MySQL: Crash Course Introduction

Keith Larson
keith.larson@oracle.com
MySQL Community Manager
The following is intended to outline our general product direction. It is intended for information purposes only, and may not be incorporated into any contract. It is not a commitment to deliver any material, code, or functionality, and should not be relied upon in making purchasing decisions.

The development, release, and timing of any features or functionality described for Oracle’s products remains at the sole discretion of Oracle.
Who am I and who are you?

Keith Larson
keith.larson@oracle.com
MySQL Community Manager
sqlhjalp.blogspot.com

Started with MySQL during the dot.com days. Primary real world work was with a MySQL InnoDB replicated chain environment that easily held over 4 billion rows of user data. Numerous other sites developed on LAMP stack over the last 13 years.

Who are you?
- DBAs?
- Developers?
- Already have replicated databases?
- Cluster Users or Cluster curious?
Agenda

- Oracle's Investment into MySQL
- Provide high-level overview
- Familiarize with the key concepts
- Emphasize MySQL specificity
- Community Edition, version 5.5 GA
The official way to pronounce “MySQL” is “My Ess Que Ell”

but we do not mind if you pronounce it as “my sequel”
MySQL Crash Course

Background of MySQL

Started in 80s
Acquired by SUN Microsystems in 2008 for 1B USD
Acquired by Oracle in 2009
Dual licensing: GPL v.2 + commercial
“M” in “LAMP” stack
Easy of use: the 15 minute rule
MySQL Makes The Cover!
Hardware and Software
Engineered to Work Together

Built together
Tested together
Managed together
Serviced together
Based on open standards
Lower cost
Lower risk
More reliable

MySQL Completes The Stack
More Product Releases Than Ever Before
Continuous Innovation

Q2 CY2010
- MySQL Workbench 5.2
- MySQL Database 5.5
- MySQL Enterprise Backup 3.5
- MySQL Enterprise Monitor 2.3
- MySQL Cluster Manager 1.1
  All GA!

Q3 CY2010
- MySQL Database 5.6
- MySQL Cluster 7.2
  DMR*
  and MySQL Labs!
  (“early and often”)

Q4 CY2010
- MySQL Enterprise Monitor 2.2
- MySQL Cluster 7.1
- MySQL Cluster Manager 1.0
  All GA!

Q1 CY2011
- MySQL Database 5.5
  DMGA!

Q2 CY2011

A Better MySQL

*Development Milestone Release
Industry Leading Customers

Web
- Google
- eBay
- Flickr
- Zillow.com
- Wikipedia
- Mixi
- Velocity
- YouTube
- Yahoo!

OEM / ISV’s
- Sage
- Ingenico
- Tripwire
- Check Point
- SafeNet
- Adobe

SaaS, Cloud
- SurfControl
- Zimbra
- F-Secure
- RightNow Technologies

Telecommunications
- SFR
- T-Mobile (Deutsche Telekom)
- Comcast
- Ericsson
- Alcatel-Lucent
- Telenor

Enterprise 2.0
- Lafarge
- Toys"R"Us
- Associated Press
- Minister of Home Affairs
- Shinsei Bank

Rely on MySQL
70% of Oracle shops run MySQL

MySQL: Still Free, Open to the Community
Available to download and use under the GPL:
- MySQL Database (Community Server)
- MySQL Cluster
- MySQL Workbench Community Edition
- MySQL Connectors
- MySQL Proxy
- Documentation (free to use, not covered under GPL)
- Forums

mysql.com/downloads/
MySQL 5.5 Early Adopters Speak!

