Oracle Database: SQL Fundamentals I

Student Guide - Volume II

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Authors

Supriya Ananth
Salome Clement
Brian Pottle

Technical Contributors and Reviewers

Diganta Choudhury
Bryan Roberts
Kimseong Loh
Laszlo Czinkoczki
Brent Dayley
Nancy Greenberg
Manish Pawar
Clair Bennett
Zarko Cesljas
Yanti Chang
Gerlinde Frenzen
Helen Robertson
Joel Goodman
Pedro Neves
Hilda Simon

Editor

Raj Kumar

Graphic Designer

Satish Bettegowda

Publishers

Sujatha Nagendra
Joseph Fernandez

Contents

9

Using the Set Operators

Objectives

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

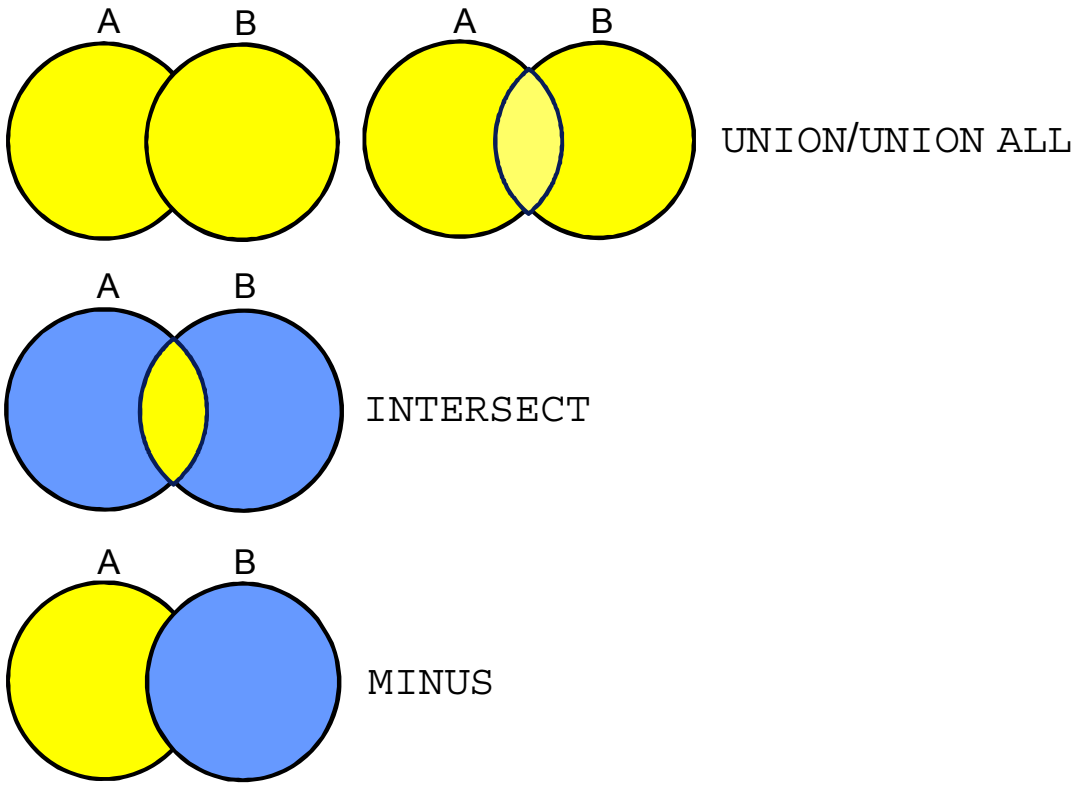
- Describe set operators
- Use a set operator to combine multiple queries into a single query
- Control the order of rows returned

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 the `SELECT` statements
- Using the `ORDER BY` clause in set operations

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 Guidelines

- The expressions in the SELECT lists must match in number.
- The data type of each column in the second 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.

- 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 in their WHERE clause 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`.

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 the `SELECT` statements
- Using the `ORDER BY` clause in set operations

Tables Used in This Lesson

The tables used in this lesson are:

- EMPLOYEES: Provides details regarding all current employees
- JOB_HISTORY: Records the details of the start date and end date of the former job, and the job identification number and department when an employee switches jobs

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

Some of the employees have been with the company for a long time and have switched to different jobs. This is monitored using the JOB_HISTORY table. When an employee switches jobs, the details of the start date and end date of the former job, the job_id (such as ST_CLERK, SA_REP, and so on), and the department are recorded in the JOB_HISTORY table.

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

There have been instances in the company of people who have held the same position more than once during their tenure with the company. For example, consider the employee Taylor, who joined the company on 24-MAR-1998. Taylor held the job title `SA_REP` for the period 24-MAR-98 to 31-DEC-98 and the job title `SA_MAN` for the period 01-JAN-99 to 31-DEC-99. Taylor moved back into the job title of `SA_REP`, which is his current job title.

```
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	200	Whalen	AD_ASST	17-SEP-87	10
2	201	Hartstein	MK_MAN	17-FEB-96	20
3	202	Fay	MK_REP	17-AUG-97	20
4	205	Higgins	AC_MGR	07-JUN-94	110
5	206	Gietz	AC_ACCOUNT	07-JUN-94	110
6	100	King	AD_PRES	17-JUN-87	90
7	101	Kochhar	AD_VP	21-SEP-89	90
8	102	De Haan	AD_VP	13-JAN-93	90
9	103	Hunold	IT_PROG	03-JAN-90	60
10	104	Ernst	IT_PROG	21-MAY-91	60
11	107	Lorentz	IT_PROG	07-FEB-99	60
12	124	Mourgos	ST_MAN	16-NOV-99	50
13	141	Rajs	ST_CLERK	17-OCT-95	50
14	142	Davies	ST_CLERK	29-JAN-97	50
15	143	Matos	ST_CLERK	15-MAR-98	50
16	144	Vargas	ST_CLERK	09-JUL-98	50
17	149	Zlotkey	SA_MAN	29-JAN-00	80
18	174	Abel	SA_REP	11-MAY-96	80
19	176	Taylor	SA_REP	24-MAR-98	80
20	178	Grant	SA_REP	24-MAY-99	(null)

```
DESCRIBE job_history
```

```
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-93	24-JUL-98	IT_PROG	60
2	101	21-SEP-89	27-OCT-93	AC_ACCOUNT	110
3	101	28-OCT-93	15-MAR-97	AC_MGR	110
4	201	17-FEB-96	19-DEC-99	MK_REP	20
5	114	24-MAR-98	31-DEC-99	ST_CLERK	50
6	122	01-JAN-99	31-DEC-99	ST_CLERK	50
7	200	17-SEP-87	17-JUN-93	AD_ASST	90
8	176	24-MAR-98	31-DEC-98	SA_REP	80
9	176	01-JAN-99	31-DEC-99	SA_MAN	80
10	200	01-JUL-94	31-DEC-98	AC_ACCOUNT	90

Lesson Agenda

- Set Operators: Types and guidelines
- Tables used in this lesson
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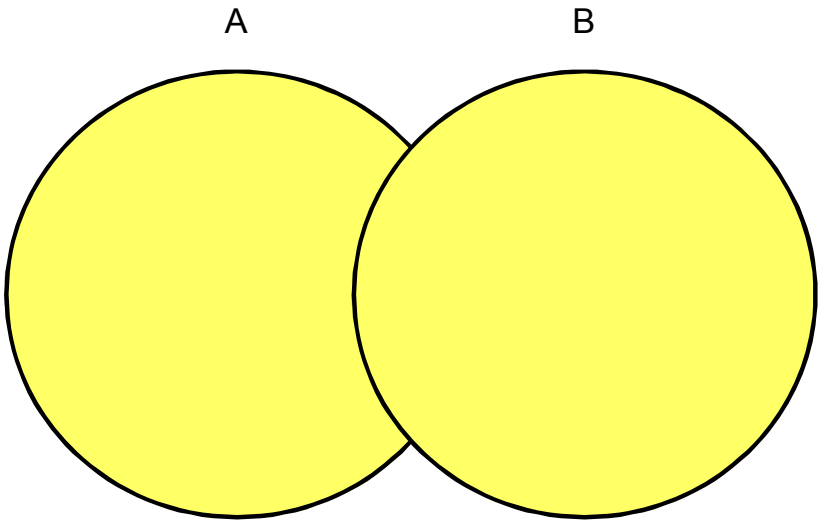
UNION Operator



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

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 current and previous job details of all employees. Display each employee only once.

```
SELECT employee_id, job_id
FROM   employees
UNION
SELECT employee_id, job_id
FROM   job_history;
```

	EMPLOYEE_ID	JOB_ID
1	100	AD_PRES
2	101	AC_ACCOUNT
...		
22	200	AC_ACCOUNT
23	200	AD_ASST
...		
27	205	AC_MGR
28	206	AC_ACCOUNT

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The UNION operator eliminates any duplicate records. If records that occur in both the EMPLOYEES and the JOB_HISTORY tables are identical, the records are displayed only once. Observe in the output shown in the slide that the record for the employee with the EMPLOYEE_ID 200 appears twice because the JOB_ID is different in each row.

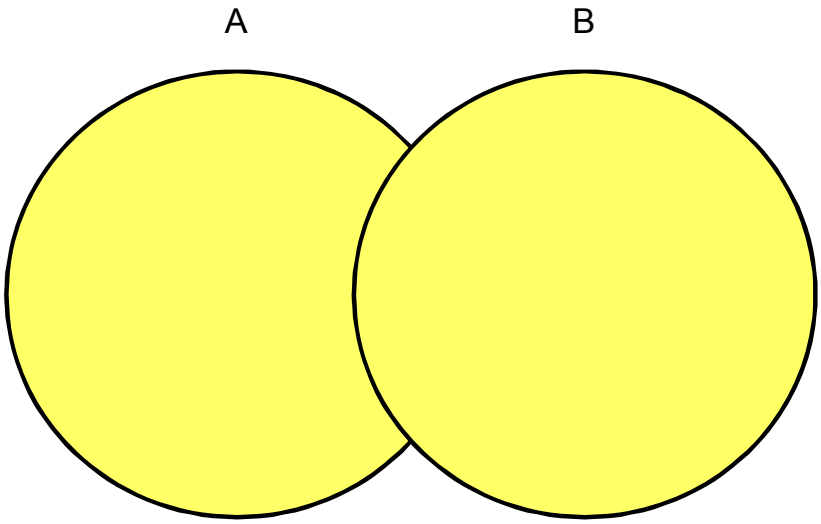
Consider the following example:

```
SELECT  employee_id, job_id, department_id
FROM    employees
UNION
SELECT  employee_id, job_id, department_id
FROM    job_history;
```

	EMPLOYEE_ID	JOB_ID	DEPARTMENT_ID
1	100	AD_PRES	90
...			
22	200	AC_ACCOUNT	90
23	200	AD_ASST	10
24	200	AD_ASST	90
...			
29	206	AC_ACCOUNT	110

In the preceding output, employee 200 appears three times. Why? Note the DEPARTMENT_ID values for employee 200. One row has a DEPARTMENT_ID of 90, another 10, and the third 90. Because of these unique combinations of job IDs and department IDs, each row for employee 200 is unique and, therefore, not considered to be a duplicate. Observe that the output is sorted in ascending order of the first column of the SELECT clause (in this case, EMPLOYEE_ID).

UNION ALL Operator



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

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 current and previous departments of all employees.

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

	EMPLOYEE_ID	JOB_ID	DEPARTMENT_ID
1	100	AD_PRES	90
...			
17	149	SA_MAN	80
18	174	SA_REP	80
19	176	SA_REP	80
20	176	SA_MAN	80
21	176	SA_REP	80
22	178	SA_REP	(null)
23	200	AD_ASST	10
...			
30	206	AC_ACCOUNT	110

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In the example, 30 rows are selected. The combination of the two tables totals to 30 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   employee_id, job_id,department_id
FROM     employees
UNION
SELECT   employee_id, job_id,department_id
FROM     job_history
ORDER BY employee_id;
```

The preceding query returns 29 rows. This is because it eliminates the following row (because it is a duplicate):

176	SA_REP	80

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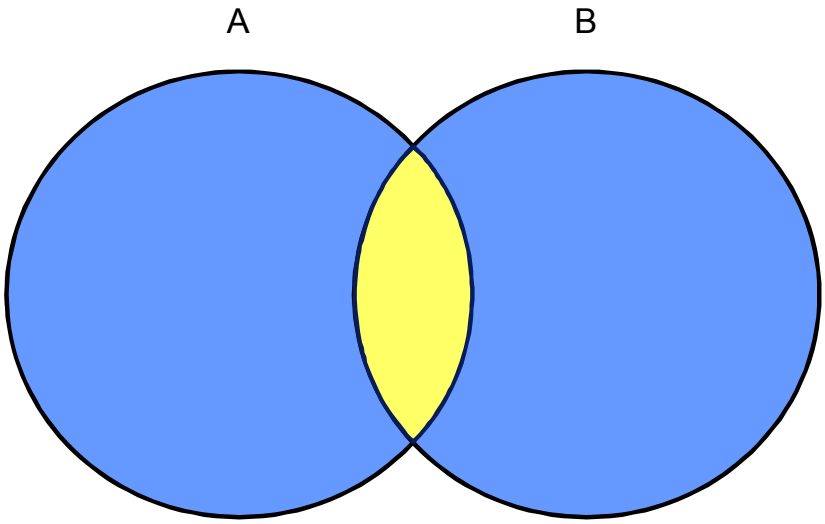
INTERSECT Operator



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

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 employee IDs and job IDs of those employees who currently have a job title that is the same as their previous one (that is, they changed jobs but have now gone back to doing the same job they did previously).

```
SELECT employee_id, job_id
FROM   employees
INTERSECT
SELECT employee_id, job_id
FROM   job_history;
```

	EMPLOYEE_ID	JOB_ID
1	176	SA_REP
2	200	AD_ASST

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

What will be the results if you add the DEPARTMENT_ID column to the SELECT statement from the EMPLOYEES table and add the DEPARTMENT_ID column to the SELECT statement from the JOB_HISTORY table, and run this query? The results may be different because of the introduction of another column whose values may or may not be duplicates.

Example

```
SELECT employee_id, job_id, department_id
FROM   employees
INTERSECT
SELECT employee_id, job_id, department_id
FROM   job_history;
```

	EMPLOYEE_ID	JOB_ID	DEPARTMENT_ID
1	176	SA_REP	80

Employee 200 is no longer part of the results because the EMPLOYEES.DEPARTMENT_ID value is different from the JOB_HISTORY.DEPARTMENT_ID value.

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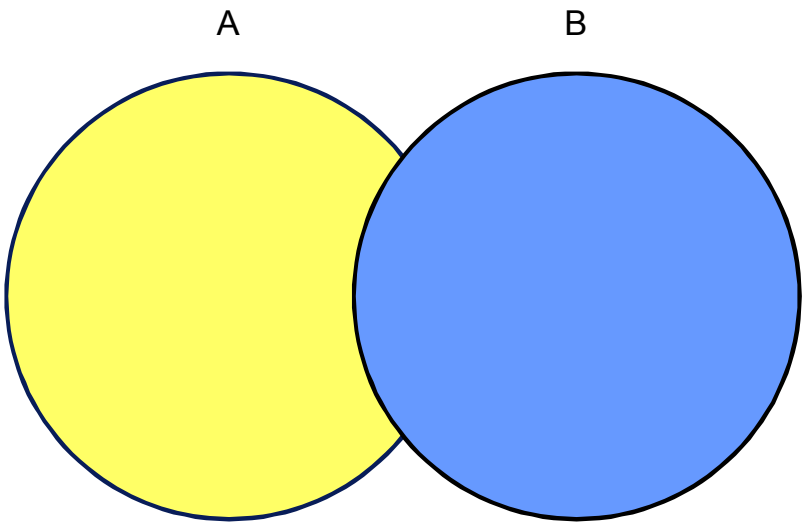
MINUS Operator



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

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 of those employees who have not changed their jobs even once.

```
SELECT employee_id
FROM   employees
MINUS
SELECT employee_id
FROM   job_history;
```

	EMPLOYEE_ID
1	100
2	103
3	104
...	
13	202
14	205
15	206

In the example in the slide, the employee IDs in the JOB_HISTORY 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 JOB_HISTORY table. These are the records of the employees who have not changed their jobs even once.

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Matching the SELECT Statements

- Using the UNION operator, display the location ID, department name, and the state where it is located.
- 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. 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.

The output of the query is shown:

	LOCATION_ID	Department	Warehouse location
1	1400	IT	(null)
2	1400	(null)	Texas
3	1500	Shipping	(null)
4	1500	(null)	California
5	1700	Accounting	(null)
6	1700	Administration	(null)
7	1700	Contracting	(null)
8	1700	Executive	(null)

. . .

Matching the SELECT Statement: Example

Using the UNION operator, display the employee ID, job ID, and salary of all employees.

```
SELECT employee_id, job_id,salary
FROM   employees
UNION
SELECT employee_id, job_id,0
FROM   job_history;
```

	EMPLOYEE_ID	JOB_ID	SALARY
1	100	AD_PRES	24000
2	101	AC_ACCOUNT	0
3	101	AC_MGR	0
4	101	AD_VP	17000
5	102	AD_VP	17000
...			
29	205	AC_MGR	12000
30	206	AC_ACCOUNT	8300

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The EMPLOYEES and JOB_HISTORY 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 employee ID, job ID, and salary using the UNION operator, knowing that the salary exists only in the EMPLOYEES table?

The code example in the slide matches the EMPLOYEE_ID and JOB_ID columns in the EMPLOYEES and JOB_HISTORY tables. A literal value of 0 is added to the JOB_HISTORY SELECT statement to match the numeric SALARY 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 JOB_HISTORY table contains a 0 in the SALARY column.

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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.

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   job_history
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 the 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.

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

- 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

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

10

Manipulating Data

Objectives

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

- Describe each data manipulation language (DML) statement
- Insert rows into a table
- Update rows in a table
- Delete rows from a table
- Control transactions

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 transactions 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.

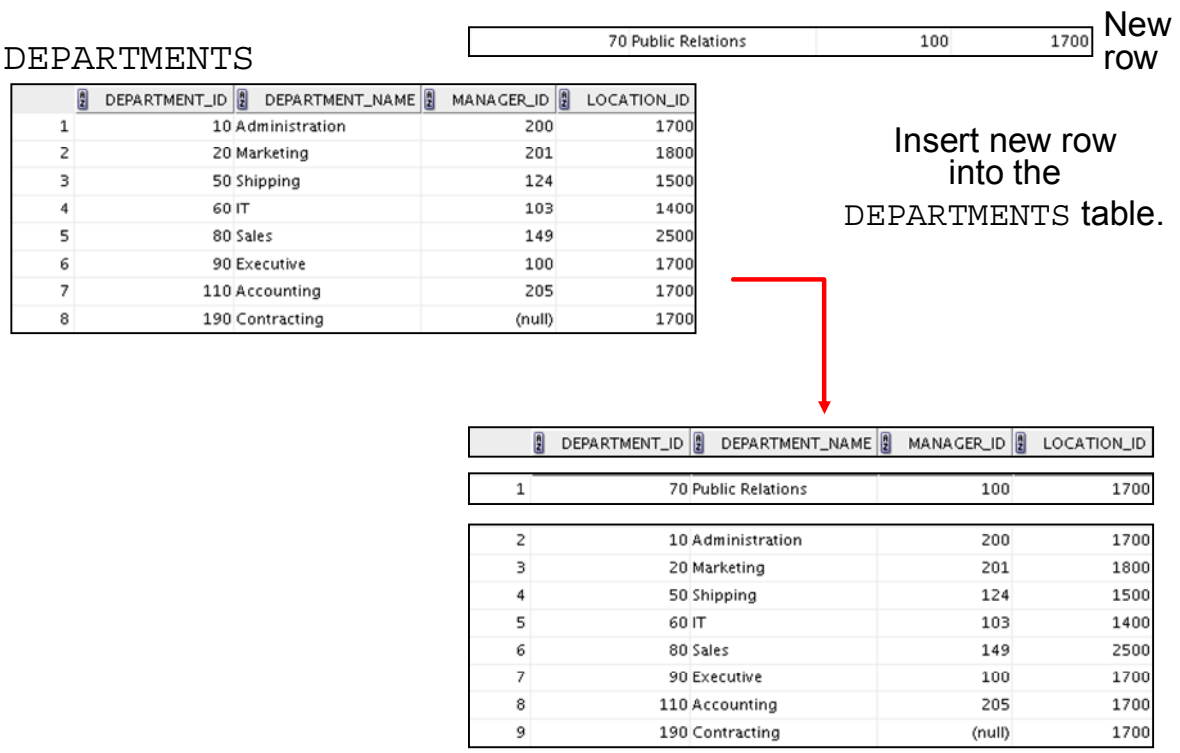
Data manipulation language (DML) is a core part of SQL. When you want to add, update, or delete data in the database, you execute a DML statement. A collection of DML statements that form a logical unit of work is called a *transaction*.

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.

Note

- 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



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.

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

In the syntax:

table	Is the name of the table
column	Is the name of the column in the table to populate
value	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.

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
```

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

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
```


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 we 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 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',
                       SYSDATE, 'AC_ACCOUNT', 6900,
                       NULL, 205, 110);
1 rows inserted
```


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 SYSDATE function that returns the current date and time of the database server. You may also use the CURRENT_DATE function to get 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;
```

	EMPLOYEE_ID	LAST_NAME	JOB_ID	HIRE_DATE	COMMISSION_PCT
1	113	Popp	AC_ACCOUNT	10-JUL-09	(null)

Inserting Specific Date and Time Values

- Add a new employee.

```
INSERT INTO employees
VALUES      (114,
             'Den', 'Raphealy',
             'DRAPHEAL', '515.127.4561',
             TO_DATE('FEB 3, 1999', '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
1	114	Den	Raphealy	DRAPHEAL	515.127.4561	03-FEB-99	SA_REP	11000	0.2

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.

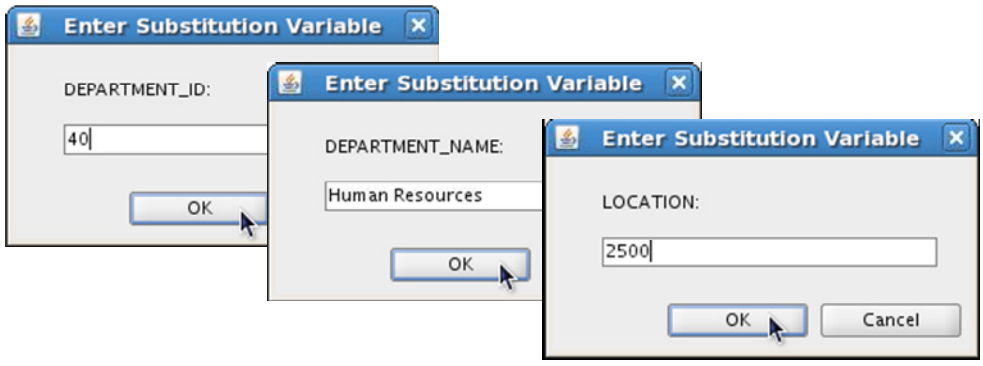
If a date must be entered in a format other than the default format (for example, with another century or a specific time), you must use the `TO_DATE` function.

The example in the slide records information for employee Raphealy in the `EMPLOYEES` table. It sets the `HIRE_DATE` column to be February 3, 1999.

