恒生电子股份有限公司

Oracle 到 LightDB
迁移实施手册

恒生研究院

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说　明

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目 录

一、引言

1.1 编写目的

本文档为恒生电子股份有限公司 Oracle 到 LightDB 迁移实施手册说明书，本文档主要阐述 Oracle 到 LightDB 工具的迁移实施的详细功能介绍，完整的数据库功能请参考《LightDB 用户手册》。其迁移实施手册提供了一种异构数据库 Oracle 向 LightDB 迁移方案，旨在满足数据库用户的需求，简化了对 LightDB 数据库的维护和使用。

1.2 预期读者

本文档主要适用于LightDB数据库的：

- 数据库管理员
- 开发工程师
- 测试工程师
- 技术支持工程师

1.3 参考文献

《LightDB 数据库安装手册》

二、LightDB 功能介绍 ora2pg 安装

LightDB 提供两种 ora2pg 的安装，第一种手工安装，第二种使用 docker 安装。
安装可在 lightdb 所在服务器进行，也可以单独使用一台服务器，无硬性要求，推荐 Linux 7 x86_64

2.1 手工安装 ora2pg

2.1.1 安装 perl 依赖

首先要配置好 yum 源

```
[root@localhost ~]$ yum install -y perl perl-ExtUtils-CBuilder
perl-ExtUtils-MakeMaker
Loaded plugins: langpacks, ulninfo
```

```
Resolving Dependencies
--> Running transaction check
---> Package perl.x86_64 4:5.16.3-294.el7_6 will be updated
---> Package perl.x86_64 4:5.16.3-297.el7 will be an update

(省略中间...)

Dependency Installed:
gdbm-devel.x86_64 0:1.10-8.el7
perl-ExtUtils-Install.noarch 0:1.58-297.el7
perl-ExtUtils-ParseXS.noarch 1:3.18-3.el7
perl-Locale-Maketext.noarch 0:1.23-3.el7
perl-Module-CoreList.noarch 1:2.76.02-297.el7
perl-Module-Load-Conditional.noarch 0:0.54-3.el7
perl-Params-Check.noarch 1:0.38-2.el7
perl-Test-Harness.noarch 0:3.28-3.el7
perl-version.x86_64 3:0.99.07-6.el7
systemtap-sdt-devel.x86_64 0:4.0-13.0.1.el7

Updated:
perl.x86_64 4:5.16.3-297.el7

Dependency Updated:
perl-libs.x86_64 4:5.16.3-297.el7

Complete!
```

2.1.2 安装 DBI 模块

DBI，Database Independent Interface，是 Perl 语言连接数据库的接口，下载地址 https://metacpan.org/release/DBI
下载 DBI-1.643.tar.gz
然后解压安装，如果安装失败，多数是 2.11 章节 perl 没配置好

```
[root@node1 ora2pg]# tar -xzvf DBI-1.643.tar.gz
[root@node1 ora2pg]# cd DBI-1.643/
[root@node1 DBI-1.643]# perl Makefile.PL
[root@node1 DBI-1.643]# make && make install
```

2.1.3 安装 DBD::Oracle 模块

添加环境变量，需要在本机安装 Oracle，在 root 下执行 export 即可

```
unzip instantclient-basic-linux.x64-21.6.0.0.0dbru.zip
```

```
unzip instantclient-sdk-linux.x64-21.6.0.0.0dbru.zip
unzip instantclient-sqlplus-linux.x64-21.6.0.0.0dbru.zip
export PATH
export EDITOR=vi
export GGATE=
export NLS_LANG=AMERICAN_AMERICA.AL32UTF8
export ORACLE_BASE=/root/instantclient_21_6
export ORACLE_HOME=/root/instantclient_21_6
export ORACLE_SID=
export PATH=$ORACLE_HOME:$ORACLE_HOME/OPatch:$GGATE:$PATH
export LD_LIBRARY_PATH=$ORACLE_HOME:/usr/lib:$GGATE:$LD_LIBRARY_PATH
export TNS_ADMIN=$ORACLE_HOME/network/admin
```

安装 DBD-Oracle 驱动，下载地址：点开后面连接找到 download 下载 https://metacpan.org/pod/release/PYTHIAN/DBD-Oracle-1.74/lib/DBD/Oracle.pm

【 https://metacpan.org/pod/DBD::Oracle 下载最新 1.83 版本】

或者直接点开 https://cpan.metacpan.org/authors/id/P/PY/PYTHIAN/DBD-Oracle-1.74.tar.gz 下载 DBD-Oracle-1.74.tar.gz

```
[root@node1 ora2pg]# tar -xzvf DBD-Oracle-1.83.tar.gz
[root@node1 ora2pg]# cd DBD-Oracle-1.83/
[root@node1 DBD-Oracle-1.83]# perl Makefile.PL
[root@localhost /usr/local/DBD-Oracle-1.83]$ make && make install
...略...
Installing /usr/local/share/man/man3/DBD::Oracle::Troubleshooting::Win64.3pm
Installing /usr/local/share/man/man3/DBD::Oracle::Troubleshooting::Cygwin.3pm
Installing /usr/local/share/man/man3/DBD::Oracle::Troubleshooting::Hpux.3pm
Installing /usr/local/share/man/man3/DBD::Oracle::GetInfo.3pm
Appending installation info to /usr/lib64/perl5/perllocal.pod
```

最后安装成功信息如上所示

2.1.4 安装 DBD::Pg 模块

安装 DBD-Pg 驱动，下载地址 https://metacpan.org/release/DBD-Pg，下载出 DBD-Pg-3.14.2.tar.gz

登录到 lightdb 用户，配置 pg_config

```
cd $PGHOME/bin
ln -s lt_config pg_config
```

root 用户配置环境变量并安装

```
export LIGHTDB_PORT=5432
export PGUSER=lightdb
export LIGHTDB_HOST=10.0.4.4
export POSTGRES_HOME=/home/lightdb/base/lightdb-x/13.3-22.1
export PGDATA=/home/lightdb/data
```

```
export
PATH=${POSTGRES_HOME}/bin:${POSTGRES_HOME}/tools/iftop/bin:${POSTGRES_HOME}/
tools/iotop/bin:${POSTGRES_HOME}/tools/linux-ftools/bin:${POSTGRES_HOME}/too
ls/vmtouch/bin:${PATH}
export
LD_LIBRARY_PATH=${POSTGRES_HOME}/lib:${POSTGRES_HOME}/lib/ltext:${LD_LIBRARY
_PATH}


[root@node1 ora2pg]# tar -zxvf DBD-Pg-3.15.1.tar.gz
[root@node1 ora2pg]# cd DBD-Pg-3.15.1/

[root@localhost /usr/local]$ perl Makefile.PL
[root@localhost /usr/local]$ make
[root@localhost /usr/local]$ make install
Files found in blib/arch: installing files in blib/lib into architecture dependent
library tree
Installing /usr/local/lib64/perl5/auto/DBD/Pg/Pg.so
Installing /usr/local/lib64/perl5/auto/DBD/Pg/Pg.bs
Installing /usr/local/lib64/perl5/DBD/Pg.pm
Installing /usr/local/lib64/perl5/Bundle/DBD/Pg.pm
Installing /usr/local/share/man/man3/Bundle::DBD::Pg.3pm
Installing /usr/local/share/man/man3/DBD::Pg.3pm
Appending installation info to /usr/lib64/perl5/perllocal.pod
```

