Optimizing MySQL Configuration

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Agenda

- **MySQL Configuration Tuning Basics**
- Tools to Configure MySQL
- Looking at Most Important Options

Things to Know About MySQL Configuration

- Default configuration is poor
  - MySQL does not scale it with server size
- 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  - They are pretty outdated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?

Most Options Do Not Scale

- Going to Server with 8x memory you can't just multiply all configuration variables 8x

- 16GB of memory to 128GB of memory
  - **sort_buffer_size** 4MB to 32MB is bad idea.

Know Scope and Unit

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

Set Variables Locally

- Many variables are **SESSION**
  - Can be set for current session only

- Set variable value for session doing complex queries instead of setting it globally:

```
mysql> set session sort_buffer_size=16*1024*1024;
Query OK, 0 rows affected (0.00 sec)
```

Avoid Basic Mistakes

- Setting variables in the 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 options
  - Server reads **[mysqld]**, client **[mysql]**

Config Management Practices

- Keep Config files in sync on different servers
  - Out of Sync config files is a frequent cause of mistakes and confusion
- Keep record of changes
  - Config files under version control is great
  - At least keep your changes documented

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

```
pz@ubuntu:~$ vmstat 5
procs -----------memory---------- ---swap-- -----io---- -system-- ----cpu----
 r  b   swpd   free   buff  cache   si   so    bi    bo   in   cs us sy id wa
 1  0      0 2725708 253216 513572    0    0     1     1   20   22  0  0 100  0
 0  0      0 2725700 253216 513596    0    0     0     0   72   73  0  0 100  0
 0  0      0 2725700 253216 513596    0    0     0     3   70   74  0  0 99  1
 0  0      0 2725700 253216 513596    0    0     0     0   70   74  0  0 100  0
 0  0      0 2725700 253216 513596    0    0     0     0   70   74  0  0 100  0
 0  0      0 2725700 253216 513596    0    0     0     0   70   72  0  0 100  0
```

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Automated Configuration Tuning

- Configuration Tuning Tools
  - Tools which give configuration advice by looking at status variables

- 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 you started with better configuration than default

mysqtuner

```
-------- General Statistics ---------------------------------------------------
[--] Skipped version check for MySQLTuner script
[OK] Currently running supported MySQL version 5.1.57-rel12.8-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.
```

