

Mariadb数据库备份恢复系列(三): xtrabackup物理备份工具之增量备份

实验三：利用xtrabackup+二进制日志实现增量备份和恢复数据库

本例中实现的是将所有的增量日志都通过apply-log的步骤同步到完全备份文件中，如果希望利用增量日志还原到固定某次增量备份的数据，则不能使用本例中方式对所有的备份都进行apply-log操作，如果希望利用增量日志还原到固定哪次增量备份的数据，则将最初的完全备份的数据、和期望还原到某个增量备份前的增量备份的数据，拷贝一份到别的地方，然后依次对拷贝出来的完全备份做apply-log，对每次增量备份做apply-log，然后用形成的apply-log后形成的完全备份的数据，进行恢复

实验环境：将node72(10.1.32.72)上的数据库的数据还原到node73(10.1.32.73)上

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
```

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、先进行完全备份，对完全备份进行apply-log，查看完全备份生成的文件

```

[root@node72 ~]# innobackupex --user='root' --host='localhost' --password='111111' /tmp
160823 21:59:36 innobackupex: Starting the backup operation
IMPORTANT: Please check that the backup run completes successfully.
          At the end of a successful backup run innobackupex
          prints "completed OK!".

Can't locate Digest/MD5.pm in @INC (@INC contains: /usr/local/lib64/perl5 /usr/local/share/perl5 /usr/lib64/pe
r15/vendor_perl /usr/share/perl5/vendor_perl /usr/lib64/perl5 /usr/share/perl5 .) at - line 693.
BEGIN failed--compilation aborted at - line 693.
160823 21:59:36 Connecting to MySQL server host: localhost, user: root, password: set, port: 0, socket: /var/l
ib/mysql/mysql.sock
Using server version 5.5.44-MariaDB-log
innobackupex version 2.4.4 based on MySQL server 5.7.13 Linux (x86_64) (revision id: df58cf2)
xtrabackup: uses posix_fadvise().
xtrabackup: cd to /var/lib/mysql
xtrabackup: open files limit requested 0, set to 1024
xtrabackup: using the following InnoDB configuration:
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 = 2
xtrabackup: innodb_log_file_size = 5242880
InnoDB: Number of pools: 1
160823 21:59:36 >> log scanned up to (1733657)
xtrabackup: Generating a list of tablespaces
InnoDB: Allocated tablespace ID 33 for hellodb/classes, old maximum was 0
160823 21:59:36 [01] Copying ./ibdata1 to /tmp/2016-08-23_21-59-36/ibdata1
160823 21:59:36 [01] ...done
160823 21:59:36 [01] Copying ./hellodb/classes.ibd to /tmp/2016-08-23_21-59-36/hellodb/classes.ibd
160823 21:59:36 [01] ...done
160823 21:59:37 Executing UNLOCK TABLES
160823 21:59:37 All tables unlocked
160823 21:59:37 Backup created in directory '/tmp/2016-08-23_21-59-36'
MySQL binlog position: filename 'binary.000001', position '7742'
160823 21:59:37 [00] Writing backup-my.cnf
160823 21:59:37 [00] ...done
160823 21:59:37 [00] Writing xtrabackup_info
160823 21:59:37 [00] ...done
xtrabackup: Transaction log of lsn (1733657) to (1733657) was copied.
160823 21:59:38 completed OK!
[root@node72 ~]#
[root@node72 ~]# innobackupex --apply-log --redo-only /tmp/2016-08-23_21-59-36/
160823 22:03:42 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_21-59-36
xtrabackup: This target seems to be not prepared yet.
InnoDB: Number of pools: 1
xtrabackup: xtrabackup_logfile detected: size=8388608, start_lsn=(1733657)
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: Uses event mutexes
InnoDB: GCC builtin __atomic_thread_fence() is used for memory barrier
[root@node72 ~]#

```

先进行完全备份，因为增量备份都是基于完全备份来实现的

对完全备份做apply-log操作，且限定只能执行redo-only，表示只对事务日志中，提交的事务同步到数据文件中，没有提交的事务不能回滚，因为在基于增量备份的备份模式下，完全备份中尚未提交的事务，有可能在下一个增量备份中就已经提交，如果在此进行回滚，会造成增量备份时的数据不一致

