



# Optimizing MySQL Configuration

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# Agenda

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- Approach to getting great MySQL Configuration
- Types of Configuration Options
- Tools to Configure MySQL
- Looking at Most Important Options

# But Before We start

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- How many settings do you set in Config File ?

# Also

- How useful do you think MySQL Default Configuration ?

# Configuration Tuning Basics

- Understand what you're changing
  - Google Copy/Paste without thinking can be bad
- Avoid Obsessive Tuning Disorder
  - Setting 10 settings will give 95% of possible performance in 95% cases
- Beware of “Sample Configs” In MySQL distributions
  - They are pretty outdated
  - 2GB of memory is “huge” these days ?
    - Right for Cell Phone

# Most Options do not Scale

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- Going to Server with 4x memory you can't just multiply all configuration variables 2x

# Know Scope and Unit

- `sort_buffer_size=16G`
  - Wrong! `sort_buffer_size` is set per connection
- `table_cache=64M`
  - Wrong! `table_cache` is set in elements not memory size.

# Avoid Basic Mistakes

- Setting variables in wrong config file
  - /etc/mysql/my.cnf instead of /etc/my.cnf
    - These depend on Linux Distro, Beware
- Duplicating Options
  - Last option will override previously set
- Not knowing Synonyms
  - **table\_cache** is same as **table\_open\_cache**
- Using wrong section for option
  - Server reads [mysqld], client [mysql]



# Config Management Practices

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- Keep Config Files in Sync on different servers
  - Out of Sync config files is frequent cause of mistakes and confusion
- Keep Record of Changes
  - Config files under version control is great

# Why would set an option

- Sanity Check Options
  - Many do not impact Performance at all
- General Options to set for Hardware and Workload
  - Few of them
- Special Options
  - Defaults generally fine, unless your circumstances are very special

# Do not let MySQL Swap

- Allocating too much memory and having MySQL swapping is a lot worse than not using all memory
- Monitor swapping (si/so from vmstat closely)
- Start with safe buffer values and increase them gradually if a lot of memory stays free

# Automated Configuration Tuning

- Tools which claim to create best configuration by looking at status variables
  - Beware. Recommendations are often poor
- Advisory Tools
  - Tools which check your config file for typical mistakes and omissions
- Basic configuration creation tools
  - Do not claim to do magic but can get your started with better configuration than default

# mysq tuner

## ----- General Statistics -----

[--] Skipped version check for MySQLTuner script  
[OK] Currently running supported MySQL version 5.1.57-rel | 2.8-log  
[OK] Operating on 64-bit architecture

## ----- Storage Engine Statistics -----

[--] Status: +Archive -BDB -Federated +InnoDB -ISAM -NDBCluster  
[--] Data in MyISAM tables: 73G (Tables: 1282)  
[--] Data in InnoDB tables: 1G (Tables: 338)  
[--] Data in MEMORY tables: 0B (Tables: 2)  
[!!] Total fragmented tables: 110

## ----- Security Recommendations -----

[!!] User '@' has no password set.

# Mysq tuner (2)

## ----- Performance Metrics -----

- [--] Up for: 157d 10h 0m 23s (533M q [39.219 qps], 8M conn, TX: 1202B, RX: 146B)
- [--] Reads / Writes: 97% / 3%
- [--] Total buffers: 4.3G global + 2.7M per thread (200 max threads)
- [OK] Maximum possible memory usage: 4.8G (40% of installed RAM)
- [!!] Slow queries: 7% (41M/533M)
- [OK] Highest usage of available connections: 54% (109/200)
- [OK] Key buffer size / total MyISAM indexes: 4.0G/1.3G
- [OK] Key buffer hit rate: 100.0% (45B cached / 6M reads)
- [!!] Query cache is disabled
- [OK] Sorts requiring temporary tables: 0% (44K temp sorts / 60M sorts)
- [!!] Joins performed without indexes: 255685
- [!!] Temporary tables created on disk: 41% (25M on disk / 61M total)
- [OK] Thread cache hit rate: 91% (791K created / 8M connections)
- [!!] Table cache hit rate: 2% (1K open / 59K opened)
- [OK] Open file limit used: 32% (2K/8K)
- [OK] Table locks acquired immediately: 99% (436M immediate / 436M locks)
- [!!] InnoDB data size / buffer pool: 1.1G/256.0M
-

