

MySQL 8.0 for Database Administrators LVC

MySQL

DURATION

5 Days

MODULES

15 Lectures

COURSE CODE

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Course Overview

This course will be delivered with a live lab The MySQL for Database Administrators enables DBAs and other database professionals to maximize their organization's investment in MySQL. Learn to configure the MySQL Server, set up replication and security, perform database backups and recoveries, optimize query performance, and configure for high availability.

What You Will Learn

Introduction to MySQL

- Objectives
- Course Goals
- Course Lesson Map
- Introductions
- Classroom Environment
- MySQL Powers the Web
- MySQL Market Share: DB-Engines 2019
- MySQL Enterprise Edition
- Oracle Premier Support for MySQL
- MySQL and Oracle Integration
- MySQL Websites
- Community Resources
- Oracle University: MySQL Training
- MySQL Certification
- Summary
- Practices

Installing and Upgrading MySQL

- Objectives
- Topics
- Installation Sequence

- [Installing MySQL from Downloaded Packages](#)
- [MySQL RPM Installation Files for Linux](#)
- [MySQL RPM Installation Process](#)
- [MySQL DEB Installation](#)
- [Linux Distribution-Specific Repositories](#)
- [Installing MySQL by Using a Package Manager](#)
- [Adding a Yum Repository](#)
- [Configuring Yum Repository Versions](#)
- [Adding an APT Repository](#)
- [Configuring Repository Versions](#)
- [Manually Configuring the APT Repositories](#)
- [Installing MySQL on Windows](#)
- [Installing on Windows: MySQL Installer](#)
- [Installing on Windows: Selecting Products and Features](#)
- [Installing on Windows: Product Configuration](#)
- [Installing MySQL as a Windows Service](#)
- [Installing MySQL from Source](#)
- [Installing MySQL from Binary Archive](#)
- [Deploying MySQL Server with Docker](#)
- [Quiz](#)
- [Topics](#)
- [Linux MySQL Server Installation Directories](#)
- [Windows MySQL Server Installation Directory](#)
- [MySQL Programs](#)
- [mysqld: MySQL Server Process](#)
- [Installation Programs](#)
- [Utility Programs](#)
- [mysql_config_editor](#)
- [.mylogin.cnf Format](#)
- [Login Paths](#)
- [Command-Line Client Programs](#)
- [Launching Command-Line Client Programs](#)
- [Topics](#)
- [Configuring Mandatory Access Control](#)
- [SELinux Example](#)
- [AppArmor: Example](#)
- [Changing the root Password](#)
- [Using mysqladmin to Change the root Password](#)
- [Quiz](#)
- [Topics](#)
- [Starting and Stopping MySQL](#)
- [Stopping MySQL with mysqladmin](#)
- [MySQL Service Files](#)
- [Starting and Stopping MySQL on Windows](#)
- [Starting and Stopping MySQL on Windows: MySQL Notifier](#)
- [Topics](#)

- Upgrading MySQL
- Reading Release Notes
- MySQL Shell Upgrade Checker Utility
- Using In-Place Upgrade Method
- Using Logical Upgrade Method
- mysql_upgrade
- Summary
- Practices

Understanding MySQL Architecture

- Objectives
- Topics
- Architecture
- Client/Server Connectivity
- MySQL Server Process
- Terminology
- Server Process
- Topics
- Connection Layer
- Connection Protocols
- Local and Remote Connection Protocol: TCP/IP
- Local Connection Protocol in Linux: Socket
- MySQL and localhost
- Local Connection Protocols in Windows: Shared Memory and Named Pipes
- SSL by Default
- Connection Threads
- Quiz
- Topics
- SQL Layer
- SQL Layer Components
- SQL Statement Processing
- Topics
- Storage Layer
- Storage Engines Provided with MySQL
- Storage Engines: Function
- SQL and Storage Layer Interactions
- Features Dependent on Storage Engine
- InnoDB Storage Engine
- MyISAM Storage Engine
- MEMORY Storage Engine
- ARCHIVE Storage Engine
- NDBCluster Storage Engine
- BLACKHOLE Storage Engine
- Storage Engines Feature Summary
- How MySQL Uses Disk Space