Mysqltuner (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

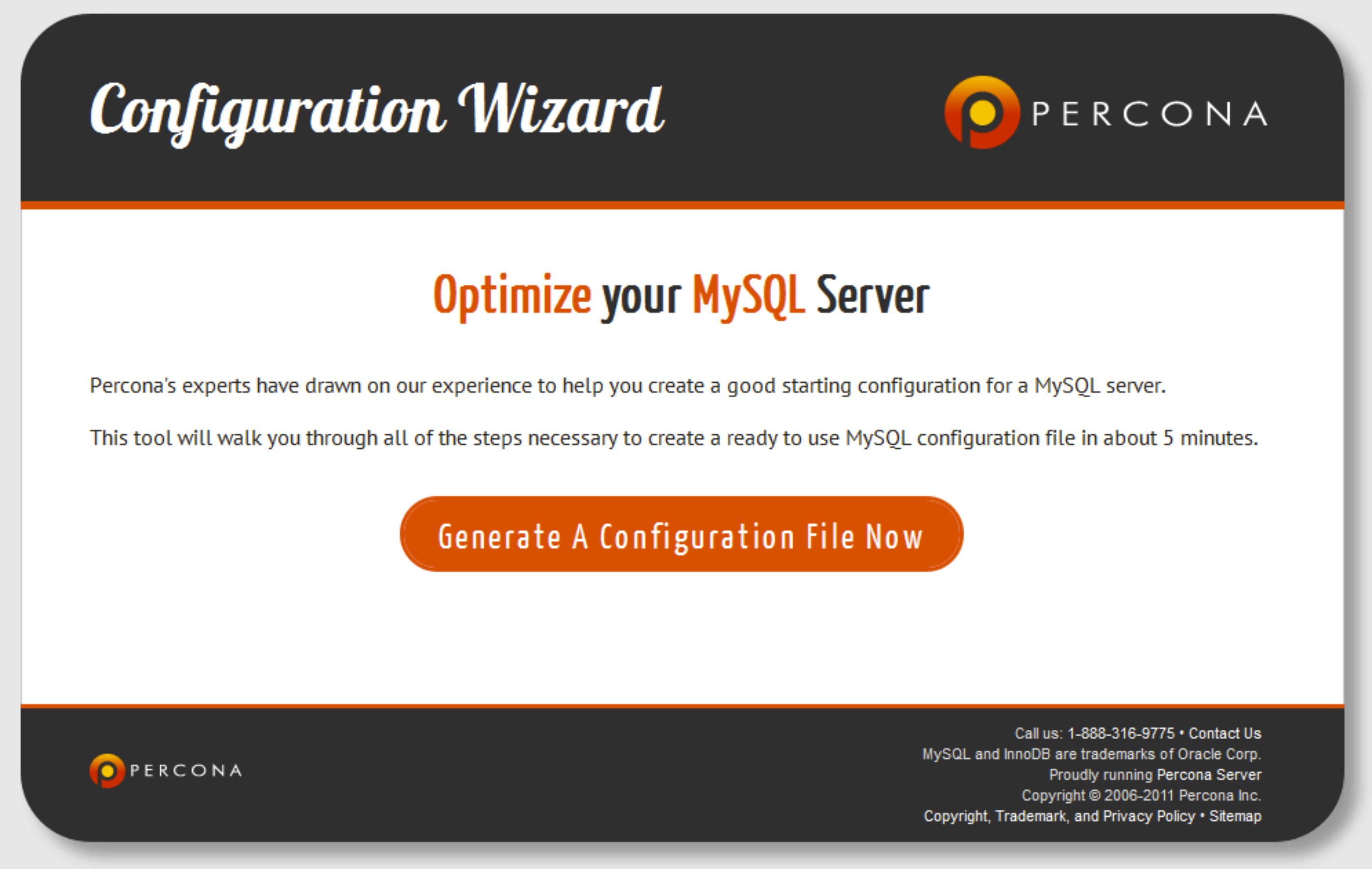
mysqltuner(3)

```
-------- 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 (>= 8M)
•   join_buffer_size (> 128.0K, or always use indexes with joins)
•   tmp_table_size (> 16M)
•   max_heap_table_size (> 16M)
•   table_cache (> 4096)
•   innodb_buffer_pool_size (>= 1G)
```

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



Optimize your MySQL Server

Percona's experts have drawn on our experience to help you create a good starting configuration for a MySQL server.

This tool will walk you through all of the steps necessary to create a ready to use MySQL configuration file in about 5 minutes.

