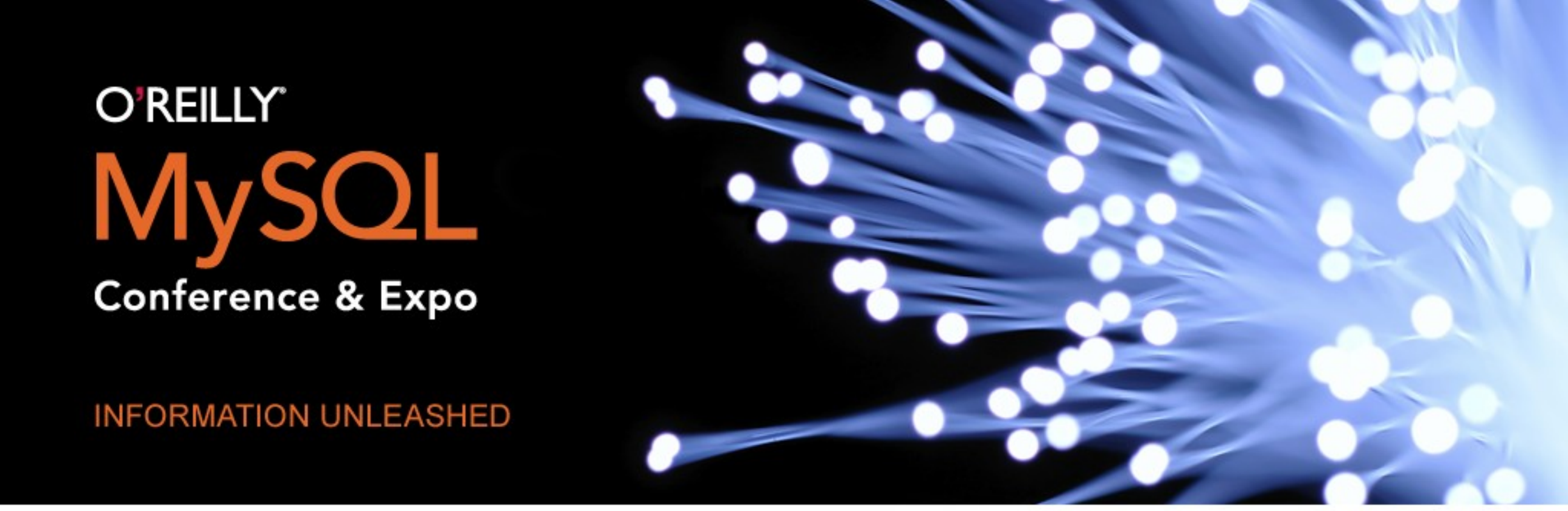

Valuable MariaDB Features That Somebody Paid for

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Monty Program sponsor talk at MySQL User Conference 2010

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Topics

- Table elimination
- mysqlbinlog improvements
- MyISAM keycache performance improvements
- Future work

Table elimination

- Optimization for queries over highly-normalized data
- Present in “big” databases, like Oracle, SQL Server
- Basic idea