```
[root@node72 ~]# ls /tmp/2016-08-23_21-59-36/ 查看完全备份生成的文件以及完全备份时的二进制日志文件所处的位置
backup-my.cnf  ibdata1  performance_schema  xtrabackup_binlog_pos_innodb  xtrabackup_info
hellodb       mysql    xtrabackup_binlog_info  xtrabackup_checkpoints      xtrabackup_logfile
[root@node72 ~]# cat /tmp/2016-08-23_21-59-36/xtrabackup_binlog_info
binary.000001  7742
[root@node72 ~]#
```

5、进行第一次增量备份，对增量备份进行**apply-log**，将增量日志合并到完全备份中，查看第一次增量备份生成的文件信息

```
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]> INSERT INTO courses (Course) VALUES ('zlbfc1'),('zlbfc2');
```

Query OK, 2 rows affected (0.01 sec)

Records: 2 Duplicates: 0 Warnings: 0

在完全备份后，对数据做出修改，然后模拟增量备份

```
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 | zlbfc1 |
|         9 | zlbfc2 |
+-----+-----+
```

9 rows in set (0.00 sec)

```
MariaDB [hellodb]>
```

```
[root@node72 ~]#
```

```
[root@node72 ~]# innobackupex --user=root --host='localhost' --password='111111' --incremental /testdir/1/ --incremental-basedir=/tmp/2016-08-23_21-59-36/
```

```
160823 22:15:35 innobackupex: Starting the backup operation
```

IMPORTANT: Please check that the backup run completes successfully.

At the end of a successful backup run innobackupex prints "completed OK!".

进行增量备份，--incremental指明增量备份的存储位置，--incremental-basedir= 指明相对那一次备份的增量备份，因为此为第一次增量备份，因此相对于上次的完全备份的路径，如果是以后的增量备份，则相对于上一次增量备份的路径，如果每一次增量备份都相对于上次的完全备份，则相当于做了差异备份

Can't locate Digest/MD5.pm in @INC (@INC contains: /usr/local/lib64/perl5 /usr/local/share/perl5 /usr/lib64/perl5/vendor_perl /usr/share/perl5/vendor_perl /usr/lib64/perl5 /usr/share/perl5 .) at - line 693.

BEGIN failed--compilation aborted at - line 693.

```
160823 22:15:35 Connecting to MySQL server host: localhost, user: root, password: set, port: 0, socket: /var/lib/mysql/mysql.sock
```

Using server version 5.5.44-MariaDB-log

innobackupex version 2.4.4 based on MySQL server 5.7.13 Linux (x86_64) (revision id: df58cf2)

incremental backup from 1733657 is enabled.

xtrabackup: uses posix_fadvise().

xtrabackup: cd to /var/lib/mysql

xtrabackup: open files limit requested 0, set to 1024

xtrabackup: using the following InnoDB configuration:

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 = 2

xtrabackup: innodb_log_file_size = 5242880

InnoDB: Number of pools: 1

```
160823 22:15:35 >> log scanned up to (1734739)
```

```
.160823 22:15:38 >> log scanned up to (1734739)
```

```
160823 22:15:38 Executing UNLOCK TABLES
```

```
160823 22:15:38 All tables unlocked
```

```
160823 22:15:38 Backup created in directory '/testdir/1/2016-08-23_22-15-35'
```

MySQL binlog position: filename 'binary.000001', position '7993'

```
160823 22:15:38 [00] Writing backup-my.cnf
```

```
160823 22:15:38 [00] ...done
```

```
160823 22:15:38 [00] Writing xtrabackup_info
```

```
160823 22:15:38 [00] ...done
```

xtrabackup: Transaction log of lsn (1734739) to (1734739) was copied.

