

障害時回復をmysqlでためしてみよう！

本日の内容

- ▶ MySQLのトランザクション管理
 - ▶ トランザクション開始と終了を指定する
 - ▶ トランザクション中にいろいろやってみる
 - ▶ 途中で他のクライアントからアクセスしてみる
 - ▶ 途中でアボートしてみる(ロールバック)
 - ▶ 途中でサーバ落としてみる
 - ▶ バックアップとってみる(Checkpoint)
 - ▶ メディア障害からの対応
 - ▶ データベースファイル壊してみる
 - ▶ ログから復活してみる
-



今回はMySQL使います

▶ MySQLの2種類のデータベースエンジン

▶ MyISAM

- ▶ MySQLのデフォルトのデータベースエンジン
- ▶ 内部構造はヒープファイル
- ▶ トランザクション管理をしない
- ▶ スキャン系の処理が早い
- ▶ 更新処理に弱い

▶ InnoDB

- ▶ 内部構造は主キーによるB+-tree
 - ▶ トランザクション管理をする
 - ▶ 更新処理に強い
-



今回はInnoDBを使います

- ▶ MySQLでInnoDBを使うには
 - ▶ CREATE TABLEでデータベースエンジンを指定することができます

```
CREATE TABLE friends  
  (id SERIAL,  
   name VARCHAR(30))  
ENGINE=InnoDB;
```

integer primary key auto_increment
と同じ意味



トランザクションの開始と終了を指定する

- ▶ デフォルトではSQL文ごとにトランザクション開始と終了が自動的に宣言される
- ▶ 指定する場合は...(正しく終了する)

```
START TRANSACTION;  
INSERT INTO friends(name) values ('chiemi');  
INSERT INTO friends(name) values ('ayumi');  
COMMIT;
```



トランザクション中、ほかのアカウントからはどうみえるか

START TRANSACTION;

INSERT INTO friends(name) values ('tomoko');

もう一つの端末からログインして以下のSQLをうってみる

SELECT * FROM friends;

```
C:\Windows\system32\cmd.exe - mysql -u root -p test
mysql> insert into friends(name) values('chiemi');
Query OK, 1 row affected (0.00 sec)

mysql> insert into friends(name) values('ayumi');
Query OK, 1 row affected (0.00 sec)

mysql> commit;
Query OK, 0 rows affected (0.01 sec)

mysql> select * from friends;
+-----+
| id | name |
+-----+
| 1 | chiemi |
| 2 | ayumi |
+-----+
2 rows in set (0.00 sec)

mysql> start transaction;
Query OK, 0 rows affected (0.00 sec)

mysql> insert into friends(name) values('tomoko');
Query OK, 1 row affected (0.00 sec)

mysql>
```

```
C:\Windows\system32\cmd.exe - mysql -u root -p test
C:\Users\chiemi>mysql -u root -p test
Enter password: *****
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 13
Server version: 5.5.28-log MySQL Community Server (GPL)

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

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

mysql> select * from friends;
+-----+
| id | name |
+-----+
| 1 | chiemi |
| 2 | ayumi |
+-----+
2 rows in set (0.00 sec)

mysql>
```

トランザクションをわざとアボートさせよう

- ▶ undo処理(ロールバック)が行われます

ROLLBACK;

```
C:\Windows\system32\cmd.exe - mysql -u root -p test

mysql> start transaction;
Query OK, 0 rows affected (0.00 sec)

mysql> insert into friends(name) values('tomoko');
Query OK, 1 row affected (0.00 sec)

mysql> ROLLBACK;
Query OK, 0 rows affected (0.01 sec)

mysql> start transaction;
Query OK, 0 rows affected (0.00 sec)

mysql> insert into friends(name) values('tomoko');
Query OK, 1 row affected (0.00 sec)

mysql> select * from friends;
+----+-----+
| id | name |
+----+-----+
| 1  | chiemi |
| 2  | ayumi |
| 4  | tomoko |
+----+-----+
3 rows in set (0.00 sec)

mysql> ROLLBACK;
Query OK, 0 rows affected (0.01 sec)

mysql> select * from friends;
+----+-----+
| id | name |
+----+-----+
| 1  | chiemi |
| 2  | ayumi |
+----+-----+
2 rows in set (0.00 sec)
```

途中でサーバを落としてみる

▶ ちょっとどきどき...

The image shows a MySQL Workbench window and a Windows command prompt. The command prompt is running a MySQL session. The user first queries the 'friends' table, which returns 3 rows. Then, they execute a ROLLBACK, which returns 0 rows affected. Next, they query the 'friends' table again, which returns 2 rows. Then, they start a transaction and insert a new row into the 'friends' table. Finally, they query the 'friends' table, but the MySQL server has crashed, resulting in an error message: 'ERROR 2006 (HY000): MySQL server has gone away'. The error message is highlighted with a red box.

```
C:\Windows\system32\cmd.exe - mysql -u root -p test

mysql> select * from friends;
+-----+
| id | name |
+-----+
| 1 | chiemi |
| 2 | ayumi |
| 4 | tomoko |
+-----+
3 rows in set (0.00 sec)

mysql> ROLLBACK;
Query OK, 0 rows affected (0.01 sec)

mysql> select * from friends;
+-----+
| id | name |
+-----+
| 1 | chiemi |
| 2 | ayumi |
+-----+
2 rows in set (0.00 sec)

mysql>
mysql> start transaction;
Query OK, 0 rows affected (0.00 sec)

mysql> insert into friends(name) values('tomoko');
Query OK, 1 row affected (0.00 sec)

mysql> select * from friends;
ERROR 2006 (HY000): MySQL server has gone away
No connection. Trying to reconnect...
ERROR 2003 (HY000): Can't connect to MySQL server on 'localhost' (10061)
ERROR:
Can't connect to the server

mysql>
```

MySQL Workbench Admin (Local MySQL55) x

File Edit View Database Plugins Scripting Help

Startup / Shutdown

Database Server Status
The database server is stopped. To start the Server, use the "Start Server" button

The database server instance is **stopped**

If you stop the server, you and your applications will not be able to use the Database and all current connections will be closed.