  Detect outer joins that have “unused” inner sides and delete those inner sides

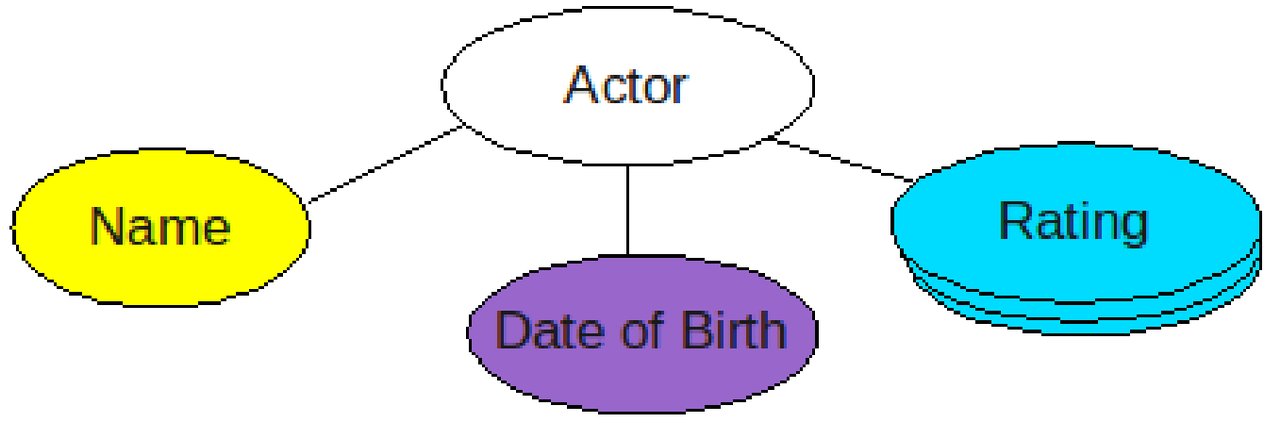
  - SELECT tbl1.*
    FROM
      tbl1 LEFT JOIN tbl2 ON
    tbl1.id=tbl2.primary_key
  - WHERE
  - condition(tbl1.*)
- It is guaranteed that for each record of tbl1
- tbl2 will have not more than one match (tbl2.primary_key=..)
- If tbl2 has no match, LEFT JOIN will generate a NULL-record

The case for table elimination

- Highly-normalized data:

  actor(name,
  date_of_birth,
  rating)

  is stored as:




```
create table  ac_anchor(AC_ID int primary key);

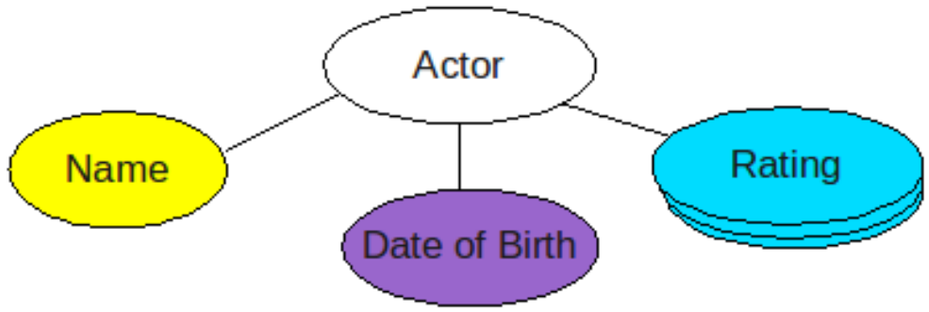
create table ac_name(AC_ID int, ACNAM_name char(N),
                     primary key(AC_ID));

create table ac_dob(AC_ID int, ACDOB_birthdate date,
                    primary key(AC_ID));

create table ac_rating(AC_ID int,
                       ACRAT_rating int,  ACRAT_fromdate date,
                       primary key(AC_ID, ACRAT_fromdate));
```

The case for table elimination (2)

- Then select back:




```
create view actors as select * from

select
  ac_anchor.AC_ID, ACNAM_Name, ACDOB_birthdate, ACRAT_rating
from
  ac_anchor
  left join ac_name on ac_anchor.AC_ID=ac_name.AC_ID
  left join ac_dob on ac_anchor.AC_ID=ac_dob.AC_ID
  left join ac_rating on (ac_anchor.AC_ID=ac_rating.AC_ID and
                          ac_rating.ACRAT_fromdate =
                            (select max(sub.ACRAT_fromdate)
                             from ac_rating sub
                             where sub.AC_ID=ac_rating.AC_ID))

select ACRAT_rating from actors where ACNAM_name='Gary Oldman';
```

