Oracle Database 12c: Architecture & Internals

Course Summary

Description

This is a core curriculum course applicable to most learning paths within the Oracle course series. We begin with a discussion of the broad systems infrastructure where one finds Oracle database installations, and we outline how the database fits with other systems in multi-tiered architecture, including web servers, application servers and engineered systems such as the Oracle Exadata database computing platform. We then explore the intricacies of a single database installation, including memory, process and storage structures. Periodically we delve into the internals of the database, probing into such areas internal locking mechanisms, kernel module calls and database failures.

This course initially presents the Oracle database architecture from the perspective of a traditional, single-tenant database configuration as it exists within an on-premise systems infrastructure. We then draw comparisons between such a traditional environment and the new Oracle 12c multi-tenant architecture, used in both traditional and cloud-based computing models.

We present this information in a form that goes beyond a discussion of theoretical concepts. In many cases the Enterprise Manager interface is used to explore the components under consideration. Therefore one of the secondary objectives of this course is to acquaint you with the built-in Enterprise Manager Database Express interface and sometimes with its EM Cloud Control (CC) companion. In particular our focus is to discover the capabilities of the Enterprise Manager Database Express interface newly introduced with the Oracle 12 database release.

The architecture of different Oracle database installations are not all uniform, as there is considerable flexibility regarding the way a particular installation is configured. Such configuration options exist largely in the form of database parameter settings. So this course will devote considerable time to identifying these parameters and how these settings can be used to configure a database installation to suit local requirements.

The information contained within this course is critical to the success of most Oracle technology professionals, whether they are database administrators, security specialists, tuning experts or cloud computing administrators.

Topics

- Oracle Architecture: The Systems Infrastructure
- Oracle Architecture: The Database Host
- Oracle Architecture: Principles & Technology Concepts
- Oracle Architecture: The RDBMS Installation & The Database Instance
- Oracle Database Instance: Memory Architecture
- Oracle Database Instance: Background Process Architecture
- Oracle Database Instance: Foreground Process Architecture
- Oracle Database Storage Architecture: Logical Database Objects
- Oracle Database Storage Architecture: Physical Database Files
- Oracle Database Storage Architecture: Tablespaces
- Oracle Database Internal Mechanisms: Data Concurrency
- Using AWR

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Course Summary (con't)

Audience

- Database administrators
- Application designers and developers
- Web server administrators
- System administrators
- Implementation specialists
- Data center support engineers
- Chief Information Officers (CIO) and other information technology (IT) management professionals

Prerequisites

- Oracle Database 12c: SQL Fundamentals (Levels I & II)
- Oracle Database 12c: Install & Upgrade Workshop

Duration

Two to three days

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Course Outline

I. Oracle Architecture: The Systems Infrastructure

A. ABOUT ENTERPRISE ARCHITECTURES
B. The Relational Database
C. Legacy Computing Models
D. The Multi-Tiered Computing Model
E. Scaling Up
F. Cloud-Based Deployment
G. ORACLE INFRASTRUCTURE ECOSYSTEM
H. USING ORACLE ENTERPRISE MANAGER
I. More About EM
J. Using EM Database Express
K. Using EM Cloud Control

II. Oracle Architecture: The Database Host

A. THE DATABASE SERVER STACK
B. PROCESSOR LAYER
C. CPU Resources
D. Memory Resources
E. I/O & STORAGE PROCESSING
F. OS LAYER PROCESSING MODES
G. DATABASE SERVER VIRTUALIZATION
H. STORAGE VIRTUALIZATION
I. ORACLE DATABASE SERVER STACK
J. ORACLE ENGINEERED SYSTEMS
K. Oracle Exadata Database Platform
L. Exalogic Cloud Machine
M. Exalytics BI Machine
N.

