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Contents

1 Introduction

Lesson Objectives	1-2
Lesson Agenda	1-3
Course Objectives	1-4
Course Agenda	1-5
Appendixes and Practices Used in the Course	1-7
Lesson Agenda	1-8
Oracle Database 12c: Focus Areas	1-9
Oracle Database 12c	1-10
Oracle Fusion Middleware	1-12
Oracle Cloud	1-14
Oracle Cloud Services	1-15
Cloud Deployment Models	1-16
Lesson Agenda	1-17
Relational and Object Relational Database Management Systems	1-18
Data Storage on Different Media	1-19
Relational Database Concept	1-20
Definition of a Relational Database	1-21
Data Models	1-22
Entity Relationship Model	1-23
Entity Relationship Modeling Conventions	1-25
Relating Multiple Tables	1-27
Relational Database Terminology	1-29
Lesson Agenda	1-31
Using SQL to Query Your Database	1-32
SQL Statements Used in the Course	1-33
Development Environments for SQL	1-34
Lesson Agenda	1-35
Human Resources (HR) Schema	1-36
Tables Used in the Course	1-37
Lesson Agenda	1-38
Oracle Database Documentation	1-39
Additional Resources	1-40
Summary	1-41
Practice 1: Overview	1-42

2 Retrieving Data Using the SQL SELECT Statement

- Objectives 2-2
- Lesson Agenda 2-3
- Basic SELECT Statement 2-4
- Selecting All Columns 2-5
- Selecting Specific Columns 2-6
- Writing SQL Statements 2-7
- Column Heading Defaults 2-8
- Lesson Agenda 2-9
- Arithmetic Expressions 2-10
- Using Arithmetic Operators 2-11
- Operator Precedence 2-12
- Defining a Null Value 2-13
- Null Values in Arithmetic Expressions 2-14
- Lesson Agenda 2-15
- Defining a Column Alias 2-16
- Using Column Aliases 2-17
- Lesson Agenda 2-18
- Concatenation Operator 2-19
- Literal Character Strings 2-20
- Using Literal Character Strings 2-21
- Alternative Quote (q) Operator 2-22
- Duplicate Rows 2-23
- Lesson Agenda 2-24
- Displaying Table Structure 2-25
- Using the DESCRIBE Command 2-26
- Quiz 2-27
- Summary 2-28
- Practice 2: Overview 2-29

3 Restricting and Sorting Data

- Objectives 3-2
- Lesson Agenda 3-3
- Limiting Rows by Using a Selection 3-4
- Limiting Rows That Are Selected 3-5
- Using the WHERE Clause 3-6
- Character Strings and Dates 3-7
- Comparison Operators 3-8
- Using Comparison Operators 3-9
- Range Conditions Using the BETWEEN Operator 3-10

- Using the IN Operator 3-11
- Pattern Matching Using the LIKE Operator 3-12
- Combining Wildcard Characters 3-13
- Using NULL Conditions 3-14
- Defining Conditions Using Logical Operators 3-15
- Using the AND Operator 3-16
- Using the OR Operator 3-17
- Using the NOT Operator 3-18
- Lesson Agenda 3-19
- Rules of Precedence 3-20
- Lesson Agenda 3-22
- Using the ORDER BY Clause 3-23
- Sorting 3-24
- Lesson Agenda 3-26
- SQL Row Limiting Clause 3-27
- Using SQL Row Limiting Clause in a Query 3-28
- SQL Row Limiting Clause: Example 3-29
- Lesson Agenda 3-30
- Substitution Variables 3-31
- Using the Single-Ampersand Substitution Variable 3-33
- Character and Date Values with Substitution Variables 3-35
- Specifying Column Names, Expressions, and Text 3-36
- Using the Double-Ampersand Substitution Variable 3-37
- Using the Ampersand Substitution Variable in SQL*Plus 3-38
- Lesson Agenda 3-39
- Using the DEFINE Command 3-40
- Using the VERIFY Command 3-41
- Quiz 3-42
- Summary 3-43
- Practice 3: Overview 3-44

4 Using Single-Row Functions to Customize Output

- Objectives 4-2
- Lesson Agenda 4-3
- SQL Functions 4-4
- Two Types of SQL Functions 4-5
- Single-Row Functions 4-6
- Lesson Agenda 4-8
- Character Functions 4-9
- Case-Conversion Functions 4-11
- Using Case-Conversion Functions 4-12

- Character-Manipulation Functions 4-13
- Using Character-Manipulation Functions 4-14
- Lesson Agenda 4-15
- Nesting Functions 4-16
- Nesting Functions: Example 4-17
- Lesson Agenda 4-18
- Numeric Functions 4-19
- Using the ROUND Function 4-20
- Using the TRUNC Function 4-21
- Using the MOD Function 4-22
- Lesson Agenda 4-23
- Working with Dates 4-24
- RR Date Format 4-25
- Using the SYSDATE Function 4-27
- Using the CURRENT_DATE and CURRENT_TIMESTAMP Functions 4-28
- Arithmetic with Dates 4-29
- Using Arithmetic Operators with Dates 4-30
- Lesson Agenda 4-31
- Date-Manipulation Functions 4-32
- Using Date Functions 4-33
- Using ROUND and TRUNC Functions with Dates 4-34
- Quiz 4-35
- Summary 4-36
- Practice 4: Overview 4-37

5 Using Conversion Functions and Conditional Expressions

- Objectives 5-2
- Lesson Agenda 5-3
- Conversion Functions 5-4
- Implicit Data Type Conversion 5-5
- Explicit Data Type Conversion 5-7
- Lesson Agenda 5-9
- Using the TO_CHAR Function with Dates 5-10
- Elements of the Date Format Model 5-11
- 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
- Lesson Agenda 5-21
- General Functions 5-22
- NVL Function 5-23

Using the NVL Function 5-24
Using the NVL2 Function 5-25
Using the NULLIF Function 5-26
Using the COALESCE Function 5-27
Lesson Agenda 5-29
Conditional Expressions 5-30
CASE Expression 5-31
Using the CASE Expression 5-32
Searched CASE Expression 5-33
DECODE Function 5-34
Using the DECODE Function 5-35
Quiz 5-37
Summary 5-38
Practice 5: Overview 5-39

6 Reporting Aggregated Data Using the Group Functions

Objectives 6-2
Lesson Agenda 6-3
Group Functions 6-4
Types of Group Functions 6-5
Group Functions: Syntax 6-6
Using the AVG and SUM Functions 6-7
Using the MIN and MAX Functions 6-8
Using the COUNT Function 6-9
Using the DISTINCT Keyword 6-10
Group Functions and Null Values 6-11
Lesson Agenda 6-12
Creating Groups of Data 6-13
Creating Groups of Data: GROUP BY Clause Syntax 6-14
Using the GROUP BY Clause 6-15
Grouping by More Than One Column 6-17
Using the GROUP BY Clause on Multiple Columns 6-18
Illegal Queries Using Group Functions 6-19
Restricting Group Results 6-21
Restricting Group Results with the HAVING Clause 6-22
Using the HAVING Clause 6-23
Lesson Agenda 6-25
Nesting Group Functions 6-26
Quiz 6-27
Summary 6-28
Practice 6: Overview 6-29

7 Displaying Data from Multiple Tables Using Joins

Objectives 7-2

Lesson Agenda 7-3

Obtaining Data from Multiple Tables 7-4

Types of Joins 7-5

Joining Tables Using SQL:1999 Syntax 7-6

Lesson Agenda 7-7

Creating Natural Joins 7-8

Retrieving Records with Natural Joins 7-9

Creating Joins with the USING Clause 7-10

Joining Column Names 7-11

Retrieving Records with the USING Clause 7-12

Qualifying Ambiguous Column Names 7-13

Using Table Aliases with the USING Clause 7-14

Creating Joins with the ON Clause 7-15

Retrieving Records with the ON Clause 7-16

Creating Three-Way Joins 7-17

Applying Additional Conditions to a Join 7-18

Lesson Agenda 7-19

Joining a Table to Itself 7-20

Self-Joins Using the ON Clause 7-21

Lesson Agenda 7-22

Nonequijoins 7-23

Retrieving Records with Nonequijoins 7-24

Lesson Agenda 7-25

Returning Records with No Direct Match Using OUTER Joins 7-26

INNER Versus OUTER Joins 7-27

LEFT OUTER JOIN 7-28

RIGHT OUTER JOIN 7-29

FULL OUTER JOIN 7-30

Lesson Agenda 7-31

Cartesian Products 7-32

Generating a Cartesian Product 7-33

Creating Cross Joins 7-34

Quiz 7-35

Summary 7-36

Practice 7: Overview 7-37

8 Using Subqueries to Solve Queries

Objectives 8-2

Lesson Agenda 8-3

Using a Subquery to Solve a Problem 8-4

Subquery Syntax 8-5

Using a Subquery 8-6

Rules and Guidelines for Using Subqueries 8-7

Types of Subqueries 8-8

Lesson Agenda 8-9

Single-Row Subqueries 8-10

Executing Single-Row Subqueries 8-11

Using Group Functions in a Subquery 8-12

HAVING Clause with Subqueries 8-13

What Is Wrong with This Statement? 8-14

No Rows Returned by the Inner Query 8-15

Lesson Agenda 8-16

Multiple-Row Subqueries 8-17

Using the ANY Operator in Multiple-Row Subqueries 8-18

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

Multiple-Column Subqueries 8-20

Multiple-Column Subquery: Example 8-21

Lesson Agenda 8-22

Null Values in a Subquery 8-23

Quiz 8-25

Summary 8-26

Practice 8: Overview 8-27

9 Using the Set Operators

Objectives 9-2

Lesson Agenda 9-3

Set Operators 9-4

Set Operator Rules 9-5

Oracle Server and Set Operators 9-6

Lesson Agenda 9-7

Tables Used in This Lesson 9-8

Lesson Agenda 9-12

UNION Operator 9-13

Using the UNION Operator 9-14

UNION ALL Operator 9-15

Using the UNION ALL Operator 9-16

Lesson Agenda 9-17

- INTERSECT Operator 9-18
- Using the INTERSECT Operator 9-19
- Lesson Agenda 9-20
- MINUS Operator 9-21
- Using the MINUS Operator 9-22
- Lesson Agenda 9-23
- Matching SELECT Statements 9-24
- Matching the SELECT Statement: Example 9-25
- Lesson Agenda 9-26
- Using the ORDER BY Clause in Set Operations 9-27
- Quiz 9-28
- Summary 9-29
- Practice 9: Overview 9-30

10 Managing Tables Using DML Statements

- Objectives 10-2
- Lesson Agenda 10-3
- Data Manipulation Language 10-4
- Adding a New Row to a Table 10-5
- INSERT Statement Syntax 10-6
- Inserting New Rows 10-7
- Inserting Rows with Null Values 10-8
- Inserting Special Values 10-9
- Inserting Specific Date and Time Values 10-10
- Creating a Script 10-11
- Copying Rows from Another Table 10-12
- Lesson Agenda 10-13
- Changing Data in a Table 10-14
- UPDATE Statement Syntax 10-15
- Updating Rows in a Table 10-16
- Updating Two Columns with a Subquery 10-17
- Updating Rows Based on Another Table 10-18
- Lesson Agenda 10-19
- Removing a Row from a Table 10-20
- DELETE Statement 10-21
- Deleting Rows from a Table 10-22
- Deleting Rows Based on Another Table 10-23
- TRUNCATE Statement 10-24
- Lesson Agenda 10-25
- Database Transactions 10-26
- Database Transactions: Start and End 10-27

Advantages of COMMIT and ROLLBACK Statements	10-28
Explicit Transaction Control Statements	10-29
Rolling Back Changes to a Marker	10-30
Implicit Transaction Processing	10-31
State of Data Before COMMIT or ROLLBACK	10-33
State of Data After COMMIT	10-34
Committing Data	10-35
State of Data After ROLLBACK	10-36
State of Data After ROLLBACK: Example	10-37
Statement-Level Rollback	10-38
Lesson Agenda	10-39
Read Consistency	10-40
Implementing Read Consistency	10-41
Lesson Agenda	10-42
FOR UPDATE Clause in a SELECT Statement	10-43
FOR UPDATE Clause: Examples	10-44
Quiz	10-46
Summary	10-47
Practice 10: Overview	10-48

11 Introduction to Data Definition Language

Objectives	11-2
Lesson Agenda	11-3
Database Objects	11-4
Naming Rules	11-5
Lesson Agenda	11-6
CREATE TABLE Statement	11-7
Creating Tables	11-8
Lesson Agenda	11-9
Datetime Data Types	11-12
DEFAULT Option	11-13
Lesson Agenda	11-14
Including Constraints	11-15
Constraint Guidelines	11-16
Defining Constraints	11-17
NOT NULL Constraint	11-19
UNIQUE Constraint	11-20
PRIMARY KEY Constraint	11-22
FOREIGN KEY Constraint	11-23
FOREIGN KEY Constraint: Keywords	11-25
CHECK Constraint	11-26

CREATE TABLE: Example	11-27
Violating Constraints	11-28
Lesson Agenda	11-30
Creating a Table Using a Subquery	11-31
Lesson Agenda	11-33
ALTER TABLE Statement	11-34
Adding a Column	11-36
Modifying a Column	11-37
Dropping a Column	11-38
SET UNUSED Option	11-39
Read-Only Tables	11-41
Lesson Agenda	11-42
Dropping a Table	11-43
Quiz	11-44
Summary	11-45
Practice 11: Overview	11-46

A Table Descriptions

B Using SQL Developer

Objectives	B-2
What Is Oracle SQL Developer?	B-3
Specifications of SQL Developer	B-4
SQL Developer 3.2 Interface	B-5
Creating a Database Connection	B-7
Browsing Database Objects	B-10
Displaying the Table Structure	B-11
Browsing Files	B-12
Creating a Schema Object	B-13
Creating a New Table: Example	B-14
Using the SQL Worksheet	B-15
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
Search Engines and External Tools B-30
Setting Preferences B-31
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*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
Additional Search Conditions Using the AND and WHERE Operators 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

9

Using the Set Operators

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Objectives

After completing this lesson, you should be able to do the following:

- Describe set operators
- Use a set operator to combine multiple queries into a single query
- Control the order of rows returned

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In this lesson, you learn how to write queries by using set operators.

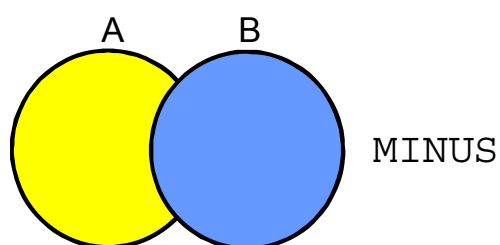
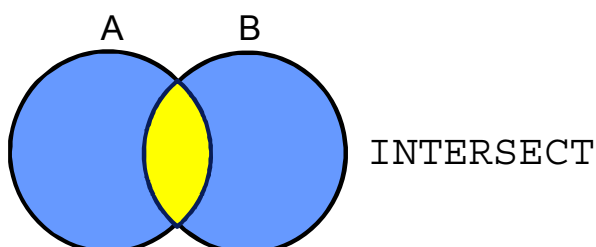
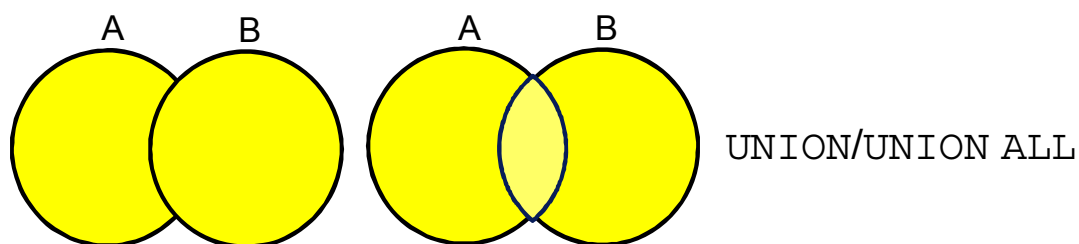
Lesson Agenda

- Set operators: Types and guidelines
- Tables used in this lesson
- UNION and UNION ALL operator
- INTERSECT operator
- MINUS operator
- Matching SELECT statements
- Using the ORDER BY clause in set operations

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Set Operators



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Set operators combine the results of two or more component queries into one result. Queries containing set operators are called *compound queries*.

Operator	Returns
UNION	Rows from both queries after eliminating duplications
UNION ALL	Rows from both queries, including all duplications
INTERSECT	Rows that are common to both queries
MINUS	Rows in the first query that are not present in the second query

All set operators have equal precedence. If a SQL statement contains multiple set operators, the Oracle server evaluates them from left (top) to right (bottom), if no parentheses explicitly specify another order. You should use parentheses to specify the order of evaluation explicitly in queries that use the `INTERSECT` operator with other set operators.

Set Operator Rules

- The expressions in the `SELECT` lists must match in number.
- The data type of each column in the subsequent query must match the data type of its corresponding column in the first query.
- Parentheses can be used to alter the sequence of execution.
- `ORDER BY` clause can appear only at the very end of the statement.

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- The expressions in the `SELECT` lists of the queries must match in number and data type. Queries that use `UNION`, `UNION ALL`, `INTERSECT`, and `MINUS` operators must have the same number and data type of columns in their `SELECT` list. The data type of the columns in the `SELECT` list of the queries in the compound query may not be exactly the same. The column in the second query must be in the same data type group (such as numeric or character) as the corresponding column in the first query.
- Set operators can be used in subqueries.
- You should use parentheses to specify the order of evaluation in queries that use the `INTERSECT` operator with other set operators. This ensures compliance with emerging SQL standards that will give the `INTERSECT` operator greater precedence than the other set operators.

Oracle Server and Set Operators

- Duplicate rows are automatically eliminated except in `UNION ALL`.
- Column names from the first query appear in the result.
- The output is sorted in ascending order by default except in `UNION ALL`.

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When a query uses set operators, the Oracle server eliminates duplicate rows automatically except in the case of the `UNION ALL` operator. The column names in the output are decided by the column list in the first `SELECT` statement. By default, the output is sorted in ascending order of the first column of the `SELECT` clause.

The corresponding expressions in the `SELECT` lists of the component queries of a compound query must match in number and data type. If component queries select character data, the data type of the return values is determined as follows:

- If both queries select values of `CHAR` data type, of equal length, the returned values have the `CHAR` data type of that length. If the queries select values of `CHAR` with different lengths, the returned value is `VARCHAR2` with the length of the larger `CHAR` value.
- If either or both of the queries select values of `VARCHAR2` data type, the returned values have the `VARCHAR2` data type.

If component queries select numeric data, the data type of the return values is determined by numeric precedence. If all queries select values of the `NUMBER` type, the returned values have the `NUMBER` data type. In queries using set operators, the Oracle server does not perform implicit conversion across data type groups. Therefore, if the corresponding expressions of component queries resolve to both character data and numeric data, the Oracle server returns an error.

Lesson Agenda

- Set operators: Types and guidelines
- **Tables used in this lesson**
- UNION and UNION ALL operator
- INTERSECT operator
- MINUS operator
- Matching SELECT statements
- Using the ORDER BY clause in set operations

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Tables Used in This Lesson

The tables used in this lesson are:

- **EMPLOYEES**: Provides details regarding all current employees
- **RETIRED_EMPLOYEES**: Provides details regarding all past employees

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Two tables are used in this lesson: the **EMPLOYEES** table and the **RETIRED_EMPLOYEES** table.

You are already familiar with the **EMPLOYEES** table that stores employee details such as a unique identification number, email address, job identification (such as **ST_CLERK**, **SA_REP**, and so on), salary, manager, and so on.

RETIRED_EMPLOYEES stores the details of the employees who have left the company.

The structure and data from the **EMPLOYEES** and **RETIRED_EMPLOYEES** tables are shown on the following pages.

DESCRIBE employees

DESCRIBE employees		
Name	Null	Type
-----	-----	-----
EMPLOYEE_ID	NOT NULL	NUMBER(6)
FIRST_NAME		VARCHAR2(20)
LAST_NAME	NOT NULL	VARCHAR2(25)
EMAIL	NOT NULL	VARCHAR2(25)
PHONE_NUMBER		VARCHAR2(20)
HIRE_DATE	NOT NULL	DATE
JOB_ID	NOT NULL	VARCHAR2(10)
SALARY		NUMBER(8,2)
COMMISSION_PCT		NUMBER(2,2)
MANAGER_ID		NUMBER(6)
DEPARTMENT_ID		NUMBER(4)

```
SELECT employee_id, last_name, job_id, hire_date, department_id
FROM employees;
```

	EMPLOYEE_ID	LAST_NAME	JOB_ID	HIRE_DATE	DEPARTMENT_ID
1	100	King	AD_PRES	17-JUN-03	90
2	101	Kochhar	AD_VP	21-SEP-05	90
3	102	De Haan	AD_VP	13-JAN-01	90
4	103	Hunold	IT_PROG	03-JAN-06	60
5	104	Ernst	IT_PROG	21-MAY-07	60
6	107	Lorentz	IT_PROG	07-FEB-07	60
7	124	Mourgos	ST_MAN	16-NOV-07	50
8	141	Rajs	ST_CLERK	17-OCT-03	50
9	142	Davies	ST_CLERK	29-JAN-05	50
10	143	Matos	ST_CLERK	15-MAR-06	50
11	144	Vargas	ST_CLERK	09-JUL-06	50
12	149	Zlotkey	SA_MAN	29-JAN-08	80
13	174	Abel	SA_REP	11-MAY-04	80
14	176	Taylor	SA_REP	24-MAR-06	80
15	178	Grant	SA_REP	24-MAY-07	(null)
16	200	Whalen	AD_ASST	17-SEP-03	10
17	201	Hartstein	MK_MAN	17-FEB-04	20
18	202	Fay	MK_REP	17-AUG-05	20
19	205	Higgins	AC_MGR	07-JUN-02	110
20	206	Gietz	AC_ACCOUNT	07-JUN-02	110

```
DESCRIBE retired_employees
```

Name	Null	Type
EMPLOYEE_ID		NUMBER(7)
FIRST_NAME		VARCHAR2(20)
LAST_NAME		VARCHAR2(20)
EMAIL		VARCHAR2(25)
RETIRED_DATE		DATE
JOB_ID		VARCHAR2(20)
SALARY		NUMBER(8,2)
MANAGER_ID		NUMBER(4)
DEPARTMENT_ID		NUMBER(6)


```
SELECT * FROM retired_employees;
```

	EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	RETIRED_DATE	JOB_ID	SALARY	MANAGER_ID	DEPARTMENT_ID
1	301	Rick	Dayle	RDAYLE	18-MAR-10	AD_PRES	8000	124	90
2	302	Meena	Rac	MRAC	21-SEP-11	AD_VP	11000	149	90
3	303	Mex	Haan	MHAAN	13-JAN-10	AD_VP	9500	149	80
4	304	Alexandera	Runold	ARUNOLD	03-JAN-11	IT_PROG	7500	124	60
5	305	Brük	Ernst	BERNST	21-MAY-10	IT_PROG	6000	149	60
6	306	Dravid	Aust	DAUST	25-JUN-09	IT_PROG	4800	124	60
7	307	Raj	Patil	RPATIL	05-FEB-12	IT_PROG	4800	201	60
8	308	Rahul	Bose	RBOSE	17-AUG-12	FI_MGR	12008	124	100
9	309	Dany	Fav	DFAV	16-AUG-11	FI_ACCOUNT	9000	101	100
10	310	James	Ken	JKHEN	28-SEP-10	FI_ACCOUNT	8200	101	90
11	311	Shana	Garg	SGARG	30-SEP-10	FI_ACCOUNT	7700	201	100
12	313	Lui	Pops	LPOPS	07-DEC-10	FI_ACCOUNT	6900	201	100
13	314	Del	Raph	DRAPH	07-DEC-12	PU_MAN	11000	101	30
14	315	Alex	Khurl	AKHURL	18-MAY-11	PU_CLERK	3100	149	30
15	312	Supriya	Ananth	SANANTH	07-JUN-14	FI_ACCOUNT	7800	124	100

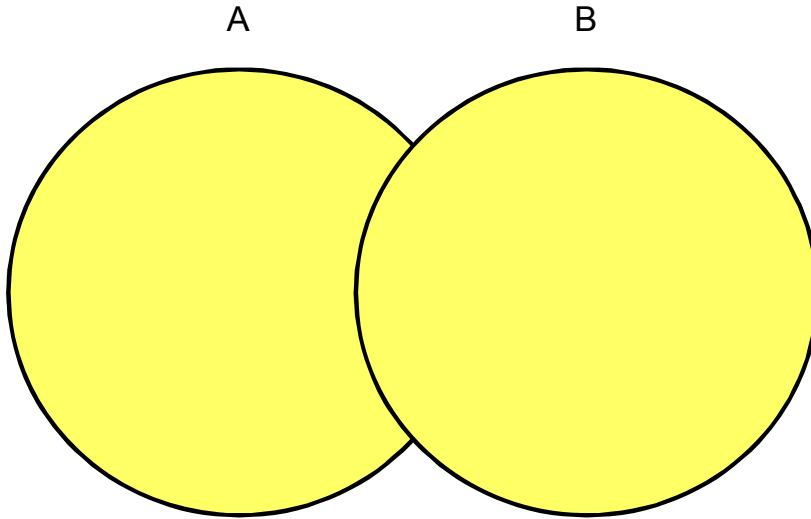
Lesson Agenda

- Set operators: Types and guidelines
- Tables used in this lesson
- **UNION and UNION ALL operator**
- INTERSECT operator
- MINUS operator
- Matching SELECT statements
- Using the ORDER BY clause in set operations

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UNION Operator



The `UNION` operator returns rows from both queries after eliminating duplications.

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The `UNION` operator returns all rows that are selected by either query. Use the `UNION` operator to return all rows from multiple tables and eliminate any duplicate rows.

Guidelines

- The number of columns being selected must be the same.
- The data types of the columns being selected must be in the same data type group (such as numeric or character).
- The names of the columns need not be identical.
- `UNION` operates over all of the columns being selected.
- `NULL` values are not ignored during duplicate checking.
- By default, the output is sorted in ascending order of the columns of the `SELECT` clause.

Using the UNION Operator

Display the job details of all the current and retired employees.
Display each job only once.

```
SELECT job_id
FROM employees
UNION
SELECT job_id
FROM retired_employees
```

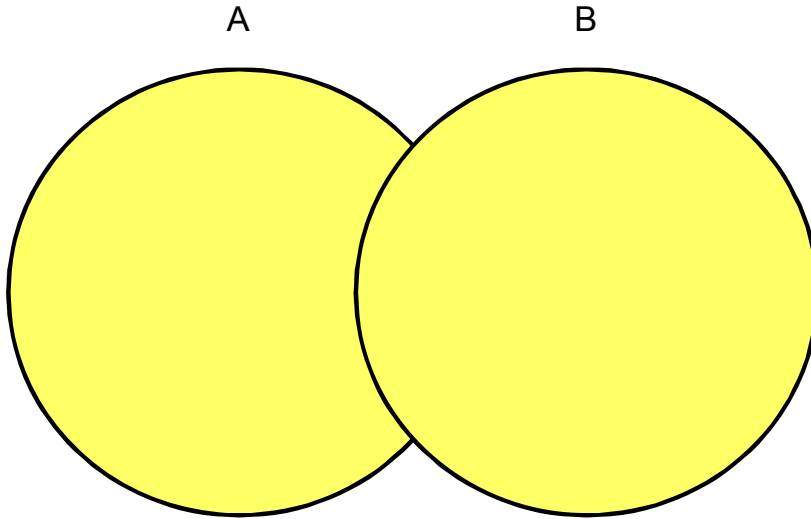
	JOB_ID
1	AC_ACCOUNT
2	AC_MGR
3	AD_ASST
4	AD_PRES
5	AD_VP
6	FI_ACCOUNT
7	FI_MGR
8	IT_PROG
9	MK_MAN
10	MK_REP
11	PU_CLERK
12	PU_MAN
13	SA_MAN
14	SA_REP
15	ST_CLERK
16	ST_MAN

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The UNION operator eliminates any duplicate records. If records that occur in both the EMPLOYEES and the RETIRED_EMPLOYEES tables are identical, the records are displayed only once.

UNION ALL Operator



The `UNION ALL` operator returns rows from both queries, including all duplications.

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Use the `UNION ALL` operator to return all rows from multiple queries.

Guidelines

The guidelines for `UNION` and `UNION ALL` are the same, with the following two exceptions that pertain to `UNION ALL`: Unlike `UNION`, duplicate rows are not eliminated and the output is not sorted by default.

Using the UNION ALL Operator

Display the jobs and departments of all current and previous employees.

```
SELECT job_id, department_id
FROM   employees
UNION ALL
SELECT job_id, department_id
FROM   retired_employees
ORDER BY job_id;
```

JOB_ID	DEPARTMENT_ID
1 AC_ACCOUNT	110
2 AC_MGR	110
3 AD_ASST	10
4 AD_PRES	90
5 AD_PRES	90
6 AD_VP	90
7 AD_VP	80
8 AD_VP	90
9 AD_VP	90

...

28 SA_REP	80
29 SA_REP	80
30 SA_REP	(null)
31 ST_CLERK	50
32 ST_CLERK	50
33 ST_CLERK	50
34 ST_CLERK	50
35 ST_MAN	50

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In the example, 35 rows are selected. The combination of the two tables totals to 35 rows. The UNION ALL operator does not eliminate duplicate rows. UNION returns all distinct rows selected by either query. UNION ALL returns all rows selected by either query, including all duplicates. Consider the query in the slide, now written with the UNION clause:

```
SELECT job_id, department_id
FROM   employees
UNION
SELECT job_id, department_id
FROM   retired_employees
ORDER BY job_id;
```

The preceding query returns 19 rows. This is because it eliminates all the duplicate rows.

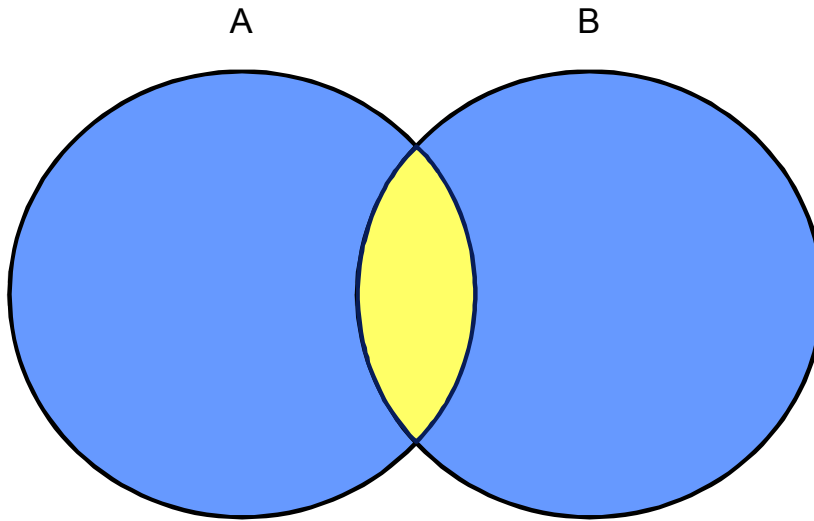
Lesson Agenda

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INTERSECT Operator



The `INTERSECT` operator returns rows that are common to both queries.

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Use the `INTERSECT` operator to return all rows that are common to multiple queries.

Guidelines

- The number of columns and the data types of the columns being selected by the `SELECT` statements in the queries must be identical in all the `SELECT` statements used in the query. The names of the columns, however, need not be identical.
- Reversing the order of the intersected tables does not alter the result.
- `INTERSECT` does not ignore `NULL` values.

Using the INTERSECT Operator

Display the common manager IDs and department IDs of current and previous employees.

```
SELECT  manager_id,department_id
FROM    employees
INTERSECT
SELECT  manager_id,department_id
FROM    retired_employees
```

	MANAGER_ID	DEPARTMENT_ID
1	149	80

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In the example in this slide, the query returns only those records that have the same values in the selected columns in both tables.

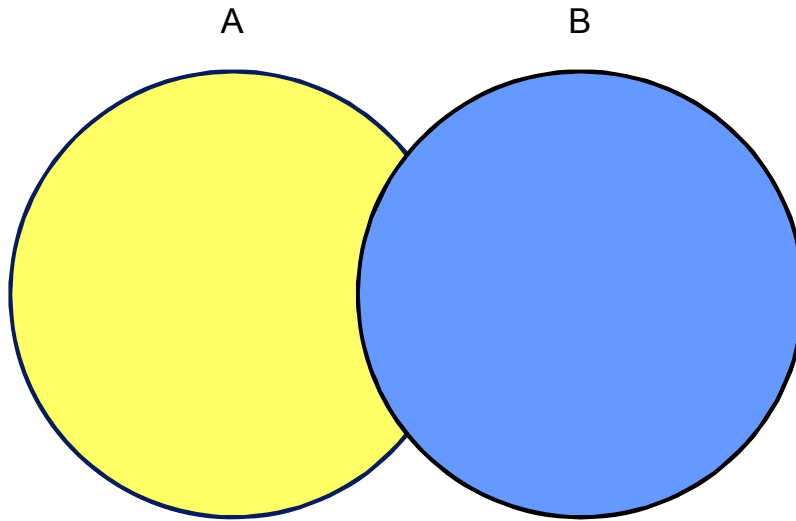
Lesson Agenda

- Set operators: Types and guidelines
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MINUS Operator



The `MINUS` operator returns all the distinct rows selected by the first query, but not present in the second query result set.