Startup Message Log

- 2012-12-17 19:29:33 - Workbench will use cmd shell commands to start/stop this instance
- 2012-12-17 19:29:33 - Status check of service 'MySQL55' returned running
- 2012-12-17 19:29:34 - Status check of service 'MySQL55' returned running
- 2012-12-17 19:30:17 - Status check of service 'MySQL55' returned running
- 2012-12-17 19:30:17 - Status check of service 'MySQL55' returned running
- 2012-12-17 19:30:22 - Status check of service 'MySQL55' returned running
- 2012-12-17 19:30:23 - Server stop done.
- 2012-12-17 19:30:23 - Status check of service 'MySQL55' returned stop pending

怒られました...

サーバ起動しなおしてみる

```
C:\Windows\system32\cmd.exe - mysql -u root -p test

mysql> select * from friends;
+-----+
| id | name |
+-----+
| 1 | chiemi |
| 2 | ayumi |
+-----+
2 rows in set (0.00 sec)

mysql>
mysql> start transaction;
Query OK, 0 rows affected (0.00 sec)

mysql> insert into friends(name) values('tomoko');
Query OK, 1 row affected (0.00 sec)

mysql> select * from friends;
ERROR 2006 (HY000): MySQL server has gone away
No connection. Trying to reconnect...
ERROR 2003 (HY000): Can't connect to MySQL server on 'localhost' (10061)
ERROR:
Can't connect to the server

mysql> select * from friends;
No connection. Trying to reconnect...
Connection id: 2
Current database: test

+-----+
| id | name |
+-----+
| 1 | chiemi |
| 2 | ayumi |
+-----+
2 rows in set (0.01 sec)

mysql>
```

- ▶ 無事に再接続
- ▶ でもトランザクション途中の処理はきっちりロールバック

ログファイルを確認する

▶ ログの種類

▶ 実行エラーログ

▶ クエリログ

- ▶ 実行されたクエリを記録

▶ スロークエリログ

- ▶ 実行時間が規定値より遅かったクエリを記録

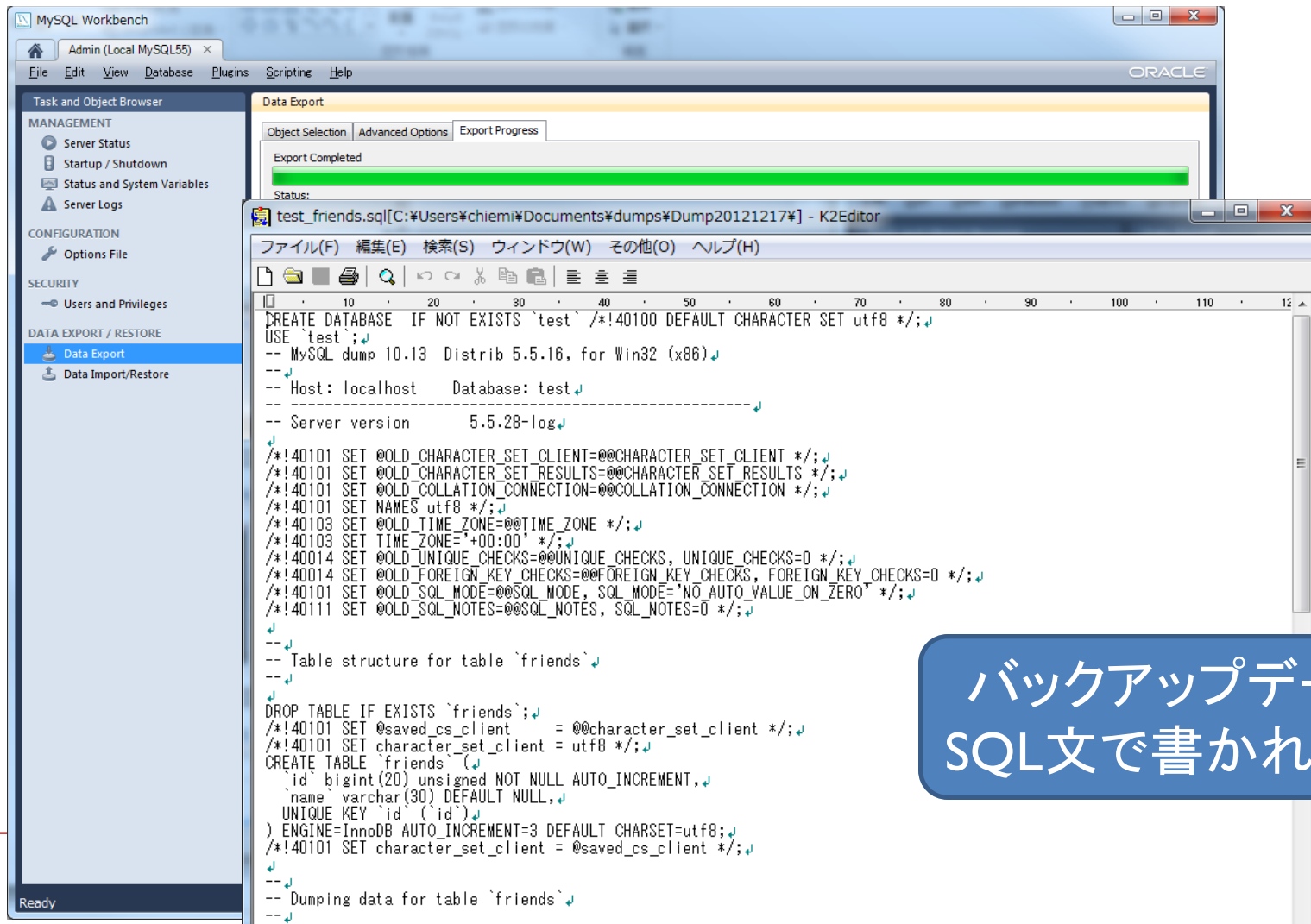
▶ バイナリログ(トランザクションログ)

