MySQL Performance Tuning

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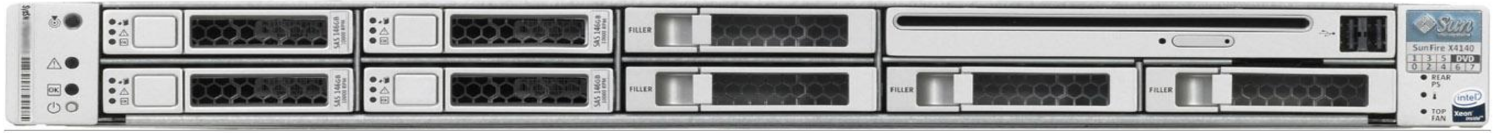
Program Agenda

- Basics: Hardware, Storage Engines and Versions
- Server Tuning
- Index, Query and Schema Optimization
- MySQL Performance Schema Introduction
- MySQL Enterprise Monitor and Query Analyzer

Choosing Hardware

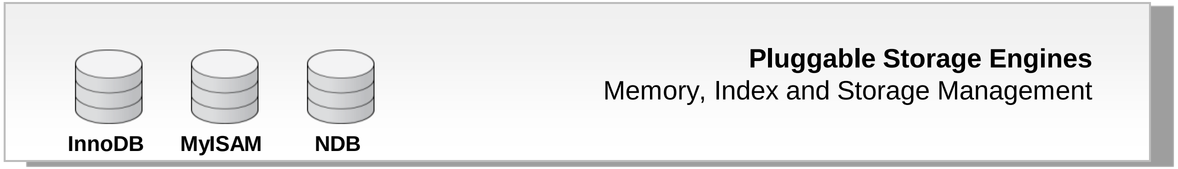


- Up to 64 CPU cores (MySQL 5.6 and above)
- RAM
- Linux, Solaris, Windows http://www.mysql.com/support
- Disks
  - Fast HD (10-15k RPM SATA)
  - RAID 10, Battery Backed Write Cache (RAID controller)
  - SSD (for higher throughput) -- MySQL 5.6
- Redundant Network and Power
- Slaves = Master

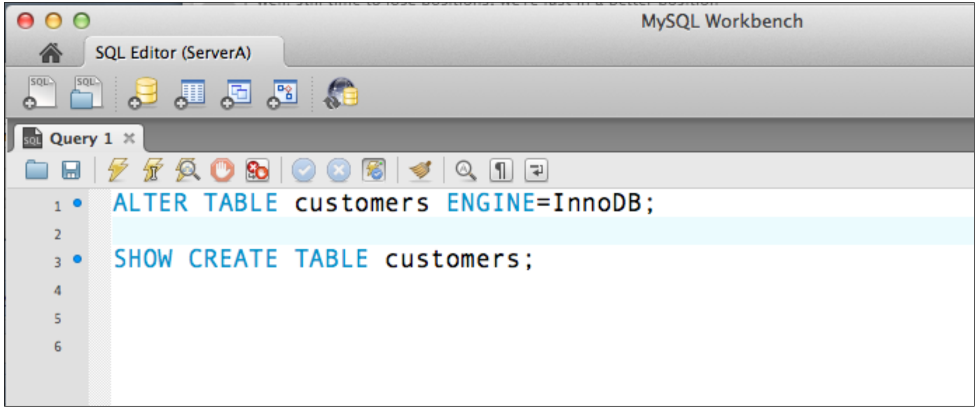
MySQL Storage Engines

MySQL Engines

Tuning Decision

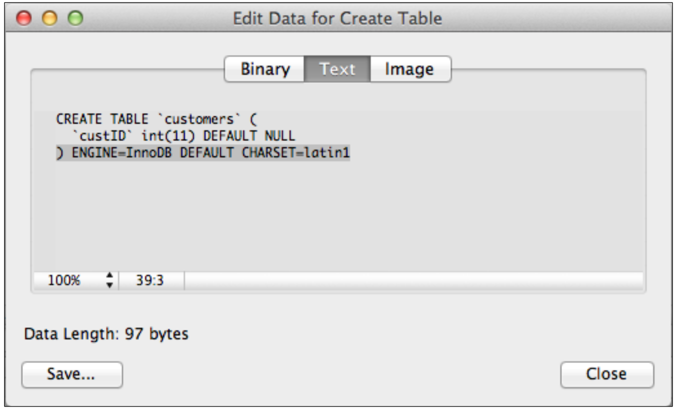


Pluggable Storage Engines
Memory, Index and Storage Management



```
ALTER TABLE customers ENGINE=InnoDB;

SHOW CREATE TABLE customers;
```



```
CREATE TABLE `customers` (
  `custID` int(11) DEFAULT NULL
) ENGINE=InnoDB DEFAULT CHARSET=latin1
```

Data Length: 97 bytes

InnoDB

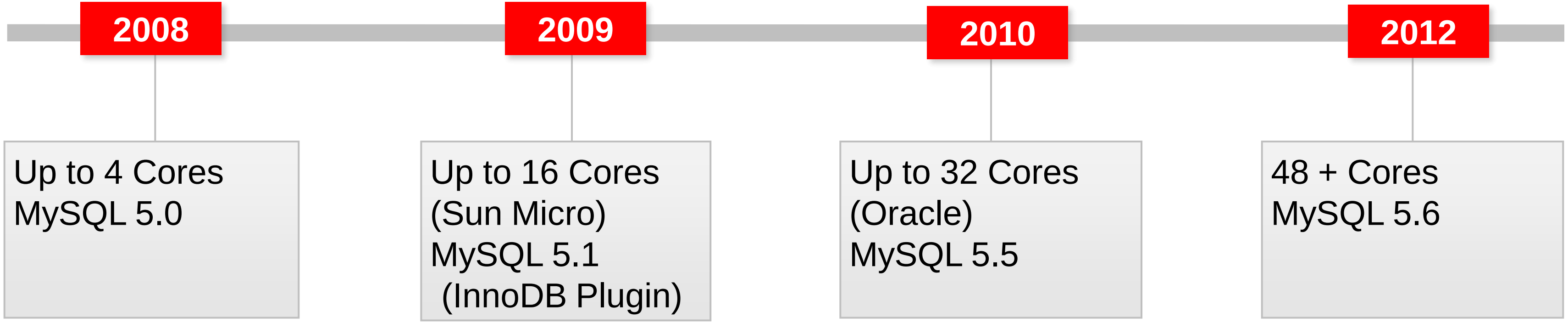
- Transactional and fully ACID compliant
  - Crash Recovery
  - Multi-version Concurrency Control (MVCC)
  - Row-level Locking
- Data and Index in Memory
- In 5.6, InnoDB Provides
  - Equivalent Read Performance
  - Full-Text Search Indexes
  - Improved Partitioning for Load Speeds

MyISAM

- MyISAM Traditional Use Case:
  - High Reads
  - No Transactions or No Crash Recovery
  - Table-level Locking
  - Geospatial Support (RTREE Indexes)

MySQL Versions

MySQL Version – A Tuning Decision



2008

Up to 4 Cores
MySQL 5.0

2009

Up to 16 Cores
(Sun Micro)
MySQL 5.1
(InnoDB Plugin)

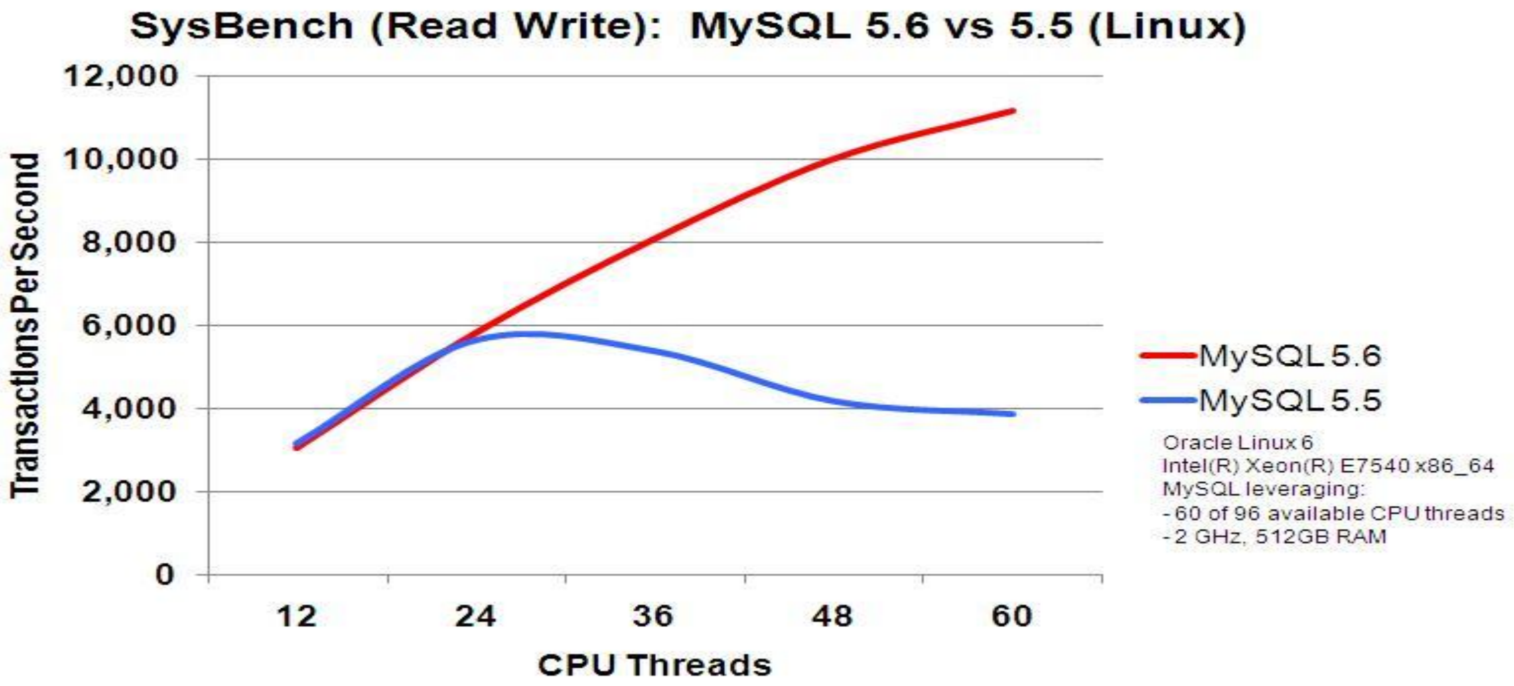
2010

Up to 32 Cores
(Oracle)
MySQL 5.5

2012

48 + Cores
MySQL 5.6

MySQL 5.6: Scalability



- Users can fully utilize latest generations of hardware and OS
- Scales as data volumes and users grow