Functional Dependencies (1)

```
select ac_anchor.AC_ID, ACNAM_Name, ACDOB_birthdate, ACRAT_rating
from ac_anchor
     left join ac_name on ac_anchor.AC_ID=ac_name.AC_ID
     left join ac_dob on ac_anchor.AC_ID=ac_dob.AC_ID
     left join ac_rating on (ac_anchor.AC_ID=ac_rating.AC_ID and
                             ac_rating.ACRAT_fromdate =
                            (select max(sub.ACRAT_fromdate) from ac_rating sub
                               where sub.AC_ID=ac_rating.AC_ID))

select ACDOB_birthdate from actors where ACNAM_name='Gary Oldman';
=>
select ac_anchor.AC_ID, ACNAM_Name, ACDOB_birthdate, ACRAT_rating
from ac_anchor
     left join ac_name on ac_anchor.AC_ID=ac_name.AC_ID
     left join ac_dob on ac_anchor.AC_ID=ac_dob.AC_ID
     left join ac_rating on (ac_anchor.AC_ID=ac_rating.AC_ID and
                             ac_rating.ACRAT_fromdate =
                            (select max(sub.ACRAT_fromdate) from ac_rating sub
                               where sub.AC_I=ac_rating.AC_ID))
  where ACNAM_name='Gary Oldman'

ac_ancor.AC_ID  -> ac_rating.AC_ID           (1)
ac_rating.AC_ID -> ac_rating.ACRAT_fromdate  (2)

 => ac_ancor.AC_ID -> ac_rating.primary_key(AC_ID,ACRAT_fromdate)
```

Functional Dependencies (2)

- Check: columns of the inner table(s) to be eliminated are:
- functionally dependent of some columns of the outer table(s).
- Types of dependencies:
- a -> b: t2.b= t..a or t2.b = t1.a+1
- (a,b)-> c: t2.full_name= concat(t1.first_name, t1.last_name)
- a -> (b,c): (t2.b,t2.c)=(select max(b), max(c) from t where t.a=t1.a)
- t.pk1,..,t.pkm -> t.c1,...,t.cn
- Algorithms:
- 1. Simple Wave Algorithm:
- Using the basic dependencies iteratively expand the set C of the columns functionally dependent on the columns from outer tables C0 until the set stabilizes.
- Complexity: O(#D*#A)
- 2. More Sophisticated Algorithm:
- Every time a new column c is added to the set C decrement the counters of 'unknown' columns in the dependencies that contain c as an argument . Apply a dependency when its counter of 'unknown' arguments becomes 0.
- Complexity : O(#E)

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Table elimination – examples

```
explain select ACRAT_rating, ACDOB_birthdate from actors where ACNAM_name='Gary Oldman';
+----+--------------------+----------+--------+---------------+---------+---------+---------------
+-..
| id | select_type        | table    | type   | possible_keys | key     | key_len | ref
+----+--------------------+----------+--------+---------------+---------+---------+---------------
+-..
|  1 | PRIMARY            | ac_anchor | index  | PRIMARY       | PRIMARY | 4       | NULL          |
|  1 | PRIMARY            | ac_name   | eq_ref | PRIMARY       | PRIMARY | 4       | ac_anchor.AC_ID |
|  1 | PRIMARY            | ac_dob    | eq_ref | PRIMARY       | PRIMARY | 4       | ac_anchor.AC_ID |
|  1 | PRIMARY            | ac_rating | ref    | PRIMARY       | PRIMARY | 4       | ac_anchor.AC_ID |
|  3 | DEPENDENT SUBQUERY | sub       | ref    | PRIMARY       | PRIMARY | 4       | ac_rating.AC_ID |
+----+--------------------+----------+--------+---------------+---------+---------+---------------
+-..
```

```
explain select ACRAT_rating from actors where ACNAM_name='Gary Oldman';
+----+--------------------+----------+--------+---------------+---------+---------+---------------+-..
| id | select_type        | table    | type   | possible_keys | key     | key_len | ref           |
+----+--------------------+----------+--------+---------------+---------+---------+---------------+-..
|  1 | PRIMARY            | ac_anchor | index  | PRIMARY       | PRIMARY | 4       | NULL          |
|  1 | PRIMARY            | ac_name   | eq_ref | PRIMARY       | PRIMARY | 4       | ac_anchor.AC_ID |
|  1 | PRIMARY            | ac_rating | ref    | PRIMARY       | PRIMARY | 4       | ac_anchor.AC_ID |
|  3 | DEPENDENT SUBQUERY | sub       | ref    | PRIMARY       | PRIMARY | 4       | ac_rating.AC_ID |
+----+--------------------+----------+--------+---------------+---------+---------+---------------+-..
```

```
explain select ACDOB_birthdate from actors where ACNAM_name='Gary Oldman';
+----+-------------+----------+--------+---------------+---------+---------+---------------+-..
| id | select_type | table    | type   | possible_keys | key     | key_len | ref           |
+----+-------------+----------+--------+---------------+---------+---------+---------------+-..
|  1 | PRIMARY     | ac_anchor | index  | PRIMARY       | PRIMARY | 4       | NULL          |
|  1 | PRIMARY     | ac_name   | eq_ref | PRIMARY       | PRIMARY | 4       | ac_anchor.AC_ID |
|  1 | PRIMARY     | ac_dob    | eq_ref | PRIMARY       | PRIMARY | 4       | ac_anchor.AC_ID |
+----+-------------+----------+--------+---------------+---------+---------+---------------+-..
```