```
160823 22:15:38 completed OK!
```

```
[root@node72 ~]#
```

```
[root@node72 ~]# innobackupex --apply-log --redo-only /tmp/2016-08-23_21-59-36/ --incremental-dir=/testdir/1/2016-08-23_22-15-35/
```

```
160823 22:28:30 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

对第一次做增量的增量备份的数据进行apply-log操作，指明完全备份路径，--incremental-dir= 指明增量备份的路径，进行apply-log操作时，也只能限定为

```

prints "completed OK!".
redo-only, 也即是只能将事务日志中提交的事务同步
到数据文件中, 未提交的事务不能回滚, 因为后续的
增量备份上, 这些未提交的事务可能就已经提交了
innobackupex version 2.4.4 based on MySQL server 5.7.13 Linux (x86_64) (revision id: df58cf2)
incremental backup from 1733657 is enabled.
xtrabackup: cd to /tmp/2016-08-23_21-59-36
xtrabackup: This target seems to be already prepared with --apply-log-only.
InnoDB: Number of pools: 1
xtrabackup: xtrabackup_logfile detected: size=8388608, start_lsn=(1734739)
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 = /testdir/1/2016-08-23_22-15-35/
xtrabackup:   innodb_log_files_in_group = 1
xtrabackup:   innodb_log_file_size = 8388608
xtrabackup: Generating a list of tablespaces
InnoDB: Allocated tablespace ID 33 for hellodb/classes, old maximum was 0
xtrabackup: page size for /testdir/1/2016-08-23_22-15-35//ibdata1.delta is 16384 bytes
Applying /testdir/1/2016-08-23_22-15-35//ibdata1.delta to ./ibdata1...
xtrabackup: page size for /testdir/1/2016-08-23_22-15-35//hellodb/classes.ibd.delta is 16384 bytes
Applying /testdir/1/2016-08-23_22-15-35//hellodb/classes.ibd.delta to ./hellodb/classes.ibd...
xtrabackup: page size for /testdir/1/2016-08-23_22-15-35//hellodb/coc.ibd.delta is 16384 bytes
Applying /testdir/1/2016-08-23_22-15-35//hellodb/coc.ibd.delta to ./hellodb/coc.ibd...
xtrabackup: page size for /testdir/1/2016-08-23_22-15-35//hellodb/courses.ibd.delta is 16384 bytes
Applying /testdir/1/2016-08-23_22-15-35//hellodb/courses.ibd.delta to ./hellodb/courses.ibd...
xtrabackup: page size for /testdir/1/2016-08-23_22-15-35//hellodb/scores.ibd.delta is 16384 bytes
[root@node72 ~]# ls /testdir/1/2016-08-23_22-15-35/ 查看第一次增量备份生成的数据文件
backup-my.cnf  ibdata1.delta  mysql  xtrabackup_binlog_info  xtrabackup_info
hellodb        ibdata1.meta  performance_schema  xtrabackup_checkpoints  xtrabackup_logfile
[root@node72 ~]#
[root@node72 ~]# cat /testdir/1/2016-08-23_22-15-35/xtrabackup_checkpoints 查看增量备份的数据说明
backup_type = incremental 标明为增量备份
from_lsn = 1733657
to_lsn = 1734739 标明本次备份的起始lsn号和结束lsn号, 相当于指明了本次本分的范围
last_lsn = 1734739
compact = 0
recover_binlog_info = 0
[root@node72 ~]# cat /testdir/1/2016-08-23_22-15-35/xtrabackup_binlog_info 查看本次备份时的二进制日志文件所处的位置
binary.000001 7993
[root@node72 ~]# █

```

6、进行第二次增量备份，对增量备份进行**apply-log**，将增量日志合并到完全备份中，查看第二次增量备份生成的文件信息


```
MariaDB [(none)]> use helloddb;
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 [helloddb]> INSERT INTO courses (Course) VALUES ('zlbfc3'),('zlbfc4');
```

Query OK, 2 rows affected (0.00 sec)

Records: 2 Duplicates: 0 Warnings: 0

```
MariaDB [helloddb]> 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	zlbfc1
9	zlbfc2
10	zlbfc3
11	zlbfc4

11 rows in set (0.02 sec)