- ▶ 更新情報を記録

Error Log File General Log File Slow Log File			
Time	Thread	Command T...	Detail
	15	Query	SHOW VARIABLES LIKE 'datadir'
	15	Query	SHOW VARIABLES LIKE 'general_log'
	15	Query	SHOW VARIABLES LIKE 'log_slow_queries'
	15	Query	SHOW VARIABLES LIKE 'general_log_file'
	15	Query	SHOW VARIABLES LIKE 'slow_query_log_file'
	15	Query	SHOW VARIABLES LIKE 'log_error'
121217 19:25:44	16	Connect	root@localhost on
	16	Query	set autocommit=1
	16	Query	SET SESSION TRANSACTION ISOLATION LEVEL REPEATABLE READ
	16	Query	SHOW SESSION VARIABLES LIKE 'lower_case_table_names'
	16	Query	SELECT current_user()
	15	Query	SHOW PROCESSLIST
	15	Query	SHOW PROCESSLIST
	15	Query	select version() as version
	15	Query	SHOW PLUGINS
	15	Query	SHOW VARIABLES LIKE 'hostname'
	15	Query	SHOW VARIABLES LIKE 'datadir'
	15	Query	SHOW VARIABLES LIKE 'general_log'
	15	Query	SHOW VARIABLES LIKE 'log_slow_queries'
	15	Query	SHOW VARIABLES LIKE 'general_log_file'
	15	Query	SHOW VARIABLES LIKE 'slow_query_log_file'
	15	Query	SHOW VARIABLES LIKE 'log_error'
121217 19:25:47	16	Query	show global status
121217 19:25:48	11	Query	show global status
121217 19:25:48	16	Query	show global status
121217 19:25:50	15	Query	SHOW PROCESSLIST
121217 19:25:51	11	Query	show global status
	16	Query	show global status
121217 19:25:54	11	Query	show global status
121217 19:25:55	16	Query	show global status
121217 19:25:56	15	Query	SHOW PROCESSLIST
121217 19:25:58	11	Query	show global status

