

Oracle AI Database: SQL Workshop

Student Guide – Volume I S1106065GC10



Copyright © 2025, Oracle and/or its affiliates.

Disclaimer

This document contains proprietary information and is protected by copyright and other intellectual property laws. The document may not be modified or altered in any way. Except where your use constitutes "fair use" under copyright law, you may not use, share, download, upload, copy, print, display, perform, reproduce, publish, license, post, transmit, or distribute this document in whole or in part without the express authorization of Oracle.

The information contained in this document is subject to change without notice and is not warranted to be error-free. If you find any errors, please report them to us in writing.

Restricted Rights Notice

If this documentation is delivered to the United States Government or anyone using the documentation on behalf of the United States Government, the following notice is applicable:

U.S. GOVERNMENT END USERS: Oracle programs (including any operating system, integrated software, any programs embedded, installed or activated on delivered hardware, and modifications of such programs) and Oracle computer documentation or other Oracle data delivered to or accessed by U.S. Government end users are "commercial computer software" or "commercial computer software documentation" pursuant to the applicable Federal Acquisition Regulation and agency-specific supplemental regulations. As such, the use, reproduction, duplication, release, display, disclosure, modification, preparation of derivative works, and/or adaptation of i) Oracle programs (including any operating system, integrated software, any programs embedded, installed or activated on delivered hardware, and modifications of such programs), ii) Oracle computer documentation and/or iii) other Oracle data, is subject to the rights and limitations specified in the license contained in the applicable contract. The terms governing the U.S. Government's use of Oracle cloud services are defined by the applicable contract for such services. No other rights are granted to the U.S. Government.

Trademark Notice

Oracle®, Java, MySQL, and NetSuite are registered trademarks of Oracle and/or its affiliates. Other names may be trademarks of their respective owners.

Intel and Intel Inside are trademarks or registered trademarks of Intel Corporation. All SPARC trademarks are used under license and are trademarks or registered trademarks of SPARC International, Inc. AMD, Epyc, and the AMD logo are trademarks or registered trademarks of Advanced Micro Devices. UNIX is a registered trademark of The Open Group.

Third-Party Content, Products, and Services Disclaimer

This documentation may provide access to or information about content, products, and services from third parties. Oracle Corporation and its affiliates are not responsible for and expressly disclaim all warranties of any kind with respect to third-party content, products, and services unless otherwise set forth in an applicable agreement between you and Oracle. Oracle Corporation and its affiliates will not be responsible for any loss, costs, or damages incurred due to your access to or use of third-party content, products, or services, except as set forth in an applicable agreement between you and Oracle.

1011042025

Contents

----- Note ----- Important Note ------------

Oracle Al Database 26ai has replaced **Oracle Database 23ai**. This change was announced at Oracle Al World in October 2025. The architecture, concepts, and features presented in this course remain fully relevant to 26ai.

