

Oracle Database 19c: Advanced PL/SQL

Oracle Database

DURATION

3 Days

MODULES

14 Lectures

COURSE CODE

—

Course Overview

Further, you will be introduced to utilities such as PL/Scope and hierarchical profiler to analyze, trace, and profile PL/SQL code. These functions help you in improving the performance of the application. In addition, you will be introduced to various security mechanisms that can be used to secure applications.

What You Will Learn

Introduction

- Course Agenda
- Lesson Agenda
- Assumptions
- Course Objectives
- Course Agenda
- Appendixes Used in This Course
- Lesson Agenda
- PL/SQL Development Environments
- Oracle SQL Developer
- Specifications of SQL Developer
- SQL Developer 19.x.x Interface
- Coding PL/SQL in SQL*Plus
- Lesson Agenda
- Tables Used in This Course
- Order Entry Schema
- Human Resources Schema
- Lesson Agenda
- Oracle Database 19c: Focus Areas
- Oracle Database 19c
- Lesson Agenda
- Introduction to Oracle Cloud

- Oracle Cloud Services
- Cloud Deployment Models
- Lesson Agenda
- Oracle SQL and PL/SQL Documentation
- Lesson Agenda
- New Features in 18c and 19c
- Polymorphic Table Functions
- Qualified Expressions
- SQL Macros
- Non-Persistence Support for Object Types
- Summary

Working with Exadata Express Cloud Service

- Course Agenda
- Lesson Objectives
- Lesson Agenda
- Evolving from On-premises to Exadata Express
- Exadata Express for Users
- Exadata Express for Developers
- Getting Started with Exadata Express
- Managing Exadata
- Lesson Agenda
- Service Console
- Web Access Through Service Console
- Client Access Configuration Through Service Console
- Database Administration Through Service Console
- Lesson Agenda
- SQL Workshop
- Lesson Agenda
- Connecting Through Database Clients
- Enabling SQL*Net Access for Client Applications
- Downloading Client Credentials
- Connecting Oracle SQL Developer
- Connecting Oracle SQLcl
- Summary
- Practice 2: Overview

Overview of Collections

- Course Agenda
- Objectives
- Lesson Agenda
- Collections
- Why Collections?
- Collection Types
- Lesson Agenda

- Using Associative Arrays
- Creating an Associative Array
- Traversing an Associative Array
- Collection Methods
- Lesson Agenda
- Nested Tables
- Creating Nested Table Types
- Nested Tables: Example
- Collection Constructors
- Declaring Collections: Nested Table
- Using Nested Tables
- Referencing Collection Elements
- Using Nested Tables in PL/SQL
- Lesson Agenda
- Varrays
- Declaring Collections: Varray
- Using Varrays
- Quiz
- Summary
- Practice 3: Overview

Using Collections

- Course Agenda
- Objectives
- Lesson Agenda
- Usage of Collections in Applications
- Working with Collections in PL/SQL
- Assigning Values to Collection Variables
- Accessing Values in the Collection
- Working with Collection Methods
- Using Collection Methods
- Manipulating Individual Elements
- Querying a Collection by Using the TABLE Operator
- Querying a Collection with the TABLE Operator
- Lesson Agenda
- Collection Exceptions
- Collection Exceptions: Example
- Lesson Agenda
- Listing Characteristics for Collections
- Lesson Agenda
- PL/SQL Bind Types
- Subprogram with a BOOLEAN Parameter
- Quiz
- Summary
- Practice 4: Overview

- Course Agenda
- Objectives
- Lesson Agenda
- What Is a LOB?
- Types of LOBs
- LOB Locators and LOB Values
- Lesson Agenda
- DBMS_LOB Package
- Security Model of the DBMS_LOB Package
- What Is a DIRECTORY Object?
- Managing BFILES: Role of a DBA
- Managing BFILES: Role of a Developer
- Lesson Agenda
- Working on BFILES
- Preparing to Use BFILES
- Creating BFILE Columns in the Table
- Populating a BFILE Column with PL/SQL
- Using Data in the BFILE Column
- Lesson Agenda
- Working on CLOBs
- Initializing the LOB Columns Added to a Table
- Populating LOB Columns
- Loading Data to a LOB Column
- Writing Data to a LOB
- Lesson Agenda
- Reading LOBs from the Table
- Updating LOB by Using DBMS_LOB in PL/SQL
- Selecting CLOB Values by Using SQL
- Selecting CLOB Values by Using DBMS_LOB
- Selecting CLOB Values in PL/SQL
- Removing LOBs
- Quiz
- Lesson Agenda
- Temporary LOBs
- Creating a Temporary LOB
- Lesson Agenda
- SecureFile LOBs
- Storage of SecureFile LOBs
- Creating a SecureFile LOB
- Quiz
- Summary
- Practice 5: Overview