バックアップを取ってみる

▶ mysqldumpというコマンドを使います

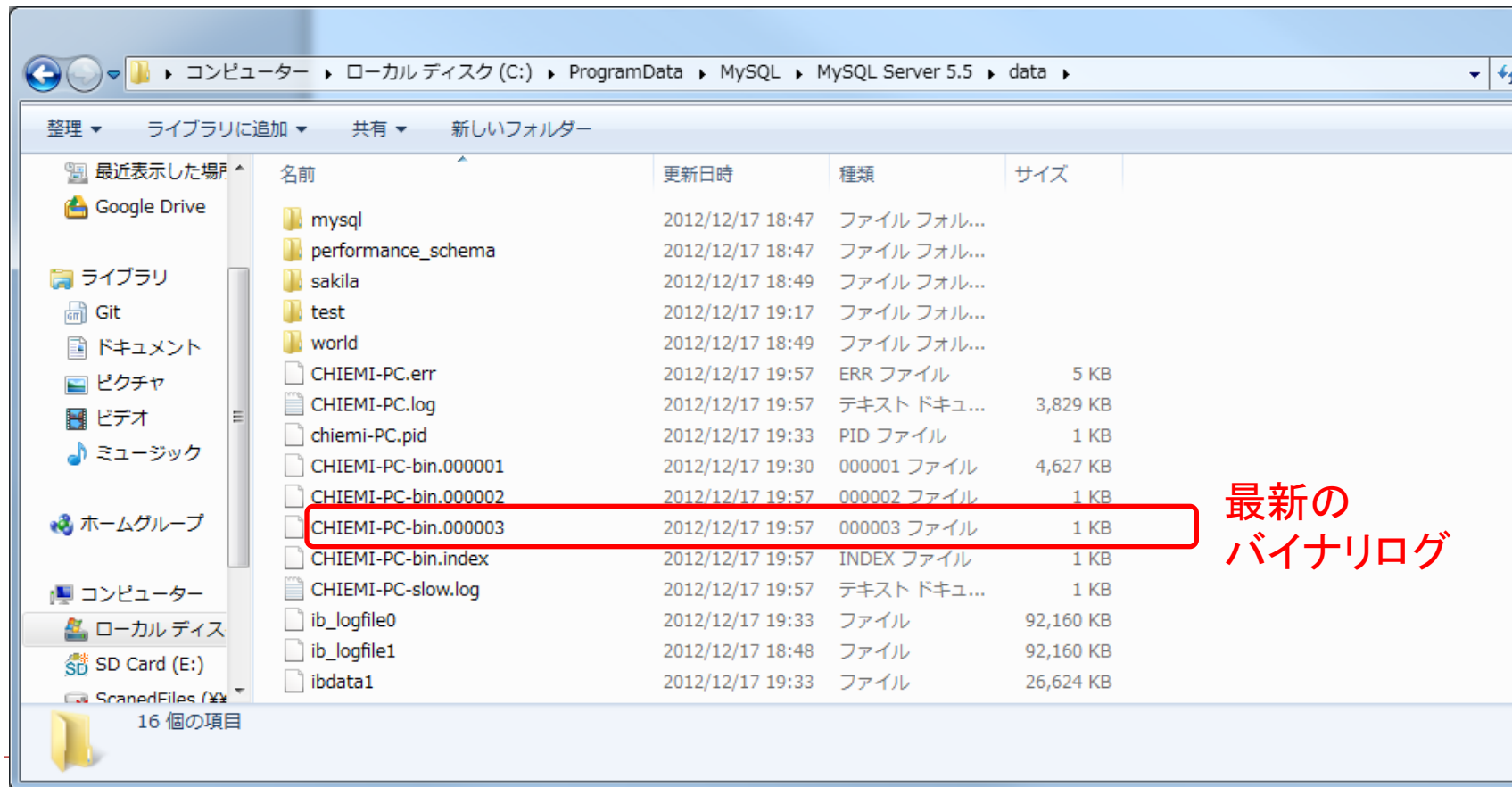


バックアップデータは
SQL文で書かれている

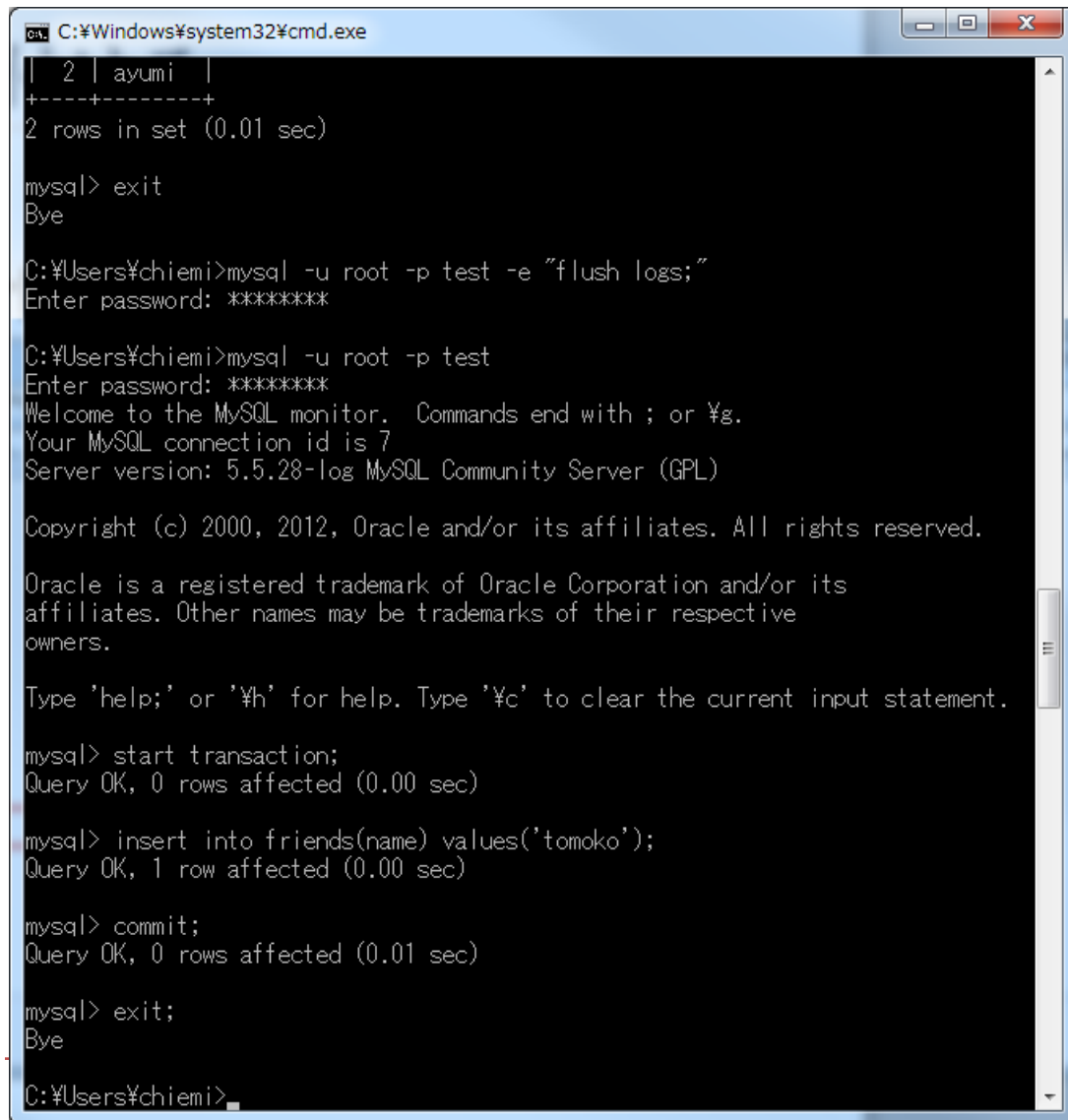
チェックポイントを付ける

▶ ログをフラッシュする

```
% mysql -u root -p test -e "flush logs;"
```



チェックポイントを付けてからちょっと更新



```
C:\Windows\system32\cmd.exe

| 2 | ayumi |
+---+-----+
2 rows in set (0.01 sec)

mysql> exit
Bye

C:\Users\chiemi>mysql -u root -p test -e "flush logs;"
Enter password: *****

C:\Users\chiemi>mysql -u root -p test
Enter password: *****
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 7
Server version: 5.5.28-log MySQL Community Server (GPL)

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owners.

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

mysql> start transaction;
Query OK, 0 rows affected (0.00 sec)

mysql> insert into friends(name) values('tomoko');
Query OK, 1 row affected (0.00 sec)

mysql> commit;
Query OK, 0 rows affected (0.01 sec)

mysql> exit;
Bye

C:\Users\chiemi>
```