最后安装成功信息如上所示

2.1.5 安装 ora2pg

下载地址 https://sourceforge.net/projects/ora2pg/

```
[root@node1 ora2pg]# cd ora2pg
[root@node1 ora2pg]# ls
changelog  doc  INSTALL  lib  LICENSE  Makefile.PL  MANIFEST  packaging  README
scripts
[root@node1 ora2pg]# perl Makefile.PL
Checking if your kit is complete...
[root@node1 ora2pg]# make
cp lib/Ora2Pg.pm blib/lib/Ora2Pg.pm
cp lib/Ora2Pg/GEOM.pm blib/lib/Ora2Pg/GEOM.pm
cp lib/Ora2Pg/PLSQL.pm blib/lib/Ora2Pg/PLSQL.pm
cp lib/Ora2Pg/Oracle.pm blib/lib/Ora2Pg/Oracle.pm
cp lib/Ora2Pg/MySQL.pm blib/lib/Ora2Pg/MySQL.pm
cp scripts/ora2pg blib/script/ora2pg
/usr/bin/perl -MExtUtils::MY -e 'MY->fixin(shift)' -- blib/script/ora2pg
```

```
cp scripts/ora2pg_scanner blib/script/ora2pg_scanner
/usr/bin/perl -MExtUtils::MY -e 'MY->fixin(shift)' --
blib/script/ora2pg_scanner
Manifying blib/man3/ora2pg.3
[root@node1 ora2pg]# make install
Installing /usr/local/share/perl5/Ora2Pg.pm
Installing /usr/local/share/perl5/Ora2Pg/GEOM.pm
Installing /usr/local/share/perl5/Ora2Pg/PLSQL.pm
Installing /usr/local/share/perl5/Ora2Pg/Oracle.pm
Installing /usr/local/share/perl5/Ora2Pg/MySQL.pm
Installing /usr/local/share/man/man3/ora2pg.3
Installing /usr/local/bin/ora2pg_scanner
Installing /usr/local/bin/ora2pg
Installing default configuration file (ora2pg.conf.dist) to /etc/ora2pg
Appending installation info to /usr/lib64/perl5/perllocal.pod
```

2.1.6 查看软件是否安装成功

```
[root@node1 ora2pg]# ora2pg --help
Usage: ora2pg [-dhpqv --estimate_cost --dump_as_html] [--option value]

   -a | --allow str  : Comma separated list of objects to allow from export.
                       Can be used with SHOW_COLUMN too.
```

如上，ora2pg 命令正确显示即安装成功

2.2 使用 docker 安装

2.2.1 导入镜像

下载 docker 镜像并执行下面命令导入：

```
$ docker load -i /home/lightdb/ora2pg.tar
sudo docker run -it --rm -v /home/lightdb/config:/config ora2pg:1 /bin/bash
```

```
[lightdb@hs docker]$ docker load -i /home/lightdb/ora2pg.tar
764055ebc9a7: Loading layer [==================================================>]  72.53MB/72.53MB
4e5c615cbaf5: Loading layer [==================================================>]  3.584kB/3.584kB
0331048e9df6: Loading layer [==================================================>]  59.81MB/59.81MB
4b3f02c5470d: Loading layer [==================================================>]  4.096kB/4.096kB
a71002aa012d: Loading layer [==================================================>]  269.7MB/269.7MB
4745c22c676c: Loading layer [==================================================>]  4.868MB/4.868MB
806722b8e583: Loading layer [==================================================>]  54.15MB/54.15MB
6db07d8402ec: Loading layer [==================================================>]   5.12kB/5.12kB
b341f07d521c: Loading layer [==================================================>]  228.2MB/228.2MB
1060577ff0b6: Loading layer [==================================================>]  62.35MB/62.35MB
ec2511903b6d: Loading layer [==================================================>]  2.048kB/2.048kB
d434d295b3ea: Loading layer [==================================================>]  131.6kB/131.6kB
8970e81d8a49: Loading layer [==================================================>]  2.048kB/2.048kB
962c60586eae: Loading layer [==================================================>]  4.608kB/4.608kB
Loaded image ID: sha256:0aa0eb8cb1b6563bd2d4e76e3a2718cd3e1f5f99392daafe914f988119c1abcb
```

2.2.2 重命名镜像

```
$ sudo docker images
REPOSITORY    TAG       IMAGE ID       CREATED         SIZE
<none>        <none>    0aa0eb8cb1b6   20 months ago   741MB
$ sudo docker tag  0aa0eb8cb1b6 ora2pg:1
$ sudo docker images
REPOSITORY    TAG       IMAGE ID       CREATED         SIZE
ora2pg        1         0aa0eb8cb1b6   20 months ago   741MB
```

到此 docker 镜像方式安装完成

三、ora2pg 迁移数据

3.1 编辑配置文件 ora2pg.conf

用 root 账户，编辑配置文件 ora2pg.conf

```
### Oracle 客户端的 ORACLE_HOME
ORACLE_HOME /oracle/app/product/19.3.0/db_1
### 源端连接串  MySQL 如:   dbi:mysql:host=192.168.1.10;database=tpch;port=3306
ORACLE_DSN  dbi:Oracle:host=10.0.4.4;sid=orcl1;port=1521

PG_VERSION 13
TRUNCATE_TABLE      1 #If set 1, a TRUNCATE TABLE instruction will be add before
loading data. This is usable only during INSERT or COPY export type.
PG_NUMERIC_TYPE     0
PG_INTEGER_TYPE     0 #指定 0 转换成 bigint 或者 bigint
#PG_INTEGER_TYPE    1 #指定 1 转换成 numeric
EXPORT_SCHEMA       1 #ALTER SCHEMA fund60trans1 OWNER TO fund60trans1;  SET
search_path = fund60trans1,public;
DROP_IF_EXISTS      1 #CREATE SCHEMA IF NOT EXISTS fund60trans1;
PREFIX_PARTITION    1 #导出的分区表加上主表文件名前缀
PREFIX_SUB_PARTITION 1 #同上，针对的对象是子分区
FILE_PER_CONSTRAINT  1 #将导出的约束单独放在一个文件中
FILE_PER_INDEX      1 #将导出的索引单独放在一个文件中
FILE_PER_FKEYS      1 #将导出的外键放在单独的文件中
USE_RESERVED_WORDS   1 #如果 oracle 中导出的表名或列名有关键字，则导出时自动为其加上双引
号，尽量询问应用看能否更改 PG 中的表名或字段名
TRANSACTION readonly   #设置为只读事务，避免误操作 Oracle 端数据
DISABLE_UNLOGGED    1 #禁止转换 unlogged 表，避免出现 unlogged 表
#DEFAULT_NUMERIC    float
```

```
JOBS              6

NLS_LANG    AMERICAN_AMERICA.UTF8
```