- Data Directory
- Topics
- What Is a Data Dictionary?
- Types of Metadata
- Data Dictionary in Earlier Versions of MySQL
- Transactional Data Dictionary in MySQL 8
- Transactional Data Dictionary: Features
- Serialization of the Data Dictionary
- Dictionary Object Cache
- Topics
- InnoDB Tablespaces
- InnoDB System Tablespace
- File-per-Table Tablespaces
- General Tablespaces
- Choosing Between File-Per-Table and General Tablespaces
- Locating Tablespaces Outside the Data Directory
- Temporary Tablespaces
- Topics
- Redo Logs
- Undo Logs
- Undo Tablespaces
- Temporary Table Undo Log
- Quiz
- Topics
- How MySQL Uses Memory
- Global Memory
- Session Memory
- Log Files and Buffers
- InnoDB Buffer Pool
- Configuring the Buffer Pool
- Topics
- MySQL Plugin Interface
- MySQL Component Interface
- Summary
- Practices

Configuring MySQL

- Objectives
- Topics
- MySQL Configuration Options
- Deciding When to Use Options
- Displaying Configured Server Options
- Option Naming Convention
- Using Command-Line Options
- Topics

- Reasons to Use Option Files
- Option File Locations
- Option Files That Each Program Reads
- Standard Option Files
- Option File Groups
- Option Groups That Each Program Reads
- Option Group Names
- Client Options: Examples
- Writing Option Files
- Option File : Example
- Option Precedence in Option Files
- Loading or Ignoring Option Files from the Command Line
- Loading Option Files with Directives
- Displaying Options from Option Files
- Quiz
- Topics
- Server System Variables
- System Variable Scope: GLOBAL and SESSION
- Dynamic System Variables
- Changing Variable Values
- Persisting Global Variables
- Displaying System Variables
- Viewing Variables with Performance Schema
- Topics
- Launching Multiple Servers on the Same Host
- Settings That Must Be Unique
- mysql_d_multi
- mysql_d_multi: Example Configuration File
- systemd: Multiple MySQL Servers
- Quiz
- Summary
- Practices

Monitoring MySQL

- Objectives
- Topics
- Monitoring MySQL with Log Files
- Log File Characteristics
- Error Log
- Binary Log
- General Query Log
- General Query Log: Example
- Slow Query Log
- Slow Query Log: Logging Administrative and Replicated Statements
- Filtering Slow Query Log Events

- [Slow Query Log: Example](#)
- [Viewing the Slow Query Log with mysqldumpslow](#)
- [mysqldumpslow: Example](#)
- [Specifying TABLE or FILE Log Output](#)
- [Log File Rotation](#)
- [Flushing Logs](#)
- [Quiz](#)
- [Topics](#)
- [Status Variables](#)
- [Displaying Status Information](#)
- [Monitoring Status with mysqladmin](#)
- [Topics](#)
- [Performance Schema](#)
- [Performance Schema Table Groups](#)
- [Configuring Performance Schema](#)
- [Performance Schema Setup Tables](#)
- [Performance Schema Instruments](#)
- [Top-Level Instrument Components](#)
- [Accessing Performance Schema Metrics](#)
- [The sys Schema](#)
- [Using the sys Schema Example 1](#)
- [Using the sys Schema: Example 2](#)
- [Topics](#)
- [MySQL Enterprise Audit](#)
- [Installing MySQL Enterprise Audit](#)
- [Audit Log File Configuration](#)
- [Audit Log Filtering](#)
- [Audit Log Filter Definitions](#)
- [Audit Log File Format](#)
- [Audit Log File: New-Style XML Format](#)
- [Audit Log File: JSON Format](#)
- [Audit Record Values](#)
- [Quiz](#)
- [Topics](#)
- [MySQL Enterprise Monitor](#)
- [Installing MySQL Enterprise Monitor](#)
- [Installing the Service Manager](#)
- [Post-Installation Configuration](#)
- [Installing Agents](#)
- [MySQL Enterprise Monitor: Managing Multiple Servers](#)
- [MySQL Enterprise Monitor: Timeseries Graphs](#)
- [MySQL Enterprise Monitor: Advisors](#)
- [MySQL Enterprise Monitor: Events](#)
- [Topics](#)
- [SHOW PROCESSLIST](#)
- [Performance Schema Threads Table](#)

- Killing Processes
- Limiting User Activity
- Setting Resource Limits
- Resetting Limits to Default Values
- Summary
- Practices

Managing MySQL Users

- Objectives
- Topics
- Importance of User Management
- Authentication and Authorization
- User Connection and Query Process
- Viewing User Account Settings
- Pluggable Authentication
- Local Connection
- Remote Connection
- Topics
- Account Names
- Host Name Patterns
- Creating a User Account
- Roles
- Creating a Role
- Manipulating User Accounts and Roles
- Topics
- Setting the Account Password
- Dual Password Support
- Expiring Passwords Manually
- Configuring Password Expiration
- Changing Expired Passwords
- Quiz
- Topics
- Pluggable Authentication
- Cleartext Client-Side Authentication Plugin
- Loadable Authentication Plugins
- Enterprise Authentication Plugins
- PAM Authentication Plugin
- Configuring the PAM Authentication Plugin
- Creating Users that Authenticate with PAM
- Creating PAM Proxied Users
- Logging In with PAM Accounts
- Topics
- Authorization
- Determining Appropriate User Privileges
- Privilege Scope