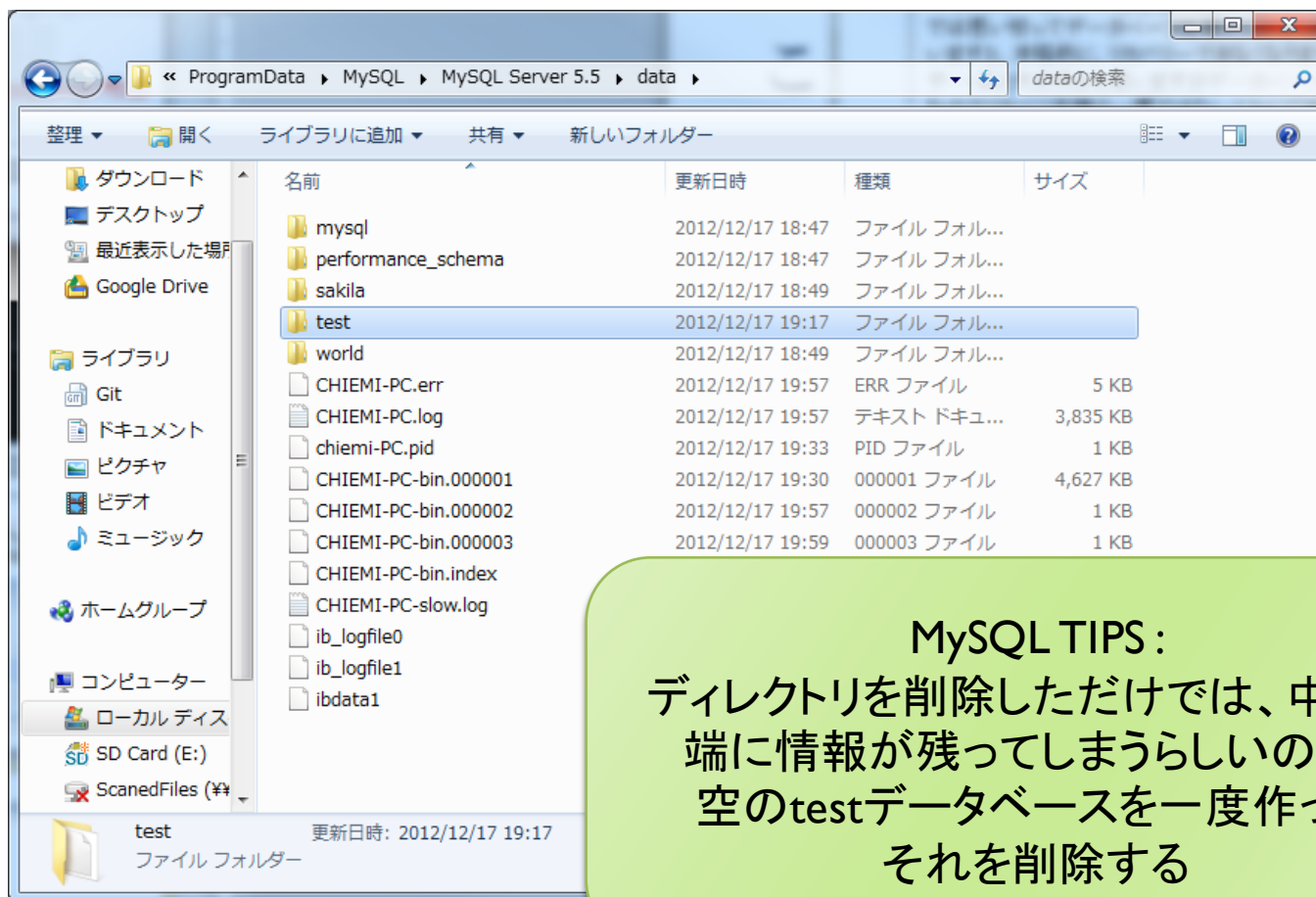
バックアップとバイナリファイルは安全な ところに保存する

- ▶ ***-bin.0000xファイルと***.indexを使って復帰をさせますので、念のため退避しておきます



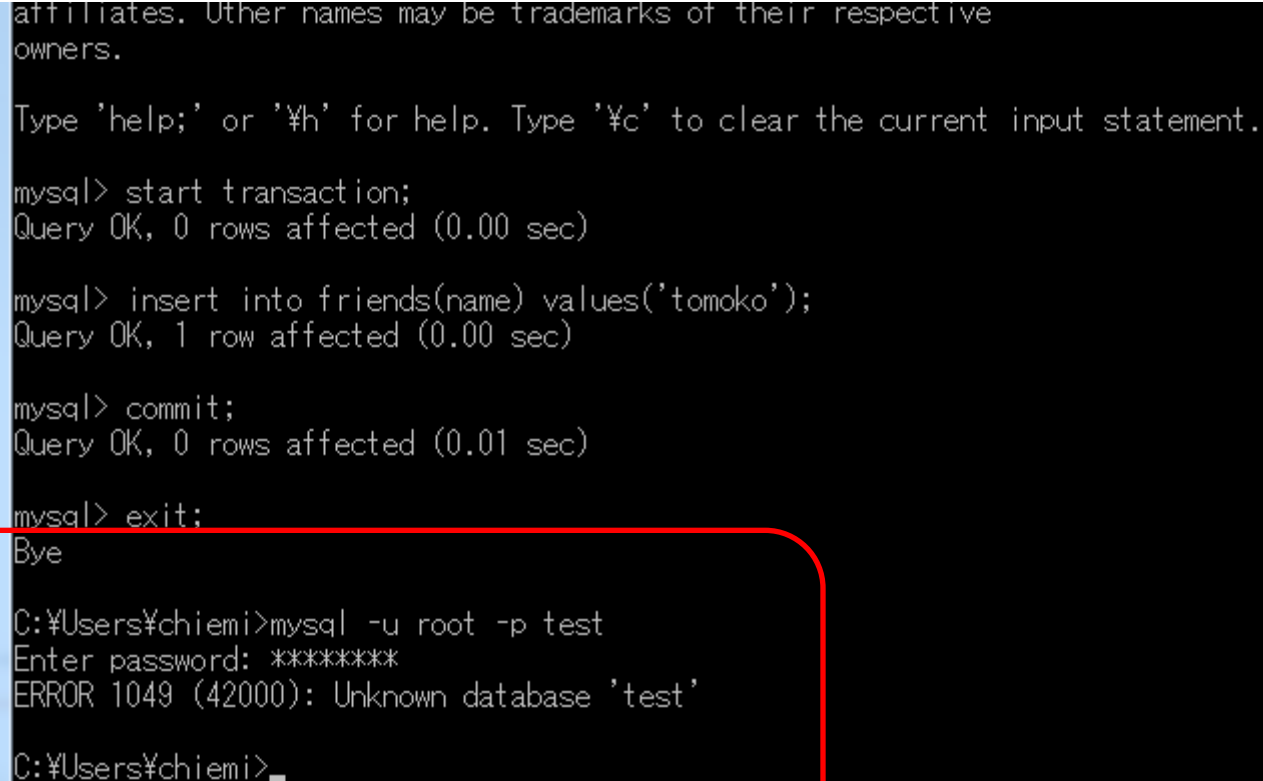
ここでデータベースファイルを破壊してみる

- ▶ testディレクトリとその中のfriends.frmファイルを消す！



testデータベースにアクセスしてみます

▶ できません...



```
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owners.

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