O Course Overview

Course Outline O-2
Target Audience O-4
Learning Outcomes O-5
What's Next? I-7

1 Introduction

Objectives 1-2

Overview of Oracle Database 23c and Related Products 1-3

Oracle Database 23c: Focus Areas 1-4

Oracle Database 23c 1-5

Overview of Relational Database Management Concepts and Terminologies 1-7

Relational and Object Relational Database Management Systems 1-8

Data Storage on Different Media 1-9

Relational Database Concept 1-10

Definition of a Relational Database 1-11

Data Models 1-12

Entity Relationship Model 1-13

Entity Relationship Modeling Conventions 1-14

Relating Multiple Tables 1-16

Relational Database Terminology 1-17

Human Resources (HR) Schema and the Tables Used in This Course 1-18

Human Resources (HR) Application 1-19

Tables Used in This Course 1-20

Tables Used in the Course 1-21

Introduction to SQL and Its Development Environments 1-22

Using SQL to Query Your Database 1-23

How SQL Works 1-24

SQL Statements Used in the Course 1-25

Development Environments for SQL in Oracle 1-26

Introduction to Oracle Live SQL 1-27

Oracle Database 23c SQL Documentation and Additional Resources 1-28

Oracle Database Documentation 1-29

Additional Resources for Oracle 1-30

Oracle University: Oracle SQL Training 1-31

Oracle SQL Certification 1-32

Summary 1-33

2 Retrieving Data Using the SQL SELECT Statement

Course Roadmap 2-2

Objectives 2-3

Capabilities of SQL SELECT Statements 2-4

HR Application Scenario 2-5

Writing SQL Statements 2-6

Basic SELECT Statement 2-7

Selecting All Columns 2-8

Executing SQL Statements with Oracle SQL Developer and SQL*Plus 2-9

Column Heading Defaults in SQL Developer and SQL*Plus 2-10

Selecting Specific Columns 2-11

Selecting from dual with Oracle Database 2-12

New Feature in 23c: SELECT Without FROM Clause 2-13

Arithmetic Expressions and NULL Values in the SELECT statement 2-14

Arithmetic Expressions 2-15

Using Arithmetic Operators 2-16

Operator Precedence 2-17

Defining a Null Value 2-18

Null Values in Arithmetic Expressions 2-19

Column Aliases 2-20

Defining a Column Alias 2-21

Using Column Aliases 2-22

Use of the Concatenation Operator, Literal Character Strings, Alternative

Quote Operator, and the DISTINCT Keyword 2-23

Concatenation Operator in Oracle 2-24

Literal Character Strings 2-25

Using Literal Character Strings in Oracle 2-26

Alternative Quote (q) Operator in Oracle 2-27

Duplicate Rows 2-28

DESCRIBE Command 2-29

Displaying Table Structure by Using the DESCRIBE Command 2-30

Displaying Table Structure by Using Oracle SQL Developer 2-31

Summary 2-32

3 Restricting and Sorting Data

Course Roadmap 3-2

Objectives 3-3

Limiting Rows 3-4

Limiting Rows by Using a Selection 3-5

Limiting Rows That Are Selected 3-6

Using the WHERE Clause 3-7

Character Strings and Dates 3-8

Comparison Operators 3-9

Using Comparison Operators 3-10

Range Conditions Using the BETWEEN Operator 3-11

Using the IN Operator 3-12

Pattern Matching Using the LIKE Operator 3-13

Combining Wildcard Symbols 3-14

Using NULL Conditions 3-15

Defining Conditions Using Logical Operators 3-16

Using the AND Operator 3-17

Using the OR Operator 3-18

Using the NOT Operator 3-19

Rules of Precedence for Operators in an Expression 3-20

Rules of Precedence 3-21

Sorting Rows Using the ORDER BY Clause 3-23

Using the ORDER BY Clause 3-24

Sorting 3-25

SQL Row Limiting Clause in a Query 3-27

SQL Row Limiting Clause 3-28

Using SQL Row Limiting Clause in a Query in Oracle 3-29

SQL Row Limiting Clause: Example in Oracle 3-30

Substitution Variables in Oracle 3-31

Using the Single-Ampersand Substitution Variable 3-34

Character and Date Values with Substitution Variables 3-36

Specifying Column Names, Expressions, and Text 3-37

Using the Double-Ampersand Substitution Variable 3-38

Using the Ampersand Substitution Variable in SQL*Plus 3-39

Assigning Values to Variables 3-40

Using the DEFINE Command in Oracle 3-41

Using the VERIFY Command in Oracle 3-42

Summary 3-43

4 Using Single-Row Functions to Customize Output

Course Roadmap 4-2

Objectives 4-3

HR Application Scenario 4-4

Single-Row SQL Functions 4-5

SQL Functions 4-6

Two Types of SQL Functions 4-7