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Use the `MINUS` operator to return all distinct rows selected by the first query, but not present in the second query result set (the first `SELECT` statement `MINUS` the second `SELECT` statement).

Note: The number of columns must be the same and the data types of the columns being selected by the `SELECT` statements in the queries must belong to the same data type group in all the `SELECT` statements used in the query. The names of the columns, however, need not be identical.

Using the MINUS Operator

Display the employee IDs and Job IDs of those employees who works in the sales department.

```
SELECT employee_id, job_id
FROM employees
WHERE department_id = 80
MINUS
SELECT employee_id, job_id
FROM retired_employees
WHERE department_id = 90;
```

	EMPLOYEE_ID	JOB_ID
1	149	SA_MAN
2	174	SA_REP
3	176	SA_REP

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In the example in the slide, the employee IDs in the RETIRED_EMPLOYEES table are subtracted from those in the EMPLOYEES table. The results set displays the employees remaining after the subtraction; they are represented by rows that exist in the EMPLOYEES table, but do not exist in the RETIRED_EMPLOYEES table. These are the records of the employees who work in the sales department.

Lesson Agenda

- Set operators: Types and guidelines
- Tables used in this lesson
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- INTERSECT operator
- MINUS operator
- **Matching SELECT statements**
- Using ORDER BY clause in set operations

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Matching SELECT Statements

You must match the data type (using the `TO_CHAR` function or any other conversion functions) when columns do not exist in one or the other table.

```
SELECT location_id, department_name "Department",  
       TO_CHAR(NULL) "Warehouse location"  
FROM departments  
UNION  
SELECT location_id, TO_CHAR(NULL) "Department",  
       state_province  
FROM locations;
```

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Because the expressions in the `SELECT` lists of the queries must match in number, you can use the dummy columns and the data type conversion functions to comply with this rule. To match the column list explicitly, you can insert `NULL` columns at the missing positions so as to match the count and data type of selected columns in each `SELECT` statement. In the slide, the name `Warehouse location` is given as the dummy column heading. The `TO_CHAR` function is used in the first query to match the `VARCHAR2` data type of the `state_province` column that is retrieved by the second query. Similarly, the `TO_CHAR` function in the second query is used to match the `VARCHAR2` data type of the `department_name` column that is retrieved by the first query.

Matching the SELECT Statement: Example

Using the UNION operator, display the employee name, department_id, and location_id of all employees.

```
SELECT  FIRST_NAME, JOB_ID, TO_DATE(hire_date) "HIRE_DATE"
FROM employees
UNION
SELECT FIRST_NAME, JOB_ID, TO_DATE(NULL) "HIRE_DATE"
FROM retired_employees;
```

	FIRST_NAME	JOB_ID	HIRE_DATE
1	Alex	PU_CLERK	(null)
2	Alexander	IT_PROG	03-JAN-06
3	Alexandra	IT_PROG	(null)
4	Bruce	IT_PROG	21-MAY-07
5	Bruk	IT_PROG	(null)
6	Curtis	ST_CLERK	29-JAN-05
7	Dany	FI_ACCOUNT	(null)
8	Del	PU_MAN	(null)
9	Diana	IT_PROG	07-FEB-07

...



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The EMPLOYEES and RETIRED_EMPLOYEES tables have several columns in common (for example, EMPLOYEE_ID, JOB_ID, and DEPARTMENT_ID). But what if you want the query to display the FIRST_NAME, JOB_ID, and HIRE_DATE using the UNION operator, knowing that the HIRE_DATE exists only in the EMPLOYEES table?

The code example in the slide matches the FIRST_NAME and JOB_ID columns in the EMPLOYEES and RETIRED_EMPLOYEES tables. NULL is added to the RETIRED_EMPLOYEES SELECT statement to match the HIRE_DATE column in the EMPLOYEES SELECT statement.

In the results shown in the slide, each row in the output that corresponds to a record from the RETIRED_EMPLOYEES table contains a NULL in the HIRE_DATE column.

Lesson Agenda

- Set operators: Types and guidelines
- Tables used in this lesson
- UNION and UNION ALL operator
- INTERSECT operator
- MINUS operator
- Matching SELECT statements
- Using the ORDER BY clause in set operations

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Using the ORDER BY Clause in Set Operations

- The ORDER BY clause can appear only once at the end of the compound query.
- Component queries cannot have individual ORDER BY clauses.
- The ORDER BY clause recognizes only the columns of the first SELECT query.
- By default, the first column of the first SELECT query is used to sort the output in an ascending order.

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The ORDER BY clause can be used only once in a compound query. If used, the ORDER BY clause must be placed at the end of the query. The ORDER BY clause accepts the column name or an alias. By default, the output is sorted in ascending order in the first column of the first SELECT query.

Note: The ORDER BY clause does not recognize the column names of the second SELECT query. To avoid confusion over column names, it is a common practice to ORDER BY column positions.

For example, in the following statement, the output will be shown in ascending order of job_id.

```
SELECT employee_id, job_id, salary
FROM   employees
UNION
SELECT employee_id, job_id, 0
FROM   retired_employees
ORDER BY 2;
```

If you omit ORDER BY, by default, the output will be sorted in ascending order of employee_id. You cannot use the columns from the second query to sort the output.

Quiz

Identify two set operator guidelines.

- a. The expressions in the `SELECT` lists must match in number.
- b. Parentheses may not be used to alter the sequence of execution.
- c. The data type of each column in the second query must match the data type of its corresponding column in the first query.
- d. The `ORDER BY` clause can be used only once in a compound query, unless a `UNION ALL` operator is used.

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Answer: a, c

Summary

In this lesson, you should have learned how to use:

- `UNION` to return all distinct rows
- `UNION ALL` to return all rows, including duplicates
- `INTERSECT` to return all rows that are shared by both queries
- `MINUS` to return all distinct rows that are selected by the first query, but not by the second
- `ORDER BY` only at the very end of the statement

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- The `UNION` operator returns all the distinct rows selected by each query in the compound query. Use the `UNION` operator to return all rows from multiple tables and eliminate any duplicate rows.
- Use the `UNION ALL` operator to return all rows from multiple queries. Unlike the case with the `UNION` operator, duplicate rows are not eliminated and the output is not sorted by default.
- Use the `INTERSECT` operator to return all rows that are common to multiple queries.
- Use the `MINUS` operator to return rows returned by the first query that are not present in the second query.
- Remember to use the `ORDER BY` clause only at the very end of the compound statement.
- Make sure that the corresponding expressions in the `SELECT` lists match in number and data type.

Practice 9: Overview

In this practice, you create reports by using:

- The `UNION` operator
- The `INTERSECT` operator
- The `MINUS` operator

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In this practice, you write queries using the set operators.

10

Managing Tables Using DML Statements

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Objectives

After completing this lesson, you should be able to do the following:

- Describe each data manipulation language (DML) statement
- Control transactions

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In this lesson, you learn how to use the data manipulation language (DML) statements to insert rows into a table, update existing rows in a table, and delete existing rows from a table. You also learn how to control transactions with the `COMMIT`, `SAVEPOINT`, and `ROLLBACK` statements.

Lesson Agenda

- Adding new rows in a table
 - `INSERT` statement
- Changing data in a table
 - `UPDATE` statement
- Removing rows from a table:
 - `DELETE` statement
 - `TRUNCATE` statement
- Database transaction control using `COMMIT`, `ROLLBACK`, and `SAVEPOINT`
- Read consistency
- `FOR UPDATE` clause in a `SELECT` statement

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Data Manipulation Language

- A DML statement is executed when you:
 - Add new rows to a table
 - Modify existing rows in a table
 - Remove existing rows from a table
- A *transaction* consists of a collection of DML statements that form a logical unit of work.

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Data manipulation language (DML) is a core part of SQL. When you want to add, update, or delete data in the database, you execute a DML statement. A collection of DML statements that form a logical unit of work is called a *transaction*.

Consider a banking database. When a bank customer transfers money from a savings account to a checking account, the transaction might consist of three separate operations: decreasing the savings account, increasing the checking account, and recording the transaction in the transaction journal. The Oracle server must guarantee that all the three SQL statements are performed to maintain the accounts in proper balance. When something prevents one of the statements in the transaction from executing, the other statements of the transaction must be undone.

Notes

- Most of the DML statements in this lesson assume that no constraints on the table are violated. Constraints are discussed later in this course.
- In SQL Developer, click the Run Script icon or press [F5] to run the DML statements. The feedback messages will be shown on the Script Output tabbed page.

Adding a New Row to a Table

DEPARTMENTS

	DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
1	10	Administration	200	1700
2	20	Marketing	201	1800
3	50	Shipping	124	1500
4	60	IT	103	1400
5	80	Sales	149	2500
6	90	Executive	100	1700
7	110	Accounting	205	1700
8	190	Contracting	(null)	1700

70 Public Relations	100	1700
---------------------	-----	------

New
row

Insert new row
into the
DEPARTMENTS table.

	DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
1	70	Public Relations	100	1700
2	10	Administration	200	1700
3	20	Marketing	201	1800
4	50	Shipping	124	1500
5	60	IT	103	1400
6	80	Sales	149	2500
7	90	Executive	100	1700
8	110	Accounting	205	1700
9	190	Contracting	(null)	1700

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The graphic in the slide illustrates the addition of a new department to the DEPARTMENTS table.

INSERT Statement Syntax

- Add new rows to a table by using the INSERT statement:

```
INSERT INTO  table [(column [, column...])]  
VALUES      (value [, value...]);
```

- With this syntax, only one row is inserted at a time.

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You can add new rows to a table by issuing the INSERT statement.

In the syntax:

<i>table</i>	Is the name of the table
<i>column</i>	Is the name of the column in the table to populate
<i>value</i>	Is the corresponding value for the column

Note: This statement with the VALUES clause adds only one row at a time to a table.

Inserting New Rows

- Insert a new row containing values for each column.
- List values in the default order of the columns in the table.
- Optionally, list the columns in the `INSERT` clause.

```
INSERT INTO departments(department_id,  
                        department_name, manager_id, location_id)  
VALUES (70, 'Public Relations', 100, 1700);
```

1 rows inserted

- Enclose character and date values within single quotation marks.

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Because you can insert a new row that contains values for each column, the column list is not required in the `INSERT` clause. However, if you do not use the column list, the values must be listed according to the default order of the columns in the table, and a value must be provided for each column.

```
DESCRIBE departments
```

For clarity, use the column list in the `INSERT` clause.

Enclose character and date values within single quotation marks; however, it is not recommended that you enclose numeric values within single quotation marks.

Inserting Rows with Null Values

- Implicit method: Omit the column from the column list.

```
INSERT INTO departments (department_id,  
                          department_name)  
VALUES (30, 'Purchasing');  
1 rows inserted
```

- Explicit method: Specify the NULL keyword in the VALUES clause.

```
INSERT INTO departments  
VALUES (100, 'Finance', NULL, NULL);  
1 rows inserted
```

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Method	Description
Implicit	Omit the column from the column list.
Explicit	Specify the NULL keyword in the VALUES list; specify the empty string (' ') in the VALUES list for character strings and dates.

Be sure that you can use null values in the targeted column by verifying the Null status with the DESCRIBE command.

The Oracle server automatically enforces all data types, data ranges, and data integrity constraints. Any column that is not listed explicitly obtains a null value in the new row unless you have default values for the missing columns that are used.

Common errors that can occur during user input are checked in the following order:

- Mandatory value missing for a NOT NULL column
- Duplicate value violating any unique or primary key constraint
- Any value violating a CHECK constraint
- Referential integrity maintained for foreign key constraint
- Data type mismatches or values too wide to fit in a column

Note: Use of the column list is recommended because it makes the INSERT statement more readable and reliable, or less prone to mistakes.

Inserting Special Values

The SYSDATE function records the current date and time.

```
INSERT INTO employees (employee_id,
                        first_name, last_name,
                        email, phone_number,
                        hire_date, job_id, salary,
                        commission_pct, manager_id,
                        department_id)
VALUES (113,
        'Louis', 'Popp',
        'LPOPP', '515.124.4567',
        CURRENT_DATE, 'AC_ACCOUNT', 6900,
        NULL, 205, 110);
```

1 rows inserted

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You can use functions to enter special values in your table.

The slide example records information for employee Popp in the EMPLOYEES table. It supplies the current date and time in the HIRE_DATE column. It uses the CURRENT_DATE function that returns the current date in the session time zone. You can also use the USER function when inserting rows in a table. The USER function records the current username.

Confirming Additions to the Table

```
SELECT employee_id, last_name, job_id, hire_date, commission_pct
FROM   employees
WHERE  employee_id = 113;
```

Inserting Specific Date and Time Values

- Add a new employee.

```
INSERT INTO employees
VALUES
    (114,
     'Den', 'Rappealy',
     'DRAPHEAL', '515.127.4561',
     TO_DATE('FEB 3, 2003', 'MON DD, YYYY'),
     'SA_REP', 11000, 0.2, 100, 60);
```

1 rows inserted

- Verify your addition.

	EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	PHONE_NUMBER	HIRE_DATE	JOB_ID	SALARY	COMMISSION_PCT	MANAGER_ID
1	114	Den	Rappealy	DRAPHEAL	515.127.4561	03-FEB-03	SA_REP	11000	0.2	100

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The DD-MON-RR format is generally used to insert a date value. With the RR format, the system provides the correct century automatically.

You may also supply the date value in the DD-MON-YYYY format. This is recommended because it clearly specifies the century and does not depend on the internal RR format logic of specifying the correct century.

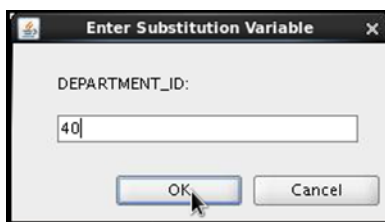
If a date must be entered in a format other than the default format (for example, with another century or a specific time), you must use the TO_DATE function.

The example in the slide records information for employee Rappealy in the EMPLOYEES table. It sets the HIRE_DATE column to be February 3, 2003.

Creating a Script

- Use the & substitution in a SQL statement to prompt for values.
- & is a placeholder for the variable value.

```
INSERT INTO departments
      (department_id, department_name, location_id)
VALUES (&department_id, '&department_name', &location);
```

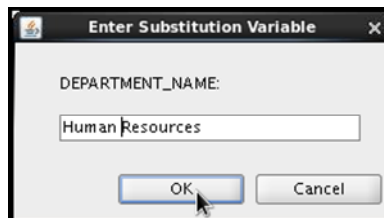


Enter Substitution Variable

DEPARTMENT_ID:

40

OK Cancel

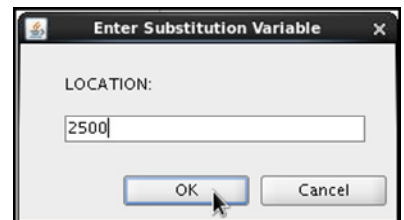


Enter Substitution Variable

DEPARTMENT_NAME:

Human Resources

OK Cancel



Enter Substitution Variable

LOCATION:

2500

OK Cancel

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You can save commands with substitution variables to a file and execute the commands in the file. The example in the slide records information for a department in the `DEPARTMENTS` table.

Run the script file and you are prompted for input for each of the ampersand (&) substitution variables. After entering a value for the substitution variable, click the OK button. The values that you input are then substituted into the statement. This enables you to run the same script file over and over, but supply a different set of values each time you run it.

Copying Rows from Another Table

- Write your INSERT statement with a subquery:

```
INSERT INTO sales_reps(id, name, salary, commission_pct)
SELECT employee_id, last_name, salary, commission_pct
FROM employees
WHERE job_id LIKE '%REP%';
```

5 rows inserted.

- Do not use the VALUES clause.
- Match the number of columns in the INSERT clause to those in the subquery.
- Inserts all the rows returned by the subquery in the table, sales_reps.

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You can use the INSERT statement to add rows to a table where the values are derived from existing tables. In the example in the slide, for the INSERT INTO statement to work, you must have already created the sales_reps table using the CREATE TABLE statement. CREATE TABLE is discussed in the lesson titled “Introduction to Data Definition Language.”

In place of the VALUES clause, you use a subquery.

Syntax

```
INSERT INTO table [ column (, column) ] subquery;
```

In the syntax:

<i>table</i>	Is the name of the table
<i>column</i>	Is the name of the column in the table to populate
<i>subquery</i>	Is the subquery that returns rows to the table

The number of columns and their data types in the column list of the INSERT clause must match the number of values and their data types in the subquery. Zero or more rows are added depending on the number of rows returned by the subquery. To create a copy of the rows of a table, use SELECT * in the subquery:

```
INSERT INTO copy_emp
SELECT *
FROM employees;
```


Lesson Agenda

- Adding new rows in a table
 - `INSERT` statement
- Changing data in a table
 - `UPDATE` statement
- Removing rows from a table:
 - `DELETE` statement
 - `TRUNCATE` statement
- Database transaction control using `COMMIT`, `ROLLBACK`, and `SAVEPOINT`
- Read consistency
- `FOR UPDATE` clause in a `SELECT` statement

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Changing Data in a Table

EMPLOYEES

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	SALARY	MANAGER_ID	COMMISSION_PCT	DEPARTMENT_ID
100	Steven	King	24000	(null)	(null)	90
101	Neena	Kochhar	17000	100	(null)	90
102	Lex	De Haan	17000	100	(null)	90
103	Alexander	Hunold	9000	102	(null)	60
104	Bruce	Ernst	6000	103	(null)	60
107	Diana	Lorentz	4200	103	(null)	60
124	Kevin	Mourgos	5800	100	(null)	50

Update rows in the EMPLOYEES table:



EMPLOYEE_ID	FIRST_NAME	LAST_NAME	SALARY	MANAGER_ID	COMMISSION_PCT	DEPARTMENT_ID
100	Steven	King	24000	(null)	(null)	90
101	Neena	Kochhar	17000	100	(null)	90
102	Lex	De Haan	17000	100	(null)	90
103	Alexander	Hunold	9000	102	(null)	80
104	Bruce	Ernst	6000	103	(null)	80
107	Diana	Lorentz	4200	103	(null)	80
124	Kevin	Mourgos	5800	100	(null)	50

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The slide illustrates changing the department number for employees in department 60 to department 80.

UPDATE Statement Syntax

- Modify existing values in a table with the UPDATE statement:

```
UPDATE      table
SET         column = value [, column = value, ...]
[WHERE      condition];
```

- Update more than one row at a time (if required).

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You can modify the existing values in a table by using the UPDATE statement.

In the syntax:

<i>table</i>	Is the name of the table
<i>column</i>	Is the name of the column in the table to populate
<i>value</i>	Is the corresponding value or subquery for the column
<i>condition</i>	Identifies the rows to be updated and is composed of column names, expressions, constants, subqueries, and comparison operators

Confirm the update operation by querying the table to display the updated rows.

For more information, see the section on “UPDATE” in *Oracle Database SQL Language Reference* for 12c database.

Note: In general, use the primary key column in the WHERE clause to identify a single row for update. Using other columns can unexpectedly cause several rows to be updated. For example, identifying a single row in the EMPLOYEES table by name may return more than one employee having the same name.

Updating Rows in a Table

- Values for a specific row or rows are modified if you specify the WHERE clause:

```
UPDATE employees
SET    department_id = 50
WHERE  employee_id = 113;
```

1 rows updated

- Values for all the rows in the table are modified if you omit the WHERE clause:

```
UPDATE    copy_emp
SET       department_id = 110;
```

22 rows updated

- Specify SET *column_name* = NULL to update a column value to NULL.

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The UPDATE statement modifies the values of a specific row or rows if the WHERE clause is specified. The example in the slide shows the transfer of employee 113 (Popp) to department 50. If you omit the WHERE clause, values for all the rows in the table are modified. Examine the updated rows in the COPY_EMP table.

```
SELECT last_name, department_id
FROM    copy_emp;
```

For example, an employee who was an SA_REP has now changed his job to an IT_PROG. Therefore, his JOB_ID needs to be updated and the commission field needs to be set to NULL.

```
UPDATE employees
SET job_id = 'IT_PROG', commission_pct = NULL
WHERE employee_id = 114;
```

Note: The COPY_EMP table has the same data as the EMPLOYEES table.

Updating Two Columns with a Subquery

Update employee 103's job and salary to match those of employee 205.

```
UPDATE employees
SET      (job_id,salary) = (SELECT job_id,salary
                           FROM employees
                           WHERE employee id = 205)
WHERE    employee_id     = 103;
```

1 rows updated

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You can update multiple columns in the SET clause of an UPDATE statement by writing multiple subqueries. The syntax is as follows:

```
UPDATE table
SET      column =
          (SELECT column
           FROM table
           WHERE condition)
[ ,
  column =
          (SELECT column
           FROM table
           WHERE condition)]
[WHERE condition ] ;
```

Updating Rows Based on Another Table

Use the subqueries in the UPDATE statements to update row values in a table based on values from another table:

```
UPDATE copy_emp
SET    department_id = (SELECT department_id
                        FROM employees
                        WHERE employee_id = 100)
WHERE  job_id        = (SELECT job_id
                        FROM employees
                        WHERE employee_id = 200);
```

1 rows updated

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You can use the subqueries in the UPDATE statements to update values in a table. The example in the slide updates the COPY_EMP table based on the values from the EMPLOYEES table. It changes the department number of all employees with employee 200's job ID to employee 100's current department number.

Lesson Agenda

- Adding new rows in a table
 - INSERT statement
- Changing data in a table
 - UPDATE statement
- Removing rows from a table:
 - DELETE statement
 - TRUNCATE statement
- Database transaction control using COMMIT, ROLLBACK, and SAVEPOINT
- Read consistency
- FOR UPDATE clause in a SELECT statement

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Removing a Row from a Table

DEPARTMENTS

	DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
1	10	Administration	200	1700
2	20	Marketing	201	1800
3	50	Shipping	124	1500
4	60	IT	103	1400
5	80	Sales	149	2500
6	90	Executive	100	1700
7	110	Accounting	205	1700
8	190	Contracting	(null)	1700

Delete a row from the DEPARTMENTS table:

	DEPARTMENT_ID	DEPARTMENT_NAME	MANAGER_ID	LOCATION_ID
1	10	Administration	200	1700
2	20	Marketing	201	1800
3	50	Shipping	124	1500
4	60	IT	103	1400
5	80	Sales	149	2500
6	90	Executive	100	1700
7	110	Accounting	205	1700

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The contracting department has been removed from the DEPARTMENTS table (assuming no constraints on the DEPARTMENTS table are violated), as shown by the graphic in the slide.

DELETE Statement

You can remove existing rows from a table by using the DELETE statement:

```
DELETE [FROM]    table
[WHERE           condition] ;
```

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You can remove existing rows from a table by using the DELETE statement.

In the syntax:

<i>table</i>	Is the name of the table
<i>condition</i>	Identifies the rows to be deleted, and is composed of column names, expressions, constants, subqueries, and comparison operators

Note: If no rows are deleted, the message “0 rows deleted” is returned (on the Script Output tab in SQL Developer).

For more information, see the section on “DELETE” in *Oracle Database SQL Language Reference* for 12c database.

Deleting Rows from a Table

- Specific rows are deleted if you specify the WHERE clause:

```
DELETE FROM departments
WHERE department_name = 'Finance';
```

1 rows deleted

- All rows in the table are deleted if you omit the WHERE clause:

```
DELETE FROM copy_emp;
```

22 rows deleted

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You can delete specific rows by specifying the WHERE clause in the DELETE statement. The first example in the slide deletes the accounting department from the DEPARTMENTS table. You can confirm the delete operation by displaying the deleted rows using the SELECT statement.

```
SELECT *
FROM departments
WHERE department_name = 'Finance';
```

However, if you omit the WHERE clause, all rows in the table are deleted. The second example in the slide deletes all rows from the COPY_EMP table, because no WHERE clause was specified.

Example

Remove rows identified in the WHERE clause.

```
DELETE FROM employees WHERE employee_id = 114;
```

```
DELETE FROM departments WHERE department_id IN (30, 40);
```

Deleting Rows Based on Another Table

Use the subqueries in the `DELETE` statements to remove rows from a table based on values from another table:

```
DELETE FROM employees
WHERE department_id IN
    (SELECT department_id
     FROM departments
     WHERE department_name
       LIKE '%Public%');
1 rows deleted
```

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You can use the subqueries to delete rows from a table based on values from another table. The example in the slide deletes all the employees in a department, where the department name contains the string `Public`.

The subquery searches the `DEPARTMENTS` table to find the department number based on the department name containing the string `Public`. The subquery then feeds the department number to the main query, which deletes rows of data from the `EMPLOYEES` table based on this department number.

TRUNCATE Statement

- Removes all rows from a table, leaving the table empty and the table structure intact
- Is a data definition language (DDL) statement rather than a DML statement; cannot easily be undone
- Syntax:

```
TRUNCATE TABLE table_name;
```

- Example:

```
TRUNCATE TABLE copy_emp;
```

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A more efficient method of emptying a table is by using the `TRUNCATE` statement. You can use the `TRUNCATE` statement to quickly remove all rows from a table or cluster. Removing rows with the `TRUNCATE` statement is faster than removing them with the `DELETE` statement for the following reasons:

- The `TRUNCATE` statement is a data definition language (DDL) statement and generates no rollback information. Rollback information is covered later in this lesson.

If the table is the parent of a referential integrity constraint, you cannot truncate the table. You need to disable the constraint before issuing the `TRUNCATE` statement. Disabling constraints is covered in the lesson titled “Introduction to DDL Statements.”

Lesson Agenda

- Adding new rows in a table
 - INSERT statement
- Changing data in a table
 - UPDATE statement
- Removing rows from a table:
 - DELETE statement
 - TRUNCATE statement
- **Database transaction control using COMMIT, ROLLBACK, and SAVEPOINT**
- Read consistency
- FOR UPDATE clause in a SELECT statement

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Database Transactions

A database transaction consists of one of the following:

- DML statements that constitute one consistent change to the data
- One DDL statement
- One data control language (DCL) statement

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The Oracle server ensures data consistency based on transactions. Transactions give you more flexibility and control when changing data, and they ensure data consistency in the event of user process failure or system failure.

Transactions consist of DML statements that constitute one consistent change to the data. For example, a transfer of funds between two accounts should include the debit in one account and the credit to another account of the same amount. Both actions should either fail or succeed together; the credit should not be committed without the debit.

Transaction Types

Type	Description
Data manipulation language (DML)	Consists of any number of DML statements that the Oracle server treats as a single entity or a logical unit of work
Data definition language (DDL)	Consists of only one DDL statement
Data control language (DCL)	Consists of only one DCL statement

Database Transactions: Start and End

- Begin when the first DML SQL statement is executed.
- End with one of the following events:
 - A COMMIT or ROLLBACK statement is issued.
 - A DDL or DCL statement executes (automatic commit).
 - The user exits SQL Developer or SQL*Plus.
 - The system crashes.

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When does a database transaction start and end?

A transaction begins when the first DML statement is encountered and ends when one of the following occurs:

- A COMMIT or ROLLBACK statement is issued.
- A DDL statement, such as CREATE, is issued.
- A DCL statement is issued.
- The user exits SQL Developer or SQL*Plus.
- A machine fails or the system crashes.

After one transaction ends, the next executable SQL statement automatically starts the next transaction.

A DDL statement or a DCL statement is automatically committed and, therefore, implicitly ends a transaction.

Advantages of COMMIT and ROLLBACK Statements

With COMMIT and ROLLBACK statements, you can:

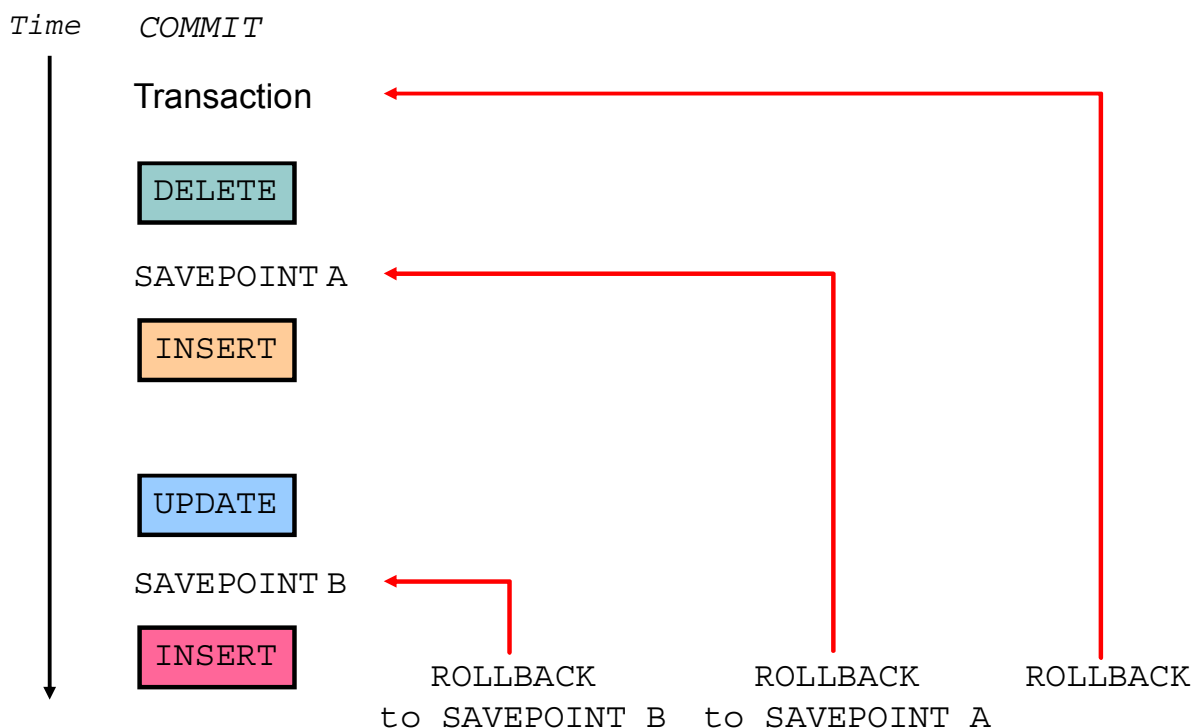
- Ensure data consistency
- Preview data changes before making changes permanent
- Group logically related operations

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With the COMMIT and ROLLBACK statements, you have control over making changes to the data permanent.

Explicit Transaction Control Statements



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You can control the logic of transactions by using the **COMMIT**, **SAVEPOINT**, and **ROLLBACK** statements.

Statement	Description
COMMIT	COMMIT ends the current transaction by making all pending data changes permanent.
SAVEPOINT <i>name</i>	SAVEPOINT <i>name</i> marks a savepoint within the current transaction.
ROLLBACK	ROLLBACK ends the current transaction by discarding all pending data changes.
ROLLBACK TO <i>SAVEPOINT name</i>	ROLLBACK TO <savepoint> rolls back the current transaction to the specified savepoint, thereby discarding any changes and/or savepoints that were created after the savepoint to which you are rolling back. If you omit the TO SAVEPOINT clause, the ROLLBACK statement rolls back the entire transaction. Because savepoints are logical, there is no way to list the savepoints that you have created.

Note: You cannot COMMIT to a SAVEPOINT. SAVEPOINT is not ANSI-standard SQL.

Rolling Back Changes to a Marker

- Create a marker in the current transaction by using the `SAVEPOINT` statement.
- Roll back to that marker by using the `ROLLBACK TO SAVEPOINT` statement.

```
UPDATE...  
SAVEPOINT update_done;  
SAVEPOINT update_done succeeded.  
INSERT...  
ROLLBACK TO update_done;  
ROLLBACK TO succeeded.
```

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You can create a marker in the current transaction by using the `SAVEPOINT` statement, which divides the transaction into smaller sections. You can then discard pending changes back to that marker by using the `ROLLBACK TO SAVEPOINT` statement.

Note that if you create a second savepoint with the same name as an earlier savepoint, the earlier savepoint is deleted.

Implicit Transaction Processing

- An automatic commit occurs in the following circumstances:
 - A DDL statement issued
 - A DCL statement issued
 - Normal exit from SQL Developer or SQL*Plus, without explicitly issuing `COMMIT` or `ROLLBACK` statements
- An automatic rollback occurs when there is an abnormal termination of SQL Developer or SQL*Plus or a system failure.

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Status	Circumstances
Automatic commit	DDL statement or DCL statement issued SQL Developer or SQL*Plus exited normally, without explicitly issuing <code>COMMIT</code> or <code>ROLLBACK</code> commands
Automatic rollback	Abnormal termination of SQL Developer or SQL*Plus or system failure

Note: In SQL*Plus, the `AUTOCOMMIT` command can be toggled `ON` or `OFF`. If set to `ON`, each individual DML statement is committed as soon as it is executed. You cannot roll back the changes. If set to `OFF`, the `COMMIT` statement can still be issued explicitly. Also, the `COMMIT` statement is issued when a DDL statement is issued or when you exit SQL*Plus. The `SET AUTOCOMMIT ON/OFF` command is skipped in SQL Developer. DML is committed on a normal exit from SQL Developer only if you have the Autocommit preference enabled. To enable Autocommit, perform the following:

- In the Tools menu, select Preferences. In the Preferences dialog box, expand Database and select Worksheet Parameters.
- In the right pane, select the “Autocommit in SQL Worksheet” option. Click OK.

System Failures

When a transaction is interrupted by a system failure, the entire transaction is automatically rolled back. This prevents the error from causing unwanted changes to the data and returns the tables to the state at the time of the last commit. In this way, the Oracle server protects the integrity of the tables.