Server Tuning

Tuning Rules

- Never make a change in production first
- Have a good benchmark or reliable load
- Start with a good baseline
- Only change 1 thing at a time

Tuning Rules -- continued

- Monitor the results
  - Query performance - query analyzer, slow query log, etc.
    - throughput
    - single query time
    - average query time
  - CPU - top, vmstat
  - IO - iostat, top, vmstat, bonnie++
- Document and save the results

Benchmarks

- Make your own
  - Can use general query log output
  - JMeter, LoadRunner, Visual Studio

- mysqlslap http://dev.mysql.com/doc/refman/5.6/en/mysqlslap.html
- supersmack http://vegan.net/tony/supersmack/
- mybench http://jeremy.zawodny.com/mysql/mybench/

- SysBench http://sysbench.sourceforge.net/
- DBT2 http://osdldbt.sourceforge.net/

MySQL VARIABLES

- SYSTEM:
  - my.cnf/my.ini
  - Some Dynamic
  - Some Session/Global
- STATUS:
  - Session/Global

SYSTEM VARIABLES	STATUS VARIABLES
datadir	aborted_clients
general-log	connections
innodb_buffer_pool_size	created_tmp_disk_tables
max_connections	threads_created
port	uptime
…	…

- http://dev.mysql.com/doc/refman/5.6/en/server-system-variables.html
- http://dev.mysql.com/doc/refman/5.6/en/server-status-variables.html

MySQL Status

Status Variables

WATCH

- max_used_connections

- TUNE: System Variables
- MONITOR: Status Variables

- SHOW [GLOBAL|SESSION] STATUS

```
mysql>SHOW global status like ‘max_used_connections’
```

- “WATCH” box identifies status variables

Defaults and Configuration Files

- 5.6
  - Updated Defaults for Modern Systems
  - Auto-sized Variables
- Prior to 5.6
  - Out-of-date Configuration File Samples
    - example: my-innodb-heavy-4G.cnf
- Advice:
  - Consider 5.6 Defaults
  - Re-evaluate older config file entries

InnoDB Tuning

WATCH

- Innodb_buffer_pool_reads
- Innodb_buffer_pool_read_requests

- innodb_buffer_pool_size
  - 80% of Available Memory
  - mysql>show status like 'Innodb_buffer%' ;

- innodb_log_file_size = ~512MB 5.5+
  - recovery time vs. performance
  - high writes

InnoDB Tuning -- next-level

Depends on Your Workload

- innodb_flush_log_at_trx_commit (caution)
  - 1 sync to file (fsync) on each commit
  - 0/2 may lose 1 second of data
- innodb_flush_method=O_Direct
  - depends on workload and hardware
- innodb_buffer_pool_instances = 8
  - 5.5 and 5.6 only

http://dev.mysql.com/doc/refman/5.6/en/innodb-parameters.html

MyISAM Tuning

WATCH

- Key_read_requests
- Key_reads
- Key_buffer_size

- Caches
  - key_buffer_cache – 25% of Available Memory
  - System Cache – 75% of Available Memory
- Multiple Key Buffers
- Pre-load Key Buffers
- Details:
  - ***http://dev.mysql.com/doc/refman/5.6/en/myisam-key-cache.html***

General Server System Variables

Commonly Tuned

- table_open_cache
  - 5.6 changed default from 400-2000
- thread_cache_size
  - goal Threads_created ~ thread_cache_size

WATCH

- %opened%
- %thread%
- Threads_created

General Server System Variables

Query Cache

- Only Use If
  - Identical Queries and Data
  - Very Few Inserts/Updates/Deletes
- Caches Query and ResultSet
  - 0 or OFF
  - 1 or ON Cache all unless SELECT SQL_NO_CACHE
  - 2 or DEMAND cache none unless SELECT SQL_CACHE

WATCH

- qcache_hits
- qcache_inserts
- qcache_not_cached
- qcache_total_blocks
- qcache_free_memory

General Server System Variables

Temporary Tables – Caution → RAM

- tmp_table_size
  - Maximum size for “in memory” tables
  - Memory vs. MyISAM (on disk)
- If temporary table >
  - tmp_table_size or max_heap_table_size or
  - BLOB/TEXT

  Converts to MyISAM table on disk

WATCH

- created_tmp_tables
- created_tmp_disk_tables

http://dev.mysql.com/doc/refman/5.6/en/internal-temporary-tables.html

System Variables -- Caution

Depends on Workload or Query
Bigger is Not Always Better
Uses Memory Per Thread or JOIN

- soft_buffer_size
  - sorting for group by and order by
  - If 100M = 100M of RAM per sort
  - mixed results in lab
  - 2M -> 256K in 5.6
- Advice
  - leave default or thoroughly test
  - set dynamically

WATCH

- %opened%
- %thread%
- Threads_created

System Variables – Caution -- Continued

Depends on Workload or Query
Bigger is Not Always Better
Uses Memory Per Thread or JOIN

- join_buffer_size
  - joins that don’t use indexes
  - minimum allocated per join per thread
- Advice
  - leave default
  - set dynamically
  - benchmark
  - tune query

WATCH

- Select_full_join

Summary

Definitely Tune:

- InnoDB Buffer Pool
- Key Buffer Cache (MyISAM)

Tune and Evaluate:

- innodb_log_file_size
- innodb_flush_log_at_trx_commit
- innodb_flush_method
- innodb_buffer_pool_instances (5.5, 5.6+)
- table_open_cache
- thread_cache_size
- query cache (turn off?)
- tmp_table_size (per session)

Caution

- sort_buffer_size
- join_buffer_size
- read_buffer_size (MyISAM)
- read_rnd_buffer_size

Summary – 5.6 Defaults

Less Tuning Required 5.5->5.6

Definitely Tune:

- InnoDB Buffer Pool
- Key Buffer Cache (MyISAM)

Tune and Evaluate:

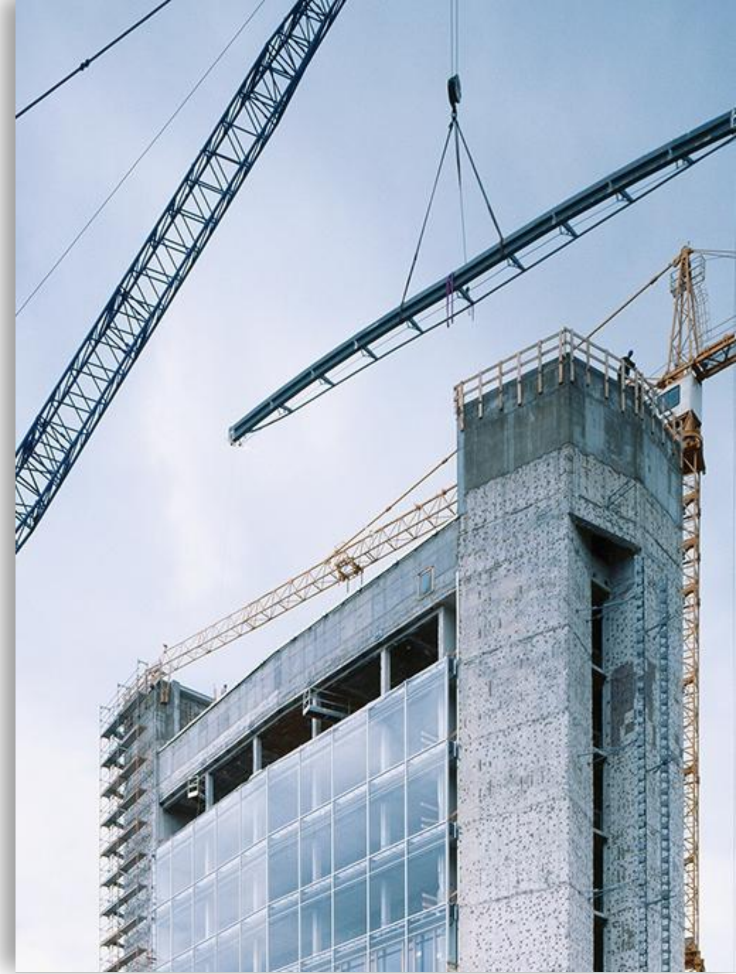
- innodb_log_file_size **5M->48M**
- innodb_flush_log_at_trx_commit
- innodb_flush_method
- innodb_buffer_pool_instances **1->8**
- table_open_cache **400->2000**
- thread_cache_size **0->8+max_con/100**
- query cache
- tmp_table_size

Caution

- sort_buffer_size **2MB->256K**
- join_buffer_size **128K->256K**
- read_buffer_size (MyISAM)
- read_rnd_buffer_size

– https://blogs.oracle.com/supportingmysql/entry/server_defaults_changes_in_mysql

Indexes, Queries and Schemas



InnoDB vs. MyISAM Indexes

- InnoDB “Clustered” Indexes
  - Primary Key Includes Data
  - Secondary Keys Append Primary Key
    - Data Retrieved From Primary Key
- MyISAM
  - Primay Key Points to Physical Data
  - Secondary Key Points to Physical Data

Implications

- InnoDB
  - Fast Primary Key Lookups and Range Scans
  - Specify a Primary Key
  - Keep Primary Keys Small
  - Auto-Increment
  - Covering Index (All Data to Satisfy Query Is in Index)
- MyISAM
  - Covering Index

SELECT fname, lname FROM customer WHERE lname=‘Jones’;

Index Best Practices

- Avoid Unnecessary Indexes

  mysql > SHOW CREATE TABLE tablename

- Avoid Duplication
  - index key123 (col1,col2,col3)
  - index key12 (col1,col2) <- Not needed!
  - index key1 (col1) <-- Not needed!
- Indexes should be 16 bytes/chars or less
- Large Strings or URL
  - Separate Column with MySQL MD5 to Create Hash Key Column

Schemas

- Smaller is Better
  - Don’t set VARCHAR to 255 by Default
  - Temp Tables and Caches Expand to Full Size
- Use VARCHAR instead of BLOB
  - MEMORY engine for GROUP BY and ORDER BY
- PROCEDURE ANALYSE()
  - http://dev.mysql.com/doc/refman/5.6/en/procedure-analyse.html
- InnoDB Primary Keys

Queries

- The IN clause in MySQL is very fast!
  - Select ... Where idx IN(1,23,345,456)
- Keep column alone on left side of condition
  - Select ... Where func(idx) = 20 [index ignored]
  - Select .. Where idx = otherfunc(20) [may use index]
- Avoid % at the start of LIKE on an index
  - Select ... Where idx LIKE(‘ABC%’) can use index
  - Select ... Where idx LIKE(‘%XYZ’) must do full table scan

Queries -- Continued

WATCH

- select_scan (full table scan)
- select_full_join (joins w/o Indexes)

- Enable Slow Query Log
  - Use: log_queries_not_using_indexes
- Use mysqldumpslow :