“I’m really blown away by MySQL 5.5’s improvements. “
- Don MacAskill, SmugMug

“My expectations for 5.5 were not high. I am pleasantly surprised!”
- Mark Callaghan, Facebook, MySQL UC Keynote

"Oracle really did a great job with MySQL 5.5 -- in record time! It has lots of new features and performance improvements that our customers need and want. We're very excited about this release."
- Sheeri K. Cabral, Oracle Ace Director and Database Operations Manager, PalominoDB
MySQL Server

**Standalone (mysqld)**
- UNIX daemon
- Windows service
- Regular process on UNIX or Windows

**Embedded (libmysqld)**
- Shared / Dynamic library
MySQL Server Components

The Core

Plugins

- Storage Engines
- Full-text search plugins
- Audit plugins
- Authentication plugins
- ...
MySQL Server Components

Storage Engine

SE defines data storage and retrieval
Every regular table belongs to some SE
Most known Storage Engines:
  - InnoDB (default since 5.5) – fully transactional SE
  - MyISAM (default prior to 5.5) – NON-transactional SE
Default Storage Engine
MySQL Database
InnoDB - Transactional by Default

- Default Storage Engine for MySQL 5.5 and above
- ACID-compliant transactions, MVCC
- Row-level locking
- Two phase commit
- Efficient indexing
- Fast DDL operations
- Table compression
- Automatic crash recovery
- Referential integrity
- Online backup
- More
Storage Engines:

Select a specialized storage engine for a particular application need.

**InnoDB**: a high-reliability and high-performance storage engine for MySQL designed for transaction processing. It follows the ACID model. Row-level locking and Oracle-style consistent reads increase multi-user concurrency and performance.

**MyISAM**: oldest storage engine has many features that have been developed over years.

**Memory**: creates tables with contents that are stored in memory. MySQL Cluster offers the same features as the MEMORY engine with higher performance levels, and provides additional features.
Storage Engines:

**CSV**: data file is a plain text file

**ARCHIVE**: is used for storing large amounts of data without indexes in a very small footprint.

**BLACKHOLE**: accepts data but throws it away and does not store it but the binary log is enabled.
MySQL Server Components

Partitioning

Open Source
A Storage Engine
Horizontal partitioning (distribute rows, not columns)
Partitioning functions:
The modulus
Range
Internal hashing function
Linear hashing function
MySQL Server Components

Replication

Open Source
One-way, master and slaves
Asynchronous or Semi-synchronous replication

Replication formats:

- Statement-based replication (SBR): propagate SQL statements
- Row-based replication (RBR): propagate row changes
- Mixed-based replication: SBR or RBR depending on the query
MySQL Replication Overview

Native in MySQL
Used for Scalability and HA
Asynchronous as standard
Semi-Synchronous support added in MySQL 5.5
Each slave adds minimal load on master
MySQL Database

Replication Enables Scalability

- Write to one master
- Read from many slaves, easily add more as needed
- Perfect for read/write intensive apps
Replication Topologies

- Single
- Chain
- Circular
- Multiple
- Multi-Master
- Multi-Circular
MySQL Server Components

Cluster

Open Source
Different source tree, different versioning (7.x)
In-memory, shared-nothing architecture
“Synchronous, multi-master replication”
MySQL Database
High Availability with MySQL Replication
MySQL Architecture
Parallel Database with no SPOF: High Read & Write Performance & 99.999% uptime

MySQL Cluster Data Nodes
MySQL Cluster
Application Nodes

Clients

NoSQL

REST
Java
LDAP

MySQL
Cluster
Mgmt

MySQL Cluster
Data Nodes
Node Failure Detection & Self-Healing Recovery
Cluster – Typical Performance

Availability
  99.999% (<5 min downtime / year)

Performance
  Response Time 2-5 millisecond (with synchronous replication and access via NDB API)
  Throughput of 10,000+ replicated transactions/sec on a 2 Node Cluster, with 1 CPU Per Node (minimal configuration)
  Throughput of 100,000 replicated transactions/sec on 4 Node Cluster, with 2 CPU Per Node (low-end configuration)

Failover
  Sub-second failover enables you to deliver service without interruption
Backup

Overview

The way depends on the application
Possible solutions:
MySQL Enterprise Backup
Replication
mysqldump
...
MySQL Enterprise Backup

- Online Backup for InnoDB
- Full, Incremental, Partial Backups (scriptable interface)
- Compression
- Point in Time, Full, Partial Recovery options
- Metadata on status, progress, history
- Unlimited Database Size
- Cross-Platform
  - Windows, Linux, Unix
- Certified with Oracle Secure Backup

Ensures quick, online backup and recovery of your MySQL apps.
Is it standard SQL?