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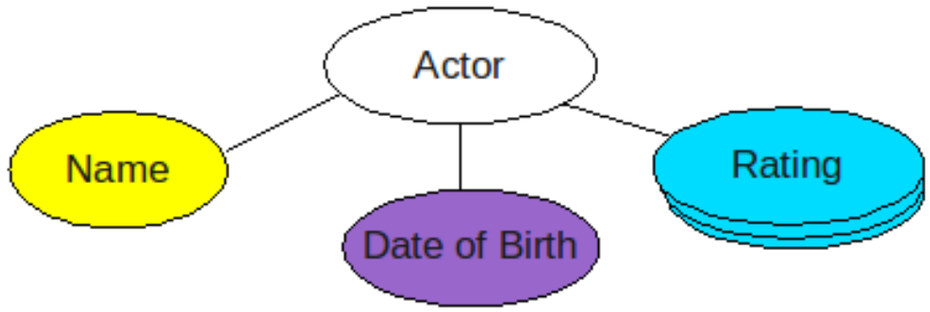
Table elimination: conclusion



- With table elimination, you can:
  - Do normalization on optional/historic data
  - Create a denormalized view with LEFT JOINs
  - Use this view and get something like "index only" scans.

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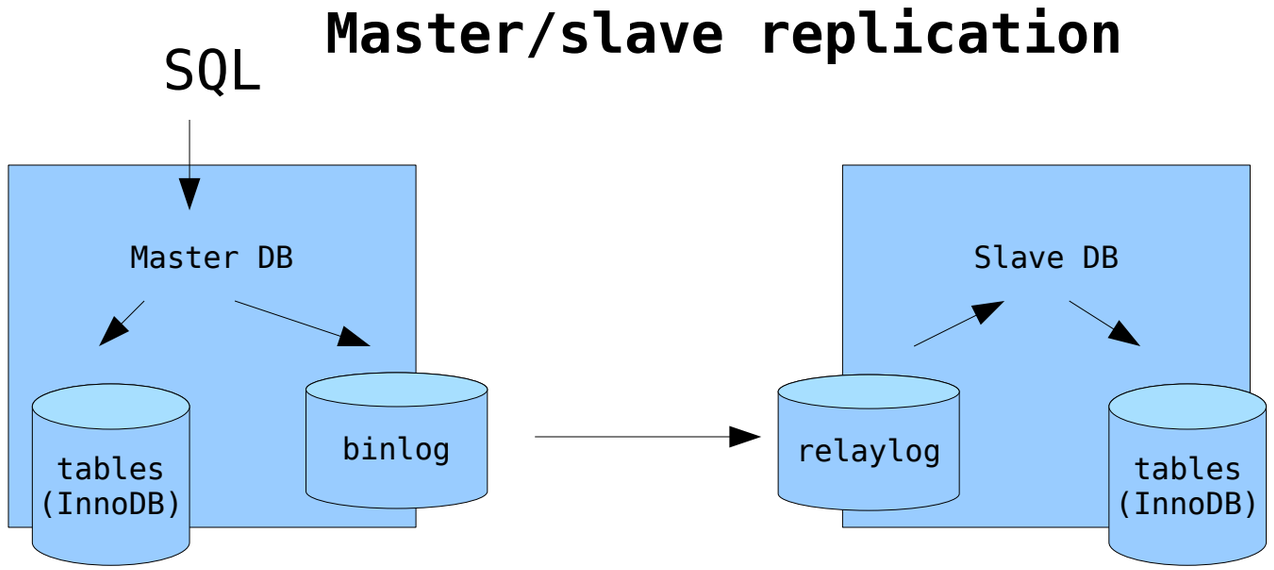
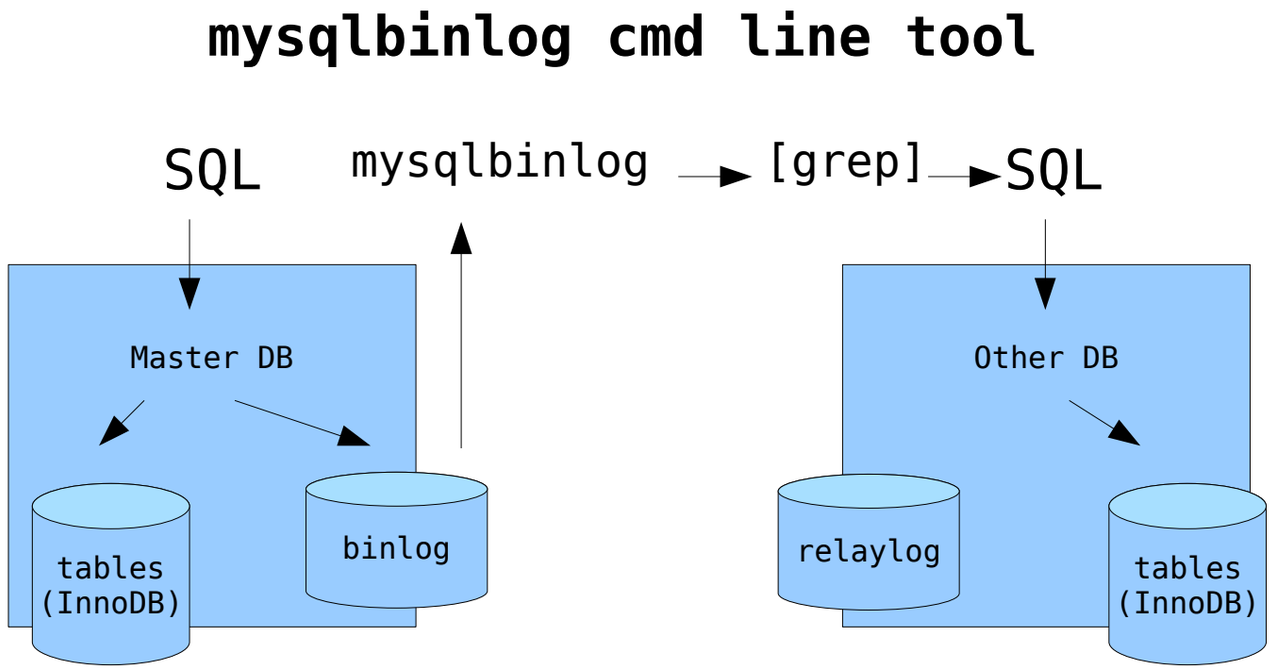
mysqlbinlog cmdline tool





- Use cases
- Human readable output of contents in binlog
- Valid SQL, can replay statements
- Point in Time recovery
- "Manual replication" to other DB
- Hacks: You can grep, awk, sed, perl massage the output