- Granting Administrative Privileges
- Dynamic Privileges
- Special Privileges
- GRANT Statement
- Granting Permissions on Columns
- Granting Roles to Users
- Displaying GRANT Privileges
- Displaying Privileges for Another User
- Displaying Privileges for a Role
- Revoking Account Privileges
- REVOKE: Examples
- Partial Revoke
- User Privilege Restrictions
- Quiz
- Topics
- Using Role Privileges
- Activating Roles at Server Level
- Activating Roles at User Level
- Activating Roles at Session Level
- Mandatory Roles
- Topics
- Grant Tables
- Grant Table
- Use of Grant Tables
- Effecting Privilege Changes
- Summary
- Practices

Securing MySQL

- Objectives
- Topics
- Security Risks
- MySQL Installation Security Risks
- Topics
- Securing MySQL from Public Networks
- Preventing Network Security Risks
- Securing MySQL in Private Networks
- Topics
- Secure Connections
- Secure Connection: Overview
- Generating a Digital Certificate
- Server Security Defaults
- SSL Is Enabled by Default with MySQL Clients
- Disabling SSL on MySQL Server
- Setting Client Options for Secure Connections

- Client -ssl-mode Option: Example
- Setting the Permitted Versions for SSL/TLS for the Server
- Setting the Permitted Versions for SSL/TLS for the Client
- Setting the Cipher to Use for Secure Connections
- Global System Variable and Session Status Variables for Ciphers
- Cipher System and Status Variables: Example 1
- Cipher System and Status Variables: Example 2
- Setting Client SSL/TLS Options by User Account
- Generating a Digital Certificate
- SSL Server Variables for Digital Certificates
- SSL Client Options for Digital Certificates
- Securing a Remote Connection to MySQL
- Quiz
- Topics
- Preventing MySQL Password Security Risks
- How Attackers Derive Passwords
- Password Validation Component
- Validate Password Component Variables
- Changing the Default Password Validation Variables
- Other Password Considerations
- Locking an Account
- Pluggable Authentication
- Preventing Application Password Security Risks
- Connection-Control Plugin
- Installing the Connection-Control Plugin
- Monitoring Connection Failures
- Using the CONNECTION_CONTROL_FAILED_LOGIN_ATTEMPTS Plugin
- Quiz
- Topics
- Limiting Operating System Usage
- Limiting Operating System Accounts
- Operating System Security
- File System Security
- Preventing File System Security Risks
- Topics
- Keyring
- Deploying a Keyring
- Key Management Functions
- Encrypting InnoDB Tablespace
- Encrypting InnoDB Redo Logs and Undo Logs
- InnoDB Encryption Keys
- Encrypting Binary Log and Relay Log
- Binary Log Encryption Keys
- Topics
- Protecting Your Data from SQL Injection Attacks
- SQL Injection: Example

- Detecting Potential SQL Injection Attack Vectors
- Preventing SQL Injection Attacks
- Topics
- MySQL Enterprise Firewall
- Enterprise Firewall Plugins
- Enterprise Firewall Database Components
- Installing MySQL Enterprise Firewall
- Registering Accounts with the Firewall
- Training the Firewall
- Statement Digests
- Enabling Firewall Protection
- Disabling the Firewall
- Monitoring the Firewall
- Quiz
- Summary
- Practices

Maintaining a Stable System

- Objectives
- Topics
- Stable Systems
- Measuring What You Manage
- Establishing a Baseline
- Application Profiling
- Topics
- Asking “What Could Go Wrong?”
- Components in a MySQL Server Installation
- Server Hardware
- Problems with Hardware
- Virtualized Environment
- Operating System
- Coexistent Applications
- Network Failures
- Application Failures
- Force Majeure
- Topics
- Capacity Planning
- Monitoring Table Size
- Calculating Logical Size: Data and Indexes
- Calculating Physical Size: Querying Information Schema
- Calculating Physical Size: Reading the File System
- Scalability
- Scaling Up and Scaling Out
- Quiz
- Topics

