Effective Software Development with MySQL

Ronald Bradford
August 2015

25+ YEARS EXPERIENCE

"The greatest performance overhead in MySQL systems today is the lack of SQL skills and general development skills by the software creators."

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CHANGE IN ROLES/SKILLS

when I started 25 years ago

Past 5+ years [startups]

Historically	Now
✻ System Architect(s)	✻ Software Developer
✻ Senior Analyst(s)	✻ Software Engineer
✻ Developer(s)	✻ Coder
✻ QA Tester(s)	✻ Entrepreneur
✻ Database Administrator(s)	
✻ System Administrator(s)	

EFFECTIVE TIPS

1. SQL Basics
2. SQL Constructs to avoid
3. SQL Constructs to use
4. Use Transactions
5. Do Less Work

...

EFFECTIVE TIPS

6. The problem with timezones
7. The lack of standards
8. Read the MySQL documentation

1 SQL Basics

COMMENT YOUR SQL

- Add a C style comment to any/all SQL

```
SELECT /* MySQLEMEA2014 Demo */ NOW();
+---------------------+
| NOW()               |
+---------------------+
| 2014-08-09 14:01:18 |
+---------------------+

INSERT /* AddGameStats:42 */ INTO stats(counter) VALUES(1);
```

- Enables DBA to more easily find SQL via tools like grep.

mysql -c

ENABLE GENERAL LOG

- For all developer/test environments
  - NOT FOR PRODUCTION

5.1+ syntax

```
[mysqld]
general-log=1
general-log-file=/mysql/log/general.log
```

Demonstrate use later

```
tail -f /mysql/log/general.log
...
15:01:18 6 Query   SELECT /* MySQLEMEA2014 Demo */ NOW()
15:02:09 6 Query   INSERT /* AddGameStats:42 */ INTO stats(counter)
```

WHY VIEW QUERIES?

- Developer needs to find bad habits early
  - Row At a Time (RAT) processing
- The total queries to be executed
  - Turn all caching off (memcache, QC etc)
- Learn about the Query Execution Plan (QEP) and how to appreciate EXPLAIN
- Understand the true impact of frameworks

Discuss in Point 5

FRAMEWORKS

CLAIM

- improve speed of development
- Abstract need to know SQL

REALITY

- Undocumented cost to sub-optimal performance, especially with data persistence

FUTURE PROOF SQL

- Always alias columns when using joins
- SELECT only required columns
- Define columns for INSERTs

ALIAS COLUMNS

```
CREATE TABLE products (
  id          INT UNSIGNED NOT NULL,
  name        VARCHAR(100) NOT NULL,
  description TEXT NULL);

CREATE TABLE orders (
  id          INT UNSIGNED NOT NULL,
  product_id  INT UNSIGNED NOT NULL,
  qty         TINYINT UNSIGNED NOT NULL);

SELECT product_id, description
FROM   orders o, products p
WHERE  o.product_id = p.id;
```

ALIAS COLUMNS

```
ALTER TABLE orders ADD description TEXT NULL;

SELECT product_id, description
FROM   orders o, products p
WHERE  o.product_id = p.id;

ERROR 1052 (23000): Column 'description' in field list is ambiguous

SELECT o.product_id, p.description
FROM   orders o, products p
WHERE  o.product_id = p.id;
```


FUTURE PROOF INSERT

```
CREATE TABLE countries (
  code      CHAR(2) NOT NULL PRIMARY KEY,
  name      VARCHAR(60) NOT NULL,
  capital   VARCHAR(60) NOT NULL
);
```

```
INSERT INTO countries
VALUES ('AU','Australia','Canberra');
```

```
INSERT INTO countries (code, name,capital)
VALUES ('US','USA','Washington DC');
```


FUTURE PROOF INSERT

```
CREATE TABLE countries (
  code      CHAR(2) NOT NULL PRIMARY KEY,
  name      VARCHAR(60) NOT NULL,
  capital   VARCHAR(60) NOT NULL
);
ALTER TABLE countries
  ADD population  INT UNSIGNED NULL;
```

```
INSERT INTO countries
VALUES ('AU','Australia','Canberra');
ERROR 1136 (21S01): Column count doesn't match value count at row 1
```

```
INSERT INTO countries (code, name,capital)
VALUES ('CA','Canada','Ottawa');
```


SQL LINT

- valid SQL can produce invalid results

```
SELECT YEAR(created) AS yy, MONTH(created) AS mm,
       COUNT(*) AS cnt, FORMAT(SUM(total),2) AS total
FROM   sales;
```