- http://dev.mysql.com/doc/refman/5.6/en/slow-query-log.html
- http://dev.mysql.com/doc/refman/5.6/en/mysqldumpslow.html

Explain Plan Can Help with Tuning

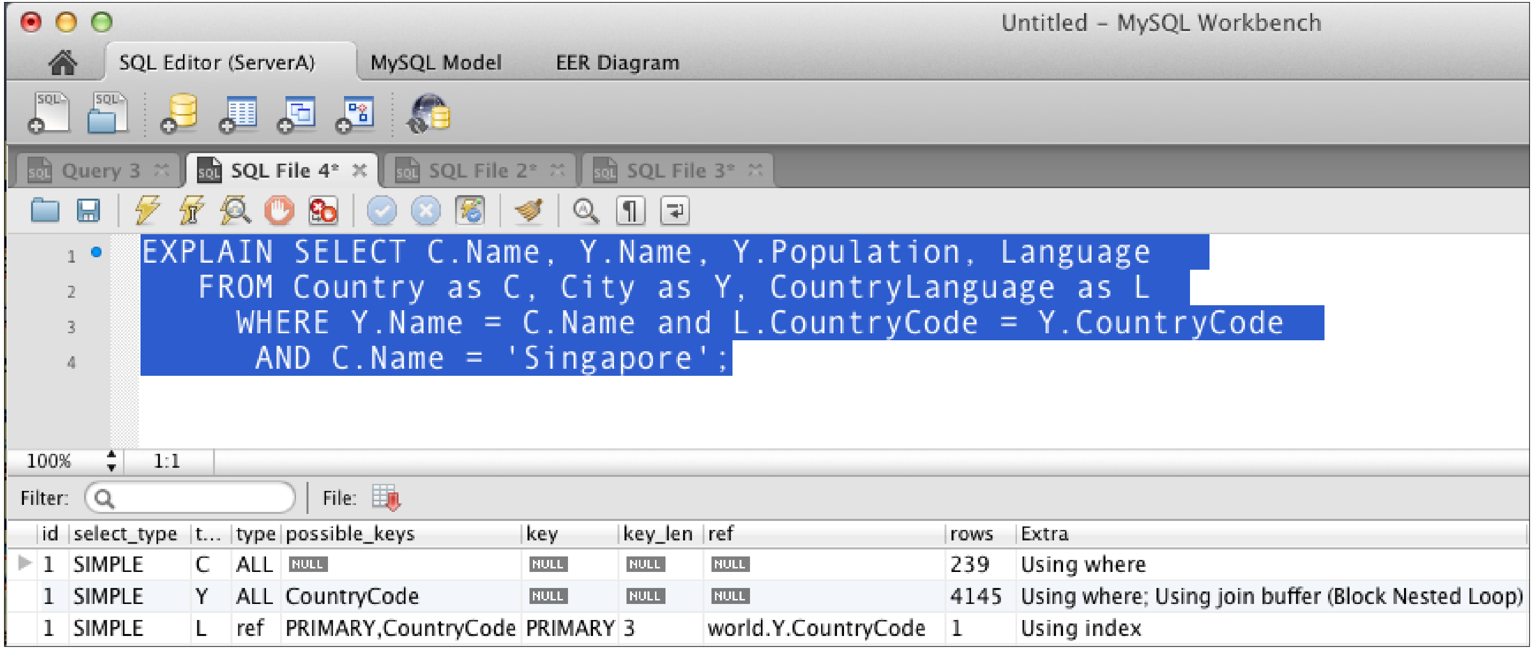
- Order that the tables are accessed
- Indexes used
- Estimated number of rows accessed per table

EXPLAIN SELECT * FROM …

EXPLAIN FORMAT = JSON SELECT * FROM …

Explain Plan

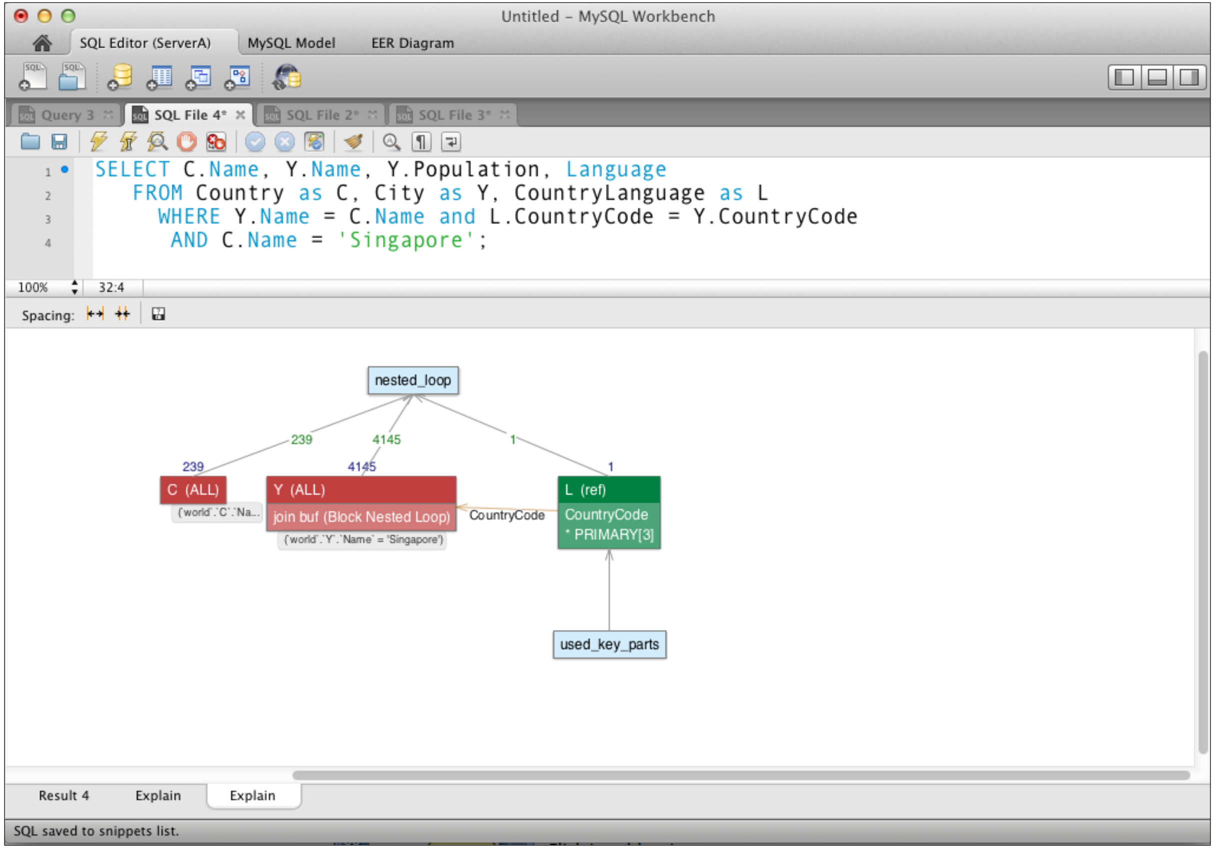
- **Cost: 239 * 4145 * 1 = 990655**



```
EXPLAIN SELECT C.Name, Y.Name, Y.Population, Language
   FROM Country as C, City as Y, CountryLanguage as L
     WHERE Y.Name = C.Name and L.CountryCode = Y.CountryCode
      AND C.Name = 'Singapore';
```

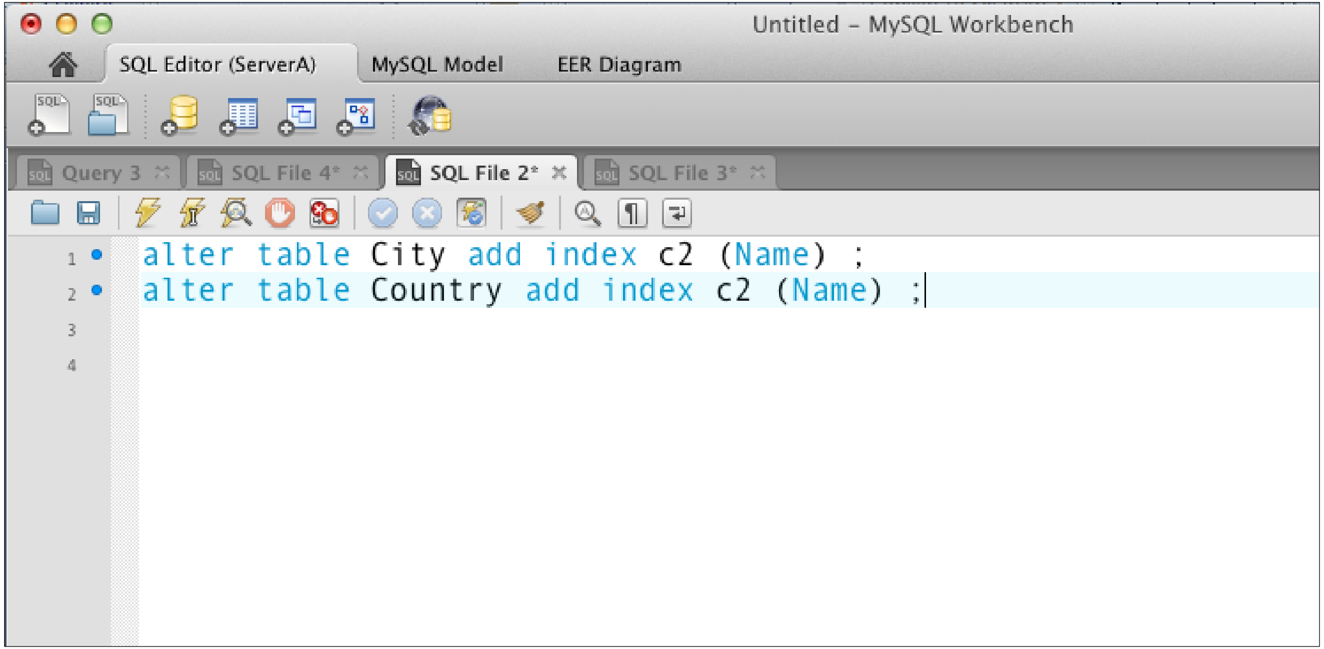
id	select_type	t...	type	possible_keys	key	key_len	ref	rows	Extra
1	SIMPLE	C	ALL	NULL	NULL	NULL	NULL	239	Using where
1	SIMPLE	Y	ALL	CountryCode	NULL	NULL	NULL	4145	Using where; Using join buffer (Block Nested Loop)
1	SIMPLE	L	ref	PRIMARY,CountryCode	PRIMARY	3	world.Y.CountryCode	1	Using index

Explain – Workbench and JSON



```
SELECT C.Name, Y.Name, Y.Population, Language
   FROM Country as C, City as Y, CountryLanguage as L
     WHERE Y.Name = C.Name and L.CountryCode = Y.CountryCode
      AND C.Name = 'Singapore';
```

