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The Top 20 Design Tips

For MySQL Enterprise Data Architects

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1. Know Your Technology Tools

- Generics are inefficient
- Product expertise in a different RDBMS is not enough
- You have chosen MySQL
  - Maximize it's strengths
  - Minimize it's weaknesses

Overview

- Table Structure
- SQL
- Indexes
- Enterprise Approaches

1. Know Your Technology Tools

- Maximize MySQL strengths
  - Scale out / HA Options
  - Different Storage Engines
  - Query Cache
- Minimize MySQL weaknesses
  - No Online Alter
  - Backup Strategies
  - Instrumentation

2. Know Your Disk Footprint

Disk = Memory = Performance

- Every single byte counts
- Average 25% - 30% saving on engagements
- Better 60% (200GB System)
- Best 78% (8GB per master with 12 masters)

Less disk accesses and more data in memory

3. Choose Your Numeric Data Type

- MySQL has 9 numeric data types
  - Oracle for example has only 1

3. Choose Your Numeric Data Type

❖ Integer:	TINYINT, SMALLINT, MEDIUMINT, INT, BIGINT
❖ Floating Point:	FLOAT, DOUBLE
❖ Fixed Point:	DECIMAL
❖ Other:	BIT, (ENUM maybe)

3. Choose Your Numeric Data Type

- Favorite signs of poor design
  - INT(1)
  - BIGINT AUTO_INCREMENT
  - no UNSIGNED used
  - DECIMAL(31,0)

3. Choose Your Numeric Data Type

- INT(1) - 1 does not mean 1 digit
  - (1) represents client output display format only
  - INT is 4 Bytes, TINYINT is 1 Byte
  - TINYINT UNSIGNED can store from 0 – 255
  - BIT is even better when values are 0 - 1

3. Choose Your Numeric Data Type

- BIGINT is not needed for AUTO_INCREMENT
- INT UNSIGNED stores 4.3 billion values
  - You should be partitioning when at billions of rows
- BIGINT is applicable for some columns
  - e.g. summation of values

3. Choose Your Numeric Data Type

Best Practice

- Best Practice
  - All integer columns UNSIGNED unless there is a reason otherwise
  - Adds a level of data integrity for negative values

4. Other Data Type Efficiencies

- TIMESTAMP v DATETIME
  - Suitable for EPOCH only values
  - TIMESTAMP is 4 bytes
  - DATETIME is 8 bytes
  - FYI: DATE is 3 bytes, TIME is 3 bytes = 6 Bytes???

4. Other Data Type Efficiencies

- CHAR(n)
- Use VARCHAR(n) for variable values
- e.g. CHAR(128) when storing ~10 bytes

5. Application Data Type Efficiencies

- Using Codes or ENUM
  - A description is a presentation layer function
  - e.g. 'M', 'F' instead of 'Male', 'Female'
  - e.g. 'A', 'I' instead of 'Active', 'Inactive'
- BINARY(16/20) v CHAR(32/40)
  - MD5() or HASH() Hex value with twice the length
- INT UNSIGNED for IPv4 address
  - VARCHAR(15) results in average 12 bytes v 4 bytes

6. NOT NULL

- ❖ Saves up to a byte per column per row of data
- ❖ Double benefit for indexed columns

- ❖ Don't use frameworks or tools
- ❖ NOT NULL DEFAULT '' is bad design

Always use NOT NULL unless there is a reason why not

Best Practice

7. Know about character sets

- Default in MySQL 5 is UTF8
- Can be defined at database, schema, table or column level
- Only define columns that need UTF8
  - e.g. Codes, MD5 Value, web address
- MySQL internal buffers are fixed width
  - e.g. VARCHAR(255) utf8 is 765 bytes to store just 1 byte

8. When VARCHAR Is Bad

- VARCHAR(255)
  - Poor Design - No understanding of underlying data
  - Old Design - (4.x limitation, now 3-4 years old)

- Disk usage may be efficient
- MySQL internal memory usage is not

8. When VARCHAR is bad

```
    CREATE TABLE `XXX` (
  `orderHandle` varchar(255) NOT NULL default '',
  `personName` varchar(255) default NULL,
  `addressLines` varchar(255) default NULL,
  `city` varchar(255) default NULL,
  `state` varchar(255) default NULL,
  `postalCode` varchar(255) default NULL,
  `countryCode` varchar(255) default NULL,
  `phone` varchar(255) default NULL,
  `email` varchar(255) default NULL,
  `shipMethod` varchar(255) default NULL,
  `shipTo` varchar(255) default NULL,
  `receiveByDate` date default NULL,
  `currency` varchar(3) default NULL,
  `price` varchar(255) default NULL,
  `flags` int(11) default '0',
  `lastUpdateTime` timestamp NOT NULL default CURRENT_TIMESTAMP on update CURRENT_TIMESTAMP,
  `creationTime` timestamp NOT NULL default '0000-00-00 00:00:00',
  PRIMARY KEY  (`orderHandle`)
) ENGINE=MyISAM DEFAULT CHARSET=utf8
```

