# Mariadb数据库备份恢复系列(二)：xtrabackup物理备份工具之完全备份

# 实验二：利用xtrabackup+二进制日志实现完全备份和恢复数据库

## 1、安装xtrabackup软件包

```
[root@node72 ~]# ls
anaconda-ks.cfg  percona-xtrabackup-24-2.4.4-1.el7.x86_64.rpm
[root@node72 ~]# yum install -y percona-xtrabackup-24-2.4.4-1.el7.x86_64.rpm
已加载插件：fastestmirror, langpacks
正在检查 percona-xtrabackup-24-2.4.4-1.el7.x86_64.rpm: percona-xtrabackup-24-2.4.4-1.el7.x86_64
percona-xtrabackup-24-2.4.4-1.el7.x86_64.rpm 将被安装
正在解决依赖关系
--> 正在检查事务
---> 软件包 percona-xtrabackup-24.x86_64.0.2.4.4-1.el7 将被 安装
--> 正在处理依赖关系 libev.so.4()(64bit)，它被软件包 percona-xtrabackup-24-2.4.4-1.el7.x86_64 需要
Loading mirror speeds from cached hostfile
--> 正在检查事务
---> 软件包 libev.x86_64.0.4.15-3.el7 将被 安装
--> 解决依赖关系完成

依赖关系解决

================================================================================================================
 Package                  架构        版本                源                                                大小
================================================================================================================
正在安装:
 percona-xtrabackup-24    x86_64      2.4.4-1.el7         /percona-xtrabackup-24-2.4.4-1.el7.x86_64         31 M
为依赖而安装:
 libev                    x86_64      4.15-3.el7          EPEL                                              43 k

事务概要
================================================================================================================
安装  1 软件包 (+1 依赖软件包)

总计：31 M
总下载量：43 k
```

下载并安装xtrabackup软件包

## 2、验证数据的存储引擎类型

```
MariaDB [hellodb]> use hellodb;
Database changed
MariaDB [hellodb]>
MariaDB [hellodb]> SHOW TABLE STATUS LIKE 'courses'\G
*************************** 1. row ***************************
           Name: courses
         Engine: InnoDB
        Version: 10
     Row_format: Compact
           Rows: 7
 Avg_row_length: 2340
    Data_length: 16384
Max_data_length: 0
   Index_length: 0
      Data_free: 0
 Auto_increment: 8
    Create_time: 2016-08-23 18:26:20
    Update_time: NULL
     Check_time: NULL
      Collation: utf8_general_ci
       Checksum: NULL
 Create_options:
        Comment:
1 row in set (0.01 sec)

MariaDB [hellodb]>
```