III. Oracle Architecture: Principles & Technology Concepts

A. GRID COMPUTING PRINCIPLES
B. Why Grid Computing?
C. What Is Grid Computing?
D. PARALLELIZATION PRINCIPLES
E. Hardware Parallelization
F. Grid Computing Devices
G. Clustered Database Servers
H. CLOUD COMPUTING PRINCIPLES
I. Multi-Tenancy

IV. Oracle Architecture: The Rdbms Installation & The Database Instance

A. THE DATABASE SERVER SOFTWARE
B. Database Versions & Releases
C. Database Editions
D. Using PRODUCT_COMPONENT_VERSION View
E. The Core Database Components
F. Using V$VERSION View
G. Understanding The Database Version Number
H. The COMPATIBLE Database Parameter
I. DATABASE INSTANCE ELEMENTS
J. Individual Elements Of A Database Instance
K. Physical Database Elements
L. An Operational Database installation
M. DATABASE INSTANCE CONFIGURATIONS
N. Single Instance
O. Parameter Files & Instance Configuration
P. MAX_STRING_SIZE Parameter Example
Q. Independent Instances
R. Clustered Instances
S. The Database Instance In A Multi--- tenant Configuration
T. RECONFIGURING A DATABASE INSTANCE
U. Static Vs. Dynamic Parameters
V. Dynamic Parameter Setting
W. Parameter Setting Scope
X. Parameter Setting Level
Y. Setting Upgrade Related Parameters
Z. DATABASE COMPONENTS
AA. Advanced Data Functionality Components
BB. Security Components
CC. High-Performance Components
DD. Administration Components
EE. Database Feature Usage

V. Oracle Database Instance: Memory Architecture

A. SHARED & PRIVATE MEMORY
B. SGA INTERNALS
C. The Buffer Cache
D. The Database Smart Flash Cache
E. The Redo Log Buffer
F. The Shared Pool
G. The Large Pool
H. The Java Pool
I. Unified Auditing Queues
J. PGA INTERNALS
K. What Is Inside The PGA?
L. Tunable & Non-tunable PGA Space
M. Client-Side Cursors
N. Where Is The PGA Stored?
O. PGA/UGA In Shared Server Mode
P. PGA/UGA With Optional Large Pool

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Course Outline (con't)

Q. LOB OBJECTS & MEMORY HANDLING
R. LOB Buffer Caching
S. Shared I/O Pool
T. LOB Workspace & The PGA
U. INSTANCE MEMORY MANAGEMENT
V. About Automatic Memory Management
W. Default Settings
X. Configure MEMORY_TARGET Parameter
Y. Configure SGA_TARGET Parameter
Z. Configure PGA_AGGREGATE_TARGET Parameter
AA. PGA_AGGREGATE_LIMIT Parameter
BB. Configure Memory Using EM DE

VI. Oracle Database Instance: Background Process Architecture

A. FOREGROUND VS. BACKGROUND
B. ABOUT THE BACKGROUND PROCESSES
C. The Background Processes
D. Linux System Processes
E. The DBWR Process
F. The LGWR Process
G. Checkpoints And The CKPT Process
H. The SMON Process
I. The PMON Process
J. The LREG Process
K. The ARCH Process
L. The RECO Process
M. The CJQx Process
N. The DBRM Process
O. The Management Framework Processes
P. Flashback Data Archive (FBDA) Process
Q. Fault Diagnostics
R. Other Housekeeping Processes
S. Background Process Performance Monitors
T. THREADED MODE
U. About Process Mode
V. About Threaded Mode
W. KERNEL ERRORS & EXCEPTIONS
X. The Error Message
Y. The Error Message Stack
Z. Kernel Errors & Core Dumps
AA. ORA-006xx & ORA-07445 Errors
BB. Understanding The Kernel Errors
CC. The Kernel Module
DD. Kernel Module Arguments
EE. Diagnostic Modules
FF. The Call Stack Trace
GG. ORA-600/ORA-7445/ORA-700 Error Lookup Tool