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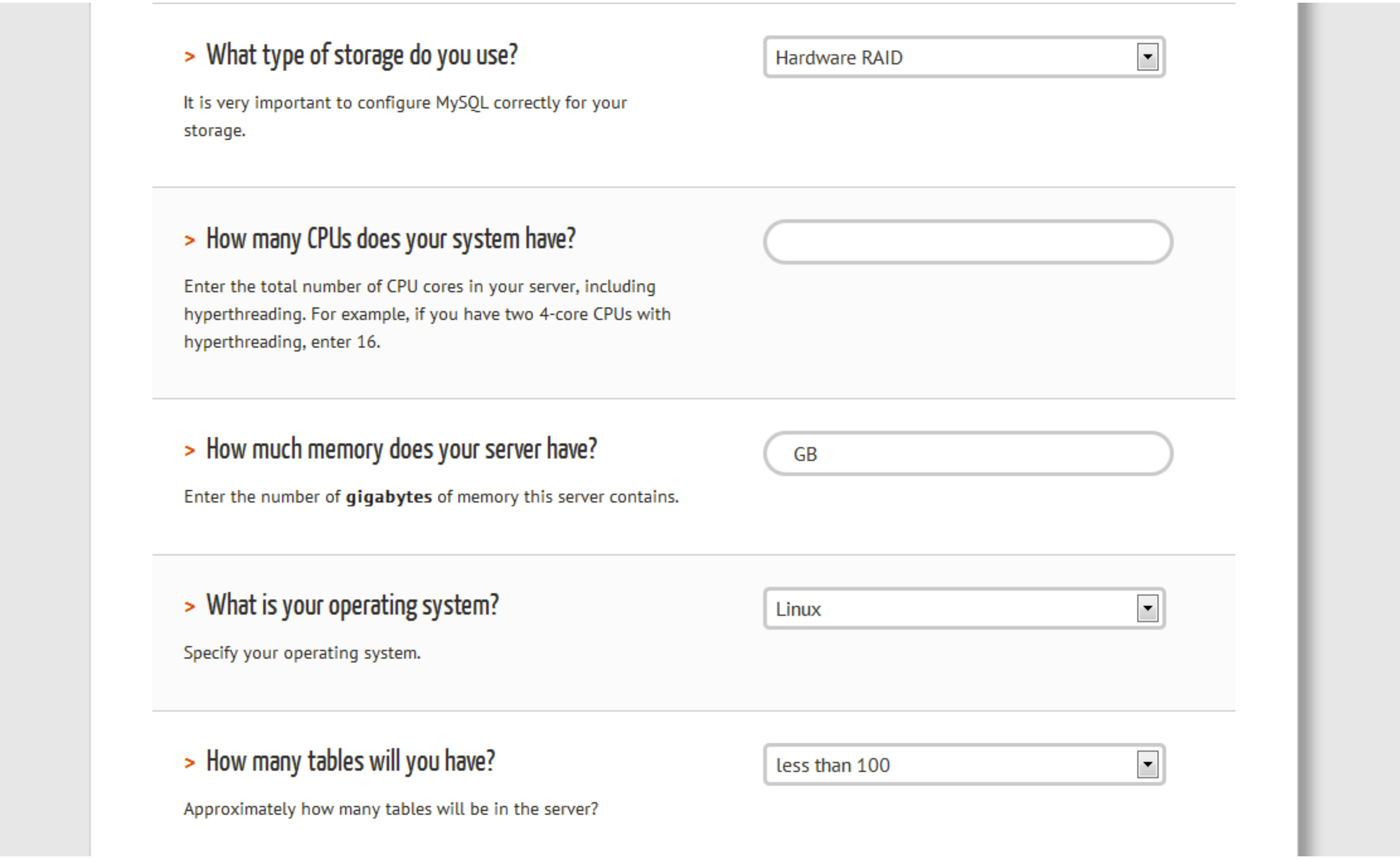

> What type of storage do you use?

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

Hardware RAID ▾

> 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?

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

GB

> What is your operating system?

Specify your operating system.

Linux ▾

> How many tables will you have?

Approximately how many tables will be in the server?