3.2 编辑导出脚本

vim exp 添加如下内容

```
filedate=`date +"%Y%m%d_%H%M%S"`
if [ "$1" = "ora2pg" ]; then
   if [ "$2" = "" ]; then
     echo "Usage: ora ora2pg <exp/imp>"
     exit 0
   fi

   if [ "$2" = "exp" ]; then
     echo ""
     echo "First edit ora2pg config file ora2pg.conf to make sure datasource is
correct"
     echo "vim ora set data_type_list parameter to set export object type"
     echo ""
     while true
     do

       read -p "please input schema name[exit or EXIT]:" schema
       read -p "please input schema password[exit or EXIT]:" password
       if [ -z "${schema}" ];then
       echo "The username or password is empty, program exit"
       exit 0
       fi
       if [ -z "${password}" ];then
       echo "The username or password is empty, program exit"
       exit 0
       fi
       if [ "$schema" = "exit" -o "$schema" = "EXIT" -o "$schema" = "exit" -o
"$schema" = "EXIT" ]; then
         echo "input exit, program exit"
                exit 0          ###执行退出命令
       fi
       connect=`ora2pg -t SHOW_VERSION -c ora2pg.conf -u $schema -w $password`
       echo $connect
       ora28000_flag="ORA-28000"
       ora01017_flag="ORA-01017"
```

```
      oracle_logon_flag="Oracle"
      if [[ "$connect" =~ ^"${ora01017_flag}".* ]]; then
        echo $connect
        echo "ORA-01017: invalid username/password; logon denied"
      elif [[ "$connect" =~ ^"${ora28000_flag}".* ]]; then
        echo $connect
        echo "ORA-28000: The account is locked"
      elif [[ "$connect" =~ ^"${oracle_logon_flag}".* ]]; then
              mkdir -p $schema
              # default export object
        data_type_list='TABLE
        PARTITION
        COPY
        SEQUENCE
        SYNONYM'
        #PROCEDURE
        #FUNCTION
        #PACKAGE
        #GRANT
        #VIEW
        for data_type in $data_type_list
        do
          echo 'exporting' ${data_type}' please wait...'
          # 添加 -P 10 指定并行
          ora2pg -c ora2pg.conf -t SHOW_REPORT --estimate_cost -u $schema -w
$password -n $schema -t$data_type -b $schema -o
${data_type}_${schema}_${filedate}.sql >
${data_type}_${schema}_${filedate}.log 2>&1 &
        done
        echo 'background exporting...'
      fi
    done
   elif [ "$2" = "imp" ]; then
    echo ""
    echo "Make sure target Lightdb has been created database and schemas for the
importing database"
    echo ""
    while true
    do
      read -p "please input superuser [exit or EXIT]:" username
      read -p "please input superuser password[exit or EXIT]:" password
      read -p "please input database name[exit or EXIT]:" db_name
      read -p "please input target ip address[exit or EXIT]:" ip
      read -p "please input target lightdb port[exit or EXIT]:" port
```

```
      read -p "please input data folder[exit or EXIT]:" data_folder
      read -p "import option?
[table_only/view_only/data_only/index_only/foreign_key_only/all/ | exit or
EXIT]:" import_option

      if [ -z "${username}" ];then
        echo "The superuser name is empty, program exit"
        exit 0
      fi
      if [ -z "${password}" ];then
        echo "The superuser password is empty, program exit"
        exit 0
      fi
      if [ -z "${db_name}" ];then
        echo "The target database name empty, program exit"
        exit 0
      fi
      if [ -z "${ip}" ];then
        echo "The target database ip information is empty, program exit"
        exit 0
      fi
      if [ -z "${port}" ];then
        echo "The target database port information is empty, program exit"
        exit 0
      fi
      if [ -z "${data_folder}" ];then
        echo "The data folder information is empty, program exit"
        exit 0
      fi
      if [ -z "${import_option}" ];then
        echo "The import option parameter is empty, program exit"
        exit 0
      fi
      if [ "$import_option" = "exit" -o "$import_option" = "EXIT" -o "$username"
= "exit" -o "$username" = "EXIT" -o "$password" = "exit" -o "$password" = "EXIT"
-o "$db_name" = "exit" -o "$db_name" = "EXIT" -o "$ip" = "exit" -o "$ip" = "EXIT"
-o "$port" = "exit" -o "$port" = "EXIT" -o "$data_folder" = "exit" -o "$data_folder"
= "EXIT" ]; then
        echo "input exit, program exit"
               exit 0  ###执行退出命令
      fi

      #-v ON_ERROR_STOP=ON
# 如果要单独导入数据，需要先删除掉外键
```

```
# alter table act_ge_bytearray drop constraint if EXISTS act_fk_bytearr_depl;
# 然后再根据 FKEYS_中的内容去创建
# ALTER TABLE act_ge_bytearray ADD CONSTRAINT act_fk_bytearr_depl FOREIGN KEY
(deployment_id_) REFERENCES act_re_deployment(id_) ON DELETE NO ACTION NOT
DEFERRABLE INITIALLY IMMEDIATE;
      if [ "$import_option" = "data_only" ]; then
        echo 'Importing data begin at '`date +"%Y-%m-%d %H:%M:%S"`'...'
> imp_${db_name}_${data_folder}_${import_option}.log 2>&1 &&
        PGPASSWORD=$password ltsql -U $username -h $ip -p $port -d $db_name -f
${data_folder}/`ls ${data_folder} | grep '^COPY_'`     >>
imp_${db_name}_${data_folder}_${import_option}.log 2>&1 &&
        echo 'analyze verbose begin at '`date +"%Y-%m-%d %H:%M:%S"`'...'
>> imp_${db_name}_${data_folder}_${import_option}.log 2>&1 &&
        PGPASSWORD=$password ltsql -U $username -h $ip -p $port -d $db_name -c
"analyze verbose"                                    >>
imp_${db_name}_${data_folder}_${import_option}.log 2>&1 &

      elif [ "$import_option" = "view_only" ]; then
        echo 'Importing views begin at '`date +"%Y-%m-%d %H:%M:%S"`'...'
> imp_${db_name}_${data_folder}_${import_option}.log 2>&1 &&
        PGPASSWORD=$password ltsql -U $username -h $ip -p $port -d $db_name -f
${data_folder}/`ls ${data_folder} | grep '^VIEW_'`     >>
imp_${db_name}_${data_folder}_${import_option}.log 2>&1 &&
        echo 'analyze verbose begin at '`date +"%Y-%m-%d %H:%M:%S"`'...'
>> imp_${db_name}_${data_folder}_${import_option}.log 2>&1 &&
        PGPASSWORD=$password ltsql -U $username -h $ip -p $port -d $db_name -c
"analyze verbose"                                    >>
imp_${db_name}_${data_folder}_${import_option}.log 2>&1 &

      elif [ "$import_option" = "index_only" ]; then
        echo 'Importing indexes begin at '`date +"%Y-%m-%d %H:%M:%S"`'...'
> imp_${db_name}_${data_folder}_${import_option}.log 2>&1 &&
        PGPASSWORD=$password ltsql -U $username -h $ip -p $port -d $db_name -f
${data_folder}/`ls ${data_folder} | grep '^INDEXES_'`  >>
imp_${db_name}_${data_folder}_${import_option}.log 2>&1 &&
        echo 'analyze verbose begin at '`date +"%Y-%m-%d %H:%M:%S"`'...'
>> imp_${db_name}_${data_folder}_${import_option}.log 2>&1 &&
        PGPASSWORD=$password ltsql -U $username -h $ip -p $port -d $db_name -c
"analyze verbose"                                    >>
imp_${db_name}_${data_folder}_${import_option}.log 2>&1 &

      elif [ "$import_option" = "foreign_key_only" ]; then
        echo 'Importing foreign key begin at '`date +"%Y-%m-%d %H:%M:%S"`'...'
> imp_${db_name}_${data_folder}_${import_option}.log 2>&1 &&
```

```
       PGPASSWORD=$password ltsql -U $username -h $ip -p $port -d $db_name -f
${data_folder}/`ls ${data_folder} | grep '^FKEYS_'`     >>
imp_${db_name}_${data_folder}_${import_option}.log 2>&1 &&
       echo 'analyze verbose begin at '`date +"%Y-%m-%d %H:%M:%S"`'...'
>> imp_${db_name}_${data_folder}_${import_option}.log 2>&1 &&
       PGPASSWORD=$password ltsql -U $username -h $ip -p $port -d $db_name -c
"analyze verbose"                                    >>
imp_${db_name}_${data_folder}_${import_option}.log 2>&1 &
      elif [ "$import_option" = "table_only" ]; then
       echo 'Importing only tables begin at '`date +"%Y-%m-%d %H:%M:%S"`'...'
> imp_${db_name}_${data_folder}_${import_option}.log 2>&1 &&
       PGPASSWORD=$password ltsql -U $username -h $ip -p $port -d $db_name -f
${data_folder}/`ls ${data_folder} | grep '^TABLE_'`     >>
imp_${db_name}_${data_folder}_${import_option}.log 2>&1 &&
       echo 'analyze verbose begin at '`date +"%Y-%m-%d %H:%M:%S"`'...'
>> imp_${db_name}_${data_folder}_${import_option}.log 2>&1 &&
       PGPASSWORD=$password ltsql -U $username -h $ip -p $port -d $db_name -c
"analyze verbose"                                    >>
imp_${db_name}_${data_folder}_${import_option}.log 2>&1 &
      elif [ "$import_option" = "all" ]; then
       echo 'Importing all folder please wait...'
       ## 如果要不导入表注释掉下两行...
       echo 'Importing tables begin at '`date +"%Y-%m-%d %H:%M:%S"`'...'
> imp_${db_name}_${data_folder}.log 2>&1 &&
       PGPASSWORD=$password ltsql -U $username -h $ip -p $port -d $db_name -f
${data_folder}/`ls ${data_folder} | grep '^TABLE_'` >>
imp_${db_name}_${data_folder}.log 2>&1 &&
       for sql_file in `ls ${data_folder} | grep -v '^TABLE_' | grep -v '^FKEYS_'`
        do
         echo 'Importing '${sql_file}' begin at '`date
+"%Y-%m-%d %H:%M:%S"`'...'                                    >>
imp_${db_name}_${data_folder}.log 2>&1
         PGPASSWORD=$password ltsql -U $username -h $ip -p $port -d $db_name -f
${data_folder}/${sql_file}            >> imp_${db_name}_${data_folder}.log
2>&1
        done &&
       echo 'analyze verbose begin at '`date +"%Y-%m-%d %H:%M:%S"`'...'
>> imp_${db_name}_${data_folder}.log 2>&1 &&
       PGPASSWORD=$password ltsql -U $username -h $ip -p $port -d $db_name -c
"analyze verbose"                                 >>
imp_${db_name}_${data_folder}.log 2>&1 &&
       echo 'Importing foreign key begin at '`date +"%Y-%m-%d %H:%M:%S"`'...'
>> imp_${db_name}_${data_folder}.log 2>&1 &&
```

```
       PGPASSWORD=$password ltsql -U $username -h $ip -p $port -d $db_name -f
${data_folder}/`ls ${data_folder} | grep '^FKEYS_'` >>
imp_${db_name}_${data_folder}.log 2>&1 &&
       echo 'Importing complete at '`date +"%Y-%m-%d %H:%M:%S"`'...'
>> imp_${db_name}_${data_folder}.log 2>&1 &
      fi
    done
  echo 'importing complete'
  fi
fi
```