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);
```



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%';

4 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.

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 "Using DDL Statements to Create and Manage Tables."

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

Syntax

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

In the syntax:

table	Is the name of the table
column	Is the name of the column in the table to populate
subquery	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 transactions 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).

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

In the syntax:

table	Is the name of the table
column	Is the name of the column in the table to populate
value	Is the corresponding value or subquery for the column
condition	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 10*g* or 11*g* 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 is dangerous, because more than one employee may have 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;
```

	LAST_NAME	DEPARTMENT_ID
1	Whalen	110
2	Hartstein	110
3	Fay	110

...

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 113'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
```


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 ]    ;
```

The example in the slide can also be written as follows:

```
UPDATE employees
SET (job_id, salary)  = (SELECT  job_id, salary
                     FROM    employees
                     WHERE   employee_id = 205)
WHERE    employee_id    =  113;
```

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
```


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 transactions 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];
```


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

In the syntax:

table	Is the name of the table
condition	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 10*g* or 11*g* 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
```


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';

0 rows selected
```

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;

1 rows deleted

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

2 rows deleted
```

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
```


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;
```


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.
- Truncating a table does not fire the delete triggers of the table.

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 “Using DDL Statements to Create and Manage Tables.”

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 transactions 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

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.

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.

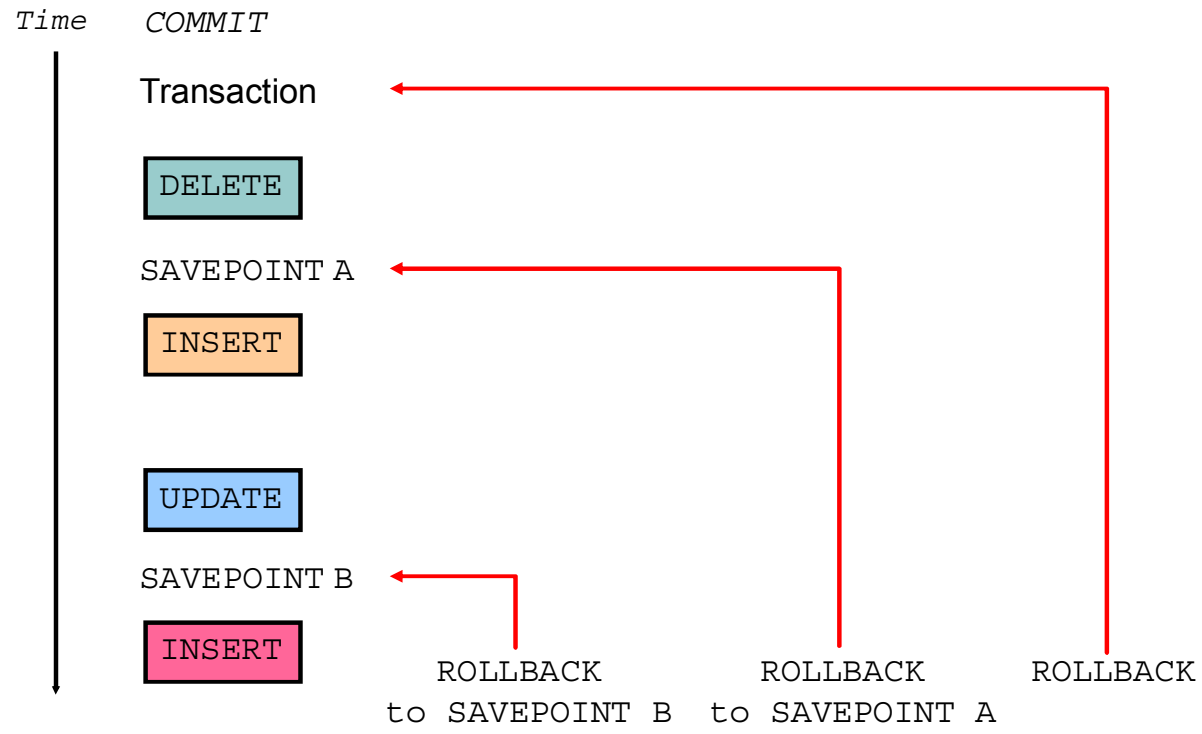
Advantages of COMMIT and ROLLBACK Statements

With COMMIT and ROLLBACK statements, you can:

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

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

Explicit Transaction Control Statements



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 *name*	SAVEPOINT *name* marks a savepoint within the current transaction.
ROLLBACK	ROLLBACK ends the current transaction by discarding all pending data changes.
ROLLBACK TO *SAVEPOINT name*	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.
```


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 up 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.

Status	Circumstances
Automatic commit	DDL statement or DCL statement issued SQL Developer or SQL*Plus exited normally, without explicitly issuing `COMMIT` or `ROLLBACK` 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 the Data Before COMMIT or ROLLBACK

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

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 user can review the results of the data manipulation operations by querying the tables.
- Other users cannot view the results of the data manipulation operations made by the current user. The Oracle server institutes read consistency to ensure that each user sees data as it existed at the last commit.
- The affected rows are locked; other users cannot change the data in the affected rows.

State of the Data After COMMIT

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

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 users can view the results of the transaction.
- The locks on the affected rows are released; the rows are now available for other users to perform new data changes.
- All savepoints are erased.

Committing Data

- Make the changes:

```
DELETE FROM employees
WHERE  employee_id = 99999;
1 rows deleted

INSERT INTO departments
VALUES (290, 'Corporate Tax', NULL, 1700);
1 rows inserted
```

- Commit the changes:

```
COMMIT;
COMMIT succeeded.
```

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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 the 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 ;
```


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 the Data After ROLLBACK: Example

```
DELETE FROM test;
25,000 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.
```


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.

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 transactions 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

Database users access the database in two ways:

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

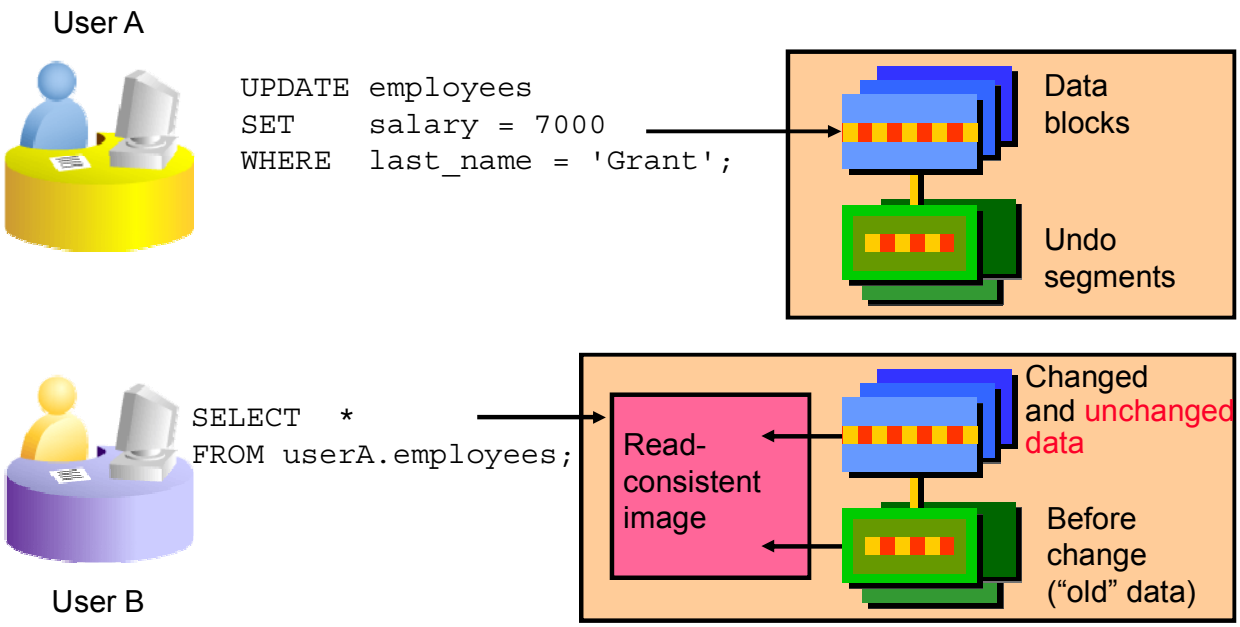
You need read consistency so that the following occur:

- 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



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 transactions 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.

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

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

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

Using DDL Statements to Create and Manage Tables

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

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:
  - Access another user's tables
  - `DEFAULT` option
- Data types
- Overview of constraints: `NOT NULL`, `UNIQUE`, `PRIMARY KEY`, `FOREIGN KEY`, `CHECK` constraints
- Creating a table using a subquery
- `ALTER TABLE`
  - Read-only tables
- `DROP TABLE` statement

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Database Objects

Object	Description
Table	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

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:** Subset 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

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

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 10*g* or 11*g* database.

Lesson Agenda

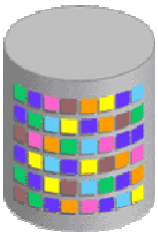
- Database objects
  - Naming rules
- `CREATE TABLE` statement:
  - Access another user's tables
  - `DEFAULT` option
- Data types
- Overview of constraints: `NOT NULL`, `UNIQUE`, `PRIMARY KEY`, `FOREIGN KEY`, `CHECK` constraints
- Creating a table using a subquery
- `ALTER TABLE`
  - Read-only tables
- `DROP TABLE` statement

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



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.

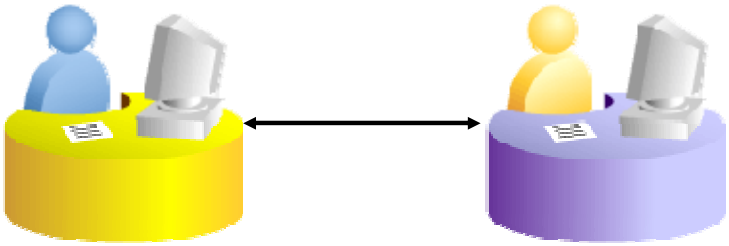
In the syntax:

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

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

Referencing Another User's Tables

- Tables belonging to other users are not in the user's schema.
- You should use the owner's name as a prefix to those tables.



USERA

```
SELECT *
FROM userB.employees;
```

USERB

```
SELECT *
FROM userA.employees;
```


A schema is a collection of logical structures of data or *schema objects*. A schema is owned by a database user and has the same name as that user. Each user owns a single schema.

Schema objects can be created and manipulated with SQL and include tables, views, synonyms, sequences, stored procedures, indexes, clusters, and database links.

If a table does not belong to the user, the owner's name must be prefixed to the table. For example, if there are schemas named `USERA` and `USERB`, and both have an `EMPLOYEES` table, then if `USERA` wants to access the `EMPLOYEES` table that belongs to `USERB`, `USERA` must prefix the table name with the schema name:

```
SELECT *
FROM   userb.employees;
```

If `USERB` wants to access the `EMPLOYEES` table that is owned by `USERA`, `USERB` must prefix the table name with the schema name:

```
SELECT *
FROM   usera.employees;
```

DEFAULT Option

- Specify a default value for a column during an insert.

```
... 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 above statement will insert the null value rather than the default value.

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

The above 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.

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
```

ORACLE

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 you own by querying the data dictionary. For 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 Fundaments II* course.

Lesson Agenda

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

Data Type	Description
VARCHAR2(*size*)	Variable-length character data
CHAR(*size*)	Fixed-length character data
NUMBER(*p*,*s*)	Variable-length numeric data
DATE	Date and time values
LONG	Variable-length character data (up to 2 GB)
CLOB	Character data (up to 4 GB)
RAW and LONG RAW	Raw binary data
BLOB	Binary data (up to 4 GB)
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

ORACLE

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(*size*)	Variable-length character data (A maximum *size* must be specified: minimum *size* is 1; maximum *size* is 4,000.)
CHAR [(*size*)]	Fixed-length character data of length *size* bytes (Default and minimum *size* is 1; maximum *size* is 2,000.)
NUMBER [(*p*,*s*)]	Number having precision *p* and scale *s* (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.
LONG	Variable-length character data (up to 2 GB)
CLOB	Character data (up to 4 GB)

Data Type	Description
RAW(*size*)	Raw binary data of length *size* (A maximum *size* must be specified: maximum *size* is 2,000.)
LONG RAW	Raw binary data of variable length (up to 2 GB)
BLOB	Binary data (up to 4 GB)
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

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

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 DATE data type as well as the fractional seconds value There are several variations of this data type such as WITH TIMEZONE, WITH LOCALTIMEZONE.
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 Oracle9*i* 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 Fundamentals 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 10*g* or 11*g* database.

Lesson Agenda

- Database objects
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Including Constraints

- Constraints enforce rules at the table level.
- Constraints prevent the deletion of a table and its contents if there are dependencies.
- The following constraint types are valid:
  - NOT NULL
  - UNIQUE
  - PRIMARY KEY
  - FOREIGN KEY
  - CHECK

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.

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 10*g* or 11*g* 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 must be defined at the column level.

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

In the syntax:

`schema`	Is the same as the owner's name
`table`	Is the name of the table
`DEFAULT expr`	Specifies a default value to be used if a value is omitted in the `INSERT` statement
`column`	Is the name of the column
`datatype`	Is the column's data type and length
`column_constraint`	Is an integrity constraint as part of the column definition
`table_constraint`	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	WGIETZ	515.123.8181	07-JUN-94

NOT NULL constraint (Primary Key enforces NOT NULL constraint.)

NOT NULL constraint

Absence of NOT NULL constraint (Any row can contain a null value for this column.)

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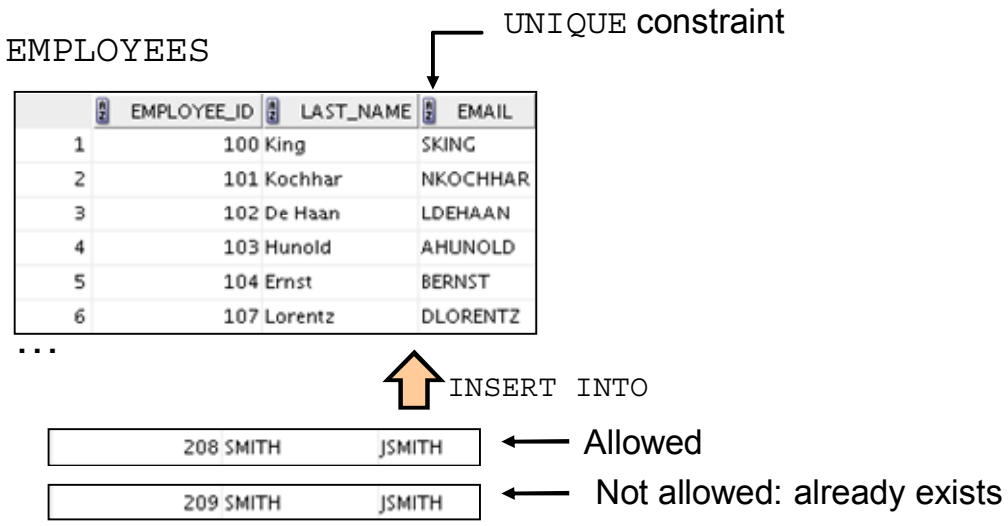
The NOT NULL constraint ensures that the column contains no null values. Columns without the NOT NULL constraint can contain null values by default. NOT NULL constraints must be defined at the column level. In the EMPLOYEES table, the EMPLOYEE_ID column inherits a NOT NULL constraint as it is defined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

Note: Primary key constraint is discussed in detail later in this lesson.

UNIQUE Constraint



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:

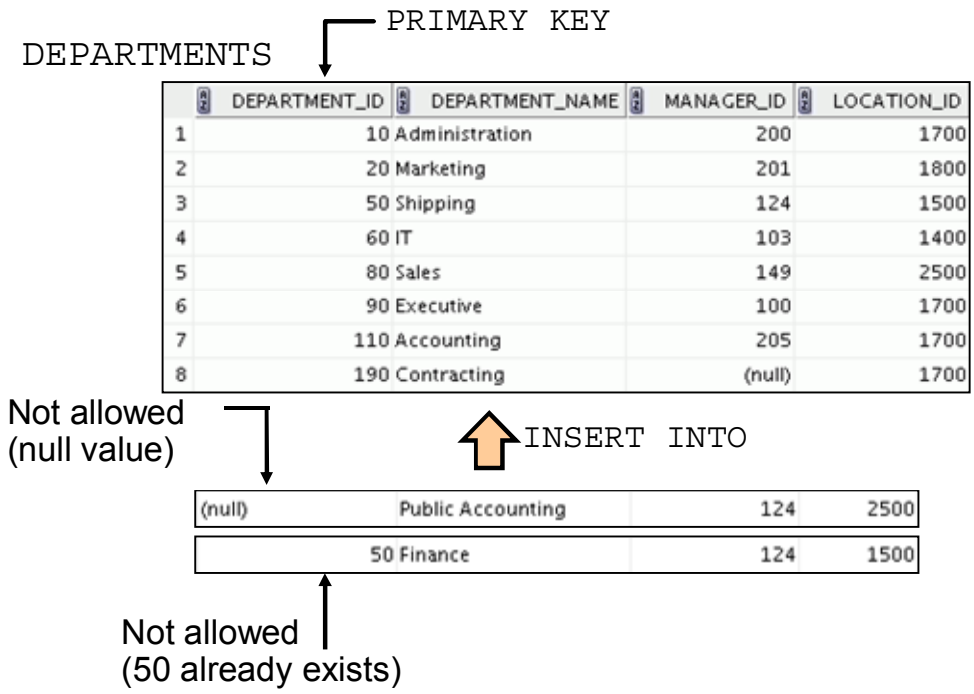
```
CREATE TABLE employees(
    employee_id      NUMBER(6),
    last_name        VARCHAR2(25) NOT NULL,
    email            VARCHAR2(25),
    salary           NUMBER(8,2),
    commission_pct   NUMBER(2,2),
    hire_date        DATE NOT NULL,
...
    CONSTRAINT emp_email_uk UNIQUE(email));
```


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

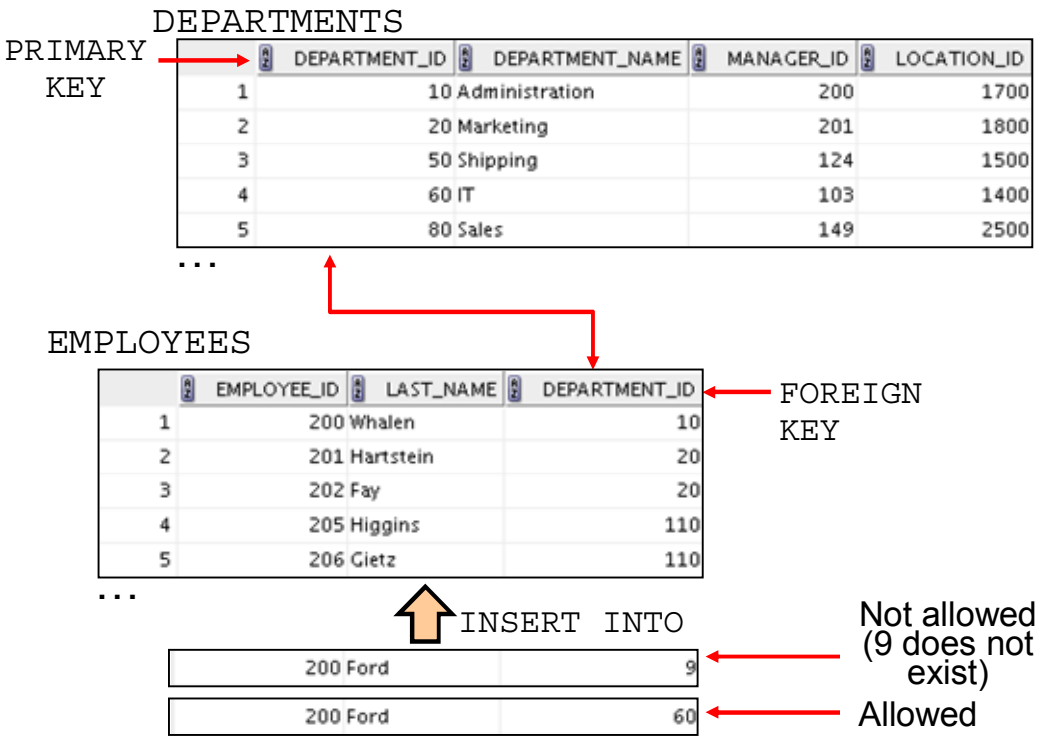


ORACLE

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



ORACLE

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));
```


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. For 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

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.

CHECK Constraint

- Defines a condition that each row must satisfy
- The following expressions are not allowed:
  - References to CURRVAL, NEXTVAL, LEVEL, and ROWNUM pseudocolumns
  - Calls to SYSDATE, UID, USER, and USERENV functions
  - Queries that refer to other values in other rows

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


The CHECK constraint defines a condition that each row must satisfy. The condition can use the same constructs as the query conditions, with the following exceptions:

- References to the CURRVAL, NEXTVAL, LEVEL, and ROWNUM pseudocolumns
- Calls to SYSDATE, UID, USER, and USERENV functions
- 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 employees
    ( employee_id    NUMBER(6)
        CONSTRAINT     emp_employee_id   PRIMARY KEY
    , first_name     VARCHAR2(20)
    , last_name      VARCHAR2(25)
        CONSTRAINT     emp_last_name_nn  NOT NULL
    , email          VARCHAR2(25)
        CONSTRAINT     emp_email_nn      NOT NULL
        CONSTRAINT     emp_email_uk      UNIQUE
    , phone_number   VARCHAR2(20)
    , hire_date      DATE
        CONSTRAINT     emp_hire_date_nn  NOT NULL
    , job_id         VARCHAR2(10)
        CONSTRAINT     emp_job_nn        NOT NULL
    , salary         NUMBER(8,2)
        CONSTRAINT     emp_salary_ck     CHECK (salary>0)
    , commission_pct NUMBER(2,2)
    , manager_id     NUMBER(6)
         CONSTRAINT emp_manager_fk REFERENCES
          employees (employee_id)
    , department_id  NUMBER(4)
        CONSTRAINT     emp_dept_fk       REFERENCES
          departments (department_id));
```

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The example in the slide shows the statement that is used to create the EMPLOYEES table in the HR schema.

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.

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.
```


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;
```

```
0 rows deleted.
```

Lesson Agenda

- Database objects
  - Naming rules
- `CREATE TABLE` statement:
  - Access another user's tables
  - `DEFAULT` option
- Data types
- Overview of constraints: `NOT NULL`, `UNIQUE`, `PRIMARY KEY`, `FOREIGN KEY`, `CHECK` constraints
- Creating a table using a subquery
- `ALTER TABLE`
  - Read-only tables
- `DROP TABLE` statement

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.

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:

table	Is the name of the table
column	Is the name of the column, default value, and integrity constraint
subquery	Is the `SELECT` 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
- `CREATE TABLE` statement:
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  - `DEFAULT` option
- Data types
- Overview of constraints: `NOT NULL`, `UNIQUE`, `PRIMARY KEY`, `FOREIGN KEY`, `CHECK` constraints
- Creating a table using a subquery
- `ALTER TABLE`
  - Read-only tables
- `DROP TABLE` statement

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

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 the read-only mode

You can do this by using the ALTER TABLE statement.

Read-Only Tables

You can use the ALTER TABLE syntax to:

- Put a table into 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;
```


With Oracle Database 11*g,* you can specify READ ONLY to place a table in the read-only mode. When the table is in the 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 the READ ONLY mode.

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

Note: You can drop a table that is in the 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: SQL Fundamentals II*.

