实验三报告

关卡一：openGauss 数据库的编译和安装

1. 关卡验证

步骤 1 首先需要对数据库状态进行验证。

```
[omm@opengauss01 openGauss-server]$ gs_ctl status
```

（截图语句和执行结果）

```
~ omm@opengauss01 ~ gs_ctl status
[2022-12-06 15:04:55.356][228668][][gs_ctl]: gs_ctl status,datadir is /opt/software/openGauss/data
gs_ctl: server is running (PID: 228612)
/opt/software/openGauss/bin/gaussdb "-D" "/opt/software/openGauss/data"
~ omm@opengauss01 ~
```

步骤 2 对数据库进程进行截图验证，需包含数据库服务器的主机名。

```
[omm@opengauss01 openGauss-server]$ ps -ef|grep omm
```

（截图语句和执行结果）

```
~ omm@opengauss01 ~ ps -ef|grep omm
root      228360    5909  0 15:02 pts/0    00:00:00 su - omm
omm       228361  228360  0 15:02 pts/0    00:00:00 -bash
omm       228406  228361  0 15:02 pts/0    00:00:00 zsh
omm       228612       1  1 15:04 pts/0    00:00:01 /opt/software/openGauss/bin/gaussdb -D /opt/software/openGauss/data
omm       228680  228406  0 15:05 pts/0    00:00:00 ps -ef
omm       228681  228406  0 15:05 pts/0    00:00:00 grep --color=auto --exclude-dir=.bzr --exclude-dir=CVS --exclude-dir=.gi
t --exclude-dir=.hg --exclude-dir=.svn --exclude-dir=.idea --exclude-dir=.tox omm
~ omm@opengauss01 ~
```

关卡二：openGauss 数据导入及基本操作

1. 关卡验证

步骤 12 登录数据库验证

```
[omm@opengauss01 dbgen]$ gsql -d tpch -p 5432 -r
tpch=# select count(*) from supplier;
```

（截图语句和执行结果）

```
→ omm@opengauss01  /opt/software/tpch-kit/dbgen git:(master) x sh ./LoadData.sh
Loading customer...
Loading lineitem...
Loading nation...
Loading orders...
Loading partsupp...
Loading part...
Loading region...
Loading supplier...
→ omm@opengauss01  /opt/software/tpch-kit/dbgen git:(master) x gsql -d tpch -p 5432 -r
gsql ((GaussDB Kernel V500R002C00 build b2ff10be) compiled at 2022-12-06 14:40:54 commit 0 last mr  debug)
Non-SSL connection (SSL connection is recommended when requiring high-security)
Type "help" for help.

tpch=# select count(*) from supplier;
 count
-------
 10000
(1 row)

tpch=#
```

步骤 21 登录数据库进行验证

```
[omm@opengauss01 ~]$ gsql -d tpch -p 5432 -r
tpch=# \dt
```

（截图语句和执行结果）

```
→ omm@opengauss01  /opt/software/tpch-kit/dbgen/queries git:(master) x gsql -d tpch -p 5432 -r
gsql ((GaussDB Kernel V500R002C00 build b2ff10be) compiled at 2022-12-06 14:40:54 commit 0 last mr  debug)
Non-SSL connection (SSL connection is recommended when requiring high-security)
Type "help" for help.

tpch=# \dt
                        List of relations
 Schema |       Name        | Type  | Owner |             Storage
--------+-------------------+-------+-------+---------------------------------
 public | address_dimension | table | omm   | {orientation=row,compression=no}
 public | customer          | table | omm   | {orientation=row,compression=no}
 public | date_dimension    | table | omm   | {orientation=row,compression=no}
 public | lineitem          | table | omm   | {orientation=row,compression=no}
 public | litemall_orders   | table | omm   | {orientation=row,compression=no}
 public | nation            | table | omm   | {orientation=row,compression=no}
 public | orders            | table | omm   | {orientation=row,compression=no}
 public | part              | table | omm   | {orientation=row,compression=no}
 public | partsupp          | table | omm   | {orientation=row,compression=no}
 public | region            | table | omm   | {orientation=row,compression=no}
 public | supplier          | table | omm   | {orientation=row,compression=no}
 public | user_dimension    | table | omm   | {orientation=row,compression=no}
(12 rows)

tpch=#
```