Yes

aim is to support the full ANSI/ISO SQL standard, but without making concessions to speed and quality of the code

No

Depends on engine
MySQL Concepts

MySQL aims to follow The SQL Standard
Not PL/SQL
Prepared Statements
Views
Stored Programs
SHOW statements and especially SHOW CREATE ...
Administrative statements
**MySQL Concepts**

**Database**

Database or Schema

Current database (per connection)

Database – a set of files in “the data directory”

System database (mysql)

Virtual databases:

  INFORMATION_SCHEMA
  PERFORMANCE_SCHEMA
MySQL Concepts

Unicode

Full Unicode 5.0 for data
Encodings: UTF-8, UTF-16, UTF-32, UCS-2
Two encodings for UTF-8:
  utf8 – 1..3 bytes, BMP only
  utf8mb4 – 1..4 bytes, BMP and supplemental
Alias utf8mb3 == utf8
Metadata are in utf8
  (no supplementary characters in identifiers)
MySQL Concepts

Types

Know your options

9 numeric data types
CHAR, VARCHAR
BLOBs
Date/time types

... Weak typing
SELECT 1 + ' 2nd place' => 3
MySQL Concepts

SQL Conditions

Error: code, level, SQL-state, message
Error messages are localized
Error level: errors, warnings, notes
The actual error level depends on configuration
Serious errors might be thrown as warnings:

```
SELECT 1 + '  2nd place'
Truncated incorrect DOUBLE value: ' 2nd place'
```

SHOW WARNINGS
MySQL Variables

Overview

MySQL Variables

User Variables

Stored Program Variables

System Variables

Status Variables

Session

Global

Session

Global

Read-only

Dynamic

Plain

Structured
MySQL Variables

User Variables:

- Weakly typed
- SESSION variables
- Arbitrary names
- Available for any user
- No declaration needed
- Syntax:
  - SELECT @a
  - SET @a = 1
MySQL Variables

Stored Program Variables

SP Variables:
- Strongly typed
- Only inside SP
- Arbitrary names
- Must be declared
- Syntax:
  - DECLARE x INT
  - SELECT x
  - SET x = 1
MySQL Variables

System Variables:

- Configuration options
- Fixed names
- Fixed types
- GLOBAL requires SUPER

Syntax:
- SET / SELECT @@v1
- SET / SELECT @@session.v1
- SET / SELECT @@global.v2
- SHOW VARIABLES LIKE ...
MySQL Variables

System Variables

Status Variables:
- Read-only
- Provide stat / information
- Not
  PERFORMANCE_SCHEMA
- SHOW GLOBAL STATUS ...
- SHOW SESSION STATUS ...

MySQL Variables

System Variables

User Variables

Stored Program Variables

Session

Global

Session

Global

Read-only

Dynamic

Plain

Structured
MySQL Configuration

Overview

Highly configurable
Command line options
Configuration files (plain-text, INI-like files with groups)
Several configuration files (/etc, $HOME, …)
The last value takes precedence
<exe> --help – order of loading files
SQL interface to get or change configuration parameters
MySQL Configuration

SQL MODE

Very important variable •
Affects data consistency!
It might be remembered ...
... or it might be not
Thus: set it once for all

Recommended:

- STRICT_ALL_TABLES
- NO_ZERO_DATE
- NO_ZERO_IN_DATE
- NO_ENGINE_SUBSTITUTION
- NO_AUTO_CREATE_USER
- ERROR_FOR_DIVISION_BY_ZERO
**MySQL Configuration**

**AUTOCOMMIT**

- SET AUTOCOMMIT = ON | OFF (default: ON)
- Auto-commit means COMMIT after each statement
- Use START TRANSACTION if you plan to use ROLLBACK
- START TRANSACTION == BEGIN [WORK]
MySQL Configuration

Identifier Case Sensitivity

Database name – directory name
Table name – file name(s)
Case-sensitive or case-insensitive?
lower_case_table_names = 0, 1, 2
  Defines how to name files on disk
  Defines how to compare
So: use lowercase everywhere
# Connecting to The Server