JSON Data in Database

- Course Agenda
- Objectives
- Lesson Agenda
- What Is JSON?
- Structure of JSON Data
- JSON Data: Example
- Why JSON?
- Lesson Agenda
- JSON Data in Oracle Database: Scenario
- JSON Data in Oracle Database
- Creating a Table with JSON Column
- JSON or Not?
- Inserting Data into JSON Columns
- Lesson Agenda
- SQL/JSON Generation Functions
- JSON_OBJECT Function
- JSON_ARRAY Function
- JSON_OBJECTAGG Function
- JSON_ARRAYAGG Function
- SQL/JSON Functions
- Lesson Agenda
- Retrieving SQL Data from JSON Object
- Accessing JSON Data
- JSON_VALUE Function
- Using SQL/JSON Functions
- Lesson Agenda
- PL/SQL Objects for JSON
- JSON Object Types in PL/SQL
- JSON Object Methods
- Getter and Setter Methods
- JSON Methods in PL/SQL: Example
- Summary
- Practice 6: Overview

Advanced Interface Methods

- Course Agenda
- Objectives
- Lesson Agenda
- PL/SQL External Procedures
- Oracle Database with Different Languages
- Scenario
- Lesson Agenda
- External Procedure Execution Architecture

- Components for External C Procedure Execution
- Defining an External C Procedure
- Define a C Function
- Creating an Alias Library
- Publishing External C Procedures
- Call Specification Syntax
- Call Specification
- Publishing an External C Routine
- Executing an External C Procedure
- Lesson Agenda
- Executing Java Programs from PL/SQL
- External Procedure Execution Architecture
- Development Steps for Java Class Methods
- Loading Java Class Methods
- Publishing a Java Class Method
- Executing the Java Routine
- Creating Call Specifications in Packages
- Quiz
- Summary
- Practice 7: Overview

Performance and Tuning

- Course Agenda
- Objectives
- Lesson Agenda
- Compiling a PL/SQL Unit
- Deciding on a Compilation Method
- Configuring the Compiler
- Viewing the Compilation Settings
- Setting Up a Database for Native Compilation
- Modifying Compilation Mode of a Program Unit
- Lesson Agenda
- PL/SQL Optimizer
- Subprogram Inlining: Introduction
- Using Inlining
- Inlining Concepts
- Inlining: How to Enable It?
- PRAGMA INLINE Example
- Inlining: Summary
- Lesson Agenda
- Why PL/SQL Tuning?
- Tuning PL/SQL Code
- Avoid Implicit Data Type Conversion
- NOT NULL Constraint
- PLS_INTEGER Data Type for Integers

- Using the SIMPLE_INTEGER Data Type
- Modularizing Your Code
- Bulk Binding
- FORALL Instead of FOR
- BULK COLLECT
- Exception While Bulk Collecting
- Handling FORALL Exceptions
- Tuning Conditional Control Statements
- Passing Data Between PL/SQL Programs
- Quiz
- Summary
- Practice 8: Overview

Improving Performance with Caching

- Course Agenda
- Objectives
- Lesson Agenda
- What Is Caching?
- Memory Architecture
- Caching in the Database Instance
- What Is Result Caching?
- Lesson Agenda
- Configuring the Server Result Cache
- Setting Result_Cache_Max_Size
- Setting the Result Cache Mode
- Using the DBMS_RESULT_CACHE Package
- Lesson Agenda
- SQL Query Result Cache
- Examining the Memory Cache
- Examining the Execution Plan for a Query
- Examining Another Execution Plan
- Executing Both Queries
- Viewing Cache Results Created
- Viewing Cache Results Found
- Lesson Agenda
- PL/SQL Function Result Cache
- Marking PL/SQL Function Results to Be Cached
- Clearing the Shared Pool and Result Cache
- Creating a PL/SQL Function by Using the RESULT_CACHE Clause
- Calling the PL/SQL Function Inside a Query
- Viewing Cache Results Created
- Calling the PL/SQL Function Again
- Viewing Cache Results Found
- Confirming That the Cached Result Was Used
- Lesson Agenda