- 1 row

sql_mode helps to identify and correct

```
SELECT YEAR(created) AS yy, MONTH(created) AS mm,
       COUNT(*) AS cnt, FORMAT(SUM(total),2) AS total
FROM   sales
GROUP BY YEAR(created), MONTH(created);
```

- n rows

SQL LINT

- valid SQL can produce invalid results

```
SELECT o.id,o.state,o.zip
FROM sales_tax o
LEFT JOIN new_sales_tax n ON (o.state = n.state AND o.zip = n.zip)
AND n.id IS NULL;
```

- 6,000 rows

AND is part of ON, not part of WHERE

```
SELECT o.id,o.state,o.zip
FROM sales_tax o
LEFT JOIN new_sales_tax n ON (o.state = n.state AND o.zip = n.zip)
WHERE n.id IS NULL;
```

- 6 rows

RECAP

SQL Basics

- Comment your SQL
- Log, View and Review ALL SQL
- Future proof your SQL
- A valid SQL syntax is not always correct

Non standard SQL

MYSQL SYNTAX

- REPLACE
- DELAYED
- IGNORE
- LOW_PRIORITY
- HIGH_PRIORITY
- SHOW & DESC

REPLACE

- If row exists UPDATE, if does not exist then INSERT e.g. UPSERT

NOT THIS, BUT:

- Implemented as DELETE row, then INSERT

Also no REPLACE TRIGGER option

DELAYED/IGNORE

- INSERT DELAYED
- INSERT IGNORE
  - Do not provide errors when errors occur
- LOW_PRIORITY | HIGH_PRIORITY
  - Changing locking strategy

Does not work with InnoDB

SHOW

- SHOW
  - 41 different options in 5.5
- Use INFORMATION_SCHEMA when possible
  - 5.0 - 17 views
  - 5.1 - 27+ views
  - 5.5 - 39+ views
  - 5.6 - 58+ views
  - 5.7 - 59+ views

3 MySQL SQL Constructs

INFORMATION SCHEMA

"INFORMATION_SCHEMA is a database within each MySQL instance, the place that stores information about all the other databases that the MySQL server maintains. The INFORMATION_SCHEMA database contains several read-only tables. They are actually views, not base tables, so there are no files associated with them, and you cannot set triggers on them. Also, there is no database directory with that name."

http://dev.mysql.com/doc/refman/5.5/en/information-schema.html

MYSQL SYNTAX

- Multi-row INSERT
  - VALUES (), (), ()....

```
TRUNCATE TABLE stats;
START TRANSACTION;
INSERT INTO stats(counter)
       VALUES(1),(2),(3),(4),(5),(6),(7),(8),(9);
COMMIT;

SELECT * FROM stats;
```


MYSQL SYNTAX

- LIMIT [n],[m]

```
SELECT counter FROM stats WHERE counter > 2 LIMIT 2;
+---------+
| counter |
+---------+
|       3 |
|       4 |
+---------+
2 rows in set (0.00 sec)
SELECT counter FROM stats WHERE counter > 2 LIMIT 3,2;
+---------+
| counter |
+---------+
|       6 |
|       7 |
+---------+
2 rows in set (0.00 sec)
```


STRING MATCHING

```
SELECT Name,CountryCode FROM City
WHERE LOWER(name) LIKE 'bris%';
+----------+-------------+
| Name     | CountryCode |
+----------+-------------+
| Brisbane | AUS         |
| Bristol  | GBR         |
+----------+-------------+
```

No CASE function needed

```
SELECT Name,CountryCode FROM City
WHERE name LIKE 'bris%';
+----------+-------------+
| Name     | CountryCode |
+----------+-------------+
| Brisbane | AUS         |
| Bristol  | GBR         |
+----------+-------------+
```

http://dev.mysql.com/doc/index-other.html

STRING MATCHING

- String comparison is case insensitive by default
- Character set collation is configurable at column, table, schema level
- MySQL supports 70+ collations for 30+ character sets.
- MySQL does not support function based indexes

4 Transactions

TRANSACTIONS

- The foundation of RDBMS
- The basis of ACID
- Required for business systems

BUT

- So often no used in MySQL systems

WHY?