```
MariaDB [helloddb]>
```

```
[root@node72 ~]# innobackupex --user=root --host='localhost' --password='111111' --incremental /testdir/2/ --incremental-basedir=/testdir/1/2016-08-23_22-15-35/
```

160823 22:33:24 innobackupex: Starting the backup operation

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

进行第二次增量备份, --incremental指明备份存储的位置, --incremental-basedir= 指明相对于哪次备份的增量, 此处由于是第二次增量备份, 故指明为相对第一次增量备份

Can't locate Digest/MD5.pm in @INC (@INC contains: /usr/local/lib64/perl5 /usr/local/share/perl5 /usr/lib64/perl5/vendor_perl /usr/share/perl5/vendor_perl /usr/lib64/perl5 /usr/share/perl5 .) at - line 693.

BEGIN failed--compilation aborted at - line 693.

160823 22:33:24 Connecting to MySQL server host: localhost, user: root, password: set, port: 0, socket: /var/lib/mysql/mysql.sock

Using server version 5.5.44-MariaDB-log

innobackupex version 2.4.4 based on MySQL server 5.7.13 Linux (x86_64) (revision id: df58cf2)

incremental backup from 1734739 is enabled.

xtrabackup: uses posix_fadvise().

xtrabackup: cd to /var/lib/mysql

xtrabackup: open files limit requested 0, set to 1024

xtrabackup: using the following InnoDB configuration:

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 = 2

xtrabackup: innodb_log_file_size = 5242880

InnoDB: Number of pools: 1

160823 22:33:24 >> log scanned up to (1735811)

xtrabackup: Generating a list of tablespaces

InnoDB: Allocated tablespace ID 33 for helloddb/classes, old maximum was 0

xtrabackup: using the full scan for incremental backup

160823 22:33:24 [01] Copying ./ibdata1 to /testdir/2/2016-08-23_22-33-24/ibdata1.delta

160823 22:33:26 >> log scanned up to (1735811)

160823 22:33:26 Executing UNLOCK TABLES

160823 22:33:26 All tables unlocked

160823 22:33:26 Backup created in directory '/testdir/2/2016-08-23_22-33-24'

MySQL binlog position: filename 'binary.000001', position '8244'

160823 22:33:26 [00] Writing backup-my.cnf

160823 22:33:26 [00] ...done

160823 22:33:26 [00] Writing xtrabackup_info

160823 22:33:26 [00] ...done

xtrabackup: Transaction log of lsn (1735811) to (1735811) was copied.

160823 22:33:26 completed OK!

```
[root@node72 ~]#
```

```
[root@node72 ~]# innobackupex --apply-log --redo-only /tmp/2016-08-23_21-58-36/ --incremental-dir=/testdir/2/2
```



