# Oracle Exadata Database Machine: Implementation and Administration

Infrastructure

| DURATION | MODULES | COURSE CODE |
| --- | --- | --- |
| **5 Days** | **23 Lectures** | **—** |

## Course Overview

After completing this course, you should be able to: Describe the key capabilities of Exadata Database Machine Identify the benefits of using Exadata Database Machine for different application classes Describe the architecture of Exadata Database Machine and its integration with Oracle Database, Clusterware, and ASM Complete the initial configuration of Exadata Database Machine Describe various recommended approaches for migrating to Exadata Database Machine Configure I/O Resource Management Monitor Exadata Database Machine health and optimize performance

## What You Will Learn

### Introduction

- Course Objectives
- Audience and Prerequisites
- Oracle Exadata: 10 Years of Innovation
- Oracle Provides Full Choice of Deployment Model
- Oracle Database Deployment Models
- Additional Resources
- Practice 1: Overview

### Exadata Database Machine: Overview

- Objectives
- Exadata Database Machine: Introduction
- Why Exadata Database Machine?
- Exadata X8M Hardware
- Exadata Database Machine X8M-2 Database Server Hardware: Overview
- Exadata X8M-2 High Capacity Storage Server Hardware: Overview
- Exadata X8M-2 Extreme Flash Storage Server Hardware: Overview
- Exadata X8M-2 Extended Storage Server Hardware: Overview

- Exadata Capacity and Performance Metrics: Individual Servers
- Exadata 8M-2 Rack Configurations
- Elastic Configuration: Examples
- Exadata Database Machine X8M-8
- Exadata Database Machine X8M-8 Database Server Hardware: Overview
- Exadata Database Machine X8M-8 Use Cases
- Oracle Exadata Virtual Machines
- RDMA Over Converged Ethernet (RoCE): Overview
- Exadata Storage Expansion Racks
- Exadata Database Machine Support: Overview
- Oracle Platinum Services: Enhanced Support at No Additional Cost
- Quiz
- Summary

## Exadata Database Machine Architecture

- Objectives
- Exadata Architecture: Overview
- Remote Direct Memory Access (RDMA)
- RDMA over Converged Ethernet (RoCE)
- Exadata Network Architecture
- Leaf Switch Topology
- Scale Performance and Capacity Beyond a Single Rack
- Two Rack Case: Leaf/Spine Topology
- Multiple Rack Case: Up to Eight Racks
- Multiple Rack Case: 9 to 18 Racks
- Exadata Software Architecture: Overview
- Support for Mixed Database Versions
- High Capacity Storage Server: Disk Storage Entities and Relationships
- High Capacity Storage Server: Flash Storage Entities and Relationships
- Extreme Flash Storage Server: Flash Storage Entities and Relationships
- HC and EF Storage Server: Persistent Memory Entities and Relationships
- Disk Group Configuration
- Quiz
- Summary
- Practice 3: Overview

## Key Capabilities of Exadata Database Machine

- Objectives
- Classic Database I/O and SQL Processing Model
- Exadata Smart Scan Model
- Exadata Storage Index: Overview
- Performance Optimization for SQL Queries with MIN or MAX Functions
- Hybrid Columnar Compression: Overview
- Hybrid Columnar Compression: Data Organization
- Exadata Smart Flash Cache: Overview

- Exadata Smart Flash Cache Intelligent Caching: Overview
- Exadata Smart Flash Cache Intelligent Caching Details
- Conventional Read: Write-Through Cache
- Conventional Write: Write-Back Cache
- Conventional Log Write: Overview
- Persistent Memory (PMEM)
- PMEM Advantages
- Exadata Smart PMEM Cache: Read Operation
- Exadata Smart PMEM Log: Log Write Operation
- In-Memory Columnar Caching on Storage Servers
- Smart Aggregation
- Smart In-Memory Columnar Cache with Row IDs
- Exafusion Direct-to-Wire Protocol
- Exadata X8M RoCE: High Priority Networking
- Exadata X8M RoCE: Avoiding Packet Loss
- Exadata X8M RoCE: Instant Failure Detection
- Cell-to-Cell Rebalance
- I/O Resource Management: Overview
- Exadata Benefits for Data Warehousing and Analytics
- Exadata Benefits for OLTP
- Quiz
- Summary
- Practice 4: Overview

## Exadata Database Machine Initial Configuration

- Objectives
- Exadata Implementation: Overview
- Key Documentation
- Exadata Site Preparation
- Exadata Configuration Tool: Overview
- Web-Based Version of OEDA
- Hardware Page: Select Hardware
- Hardware Page: Rack and Customer Details
- Operating System Page
- Rack Networks Page: Admin Network
- Rack Networks Page: Enable VLAN
- Rack Networks Page: Admin network Review and Edit
- Rack Networks Page: Private Network
- Rack Networks Page: Private network Review and Edit
- Users and Groups Page
- Define Clusters Page
- Diskgroup Page
- Quorum Disks on Database Servers
- Database Home Page
- Database Page