In SQL Developer, a normal exit from the session is accomplished by selecting Exit from the File menu. In SQL*Plus, a normal exit is accomplished by entering the `EXIT` command at the prompt. Closing the window is interpreted as an abnormal exit.

State of Data Before COMMIT or ROLLBACK

- The previous state of the data can be recovered.
- The current session can review the results of the DML operations by using the `SELECT` statement.
- Other sessions *cannot* view the results of the DML statements issued by the current session.
- The affected rows are *locked*; other session cannot change the data in the affected rows.

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Every data change made during the transaction is temporary until the transaction is committed.

The state of the data before `COMMIT` or `ROLLBACK` statements are issued can be described as follows:

- Data manipulation operations primarily affect the database buffer; therefore, the previous state of the data can be recovered.
- The current session can review the results of the data manipulation operations by querying the tables.
- Other sessions cannot view the results of the data manipulation operations made by the current session. The Oracle server institutes read consistency to ensure that each session sees data as it existed at the last commit.
- The affected rows are locked; other session cannot change the data in the affected rows.

State of Data After COMMIT

- Data changes are saved in the database.
- The previous state of the data is overwritten.
- All sessions can view the results.
- Locks on the affected rows are released; those rows are available for other sessions to manipulate.
- All savepoints are erased.

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Make all pending changes permanent by using the `COMMIT` statement. Here is what happens after a `COMMIT` statement:

- Data changes are written to the database.
- The previous state of the data is no longer available with normal SQL queries.
- All sessions can view the results of the transaction.
- The locks on the affected rows are released; the rows are now available for other sessions to perform new data changes.
- All savepoints are erased.

Committing Data

- Make the changes:

```
DELETE FROM EMPLOYEES
WHERE employee_id=113;
1 rows deleted
INSERT INTO departments
VALUES (290, 'Corporate Tax', NULL, 1700);
1 rows inserted
```

- Commit the changes:

```
COMMIT;
```

```
Committed.
```

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In the example in the slide, a row is deleted from the `EMPLOYEES` table and a new row is inserted into the `DEPARTMENTS` table. The changes are saved by issuing the `COMMIT` statement.

Example

Remove departments 290 and 300 in the `DEPARTMENTS` table and update a row in the `EMPLOYEES` table. Save the data change.

```
DELETE FROM departments
WHERE department_id IN (290, 300);

UPDATE employees
SET department_id = 80
WHERE employee_id = 206;

COMMIT;
```

State of Data After ROLLBACK

Discard all pending changes by using the ROLLBACK statement:

- Data changes are undone.
- Previous state of the data is restored.
- Locks on the affected rows are released.

```
DELETE FROM copy_emp;  
ROLLBACK ;
```

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Discard all pending changes by using the ROLLBACK statement, which results in the following:

- Data changes are undone.
- The previous state of the data is restored.
- Locks on the affected rows are released.

State of Data After ROLLBACK: Example

```
DELETE FROM test;  
4 rows deleted.  
  
ROLLBACK;  
Rollback complete.  
  
DELETE FROM test WHERE id = 100;  
1 row deleted.  
  
SELECT * FROM test WHERE id = 100;  
No rows selected.  
  
COMMIT;  
Commit complete.
```

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While attempting to remove a record from the `TEST` table, you may accidentally empty the table. However, you can correct the mistake, reissue a proper statement, and make the data change permanent.

Statement-Level Rollback

- If a single DML statement fails during execution, only that statement is rolled back.
- The Oracle server implements an implicit savepoint.
- All other changes are retained.
- The user should terminate transactions explicitly by executing a `COMMIT` or `ROLLBACK` statement.

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A part of a transaction can be discarded through an implicit rollback if a statement execution error is detected. If a single DML statement fails during execution of a transaction, its effect is undone by a statement-level rollback, but the changes made by the previous DML statements in the transaction are not discarded. They can be committed or rolled back explicitly by the user.

The Oracle server issues an implicit commit before and after any DDL statement. So, even if your DDL statement does not execute successfully, you cannot roll back the previous statement because the server issued a commit.

Terminate your transactions explicitly by executing a `COMMIT` or `ROLLBACK` statement.

Lesson Agenda

- Adding new rows in a table
 - INSERT statement
- Changing data in a table
 - UPDATE statement
- Removing rows from a table:
 - DELETE statement
 - TRUNCATE statement
- Database transaction control using COMMIT, ROLLBACK, and SAVEPOINT
- **Read consistency**
- FOR UPDATE clause in a SELECT statement

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Read Consistency

- Read consistency guarantees a consistent view of the data at all times.
- Changes made by one user do not conflict with the changes made by another user.
- Read consistency ensures that, on the same data:
 - Readers do not wait for writers
 - Writers do not wait for readers
 - Writers wait for writers

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Database users access the database in two ways:

- Read operations (`SELECT` statement)
- Write operations (`INSERT`, `UPDATE`, `DELETE` statements)

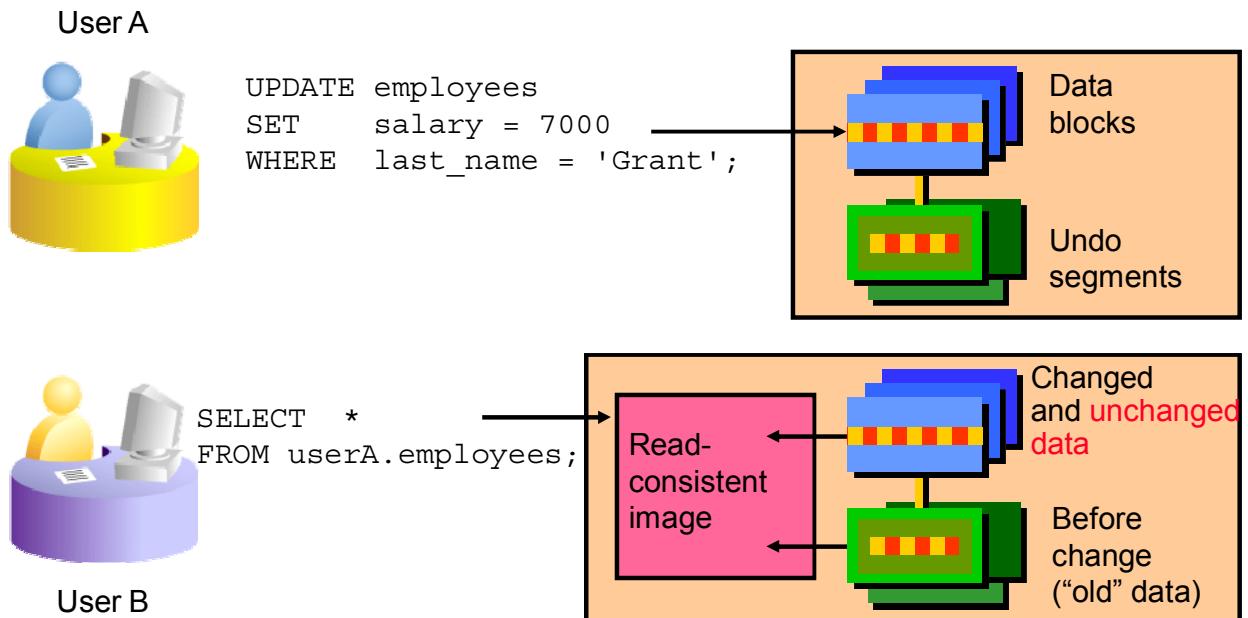
You need read consistency so that the following occur:

- The database reader and writer are ensured a consistent view of the data.
- Readers do not view data that is in the process of being changed.
- Writers are ensured that the changes to the database are done in a consistent manner.
- Changes made by one writer do not disrupt or conflict with the changes being made by another writer.

The purpose of read consistency is to ensure that each user sees data as it existed at the last commit, before a DML operation started.

Note: The same user can log in to different sessions. Each session maintains read consistency in the manner described above, even if they are the same users.

Implementing Read Consistency



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Read consistency is an automatic implementation. It keeps a partial copy of the database in the undo segments. The read-consistent image is constructed from the committed data in the table and the old data that is being changed and is not yet committed from the undo segment.

When an insert, update, or delete operation is made on the database, the Oracle server takes a copy of the data before it is changed and writes it to an *undo segment*.

All readers, except the one who issued the change, see the database as it existed before the changes started; they view the undo segment's "snapshot" of the data.

Before the changes are committed to the database, only the user who is modifying the data sees the database with the alterations. Everyone else sees the snapshot in the undo segment. This guarantees that readers of the data read consistent data that is not currently undergoing change.

When a DML statement is committed, the change made to the database becomes visible to anyone issuing a *SELECT* statement *after* the commit is done. The space occupied by the *old* data in the undo segment file is freed for reuse.

If the transaction is rolled back, the changes are undone:

- The original, older version of the data in the undo segment is written back to the table.
- All users see the database as it existed before the transaction began.

Lesson Agenda

- Adding new rows in a table
 - INSERT statement
- Changing data in a table
 - UPDATE statement
- Removing rows from a table:
 - DELETE statement
 - TRUNCATE statement
- Database transaction control using COMMIT, ROLLBACK, and SAVEPOINT
- Read consistency
- **FOR UPDATE clause in a SELECT statement**

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FOR UPDATE Clause in a SELECT Statement

- Locks the rows in the EMPLOYEES table where job_id is SA_REP.

```
SELECT employee_id, salary, commission_pct, job_id
FROM employees
WHERE job_id = 'SA_REP'
FOR UPDATE
ORDER BY employee_id;
```

- Lock is released only when you issue a ROLLBACK or a COMMIT.
- If the SELECT statement attempts to lock a row that is locked by another user, the database waits until the row is available, and then returns the results of the SELECT statement.

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When you issue a SELECT statement against the database to query some records, no locks are placed on the selected rows. In general, this is required because the number of records locked at any given time is (by default) kept to the absolute minimum: only those records that have been changed but not yet committed are locked. Even then, others will be able to read those records as they appeared before the change (the “before image” of the data). There are times, however, when you may want to lock a set of records even before you change them in your program. Oracle offers the FOR UPDATE clause of the SELECT statement to perform this locking.

When you issue a SELECT . . . FOR UPDATE statement, the relational database management system (RDBMS) automatically obtains exclusive row-level locks on all the rows identified by the SELECT statement, thereby holding the records “for your changes only.” No one else will be able to change any of these records until you perform a ROLLBACK or a COMMIT.

You can append the optional keyword NOWAIT to the FOR UPDATE clause to tell the Oracle server not to wait if the table has been locked by another user. In this case, control will be returned immediately to your program or to your SQL Developer environment so that you can perform other work, or simply wait for a period of time before trying again. Without the NOWAIT clause, your process will block until the table is available, when the locks are released by the other user through the issue of a COMMIT or a ROLLBACK command.

FOR UPDATE Clause: Examples

- You can use the FOR UPDATE clause in a SELECT statement against multiple tables.

```
SELECT e.employee_id, e.salary, e.commission_pct
FROM employees e JOIN departments d
USING (department_id)
WHERE job_id = 'ST_CLERK'
AND location_id = 1500
FOR UPDATE
ORDER BY e.employee_id;
```

- Rows from both the EMPLOYEES and DEPARTMENTS tables are locked.
- Use FOR UPDATE OF *column_name* to qualify the column you intend to change, then only the rows from that specific table are locked.

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In the example in the slide, the statement locks rows in the EMPLOYEES table with JOB_ID set to ST_CLERK and LOCATION_ID set to 1500, and locks rows in the DEPARTMENTS table with departments in LOCATION_ID set as 1500.

You can use the FOR UPDATE OF *column_name* to qualify the column that you intend to change. The OF list of the FOR UPDATE clause does not restrict you to changing only those columns of the selected rows. Locks are still placed on all rows; if you simply state FOR UPDATE in the query and do not include one or more columns after the OF keyword, the database will lock all identified rows across all the tables listed in the FROM clause.

The following statement locks only those rows in the EMPLOYEES table with ST_CLERK located in LOCATION_ID 1500. No rows are locked in the DEPARTMENTS table:

```
SELECT e.employee_id, e.salary, e.commission_pct
FROM employees e JOIN departments d
USING (department_id)
WHERE job_id = 'ST_CLERK' AND location_id = 1500
FOR UPDATE OF e.salary
ORDER BY e.employee_id;
```


In the following example, the database is instructed to wait for five seconds for the row to become available, and then return control to you.

```
SELECT employee_id, salary, commission_pct, job_id
FROM employees
WHERE job_id = 'SA_REP'
FOR UPDATE WAIT 5
ORDER BY employee_id;
```

Quiz

The following statements produce the same results:

```
DELETE FROM copy_emp;
```

```
TRUNCATE TABLE copy_emp;
```

- a. True
- b. False

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Answer: b

Summary

In this lesson, you should have learned how to use the following statements:

Function	Description
INSERT	Adds a new row to the table
UPDATE	Modifies existing rows in the table
DELETE	Removes existing rows from the table
TRUNCATE	Removes all rows from a table
COMMIT	Makes all pending changes permanent
SAVEPOINT	Is used to roll back to the savepoint marker
ROLLBACK	Discards all pending data changes
FOR UPDATE clause in SELECT	Locks rows identified by the SELECT query

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In this lesson, you should have learned how to manipulate data in the Oracle database by using the `INSERT`, `UPDATE`, `DELETE`, and `TRUNCATE` statements, as well as how to control data changes by using the `COMMIT`, `SAVEPOINT`, and `ROLLBACK` statements. You also learned how to use the `FOR UPDATE` clause of the `SELECT` statement to lock rows for your changes only.

Remember that the Oracle server guarantees a consistent view of data at all times.

Practice 10: Overview

This practice covers the following topics:

- Inserting rows into the tables
- Updating and deleting rows in the table
- Controlling transactions

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In this practice, you add rows to the `MY_EMPLOYEE` table, update and delete data from the table, and control your transactions. You run a script to create the `MY_EMPLOYEE` table.

11

Introduction to Data Definition Language

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Objectives

After completing this lesson, you should be able to do the following:

- Categorize the main database objects
- Review the table structure
- List the data types that are available for columns
- Create a simple table
- Explain how constraints are created at the time of table creation
- Describe how schema objects work

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In this lesson, you are introduced to the data definition language (DDL) statements. You learn the basics of how to create simple tables, alter them, and remove them. The data types available in DDL are shown and schema concepts are introduced. Constraints are discussed in this lesson. Exception messages that are generated from violating constraints during DML operations are shown and explained.

Lesson Agenda

- Database objects
 - Naming rules
- CREATE TABLE statement
- Data types
- Overview of constraints: NOT NULL, UNIQUE, PRIMARY KEY, FOREIGN KEY, CHECK constraints
- Creating a table using a subquery
- ALTER TABLE statement
- DROP TABLE statement

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Database Objects

Object	Description
Table	Is the basic unit of storage; composed of rows
View	Logically represents subsets of data from one or more tables
Sequence	Generates numeric values
Index	Improves the performance of some queries
Synonym	Gives alternative name to an object

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The Oracle database can contain multiple data structures. Each structure should be outlined in the database design so that it can be created during the build stage of database development.

- **Table:** Stores data
- **View:** Is a subset of data from one or more tables
- **Sequence:** Generates numeric values
- **Index:** Improves the performance of some queries
- **Synonym:** Gives an alternative name to an object

Oracle Table Structures

- Tables can be created at any time, even when users are using the database.
- You do not need to specify the size of a table. The size is ultimately defined by the amount of space allocated to the database as a whole. It is important, however, to estimate how much space a table will use over time.
- Table structure can be modified online.

Note: More database objects are available, but are not covered in this course.

Naming Rules

Table names and column names must:

- Begin with a letter
- Be 1–30 characters long
- Contain only A–Z, a–z, 0–9, _, \$, and #
- Not duplicate the name of another object owned by the same user
- Not be an Oracle server–reserved word

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You name database tables and columns according to the standard rules for naming any Oracle database object.

- Table names and column names must begin with a letter and be 1–30 characters long.
- Names must contain only the characters A–Z, a–z, 0–9, _ (underscore), \$, and # (legal characters, but their use is discouraged).
- Names must not duplicate the name of another object owned by the same Oracle server user.
- Names must not be an Oracle server–reserved word.
 - You may also use quoted identifiers to represent the name of an object. A quoted identifier begins and ends with double quotation marks ("""). If you name a schema object using a quoted identifier, you must use the double quotation marks whenever you refer to that object. Quoted identifiers can be reserved words, although this is not recommended.

Naming Guidelines

Use descriptive names for tables and other database objects.

Note: Names are not case-sensitive. For example, EMPLOYEES is treated to be the same name as eMPloyees or eMpLOYEES. However, quoted identifiers are case-sensitive.

For more information, see the “Schema Object Names and Qualifiers” section in the *Oracle Database SQL Language Reference* for 12c database.

Lesson Agenda

- Database objects
 - Naming rules
- CREATE TABLE statement
- Data types
- Overview of constraints: NOT NULL, UNIQUE, PRIMARY KEY, FOREIGN KEY, CHECK constraints
- Creating a table using a subquery
- ALTER TABLE statement
- DROP TABLE statement

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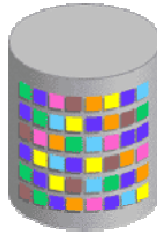
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CREATE TABLE Statement

- You must have:
 - The CREATE TABLE privilege
 - A storage area

```
CREATE TABLE [schema.]table  
    (column datatype [DEFAULT expr] [, ...]);
```

- You specify:
 - The table name
 - The column name, column data type, and column size



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You create tables to store data by executing the SQL CREATE TABLE statement. This statement is one of the DDL statements that are a subset of the SQL statements used to create, modify, or remove Oracle Database structures. These statements have an immediate effect on the database and they also record information in the data dictionary.

To create a table, a user must have the CREATE TABLE privilege and a storage area in which to create objects. The database administrator (DBA) uses data control language (DCL) statements to grant privileges to users.

In the syntax:

<i>schema</i>	Is the same as the owner's name
<i>table</i>	Is the name of the table
DEFAULT <i>expr</i>	Specifies a default value if a value is omitted in the INSERT statement
<i>column</i>	Is the name of the column
<i>datatype</i>	Is the column's data type and length

Note: The CREATE ANY TABLE privilege is needed to create a table in any schema other than the user's schema.

Creating Tables

- Create the table:

```
CREATE TABLE dept
  (deptno      NUMBER(2) ,
   dname       VARCHAR2(14) ,
   loc         VARCHAR2(13) ,
   create_date DATE DEFAULT SYSDATE) ;
```

table DEPT created.

- Confirm table creation:

```
DESCRIBE dept
```

```
DESCRIBE dept
Name          Null Type
-----
DEPTNO        NUMBER(2)
DNAME         VARCHAR2(14)
LOC           VARCHAR2(13)
CREATE_DATE   DATE
```

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The example in the slide creates the DEPT table with four columns: DEPTNO, DNAME, LOC, and CREATE_DATE. The CREATE_DATE column has a default value. If a value is not provided for an INSERT statement, the system date is automatically inserted.

To confirm that the table was created, run the DESCRIBE command.

Because creating a table is a DDL statement, an automatic commit takes place when this statement is executed.

Note: You can view the list of tables that you own by querying the data dictionary. Example:

```
select table_name from user_tables;
```

Using data dictionary views, you can also find information about other database objects such as views, indexes, and so on. You will learn about data dictionaries in detail in the *Oracle Database: SQL Workshop II* course.

Lesson Agenda

- Database objects
 - Naming rules
- CREATE TABLE statement
- **Data types**
- Overview of constraints: NOT NULL, UNIQUE, PRIMARY KEY, FOREIGN KEY, CHECK constraints
- Creating a table using a subquery
- ALTER TABLE statement
- DROP TABLE statement

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Data Types

Data Type	Description
VARCHAR2 (<i>size</i>)	Variable-length character data
CHAR (<i>size</i>)	Fixed-length character data
NUMBER (<i>p</i> , <i>s</i>)	Variable-length numeric data
DATE	Date and time values
LONG	Variable-length character data (up to 2 GB)
CLOB	Maximum size is (4 gigabytes - 1) * (DB_BLOCK_SIZE).
RAW and LONG RAW	Raw binary data
BLOB	Maximum size is (4 gigabytes - 1) * (DB_BLOCK_SIZE initialization parameter (8 TB to 128 TB)).
BFILE	Binary data stored in an external file (up to 4 GB)
ROWID	A base-64 number system representing the unique address of a row in its table

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When you identify a column for a table, you need to provide a data type for the column. There are several data types available:

Data Type	Description
VARCHAR2 (<i>size</i>)	Variable-length character data (A maximum <i>size</i> must be specified: minimum <i>size</i> is 1.) Maximum size is: <ul style="list-style-type: none"> 32767 bytes if MAX_SQL_STRING_SIZE = EXTENDED 4000 bytes if MAX_SQL_STRING_SIZE = LEGACY
CHAR [(<i>size</i>)]	Fixed-length character data of length <i>size</i> bytes (Default and minimum <i>size</i> is 1; maximum <i>size</i> is 2,000.)
NUMBER [(<i>p</i> , <i>s</i>)]	Number having precision <i>p</i> and scale <i>s</i> (Precision is the total number of decimal digits and scale is the number of digits to the right of the decimal point; precision can range from 1 to 38, and scale can range from -84 to 127.)
DATE	Date and time values to the nearest second between January 1, 4712 B.C., and December 31, 9999 A.D.

Data Type	Description
LONG	Variable-length character data (up to 2 GB)
CLOB	A character large object containing single-byte or multibyte characters. Maximum size is (4 gigabytes - 1) * (DB_BLOCK_SIZE); stores national character set data.
NCLOB	A character large object containing Unicode characters. Both fixed-width and variable-width character sets are supported, both using the database national character set. Maximum size is (4 gigabytes - 1) * (database block size); stores national character set data.
RAW(size)	Raw binary data of length <i>size</i> bytes. You must specify <i>size</i> for a RAW value. Maximum <i>size</i> is: 32767 bytes if MAX_SQL_STRING_SIZE = EXTENDED 4000 bytes if MAX_SQL_STRING_SIZE = LEGACY
LONG RAW	Raw binary data of variable length up to 2 gigabytes
BLOB	A binary large object. Maximum size is (4 gigabytes - 1) * (DB_BLOCK_SIZE initialization parameter (8 TB to 128 TB)).
BFILE	Binary data stored in an external file (up to 4 GB)
ROWID	Base 64 string representing the unique address of a row in its table. This data type is primarily for values returned by the ROWID pseudocolumn

Guidelines

- A LONG column is not copied when a table is created using a subquery.
- A LONG column cannot be included in a GROUP BY or an ORDER BY clause.
- Only one LONG column can be used per table.
- No constraints can be defined on a LONG column.
- You might want to use a CLOB column rather than a LONG column.

Datetime Data Types

You can use several datetime data types:

Data Type	Description
TIMESTAMP	Date with fractional seconds
INTERVAL YEAR TO MONTH	Stored as an interval of years and months
INTERVAL DAY TO SECOND	Stored as an interval of days, hours, minutes, and seconds



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Data Type	Description
TIMESTAMP	Enables storage of time as a date with fractional seconds. It stores the year, month, day, hour, minute, and the second value of the <code>DATE</code> data type, as well as the fractional seconds value. There are several variations of this data type such as <code>WITH TIMEZONE</code> and <code>WITH LOCALTIMEZONE</code> .
INTERVAL YEAR TO MONTH	Enables storage of time as an interval of years and months; used to represent the difference between two datetime values in which the only significant portions are the year and month
INTERVAL DAY TO SECOND	Enables storage of time as an interval of days, hours, minutes, and seconds; used to represent the precise difference between two datetime values

Note: These datetime data types are available with Oracle9i and later releases. The datetime data types are discussed in detail in the lesson titled “Managing Data in Different Time Zones” in the *Oracle Database: SQL Workshop II* course.

Also, for more information about the datetime data types, see the sections on “TIMESTAMP Datatype,” “INTERVAL YEAR TO MONTH Datatype,” and “INTERVAL DAY TO SECOND Datatype” in *Oracle Database SQL Language Reference* for 12c database.

DEFAULT Option

- Specify a default value for a column during the CREATE table.

```
... hire_date DATE DEFAULT SYSDATE, ...
```

- Literal values, expressions, or SQL functions are legal values.
- Another column's name or a pseudocolumn are illegal values.
- The default data type must match the column data type.

```
CREATE TABLE hire_dates
(id          NUMBER(8),
 hire date DATE DEFAULT SYSDATE);
table HIRE_DATES created.
```

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When you define a table, you can specify that a column should be given a default value by using the `DEFAULT` option. This option prevents null values from entering the columns when a row is inserted without a value for the column. The default value can be a literal, an expression, or a SQL function (such as `SYSDATE` or `USER`), but the value cannot be the name of another column or a pseudocolumn (such as `NEXTVAL` or `CURRVAL`). The default expression must match the data type of the column.

Consider the following examples:

```
INSERT INTO hire_dates values(45, NULL);
```

The preceding statement will insert the null value rather than the default value.

```
INSERT INTO hire_dates(id) values(35);
```

The preceding statement will insert `SYSDATE` for the `HIRE_DATE` column.

Note: In SQL Developer, click the Run Script icon or press F5 to run the DDL statements. The feedback messages will be shown on the Script Output tabbed page.

Lesson Agenda

- Database objects
 - Naming rules
- CREATE TABLE statement
- Data types
- **Overview of constraints: NOT NULL, UNIQUE, PRIMARY KEY, FOREIGN KEY, CHECK constraints**
- Creating a table using a subquery
- ALTER TABLE statement
- DROP TABLE statement

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Including Constraints

- Constraints enforce rules at the table level.
- Constraints ensure the consistency and integrity of the database.
- The following constraint types are valid:
 - NOT NULL
 - UNIQUE
 - PRIMARY KEY
 - FOREIGN KEY
 - CHECK



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The Oracle server uses constraints to prevent invalid data entry into tables.

You can use constraints to do the following:

- Enforce rules on the data in a table whenever a row is inserted, updated, or deleted from that table. The constraint must be satisfied for the operation to succeed.
- Prevent the dropping of a table if there are dependencies from other tables.
- Provide rules for Oracle tools, such as Oracle Developer.

Data Integrity Constraints

Constraint	Description
NOT NULL	Specifies that the column cannot contain a null value
UNIQUE	Specifies a column or combination of columns whose values must be unique for all rows in the table
PRIMARY KEY	Uniquely identifies each row of the table
FOREIGN KEY	Establishes and enforces a referential integrity between the column and a column of the referenced table such that values in one table match values in another table.
CHECK	Specifies a condition that must be true

Constraint Guidelines

- You can name a constraint or the Oracle server generates a name by using the `SYS_Cn` format.
- Create a constraint at either of the following times:
 - At the same time as the creation of the table
 - After the creation of the table
- Define a constraint at the column or table level.
- View a constraint in the data dictionary.

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All constraints are stored in the data dictionary. Constraints are easy to reference if you give them a meaningful name. Constraint names must follow the standard object-naming rules, except that the name cannot be the same as another object owned by the same user. If you do not name your constraint, the Oracle server generates a name with the format `SYS_Cn`, where *n* is an integer so that the constraint name is unique.

Constraints can be defined at the time of table creation or after the creation of the table. You can define a constraint at the column or table level. Functionally, a table-level constraint is the same as a column-level constraint.

For more information, see the section on “Constraints” in *Oracle Database SQL Language Reference* for 12c database.

Defining Constraints

- Syntax:

```
CREATE TABLE [schema.]table
  (column datatype [DEFAULT expr]
   [column_constraint],
   ...
   [table_constraint] [, ...] );
```

- Column-level constraint syntax:

```
column [CONSTRAINT constraint_name] constraint_type,
```

- Table-level constraint syntax:

```
column, ...
  [CONSTRAINT constraint_name] constraint_type
  (column, ...),
```

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The slide gives the syntax for defining constraints when creating a table. You can create constraints at either the column level or table level. Constraints defined at the column level are included when the column is defined. Table-level constraints are defined at the end of the table definition, and must refer to the column or columns on which the constraint pertains in a set of parentheses. It is mainly the syntax that differentiates the two; otherwise, functionally, a column-level constraint is the same as a table-level constraint.

NOT NULL constraints can be defined only at the column level.

Constraints that apply to more than one column must be defined at the table level.

In the syntax:

<i>schema</i>	Is the same as the owner's name
<i>table</i>	Is the name of the table
DEFAULT <i>expr</i> INSERT	Specifies a default value to be used if a value is omitted in the statement
<i>column</i>	Is the name of the column
<i>datatype</i>	Is the column's data type and length
<i>column_constraint</i>	Is an integrity constraint as part of the column definition
<i>table_constraint</i>	Is an integrity constraint as part of the table definition

Defining Constraints

- Example of a column-level constraint:

```
CREATE TABLE employees(  
  employee_id  NUMBER(6)  
    CONSTRAINT emp_emp_id_pk PRIMARY KEY,  
  first_name   VARCHAR2(20),  
  ...);
```

1

- Example of a table-level constraint:

```
CREATE TABLE employees(  
  employee_id  NUMBER(6),  
  first_name   VARCHAR2(20),  
  ...  
  job_id       VARCHAR2(10) NOT NULL,  
  CONSTRAINT emp_emp_id_pk  
    PRIMARY KEY (EMPLOYEE_ID));
```

2

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Constraints are usually created at the same time as the table. Constraints can be added to a table after its creation and also be temporarily disabled.

Both examples in the slide create a primary key constraint on the `EMPLOYEE_ID` column of the `EMPLOYEES` table.

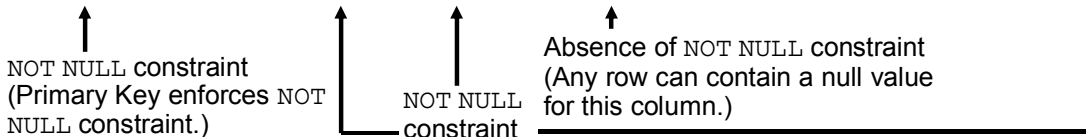
1. The first example uses the column-level syntax to define the constraint.
2. The second example uses the table-level syntax to define the constraint.

More details about the primary key constraint are provided later in this lesson.

NOT NULL Constraint

Ensures that null values are not permitted for the column:

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	SALARY	COMMISSION_PCT	DEPARTMENT_ID	EMAIL	PHONE_NUMBER	HIRE_DATE
100	Steven	King	24000	(null)	90	SKING	515.123.4567	17-JUN-87
101	Neena	Kochhar	17000	(null)	90	NKOCHHAR	515.123.4568	21-SEP-89
102	Lex	De Haan	17000	(null)	90	LDEHAAN	515.123.4569	13-JAN-93
103	Alexander	Hunold	9000	(null)	60	AHUNOLD	590.423.4567	03-JAN-90
104	Bruce	Ernst	6000	(null)	60	BERNST	590.423.4568	21-MAY-91
107	Diana	Lorentz	4200	(null)	60	DLORENTZ	590.423.5567	07-FEB-99
124	Kevin	Mourgos	5800	(null)	50	KMOURGOS	650.123.5234	16-NOV-99
141	Trenna	Rajs	3500	(null)	50	TRAJS	650.121.8009	17-OCT-95
142	Curtis	Davies	3100	(null)	50	CDAVIES	650.121.2994	29-JAN-97
143	Randall	Matos	2600	(null)	50	RMATOS	650.121.2874	15-MAR-98
144	Peter	Vargas	2500	(null)	50	PVARGAS	650.121.2004	09-JUL-98
149	Eleni	Zlotkey	10500	0.2	80	EZLOTKEY	011.44.1344.429018	29-JAN-00
174	Ellen	Abel	11000	0.3	80	EABEL	011.44.1644.429267	11-MAY-96
176	Jonathon	Taylor	8600	0.2	80	JTAYLOR	011.44.1644.429265	24-MAR-98
178	Kimberely	Grant	7000	0.15	(null)	KGRANT	011.44.1644.429263	24-MAY-99
200	Jennifer	Whalen	4400	(null)	10	JWHALEN	515.123.4444	17-SEP-87
201	Michael	Hartstein	13000	(null)	20	MHARTSTE	515.123.5555	17-FEB-96
202	Pat	Fay	6000	(null)	20	PFAY	603.123.6666	17-AUG-97
205	Shelley	Higgins	12000	(null)	110	SHIGGINS	515.123.8080	07-JUN-94
206	William	Gietz	8300	(null)	110	WGIEZT	515.123.8181	07-JUN-94

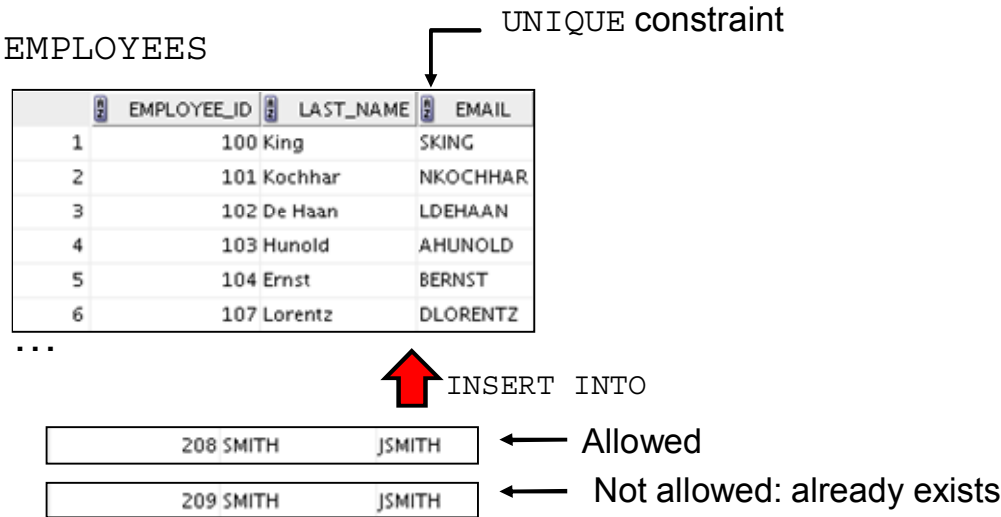


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The NOT NULL constraint ensures that the column contains no null values. Columns without the NOT NULL constraint can contain null values by default. NOT NULL constraints must be defined at the column level. In the EMPLOYEES table, the EMPLOYEE_ID column inherits a NOT NULL constraint because it is defined as a primary key. Otherwise, the LAST_NAME, EMAIL, HIRE_DATE, and JOB_ID columns have the NOT NULL constraint enforced on them.