9. Be Wary of TEXT/BLOB

- Using SELECT *
  - MySQL Internal Temporary table will force Temp Disk Table
- Internal storage (e.g. Innodb)
  - Stores first 768 bytes, then a separate 16k data page per row per TEXT/BLOB field

10. Know Every SQL Statement

- Developers don't write proper SQL statements
- SQL statements will directly affect your performance
- For Example
  - Repeating SQL statements for no benefit
  - 1000 very quick small unnecessary queries is worse then 1 slow query

10. Know Every SQL Statement

- Data collection options
- Incomplete Options
  - Slow Query Log
  - SHOW PROCESSLIST
  - Application level logging
- Impractical Options
  - General Log

10. Know Every SQL Statement

- Data collection options
  - MySQL Proxy
    - See histogram.lua
    - Firewall forwarding rules

11. Monitor Every SQL Statement

- Review Query Execution Plan (QEP)
  - EXPLAIN
- Time queries
- Row Count / Affected rows
- Result Set Size

Best Practice

Review over time, things change

12. The Impact Of Indexes

- Good
  - Dramatic performance improvements
  - Improves memory usage
  - Data Integrity
- Bad
  - Slows performance for writes
  - Wastes disk space for unused, duplicate or ineffective indexes
  - In-effective usage of memory

13. Index Types For Design

- Concatenated Indexes
  - (col1, col2)
- Partial Indexes
  - (name(20))
- Covering Indexes
- Full Text Indexes
- No function based indexes

14. Minimizing internal MySQL processing

- Correctly design tables, indexes and SQL to eliminate
  - Using temporary table
  - Using filesort

15. Transactions

- Always design for transactions
- Always use transactions
- Use a transactional storage engine

16. Data Integrity is Key

- MySQL historically has been very lax
- Warnings (e.g. Truncations) are rarely every caught
- SQL_MODE=STRICT_ALL_TABLES
- Within Schema
  - NOT NULL
  - ENUM
  - UNSIGNED