步骤 22 查询 customer 表的数据

```
tpch=# select * from customer limit 10;
```

（截图语句和执行结果）

```
 c_custkey |       c_name       |                c_address                | c_nationkey |     c_phone     | c_acctbal | c_mktsegment |                                                    c_comment
-----------+--------------------+-----------------------------------------+-------------+-----------------+-----------+--------------+-----------------------------------------------------------------------------------------------------
         1 | Customer#000000001 | IVhzIApeRb ot,c,E                       |          15 | 25-989-741-2988 |    711.56 | BUILDING     | to the even, regular platelets. regular, ironic epitaphs nag e
         2 | Customer#000000002 | XSTf4,NCwDVaWNe6tEgvwfmRchLXak          |          13 | 23-768-687-3665 |    121.65 | AUTOMOBILE   | l accounts. blithely ironic theodolites integrate boldly: caref
         3 | Customer#000000003 | MG9kdTD2WBHm                            |           1 | 11-719-748-3364 |   7498.12 | AUTOMOBILE   |  deposits eat slyly ironic, even instructions. express foxes detect slyly. blithely even accounts abov
         4 | Customer#000000004 | XxVSJsLAGtn                             |           4 | 14-128-190-5944 |   2866.83 | MACHINERY    |  requests. final, regular ideas sleep final accou
         5 | Customer#000000005 | KvpyuHCplrB84WgAiGV6sYpZq7Tj            |           3 | 13-750-942-6364 |    794.47 | HOUSEHOLD    | n accounts will have to unwind. foxes cajole accor
         6 | Customer#000000006 | sKZz0CsnMD7mp4Xd0YrBvx,LREYKUWAh yVn    |          20 | 30-114-968-4951 |   7638.57 | AUTOMOBILE   | tions. even deposits boost according to the slyly bold packages. final accounts cajole requests. furious
         7 | Customer#000000007 | TcGeSpaZNqVePvI5KRrvXBfkasDTea          |          18 | 28-190-982-9759 |   9561.95 | AUTOMOBILE   | ainst the ironic, express theodolites. express, even pinto beans among the exp
         8 | Customer#000000008 | I0B10bB0AymmC, 0PrRYBCP1yGJ8xcBPmWhl5   |          17 | 27-147-574-9335 |   6819.74 | BUILDING     | among the slyly regular theodolites kindle blithely courts. carefully even theodolites haggle slyly along the ide
         9 | Customer#000000009 | xKiAFTjUsCuxfeleNqefumTrjS              |           8 | 18-338-906-3675 |   8324.07 | FURNITURE    | r theodolites according to the requests wake thinly excuses: pending requests haggle furiousl
        10 | Customer#000000010 | 6LrEaV6KR6PLVcgl2ArL Q3rqzLzcT1 v2      |           5 | 15-741-346-9870 |   2753.54 | HOUSEHOLD    | es regular deposits haggle. fur
(10 rows)
```

2. 思考题

数据初始化中出现了 TPC-H，这是什么?