UNIQUE Constraint



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A `UNIQUE` key integrity constraint requires that every value in a column or a set of columns (key) be unique—that is, no two rows of a table can have duplicate values in a specified column or a set of columns. The column (or set of columns) included in the definition of the `UNIQUE` key constraint is called the *unique key*. If the `UNIQUE` constraint comprises more than one column, that group of columns is called a *composite unique key*.

`UNIQUE` constraints enable the input of nulls unless you also define `NOT NULL` constraints for the same columns. In fact, any number of rows can include nulls for columns without the `NOT NULL` constraints because nulls are not considered equal to anything. A null in a column (or in all columns of a composite `UNIQUE` key) always satisfies a `UNIQUE` constraint.

Note: Because of the search mechanism for the `UNIQUE` constraints on more than one column, you cannot have identical values in the non-null columns of a partially null composite `UNIQUE` key constraint.

UNIQUE Constraint

Defined at either the table level or the column level:

```
CREATE TABLE employees (  
    employee_id      NUMBER(6),  
    last_name        VARCHAR2(25) NOT NULL,  
    email            VARCHAR2(25),  
    salary           NUMBER(8,2),  
    commission_pct   NUMBER(2,2),  
    hire_date        DATE NOT NULL,  
    ...  
    CONSTRAINT emp_email_uk UNIQUE(email));
```

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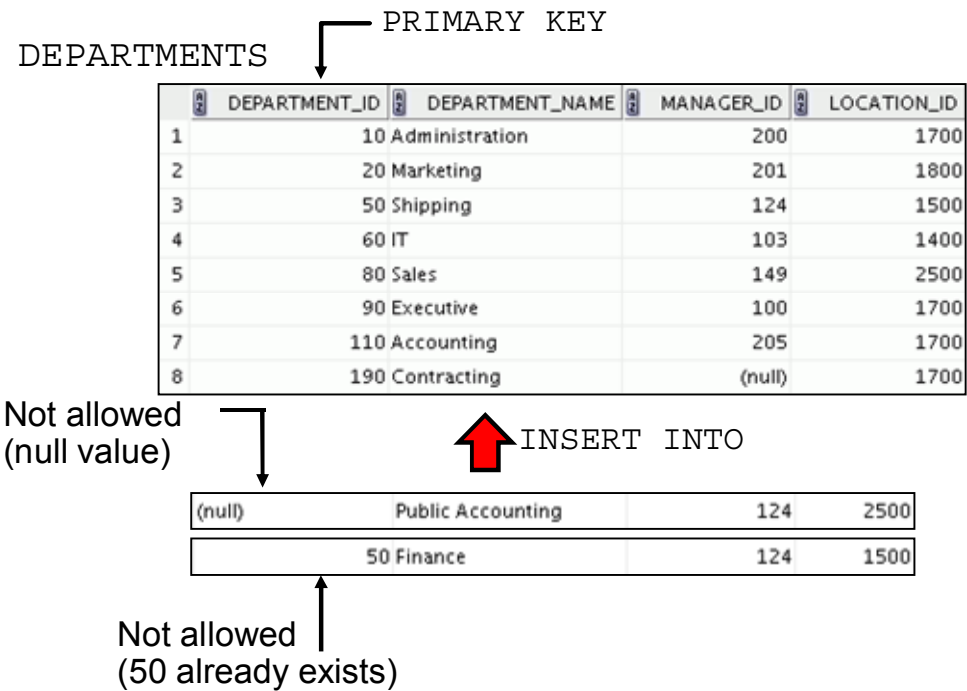
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UNIQUE constraints can be defined at the column level or table level. You define the constraint at the table level when you want to create a composite unique key. A composite key is defined when there is not a single attribute that can uniquely identify a row. In that case, you can have a unique key that is composed of two or more columns, the combined value of which is always unique and can identify rows.

The example in the slide applies the UNIQUE constraint to the EMAIL column of the EMPLOYEES table. The name of the constraint is EMP_EMAIL_UK.

Note: The Oracle server enforces the UNIQUE constraint by implicitly creating a unique index on the unique key column or columns.

PRIMARY KEY Constraint



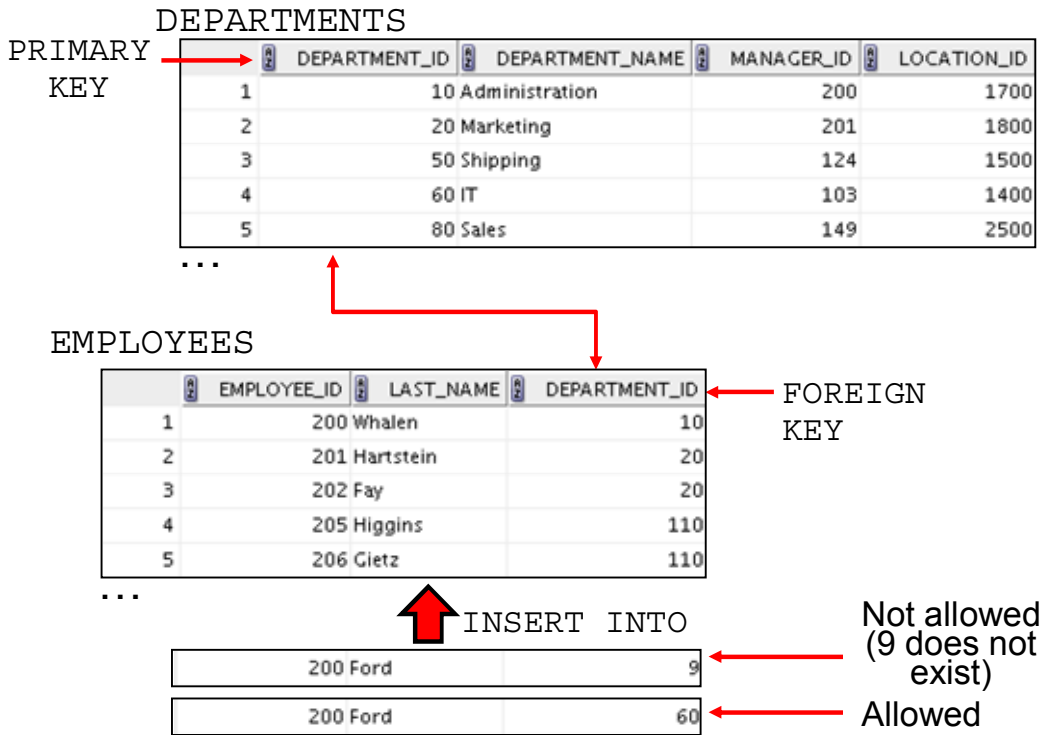
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A PRIMARY KEY constraint creates a primary key for the table. Only one primary key can be created for each table. The PRIMARY KEY constraint is a column or a set of columns that uniquely identifies each row in a table. This constraint enforces the uniqueness of the column or column combination, and ensures that no column that is part of the primary key can contain a null value.

Note: Because uniqueness is part of the primary key constraint definition, the Oracle server enforces the uniqueness by implicitly creating a unique index on the primary key column or columns.

FOREIGN KEY Constraint



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The `FOREIGN KEY` (or referential integrity) constraint designates a column or a combination of columns as a foreign key, and establishes a relationship with a primary key or a unique key in the same table or a different table.

In the example in the slide, `DEPARTMENT_ID` has been defined as the foreign key in the `EMPLOYEES` table (dependent or child table); it references the `DEPARTMENT_ID` column of the `DEPARTMENTS` table (the referenced or parent table).

Guidelines

- A foreign key value must match an existing value in the parent table or be NULL.
- Foreign keys are based on data values and are purely logical, rather than physical, pointers.

FOREIGN KEY Constraint

Defined at either the table level or the column level:

```
CREATE TABLE employees(  
    employee_id      NUMBER(6),  
    last_name        VARCHAR2(25) NOT NULL,  
    email            VARCHAR2(25),  
    salary           NUMBER(8,2),  
    commission_pct   NUMBER(2,2),  
    hire_date        DATE NOT NULL,  
    ...  
    department_id    NUMBER(4),  
    CONSTRAINT emp_dept_fk FOREIGN KEY (department_id)  
        REFERENCES departments(department_id),  
    CONSTRAINT emp_email_uk UNIQUE(email));
```

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FOREIGN KEY constraints can be defined at the column or table constraint level. A composite foreign key must be created by using the table-level definition.

The example in the slide defines a FOREIGN KEY constraint on the DEPARTMENT_ID column of the EMPLOYEES table, using table-level syntax. The name of the constraint is EMP_DEPT_FK.

The foreign key can also be defined at the column level, provided that the constraint is based on a single column. The syntax differs in that the keywords FOREIGN KEY do not appear.

Example:

```
CREATE TABLE employees  
(  
    ...  
    department_id NUMBER(4) CONSTRAINT emp_deptid_fk  
        REFERENCES departments(department_id),  
    ...  
)
```

FOREIGN KEY Constraint: Keywords

- **FOREIGN KEY:** Defines the column in the child table at the table-constraint level
- **REFERENCES:** Identifies the table and column in the parent table
- **ON DELETE CASCADE:** Deletes the dependent rows in the child table when a row in the parent table is deleted
- **ON DELETE SET NULL:** Converts dependent foreign key values to null

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The foreign key is defined in the child table and the table containing the referenced column is the parent table. The foreign key is defined using a combination of the following keywords:

- **FOREIGN KEY** is used to define the column in the child table at the table-constraint level.
- **REFERENCES** identifies the table and the column in the parent table.
- **ON DELETE CASCADE** indicates that when a row in the parent table is deleted, the dependent rows in the child table are also deleted.
- **ON DELETE SET NULL** indicates that when a row in the parent table is deleted, the foreign key values are set to null.

The default behavior is called the *restrict rule*, which disallows the update or deletion of referenced data.

Without the **ON DELETE CASCADE** or the **ON DELETE SET NULL** options, the row in the parent table cannot be deleted if it is referenced in the child table. And these keyword cannot be used in column-level syntax.

CHECK Constraint

- It defines a condition that each row must satisfy.
- It cannot reference columns from other tables.

```
..., salary  NUMBER(2)
      CONSTRAINT emp_salary_min
      CHECK (salary > 0),...
```

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The **CHECK** constraint defines a condition that each row must satisfy. To satisfy the constraint, each row in the table must make the condition either **TRUE** or unknown (due to a null).

The condition can use the same constructs as the query conditions except the queries that refer to other values in other rows.

A single column can have multiple **CHECK** constraints that refer to the column in its definition. There is no limit to the number of **CHECK** constraints that you can define on a column.

CHECK constraints can be defined at the column level or table level.

```
CREATE TABLE employees
(
  ...
  salary NUMBER(8,2) CONSTRAINT emp_salary_min
                        CHECK (salary > 0),
  ...
)
```

CREATE TABLE: Example

```
CREATE TABLE teach_emp (  
    empno      NUMBER(5) PRIMARY KEY,  
    ename      VARCHAR2(15) NOT NULL,  
    job        VARCHAR2(10),  
    mgr        NUMBER(5),  
    hiredate   DATE DEFAULT (sysdate),  
    photo      BLOB,  
    sal        NUMBER(7,2),  
    deptno     NUMBER(3) NOT NULL  
                CONSTRAINT admin_dept_fkey REFERENCES  
                departments(department_id));
```

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The example in the slide shows the statement that is used to create the TEACH_EMP table.

Violating Constraints

```
UPDATE employees
SET   department_id = 55
WHERE department_id = 110;
```

```
Error starting at line 1 in command:
UPDATE employees
SET   department_id = 55
WHERE department_id = 110
Error report:
SQL Error: ORA-02291: integrity constraint (ORA1.EMP_DEPT_FK) violated - parent key not found
02291. 00000 - "integrity constraint (%s.%s) violated - parent key not found"
*Cause:      A foreign key value has no matching primary key value.
*Action:     Delete the foreign key or add a matching primary key.
```

Department 55 does not exist.

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When you have constraints in place on columns, an error is returned if you try to violate the constraint rule. For example, if you try to update a record with a value that is tied to an integrity constraint, an error is returned.

In the example in the slide, department 55 does not exist in the parent table, DEPARTMENTS, and so you receive the “parent key not found” violation ORA-02291.

Violating Constraints

You cannot delete a row that contains a primary key that is used as a foreign key in another table.

```
DELETE FROM departments
WHERE department_id = 60;
```

```
Error starting at line 1 in command:
DELETE FROM departments
WHERE department_id = 60
```

Error report:

```
SQL Error: ORA-02292: integrity constraint (ORA1.JHIST_DEPT_FK) violated - child record found
02292. 00000 - "integrity constraint (%s.%s) violated - child record found"
```

```
*Cause:      attempted to delete a parent key value that had a foreign
              dependency.
```

```
*Action:     delete dependencies first then parent or disable constraint.
```

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If you attempt to delete a record with a value that is tied to an integrity constraint, an error is returned.

The example in the slide tries to delete department 60 from the `DEPARTMENTS` table, but it results in an error because that department number is used as a foreign key in the `EMPLOYEES` table. If the parent record that you attempt to delete has child records, you receive the “child record found” violation `ORA-02292`.

The following statement works because there are no employees in department 70:

```
DELETE FROM departments
WHERE department_id = 70;
```

```
1 rows deleted
```

Lesson Agenda

- Database objects
 - Naming rules
- Data types
- CREATE TABLE statement
- Overview of constraints: NOT NULL, UNIQUE, PRIMARY KEY, FOREIGN KEY, CHECK constraints
- **Creating a table using a subquery**
- ALTER TABLE statement
- DROP TABLE statement

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Creating a Table Using a Subquery

- Create a table and insert rows by combining the `CREATE TABLE` statement and the `AS subquery` option.

```
CREATE TABLE table
      [(column, column...)]
AS subquery;
```

- Match the number of specified columns to the number of subquery columns.
- Define columns with column names and default values.

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A second method for creating a table is to apply the `AS subquery` clause, which both creates the table and inserts rows returned from the subquery.

In the syntax:

<i>table</i>	Is the name of the table
<i>column</i>	Is the name of the column, default value, and integrity constraint
<i>subquery</i>	Is the <code>SELECT</code> statement that defines the set of rows to be inserted into the new table

Guidelines

- The table is created with the specified column names, and the rows retrieved by the `SELECT` statement are inserted into the table.
- The column definition can contain only the column name and default value.
- If column specifications are given, the number of columns must equal the number of columns in the subquery `SELECT` list.
- If no column specifications are given, the column names of the table are the same as the column names in the subquery.
- The column data type definitions and the `NOT NULL` constraint are passed to the new table. Note that only the explicit `NOT NULL` constraint will be inherited. The `PRIMARY KEY` column will not pass the `NOT NULL` feature to the new column. Any other constraint rules are not passed to the new table. However, you can add constraints in the column definition.

Creating a Table Using a Subquery

```
CREATE TABLE dept80
AS
  SELECT  employee_id, last_name,
          salary*12 ANNSAL,
          hire_date
  FROM    employees
  WHERE   department_id = 80;
```

table DEPT80 created.

```
DESCRIBE dept80
```

Name	Null	Type
-----	-----	-----
EMPLOYEE_ID		NUMBER(6)
LAST_NAME	NOT NULL	VARCHAR2(25)
ANNSAL		NUMBER
HIRE_DATE	NOT NULL	DATE

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The example in the slide creates a table named `DEPT80`, which contains details of all the employees working in department 80. Notice that the data for the `DEPT80` table comes from the `EMPLOYEES` table.

You can verify the existence of a database table and check the column definitions by using the `DESCRIBE` command.

However, be sure to provide a column alias when selecting an expression. The expression `SALARY*12` is given the alias `ANNSAL`. Without the alias, the following error is generated:

Error starting at line 1 in command:

```
CREATE TABLE dept80
AS
  SELECT  employee_id, last_name,
          salary*12,
          hire_date
  FROM    employees
  WHERE   department_id = 80
```

Error at Command Line:4 Column:18

Error report:

SQL Error: ORA-00998: must name this expression with a column alias
00998. 00000 - "must name this expression with a column alias"

*Cause:

*Action:

Lesson Agenda

- Database objects
 - Naming rules
- Data types
- CREATE TABLE statement
- Overview of constraints: NOT NULL, UNIQUE, PRIMARY KEY, FOREIGN KEY, CHECK constraints
- Creating a table using a subquery
- ALTER TABLE **statement**
- DROP TABLE statement

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ALTER TABLE Statement

Use the `ALTER TABLE` statement to:

- Add a new column
- Modify an existing column definition
- Define a default value for the new column
- Drop a column
- Rename a column
- Change table to read-only status

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After you create a table, you may need to change the table structure for any of the following reasons:

- You omitted a column.
- Your column definition or its name needs to be changed.
- You need to remove columns.
- You want to put the table into read-only mode

You can do this by using the `ALTER TABLE` statement.

ALTER TABLE Statement

Use the ALTER TABLE statement to add, modify, or drop columns:

```
ALTER TABLE table
ADD          (column datatype [DEFAULT expr]
              [, column datatype]...);
```

```
ALTER TABLE table
MODIFY       (column datatype [DEFAULT expr]
              [, column datatype]...);
```

```
ALTER TABLE table
DROP (column [, column] ...);
```

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You can add columns to a table, modify columns, and drop columns from a table by using the ALTER TABLE statement.

In the syntax:

<i>table</i>	Is the name of the table
ADD MODIFY DROP	Is the type of modification
<i>column</i>	Is the name of the column
<i>datatype</i>	Is the data type and length of the column
DEFAULT <i>expr</i>	Specifies the default value for a column

Adding a Column

- You use the ADD clause to add columns:

```
ALTER TABLE dept80  
ADD          (job_id VARCHAR2(9));
```

```
table DEPT80 altered.
```

- The new column becomes the last column:

	EMPLOYEE_ID	LAST_NAME	ANNSAL	HIRE_DATE	JOB_ID
1	149	Zlotkey	10500	29-JAN-08	(null)
2	174	Abe1	11000	11-MAY-04	(null)
3	176	Taylor	8600	24-MAR-06	(null)

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Guidelines for Adding a Column

- You can add or modify columns.
- You cannot specify where the column is to appear. The new column becomes the last column.

The example in the slide adds a column named `JOB_ID` to the `DEPT80` table. The `JOB_ID` column becomes the last column in the table.

Note: If a table already contains rows when a column is added, the new column is initially null or takes the default value for all the rows. You can add a mandatory `NOT NULL` column to a table that contains data in the other columns only if you specify a default value. You can add a `NOT NULL` column to an empty table without the default value.

Modifying a Column

- You can change a column's data type, size, and default value.

```
ALTER TABLE dept80  
MODIFY      (last_name VARCHAR2(30));
```

```
table DEPT80 altered.
```

- A change to the default value affects only subsequent insertions to the table.

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You can modify a column definition by using the `ALTER TABLE` statement with the `MODIFY` clause. Column modification can include changes to a column's data type, size, and default value.

Guidelines

- You can increase the width or precision of a numeric column.
- You can increase the width of character columns.
- You can decrease the width of a column if:
 - The column contains only null values
 - The table has no rows
 - The decrease in column width is not less than the existing values in that column
- You can change the data type if the column contains only null values. The exception to this is `CHAR`-to-`VARCHAR2` conversions, which can be done with data in the columns.
- You can convert a `CHAR` column to the `VARCHAR2` data type or convert a `VARCHAR2` column to the `CHAR` data type only if the column contains null values or if you do not change the size.
- A change to the default value of a column affects only subsequent insertions to the table.

Dropping a Column

Use the `DROP COLUMN` clause to drop columns that you no longer need from the table:

```
ALTER TABLE dept80
DROP (job_id);
```

```
table DEPT80 altered.
```

	EMPLOYEE_ID	LAST_NAME	ANNSAL	HIRE_DATE
1	149	Zlotkey	10500	29-JAN-08
2	174	Abel	11000	11-MAY-04
3	176	Taylor	8600	24-MAR-06

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You can drop a column from a table by using the `ALTER TABLE` statement with the `DROP COLUMN` clause.

Guidelines

- The column may or may not contain data.
- Using the `ALTER TABLE DROP COLUMN` statement, only one column can be dropped at a time.
- The table must have at least one column remaining in it after it is altered.
- After a column is dropped, it cannot be recovered.
- A primary key that is referenced by another column cannot be dropped, unless the cascade option is added.
- Dropping a column can take a while if the column has a large number of values. In this case, it may be better to set it to be unused and drop it when there are fewer users on the system to avoid extended locks.

Note: Certain columns can never be dropped, such as columns that form part of the partitioning key of a partitioned table or columns that form part of the `PRIMARY KEY` of an index-organized table. For more information about index-organized tables and partitioned tables, refer to *Oracle Database Concepts* and *Oracle Database Administrator's Guide*.

SET UNUSED Option

- You use the SET UNUSED option to mark one or more columns as unused.
- You use the DROP UNUSED COLUMNS option to remove the columns that are marked as unused.
- You can specify the ONLINE keyword to indicate that DML operations on the table will be allowed while marking the column or columns UNUSED.

```
ALTER TABLE <table_name>
SET UNUSED(<column_name> [ , <column_name>] );
OR
ALTER TABLE <table_name>
SET UNUSED COLUMN <column_name> [ , <column_name>];

ALTER TABLE <table_name>
DROP UNUSED COLUMNS;
```

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The SET UNUSED option marks one or more columns as unused so that they can be dropped when the demand on system resources is lower. Specifying this clause does not actually remove the target columns from each row in the table (that is, it does not restore the disk space used by these columns). Therefore, the response time is faster than if you executed the DROP clause. Unused columns are treated as if they were dropped, even though their column data remains in the table's rows. After a column has been marked as unused, you have no access to that column. A SELECT * query will not retrieve data from unused columns. In addition, the names and types of columns marked as unused will not be displayed during a DESCRIBE statement, and you can add to the table a new column with the same name as an unused column. The SET UNUSED information is stored in the USER_UNUSED_COL_TABS dictionary view.

You can specify the ONLINE keyword to indicate that DML operations on the table will be allowed while marking the column or columns UNUSED. The code example shows the use of SET UNUSED COLUMN that sets a column unused forever using the ONLINE keyword.

```
ALTER TABLE dept80 SET UNUSED(hire_date) ONLINE;
```

Note: The guidelines for setting a column to be UNUSED are similar to those for dropping a column.

DROP UNUSED COLUMNS Option

DROP UNUSED COLUMNS removes from the table all columns that are currently marked as unused. You can use this statement when you want to reclaim the extra disk space from the unused columns in the table. If the table contains no unused columns, the statement returns with no errors.

```
ALTER TABLE dept80  
SET UNUSED (last_name);
```

```
ALTER TABLE dept80  
DROP UNUSED COLUMNS;
```

Note: A subsequent DROP UNUSED COLUMNS will physically remove all unused columns from a table, similar to a DROP COLUMN.

Read-Only Tables

You can use the `ALTER TABLE` syntax to:

- Put a table in read-only mode, which prevents DDL or DML changes during table maintenance
- Put the table back into read/write mode

```
ALTER TABLE employees READ ONLY;

-- perform table maintenance and then
-- return table back to read/write mode

ALTER TABLE employees READ WRITE;
```

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You can specify `READ ONLY` to place a table in read-only mode. When the table is in `READ ONLY` mode, you cannot issue any DML statements that affect the table or any `SELECT . . . FOR UPDATE` statements. You can issue DDL statements as long as they do not modify any data in the table. Operations on indexes associated with the table are allowed when the table is in `READ ONLY` mode.

Specify `READ/WRITE` to return a read-only table to read/write mode.

Note: You can drop a table that is in `READ ONLY` mode. The `DROP` command is executed only in the data dictionary, so access to the table contents is not required. The space used by the table will not be reclaimed until the tablespace is made read/write again, and then the required changes can be made to the block segment headers, and so on.

For information about the `ALTER TABLE` statement, see the course titled *Oracle Database 12c: SQL Workshop II*.

Lesson Agenda

- Database objects
 - Naming rules
- Data types
- CREATE TABLE statement
- Overview of constraints: NOT NULL, UNIQUE, PRIMARY KEY, FOREIGN KEY, CHECK constraints
- Creating a table using a subquery
- ALTER TABLE statement
- DROP TABLE statement

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Dropping a Table

- Moves a table to the recycle bin
- Removes the table and all its data entirely if the `PURGE` clause is specified
- Invalidates dependent objects and removes object privileges on the table

```
DROP TABLE dept80;  
table DEPT80 dropped.
```

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The `DROP TABLE` statement moves a table to the recycle bin or removes the table and all its data from the database entirely. Unless you specify the `PURGE` clause, the `DROP TABLE` statement does not result in space being released back to the tablespace for use by other objects, and the space continues to count toward the user's space quota. Dropping a table invalidates the dependent objects and removes object privileges on the table.

When you drop a table, the database loses all the data in the table and all the indexes associated with it.

Syntax

```
DROP TABLE table [PURGE]
```

In the syntax, *table* is the name of the table.

Guidelines

- All data is deleted from the table.
- Any views and synonyms remain, but are invalid.
- Any pending transactions are committed.
- Only the creator of the table or a user with the `DROP ANY TABLE` privilege can remove a table.

Note: Use the `FLASHBACK TABLE` statement to restore a dropped table from the recycle bin. This is discussed in detail in the course titled *Oracle Database 12c: SQL Workshop II*.

Quiz

To do which three of the following can you use constraints?

- a. Enforce rules on the data in a table whenever a row is inserted, updated, or deleted.
- b. Prevent the dropping of a table.
- c. Prevent the creation of a table.
- d. Prevent the creation of data in a table.

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Answer: a, b, d

Summary

In this lesson, you should have learned how to use the `CREATE TABLE`, `ALTER TABLE`, and `DROP TABLE` statement to create a table, modify a table and columns, and include constraints.

- Categorize the main database objects
- Review the table structure
- List the data types that are available for columns
- Create a simple table
- Explain how constraints are created at the time of table creation
- Describe how schema objects work

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In this lesson, you should have learned how to do the following:

CREATE TABLE

- Use the `CREATE TABLE` statement to create a table and include constraints.
- Create a table based on another table by using a subquery.

DROP TABLE

- Remove rows and a table structure.
- When executed, this statement cannot be rolled back.

Practice 11: Overview

This practice covers the following topics:

- Creating new tables
- Creating a new table by using the `CREATE TABLE AS` syntax
- Verifying that tables exist
- Altering tables
- Adding columns
- Dropping columns
- Setting a table to read-only status
- Dropping tables

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You create new tables by using the `CREATE TABLE` statement and confirm that the new table was added to the database. You also learn to set the status of a table as `READ ONLY`, and then revert to `READ/WRITE`.

Note: For all DDL and DML statements, click the Run Script icon (or press F5) to execute the query in SQL Developer. Thus, you get to see the feedback messages on the Script Output tabbed page. For `SELECT` queries, continue to click the Execute Statement icon or press F9 to get the formatted output on the Results tabbed page.



Table Descriptions

Schema Description

Overall Description

The Oracle Database sample schemas portray a sample company that operates worldwide to fill orders for several different products. The company has three divisions:

- **Human Resources:** Tracks information about employees and facilities
- **Order Entry:** Tracks product inventories and sales through various channels
- **Sales History:** Tracks business statistics to facilitate business decisions

Each of these divisions is represented by a schema. In this course, you have access to the objects in all the schemas. However, the emphasis of the examples, demonstrations, and practices is on the `Human Resources` (HR) schema.

All scripts necessary to create the sample schemas reside in the `$ORACLE_HOME/demo/schema/` folder.

Human Resources (HR)

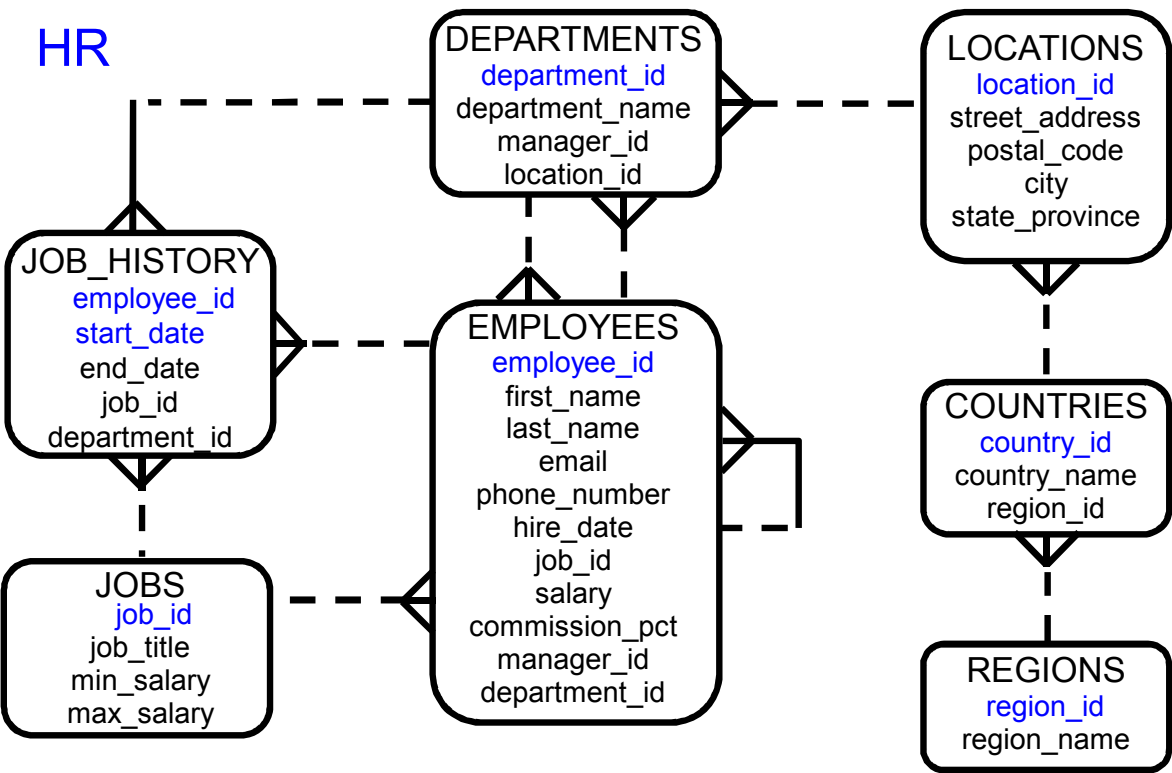
This is the schema that is used in this course. In the Human Resource (HR) records, each employee has an identification number, email address, job identification code, salary, and manager. Some employees earn commissions in addition to their salary.

The company also tracks information about the jobs within the organization. Each job has an identification code, job title, and a minimum and maximum salary range for the job. Some employees have been with the company for a long time and have held different positions within the company. When an employee resigns, the duration the employee was working for, the job identification number, and the department are recorded.

The sample company is regionally diverse, so it tracks the locations of its warehouses and departments. Each employee is assigned to a department, and each department is identified either by a unique department number or a short name. Each department is associated with one location, and each location has a full address that includes the street name, postal code, city, state or province, and the country code.

In places where the departments and warehouses are located, the company records details such as the country name, currency symbol, currency name, and the region where the country is located geographically.

