462D7vd2Zx,6wREFp7FCnKvY g6bq            |
| Supplier#000998292 | n96ZvkQ20HSF                             |
| Supplier#000998376 |  uaxclmu6pHhRbOy                         |
| Supplier#000998471 | pRqHtSo0,W,7ZZunFvHF1fFJalv9lzO4         |
| Supplier#000998606 | YHHOFpoewJmEBwg,JM4yIxBwkUjpAYNoRpCl     |
| Supplier#000998610 | qtlLOrVqjq8W                             |
| Supplier#000998626 | mGvoIeTJBWeoGwTTMyvddZjBm,NN6ClbF5Ew     |
| Supplier#000998660 | oHlglVhRLErAlZqw9lmDHZJ                  |
| Supplier#000998665 | c3zbFgknxZrK4NGGJ                        |
| Supplier#000998670 | PJafYJg9bqsi4I MW2                       |
| Supplier#000998685 | ,pBgWoyKl4WeDREyVA,8 2FYOgz              |
| Supplier#000998686 | 7vi3UlpCGesLoQvM3lTXuN                   |
| Supplier#000998705 | Sx6w23MxiXW,kxA                          |
| Supplier#000998744 | zotOv,9mE2eZjU                           |
| Supplier#000998814 | rzPsJaw,HiSli                            |
| Supplier#000998863 | x6MraWiyWlk1jGUWqWfpaEnYAo8R             |
| Supplier#000999074 | DPTn8g22bULEs304Ulp9rpV3uyTBsl8e4C       |
| Supplier#000999085 | egFwcBv5TkH                              |
| Supplier#000999105 | lCKYsKKIxqM                              |
| Supplier#000999264 | joTiSJjPj,DjBdIy3E6enK                   |
| Supplier#000999403 | oiT3d8PvNQD8K0wLZ                        |
| Supplier#000999489 | qq4Yb5SLhiXwcRROptgiXZtpwsVSg009         |
| Supplier#000999698 | CziGx o4mKuLbpcqHzuEE                    |
| Supplier#000999785 | lNejAJJ,ftLF4EjY4O87eS                   |
| Supplier#000999869 | LfFcR9NdFRl6F98e2yewnEOb8dxJCkX3gEcVkRT  |
| Supplier#000999902 | D4XvfAYuocmiUFM1N,EScgAHQcF              |
| Supplier#000999936 | GkUI05zvDkNpMPlE,AplBgF8PxfEhe           |
| Supplier#000999956 | 5r fovHlBwu087yF5L7YHitAZWtmK            |
+--------------------+------------------------------------------+
17853 rows in set (6.55 sec)
```

21) SQL21: 22.72 sec

```
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 = 'PERU'
group by
        s_name
order by
        numwait desc,
        s_name
limit 100;
```





```
| Supplier#000865414 |      21 |
| Supplier#000896519 |      21 |
| Supplier#000904325 |      21 |
| Supplier#000915482 |      21 |
| Supplier#000921974 |      21 |
| Supplier#000939633 |      21 |
| Supplier#000971500 |      21 |
| Supplier#000977652 |      21 |
| Supplier#000982874 |      21 |
| Supplier#000000641 |      20 |
| Supplier#000002809 |      20 |
| Supplier#000020394 |      20 |
| Supplier#000022487 |      20 |
| Supplier#000022796 |      20 |
| Supplier#000022879 |      20 |
| Supplier#000029284 |      20 |
| Supplier#000038064 |      20 |
| Supplier#000040252 |      20 |
| Supplier#000066366 |      20 |
| Supplier#000077963 |      20 |
| Supplier#000100483 |      20 |
| Supplier#000109595 |      20 |
| Supplier#000122607 |      20 |
| Supplier#000160691 |      20 |
| Supplier#000178080 |      20 |
| Supplier#000182830 |      20 |
| Supplier#000187089 |      20 |
| Supplier#000206362 |      20 |
| Supplier#000216654 |      20 |
| Supplier#000230597 |      20 |
| Supplier#000232787 |      20 |
| Supplier#000257019 |      20 |
| Supplier#000274356 |      20 |
| Supplier#000275132 |      20 |
| Supplier#000279581 |      20 |
| Supplier#000283767 |      20 |
| Supplier#000312144 |      20 |
| Supplier#000317962 |      20 |
| Supplier#000324303 |      20 |
| Supplier#000325404 |      20 |
| Supplier#000343202 |      20 |
| Supplier#000343898 |      20 |
| Supplier#000355732 |      20 |
| Supplier#000357901 |      20 |
| Supplier#000373557 |      20 |
| Supplier#000383109 |      20 |
| Supplier#000403526 |      20 |
| Supplier#000409089 |      20 |
| Supplier#000429517 |      20 |
| Supplier#000439167 |      20 |
| Supplier#000474917 |      20 |
| Supplier#000507368 |      20 |
| Supplier#000517229 |      20 |
+--------------------+---------+
100 rows in set (22.72 sec)