mysql> start transaction;
Query OK, 0 rows affected (0.00 sec)

mysql> insert into friends(name) values('tomoko');
Query OK, 1 row affected (0.00 sec)

mysql> commit;
Query OK, 0 rows affected (0.01 sec)

mysql> exit;
Bye

C:\Users\chiemi>mysql -u root -p test
Enter password: *****
ERROR 1049 (42000): Unknown database 'test'

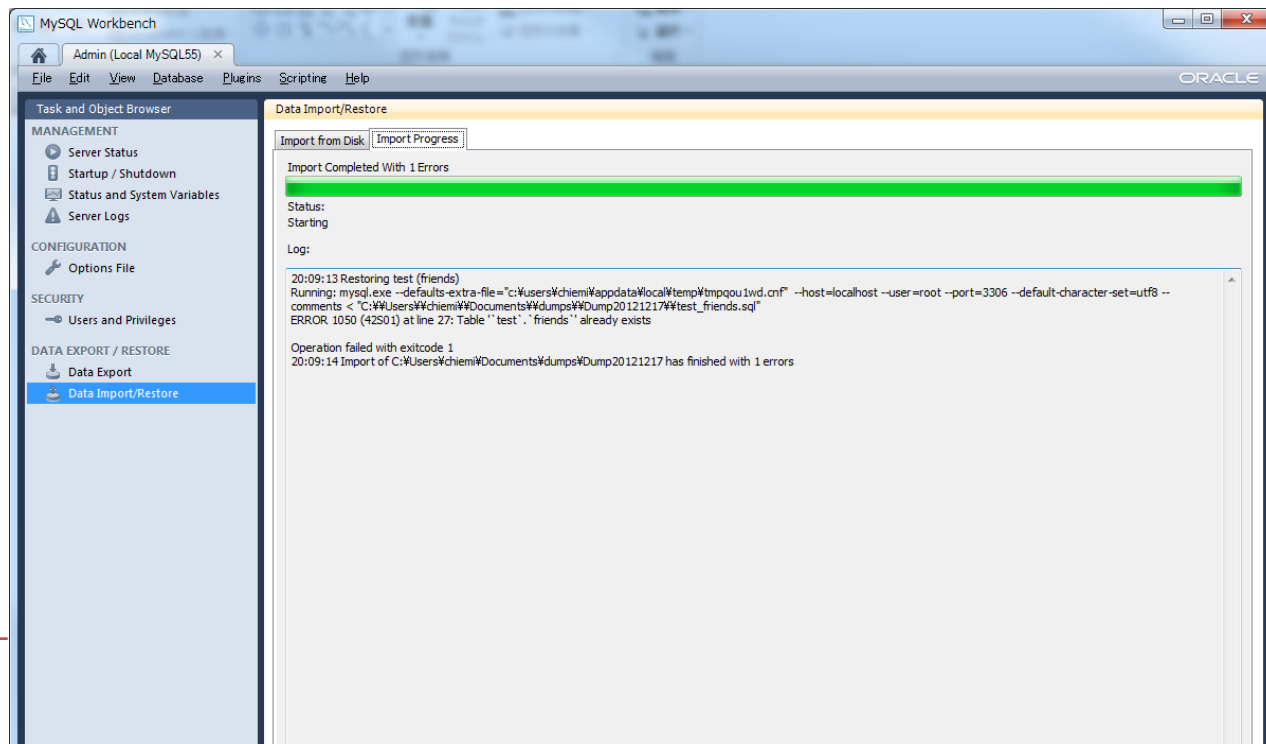
C:\Users\chiemi>
```