HR Entity Relationship Diagram



Human Resources (HR) Table Descriptions

DESCRIBE countries

Name	Null	Type
COUNTRY_ID	NOT NULL	CHAR(2)
COUNTRY_NAME		VARCHAR2(40)
REGION_ID		NUMBER





SELECT * FROM countries

	 COUNTRY_ID	 COUNTRY_NAME	 REGION_ID
1	CA	Canada	2
2	DE	Germany	1
3	UK	United Kingdom	1
4	US	United States of America	2

DESCRIBE departments

Name	Null	Type
DEPARTMENT_ID	NOT NULL	NUMBER(4)
DEPARTMENT_NAME	NOT NULL	VARCHAR2(30)
MANAGER_ID		NUMBER(6)
LOCATION_ID		NUMBER(4)

SELECT * FROM departments

	 DEPARTMENT_ID	 DEPARTMENT_NAME	 MANAGER_ID	 LOCATION_ID
1	10	Administration	200	1700
2	20	Marketing	201	1800
3	50	Shipping	124	1500
4	60	IT	103	1400
5	80	Sales	149	2500
6	90	Executive	100	1700
7	110	Accounting	205	1700
8	190	Contracting	(null)	1700

DESCRIBE employees

Name	Null	Type
-----	-----	-----
EMPLOYEE_ID	NOT NULL	NUMBER(6)
FIRST_NAME		VARCHAR2(20)
LAST_NAME	NOT NULL	VARCHAR2(25)
EMAIL	NOT NULL	VARCHAR2(25)
PHONE_NUMBER		VARCHAR2(20)
HIRE_DATE	NOT NULL	DATE
JOB_ID	NOT NULL	VARCHAR2(10)
SALARY		NUMBER(8,2)
COMMISSION_PCT		NUMBER(2,2)
MANAGER_ID		NUMBER(6)
DEPARTMENT_ID		NUMBER(4)






SELECT * FROM employees

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	PHONE_NUMBER	HIRE_DATE	JOB_ID	SALARY	COMMISSION_PCT	MANAGER_ID	DEPARTMENT_ID
100	Steven	King	SKING	515.123.4567	17-JUN-03	AD_PRES	24000	(null)	(null)	90
101	Neena	Kochhar	NKOCHHAR	515.123.4568	21-SEP-05	AD_VP	17000	(null)	100	90
102	Lex	De Haan	LDEHAAN	515.123.4569	13-JAN-01	AD_VP	17000	(null)	100	90
103	Alexander	Hunold	AHUNOLD	590.423.4567	03-JAN-06	IT_PROG	9000	(null)	102	60
104	Bruce	Ernst	BERNST	590.423.4568	21-MAY-07	IT_PROG	6000	(null)	103	60
107	Diana	Lorentz	DLORENTZ	590.423.5567	07-FEB-07	IT_PROG	4200	(null)	103	60
124	Kevin	Mourgos	KMOURGOS	650.123.5234	16-NOV-07	ST_MAN	5800	(null)	100	50
141	Trenna	Rajs	TRAJS	650.121.8009	17-OCT-03	ST_CLERK	3500	(null)	124	50
142	Curtis	Davies	CDAVIES	650.121.2994	29-JAN-05	ST_CLERK	3100	(null)	124	50
143	Randall	Matos	RMATOS	650.121.2874	15-MAR-06	ST_CLERK	2600	(null)	124	50
144	Peter	Vargas	PVARGAS	650.121.2004	09-JUL-06	ST_CLERK	2500	(null)	124	50
149	Eleni	Zlotkey	EZLOTKEY	011.44.1344.429018	29-JAN-08	SA_MAN	10500	0.2	100	80
174	Ellen	Abel	EABEL	011.44.1644.429267	11-MAY-04	SA_REP	11000	0.3	149	80
176	Jonathon	Taylor	JTAYLOR	011.44.1644.429265	24-MAR-06	SA_REP	8600	0.2	149	80
178	Kimberely	Grant	KGRANT	011.44.1644.429263	24-MAY-07	SA_REP	7000	0.15	149	(null)
200	Jennifer	Whalen	JWHALEN	515.123.4444	17-SEP-03	AD_ASST	4400	(null)	101	10
201	Michael	Hartstein	MHARTSTE	515.123.5555	17-FEB-04	MK_MAN	13000	(null)	100	20
202	Pat	Fay	PFAY	603.123.6666	17-AUG-05	MK_REP	6000	(null)	201	20
205	Shelley	Higgins	SHIGGINS	515.123.8080	07-JUN-02	AC_MGR	12008	(null)	101	110
206	William	Gietz	WGIETZ	515.123.8181	07-JUN-02	AC_ACCOUNT	8300	(null)	205	110


```
DESCRIBE job_history
```

Name	Null	Type
-----	-----	-----
EMPLOYEE_ID	NOT NULL	NUMBER(6)
START_DATE	NOT NULL	DATE
END_DATE	NOT NULL	DATE
JOB_ID	NOT NULL	VARCHAR2(10)
DEPARTMENT_ID		NUMBER(4)





```
SELECT * FROM job_history
```

		EMPLOYEE_ID		START_DATE		END_DATE		JOB_ID		DEPARTMENT_ID
1		102		13-JAN-01		24-JUL-06		IT_PROG		60
2		101		21-SEP-97		27-OCT-01		AC_ACCOUNT		110
3		101		28-OCT-01		15-MAR-05		AC_MGR		110
4		201		17-FEB-04		19-DEC-07		MK_REP		20
5		114		24-MAR-06		31-DEC-07		ST_CLERK		50
6		122		01-JAN-07		31-DEC-07		ST_CLERK		50
7		200		17-SEP-95		17-JUN-01		AD_ASST		90
8		176		24-MAR-06		31-DEC-06		SA_REP		80
9		176		01-JAN-07		31-DEC-07		SA_MAN		80
10		200		01-JUL-02		31-DEC-06		AC_ACCOUNT		90

DESCRIBE jobs

Name	Null	Type
JOB_ID	NOT NULL	VARCHAR2(10)
JOB_TITLE	NOT NULL	VARCHAR2(35)
MIN_SALARY		NUMBER(6)
MAX_SALARY		NUMBER(6)







SELECT * FROM jobs

	 JOB_ID	 JOB_TITLE	 MIN_SALARY	 MAX_SALARY
1	AD_PRES	President	20080	40000
2	AD_VP	Administration Vice President	15000	30000
3	AD_ASST	Administration Assistant	3000	6000
4	AC_MGR	Accounting Manager	8200	16000
5	AC_ACCOUNT	Public Accountant	4200	9000
6	SA_MAN	Sales Manager	10000	20080
7	SA_REP	Sales Representative	6000	12008
8	ST_MAN	Stock Manager	5500	8500
9	ST_CLERK	Stock Clerk	2008	5000
10	IT_PROG	Programmer	4000	10000
11	MK_MAN	Marketing Manager	9000	15000
12	MK_REP	Marketing Representative	4000	9000

DESCRIBE locations

Name	Null	Type
-----	-----	-----
LOCATION_ID	NOT NULL	NUMBER(4)
STREET_ADDRESS		VARCHAR2(40)
POSTAL_CODE		VARCHAR2(12)
CITY	NOT NULL	VARCHAR2(30)
STATE_PROVINCE		VARCHAR2(25)
COUNTRY_ID		CHAR(2)

SELECT * FROM locations

	 LOCATION_ID	 STREET_ADDRESS	 POSTAL_CODE	 CITY	 STATE_PROVINCE	 COUNTRY_ID
1	1400	2014 Jabberwocky Rd	26192	Southlake	Texas	US
2	1500	2011 Interiors Blvd	99236	South San Francisco	California	US
3	1700	2004 Charade Rd	98199	Seattle	Washington	US
4	1800	460 Bloor St. W.	ON M5S 1X8	Toronto	Ontario	CA
5	2500	Magdalen Centre, The Oxford Science Park	OX9 9ZB	Oxford	Oxford	UK

DESCRIBE regions

Name	Null	Type
REGION_ID	NOT NULL	NUMBER
REGION_NAME		VARCHAR2(25)

SELECT * FROM regions

	REGION_ID	REGION_NAME
1	1	Europe
2	2	Americas
3	3	Asia
4	4	Middle East and Africa

Using SQL Developer

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Objectives

After completing this appendix, you should be able to:

- List the key features of Oracle SQL Developer
- Identify the menu items of Oracle SQL Developer
- Create a database connection
- Manage database objects
- Use SQL Worksheet
- Save and run SQL scripts
- Create and save reports
- Browse the Data Modeling options in SQL Developer

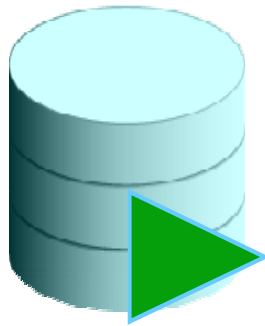
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In this appendix, you are introduced to the graphical tool called SQL Developer. You learn how to use SQL Developer for your database development tasks. You learn how to use SQL Worksheet to execute SQL statements and SQL scripts.

What Is Oracle SQL Developer?

- Oracle SQL Developer is a graphical tool that enhances productivity and simplifies database development tasks.
- You can connect to any target Oracle database schema by using standard Oracle database authentication.



SQL Developer

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Oracle SQL Developer is a free graphical tool designed to improve your productivity and simplify the development of everyday database tasks. With just a few clicks, you can easily create and debug stored procedures, test SQL statements, and view optimizer plans.

SQL Developer, which is the visual tool for database development, simplifies the following tasks:

- Browsing and managing database objects
- Executing SQL statements and scripts
- Editing and debugging PL/SQL statements
- Creating reports

You can connect to any target Oracle database schema by using standard Oracle database authentication. When connected, you can perform operations on objects in the database.

SQL Developer is the interface to administer the Oracle Application Express Listener. The new interface enables you to specify global settings and multiple database settings with different database connections for the Application Express Listener. SQL Developer provides the option to drag and drop objects by table or column name onto the worksheet. It provides improved DB Diff comparison options, `GRANT` statement support in the SQL editor, and DB Doc reporting. Additionally, SQL Developer includes support for Oracle Database 12c features.

Specifications of SQL Developer

- Is shipped along with Oracle Database 12c Release 1
- Is developed in Java
- Supports Windows, Linux, and Mac OS X platforms
- Enables default connectivity using the JDBC Thin driver
- Connects to Oracle Database version 9.2.0.1 and later

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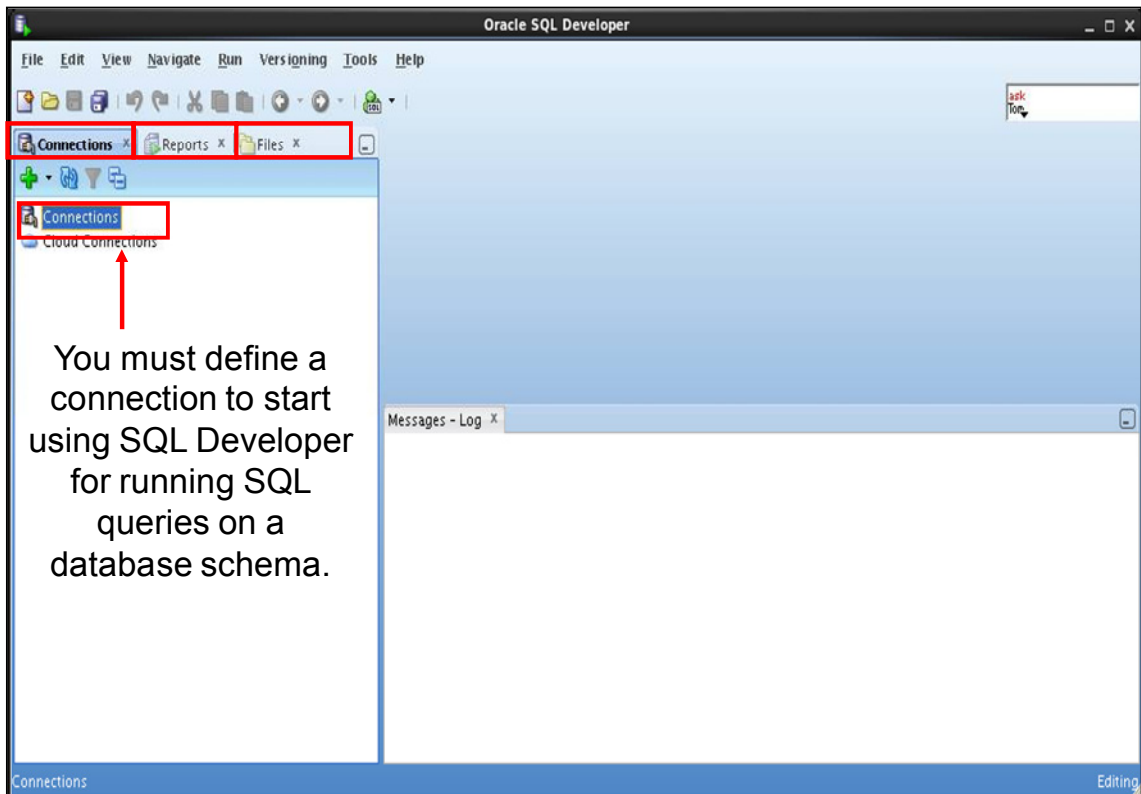
Oracle SQL Developer is shipped along with Oracle Database 12c Release 1 by default. SQL Developer is developed in Java, leveraging the Oracle JDeveloper integrated development environment (IDE). Therefore, it is a cross-platform tool. The tool runs on Windows, Linux, and Mac operating system (OS) X platforms.

The default connectivity to the database is through the Java Database Connectivity (JDBC) Thin driver, and therefore, no Oracle Home is required. SQL Developer does not require an installer and you need to simply unzip the downloaded file. With SQL Developer, users can connect to Oracle Databases 9.2.0.1 and later, and all Oracle database editions, including Express Edition.

Note: For Oracle Database 12c Release 1, you will have to download and install SQL Developer. SQL Developer is freely downloadable from the following link:
<http://www.oracle.com/technetwork/developer-tools/sql-developer/downloads/index.html>

For instructions on how to install SQL Developer, see the website at:
<http://www.oracle.com/technetwork/developer-tools/sql-developer/overview/index.html>

SQL Developer 3.2 Interface



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The SQL Developer interface contains three main navigation tabs, from left to right:

- **Connections:** By using this tab, you can browse database objects and users to which you have access.
- **Reports:** Identified by the Reports icon, this tab enables you to run predefined reports or create and add your own reports.
- **Files:** Identified by the Files folder icon, this tab enables you to access files from your local machine without having to use the File > Open menu.

General Navigation and Use

SQL Developer uses the left side for navigation to find and select objects, and the right side to display information about selected objects. You can customize many aspects of the appearance and behavior of SQL Developer by setting preferences.

Note: You need to define at least one connection to be able to connect to a database schema and issue SQL queries or run procedures and functions.

Menus

The following menus contain standard entries, plus entries for features that are specific to SQL Developer:

- **View:** Contains options that affect what is displayed in the SQL Developer interface
- **Navigate:** Contains options for navigating to panes and for executing subprograms
- **Run:** Contains the Run File and Execution Profile options that are relevant when a function or procedure is selected, and also debugging options
- **Versioning:** Provides integrated support for the following versioning and source control systems—Concurrent Versions System (CVS) and Subversion
- **Tools:** Invokes SQL Developer tools such as SQL*Plus, Preferences, and SQL Worksheet. It also contains options related to migrating third-party databases to Oracle.

Note: The Run menu also contains options that are relevant when a function or procedure is selected for debugging.

Creating a Database Connection

- You must have at least one database connection to use SQL Developer.
- You can create and test connections for:
 - Multiple databases
 - Multiple schemas
- SQL Developer automatically imports any connections defined in the `tnsnames.ora` file on your system.
- You can export connections to an Extensible Markup Language (XML) file.
- Each additional database connection created is listed in the Connections Navigator hierarchy.

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A connection is a SQL Developer object that specifies the necessary information for connecting to a specific database as a specific user of that database. To use SQL Developer, you must have at least one database connection, which may be existing, created, or imported.

You can create and test connections for multiple databases and for multiple schemas.

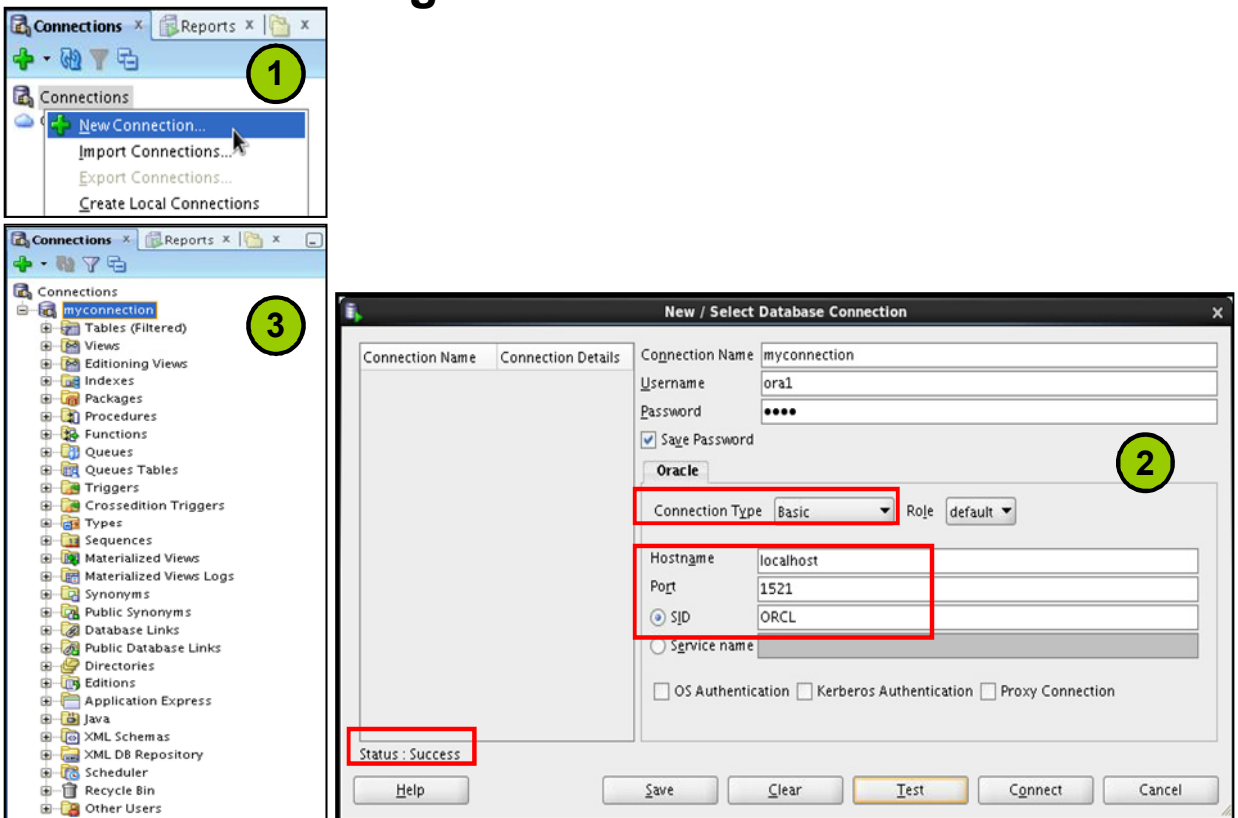
By default, the `tnsnames.ora` file is located in the `$ORACLE_HOME/network/admin` directory, but it can also be in the directory specified by the `TNS_ADMIN` environment variable or registry value. When you start SQL Developer and open the Database Connections dialog box, SQL Developer automatically imports any connections defined in the `tnsnames.ora` file on your system.

Note: On Windows, if the `tnsnames.ora` file exists, but its connections are not being used by SQL Developer, define `TNS_ADMIN` as a system environment variable.

You can export connections to an XML file so that you can reuse it.

You can create additional connections as different users to the same database or to connect to the different databases.

Creating a Database Connection



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To create a database connection, perform the following steps:

1. On the Connections tabbed page, right-click Connections and select New Connection.
2. In the New / Select Database Connection window, enter the connection name. Enter the username and password of the schema that you want to connect to.
 - a. From the Role drop-down list, you can select either *default* or *SYSDBA*. (You choose *SYSDBA* for the *sys* user or any user with database administrator privileges.)
 - b. You can select the connection type as:

Basic: In this type, enter host name and SID for the database that you want to connect to. Port is already set to 1521. You can also choose to enter the Service name directly if you use a remote database connection.

TNS: You can select any one of the database aliases imported from the `tnsnames.ora` file.

LDAP: You can look up database services in Oracle Internet Directory, which is a component of Oracle Identity Management.

Advanced: You can define a custom Java Database Connectivity (JDBC) URL to connect to the database.

Local/Bequeath: If the client and database exist on the same computer, a client connection can be passed directly to a dedicated server process without going through the listener.

- c. Click Test to ensure that the connection has been set correctly.
- d. Click Connect.

If you select the Save Password check box, the password is saved to an XML file. So, after you close the SQL Developer connection and open it again, you are not prompted for the password.

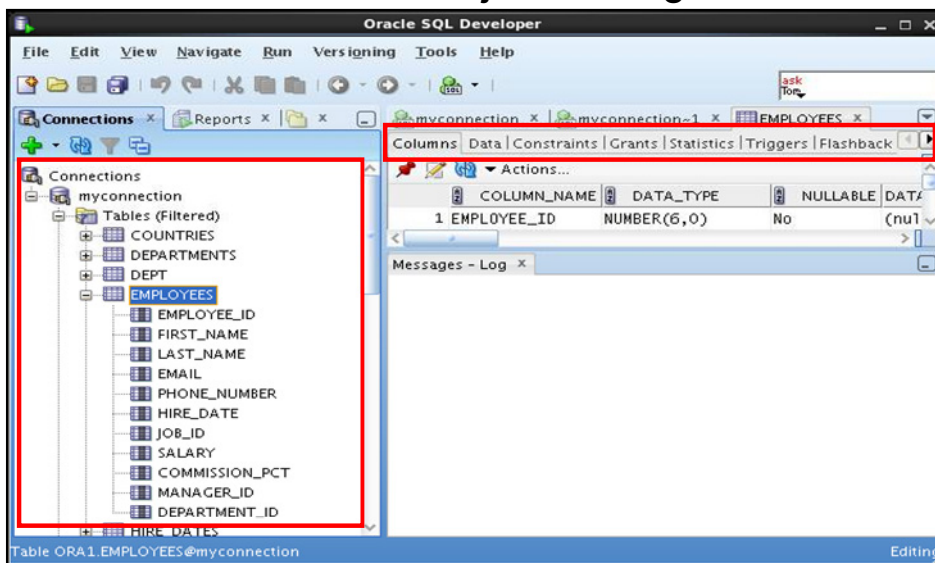
3. The connection gets added in the Connections Navigator. You can expand the connection to view the database objects and view object definitions (dependencies, details, statistics, and so on).

Note: From the same New/Select Database Connection window, you can define connections to non-Oracle data sources using the Access, MySQL, and SQL Server tabs. However, these connections are read-only connections that enable you to browse objects and data in that data source.

Browsing Database Objects

Use the Connections Navigator to to:

- Browse through many objects in a database schema
- Review the definitions of objects at a glance



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After you create a database connection, you can use the Connections Navigator to browse through many objects in a database schema, including Tables, Views, Indexes, Packages, Procedures, Triggers, and Types.

SQL Developer uses the left side for navigation to find and select objects, and the right side to display information about the selected objects. You can customize many aspects of the appearance of SQL Developer by setting preferences.

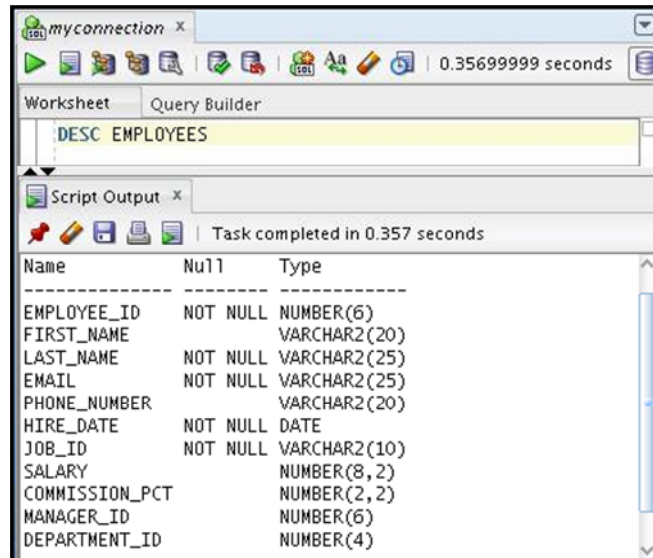
You can see the definition of the objects broken into tabs of information that is pulled out of the data dictionary. For example, if you select a table in the Navigator, details about columns, constraints, grants, statistics, triggers, and so on are displayed on an easy-to-read tabbed page.

If you want to see the definition of the `EMPLOYEES` table as shown in the slide, perform the following steps:

1. Expand the Connections node in the Connections Navigator.
2. Expand Tables.
3. Click `EMPLOYEES`. By default, the Columns tab is selected. It shows the column description of the table. Using the Data tab, you can view the table data and also enter new rows, update data, and commit these changes to the database.

Displaying the Table Structure

Use the `DESCRIBE` command to display the structure of a table:



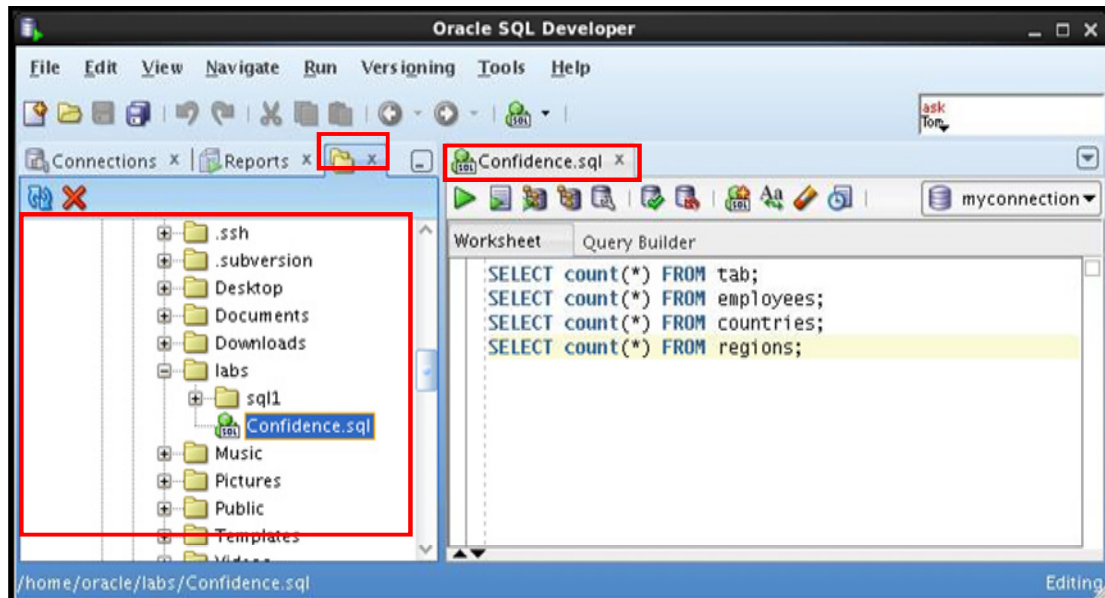
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In SQL Developer, you can also display the structure of a table using the `DESCRIBE` command. The result of the command is a display of column names and data types, as well as an indication of whether a column must contain data.

Browsing Files

Use the File Navigator to explore the file system and open system files.



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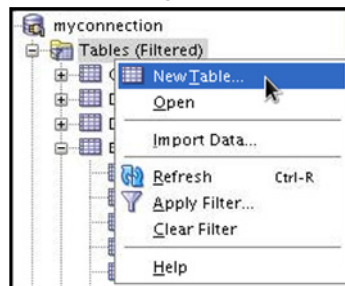
Browsing Database Objects

You can use the File Navigator to browse and open system files.

- To view the File Navigator, click the View tab and select Files, or select View > Files.
- To view the contents of a file, double-click a file name to display its contents in the SQL Worksheet area.

Creating a Schema Object

- SQL Developer supports the creation of any schema object by:
 - Executing a SQL statement in SQL Worksheet
 - Using the context menu
- Edit the objects by using an edit dialog box or one of the many context-sensitive menus.
- View the data definition language (DDL) for adjustments such as creating a new object or editing an existing schema object.



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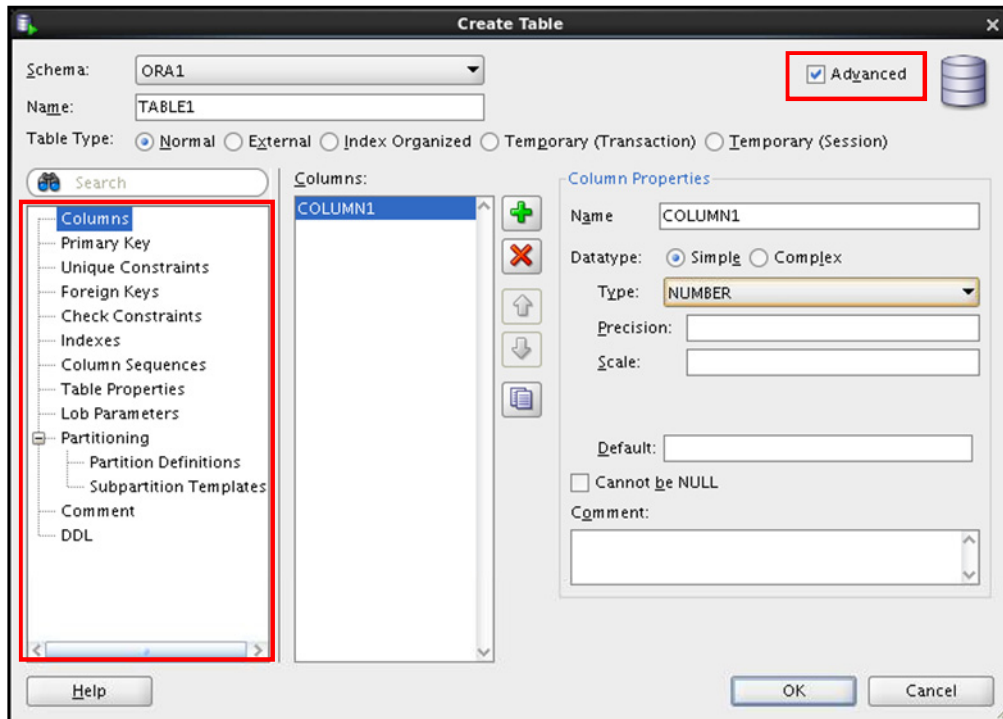
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SQL Developer supports the creation of any schema object by executing a SQL statement in SQL Worksheet. Alternatively, you can create objects by using the context menus. When created, you can edit objects using an edit dialog box or one of the many context-sensitive menus.

As new objects are created or existing objects are edited, the DDL for those adjustments is available for review. An Export DDL option is available if you want to create the full DDL for one or more objects in the schema.

The slide shows how to create a table using the context menu. To open a dialog box for creating a new table, right-click Tables and select New Table. The dialog boxes to create and edit database objects have multiple tabs, each reflecting a logical grouping of properties for that type of object.

Creating a New Table: Example



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In the Create Table dialog box, if you do not select the Advanced check box, you can create a table quickly by specifying columns and some frequently used features.

If you select the Advanced check box, the Create Table dialog box changes to one with multiple options, in which you can specify an extended set of features while you create the table.

The example in the slide shows how to create the `DEPENDENTS` table by selecting the Advanced check box.

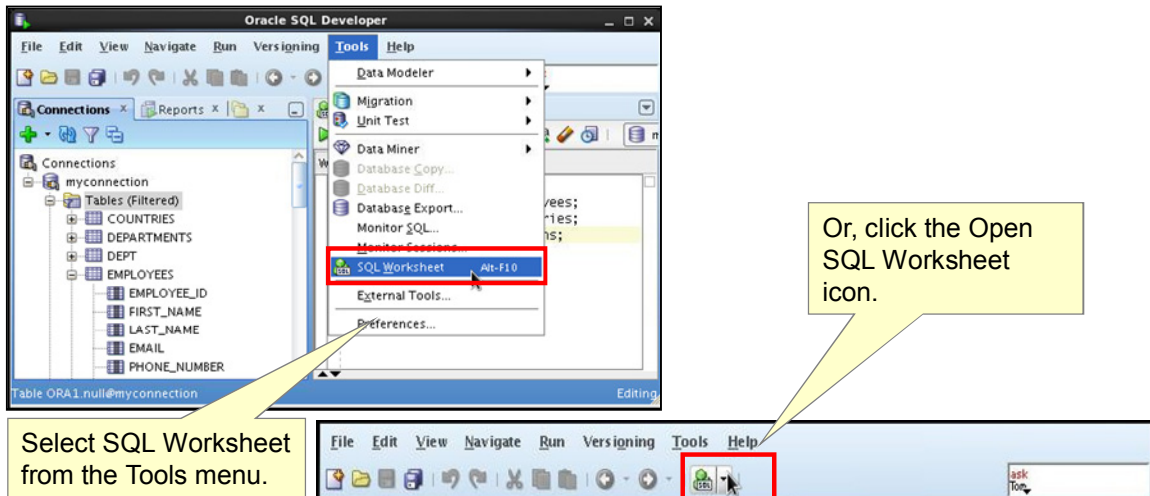
To create a new table, perform the following steps:

1. In the Connections Navigator, right-click Tables and select Create TABLE.
2. In the Create Table dialog box, select Advanced.
3. Specify the column information.
4. Click OK.

Although it is not required, you should also specify a primary key by using the Primary Key tab in the dialog box. Sometimes, you may want to edit the table that you have created; to do so, right-click the table in the Connections Navigator and select Edit.

Using the SQL Worksheet

- Use the SQL Worksheet to enter and execute SQL, PL/SQL, and SQL*Plus statements.
- Specify any actions that can be processed by the database connection associated with the worksheet.



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When you connect to a database, a SQL Worksheet window for that connection automatically opens. You can use the SQL Worksheet to enter and execute SQL, PL/SQL, and SQL*Plus statements. The SQL Worksheet supports SQL*Plus statements to a certain extent. SQL*Plus statements that are not supported by the SQL Worksheet are ignored and not passed to the database.