Lesson Agenda

- Database objects
  - Naming rules
- `CREATE TABLE` statement:
  - Access another user's tables
  - `DEFAULT` option
- Data types
- Overview of constraints: `NOT NULL`, `UNIQUE`, `PRIMARY KEY`, `FOREIGN KEY`, `CHECK` constraints
- Creating a table using a subquery
- `ALTER TABLE`
  - Read-only tables
- `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.
```


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 towards 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 the 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: SQL Fundamentals 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.

Answer: a, b, d

Summary

In this lesson, you should have learned how to use the `CREATE TABLE` statement to create a table 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

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
- Setting a table to read-only status
- Dropping tables

Create new tables by using the `CREATE TABLE` statement. 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 the `DDL` and `DML` statements, click the Run Script icon (or press [F5]) to execute the query in SQL Developer. This way 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.

12

Creating Other Schema Objects

Objectives

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

- Create simple and complex views
- Retrieve data from views
- Create, maintain, and use sequences
- Create and maintain indexes
- Create private and public synonyms

In this lesson, you are introduced to the view, sequence, synonym, and index objects. You learn the basics of creating and using views, sequences, and indexes.

Lesson Agenda

- Overview of views:
  - Creating, modifying, and retrieving data from a view
  - Data manipulation language (DML) operations on a view
  - Dropping a view
- Overview of sequences:
  - Creating, using, and modifying a sequence
  - Cache sequence values
  - `NEXTVAL` and `CURRVAL` pseudocolumns
- Overview of indexes
  - Creating, dropping indexes
- Overview of synonyms
  - Creating, dropping synonyms

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Database Objects

Object	Description
Table	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 data retrieval queries
Synonym	Gives alternative names to objects

ORACLE

There are several other objects in a database in addition to tables.

With views, you can present and hide data from the tables.

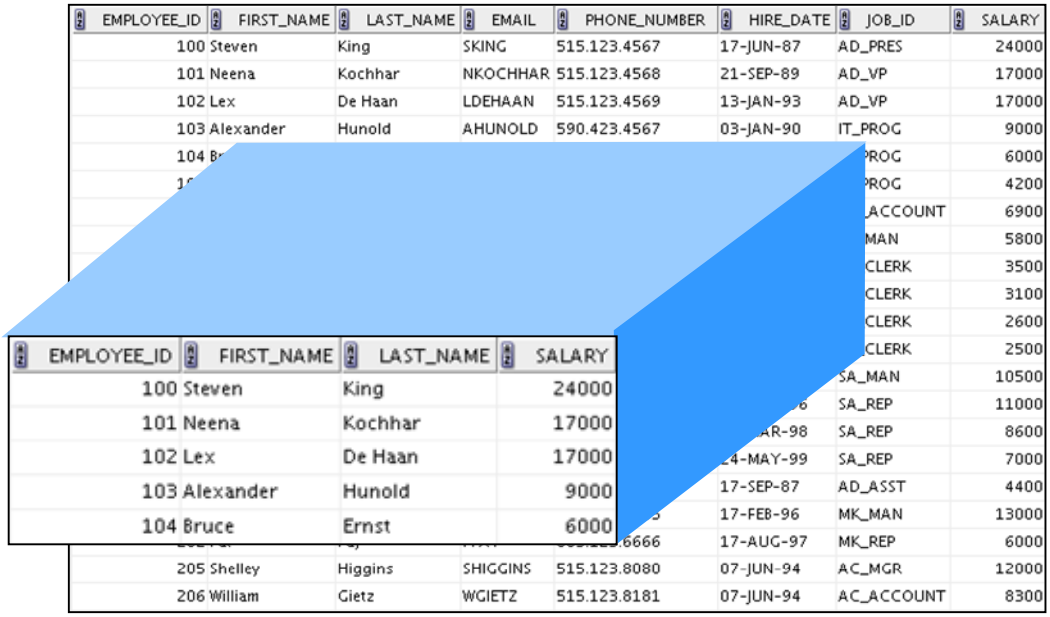
Many applications require the use of unique numbers as primary key values. You can either build code into the application to handle this requirement or use a sequence to generate unique numbers.

If you want to improve the performance of data retrieval queries, you should consider creating an index. You can also use indexes to enforce uniqueness on a column or a collection of columns.

You can provide alternative names for objects by using synonyms.

What Is a View?

EMPLOYEES table



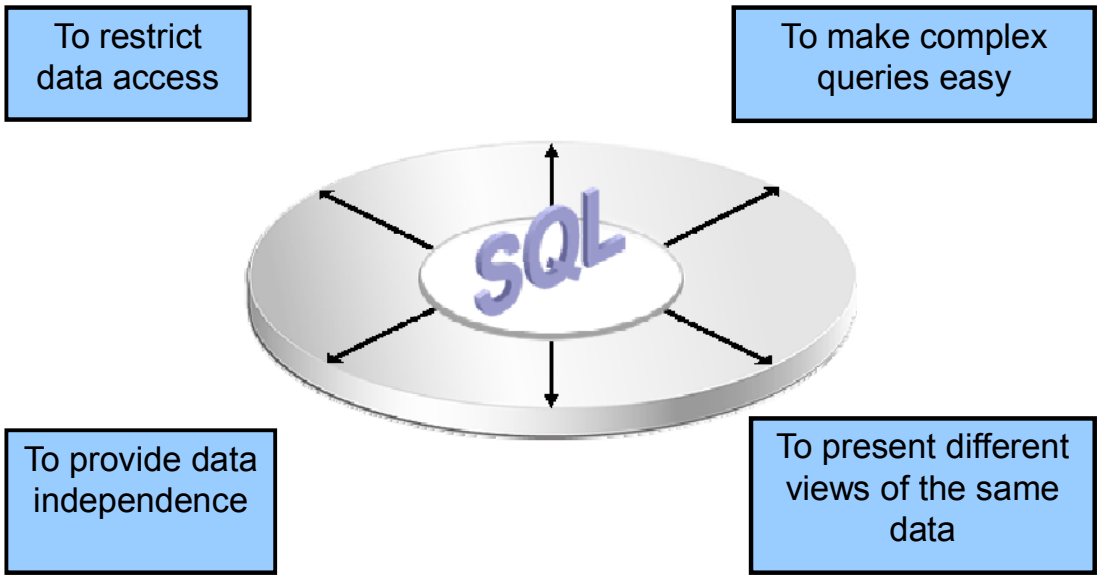
EMPLOYEE_ID	FIRST_NAME	LAST_NAME	EMAIL	PHONE_NUMBER	HIRE_DATE	JOB_ID	SALARY
100	Steven	King	SKING	515.123.4567	17-JUN-87	AD_PRES	24000
101	Neena	Kochhar	NKOCHHAR	515.123.4568	21-SEP-89	AD_VP	17000
102	Lex	De Haan	LDEHAAN	515.123.4569	13-JAN-93	AD_VP	17000
103	Alexander	Hunold	AHUNOLD	590.423.4567	03-JAN-90	IT_PROG	9000
104	Bruce	Ernst				PROG	6000
						PROG	4200
						ACCOUNT	6900
						MAN	5800
						CLERK	3500
						CLERK	3100
						CLERK	2600
						CLERK	2500
						SA_MAN	10500
						SA_REP	11000
					AR-98	SA_REP	8600
					4-MAY-99	SA_REP	7000
					17-SEP-87	AD_ASST	4400
					17-FEB-96	MK_MAN	13000
				6666	17-AUG-97	MK_REP	6000
205	Shelley	Higgins	SHIGGINS	515.123.8080	07-JUN-94	AC_MGR	12000
206	William	Gietz	WGIETZ	515.123.8181	07-JUN-94	AC_ACCOUNT	8300

EMPLOYEE_ID	FIRST_NAME	LAST_NAME	SALARY
100	Steven	King	24000
101	Neena	Kochhar	17000
102	Lex	De Haan	17000
103	Alexander	Hunold	9000
104	Bruce	Ernst	6000

ORACLE

You can present logical subsets or combinations of data by creating views of tables. A view is a logical table based on a table or another view. A view contains no data of its own, but is like a window through which data from tables can be viewed or changed. The tables on which a view is based are called *base tables*. The view is stored as a `SELECT` statement in the data dictionary.

Advantages of Views



- Views restrict access to the data because it displays selected columns from the table.
- Views can be used to make simple queries to retrieve the results of complicated queries. For example, views can be used to query information from multiple tables without the user knowing how to write a join statement.
- Views provide data independence for ad hoc users and application programs. One view can be used to retrieve data from several tables.
- Views provide groups of users access to data according to their particular criteria.

For more information, see the "`CREATE VIEW`" section in *Oracle Database SQL Language Reference* for 10*g* or 11*g* database.

Simple Views and Complex Views

Feature	Simple Views	Complex Views
Number of tables	One	One or more
Contain functions	No	Yes
Contain groups of data	No	Yes
DML operations through a view	Yes	Not always

There are two classifications for views: simple and complex. The basic difference is related to the DML (`INSERT`, `UPDATE`, and `DELETE`) operations.

- A simple view is one that:
  - Derives data from only one table
  - Contains no functions or groups of data
  - Can perform DML operations through the view
- A complex view is one that:
  - Derives data from many tables
  - Contains functions or groups of data
  - Does not always allow DML operations through the view

Creating a View

- You embed a subquery in the CREATE VIEW statement:

```
CREATE [OR REPLACE] [FORCE|NOFORCE] VIEW view
  [(alias[, alias]...)]
 AS subquery
[WITH CHECK OPTION [CONSTRAINT constraint]]
[WITH READ ONLY [CONSTRAINT constraint]];
```

- The subquery can contain complex SELECT syntax.

You can create a view by embedding a subquery in the CREATE VIEW statement.

In the syntax:

OR REPLACE	Re-creates the view if it already exists
FORCE	Creates the view regardless of whether or not the base tables exist
NOFORCE	Creates the view only if the base tables exist (This is the default.)
view	Is the name of the view
alias	Specifies names for the expressions selected by the view's query (The number of aliases must match the number of expressions selected by the view.)
subquery	Is a complete SELECT statement (You can use aliases for the columns in the SELECT list.)
WITH CHECK OPTION	Specifies that only those rows that are accessible to the view can be inserted or updated
constraint	Is the name assigned to the CHECK OPTION constraint
WITH READ ONLY	Ensures that no DML operations can be performed on this view

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

Creating a View

- Create the EMPVU80 view, which contains details of the employees in department 80:

```
CREATE VIEW  empvu80
 AS SELECT  employee_id, last_name, salary
    FROM    employees
    WHERE   department_id = 80;
view EMPVU80 created.
```

- Describe the structure of the view by using the SQL*Plus DESCRIBE command:

```
DESCRIBE empvu80;
```


The example in the slide creates a view that contains the employee number, last name, and salary for each employee in department 80.

You can display the structure of the view by using the DESCRIBE command.

```
Name                          Null     Type
----------------------------- -------- --------------
EMPLOYEE_ID                   NOT NULL NUMBER(6)
LAST_NAME                     NOT NULL VARCHAR2(25)
SALARY                                 NUMBER(8,2)
```

Guidelines

- The subquery that defines a view can contain complex SELECT syntax, including joins, groups, and subqueries.
- If you do not specify a constraint name for the view created with the WITH CHECK OPTION, the system assigns a default name in the SYS_C*n* format.
- You can use the OR REPLACE option to change the definition of the view without dropping and re-creating it, or regranting the object privileges previously granted on it.

Creating a View

- Create a view by using column aliases in the subquery:

```
CREATE VIEW  salvu50
 AS SELECT  employee_id ID_NUMBER, last_name NAME,
            salary*12 ANN_SALARY
    FROM    employees
    WHERE   department_id = 50;
view SALVU50 created.
```

- Select the columns from this view by the given alias names.

You can control the column names by including column aliases in the subquery.

The example in the slide creates a view containing the employee number (EMPLOYEE_ID) with the alias ID_NUMBER, name (LAST_NAME) with the alias NAME, and annual salary (SALARY) with the alias ANN_SALARY for every employee in department 50.

Alternatively, you can use an alias after the CREATE statement and before the SELECT subquery. The number of aliases listed must match the number of expressions selected in the subquery.

```
CREATE OR REPLACE VIEW salvu50 (ID_NUMBER, NAME, ANN_SALARY)
  AS SELECT  employee_id, last_name, salary*12
     FROM    employees
     WHERE   department_id = 50;

view SALVU50 created.
```

Retrieving Data from a View

```
SELECT *
FROM   salvu50;
```

	ID_NUMBER	NAME	ANN_SALARY
1	124	Mourgos	69600
2	141	Rajs	42000
3	142	Davies	37200
4	143	Matos	31200
5	144	Vargas	30000

You can retrieve data from a view as you would from any table. You can display either the contents of the entire view or just specific rows and columns.

Modifying a View

- Modify the EMPVU80 view by using a CREATE OR REPLACE VIEW clause. Add an alias for each column name:

```
CREATE OR REPLACE VIEW empvu80
  (id_number, name, sal, department_id)
AS SELECT  employee_id, first_name || ' '
           || last_name, salary, department_id
   FROM    employees
   WHERE   department_id = 80;
view EMPVU80 created.
```

- Column aliases in the CREATE OR REPLACE VIEW clause are listed in the same order as the columns in the subquery.

With the OR REPLACE option, a view can be created even if one exists with this name already, thus replacing the old version of the view for its owner. This means that the view can be altered without dropping, re-creating, and regranting object privileges.

Note: When assigning column aliases in the CREATE OR REPLACE VIEW clause, remember that the aliases are listed in the same order as the columns in the subquery.

Creating a Complex View

Create a complex view that contains group functions to display values from two tables:

```
CREATE OR REPLACE VIEW dept_sum_vu
  (name, minsal, maxsal, avgsal)
AS SELECT   d.department_name, MIN(e.salary),
           MAX(e.salary),AVG(e.salary)
   FROM     employees e JOIN departments d
   ON       (e.department_id = d.department_id)
   GROUP BY d.department_name;
view DEPT_SUM_VU created.
```


The example in the slide creates a complex view of department names, minimum salaries, maximum salaries, and the average salaries by department. Note that alternative names have been specified for the view. This is a requirement if any column of the view is derived from a function or an expression.

You can view the structure of the view by using the `DESCRIBE` command. Display the contents of the view by issuing a `SELECT` statement.

```
SELECT  *
FROM    dept_sum_vu;
```

	NAME	MINSAL	MAXSAL	AVGSAL
1	Administration	4400	4400	4400
2	Accounting	8300	12000	10150
3	IT	4200	9000	6400
4	Executive	17000	24000	19333.333333333...
5	Shipping	2500	5800	3500
6	Sales	8600	11000	10033.333333333...
7	Marketing	6000	13000	9500

Rules for Performing DML Operations on a View

- You can usually perform DML operations on simple views.
- You cannot remove a row if the view contains the following:
  - Group functions
  - A `GROUP BY` clause
  - The `DISTINCT` keyword
  - The pseudocolumn `ROWNUM` keyword

ORACLE

- You can perform DML operations on data through a view if those operations follow certain rules.
- You can remove a row from a view unless it contains any of the following:
  - Group functions
  - A `GROUP BY` clause
  - The `DISTINCT` keyword
  - The pseudocolumn `ROWNUM` keyword

Rules for Performing DML Operations on a View

You cannot modify data in a view if it contains:

- Group functions
- A `GROUP BY` clause
- The `DISTINCT` keyword
- The pseudocolumn `ROWNUM` keyword
- Columns defined by expressions

You can modify data through a view unless it contains any of the conditions mentioned in the previous slide or columns defined by expressions (for example, `SALARY * 12`).

Rules for Performing DML Operations on a View

You cannot add data through a view if the view includes:

- Group functions
- A `GROUP BY` clause
- The `DISTINCT` keyword
- The pseudocolumn `ROWNUM` keyword
- Columns defined by expressions
- `NOT NULL` columns in the base tables that are not selected by the view

You can add data through a view unless it contains any of the items listed in the slide. You cannot add data to a view if the view contains `NOT NULL` columns without default values in the base table. All the required values must be present in the view. Remember that you are adding values directly to the underlying table *through* the view.

For more information, see the "`CREATE VIEW`" section in *Oracle Database SQL Language Reference* for 10*g* or 11*g* database.

Using the WITH CHECK OPTION Clause

- You can ensure that DML operations performed on the view stay in the domain of the view by using the WITH CHECK OPTION clause:

```
CREATE OR REPLACE VIEW empvu20
AS SELECT    *
   FROM      employees
   WHERE     department_id = 20
   WITH CHECK OPTION CONSTRAINT empvu20_ck ;
view EMPVU20 created.
```

- Any attempt to INSERT a row with a department_id other than 20, or to UPDATE the department number for any row in the view fails because it violates the WITH CHECK OPTION constraint.

It is possible to perform referential integrity checks through views. You can also enforce constraints at the database level. The view can be used to protect data integrity, but the use is very limited.

The WITH CHECK OPTION clause specifies that INSERTs and UPDATEs performed through the view cannot create rows that the view cannot select. Therefore, it enables integrity constraints and data validation checks to be enforced on data being inserted or updated. If there is an attempt to perform DML operations on rows that the view has not selected, an error is displayed, along with the constraint name if that has been specified.

```
UPDATE empvu20
SET    department_id = 10
WHERE  employee_id = 201;
```

causes:

```
Error report:
SQL Error: ORA-01402: view WITH CHECK OPTION where-clause violation
01402. 00000 -  "view WITH CHECK OPTION where-clause violation"
```

Note: No rows are updated because, if the department number were to change to 10, the view would no longer be able to see that employee. With the WITH CHECK OPTION clause, therefore, the view can see only the employees in department 20 and does not allow the department number for those employees to be changed through the view.

Denying DML Operations

- You can ensure that no DML operations occur by adding the `WITH READ ONLY` option to your view definition.
- Any attempt to perform a DML operation on any row in the view results in an Oracle server error.

You can ensure that no DML operations occur on your view by creating it with the `WITH READ ONLY` option. The example in the next slide modifies the `EMPVU10` view to prevent any DML operations on the view.

Denying DML Operations

```
CREATE OR REPLACE VIEW empvu10
    (employee_number, employee_name, job_title)
AS SELECT    employee_id, last_name, job_id
   FROM     employees
   WHERE    department_id = 10
   WITH READ ONLY ;
view EMPVU10 created.
```


Any attempt to remove a row from a view with a read-only constraint results in an error:

```
DELETE FROM empvu10
WHERE  employee_number = 200;
```

Similarly, any attempt to insert a row or modify a row using the view with a read-only constraint results in the same error.

```
Error report:
SQL Error: ORA-42399: cannot perform a DML operation on a read-only view
```

Removing a View

You can remove a view without losing data because a view is based on underlying tables in the database.

```
DROP VIEW view;
```

```
DROP VIEW empvu80;
view EMPVU80 dropped.
```


You use the `DROP VIEW` statement to remove a view. The statement removes the view definition from the database. However, dropping views has no effect on the tables on which the view was based. Alternatively, views or other applications based on the deleted views become invalid. Only the creator or a user with the `DROP ANY VIEW` privilege can remove a view.

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

Practice 12: Overview of Part 1

This practice covers the following topics:

- Creating a simple view
- Creating a complex view
- Creating a view with a check constraint
- Attempting to modify data in the view
- Removing views

Part 1 of this lesson's practice provides you with a variety of exercises in creating, using, and removing views.

Lesson Agenda

- Overview of views:
  - Creating, modifying, and retrieving data from a view
  - DML operations on a view
  - Dropping a view
- Overview of sequences:
  - Creating, using, and modifying a sequence
  - Cache sequence values
  - `NEXTVAL` and `CURRVAL` pseudocolumns
- Overview of indexes
  - Creating, dropping indexes
- Overview of synonyms
  - Creating, dropping synonyms

Sequences

Object	Description
Table	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 names to objects

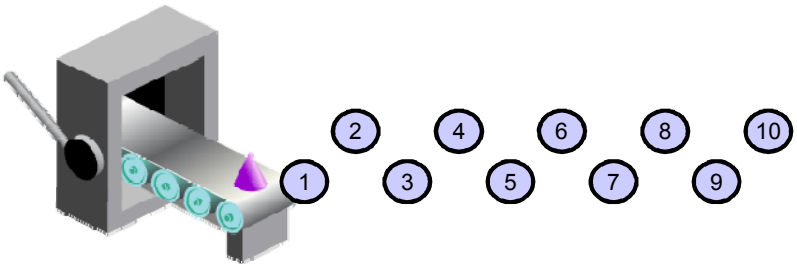
ORACLE

A sequence is a database object that creates integer values. You can create sequences and then use them to generate numbers.

Sequences

A sequence:

- Can automatically generate unique numbers
- Is a shareable object
- Can be used to create a primary key value
- Replaces application code
- Speeds up the efficiency of accessing sequence values when cached in memory



A sequence is a user-created database object that can be shared by multiple users to generate integers.

You can define a sequence to generate unique values or to recycle and use the same numbers again.

A typical usage for sequences is to create a primary key value, which must be unique for each row. A sequence is generated and incremented (or decremented) by an internal Oracle routine. This can be a time-saving object because it can reduce the amount of application code needed to write a sequence-generating routine.

Sequence numbers are stored and generated independent of tables. Therefore, the same sequence can be used for multiple tables.

CREATE SEQUENCE Statement: Syntax

Define a sequence to generate sequential numbers automatically:

```
CREATE SEQUENCE sequence
       [INCREMENT BY n]
       [START WITH n]
       [{MAXVALUE n | NOMAXVALUE}]
       [{MINVALUE n | NOMINVALUE}]
       [{CYCLE | NOCYCLE}]
       [{CACHE n | NOCACHE}];
```


Automatically generate sequential numbers by using the CREATE SEQUENCE statement.

In the syntax:

sequence	Is the name of the sequence generator
INCREMENT BY *n*	Specifies the interval between sequence numbers, where *n* is an integer (If this clause is omitted, the sequence increments by 1.)
START WITH *n*	Specifies the first sequence number to be generated (If this clause is omitted, the sequence starts with 1.)
MAXVALUE *n*	Specifies the maximum value the sequence can generate
NOMAXVALUE	Specifies a maximum value of 10^27 for an ascending sequence and –1 for a descending sequence (This is the default option.)
MINVALUE *n*	Specifies the minimum sequence value
NOMINVALUE	Specifies a minimum value of 1 for an ascending sequence and –(10^26) for a descending sequence (This is the default option.)

Creating a Sequence

- Create a sequence named DEPT_DEPTID_SEQ to be used for the primary key of the DEPARTMENTS table.
- Do not use the CYCLE option.