# mysqltuner(3)

## ----- Recommendations -----

- General recommendations:
- Run OPTIMIZE TABLE to defragment tables for better performance
- Adjust your join queries to always utilize indexes
- When making adjustments, make tmp\_table\_size/max\_heap\_table\_size equal
- Reduce your SELECT DISTINCT queries without LIMIT clauses
- Increase table\_cache gradually to avoid file descriptor limits
- Variables to adjust:
- query\_cache\_size ( $\geq 8\text{M}$ )
- join\_buffer\_size ( $> 128.0\text{K}$ , or always use indexes with joins)
- tmp\_table\_size ( $> 16\text{M}$ )
- max\_heap\_table\_size ( $> 16\text{M}$ )
- table\_cache ( $> 4096$ )
- innodb\_buffer\_pool\_size ( $\geq 1\text{G}$ )

# pt-variable-advisor

- # WARN innodb\_flush\_log\_at\_trx\_commit-1: InnoDB is not configured in strictly ACID mode.
- 
- # NOTE innodb\_max\_dirty\_pages\_pct: The innodb\_max\_dirty\_pages\_pct is lower than the default.
- 
- # NOTE log\_warnings-2: Log\_warnings must be set greater than 1 to log unusual events such as aborted connections.
- 
- # NOTE max\_connect\_errors: max\_connect\_errors should probably be set as large as your platform allows.
- 
- # WARN old\_passwords: Old-style passwords are insecure.
- 
- # WARN slave\_net\_timeout: This variable is set too high.
- 
- # NOTE innodb\_data\_file\_path: Auto-extending InnoDB files can consume a lot of disk space that is very difficult to reclaim later.
- 
- # WARN myisam\_recover\_options: myisam\_recover\_options should be set to some value such as BACKUP,FORCE to ensure that table corruption is noticed.
- 
- # WARN sync\_binlog: Binary logging is enabled, but sync\_binlog isn't configured so that every transaction is flushed to the binary log for durability.



# tools.percona.com

The image shows a landing page for the Percona Configuration Wizard. The page has a dark grey header with the title "Configuration Wizard" in a white serif font on the left and the Percona logo on the right. The logo consists of a stylized orange and yellow 'P' followed by the word "PERCONA" in a white sans-serif font. Below the header is a white main content area. In the center, the text "Optimize your MySQL Server" is displayed, with "Optimize" in orange and "your MySQL Server" in black. Below this, two lines of text describe the tool's purpose: "Percona's experts have drawn on our experience to help you create a good starting configuration for a MySQL server." and "This tool will walk you through all of the steps necessary to create a ready to use MySQL configuration file in about 5 minutes." A large, rounded orange button with white text "Generate A Configuration File Now" is centered below the text. At the bottom of the page is a dark grey footer. On the left is the Percona logo. On the right, there is contact information: "Call us: 1-888-316-9775 • Contact Us", "MySQL and InnoDB are trademarks of Oracle Corp.", "Proudly running Percona Server", "Copyright © 2006-2011 Percona Inc.", and "Copyright, Trademark, and Privacy Policy • Sitemap".

*Configuration Wizard*

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> What type of storage do you use?

Hardware RAID



It is very important to configure MySQL correctly for your storage.

> How many CPUs does your system have?

Enter the total number of CPU cores in your server, including hyperthreading. For example, if you have two 4-core CPUs with hyperthreading, enter 16.

> How much memory does your server have?

GB

Enter the number of **gigabytes** of memory this server contains.

> What is your operating system?

Linux



Specify your operating system.

> How many tables will you have?

less than 100



Approximately how many tables will be in the server?

