# How to Upgrade Like a Boss to MySQL 8.0

Upgrading successfully to latest version

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Oct 2019

# Who Am I? @ask_dba

Born to Sail, Forced to Work
- Open Source Database Evangelist
- Global Database Operations Expert
- Cloud Infrastructure Architect AWS
- Inspiring Technical and Strategic Leader
- Creative Team Builder
- Speaker, Mentor, and Coach

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Solutions for your success with MySQL, PostgreSQL, and MongoDB

Support, Managed Services, Consulting, Software, and Tools

Our Software is 100% Open Source

Support Broad Ecosystem – MySQL, MariaDB, Amazon RDS, MongoDB, PostgreSQL

In Business over 10 years

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# Most Recent Percona Software Updates Sep 2019

Percona Server for MySQL 8.0.16-7

Percona Server for MongoDB 4.2.0.1

Percona XtraDB Cluster 5.7.25-31.39

Percona XtraBackup 8.0.7

Percona Monitoring and Management 2.0.1

Percona Toolkit 3.1.0

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# Agenda

Why even upgrade?

How we always did it in the past?

MySQL 8.0 is great!

How to upgrade?

Nice things about MySQL Shell

Latest news on MySQL 8.0

Conclusion Q&A

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# Why Even Upgrade?

Feature rich and secure version is always a right choice

# Because MySQL 8 is Good ☺

- SQL DML
  - Window Functions, Recursive/Non-Recursive CTEs, Derived Tables,…
- SQL DDL
  - Instant ADD/RENAME Column,…
- INDEXES
  - Invisible/Descending/Functional Indexes,…
- FUNCTIONS
  - Regexp_%, UUID,…
- JSON
  - JSON_%, Sorting, In-place

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# Because MySQL 8 is Better ☺

- GIS
  - Spatial Reference Systems, ST functions, Geography Support
- Character Sets and Collations
  - UTF-8, Unicode 9.0, …
- Information Schema
  - Views over Data Dictionary, New Views, …
- Performance Schema
  - Indexes, Error handling, Data Locks, Latency histograms
- Show
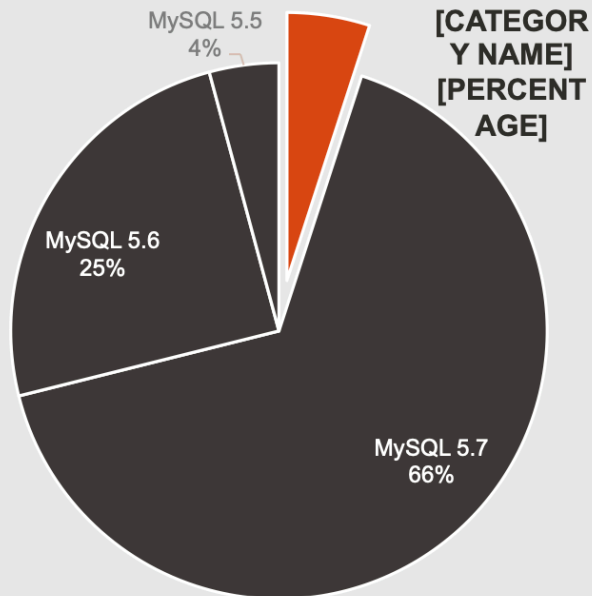  - Hidden columns, Index information

# Because MySQL 8 is Great ☺

- Optimizer
  - Histograms, Hints,
- InnoDB
  - Redo Log, Encryption, ...
- Data Dictionary and Upgrade
  - Transactional DD, Meta Data in InnoDB, Auto Upgrade
- Replication / Group Replication
  - Binlog Encryption, Atomic DDL Recovery /  Savepoints, Switchovers, Auto-rejoin
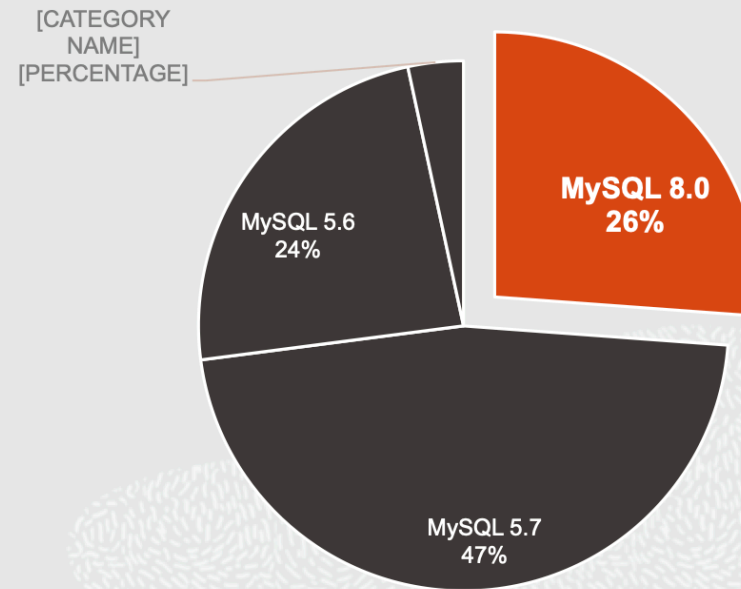- Security, Shell, Router and many more features.