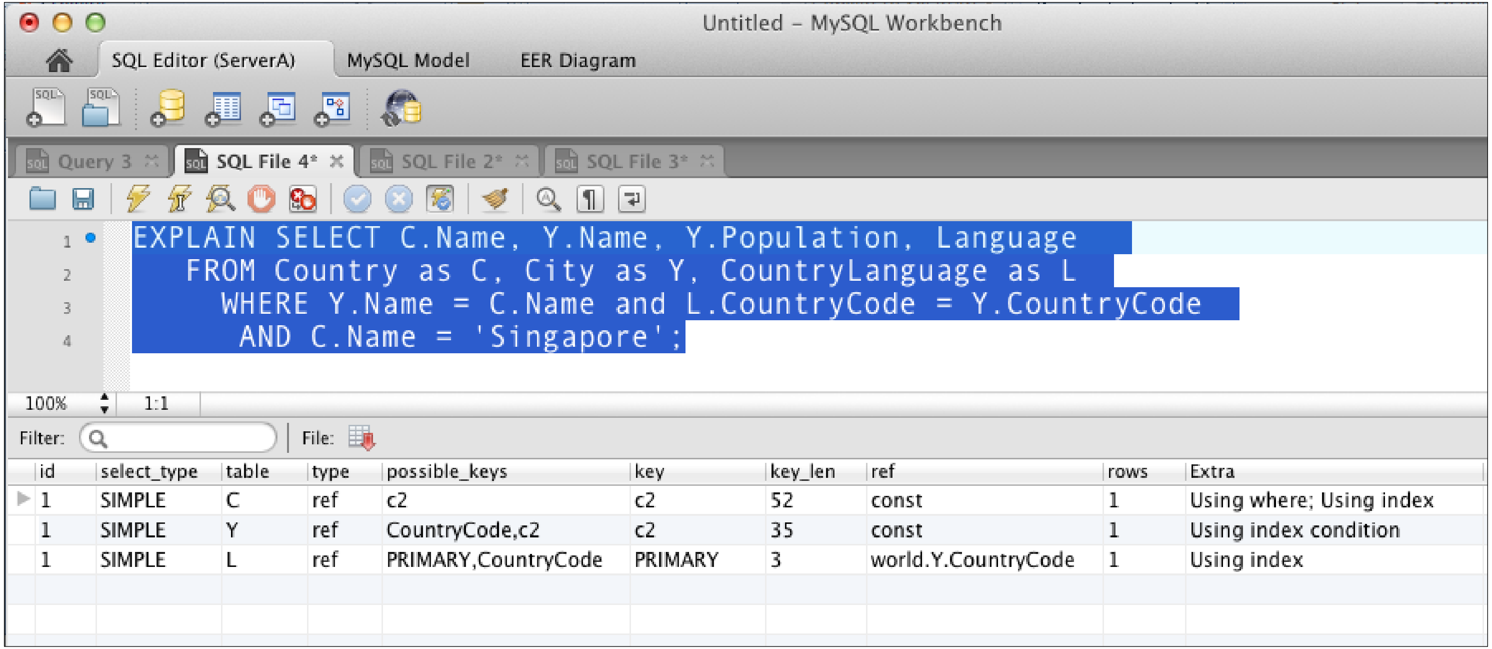
Add Index



```
alter table City add index c2 (Name) ;
alter table Country add index c2 (Name) ;
```

Optimized

- **The original cost was 239 * 4145 * 1 = 990,655**
- **The new cost is 1 * 1 * 1 = *1***



```
EXPLAIN SELECT C.Name, Y.Name, Y.Population, Language
   FROM Country as C, City as Y, CountryLanguage as L
     WHERE Y.Name = C.Name and L.CountryCode = Y.CountryCode
      AND C.Name = 'Singapore';
```

id	select_type	table	type	possible_keys	key	key_len	ref	rows	Extra
1	SIMPLE	C	ref	c2	c2	52	const	1	Using where; Using index
1	SIMPLE	Y	ref	CountryCode,c2	c2	35	const	1	Using index condition
1	SIMPLE	L	ref	PRIMARY,CountryCode	PRIMARY	3	world.Y.CountryCode	1	Using index

Type Column

Access or Join Types

Positive

- eq ref – unique key/primary to reference value
- const, system –turn part of query into constant
- Null – table or index not even accessed
- ref – match single value, non-unique index, ref_or_null = possible extra step
- range – WHERE .. BETWEEN, >

Possible Issue

- ALL table scan (depends on table size)
- INDEX (unless “using Index in EXTRA column”

http://dev.mysql.com/doc/refman/5.6/en/explain-output.htm

Extra Column

Positive

- Using Index
- Using index for group by

Possible Issue

- Using temporary
- Using filesort
- Using Where
  - Good – Using Index

http://dev.mysql.com/doc/refman/5.6/en/explain-output.html#explain-extra-information

MySQL Performance Schema

Performance Schema -- Configuration

- Enabling/Disabling Performance Schema
  - Within my.cnf add:

```
[mysqld]
performance_schema=on
```

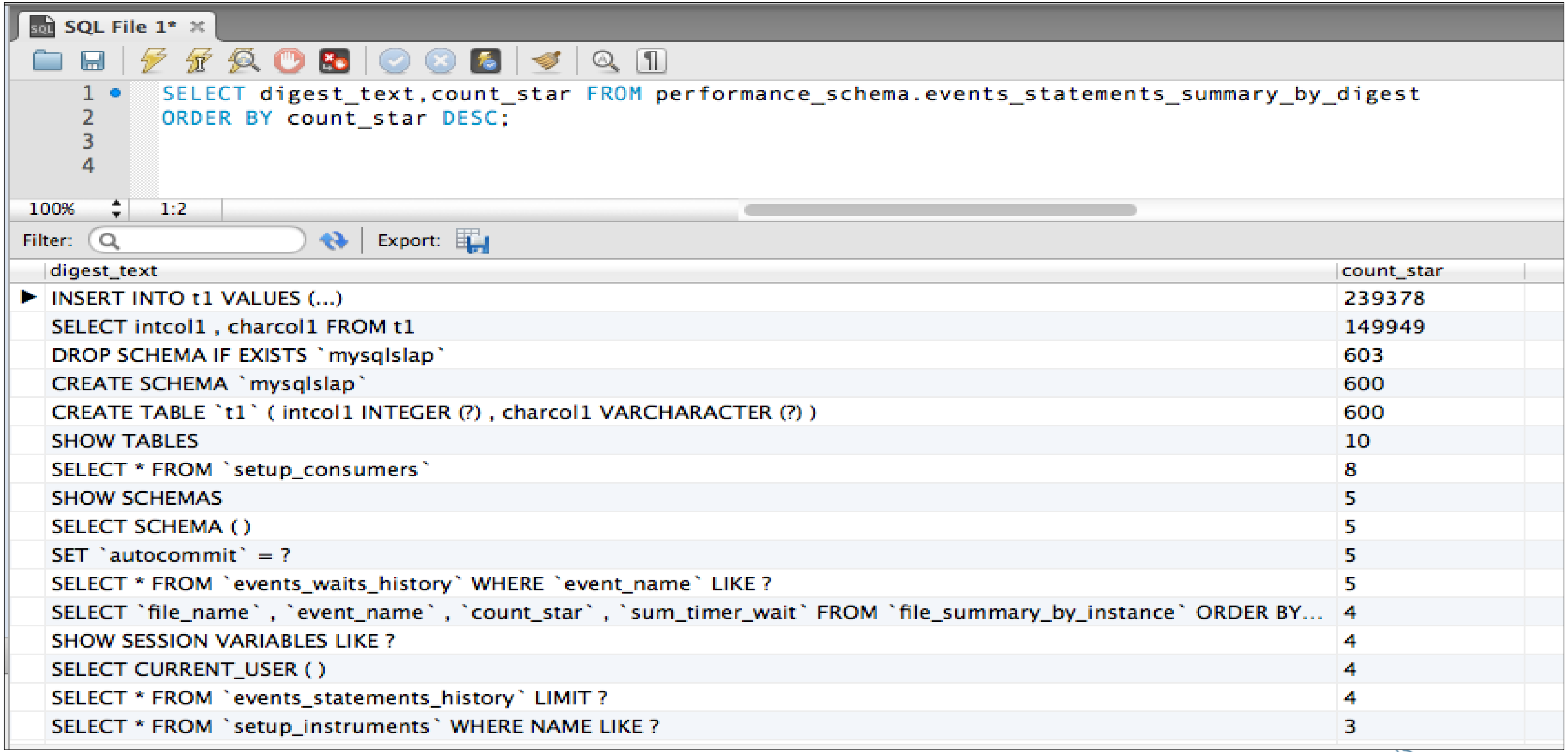
- Enable individual Instruments:
  - Within my.cnf add:

```
[mysqld]
--performance_schema_instrument='wait/synch/cond/%=counted’
```

    - off/false/0 = Disabled
    - on/true/1 = Enabled & Timed
    - counted = Enabled & Counted, rather than Timed