less than 100 ▾

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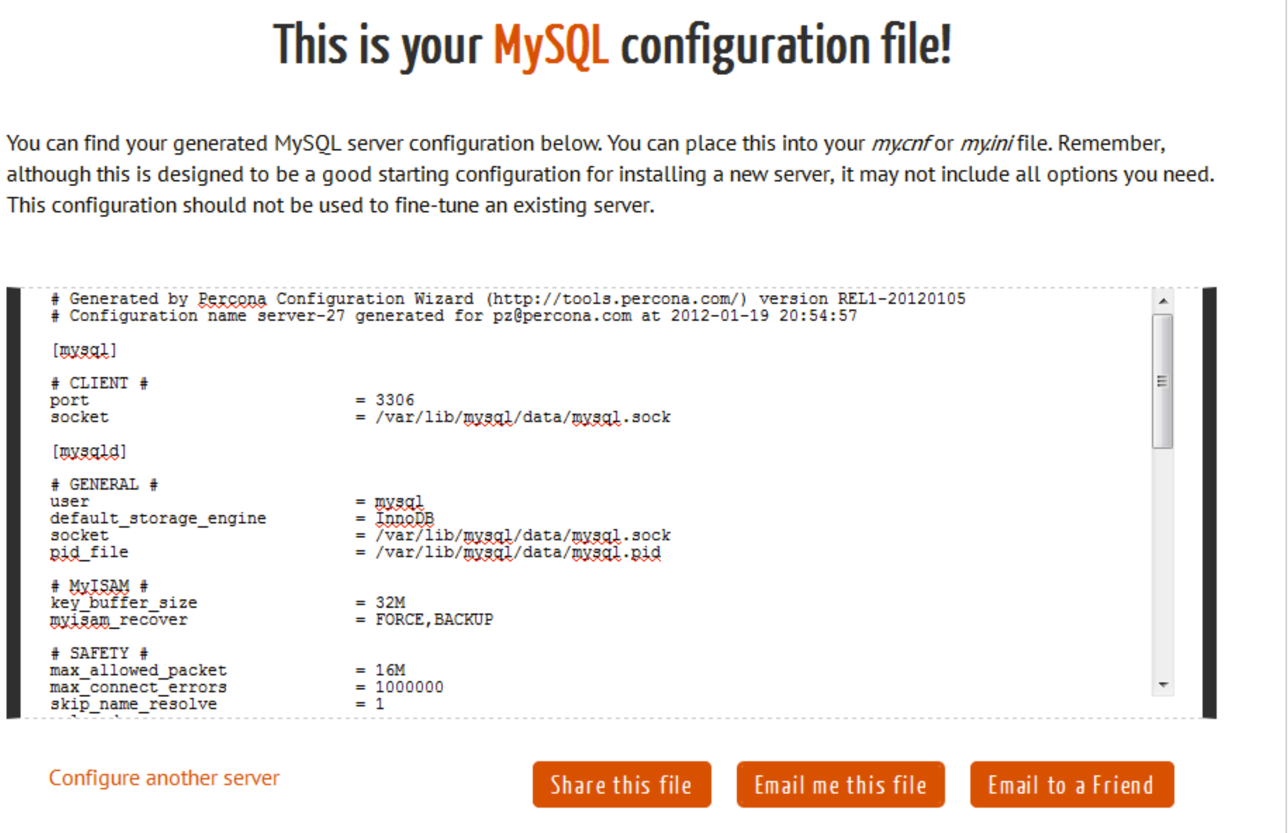

This is your MySQL configuration file!

You can find your generated MySQL server configuration below. You can place this into your *my.cnf* or *my.ini* file. Remember, although this is designed to be a good starting configuration for installing a new server, it may not include all options you need. This configuration should not be used to fine-tune an existing server.

```
# Generated by Percona Configuration Wizard (http://tools.percona.com/) version REL1-20120105
# Configuration name server-27 generated for pz@percona.com at 2012-01-19 20:54:57

[mysql]

# CLIENT #
port                           = 3306
socket                         = /var/lib/mysql/data/mysql.sock

[mysqld]

# GENERAL #
user                           = mysql
default_storage_engine         = InnoDB
socket                         = /var/lib/mysql/data/mysql.sock
pid_file                       = /var/lib/mysql/data/mysql.pid

# MyISAM #
key_buffer_size                = 32M
myisam_recover                 = FORCE,BACKUP

# SAFETY #
max_allowed_packet             = 16M
max_connect_errors             = 1000000
skip_name_resolve              = 1
```

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Lets Look at the Options Now

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

Getting Status Variables

- We refer to **SHOW GLOBAL STATUS** output in many descriptions
- pt-mext from Percona Toolkit 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 number of tables + 10% 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 **GRANT**s

- **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 a real performance killer with slow drives.
- **expire_log_days**
  - Purge old binary logs after this number of days
  - 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
- Beware 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 around 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 offer
  - 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.

- **tmpdir=/dev/shm**

MyISAM Options

- **key_buffer_size**
  - Cache MyISAM Tables 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 ¼ 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 ½ 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. “cont” for HDD.

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 a 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 use of 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=1**
    - Get advanced table and index usage statistics in Percona Server and MariaDB

Summary

- Many options to chose from!
- 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.

Thank You!

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