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Making the Performance Schema Easier to Use

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Program Agenda

- Introduction, configuration, formatting
- Slow Queries
- Disk I/O
- The Schema
- MySQL 5.7

Introduction

events_stages_current

events_statements_current

events_waits_current

Terminology

What is what?

- Instruments – the instrumentation points in the source code. What we measure.
- Consumers – what uses the measurements
- Actors – the user@host combinations – who will be instrumented
- Objects – the objects being instrumented. In 5.6 this is only tables – more about 5.7 later.

What's the Problem?

There is so much information

- 52 Performance Schema tables in MySQL 5.6
 - 64 tables in MySQL 5.7.2
- 553 instruments in MySQL 5.6
 - 775 instruments in MySQL 5.7.2
- Need to change settings for tests
- Even more related data in the Information Schema

Toolkits

ps_helper and ps_tools

- ps_helper by Mark Leith
 - http://www.markleith.co.uk/ps_helper/
 - <https://github.com/MarkLeith/dbahelper>
- ps_tools by Jesper Krogh
 - <http://mysql.wisborg.dk/>

Which Consumers are Enabled?

Problem

- The consumes form a hierarchy.
- Not enough just to look at the ENABLED column.

```
mysql> SELECT mysql* FROM setup_consumers;
```

NAME	ENABLED
events_stages_current	NO
events_stages_history	NO
events_stages_history_long	NO
events_statements_current	YES
events_statements_history	NO
events_statements_history_long	NO
events_waits_current	NO
events_waits_history	NO
events_waits_history_long	NO
global_instrumentation	NO
thread_instrumentation	YES
statements_digest	YES

12 rows in set (0.00 sec)

Which Consumers are Enabled?

Solution

- ps_setup_consumers
- Includes whether the consumer is effectively enabled

```
mysql> SELECT * FROM ps_tools.ps_setup_consumers;
```

NAME	ENABLED	COLLECTS
events_stages_current	NO	NO
events_stages_history	NO	NO
events_stages_history_long	NO	NO
events_statements_current	YES	NO
events_statements_history	NO	NO
events_statements_history_long	NO	NO
events_waits_current	NO	NO
events_waits_history	NO	NO
events_waits_history_long	NO	NO
global_instrumentation	YES	NO
thread_instrumentation	YES	NO
statements_digest	YES	NO

```
12 rows in set (0.08 sec)
```

Which Consumers are Enabled?

ps_tools.ps_setup_tree_consumers

```
MySQL 5.6$ echo -e "$(mysql -Ee "CALL ps_tools.ps_setup_tree_consumers('Text: Left-Right', TRUE)")"
***** 1. row *****
```

Consumers:

```

      +--statements_digest
      |
global_instrumentation-- +
      |
      +--thread_instrumentation-- +--events_stages_current-----+
                                  |
                                  +--events_stages_history
                                  |
                                  +--events_stages_history_long
                                  |
                                  +--events_statements_history
                                  |
                                  +--events_statements_history_long
                                  |
                                  +--events_statements_current-- +
                                  |
                                  +--events_waits_history
                                  |
                                  +--events_waits_current-----+
                                  |
                                  +--events_waits_history_long
```

Legend: Enabled - Partially enabled - Disabled

Temporarily Changing Configuration

Problem

- You need to investigate issue
- Default configuration doesn't work for the investigation
- Can't enable all consumers and instruments permanently

```
mysql> SHOW TABLES LIKE 'setup%';
+-----+
| Tables_in_performance_schema (setup%) |
+-----+
| setup_actors                          |
| setup_consumers                      |
| setup_instruments                    |
| setup_objects                       |
| setup_timers                         |
+-----+
5 rows in set (0.00 sec)
```

Temporarily Changing Configuration

Solution

- `save_current_config()`
- `reload_saved_config()`
- `reset_to_default()`

- `truncate_all()`
- `ps_enable_all()`

```
mysql> CALL ps_helper.save_current_config();  
Query OK, 22 rows affected (0.05 sec)
```

```
mysql> -- Perform investigation
```

```
mysql> -- ...
```

```
mysql> -- ...
```

```
mysql> -- ...
```

```
mysql> CALL ps_helper.reload_saved_config();  
Query OK, 0 rows affected (0.09 sec)
```

```
mysql> CALL ps_helper.reset_to_default(FALSE);  
Query OK, 0 rows affected (0.02 sec)
```

Other Configuration Tools

Views, functions, and procedures in `ps_helper` and `ps_tools`

- Setup trees for instruments and account
 - Challenge with instruments is that there are so many of them
- View to see which accounts are enabled
- Overview of all setups with `ps_helper.currently_enabled()`
- Functions used by the views and procedures
- Procedures to enable all or reset the settings
- And more

Difficult to Read Output

Problem

- Timings are in picoseconds
- Data amounts are in bytes
- Raw file paths

```
mysql> SELECT FILE_NAME, SUM_TIMER_WAIT, SUM_NUMBER_OF_BYTES_WRITE  
-> FROM performance_schema.file_summary_by_instance  
-> WHERE FILE_NAME LIKE '%/ib%' OR FILE_NAME LIKE '%/undo%';
```

FILE_NAME	SUM_TIMER_WAIT	SUM_NUMBER_OF_BYTES_WRITE
/usr/lib/mysql/ibdata1	141803307158700	1807253504
/usr/lib/mysql/ib_logfile0	97061981943804	1049455104
/usr/lib/mysql/ib_logfile1	87922084229676	1039093760
/usr/lib/mysql/undo001	10825580464008	234913792
/usr/lib/mysql/undo002	12975218983032	333463552
/usr/lib/mysql/undo003	12969475543332	272220160
/usr/lib/mysql/undo004	8615489076588	214679552

7 rows in set (0.00 sec)

Difficult to Read Output

Solution

- `format_bytes()`
- `format_path()`
- `format_statement()`
- `format_time()`

```
mysql> SELECT format_path(FILE_NAME) AS FILE_NAME,  
->          format_time(SUM_TIMER_WAIT) AS SUM_TIMER_WAIT,  
->          format_bytes(SUM_NUMBER_OF_BYTES_WRITE) AS SUM_NUMBER_OF_BYTES_WRITE  
-> FROM performance_schema.file_summary_by_instance  
-> WHERE FILE_NAME LIKE '%/ib%' OR FILE_NAME LIKE '%/undo%';
```

FILE_NAME	SUM_TIMER_WAIT	SUM_NUMBER_OF_BYTES_WRITE
@@datadir/ibdata1	00:02:21.83	1.68 GiB
@@datadir/ib_logfile0	00:01:37.07	1000.84 MiB
@@datadir/ib_logfile1	00:01:27.93	990.96 MiB
@@datadir/undo001	10.85 s	224.05 MiB
@@datadir/undo002	12.98 s	318.02 MiB
@@datadir/undo003	12.97 s	259.61 MiB
@@datadir/undo004	8.62 s	204.73 MiB

7 rows in set (0.00 sec)

Slow Queries

{com.mysql.ertools.inventory.model}

Topic: Average Statement Execution Time Excessive

Categories: Query Analysis

Current State: Open

Auto-Closes by Default: No

Advisor: Average Statement Ex

Current Status: Critical

Last Checked: Sep 16, 2013 2:

Notes:

No notes provided.