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

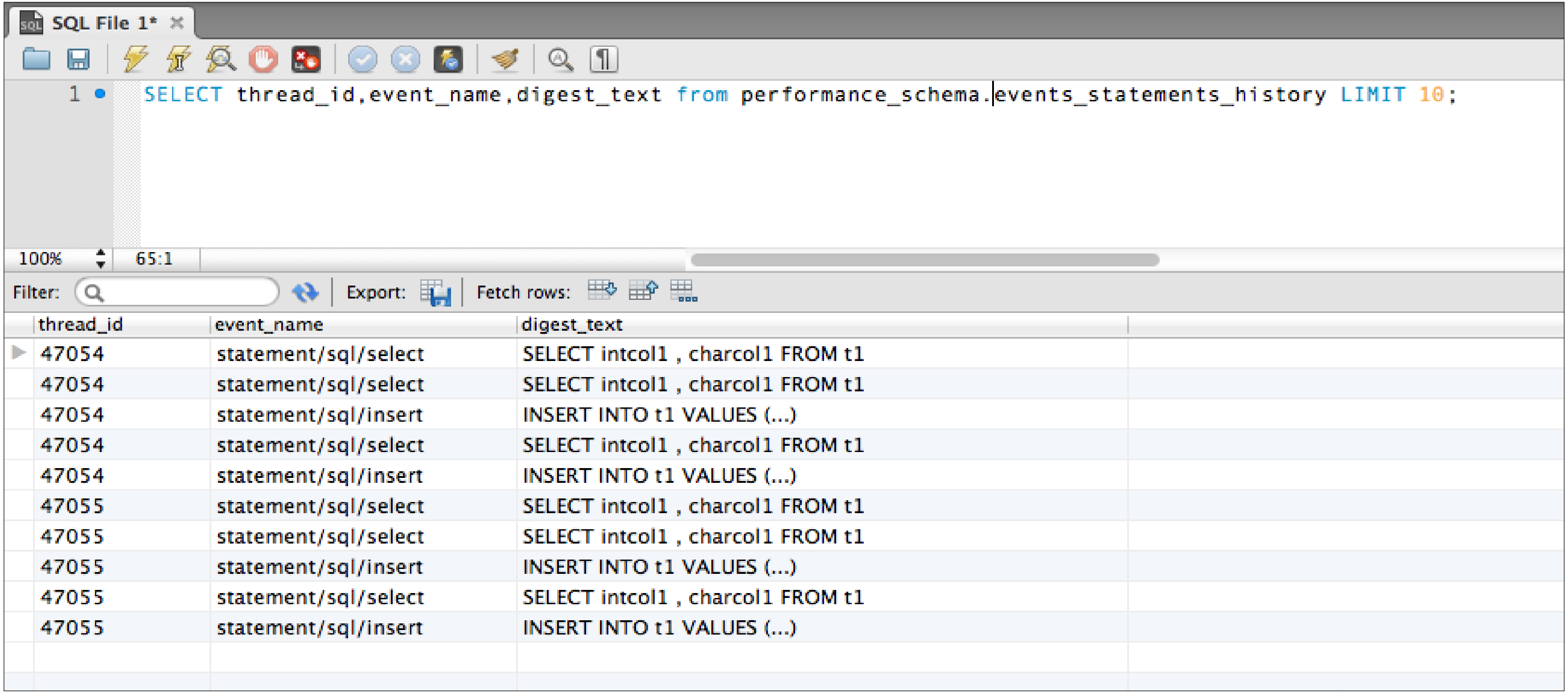
Most Common Queries



```sql
SELECT digest_text,count_star FROM performance_schema.events_statements_summary_by_digest
ORDER BY count_star DESC;
```

digest_text	count_star
INSERT INTO t1 VALUES (...)	239378
SELECT intcol1 , charcol1 FROM t1	149949
DROP SCHEMA IF EXISTS `mysqlslap`	603
CREATE SCHEMA `mysqlslap`	600
CREATE TABLE `t1` (intcol1 INTEGER (?) , charcol1 VARCHARACTER (?))	600
SHOW TABLES	10
SELECT * FROM `setup_consumers`	8
SHOW SCHEMAS	5
SELECT SCHEMA ( )	5
SET `autocommit` = ?	5
SELECT * FROM `events_waits_history` WHERE `event_name` LIKE ?	5
SELECT `file_name` , `event_name` , `count_star` , `sum_timer_wait` FROM `file_summary_by_instance` ORDER BY...	4
SHOW SESSION VARIABLES LIKE ?	4
SELECT CURRENT_USER ( )	4
SELECT * FROM `events_statements_history` LIMIT ?	4
SELECT * FROM `setup_instruments` WHERE NAME LIKE ?	3

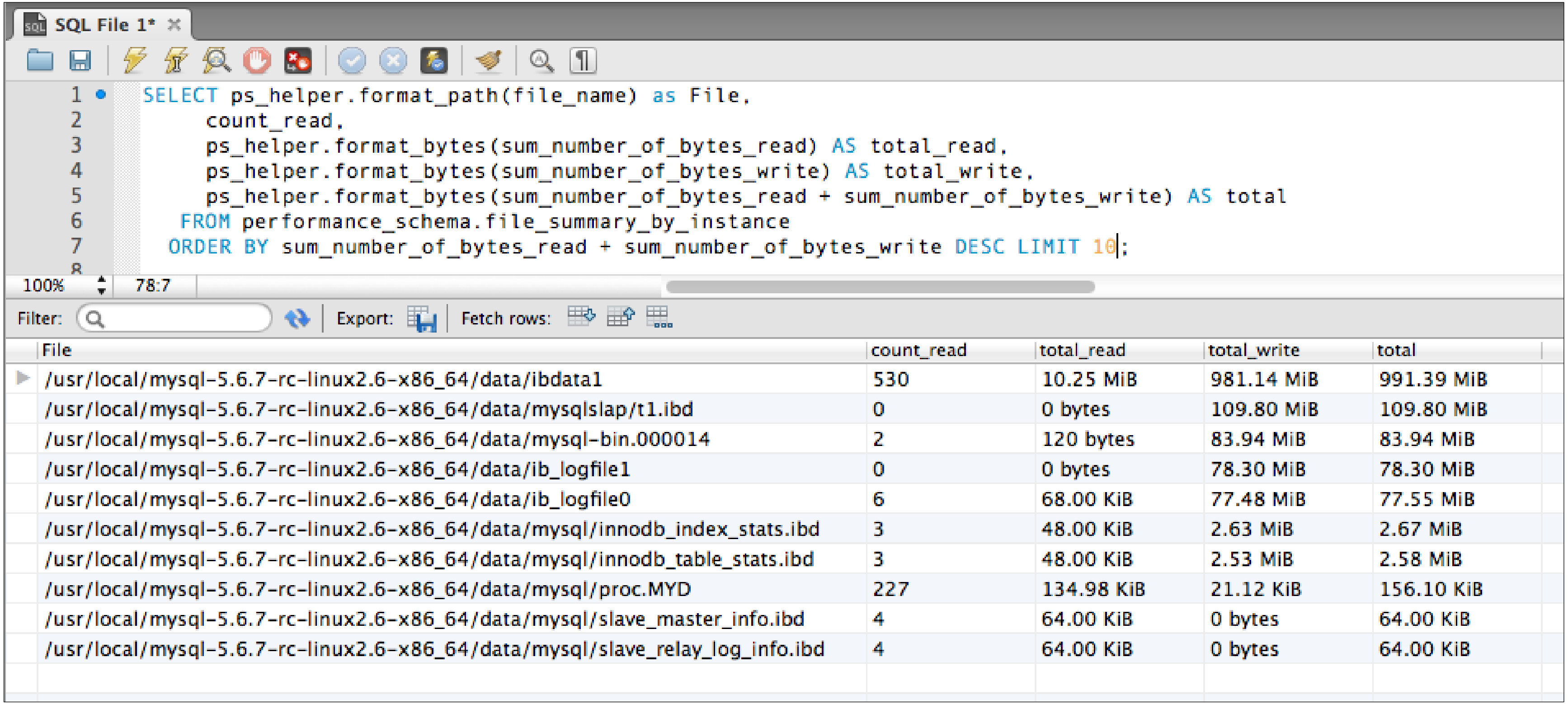
Last 10 Statements



```
SELECT thread_id,event_name,digest_text from performance_schema.events_statements_history LIMIT 10;
```

thread_id	event_name	digest_text
47054	statement/sql/select	SELECT intcol1 , charcol1 FROM t1
47054	statement/sql/select	SELECT intcol1 , charcol1 FROM t1
47054	statement/sql/insert	INSERT INTO t1 VALUES (...)
47054	statement/sql/select	SELECT intcol1 , charcol1 FROM t1
47054	statement/sql/insert	INSERT INTO t1 VALUES (...)
47055	statement/sql/select	SELECT intcol1 , charcol1 FROM t1
47055	statement/sql/select	SELECT intcol1 , charcol1 FROM t1
47055	statement/sql/insert	INSERT INTO t1 VALUES (...)
47055	statement/sql/select	SELECT intcol1 , charcol1 FROM t1
47055	statement/sql/insert	INSERT INTO t1 VALUES (...)

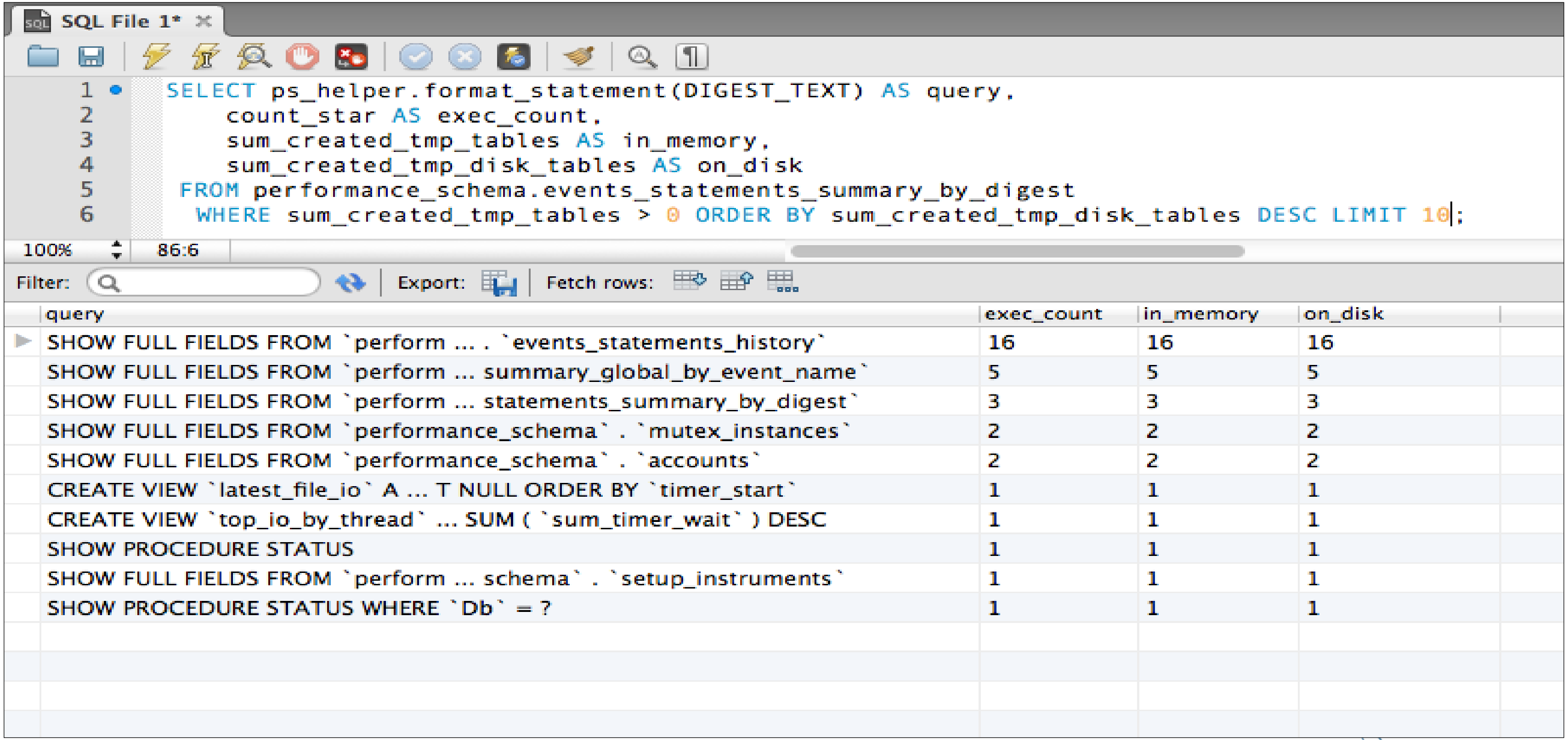
Files by File I/O



```
SELECT ps_helper.format_path(file_name) as File,
     count_read,
     ps_helper.format_bytes(sum_number_of_bytes_read) AS total_read,
     ps_helper.format_bytes(sum_number_of_bytes_write) AS total_write,
     ps_helper.format_bytes(sum_number_of_bytes_read + sum_number_of_bytes_write) AS total
   FROM performance_schema.file_summary_by_instance
  ORDER BY sum_number_of_bytes_read + sum_number_of_bytes_write DESC LIMIT 10;
```