这是一个性能测试程序，主要目的是评价特定查询的决策支持能力，强调服务器在数据挖掘、分析处理方面的能力，用于测试并得到数据库性能指标。

关卡三：openGauss 的 AI4DB 特性应用

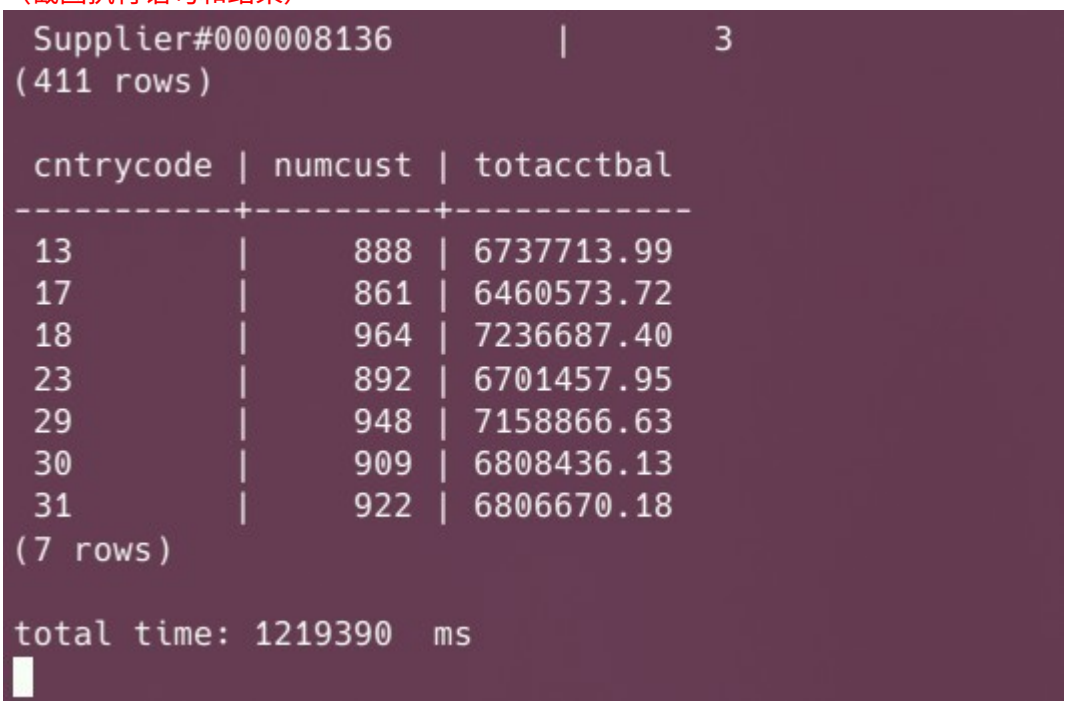
1. 关卡验证

（1）使用 X-Tuner 进行参数优化

步骤 2 在原来 CloudShell 连接窗口中查看 queries01.log。

```
[omm@opengauss01 ~]$ tail -10 /opt/software/tpch-kit/dbgen/queries/queries01.log
```

（截图执行语句和结果）



步骤 3 切换至 root 用户，执行 X-Tuner 进行参数建议优化

```
[omm@opengauss01 ~]$ exit
[root@opengauss01 xtuner]# gs_xtuner recommend --db-name tpch --db-user omm --port 5432 --host 127.0.0.1 --host-user omm
```

（截图执行语句和结果）

```
+---------------------------+-----------+----------+----------+---------+
|           name            | recommend |   min    |   max    | restart |
+---------------------------+-----------+----------+----------+---------+
| default_statistics_target |    1000   |   100    |   1000   |  False  |
|    effective_cache_size   |  21602334 |  186752  | 21602334 |  False  |
|  effective_io_concurrency |    200    |   150    |   250    |  False  |
|      enable_mergejoin     |    off    |    0     |    1     |  False  |
|      enable_nestloop      |    off    |    0     |    1     |  False  |
|      max_connections      |    370    |    50    |   741    |   True  |
| max_prepared_transactions |    370    |    50    |   741    |   True  |
|     max_process_memory    |  28803112 | 22402420 | 28803112 |   True  |
|      random_page_cost     |    1.0    |    1.0   |    2.0   |  False  |
|       shared_buffers      |   186752  |  186756  |  214768  |   True  |
|        wal_buffers        |    5836   |   2048   |   5836   |   True  |
+---------------------------+-----------+----------+----------+---------+
→ root@opengauss01  /opt/software/openGauss/bin/dbmind/xtuner
```

步骤 6 获取参数值

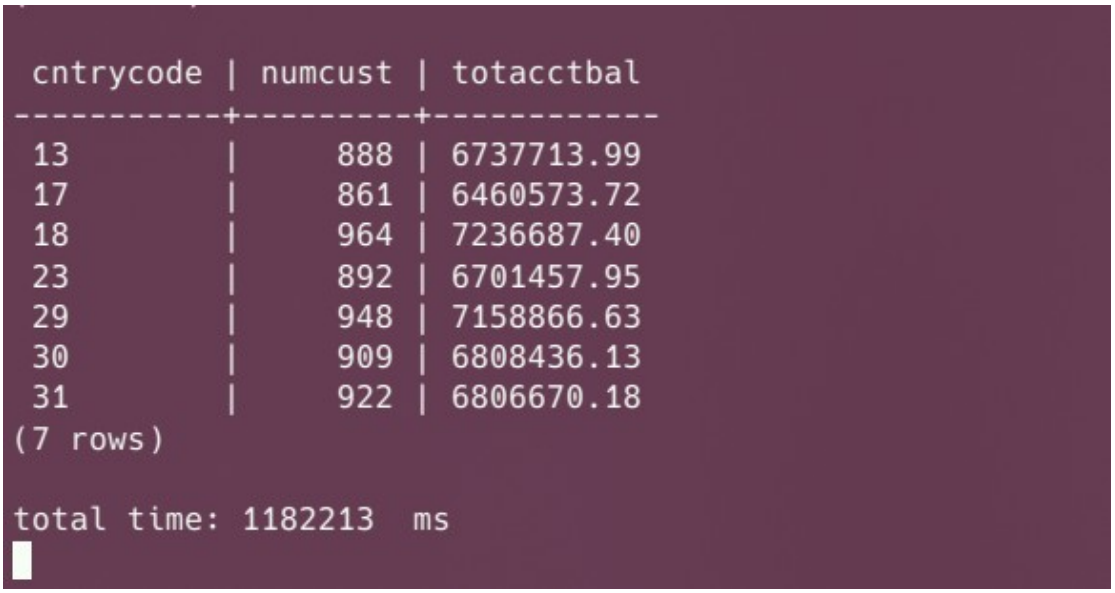
```
[omm@opengauss01 ~]$ cd /opt/software/openGauss/data
[omm@opengauss01 data]$ cat postgresql.conf|grep -E 'shared_buffers|max_connections|effective_cache_size|effective_io_concurrency|wal_buffers|random_page_cost|default_statistics_target'
```