```

[root@node72 ~]# innobackupex --apply-log --redo-only /tmp/2016-08-23_21-59-36/ --incremental-dir=/testdir/2/2016-08-23_22-33-24/
160823 22:37:53 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)
incremental backup from 1734739 is enabled.
xtrabackup: cd to /tmp/2016-08-23_21-59-36
xtrabackup: This target seems to be already prepared with --apply-log-only.
InnoDB: Number of pools: 1
xtrabackup: xtrabackup_logfile detected: size=8388608, start_lsn=(1735811)
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 = /testdir/2/2016-08-23_22-33-24/
xtrabackup:   innodb_log_files_in_group = 1
xtrabackup:   innodb_log_file_size = 8388608
xtrabackup: Generating a list of tablespaces
InnoDB: Allocated tablespace ID 33 for hellodb/classes, old maximum was 0
xtrabackup: page size for /testdir/2/2016-08-23_22-33-24//ibdata1.delta is 16384 bytes
Applying /testdir/2/2016-08-23_22-33-24//ibdata1.delta to ./ibdata1...
xtrabackup: page size for /testdir/2/2016-08-23_22-33-24//hellodb/classes.ibd.delta is 16384 bytes
Applying /testdir/2/2016-08-23_22-33-24//hellodb/classes.ibd.delta to ./hellodb/classes.ibd...
xtrabackup: page size for /testdir/2/2016-08-23_22-33-24//hellodb/coc.ibd.delta is 16384 bytes
Applying /testdir/2/2016-08-23_22-33-24//hellodb/coc.ibd.delta to ./hellodb/coc.ibd...
xtrabackup: page size for /testdir/2/2016-08-23_22-33-24//hellodb/courses.ibd.delta is 16384 bytes
Applying /testdir/2/2016-08-23_22-33-24//hellodb/courses.ibd.delta to ./hellodb/courses.ibd...
[root@node72 ~]#
[root@node72 ~]#
[root@node72 ~]# ls /testdir/2/2016-08-23_22-33-24/ 查看第二次增量备份后生成的数据文件
backup-my.cnf  ibdata1.delta  mysql  xtrabackup_binlog_info  xtrabackup_info
hellodb       ibdata1.meta  performance_schema  xtrabackup_checkpoints  xtrabackup_logfile
[root@node72 ~]#
[root@node72 ~]# cat /testdir/2/2016-08-23_22-33-24/xtrabackup_checkpoints 查看本次备份的数据说明信息
backup_type = incremental 标明本次备份为增量备份
from_lsn = 1734739
to_lsn = 1735811 指明此次备份的lsn范围，相当于指明了本次备份从哪里备份到哪里
last_lsn = 1735811
compact = 0
recover_binlog_info = 0
[root@node72 ~]#
[root@node72 ~]# cat /testdir/2/2016-08-23_22-33-24/xtrabackup_binlog_info 查看第二次增量时的二进制日志所处位置
binary.000001 8244
[root@node72 ~]#
[root@node72 ~]# cat /tmp/2016-08-23_21-59-36/xtrabackup_checkpoints 查看完全备份的数据说明信息
backup_type = log-applied
from_lsn = 0
to_lsn = 1735811
last_lsn = 1735811 指明了完全备份的lsn范围，相当于指明了数据范围，由于将前两次的增量备份的数据合并到了完全备份中，因此此处显示的范围是从最开始到第二次增量备份的位置，从而进一步验证，还原时只需要还原此完全备份的数据即可
compact = 0
recover_binlog_info = 0
[root@node72 ~]#

```

7、模拟进行二进制日志的导出

```
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]> INSERT INTO courses (Course) VALUES ('ejz1'),('ejz2');
```

Query OK, 2 rows affected (0.01 sec)

Records: 2 Duplicates: 0 Warnings: 0

模拟第二次增量备份后，对数据进行修改，为利用二进制日志恢复模拟环境

```
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	zlbfc1
9	zlbfc2
10	zlbfc3
11	zlbfc4
12	ejz1
13	ejz2

13 rows in set (0.00 sec)

```
MariaDB [hellodb]> SHOW MASTER LOGS;
```

Log_name	File_size
binary.000001	8489

1 row in set (0.00 sec)

```
MariaDB [hellodb]> SHOW MASTER STATUS;
```

查看恢复时的二进制日志及其对应的位置

File	Position	Binlog_Do_DB	Binlog_Ignore_DB
binary.000001	8489		

1 row in set (0.00 sec)

```
MariaDB [hellodb]>
```

```
[root@node72 ~]# mysqlbinlog --start-position=8244 /var/lib/mysql/binary.000001 > /tmp/2jz.sql
```

```
[root@node72 ~]#
```

```
[root@node72 ~]# cat /tmp/2jz.sql
```