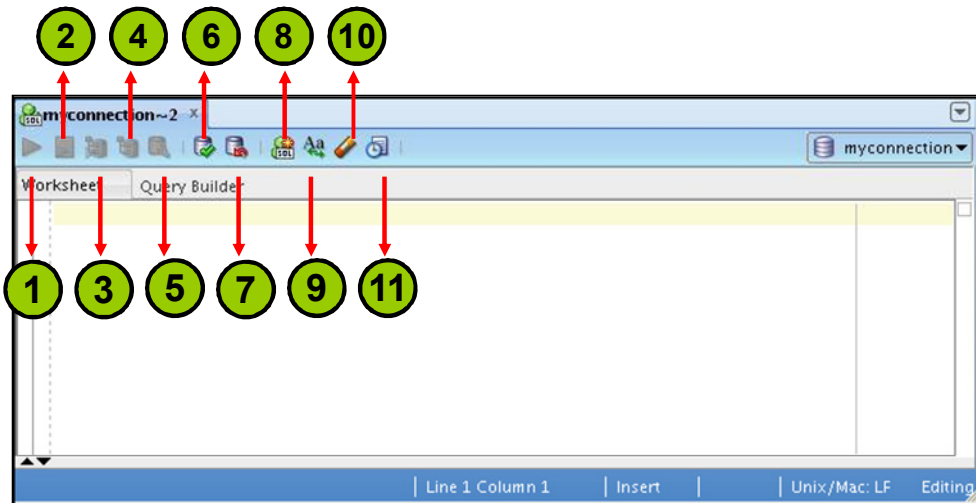
You can specify the actions that can be processed by the database connection associated with the worksheet, such as:

- Creating a table
- Inserting data
- Creating and editing a trigger
- Selecting data from a table
- Saving the selected data to a file

You can display a SQL Worksheet by using one of the following:

- Select Tools > SQL Worksheet.
- Click the Open SQL Worksheet icon.

Using the SQL Worksheet



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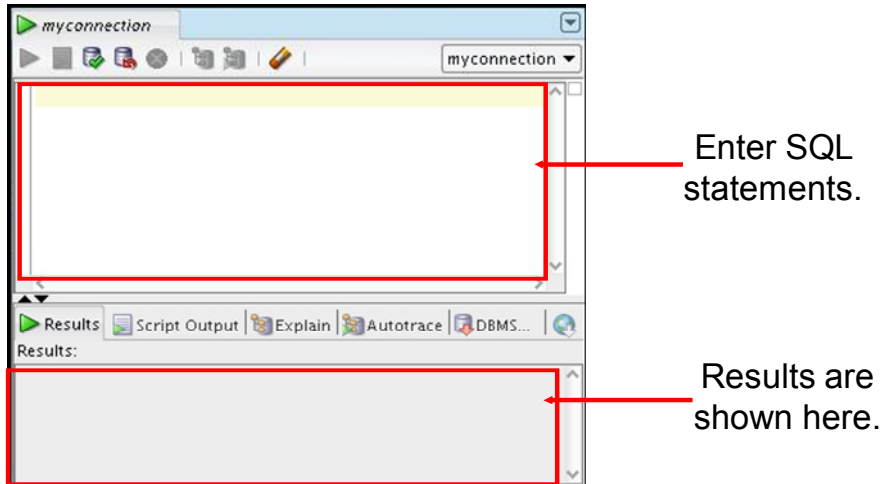
You may want to use the shortcut keys or icons to perform certain tasks such as executing a SQL statement, running a script, and viewing the history of the SQL statements that you have executed. You can use the SQL Worksheet toolbar that contains icons to perform the following tasks:

1. **Run Statement:** Executes the statement where the cursor is located in the Enter SQL Statement box. You can use bind variables in the SQL statements, but not substitution variables.
2. **Run Script:** Executes all the statements in the Enter SQL Statement box by using the Script Runner. You can use substitution variables in the SQL statements, but not bind variables.
3. **Autotrace:** Generates trace information for the statement
4. **Explain Plan:** Generates the execution plan, which you can see by clicking the Explain tab
5. **SQL Tuning Advisory:** Analyzes high-volume SQL statements and offers tuning recommendations
6. **Commit:** Writes any changes to the database and ends the transaction
7. **Rollback:** Discards any changes to the database, without writing them to the database, and ends the transaction

8. **Unshared SQL Worksheet:** Creates a separate unshared SQL Worksheet for a connection
9. **To Upper/Lower/InitCap:** Changes the selected text to uppercase, lowercase, or initcap, respectively
10. **Clear:** Erases the statement or statements in the Enter SQL Statement box
11. **SQL History:** Displays a dialog box with information about the SQL statements that you have executed

Using the SQL Worksheet

- Use the SQL Worksheet to enter and execute SQL, PL/SQL, and SQL*Plus statements.
- Specify any actions that can be processed by the database connection associated with the worksheet.



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When you connect to a database, a SQL Worksheet window for that connection automatically opens. You can use the SQL Worksheet to enter and execute SQL, PL/SQL, and SQL*Plus statements. All SQL and PL/SQL commands are supported as they are passed directly from the SQL Worksheet to the Oracle database. The SQL*Plus commands that are used in SQL Developer must be interpreted by the SQL Worksheet before being passed to the database. The SQL Worksheet currently supports a number of SQL*Plus commands. Commands that are not supported by the SQL Worksheet are ignored and not sent to the Oracle database. Through the SQL Worksheet, you can execute the SQL statements and some of the SQL*Plus commands.

Executing SQL Statements

Use the Enter SQL Statement box to enter single or multiple SQL statements.

The screenshot shows the SQL Developer interface with the following components:

- Worksheet:** Contains the SQL statement `SELECT employee_id, last_name from employees;`. A red box highlights the 'Run' button (a green play icon) with an arrow pointing to it from a green circle labeled **F9**.
- Query Result:** A table showing the results of the query. It has columns `EMPLOYEE_ID` and `LAST_NAME`. The data is as follows:

	EMPLOYEE_ID	LAST_NAME
1	174	Abel
2	142	Davies
3	102	De Haan
4	104	Ernst
5	202	Fay

A green circle labeled **F9** points to the 'Query Result' tab.
- Script Output:** Shows the same data as the 'Query Result' tab but in a text format. A green circle labeled **F5** points to the 'Run' button in the 'Script Output' tab.

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The example in the slide shows the difference in output for the same query when the F9 key or Execute Statement is used versus the output when F5 or Run Script is used.

Saving SQL Scripts

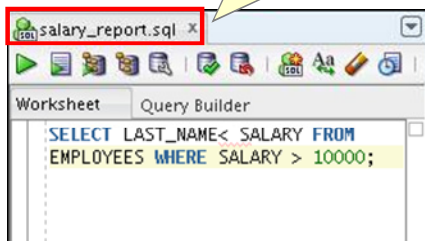
1

Click the Save icon to save your SQL statement to a file.



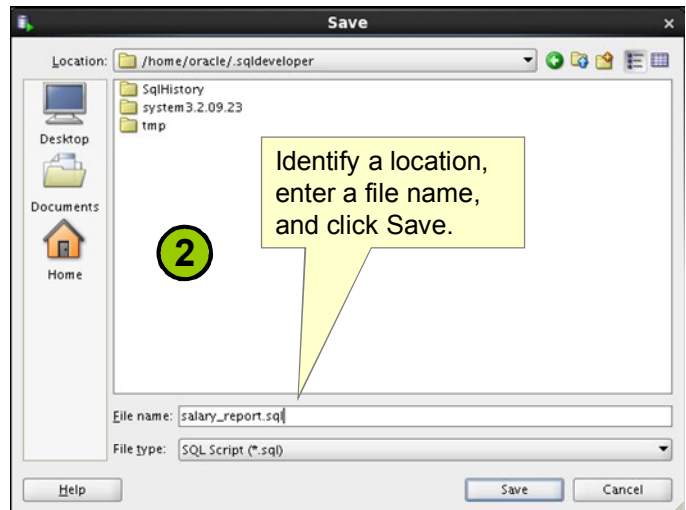
3

The contents of the saved file are visible and editable in your SQL Worksheet window.



2

Identify a location, enter a file name, and click Save.



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You can save your SQL statements from the SQL Worksheet to a text file. To save the contents of the Enter SQL Statement box, perform the following steps:

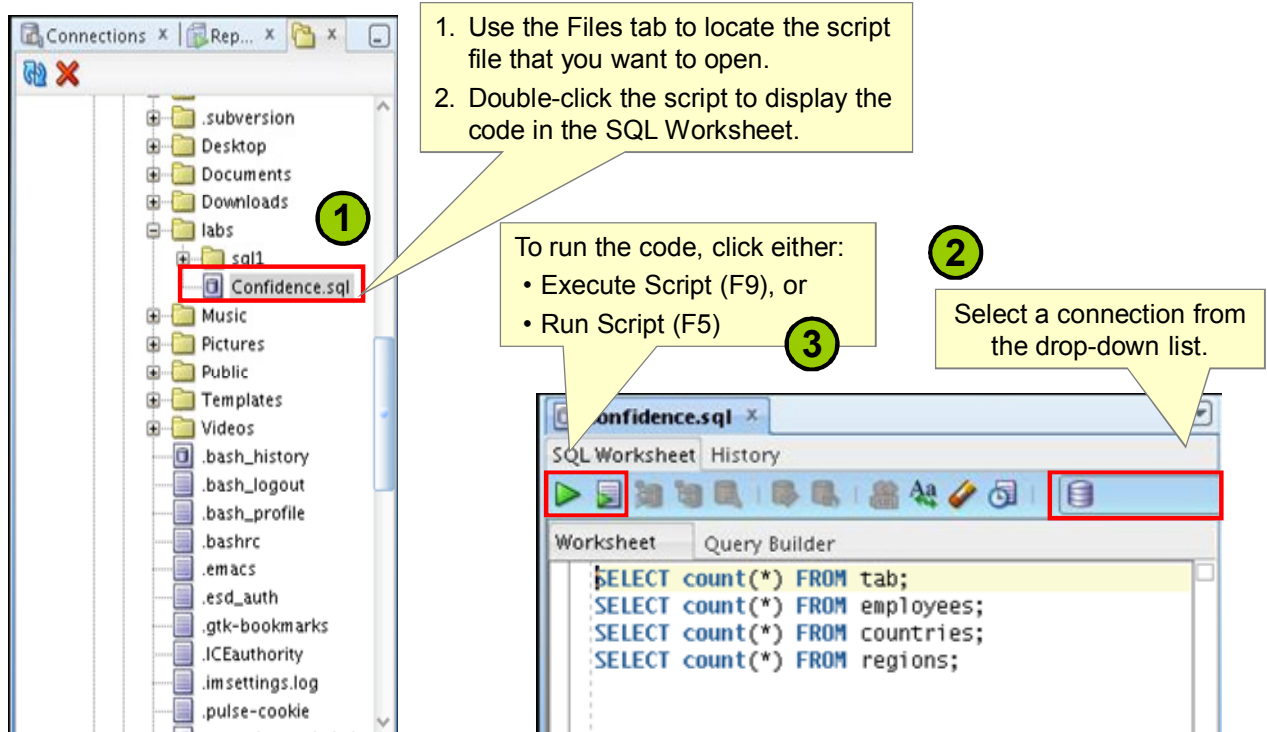
1. Click the Save icon or use the File > Save menu item.
2. In the Save dialog box, enter a file name and the location where you want the file saved.
3. Click Save.

After you save the contents to a file, the Enter SQL Statement window displays a tabbed page of your file contents. You can have multiple files open at the same time. Each file is displayed as a tabbed page.

Script Pathing

You can select a default path to look for scripts and to save scripts. Under Tools > Preferences > Database > Worksheet Parameters, enter a value in the "Select default path to look for scripts" field.

Executing Saved Script Files: Method 1



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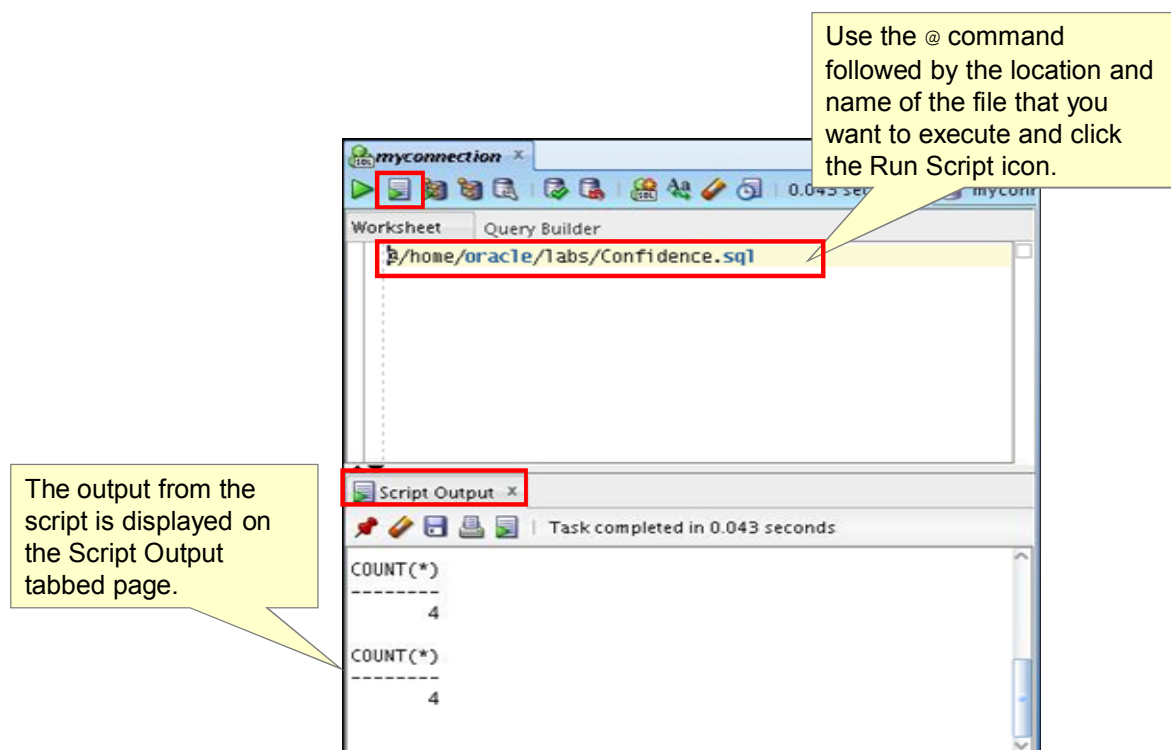
To open a script file and display the code in the SQL Worksheet area, perform the following steps:

1. In the files navigator, select (or navigate to) the script file that you want to open.
2. Double-click the file to open it. The code of the script file is displayed in the SQL Worksheet area.
3. Select a connection from the connection drop-down list.
4. To run the code, click the Run Script (F5) icon on the SQL Worksheet toolbar. If you have not selected a connection from the connection drop-down list, a connection dialog box will appear. Select the connection that you want to use for the script execution.

Alternatively, you can also do the following:

1. Select File > Open. The Open dialog box is displayed.
2. In the Open dialog box, select (or navigate to) the script file that you want to open.
3. Click Open. The code of the script file is displayed in the SQL Worksheet area.
4. Select a connection from the connection drop-down list.
5. To run the code, click the Run Script (F5) icon on the SQL Worksheet toolbar. If you have not selected a connection from the connection drop-down list, a connection dialog box will appear. Select the connection that you want to use for the script execution.

Executing Saved Script Files: Method 2



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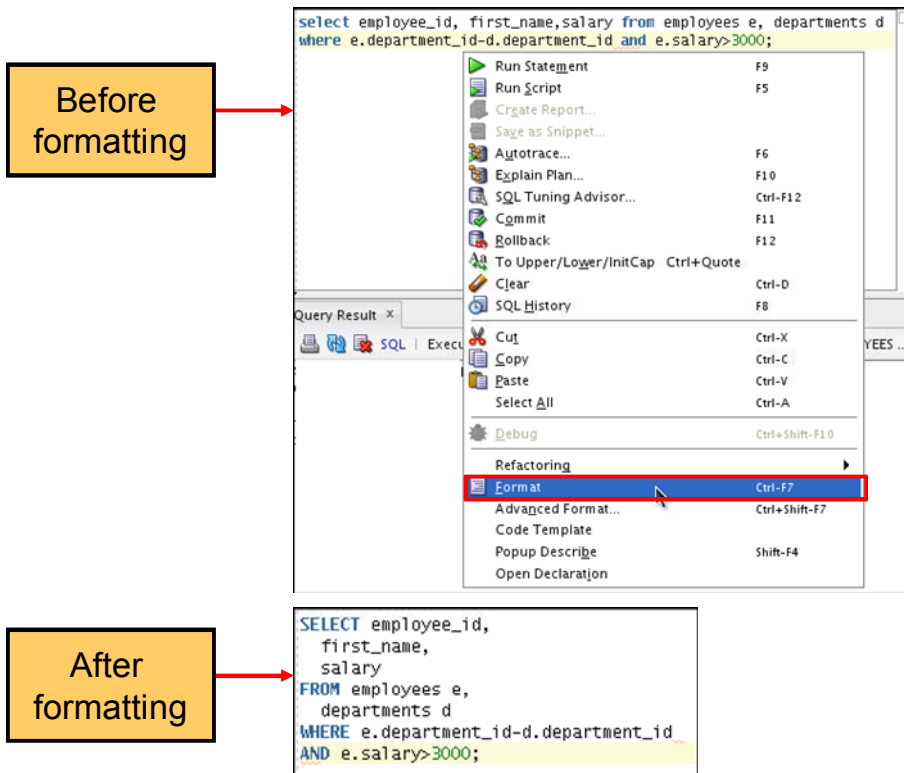
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To run a saved SQL script, perform the following steps:

1. Use the @ command followed by the location and the name of the file that you want to run in the Enter SQL Statement window.
2. Click the Run Script icon.

The results from running the file are displayed on the Script Output tabbed page. You can also save the script output by clicking the Save icon on the Script Output tabbed page. The File Save dialog box appears and you can identify a name and location for your file.

Formatting the SQL Code



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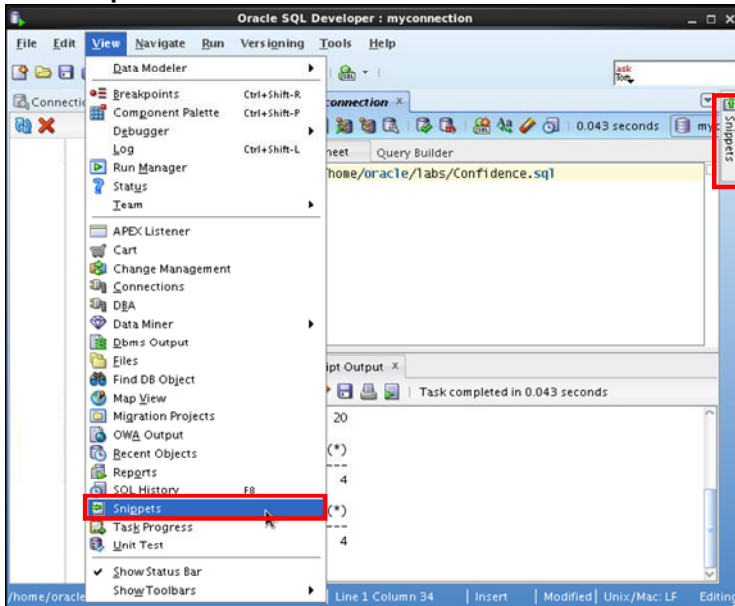
You may want to format the indentation, spacing, capitalization, and line separation of the SQL code. SQL Developer has a feature for formatting SQL code.

To format the SQL code, right-click in the statement area and select Format.

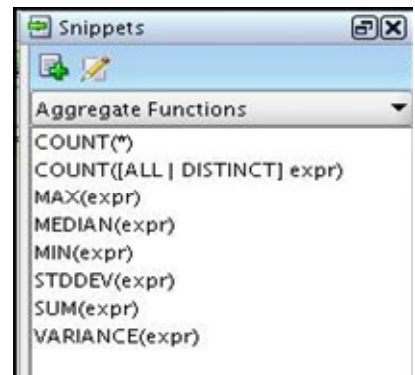
In the example in the slide, before formatting, the SQL code has the keywords not capitalized and the statement not properly indented. After formatting, the SQL code is beautified with the keywords capitalized and the statement properly indented.

Using Snippets

Snippets are code fragments that may be just syntax or examples.



When you place your cursor here, it shows the Snippets window. From the drop-down list, you can select the functions category that you want.



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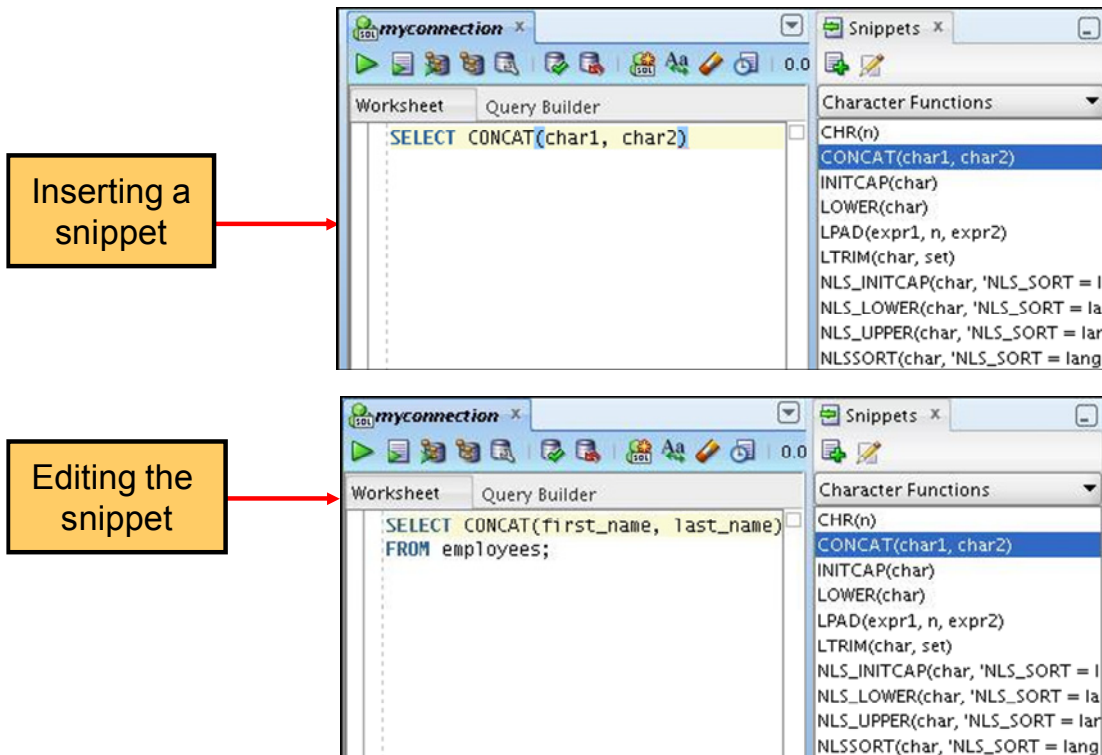
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You may want to use certain code fragments when you use the SQL Worksheet or create or edit a PL/SQL function or procedure. SQL Developer has a feature called Snippets. Snippets are code fragments such as SQL functions, optimizer hints, and miscellaneous PL/SQL programming techniques. You can drag snippets to the Editor window.

To display Snippets, select View > Snippets.

The Snippets window is displayed on the right. You can use the drop-down list to select a group. A Snippets button is placed in the right window margin, so that you can display the Snippets window if it becomes hidden.

Using Snippets: Example



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To insert a Snippet into your code in a SQL Worksheet or in a PL/SQL function or procedure, drag the snippet from the Snippets window to the desired place in your code. Then you can edit the syntax so that the SQL function is valid in the current context. To see a brief description of a SQL function in a tool tip, place the cursor over the function name.

The example in the slide shows that `CONCAT(char1, char2)` is dragged from the Character Functions group in the Snippets window. Then the `CONCAT` function syntax is edited and the rest of the statement is added as in the following:

```
SELECT CONCAT(first_name, last_name)
FROM employees;
```

Using the Recycle Bin

The recycle bin holds objects that have been dropped.

1. In the Connections navigator, select (or navigate to) the recycle bin.

2. Expand Recycle Bin and click the object name. The object details are displayed in the SQL Worksheet area.

3. Click the Actions drop-down list and select the operation that you want to perform on the object.

4. Select the operations from the drop-down Actions list.

Purge: Removes the object from the Recycle bin and deletes it

Flashback to Before Drop: Moves the object from the recycle bin back to its appropriate place in the Connections navigator display

Object Name	Original Name	Operation	Type	TS Name	Created Time	Drop Time	Drop SCN	Partition Name	Can Undo	Can Purge	Related	Base Object	Purge Object	Space
DEPTREE_TEMP	DEPTREE_TEMP	DROP	TABLE	USERS	2012-11-30:01:14:37	2012-11-30:01:17:57	3398921	(null)	YES	YES	94960	94960	94960	0

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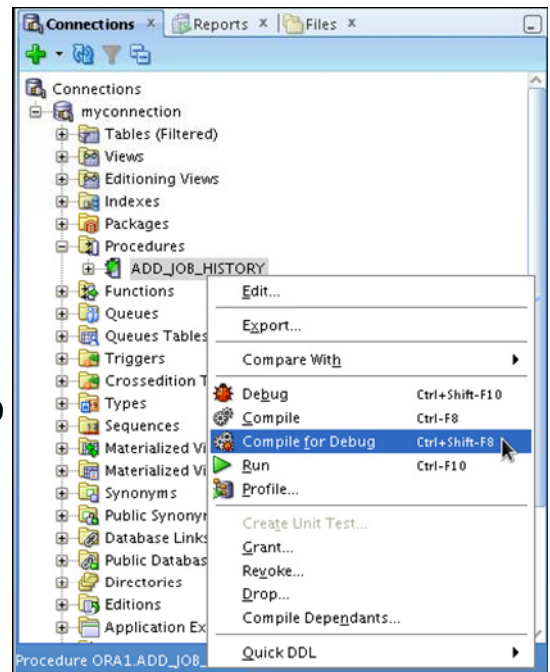
The recycle bin is a data dictionary table containing information about dropped objects. Dropped tables and any associated objects such as indexes, constraints, nested tables, and the likes are not removed and still occupy space. They continue to count against user space quotas, until specifically purged from the recycle bin or the unlikely situation where they must be purged by the database because of tablespace space constraints.

To use the recycle bin, perform the following steps:

1. In the Connections navigator, select (or navigate to) the recycle bin.
2. Expand Recycle Bin and click the object name. The object details are displayed in the SQL Worksheet area.
3. Click the Actions drop-down list and select the operation that you want to perform on the object.

Debugging Procedures and Functions

- Use SQL Developer to debug PL/SQL functions and procedures.
- Use the Compile for Debug option to perform a PL/SQL compilation so that the procedure can be debugged.
- Use the Debug menu options to set breakpoints, and to perform Step Into and Step Over tasks.



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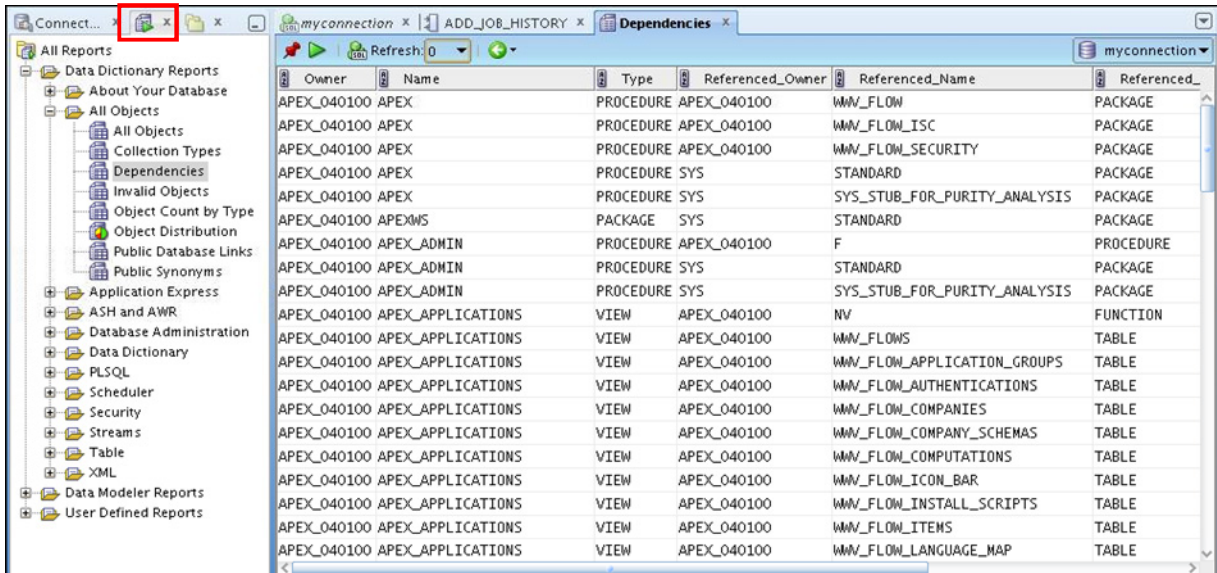
In SQL Developer, you can debug PL/SQL procedures and functions. Using the Debug menu options, you can perform the following debugging tasks:

- **Find Execution Point** goes to the next execution point.
- **Resume** continues execution.
- **Step Over** bypasses the next method and goes to the next statement after the method.
- **Step Into** goes to the first statement in the next method.
- **Step Out** leaves the current method and goes to the next statement.
- **Step to End of Method** goes to the last statement of the current method.
- **Pause** halts execution, but does not exit, thus allowing you to resume execution.
- **Terminate** halts and exits the execution. You cannot resume execution from this point; instead, to start running or debugging from the beginning of the function or procedure, click the Run or Debug icon on the Source tab toolbar.
- **Garbage Collection** removes invalid objects from the cache in favor of more frequently accessed and more valid objects.

These options are also available as icons on the Debugging tab of the output window.

Database Reporting

SQL Developer provides a number of predefined reports about the database and its objects.



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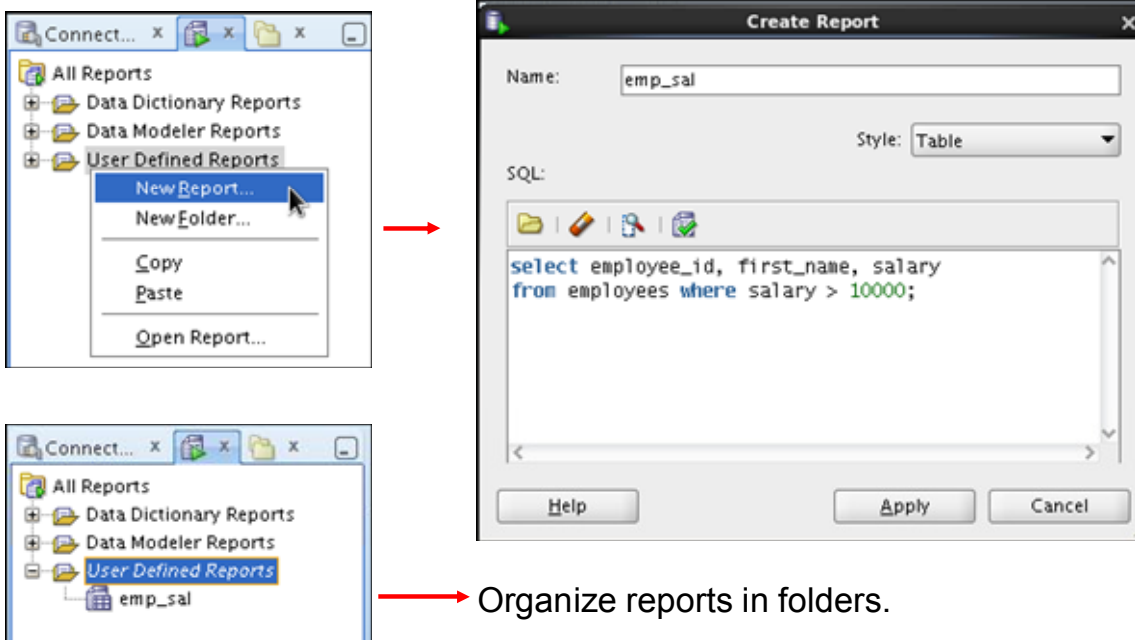
SQL Developer provides many reports about the database and its objects. These reports can be grouped into the following categories:

- About Your Database reports
- Database Administration reports
- Table reports
- PL/SQL reports
- Security reports
- XML reports
- Jobs reports
- Streams reports
- All Objects reports
- Data Dictionary reports
- User-Defined reports

To display reports, click the Reports tab on the left of the window. Individual reports are displayed in tabbed panes on the right of the window; for each report, you can select (using a drop-down list) the database connection for which to display the report. For reports about objects, the objects shown are only those visible to the database user associated with the selected database connection, and the rows are usually ordered by Owner. You can also create your own user-defined reports.

Creating a User-Defined Report

Create and save user-defined reports for repeated use.