AUTOCOMMIT

SESSION only scope until 5.5

- MySQL defaults with autocommit on
- Historical default storage engine (MyISAM) did not support transactions.
  - InnoDB existed in 3.23 (Since 2001)
- Many open source projects fail to use transactions (a necessary good practice)
- New developers have never learned what a transaction is. and why they are critical to RDBMS

TRANSACTIONS

* The general log tells all

What not to see

```
Time                 Id Command    Argument
140803 14:50:04       1 Connect    msandbox@localhost on
                      1 Init DB    test
140803 14:50:52       1 Query      INSERT INTO countries
                                   VALUES ('AU','Australia','Canberra')
140803 14:51:11       1 Query      INSERT INTO countries (code, name,capital)
                                   VALUES ('US','USA','Washington DC')
140803 14:51:13       1 Quit
```

Correct Use

```
Time                 Id Command    Argument
140803 14:53:03       2 Connect    msandbox@localhost on test
140803 14:53:22       2 Query      START TRANSACTION
140803 14:53:29       2 Query      INSERT INTO countries
                                   VALUES ('AU','Australia','Canberra')
140803 14:53:47       2 Query      INSERT INTO countries (code, name,capital)
                                   VALUES ('US','USA','Washington DC')
140803 14:53:50       2 Query      COMMIT
140803 14:53:54       2 Quit
```


TRANSACTIONS

```
SELECT variable_name,variable_value
FROM information_schema.global_status
WHERE variable_name IN ('com_insert','com_update',
'com_delete', 'com_commit','com_rollback');
+---------------+----------------+
| variable_name | variable_value |
+---------------+----------------+
| COM_COMMIT    | 2148778        |
| COM_DELETE    | 3614178        |
| COM_INSERT    | 68096778       |
| COM_ROLLBACK  | 85193          |
| COM_UPDATE    | 142914426      |
+---------------+----------------+
```


TRANSACTIONS

MyISAM Tables

```
SELECT   table_schema,
         SUM(data_length+index_length)/1024/1024 AS total_mb,
         SUM(data_length)/1024/1024 AS data_mb,
         SUM(index_length)/1024/1024 AS index_mb,
         COUNT(*) AS tables,
         CURDATE() AS today
FROM     information_schema.tables
WHERE    engine='MyISAM'
AND      table_schema NOT IN ('mysql','information_schema')
GROUP BY table_schema
ORDER BY 2 DESC;
```

```
+--------------------+---------------+--------------+------------+--------+
| table_schema       | total_mb      | data_mb      | index_mb   | tables |
+--------------------+---------------+--------------+------------+--------+
| xxxxxxxx           | 1418.39929962 | 1412.66883087 | 5.73046875 |      2 |
| xxxx               |   16.89165497 |    9.18071747 | 7.71093750 |      3 |
| xx_wordpress       |    7.82143688 |    7.45424938 | 0.36718750 |     13 |
| xxxxxxxxx_drupal   |    2.17076111 |    1.86607361 | 0.30468750 |     62 |
```


USE CORRECTLY

* Abuse of Transactions
  * One business function, 3 transactions
  * Start transaction, then programming logic (taking time to execute)
  * Additional SELECT's inside transaction
* Frameworks exhibit these patterns

25+ YEARS EXPERIENCE

"If your application (in-house, open-source, purchased) does not use transactions at all times, there will be far greater problems and long term increased cost of ownership."

Ronald Bradford
August 2014

5

Do Less Work

25+ YEARS EXPERIENCE

"Every MySQL application executes more SQL than necessary. Reducing, removing and combining SQL queries will improve performance and increase throughput capacity."

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August 2014

EXAMPLES

- Duplicate identical queries
- Repeating queries
- Queries the can be combined
- Queries that can be simplified
- Queries that can be removed

RAT PROCESSING

```
SELECT name FROM firms WHERE id=727;
SELECT name FROM firms WHERE id=758;
SELECT name FROM firms WHERE id=857;
SELECT name FROM firms WHERE id=740;
SELECT name FROM firms WHERE id=849;
SELECT name FROM firms WHERE id=839;
SELECT name FROM firms WHERE id=847;
SELECT name FROM firms WHERE id=867;
SELECT name FROM firms WHERE id=829;
SELECT name FROM firms WHERE id=812;
SELECT name FROM firms WHERE id=868;
SELECT name FROM firms WHERE id=723;
```

Classic N+1 problem

```
SELECT id, name
FROM firms
WHERE id IN (723, 727, 740, 758, 812, 829, 839, 847, 849, 857, 867, 868);
```