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Customer issues with mysqlbinlog

- MySQL bug #46640 (MWL:50)
  - mysqlbinlog 5.1 output does not apply on MySQL 5.0 server. (BINLOG statement, used for RBR)
  - A "format description" BINLOG statement includes a server_id setting from the original server, which overrides server_id at "Other DB". This should not happen, server_id should remain constant per server. (Prevents circular replication problems.)
- --rewrite-db=name (MWL:36)
  - Background: for statement based replication, customer has scripts to awk statement like "USE dbname" so that the database on target server has a different name. With RBR dbname.tblname is explicitly encoded in BINLOG statement.
  - Corner cases like ALTER DATABASE too!
- Don't write certain tables to binlog. (MWL:40)
  - After extensive architecture study, customer realizes that RBR and TEMPORARY tables does exactly this in MySQL 5.1.

Fixing bug #46640 (MWL:50)

- Root problem: too much sharing of code
  - mysqlbinlog is cmdline utility, produces SQL
  - Replication SQL thread runs in server process, applies binlog events
- Leads to using flags and conditions (if context is a, do x, if b do y...). Or not using them...
  - `thd->rli_fake= new Relay_log_info;`
  - Sharing code paths in sql/log_event.cc, sql/log_event_old.cc, sql/slave.cc
- Binlog statements are rather opaque...
  - ```
    BINLOG '
    3u9kSBMUAAAAKQAAAJEB...
    ';
    ```
  - `Where is the server_id?`
- Fix: Move (replication related) code paths away to be in SQL slave thread only so server_id is not set from MySQL server cmd line.

(But we still share code, root problem remains?)
    ```

Implementing --rewrite-db=name (MWL:36)

- Support new option in `client_priv.h, mysqlbinlog.cc`
  - Add `OPT_REWRITE_DB, parse 'db-from->db-to'` syntax, allocate memory...
- RBR: Row operation events are preceded by Table map event(s) which maps table id(s) to database and table names. So, it's enough to support rewriting database name in a Table map.
  - `case TABLE_MAP_EVENT:`
  - `Table_map_log_event::rewrite_db()`
- SBR: Limited to rewrite "USE dbname"
  - Ignores `INSERT INTO otherdbname.tblname VALUES...`
  - Considered a feature, other `*-ignore-*` options work the same.
  - `Query_log_event, Load_log_event, Execute_load_query_log_event, Create_file_log_event`
  - `print_use_stmt()` will figure out correct `"USE dbname"` to output

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mysqlbinlog conclusions

- 2 bugs fixed
- Use --rewrite-db to stream binlog to different or renamed database
- Sometimes you need consulting, not new features :-)
- Omitting some tables from binlog gives performance improvement on master due to less fsync's in writing binlog.
-
- Possible future mysqlbinlog work
  - 37: Add an option to mysqlbinlog to produce SQL script with fewer roundtrips
  - 38: Make mysqlbinlog not to output unneeded statements when using --database (BUG#23890, BUG#23894)
  - 41: Add a mysqlbinlog option to filter certain kinds of statements (filter on INSERT, UPDATE...)
  - 45: Add a mysqlbinlog option to produce succint output
  - 46: Change BINLOG statement syntax to be human-readable
  - 47: Store in binlog text of statements that caused RBR events
  - 49: Make --replicate-(do,ignore)-(db,table) behaviour for RBR identical to that of SBR

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MyISAM keycache performance improvements

- Keycache = index cache for MyISAM tables
- Before any DDL, flush cache to disk
- -> This includes DROP TABLE and DROP DATABASE!

- Big unnecessary performance hit for customer creating and dropping large tables every day
- Fix: Don't flush data to disk only to delete it!
- 24 h work on DROP TABLE, 3 h DROP DATABASE

- Win: much less disk io at customer

Possible future work

- index_merge (fair choice between index_merge union and range access)
- streaming UNION ALL (without temp table)
- IPv4 datatype
- Microsecond datatype
- Storage Engine API improvements