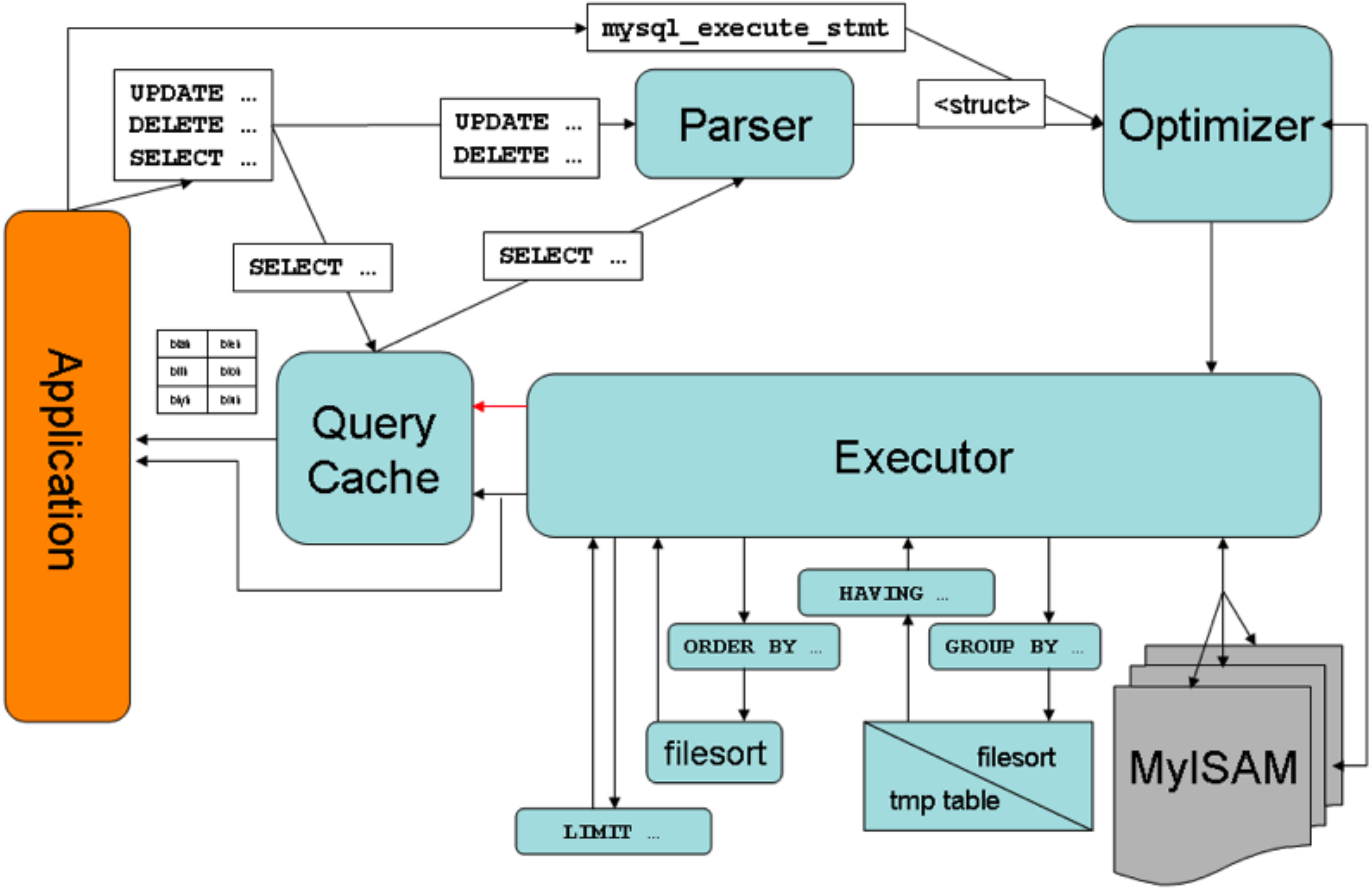
17. Leverage The Query Cache

- Query Cache can be a great benefit
- Deterministic v Non Deterministic SQL

Best Practice

MySQL Query Cache is not the only type of caching you should consider

17. Leverage The Query Cache



17. Leverage The Query Cache

- SHOW PROFILE Path
- Simple SELECT
  - No Query Cache 17 steps
  - With Query Cache 5 steps
    - Does not perform parse
    - Does not perform optimize

The Top 20 Design Tips

```
+--------------------------------+----------+---------------------------+---------------+-------------+
| Status                         | Duration | Source_function           | Source_file   | Source_line |
+--------------------------------+----------+---------------------------+---------------+-------------+
| (initialization)               | 0.000014 | send_result_to_client     | sql_cache.cc  |        1143 |
| checking query cache for query | 0.000042 | open_tables               | sql_base.cc   |        2652 |
| Opening tables                 | 0.000015 | mysql_lock_tables         | lock.cc       |         153 |
| System lock                    | 0.000009 | mysql_lock_tables         | lock.cc       |         163 |
| Table lock                     | 0.000034 | mysql_select              | sql_select.cc |        2273 |
| init                           | 0.000041 | optimize                  | sql_select.cc |         765 |
| optimizing                     | 0.000008 | optimize                  | sql_select.cc |         924 |
| statistics                     | 0.000016 | optimize                  | sql_select.cc |         934 |
| preparing                      | 0.000012 | exec                      | sql_select.cc |        1594 |
| executing                      | 0.000008 | exec                      | sql_select.cc |        2114 |
| Sending data                   | 0.000163 | mysql_select              | sql_select.cc |        2318 |
| end                            | 0.000021 | mysql_execute_command     | sql_parse.cc  |        5141 |
| query end                      | 0.000007 | query_cache_end_of_result | sql_cache.cc  |         735 |
| storing result in query cache  | 0.000007 | mysql_parse               | sql_parse.cc  |        6142 |
| freeing items                  | 0.000018 | dispatch_command          | sql_parse.cc  |        2146 |
| closing tables                 | 0.000009 | log_slow_statement        | sql_parse.cc  |        2204 |
| logging slow query             | 0.000006 | dispatch_command          | sql_parse.cc  |        2169 |
+--------------------------------+----------+---------------------------+---------------+-------------+
17 rows in set (0.00 sec)
+--------------------------------+----------+-----------------------+--------------+-------------+
| Status                         | Duration | Source_function       | Source_file  | Source_line |
+--------------------------------+----------+-----------------------+--------------+-------------+
| (initialization)               | 0.000012 | send_result_to_client | sql_cache.cc |        1143 |
| checking query cache for query | 0.00001  | send_result_to_client | sql_cache.cc |        1224 |
| checking privileges on cached  | 0.000007 | send_result_to_client | sql_cache.cc |        1317 |
| sending cached result to clien | 0.000025 | log_slow_statement    | sql_parse.cc |        2204 |
| logging slow query             | 0.000007 | dispatch_command      | sql_parse.cc |        2169 |
+--------------------------------+----------+-----------------------+--------------+-------------+
5 rows in set (0.00 sec)
```

18. Create Objects Appropriately

- Using 1 table instead of ‘n’ for same column structure
  - e.g. Code table for each type of code
- Splitting tables for optimal storage
  - e.g. Placing optional TEXT/BLOB columns in second table
- Use permanent tables instead of TEMPORARY tables

19. Naming Standards

- Name all Primary Key’s Uniquely
  - e.g. customer_id, order_id not id
- Use Data Dictionary SQL to verify data types
  - Data Types & Lengths
- Be Descriptive
  - e.g. invoice_date not just date
- Avoid Reserved Words
  - e.g. date, time, timestamp

20. Testing, Testing, Testing

- You must have a testing environment
- Testing on a Production server is not an option

Best Practice

The goal of a testing environment is not to test your software, it is to break your software.

Executive Summary

- Learn and know MySQL specifics
- Disk = Memory = Performance
- If you don't know your SQL you don't know your application. Log, Review & Monitor all SQL
- Know all benefits of different indexes
- You must test to failure in a dedicated test environment

Professional Help is Available

- PrimeBase Technologies
  - Technology Experts
  - Solution Experts

- 2 decades Expertise & Experience in Enterprise RDBMS Data Architecture
- 9 years in MySQL

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