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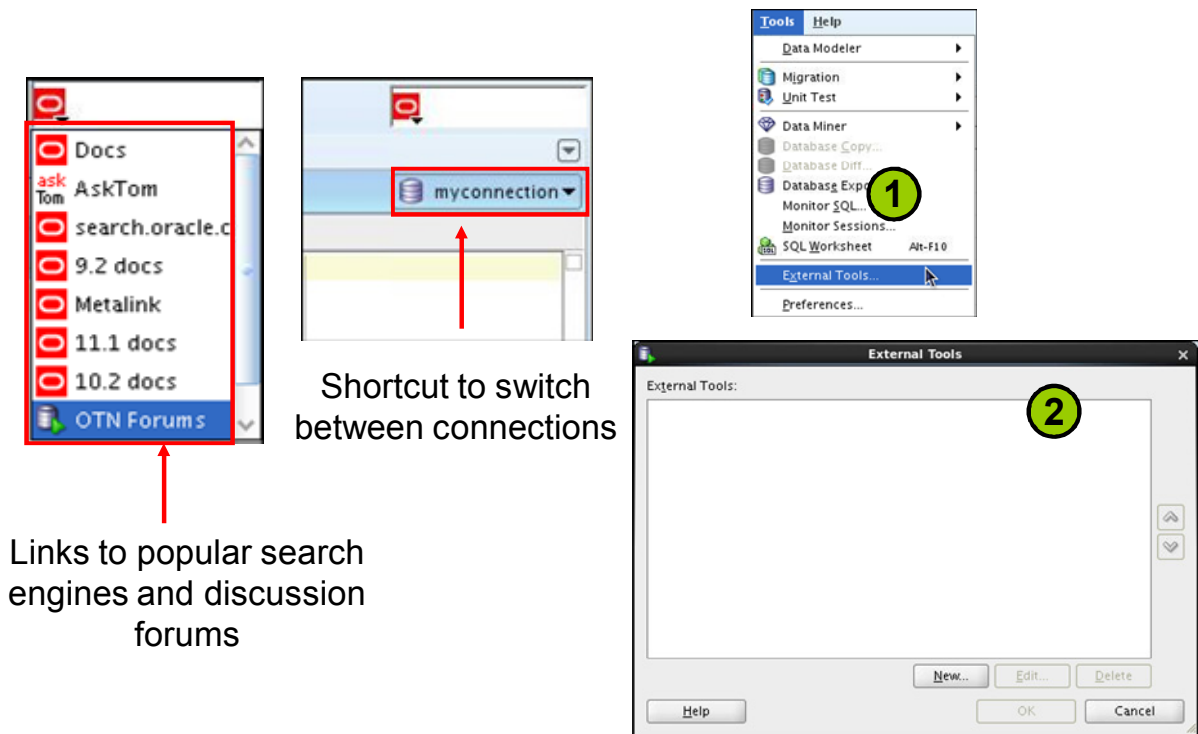
User-defined reports are reports created by SQL Developer users. To create a user-defined report, perform the following steps:

1. Right-click the User Defined Reports node under Reports and select Add Report.
2. In the Create Report dialog box, specify the report name and the SQL query to retrieve information for the report. Then click Apply.

In the example in the slide, the report name is specified as `emp_sal`. An optional description is provided indicating that the report contains details of employees with `salary >= 10000`. The complete SQL statement for retrieving the information to be displayed in the user-defined report is specified in the SQL box. You can also include an optional tool tip to be displayed when the cursor stays briefly over the report name in the Reports navigator display.

You can organize user-defined reports in folders and you can create a hierarchy of folders and subfolders. To create a folder for user-defined reports, right-click the User Defined Reports node or any folder name under that node and select Add Folder. Information about user-defined reports, including any folders for these reports, is stored in a file named `UserReports.xml` in the directory for user-specific information.

Search Engines and External Tools



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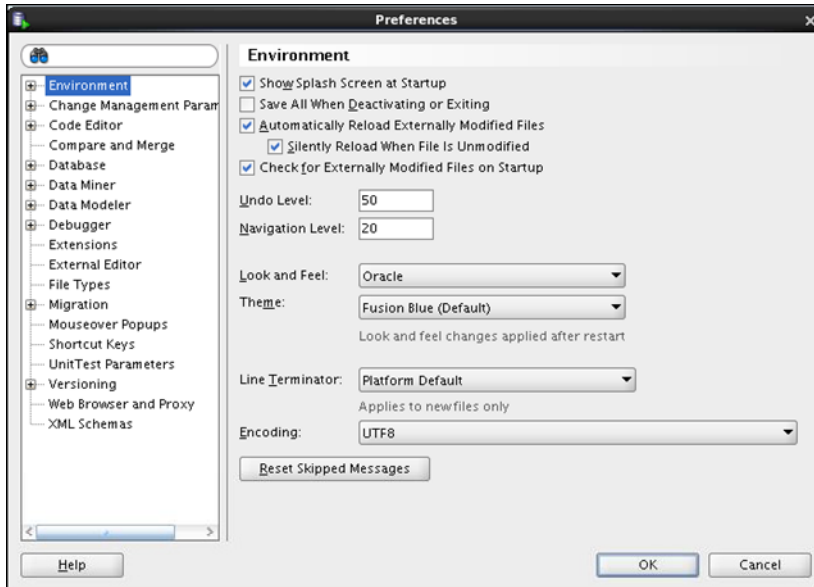
To enhance the productivity of developers, SQL Developer has added quick links to popular search engines and discussion forums such as AskTom, Google, and so on. Also, you have shortcut icons to some of the frequently used tools such as Notepad, Microsoft Word, and Dreamweaver, available to you.

You can add external tools to the existing list or even delete shortcuts to the tools that you do not use frequently. To do so, perform the following steps:

1. From the Tools menu, select External Tools.
2. In the External Tools dialog box, select New to add new tools. Select Delete to remove any tool from the list.

Setting Preferences

- Customize the SQL Developer interface and environment.
- In the Tools menu, select Preferences.



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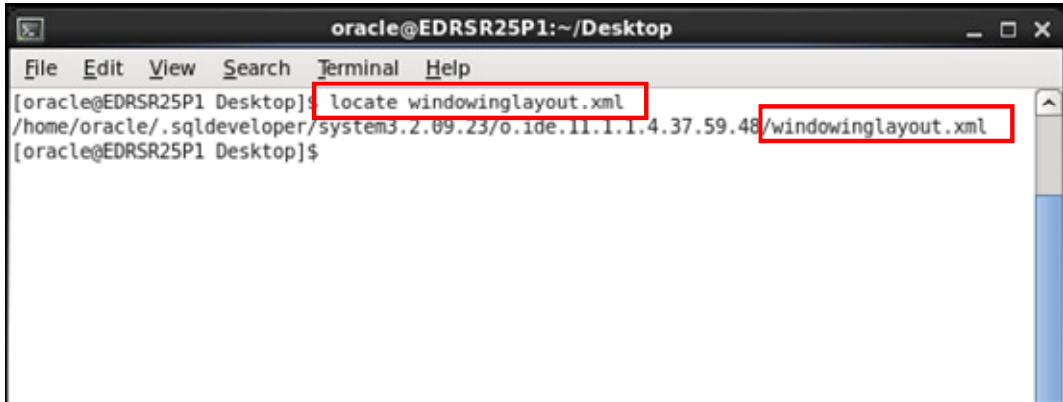
You can customize many aspects of the SQL Developer interface and environment by modifying SQL Developer preferences according to your needs. To modify SQL Developer preferences, select Tools, and then Preferences.

The preferences are grouped into the following categories:

- Environment
- Change Management Parameter
- Code Editors
- Compare and Merge
- Database
- Data Miner
- Data Modeler
- Debugger
- Extensions
- External Editor
- File Types
- Migration

- Mouseover Popups
- Shortcut Keys
- Unit Test Parameters
- Versioning
- Web Browser and Proxy
- XML Schemas

Resetting the SQL Developer Layout

A terminal window titled 'oracle@EDRSR25P1:~/Desktop' with a menu bar (File, Edit, View, Search, Terminal, Help). The command prompt shows the execution of 'locate windowinglayout.xml', which returns the path '/home/oracle/.sqldeveloper/system3.2.09.23/o.ide.11.1.1.4.37.59.48/windowinglayout.xml'. Both the command and the output path are highlighted with red boxes.

```
oracle@EDRSR25P1:~/Desktop
File Edit View Search Terminal Help
[oracle@EDRSR25P1 Desktop]$ locate windowinglayout.xml
/home/oracle/.sqldeveloper/system3.2.09.23/o.ide.11.1.1.4.37.59.48/windowinglayout.xml
[oracle@EDRSR25P1 Desktop]$
```

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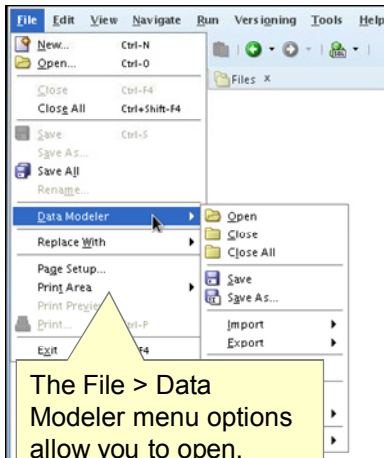
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While working with SQL Developer, if the Connections Navigator disappears or if you cannot dock the Log window in its original place, perform the following steps to fix the problem:

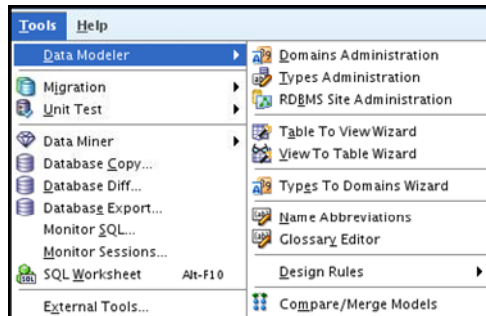
1. Exit SQL Developer.
2. Open a terminal window and use the locate command to find the location of `windowinglayout.xml`.
3. Go to the directory that has `windowinglayout.xml` and delete it.
4. Restart SQL Developer.

Data Modeler in SQL Developer

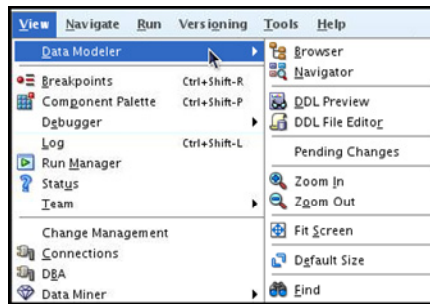
SQL Developer includes an integrated version of SQL Developer Data Modeler.



The File > Data Modeler menu options allow you to open, save, and print design models.



The Tools > Data Modeler menu options provide the administration and wizard options.



The View > Data Modeler menu options provide navigation and view options.

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Using the integrated version of the SQL Developer Data Modeler, you can:

- Create, open, import, and save a database design
- Create, modify, and delete Data Modeler objects

To display Data Modeler in a pane, click Tools, and then Data Modeler. The Data Modeler menu under Tools includes additional commands, for example, that enable you to specify design rules and preferences.

Summary

In this appendix, you should have learned how to use SQL Developer to do:

- Browse, create, and edit database objects
- Execute SQL statements and scripts in SQL Worksheet
- Create and save custom reports
- Browse the Data Modeling options in SQL Developer

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SQL Developer is a free graphical tool to simplify database development tasks. Using SQL Developer, you can browse, create, and edit database objects. You can use SQL Worksheet to run SQL statements and scripts. SQL Developer enables you to create and save your own special set of reports for repeated use.



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Objectives

After completing this appendix, you should be able to do the following:

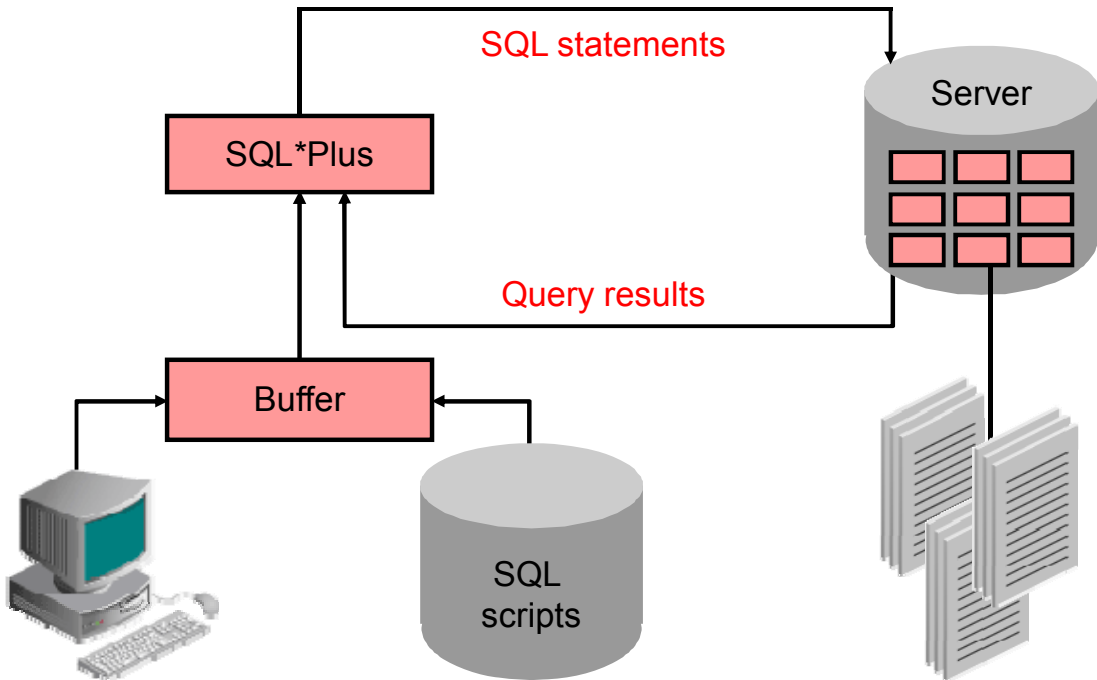
- Log in to SQL*Plus
- Edit SQL commands
- Format the output by using SQL*Plus commands
- Interact with script files

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You might want to create `SELECT` statements that can be used repeatedly. This appendix covers the use of SQL*Plus commands to execute SQL statements. You learn how to format output using SQL*Plus commands, edit SQL commands, and save scripts in SQL*Plus.

SQL and SQL*Plus Interaction



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SQL and SQL*Plus

SQL is a command language that is used for communication with the Oracle server from any tool or application. Oracle SQL contains many extensions. When you enter a SQL statement, it is stored in a part of the memory called the *SQL buffer* and remains there until you enter a new SQL statement. SQL*Plus is an Oracle tool that recognizes and submits SQL statements to the Oracle 9i Server for execution. It contains its own command language.

Features of SQL

- Can be used by a range of users, including those with little or no programming experience
- Is a nonprocedural language
- Reduces the amount of time required for creating and maintaining systems
- Is an English-like language

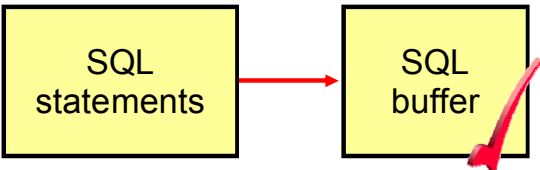
Features of SQL*Plus

- Accepts ad hoc entry of statements
- Accepts SQL input from files
- Provides a line editor for modifying SQL statements
- Controls environmental settings
- Formats query results into basic reports
- Accesses local and remote databases

SQL Statements Versus SQL*Plus Commands

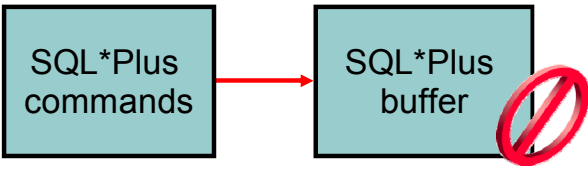
SQL

- A language
- ANSI-standard
- Keywords cannot be abbreviated.
- Statements manipulate data and table definitions in the database.



SQL*Plus

- An environment
- Oracle-proprietary
- Keywords can be abbreviated.
- Commands do not allow manipulation of values in the database.



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The following table compares SQL and SQL*Plus:

SQL	SQL*Plus
Is a language for communicating with the Oracle server to access data	Recognizes SQL statements and sends them to the server
Is based on American National Standards Institute (ANSI)–standard SQL	Is the Oracle-proprietary interface for executing SQL statements
Manipulates data and table definitions in the database	Does not allow manipulation of values in the database
Is entered into the SQL buffer on one or more lines	Is entered one line at a time, not stored in the SQL buffer
Does not have a continuation character	Uses a dash (–) as a continuation character if the command is longer than one line
Cannot be abbreviated	Can be abbreviated
Uses a termination character to execute commands immediately	Does not require termination characters; executes commands immediately
Uses functions to perform some formatting	Uses commands to format data

SQL*Plus: Overview

- Log in to SQL*Plus.
- Describe the table structure.
- Edit your SQL statement.
- Execute SQL from SQL*Plus.
- Save SQL statements to files and append SQL statements to files.
- Execute saved files.
- Load commands from the file to buffer to edit.

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SQL*Plus

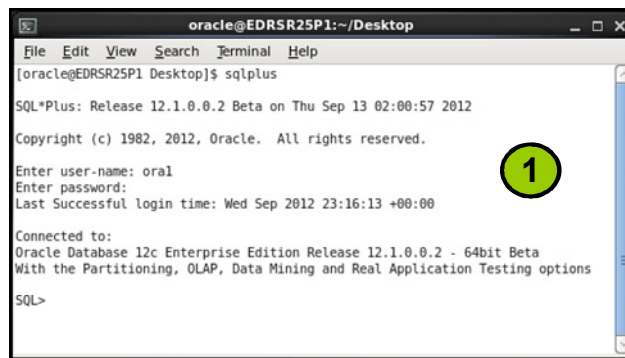
SQL*Plus is an environment in which you can:

- Execute SQL statements to retrieve, modify, add, and remove data from the database
- Format, perform calculations on, store, and print query results in the form of reports
- Create script files to store SQL statements for repeated use in the future

SQL*Plus commands can be divided into the following main categories:

Category	Purpose
Environment	Affect the general behavior of SQL statements for the session
Format	Format query results
File manipulation	Save, load, and run script files
Execution	Send SQL statements from the SQL buffer to the Oracle server
Edit	Modify SQL statements in the buffer
Interaction	Create and pass variables to SQL statements, print variable values, and print messages to the screen
Miscellaneous	Connect to the database, manipulate the SQL*Plus environment, and display column definitions

Logging In to SQL*Plus



```
oracle@EDRSR25P1:~/Desktop
File Edit View Search Terminal Help
[oracle@EDRSR25P1 Desktop]$ sqlplus

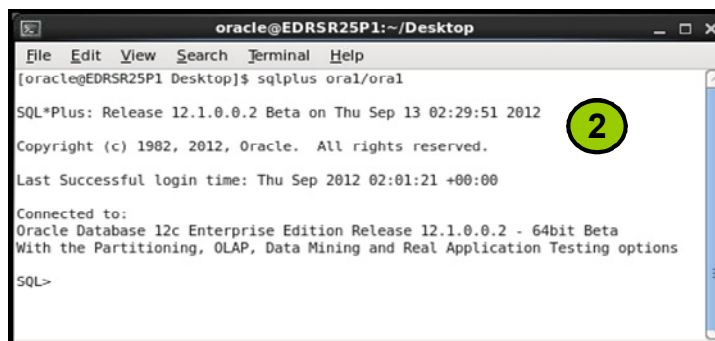
SQL*Plus: Release 12.1.0.0.2 Beta on Thu Sep 13 02:00:57 2012
Copyright (c) 1982, 2012, Oracle. All rights reserved.

Enter user-name: oral
Enter password:
Last Successful login time: Wed Sep 2012 23:16:13 +00:00

Connected to:
Oracle Database 12c Enterprise Edition Release 12.1.0.0.2 - 64bit Beta
With the Partitioning, OLAP, Data Mining and Real Application Testing options

SQL>
```

```
sqlplus [username[/password[@database]]]
```



```
oracle@EDRSR25P1:~/Desktop
File Edit View Search Terminal Help
[oracle@EDRSR25P1 Desktop]$ sqlplus oral/oral

SQL*Plus: Release 12.1.0.0.2 Beta on Thu Sep 13 02:29:51 2012
Copyright (c) 1982, 2012, Oracle. All rights reserved.

Last Successful login time: Thu Sep 2012 02:01:21 +00:00

Connected to:
Oracle Database 12c Enterprise Edition Release 12.1.0.0.2 - 64bit Beta
With the Partitioning, OLAP, Data Mining and Real Application Testing options

SQL>
```

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How you invoke SQL*Plus depends on the type of operating system that you are running Oracle Database on.

To log in from a Linux environment, perform the following steps:

1. Right-click your Linux desktop and select terminal.
2. Enter the `sqlplus` command shown in the slide.
3. Enter the username, password, and database name.

In the syntax:

<i>username</i>	Your database username
<i>password</i>	Your database password (Your password is visible if you enter it here.)
<i>@database</i>	The database connect string

Note: To ensure the integrity of your password, do not enter it at the operating system prompt. Instead, enter only your username. Enter your password at the password prompt.

Displaying the Table Structure

Use the SQL*Plus DESCRIBE command to display the structure of a table:

```
DESC[RIBE] tablename
```

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In SQL*Plus, you can display the structure of a table by using the DESCRIBE command. The result of the command is a display of column names and data types, as well as an indication if a column must contain data.

In the syntax:

tablename The name of any existing table, view, or synonym that is accessible to the user

To describe the DEPARTMENTS table, use the following command:

```
SQL> DESCRIBE DEPARTMENTS
Name                               Null    Type
-----
DEPARTMENT_ID                     NOT NULL NUMBER(4)
DEPARTMENT_NAME                   NOT NULL VARCHAR2(30)
MANAGER_ID                         NUMBER(6)
LOCATION_ID                         NUMBER(4)
```

Displaying the Table Structure

```
DESCRIBE departments
```

Name	Null	Type
-----	-----	-----
DEPARTMENT_ID	NOT NULL	NUMBER (4)
DEPARTMENT_NAME	NOT NULL	VARCHAR2 (30)
MANAGER_ID		NUMBER (6)
LOCATION_ID		NUMBER (4)

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The example in the slide displays information about the structure of the DEPARTMENTS table. In the result:

Null: Specifies whether a column must contain data (NOT NULL indicates that a column must contain data.)

Type: Displays the data type for a column

SQL*Plus Editing Commands

- A[PPEND] *text*
- C[HANGE] / *old* / *new*
- C[HANGE] / *text* /
- CL[EAR] BUFF[ER]
- DEL
- DEL *n*
- DEL *m n*

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SQL*Plus commands are entered one line at a time and are not stored in the SQL buffer.

Command	Description
A[PPEND] <i>text</i>	Adds text to the end of the current line
C[HANGE] / <i>old</i> / <i>new</i>	Changes <i>old</i> text to <i>new</i> in the current line
C[HANGE] / <i>text</i> /	Deletes <i>text</i> from the current line
CL[EAR] BUFF[ER]	Deletes all lines from the SQL buffer
DEL	Deletes current line
DEL <i>n</i>	Deletes line <i>n</i>
DEL <i>m n</i>	Deletes lines <i>m</i> to <i>n</i> inclusive

Guidelines

- If you press Enter before completing a command, SQL*Plus prompts you with a line number.
- You terminate the SQL buffer either by entering one of the terminator characters (semicolon or slash) or by pressing Enter twice. The SQL prompt appears.

SQL*Plus Editing Commands

- I [NPUT]
- I [NPUT] *text*
- L [IST]
- L [IST] *n*
- L [IST] *m n*
- R [UN]
- *n*
- *n text*
- 0 *text*

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Command	Description
I [NPUT]	Inserts an indefinite number of lines
I [NPUT] <i>text</i>	Inserts a line consisting of <i>text</i>
L [IST]	Lists all lines in the SQL buffer
L [IST] <i>n</i>	Lists one line (specified by <i>n</i>)
L [IST] <i>m n</i>	Lists a range of lines (<i>m</i> to <i>n</i>) inclusive
R [UN]	Displays and runs the current SQL statement in the buffer
<i>n</i>	Specifies the line to make the current line
<i>n text</i>	Replaces line <i>n</i> with <i>text</i>
0 <i>text</i>	Inserts a line before line 1

Note: You can enter only one SQL*Plus command for each SQL prompt. SQL*Plus commands are not stored in the buffer. To continue a SQL*Plus command on the next line, end the first line with a hyphen (-).

Using LIST, n, and APPEND

```
LIST
 1  SELECT last_name
2*  FROM    employees
```

```
1
 1*  SELECT last_name
```

```
A , job_id
 1*  SELECT last_name, job_id
```

```
LIST
 1  SELECT last_name, job_id
2*  FROM    employees
```

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- Use the `L[IST]` command to display the contents of the SQL buffer. The asterisk (*) beside line 2 in the buffer indicates that line 2 is the current line. Any edits that you made apply to the current line.
- Change the number of the current line by entering the number (n) of the line that you want to edit. The new current line is displayed.
- Use the `A[PPEND]` command to add text to the current line. The newly edited line is displayed. Verify the new contents of the buffer by using the `LIST` command.

Note: Many SQL*Plus commands, including `LIST` and `APPEND`, can be abbreviated to just their first letter. `LIST` can be abbreviated to `L`; `APPEND` can be abbreviated to `A`.

Using the CHANGE Command

```
LIST  
1* SELECT * from employees
```

```
c/employees/departments  
1* SELECT * from departments
```

```
LIST  
1* SELECT * from departments
```

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- Use `L[IST]` to display the contents of the buffer.
- Use the `C[HANGE]` command to alter the contents of the current line in the SQL buffer. In this case, replace the `employees` table with the `departments` table. The new current line is displayed.
- Use the `L[IST]` command to verify the new contents of the buffer.

SQL*Plus File Commands

- `SAVE filename`
- `GET filename`
- `START filename`
- `@ filename`
- `EDIT filename`
- `SPOOL filename`
- `EXIT`

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SQL statements communicate with the Oracle server. SQL*Plus commands control the environment, format query results, and manage files. You can use the commands described in the following table:

Command	Description
<code>SAV[E] filename [.ext]</code> <code>[REPL[ACE] APP[END]]</code>	Saves the current contents of the SQL buffer to a file. Use <code>APPEND</code> to add to an existing file; use <code>REPLACE</code> to overwrite an existing file. The default extension is <code>.sql</code> .
<code>GET filename [.ext]</code>	Writes the contents of a previously saved file to the SQL buffer. The default extension for the file name is <code>.sql</code> .
<code>STA[RT] filename [.ext]</code>	Runs a previously saved command file
<code>@ filename</code>	Runs a previously saved command file (same as <code>START</code>)
<code>ED[IT]</code>	Invokes the editor and saves the buffer contents to a file named <code>afiedt.buf</code>
<code>ED[IT] [filename [.ext]]</code>	Invokes the editor to edit the contents of a saved file
<code>SPO[OL] [filename [.ext]]</code> <code>OFF OUT]</code>	Stores query results in a file. <code>OFF</code> closes the spool file. <code>OUT</code> closes the spool file and sends the file results to the printer.
<code>EXIT</code>	Quits SQL*Plus

Using the SAVE and START Commands

```
LIST
1  SELECT last_name, manager_id, department_id
2* FROM employees
```

```
SAVE my_query
Created file my_query
```

```
START my_query

LAST_NAME                MANAGER_ID DEPARTMENT_ID
-----
King                      90
Kochhar                   100          90
...
107 rows selected.
```

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SAVE

Use the `SAVE` command to store the current contents of the buffer in a file. Thus, you can store frequently used scripts for use in the future.

START

Use the `START` command to run a script in SQL*Plus. You can also, alternatively, use the symbol `@` to run a script.

```
@my_query
```

SERVEROUTPUT Command

- Use the `SET SERVEROUT [PUT]` command to control whether to display the output of stored procedures or PL/SQL blocks in SQL*Plus.
- The `DBMS_OUTPUT` line length limit is increased from 255 bytes to 32767 bytes.
- The default size is now unlimited.
- Resources are not pre-allocated when `SERVEROUTPUT` is set.
- Because there is no performance penalty, use `UNLIMITED` unless you want to conserve physical memory.

```
SET SERVEROUT [PUT] {ON | OFF} [SIZE {n | UNL[IMITED] }]
[FOR [MAT] {WRA[PPED] | WOR[D_WRAPPED] | TRU[NCATED] }]
```

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Most of the PL/SQL programs perform input and output through SQL statements, to store data in database tables or query those tables. All other PL/SQL input/output is done through APIs that interact with other programs. For example, the `DBMS_OUTPUT` package has procedures, such as `PUT_LINE`. To see the result outside of PL/SQL requires another program, such as SQL*Plus, to read and display the data passed to `DBMS_OUTPUT`.

SQL*Plus does not display `DBMS_OUTPUT` data unless you first issue the SQL*Plus command `SET SERVEROUTPUT ON` as follows:

```
SET SERVEROUTPUT ON
```

Notes

- `SIZE` sets the number of bytes of the output that can be buffered within the Oracle Database server. The default is `UNLIMITED`. `n` cannot be less than 2000 or greater than 1,000,000.
- For additional information about `SERVEROUTPUT`, see *Oracle Database PL/SQL User's Guide and Reference 12c*.

Using the SQL*Plus SPOOL Command

```
SPO[OL] [file_name[.ext] [CRE[ATE] | REP[LACE] |  
APP[END]] | OFF | OUT]
```

Option	Description
file_name[.ext]	Spools output to the specified file name
CRE[ATE]	Creates a new file with the name specified
REP[LACE]	Replaces the contents of an existing file. If the file does not exist, REPLACE creates the file.
APP[END]	Adds the contents of the buffer to the end of the file that you specify
OFF	Stops spooling
OUT	Stops spooling and sends the file to your computer's standard (default) printer

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The SPOOL command stores query results in a file or optionally sends the file to a printer. The SPOOL command has been enhanced. You can now append to, or replace an existing file, where previously you could use SPOOL only to create (and replace) a file. REPLACE is the default.

To spool the output generated by commands in a script without displaying the output on screen, use SET TERMOUT OFF. SET TERMOUT OFF does not affect the output from commands that run interactively.

You must use quotation marks around file names that contain white space. To create a valid HTML file using SPOOL APPEND commands, you must use PROMPT or a similar command to create the HTML page header and footer. The SPOOL APPEND command does not parse HTML tags. SET SQLPLUSCOMPAT[IBILITY] to 9.2 or earlier to disable the CREATE, APPEND, and SAVE parameters.

Using the AUTOTRACE Command

- It displays a report after the successful execution of SQL DML statements such as SELECT, INSERT, UPDATE, or DELETE.
- The report can now include execution statistics and the query execution path.

```
SET AUTOT[RACE] {ON | OFF | TRACE[ONLY]} [EXP[LAIN]]  
[STAT[ISTICS]]
```

```
SET AUTOTRACE ON  
-- The AUTOTRACE report includes both the optimizer  
-- execution path and the SQL statement execution  
-- statistics
```

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EXPLAIN shows the query execution path by performing an EXPLAIN PLAN. STATISTICS displays SQL statement statistics. The formatting of your AUTOTRACE report may vary depending on the version of the server to which you are connected and the configuration of the server. The DBMS_XPLAN package provides an easy way to display the output of the EXPLAIN PLAN command in several predefined formats.

Notes

- For additional information about the package and subprograms, refer to *Oracle Database PL/SQL Packages and Types Reference 12c*.
- For additional information about the EXPLAIN PLAN, refer to *Oracle Database SQL Reference 12c*.
- For additional information about Execution Plans and the statistics, refer to *Oracle Database Performance Tuning Guide 12c*.

Summary

In this appendix, you should have learned how to use SQL*Plus as an environment to do the following:

- Execute SQL statements
- Edit SQL statements
- Format the output
- Interact with script files

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SQL*Plus is an execution environment that you can use to send SQL commands to the database server and to edit and save SQL commands. You can execute commands from the SQL prompt or from a script file.

Commonly Used SQL Commands

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Objectives

After completing this appendix, you should be able to:

- Execute a basic `SELECT` statement
- Create, alter, and drop a table using data definition language (DDL) statements
- Insert, update, and delete rows from one or more tables using data manipulation language (DML) statements
- Commit, roll back, and create savepoints by using transaction control statements
- Perform join operations on one or more tables

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This lesson explains how to obtain data from one or more tables using the `SELECT` statement, how to use DDL statements to alter the structure of data objects, how to manipulate data in the existing schema objects by using DML statements, how to manage the changes made by DML statements, and how to use joins to display data from multiple tables using SQL:1999 join syntax.

Basic SELECT Statement

- Use the SELECT statement to:
 - Identify the columns to be displayed
 - Retrieve data from one or more tables, object tables, views, object views, or materialized views
- A SELECT statement is also known as a query because it queries a database.
- Syntax:

```
SELECT { * | [DISTINCT] column | expression [alias], ... }  
FROM   table;
```

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In its simplest form, a SELECT statement must include the following:

- A SELECT clause, which specifies the columns to be displayed
- A FROM clause, which identifies the table containing the columns that are listed in the SELECT clause

In the syntax:

SELECT	Is a list of one or more columns
*	Selects all columns
DISTINCT	Suppresses duplicates
<i>column</i> / <i>expression</i>	Selects the named column or the expression
<i>alias</i>	Gives different headings to the selected columns
FROM <i>table</i>	Specifies the table containing the columns

Note: Throughout this course, the words *keyword*, *clause*, and *statement* are used as follows:

- A *keyword* refers to an individual SQL element—for example, SELECT and FROM are keywords.
- A *clause* is a part of a SQL statement (for example, SELECT employee_id, last_name).
- A *statement* is a combination of two or more clauses (for example, SELECT * FROM employees).