```
CREATE SEQUENCE dept_deptid_seq
                INCREMENT BY 10
                START WITH 120
                MAXVALUE 9999
                NOCACHE
                NOCYCLE;
sequence DEPT_DEPTID_SEQ created.
```


CYCLE | NOCYCLE	Specifies whether the sequence continues to generate values after reaching its maximum or minimum value (NOCYCLE is the default option.)
CACHE *n* | NOCACHE	Specifies how many values the Oracle server preallocates and keeps in memory (By default, the Oracle server caches 20 values.)

The example in the slide creates a sequence named DEPT_DEPTID_SEQ to be used for the DEPARTMENT_ID column of the DEPARTMENTS table. The sequence starts at 120, does not allow caching, and does not cycle.

Do not use the CYCLE option if the sequence is used to generate primary key values, unless you have a reliable mechanism that purges old rows faster than the sequence cycles.

For more information, see the "CREATE SEQUENCE" section in the *Oracle Database SQL Language Reference* for 10*g* or 11*g* database.

Note: The sequence is not tied to a table. Generally, you should name the sequence after its intended use. However, the sequence can be used anywhere, regardless of its name.

NEXTVAL and CURRVAL Pseudocolumns

- NEXTVAL returns the next available sequence value. It returns a unique value every time it is referenced, even for different users.
- CURRVAL obtains the current sequence value.
- NEXTVAL must be issued for that sequence before CURRVAL contains a value.

After you create your sequence, it generates sequential numbers for use in your tables. Reference the sequence values by using the NEXTVAL and CURRVAL pseudocolumns.

The NEXTVAL pseudocolumn is used to extract successive sequence numbers from a specified sequence. You must qualify NEXTVAL with the sequence name. When you reference *sequence*.NEXTVAL, a new sequence number is generated and the current sequence number is placed in CURRVAL.

The CURRVAL pseudocolumn is used to refer to a sequence number that the current user has just generated. However, NEXTVAL must be used to generate a sequence number in the current user's session before CURRVAL can be referenced. You must qualify CURRVAL with the sequence name. When you reference *sequence*.CURRVAL, the last value returned to that user's process is displayed.

Rules for Using NEXTVAL and CURRVAL

You can use NEXTVAL and CURRVAL in the following contexts:

- The SELECT list of a SELECT statement that is not part of a subquery
- The SELECT list of a subquery in an INSERT statement
- The VALUES clause of an INSERT statement
- The SET clause of an UPDATE statement

You cannot use NEXTVAL and CURRVAL in the following contexts:

- The SELECT list of a view
- A SELECT statement with the DISTINCT keyword
- A SELECT statement with GROUP BY, HAVING, or ORDER BY clauses
- A subquery in a SELECT, DELETE, or UPDATE statement
- The DEFAULT expression in a CREATE TABLE or ALTER TABLE statement

For more information, see the "Pseudocolumns" and "CREATE SEQUENCE" sections in *Oracle Database SQL Language Reference* for 10*g* or 11*g* database.

Using a Sequence

- Insert a new department named “Support” in location ID 2500:

```
INSERT INTO departments(department_id,
            department_name, location_id)
VALUES      (dept_deptid_seq.NEXTVAL,
            'Support', 2500);
1 rows inserted
```

- View the current value for the DEPT_DEPTID_SEQ sequence:

```
SELECT   dept_deptid_seq.CURRVAL
FROM     dual;
```

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The example in the slide inserts a new department in the DEPARTMENTS table. It uses the DEPT_DEPTID_SEQ sequence to generate a new department number as follows.

You can view the current value of the sequence using the *sequence_name*.CURRVAL, as shown in the second example in the slide. The output of the query is shown below:

	CURRVAL
1	120

Suppose that you now want to hire employees to staff the new department. The INSERT statement to be executed for all new employees can include the following code:

```
INSERT INTO employees (employee_id, department_id, ...)
VALUES (employees_seq.NEXTVAL, dept_deptid_seq .CURRVAL, ...);
```

Note: The preceding example assumes that a sequence called EMPLOYEE_SEQ has already been created to generate new employee numbers.

Caching Sequence Values

- Caching sequence values in memory gives faster access to those values.
- Gaps in sequence values can occur when:
  - A rollback occurs
  - The system crashes
  - A sequence is used in another table

You can cache sequences in memory to provide faster access to those sequence values. The cache is populated the first time you refer to the sequence. Each request for the next sequence value is retrieved from the cached sequence. After the last sequence value is used, the next request for the sequence pulls another cache of sequences into memory.

Gaps in the Sequence

Although sequence generators issue sequential numbers without gaps, this action occurs independent of a commit or rollback. Therefore, if you roll back a statement containing a sequence, the number is lost.

Another event that can cause gaps in the sequence is a system crash. If the sequence caches values in memory, those values are lost if the system crashes.

Because sequences are not tied directly to tables, the same sequence can be used for multiple tables. However, if you do so, each table can contain gaps in the sequential numbers.

Modifying a Sequence

Change the increment value, maximum value, minimum value, cycle option, or cache option:

```
ALTER SEQUENCE dept_deptid_seq
               INCREMENT BY 20
               MAXVALUE 999999
               NOCACHE
               NOCYCLE;
```

```
sequence DEPT_DEPTID_SEQ altered.
```


If you reach the `MAXVALUE` limit for your sequence, no additional values from the sequence are allocated and you will receive an error indicating that the sequence exceeds the `MAXVALUE`. To continue to use the sequence, you can modify it by using the `ALTER SEQUENCE` statement.

Syntax

```
ALTER  SEQUENCE    sequence
      [INCREMENT BY n]
      [{MAXVALUE n | NOMAXVALUE}]
      [{MINVALUE n | NOMINVALUE}]
      [{CYCLE | NOCYCLE}]
      [{CACHE n | NOCACHE}];
```

In the syntax, *sequence* is the name of the sequence generator.

For more information, see the section on "`ALTER SEQUENCE`" in *Oracle Database SQL Language Reference for 10g or 11g database*.

Guidelines for Modifying a Sequence

- You must be the owner or have the ALTER privilege for the sequence.
- Only future sequence numbers are affected.
- The sequence must be dropped and re-created to restart the sequence at a different number.
- Some validation is performed.
- To remove a sequence, use the DROP statement:

```
DROP SEQUENCE dept_deptid_seq;
sequence DEPT_DEPTID_SEQ dropped.
```


- You must be the owner or have the ALTER privilege for the sequence to modify it. You must be the owner or have the DROP ANY SEQUENCE privilege to remove it.
- Only future sequence numbers are affected by the ALTER SEQUENCE statement.
- The START WITH option cannot be changed using ALTER SEQUENCE. The sequence must be dropped and re-created to restart the sequence at a different number.
- Some validation is performed. For example, a new MAXVALUE that is less than the current sequence number cannot be imposed.

```
ALTER SEQUENCE dept_deptid_seq
      INCREMENT BY 20
      MAXVALUE 90
      NOCACHE
      NOCYCLE;
```

- The error:

```
Error report:
SQL Error: ORA-04009: MAXVALUE cannot be made to be less than the current value
04009. 00000 -  "MAXVALUE cannot be made to be less than the current value"
*Cause:    the current value exceeds the given MAXVALUE
*Action:   make sure that the new MAXVALUE is larger than the current value
```

Lesson Agenda

- Overview of views:
  - Creating, modifying, and retrieving data from a view
  - DML operations on a view
  - Dropping a view
- Overview of sequences:
  - Creating, using, and modifying a sequence
  - Cache sequence values
  - `NEXTVAL` and `CURRVAL` pseudocolumns
- Overview of indexes
  - Creating, dropping indexes
- Overview of synonyms
  - Creating, dropping synonyms

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Indexes

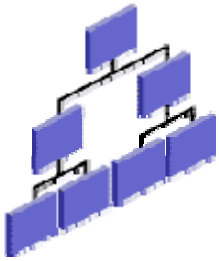
Object	Description
Table	Basic unit of storage; composed of rows
View	Logically represents subsets of data from one or more tables
Sequence	Generates numeric values
Index	Improves the performance of some queries
Synonym	Gives alternative names to objects

Indexes are database objects that you can create to improve the performance of some queries. Indexes can also be created automatically by the server when you create a primary key or a unique constraint.

Indexes

An index:

- Is a schema object
- Can be used by the Oracle server to speed up the retrieval of rows by using a pointer
- Can reduce disk input/output (I/O) by using a rapid path access method to locate data quickly
- Is dependent on the table that it indexes
- Is used and maintained automatically by the Oracle server



An Oracle server index is a schema object that can speed up the retrieval of rows by using a pointer. Indexes can be created explicitly or automatically. If you do not have an index on the column, a full table scan occurs.

An index provides direct and fast access to rows in a table. Its purpose is to reduce the disk I/O by using an indexed path to locate data quickly. An index is used and maintained automatically by the Oracle server. After an index is created, no direct activity is required by the user.

Indexes are logically and physically independent of the table that they index. This means that they can be created or dropped at any time, and have no effect on the base tables or other indexes.

Note: When you drop a table, the corresponding indexes are also dropped.

For more information, see the section on “Schema Objects: Indexes” in *Oracle Database Concepts for 10g or 11g database*.

How Are Indexes Created?

- Automatically: A unique index is created automatically when you define a `PRIMARY KEY` or `UNIQUE` constraint in a table definition.

- Manually: Users can create nonunique indexes on columns to speed up access to the rows.

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You can create two types of indexes.

- **Unique index:** The Oracle server automatically creates this index when you define a column in a table to have a `PRIMARY KEY` or a `UNIQUE` constraint. The name of the index is the name that is given to the constraint.
- **Nonunique index:** This is an index that a user can create. For example, you can create the `FOREIGN KEY` column index for a join in a query to improve the speed of retrieval.

Note: You can manually create a unique index, but it is recommended that you create a unique constraint, which implicitly creates a unique index.

Creating an Index

- Create an index on one or more columns:

```
CREATE [UNIQUE][BITMAP]INDEX index
ON table (column[, column]...);
```

- Improve the speed of query access to the LAST_NAME column in the EMPLOYEES table:

```
CREATE INDEX emp_last_name_idx
ON employees(last_name);
index EMP_LAST_NAME_IDX created.
```

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Create an index on one or more columns by issuing the CREATE INDEX statement.

In the syntax:

- index Is the name of the index
- table Is the name of the table
- Column Is the name of the column in the table to be indexed

Specify UNIQUE to indicate that the value of the column (or columns) upon which the index is based must be unique. Specify BITMAP to indicate that the index is to be created with a bitmap for each distinct key, rather than indexing each row separately. Bitmap indexes store the rowids associated with a key value as a bitmap.

For more information, see the section on "CREATE INDEX" in *Oracle Database SQL Language Reference*.

Index Creation Guidelines

	Create an index when:
✓	A column contains a wide range of values
✓	A column contains a large number of null values
✓	One or more columns are frequently used together in a `WHERE` clause or a join condition
✓	The table is large and most queries are expected to retrieve less than 2% to 4% of the rows in the table
	Do not create an index when:
✗	The columns are not often used as a condition in the query
✗	The table is small or most queries are expected to retrieve more than 2% to 4% of the rows in the table
✗	The table is updated frequently
✗	The indexed columns are referenced as part of an expression

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More Is Not Always Better

Having more indexes on a table does not produce faster queries. Each DML operation that is committed on a table with indexes means that the indexes must be updated. The more indexes that you have associated with a table, the more effort the Oracle server must make to update all the indexes after a DML operation.

When to Create an Index

Therefore, you should create indexes only if:

- The column contains a wide range of values
- The column contains a large number of null values
- One or more columns are frequently used together in a `WHERE` clause or join condition
- The table is large and most queries are expected to retrieve less than 2% to 4% of the rows

Remember that if you want to enforce uniqueness, you should define a unique constraint in the table definition. A unique index is then created automatically.

Removing an Index

- Remove an index from the data dictionary by using the `DROP INDEX` command:

```
DROP INDEX index;
```

- Remove the `emp_last_name_idx` index from the data dictionary:

```
DROP INDEX emp_last_name_idx;
index EMP_LAST_NAME_IDX dropped.
```

- To drop an index, you must be the owner of the index or have the `DROP ANY INDEX` privilege.

You cannot modify indexes. To change an index, you must drop it and then re-create it.

Remove an index definition from the data dictionary by issuing the `DROP INDEX` statement. To drop an index, you must be the owner of the index or have the `DROP ANY INDEX` privilege.

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

Note: If you drop a table, indexes and constraints are automatically dropped but views and sequences remain.

Lesson Agenda

- Overview of views:
  - Creating, modifying, and retrieving data from a view
  - DML operations on a view
  - Dropping a view
- Overview of sequences:
  - Creating, using, and modifying a sequence
  - Cache sequence values
  - `NEXTVAL` and `CURRVAL` pseudocolumns
- Overview of indexes
  - Creating, dropping indexes
- Overview of synonyms
  - Creating, dropping synonyms

Synonyms

Object	Description
Table	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 names to objects

Synonyms are database objects that enable you to call a table by another name. You can create synonyms to give an alternative name to a table.

Creating a Synonym for an Object

Simplify access to objects by creating a synonym (another name for an object). With synonyms, you can:

- Create an easier reference to a table that is owned by another user
- Shorten lengthy object names

```
CREATE [PUBLIC] SYNONYM synonym
FOR    object;
```


To refer to a table that is owned by another user, you need to prefix the table name with the name of the user who created it, followed by a period. Creating a synonym eliminates the need to qualify the object name with the schema and provides you with an alternative name for a table, view, sequence, procedure, or other objects. This method can be especially useful with lengthy object names, such as views.

In the syntax:

`PUBLIC`	Creates a synonym that is accessible to all users
`synonym`	Is the name of the synonym to be created
`object`	Identifies the object for which the synonym is created

Guidelines

- The object cannot be contained in a package.
- A private synonym name must be distinct from all other objects that are owned by the same user.

For more information, see the section on "`CREATE SYNONYM`" in *Oracle Database SQL Language Reference for 10g or 11g database*.

Creating and Removing Synonyms

- Create a shortened name for the DEPT_SUM_VU view:

```
CREATE SYNONYM  d_sum
FOR  dept_sum_vu;
synonym D_SUM created.
```

- Drop a synonym:

```
DROP SYNONYM d_sum;
synonym D_SUM dropped.
```


Creating a Synonym

The slide example creates a synonym for the DEPT_SUM_VU view for quicker reference.

The database administrator can create a public synonym that is accessible to all users. The following example creates a public synonym named DEPT for Alice's DEPARTMENTS table:

```
CREATE PUBLIC SYNONYM  dept
FOR    alice.departments;

public synonym DEPT created.
```

Removing a Synonym

To remove a synonym, use the DROP SYNONYM statement. Only the database administrator can drop a public synonym.