Details:

Problem Description

Under normal circumstances, most SQL statements should execute very quickly. Statements th
properly.

Advice

Investigate why the average execution time for the SQL statements shown below exceeds the

Critical Problem Queries (exceed 5,000 milliseconds):

Avg Exec Time	Exec Count	# Warnings
5,501,965	10	0

Warning Problem Queries (exceed 1,000 milliseconds):

Avg Exec Time	Exec Count	# Warnings
There are no warning problem queries at this time		

Notice Problem Queries (exceed 500 milliseconds):

Avg Exec Time	Exec Count	# Warnings
There are no notice problem queries at this time		

Links and Further Reading

- MySQL Manual: Optimization
- MySQL Manual: Optimizing Queries with EXPLAIN
- MySQL Manual: Optimizing InnoDB Queries
- Article: Three easy ways to optimize your MySQL queries
- Article: Optimizing MySQL: Queries and Indexes

Slow Queries

Problem

- Which queries are the slowest?
- Queries using temp tables
- Queries using sorts

```
mysql> SELECT SLEEP(3600);
+-----+
| SLEEP(3600) |
+-----+
|          0 |
+-----+
1 row in set (1 hour 0.45 sec)
```

Slow Queries

Ways to investigate slow queries using the Performance Schema

- Performance Schema
 - events_statements_summary_by_digest
- ps_helper
 - statement_analysis
 - statements_with_full_table_scans
 - statements_with_runtimes_in_95th_percentile
 - statements_with_sorting
 - statements_with_temp_tables
- MySQL Enterprise Monitor (MEM) 3.0

Slow Queries

events_statements_summary_by_digest

```
mysql> SELECT * FROM events_statements_summary_by_digest WHERE SUM_NO_INDEX_USED > 0 ORDER BY COUNT_STAR DESC LIMIT 1\G
***** 1. row *****
      SCHEMA_NAME: NULL
      DIGEST: 14479431fde223bb5dacd2a638387f77
      DIGEST_TEXT: SELECT * FROM world . Country WHERE NAME = ?
      COUNT_STAR: 99011
      SUM_TIMER_WAIT: 438517737169000
      MIN_TIMER_WAIT: 1343021000
      AVG_TIMER_WAIT: 4428979000
      MAX_TIMER_WAIT: 865607292000
      SUM_LOCK_TIME: 12045571000000
      SUM_ERRORS: 0
      SUM_WARNINGS: 0
      SUM_ROWS_AFFECTED: 0
      SUM_ROWS_SENT: 99011
      SUM_ROWS_EXAMINED: 23663629
      SUM_CREATED_TMP_DISK_TABLES: 0
      SUM_CREATED_TMP_TABLES: 0
      SUM_SELECT_FULL_JOIN: 0
      SUM_SELECT_FULL_RANGE_JOIN: 0
      SUM_SELECT_RANGE: 0
      SUM_SELECT_RANGE_CHECK: 0
      SUM_SELECT_SCAN: 99011
      SUM_SORT_MERGE_PASSES: 0
      SUM_SORT_RANGE: 0
      SUM_SORT_ROWS: 0
      SUM_SORT_SCAN: 0
      SUM_NO_INDEX_USED: 99011
      SUM_NO_GOOD_INDEX_USED: 0
      FIRST_SEEN: 2013-09-18 14:08:31
      LAST_SEEN: 2013-09-18 14:19:02
1 row in set (0.00 sec)
```

Slow Queries

statements_with_runtimes_in_95th_percentile

```
mysql> SELECT query, full_scan, exec_count, total_latency, max_latency, avg_latency, rows_sent, rows_scanned FROM statements_with_runtimes_in_95th_percentile;
```

query	full_scan	exec_count	total_latency	max_latency	avg_latency	rows_sent	rows_scanned
UPDATE salaries SET salary = salary + ?		7	00:04:54.10	52.93 s	42.01 s	0	6790378
UPDATE salaries SET salary = salary - ?		6	00:04:07.63	46.33 s	41.27 s	0	5820324
SELECT dept_no , dept_name , C ... _name ORDER BY SUM (salary)	*	6	00:02:56.59	39.15 s	29.43 s	54	7194144
SELECT emp_no , CONCAT (first ... T ?) AS title FROM employees	*	7	00:02:58.73	27.94 s	25.53 s	2100168	7303492
SELECT emp_no , CONCAT (first ... mp_no) WHERE to_date IS NULL	*	7	00:02:16.03	33.41 s	19.43 s	0	5203324
UPDATE salaries SET salary = salary + ? WHERE emp_no = ?		32	00:08:04.28	21.76 s	15.13 s	0	510

6 rows in set (0.03 sec)

Slow Queries

statements_with_full_table_scans

```
mysql> SELECT * FROM statements_with_full_table_scans LIMIT 10;
```

query	exec_count	no_index count	no_good_index	no_index pct	rows_sent	rows_examined	digest
SELECT * FROM world . Country WHERE NAME = ?	99020	99020	0	100	99020	23665780	14479431fde223bb5dacd2a638387f77
SELECT * FROM world . City WHERE NAME = ?	10011	10011	0	100	9510	40844880	778effb2d46c27ab7d467118a294da23
SELECT CountryCode , COUNT (* ... d . City GROUP BY CountryCode	2117	2117	0	100	491144	8637360	4087795b9d7c9796e8a66ffa112100d9
SELECT CountryCode , District ... OUP BY CountryCode , District	2117	2117	0	100	2989204	14615768	6ff3a5d8d0255b080581d32833922ecb
SELECT Continent , COUNT (*) Country GROUP BY Continent	2117	2117	0	100	14819	535601	0e2f38fc78d24c54c76d2ec6a99f3988
SELECT CODE , Country . Name , ... ulation ORDER BY Urbanisation	2117	2117	0	100	491144	10125611	0827caa34618576c9083d9b7bd61e72c
SELECT * FROM film_list SELECT ... `sakila` . `film` . `film_id`	382	382	0	100	380854	9496902	940c73d5c680be65b338bc1070e6aaed
SELECT * FROM nicer_but_slower ... ` . `film` ON ((`sakila` ...	381	381	0	100	379857	9472041	11991a2c7eb5adeb6329f79ed561e3e5
SELECT film . film_id AS FID , ... or_id GROUP BY film . film_id	379	379	0	100	377863	9044456	d853ddd675478634a41922107a2644c7
SELECT film . film_id AS FID , ... or_id GROUP BY film . film_id	378	378	0	100	376866	9020592	2fcdcd137b3e7d5a2d8a060627bef2dc

```
10 rows in set (0.00 sec)
```