SELECT Statement

- Select all columns:

```
SELECT *  
FROM job_history;
```

	EMPLOYEE_ID	START_DATE	END_DATE	JOB_ID	DEPARTMENT_ID
1	102	13-JAN-01	24-JUL-06	IT_PROG	60
2	101	21-SEP-97	27-OCT-01	AC_ACCOUNT	110
3	101	28-OCT-01	15-MAR-05	AC_MGR	110
4	201	17-FEB-04	19-DEC-07	MK_REP	20
5	114	24-MAR-06	31-DEC-07	ST_CLERK	50
6	122	01-JAN-07	31-DEC-07	ST_CLERK	50
7	200	17-SEP-95	17-JUN-01	AD_ASST	90
8	176	24-MAR-06	31-DEC-06	SA_REP	80
9	176	01-JAN-07	31-DEC-07	SA_MAN	80
10	200	01-JUL-02	31-DEC-06	AC_ACCOUNT	90

- Select specific columns:

```
SELECT manager_id, job_id  
FROM employees;
```

	MANAGER_ID	JOB_ID
1	(null)	AD_PRES
2	100	AD_VP
3	100	AD_VP
4	102	IT_PROG
5	103	IT_PROG
6	103	IT_PROG
7	100	ST_MAN
8	124	ST_CLERK
9	124	ST_CLERK
10	124	ST_CLERK

...

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You can display all columns of data in a table by following the `SELECT` keyword with an asterisk (*) or by listing all the column names after the `SELECT` keyword. The first example in the slide displays all the rows from the `job_history` table. Specific columns of the table can be displayed by specifying the column names, separated by commas. The second example in the slide displays the `manager_id` and `job_id` columns from the `employees` table.

In the `SELECT` clause, specify the columns in the order in which you want them to appear in the output. For example, the following SQL statement displays the `location_id` column before displaying the `department_id` column:

```
SELECT location_id, department_id FROM departments;
```

Note: You can enter your SQL statement in a SQL Worksheet and click the Run Statement icon or press F9 to execute a statement in SQL Developer. The output displayed on the Results tabbed page appears as shown in the slide.

WHERE Clause

- Use the optional WHERE clause to:
 - Filter rows in a query
 - Produce a subset of rows
- Syntax:

```
SELECT * FROM table  
[WHERE condition];
```

- Example:

```
SELECT location_id from departments  
WHERE department_name = 'Marketing';
```

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The WHERE clause specifies a condition to filter rows, producing a subset of the rows in the table. A condition specifies a combination of one or more expressions and logical (Boolean) operators. It returns a value of TRUE, FALSE, or NULL. The example in the slide retrieves the location_id of the marketing department.

The WHERE clause can also be used to update or delete data from the database.

Example:

```
UPDATE departments  
SET department_name = 'Administration'  
WHERE department_id = 20;  
and  
DELETE from departments  
WHERE department_id =20;
```

ORDER BY Clause

- Use the optional ORDER BY clause to specify the row order.
- Syntax:

```
SELECT * FROM table
[WHERE condition]
[ORDER BY {<column>|<position> } [ASC|DESC] [, ...] ];
```

- Example:

```
SELECT last_name, department_id, salary
FROM employees
ORDER BY department_id ASC, salary DESC;
```

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The ORDER BY clause specifies the order in which the rows should be displayed. The rows can be sorted in ascending or descending fashion. By default, the rows are displayed in ascending order.

The example in the slide retrieves rows from the `employees` table ordered first by ascending order of `department_id`, and then by descending order of `salary`.

GROUP BY Clause

- Use the optional GROUP BY clause to group columns that have matching values into subsets.
- Each group has no two rows having the same value for the grouping column or columns.
- Syntax:

```
SELECT <column1, column2, ... column_n>  
FROM   table  
[WHERE condition]  
[GROUP BY <column> [, ...] ]  
[ORDER BY <column> [, ...] ] ;
```

- Example:

```
SELECT department_id, MIN(salary), MAX (salary)  
FROM employees  
GROUP BY department_id ;
```

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The GROUP BY clause is used to group selected rows based on the value of `expr(s)` for each row. The clause groups rows but does not guarantee order of the result set. To order the groupings, use the ORDER BY clause.

Any SELECT list elements that are not included in aggregation functions must be included in the GROUP BY list of elements. This includes both columns and expressions. The database returns a single row of summary information for each group.

The example in the slide returns the minimum and maximum salaries for each department in the employees table.

Data Definition Language

- DDL statements are used to define, structurally change, and drop schema objects.
- The commonly used DDL statements are:
 - CREATE TABLE, ALTER TABLE, and DROP TABLE
 - GRANT, REVOKE
 - TRUNCATE

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DDL statements enable you to alter the attributes of an object without altering the applications that access the object. You can also use DDL statements to alter the structure of objects while database users are performing work in the database. These statements are most frequently used to:

- Create, alter, and drop schema objects and other database structures, including the database itself and database users
- Delete all the data in schema objects without removing the structure of these objects
- Grant and revoke privileges and roles

Oracle Database implicitly commits the current transaction before and after every DDL statement.

CREATE TABLE Statement

- Use the CREATE TABLE statement to create a table in the database.
- Syntax:

```
CREATE TABLE tablename (  
  {column-definition | Table-level constraint}  
  [ , {column-definition | Table-level constraint} ] * )
```

- Example:

```
CREATE TABLE teach_dept (  
  department_id NUMBER(3) PRIMARY KEY,  
  department_name VARCHAR2(10));
```

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Use the CREATE TABLE statement to create a table in the database. To create a table, you must have the CREATE TABLE privilege and a storage area in which to create objects.

The table owner and the database owner automatically gain the following privileges on the table after it is created:

- INSERT
- SELECT
- REFERENCES
- ALTER
- UPDATE

The table owner and the database owner can grant the preceding privileges to other users.

ALTER TABLE Statement

- Use the ALTER TABLE statement to modify the definition of an existing table in the database.
- Example1:

```
ALTER TABLE teach_dept  
ADD location_id NUMBER NOT NULL;
```

- Example 2:

```
ALTER TABLE teach_dept  
MODIFY department_name VARCHAR2(30) NOT NULL;
```

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The ALTER TABLE statement allows you to make changes to an existing table.

You can:

- Add a column to a table
- Add a constraint to a table
- Modify an existing column definition
- Drop a column from a table
- Drop an existing constraint from a table
- Increase the width of the VARCHAR and CHAR columns
- Change a table to have read-only status

Example 1 in the slide adds a new column called `location_id` to the `teach_dept` table.

Example 2 updates the existing `department_name` column from `VARCHAR2(10)` to `VARCHAR2(30)`, and adds a `NOT NULL` constraint to it.

DROP TABLE Statement

- The DROP TABLE statement removes the table and all its data from the database.
- Example:

```
DROP TABLE teach_dept;
```

- DROP TABLE with the PURGE clause drops the table and releases the space that is associated with it.

```
DROP TABLE teach_dept PURGE;
```

- The CASCADE CONSTRAINTS clause drops all referential integrity constraints from the table.

```
DROP TABLE teach_dept CASCADE CONSTRAINTS;
```

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The DROP TABLE statement allows you to remove a table and its contents from the database, and pushes it to the recycle bin. Dropping a table invalidates dependent objects and removes object privileges on the table.

Use the PURGE clause along with the DROP TABLE statement to release back to the tablespace the space allocated for the table. You cannot roll back a DROP TABLE statement with the PURGE clause, nor can you recover the table if you have dropped it with the PURGE clause.

The CASCADE CONSTRAINTS clause allows you to drop the reference to the primary key and unique keys in the dropped table.

GRANT Statement

- The `GRANT` statement assigns the privilege to perform the following operations:
 - Insert or delete data.
 - Create a foreign key reference to the named table or to a subset of columns from a table.
 - Select data, a view, or a subset of columns from a table.
 - Create a trigger on a table.
 - Execute a specified function or procedure.
- Example:

```
GRANT SELECT any table to PUBLIC;
```

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You can use the `GRANT` statement to:

- Assign privileges to a specific user or role, or to all users, to perform actions on database objects
- Grant a role to a user, to `PUBLIC`, or to another role

Before you issue a `GRANT` statement, check that the `derby.database.sql` authorization property is set to `True`. This property enables SQL Authorization mode. You can grant privileges on an object if you are the owner of the database.

You can grant privileges to all users by using the `PUBLIC` keyword. When `PUBLIC` is specified, the privileges or roles affect all current and future users.

Privilege Types

Assign the following privileges by using the GRANT statement:

- ALL PRIVILEGES
- DELETE
- INSERT
- REFERENCES
- SELECT
- UPDATE

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Oracle Database provides a variety of privilege types to grant privileges to a user or role:

- Use the ALL PRIVILEGES privilege type to grant all privileges to the user or role for the specified table.
- Use the DELETE privilege type to grant permission to delete rows from the specified table.
- Use the INSERT privilege type to grant permission to insert rows into the specified table.
- Use the REFERENCES privilege type to grant permission to create a foreign key reference to the specified table.
- Use the SELECT privilege type to grant permission to perform SELECT statements on a table or view.
- Use the UPDATE privilege type to grant permission to use the UPDATE statement on the specified table.

REVOKE Statement

- Use the REVOKE statement to remove privileges from a user to perform actions on database objects.
- Revoke a *system privilege* from a user:

```
REVOKE DROP ANY TABLE  
FROM hr;
```

- Revoke a *role* from a user:

```
REVOKE dw_manager  
FROM sh;
```

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The REVOKE statement removes privileges from a specific user (or users) or role to perform actions on database objects. It performs the following operations:

- Revokes a role from a user, from PUBLIC, or from another role
- Revokes privileges for an object if you are the owner of the object or the database owner

Note: To revoke a role or system privilege, you must have been granted the privilege with the ADMIN OPTION.

TRUNCATE TABLE Statement

- Use the TRUNCATE TABLE statement to remove all the rows from a table.
- Example:

```
TRUNCATE TABLE employees_demo;
```

- By default, Oracle Database performs the following tasks:
 - De-allocates space used by the removed rows
 - Sets the NEXT storage parameter to the size of the last extent removed from the segment by the truncation process

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The TRUNCATE TABLE statement deletes all the rows from a specific table. Removing rows with the TRUNCATE TABLE statement can be more efficient than dropping and re-creating a table.

Dropping and re-creating a table:

- Invalidates the dependent objects of the table
- Requires you to re-grant object privileges
- Requires you to re-create indexes, integrity constraints, and triggers.
- Re-specify its storage parameters

The TRUNCATE TABLE statement spares you from these efforts.

Note: You cannot roll back a TRUNCATE TABLE statement.

Data Manipulation Language

- DML statements query or manipulate data in the existing schema objects.
- A DML statement is executed when:
 - New rows are added to a table by using the `INSERT` statement
 - Existing rows in a table are modified using the `UPDATE` statement
 - Existing rows are deleted from a table by using the `DELETE` statement
- A *transaction* consists of a collection of DML statements that form a logical unit of work.

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Data Manipulation Language (DML) statements enable you to query or change the contents of an existing schema object. These statements are most frequently used to:

- Add new rows of data to a table or view by specifying a list of column values or using a subquery to select and manipulate existing data
- Change column values in the existing rows of a table or view
- Remove rows from tables or views

A collection of DML statements that forms a logical unit of work is called a transaction. Unlike DDL statements, DML statements do not implicitly commit the current transaction.

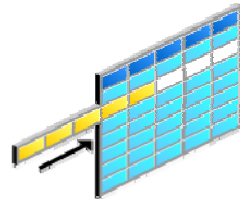
INSERT Statement

- Use the INSERT statement to add new rows to a table.
- Syntax:

```
INSERT INTO  table [(column [, column...])]  
VALUES      (value [, value...]);
```

- Example:

```
INSERT INTO  departments  
VALUES      (200, 'Development', 104, 1400);  
1 rows inserted.
```



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The INSERT statement adds rows to a table. Make sure to insert a new row containing values for each column and to list the values in the default order of the columns in the table. Optionally, you can also list the columns in the INSERT statement.

Example:

```
INSERT INTO job_history (employee_id, start_date, end_date,  
                        job_id)  
VALUES (120, '25-JUL-06', '12-FEB-08', 'AC_ACCOUNT');
```

The syntax discussed in the slide allows you to insert a single row at a time. The VALUES keyword assigns the values of expressions to the corresponding columns in the column list.

UPDATE Statement Syntax

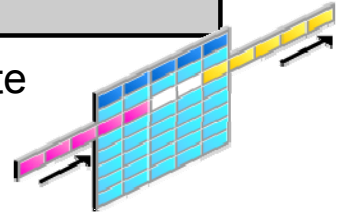
- Use the UPDATE statement to modify the existing rows in a table.
- Update more than one row at a time (if required).

```
UPDATE      table
SET         column = value [, column = value, ...]
[WHERE      condition];
```

- Example:

```
UPDATE      copy_emp
SET
22 rows updated
```

- Specify SET *column_name*= NULL to update a column value to NULL.



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The UPDATE statement modifies the existing values in a table. Confirm the update operation by querying the table to display the updated rows. You can modify a specific row or rows by specifying the WHERE clause.

Example:

```
UPDATE employees
SET      salary = 17500
WHERE    employee_id = 102;
```

In general, use the primary key column in the WHERE clause to identify the row to update. For example, to update a specific row in the employees table, use employee_id to identify the row instead of employee_name, because more than one employee may have the same name.

Note: Typically, the condition keyword is composed of column names, expressions, constants, subqueries, and comparison operators.

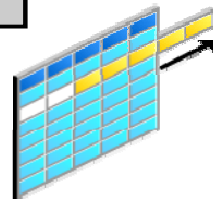
DELETE Statement

- Use the DELETE statement to delete the existing rows from a table.
- Syntax:

```
DELETE    [FROM]    table
[WHERE    condition];
```

- Write the DELETE statement using the WHERE clause to delete specific rows from a table.

```
DELETE FROM departments
WHERE  department_name = 'Finance';
1 rows deleted
```



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The DELETE statement removes existing rows from a table. You must use the WHERE clause to delete a specific row or rows from a table based on the condition. The condition identifies the rows to be deleted. It may contain column names, expressions, constants, subqueries, and comparison operators.

The first example in the slide deletes the finance department from the departments table. You can confirm the delete operation by using the SELECT statement to query the table.

```
SELECT  *
FROM    departments
WHERE   department_name = 'Finance';
```

If you omit the WHERE clause, all rows in the table are deleted. Example:

```
DELETE FROM copy_emp;
```

The preceding example deletes all the rows from the copy_emp table.

Transaction Control Statements

- Transaction control statements are used to manage the changes made by DML statements.
- The DML statements are grouped into transactions.
- Transaction control statements include:
 - COMMIT
 - ROLLBACK
 - SAVEPOINT

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A transaction is a sequence of SQL statements that Oracle Database treats as a single unit. Transaction control statements are used in a database to manage the changes made by DML statements and to group these statements into transactions.

Each transaction is assigned a unique `transaction_id` and it groups SQL statements so that they are either all committed, which means they are applied to the database, or all rolled back, which means they are undone from the database.

COMMIT Statement

- Use the COMMIT statement to:
 - Permanently save the changes made to the database during the current transaction
 - Erase all savepoints in the transaction
 - Release transaction locks
- Example:

```
INSERT INTO departments
VALUES      (201, 'Engineering', 106, 1400);
COMMIT;
```

```
1 rows inserted.
committed.
```

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The COMMIT statement ends the current transaction by making all the pending data changes permanent. It releases all row and table locks, and erases any savepoints that you may have marked since the last commit or rollback. The changes made using the COMMIT statement are visible to all users.

Oracle recommends that you explicitly end every transaction in your application programs with a COMMIT or ROLLBACK statement, including the last transaction, before disconnecting from Oracle Database. If you do not explicitly commit the transaction and the program terminates abnormally, the last uncommitted transaction is automatically rolled back.

Note: Oracle Database issues an implicit COMMIT before and after any data definition language (DDL) statement.

ROLLBACK Statement

- Use the ROLLBACK statement to undo changes made to the database during the current transaction.
- Use the TO SAVEPOINT clause to undo a part of the transaction after the savepoint.
- Example:

```
UPDATE      employees
SET         salary = 7000
WHERE      last_name = 'Ernst';
SAVEPOINT   Ernst_sal;

UPDATE      employees
SET         salary = 12000
WHERE      last_name = 'Mourgos';

ROLLBACK TO SAVEPOINT Ernst_sal;
```

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The ROLLBACK statement undoes work done in the current transaction. To roll back the current transaction, no privileges are necessary.

Using ROLLBACK with the TO SAVEPOINT clause performs the following operations:

- Rolls back only the portion of the transaction after the savepoint
- Erases all savepoints created after that savepoint. The named savepoint is retained, so you can roll back to the same savepoint multiple times.

Using ROLLBACK without the TO SAVEPOINT clause performs the following operations:

- Ends the transaction
- Undoes all the changes in the current transaction
- Erases all savepoints in the transaction

SAVEPOINT Statement

- Use the `SAVEPOINT` statement to name and mark the current point in the processing of a transaction.
- Specify a name to each savepoint.
- Use distinct savepoint names within a transaction to avoid overriding.
- Syntax:

```
SAVEPOINT savepoint;
```

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The `SAVEPOINT` statement identifies a point in a transaction to which you can later roll back. You must specify a distinct name for each savepoint. If you create a second savepoint with the same identifier as an earlier savepoint, the earlier savepoint is erased.

After a savepoint has been created, you can either continue processing, commit your work, roll back the entire transaction, or roll back to the savepoint.

A simple rollback or commit erases all savepoints. When you roll back to a savepoint, any savepoints marked after that savepoint are erased. The savepoint to which you have rolled back is retained.

When savepoint names are reused within a transaction, the Oracle Database moves (overrides) the savepoint from its old position to the current point in the transaction.

Joins

Use a join to query data from more than one table:

```
SELECT    table1.column, table2.column
FROM      table1, table2
WHERE     table1.column1 = table2.column2;
```

- Write the join condition in the `WHERE` clause.
- Prefix the column name with the table name when the same column name appears in more than one table.

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When data from more than one table in the database is required, a *join* condition is used. Rows in one table can be joined to rows in another table according to common values that exist in the corresponding columns (usually primary and foreign key columns).

To display data from two or more related tables, write a simple join condition in the `WHERE` clause.

In the syntax:

<code>table1.column</code>	Denotes the table and column from which data is retrieved
<code>table1.column1 =</code> <code>table2.column2</code>	Is the condition that joins (or relates) the tables together

Guidelines

- When writing a `SELECT` statement that joins tables, precede the column name with the table name for clarity and to enhance database access.
- If the same column name appears in more than one table, the column name must be prefixed with the table name.
- To join n tables together, you need a minimum of $n-1$ join conditions. For example, to join four tables, a minimum of three joins is required. This rule may not apply if your table has a concatenated primary key, in which case more than one column is required to uniquely identify each row.

Types of Joins

- Natural join
- Equijoin
- Nonequijoin
- Outer join
- Self-join
- Cross join

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To join tables, you can use Oracle's join syntax.

Note: Before the Oracle 9i release, the join syntax was proprietary. The SQL:1999–compliant join syntax does not offer any performance benefits over the Oracle-proprietary join syntax.

Qualifying Ambiguous Column Names

- Use table prefixes to qualify column names that are in multiple tables.
- Use table prefixes to improve performance.
- Use table aliases instead of full table name prefixes.
- Table aliases give a table a shorter name.
 - This keeps SQL code smaller and uses less memory.
- Use column aliases to distinguish columns that have identical names but reside in different tables.

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When joining two or more tables, you need to qualify the names of the columns with the table name to avoid ambiguity. Without the table prefixes, the `DEPARTMENT_ID` column in the `SELECT` list could be from either the `DEPARTMENTS` table or the `EMPLOYEES` table. Therefore, it is necessary to add the table prefix to execute your query. If there are no common column names between the two tables, there is no need to qualify the columns. However, using a table prefix improves performance, because you tell the Oracle server exactly where to find the columns.

Qualifying column names with table names can be very time consuming, particularly if table names are lengthy. Therefore, you can use *table aliases*, instead of table names. Just as a column alias gives a column another name, a table alias gives a table another name. Table aliases help to keep SQL code smaller, thereby using less memory.

The table name is specified in full, followed by a space, and then the table alias. For example, the `EMPLOYEES` table can be given an alias of `e`, and the `DEPARTMENTS` table an alias of `d`.

Guidelines

- Table aliases can be up to 30 characters in length, but shorter aliases are better than longer ones.
- If a table alias is used for a particular table name in the `FROM` clause, that table alias must be substituted for the table name throughout the `SELECT` statement.
- Table aliases should be meaningful.
- A table alias is valid only for the current `SELECT` statement.

Natural Join

- The NATURAL JOIN clause is based on all the columns in the two tables that have the same name.
- It selects rows from tables that have the same names and data values of columns.
- Example:

```
SELECT country_id, location_id, country_name, city
FROM countries NATURAL JOIN locations;
```

	COUNTRY_ID	LOCATION_ID	COUNTRY_NAME	CITY
1	US	1400	United States of America	Southlake
2	US	1500	United States of America	South San Francisco
3	US	1700	United States of America	Seattle
4	CA	1800	Canada	Toronto
5	UK	2500	United Kingdom	Oxford

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You can join tables automatically based on the columns in the two tables that have matching data types and names. You do this by using the NATURAL JOIN keywords.

Note: The join can happen only on those columns that have the same names and data types in both tables. If the columns have the same name but different data types, the NATURAL JOIN syntax causes an error.

In the example in the slide, the COUNTRIES table is joined to the LOCATIONS table by the COUNTRY_ID column, which is the only column of the same name in both tables. If other common columns were present, the join would have used them all.

Equijoins

EMPLOYEES

	EMPLOYEE_ID	DEPARTMENT_ID
1	200	10
2	201	20
3	202	20
4	205	110
5	206	110
6	100	90
7	101	90
8	102	90
9	103	60
10	104	60

...

DEPARTMENTS

	DEPARTMENT_ID	DEPARTMENT_NAME
1	10	Administration
2	20	Marketing
3	50	Shipping
4	60	IT
5	80	Sales
6	90	Executive
7	110	Accounting
8	190	Contracting

Foreign key

Primary key

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An **equijoin** is a join with a join condition containing an equality operator. An equijoin combines rows that have equivalent values for the specified columns. To determine an employee's department name, you compare the values in the `DEPARTMENT_ID` column in the `EMPLOYEES` table with the `DEPARTMENT_ID` values in the `DEPARTMENTS` table. The relationship between the `EMPLOYEES` and `DEPARTMENTS` tables is an *equijoin*; that is, values in the `DEPARTMENT_ID` column in both tables must be equal. Often, this type of join involves primary and foreign key complements.

Note: Equijoins are also called *simple joins*.

Retrieving Records with Equijoins

```
SELECT e.employee_id, e.last_name, e.department_id,  
       d.department_id, d.location_id  
FROM   employees e JOIN departments d  
ON e.department_id = d.department_id;
```

EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID	DEPARTMENT_ID_1	LOCATION_ID
1	200 Whalen	10	10	1700
2	201 Hartstein	20	20	1800
3	202 Fay	20	20	1800
4	144 Vargas	50	50	1500
5	143 Matos	50	50	1500
6	142 Davies	50	50	1500
7	141 Rajes	50	50	1500
8	124 Mourgos	50	50	1500
9	103 Hunold	60	60	1400
10	104 Ernst	60	60	1400
11	107 Lorentz	60	60	1400

...

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In the example in the slide:

- **The SELECT clause specifies the column names to retrieve:**
 - Employee last name, employee ID, and department ID, which are columns in the EMPLOYEES table
 - Department ID and location ID, which are columns in the DEPARTMENTS table
- **The FROM clause specifies the two tables that the database must access:**
 - EMPLOYEES table
 - DEPARTMENTS table
- **The WHERE clause specifies how the tables are to be joined:**

e.department_id = d.department_id

Because the DEPARTMENT_ID column is common to both tables, it must be prefixed with the table alias to avoid ambiguity. Other columns that are not present in both the tables need not be qualified by a table alias, but it is recommended for better performance.

Note: When you use the Execute Statement icon to run the query, SQL Developer suffixes a “_1” to differentiate between the two DEPARTMENT_IDS.

Additional Search Conditions Using the AND and WHERE Operators

```
SELECT d.department_id, d.department_name, l.city
FROM departments d JOIN locations l
ON d.location_id = l.location_id
AND d.department_id IN (20, 50);
```

	DEPARTMENT_ID	DEPARTMENT_NAME	CITY
1	20	Marketing	Toronto
2	50	Shipping	South San Francisco

```
SELECT d.department_id, d.department_name, l.city
FROM departments d JOIN locations l
ON d.location_id = l.location_id
WHERE d.department_id IN (20, 50);
```

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In addition to the join, you may have criteria for your `WHERE` clause to restrict the rows in consideration for one or more tables in the join. The example in the slide performs a join on the `DEPARTMENTS` and `LOCATIONS` tables and, in addition, displays only those departments with ID equal to 20 or 50. To add additional conditions to the `ON` clause, you can add `AND` clauses. Alternatively, you can use a `WHERE` clause to apply additional conditions.

Both queries produce the same output.

	LAST_NAME	DEPARTMENT_ID	DEPARTMENT_NAME
1	Matos	50	Shipping

Retrieving Records with Nonequijoins

```
SELECT e.last_name, e.salary, j.grade_level
FROM   employees e JOIN job_grades j
ON     e.salary
      BETWEEN j.lowest_sal AND j.highest_sal;
```

	LAST_NAME	SALARY	GRADE_LEVEL
1	Vargas	2500	A
2	Matos	2600	A
3	Davies	3100	B
4	Rajs	3500	B
5	Lorentz	4200	B
6	Whalen	4400	B
7	Fay	6000	C

...

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The example in the slide creates a nonequijoin to evaluate an employee's salary grade. The salary must be *between* any pair of the low and high salary ranges.

It is important to note that all employees appear exactly once when this query is executed. No employee is repeated in the list. There are two reasons for this:

- None of the rows in the job grade table contain grades that overlap. That is, the salary value for an employee can lie only between the low salary and high salary values of one of the rows in the salary grade table.
- All of the employees' salaries lie within the limits that are provided by the job grade table. That is, no employee earns less than the lowest value contained in the `LOWEST_SAL` column or more than the highest value contained in the `HIGHEST_SAL` column.

Note: Other conditions (such as `<=` and `>=`) can be used, but `BETWEEN` is the simplest. Remember to specify the low value first and the high value last when using the `BETWEEN` condition. The Oracle server translates the `BETWEEN` condition to a pair of `AND` conditions. Therefore, using `BETWEEN` has no performance benefits, but should be used only for logical simplicity.

Table aliases have been specified in the example in the slide for performance reasons, not because of possible ambiguity.

Retrieving Records by Using the USING Clause

- You can use the `USING` clause to match only one column when more than one column matches.
- You cannot specify this clause with a `NATURAL` join.
- Do not qualify the column name with a table name or table alias.
- Example:

```
SELECT country_id, country_name, location_id, city
FROM   countries JOIN locations
      USING (country_id) ;
```

	COUNTRY_ID	COUNTRY_NAME	LOCATION_ID	CITY
1	US	United States of America	1400	Southlake
2	US	United States of America	1500	South San Francisco
3	US	United States of America	1700	Seattle
4	CA	Canada	1800	Toronto
5	UK	United Kingdom	2500	Oxford

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In the example in the slide, the `COUNTRY_ID` columns in the `COUNTRIES` and `LOCATIONS` tables are joined and thus the `LOCATION_ID` of the location where an employee works is shown.

Retrieving Records by Using the ON Clause

- The join condition for the natural join is basically an equijoin of all columns with the same name.
- Use the ON clause to specify arbitrary conditions or specify columns to join.
- The ON clause makes code easy to understand.

```
SELECT e.employee_id, e.last_name, j.department_id,  
FROM   employees e JOIN job_history j  
ON     (e.employee_id = j.employee_id);
```

	EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID
1	101	Kochhar	110
2	101	Kochhar	110
3	102	De Haan	60
4	176	Taylor	80
5	176	Taylor	80
6	200	Whalen	90
7	200	Whalen	90
8	201	Hartstein	20

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Use the ON clause to specify a join condition. With this, you can specify join conditions separate from any search or filter conditions in the WHERE clause.

In this example, the EMPLOYEE_ID columns in the EMPLOYEES and JOB_HISTORY tables are joined using the ON clause. Whenever an employee ID in the EMPLOYEES table equals an employee ID in the JOB_HISTORY table, the row is returned. The table alias is necessary to qualify the matching column names.

You can also use the ON clause to join columns that have different names. The parentheses around the joined columns, as in the example in the slide, (e.employee_id = j.employee_id), is optional. So, even ON e.employee_id = j.employee_id will work.

Note: When you use the Execute Statement icon to run the query, SQL Developer suffixes a '_1' to differentiate between the two employee_ids.

Left Outer Join

- A join between two tables that returns all matched rows, as well as the unmatched rows from the left table is called a LEFT OUTER JOIN.
- Example:

```
SELECT c.country_id, c.country_name, l.location_id, l.city
FROM   countries c LEFT OUTER JOIN locations l
ON     (c.country_id = l.country_id) ;
```

	COUNTRY_ID	COUNTRY_NAME	LOCATION_ID	CITY
1	CA	Canada	1800	Toronto
2	DE	Germany	(null)	(null)
3	UK	United Kingdom	2500	Oxford
4	US	United States of America	1400	Southlake
5	US	United States of America	1500	South San Francisco
6	US	United States of America	1700	Seattle

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This query retrieves all the rows in the COUNTRIES table, which is the left table, even if there is no match in the LOCATIONS table.

Right Outer Join

- A join between two tables that returns all matched rows, as well as the unmatched rows from the right table is called a RIGHT OUTER JOIN.
- Example:

```
SELECT e.last_name, d.department_id, d.department_name
FROM   employees e RIGHT OUTER JOIN departments d
ON     (e.department_id = d.department_id) ;
```

	1 LAST_NAME	2 DEPARTMENT_ID	3 DEPARTMENT_NAME
1	Whalen	10	Administration
2	Hartstein	20	Marketing
3	Fay	20	Marketing
4	Davies	50	Shipping

...

18	Higgins	110	Accounting
19	Gietz	110	Accounting
20	(null)	190	Contracting

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This query retrieves all the rows in the DEPARTMENTS table, which is the table at the right, even if there is no match in the EMPLOYEES table.

Full Outer Join

- A join between two tables that returns all matched rows, as well as the unmatched rows from both tables is called a FULL OUTER JOIN.
- Example:

```
SELECT e.last_name, d.department_id, d.manager_id,  
       d.department_name  
FROM   employees e FULL OUTER JOIN departments d  
ON     (e.manager_id = d.manager_id) ;
```

	LAST_NAME	DEPARTMENT_ID	MANAGER_ID	DEPARTMENT_NAME
1	King	(null)	(null)	(null)
2	Kochhar	90	100	Executive
3	De Haan	90	100	Executive
4	Hunold	(null)	(null)	(null)

...

19	Higgins	(null)	(null)	(null)
20	Gietz	110	205	Accounting
21	(null)	190	(null)	Contracting
22	(null)	10	200	Administration

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This query retrieves all the rows in the EMPLOYEES table, even if there is no match in the DEPARTMENTS table. It also retrieves all the rows in the DEPARTMENTS table, even if there is no match in the EMPLOYEES table.

Self-Join: Example

```
SELECT worker.last_name || ' works for '
       || manager.last_name
FROM   employees worker JOIN employees manager
ON     worker.manager_id = manager.employee_id
ORDER BY worker.last_name;
```

	WORKER.LAST_NAME 'WORKS FOR' MANAGER.LAST_NAME
1	Abel works for Zlotkey
2	Davies works for Mourgos
3	De Haan works for King
4	Ernst works for Hunold
5	Fay works for Hartstein
6	Gietz works for Higgins
7	Grant works for Zlotkey
8	Hartstein works for King
9	Higgins works for Kochhar

...

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Sometimes you need to join a table to itself. To find the name of each employee's manager, you need to join the `EMPLOYEES` table to itself, or perform a self-join. The example in the slide joins the `EMPLOYEES` table to itself. To simulate two tables in the `FROM` clause, there are two aliases, namely `worker` and `manager`, for the same table, `EMPLOYEES`.

In this example, the `WHERE` clause contains the join that means "where a worker's manager ID matches the employee ID for the manager."

Cross Join

- A CROSS JOIN is a JOIN operation that produces the Cartesian product of two tables.
- Example:

```
SELECT department_name, city  
FROM department CROSS JOIN location;
```

	DEPARTMENT_NAME	CITY
1	Administration	Oxford
2	Administration	Seattle
3	Administration	South San Francisco
4	Administration	Southlake
5	Administration	Toronto
6	Marketing	Oxford
7	Marketing	Seattle
8	Marketing	South San Francisco
9	Marketing	Southlake
10	Marketing	Toronto

...

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The CROSS JOIN syntax specifies the cross product. It is also known as a Cartesian product. A cross join produces the cross product of two relations, and is essentially the same as the comma-delimited Oracle Database notation.

You do not specify any WHERE condition between the two tables in the CROSS JOIN.

Summary

In this appendix, you should have learned how to use:

- The `SELECT` statement to retrieve rows from one or more tables
- DDL statements to alter the structure of objects
- DML statements to manipulate data in the existing schema objects
- Transaction control statements to manage the changes made by DML statements
- Joins to display data from multiple tables

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There are many commonly used commands and statements in SQL. It includes the DDL statements, DML statements, transaction control statements, and joins.