- Cluster Network Page: Client Network
- View Network Connections
- Example: IP Address Allocation
- Cluster Network Page: Backup Network
- Alerting Page
- Comments Page
- Exadata Hardware Installation: Overview
- Configuring Exadata: Overview
- Loading the Configuration Information and Installing the Software
- Running the Exadata Deployment Tool
- Result After Installation and Configuration
- Oracle Exadata Deployment Assistant (OEDA) CLI
- OEDACLI Operating Modes
- Using OEDACLI: Manage Exadata Storage Cells
- Using OEDACLI: Manage Clusters
- Example: Use the OEDACLI CREATE CLUSTER Command
- Using OEDACLI: Add Database Homes
- Quiz
- Summary
- Practice 5: Overview

## Exadata Storage Server Configuration

- Objectives
- Exadata Storage Server Administration: Overview
- Default User Accounts for Oracle Exadata Storage Server
- Exadata Software Users, Roles, and Privileges
- Exadata Software Users, Roles, and Privileges: Examples
- Running CellCLI Commands from Database Servers
- ExaCLI: Examples
- Executing Commands Across Multiple Servers Using dcli
- dcli: Examples
- Executing Commands Across Multiple Servers Using exadcli
- exadcli: Examples
- Testing Storage Server Performance by Using CALIBRATE
- CALIBRATE: Example
- Configuring the Exadata Cell Server Software
- Starting and Stopping Exadata Cell Server Software
- Configuring Cell Disks
- Configuring Grid Disks
- Sparse Grid Disks
- Configuring Hosts to Access Exadata Cells
- Configuring ASM and Database Instances to Access Exadata Cells
- Configuring ASM Disk Groups by Using Exadata Storage
- Specifying Content Type for a Disk Group
- Reconfiguring Exadata Storage

- Optional Configuration Tasks
- Exadata Storage Security: Overview
- Exadata Storage Security Implementation
- Quiz
- Summary
- Practice 6: Overview

## I/O Resource Management

- Objectives
- I/O Resource Management: Overview
- I/O Resource Management Concepts
- I/O Resource Management Plans
- I/O Resource Management Plans: Example
- IORM Architecture
- Getting Started with IORM
- Setting the IORM Objective
- Enabling Intradatabase Resource Management
- Intradatabase Plan: Example
- Using Exadata IORM with CDB
- Enabling IORM for Multiple Databases
- Interdatabase Plan: Example
- Category Plan: Example
- Complete Example: Database A
- Complete Example: Database B
- Complete Example: Exadata Cells
- Using Share-Based Allocation in the Interdatabase Plan
- Setting Database I/O Utilization Limits
- Interdatabase Plans and Database Roles
- Flash Cache and Flash Log Resource Control
- Flash Cache Space Resource Management
- PMEM Cache and PMEM Log Resource Control
- PMEM Cache Space Resource Management
- I/O Resource Management Profiles
- Monitoring IORM Using AWR
- Monitoring IORM Using Database Statistics
- Monitoring IORM Using Exadata Metrics
- What to Look for When Monitoring IORM
- Using Database I/O Metrics
- Quiz
- Summary

## Recommendations for Optimizing Database Performance

- Objectives
- Optimizing Performance
- Persistent Memory Usage

- Setting the PMEM Cache Mode
- Flash Memory Usage
- Influencing Caching Priorities
- Using cachingPolicy attribute
- Choosing the Flash Cache Mode for Non-Extreme Flash Cells
- Setting the Flash Cache Mode
- PMEM/Flash Cache Configurations
- Administering In-Memory Columnar Caching
- Table Compression Usage
- Index Usage
- ASM Allocation Unit Size
- Extent Size
- Exadata Specific System Statistics
- Exadata I/O Latency Capping
- Setting the Exadata Cell I/O Timeout Threshold
- Quiz
- Summary
- Practice 8: Overview

## Using Smart Scan

- Objectives
- Exadata Smart Scan: Overview
- Smart Scan Requirements
- Situations Preventing Smart Scan
- Monitoring Smart Scan in SQL Execution Plans
- Smart Scan Execution Plan: Example
- Example of a Situation Preventing Smart Scan
- Smart Scan Join Processing with Bloom Filters
- Smart Scan Join Filtering: Example
- Other Situations Affecting Smart Scan
- Exadata Storage Server Statistics: Overview
- Exadata Storage Server Wait Events: Overview
- Smart Scan Statistics: Example
- Smart Scan Wait Events: Example
- Concurrent Transaction: Example
- Extreme Concurrent Transaction: Example
- Migrated Rows: Example
- I/O Sent Directly to Database Server to Balance CPU Usage: Example
- Column Filtering: Example
- Quiz
- Summary
- Practice 9: Overview