3.3 自定义导出对象

多数情况下 Oracle 数据库中是有分区表的，则需要在 ora2pg.conf 中的 data_type_list 同时指定 TABLE 和 PARTITION

```
[root@node1 ora2pg]# ./exp ora2pg exp

First edit ora2pg config file ora2pg.conf to make sure datasource is correct
vim ora set data_type_list parameter to set export object type

please input schema name[exit or EXIT]:scott
please input schema password[exit or EXIT]:tiger
Oracle Database 19c Enterprise Edition Release 19.0.0.0.0
exporting TABLE please wait...
exporting COPY please wait...
exporting SEQUENCE please wait...
exporting SYNONYM please wait...
background exporting...
please input schema name[exit or EXIT]:
please input schema password[exit or EXIT]:
The username or password is empty, program exit
[root@node1 ora2pg]# cd scott
[root@node1 scott]# ls -ltr
total 32
-rw-r--r-- 1 root root  356 Jun 25 12:02 SEQUENCE_scott_20220625_120153.sql
-rw-r--r-- 1 root root  354 Jun 25 12:02 SYNONYM_scott_20220625_120153.sql
-rw-r--r-- 1 root root  784 Jun 25 12:02 PARTITION_scott_20220625_120153.sql
-rw-r--r-- 1 root root 1333 Jun 25 12:02 TABLE_scott_20220625_120153.sql
-rw-r--r-- 1 root root  354 Jun 25 12:02 INDEXES_TABLE_scott_20220625_120153.sql
-rw-r--r-- 1 root root  463 Jun 25 12:02 FKEYS_TABLE_scott_20220625_120153.sql
-rw-r--r-- 1 root root  511 Jun 25 12:02
CONSTRAINTS_TABLE_scott_20220625_120153.sql
-rw-r--r-- 1 root root 3827 Jun 25 12:02 COPY_scott_20220625_120153.sql
```

3.4 自定义导入表结构

```
[root@node1 ora2pg]# ./exp ora2pg imp

Make sure target Lightdb has been created database and schemas for the importing
database

please input superuser [exit or EXIT]:scott
please input superuser password[exit or EXIT]:scott
please input database name[exit or EXIT]:scott
please input target ip address[exit or EXIT]:10.20.30.199
please input target lightdb port[exit or EXIT]:5435
please input data folder[exit or EXIT]:scott
import option?
[table_only/view_only/data_only/index_only/foreign_key_only/all/ | exit or
EXIT]:table_only
please input superuser [exit or EXIT]:
please input superuser password[exit or EXIT]:
please input database name[exit or EXIT]:
please input target ip address[exit or EXIT]:
please input target lightdb port[exit or EXIT]:
please input data folder[exit or EXIT]:
import option?
[table_only/view_only/data_only/index_only/foreign_key_only/all/ | exit or
EXIT]:
The superuser name is empty, program exit
```

查看导入日志

```
[root@node1 ora2pg]# more imp_scott_scott_table_only.log
Importing only tables begin at 2022-06-25 12:19:55...
SET
SET
ltsql:scott/TABLE_scott_20220625_120153.sql:11: NOTICE:  schema "scott"
already exists, skipping
CREATE SCHEMA
ALTER SCHEMA
SET
CREATE TABLE
CREATE TABLE
CREATE TABLE
CREATE TABLE
CREATE TABLE
CREATE TABLE
CREATE TABLE
```

```
SET
SET
SET
```