Slow Queries

statements_with_sorting

```
mysql> SELECT query, exec_count, avg_sort_merges, sorts_using_scans, sort_using_range, rows_sorted, avg_rows_sorted FROM statements_with_sorting LIMIT 10;
```

query	exec_count	sort_merge_passes	avg_sort_merges	sorts_using_scans	sort_using_range	rows_sorted	avg_rows_sorted
SELECT emp_no , CONCAT (first ... T ?) AS title FROM employees	7	2100168	300024	0	2100168	2100168	300024
SELECT CountryCode , District ... OUP BY CountryCode , District	2117	0	0	2117	0	2989204	1412
SELECT CODE , Country . Name , ... ulation ORDER BY Urbanisation	2117	0	0	2117	0	491144	232
SELECT Continent , COUNT (*) Country GROUP BY Continent	2117	0	0	2117	0	14819	7
SELECT * FROM film_list SELECT ... `sakila` . `film` . `film_id`	382	0	0	382	0	2086484	5462
SELECT * FROM nicer_but_slower ... ` . `film` ON ((`sakila` ...	381	0	0	381	0	2081022	5462
SELECT film . film_id AS FID , ... or_id GROUP BY film . film_id	379	0	0	379	0	2070098	5462
SELECT film . film_id AS FID , ... or_id GROUP BY film . film_id	378	0	0	378	0	2064636	5462
SELECT emp_no , first_name , l ... R BY TotalSalary DESC LIMIT ?	12	0	0	12	0	120	10
SELECT dept_no , dept_name , C ... _name ORDER BY SUM (salary)	6	0	0	12	0	108	18

```
10 rows in set (0.00 sec)
```

Slow Queries

statements_with_temp_tables

```
mysql> SELECT query, exec_count, memory_tmp_tables, disk_tmp_tables, avg_tmp_tables_per_query, tmp_tables_to_disk_pct FROM statements_with_temp_tables LIMIT 10;
```

query	exec_count	memory_tmp_tables	disk_tmp_tables	avg_tmp_tables_per_query	tmp_tables_to_disk_pct
SELECT * FROM film_list SELECT ... `sakila`.`film`.`film_id`	382	1146	764	3	67
SELECT * FROM nicer_but_slower ... `sakila`.`film` ON ((`sakila`...	381	1143	762	3	67
SELECT film . film_id AS FID , ... or_id GROUP BY film . film_id	379	758	379	2	50
SELECT film . film_id AS FID , ... or_id GROUP BY film . film_id	378	756	378	2	50
SELECT `information_schema` TICS `INDEX_TYPE` UNION ...	2	14	6	7	43
SELECT `stmts` . `DIGEST_TEXT` ... / (SELECT COUNT (?) FROM ...	2	8	2	4	25
SELECT IF ((`locate` (? , `...` . `COMPRESSED_SIZE`)) DESC	2	4	2	2	50
SELECT IF ((`locate` (? , `...` . `COMPRESSED_SIZE`)) DESC	2	4	2	2	50
SELECT IF ((`locate` (? , `...` . `COMPRESSED_SIZE`)) DESC	2	4	2	2	50
SELECT IF ((`locate` (? , `...` . `COMPRESSED_SIZE`)) DESC	2	4	2	2	50

```
10 rows in set (0.00 sec)
```

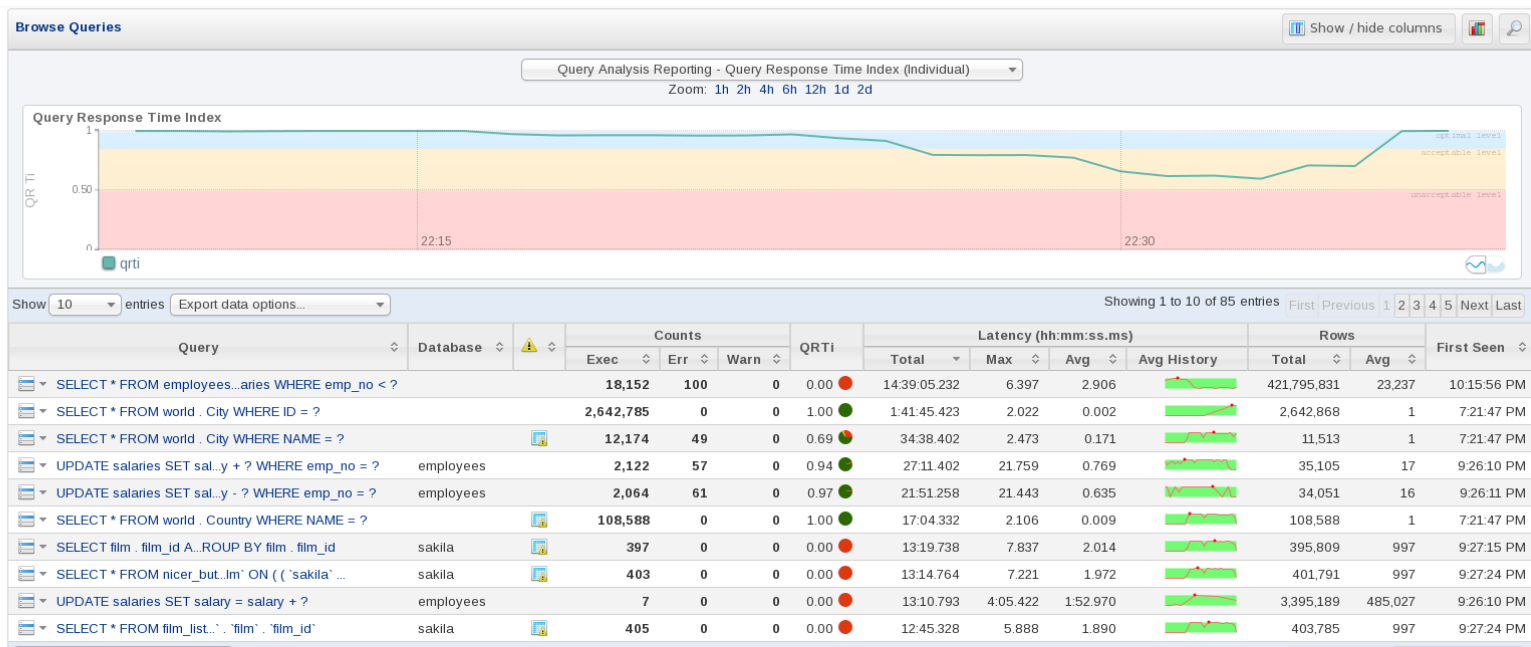

Slow Queries

MySQL Enterprise Monitor (MEM) 3.0

- Query Analyzer uses the Performance Schema out of the box
- Only for MySQL 5.6.14+, 5.7.2+
- Level of detail depends on Performance Schema settings