Single-Row Functions 4-8

Character Functions 4-10

Case-Conversion Functions 4-13

Using Case-Conversion Functions in WHERE Clauses in Oracle 4-14

Character-Manipulation Functions 4-15

Using Character-Manipulation Functions 4-16

Nesting Functions 4-17

Nesting Functions: Example 4-19

Number Functions 4-20

Numeric Functions 4-21

Using the ROUND Function 4-22

Using the TRUNC Function in Oracle 4-23

Using the MOD Function 4-24

Working with Dates in Oracle Databases 4-25

RR Date Format in Oracle 4-27

Using the SYSDATE Function in Oracle 4-29

Using the CURRENT_DATE and CURRENT_TIMESTAMP Functions

in Oracle 4-30

Arithmetic with Dates in Oracle 4-31

Using Arithmetic Operators with Dates in Oracle 4-32

Date Functions 4-33

Date-Manipulation Functions in Oracle 4-34

Using Date Functions in Oracle 4-35

Using ROUND and TRUNC Functions with Dates in Oracle 4-36

Summary 4-37

5 Using Conversion Functions and Conditional Expressions

Course Roadmap 5-2

Objectives 5-3

Implicit and Explicit Data Type Conversion 5-4

Conversion Functions 5-5

Implicit Data Type Conversion of Strings to Numbers 5-6

Implicit Data Type Conversion of Numbers to Strings 5-7

TO_CHAR, TO_DATE, and TO_NUMBER Functions in Oracle 5-8

Using the TO CHAR Function with Dates 5-9

Elements of the Date Format Model 5-10

Using the TO CHAR Function with Dates 5-14

Using the TO CHAR Function with Numbers 5-15

Using the TO NUMBER and TO DATE Functions 5-18

Using TO_CHAR and TO_DATE Functions with the RR Date Format 5-20

General Functions 5-21

NVL Function 5-23

Using the NVL Function in Oracle 5-24

Using the NVL2 Function in Oracle 5-25

Using the NULLIF Function 5-26

Using the COALESCE Function 5-27

Conditional Expressions 5-29

CASE Expression 5-31

Using the CASE Expression 5-32

Searched CASE Expression 5-33

DECODE Function in Oracle 5-34

Using the DECODE Function 5-35

JSON Functions 5-37

JSON QUERY Function 5-38

JSON TABLE Function 5-39

JSON VALUE Function 5-40

Summary 5-41

6 Reporting Aggregated Data Using the Group Functions

Course Roadmap 6-2

Objectives 6-3

Group Functions 6-4

Types of Group Functions 6-6

Group Functions: Syntax 6-7

Using the AVG and SUM Functions 6-8

Using the MIN and MAX Functions 6-9

Using the COUNT Function 6-10

Using the DISTINCT Keyword 6-11

Group Functions and Null Values in Oracle 6-12

Grouping Rows 6-13

Creating Groups of Data 6-14

Creating Groups of Data: GROUP BY Clause Syntax 6-15

Using the GROUP BY Clause 6-16

Using the GROUP BY Column Position 6-17

Using the GROUP BY Clause 6-18

Grouping by More Than One Column 6-19

Using the GROUP BY Clause on Multiple Columns 6-20

Illegal Queries Using Group Functions 6-21

Illegal Queries Using Group Functions in a WHERE Clause 6-22

Restricting Group Results 6-23

Restricting Group Results with the HAVING Clause 6-24

Using the HAVING Clause 6-25

Nesting Group Functions 6-27

Nesting Group Functions in Oracle 6-28

Summary 6-29

7 Displaying Data from Multiple Tables Using Joins

Course Roadmap 7-2

Objectives 7-3

Types of Joins and Their Syntax 7-4

Why Join? 7-5

Obtaining Data from Multiple Tables 7-6

Types of Joins 7-7

Joining Tables Using SQL Syntax 7-8

Natural Join 7-9

Creating Natural Joins 7-10

Retrieving Records with Natural Joins 7-11

Join with the USING Clause 7-12

Creating Joins with the USING Clause 7-13

Joining Column Names 7-14

Retrieving Records with the USING Clause 7-15

Qualifying Ambiguous Column Names 7-16

Using Table Aliases with the USING Clause in Oracle 7-17

Join with the ON Clause 7-18

Creating Joins with the ON Clause 7-19

Retrieving Records with the ON Clause 7-20

Creating Three-Way Joins 7-21

Applying Additional Conditions to a Join 7-22

Self-Join 7-23

Joining a Table to Itself 7-24

Self-Joins Using the ON Clause 7-25

Nonequijoins 7-26

Retrieving Records with Nonequijoins 7-28

Outer Join 7-29

Returning Records with No Direct Match Using OUTER Joins 7-30

INNER Versus OUTER Joins 7-31

LEFT OUTER JOIN 7-32

RIGHT OUTER JOIN 7-33

FULL OUTER JOIN in Oracle 7-34

Cartesian Product 7-35

Cartesian Products 7-36

Generating a Cartesian Product 7-37

Creating Cross Joins 7-38