3.5 自定义导入表数据

```
[root@node1 ora2pg]# ./exp ora2pg imp

Make sure target Lightdb has been created database and schemas for the importing
database

please input superuser [exit or EXIT]:scott
please input superuser password[exit or EXIT]:scott
please input database name[exit or EXIT]:scott
please input target ip address[exit or EXIT]:10.20.30.199
please input target lightdb port[exit or EXIT]:5435
please input data folder[exit or EXIT]:scott
import option?
[table_only/view_only/data_only/index_only/foreign_key_only/all/ | exit or
EXIT]:data_only
please input superuser [exit or EXIT]:
please input superuser password[exit or EXIT]:
please input database name[exit or EXIT]:
please input target ip address[exit or EXIT]:
please input target lightdb port[exit or EXIT]:
please input data folder[exit or EXIT]:
import option?
[table_only/view_only/data_only/index_only/foreign_key_only/all/ | exit or
EXIT]:
The superuser name is empty, program exit
```

查看导入日志

```
[root@node1 ora2pg]# more imp_scott_scott_data_only.log
Importing data begin at 2022-06-25 12:23:24...
SET
BEGIN
SET
SET
SET
TRUNCATE TABLE
COPY 0
SET
SET
```

```
SET
```

3.6 目标端数据确认

```
scott@scott=# select * from orders;
 o_orderkey |     o_orderdate     |  o_name
------------+---------------------+----------
      1.00 | 2021-11-11 00:00:00 | xiaoming
      2.00 | 2022-01-11 00:00:00 | xiaogang
      3.00 | 2022-02-11 00:00:00 | xiaoju
(3 rows)

scott@scott=# \d orders
                  Partitioned table "scott.orders"
   Column    |           Type           | Collation | Nullable | Default
-------------+--------------------------+-----------+----------+---------
 o_orderkey  | numeric(20,2)            |           | not null |
 o_orderdate | timestamp without time zone |           | not null |
 o_name      | character varying(79)    |           | not null |
Partition key: RANGE (o_orderdate)
Number of partitions: 3 (Use \d+ to list them.)
```

3.7 使用 docker 方式进行数据迁移

如果使用 docker 方式进行迁移，首先需要确认工作目录，比如您想将数据导入到 /home/lightdb/config，需要现将 ora2pg.conf 和 ora 导出文件放到该目录中，然后执行下面命令登录到 docker 中，执行

```
sudo docker run -it --rm -v /home/lightdb/config:/config ora2pg:1 /bin/bash
```

登录后进行导出执行

```
root@f91cb5dac1b5:~# cd /config
root@f91cb5dac1b5:/config# ls
ora ora2pg.conf
root@f91cb5dac1b5:/config# ./ora ora2pg exp
First edit ora2pg config file ora2pg.conf to make sure datasource is correct
vim ora set data_type_list parameter to set export object type
If specify table input null, exporting schema mode,else exporting specify table

please input schema name[exit or EXIT]:
```

四、数据校验

数据从 Oracle 迁移到 LightDB，要进行数据校验对比，下面给出比对表数量，字段类型、索引数量、具体每个表的数量、约束类型和数量的具体方法，我们以 hr 用户为例：

4.1 Oracle 源端操作

创建精确统计表数量的方法，注意要在业务用户内创建，比如你迁移的是 hr 用户，那么要用 hr 用户登录进行创建，执行

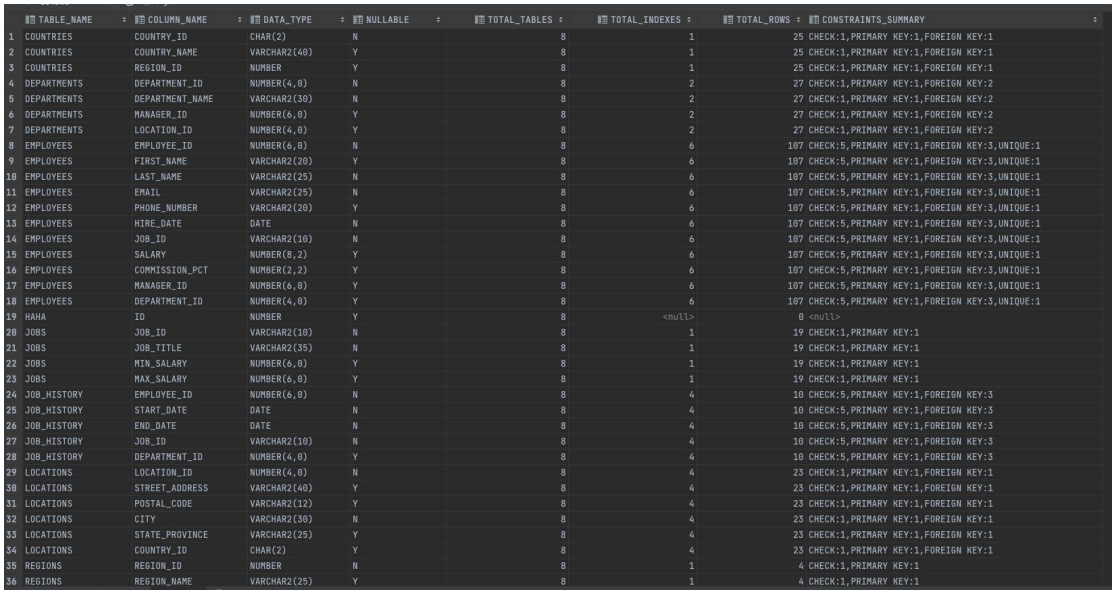
```
CREATE TYPE table_data_count_type AS OBJECT (
  table_name VARCHAR2(50),
  total_rows NUMBER
);
/
CREATE TYPE table_data_count_table AS TABLE OF table_data_count_type;
/
CREATE OR REPLACE FUNCTION get_table_data_counts
RETURN table_data_count_table
AS
  table_data table_data_count_table := table_data_count_table();
  table_name_list sys_refcursor;
  table_name VARCHAR2(50);
  total_rows NUMBER;
BEGIN
  OPEN table_name_list FOR
    SELECT table_name
    FROM user_tables;

  LOOP
    FETCH table_name_list INTO table_name;
    EXIT WHEN table_name_list%NOTFOUND;

    EXECUTE IMMEDIATE 'SELECT COUNT(*) FROM "' || table_name || '"' INTO
total_rows;

    table_data.EXTEND;
    table_data(table_data.COUNT) := table_data_count_type(table_name,
total_rows);
  END LOOP;

  CLOSE table_name_list;

  RETURN table_data;
```

```
END;
/
```