## Overview

<table>
<thead>
<tr>
<th>Protocol</th>
<th>Connection Type</th>
<th>Operating Systems</th>
</tr>
</thead>
<tbody>
<tr>
<td>TCP/IP</td>
<td>Local and Remote</td>
<td>Any</td>
</tr>
<tr>
<td>UNIX Socket File</td>
<td>Local only</td>
<td>UNIX</td>
</tr>
<tr>
<td>Named Pipe</td>
<td>Local only</td>
<td>Windows</td>
</tr>
<tr>
<td>Shared Memory</td>
<td>Local only</td>
<td>Windows</td>
</tr>
</tbody>
</table>

Named Pipe and Shared Memory are disabled by default. IPv4 and IPv6 connectivity supported.
Connecting to The Server

Hints

--bind-address can be of use (all: 0.0.0.0)

Beware:

‘s’mysql -pfoo’ != ‘mysql -p foo’
   -pfoo means password is ‘foo’
   -p foo means “ask password”, and the default database is ‘foo’

mysql does SHOW DATABASES and SHOW TABLES on connect
Understanding Privileges

Basics

User or User Account
Privilege – what is allowed for the user
SHOW GRANTS – get privileges for the current user
SHOW GRANTS FOR …
SHOW PRIVILEGES – list of all available privileges
Understanding Privileges

Hierarchy

Global:          GRANT SELECT    ON *.*    TO ...
Database:        GRANT SELECT    ON db1.*  TO ...
Table:           GRANT SELECT    ON db1.t1 TO ...
Column:          GRANT SELECT(a) ON db1.t1 TO ...

Server administration privileges – global only
  SUPER
  USAGE

Other privileges
Understanding Privileges

Beware of …

SUPER

A “different” privilege
Ignores init_connect
Bypasses read_only

…

GRANT ALL ON *.* … grants SUPER!

USAGE

Allows the user to just connect to the server
Mind the default database in client connections
Understanding Privileges

Beware of …

WITH GRANT OPTION

enables the user to give to / to remove from other
users those privileges that the user has

GRANT SELECT ON db1.* TO foo@bar WITH
GRANT OPTION
GRANT DELETE ON db1.* TO foo@bar
SHOW GRANTS FOR foo@bar
-> GRANT SELECT, DELETE ON db1.*
   TO foo@bar WITH GRANT OPTION
Understanding Privileges

Identifying the User

User: username@hostname
Precisely: ‘user-name-mask’@’host-name-mask’
Host name – client host name (“from” host name)
User name mask:
   can be empty (anonymous user) – all users
Host name mask:
   can be empty – all host names
   can have ‘%’ (e.g.: %.foo.com)
Understanding Privileges

Anonymous users...

Connecting as foo from localhost…
Should be foo@%, right?
The most specific values are used
BUT: host name matching is done before user name

<table>
<thead>
<tr>
<th>host</th>
<th>user</th>
</tr>
</thead>
<tbody>
<tr>
<td>localhost</td>
<td>bar</td>
</tr>
<tr>
<td>localhost</td>
<td></td>
</tr>
<tr>
<td>%</td>
<td>foo</td>
</tr>
</tbody>
</table>

"@localhost will be chosen!
Understanding Privileges

Useful Functions

SELECT CURRENT_USER()
  The authenticated user name and host name

SELECT USER()
  The user name and host name provided by the client

For our example:
  CURRENT_USER(): "@localhost
  USER():     foo@localhost
Working With Tables

Overview

Regular tables
Temporary tables (per session)
Views
INFORMATION_SCHEMA tables
PERFORMANCE_SCHEMA tables
Working With Tables

Hints

Mind the storage engine!
Temporary tables are in the same namespace!
Temporary tables shadow regular ones!
5.5: CREATE TEMPORARY TABLES is **not** enough
5.6: CREATE TEMPORARY TABLES is **is** enough
The First Steps

Installation Options

Server – Community or Enterprise (for 30 days)

Cluster – real-time open source transactional database designed for fast, always-on access to data under high throughput conditions.

Workbench – visual database design application that can be used to efficiently design, manage and document database schemata.

Proxy – a simple program that sits between your client and MySQL server(s) that can monitor, analyze or transform their communication.