```
DROP PUBLIC SYNONYM  dept;
```

For more information, see the section on "DROP SYNONYM" in *Oracle Database SQL Language Reference for 10g or 11g database*.

Quiz

Indexes must be created manually and serve to speed up access to rows in a table.

a. True
b. False

Answer: b

Note: Indexes are designed to speed up query performance. However, not all indexes are created manually. The Oracle server automatically creates an index when you define a column in a table to have a `PRIMARY KEY` or a `UNIQUE` constraint.

Summary

In this lesson, you should have learned how to:

- Create, use, and remove views
- Automatically generate sequence numbers by using a sequence generator
- Create indexes to improve speed of query retrieval
- Use synonyms to provide alternative names for objects

In this lesson, you should have learned about database objects such as views, sequences, indexes, and synonyms.

Practice 12: Overview of Part 2

This practice covers the following topics:

- Creating sequences
- Using sequences
- Creating nonunique indexes
- Creating synonyms

Part 2 of this lesson's practice provides you with a variety of exercises in creating and using a sequence, an index, and a synonym.

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 the 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`)

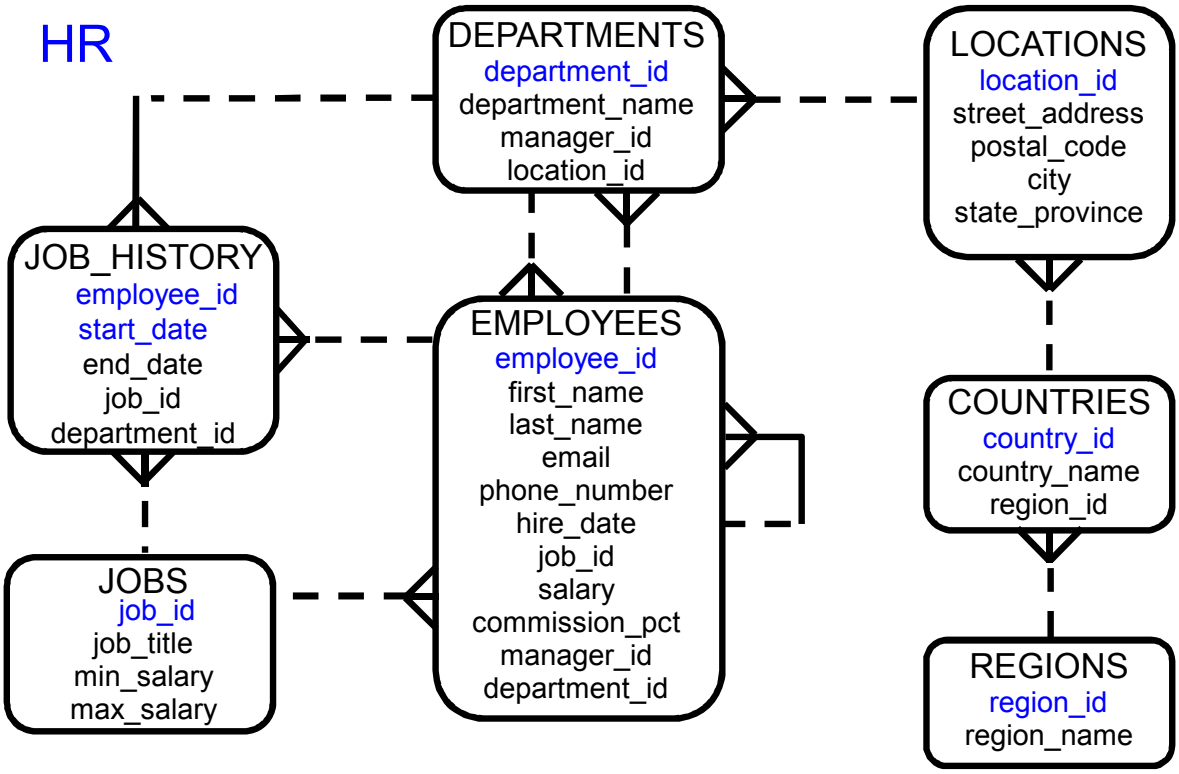
This is the schema that is used in this course. In the Human Resource (`HR`) records, each employee has an identification number, email address, job identification code, salary, and manager. Some employees earn commissions in addition to their salary.

The company also tracks information about 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_...	LAS...	EMAIL	PHONE_N...	HIRE_DATE	JOB_ID	SALARY	COMMISSIO...	MANAG...	DEPAR...
1	100	Steven	King	SKING	515.123.4567	17-JUN-87	AD_PRES	24000	(null)	(null)	90
2	101	Neena	Kochhar	NKOCHHAR	515.123.4568	21-SEP-89	AD_VP	17000	(null)	100	90
3	102	Lex	De Haan	LDEHAAN	515.123.4569	13-JAN-93	AD_VP	17000	(null)	100	90
4	103	Alexander	Hunold	AHUNOLD	590.423.4567	03-JAN-90	IT_PROG	9000	(null)	102	60
5	104	Bruce	Ernst	BERNST	590.423.4568	21-MAY-91	IT_PROG	6000	(null)	103	60
6	107	Diana	Lorentz	DLORENTZ	590.423.5567	07-FEB-99	IT_PROG	4200	(null)	103	60
7	124	Kevin	Mourgos	KMOURGOS	650.123.5234	16-NOV-99	ST_MAN	5800	(null)	100	50
8	141	Trenna	Rajs	TRAJS	650.121.8009	17-OCT-95	ST_CLERK	3500	(null)	124	50
9	142	Curtis	Davies	CDAVIES	650.121.2994	29-JAN-97	ST_CLERK	3100	(null)	124	50
10	143	Randall	Matos	RMATOS	650.121.2874	15-MAR-98	ST_CLERK	2600	(null)	124	50
11	144	Peter	Vargas	PVARGAS	650.121.2004	09-JUL-98	ST_CLERK	2500	(null)	124	50
12	149	Eleni	Zlotkey	EZLOTKEY	011.44.1344....	29-JAN-00	SA_MAN	10500	0.2	100	80
13	174	Ellen	Abel	EABEL	011.44.1644....	11-MAY-96	SA_REP	11000	0.3	149	80
14	176	Jonathon	Taylor	JTAYLOR	011.44.1644....	24-MAR-98	SA_REP	8600	0.2	149	80
15	178	Kimberely	Grant	KGRANT	011.44.1644....	24-MAY-99	SA_REP	7000	0.15	149	(null)
16	200	Jennifer	Whalen	JWHALEN	515.123.4444	17-SEP-87	AD_ASST	4400	(null)	101	10
17	201	Michael	Hartstein	MHARTSTE	515.123.5555	17-FEB-96	MK_MAN	13000	(null)	100	20
18	202	Pat	Fay	PFAY	603.123.6666	17-AUG-97	MK_REP	6000	(null)	201	20
19	205	Shelley	Higgins	SHIGGINS	515.123.8080	07-JUN-94	AC_MGR	12000	(null)	101	110
20	206	William	Gietz	WGIETZ	515.123.8181	07-JUN-94	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-93	24-JUL-98	IT_PROG	60
2	101	21-SEP-89	27-OCT-93	AC_ACCOUNT	110
3	101	28-OCT-93	15-MAR-97	AC_MGR	110
4	201	17-FEB-96	19-DEC-99	MK_REP	20
5	114	24-MAR-98	31-DEC-99	ST_CLERK	50
6	122	01-JAN-99	31-DEC-99	ST_CLERK	50
7	200	17-SEP-87	17-JUN-93	AD_ASST	90
8	176	24-MAR-98	31-DEC-98	SA_REP	80
9	176	01-JAN-99	31-DEC-99	SA_MAN	80
10	200	01-JUL-94	31-DEC-98	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	20000	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	20000
7	SA_REP	Sales Representative	6000	12000
8	ST_MAN	Stock Manager	5500	8500
9	ST_CLERK	Stock Clerk	2000	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

B

Using SQL Developer

Objectives

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

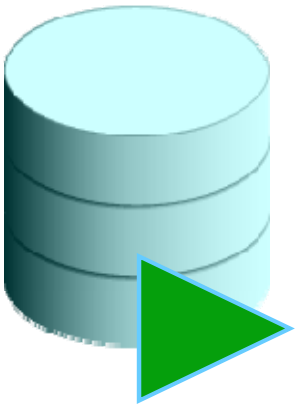
- List the key features of Oracle SQL Developer
- Identify the menu items of Oracle SQL Developer
- Create a database connection
- Manage database objects
- Use SQL Worksheet
- Save and run SQL scripts
- Create and save reports
- Browse the Data Modeling options in SQL Developer

ORACLE

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

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.

The SQL Developer 3.1 release tightly integrates with *Developer Migration Workbench* that provides users with a single point to browse database objects and data in third-party databases, and to migrate from these databases to Oracle. You can also connect to schemas for selected third-party (non-Oracle) databases, such as MySQL, Microsoft SQL Server, and Microsoft Access, and view metadata and data in these databases.

Additionally, SQL Developer includes support for Oracle Application Express 3.0.1 (Oracle APEX).

Specifications of SQL Developer

- Is shipped along with Oracle Database 11*g* Release 2
- 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

Oracle SQL Developer 1.5 is shipped along with Oracle Database 11*g* Release 2 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

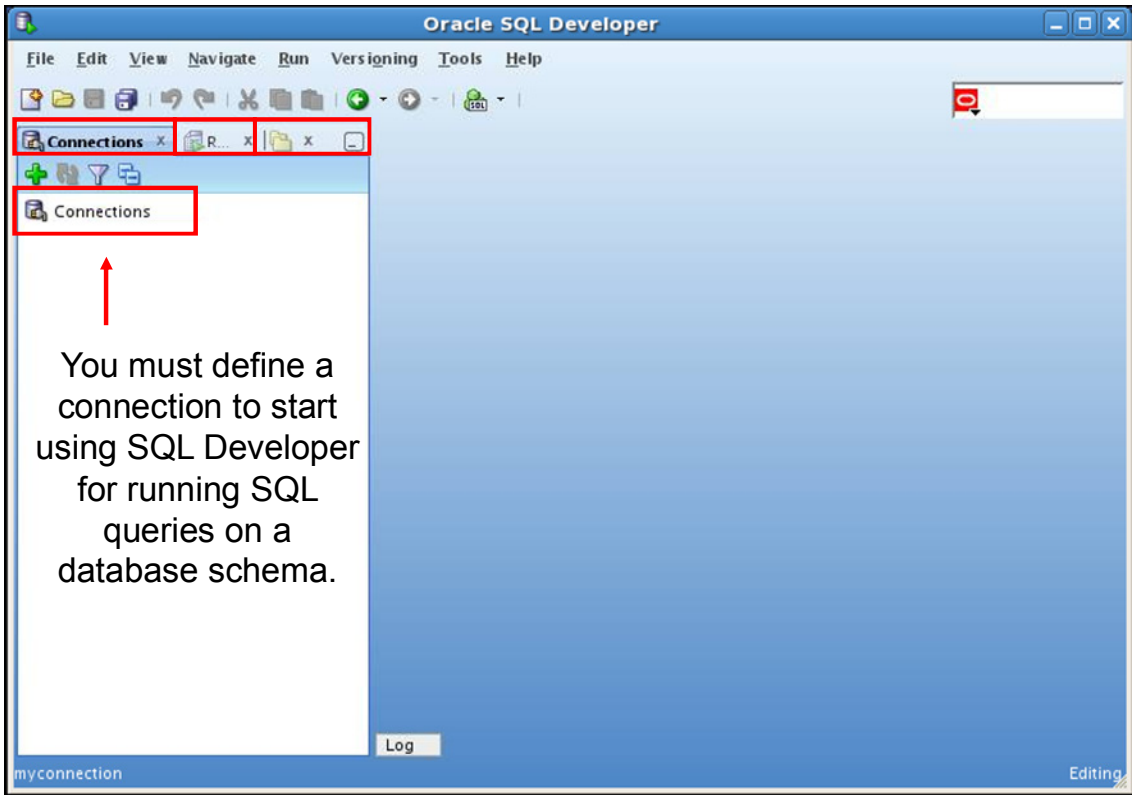
For Oracle Database 11*g* Release 2, you will have to download and install SQL Developer. SQL Developer is freely downloadable from the following link:

http://www.oracle.com/technetwork/developer-tools/sql-developer/sqldev-ea-download-486950.html

For instructions on how to install SQL Developer, see the Web site at:

http://www.oracle.com/technetwork/developer-tools/sql-developer/overview/index.html

SQL Developer 3.1 Interface



The SQL Developer 3.1 interface contains three main navigation tabs, from left to right:

- **Connections tab:** By using this tab, you can browse database objects and users to which you have access.
- **Reports tab:** Identified by the Reports icon, this tab enables you to run predefined reports or create and add your own reports.
- **Files tab:** 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/functions.

Menus

The following menus contain standard entries, plus entries for features 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: CVS (Concurrent Versions System) 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.

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.

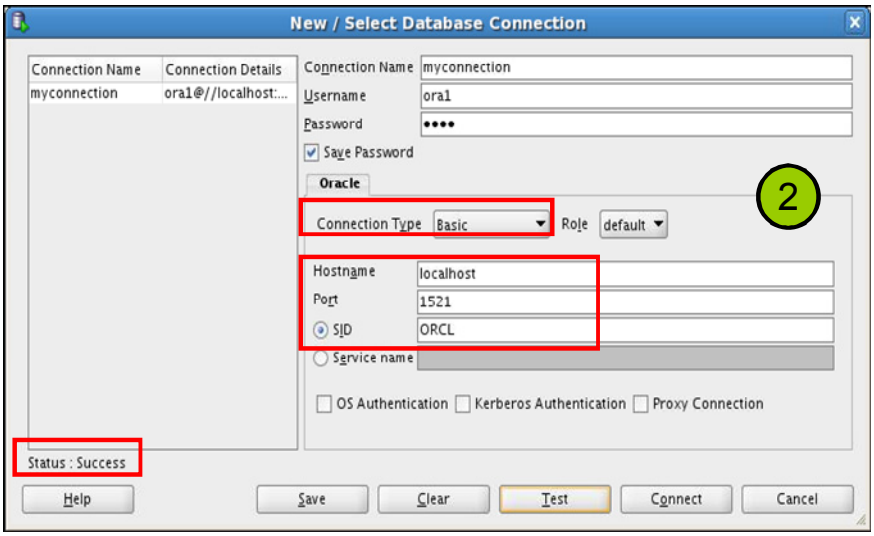
By default, the `tnsnames.ora` file is located in the `$ORACLE_HOME/network/admin` directory, but it can also be in the directory specified by the `TNS_ADMIN` environment variable or registry value. When you start SQL Developer and display the Database Connections dialog box, SQL Developer automatically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

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.

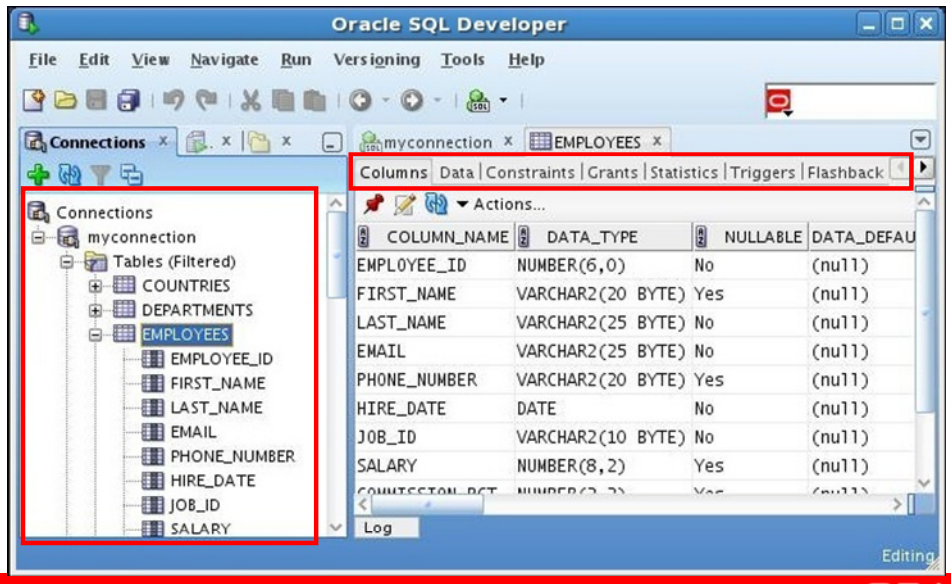
3. The connection gets added in the Connections Navigator. You can expand the connection to view the database objects and view object definitions—for example, dependencies, details, statistics, and so on.

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:

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



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.

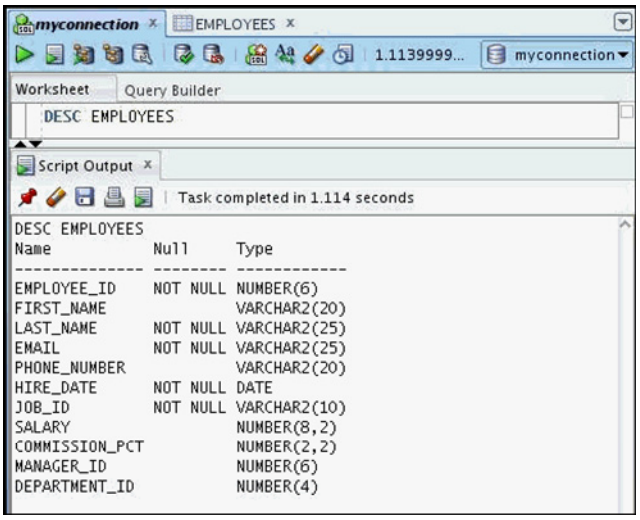
You can see the definition of the objects broken into tabs of information that is pulled out of the data dictionary. For example, if you select a table in the Navigator, the details about columns, constraints, grants, statistics, triggers, and so on are displayed on an easy-to-read tabbed page.

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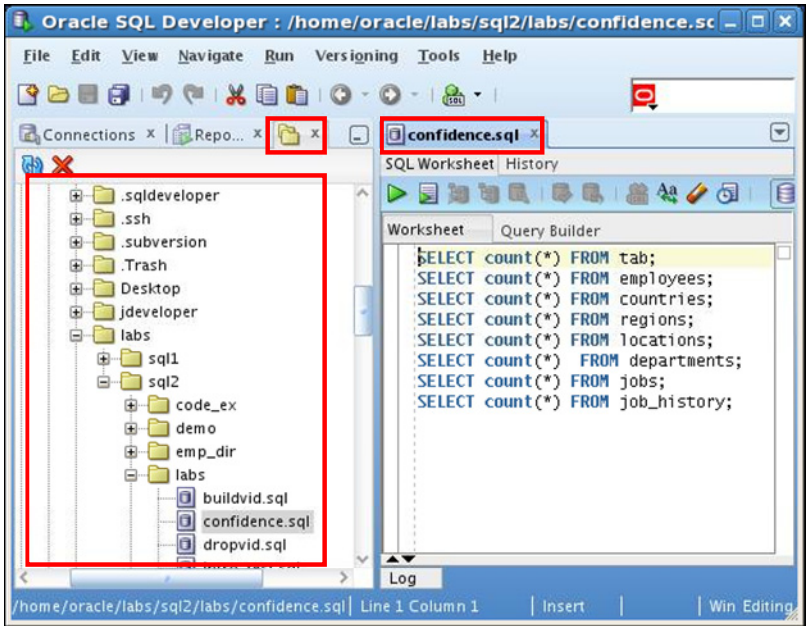
In SQL Developer, you can also display the structure of a table using the `DESCRIBE` command. The result of the command is a display of column names and data types as well as an indication if a column must contain data.

Browsing Files

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



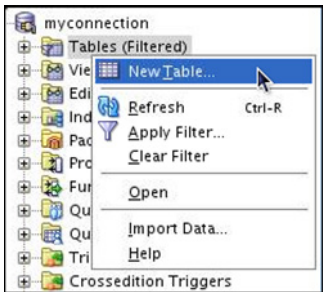
Browsing Database Objects

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

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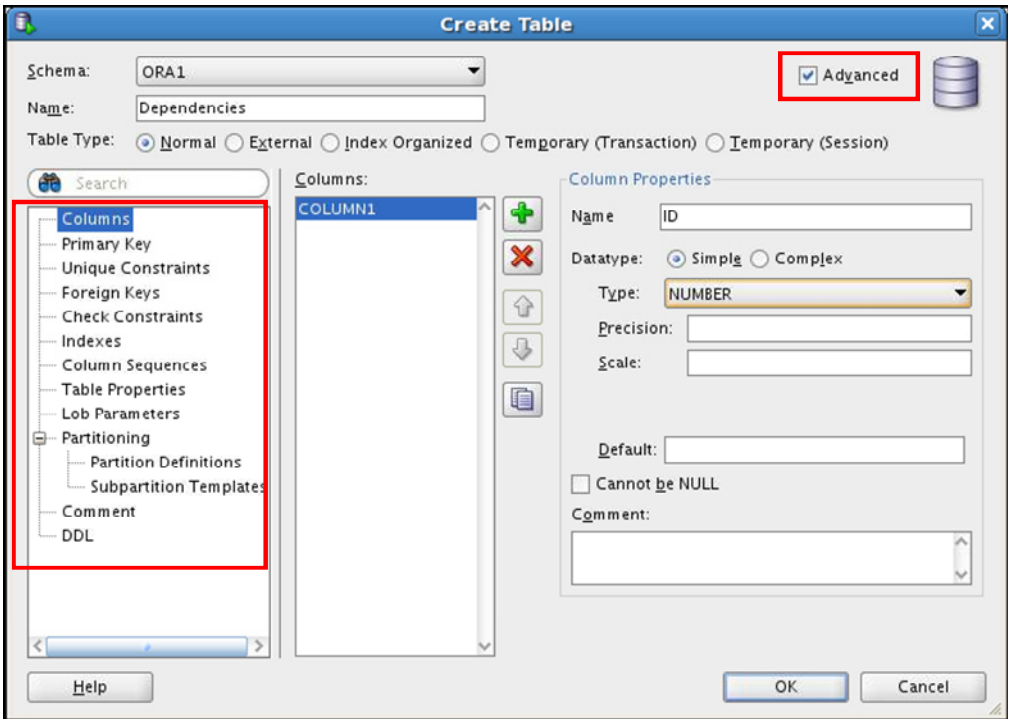
SQL Developer supports the creation of any schema object by executing a SQL statement in SQL Worksheet. Alternatively, you can create objects using the context menus. When created, you can edit the objects using an edit dialog box or one of the many context-sensitive menus.

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



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.

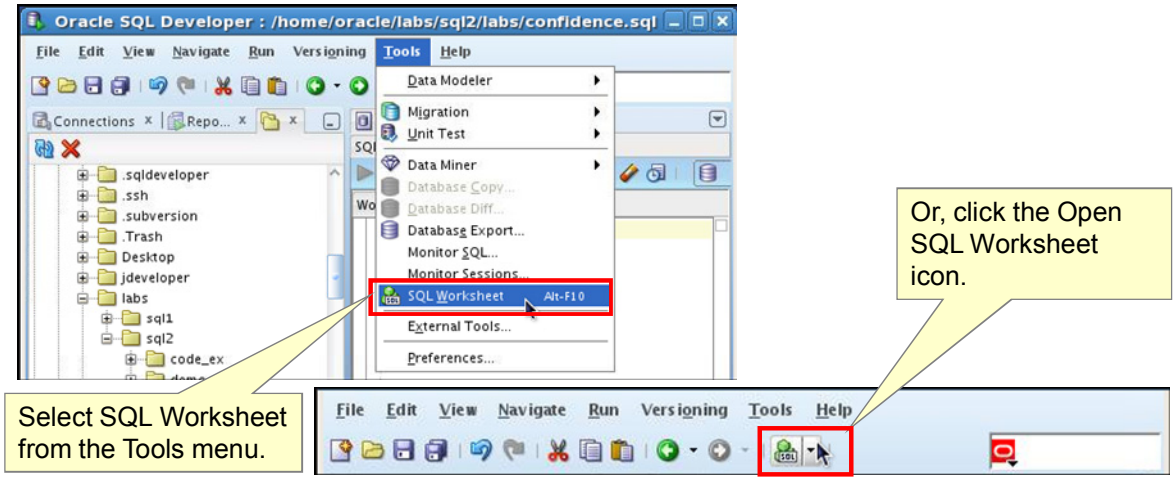
To create a new table, perform the following steps:

1. In the Connections Navigator, right-click Tables.
2. Select Create TABLE.
3. In the Create Table dialog box, select Advanced.
4. Specify the column information.
5. 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.

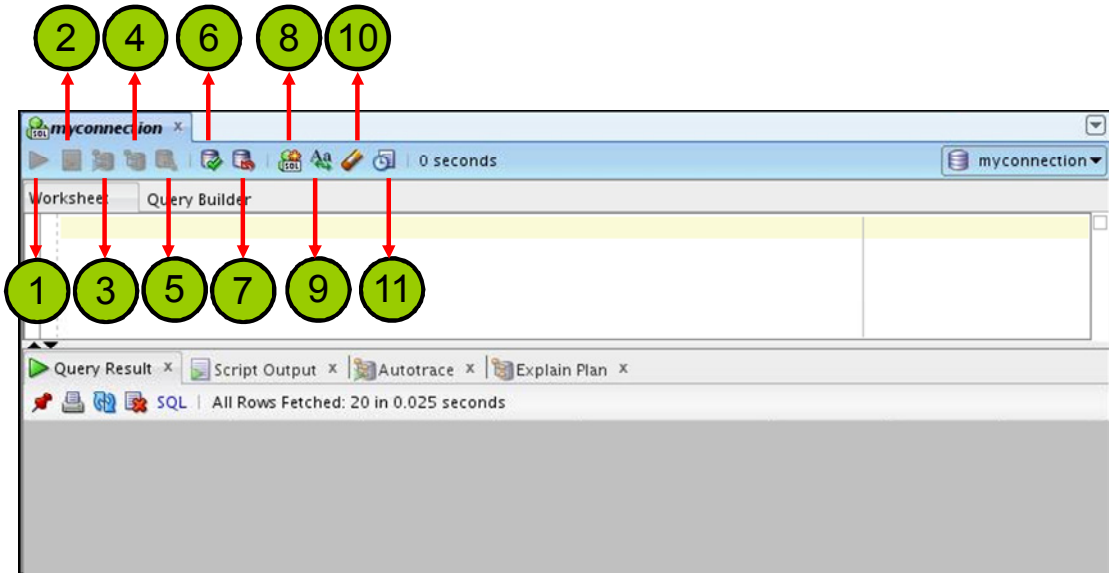
You can specify actions that can be processed by the database connection associated with the worksheet, such as:

- 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

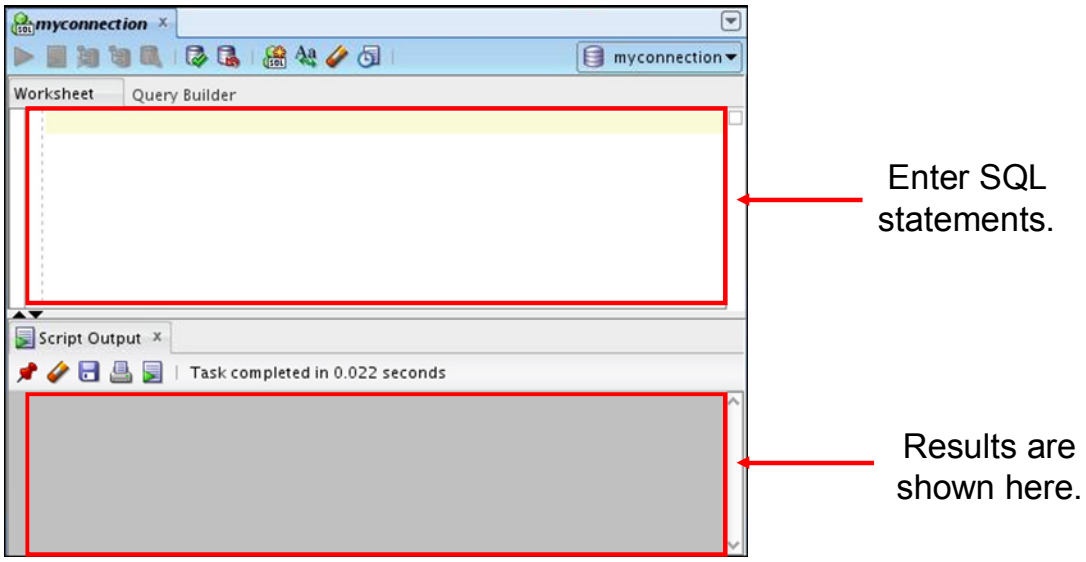


You may want to use the shortcut keys or icons to perform certain tasks such as executing a SQL statement, running a script, and viewing the history of SQL statements that you have executed. You can use the SQL Worksheet toolbar that contains icons to perform the following tasks:

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 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 SQL statements that you have executed

Using the SQL Worksheet



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. SQL*Plus commands used in the SQL Developer have to be interpreted by the SQL Worksheet before being passed to the database.

The SQL Worksheet currently supports a number of SQL*Plus commands. Commands not supported by the SQL Worksheet are ignored and are not sent to the Oracle database. Through the SQL Worksheet, you can execute SQL statements and some of the SQL*Plus commands.

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

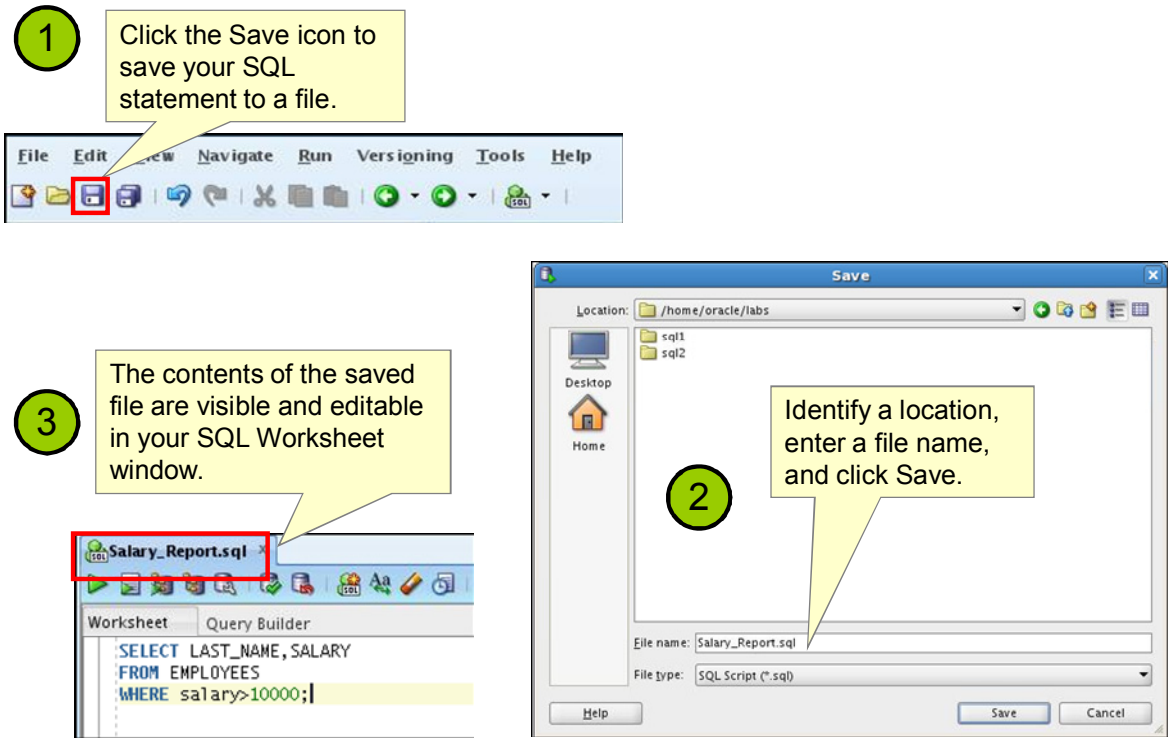
- Select Tools > SQL Worksheet.
- Click the Open SQL Worksheet icon.

Executing SQL Statements

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

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



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

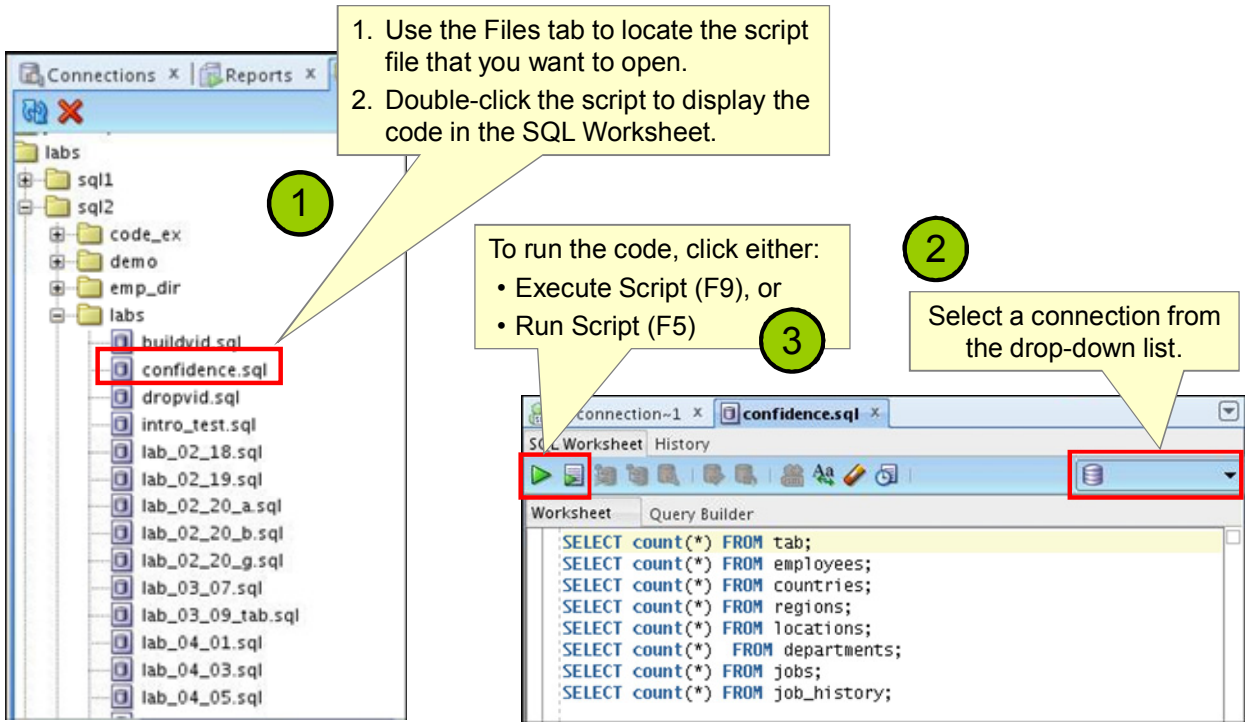
1. Click the Save icon or use the File > Save menu item.
2. In the Save dialog box, enter a file name and the location where you want the file saved.
3. Click Save.

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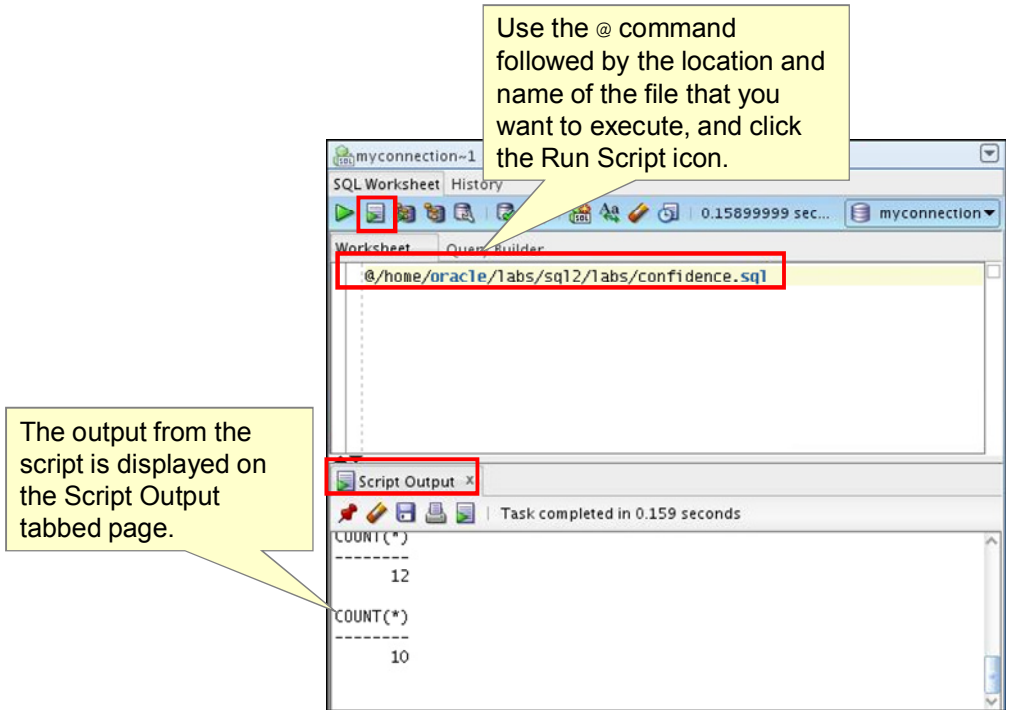
To open a script file and display the code in the SQL Worksheet area, perform the following steps:

1. In the files navigator, select (or navigate to) the script file that you want to open.
2. Double-click to open. 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 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 you want to use for the script execution

Executing Saved Script Files: Method 2



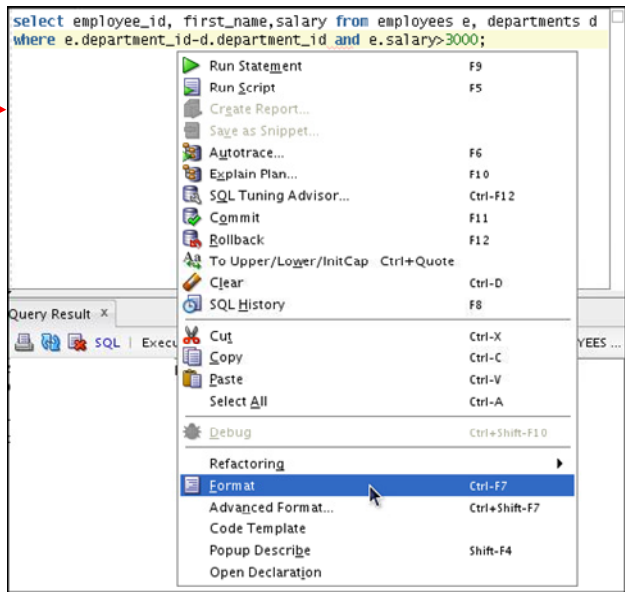
To run a saved SQL script, perform the following steps:

1. Use the @ command, followed by the location, and name of the file 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

Before formatting



After formatting