4.1.1 进行查询统计

```
WITH table_count AS (
  SELECT COUNT(*) AS total_tables FROM user_tables
),
index_count AS (
  SELECT table_name, COUNT(*) AS total_indexes
  FROM user_indexes
  GROUP BY table_name
),
constraint_count AS (
  SELECT table_name, LISTAGG(constraint_type_desc || ':' || total_constraints,
',') WITHIN GROUP (ORDER BY constraint_type) AS constraints_summary
  FROM (
    SELECT table_name, constraint_type,
          CASE constraint_type
             WHEN 'C' THEN 'CHECK'
             WHEN 'P' THEN 'PRIMARY KEY'
             WHEN 'R' THEN 'FOREIGN KEY'
             WHEN 'U'  THEN 'UNIQUE'
             ELSE constraint_type
          END AS constraint_type_desc,
          COUNT(*) AS total_constraints
    FROM user_constraints
    GROUP BY table_name, constraint_type
  ) subquery
  GROUP BY table_name
),
table_data_count AS (
  SELECT * FROM TABLE(get_table_data_counts())
)
SELECT utc.table_name, utc.column_name,
  CASE
    WHEN utc.data_type = 'VARCHAR2' THEN utc.data_type || '(' || utc.data_length
|| ')'
    WHEN utc.data_type = 'NUMBER' AND utc.data_precision IS NOT NULL AND
utc.data_scale IS NOT NULL THEN utc.data_type || '(' || utc.data_precision ||
',' || utc.data_scale || ')'
    WHEN utc.data_type = 'NUMBER' AND utc.data_precision IS NULL AND
utc.data_scale IS NULL THEN utc.data_type
```

```
   WHEN utc.data_type = 'CHAR' THEN utc.data_type || '(' || utc.data_length ||
')'
   WHEN utc.data_type = 'DATE' THEN utc.data_type
   WHEN utc.data_type = 'TIMESTAMP' THEN utc.data_type || '(' ||
utc.data_precision || ')'
   WHEN utc.data_type = 'TIMESTAMP WITH TIME ZONE' THEN utc.data_type || '(' ||
utc.data_precision || ')'
   WHEN utc.data_type = 'TIMESTAMP WITH LOCAL TIME ZONE' THEN utc.data_type ||
'(' || utc.data_precision || ')'
   WHEN utc.data_type = 'INTERVAL YEAR TO MONTH' THEN utc.data_type
   WHEN utc.data_type = 'INTERVAL DAY TO SECOND' THEN utc.data_type || '(' ||
utc.data_precision || ')'
   WHEN utc.data_type = 'LONG' THEN utc.data_type
   WHEN utc.data_type = 'CLOB' THEN utc.data_type
   WHEN utc.data_type = 'BLOB' THEN utc.data_type
   WHEN utc.data_type = 'BFILE' THEN utc.data_type
   WHEN utc.data_type = 'RAW' THEN utc.data_type || '(' || utc.data_length ||
')'
   WHEN utc.data_type = 'LONG RAW' THEN utc.data_type
   WHEN utc.data_type = 'ROWID' THEN utc.data_type
   WHEN utc.data_type = 'UROWID' THEN utc.data_type || '(' || utc.data_length
|| ')'
   WHEN utc.data_type = 'NCHAR' THEN utc.data_type || '(' || utc.data_length ||
')'
   WHEN utc.data_type = 'NVARCHAR2' THEN utc.data_type || '(' || utc.data_length
|| ')'
   WHEN utc.data_type = 'NCLOB' THEN utc.data_type
   ELSE utc.data_type
  END AS data_type,
  utc.nullable, tc.total_tables, idx.total_indexes, tdc.total_rows,
cc.constraints_summary
FROM user_tab_columns utc
JOIN table_count tc ON 1=1
LEFT JOIN index_count idx ON utc.table_name = idx.table_name
JOIN table_data_count tdc ON utc.table_name = tdc.table_name
LEFT JOIN constraint_count cc ON utc.table_name = cc.table_name
ORDER BY utc.table_name, utc.column_id;
```



	TABLE_NAME	COLUMN_NAME	DATA_TYPE	NULLABLE	TOTAL_TABLES	TOTAL_INDEXES	TOTAL_ROWS	CONSTRAINTS_SUMMARY
1	COUNTRIES	COUNTRY_ID	CHAR(2)	N	8	1	25	CHECK:1,PRIMARY KEY:1,FOREIGN KEY:1
2	COUNTRIES	COUNTRY_NAME	VARCHAR2(40)	Y	8	1	25	CHECK:1,PRIMARY KEY:1,FOREIGN KEY:1
3	COUNTRIES	REGION_ID	NUMBER	Y	8	1	25	CHECK:1,PRIMARY KEY:1,FOREIGN KEY:1
4	DEPARTMENTS	DEPARTMENT_ID	NUMBER(4,0)	N	8	2	27	CHECK:1,PRIMARY KEY:1,FOREIGN KEY:2
5	DEPARTMENTS	DEPARTMENT_NAME	VARCHAR2(30)	N	8	2	27	CHECK:1,PRIMARY KEY:1,FOREIGN KEY:2
6	DEPARTMENTS	MANAGER_ID	NUMBER(6,0)	Y	8	2	27	CHECK:1,PRIMARY KEY:1,FOREIGN KEY:2
7	DEPARTMENTS	LOCATION_ID	NUMBER(4,0)	Y	8	2	27	CHECK:1,PRIMARY KEY:1,FOREIGN KEY:2
8	EMPLOYEES	EMPLOYEE_ID	NUMBER(6,0)	N	8	6	107	CHECK:5,PRIMARY KEY:1,FOREIGN KEY:3,UNIQUE:1
9	EMPLOYEES	FIRST_NAME	VARCHAR2(20)	Y	8	6	107	CHECK:5,PRIMARY KEY:1,FOREIGN KEY:3,UNIQUE:1
10	EMPLOYEES	LAST_NAME	VARCHAR2(25)	N	8	6	107	CHECK:5,PRIMARY KEY:1,FOREIGN KEY:3,UNIQUE:1
11	EMPLOYEES	EMAIL	VARCHAR2(25)	N	8	6	107	CHECK:5,PRIMARY KEY:1,FOREIGN KEY:3,UNIQUE:1
12	EMPLOYEES	PHONE_NUMBER	VARCHAR2(20)	Y	8	6	107	CHECK:5,PRIMARY KEY:1,FOREIGN KEY:3,UNIQUE:1
13	EMPLOYEES	HIRE_DATE	DATE	N	8	6	107	CHECK:5,PRIMARY KEY:1,FOREIGN KEY:3,UNIQUE:1
14	EMPLOYEES	JOB_ID	VARCHAR2(10)	N	8	6	107	CHECK:5,PRIMARY KEY:1,FOREIGN KEY:3,UNIQUE:1
15	EMPLOYEES	SALARY	NUMBER(8,2)	Y	8	6	107	CHECK:5,PRIMARY KEY:1,FOREIGN KEY:3,UNIQUE:1
16	EMPLOYEES	COMMISSION_PCT	NUMBER(2,2)	Y	8	6	107	CHECK:5,PRIMARY KEY:1,FOREIGN KEY:3,UNIQUE:1
17	EMPLOYEES	MANAGER_ID	NUMBER(6,0)	Y	8	6	107	CHECK:5,PRIMARY KEY:1,FOREIGN KEY:3,UNIQUE:1
18	EMPLOYEES	DEPARTMENT_ID	NUMBER(4,0)	Y	8	6	107	CHECK:5,PRIMARY KEY:1,FOREIGN KEY:3,UNIQUE:1
19	HAHA	ID	NUMBER	Y	8	<null>	0	<null>
20	JOBS	JOB_ID	VARCHAR2(10)	N	8	1	19	CHECK:1,PRIMARY KEY:1
21	JOBS	JOB_TITLE	VARCHAR2(35)	N	8	1	19	CHECK:1,PRIMARY KEY:1
22	JOBS	MIN_SALARY	NUMBER(6,0)	Y	8	1	19	CHECK:1,PRIMARY KEY:1
23	JOBS	MAX_SALARY	NUMBER(6,0)	Y	8	1	19	CHECK:1,PRIMARY KEY:1
24	JOB_HISTORY	EMPLOYEE_ID	NUMBER(6,0)	N	8	4	10	CHECK:5,PRIMARY KEY:1,FOREIGN KEY:3
25	JOB_HISTORY	START_DATE	DATE	N	8	4	10	CHECK:5,PRIMARY KEY:1,FOREIGN KEY:3
26	JOB_HISTORY	END_DATE	DATE	N	8	4	10	CHECK:5,PRIMARY KEY:1,FOREIGN KEY:3
27	JOB_HISTORY	JOB_ID	VARCHAR2(10)	N	8	4	10	CHECK:5,PRIMARY KEY:1,FOREIGN KEY:3
28	JOB_HISTORY	DEPARTMENT_ID	NUMBER(4,0)	Y	8	4	10	CHECK:5,PRIMARY KEY:1,FOREIGN KEY:3
29	LOCATIONS	LOCATION_ID	NUMBER(4,0)	N	8	4	23	CHECK:1,PRIMARY KEY:1,FOREIGN KEY:1
30	LOCATIONS	STREET_ADDRESS	VARCHAR2(40)	Y	8	4	23	CHECK:1,PRIMARY KEY:1,FOREIGN KEY:1
31	LOCATIONS	POSTAL_CODE	VARCHAR2(12)	Y	8	4	23	CHECK:1,PRIMARY KEY:1,FOREIGN KEY:1
32	LOCATIONS	CITY	VARCHAR2(30)	N	8	4	23	CHECK:1,PRIMARY KEY:1,FOREIGN KEY:1
33	LOCATIONS	STATE_PROVINCE	VARCHAR2(25)	Y	8	4	23	CHECK:1,PRIMARY KEY:1,FOREIGN KEY:1
34	LOCATIONS	COUNTRY_ID	CHAR(2)	Y	8	4	23	CHECK:1,PRIMARY KEY:1,FOREIGN KEY:1
35	REGIONS	REGION_ID	NUMBER	N	8	1	4	CHECK:1,PRIMARY KEY:1
36	REGIONS	REGION_NAME	VARCHAR2(25)	Y	8	1	4	CHECK:1,PRIMARY KEY:1