File	count_read	total_read	total_write	total
/usr/local/mysql-5.6.7-rc-linux2.6-x86_64/data/ibdata1	530	10.25 MiB	981.14 MiB	991.39 MiB
/usr/local/mysql-5.6.7-rc-linux2.6-x86_64/data/mysqlslap/t1.ibd	0	0 bytes	109.80 MiB	109.80 MiB
/usr/local/mysql-5.6.7-rc-linux2.6-x86_64/data/mysql-bin.000014	2	120 bytes	83.94 MiB	83.94 MiB
/usr/local/mysql-5.6.7-rc-linux2.6-x86_64/data/ib_logfile1	0	0 bytes	78.30 MiB	78.30 MiB
/usr/local/mysql-5.6.7-rc-linux2.6-x86_64/data/ib_logfile0	6	68.00 KiB	77.48 MiB	77.55 MiB
/usr/local/mysql-5.6.7-rc-linux2.6-x86_64/data/mysql/innodb_index_stats.ibd	3	48.00 KiB	2.63 MiB	2.67 MiB
/usr/local/mysql-5.6.7-rc-linux2.6-x86_64/data/mysql/innodb_table_stats.ibd	3	48.00 KiB	2.53 MiB	2.58 MiB
/usr/local/mysql-5.6.7-rc-linux2.6-x86_64/data/mysql/proc.MYD	227	134.98 KiB	21.12 KiB	156.10 KiB
/usr/local/mysql-5.6.7-rc-linux2.6-x86_64/data/mysql/slave_master_info.ibd	4	64.00 KiB	0 bytes	64.00 KiB
/usr/local/mysql-5.6.7-rc-linux2.6-x86_64/data/mysql/slave_relay_log_info.ibd	4	64.00 KiB	0 bytes	64.00 KiB

Statements with Temporary Tables

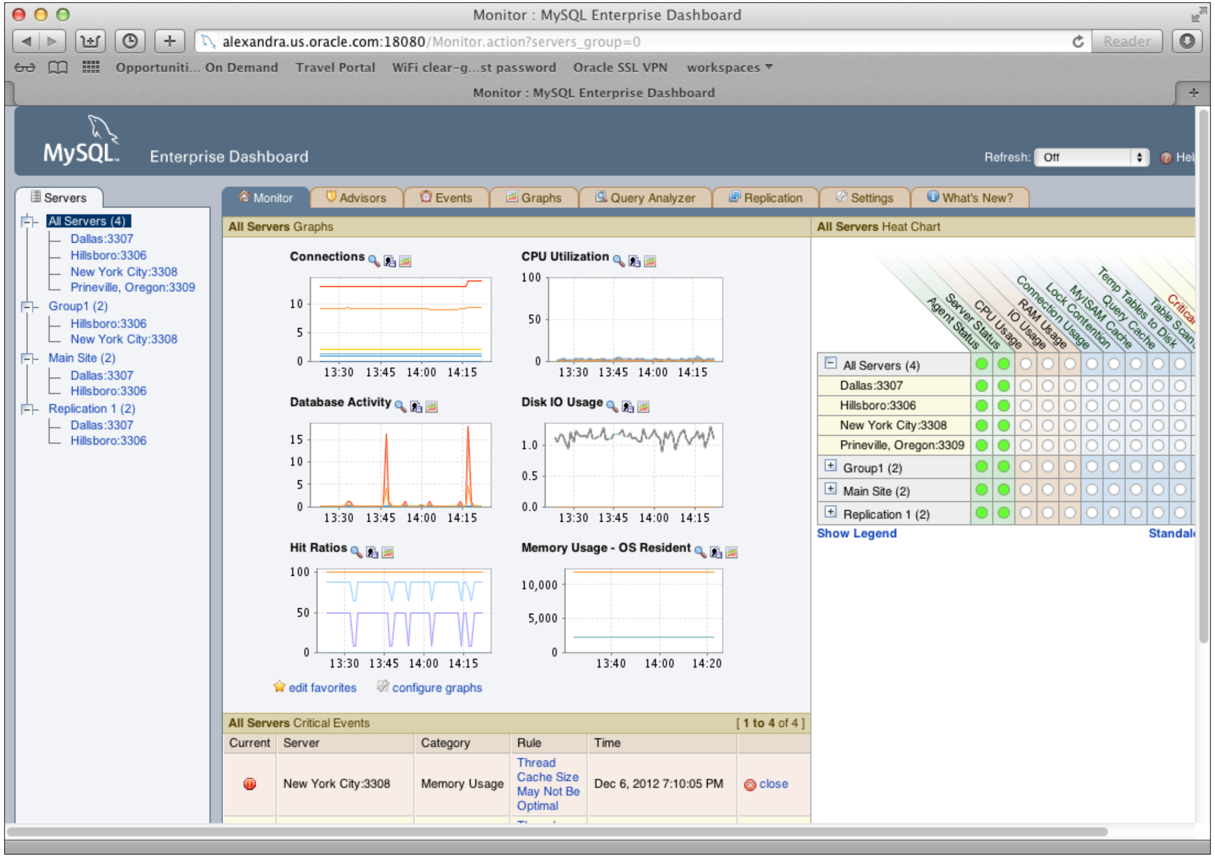


```
SELECT ps_helper.format_statement(DIGEST_TEXT) AS query,
    count_star AS exec_count,
    sum_created_tmp_tables AS in_memory,
    sum_created_tmp_disk_tables AS on_disk
 FROM performance_schema.events_statements_summary_by_digest
  WHERE sum_created_tmp_tables > 0 ORDER BY sum_created_tmp_disk_tables DESC LIMIT 10;
```

query	exec_count	in_memory	on_disk
SHOW FULL FIELDS FROM `perform ... . `events_statements_history`	16	16	16
SHOW FULL FIELDS FROM `perform ... summary_global_by_event_name`	5	5	5
SHOW FULL FIELDS FROM `perform ... statements_summary_by_digest`	3	3	3
SHOW FULL FIELDS FROM `performance_schema` . `mutex_instances`	2	2	2
SHOW FULL FIELDS FROM `performance_schema` . `accounts`	2	2	2
CREATE VIEW `latest_file_io` A ... T NULL ORDER BY `timer_start`	1	1	1
CREATE VIEW `top_io_by_thread` ... SUM (`sum_timer_wait`) DESC	1	1	1
SHOW PROCEDURE STATUS	1	1	1
SHOW FULL FIELDS FROM `perform ... schema` . `setup_instruments`	1	1	1
SHOW PROCEDURE STATUS WHERE `Db` = ?	1	1	1

MySQL Enterprise Monitor

Global Tuning Advisor



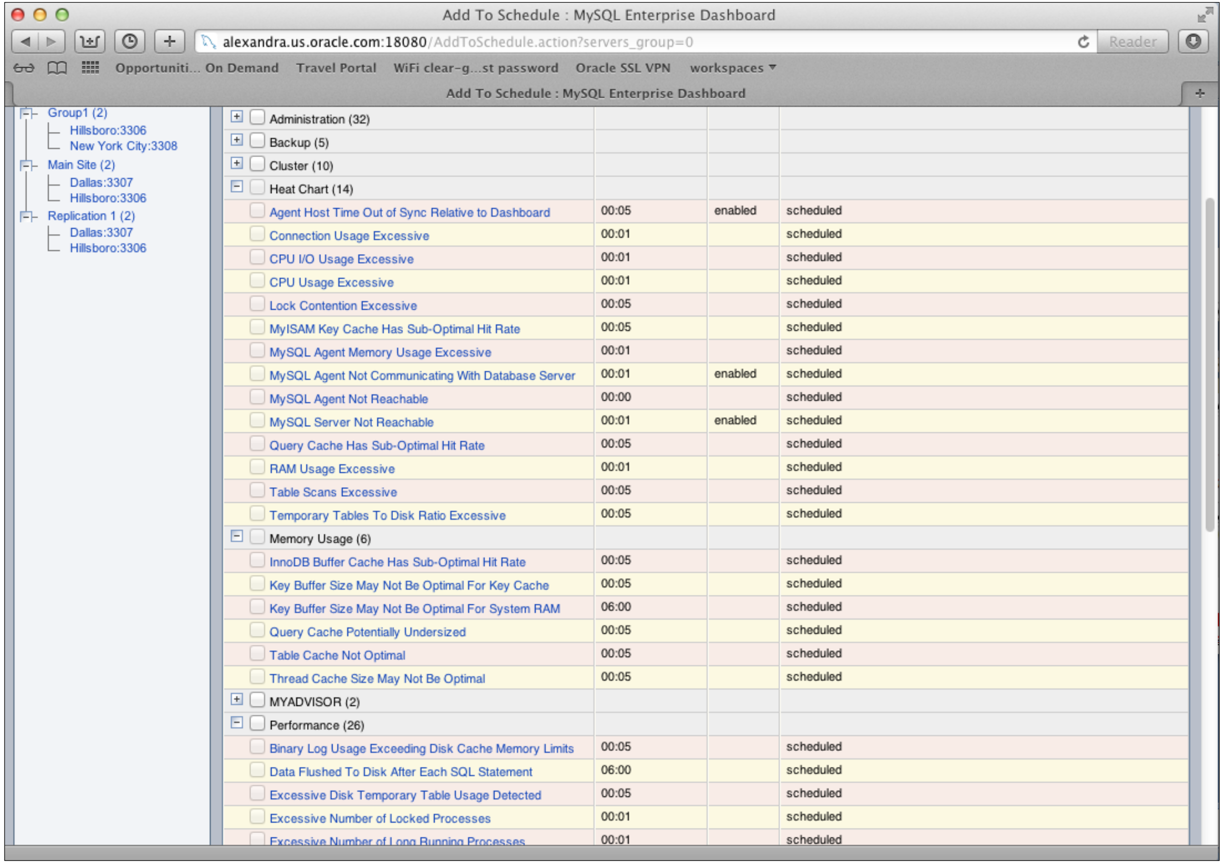
	Agent Status	Server Status	CPU Usage	IO Usage	RAM Usage	Connection Usage	Lock Contention	MyISAM Cache	Query Cache	Temp Tables to Disk
⊟ All Servers (4)	●	●	○	○	○	○	○	○	○	○
Dallas:3307	●	●	○	○	○	○	○	○	○	○
Hillsboro:3306	●	●	○	○	○	○	○	○	○	○
New York City:3308	●	●	○	○	○	○	○	○	○	○
Prineville, Oregon:3309	●	●	○	○	○	○	○	○	○	○
⊞ Group1 (2)	●	●	○	○	○	○	○	○	○	○
⊞ Main Site (2)	●	●	○	○	○	○	○	○	○	○
⊞ Replication 1 (2)	●	●	○	○	○	○	○	○	○	○