Summary 7-39

8 Using Subqueries to Solve Queries

Course Roadmap 8-2

Objectives 8-3

Subquery: Types, Syntax, and Guidelines 8-4

Using a Subquery to Solve a Problem 8-5

Subquery Syntax 8-6

Using a Subquery 8-7

Rules and Guidelines for Using Subqueries 8-8

Types of Subqueries 8-9

Single-Row Subqueries 8-10

Executing Single-Row Subqueries 8-12

Using Group Functions in a Subquery 8-13

HAVING Clause with Subqueries 8-14

What is wrong with this statement? 8-15

No Rows Returned by the Inner Query 8-16

Multiple-Row Subqueries 8-17

Using the ANY Operator in Multiple-Row Subqueries 8-19

Using the ALL Operator in Multiple-Row Subqueries 8-20

Multiple-Column Subqueries 8-21

Multiple-Column Subquery: Example 8-23

Null Values in a Subquery 8-24

Summary 8-26

9 Using Set Operators

Course Roadmap 9-2

Objectives 9-3

Set Operators: Types and Guidelines 9-4

Set Operators 9-5

Set Operator Rules 9-6

Oracle Server and Set Operators 9-7

Tables Used in This Lesson 9-8

UNION and UNION ALL Operators 9-13

UNION Operator 9-14

Using the UNION Operator 9-15

UNION ALL Operator 9-16

Using the UNION ALL Operator 9-17

INTERSECT Operator 9-18

Using the INTERSECT Operator 9-20

MINUS Operator 9-21

Using the MINUS Operator 9-23

Matching SELECT Statements 9-24

Matching SELECT Statements in Oracle 9-25

Matching the SELECT Statement: Example in Oracle 9-26

Using the ORDER BY Clause in Set Operations 9-27

Using the ORDER BY Clause in Set Operations in Oracle 9-28

Using the ORDER BY Clause in Set Operations in Oracle: Example 9-29

Summary 9-30

10 Managing Tables Using DML Statements

Course Roadmap 10-2

Objectives 10-3

HR Application Scenario 10-4

Adding New Rows in a Table 10-5

Data Manipulation Language 10-6

Adding a New Row to a Table 10-7

INSERT Statement Syntax 10-8

Inserting New Rows 10-9

INSERT Statement Syntax 10-10

Inserting Rows with Null Values 10-11

Inserting Special Values 10-12

Inserting Specific Date and Time Values 10-13

Creating a Script 10-14

Copying Rows from Another Table 10-15

Changing Data in a Table 10-16

UPDATE Statement Syntax 10-18

Updating Rows in a Table 10-19

Updating Two Columns with a Subquery 10-20

Updating Rows Based on Another Table 10-21

Enhancement in 23c 10-22

RETURNING Clause in 23c: Example 10-23

Removing Rows from a Table 10-24

Removing a Row from a Table 10-25

DELETE Statement 10-26

Deleting Rows from a Table 10-27

Deleting Rows Based on Another Table 10-28

Enhancements to UPDATE and DELETE Statements in 23c 10-29

UPDATE: Example 10-30
DELETE: Example 10-31
TRUNCATE Statement 10-32

Database Transaction Control 10-33

Database Transactions 10-34

Database Transactions: Start and End 10-35

Advantages of the COMMIT and ROLLBACK Statements 10-36

Explicit Transaction Control Statements 10-37

Rolling Back Changes to a Marker 10-38

Implicit Transaction Processing 10-39

State of Data Before COMMIT or ROLLBACK 10-40

State of Data After COMMIT 10-41

Committing Data 10-42

State of Data After ROLLBACK 10-43

State of Data After ROLLBACK: Example 10-44

Statement-Level Rollback 10-45

Read Consistency 10-46

Implementing Read Consistency 10-48

Manual Data Locking 10-49

FOR UPDATE Clause in a SELECT Statement 10-50

FOR UPDATE Clause: Examples 10-51

LOCK TABLE Statement 10-52

Summary 10-53

11 Introduction to Data Definition Language

Course Roadmap 11-2

Objectives 11-3

HR Application Scenario 11-4

Database Objects 11-5

Naming Rules for Tables and Columns 11-7

CREATE TABLE Statement 11-8

Creating Tables 11-10

Staging Tables 11-11

Creating Staging Tables: Methods 11-12
Using Staging Tables: Example 11-13

Data Types 11-14

Datetime Data Types 11-17

SQL*Plus Support for Boolean Data Type in 23c 11-18

Creating a Table with Boolean Type and Inserting Data: Example 11-19

Querying the Table Containing BOOLEAN Values in SQL Developer:

Example 11-20

Default Output in SQL*Plus: Example 11-21

Using the COLUMN Command to Customize Output: Example 11-22

DEFAULT Option 11-23

23c Enhancement to SQL Statements 11-24

UPDATE Option to the Existing DEFAULT ON NULL Clause: Example 11-25

Updating demo_t and Setting ename to the 'missing name' Value:

Example 11-26

DEFAULT ON NULL with IDENTITY Columns and Update Column c2

to <sequence>.nextval: Example 11-27

Constraints: Overview 11-28

Including Constraints 11-29

Constraint Guidelines 11-30

Defining Constraints 11-31

Defining Constraints: Example 11-32

NOT NULL Constraint 11-33

UNIQUE Constraint 11-34

PRIMARY KEY Constraint 11-36

FOREIGN KEY Constraint 11-37

FOREIGN KEY Constraint: Keywords 11-39

CHECK Constraint 11-40

CREATE TABLE: Example 11-41

IF (NOT) EXISTS Enhancement 11-42

IF NOT EXISTS Clause: Example 11-43

Violating Constraints 11-44

Creating a Table by Using a Subquery 11-46

ALTER TABLE Statement 11-49

Adding a Column 11-52

Modifying a Column 11-53

Dropping a Column 11-54

SET UNUSED Option 11-55

Read-Only Tables 11-57

DROP TABLE Statement 11-58

Dropping a Table 11-59

Dropping the DEMO Table If It Exists: Example 11-60

Summary 11-61

12 Introduction to Data Dictionary Views

Objectives 12-2

Introduction to Data Dictionary 12-3

Why data dictionary? 12-4

Data Dictionary 12-5

Data Dictionary Structure 12-6

How to Use Dictionary Views 12-8

USER OBJECTS and ALL OBJECTS Views 12-9

USER OBJECTS View 12-10

Querying the Dictionary Views 12-11

Table Information 12-12

Column Information 12-13

Constraint Information 12-15

USER CONSTRAINTS: Example 12-16

Querying USER CONS COLUMNS 12-17

Adding a Comment to a Table and Querying the Dictionary Views 12-18

Adding Comments to a Table 12-19

Summary 12-20

13 Creating Sequences, Synonyms, and Indexes

Objectives 13-2

Create, Maintain, and Use Sequences 13-3

E-Commerce Scenario 13-4

Database Objects 13-5

Referencing Another User's Tables 13-6

Sequences 13-7

CREATE SEQUENCE Statement: Syntax 13-8

Creating a Sequence 13-10

NEXTVAL and CURRVAL Pseudocolumns 13-11

Using a Sequence 13-13

SQL Column Defaulting Using a Sequence 13-14

Caching Sequence Values 13-15

Modifying a Sequence 13-16

Guidelines for Modifying a Sequence 13-17

Sequence Information 13-18

Create Private and Public Synonyms 13-19

Synonyms 13-20

Creating a Synonym for an Object 13-21

Creating and Removing Synonyms 13-22

Synonym Information 13-23

Create and Maintain Indexes 13-24

Indexes 13-25

How are indexes created? 13-26

Creating an Index 13-27

CREATE INDEX with the CREATE TABLE Statement 13-28

Function-Based Indexes 13-30

Creating Multiple Indexes on the Same Set of Columns 13-31

Creating Multiple Indexes on the Same Set of Columns: Example 13-32

Index Information 13-33

USER INDEXES: Examples 13-34

Querying USER IND COLUMNS 13-35

Removing an Index 13-36

Summary 13-37

14 Creating Views

Objectives 14-2

Overview of Views 14-3

Why views? 14-4

Database Objects 14-5

What is a view? 14-6

Advantages of Views 14-7

Simple Views and Complex Views 14-8

Creating, Modifying, and Retrieving Data from a View 14-9

Creating a View 14-10

Retrieving Data from a View 14-13

Modifying a View 14-14

Creating a Complex View 14-15

View Information 14-16

Data Manipulation Language (DML) Operations on a View 14-17

Rules for Performing DML Operations on a View 14-18

Rules for Performing Modify Operations on a View 14-19

Rules for Performing Insert Operations Through a View 14-20

Using the WITH CHECK OPTION Clause 14-21

Denying DML Operations 14-22

Dropping a View 14-24 Removing a View 14-25 Summary 14-26

15 Managing Schema Objects

Objectives 15-2

Manage Constraints 15-3

Adding a Constraint: Syntax 15-4

Adding a Constraint 15-5

Dropping a Constraint 15-6

Dropping a Constraint: ONLINE 15-7

ON DELETE Clause 15-8

Cascading Constraints 15-9

Cascading Constraints: Example 15-10

Renaming Table Columns and Constraints 15-11

Disabling Constraints 15-12

Enabling Constraints 15-13

Constraint States 15-14

Deferring Constraints 15-15

Difference Between INITIALLY DEFERRED and INITIALLY IMMEDIATE 15-16

DROP TABLE ... PURGE 15-18

Create and Use Temporary Tables 15-19

Using Temporary Tables 15-20

Temporary Table 15-21

Temporary Table: Characteristics 15-22

Creating a Global Temporary Table 15-23

Creating a Private Temporary Table 15-24

Creating and Using External Tables 15-25

External Tables 15-26

Creating a Directory for the External Table 15-27

Creating an External Table 15-29

Creating an External Table by Using ORACLE LOADER 15-31

Querying External Tables 15-32

Creating an External Table by Using ORACLE DATAPUMP: Example 15-33

Summary 15-34

16 Retrieving Data by Using Subqueries

Objectives 16-2

Retrieving Data by Using a Subquery as a Source 16-3

Writing a Multiple - Column Subquery 16-6

Multiple-Column Subqueries 16-7

Column Comparisons 16-8

Pairwise Comparison Subquery 16-9

Nonpairwise Comparison Subquery 16-10

Using Scalar Subqueries in SQL 16-11

Scalar Subquery Expressions 16-12

Scalar Subqueries: Examples 16-13

Solving Problems with Correlated Subqueries 16-14

Correlated Subqueries 16-15

Using Correlated Subqueries: Example 1 16-17