4.2 LightDB 目标端操作

创建精确统计表数量的方法，注意要在业务用户内创建，比如你迁移的是 hr 用户，那么要在 LightDB 端用 hr 用户登录进行创建，执行，另外如果你的用户名是“其他的”，那么脚本中的 hr 要对应替换掉

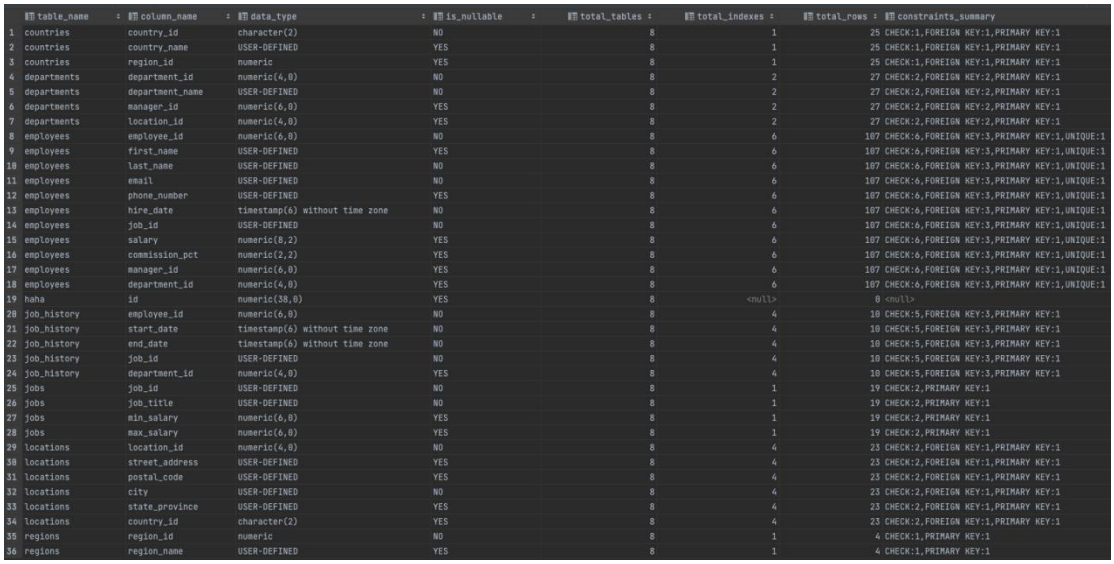
```
CREATE OR REPLACE FUNCTION get_table_data_counts()
RETURNS TABLE (
  table_name TEXT,
  total_rows BIGINT
) AS $$
DECLARE
  current_table_name TEXT;
  current_total_rows BIGINT;
  tables_cur CURSOR FOR SELECT t.table_name FROM information_schema.tables t
WHERE t.table_schema = 'hr';
BEGIN
  OPEN tables_cur;
  LOOP
    FETCH NEXT FROM tables_cur INTO current_table_name;
    EXIT WHEN NOT FOUND;

    EXECUTE format('SELECT COUNT(*) FROM %I', current_table_name) INTO
current_total_rows;

    table_name := current_table_name;
    total_rows := current_total_rows;
    RETURN NEXT;
  END LOOP;
```

```
  CLOSE tables_cur;
END; $$ LANGUAGE plpgsql;
```

4.2.1 进行查询统计

```
WITH table_count AS (
  SELECT COUNT(*) AS total_tables FROM information_schema.tables WHERE
table_schema = 'hr'
),
index_count AS (
  SELECT tablename, COUNT(*) AS total_indexes
  FROM pg_indexes
  WHERE schemaname = 'hr'
  GROUP BY tablename
),
constraint_count AS (
  SELECT table_name, string_agg(constraint_type || ':' ||
total_constraints::text, ',') AS constraints_summary
  FROM (
    SELECT table_name, constraint_type, COUNT(*) AS total_constraints
    FROM information_schema.table_constraints
    WHERE table_schema = 'hr'
    GROUP BY table_name, constraint_type
  ) subquery
  GROUP BY table_name
),
table_data_count AS (
  SELECT * FROM get_table_data_counts()
)
SELECT ic.table_name, ic.column_name,
  CASE
    WHEN ic.data_type = 'character varying' THEN ic.data_type || '(' ||
ic.character_maximum_length || ')'
    WHEN ic.data_type = 'numeric' AND ic.numeric_precision IS NOT NULL AND
ic.numeric_scale IS NOT NULL THEN ic.data_type || '(' || ic.numeric_precision
|| ',' || ic.numeric_scale || ')'
    WHEN ic.data_type = 'numeric' AND ic.numeric_precision IS NULL AND
ic.numeric_scale IS NULL THEN ic.data_type
    WHEN ic.data_type = 'character' THEN ic.data_type || '(' ||
ic.character_maximum_length || ')'
    WHEN ic.data_type = 'timestamp without time zone' THEN 'timestamp(' ||
ic.datetime_precision || ') without time zone'
```

```
    WHEN ic.data_type = 'timestamp with time zone' THEN 'timestamp(' ||
ic.datetime_precision || ') with time zone'
    WHEN ic.data_type = 'time without time zone' THEN 'time(' ||
ic.datetime_precision || ') without time zone'
    WHEN ic.data_type = 'time with time zone' THEN 'time(' || ic.datetime_precision
|| ') with time zone'
    WHEN ic.data_type = 'text' THEN ic.data_type
    WHEN ic.data_type = 'bigint' THEN ic.data_type
    WHEN ic.data_type = 'smallint' THEN ic.data_type
    WHEN ic.data_type = 'integer' THEN ic.data_type
    WHEN ic.data_type = 'bytea' THEN ic.data_type
    WHEN ic.data_type = 'real' THEN ic.data_type
    WHEN ic.data_type = 'double precision' THEN ic.data_type
    WHEN ic.data_type = 'boolean' THEN ic.data_type
    WHEN ic.data_type = 'date' THEN ic.data_type
    WHEN ic.data_type = 'uuid' THEN ic.data_type
    WHEN ic.data_type = 'json' THEN ic.data_type
    WHEN ic.data_type = 'money' THEN ic.data_type
    WHEN ic.data_type = 'interval' THEN ic.data_type
    ELSE ic.data_type
  END AS data_type,
  ic.is_nullable, tc.total_tables, idx.total_indexes, tdc.total_rows,
cc.constraints_summary
FROM information_schema.columns ic
JOIN table_count tc ON 1=1
LEFT JOIN index_count idx ON ic.table_name = idx.tablename
JOIN table_data_count tdc ON ic.table_name = tdc.table_name
LEFT JOIN constraint_count cc ON ic.table_name = cc.table_name
WHERE ic.table_schema = 'hr'
ORDER BY ic.table_name, ic.ordinal_position;
```