根据最后一次增量备份时二进制日志的位置和最后需要恢复时的二进制日志所处位置，导出对应的二进制日志文件的信息

```
/*!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 20:57:23 server id 1  end_log_pos 245  Start: binlog v 4, server v 5.5.44-MariaDB-log created 160823
20:57:23 at startup
# Warning: this binlog is either in use or was not closed properly.
ROLLBACK/*!*/;
BINLOG '
M0i8Vw8BAAAA8QAAAPUAAAAABAAQANS41LjQ0LU1hcmlhREItbG9nAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAzSLxXEzgNAAgAEgAEBAQEgAA2QAEGgAAAAICAgCAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAApV80QW==
'/*!*/;
# at 8244
#160823 22:54:57 server id 1  end_log_pos 8315  Query    thread_id=17      exec_time=0      error_code=0
SET TIMESTAMP=1471964097/*!*/;
SET @@session.pseudo_thread_id=17/*!*/;
SET @@session.foreign_key_checks=1, @@session.sql_auto_is_null=0, @@session.unique_checks=1, @@session.autocommit=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.locale_names=0/*!*/;  
SET @@session.collation_database=DEFAULT/*!*/;
```

8、拷贝完全备份的数据和二进制日志导出的事件数据到需要恢复的节点上

```
[root@node72 ~]# scp -r /tmp/2016-08-23_21-59-36/ /tmp/2jz.sql 10.1.32.73:/tmp  
The authenticity of host '10.1.32.73 (10.1.32.73)' can't be established.  
ECDSA key fingerprint is a0:c4:9d:67:22:a1:14:d6:73:79:30:5f:8c:0d:d0:b4.  
Are you sure you want to continue connecting (yes/no)? yes  
Warning: Permanently added '10.1.32.73' (ECDSA) to the list of known hosts.  
root@10.1.32.73's password:  
ibdata1                                100% 18MB 18.0MB/s 00:00  
classes.ibd                            100% 96KB 96.0KB/s 00:00  
coc.ibd                                100% 96KB 96.0KB/s 00:00  
courses.ibd                            100% 96KB 96.0KB/s 00:00  
scores.ibd                             100% 96KB 96.0KB/s 00:00  
students.ibd                           100% 96KB 96.0KB/s 00:00  
teachers.ibd                           100% 96KB 96.0KB/s 00:00  
toc.ibd                                100% 96KB 96.0KB/s 00:00  
db.opt                                 100% 61 0.1KB/s 00:00  
classes.frm                            100% 8636 8.4KB/s 00:00  
coc.frm                                100% 8630 8.4KB/s 00:00  
courses.frm                            100% 8602 8.4KB/s 00:00  
scores.frm                             100% 8658 8.5KB/s 00:00  
students.frm                           100% 8736 8.5KB/s 00:00  
teachers.frm                           100% 8656 8.5KB/s 00:00  
toc.frm                                100% 8622 8.4KB/s 00:00  
db.frm                                 100% 9582 9.4KB/s 00:00  
db.MYI                                 100% 5120 5.0KB/s 00:00  
db.MYD                                 100% 1320 1.3KB/s 00:00  
host.frm                               100% 9510 9.3KB/s 00:00
```

将完全备份的数据文件和导出的二进制日志文件复制到需要还原的node73节点上

9、在需要恢复的节点上安装xtrabackup软件包

```
[root@node73 ~]# ls  
anaconda-ks.cfg percona-xtrabackup-24-2.4.4-1.el7.x86_64.rpm  
[root@node73 ~]# yum install -y percona-xtrabackup-24-2.4.4-1.el7.x86_64.rpm  
Loaded plugins: fastestmirror  
Examining percona-xtrabackup-24-2.4.4-1.el7.x86_64.rpm: percona-xtrabackup-24-2.4.4-1.el7.x86_64  
Marking percona-xtrabackup-24-2.4.4-1.el7.x86_64.rpm to be installed  
Resolving Dependencies  
--> Running transaction check  
---> Package percona-xtrabackup-24.x86_64 0:2.4.4-1.el7 will be installed  
--> Processing Dependency: rsync for package: percona-xtrabackup-24-2.4.4-1.el7.x86_64  
Loading mirror speeds from cached hostfile  
--> Processing Dependency: libev.so.4()(64bit) for package: percona-xtrabackup-24-2.4.4-1.el7.x86_64  
4
```