## Consolidation Options and Recommendations

- Objectives

- Consolidation: Overview
- Methods for Database Consolidation
- Core Principles for Database Consolidation
- Recommended Consolidation Approach
- Recommended Storage Configuration for Consolidation
- Alternative Storage Configurations
- Benefits and Limitations of Partitioned Storage Configurations
- Cluster Configuration Options
- Operating System Parameter Recommendations
- Memory Management Recommendations
- CPU Management Recommendations
- Process Management Recommendations
- Other Recommendations
- Isolating Management Roles
- Consolidation Using Virtual Machines
- Consolidation Using Oracle Multitenant Architecture
- Schema Consolidation Recommendations
- General Maintenance Considerations
- Quiz
- Summary

## Migrating Databases to Exadata Database Machine

- Objectives
- Migration Best Practices: Overview
- Performing Capacity Planning
- Exadata Migration Considerations
- Choosing the Right Migration Path
- Logical Migration Approaches
- Physical Migration Approaches
- Reducing Down Time for Migration by Using Transportable Tablespaces
- Other Approaches
- Post-Migration: Best Practices
- Quiz
- Summary
- Practice 11: Overview

## Bulk Data Loading

- Objectives
- Bulk Data Loading Architectures for Exadata
- Staging Data Files Using DBFS
- Staging Data Files Using ACFS
- Staging Data Files Using External File Systems
- Comparison of Staging Area Options
- Bulk Data Loading Using Oracle DBFS: Overview
- Preparing the Data Files

- Configuring a DBFS Staging Area
- Configuring the Target Database
- Loading the Target Database
- Quiz
- Summary
- Practice 12: Overview

## Exadata Database Machine Platform Monitoring: Introduction

- Objectives
- Monitoring Technologies and Standards
- Simple Network Management Protocol (SNMP)
- Intelligent Platform Management Interface (IPMI)
- Integrated Lights Out Manager (ILOM)
- Exadata Storage Server: Metrics, Thresholds, and Alerts
- Automatic Diagnostic Repository (ADR)
- Automatic Workload Repository (AWR)
- Enterprise Manager Cloud Control
- Quiz
- Summary

## Monitoring Exadata System Software Components

- Objectives
- Guidelines for Exadata Monitoring
- Monitoring Oracle Exadata System Software Components
- Monitoring Exadata Smart Flash Cache
- Using AWR
- Using Database Statistics and Wait Events
- Using Exadata Metrics
- What to Look for When Monitoring Exadata Smart Flash Cache
- Monitoring PMEM Cache
- Using AWR
- Using Database Statistics and Wait Events
- Using Exadata Metrics
- What to Look for When Monitoring PMEM Cache
- Monitoring Exadata Smart Flash Log
- Using AWR
- Using Database Statistics and Wait Events
- Using Exadata Metrics
- What to Look for When Monitoring Exadata Smart Flash Log
- Monitoring PMEM Log
- Using Database Statistics and Wait Events
- What to Look for When Monitoring PMEM Log
- Monitoring Cell Disk I/O
- Using AWR
- Using Database Statistics and Wait Events

- Using Exadata Metrics
- What to Look for When Monitoring Cell Disk I/O
- Quiz
- Summary

## Configuring Enterprise Manager Cloud Control to Monitor Exadata Database Machine

- Objectives
- Enterprise Manager Cloud Control Architecture: Overview
- Enterprise Manager Cloud Control: Supported Exadata Configurations
- Cloud Control Monitoring Architecture for Exadata
- Configuring Cloud Control to Monitor Exadata
- Pre-Discovery Configuration and Verification
- Deploying the Oracle Management Agent
- Discovering Exadata
- Discovering Additional Targets
- Post-Discovery Configuration and Verification
- Configuring an Exadata Dashboard
- Quiz
- Summary
- Practice 15: Overview

## Monitoring Exadata Storage Servers

- Objectives
- Lesson Overview
- Exadata Storage Server Metrics and Alerts Architecture
- Monitoring Exadata Storage Server with Metrics
- Monitoring Exadata Cell Metrics: Examples
- Monitoring Exadata Storage Server with Alerts
- Monitoring Cell Alerts and Creating Thresholds: Examples
- Isolating Faults with Exadata Storage Server Quarantine
- Monitoring Exadata Storage Server with Active Requests
- Automatic Hard Disk Scrubbing and Repair
- Adaptive Hard Disk Scrubbing
- Cell Alert Summary
- Cell Diagnostic Packages
- Monitoring Exadata Storage Server with Enterprise Manager: Overview
- Monitoring Metrics in a Storage Server
- Accessing Exadata Metrics
- Aggregated Exadata FlashDisk and HardDisk Metric
- Exadata Storage Server Metric
- Exadata Key Performance Indicators Metrics
- Exadata Key Performance Indicators Metrics: Example
- Comparing Metrics Across Multiple Storage Servers
- Monitoring Hardware Failure and Sensor State
- Checking for Undelivered Alerts