```
SELECT employee_id,
  first_name,
  salary
FROM employees e,
  departments d
WHERE e.department_id=d.department_id
AND e.salary>3000;
```

ORACLE

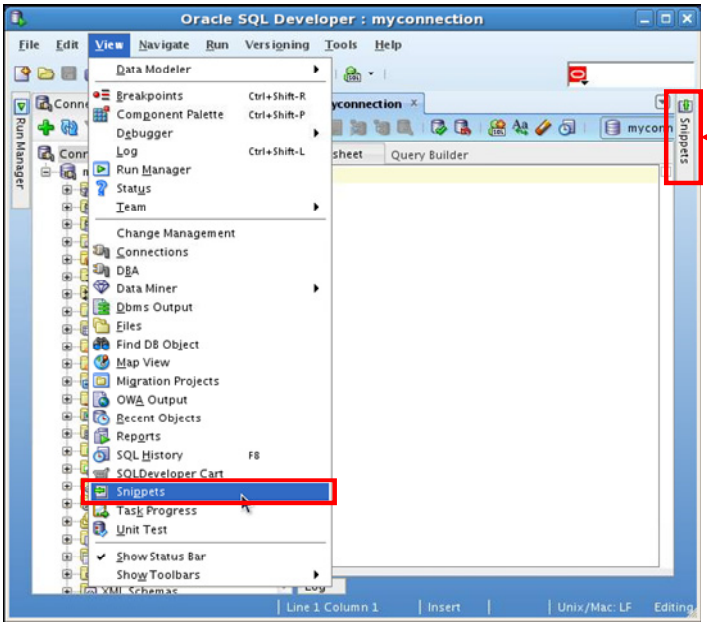
You may want to format the indentation, spacing, capitalization, and line separation of the SQL code. SQL Developer has a feature for formatting SQL code.

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

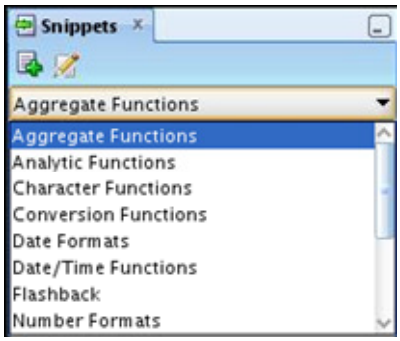
In the example in the slide, before formatting, the SQL code has the keywords not capitalized and the statement not properly indented. After formatting, the SQL code is beautified with the keywords capitalized and the statement properly indented.

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.

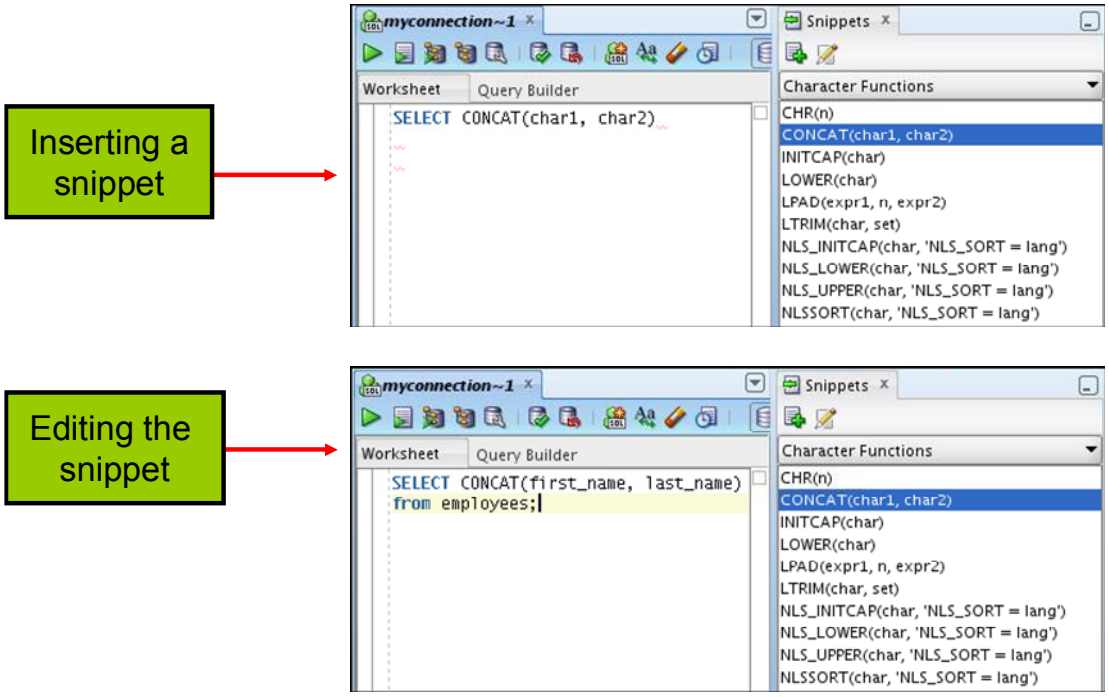


You may want to use certain code fragments when you use the SQL Worksheet or create or edit a PL/SQL function or procedure. SQL Developer has the feature called Snippets. Snippets are code fragments such as SQL functions, Optimizer hints, and miscellaneous PL/SQL programming techniques. You can drag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

To display Snippets, select View > Snippets.

The Snippets window is displayed at 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



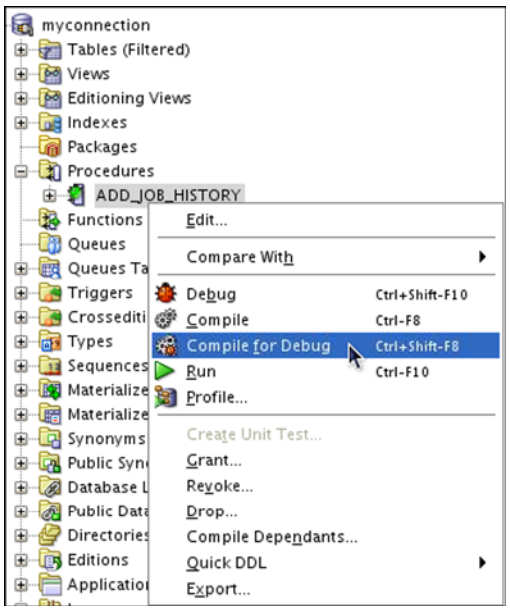
To insert a Snippet into your code in a SQL Worksheet or in a PL/SQL function or procedure, drag the snippet from the Snippets window to the desired place in your code. Then you can edit the syntax so that the SQL function is valid in the current context. To see a brief description of a SQL function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

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, step over tasks.



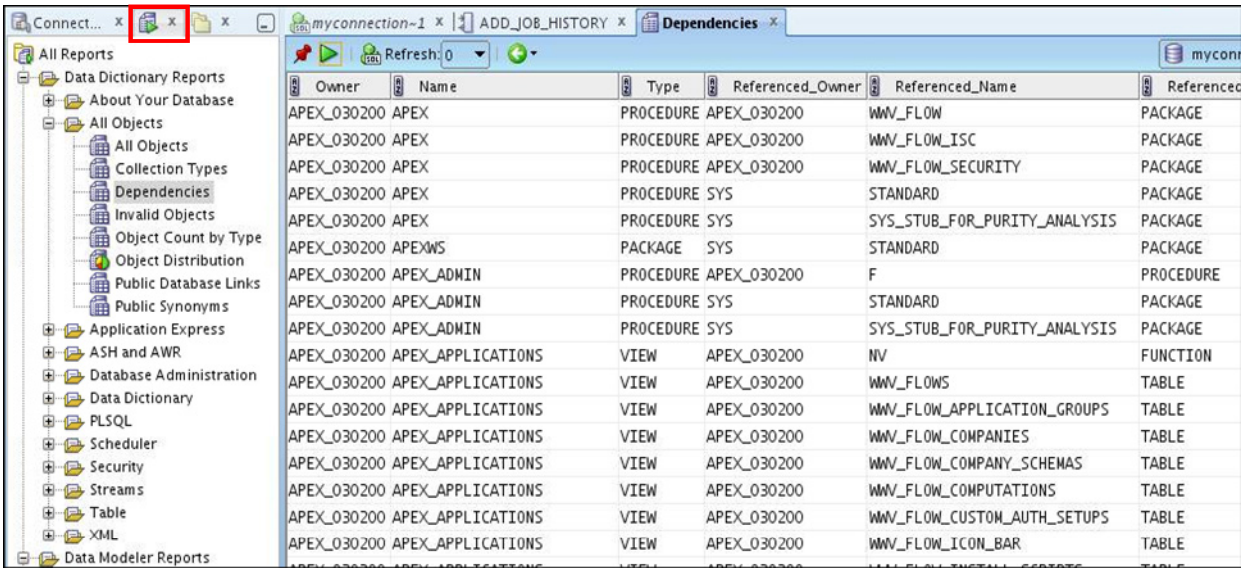
In SQL Developer, you can debug PL/SQL procedures and functions. Using the Debug menu options, you can perform the following debugging tasks:

- **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 toolbar.

Database Reporting

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



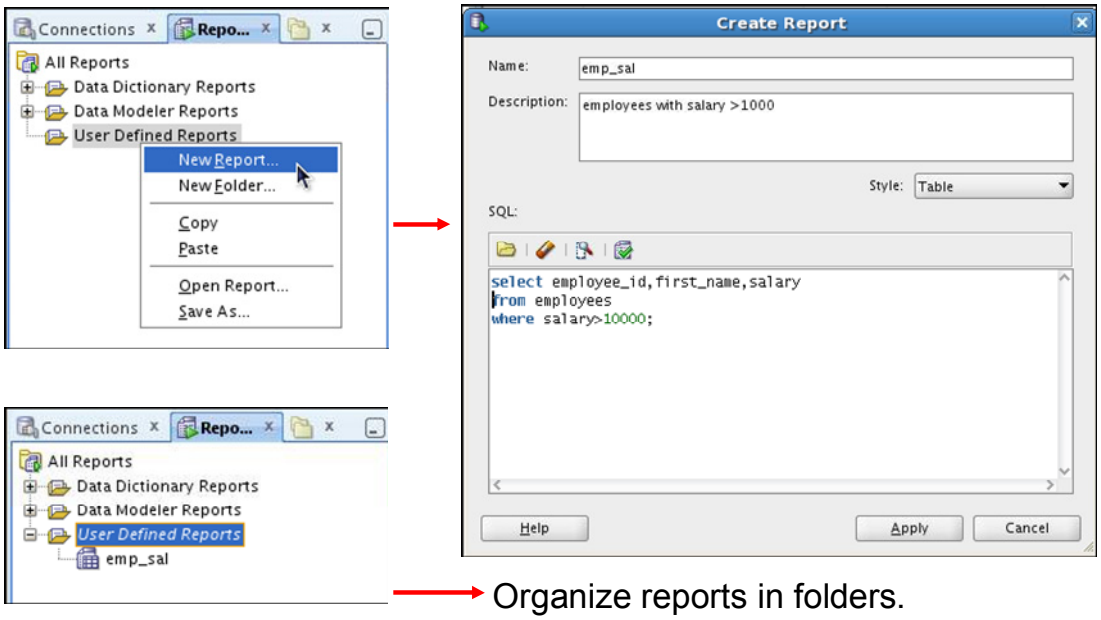
SQL Developer provides many reports about the database and its objects. These reports can be grouped into the following categories:

- 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 at the left of the window. Individual reports are displayed in tabbed panes at the right of the window; and 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.



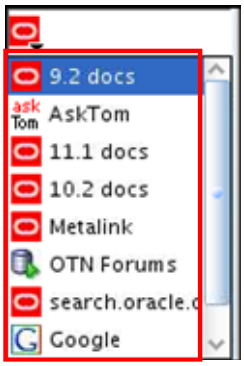
User-defined reports are reports created by SQL Developer users. To create a user-defined report, perform the following steps:

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.

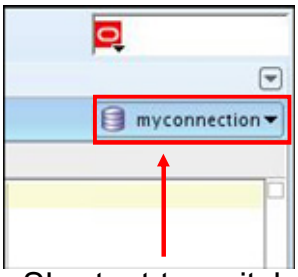
In the example in the slide, the report name is specified as `emp_sal`. An optional description is provided indicating that the report contains details of employees with `salary >= 10000`. The complete SQL statement for retrieving the information to be displayed in the user-defined report is specified 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` under the directory for user-specific information.

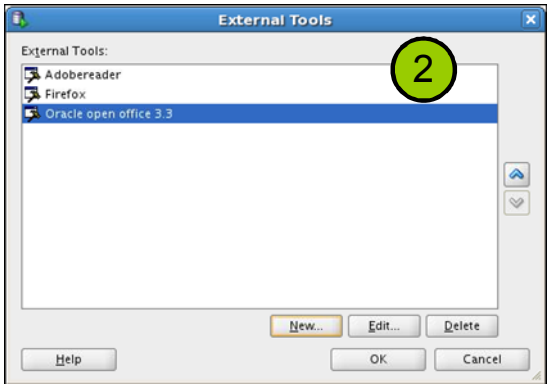
Search Engines and External Tools



Links to popular search engines and discussion forums



Shortcut to switch between connections



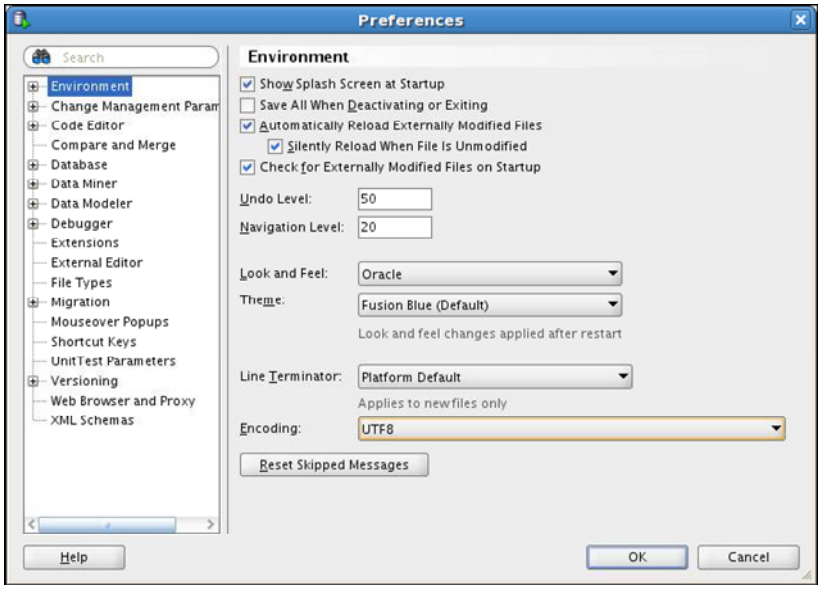
To enhance productivity of the SQL developers, SQL Developer has added quick links to popular search engines and discussion forums such as AskTom, Google, and so on. Also, you have shortcut icons to some of the frequently used tools such as Notepad, Microsoft Word, and Dreamweaver, available to you.

You can add external tools to the existing list or even delete shortcuts to 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.



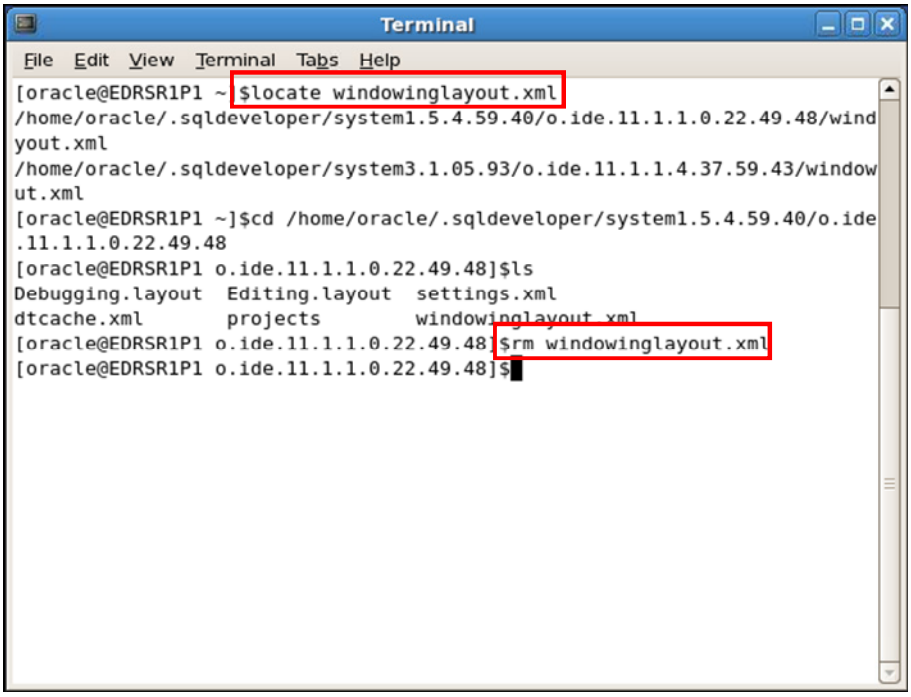
You can customize many aspects of the SQL Developer interface and environment by modifying SQL Developer preferences according to your preferences and needs. To modify SQL Developer preferences, select Tools, then Preferences.

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

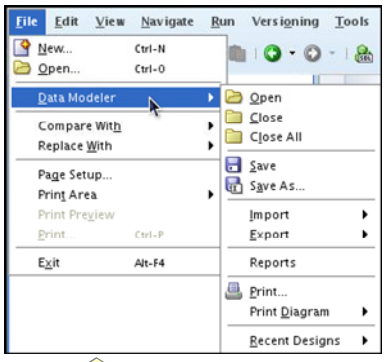


While working with SQL Developer, if the Connections Navigator disappears or if you cannot dock the Log window in its original place, perform the following steps to fix the problem:

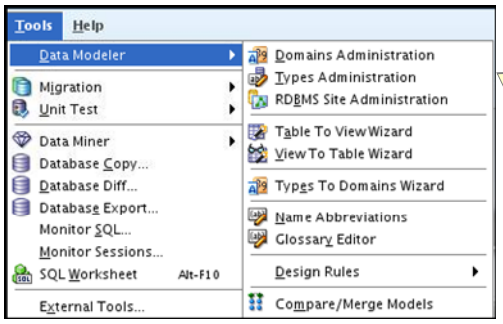
1. Exit from SQL Developer.
2. Open a terminal window and use the locate command to find the location of `windowinglayout.xml`.
3. Go to the directory that has `windowinglayout.xml` and delete it.
4. Restart SQL Developer.

Data Modeler in SQL Developer

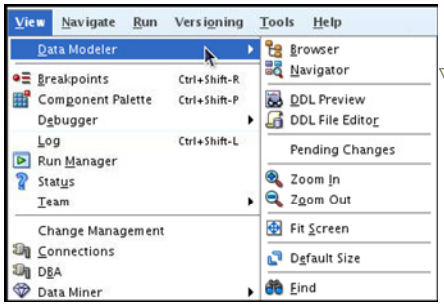
SQL Developer includes an integrated version of SQL Developer Data Modeler.



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



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



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

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Using the integrated version of 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, then Data Modeler. The Data Modeler menu under Tools includes additional commands, for example, enabling you to specify design rules and preferences.

Summary

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

- 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

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.

C

Using SQL*Plus

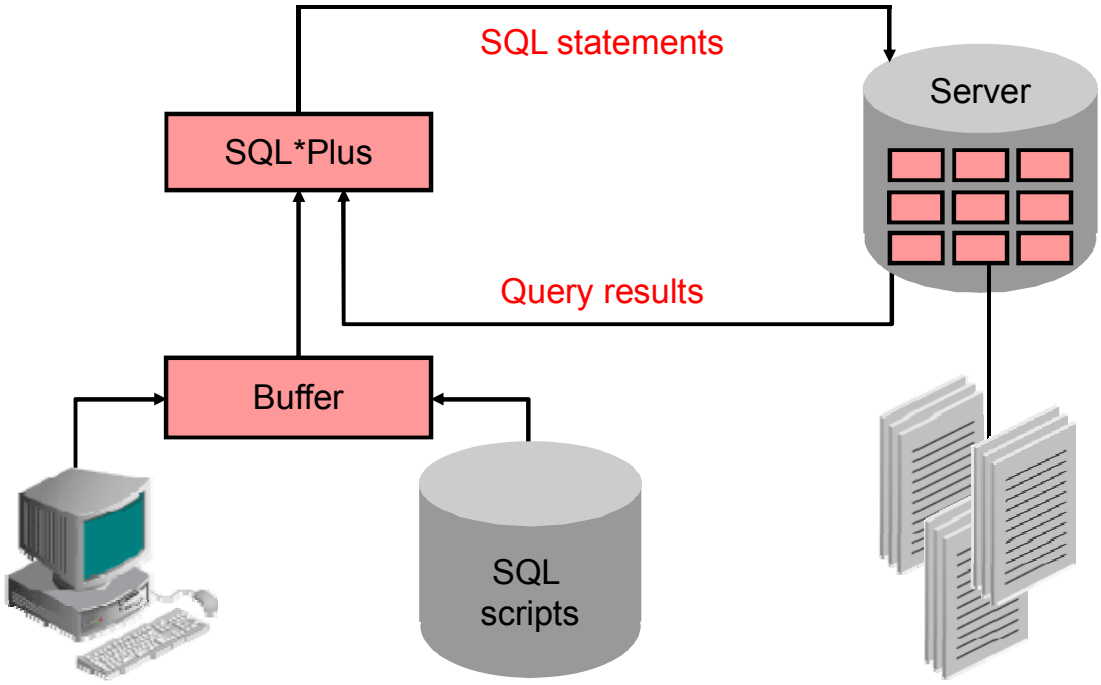
Objectives

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

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

You might want to create `SELECT` statements that can be used again and again. This appendix also 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



SQL and SQL*Plus

SQL is a command language 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 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 Oracle9*i* 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

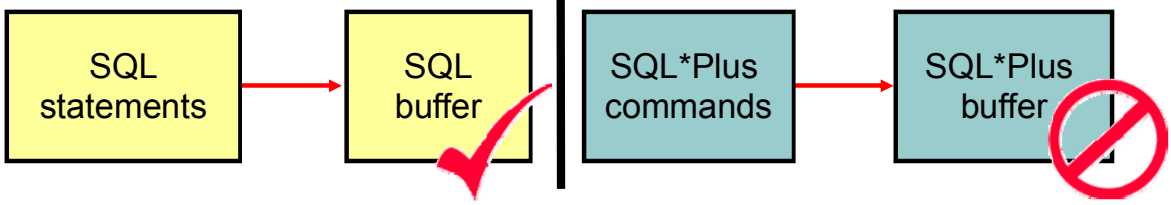
SQL Statements Versus SQL*Plus Commands

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.



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

Overview of SQL*Plus

- 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.

SQL*Plus

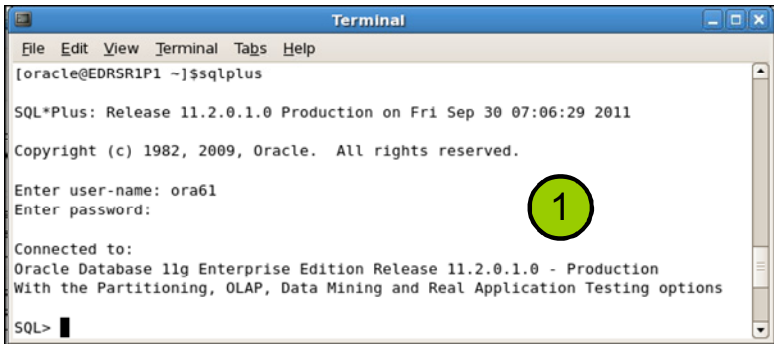
SQL*Plus is an environment in which you can:

- 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

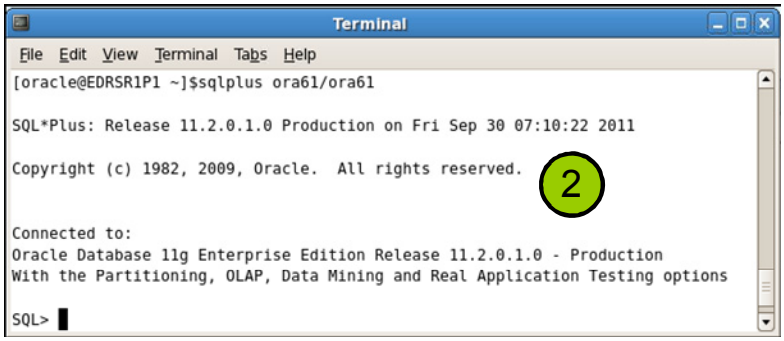
SQL*Plus commands can be divided into the following main categories:

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




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



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

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:

username	Your database username
password	Your database password (Your password is visible if you enter it here.)
@database	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
```