Table Scan
Critica

All Servers Critical Events [1 to 4 of 4]

Current	Server	Category	Rule	Time	
●	New York City:3308	Memory Usage	Thread Cache Size May Not Be Optimal	Dec 6, 2012 7:10:05 PM	⊗ close

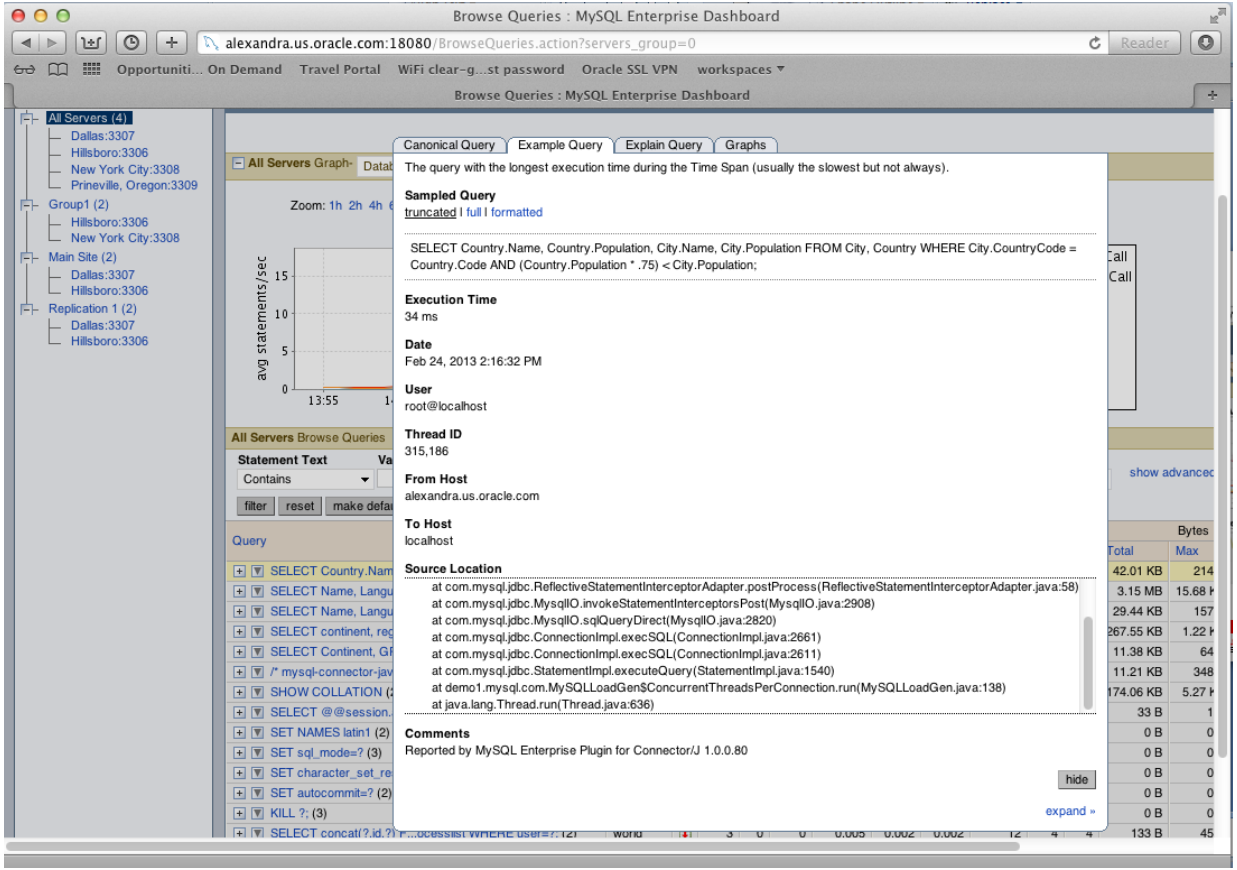
Automated Rules


Add To Schedule : MySQL Enterprise Dashboard
alexandra.us.oracle.com:18080/AddToSchedule.action?servers_group=0
Reader
Opportuniti... On Demand
Travel Portal
WiFi clear–g...st password
Oracle SSL VPN
workspaces
Add To Schedule : MySQL Enterprise Dashboard

- Group1 (2)
  - Hillsboro:3306
  - New York City:3308
- Main Site (2)
  - Dallas:3307
  - Hillsboro:3306
- Replication 1 (2)
  - Dallas:3307
  - Hillsboro:3306

⊞ □ Administration (32)			
⊞ □ Backup (5)			
⊞ □ Cluster (10)			
⊟ □ Heat Chart (14)			
□ Agent Host Time Out of Sync Relative to Dashboard	00:05	enabled	scheduled
□ Connection Usage Excessive	00:01		scheduled
□ CPU I/O Usage Excessive	00:01		scheduled
□ CPU Usage Excessive	00:01		scheduled
□ Lock Contention Excessive	00:05		scheduled
□ MyISAM Key Cache Has Sub-Optimal Hit Rate	00:05		scheduled
□ MySQL Agent Memory Usage Excessive	00:01		scheduled
□ MySQL Agent Not Communicating With Database Server	00:01	enabled	scheduled
□ MySQL Agent Not Reachable	00:00		scheduled
□ MySQL Server Not Reachable	00:01	enabled	scheduled
□ Query Cache Has Sub-Optimal Hit Rate	00:05		scheduled
□ RAM Usage Excessive	00:01		scheduled
□ Table Scans Excessive	00:05		scheduled
□ Temporary Tables To Disk Ratio Excessive	00:05		scheduled
⊟ □ Memory Usage (6)			
□ InnoDB Buffer Cache Has Sub-Optimal Hit Rate	00:05		scheduled
□ Key Buffer Size May Not Be Optimal For Key Cache	00:05		scheduled
□ Key Buffer Size May Not Be Optimal For System RAM	06:00		scheduled
□ Query Cache Potentially Undersized	00:05		scheduled
□ Table Cache Not Optimal	00:05		scheduled
□ Thread Cache Size May Not Be Optimal	00:05		scheduled
⊞ □ MYADVISOR (2)			
⊟ □ Performance (26)			
□ Binary Log Usage Exceeding Disk Cache Memory Limits	00:05		scheduled
□ Data Flushed To Disk After Each SQL Statement	06:00		scheduled
□ Excessive Disk Temporary Table Usage Detected	00:05		scheduled
□ Excessive Number of Locked Processes	00:01		scheduled
□ Excessive Number of Long Running Processes	00:01		scheduled

Query Analyzer



The query with the longest execution time during the Time Span (usually the slowest but not always).

Sampled Query

truncated | full | formatted

```
SELECT Country.Name, Country.Population, City.Name, City.Population FROM City, Country WHERE City.CountryCode =
Country.Code AND (Country.Population * .75) < City.Population;
```

Execution Time
34 ms

Date
Feb 24, 2013 2:16:32 PM

User
root@localhost

Thread ID
315,186

From Host
alexandra.us.oracle.com

To Host
localhost

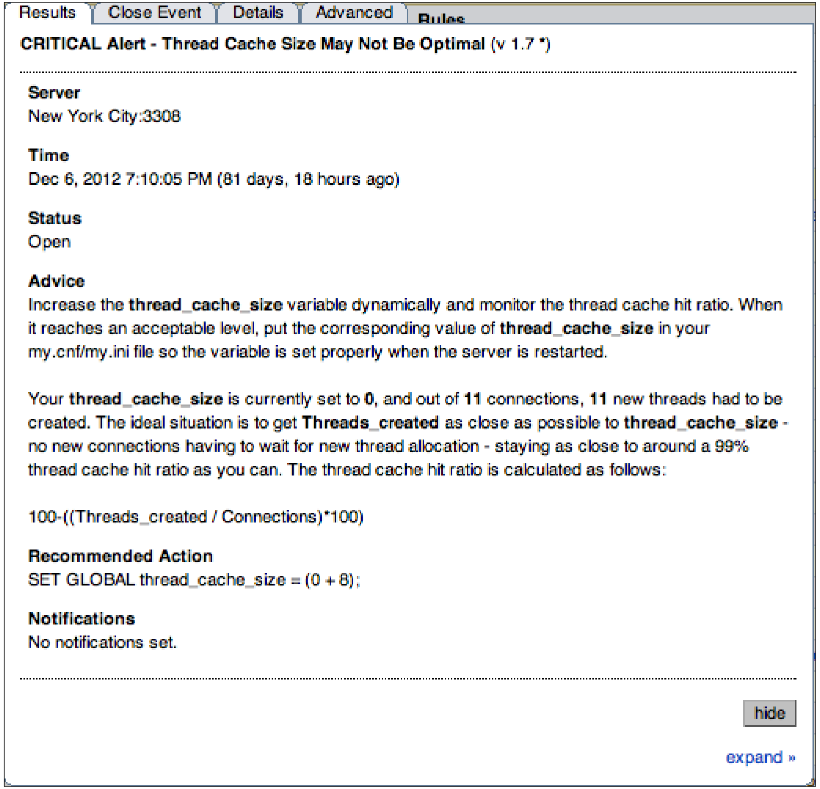
Source Location

```
at com.mysql.jdbc.ReflectiveStatementInterceptorAdapter.postProcess(ReflectiveStatementInterceptorAdapter.java:58)
at com.mysql.jdbc.MysqlIO.invokeStatementInterceptorsPost(MysqlIO.java:2908)
at com.mysql.jdbc.MysqlIO.sqlQueryDirect(MysqlIO.java:2820)
at com.mysql.jdbc.ConnectionImpl.execSQL(ConnectionImpl.java:2661)
at com.mysql.jdbc.ConnectionImpl.execSQL(ConnectionImpl.java:2611)
at com.mysql.jdbc.StatementImpl.executeQuery(StatementImpl.java:1540)
at demo1.mysql.com.MySQLLoadGen$ConcurrentThreadsPerConnection.run(MySQLLoadGen.java:138)
at java.lang.Thread.run(Thread.java:636)
```

Comments
Reported by MySQL Enterprise Plugin for Connector/J 1.0.0.80

Query	Bytes Total	Bytes Max
SELECT Country.Nam	42.01 KB	214
SELECT Name, Langu	3.15 MB	15.68 K
SELECT Name, Langu	29.44 KB	157
SELECT continent, reg	267.55 KB	1.22 K
SELECT Continent, GI	11.38 KB	64
/* mysql-connector-jav	11.21 KB	348
SHOW COLLATION (2	174.06 KB	5.27 K
SELECT @@session.	33 B	1
SET NAMES latin1 (2)	0 B	0
SET sql_mode=? (3)	0 B	0
SET character_set_re	0 B	0
SET autocommit=? (2)	0 B	0
KILL ?; (3)	0 B	0
SELECT concat(?.id,?) F...ocesslist WHERE user=?; (2)	133 B	45

Specific Tuning Advice



CRITICAL Alert - Thread Cache Size May Not Be Optimal (v 1.7 *)

Server
New York City:3308

Time
Dec 6, 2012 7:10:05 PM (81 days, 18 hours ago)

Status
Open

Advice
Increase the **thread_cache_size** variable dynamically and monitor the thread cache hit ratio. When it reaches an acceptable level, put the corresponding value of **thread_cache_size** in your my.cnf/my.ini file so the variable is set properly when the server is restarted.