Using Correlated Subqueries: Example 2 16-18

Using the EXISTS and NOT EXISTS Operators 16-19

Using the EXISTS Operator 16-20

Find All Departments That Do Not Have Employees: Example 16-22

Using the WITH Clause 16-23

WITH Clause 16-24

WITH Clause: Example 16-25

Recursive WITH Clause 16-26

Recursive WITH Clause: Example 16-27

Summary 16-28

17 Manipulating Data by Using Subqueries

Objectives 17-3

Using Subqueries to Manipulate Data 17-3

Inserting Values by Using a Subquery as a Target 17-5

Inserting by Using a Subquery as a Target (1/2) 17-6

Inserting by Using a Subquery as a Target (2/2) 17-7

Using the WITH CHECK OPTION keyword on DML statements 17-8

Using Correlated Subqueries to Update and Delete Rows 17-11

Correlated UPDATE 17-12

Using Correlated UPDATE 17-13

Correlated DELETE 17-15

Using Correlated DELETE 17-16

Summary 17-17

18 Controlling User Access

Objectives 18-2

Differentiating System Privileges from Object Privileges 18-3

Controlling User Access 18-4

Privileges 18-5

System Privileges 18-6

Creating Users 18-7

User System Privileges 18-8

Granting System Privileges 18-9

Creating a Role 18-10

What is a role? 18-11

Creating and Granting Privileges to a Role 18-12

Changing Your Password 18-13

Object Privileges 18-14

Granting Object Privileges 18-17

Passing On Your Privileges 18-18

Confirming Granted Privileges 18-19

Revoking Object Privileges 18-20

Summary 18-23

Practice 18: Overview 18-24

19 Manipulating Data Using Advanced Queries

Course Roadmap 19-2

Objectives 19-3

Specifying Explicit Default Values in INSERT and UPDATE Statements 19-4

Explicit Default Feature: Overview 19-5

Using Explicit Default Values 19-6

Multitable INSERTs 19-7

E-Commerce Scenario 19-8

Multitable INSERT Statements: Overview 19-9

Types of Multitable INSERT Statements 19-11

Multitable INSERT Statements 19-12

Unconditional INSERT ALL 19-14

Conditional INSERT ALL: Example 19-15

Conditional INSERT ALL 19-16

Conditional INSERT FIRST: Example 19-18

Conditional INSERT FIRST 19-19

Pivoting INSERT 19-20

Merging Rows in a Table 19-23

MERGE Statement 19-24

MERGE Statement Syntax 19-25

Merging Rows: Example 19-26

Performing Flashback Operations 19-29

FLASHBACK TABLE Statement 19-30

Using the FLASHBACK TABLE Statement 19-32

Tracking the Changes in Data Over a Period of Time 19-33

Tracking Changes in Data 19-34

Flashback Query: Example 19-35

Flashback Version Query: Example 19-36

VERSIONS BETWEEN Clause 19-37

Summary 19-38

20 Managing Data in Different Time Zones

Objectives 20-2

CURRENT_DATE, CURRENT_TIMESTAMP, and LOCALTIMESTAMP 20-3

E-Commerce Scenario 20-4

Time Zones 20-5

TIME ZONE Session Parameter 20-6

CURRENT DATE, CURRENT TIMESTAMP, and LOCALTIMESTAMP 20-7

Comparing Date and Time in a Session's Time Zone 20-8

DBTIMEZONE and SESSIONTIMEZONE 20-10

TIMESTAMP Data Types 20-11

TIMESTAMP Fields 20-12

Difference Between DATE and TIMESTAMP 20-13

Comparing TIMESTAMP Data Types 20-14

INTERVAL Data Types 20-15

INTERVAL Fields 20-17

INTERVAL YEAR TO MONTH: Example 20-18

INTERVAL DAY TO SECOND Data Type: Example 20-20

Additional Date Functions 20-21

EXTRACT 20-22

TZ OFFSET 20-23

FROM TZ 20-25

TO TIMESTAMP 20-26

TO YMINTERVAL 20-27

TO DSINTERVAL 20-28

Daylight Saving Time (DST) 20-29

SYSDATE and SYSTIMESTAMP Data Handling 20-31

Lesson Agenda 20-32

Date and Time in Oracle Databases 20-33

Database Time Versus OS System Time 20-34

Database-Specific Time in Oracle Database 23c 20-35

Database Administrator Configures Database-Specific Time 20-36

Summary 20-37

A Table Descriptions

B Using SQL Developer

Objectives B-2

What is Oracle SQL Developer? B-4

Specifications of SQL Developer B-5

SQL Developer 17.4.1 Interface B-6

Creating a Database Connection B-8

Browsing Database Objects B-11

Displaying the Table Structure B-12

Browsing Files B-13

Creating a Schema Object B-14

Creating a New Table: Example B-15

Using SQL Worksheet B-16

Executing SQL Statements B-19

Saving SQL Scripts B-20

Executing Saved Script Files: Method 1 B-21

Executing Saved Script Files: Method 2 B-22

Formatting the SQL Code B-23

Using Snippets B-24

Using Snippets: Example B-25

Using the Recycle Bin B-26

Debugging Procedures and Functions B-27

Database Reporting B-28

Creating a User-Defined Report B-29

External Tools B-30

Setting Preferences B-31

Data Modeler in SQL Developer B-32

Summary B-33

C Using SQL*Plus

Objectives C-2

SQL and SQL*Plus Interaction C-3

SQL Statements Versus SQL*Plus Commands C-4

SQL*Plus: Overview C-5

Logging In to SQL*Plus C-6

Displaying the Table Structure C-7

SQL*Plus Editing Commands C-9

Using LIST, n, and APPEND C-11

Using the CHANGE Command C-12

SQL*Plus File Commands C-13

Using the SAVE and START Commands C-14 SERVEROUTPUT Command C-15 Using the SQL*Plus SPOOL Command C-16 Using the AUTOTRACE Command C-17 Summary C-18