CAT PROCESSING

```
SET PROFILING=1;
SELECT ...
SHOW PROFILES;
+----------+------------+-----------------------------------------------------------------
| Query_ID | Duration   | Query
+----------+------------+-----------------------------------------------------------------
|        1 | 0.00030400 | SELECT name FROM firms WHERE id=727
|        2 | 0.00014400 | SELECT name FROM firms WHERE id=758
|        3 | 0.00014300 | SELECT name FROM firms WHERE id=857
|        4 | 0.00014000 | SELECT name FROM firms WHERE id=740
|        5 | 0.00012300 | SELECT name FROM firms WHERE id=849
|        6 | 0.00012200 | SELECT name FROM firms WHERE id=839
|        7 | 0.00011600 | SELECT name FROM firms WHERE id=847
|        8 | 0.00014300 | SELECT name FROM firms WHERE id=867
|        9 | 0.00013900 | SELECT name FROM firms WHERE id=829
|       10 | 0.00014000 | SELECT name FROM firms WHERE id=812
|       11 | 0.00012800 | SELECT name FROM firms WHERE id=868
|       12 | 0.00011700 | SELECT name FROM firms WHERE id=723
|       13 | 0.00031100 | SELECT id, name FROM firms WHERE id IN (723, 727, 740, 758, 812, 829, 839, 847, 849, 857, 867, 868)
+----------+------------+-----------------------------------------------------------------
```

4X longer processing for every page load

```
SELECT 'Sum Individual Queries' AS txt,SUM(DURATI
INFORMATION_SCHEMA.PROFILING WHERE QUERY_ID BETWE
UNION
SELECT 'Combined Query',SUM(DURATION) FROM INFORM
QUERY_ID = 13;
+-------------------------+------------+
| txt                     | total_time |
+-------------------------+------------+
| Sum Individual Queries  |   0.001311 |
| Combined Query          |   0.000311 |
+-------------------------+------------+
```

Instant DB Scalability

SIMPLICITY

Before considering how do I fix this code/SQL, ask?

Can I remove or simplify this code/SQL?
Does this process use this data?

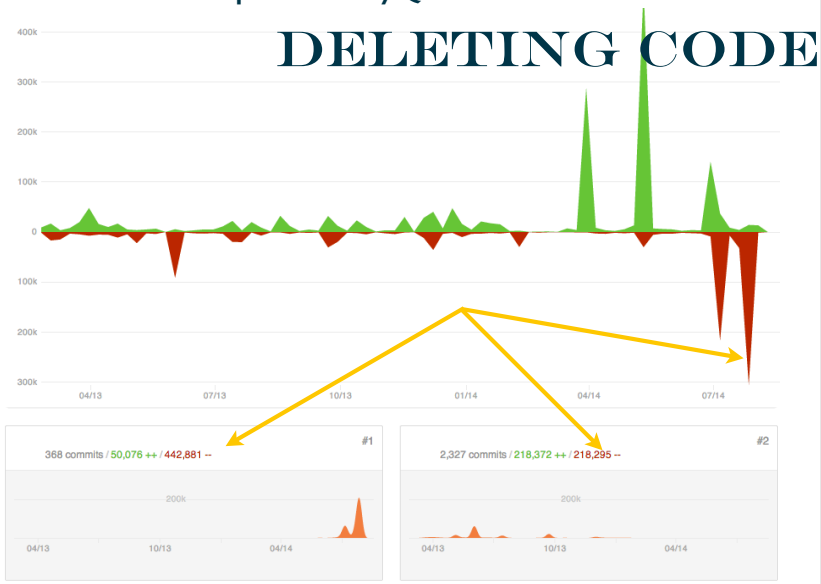
FRAMEWORK COST

Drupal "Framework" + customization

- 50 SQL statements to create a user
- Only13 actual SQL statements required with sub-optimal design
- 4-5 SQL statements with optimal design

If this exists in the most fundamental core, it exists everywhere in code

DELETING CODE



MySQL and Timezones

TIMEZONE FUNCTIONS

- Will your users ever cross timezones?
- Will your application data ever support multiple timezones?
  - CONVERT_TZ(date,from_tz,to_tz)
- Does not work by default

TIMEZONES

- Timezone data is not loaded by default

```
mysql> SELECT COUNT(*) AS cnt FROM mysql.time_zone;
+-----+
| cnt |
+-----+
|   0 |
+-----+

mysql> SELECT NOW(),
    -> CONVERT_TZ(NOW(),'America/New_York','UTC') AS utc;
+---------------------+------+
| NOW()               | utc  |
+---------------------+------+
| 2014-08-02 17:05:18 | NULL |
+---------------------+------+
```

http://dev.mysql.com/doc/refman/5.6/en/date-and-time-functions.html

TIMEZONES

```
$ mysql_tzinfo_to_sql /usr/share/zoneinfo | \
   mysql -u root mysql

mysql> SELECT COUNT(*) AS cnt FROM mysql.time_zone;
+------+
| cnt  |
+------+
| 1738 |
+------+

mysql> SELECT NOW(),
    -> CONVERT_TZ(NOW(),'America/New_York','UTC') AS utc;
+---------------------+---------------------+
| NOW()               | utc                 |
+---------------------+---------------------+
| 2014-08-02 16:14:04 | 2014-08-02 20:14:04 |
+---------------------+---------------------+
```