- Checking for Disk I/O Errors
- Checking for Network Errors
- Monitoring File System Free Space
- Third-Party Monitoring Tools
- Quiz
- Summary
- Practice 16: Overview

## Monitoring Exadata Database Machine Database Servers

- Objectives
- Monitoring Database Servers: Overview
- Monitoring Hardware
- Monitoring the Operating System
- Monitoring Oracle Grid Infrastructure and Database
- Monitoring Oracle Management Agent
- Database Monitoring with Enterprise Manager Cloud Control
- Monitoring Database Servers with MS and DBMCLI: Overview
- Running DBMCLI
- Starting and Stopping Management Services on Exadata Database Servers
- Configuring Management Services on Exadata Database Servers
- Monitoring Database Server Metrics: Examples
- Quiz
- Summary
- Practice 17: Overview

## Monitoring Other Exadata Database Machine Components

- Objectives
- Monitoring the RoCE Switches
- Verifying the RoCE Network Fabric Configuration
- Monitoring the Management Ethernet Switch
- Monitoring the Power Distribution Units
- Quiz
- Summary
- Practice 18: Overview

## Other Useful Exadata Monitoring Tools

- Objectives
- ExaWatcher: Overview
- Using ExaWacher Charts
- Exachk: Overview
- Running Exachk
- Exachk: Sample Reports
- TFA Collector: Overview
- Running TFA Collector on Exadata

- Integrated Lights Out Manager (ILOM): Overview
- Using ILOM
- Accessing the Browser Interface
- Powering the Device On or Off
- Locating the Device
- Viewing Hardware Status and Specifications
- Monitoring Power Consumption
- Accessing the Command-Line Interface (CLI)
- CLI: Examples
- Automated Cloud Scale Performance Monitoring
- Automated Cloud Scale Performance Monitoring: Example – High Memory
- Usage
- Quiz
- Summary

## Backup and Recovery

- Objectives
- Backup and Recovery: Overview
- Backup Option 1: Existing Exadata Storage Server
- Backup Option 2: Oracle ZFS Storage Appliance
- Example: 100Gb Local Backup Solution
- Example: Sharing Exadata X8M Switches
- Example: Dedicated Top of Rack (ToR) Switches
- Backup Option 3: Zero Data Loss Recovery Appliance
- Backup Option 4: Tape Library
- Backup Option 5: Oracle Database Backup Cloud Service
- Exadata Backup Recommendations
- Configuration Best Practices
- Parallelism Usage with Local Disk on Exadata
- Parallelism Usage with ZDLRA
- Other Recommendations with ZDLRA
- Oracle ZFS Storage Appliance
- Parallelism Usage with Tape Libraries
- Other recommendations with Tape Libraries
- Operational Best Practices
- RMAN Backup Operations
- Archived Log Deletion Policy
- Backup and Recovery of Database Machine Software
- Quiz
- Summary
- Practice 20: Overview

## Exadata Database Machine Maintenance Tasks

- Objectives
- Exadata Maintenance: Overview

- Powering Exadata Off and On
- Safely Shutting Down a Single Exadata Storage Server
- Do Not Service LED on Storage Servers
- Replacing a Damaged Physical Disk
- Replacing a Hard Disk Proactively
- Moving All Disks from One Cell to Another
- Replacing a Damaged Flash Card
- Replacing a Damaged PMEM Device
- Dedicated Disks for System Partitions on Storage Servers
- Replacing a Damaged M.2 Device
- Quiz
- Summary

## Patching Exadata Database Machine

- Objectives
- Patching and Updating: Overview
- Patching and Updating: Key Information Sources
- Maintaining Exadata Storage Server Software
- Using patchmgr to Orchestrate Storage Server Patching
- Maintaining Database Server Software
- Using DB Node Update Utility
- Using patchmgr to Orchestrate Database Server Patching
- Performing RoCE Network Fabric Switch Updates
- Recommended Patching Process
- Test System Recommendations
- Quiz
- Summary

## Exadata Database Machine Automated Support Ecosystem

- Objectives
- Auto Service Request: Overview
- ASR Process
- ASR Requirements
- Configuring ASR Manager
- Configuring Exadata for ASR
- Activating ASR Assets
- Verifying the ASR Configuration
- Oracle Configuration Manager: Overview
- Configuring Oracle Configuration Manager
- Quiz
- Summary