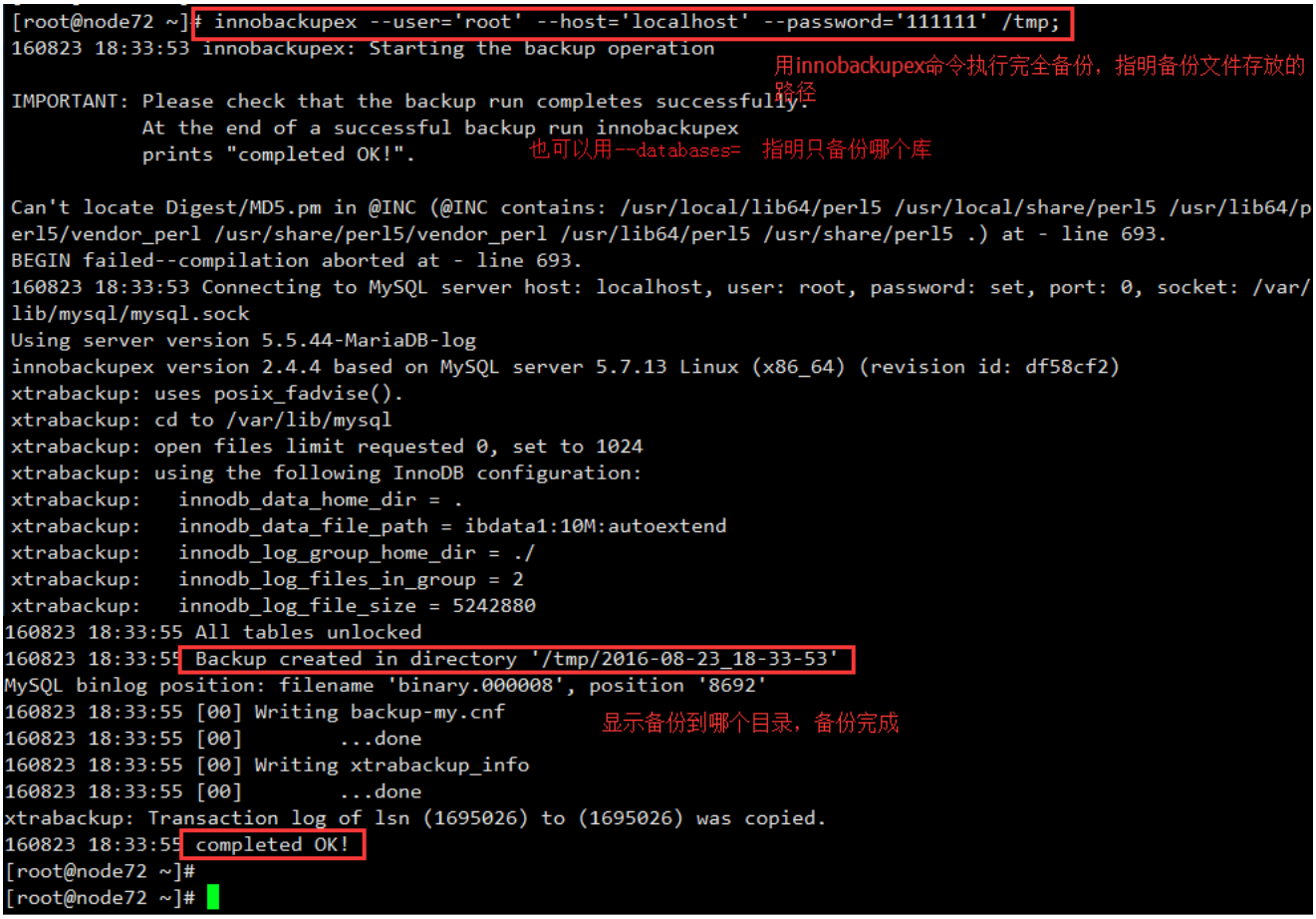
查看表的存储引擎类型，xtrabackup能对innodb存储引擎做热备、完全备份、增量备份；对MyISAM存储引擎能做温备、完全备份

## 3、查看数据初始状态

```
MariaDB [(none)]> use hellodb;
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
MariaDB [hellodb]> show tables;
+-------------------+
| Tables_in_hellodb |
+-------------------+
| classes           |
| coc               |
| courses           |
| scores            |
| students          |
| teachers          |
| toc               |
+-------------------+
7 rows in set (0.00 sec)

MariaDB [hellodb]> select * from courses;
+----------+----------------+
| CourseID | Course         |
+----------+----------------+
|        1 | Hamo Gong      |
|        2 | Kuihua Baodian |
|        3 | Jinshe Jianfa  |
|        4 | Taiji Quan     |
|        5 | Daiyu Zanghua  |
|        6 | Weituo Zhang   |
|        7 | Dagou Bangfa   |
+----------+----------------+
```