D Commonly Used SQL Commands

Objectives D-2

Basic SELECT Statement D-3

SELECT Statement D-4

WHERE Clause D-5

ORDER BY Clause D-6

GROUP BY Clause D-7

Data Definition Language D-8

CREATE TABLE Statement D-9

ALTER TABLE Statement D-10

DROP TABLE Statement D-11

GRANT Statement D-12

Privilege Types D-13

REVOKE Statement D-14

TRUNCATE TABLE Statement D-15

Data Manipulation Language D-16

INSERT Statement D-17

UPDATE Statement Syntax D-18

DELETE Statement D-19

Transaction Control Statements D-20

COMMIT Statement D-21

ROLLBACK Statement D-22

SAVEPOINT Statement D-23

Joins D-24

Types of Joins D-25

Qualifying Ambiguous Column Names D-26

Natural Join D-27

Equijoins D-28

Retrieving Records with Equijoins D-29

Add Additional Search Conditions to the ON clause Using AND or WHERE D-30

Retrieving Records with Nonequijoins D-31

Retrieving Records by Using the USING Clause D-32

Retrieving Records by Using the ON Clause D-33

Left Outer Join D-34

Right Outer Join D-35

Full Outer Join D-36

Self-Join: Example D-37

Cross Join D-38 Summary D-39

E Generating Reports by Grouping Related Data

Objectives E-2

Review of Group Functions E-3

Review of the GROUP BY Clause E-4

Review of the HAVING Clause E-5

GROUP BY with ROLLUP and CUBE Operators E-6

ROLLUP Operator E-7

ROLLUP Operator: Example E-8

CUBE Operator E-9

CUBE Operator: Example E-10

GROUPING Function E-11

GROUPING Function: Example E-12

GROUPING SETS E-13

GROUPING SETS: Example E-15

Composite Columns E-17

Composite Columns: Example E-19

Concatenated Groupings E-21

Concatenated Groupings: Example E-22

Summary E-23

F Hierarchical Retrieval

Objectives F-2

Sample Data from the EMPLOYEES Table F-3

Natural Tree Structure F-4

Hierarchical Queries F-5

Walking the Tree F-6

Walking the Tree: From the Bottom Up F-8

Walking the Tree: From the Top Down F-9

Ranking Rows with the LEVEL Pseudocolumn F-10

Formatting Hierarchical Reports Using LEVEL and LPAD F-11

Pruning Branches F-13

Summary F-14

G Writing Advanced Scripts

Objectives G-2

Using SQL to Generate SQL G-3

Creating a Basic Script G-4
Controlling the Environment G-5
The Complete Picture G-6
Dumping the Contents of a Table to a File G-7
Generating a Dynamic Predicate G-9
Summary G-11

H Oracle Database Architectural Components

Objectives H-2

Oracle Database Architecture: Overview H-3

Oracle Database Server Structures H-4

Connecting to the Database H-5

Interacting with an Oracle Database H-6

Oracle Memory Architecture H-8

Process Architecture H-10

Database Writer Process H-12

Log Writer Process H-13

Checkpoint Process H-14

System Monitor Process H-15

Process Monitor Process H-16

Oracle Database Storage Architecture H-17

Logical and Physical Database Structures H-19

Processing a SQL Statement H-21

Processing a Query H-22

Shared Pool H-23

Database Buffer Cache H-25

Program Global Area H-26

Processing a DML Statement H-27

Redo Log Buffer H-29

Rollback Segment H-30

COMMIT Processing H-31

Summary of the Oracle Database Architecture H-33

Summary H-34

I Regular Expression Support

Objectives I-2

What Are Regular Expressions? I-3

Benefits of Using Regular Expressions I-4

Using Regular Expressions Functions and Conditions in SQL and PL/SQL I-5

What are metacharacters? I-6

Using Metacharacters with Regular Expressions I-7

Regular Expressions Functions and Conditions: Syntax I-9

Performing a Basic Search by Using the REGEXP LIKE Condition I-10

Replacing Patterns by Using the REGEXP REPLACE Function I-11

Finding Patterns by Using the REGEXP INSTR Function I-12

Extracting Substrings by Using the REGEXP SUBSTR Function I-13

Subexpressions I-14

Using Subexpressions with Regular Expression Support I-15

Why access the nth subexpression? I-16

REGEXP_SUBSTR: Example I-17

Using the REGEXP_COUNT Function I-18

Regular Expressions and Check Constraints: Examples I-19

Quiz I-20

Summary I-21

J MySQL Syntax

Objectives J-2

Icons Used in This Course J-3

MySQL: A Modern Database for the Digital Age J-4

High Scalability with MySQL J-5

MySQL-Supported Operating Systems J-6

MySQL Enterprise Edition J-7

Why MySQL Enterprise Edition? J-8

Oracle Premier Support for MySQL J-9

MySQL and Oracle Integration J-10

Development Environments for SQL in MySQL J-11

MySQL Websites J-12

MySQL Community Resources J-13

Oracle University: MySQL Training J-14

MySQL Certification J-15

Selecting All Columns J-16

Executing SQL Statements in MySQL Workbench J-17

Executing SQL Statements in mysql Command-Line Client J-18

Selecting Specific Columns J-19

Selecting Constant Expressions in MySQL J-20

Using Arithmetic Operators J-21

Operator Precedence J-22

Defining a Null Value J-23

Null Values in Arithmetic Expressions J-24

Using Column Aliases J-25

Concatenation Function in MySQL: CONCAT() J-26

Using Literal Character Strings in MySQL J-27

Including a Single Quotation Mark in a String with an Escape Sequence in MySQL J-28