# Fast Adoption to MySQL 8.X

**MySQL 8.0: Fast Adoption**

**April 2018 (8.0 GA)**

MySQL 5.5 4%

MySQL 5.6 25%

[CATEGORY NAME] [PERCENTAGE]

MySQL 5.7 66%

**August 2019**

[CATEGORY NAME] [PERCENTAGE]

MySQL 5.6 24%

MySQL 8.0 26%

MySQL 5.7 47%

Ref: PLEAMS19 MySQL State of the Dolphin Geir Høydalsvik Keynote © 2019 Percona

# Pros of Upgrading to New Version

- Rich features (Business specific needs)
- Technical advantages (QPS, Throughput, Administration)
- Avoid multiple version upgrades
- Bug fixes
- Security and Compliance
- Community and Vendor support

# Cons of Upgrading to New Version

- Risks of hitting unknown issues
- Different behavior and results
- Slower throughput due to
  - sql_mode, Optimizer, Charset, etc
- Amount of time and material needed for upgrade project
- Downtime that is scheduled to happen
- Downgrade from MySQL 8.0 to MySQL 5.7 is not supported.
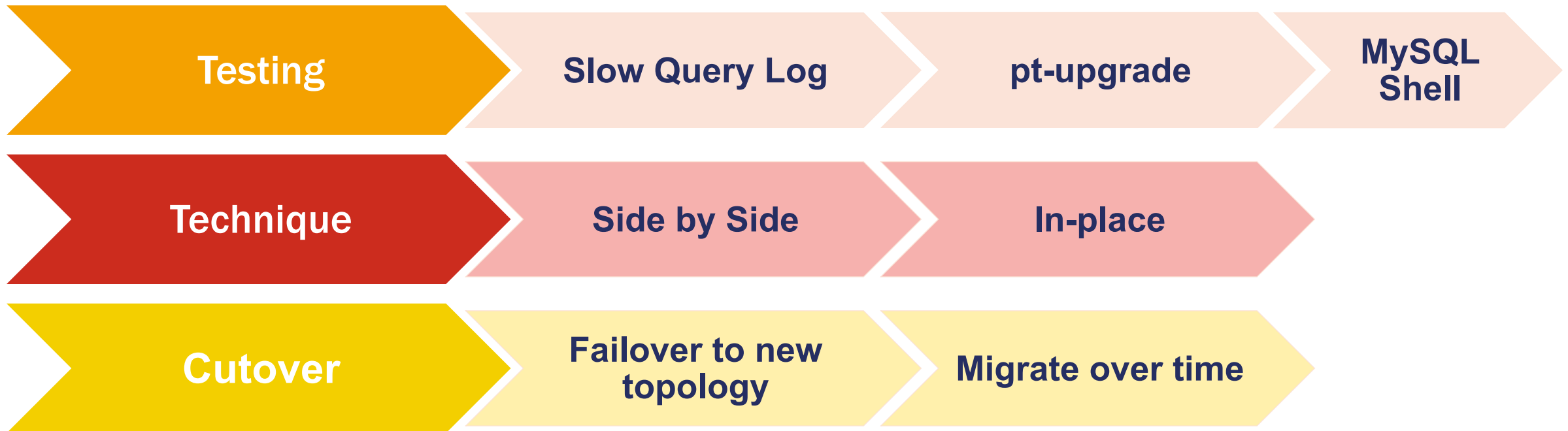
# How We Always Upgraded?

The good old-fashioned way, maybe

# Traditionally pre-V8

- Major versions only (Ascending Order)
  - 5.1 → 5.5
  - 5.5 → 5.6
  - 5.6 → 5.7
  - Set innodb_fast_shutdown=0
  - Stop existing MySQL server
  - Change binaries to new version
  - Adjust config (my.cnf) to new version
  - Start MySQL server
  - Run mysql_upgrade(Time Consuming)
  - Restart MySQL Server  (Additional Downtime)

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# MySQL 8.0 Upgrade Process

| Testing | Slow Query Log | pt-upgrade | MySQL Shell |
|---------|----------------|------------|-------------|

| Technique | Side by Side | In-place |
|-----------|--------------|----------|

| Cutover | Failover to new topology | Migrate over time |
|---------|--------------------------|-------------------|

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# Before You Even Start Testing

- Review release notes
- Changes in defaults
- Features of new version

- Removed syntax
- Deprecated functions (GIS)
- Data restrictions
- New keywords
- Changed behavior