	table_name	column_name	data_type	is_nullable	total_tables	total_indexes	total_rows	constraints_summary
1	countries	country_id	character(2)	NO	8	1	25	CHECK:1,FOREIGN KEY:1,PRIMARY KEY:1
2	countries	country_name	USER-DEFINED	YES	8	1	25	CHECK:1,FOREIGN KEY:1,PRIMARY KEY:1
3	countries	region_id	numeric	YES	8	1	25	CHECK:1,FOREIGN KEY:1,PRIMARY KEY:1
4	departments	department_id	numeric(4,0)	NO	8	2	27	CHECK:2,FOREIGN KEY:2,PRIMARY KEY:1
5	departments	department_name	USER-DEFINED	NO	8	2	27	CHECK:2,FOREIGN KEY:2,PRIMARY KEY:1
6	departments	manager_id	numeric(6,0)	YES	8	2	27	CHECK:2,FOREIGN KEY:2,PRIMARY KEY:1
7	departments	location_id	numeric(4,0)	YES	8	2	27	CHECK:2,FOREIGN KEY:2,PRIMARY KEY:1
8	employees	employee_id	numeric(6,0)	NO	8	6	107	CHECK:6,FOREIGN KEY:3,PRIMARY KEY:1,UNIQUE:1
9	employees	first_name	USER-DEFINED	YES	8	6	107	CHECK:6,FOREIGN KEY:3,PRIMARY KEY:1,UNIQUE:1
10	employees	last_name	USER-DEFINED	NO	8	6	107	CHECK:6,FOREIGN KEY:3,PRIMARY KEY:1,UNIQUE:1
11	employees	email	USER-DEFINED	NO	8	6	107	CHECK:6,FOREIGN KEY:3,PRIMARY KEY:1,UNIQUE:1
12	employees	phone_number	USER-DEFINED	YES	8	6	107	CHECK:6,FOREIGN KEY:3,PRIMARY KEY:1,UNIQUE:1
13	employees	hire_date	timestamp(6) without time zone	NO	8	6	107	CHECK:6,FOREIGN KEY:3,PRIMARY KEY:1,UNIQUE:1
14	employees	job_id	USER-DEFINED	NO	8	6	107	CHECK:6,FOREIGN KEY:3,PRIMARY KEY:1,UNIQUE:1
15	employees	salary	numeric(8,2)	YES	8	6	107	CHECK:6,FOREIGN KEY:3,PRIMARY KEY:1,UNIQUE:1
16	employees	commission_pct	numeric(2,2)	YES	8	6	107	CHECK:6,FOREIGN KEY:3,PRIMARY KEY:1,UNIQUE:1
17	employees	manager_id	numeric(6,0)	YES	8	6	107	CHECK:6,FOREIGN KEY:3,PRIMARY KEY:1,UNIQUE:1
18	employees	department_id	numeric(4,0)	YES	8	6	107	CHECK:6,FOREIGN KEY:3,PRIMARY KEY:1,UNIQUE:1
19	haha	id	numeric(38,0)	YES	8	<null>	0	<null>
20	job_history	employee_id	numeric(6,0)	NO	8	4	10	CHECK:5,FOREIGN KEY:3,PRIMARY KEY:1
21	job_history	start_date	timestamp(6) without time zone	NO	8	4	10	CHECK:5,FOREIGN KEY:3,PRIMARY KEY:1
22	job_history	end_date	timestamp(6) without time zone	NO	8	4	10	CHECK:5,FOREIGN KEY:3,PRIMARY KEY:1
23	job_history	job_id	USER-DEFINED	NO	8	4	10	CHECK:5,FOREIGN KEY:3,PRIMARY KEY:1
24	job_history	department_id	numeric(4,0)	YES	8	4	10	CHECK:5,FOREIGN KEY:3,PRIMARY KEY:1
25	jobs	job_id	USER-DEFINED	NO	8	1	19	CHECK:2,PRIMARY KEY:1
26	jobs	job_title	USER-DEFINED	NO	8	1	19	CHECK:2,PRIMARY KEY:1
27	jobs	min_salary	numeric(6,0)	YES	8	1	19	CHECK:2,PRIMARY KEY:1
28	jobs	max_salary	numeric(6,0)	YES	8	1	19	CHECK:2,PRIMARY KEY:1
29	locations	location_id	numeric(4,0)	NO	8	4	23	CHECK:2,FOREIGN KEY:1,PRIMARY KEY:1
30	locations	street_address	USER-DEFINED	YES	8	4	23	CHECK:2,FOREIGN KEY:1,PRIMARY KEY:1
31	locations	postal_code	USER-DEFINED	YES	8	4	23	CHECK:2,FOREIGN KEY:1,PRIMARY KEY:1
32	locations	city	USER-DEFINED	NO	8	4	23	CHECK:2,FOREIGN KEY:1,PRIMARY KEY:1
33	locations	state_province	USER-DEFINED	YES	8	4	23	CHECK:2,FOREIGN KEY:1,PRIMARY KEY:1
34	locations	country_id	character(2)	YES	8	4	23	CHECK:2,FOREIGN KEY:1,PRIMARY KEY:1
35	regions	region_id	numeric	NO	8	1	4	CHECK:1,PRIMARY KEY:1
36	regions	region_name	USER-DEFINED	YES	8	1	4	CHECK:1,PRIMARY KEY:1

五、总结与说明

1．如果使用 ZIP 压缩版的 Instant Client，环境变量 LD_LIBRARY_PATH 和 ORACLE_HOME 需要设置为相同的值，也就是安装文件的所在目录
2．先导入表结构，然后在导入数据；
3．注意 LightDB 的保留的关键字是否为 oracle 表字段名；
4．所有外键约束最后导入。
5．直接通过 ora2pg 迁移数据，不要将 oracle 表数据导出为 csv 格式，然后再导入 LightDB 数据库。
6．如果遇到源端 Oracle 字段为 ctid 等 LightDB 关键字需要特殊处理
参考链接：https://ora2pg.darold.net/index.html