- Establishing the Nature of a Problem
- Identifying the Problem
- Common Problems
- Resolving Problems
- Topics
- Identifying the Causes of Server Slowdowns
- Investigating Slowdowns
- Quiz
- Topics
- How MySQL Locks Rows
- Identifying Lock Contention
- InnoDB Table Locks
- InnoDB Row Locks
- Troubleshooting Locks by Using SHOW PROCESSLIST
- Monitoring Data Locks with Information Schema and Performance Schema
- Information Schema INNODB_TRX View
- Performance Schema data_locks Table
- Performance Schema data_lock_waits Table
- sys.innodb_lock_waits View
- sys.innodb_lock_waits: Example Query
- Performance Schema metadata_locks Table
- sys.schema_table_lock_waits View
- Topics
- InnoDB Recovery
- Using -innodb_force_recovery
- Summary
- Practices

Optimizing Query Performance

- Objectives
- Topics
- Identifying Slow Queries
- Choosing What to Optimize
- Topics
- Using EXPLAIN to See Optimizer's Choice of Index
- EXPLAIN: Example
- EXPLAIN Output
- Common type Values
- Displaying Query Rewriting and Optimization Actions
- EXPLAIN Example: Table Scan
- EXPLAIN Example: Primary Key
- EXPLAIN Example: Non-unique Index
- EXPLAIN and Complex Queries
- EXPLAIN Example: Simple Join
- Explanation of Simple Join Output

- EXPLAIN FORMAT
- EXPLAIN FORMAT: JSON Example
- EXPLAIN ANALYZE
- Hash Join Optimization
- Topics
- Index Types
- Creating Indexes to Improve Query Performance
- Creating Indexes on Existing Tables
- Dropping Indexes on Existing Tables
- Displaying Indexes Metadata
- Invisible Indexes
- Topics
- Maintaining InnoDB Index Statistics
- Automatically Updating Index Statistics
- Using ANALYZE TABLE
- Rebuilding Indexes
- mysqlcheck Client Program
- Histograms
- Example: The Query
- Example: Creating a Histogram
- Example: The Query with Histogram Data
- Topics
- MySQL Query Analyzer
- Query Response Time Index
- Query Analyzer User Interface
- Quiz
- Summary
- Practices

Choosing a Backup Strategy

- Objectives
- Topics
- Reasons to Back Up
- Backup Types
- Hot Backups
- Cold Backups
- Warm Backups
- Quiz
- Topics
- Backup Techniques
- Logical Backups
- Logical Backup Conditions
- Logical Backup Performance
- Physical Backups
- Physical Backup Files

- Physical Backup Conditions
- Online Disk Copies
- Snapshot-Based Backups
- Performing a Snapshot
- Replication-Based Backups
- Binary Log Backups
- Binary Logging and Incremental Backups
- Quiz
- Topics
- Comparing Backup Methods
- Deciding a Backup Strategy
- Backup Strategy: Decision Chart
- More Complex Strategies
- Summary
- Practices

Performing Backups

- Objectives
- Topics
- Backup Tools: Overview
- Topics
- MySQL Enterprise Backup
- MySQL Enterprise Backup: Storage Engines
- MySQL Enterprise Backup: InnoDB Files
- MySQL Enterprise Backup: Non-InnoDB Files
- Full Backups
- Single-File Backups
- Backup Process
- Incremental Backups
- Differential Backups
- Validate Operations
- Restore Operations
- Restore Commands
- Restoring Incremental Backups
- Update Operations
- Single-File Operations
- Basic Privileges Required for MySQL Enterprise Backup
- Granting Required Privileges
- Quiz
- Topics
- mysqldump and mysqlpump
- mysqldump
- Ensuring Data Consistency with mysqldump
- mysqldump Options for Creating Objects
- mysqldump Options for Dropping Objects

- mysqldump General Options
- Restoring mysqldump Backups
- Using mysqlimport
- Privileges Required for mysqldump
- Privileges Required for Reloading Dump Files
- mysqlpump
- Specifying Objects to Back Up with mysqlpump
- Parallel Processing with mysqlpump
- Quiz
- Topics
- Physical InnoDB Backups: Overview
- Portability of Physical Backups
- Physical InnoDB Backup Procedure
- Recovering from Physical InnoDB Backups
- Using Transportable Tablespaces for Backup
- Transportable Tablespaces: Copying a Table to Another Instance
- Physical MyISAM and ARCHIVE Backups
- Physical MyISAM and ARCHIVE Backup Procedure
- Recovering from Physical MyISAM or Archive Backups
- LVM Snapshots
- LVM Backup Procedure
- Backing Up Log and Status Files
- Topics
- Replication as an Aid to Backup
- Backing Up from a Replication Slave
- Backing Up from Multiple Sources to a Single Server
- Topics
- Processing Binary Log
- Selective Binary Log Processing
- Point-in-Time Recovery
- Configuring MySQL for Restore Operations
- Quiz
- Summary
- Practices