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# Testing Phase

Setup a new testing environment
- Setup slaves as replication
  - Keep it for a month on no-access server
  - Try read testing batch testing
  - Verify schema / connectivity compatibility
  - Use ProxySQL (mirroring, traffic routing)
  - Inspect slow query log

Build independent cluster
- Query testing
  - Capture slow queries and digest (pt-query-digest)
  - pt-upgrade
- Application testing
  - Verify results

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# Run pt-upgrade to Compare Queries

What does it achieve?
- Identify:
  - Query execution time
  - Query row counts
  - Query checksum

How does it achieve?
- Writer Handle – Master Write
- Reader Handler (Read Only)
- Master Reader Handle
- Reporting Reader Handle

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# Steps to Verify via pt-upgrade (High Level)

1. Setup two slaves with same hardware one of them MySQL 8
2. Capture queries *(long_query_time=0)* for 24 hours
3. Detach slaves and run pt-query-digest (*pt-query-digest --output=slowlog --sample=10 --no-report > slow.log*)
4. Run pt-upgrade with (*--max-examples=1*)
5. Repeat (after with warm buffer pool)
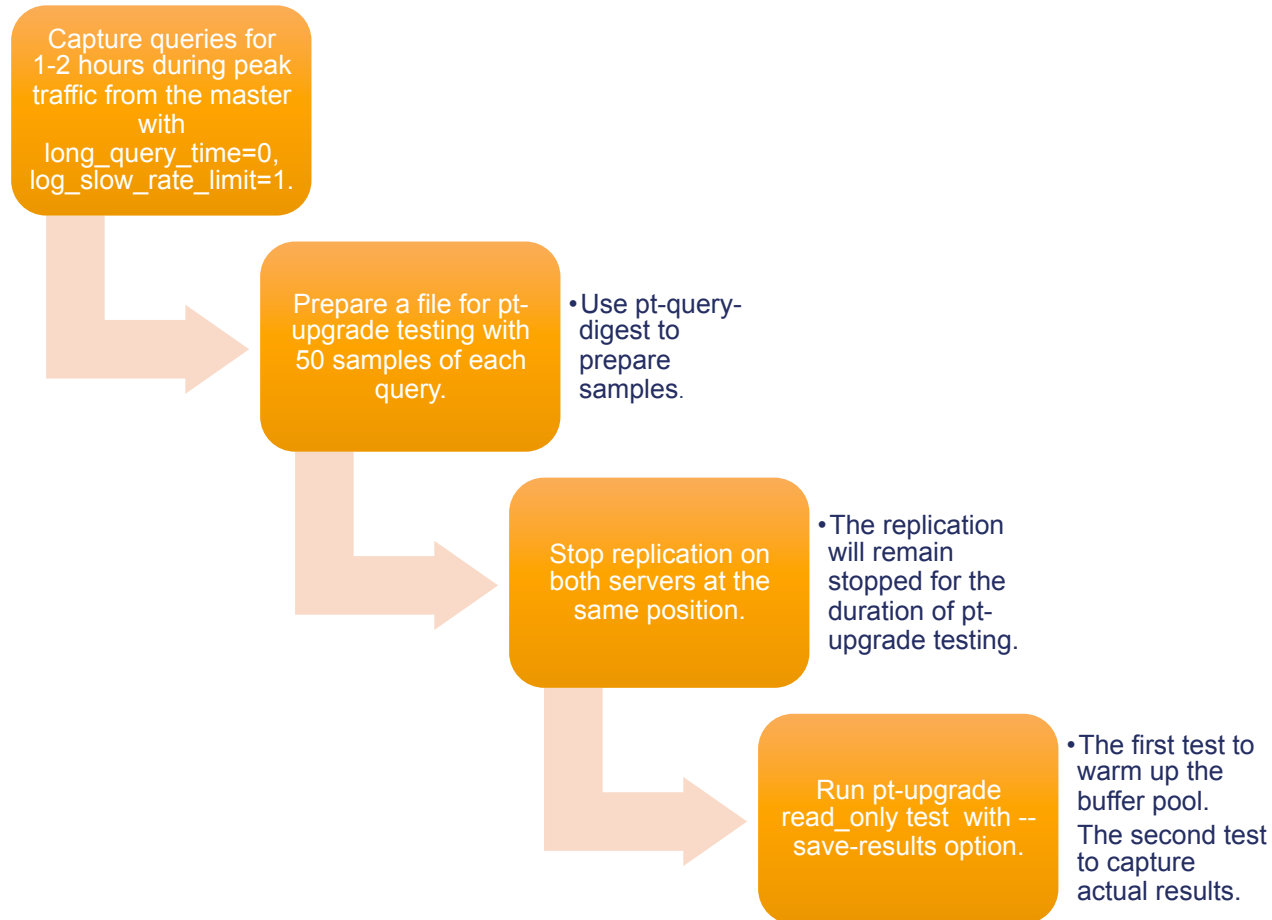6. Review and analyze results