查看原始数据的信息

## 4、利用innobackupex进行完全备份



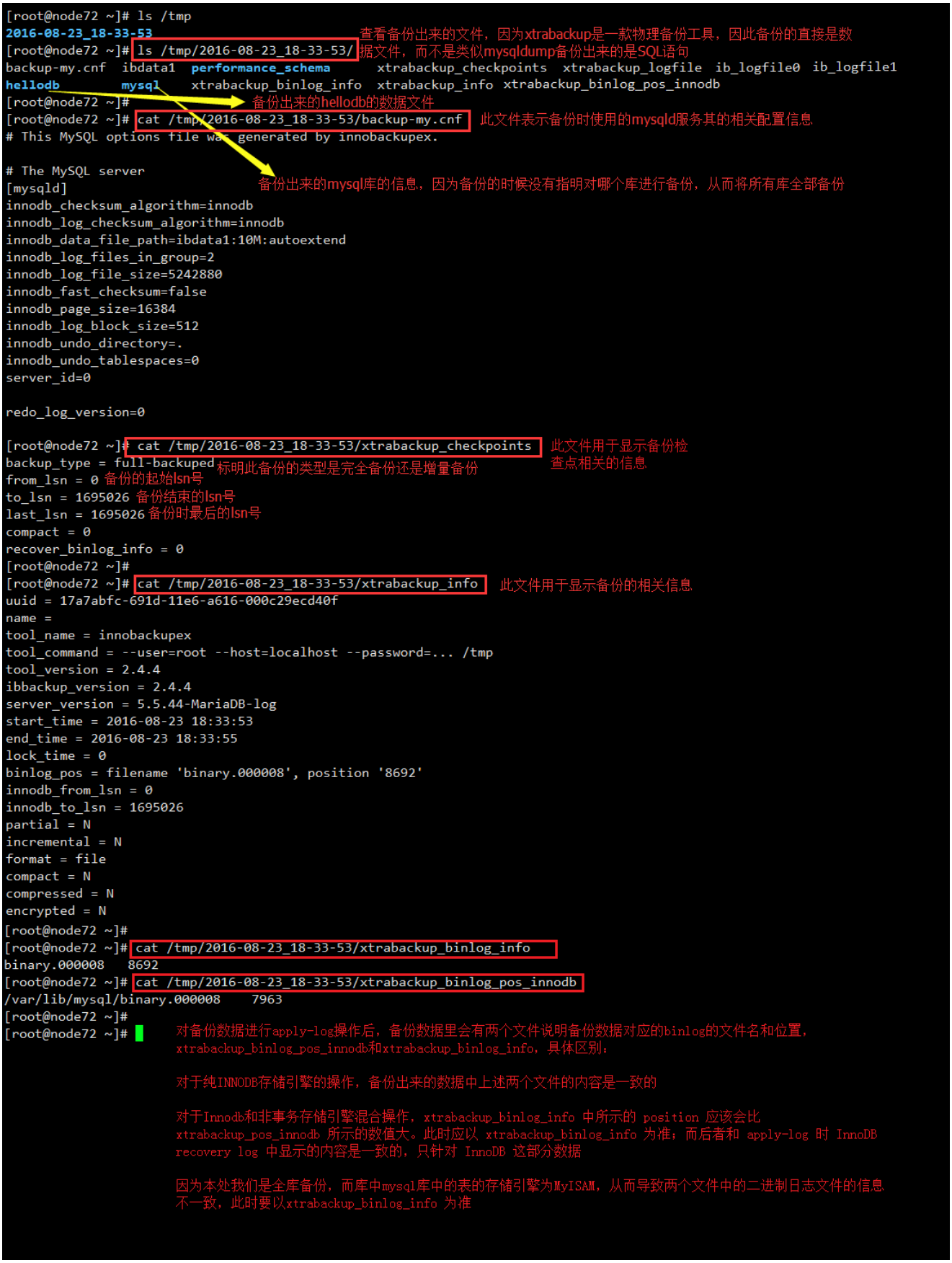

## 5、进行apply-log操作

```
[root@node72 ~]#
[root@node72 ~]# innobackupex --apply-log /tmp/2016-08-23_18-33-53/
160823 19:37:24 innobackupex: Starting the apply-log operation

IMPORTANT: Please check that the apply-log run completes successfully.
           At the end of a successful apply-log run innobackupex
           prints "completed OK!".

innobackupex version 2.4.4 based on MySQL server 5.7.13 Linux (x86_64) (revision id: df58cf2)
xtrabackup: cd to /tmp/2016-08-23_18-33-53
xtrabackup: This target seems to be not prepared yet.
InnoDB: Number of pools: 1
xtrabackup: xtrabackup_logfile detected: size=8388608, start_lsn=(1695026)
xtrabackup: using the following InnoDB configuration for recovery:
xtrabackup:   innodb_data_home_dir = .
xtrabackup:   innodb_data_file_path = ibdata1:10M:autoextend
xtrabackup:   innodb_log_group_home_dir = .
xtrabackup:   innodb_log_files_in_group = 1
xtrabackup:   innodb_log_file_size = 8388608
xtrabackup: using the following InnoDB configuration for recovery:
xtrabackup:   innodb_data_home_dir = .
xtrabackup:   innodb_data_file_path = ibdata1:10M:autoextend
xtrabackup:   innodb_log_group_home_dir = .
xtrabackup:   innodb_log_files_in_group = 1
xtrabackup:   innodb_log_file_size = 8388608
xtrabackup: Starting InnoDB instance for recovery.
xtrabackup: Using 104857600 bytes for buffer pool (set by --use-memory parameter)
InnoDB: PUNCH HOLE support available
InnoDB: Mutexes and rw_locks use GCC atomic builtins
InnoDB: 32 non-redo rollback segment(s) are active.
InnoDB: 5.7.13 started; log sequence number 1695253
xtrabackup: starting shutdown with innodb_fast_shutdown = 1
InnoDB: FTS optimize thread exiting.
InnoDB: Starting shutdown...
InnoDB: Shutdown completed; log sequence number 1695272
160823 19:37:29 completed OK!
[root@node72 ~]#
[root@node72 ~]#
```

