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# Goal Driven Performance Optimization

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Peter Zaitsev

Percona Inc

# Understanding Performance

- **Latency/Response Time**
  - Always Important
  - Can be very different
    - 50ms of Ajax Request
    - 30minutes for report
- **Capacity/Throughput**
  - Often important for multi-user systems
  - System can do 1000 transactions/second

# Throughput/Latency Relation

- Response time tends to increase with throughput
  - When system overload response time goes to infinity
- Call Center analogy
  - Fewer people servicing calls = better utilization
    - Same as throughput per person
  - More people servicing calls = better response time
    - Calls spend less time waiting in the queue
- Performance Optimization Goal
  - Maximizing Capacity/Throughput/Utilization while maintaining Response time within a guidelines

# Response Time Metrics

- **Average/Medium/Response Time**
  - Not a good metric for adequate performance
  - Same as average person temperature in hospital
  - Can be helpful for historical trending
- **Maximum Response Time**
  - Good in theory. We want No requests taking longer than X
  - Hard to work in practice – some requests will take too long
- **Define Percentile response time**
  - 95% or requests serviced within 500ms
  - 99% or requests serviced within 1000ms

# Even Response Time

- 95% response time goal will allow your system to be non responsive for an hour every day
  - le extremely bad performance when taking backup
- You want to ensure there is no stalls/performance dips.
- If page loads slow and user presses reload and it loads quickly it is OK – there are always network glitches.
- Define your performance goals at short intervals.
  - Goals should be met at ALL 5 minutes intervals.

# Response Time and an Object

- Not all the pages are created Equal
- Complexity and User Requirement Differ
- Ajax Pop Ups
  - 50ms
- Profile Page Generation
  - 150ms
- Search
  - 300ms
- Site Usage Report
  - 1000ms

# Responses by Type of Client

- Human Being
  - Actual Human waiting and being impatient
  - Response Time critical
- Bots
  - Some systems have over 80% of bot traffic
  - Bot response time is less critical
    - Though should be good enough to be indexed
- Interactive Web Services
  - Can be used to generate pages on other sites
  - Low Response time is even more critical

# Avoid Performance Holes

- Imagine multi-vendor online store
- 99.9% vendors have 100 items or less
- 5 vendors have over 1.000.000 items
  - So their admin pages are slow
- Because they are so few they do not affect your 99% response time.
- They can be extremely important for business
  - Need to ensure they get adequate performance
- Other choice is placing restriction
  - No more than 100000 items allowed in the shop



# What Performance to Measure

- Client Side Performance
  - Keynote, Gomez
  - Monitoring for Selected Pages
- Client Side Instrumentation
  - <http://code.google.com/p/jiffy-web/>
  - Show user level response for all pages
- Back End Instrumentation
  - Understanding Response Time from Backend

# Summary of the Goal

- Define 95%, 99% etc response time
- For each User Interaction/Class
- Measured/Monitored each 5 minutes
- From Front End and Backend observation
- Avoiding Performance Holes
  - Some actions always/often slow for some users.

# Production Instrumentation

- Many People Instrument Test System
  - Option to print out Queries/Web Service Requests
  - Great for Debugging/Testing
  - Will not show a lot of performance problems
    - Cold vs hot requests
    - Contention happening in production
    - Special User Cases
- Run Instrumented App in Production and Store Data
  - Can instrument only one of Web servers if overhead is large.
  - Can log only 1% of user sessions if can't handle all data

# What to Instrument

- Total Response Time
- CPU Time
- “Wait Time”
  - Connections/Database Queries
  - MemCache
  - Web Services Request
  - Other Network Requests
- Additional Information
  - Number and Nature of different queries
  - Hits/Misses for Queries
  - Options which can affect performance

# Where to Store

- Plain old log files
  - Or directly to the database for smaller systems
- Load them to the database
- Or Hadoop on the larger scale
- Generate standard reports
- Provide Ad-Hoc way to do deep data analyses