# Steps to Verify via pt-upgrade RO (Detailed)

1. *$ pt-query-digest --sample 25 --no-report --output slowlog <slow_log_file> >  slow_log_25_samples.log*

2. *$pt-upgrade h=Test1 h=Test2 --max-examples=1 slow_log_25_samples.log 1> pt-upgrade_results.out 2>  pt-upgrade_results.err*

# Steps to Verify via pt-upgrade RW (Detailed)

1. `$ pt-query-digest --sample 25 --no-report --output slowlog <slow_log_file> >  slow_log_25_samples.log`
2. `$ pt-upgrade h=Test1 h=Test2  --no-read-only --max-examples=1 slow_log_25_samples.log 1> pt-upgrade_results.out 2>  pt-upgrade_results.err`

# Summary pt-upgrade Testing

Capture queries for 1-2 hours during peak traffic from the master with long_query_time=0, log_slow_rate_limit=1.

Prepare a file for pt-upgrade testing with 50 samples of each query.

- Use pt-query-digest to prepare samples.

Stop replication on both servers at the same position.

- The replication will remain stopped for the duration of pt-upgrade testing.

Run pt-upgrade read_only test with --save-results option.

- The first test to warm up the buffer pool.
- The second test to capture actual results.

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# MySQL Shell in a Nutshell

Nice things about MySQL Shell

# The new MySQL Shell

- DBA friendly
  - Color mode
  - Auto Complete
  - Highlighted Syntax
  - History , pager/less
  - Multiple output formats

- Development friendly
  - SQL
  - JavaScript
  - Batch
  - Document Store
  - InnoDB Cluster Admin

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# How Can MySQL Shell help?
## *(upgrade_checker)*

- Built-in function *util.checkForServerUpgrade()*

The MySQL server at localhost:33060, version 5.7.26-29 - Percona Server (GPL),

Release 29, Revision 11ad961, will now be checked for compatibility issues for

upgrade to MySQL 8.0.16...

1) Usage of old temporal type

  No issues found

2) Usage of db objects with names conflicting with reserved keywords in 8.0

  No issues found

3) Usage of utf8mb3 charset

  No issues found

4) Table names in the mysql schema conflicting with new tables in 8.0

  No issues found

5) Foreign key constraint names longer than 64 characters

  No issues found

…

# MySQL Shell Can Do Even More ([mydba](#))

```
mysqlsh --py root@localhost

 import sys
 sys.path.append('/home/fred/workspace/mysql-shell-mydba')
 import mydba


MySQL  localhost:33060+ ssl  Py > mydba.getProcedures('airline')
Total: 0
 MySQL  localhost:33060+ ssl  Py > mydba.getFragmentedTables()
```

| Table | Engine | # Rows | Data Size | Idx Size | Total Size | Data Free |
|---|---|---|---|---|---|---|
| information_schema.COLUMNS | InnoDB | None | 0.00G | 0.00G | 0.00G | 8.00MB (100%) |
| information_schema.EVENTS | InnoDB | None | 0.00G | 0.00G | 0.00G | 8.00MB (100%) |
| information_schema.OPTIMIZER_TRACE | InnoDB | None | 0.00G | 0.00G | 0.00G | 8.00MB (100%) |

## https://github.com/lefred/mysql-shell-mydba

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# MySQL Shell Can Do Even More (innotop)

```
mysqlsh --py root@localhost

import sys
sys.path.append('/home/fred/workspace/mysql-shell-innotop')
import innotop


innotop.session_processlist.run()
```

MySQL Shell | Percona Server ( GPL ), Release 29, Revision 11ad961 5.7.26–29                    Tuesday 18 June 10:46:23

| Cmd | Thd | Conn | Pid | State | User | Db | Time | Lock Time | Query |
|-----|-----|------|-----|-------|------|----|------|-----------|-------|
| Sleep | 8002 | 7972 | 18925 | None | root@localhost | airline | None | 96.07 ms | None |

## https://github.com/lefred/mysql-shell-innotop

# Upgrade Checker Identifies

- Reserved Data Dictionary table names (catalogs)
- Old Style Decimals, Varchar, Time/Datetime/Timestamp
  - CHECK TABLE {table_name} FOR UPGRADE
  - Mysqlcheck
  - Check-upgrade in 5.7
    - Use REPAIR TABLE & Dump/Restore
- Partitioned tables using non-native partitioning was deprecated in 5.7 removed in 8.0
  - Switch to native partitioning or not

# Upgrade Checker Does NOT Identify

- Removed syntax
- Deprecated functions (GIS)
- Data restrictions
- New keywords
- Changed behavior
- Change in defaults