- Oracle Database In-Memory
- Quiz
- Summary
- Practice 9: Overview

Analyzing PL/SQL Code

- Course Agenda
- Objectives
- Lesson Agenda
- PL/SQL Code Analysis
- Data Dictionary Views
- Analyzing PL/SQL Code
- Using SQL Developer for Code Analysis
- Using ALL_ARGUMENTS
- ALL_ARGUMENTS
- Using SQL Developer to Report on Arguments
- Lesson Agenda
- PL/Scope
- Using PL/Scope
- USER_IDENTIFIERS View
- Sample Data for PL/Scope
- Collecting Information on Identifiers
- Viewing Identifier Information
- Performing a Basic Identifier Search
- Using USER_IDENTIFIERS to Find All Local Variables
- Finding Identifier Actions
- Lesson Agenda
- Oracle Supplied Packages for Code Analysis
- Using DBMS_DESCRIBE
- DBMS_UTILITY Package
- Using DBMS_UTILITY.FORMAT_CALL_STACK
- Using DBMS_UTILITY
- Finding Error Information
- DBMS_METADATA Package
- DBMS_METADATA Subprograms
- FETCH_xxx Subprograms
- Filters on Metadata
- SET_FILTER Procedure
- Examples of Setting Filters
- Programmatic Use: Example 1
- Programmatic Use: Example 2
- Browsing APIs
- Using the UTL_CALL_STACK Package
- DEPRECATE Pragma
- Quiz

- Summary
- Practice 10: Overview

Profiling and Tracing PL/SQL Code

- Course Agenda
- Objectives
- Lesson Agenda
- Tracing PL/SQL Execution
- Tracing PL/SQL: Steps
- Step 1: Enable Specific Subprograms
- Steps 2 and 3: Identify a Trace Level and Start Tracing
- Step 4 and Step 5: Turn Off and Examine the Trace Data
- plsql_trace_runs and plsql_trace_events
- Lesson Agenda
- Profiling PL/SQL Code
- Hierarchical Profiling
- Hierarchical Profiling Concepts
- Using the PL/SQL Profiler
- Understanding Raw Profiler Data
- Using the Hierarchical Profiler Tables
- Using DBMS_HPROF.ANALYZE
- Using DBMS_HPROF.ANALYZE to Write to Hierarchical Profiler Tables
- Analyzer Output from the DBMSHP_RUNS Table
- Analyzer Output from the DBMSHP_FUNCTION_INFO Table
- plshprof: A Simple HTML Report Generator
- Using plshprof
- Using the HTML Reports
- Quiz
- Summary
- Practice 11: Overview

Securing Applications through PL/SQL

- Course Agenda
- Objectives
- Lesson Agenda
- Invoker's Rights and Definer's Rights
- Why Invoker's Rights?
- AUTHID clause
- Lesson Agenda
- White Lists
- ACCESSIBLE BY Clause
- Using ACCESSIBLE BY Clause in Packages
- Lesson Agenda
- What Is an Application Security Policy?
- Implementing Application Security Policy

- DBMS_RLS package
- Defining a Policy
- Defining a Policy Function
- Defining a Policy
- Lesson Agenda
- Application Context – Concept
- Application Context – Implementation
- USERENV Application Context
- Creating an Application Context
- Setting a Context
- Lesson Agenda
- Virtual Private Database
- Implementing a Virtual Private Database
- Setting Up a Context
- Creating the Package
- Define the Security Policy
- Setting Up the Logon Trigger
- Policy in Action
- Data Dictionary Views
- Using the ALL_CONTEXT Dictionary View
- Policy Groups
- Quiz
- Summary
- Practice 12: Overview

Safeguarding Your Code against SQL Injection Attacks

- Course Agenda
- Objectives
- Lesson Agenda
- SQL Injection
- SQL Injection: Example
- Scenario
- Types of SQL Injection
- Avoidance Strategies against SQL Injection
- Protecting against SQL Injection: Example
- Lesson Agenda
- Reducing the Attack Surface
- Expose the Database Only Via PL/SQL API
- Using Invoker’s Rights
- Strengthen Database Security
- Lesson Agenda
- Using Static SQL
- Using Dynamic SQL
- Lesson Agenda
- Using Bind Arguments with Dynamic SQL