（截图执行语句和结果）

```
~ omm@opengauss01  /opt/software/openGauss/data  cat postgresql.conf|grep -E 'shared_buffers|max_connections|effective_cache
_size|effective_io_concurrency|wal_buffers|random_page_cost|default_statistics_target'
max_connections = 370                   # (change requires restart)
# Note:  Increasing max_connections costs ~400 bytes of shared memory per
shared_buffers = 187388                 # min 128kB
bulk_write_ring_size = 2GB              # for bulkload, max shared_buffers
#standby_shared_buffers_fraction = 0.3 #control shared buffers use in standby, 0.1-1.0
effective_io_concurrency = 200          # 1-1000; 0 disables prefetching
wal_buffers = 5855                      # min 32kB
random_page_cost = 1                    # same scale as above
effective_cache_size = 21602940
default_statistics_target = 1000        # range 1-10000
# max_locks_per_transaction * (max_connections + max_prepared_transactions)
~ omm@opengauss01  /opt/software/openGauss/data
```

步骤 7 再次执行步骤 2，对比优化前的执行时间。

（截图执行语句和结果）



```
 cntrycode | numcust | totacctbal
-----------+---------+------------
 13        |     888 | 6737713.99
 17        |     861 | 6460573.72
 18        |     964 | 7236687.40
 23        |     892 | 6701457.95
 29        |     948 | 7158866.63
 30        |     909 | 6808436.13
 31        |     922 | 6806670.18
(7 rows)

total time: 1182213  ms
```

步骤 8 【附加题】有兴趣的同学可以尝试并截图记录于此。

（截图执行语句和结果）

（2）Index-advisor：索引推荐

步骤 4 使用 explain，对该 SQL 加以分析

```
tpch=# EXPLAIN
SELECT ad.province AS province, SUM(o.actual_price) AS GMV
 FROM litemall_orders o,
     address_dimension ad,
     date_dimension dd
 WHERE o.address_key = ad.address_key
  AND o.add_date = dd.date_key
  AND dd.year = 2020
  AND dd.month = 3
 GROUP BY ad.province
 ORDER BY SUM(o.actual_price) DESC;
```

（截图执行语句和结果）

```
                                                QUERY PLAN
-----------------------------------------------------------------------------------------------------------
 Sort  (cost=4593.80..4593.88 rows=31 width=47)
   Sort Key: (sum(o.actual_price)) DESC
   ->  HashAggregate  (cost=4592.72..4593.03 rows=31 width=47)
         Group By Key: ad.province
         ->  Hash Join  (cost=4354.43..4585.97 rows=1351 width=15)
               Hash Cond: (ad.address_key = o.address_key)
               ->  Seq Scan on address_dimension ad  (cost=0.00..188.02 rows=8002 width=14)
               ->  Hash  (cost=4337.54..4337.54 rows=1351 width=9)
                     ->  Hash Join  (cost=1031.78..4337.54 rows=1351 width=9)
                           Hash Cond: (o.add_date = dd.date_key)
                           ->  Seq Scan on litemall_orders o  (cost=0.00..3041.00 rows=100000 width=13)
                           ->  Hash  (cost=1031.76..1031.76 rows=2 width=4)
                                 ->  Seq Scan on date_dimension dd  (cost=0.00..1031.76 rows=2 width=4)
                                       Filter: ((year = 2020) AND ((month)::bigint = 3))
(14 rows)

tpch=#
```