# MySQL Upgrade 5.7 to 8.0 (In-place)

- 5.7 to 8.0
  - Stop existing MySQL server
  - Change binaries to new version
  - Adjust config (my.cnf) to new version
  - Start MySQL server
    - Automatic upgrade
    - New mysqld options
      - --upgrade=AUTO  (default)
      - --upgrade=NONE (errors if anything needs upgrade)
      - --upgrade=MINIMAL (to avoid DDL on some system tables)
      - --upgrade=FORCE
  - Eliminates issues with metadata using transactional data dictionary

# MySQL Upgrade 5.7 to 8.0 (Replication & Rolling Upgrade)

- 5.7 to 8.0
  - Stop existing MySQL Slave server
  - Change binaries to new version
  - Adjust config (my.cnf) to new version
  - Start MySQL server
    - Automatic upgrade
    - New mysqld options
      - --upgrade=AUTO  (default)
      - --upgrade=NONE (errors if anything needs upgrade)
      - --upgrade=MINIMAL (to avoid DDL on some system tables)
      - --upgrade=FORCE
  - Eliminates issues with metadata using transactional data dictionary
  - Repeat above for minimum of 2 slaves and promote one as master

# MySQL 8.0 Upgrade

```
 MySQL  localhost:33060+ ssl  SQL > show global variables like "innodb_fast_shutdown";
+----------------------+-------+
| Variable_name        | Value |
+----------------------+-------+
| innodb_fast_shutdown | 1     |
+----------------------+-------+
1 row in set (0.0037 sec)


 MySQL  localhost:33060+ ssl  SQL > set global innodb_fast_shutdown=0;
Query OK, 0 rows affected (0.0007 sec)


 MySQL  localhost:33060+ ssl  SQL > show global variables like "innodb_fast_shutdown";
+----------------------+-------+
| Variable_name        | Value |
+----------------------+-------+
| innodb_fast_shutdown | 0     |
+----------------------+-------+
1 row in set (0.0054 sec)
```

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# MySQL 8.0 Packages

| Package | Contains |
|---|---|
| percona-server-server | The server itself (the `mysqld` binary) |
| percona-server-debuginfo | Debug symbols for the server |
| percona-server-client | The command line client |
| percona-server-devel | the header files needed to compile software using the client library. |
| percona-server-shared | The client shared library. |
| percona-server-shared-compat | Shared libraries for software compiled against old versions of the client library. The following libraries are included in this package: `libmysqlclient.so.12`, `libmysqlclient.so.14`, `libmysqlclient.so.15`, `libmysqlclient.so.16`, and `libmysqlclient.so.18`. |
| percona-server-test | package includes the test suite for *Percona Server for MySQL*. |

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# Percona Server for MySQL 8.0 yum Installation - Repo

Install the Percona repository

You can install Percona yum repository by running the following command as a root user or with sudo:

$ sudo yum install https://repo.percona.com/yum/percona-release-latest.noarch.rpm
You should see some output such as the following:

Retrieving http://www.percona.com/downloads/percona-release/redhat/0.1-6/percona-release-latest.noarch.rpm
Preparing...                    ############################################ [100%]
1:percona-release         ############################################ [100%]
Enable the repository:

$ sudo percona-release setup ps80
Install the packages

You can now install Percona Server for MySQL by running:

$ sudo yum install percona-server-server

# Percona Server for MySQL 8.0 yum Installation - Yum

```
Installed:
  percona-server-server.x86_64 0:8.0.15-6.1.el7


Dependency Installed:
  percona-server-client.x86_64 0:8.0.15-6.1.el7          percona-server-shared.x86_64 0:8.0.15-6.1.el7
percona-server-shared-compat.x86_64 0:8.0.15-6.1.el7


Complete!
```

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# Percona Server for MySQL 8.0 [yum](#) Installation - Connectivity

```
 MySQL  localhost:33060+ ssl  SQL > \s
MySQL Shell version 8.0.16

Session type:          X
Connection Id:          16
Default schema:
Current schema:
Current user:          root@localhost
SSL:          Cipher in use: ECDHE_RSA_AES128_GCM_SHA256 TLSv1.2
Using delimiter:          ;
Server version:          8.0.15-6 Percona Server (GPL), Release 6, Revision 63abd08
Protocol version:          X protocol
Client library:          8.0.16
Connection:          localhost via TCP/IP
TCP port:          33060
Server characterset:          utf8mb4
Schema characterset:          utf8mb4
Client characterset:          utf8mb4
Conn. characterset:          utf8mb4
Uptime:          2 min 26.0000 sec
```

# Percona Server for MySQL 8.0 yum Installation - Errorlog

2019-06-18T14:11:42.790252Z 0 [System] [MY-010116] [Server] /usr/sbin/mysqld (mysqld 8.0.15-6) starting as process 29198

2019-06-18T14:11:47.731578Z 0 [ERROR] [MY-013180] [Server] Function 'mysqlx' already exists.