因为要依赖xtrabackup进行还原，因此要安装xtrabackup程序包

10、恢复完全备份

```
[root@node73 ~]# ls /tmp
2016-08-23_21-59-36 2jz.sql
```

查看从node72上拷贝过来的完全备份和对应的二进制日志导出的文件

```
[root@node73 ~]#
[root@node73 ~]# systemctl stop mariadb
```

在恢复时确保mysql服务未启动

```
[root@node73 ~]#
[root@node73 ~]# innobackupex --copy-back /tmp/2016-08-23_21-59-36/
```

161114 13:31:28 innobackupex: Starting the copy-back operation

进行还原，确保mysql数据目录下没有文件

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)
161114 13:31:28 [01] Copying ibdata1 to /data/mysql/ibdata1
161114 13:31:29 [01] ...done
161114 13:31:29 [01] Copying ./hellodb/classes.ibd to /data/mysql/hellodb/classes.ibd
161114 13:31:29 [01] ...done
161114 13:31:29 [01] Copying ./hellodb/coc.ibd to /data/mysql/hellodb/coc.ibd
161114 13:31:29 [01] ...done
161114 13:31:29 [01] Copying ./hellodb/courses.ibd to /data/mysql/hellodb/courses.ibd
161114 13:31:29 [01] ...done
161114 13:31:29 [01] Copying ./hellodb/scores.ibd to /data/mysql/hellodb/scores.ibd
161114 13:31:29 [01] ...done
```

```
[root@node73 ~]# ll /data/mysql/
```

查看恢复出来的文件，发现属主属主是root，需要将其修改为运行mysql服务进程的用户，才能正常启动

```
total 18452
drwxr-x--- 2 root root    4096 Nov 14 13:31 hellodb
-rw-r----- 1 root root 18874368 Nov 14 13:31 ibdata1
drwxr-x--- 2 root root    4096 Nov 14 13:31 mysql
drwxr-x--- 2 root root    4096 Nov 14 13:31 performance_schema
-rw-r----- 1 root root      34 Nov 14 13:31 xtrabackup_binlog_pos_innodb
-rw-r----- 1 root root    564 Nov 14 13:31 xtrabackup_info
```

```
[root@node73 ~]#
[root@node73 ~]# chown -R mysql:mysql /data/mysql
[root@node73 ~]# systemctl start mariadb
```

```
[root@node73 ~]# 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@node73 ~]#
[root@node73 ~]# mysql -uroot -p'111111';
```

由于备份时的是所有库的信息，因此mysql库也还原回了完全备份的数据，因此用对应的账户连接到mysql

```
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)]> SELECT * FROM hellodb.courses;
```

查看数据库的信息，发现还原到了第二次增量备份时的数据，而增量备份后修改的数据要依靠二进制日志文件恢复

CourseID	Course
1	Hamo Gong
2	Kuihua Baodian
3	Jinshe Jianfa
4	Taiji Quan
5	Daiyu Zanghua
6	Weituo Zhang
7	Dagou Bangfa
8	z1bfcs1
9	z1bfcs2

9	zlbfc32
10	zlbfc33
11	zlbfc34

11 rows in set (0.04 sec)

11、恢复二进制日志事件

MariaDB [(none)]> SET sql_log_bin=OFF; 为了避免利用二进制日志进行及时点恢复时产生无用的二进制日志信息，因此关闭此会话级别的二进制日志记录功能

MariaDB [(none)]> SOURCE /tmp/2jz.sql; 导入此前根据需要导出的二进制日志文件

Query OK, 0 rows affected (0.01 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 hellodb.courses; 查看数据，发现已经恢复到最新状态

CourseID	Course
1	Hamo Gong
2	Kuihua Baodian
3	Jinshe Jianfa
4	Taiji Quan
5	Daiyu Zanghua
6	Weituo Zhang
7	Dagou Bangfa
8	zlbfc1
9	zlbfc2
10	zlbfc3
11	zlbfc4
12	ejz1
13	ejz2

13 rows in set (0.00 sec)

MariaDB [hellodb]> SET sql_log_bin=ON; 重新开启此会话级别的二进制日志记录的功能

MariaDB [hellodb]>