Configuring a Replication Topology

- Objectives
- Topics
- MySQL Replication
- Replication Masters and Slaves
- Relay Slaves
- Complex Topologies
- Quiz
- Topics
- Replication Conflicts

- Replication Conflicts: Example Scenario with No Conflict
- Replication Conflicts: Example Scenario with Conflict
- Topics
- Replication Use Cases
- Replication for Horizontal Scale-Out
- Replication for Business Intelligence and Analytics
- Replication for Geographic Data Distribution
- Replicating with the BLACKHOLE Storage Engine
- Replication for High Availability
- Topics
- Configuring Replication
- Configuring Replication Masters
- Configuring Replication Slaves
- CHANGE MASTER TO
- Finding Log Coordinates
- Global Transaction Identifiers (GTIDs)
- Identifying the Source Server
- Logging Transactions
- Replication with GTIDs
- Replication Filtering Rules
- Applying Filtering Rules
- Quiz
- Topics
- Binary Log Formats
- Row-Based Binary Logging
- Statement-Based Binary Logging
- Mixed Format Binary Logging
- Replication Logs
- Crash-Safe Replication
- Topics
- Asynchronous Replication
- Semisynchronous Replication
- Advantages and Disadvantages of Semisynchronous Replication
- Enabling Semisynchronous Replication
- Multi-Source Replication
- Configuring Multi-Source Replication for a GTID-Based Master
- Configuring Multi-Source Replication for a Binary Log Based Master
- Controlling Slaves in a Multi-Source Replication Topology
- Topics
- MySQL Clone Plugin
- Installing the Clone Plugin
- Granting Permissions to Users
- Cloning Local Data
- Cloning Remote Data
- Cloning for Replication
- Clone Plugin Limitations

- Summary
- Practices

Administering a Replication Topology

- Objectives
- Topics
- Failover with Log Coordinates
- Potential Problems When Executing a Failover with Log Coordinates
- Avoiding Problems When Executing a Failover with Log Coordinates
- Failover with GTIDs
- Topics
- Replication Threads
- The Master's Binlog Dump Thread
- Single-Threaded Slaves
- Multithreaded Slaves
- Controlling Slave Threads
- Resetting the Slave
- Quiz
- Topics
- Monitoring Replication
- Slave Thread Status
- Master Log Coordinates
- Relay Log Coordinates
- Replication Slave I/O Thread States
- Replication Slave SQL Thread States
- Monitoring Replication by Using Performance Schema
- Replication Tables in Performance Schema
- MySQL Enterprise Monitor Replication Dashboard
- Topics
- Troubleshooting MySQL Replication
- Examining the Error Log
- SHOW SLAVE STATUS Error Details
- Checking I/O Thread States
- Monitoring Multi-Source Replication
- Summary
- Practices

Achieving High Availability with MySQL InnoDB Cluster

- Objectives
- Topics
- What Is MySQL InnoDB Cluster?
- Architecture
- MySQL Group Replication Plugin
- How Group Replication Works
- Single-Primary Mode

- Multi-Primary Mode
- Conflict Resolution
- Consensus and Quorum
- Use Cases
- Group Replication: Requirements and Limitations
- Quiz
- Topics
- MySQL Shell (mysqlsh)
- Using MySQL Shell to Execute a Script
- MySQL Router (mysqlrouter)
- Topics
- Deployment Scenarios
- Deploying Sandbox Instances and Creating the Cluster
- Production Deployment
- Distributed Recovery
- Connecting Clients to the Cluster
- Quiz
- Topics
- Managing Sandbox Instances
- Checking the Status of a Cluster
- Viewing the Structure of a Cluster
- Checking the State of an Instance
- Updating a Cluster Metadata
- Removing Instances from the Cluster
- Rejoining an Instance to the Cluster
- Restoring Quorum Loss
- Recovering the Cluster from a Major Outage
- Dissolving a Cluster
- Disabling `super_read_only`
- Customizing a MySQL InnoDB Cluster
- Customizing an Instance
- Configuring Secure Connection in a Cluster
- Creating a Server Whitelist
- Summary
- Practices

Conclusion

- Course Goals
- Oracle University: MySQL Training
- MySQL Websites
- Your Evaluation
- Thank You
- Q&A Session