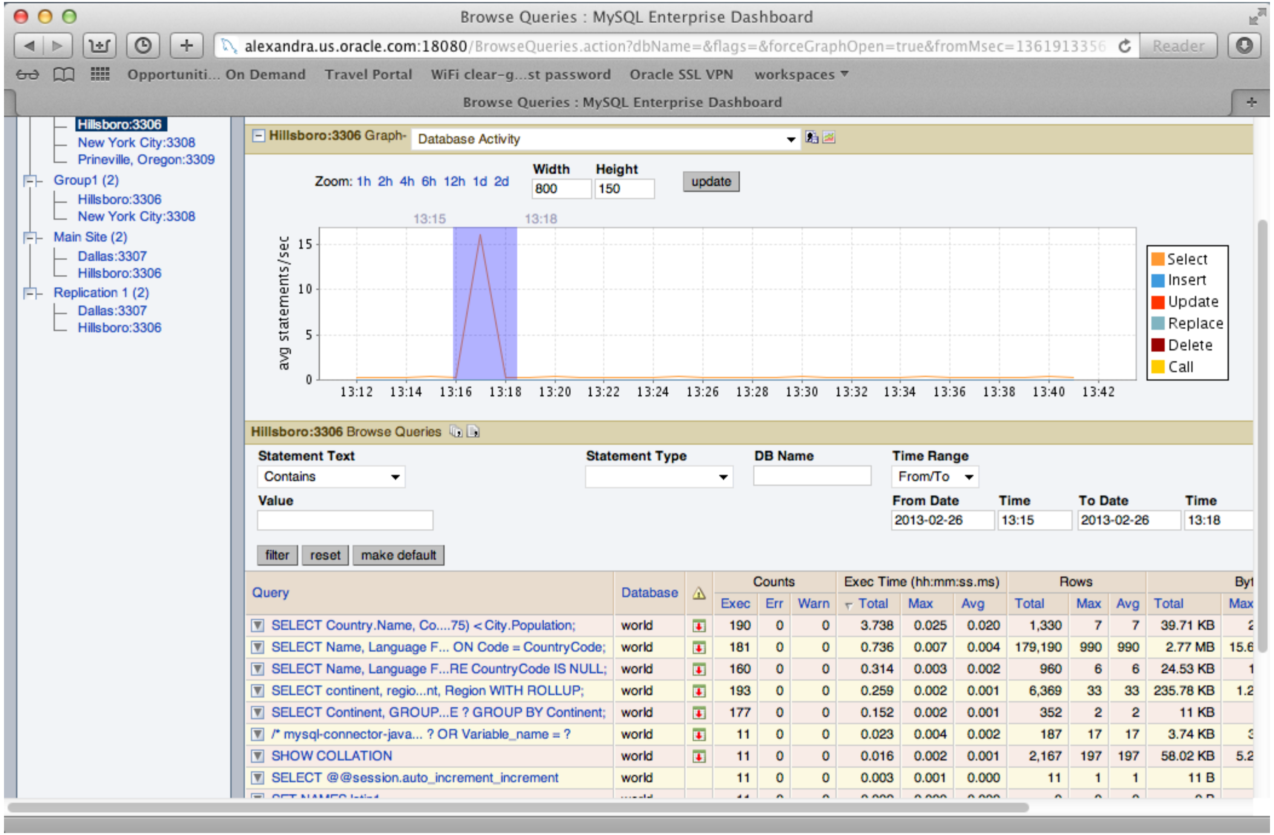
Your **thread_cache_size** is currently set to **0**, and out of **11** connections, **11** new threads had to be created. The ideal situation is to get **Threads_created** as close as possible to **thread_cache_size** - no new connections having to wait for new thread allocation - staying as close to around a 99% thread cache hit ratio as you can. The thread cache hit ratio is calculated as follows:

100-((Threads_created / Connections)*100)

Recommended Action
SET GLOBAL thread_cache_size = (0 + 8);

Notifications
No notifications set.

Correlation to Queries



Statement Text: Contains

Value:

Statement Type:

DB Name:

Time Range: From/To

From Date: 2013-02-26 Time: 13:15

To Date: 2013-02-26 Time: 13:18

filter | reset | make default

Query	Database	⚠	Counts			Exec Time (hh:mm:ss.ms)			Rows			Byt	
			Exec	Err	Warn	Total	Max	Avg	Total	Max	Avg	Total	Max
SELECT Country.Name, Co....75) < City.Population;	world	⬇	190	0	0	3.738	0.025	0.020	1,330	7	7	39.71 KB	2
SELECT Name, Language F... ON Code = CountryCode;	world	⬇	181	0	0	0.736	0.007	0.004	179,190	990	990	2.77 MB	15.6
SELECT Name, Language F...RE CountryCode IS NULL;	world	⬇	160	0	0	0.314	0.003	0.002	960	6	6	24.53 KB	1
SELECT continent, regio...nt, Region WITH ROLLUP;	world	⬇	193	0	0	0.259	0.002	0.001	6,369	33	33	235.78 KB	1.2
SELECT Continent, GROUP...E ? GROUP BY Continent;	world	⬇	177	0	0	0.152	0.002	0.001	352	2	2	11 KB	
/* mysql-connector-java... ? OR Variable_name = ?	world	⬇	11	0	0	0.023	0.004	0.002	187	17	17	3.74 KB	3
SHOW COLLATION	world	⬇	11	0	0	0.016	0.002	0.001	2,167	197	197	58.02 KB	5.2
SELECT @@session.auto_increment_increment	world		11	0	0	0.003	0.001	0.000	11	1	1	11 B	

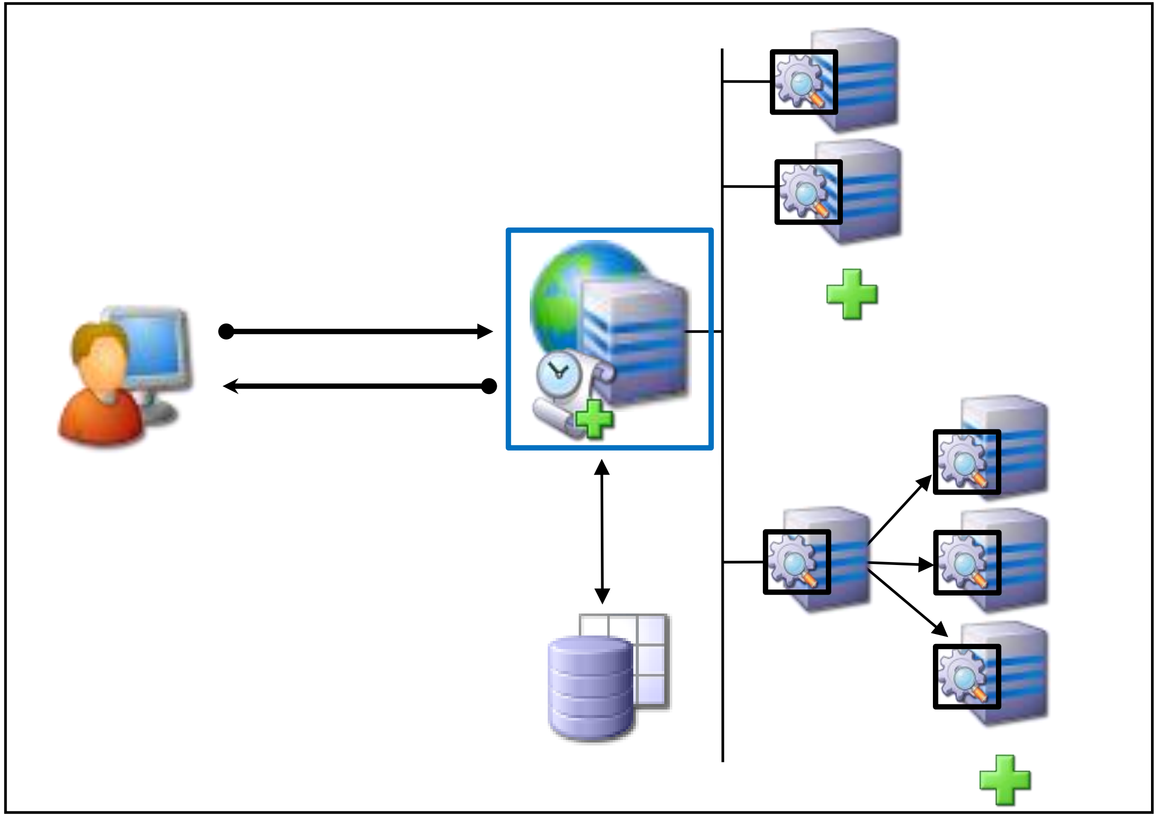
Enterprise Monitor Architecture

Agent

Service Manager

Enterprise Dashboard

Repository



Summary

- Basics: Hardware, Storage Engines and Versions
- Server Tuning
- Index, Query and Schema Optimization
- MySQL Performance Schema Introduction
- MySQL Enterprise Monitor and Query Analyzer

Resources

- MySQL Training Course – MySQL Performance Tuning

  http://education.oracle.com/pls/web_prod-plq-dad/ou_product_category.getPage?p_cat_id=159

- View Performance Tuning Webinars
  – http://www.mysql.com/news-and-events/on-demand-webinars/
- MySQL Performance Forum
  – http://forums.mysql.com/list.php?24
- Download MySQL 5.6
  – http://www.mysql.com/downloads/mysql/
- Try MySQL Enterprise Monitor:
  – http://www.mysql.com/trials/

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