# Lets look at the options now

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- Different classes of options:
  - General Options
  - MyISAM
  - Innodb
  - Visibility and Logging

# Getting Status Variables

- We refer to **SHOW GLOBAL STATUS** output in many descriptions
- Percona Toolkit too `pt-mext` is helpful
- **`pt-mext -r --mysqladmin ext -i100 -c4`**

- |                       |               |         |         |
|-----------------------|---------------|---------|---------|
| Aborted_clients       | 128           | 0       | 0       |
| Aborted_connects      | 909           | 0       | 0       |
| Binlog_cache_disk_use | 3             | 0       | 0       |
| Binlog_cache_use      | 262857        | 0       | 0       |
| Bytes_received        | 146518902681  | 580976  | 459113  |
| Bytes_sent            | 1202983049426 | 1417886 | 1018617 |

# General Options

- **max\_connections**
  - How many connections to allow ? Watch **max\_used\_connections** status value
- **thread\_cache**
  - Cache to prevent excessive thread creation
  - 50-100 is good value. Watch **threads\_created**
- **table\_cache/table\_open\_cache**
  - Cache of opened table instances
  - Single table may have multiple entries
  - Watch **opened\_tables** status value
  - Start with 4096
    - MySQL will only use as needed anyway.

# General Options

- **open\_files\_limit**
  - MyISAM tables require up to 2 file handlers
  - Each connection is file handler too
  - Safe to set to 65535 in most systems
- **table\_definition\_cache**
  - Cache table definitions (CREATE TABLE)
  - Only one entry per table
  - Watch **Opened\_table\_definitions**
  - Set to cover all tables unless 50K+ tables

# General Options

- **back\_log**
  - Need adjustment if many connections/sec
  - 2048 is reasonable value
- **max\_allowed\_packet**
  - Limits maximum size of query
  - Limits internal string variable size
  - 16MB is a good value
- **max\_connect\_errors**
  - Prevent password brute force attack
  - Can cause “Host Blocked” error messages
  - Value around 1000000 is good

# General Options

- **skip\_name\_resolve**
  - Avoid DNS lookup on connection. Faster and Safer
  - Do not use host names in **GRANTS**
- **old\_passwords**
  - Should NOT be enabled. Will cause insecure password hash to be used.



# General Options

- **log\_bin**
  - Enable for replication and point in time recovery
  - Set to “mysql-bin” to avoid default naming
- **sync\_binlog**
  - Make Binlog durable. Set to 1 if have RAID with BBU or Flash
    - Can be really performance killer with slow drives.
- **expire\_log\_days**
  - Purge old binary logs
  - 14 (2 weeks) is a good value with weekly backups.

# General Options

- **tmp\_table\_size**
- **max\_heap\_table\_size**
  - Typically set to same value (workload based)
  - **Created\_tmp\_disk\_tables** status variable
    - Bevare BLOB/TEXT fields cause on disk table with any size.
- **query\_cache\_size**
  - Enable query cache only if it is tested to provide significant gains
  - Often causes stalls and contention
  - Do not set over 512MB

# General Options

- **sort\_buffer\_size**
  - In memory buffer used for sorting
  - Watch sort\_merge\_passes
  - Consider setting for session for large queries
  - Values up to 1MB are good default
  - Large values hurt performance of small queries
- **join\_buffer\_size**
  - Helps performance of Joins with no indexes
  - Better get rid of such Joins !
  - 8MB can be reasonable value
- **default\_storage\_engine**
  - Use this engine for tables if not specified

# General Options

- **read\_rnd\_buffer\_size**
  - Buffer for reading rows in sorted order
  - Specifies Maximum Value
  - Values around 16MB often make sense
  - Do not mix with **read\_buffer\_size**
- **Tmpdir**
  - Specify location of temporary directory
  - Tmpfs often good choice unless very large temporary space is needed.

# MyISAM options

- **key\_buffer\_size**
  - Cache MyISAM Indexes.
  - Does Not cache data.
  - Up to 30% of memory if using MyISAM only
- **myisam\_recover**
  - Automatically repair corrupted MyISAM tables after crash. **BACKUP,FORCE** is a good value.
- **myisam\_sort\_buffer\_size**
  - Buffer used for building MyISAM indexes by Sort. 8MB-256MB are good values.