Connectors – ODBC, Java, .Net, MXJ, C/C++, DBI, Ruby, Python, etc.

http://dev.mysql.com/downloads/
How to get MySQL

Community:
Freely downloadable version of the world's most popular open source database. It is available under the GPL license and is supported by a huge and active community of open source developers.

Enterprise:
Paid subscription includes support and the following

- MySQL Enterprise Backup
- MySQL Enterprise Security
  - External Authentication
- MySQL Enterprise Scalability
  - Thread Pool
- MySQL Enterprise High Availability
  - Oracle VM Template
  - Windows Clustering
- MySQL Enterprise Monitor

Free for 30 day evaluation
The First Steps

Download

Choosing the version

- 5.1 – previous GA version
- 5.5 – the latest GA version
- 5.6 – development release

Choosing the edition

- Community Edition (Community Server)
- Enterprise Editions (even MySQL Classic and MySQL Standard)

Source or Binary
The First Steps

Post-installation steps: Configuration

• Where are the configuration files
Default configuration might be not so good
  Performance, …
  SQL_MODE
  AUTOCOMMIT
  …
The First Steps

Post-installation steps: Security

Secure the installation
Don’t run under ‘root’
Have separate directories (configuration, data, binary logs, …)
Change ‘root’ password
Remove default accounts
MySQL Support

How can I get help?

• Reach out to the community
  – Irc on freenode
  – Forums.mysql.com
• Oracle Support
• Certifications
Oracle Premier Support for MySQL

- 24 X 7 Problem Resolution Services
- Unlimited Support Incidents
- Knowledge Base
- Maintenance Releases, Bug fixes, Patches, Updates
- MySQL Consultative Support
- Staffed by experienced, seasoned MySQL Engineers
MySQL Enterprise Edition

- MySQL Database, Visual Development/Admin, Monitoring, Backup tools, and Oracle Lifetime Support services
MySQL Enterprise Certifications

Oracle Products

• Oracle High Availability
  • Oracle Linux
  • Oracle VM + MySQL Template

• Oracle Fusion Middleware
  • WebLogic Server 10.3.1 +
  • Database Adapter for Oracle SOA Suite 11.1.1.1 +
  • Oracle BPM 11.1.1.3 +
  • Oracle Virtual Directory 11.1.1.1+
  • Oracle Data Integrator 11.1.1.3 +
  • Oracle Enterprise Performance Management 11.1.2
  • Oracle Identity Analytics 11.1.1.3
  • Open SSO STS, Open SSO Fedlet 11.1.1.3
MySQL Enterprise Certifications

Oracle Products

• Oracle Golden Gate
  • Bi-directional replication between MySQL and Oracle
  • Exadata Data Stores – Enterprise DW, legacy apps, etc.
  • Hybrid Applications (MySQL frontend + Oracle data store)

• Oracle Secure Backup
  • MySQL Enterprise Backup 3.6 - supports backup streaming to OSB via SBT API

Enables you to manage your Oracle and MySQL databases with Oracle tools/solutions you are already using.
Additional Resources

mysql.com
• TCO calculator
• White Papers
• Customer use cases and success stories

dev.mysql.com
• Downloads
• Documentation
• Forums
• PlanetMySQL

eDelivery.com
• Download and evaluate all MySQL products
**Additional Resources**

**mysql.com**
- Download MySQL 5.5, MySQL Cluster 7.1 GA, GPL Products
- MySQL Products, Editions, Licensing Options
- TCO calculator
- Upcoming Events
- Customer use cases and success stories

**dev.mysql.com**
- Download MySQL 5.6 DMR and Labs “early access” features
- Developer Zone Articles, How to’s

**eDelivery.com**
- Download and evaluate all MySQL products
Additional Resources

Planet.mysql.com
- Blog feeds from the experts and the community

Books:
- MySQL by Paul DuBois
- MySQL Administrator's Bible
- High Performance MySQL: Optimization, Backups, Replication, and More

forums.mysql.com
- Community interaction
Additional Resources

Xaprb.com
50 things to know before migrating Oracle to MySQL
It is a little old but worth the read

www.xaprb.com/blog/2009/03/13/50-things-to-know-before-migrating-oracle-to-mysql/
Thanks for attending!

keith.larson@oracle.com
Extra Slides