mysql>
```

22) SQL22: 4.40 sec

```
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
                                ('24', '32', '17', '18', '12', '14', '22')
                        and c_acctbal > (
                                select
                                        avg(c_acctbal)
                                from
                                        customer
                                where
                                        c_acctbal > 0.00
                                        and substring(c_phone from 1 for 2) in
                                                ('24', '32', '17', '18', '12',
'14', '22')
                        )
                        and not exists (
                                select
                                        *
                                from
                                        orders
                                where
                                        o_custkey = c_custkey
                        )
        ) as custsale
group by
        cntrycode
order by
        cntrycode;
```

```
mysql> 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
    ->                                 ('24', '32', '17', '18', '12', '14', '22')
    ->                         and c_acctbal > (
    ->                                 select
    ->                                         avg(c_acctbal)
    ->                                 from
    ->                                         customer
    ->                                 where
    ->                                         c_acctbal > 0.00
    ->                                         and substring(c_phone from 1 for 2) in
    ->                                                 ('24', '32', '17', '18', '12', '14', '22')
    ->                         )
    ->                         and not exists (
    ->                                 select
    ->                                         *
    ->                                 from
    ->                                         orders
    ->                                 where
    ->                                         o_custkey = c_custkey
    ->                         )
    ->         ) as custsale
    -> group by
    ->         cntrycode
    -> order by
    ->         cntrycode;
+-----------+---------+-------------+
| cntrycode | numcust | totacctbal  |
+-----------+---------+-------------+
| 12        |   90805 | 681136537.68 |
| 14        |   91459 | 685826271.21 |
| 17        |   91313 | 685025263.11 |
| 18        |   91292 | 684588251.63 |
| 22        |   90399 | 677402363.79 |
| 24        |   90635 | 680033065.67 |
| 32        |   90668 | 680459221.16 |
+-----------+---------+-------------+
7 rows in set (4.40 sec)
```

23) TPCH性能测定结果まとめ

ADB-Mysql(32 cores, 128G memory)

TPC-H-2.18.0(100GB DataSet)	1st(sec)	2nd(sec)
SQL1	25.71	25.65
SQL2	2.02	1.35
SQL3	8.75	7.09
SQL4	12.22	12.35
SQL5	10.55	11.01
SQL6	0.67	0.4
SQL7	6.41	6.38
SQL8	17.09	16.32
SQL9	36.88	34.47
SQL10	9.39	8.06
SQL11	1.96	1.72
SQL12	3.98	3.5
SQL13	12.65	12.06
SQL14	1.22	1.19
SQL15	2.83	2.93
SQL16	2.07	2.1
SQL17	5.74	5.28
SQL18	15.65	16.42
SQL19	3.88	3.17
SQL20	6.55	6.66
SQL21	22.72	22.83
SQL22	4.4	4.15
Total	213.34	205.09

ここまでTPCH性能測定完了しました。