# Sample Logging Table

- Sample logging table from boardreader.com

```
CREATE TABLE `performance_bg_090721` (  
  `ip` varchar(15) NOT NULL,  
  `server_ip` varchar(25) NOT NULL,  
  `page` varchar(3000) NOT NULL,  
  `utime` float NOT NULL,  
  `stime` float NOT NULL,  
  `wtime` float NOT NULL,  
  `mysql_time` float NOT NULL,  
  `sphinx_time` float NOT NULL,  
  `mysql_count_queries` int(11) NOT NULL,  
  `mysql_queries` text NOT NULL,  
  `sphinx_count_queries` int(11) NOT NULL,  
  `sphinx_real_count_queries` int(11) NOT NULL,  
  `sphinx_queries` text NOT NULL,  
  `logged` timestamp NOT NULL default CURRENT_TIMESTAMP on update CURRENT_TIMESTAMP,  
  `user_agent` varchar(255) NOT NULL,  
  `referer` varchar(255) NOT NULL,  
  `bot` enum('', 'google', 'yahoo', 'msn', 'lycos', 'other') NOT NULL,  
  `js_cookie` tinyint(1) unsigned NOT NULL default '0',  
  `page_type` enum('', 'search', 'ajax', 'forumprofile', 'siteprofile', 'threadprofile', 'topicprofile', 'domainprofile', 'other') NOT  
  NULL,  
  `id` char(32) NOT NULL default ''  
) ENGINE=MyISAM DEFAULT CHARSET=latin1
```

# Sample Table Row

- The result may look like this.

```
***** 5. row *****
ip: 91.148.82.211
server_ip: web08.boardreader.com
page: boardreader.com/s/nba29k.html?f=47977&extended_search=1
utime: 0.129981
wtime: 0.242401
mysql_time: 0.004417
sphinx_time: 0.083193
sphinx_results_time: 0.078
mysql_count_queries: 15
mysql_queries:
sphinx_count_queries: 3
sphinx_real_count_queries: 3
sphinx_queries:
  stime: 0.008998
  logged: 2009-07-20 20:55:48
user_agent: Mozilla/4.0 (compatible; MSIE 7.0; Windows NT 5.1; GTB6; .NET CLR 2.0.50727; InfoPath.2)
referer: http://boardreader.com/fp/FileForums_14910/PC_Games_CD_2_DVD_Conversion_47977.html
bot:
js_cookie: 1
page_type: search
id: 5ab03bc440ffa0c62610a62db988cb81
```

# Search Response Time

- Average Distribution
- About 6% is time unaccounted for
- ```
select avg(wtime) r, avg(stime+utime)/avg(wtime) cpup ,avg(mysql_time)/avg(wtime) mp,  
avg(sphinx_time)/avg(wtime) sp, avg(wtime-stime-utime-sphinx_time-mysql_time)/avg(wtime) rst  
from performance_log_090721 where page_type='search' \G
```
- ```
***** 1. row *****
```
- ```
  r: 1.2175869055517
```
- ```
cpup: 0.16983144536072
```
- ```
 mp: 0.1544487152423
```
- ```
 sp: 0.61537297006254
```
- ```
rst: 0.060346869334443
```
- ```
1 row in set (4.16 sec)
```



# See Hourly Trend

- Not All hours are created Equal

```
mysql> select date_format(logged,"%H") h ,round(avg(wtime),3) r, round(avg(stime+utime)/avg(wtime),2) cpup  
,round(avg(mysql_time)/avg(wtime),2) mp, round(avg(sphinx_time)/avg(wtime),2) sp, round(avg(wtime-stime-utime-sphinx_time-  
mysql_time)/avg(wtime),2) rst from performance_log_090721 where page_type='search' group by 1;
```

```
+-----+-----+-----+-----+-----+  
| h | r | cpup | mp | sp | rst |  
+-----+-----+-----+-----+-----+  
| 00 | 1.816 | 0.11 | 0.14 | 0.70 | 0.05 |  
| 01 | 1.480 | 0.17 | 0.18 | 0.59 | 0.06 |  
| 02 | 1.394 | 0.16 | 0.22 | 0.53 | 0.09 |  
....  
| 08 | 1.384 | 0.13 | 0.09 | 0.74 | 0.04 |  
| 09 | 1.315 | 0.17 | 0.11 | 0.67 | 0.04 |  
| 10 | 0.950 | 0.20 | 0.15 | 0.60 | 0.05 |  
| 11 | 0.874 | 0.21 | 0.16 | 0.57 | 0.06 |  
| 12 | 1.139 | 0.17 | 0.13 | 0.65 | 0.05 |  
| 13 | 1.191 | 0.16 | 0.14 | 0.65 | 0.05 |  
| 14 | 1.349 | 0.16 | 0.19 | 0.58 | 0.06 |  
| 15 | 1.076 | 0.20 | 0.21 | 0.53 | 0.06 |  
| 16 | 1.526 | 0.14 | 0.14 | 0.58 | 0.13 |  
| 17 | 0.853 | 0.24 | 0.19 | 0.50 | 0.07 |  
| 18 | 0.978 | 0.25 | 0.23 | 0.43 | 0.09 |  
| 19 | 0.924 | 0.23 | 0.17 | 0.54 | 0.06 |  
| 20 | 1.310 | 0.18 | 0.26 | 0.47 | 0.09 |  
| 21 | 1.211 | 0.17 | 0.24 | 0.51 | 0.08 |  
| 22 | 1.538 | 0.14 | 0.19 | 0.59 | 0.08 |  
| 23 | 1.450 | 0.15 | 0.18 | 0.60 | 0.06 |  
+-----+-----+-----+-----+-----+
```