Duplicate Rows J-29

Displaying Table Structure by Using the DESCRIBE Command J-30

Displaying Table Structure by Using MySQL Workbench J-31

Limiting Rows by Using a Selection J-32

Using the WHERE Clause J-33

Character Strings and Dates J-34

Using Comparison Operators J-35

Range Conditions Using the BETWEEN Operator J-36

Using the IN Operator J-37

Pattern Matching Using the LIKE Operator J-38

Combining Wildcard Symbols J-39

Using NULL Conditions J-40

Using the AND Operator J-41

Using the OR Operator J-42

Using the NOT Operator J-43

Rules of Precedence J-44

Using the ORDER BY Clause J-45

Using SQL Row Limiting Clause in a Query in MySQL J-46

SQL Row Limiting Clause: Example in MySQL J-47

Using the SET Statement in MySQL J-48

Case-Conversion Functions J-49

Case-Insensitive Queries in MySQL J-50

Using Character-Manipulation Functions J-51

Nesting Functions: Example J-52

Numeric Functions J-53

Using the ROUND Function J-54

Using the TRUNCATE Function in MySQL J-55

Using the MOD Function J-56

Working with Dates in MySQL Databases J-57

Displaying the Current Date in MySQL J-58

Date-Manipulation Functions in MySQL J-59

Using Date Functions in MySQL J-60

Extracting the Month or Year Portion of Dates in MySQL J-61

Implicit Data Type Conversion of Strings to Numbers J-62

Implicit Data Type Conversion of Numbers to Strings J-63

Using the CAST() Function in Oracle J-64

Explicit Data Type Conversion of Strings to Numbers in MySQL J-65

Explicit Data Type Conversion of Numbers to Strings in MySQL J-66

General Functions J-67

NVL Function (Oracle) and IFNULL() Function (MySQL) J-68

Using the IFNULL Function in MySQL J-69

Using the NULLIF Function J-70

Using the COALESCE Function J-71

Using the CASE Expression J-72

Using the AVG and SUM Functions J-73

Using the MIN and MAX Functions J-74

Using the COUNT Function J-75

Using the DISTINCT Keyword J-76

Group Functions and Null Values in MySQL J-77

Using the GROUP BY Clause J-78

Using the GROUP BY Clause on Multiple Columns J-80

Illegal Queries Using Group Functions J-81

Illegal Queries Using Group Functions in a WHERE Clause J-82

Using the HAVING Clause J-83

Retrieving Records with Natural Joins J-85

Retrieving Records with the USING Clause J-86

Retrieving Records with the ON Clause J-87

Creating Three-Way Joins J-88

Self-Joins Using the ON Clause J-89

Retrieving Records with Nonequijoins J-90

LEFT OUTER JOIN J-91

RIGHT OUTER JOIN J-92

Creating Cross Joins J-93

Executing Single-Row Subqueries J-94

Using Group Functions in a Subquery J-95

HAVING Clause with Subqueries J-96

What is wrong with this statement? J-97

No Rows Returned by the Inner Query J-98

Using the ANY Operator in Multiple-Row Subqueries J-99

Using the ALL Operator in Multiple-Row Subqueries J-100

Multiple-Column Subquery: Example J-101

Null Values in a Subquery J-102

Using the UNION Operator J-103

Using the UNION ALL Operator J-104

Matching SELECT Statements in MySQL J-105

Matching the SELECT Statement: Example in MySQL J-106

Using the ORDER BY Clause with UNION in MySQL J-107

Using the ORDER BY Clause with UNION: Example in MySQL J-108

Data Manipulation Language J-109

Adding a New Row to a Table J-110

INSERT Statement Syntax J-111

Inserting New Rows: Listing Column Names J-112
Inserting New Rows: Omitting Column Names J-113

Inserting Rows with Null Values J-114
Inserting Special Values in MySQL J-115

Inserting Specific Date and Time Values in MySQL J-116

Inserting and Reformatting Specific Date and Time Values in MySQL J-117

Copying Rows from Another Table J-118

Changing Data in a Table J-119

UPDATE Statement Syntax J-120

Updating Rows in a Table J-121

Updating Rows Based on Another Table J-122

Removing a Row from a Table J-123

DELETE Statement J-124

Deleting Rows from a Table J-125

Deleting Rows Based on Another Table J-126

TRUNCATE Statement J-127

Multiple-Statement Transactions J-128

Transaction Diagram J-129

AUTOCOMMIT and Transaction Control Statements J-130

Committing Data in a Transaction J-131

Rolling Back Changes J-132

Rolling Back Changes to a Marker J-133

Consistent Reads J-134

FOR UPDATE Clause in a SELECT Statement J-135

FOR UPDATE Clause: Examples J-136

Creating a Database: Syntax J-137

MySQL Naming Conventions J-138

CREATE TABLE Statement J-139

Data Types: Overview J-140

Numeric Data Types J-141

Date and Time Data Types J-142

String Data Types J-143

Indexes, Keys, and Constraints J-144

Table Indexes J-145

Primary Keys J-146

Unique Key Constraints J-147

Foreign Key Constraints J-148

Foreign Key Constraint: Example Tables J-149

FOREIGN KEY Constraint: Example Statement J-150 FOREIGN KEY Constraint: Referential Actions J-151

Secondary Indexes J-152

Column Options J-153

Creating a Table Using a Subquery J-154

Creating a Table Using a Subquery: Example J-155

ALTER TABLE Statement J-156

ALTER TABLE Statement: Add, Modify, or Drop Columns J-157

Adding a Column J-158

Modifying a Column J-159

Dropping a Column J-160

ALTER TABLE Statement: Add an Index or Constraint J-161

ALTER TABLE to Add a Constraint or Index: Example J-162

Creating Indexes by Using the CREATE INDEX Statement J-163

Viewing Index Definitions by Using the SHOW INDEX Statement J-164

Showing How a Table Was Created with the SHOW CREATE

TABLE Statement J-165

Dropping a Table J-166

Summary J-167