2019-06-18T14:11:47.731590Z 0 [Warning] [MY-010736] [Server] Couldn't load plugin named 'mysqlx' with soname 'mysqlx.so'.

2019-06-18T14:11:47.738319Z 0 [Warning] [MY-013129] [Server] A message intended for a client cannot be sent there as no client-session is attached. Therefore, we're sending the information to the error-log instead: MY-001287 - 'validate password plugin' is deprecated and will be removed in a future release. Please use validate_password component instead

2019-06-18T14:11:49.700555Z 0 [Warning] [MY-010068] [Server] CA certificate ca.pem is self signed.

2019-06-18T14:11:49.709724Z 0 [ERROR] [MY-013129] [Server] A message intended for a client cannot be sent there as no client-session is attached. Therefore, we're sending the information to the error-log instead: MY-001146 - Table 'mysql.component' doesn't exist

2019-06-18T14:11:49.709743Z 0 [Warning] [MY-013129] [Server] A message intended for a client cannot be sent there as no client-session is attached. Therefore, we're sending the information to the error-log instead: MY-003543 - The mysql.component table is missing or has an incorrect definition.

2019-06-18T14:11:49.719544Z 0 [Warning] [MY-010929] [Server] Storage engine 'MyISAM' does not support system tables. [mysql.user].

2019-06-18T14:11:49.719552Z 0 [Warning] [MY-010929] [Server] Storage engine 'MyISAM' does not support system tables. [mysql.db].

2019-06-18T14:11:49.719561Z 0 [Warning] [MY-010929] [Server] Storage engine 'MyISAM' does not support system tables. [mysql.tables_priv].

2019-06-18T14:11:49.719568Z 0 [Warning] [MY-010929] [Server] Storage engine 'MyISAM' does not support system tables. [mysql.columns_priv].

2019-06-18T14:11:49.719576Z 0 [Warning] [MY-010929] [Server] Storage engine 'MyISAM' does not support system tables. [mysql.procs_priv].

2019-06-18T14:11:49.719587Z 0 [Warning] [MY-010929] [Server] Storage engine 'MyISAM' does not support system tables. [mysql.proxies_priv].

2019-06-18T14:11:49.720019Z 0 [ERROR] [MY-013143] [Server] Column count of mysql.user is wrong. Expected 51, found 45. The table is probably corrupted

2019-06-18T14:11:49.720107Z 0 [Warning] [MY-010966] [Server] ACL table mysql.role_edges missing. Some operations may fail.

2019-06-18T14:11:49.720125Z 0 [Warning] [MY-010966] [Server] ACL table mysql.default_roles missing. Some operations may fail.

2019-06-18T14:11:49.720135Z 0 [Warning] [MY-010966] [Server] ACL table mysql.global_grants missing. Some operations may fail.

2019-06-18T14:11:49.720143Z 0 [Warning] [MY-010966] [Server] ACL table mysql.password_history missing. Some operations may fail.

2019-06-18T14:11:49.721700Z 0 [ERROR] [MY-010965] [Server] Missing system table mysql.global_grants; please run mysql_upgrade to create it.

2019-06-18T14:11:49.727806Z 0 [Warning] [MY-010727] [Server] System table 'func' is expected to be transactional.

2019-06-18T14:11:49.729669Z 0 [Warning] [MY-010405] [Repl] Info table is not ready to be used. Table 'mysql.slave_master_info' cannot be opened.

2019-06-18T14:11:49.729696Z 0 [ERROR] [MY-010422] [Repl] Error in checking mysql.slave_master_info repository info type of TABLE.

2019-06-18T14:11:49.729707Z 0 [ERROR] [MY-010415] [Repl] Error creating master info: Error checking repositories.

2019-06-18T14:11:49.729716Z 0 [ERROR] [MY-010426] [Repl] Slave: Failed to initialize the master info structure for channel ''; its record may still be present in 'mysql.slave_master_info' table, consider deleting it.

2019-06-18T14:11:49.729735Z 0 [ERROR] [MY-010529] [Repl] Failed to create or recover replication info repositories.

2019-06-18T14:11:49.732745Z 0 [System] [MY-010931] [Server] /usr/sbin/mysqld: ready for connections. Version: '8.0.15-6'  socket: '/var/lib/mysql/mysql.sock'  port: 3306  Percona Server (GPL), Release 6, Revision 63abd08.