In SQL*Plus, you can 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 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 this 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)
```


The example in the slide displays the 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*

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

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

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


- 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
```


- 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

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

Using the SAVE, 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.
```


SAVE

Use the SAVE command to store the current contents of the buffer in a file. In this way, 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 preallocated 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
```

Note

- 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 11g*.

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 you specify
OFF	Stops spooling
OUT	Stops spooling and sends the file to your computer's standard (default) printer

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 only use SPOOL to create (and replace) a file. REPLACE is the default.

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

You must use quotation marks around file names containing 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.

Note

- For additional information about the package and subprograms, refer to *Oracle Database PL/SQL Packages and Types Reference 11g*.
- For additional information about the EXPLAIN PLAN, refer to *Oracle Database SQL Reference 11g*.
- For additional information about Execution Plans and the statistics, refer to *Oracle Database Performance Tuning Guide 11g*.

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

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.

Using JDeveloper

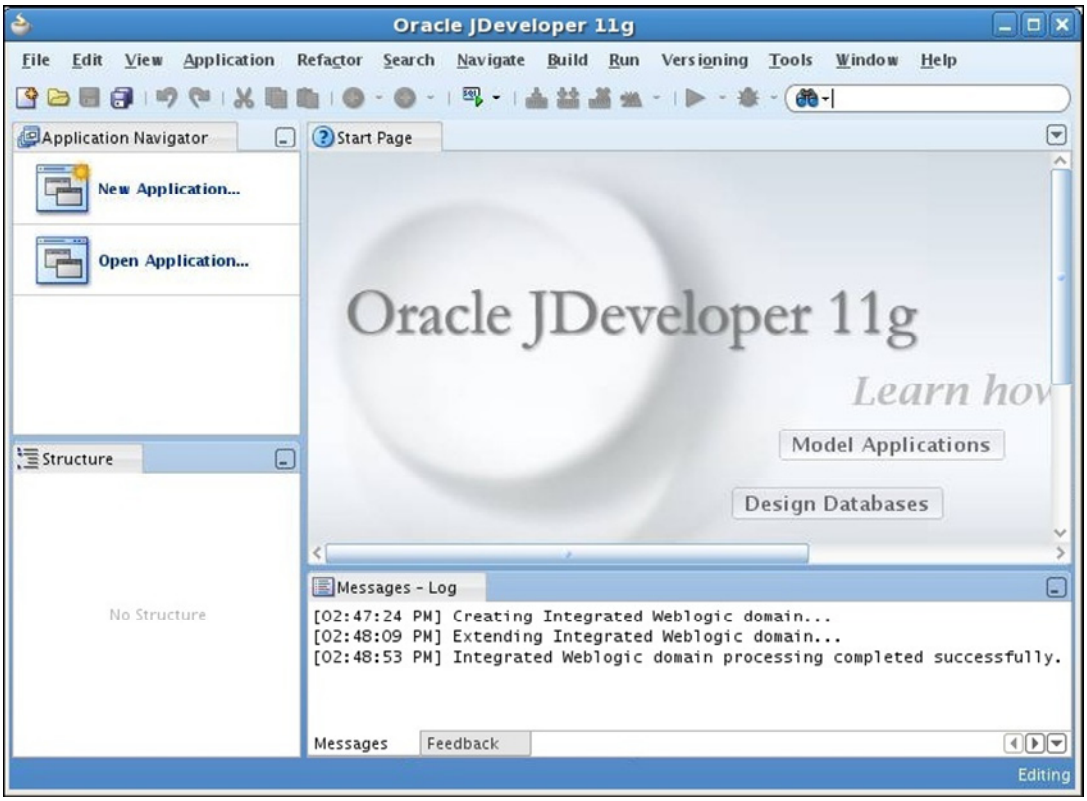
Objectives

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

- List the key features of Oracle JDeveloper
- Create a database connection in JDeveloper
- Manage database objects in JDeveloper
- Use JDeveloper to execute SQL Commands
- Create and run PL/SQL Program Units

In this appendix, you are introduced to JDeveloper. You learn how to use JDeveloper for your database development tasks.

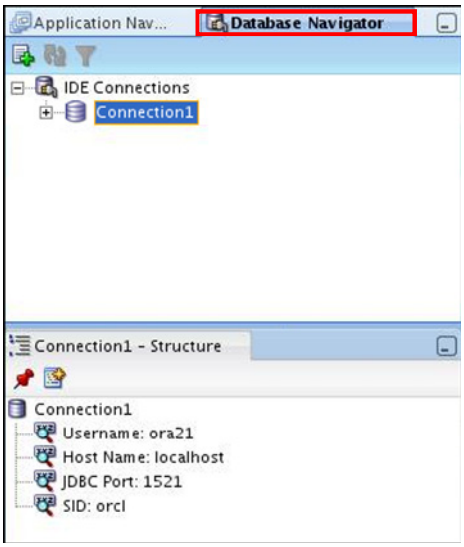
Oracle JDeveloper



Oracle JDeveloper is an integrated development environment (IDE) for developing and deploying Java applications and Web services. It supports every stage of the software development life cycle (SDLC) from modeling to deploying. It has the features to use the latest industry standards for Java, XML, and SQL while developing an application.

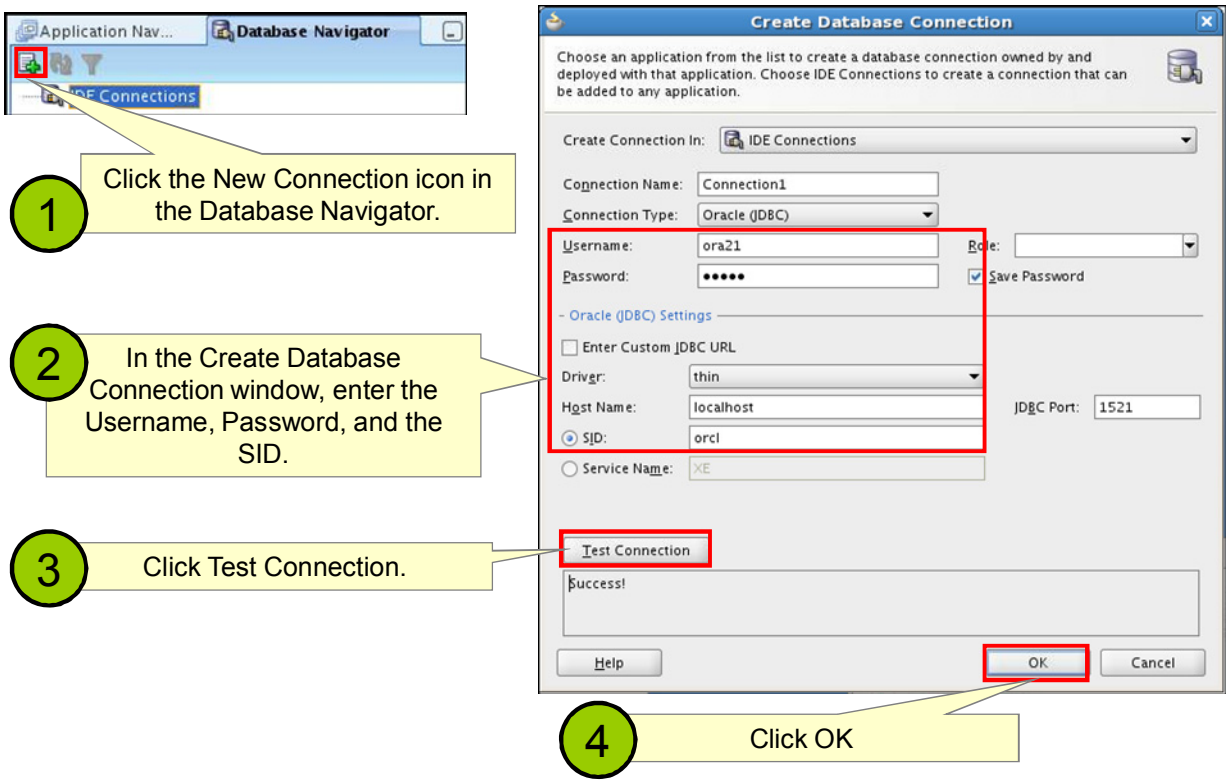
Oracle JDeveloper 11*g* initiates a new approach to J2EE development with features that enable visual and declarative development. This innovative approach makes J2EE development simple and efficient.

Database Navigator



Using Oracle JDeveloper, you can store the information necessary to connect to a database in an object called “connection.” A connection is stored as part of the IDE settings, and can be exported and imported for easy sharing among groups of users. A connection serves several purposes from browsing the database and building applications, all the way through to deployment.

Creating Connection



A connection is an object that specifies the necessary information for connecting to a specific database as a specific user of that database. You can create and test connections for multiple databases and for multiple schemas.

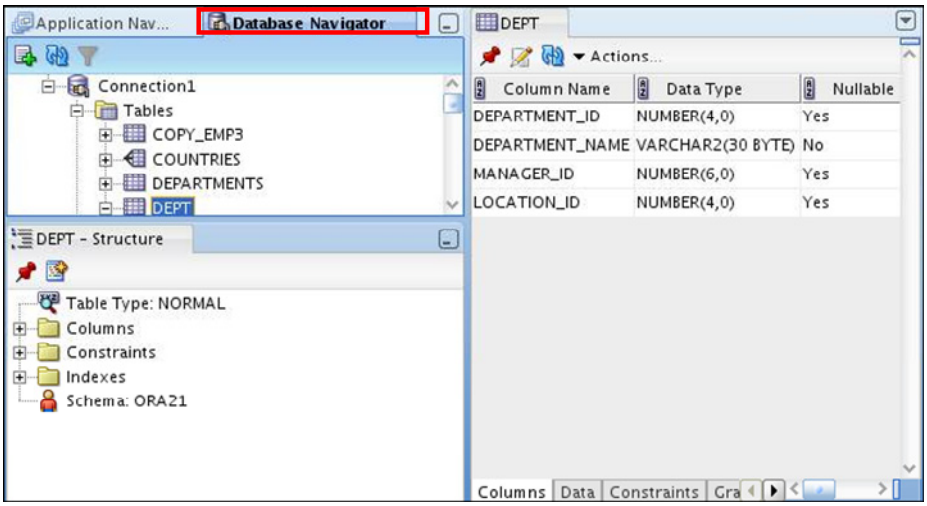
To create a database connection, perform the following steps:

1. Click the New Connection icon in the Database Navigator.
2. In the Create Database Connection window, enter the connection name. Enter the username and password of the schema that you want to connect to. Enter the SID of the Database you want to connect.
3. Click Test to ensure that the connection has been set correctly.
4. Click OK.

Browsing Database Objects

Use the Database Navigator to:

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



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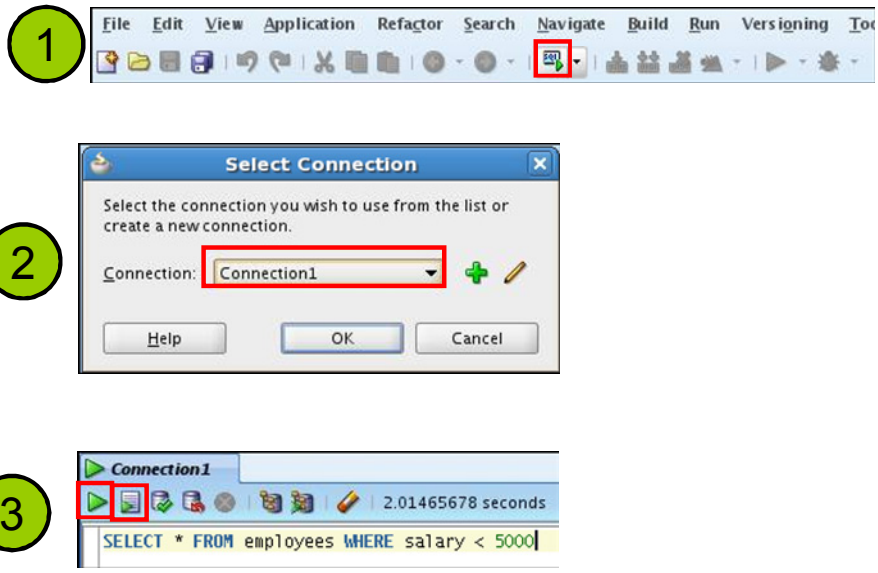
After you create a database connection, you can use the Database Navigator to browse through many objects in a database schema including Tables, Views, Indexes, Packages, Procedures, Triggers, and Types.

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, the details about columns, constraints, grants, statistics, triggers, and so on are displayed on an easy-to-read Database Navigator.

Executing SQL Statements



To execute a SQL statement, perform the following steps:

1. Click the Open SQL Worksheet icon.
2. Select the connection.
3. Execute the SQL command by clicking:
   1. The **Execute statement** button or by pressing F9. The output is as follows:

Results | Script Output | Explain | Autotrace | DBM

Results:

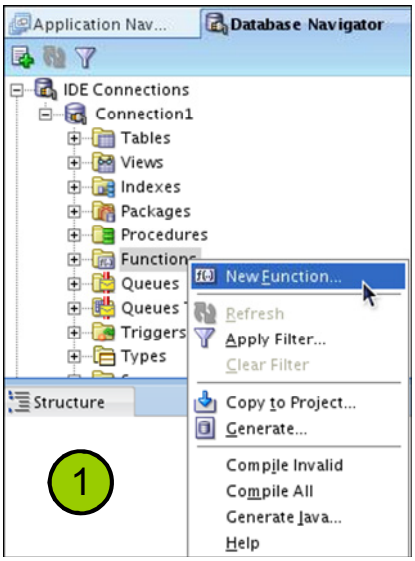
	EMPLOYEE_ID	FIRST_NAME	LAST_NAME	
1	100	Steven	King	SK
2	101	Neena	Kochhar	NK

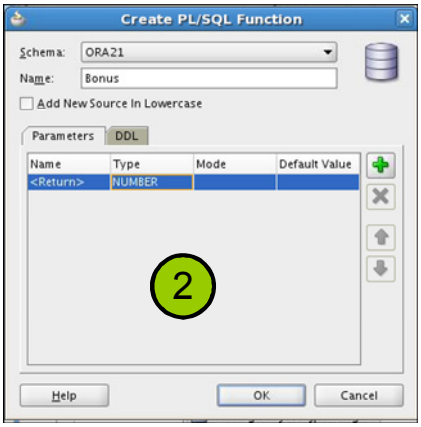
   2. The **Run Script** button or by pressing F5. The output is as follows:

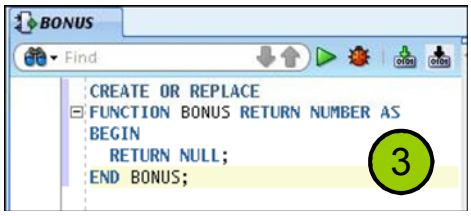
Results | Script Output | Explain | Autotrace | DBM

```
EMPLOYEE_ID          FIRST_NAME           LAST_
-------------------- -------------------- -----
100                  Steven               King
```

Creating Program Units





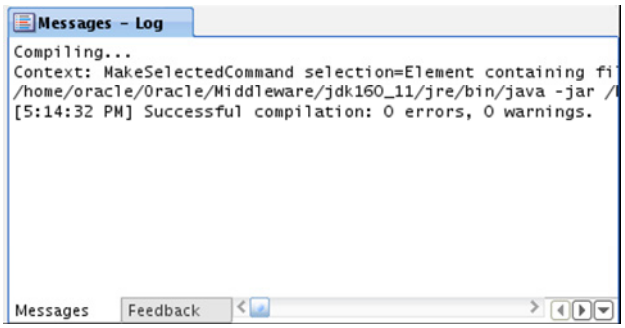


Skeleton of the function

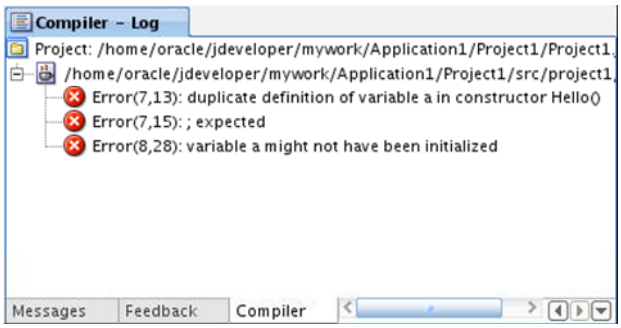
To create a PL/SQL program unit, perform the following steps:

1. Select View > Database Navigator. Select and expand a database connection. Right-click a folder corresponding to the object type (Procedures, Packages, Functions). Choose “New [Procedures|Packages|Functions].”
2. Enter a valid name for the function, package, or procedure and click OK.
3. A skeleton definition is created and opened in the Code Editor. You can then edit the subprogram to suit your need.