VII. Oracle Database Instance: Foreground Process Architecture

A. DEDICATED SERVER MODE
B. Session Details From V$SESSION View
C. Session Details From EM Database Express
D. What Is The Impact Of Dedicated Server Mode?
E. SHARED SERVERS MODE
F. Processing SQL In Shared Servers Mode
G. Comparing Dedicated Server & Shared Servers Mode
H. Dedicated Server Mode Client Connection
I. Dedicated Server Mode SQL Statement Execution
J. Shared Servers Mode Client Connection
K. Shared Servers Mode SQL Statement Execution
L. Consider Dedicated Server Mode
M. Consider Shared Servers Mode
N. Shared Servers Mode Advantages
O. CHOOSING THE SQL EXECUTION MODE
P. Instance-Level SQL Execution Mode Configuration
Q. Session-Level SQL Execution Mode Configuration

VIII. Parallel SQL Execution

A. What Is Parallel Execution?
B. The Impact On SQL Statement Execution
C. SQL STATEMENT EXECUTION
D. Parse Phase
E. Execute Phase
F. Fetch Phase
G. SQL OPTIMIZATION & EXECUTION PLANS
H. Optimization Methods
I. Rule-Based Optimizer
J. Cost-Based Optimizer
K. Automatic Tuning Optimizer
L. Adaptive Execution Plans
M. Adaptive Statistics

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Course Outline (con't)

IX. Oracle Database Storage Architecture: Logical Database Objects

A. ABOUT DATABASE OBJECTS
B. Relational Database Objects List
C. Database-Resident Program Units
D. Additional Database Objects
E. Database Objects Illustrated
F. DATABASE OBJECTS CONTEXT
G. The Data Dictionary Schema(s)
H. Making An Object Reference
I. Explicit Schema Context
J. Explicit Database Context
K. Partition Context
L. EDITIONS CONTEXT & REDEFINITION
M. About Application Upgrades
N. About Application Downtime
O. The Edition Hierarchy
P. The Editions In Action

X. Oracle Database Storage Architecture: Physical Database Files

A. ABOUT THE DATABASE FILES
B. SERVER PARAMETER FILES
C. CONTROL FILES
D. REDO LOG FILES
E. DIAGNOSTIC FILES
F. What Are The Diagnostic Files?
G. EM Cloud Control Access
H. The MAX_DUMP_FILE_SIZE Parameter
I. The DIAGNOSTIC_DEST Parameter
J. The Log Files
K. Text Alert Log Contents
L. Viewing Text Alert Log Contents
M. Viewing Alert Log Errors
N. Maintaining The Alert Log
O. The Trace Files
P. Background Process Trace Files
Q. SQL Execution Process (User) Trace Files
R. Incident Dump Files
S. Core Dump Files
T. Trace Files At The OS Level
U. Sample DIAG Trace File
V. Monitoring Trace File Space Usage
W. Maintaining The Trace Directories
X. FILES IN A MULTI-TENANT DATABASE

XI. Oracle Database Storage Architecture: Tablespaces

A. TABLESPACES & DATA FILES
B. Peering Into The Tablespace Storage Hierarchy
C. More About Clustered Table Storage
D. More About The RowID
E. Hybrid Columnar Compression
F. TEMPORARY SEGMENTS
G. About Temporary Segments
H. About Temporary Tablespace Groups
I. Advantages
J. INDEX SEGMENTS
K. B-tree Index Segments
L. Bitmap Index Segments

XII. Oracle Database Internal Mechanisms: Data Concurrency

A. SYSTEM VS. USER LOCKS
B. Internal Locks
C. Using V$LOCK_TYPE View
D. Latches
E. Using V$LATCH View
F. Mutexes & V$MUTEXT_SLEEP
G. User Locks
H. MANAGE & MONITOR SYSTEM LOCKS
I. About Database Wait Events
J. Concurrency Wait Events (Mutex)
K. Concurrency Wait Events (Latch)
L. Spinning Vs. Sleeping
M. Using EM Cloud Control
N. Using AWR