The screenshot shows a terminal window with a black background and white text. The text represents a MySQL session. The first part shows successful execution of 'start transaction;', 'insert into friends(name) values('tomoko');', and 'commit;'. The second part shows the user exiting MySQL and then attempting to run 'mysql -u root -p test' from the command prompt. This attempt results in an error: 'ERROR 1049 (42000): Unknown database 'test''. A red rounded rectangle is drawn around the command prompt section, highlighting the error.



復帰（リストア）してみる

- ▶ さっきとったバックアップファイルを使って
チェックポイントまで元に戻す
- ▶ バックアップファイル内のSQL文を実行して復帰
させる



復帰されたか？

- ▶ tomokoさんいません
 - ▶ チェックポイント後にコミットしたため

```
time_zone_leap_second
time_zone_name
time_zone_transition
time_zone_transition_type
user
+-----+
24 rows in set (0.00 sec)

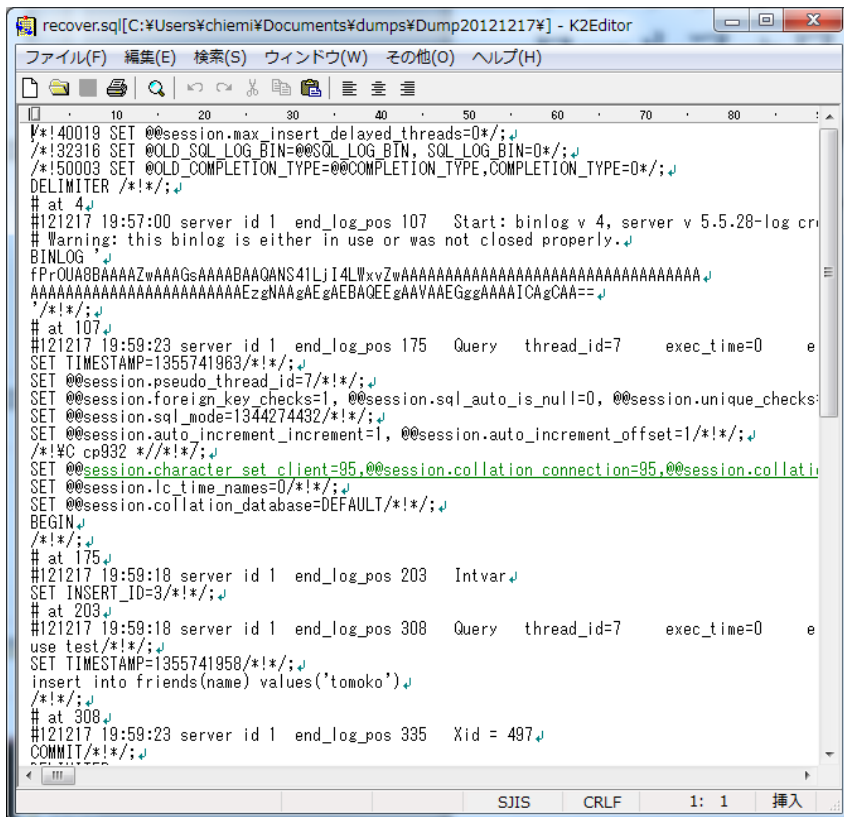
mysql> use test
Database changed
mysql> show tables;
+-----+
| Tables_in_test |
+-----+
| friends         |
+-----+
1 row in set (0.00 sec)

mysql> select * from friends;
+----+-----+
| id | name  |
+----+-----+
|  1 | chiemi |
|  2 | ayumi  |
+----+-----+
2 rows in set (0.00 sec)

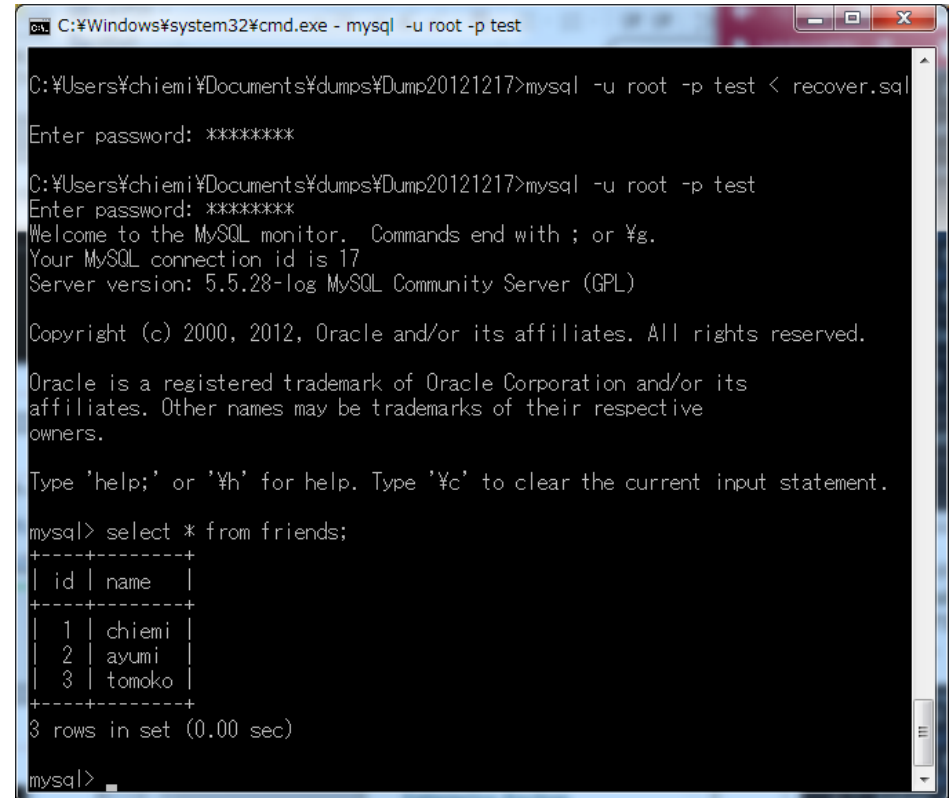
mysql>
```