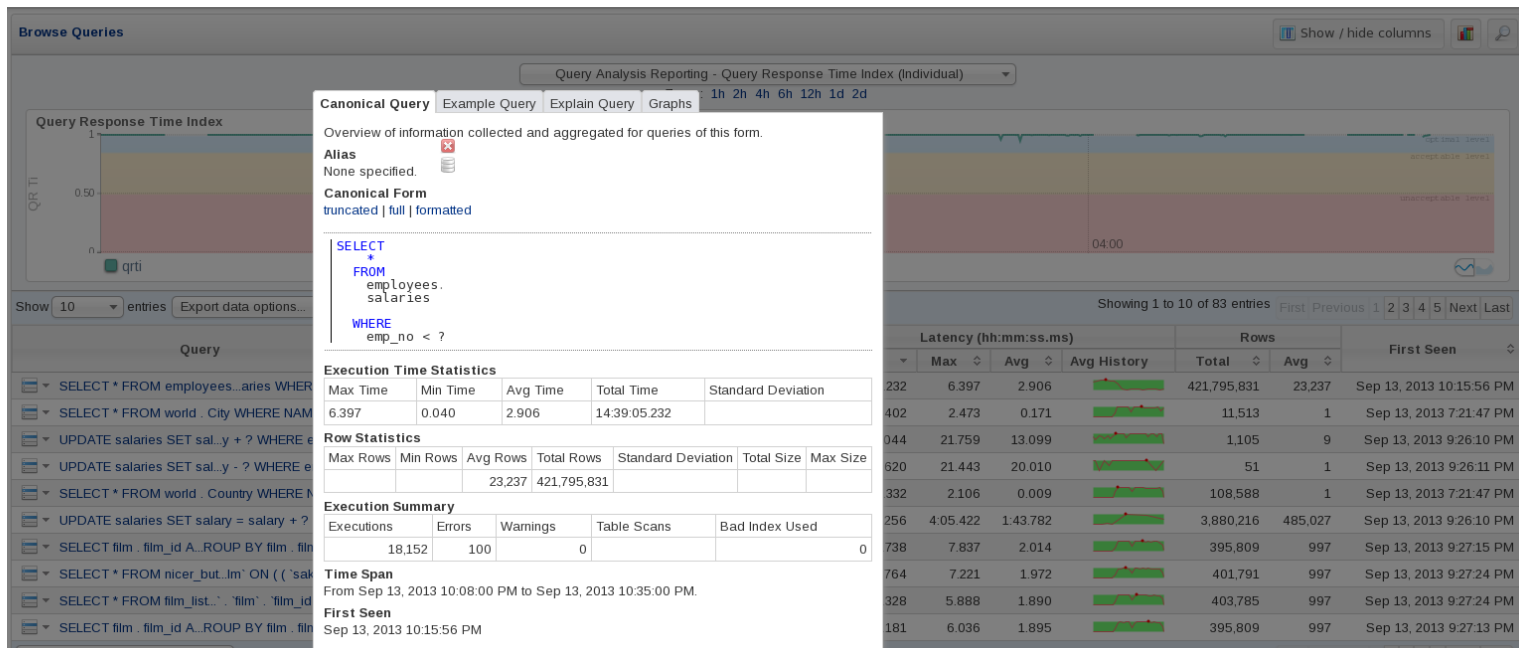
Slow Queries

MySQL Enterprise Monitor (MEM) 3.0



Slow Queries

MySQL Enterprise Monitor (MEM) 3.0



Slow Queries

MySQL Enterprise Monitor (MEM) 3.0

Canonical Query

Example Query

Explain Query

Graphs

Overview of information collected and aggregated for queries of this form.

Alias
None specified.

Canonical Form
[truncated](#) | [full](#) | [formatted](#)

```
SELECT CODE , Country . Name , COUNT ( ID ) , Country . Population AS CountryPopulation , SUM ( City . Population ) AS CityPopulation , ROUND ( SUM ( City . Population ) / Country . Population * ? , ... ) AS Urbanisation FROM world . Country INNER JOIN world . City ON City . CountryCode = Country . Code GROUP BY CODE , Country . Name , Country . Population ORDER BY Urbanisation
```

Execution Time Statistics

Max Time	Min Time	Avg Time	Total Time	Standard Deviation
2.667	0.039	0.117	39.601	

Row Statistics

Max Rows	Min Rows	Avg Rows	Total Rows	Standard Deviation	Total Size	Max Size
		232	78,648			

Execution Summary

Executions	Errors	Warnings	Table Scans	Bad Index Used
339	0	0		0

Time Span
From Sep 14, 2013 8:11:45 AM to Sep 14, 2013 8:41:45 AM.

First Seen
Sep 13, 2013 7:21:47 PM

Close

Canonical Query

Example Query

Explain Query

Graphs

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

Sampled Query
[truncated](#) | [full](#) | [formatted](#)

```
SELECT Code, CountryName, COUNT(ID), CountryPopulation AS CountryPopulation, SUM(CityPopulation_y.CountryCode = CountryCode GROUP BY Code, CountryName, CountryPopulation ORDER BY Urbanisation
```

Execution Time
136 ms

Date
Sep 14, 2013 8:36:03 AM

User

Thread ID
253,621

From Host

To Host

Source Location
None found.

Comments
None found.

Close

Canonical Query

Example Query

Explain Query

Graphs

Explain of a query that occurred during the Time Span (usually the slowest but not always).

Explain

id	select_type	table	type	possible_keys	key	key_len	ref	rows	extra
1	SIMPLE	Country	ALL	PRIMARY	null	0	null	239	Using temporary; Using filesort
1	SIMPLE	City	ref	CountryCode	CountryCode	3	world.CountryCode	9	null

Close

Slow Queries

Problem

- A problematic query has been identified
- How to investigate it in details?

```
mysql> INSERT INTO City  
      -> VALUES (DEFAULT, 'Redwood City', 'USA', 'California', 77000);  
Query OK, 1 row affected (0.01 sec)
```