对备份出来的数据进行apply-log操作，相当于将备份出来的数据中事务日志中已经提交的事务信息写入数据文件中，未提交的事务进行回滚操作

apply log完成

## 6、查看备份出来的文件的信息




7、模拟在完全备份后，对数进行修改，以测试通过二进制日志还原完全备份后尚未来得及备份的变化的数据

```
MariaDB [hellodb]> SELECT * FROM courses;
+----------+----------------+
| CourseID | Course         |
+----------+----------------+
|        1 | Hamo Gong      |
|        2 | Kuihua Baodian |
|        3 | Jinshe Jianfa  |
|        4 | Taiji Quan     |
|        5 | Daiyu Zanghua  |
|        6 | Weituo Zhang   |
|        7 | Dagou Bangfa   |
+----------+----------------+
7 rows in set (0.00 sec)

MariaDB [hellodb]> INSERT INTO courses (Course) VALUES ('2jz_test1'),('2jz_test2');
Query OK, 2 rows affected (0.02 sec)
Records: 2  Duplicates: 0  Warnings: 0

MariaDB [hellodb]> SELECT * FROM courses;
+----------+----------------+
| CourseID | Course         |
+----------+----------------+
|        1 | Hamo Gong      |
|        2 | Kuihua Baodian |
|        3 | Jinshe Jianfa  |
|        4 | Taiji Quan     |
|        5 | Daiyu Zanghua  |
|        6 | Weituo Zhang   |
|        7 | Dagou Bangfa   |
|        8 | 2jz_test1      |
|        9 | 2jz_test2      |
```

模拟在完全备份后，对数据库做出的更改操作，以测试用二进制日志文件对完全备份后，修改的尚未进行备份的数据进行还原

## 8、模拟损坏数据库，以测试还原

```
MariaDB [hellodb]>
MariaDB [hellodb]> DROP DATABASE hellodb;
Query OK, 7 rows affected (0.08 sec)

MariaDB [(none)]>
MariaDB [(none)]> SHOW DATABASES;
+--------------------+
| Database           |
+--------------------+
| information_schema |
| mysql              |
| performance_schema |
+--------------------+
3 rows in set (0.00 sec)

MariaDB [(none)]> \q
Bye
[root@node72 ~]# ls /var/lib/mysql/
aria_log.00000001  binary.000002  binary.000005  binary.000008  ib_logfile0  mysql.sock
aria_log_control   binary.000003  binary.000006  binary.index   ib_logfile1  node72.log
binary.000001      binary.000004  binary.000007  ibdata1        mysql        performance_schema
[root@node72 ~]#

MariaDB [(none)]> SHOW MASTER STATUS;
+---------------+----------+--------------+------------------+
| File          | Position | Binlog_Do_DB | Binlog_Ignore_DB |
+---------------+----------+--------------+------------------+
| binary.000008 |     9034 |              |                  |
+---------------+----------+--------------+------------------+
1 row in set (0.00 sec)
```