# MyISAM Options

- **low\_priority\_updates**
  - Allow higher concurrency for SELECTs
  - May starve update queries
- **bulk\_insert\_buffer\_size**
  - Buffer to optimize Bulk Inserts
  - Values of  $\frac{1}{4}$  of **key\_buffer\_size** make sense
  - Note it is per connection value
-

# InnoDB – Memory Settings

- **innodb\_buffer\_pool\_size**
  - The most important setting. Often 80%+ of memory is allocated here.
- **innodb\_buffer\_pool\_instances**
  - Reduce contention. Set to 4+ in MySQL 5.5+
- **innodb\_log\_buffer\_size**
  - Buffer for log files. Good Values 4MB-128MB
  - Not only reduce writes but help contention
- **innodb\_ibuf\_max\_size**
  - Control size of Insert buffer. Default is  $\frac{1}{2}$  of Buffer pool. Smaller values are good for SSD

# InnoDB IO Options

- **innodb\_flush\_log\_at\_trx\_commit**
  - Control Durability
  - 1=flush and sync; 2=flush; 0=neither
- **innodb\_flush\_method**
  - Controls how InnoDB Performs IO
  - **O\_DIRECT** good value for most servers
- **innodb\_auto\_lru\_dump**
  - Percona Server Feature to warmup quickly
  - 300 (seconds) is a good value
- **innodb\_io\_capacity**
  - Controls InnoDB Assumption about Disk Performance. Increase for faster drives.



# InnoDB IO Options

- **innodb\_read\_io\_threads**
- **innodb\_write\_io\_threads**
  - Control number of threads doing reads and writes
  - MySQL 5.5 has async IO so very high values might not be needed
  - 4 is good default. Higher for large IO systems.
- **innodb\_flush\_neighbor\_pages**
  - Percona Server feature to control how flushing works
  - Disable (set to 0) for SSD

# Other InnoDB Options

- **innodb\_log\_file\_size**
  - Size of redo log file. Larger logs better performance but longer recovery.
- **innodb\_log\_files\_in\_group**
  - Leave at 2 which is default.
- **innodb\_file\_per\_table**
  - Store each InnoDB table in separate file. Usually Good choice
- **innodb=force**
  - Enable so MySQL does not start if InnoDB could not initialize. Otherwise it might start but error on access to all InnoDB tables.

# Other InnoDB Options

- `innodb_data_file_path`
  - Settings for InnoDB System Tablespace
  - Use one file. Limit growth as you can't shrink it
  - **`ibdata1:10M:autoextend:max:10G`**
- `innodb_lock_wait_timeout`
  - How long to wait for row level locks before bailing out ?
- **`innodb_old_blocks_time`**
  - Helps to make buffer pool scan resistant
  - Values around 1000 make sense

# Other Innodb Options

- **innodb\_file\_format**
  - Which file format Innodb will use
  - “Antelope” is default legacy format
  - “Barracuda” allows to use new features like compression
- **innodb\_stats\_on\_metadata**
  - Update statistics on meta data access
  - Such as Information\_schema queries
  - Typically best disabled for more workloads
    - Set to 0
  - Innodb will still refresh stats when table changes significantly

# Visibility Options

- **performance\_schema**
  - Enable Performance Schema in MySQL 5.5+
  - Watch potential overhead.
- **log\_slow\_queries**
  - Enable Slow Query Log. Old but very helpful.
- **long\_query\_time**
  - Especially with long\_query\_time set to 0 periodically to get sample of the load
- **log\_slow\_verbosity=full**
  - Get a lot more data about queries in Percona Server

# Visibility Options

- **low\_warnings=2**
  - Get warnings about disconnects and other minor issues in error log.
  - More information but it can get spammy
- **userstat\_running=1**
  - Get advanced Table and Index usage statistics in Percona Server and MariaDB

# Summary

- Many Options to chose from !
- And these are selected “few”
- Close to 400 variables available In latest versions
- Remember in most cases you do not need to tune more than a few
- Consider starting with config file generated by <http://tools.percona.com>
  - At least it will show you which options to pay attention to first.

# Main Body Slides

- Use this layout for the main body of your presentation
- Keep the following slides at the end of your presentation:
  - Percona Live DC Sponsors
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  - Percona Training (2 slides)
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