Slow Queries

dump_thread_stack()

```
mysql> CALL ps_helper.dump_thread_stack(52134, '/tmp/stack.dot', 10, 0.1, TRUE, TRUE, TRUE);
+-----+
| Info                                     |
+-----+
| Data collection starting for THREAD_ID = 52134 |
+-----+
1 row in set (0.18 sec)

+-----+
| Info                                     |
+-----+
| Stack trace written to /tmp/stack.dot |
+-----+
1 row in set (10.15 sec)

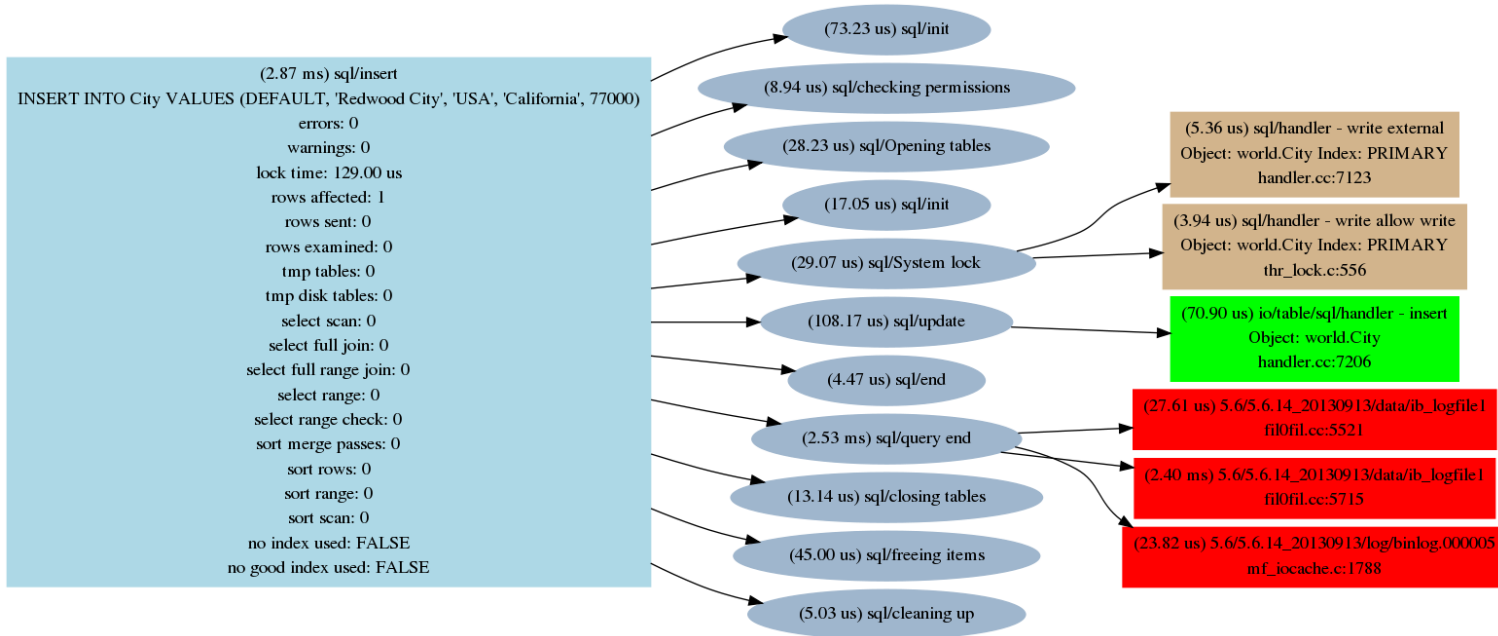
+-----+
| Convert to PDF                           |
+-----+
| dot -Tpdf -o /tmp/stack_52134.pdf /tmp/stack.dot |
+-----+
1 row in set (10.15 sec)

+-----+
| Convert to PNG                           |
+-----+
| dot -Tpng -o /tmp/stack_52134.png /tmp/stack.dot |
+-----+
1 row in set (10.15 sec)

Query OK, 0 rows affected (10.17 sec)
```

Slow Queries

dump_thread_stack()



Slow Queries

analyse_statement_digest()

```
mysql> CALL ps_helper.analyse_statement_digest('9124aee2969f2da91d320cbc46458411', 15, 0.1, TRUE, TRUE);
```

```
+-----+  
| SUMMARY STATISTICS |  
+-----+  
| SUMMARY STATISTICS |  
+-----+  
1 row in set (15.54 sec)
```

```
+-----+-----+-----+-----+-----+-----+-----+  
| executions | exec_time | lock_time | rows_sent | rows_affected | rows_examined | tmp_tables | full_scans |  
+-----+-----+-----+-----+-----+-----+-----+  
|          3252 | 8.41 s | 1.07 s |          3252 |              0 |          3252 |          0 |          0 |  
+-----+-----+-----+-----+-----+-----+-----+  
1 row in set (15.54 sec)
```

```
+-----+-----+-----+  
| event_name | count | latency |  
+-----+-----+-----+  
| stage/sql/statistics | 1459 | 1.57 s |  
| stage/sql/init | 2868 | 231.04 ms |  
| stage/sql/logging slow query | 1472 | 177.08 ms |  
| stage/sql/System lock | 1519 | 159.98 ms |  
| stage/sql/freeing items | 1301 | 125.48 ms |  
| stage/sql/Opening tables | 1105 | 90.66 ms |  
| stage/sql/closing tables | 1216 | 47.40 ms |  
| stage/sql/checking permissions | 2334 | 38.96 ms |  
| stage/sql/optimizing | 1433 | 30.55 ms |  
| stage/sql/cleaning up | 1452 | 30.14 ms |  
| stage/sql/Sending data | 939 | 20.13 ms |  
| stage/sql/end | 1116 | 15.47 ms |  
| stage/sql/preparing | 940 | 14.65 ms |  
| stage/sql/query end | 1100 | 10.75 ms |  
| stage/sql/executing | 881 | 7.32 ms |  
+-----+-----+-----+  
15 rows in set (15.59 sec)
```


Slow Queries

analyse_statement_digest()

```
+-----+
| LONGEST RUNNING STATEMENT |
+-----+
| LONGEST RUNNING STATEMENT |
+-----+
1 row in set (15.59 sec)
```

```
+-----+-----+-----+-----+-----+-----+-----+
| thread_id | exec_time | lock_time | rows_sent | rows_affected | rows_examined | tmp_tables | full_scan |
+-----+-----+-----+-----+-----+-----+-----+
| 105554 | 231.80 ms | 607.00 us | 1 | 0 | 1 | 0 | 0 |
+-----+-----+-----+-----+-----+-----+-----+
1 row in set (15.60 sec)
```

```
+-----+
| sql_text |
+-----+
| SELECT ci.ID, ci.Name AS CityName, ci.CountryCode, co.Name AS CountryName
  FROM world.City ci
        INNER JOIN world.Country co ON co.Code = ci.CountryCode
 WHERE ci.ID = 153 |
+-----+
1 row in set (15.60 sec)
```

Slow Queries

analyse_statement_digest()

event_name	latency
stage/sql/init	249.60 us
stage/sql/checking permissions	6.43 us
stage/sql/checking permissions	7.27 us
stage/sql/Opening tables	45.00 us
stage/sql/init	25.44 us
stage/sql/System lock	132.21 us
stage/sql/optimizing	18.45 us
stage/sql/statistics	106.77 us
stage/sql/preparing	10.34 us
stage/sql/executing	5.03 us
stage/sql/Sending data	14.81 us
stage/sql/end	6.71 us
stage/sql/query end	6.15 us
stage/sql/closing tables	26.55 us
stage/sql/closing tables	48.35 us
stage/sql/freeing items	109.57 us
stage/sql/freeing items	178.60 us
stage/sql/logging slow query	41.37 us
stage/sql/logging slow query	871.22 us
stage/sql/cleaning up	15.65 us
stage/sql/cleaning up	25.71 us




21 rows in set (15.60 sec)

id	select_type	table	type	possible_keys	key	key_len	ref	rows	Extra
1	SIMPLE	ci	const	PRIMARY,CountryCode	PRIMARY	4	const	1	NULL
1	SIMPLE	co	const	PRIMARY	PRIMARY	3	const	1	NULL

2 rows in set (15.67 sec)

Query OK, 0 rows affected (15.67 sec)

Disk I/O



Topic: CPU I/O Wait Usage Excessive: 9.7%

Categories: Operating System

Current State: Closed

Auto-Closes by Default: Yes

Notes:

Automatically closed based on scheduling option

Details:

Problem Description

CPU I/O wait usage should be low on a properly

Advice

Use whatever system tools are available to you (time (9.7%) is high relative to CPU sys (kernel), C

Links and Further Reading

- [Performance Monitoring on Linux](#)
- [Windows 2000: Overview of Performance Mo](#)
- [Windows 2003 Performance Monitor](#)

Disk I/O

Problem

- Disk is fully utilised
- Can any files be moved to new disk?

```
avg-cpu:  %user   %nice %system %iowait  %steal   %idle
           40.40    0.00   7.98   38.15    0.00   13.47

Device:  rrqm/s   wrqm/s     r/s     w/s    rsec/s    wsec/s   avgrq-sz   avgqu-sz   await  svctm   %util
sda      0.00   183.00   28.00   37.00   7168.00   1648.00   135.63     2.98   42.97   15.38  100.00
sdb      0.00    0.00    0.00    0.00    0.00     0.00     0.00     0.00    0.00    0.00    0.00
dm-0     0.00    0.00   28.00    6.00   7168.00    48.00   212.24     2.04   61.44   29.35   99.80
dm-1     0.00    0.00    0.00    0.00    0.00     0.00     0.00     0.00    0.00    0.00    0.00
dm-2     0.00    0.00    0.00   226.00    0.00   1720.00     7.61     1.06    3.60    4.38   98.90
```

Disk I/O

Solution

- latest_file_io
- io_by_thread_by_latency
- io_global_by_file_by_bytes
- io_global_by_file_by_latency
- io_global_by_wait_by_bytes
- io_global_by_wait_by_latency

```
mysql> SELECT * FROM latest_file_io LIMIT 5;
```

thread	file	latency	operation	requested
root@localhost:13122	@tmpdir//#sql_70e0_0.MYD	3.78 us	read	20 bytes
root@localhost:13122	@tmpdir//#sql_70e0_0.MYD	3.35 ms	seek	NULL
page_cleaner_thread:18	@@datadir/ibdata1	281.48 us	write	144.00 KiB
page_cleaner_thread:18	@@datadir/ibdata1	5.38 ms	sync	NULL
page_cleaner_thread:18	@@datadir/undo001	292.41 us	write	16.00 KiB

```
5 rows in set (0.09 sec)
```

Disk I/O

io_global_by_file_by_bytes

```
mysql> SELECT * FROM io_global_by_file_by_bytes LIMIT 10;
```

file	count_read	total_read	avg_read	count_write	total_written	avg_write	total	write_pct
@@datadir/ibdata1	30	2.44 MiB	83.20 KiB	588	338.75 MiB	589.93 KiB	341.19 MiB	99.29
@@datadir/ib_logfile1	0	0 bytes	0 bytes	273	250.12 MiB	938.18 KiB	250.12 MiB	100.00
@@datadir/ib_logfile0	6	68.00 KiB	11.33 KiB	249	207.14 MiB	851.86 KiB	207.21 MiB	99.97
@@datadir/undo004	94	1.47 MiB	16.00 KiB	4361	68.14 MiB	16.00 KiB	69.61 MiB	97.89
@@datadir/employees/salaries.ibd	1063	16.61 MiB	16.00 KiB	3111	48.61 MiB	16.00 KiB	65.22 MiB	74.53
@@datadir/binlog.000005	2	120 bytes	60 bytes	5375	41.82 KiB	7.97 KiB	41.82 MiB	100.00
@@tmpdir//#sql70e0_17e_2.ibd	0	0 bytes	0 bytes	866	36.48 MiB	43.14 KiB	36.48 MiB	100.00
@@tmpdir//#sql70e0_17b_2.ibd	0	0 bytes	0 bytes	795	35.38 MiB	45.56 KiB	35.38 MiB	100.00
@@tmpdir//#sql70e0_17f_2.ibd	0	0 bytes	0 bytes	737	33.48 MiB	46.52 KiB	33.48 MiB	100.00
@@datadir/undo001	93	1.45 MiB	16.00 KiB	2024	31.63 MiB	16.00 KiB	33.08 MiB	95.61

10 rows in set (0.00 sec)

Disk I/O

io_global_by_wait_by_bytes

```
mysql> SELECT * FROM io_global_by_wait_by_bytes LIMIT 10;
```

event_name	count_star	total_latency	min_latency	avg_latency	max_latency	count_read	...
mysam/dfile	18928396	00:04:09.21	0 ps	13.17 us	940.47 ms	9454924	...
innodb/innodb_data_file	47193	00:04:52.97	0 ps	6.21 ms	2.00 s	5557	...
innodb/innodb_log_file	1892	00:01:31.18	0 ps	48.19 ms	1.95 s	6	...
sql/binlog	7200	493.86 ms	0 ps	68.59 us	198.17 ms	7	...
mysam/kfile	29073	1.07 s	0 ps	36.77 us	175.04 ms	2658	...
sql/FRM	2964	2.68 s	0 ps	905.06 us	1.04 s	1111	...
sql/ERRMSG	5	30.12 ms	0 ps	6.02 ms	29.39 ms	3	...
mysys/charset	3	5.76 ms	0 ps	1.92 ms	5.66 ms	1	...
sql/slow_log	34	3.82 ms	0 ps	112.25 us	3.24 ms	0	...
sql/file_parser	67	289.50 ms	0 ps	4.32 ms	100.19 ms	3	...

```
10 rows in set (0.00 sec)
```

total_read	avg_read	count_write	total_written	avg_written	total_requested
1.37 GiB	155 bytes	4736124	745.04 MiB	165 bytes	2.09 GiB
88.80 MiB	16.36 KiB	38170	1.56 GiB	42.95 KiB	1.65 GiB
68.00 KiB	11.33 KiB	978	750.20 MiB	785.49 KiB	750.27 MiB
40.12 KiB	5.73 KiB	7171	55.76 MiB	7.96 KiB	55.80 MiB
473.39 KiB	182 bytes	17191	605.89 KiB	36 bytes	1.05 MiB
375.93 KiB	346 bytes	598	120.83 KiB	207 bytes	496.76 KiB
57.57 KiB	19.19 KiB	0	0 bytes	0 bytes	57.57 KiB
17.31 KiB	17.31 KiB	0	0 bytes	0 bytes	17.31 KiB
0 bytes	0 bytes	31	8.85 KiB	292 bytes	8.85 KiB
3.26 KiB	1.09 KiB	161	0 bytes	0 bytes	3.26 KiB

Schema

{com.mysql.etc

Topic: Indexes Not Being Used Efficiently

Categories: Performance

Current State: Open

Auto-Closes by Default: No

Notes:

No notes provided.

Details:

Problem Description

The target server does not appear to be using indexes efficiently. The value of `Handler_read_key` and `Handler_read_primary` which denote index accesses - such as `Handler_read_key`, `Handler_read_primary`

Advice

If Query Analyzer is enabled, browse to the [Query Analyzer tab](#) and set the `max_execution_time` to another, or queries where max execution time is much greater than average

Another option is to turn on the Slow Query Log (if it is not already turned on) for a period of time greater than **long_query_time** seconds to run, so statements triggering full scans should have indexes added to them.