模拟误操作，导致将库删除的场景

查看数据库的数据目录下，已经没有hellodb库的文件

查看要恢复时刻，二进制日志的文件和所处位置

## 9、导出自从完全备份到数据库损坏时的二进制日志事件

```
[root@node72 ~]# mysqlbinlog --start-position=8692 /var/lib/mysql/binary.000008
/*!50530 SET @@SESSION.PSEUDO_SLAVE_MODE=1*/;
/*!40019 SET @@session.max_insert_delayed_threads=0*/;
/*!50003 SET @OLD_COMPLETION_TYPE=@@COMPLETION_TYPE,COMPLETION_TYPE=0*/;
DELIMITER /*!*/;
# at 4
#160823 16:51:09 server id 1  end_log_pos 245   Start: binlog v 4, server v 5.5.44-MariaDB-log created 160823
16:51:09 at startup
# Warning: this binlog is either in use or was not closed properly.
ROLLBACK/*!*/;
BINLOG '
fQ68Vw8BAAAA8QAAAPUAAAABAAQANS41LjQ0LU1hcmlhREItbG9nAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAB9DrxXEzgNAAgAEgAEBAQEEgAA2QAEGggAAAAICAgCAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAhD7gnA==
'/*!*/;
# at 8692
#160823 19:46:23 server id 1  end_log_pos 8763  Query   thread_id=18    exec_time=0     error_code=0
SET TIMESTAMP=1471952783/*!*/;
SET @@session.pseudo_thread_id=18/*!*/;
SET @@session.foreign_key_checks=1, @@session.sql_auto_is_null=0, @@session.unique_checks=1, @@session.autocom
mit=1/*!*/;
SET @@session.sql_mode=0/*!*/;
SET @@session.auto_increment_increment=1, @@session.auto_increment_offset=1/*!*/;
/*!\C utf8 *//*!*/;
SET @@session.character_set_client=33,@@session.collation_connection=33,@@session.collation_server=8/*!*/;
SET @@session.lc_time_names=0/*!*/;
SET @@session.collation_database=DEFAULT/*!*/;
# at 8763
#160823 19:46:23 server id 1  end_log_pos 8791  Intvar
SET INSERT_ID=8/*!*/;
# at 8791
#160823 19:46:23 server id 1  end_log_pos 8920  Query   thread_id=18    exec_time=0     error_code=0
use `hellodb`/*!*/;
SET TIMESTAMP=1471952783/*!*/;
INSERT INTO courses (Course) VALUES ('2jz_test1'),('2jz_test2')
/*!*/;
# at 8920
#160823 19:46:23 server id 1  end_log_pos 8947  Xid = 280
COMMIT/*!*/;
# at 8947
#160823 19:49:00 server id 1  end_log_pos 9034  Query   thread_id=18    exec_time=0     error_code=0
SET TIMESTAMP=1471952940/*!*/;
DROP DATABASE hellodb
/*!*/;
DELIMITER ;
# End of log file
ROLLBACK /* added by mysqlbinlog */;
/*!50003 SET COMPLETION_TYPE=@OLD_COMPLETION_TYPE*/;
/*!50530 SET @@SESSION.PSEUDO_SLAVE_MODE=0*/;
```

根据完全备份时的二进制日志文件的位置，和需要恢复时二进制日志文件的位置，来查看相关二进制日志文件，找到此前误删除数据库时二进制日志文件的位置，然后将完全备份到删除数据库前的这一部分二进制日志文件进行导出

找到误删除时，二进制日志文件的位置

```
[root@node72 ~]# mysqlbinlog --start-position=8692 --stop-position=8947 /var/lib/mysql/binary.000008 > /tmp/2j
z.sql
[root@node72 ~]# cat /tmp/2jz.sql
/*!50530 SET @@SESSION.PSEUDO_SLAVE_MODE=1*/;
/*!40019 SET @@session.max_insert_delayed_threads=0*/;
/*!50003 SET @OLD_COMPLETION_TYPE=@@COMPLETION_TYPE,COMPLETION_TYPE=0*/;
DELIMITER /*!*/;
# at 4
#160823 16:51:09 server id 1  end_log_pos 245   Start: binlog v 4, server v 5.5.44-MariaDB-log created 160823
16:51:09 at startup
# Warning: this binlog is either in use or was not closed properly.
ROLLBACK/*!*/;
BINLOG '
fQ68Vw8BAAAA8QAAAPUAAAABAAQANS41LjQ0LU1hcmlhREItbG9nAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAB9DrxXEzgNAAgAEgAEBAQEEgAA2QAEGggAAAAICAgCAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAhD7gnA==
'/*!*/;
# at 8692
#160823 19:46:23 server id 1  end_log_pos 8763  Query   thread_id=18    exec_time=0     error_code=0
SET TIMESTAMP=1471952783/*!*/;
```