步骤 10 使用 explain，对该 SQL 加以分析

```
tpch=# EXPLAIN
SELECT ad.province AS province, SUM(o.actual_price) AS GMV
 FROM litemall_orders o,
     address_dimension ad,
     date_dimension dd
 WHERE o.address_key = ad.address_key
  AND o.add_date = dd.date_key
  AND dd.year = 2020
  AND dd.month = 3
 GROUP BY ad.province
 ORDER BY SUM(o.actual_price) DESC;
```

（截图执行语句和结果）

```
                                                QUERY PLAN
-----------------------------------------------------------------------------------------------------------
 Sort  (cost=3579.58..3579.65 rows=31 width=47)
   Sort Key: (sum(o.actual_price)) DESC
   ->  HashAggregate  (cost=3578.50..3578.81 rows=31 width=47)
         Group By Key: ad.province
         ->  Hash Join  (cost=3340.21..3571.74 rows=1351 width=15)
               Hash Cond: (ad.address_key = o.address_key)
               ->  Seq Scan on address_dimension ad  (cost=0.00..188.02 rows=8002 width=14)
               ->  Hash  (cost=3323.32..3323.32 rows=1351 width=9)
                     ->  Hash Join  (cost=17.56..3323.32 rows=1351 width=9)
                           Hash Cond: (o.add_date = dd.date_key)
                           ->  Seq Scan on litemall_orders o  (cost=0.00..3041.00 rows=100000 width=13)
                           ->  Hash  (cost=17.53..17.53 rows=2 width=4)
                                 ->  Index Scan using <16503>btree_date_dimension_year on date_dimension dd  (cost=0.00..17.53 rows=2 width=4)
                                       Index Cond: (year = 2020)
                                       Filter: ((month)::bigint = 3)
(15 rows)
```

步骤 11 【附加题】有兴趣的同学可以尝试并截图记录于此。仅需要从 queries.sql 文件里选择一条或多条进行索引优化即可。

（截图执行语句和结果）

关卡四【附加题】：openGauss 的 DB4AI 特性应用

*本关卡为附加题，有兴趣的同学可以尝试实验并记录于此。

1. 关卡验证

步骤 10 利用训练好的逻辑回归模型预测数据，并与 SVM 算法进行比较，将执行结果截图。

```
openGauss=# SELECT tax, bath, size, price, price < 100000 AS price_actual, PREDICT BY
house_binary_classifier (FEATURES tax, bath, size) AS price_svm_pred, PREDICT BY
house_logistic_classifier (FEATURES tax, bath, size) AS price_logistic_pred FROM houses;
```

（截图执行语句和结果）

```
tpch=# SELECT tax, bath, size, price, price < 100000 AS price_actual, PREDICT BY house_binary_classifier (FEATURES tax, bath
, size) AS price_svm_pred, PREDICT BY house_logistic_classifier (FEATURES tax, bath, size) AS price_logistic_pred FROM house
s;
 tax  | bath | size | price  | price_actual | price_svm_pred | price_logistic_pred
------+------+------+--------+--------------+----------------+---------------------
  590 |    1 |  770 |  50000 | t            | t              | t
 1050 |    2 | 1410 |  85000 | t            | t              | t
   20 |    1 | 1060 |  22500 | t            | t              | t
  870 |    2 | 1300 |  90000 | t            | t              | t
 1320 |    2 | 1500 | 133000 | f            | t              | t
 1350 |    1 |  820 |  90500 | t            | f              | f
 2790 |  2.5 | 2130 | 260000 | f            | f              | f
  680 |    1 | 1170 | 142500 | f            | t              | t
 1840 |    2 | 1500 | 160000 | f            | f              | f
 3680 |    2 | 2790 | 240000 | f            | f              | f
 1660 |    1 | 1030 |  87000 | t            | f              | f
 1620 |    2 | 1250 | 118600 | f            | f              | f
 3100 |    2 | 1760 | 140000 | f            | f              | f
 2070 |    3 | 1550 | 148000 | f            | f              | f
  650 |  1.5 | 1450 |  65000 | t            | t              | t
(15 rows)

tpch=#
```

清理工作：资源释放

1. 关卡验证

步骤 3 查看到列表中已没有资源时，表示弹性云服务器已删除。

（截图执行语句和结果）