If you are using MySQL 4.1 or later you can use the `--log-queries-not-using-indexes` option

Note that full table scans are not necessarily bad, as long as they are controlled


Recommended Action


None specified.

Links and Further Reading

[MySQL Manual: How MySQL Uses Indexes](#)
[MySQL Manual: The Slow Query Log](#)
[MySQL Manual: log-queries-not-using-indexes Server Option](#)
[MySQL Manual: long_query_time Server Variable](#)
[MySQL Manual: EXPLAIN Syntax](#)

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MySQL Connect

ORACLE

Schema

Problem

- Which are my hot tables and indexes?
- Do I have indexes that aren't used?

```
mysql> SHOW TABLES;
+-----+
| Tables_in_employees |
+-----+
| departments          |
| dept_emp             |
| dept_manager         |
| employees            |
| salaries             |
| titles               |
+-----+
6 rows in set (0.00 sec)
```

Schema

Solution

- schema_table_statistics
- schema_table_statistics_with_buffer
- schema_tables_with_full_table_scans
- schema_unused_indexes
- schema_index_statistics

```
mysql> SELECT * FROM schema_tables_with_full_table_scans;
```

object_schema	object_name	rows_full_scanned
world	City	33680400
world	Country	16600800
employees	salaries	16490957
employees	employees	2400200
sakila	catagory	16524
sakila	staff	735
employees	departments	40

```
8 row in set (0.00 sec)
```

Schema

schema_index_statistics

```
mysql> SELECT * FROM schema_index_statistics LIMIT 10;
```

table_schema	table_name	index_name	rows_selected	select_latency	...	rows_updated	update_latency	...
employees	salaries	PRIMARY	5894705	00:15:04:49	...	2425135	57.11 s	...
world	City	CountryCode	11715210	00:01:56:53	...	0	0 ps	...
sakila	actor	PRIMARY	5308092	00:01:22:86	...	0	0 ps	...
employees	titles	PRIMARY	5946656	00:01:11:31	...	0	0 ps	...
sakila	film_actor	idx_fk_film_id	6281064	54.46 s	...	0	0 ps	...
sakila	film	PRIMARY	2752640	44.26 s	...	0	0 ps	...
employees	dept_emp	dept_no	1326448	40.52 s	...	0	0 ps	...
world	City	PRIMARY	384400	18.81 s	...	0	0 ps	...
employees	employees	PRIMARY	1664084	17.09 s	...	0	0 ps	...
sakila	film_category	fk_film_category_category	987552	8.21 s	...	0	0 ps	...

Schema

schema_unused_indexes and schema_table_statistics_with_buffer

```
mysql> SELECT *  
-> FROM schema_unused_indexes  
-> WHERE object_schema = 'employees';  
+-----+-----+-----+  
| object_schema | object_name | index_name |  
+-----+-----+-----+  
| employees    | departments | PRIMARY    |  
| employees    | departments | dept_name  |  
| employees    | dept_emp    | emp_no     |  
| employees    | dept_emp    | PRIMARY    |  
| employees    | dept_manager | PRIMARY    |  
| employees    | dept_manager | emp_no     |  
| employees    | dept_manager | dept_no    |  
| employees    | salaries    | emp_no     |  
| employees    | titles      | emp_no     |  
+-----+-----+-----+  
9 rows in set (0.00 sec)
```

```
mysql> SELECT * FROM schema_table_statistics_with_buffer LIMIT 1\G  
***** 1. row *****  
table_schema: employees  
table_name: salaries  
rows_fetched: 22385662  
fetch_latency: 00:42:37.30  
rows_inserted: 0  
insert_latency: 0 ps  
rows_updated: 2425135  
update_latency: 57.11 s  
rows_deleted: 0  
delete_latency: 0 ps  
io_read_requests: 1070  
io_read: 16.61 MiB  
io_read_latency: 586.72 ms  
io_write_requests: 5208  
io_write: 81.38 MiB  
io_write_latency: 151.11 ms  
io_misc_requests: 193  
io_misc_latency: 2.71 s  
innodb_buffer_allocated: 16.28 MiB  
innodb_buffer_data: 14.83 MiB  
innodb_buffer_pages: 1042  
innodb_buffer_pages_hashed: 1042  
innodb_buffer_pages_old: 1042  
innodb_buffer_rows_cached: 243545  
1 row in set (0.66 sec)
```

[illegible]

MySQL 5.7



Memory

Problem

- MySQL is using too much memory
- Why?

{com.mysql.etoools.inventory.model.os.Os : ssh:{66.5f...}

RAM Usage Excessive

Topic: RAM Usage Excessive

Categories: Operating System

Current State: Open

Auto-Closes by Default: No

Advisor: RAM Usage Excessive

Current Status: Notice

Last Checked: Sep 18, 2013 6:04:10 AM

Notes:

No notes provided.

Details:

Problem Description

A reasonable amount of free memory is required for a system to perform well. Without free memory, new processes and threads cannot start, and the

Advice

Use whatever system tools are available to you on {com.mysql.etoools.inventory.model.os.Os : ssh:{66.5f:ef:88:fd:25:bc:09:ca:88:54:b6:29:a} is being used, so you can determine the appropriate action to take to improve the situation. The amount of free memory on {com.mysql.etoools.inven} low. Only 208.06 MB of memory are free out of a total of 3.86 GB.

Recommended Action

None specified.

Links and Further Reading

[Performance Monitoring on Linux](#)
[Windows 2000: Overview of Performance Monitoring](#)
[Windows 2003 Performance Monitor](#)

Expression

(%ram_unused% / 1024 / 1024) < THRESHOLD

Evaluated Expression

(218165248 / 1024 / 1024) < 300

Memory

Solution

- Performance Schema now includes memory instrumentation.
- Not all of MySQL – most notably InnoDB – is instrumented yet.

```
mysql> SELECT * FROM memory_global_total;
+-----+
| total_allocated |
+-----+
| 2.61 MiB        |
+-----+
1 row in set (0.00 sec)
```


Memory

Which threads use the memory?

```
mysql> SELECT thd_id, conn_id, time, current_statement, current_memory
-> FROM processlist
-> WHERE current_memory <> '0 bytes';
```

thd_id	conn_id	time	current_statement	current_memory
23	4	54	SELECT * FROM employees INNER ... USING (emp_no) ORDER BY salary	181.85 MiB
21	2	24	SELECT * FROM (SELECT * FROM s ... JOIN employees USING (emp_no)	141.44 MiB
20	1	0	SELECT thd_id, conn_id, user, ... RE current_memory <> '0 bytes'	2.19 MiB

```
3 rows in set (0.05 sec)
```