2019-06-18T14:11:49.750837Z 0 [System] [MY-011323] [Server] X Plugin ready for connections. Socket: '/var/lib/mysql/mysqlx.sock' bind-address: '::' port: 33060

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# Run mysql_upgrade (8.0.15-6)

```
[root@localhost ~]# screen -r download_airline

Checking server version.
Running queries to upgrade MySQL server.
Upgrading system table data.
Checking system database.
mysql.default_roles                                OK
mysql.engine_cost                                  OK
…
Found outdated sys schema version 1.5.1.
Upgrading the sys schema.
Checking databases.
airline.ontime                                     OK
sys.sys_config                                     OK
Upgrade process completed successfully.
Checking if update is needed.
```

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# Best Practices

- Upgrade slaves first
- Beware of optimizer changes
- Watch default values
- Pay attention to reserve words
- Inspect character sets, file types
- Prepare tooling, backups and monitoring in advance
- Plan your rollback scenarios

# Latest News on MySQL 8.0.X

Minor versions aren't minor anymore

# MySQL 8.0.16

- 8.0.0 to 8.0.5 Several Bugs Fixed
- 8.0.11 Deprecates uft8mb3
- 8.0.12 Improves performance_schema defaults
- 8.0.13 Major deprecations InnoDB, Partitioning
- 8.0.14 Dual passwords, Lateral Derived Tables, Parallel Read of Index , GR Consistency Levels
- 8.0.15 Bugs Fixed
  - InnoDB: After a checkpoint operation persisted modifications to data dictionary metadata, there was potential for new metadata changes to be lost under certain circumstances. (Bug #29120297)
  - Group Replication was unable to function in the 8.0.14 release of MySQL Server if IPv6 support was disabled at the operating system level, even if the replication group did not use any IPv6 addresses. The issue is fixed by this release of MySQL Server, 8.0.15. (Bug #29249542, Bug #94004)
  - If MySQL was running on the host system and within Docker, it was not possible to update or remove MySQL on the host system. (Bug #28244773, Bug #91405)8.0.0 to 8.0.11 several bug fixes
- 8.0.16  Account-management capabilities, deprecation of mysql_upgrade, Check Constraints, GR Auto Re-Join
- 8.0.17 Clone Plugin, JSON Array Indexes and Schema
- 8.0.18 Hash Join, Explain Analyze

# Percona Server for MySQL 8.0.16-7

- Faster and more consistently run queries
- Enhanced security with binary log (binlog) encryption and data-at-rest encryption
- MyRocks, TokuDB Storage Engines
- InnoDB Full-Text Search Improvements
- Extra Hash/Digest Functions
- Improved diagnostics with instrumentation and troubleshooting features

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percona.com/community-blog

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- Contribute to our open source
projects