チェックポイント後ログを使って ロールフォワード

- ▶ `mysqlbinlog -D -u root -p xxx-bin.000003 > recover.sql`
- ▶ `mysql -u root -p test < recover.sql`



```
recover.sql[C:\Users\chiemi\Documents\dumps\Dump20121217] - K2Editor
ファイル(F) 編集(E) 検索(S) ウィンドウ(W) その他(O) ヘルプ(H)
10 20 30 40 50 60 70 80
/*!40019 SET @@session.max_insert_delayed_threads=0*/;
/*!132318 SET @OLD_SQL_LOG_BIN=@@SQL_LOG_BIN, SQL_LOG_BIN=0*/;
/*!150003 SET @OLD_COMPLETION_TYPE=@@COMPLETION_TYPE, COMPLETION_TYPE=0*/;
DELIMITER /*!*/;
# at 4
#121217 19:57:00 server id 1 end_log_pos 107 Start: binlog v 4, server v 5.5.28-log cr
# Warning: this binlog is either in use or was not closed properly.
BINLOG '
fPrOUA8BAAAAZwAAAGsAAAAAQAANS41LjI4LWxvZwAAAAAAAAAAAAAAAAAAAAAAAAAAAA
AAAAAAAAAAAAAAAAAAAAAAAEzNAAGAEgAEBAQEEgAAVAAGGgAAAAICAACAA==
'/*!*/;
# at 107
#121217 19:59:23 server id 1 end_log_pos 175 Query thread_id=7 exec_time=0 e
SET TIMESTAMP=1355741963/*!*/;
SET @@session.pseudo_thread_id=7/*!*/;
SET @@session.foreign_key_checks=1, @@session.sql_auto_is_null=0, @@session.unique_checks
SET @@session.sql_mode=1344274432/*!*/;
SET @@session.auto_increment_increment=1, @@session.auto_increment_offset=1/*!*/;
/*!%C cp932 *//*!*/;
SET @@session.character_set_client=95,@@session.collation_connection=95,@@session.collati
SET @@session.locale_time_names=0/*!*/;
SET @@session.collation_database=DEFAULT/*!*/;
BEGIN
/*!*/;
# at 175
#121217 19:59:18 server id 1 end_log_pos 203 Intvar
SET INSERT_ID=3/*!*/;
# at 203
#121217 19:59:18 server id 1 end_log_pos 308 Query thread_id=7 exec_time=0 e
use test/*!*/;
SET TIMESTAMP=1355741958/*!*/;
insert into friends(name) values('tomoko')
/*!*/;
# at 308
#121217 19:59:23 server id 1 end_log_pos 335 Xid = 497
COMMIT/*!*/;
```



```
C:\Windows\system32\cmd.exe - mysql -u root -p test
C:\Users\chiemi\Documents\dumps\Dump20121217>mysql -u root -p test < recover.sql
Enter password: *****
C:\Users\chiemi\Documents\dumps\Dump20121217>mysql -u root -p test
Enter password: *****
Welcome to the MySQL monitor.  Commands end with ; or \g.
Your MySQL connection id is 17
Server version: 5.5.28-log MySQL Community Server (GPL)

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owners.

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

mysql> select * from friends;
+-----+
| id | name |
+-----+
| 1 | chiemi |
| 2 | ayumi |
| 3 | tomoko |
+-----+
3 rows in set (0.00 sec)

mysql>
```