- Using Bind Arguments with Dynamic PL/SQL
- What If You Cannot Use Bind Arguments?
- Lesson Agenda
- DBMS_ASSERT Package
- Understanding DBMS_ASSERT
- Oracle Identifiers
- Working with Identifiers in Dynamic SQL
- Choosing a Verification Route
- Validate Input Using DBMS_ASSERT
- Avoiding Injection by Using DBMS_ASSERT.SIMPLE_SQL_NAME
- DBMS_ASSERT Guidelines
- Quiz
- Summary
- Practice 13: Overview

Advanced Security Mechanisms

- Course Agenda
- Objectives
- Lesson Agenda
- Real Application Security
- How It Works Without RAS?
- How It Works with RAS?
- Real Application Security - Components
- Implementing a RAS Data Security Policy
- Application Sessions in RAS
- RAS Sessions
- Lesson Agenda
- Transparent Data Encryption
- Encrypting a Table Column Using TDE
- Encrypting a Tablespace Using TDE
- Keystores in TDE
- Lesson Agenda
- Oracle Data Redaction
- Data Redaction Methods
- Benefits of Data Redaction
- Summary
- A Table Descriptions and Data
- B Using SQL Developer
- Objectives B-2
- What Is Oracle SQL Developer? B-3
- Specifications of SQL Developer B-4
- SQL Developer Interface B-5
- Creating a Database Connection B-7
- Browsing Database Objects B-10
- Displaying the Table Structure B-11
- Browsing Files B-12

- Finding Database Objects B-13
- Creating a Schema Object B-15
- Creating a New Table: Example B-16
- Using the SQL Worksheet B-17
- Executing SQL Statements B-20
- Saving SQL Scripts B-21
- Executing Saved Script Files: Method 1 B-22
- Executing Saved Script Files: Method 2 B-23
- Formatting the SQL Code B-24
- Using Snippets B-25
- Using Snippets: Example B-26
- Using Recycle Bin B-27
- Debugging Procedures and Functions B-28
- Database Reporting B-29
- Creating a User-Defined Report B-30
- Search Engines and External Tools B-31
- Setting Preferences B-32
- Resetting the SQL Developer Layout B-33
- Data Modeler in SQL Developer B-34
- Summary B-35
- C Using SQL*Plus
- Objectives C-2
- SQL and SQL*Plus Interaction C-3
- SQL Statements Versus SQL*Plus Commands C-4
- SQL Versus SQL*Plus C-5
- Using SQL*Plus C-6
- SQL Plus Commands: Categories C-7
- Logging In to SQL*Plus C-8
- Displaying the Table Structure C-9
- SQL*Plus Editing Commands C-11
- Using LIST, n, and APPEND C-13
- Using the CHANGE Command C-14
- SQL*Plus File Commands C-15
- Using the SAVE and START Commands C-16
- SERVEROUTPUT Command C-17
- Using the SQL*Plus SPOOL Command C-18
- Using the AUTOTRACE Command C-19
- Summary C-20
- D PL/SQL Programming Concepts: Review
- Objectives D-2
- Lesson Agenda D-3
- PL/SQL Block Structure D-4
- Naming Conventions D-5
- Procedures D-7
- Procedure: Example D-8
- Stored Functions D-9

- Functions: Example D-10
- Ways to Execute Functions D-11
- Lesson Agenda D-12
- Restrictions on Calling Functions from SQL Expressions D-13
- Lesson Agenda D-15
- PL/SQL Packages: Review D-16
- Components of a PL/SQL Package D-17
- Creating the Package Specification D-18
- Creating the Package Body D-19
- Lesson Agenda D-20
- Cursor D-21
- Processing Explicit Cursors D-23
- Explicit Cursor Attributes D-24
- Cursor FOR Loops D-25
- Cursor: Example D-26
- Lesson Agenda D-27
- Handling Exceptions D-28
- Exceptions: Example D-30
- Predefined Oracle Server Errors D-31
- Predefined Oracle Server Exceptions D-32
- Trapping Non-Predefined Oracle Server Errors D-34
- Trapping User-Defined Exceptions D-36
- Lesson Agenda D-37
- RAISE_APPLICATION_ERROR Procedure D-38
- Lesson Agenda D-40
- Dependencies D-41
- Displaying Direct and Indirect Dependencies D-43
- Lesson Agenda D-44
- Using Oracle-Supplied Packages D-45
- Some of the Oracle-Supplied Packages D-46
- DBMS_OUTPUT Package D-47
- UTL_FILE Package D-48
- Summary D-49