Memory

Why is the thread using so much memory?

```
mysql> SELECT event, alloc, free, bytes_alloc, bytes_free, low, current, high, bytes_low, bytes_current, bytes_high
-> FROM ps_memory_current_by_thread_by_event
-> WHERE thd_id = 23
-> LIMIT 10;
```

event	alloc	free	bytes_alloc	bytes_free	low	current	high	bytes_low	bytes_current	bytes_high
memory/sql/thd::main_mem_root	25	21	146.09 KiB	114.16 KiB	0	4	11	0 bytes	31.92 KiB	39.89 KiB
memory/sql/String::value	3	2	32.06 KiB	16.06 KiB	0	1	2	0 bytes	16.00 KiB	32.01 KiB
memory/sql/TABLE	27	22	63.95 KiB	54.55 KiB	0	5	5	0 bytes	9.39 KiB	16.19 KiB
memory/sql/THD::transactions::mem_root	1	0	4.02 KiB	0 bytes	0	1	1	0 bytes	4.02 KiB	4.02 KiB
memory/myisam/MYISAM_SHARE	6	5	5.77 KiB	3.84 KiB	0	1	1	0 bytes	1.92 KiB	1.92 KiB
memory/myisam/MI_INFO	3	2	3.16 KiB	2.11 KiB	0	1	1	0 bytes	1.05 KiB	1.05 KiB
memory/mysys/lf_node	9	0	360 bytes	0 bytes	0	9	9	0 bytes	360 bytes	360 bytes
memory/mysys/my_file_info	12	10	672 bytes	560 bytes	0	2	2	0 bytes	112 bytes	112 bytes
memory/mysys/lf_slist	3	0	96 bytes	0 bytes	0	3	3	0 bytes	96 bytes	96 bytes
memory/sql/MYSQL_LOCK	6	5	336 bytes	264 bytes	0	1	1	0 bytes	72 bytes	72 bytes

10 rows in set (0.02 sec)

Memory

Why is the thread using so much memory?

```
mysql> SELECT event, alloc, free, bytes_alloc, bytes_free, low, current, high, bytes_low, bytes_current, bytes_high
-> FROM ps_memory_current_by_thread_by_event
-> WHERE thd_id = 23
-> LIMIT 10;
```

event	alloc	free	bytes_alloc	bytes_free	low	current	high	bytes_low	bytes_current	bytes_high
memory/sql/Filesort_buffer::sort_keys	3	2	545.17 MiB	363.45 MiB	0	1	1	0 bytes	181.72 MiB	181.72 MiB
memory/mysys/IO_CACHE	15	12	1.69 MiB	1.63 MiB	0	3	4	0 bytes	64.04 KiB	320.04 KiB
memory/sql/thd::main_mem_root	25	21	146.09 KiB	114.16 KiB	0	4	11	0 bytes	31.92 KiB	39.89 KiB
memory/sql/String::value	3	2	32.06 KiB	16.06 KiB	0	1	2	0 bytes	16.00 KiB	32.01 KiB
memory/sql/TABLE	27	22	63.95 KiB	54.55 KiB	0	5	5	0 bytes	9.39 KiB	16.19 KiB
memory/sql/THD::transactions::mem_root	1	0	4.02 KiB	0 bytes	0	1	1	0 bytes	4.02 KiB	4.02 KiB
memory/myisam/MYISAM_SHARE	6	5	5.77 KiB	3.84 KiB	0	1	1	0 bytes	1.92 KiB	1.92 KiB
memory/myisam/MI_INFO	3	2	3.16 KiB	2.11 KiB	0	1	1	0 bytes	1.05 KiB	1.05 KiB
memory/mysys/lf_node	9	0	360 bytes	0 bytes	0	9	9	0 bytes	360 bytes	360 bytes
memory/sql/TABLE::sort_io_cache	3	2	912 bytes	608 bytes	0	1	1	0 bytes	304 bytes	304 bytes

10 rows in set (0.02 sec)

Stored Routines

Problem

- Are your stored routines actually being used?
- The Information Schema and the mysql database provides info on the routines, but not about their usage.

```
mysql> SELECT ROUTINE_SCHEMA, ROUTINE_NAME, ROUTINE_TYPE  
-> FROM ROUTINES  
-> LIMIT 10;
```

ROUTINE_SCHEMA	ROUTINE_NAME	ROUTINE_TYPE
db1	mysleep	PROCEDURE
ps_helper	analyze_statement_digest	PROCEDURE
ps_helper	currently_enabled	PROCEDURE
ps_helper	disable_background_threads	PROCEDURE
ps_helper	disable_current_thread	PROCEDURE
ps_helper	dump_thread_stack	PROCEDURE
ps_helper	enable_background_threads	PROCEDURE
ps_helper	enable_current_thread	PROCEDURE
ps_helper	extract_schema_from_file_name	FUNCTION
ps_helper	extract_table_from_file_name	FUNCTION

```
10 rows in set (0.02 sec)
```

Stored Routines

schema_unused_routines

```
mysql> SELECT * FROM schema_unused_routines LIMIT 10;
```

object_schema	object_name	object_type
ps_helper	analyze_statement_digest	PROCEDURE
ps_helper	currently_enabled	PROCEDURE
ps_helper	disable_background_threads	PROCEDURE
ps_helper	disable_current_thread	PROCEDURE
ps_helper	dump_thread_stack	PROCEDURE
ps_helper	enable_background_threads	PROCEDURE
ps_helper	enable_current_thread	PROCEDURE
ps_helper	only_enable	PROCEDURE
ps_helper	reload_saved_config	PROCEDURE
ps_helper	reset_to_default	PROCEDURE

```
10 rows in set (0.01 sec)
```

Replication

Problem

- SHOW SLAVE STATUS is difficult to read
- It is a SHOW command, so all columns are always included
- Does not work well for multi-threaded slave.

```
mysql> SHOW SLAVE STATUS\G
***** 1. row *****
...
      Master_Log_File: binlog.000009
    Read_Master_Log_Pos: 120
      Relay_Log_File: relaylog.000005
      Relay_Log_Pos: 280
    Relay_Master_Log_File: binlog.000009
      Slave_IO_Running: Yes
      Slave_SQL_Running: Yes
      Replicate_Do_DB:
      Replicate_Ignore_DB:
      Replicate_Do_Table:
      Replicate_Ignore_Table:
      Replicate_Wild_Do_Table:
      Replicate_Wild_Ignore_Table:
      Last_Errno: 0
      Last_Error:
      Skip_Counter: 0
    Exec_Master_Log_Pos: 120
      Relay_Log_Space: 606
      Until_Condition: None
      Until_Log_File:
      ...
```

Replication

Solution

- MySQL 5.7.2 has some of the replication information available in the Performance Schema.
- Easier to monitor multi-threaded slaves.

```
mysql> SHOW TABLES LIKE 'replication%';
+-----+
| Tables_in_performance_schema (replication%) |
+-----+
| replication_connection_configuration          |
| replication_connection_status                |
| replication_execute_configuration            |
| replication_execute_status                   |
| replication_execute_status_by_coordinator    |
| replication_execute_status_by_worker        |
+-----+
6 rows in set (0.00 sec)
```

Training

Problem

- This still seems overwhelming



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Questions & Answers