导出完全备份到误操作删除之间的二进制日志信息，

如果中间不止一个日志文件，可类似如下操作：
msyqlbinlog --start-position=1122 /binary.0001 /binary.0002 --stop-position=356 /binary.0003 > /aaa.sql
相当于道出了/binary.0001从1122位置开始的内容，/binary.00002文件的所有内容，以及/binary.00003从开始到356位置的内容

```
SET @@session.pseudo_thread_id=18/*!*/;
SET @@session.foreign_key_checks=1, @@session.sql_auto_is_null=0, @@session.unique_checks=1, @@session.autocom
mit=1/*!*/;
SET @@session.sql_mode=0/*!*/;
SET @@session.auto_increment_increment=1, @@session.auto_increment_offset=1/*!*/;
/*!\C utf8 *//*!*/;
SET @@session.character_set_client=33,@@session.collation_connection=33,@@session.collation_server=8/*!*/;
SET @@session.lc_time_names=0/*!*/;
SET @@session.collation_database=DEFAULT/*!*/;
```

## 10、利用完全备份，进行恢复

```
[root@node72 ~]# systemctl stop mariadb
[root@node72 ~]#
[root@node72 ~]# innobackupex --copy-back /tmp/2016-08-23_18-33-53/
160823 20:48:21 innobackupex: Starting the copy-back operation

IMPORTANT: Please check that the copy-back run completes successfully.
           At the end of a successful copy-back run innobackupex
           prints "completed OK!".

innobackupex version 2.4.4 based on MySQL server 5.7.13 Linux (x86_64) (revision id: df58cf2)
Original data directory /var/lib/mysql is not empty!
[root@node72 ~]#
[root@node72 ~]# mv /var/lib/mysql/* /tmp/
[root@node72 ~]#
[root@node72 ~]# innobackupex --copy-back /tmp/2016-08-23_18-33-53/
160823 20:51:41 innobackupex: Starting the copy-back operation

IMPORTANT: Please check that the copy-back run completes successfully.
           At the end of a successful copy-back run innobackupex
           prints "completed OK!".

innobackupex version 2.4.4 based on MySQL server 5.7.13 Linux (x86_64) (revision id: df58cf2)
160823 20:51:41 [01] Copying ib_logfile0 to /var/lib/mysql/ib_logfile0
160823 20:51:41 [01]        ...done
160823 20:51:42 [01] Copying ib_logfile1 to /var/lib/mysql/ib_logfile1
160823 20:51:42 [01]        ...done
160823 20:51:42 [01] Copying ibdata1 to /var/lib/mysql/ibdata1
160823 20:51:42 [01]        ...done
160823 20:51:42 [01] Copying ./hellodb/classes.ibd to /var/lib/mysql/hellodb/classes.ibd
160823 20:51:42 [01]        ...done
160823 20:51:42 [01] Copying ./hellodb/coc.ibd to /var/lib/mysql/hellodb/coc.ibd
160823 20:51:42 [01]        ...done
160823 20:51:42 [01] Copying ./xtrabackup_binlog_pos_innodb to /var/lib/mysql/xtrabackup_binlog_pos_innodb
160823 20:51:42 [01]        ...done
160823 20:51:42 [01] Copying ./ibtmp1 to /var/lib/mysql/ibtmp1
160823 20:51:43 [01]        ...done
160823 20:51:43 completed OK!
[root@node72 ~]#
[root@node72 ~]# ll /var/lib/mysql/
总用量 40980
drwxr-x--- 2 root root     4096 8月   23 20:51 hellodb
-rw-r----- 1 root root 18874368 8月   23 20:51 ibdata1
-rw-r----- 1 root root  5242880 8月   23 20:51 ib_logfile0
-rw-r----- 1 root root  5242880 8月   23 20:51 ib_logfile1
-rw-r----- 1 root root 12582912 8月   23 20:51 ibtmp1
drwxr-x--- 2 root root     4096 8月   23 20:51 mysql
drwxr-x--- 2 root root     4096 8月   23 20:51 performance_schema
-rw-r----- 1 root root       34 8月   23 20:51 xtrabackup_binlog_pos_innodb
-rw-r----- 1 root root      483 8月   23 20:51 xtrabackup_info
[root@node72 ~]# chown -R mysql:mysql /var/lib/mysql/*
[root@node72 ~]#
[root@node72 ~]# systemctl start mariadb
[root@node72 ~]# ss -tnl
State      Recv-Q Send-Q          Local Address:Port                         Peer Address:Port
LISTEN     0      50                          *:3306                                *:*
LISTEN     0      128                         *:22                                  *:*
LISTEN     0      100                 127.0.0.1:25                                  *:*
LISTEN     0      128                        :::22                                 :::*
LISTEN     0      100                       ::1:25                                 :::*
[root@node72 ~]#
[root@node72 ~]# mysql -uroot -p
Enter password:
Welcome to the MariaDB monitor.  Commands end with ; or \g.
Your MariaDB connection id is 3
Server version: 5.5.44-MariaDB-log MariaDB Server

Copyright (c) 2000, 2015, Oracle, MariaDB Corporation Ab and others.

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

MariaDB [(none)]>
MariaDB [(none)]> USE hellodb;
```