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**github.com/percona**

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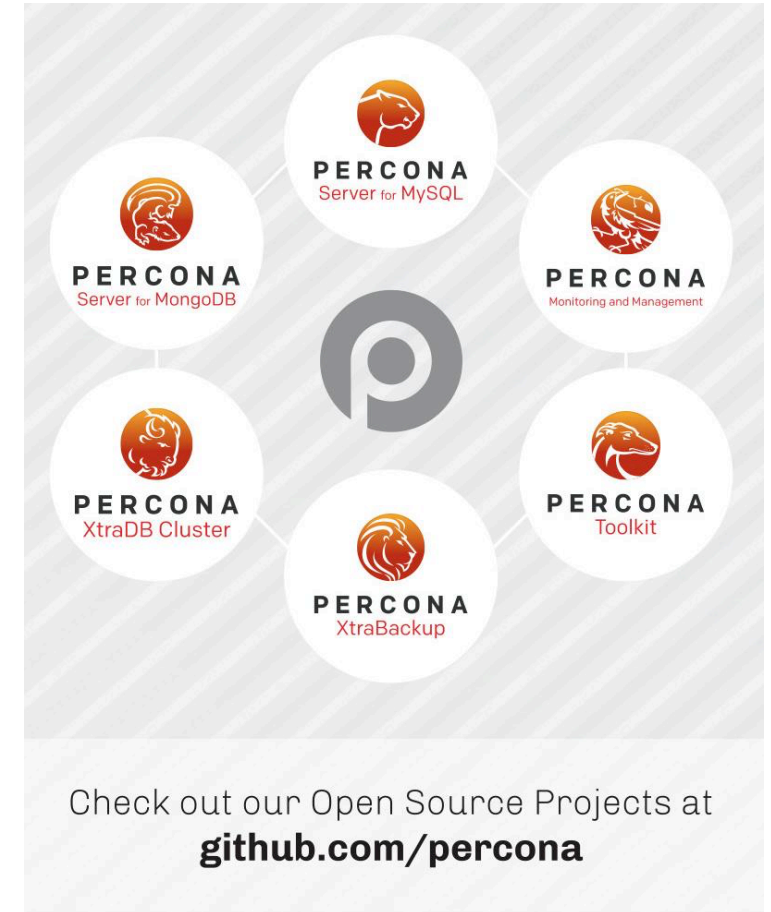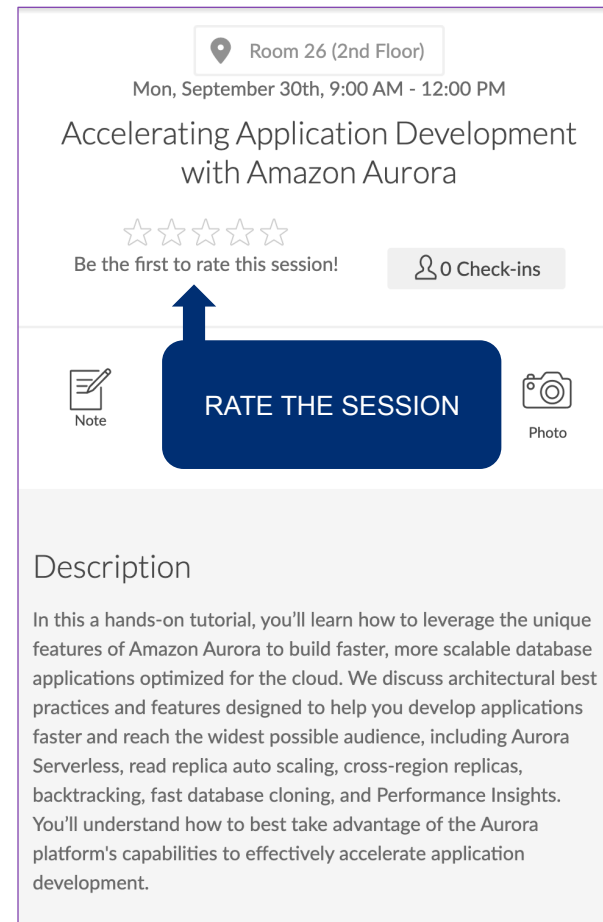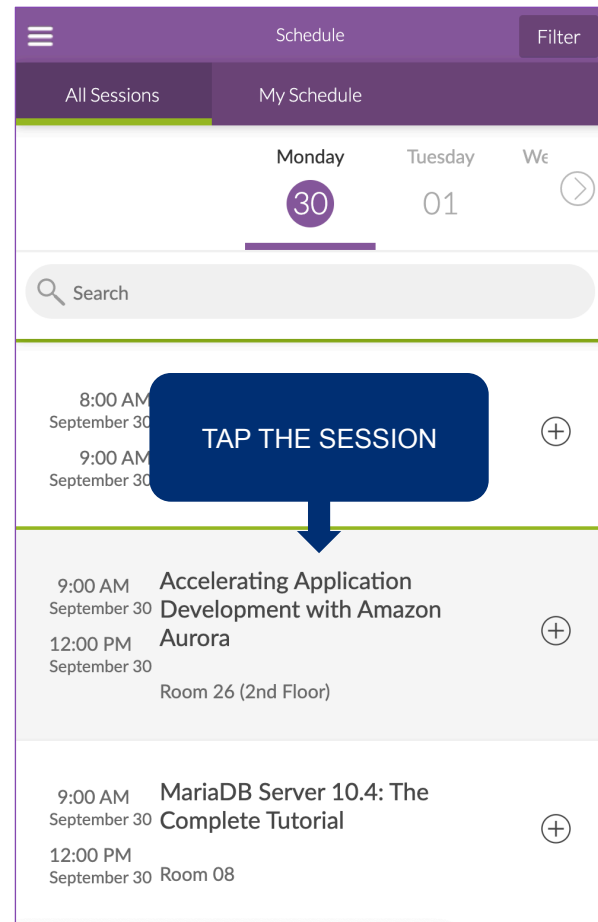
# We're Hiring!

Percona's open source database experts are true **superheroes**, improving database performance for customers across the globe.

Our staff live in nearly 30 different countries around the world, and most work remotely from home.

Discover what it means to have a Percona career with the smartest people in the database performance industries, solving the most challenging problems our customers come across.
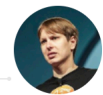


**glassdoor**

4.8 ★★★★★  ☰ Rating Trends

96% Recommend to a Friend

100% Approve of CEO

Peter Zaitsev
45 Ratings

Jul 12, 2019

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**"Best company I have ever worked for"**

★★★★★ ▼   Current Employee - Solutions Engineer

■ Recommends   ■ Positive Outlook   ■ Approves of CEO

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# References and Links

- [Automatic Upgrade and New Error Logging in MySQL 8.0](#)
- [MySQL Shell - A DevOps-engineer day with MySQL's development and administration tool](#)
- [Upgrading to MySQL 8.0? Here is what you need to know…](#)
- [Changes in MySQL 8.0](#)
- [The complete list of new features in MySQL 8.0](#)
- [Reducing Risk When Upgrading MySQL](#)
- [Changes in MySQL 8.0](#)
- [MySQL 8.0.16: mysql_upgrade is going away](#)

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# Credits

- @lefred  for answering my numerous questions
- My team at Percona helping review this presentation

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# Thank You