24 rows in set (4.33 sec)

# Apply The Goal

- We want search to be faster than 1 sec
  - Analyze pages which are slower than that
- Focus on optimizing the largest response time contributor

```
mysql> select round(avg(wtime),3) r, round(avg(stime+utime)/avg(wtime),2) cpup  
,round(avg(mysql_time)/avg(wtime),2) mp, round(avg(sphinx_time)/avg(wtime),2) sp,  
round(avg(wtime-stime-utime-sphinx_time-mysql_time)/avg(wtime),2) rst from  
performance_log_090721 where date_format(logged,"%H")=0 and  
page_type='search' and wtime>1;
```

```
+-----+-----+-----+-----+-----+  
| r    | cpup | mp  | sp  | rst |  
+-----+-----+-----+-----+-----+  
| 2.571 | 0.09 | 0.14 | 0.72 | 0.05 |  
+-----+-----+-----+-----+-----+
```

1 row in set (4.37 sec)

# Find Pages worth attention

- Focus on popular pages outside desired response time

```
mysql> select count(*) cnt, avg(wtime) wt , avg(sphinx_time) sp , avg(mysql_time) my,page from performance_log_090721 where
page_type='search' and wtime>1 group by page order by cnt desc limit 2,1 \G
***** 1. row *****
cnt: 189
wt: 1.7529319978896
sp: 1.2289490875685
my: 0.060628327807145
page: boardreader.com/s/%D8%A7%D9%81%D9%84%D8%A7%D9%85%20%D8%B3%D9%83%D8%B3%2089.html?f=393284
1 row in set (4.65 sec)
```

# The Next Step

- Analyze which Sphinx Queries are slow
  - There are multiple queries per page
- Use `request_id` to “connect” to the data in its logs
  - You need to understand why those exact queries are slow
  - [Fri Jul 24 04:03:26.466 2009] 0.011 sec [ext2/5/rel 30 (0,1000) @published] [linksfull\_node1,linksinc\_node1] [ios=2 kb=8.9 ioms=7.2]
    - We can see the request took 11ms and out of that we had 2 ios which took 7ms
- Sphinx Support passing `request_id` via API
  - In MySQL can just add comment to the query

# Start from what is most important

- Optimize Most important User Interactions first
- Pick What case to focus in
  - Queries which do not meet response time
  - But not Worse Case Scenario
    - There are always going to be outliers
- Do not analyze just queries above response time threshold
  - It is much easier to reach 95% of 1 second if 50% of the queries are below 500ms.

# Benefits of Such Approach

- Direct connection to the business goals
- High Priority problems targeted first
- Focus on real stuff
  - No guess work like “is my buffer pool hit ratio bad?” or “am I doing too much full table scans ?”
  - If these there the issues you will find and fix them anyway.
- Understandable and predictable result
  - If MySQL contributes 15% to the response time I can't possibly double performance focusing on MySQL optimization.

# Questions ?

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- Thanks For coming !
- <http://www.percona.com>
  - We do Performance/HA/Scalability Consulting and Support
- [pz@percona.com](mailto:pz@percona.com)