执行还原时，由于是物理备份，因此需要停止服务后，再进行还原操作

由于--copy-back操作，要求还原目录为空，因此可以将文件拷贝的别的地方或者修改mysql的配置文件，将datadir指向一个别的位置，然后重新执行还原操作

copy-back完成

查看还原回来的文件

发现已经有hellodb的信息，但是还原回来的文件的属主属组是root，故需要修改为mysql用户才能正常启动

启动mysql服务

```
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
MariaDB [hellodb]> SELECT * FROM courses;
+----------+----------------+
| CourseID | Course         |
+----------+----------------+
|        1 | Hamo Gong      |
|        2 | Kuihua Baodian |
|        3 | Jinshe Jianfa  |
|        4 | Taiji Quan     |
|        5 | Daiyu Zanghua  |
|        6 | Weituo Zhang   |
|        7 | Dagou Bangfa   |
+----------+----------------+
7 rows in set (0.00 sec)

MariaDB [hellodb]>
```

连接进mysql，发现并没有完全备份后的修改的数据，因此利用二进制日志还原

## 11、利用导出的二进制日志文件事件，进行及时点恢复

```
MariaDB [hellodb]> SET sql_log_bin=OFF;
Query OK, 0 rows affected (0.00 sec)

MariaDB [hellodb]> SOURCE /tmp/2jz.sql
Query OK, 0 rows affected (0.00 sec)

Query OK, 0 rows affected (0.02 sec)

Query OK, 0 rows affected (0.00 sec)

Query OK, 0 rows affected (0.00 sec)

Query OK, 0 rows affected (0.00 sec)

Query OK, 0 rows affected (0.00 sec)

Query OK, 0 rows affected (0.00 sec)

Query OK, 0 rows affected (0.00 sec)

Query OK, 0 rows affected (0.00 sec)

MariaDB [hellodb]> SELECT * FROM courses;
+----------+----------------+
| CourseID | Course         |
+----------+----------------+
|        1 | Hamo Gong      |
|        2 | Kuihua Baodian |
|        3 | Jinshe Jianfa  |
|        4 | Taiji Quan     |
|        5 | Daiyu Zanghua  |
|        6 | Weituo Zhang   |
|        7 | Dagou Bangfa   |
|        8 | 2jz_test1      |
|        9 | 2jz_test2      |
+----------+----------------+
9 rows in set (0.02 sec)

MariaDB [hellodb]> SET sql_log_bin=ON;
Query OK, 0 rows affected (0.00 sec)

MariaDB [hellodb]>
```

由于利用二进制日志还原时会产生无用的二进制日志信息，因此暂时关闭此会话级别的二进制日志功能，然后导入此前根据需要导出的二进制日志

导入完成后，发现已经成功还原了完全备份后又发生变化的数据

重新启动二进制日志记录的功能