http://dev.mysql.com/doc/refman/5.6/en/mysql-tzinfo-to-sql.html

TIMEZONES

Does not tell you the actual TZ

```
SELECT @@time_zone;
+--------------+
| @@time_zone  |
+--------------+
| SYSTEM       |
+--------------+
```

```
[mysqld]
default_time_zone='America/Chicago';
```

```
SELECT @@time_zone;
+------------------+
| @@time_zone      |
+------------------+
| America/Chicago  |
+------------------+
```


MYSQL SYNTAX

- Do not use system global in coding

```
SELECT @@system_time_zone;
+--------------------+
| @@system_time_zone |
+--------------------+
| EDT                |
+--------------------+
```

- String value not always loaded
- Set at startup, does not change for daylight savings

```
SELECT CONVERT_TZ(NOW(),@@system_time_zone,'UTC') AS wrong,
       CONVERT_TZ(NOW(),@@time_zone,'UTC') AS correct;
+-------+---------------------+
| wrong | correct             |
+-------+---------------------+
| NULL  | 2014-08-05 02:07:18 |
+-------+---------------------+
```


Having Standards

ABOUT STANDARDS

- This presentation is not about defining THE standard to use
- This is about stating you HAVE a standard that meets your needs, you USE it, and ENFORCE it
- Some recommendations...

BE CONSISTENT

- Name columns consistently
  - column for date/time a row is created

```
created_date    DATETIME
datetime        DATETIME
created_at      DATETIME
created         TIMESTAMP
```

One data model, at least 4 variances

PRIMARY KEY

- Name primary key unique across system

```
CREATE TABLE order (
  order_id     INT UNSIGNED NOT NULL PRIMARY KEY,
  customer_id  INT UNSIGNED NOT NULL,

CREATE TABLE customer (
  customer_id  INT UNSIGNED NOT NULL PRIMARY KEY,
```

```
CREATE TABLE order (
  id           INT UNSIGNED NOT NULL PRIMARY KEY,
  customer_id  INT UNSIGNED NOT NULL,

CREATE TABLE customer (
  id           INT UNSIGNED NOT NULL PRIMARY KEY,
```


DOCUMENTATION

- Where is the data model?

RESERVED WORDS

- Do not use reserved words as columns
  - datetime
  - date
  - from
  - to

MySQL allows use of reserved words using `backtick` syntax

TABLE NAMES

- Name tables either singular or plural
  - Again, be consistent
- Professionally, singular wins because it is simpler
- order, order_line,country
- orders, order[s]_lines, countries

Learn the Documentation

DOCS

http://dev.mysql.com/doc/

General	Administrators	MySQL Enterprise	Developers & Functionality	Connectors & APIs	HA/Scalability
Tutorial	Installation & Upgrades	MySQL Enterprise Edition	» MySQL Workbench	Connectors and APIs	» HA/Scalability Guide
Server Administration	MySQL Yum Repository	MySQL Enterprise Monitor	Globalization	Connector/J	MySQL and DRBD
SQL Syntax	» MySQL Installer	MySQL Enterprise Backup	Optimization	Connector/ODBC	memcached
Storage Engines	» Security	MySQL Enterprise Security	Functions and Operators	Connector/Net	memcached with InnoDB
Server Option / Variable Reference	» Startup / Shutdown	MySQL Enterprise Audit	Views and Stored Programs	Connector/Python	MySQL and Virtualization
» Release Notes	» Backup and Recovery Overview	MySQL Thread Pool	Partitioning	PHP	MySQL Proxy
» MySQL Version Reference	» MySQL Utilities		Precision Math	C API	Replication
FAQs	» Linux/Unix		Information	Connector/C	Semisynchronous

What next?

MORE

Today's Developers

- Developer should learn EXPLAIN
- Scrub/Subset your data
  - Developer should not use production data
- Actively remove unused tables/columns
- Do manual code deployments
- Enforce a QA step

CONCLUDING TOP TIPS

- Do Less Work
- Ensure developers learn how to read and write SQL
  - Use Transactions
- Read the MySQL documentation

TRIVIA TIP

- `--i-am-a-dummy`
  - Restricts UPDATE/DELETE statements
  - Alias for `--safe-updates`

CONCLUSION

Copies of these slides can be found at

http://effectiveMySQL.com

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