

MySQL 8.0: Performance Tuning

Duration: 4 Days

Course Outlines:

1 Introduction

- Objectives
- Course Goals
- Course Lesson Map
- Introductions
- Classroom Environment
- MySQL Powers the Web
- Database of the Year
- MySQL Enterprise Edition
- MySQL Database Service
- Oracle Premier Support for MySQL
- MySQL and Oracle Integration
- MySQL Websites
- Community Resources
- Oracle University: MySQL Training
- MySQL Certification

2 Performance Tuning Concepts

- Topics
- Objectives
- Improving Performance
- Areas to Tune
- Performance Tuning Terminology
- Response Time
- Measuring Response Times
- Throughput
- Scalability
- Queuing Theory
- Benchmarking
- Benchmarking Best Practices
- Benchmarking Bad Practices
- Before You Start: Establish a Performance Baseline
- Key Steps in Troubleshooting Performance Issues
- Establishing the Nature of the Problem
- Starting to Troubleshoot
- Identifying Possible Causes of Performance Issues
- Application Profiling
- Localizing Database Problems
- Tuning Steps
- General Tuning Procedure
- Deploying MySQL
- RAM Requirements
- Maintaining MySQL

3 Performance Tuning Tools

- MySQL Monitoring Tools
- SHOW STATUS
- Filtering SHOW STATUS Output
- Status Variables: Handler Operations
- Status Variables: Internal Temporary Tables and Files

- SHOW ENGINE INNODB STATUS
- SHOW PROCESSLIST
- mysqladmin
- Information Schema
- Performance Schema
- MySQL Workbench
- MySQL Enterprise Monitor: Overview, Architecture, Global Overview
- Query Analyzer
- InnoDB Performance
- Oracle Enterprise Manager for MySQL
- Oracle SQL Developer
- Community Monitoring Tools
- Linux Tools (iostat, vmstat, sar, top)
- Benchmarking Tools
- MySQL BENCHMARK() Function
- Stress Tools (mysqlslap, sysbench)

4 Performance Schema

- Why Use Performance Schema?
- How Performance Schema Works
- Instrument Names, Prefixes, Suffixes
- Structure of the Performance Schema
- Table Groups
- Configuring the Performance Schema
- Setup Tables
- Configuring Instruments and Consumers
- Event Timing
- Configuring Objects, Actors, Thread Monitoring
- Performance Schema Overhead
- Memory Usage
- Instance Tables (cond_instances, file_instances, mutex_instances, rwlock_instances, socket_instances)
- Connection Tables
- Examining Raw Event Data
- Event Hierarchy and Nested Events
- Summary Tables
- Prepared Statements
- sys Schema (Views, Stored Routines, Functions)
- MySQL Workbench Performance Dashboard and Reports

5 General Server Tuning

- Major Components of the MySQL Server
- MySQL Memory Usage
- CPU and I/O Saturation
- Global Buffers
- Dictionary Object Cache
- MySQL Thread Handling
- Per-Thread Buffers
- Displaying Memory Usage with sys
- Simultaneous Connections
- Administrative Connections
- Connection Status Variables
- Monitoring Idle Connections

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COURSE OUTLINE

- Diagnosing Network Problems
- Reusing Threads
- Thread Cache Effectiveness
- MySQL Enterprise Thread Pool

6 Tuning Tables, Files, and Logs

- Reusing Tables
- Table Cache (table_open_cache, table_definition_cache)
- Tables and Files
- Managing Open Files
- File Descriptors in OS
- Binary Logs
- ACID and Transactions
- Binary Log Caches
- Monitoring Binary Logs
- Binary Log Group Commit Settings
- Improving Binary Log Performance

7 Tuning InnoDB

- InnoDB Storage Engine
- Operating System Buffers
- How InnoDB Reads/Writes Data
- Buffer Pool Sizing
- Redo Log Files
- Tablespace Settings
- Thread Concurrency
- Buffer and Log File Flushing
- Adaptive Flushing
- Purge Behavior
- Undo Logs
- Recommended Settings (OLTP, Benchmarking, Replication)
- Linux Filesystem Recommendations
- InnoDB Metrics in Information Schema and Performance Schema
- Monitoring InnoDB Performance in Workbench
- SHOW ENGINE INNODB STATUS (Semaphores, Transactions, File I/O, Insert Buffer, Log, Buffer Pool, Row Operations, Foreign Key Errors, Deadlocks)

8 Optimizing Your Schema

- Schema Design Considerations and Tasks
- Normalization vs Performance
- Denormalization
- Data Types
- Indexes (Indexing, Optimizing, Types, B+TREE)
- InnoDB Table Compression
- Partitioning (RANGE, LIST, HASH, KEY)
- Partitioning Performance and Limitations

9 Monitoring Queries

- Query Monitoring
- Identifying Queries That Require Optimization
- General Query Log
- Slow Query Log
- mysqldumpslow
- Statement Status Variables
- Performance Schema for Slow Queries
- sys Schema for Query Analysis
- MySQL Enterprise Monitor Query Analyzer
- Workbench Query Statistics and Visual EXPLAIN

10 Query Optimization

- MySQL Query Processing
- Optimizer Stages
- Logical Transformations
- Cost-Based Optimization
- Access Method, Join Order, Subquery Optimizations
- Plan Refinement
- Index Condition Pushdown
- Understanding Query Plans (EXPLAIN, JSON, Visual EXPLAIN, EXPLAIN ANALYZE)
- Optimizer Trace
- Improving Query Performance (WHERE, Indexing, Joins, Sorting, Bulk DML, Summary Tables)

11 Optimizing Locking Operations

- Locks in MySQL (Implicit, Explicit)
- InnoDB Multiversion Concurrency Control
- InnoDB Table and Row Locks
- Metadata Locks
- Identifying Locks (SHOW PROCESSLIST, SHOW ENGINE INNODB STATUS, metadata_locks, table_handles, sys.innodb_lock_waits)

12 Tuning Replication

- MySQL Replication
- Replication Use Cases
- Replication Logs and Events
- Source and Replica Roles
- Replication Lag (Causes, Diagnosis, GTIDs, I/O Thread Lag, SQL Thread Lag)
- Performance Schema Replication Tables
- MySQL Enterprise Monitor Support
- Resolving Replication Lag

13 Conclusion

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

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