Compiling



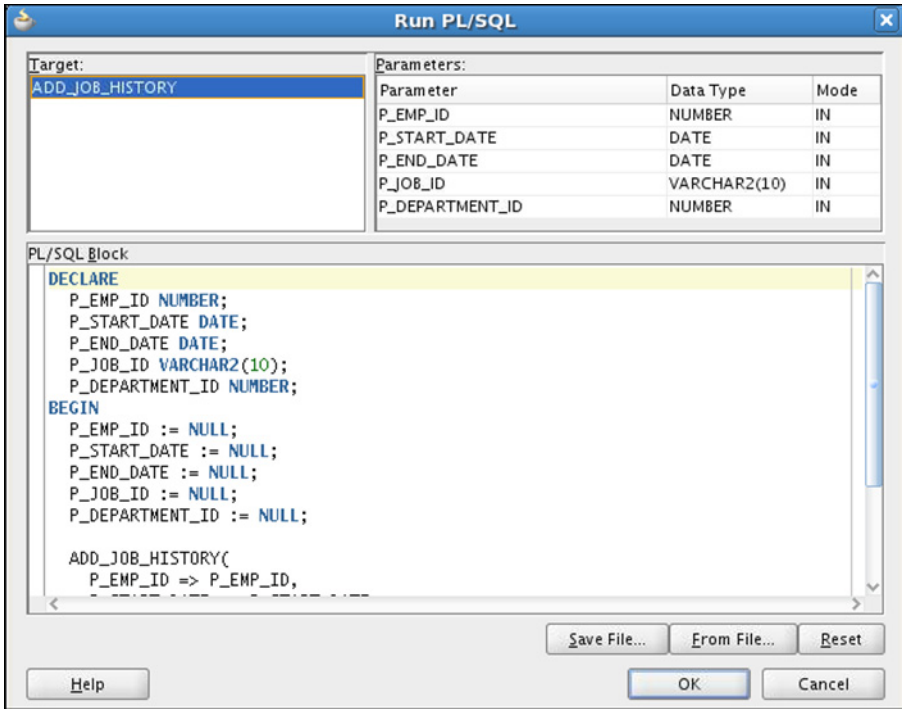
Compilation with errors



Compilation without errors

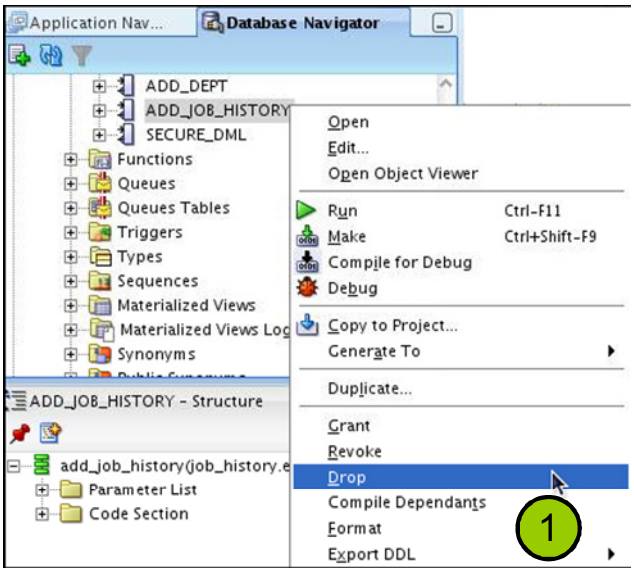
After editing the skeleton definition, you need to compile the program unit. Right-click the PL/SQL object that you need to compile in the Database Navigator, and then select Compile. Alternatively, you can also press [Ctrl] + [Shift] + [F9] to compile.

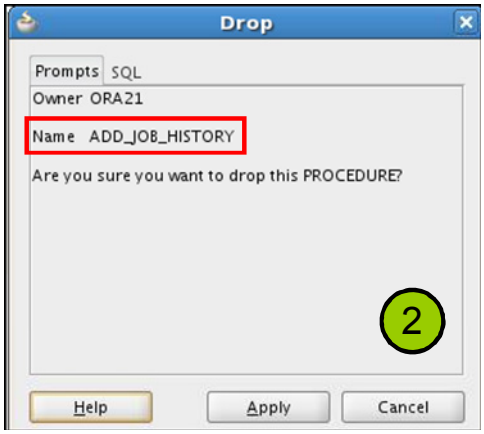
Running a Program Unit



To execute the program unit, right-click the object and click Run. The Run PL/SQL dialog box appears. You may need to change the `NULL` values with reasonable values that are passed into the program unit. After you change the values, click OK. The output is displayed in the Message-Log window.

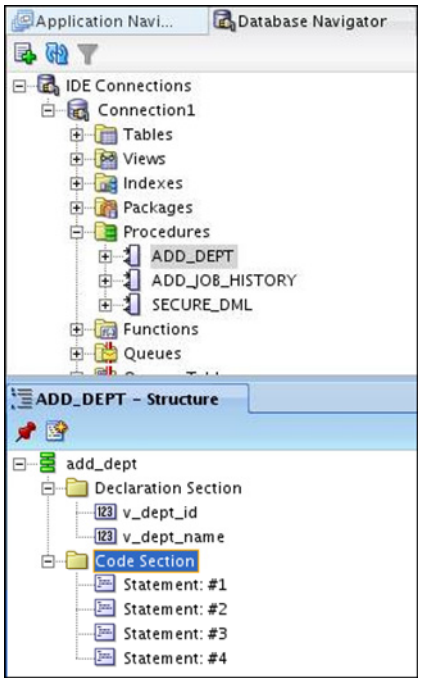
Dropping a Program Unit

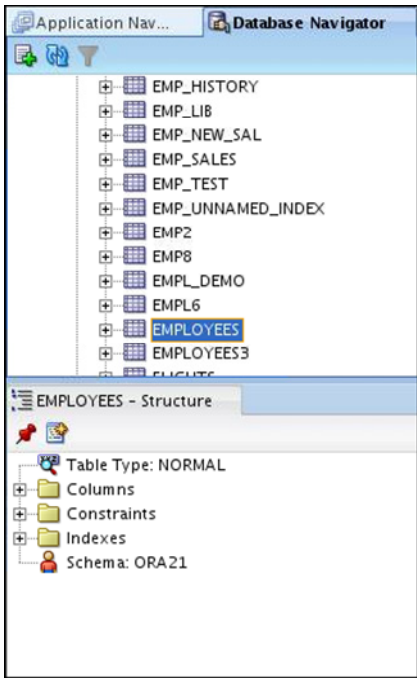




To drop a program unit, right-click the object and select Drop. The Drop Confirmation dialog box appears; click **Apply**. The object is dropped from the database.

Structure Window





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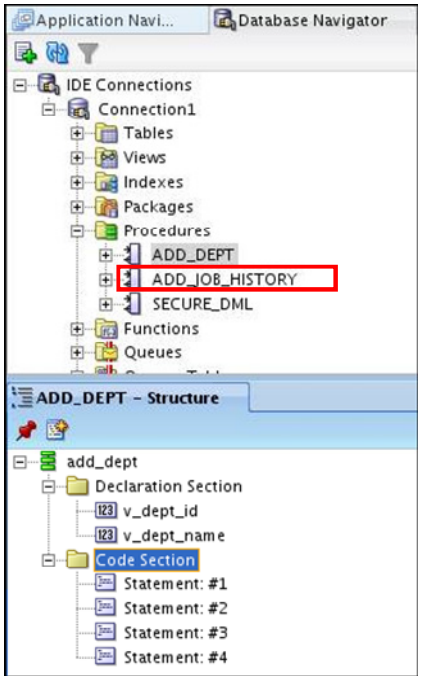
The Structure window offers a structural view of the data in the document currently selected in the active window of those windows that participate in providing structure: the navigators, the editors and viewers, and the Property Inspector.

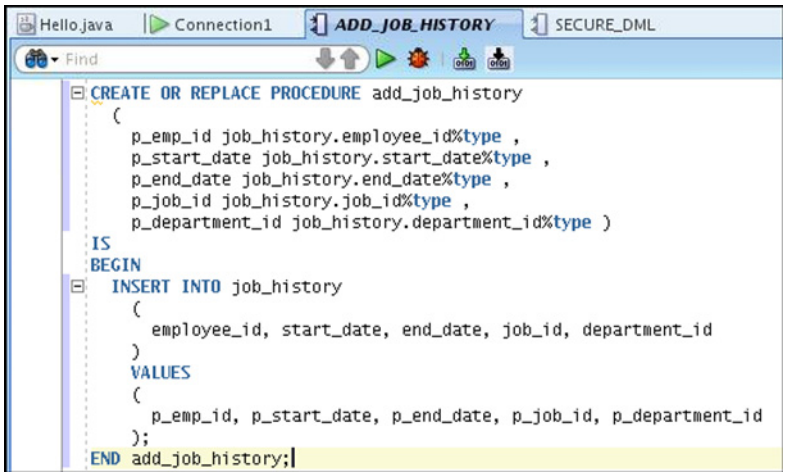
Click View > Structure window to view the Structure window.

In the Structure window, you can view the document data in a variety of ways. The structures available for display are based upon document type. For a Java file, you can view code structure, UI structure, or UI model data. For an XML file, you can view XML structure, design structure, or UI model data.

The Structure window is dynamic, tracking always the current selection of the active window (unless you freeze the window's contents on a particular view), as is pertinent to the currently active editor. When the current selection is a node in the navigator, the default editor is assumed. To change the view on the structure for the current selection, click a different structure tab.

Editor Window





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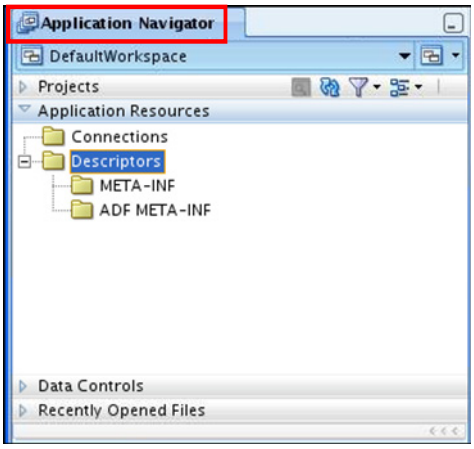
Double-clicking the name of a program unit opens it in the Editor window. You can view your project files all in one single editor window, you can open multiple views of the same file, or you can open multiple views of different files.

The tabs at the top of the editor window are the document tabs. Clicking a document tab gives that file focus, bringing it to the foreground of the window in the current editor.

The tabs at the bottom of the editor window for a given file are the editor tabs. Selecting an editor tab opens the file in that editor.

Application Navigator

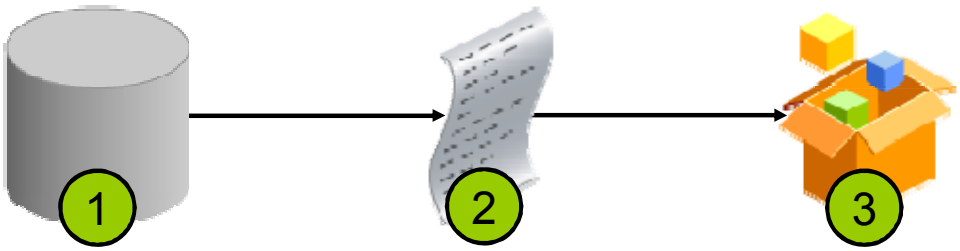


The Application Navigator gives you a logical view of your application and the data it contains. The Application Navigator provides an infrastructure that the different extensions can plug in to and use to organize their data and menus in a consistent, abstract manner. Although the Application Navigator can contain individual files (such as Java source files), it is designed to consolidate complex data. Complex data types such as entity objects, UML diagrams, EJB, or Web services appear in this navigator as single nodes. The raw files that make up these abstract nodes appear in the Structure window.

Deploying Java Stored Procedures

Before deploying Java stored procedures, perform the following steps:

1. Create a database connection.
2. Create a deployment profile.
3. Deploy the objects.

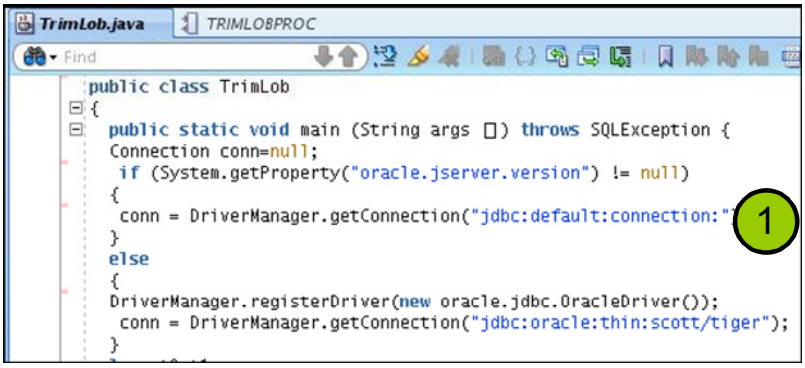


Create a deployment profile for Java stored procedures, and then deploy the classes and, optionally, any public static methods in JDeveloper using the settings in the profile.

Deploying to the database uses the information provided in the Deployment Profile Wizard and two Oracle Database utilities:

- `loadjava` loads the Java class containing the stored procedures to an Oracle database.
- `publish` generates the PL/SQL call–specific wrappers for the loaded public static methods. Publishing enables the Java methods to be called as PL/SQL functions or procedures.

Publishing Java to PL/SQL



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The slide shows the Java code and illustrates how to publish the Java code in a PL/SQL procedure.

How Can I Learn More About JDeveloper 11*g*?

Topic	Website
Oracle JDeveloper Product Page	http://www.oracle.com/technology/products/jdev/index.html
Oracle JDeveloper 11*g* Tutorials	http://www.oracle.com/technology/obe/obe11jdev/11/index.html
Oracle JDeveloper 11*g* Product Documentation	http://www.oracle.com/technology/documentation/jdev.html
Oracle JDeveloper 11*g* Discussion Forum	http://forums.oracle.com/forums/forum.jspa?forumID=83

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Summary

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

- List the key features of Oracle JDeveloper
- Create a database connection in JDeveloper
- Manage database objects in JDeveloper
- Use JDeveloper to execute SQL Commands
- Create and run PL/SQL Program Units

E

Oracle Join Syntax

Objectives

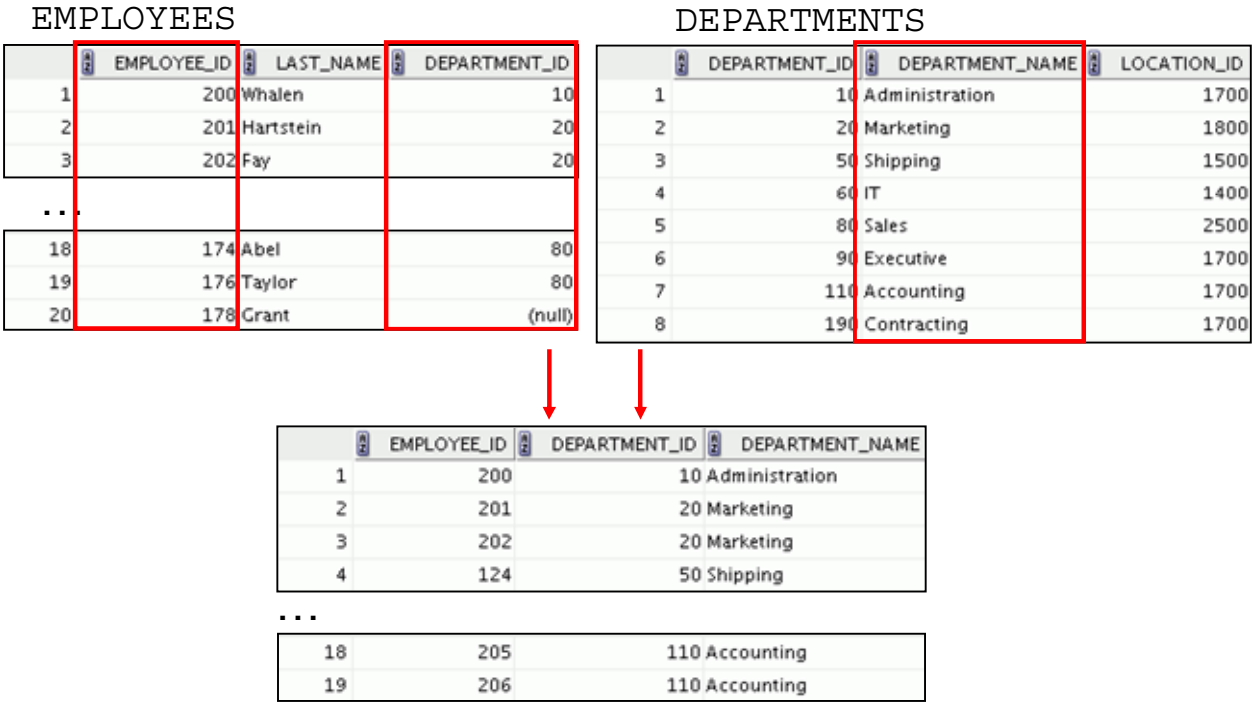
After completing this appendix, you should be able to do the following:

- Write `SELECT` statements to access data from more than one table using equijoins and nonequijoins
- Join a table to itself by using a self-join
- View data that generally does not meet a join condition by using outer joins
- Generate a Cartesian product of all rows from two or more tables

This lesson explains how to obtain data from more than one table. A *join* is used to view information from multiple tables. Therefore, you can *join* tables together to view information from more than one table.

Note: Information about joins is found in the section on “SQL Queries and Subqueries: Joins” in *Oracle Database SQL Language Reference 11g*.

Obtaining Data from Multiple Tables



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Sometimes you need to use data from more than one table. In the example in the slide, the report displays data from two separate tables:

- Employee IDs exist in the `EMPLOYEES` table.
- Department IDs exist in both the `EMPLOYEES` and `DEPARTMENTS` tables.
- Department names exist in the `DEPARTMENTS` table.

To produce the report, you need to link the `EMPLOYEES` and `DEPARTMENTS` tables, and access data from both of them.

Cartesian Products

- A Cartesian product is formed when:
  - A join condition is omitted
  - A join condition is invalid
  - All rows in the first table are joined to all rows in the second table
- To avoid a Cartesian product, always include a valid join condition in a `WHERE` clause.

When a join condition is invalid or omitted completely, the result is a *Cartesian product*, in which all combinations of rows are displayed. In other words, all rows in the first table are joined to all rows in the second table.

A Cartesian product tends to generate a large number of rows and the result is rarely useful. Therefore, you should always include a valid join condition unless you have a specific need to combine all rows from all tables.

However, Cartesian products are useful for some tests when you need to generate a large number of rows to simulate a reasonable amount of data.

Generating a Cartesian Product

EMPLOYEES (20 rows)

	EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID
1	200	Whalen	10
2	201	Hartstein	20
3	202	Fay	20
4	205	Higgins	110
...			
19	176	Taylor	80
20	178	Grant	(null)

DEPARTMENTS (8 rows)

	DEPARTMENT_ID	DEPARTMENT_NAME	LOCATION_ID
1	10	Administration	1700
2	20	Marketing	1800
3	50	Shipping	1500
4	60	IT	1400
5	80	Sales	2500
6	90	Executive	1700
7	110	Accounting	1700
8	190	Contracting	1700

Cartesian product: 20 x 8 = 160 rows

	EMPLOYEE_ID	DEPARTMENT_ID	LOCATION_ID
1	200	10	1700
2	201	20	1700
...			
21	200	10	1800
22	201	20	1800
...			
159	176	80	1700
160	178	(null)	1700

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A Cartesian product is generated when a join condition is omitted. The example in the slide displays the last name of the employee and the department name from the EMPLOYEES and DEPARTMENTS tables, respectively. Because no join condition has been specified, all rows (20 rows) from the EMPLOYEES table are joined with all rows (8 rows) in the DEPARTMENTS table, thereby generating 160 rows in the output.

```
SELECT last_name, department_name dept_name
FROM employees, departments;
```

	LAST_NAME	DEPARTMENT_NAME
1	Abel	Administration
2	Davies	Administration
3	De Haan	Administration
4	Ernst	Administration
5	Fay	Administration
...		
158	Vargas	Contracting
159	Whalen	Contracting
160	Zlotkey	Contracting

Types of Oracle-Proprietary Joins

- Equijoin
- Nonequijoin
- Outer join
- Self-join

Types of Joins

To join tables, you can use Oracle's join syntax.

Note: Before the Oracle9*i* release, the join syntax was proprietary. The SQL:1999–compliant join syntax does not offer any performance benefits over the Oracle-proprietary join syntax.

Oracle does not have an equivalent syntax to support the `FULL OUTER JOIN` of the SQL:1999–compliant join syntax.

Joining Tables Using Oracle Syntax

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.

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 (that is, 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:

table1.column	Denotes the table and column from which data is retrieved
table1.column1 = table2.column2	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.

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.
  - Keeps SQL code smaller, uses less memory
- Use column aliases to distinguish columns that have identical names, but reside in different tables.

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.

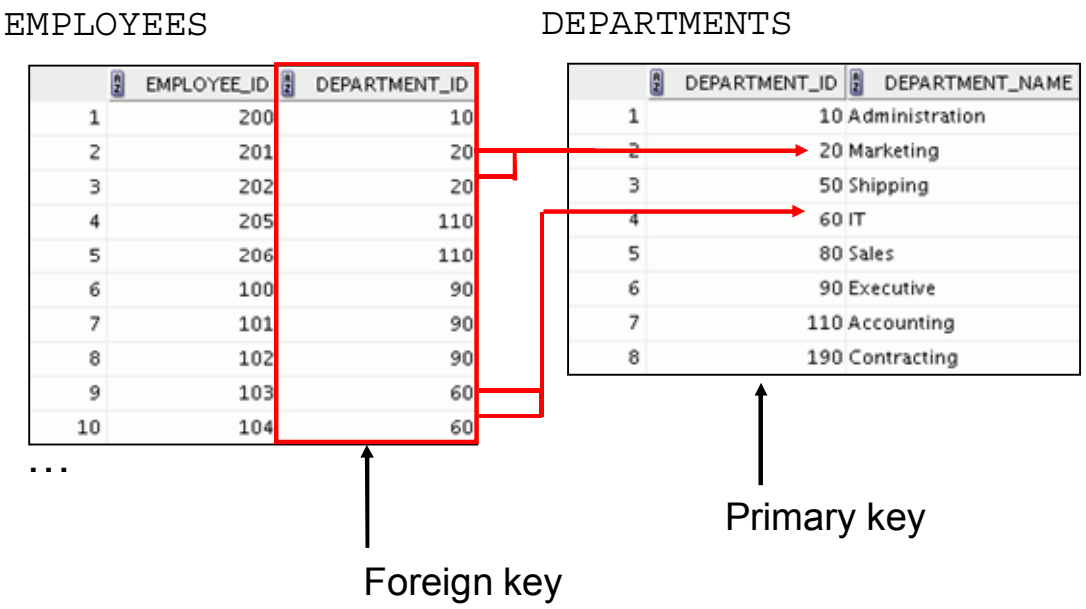
Qualifying column names with table names can be very time consuming, particularly if table names are lengthy. Therefore, you can use *table aliases*, instead of table names. Just as a column alias gives a column another name, a table alias gives a table another name. Table aliases help to keep SQL code 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.

Equijoins



To determine an employee's department name, you compare the value 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* or *inner joins*.

Retrieving Records with Equijoins

```
SELECT e.employee_id, e.last_name, e.department_id,
       d.department_id, d.location_id
FROM   employees e, departments d
WHERE  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	Rajs	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

...

In the example in the slide:

- **The `SELECT` clause specifies the column names to retrieve:**
  - Employee last name, employee number, and department number, which are columns in the `EMPLOYEES` table
  - Department number, department name, 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_ID`s.

Retrieving Records with Equijoins: Example

```
SELECT d.department_id, d.department_name,
       d.location_id, l.city
FROM   departments d, locations l
WHERE  d.location_id = l.location_id;
```

	DEPARTMENT_ID	DEPARTMENT_NAME	LOCATION_ID	CITY
1	60	IT	1400	Southlake
2	50	Shipping	1500	South San Francisco
3	10	Administration	1700	Seattle
4	90	Executive	1700	Seattle
5	110	Accounting	1700	Seattle
6	190	Contracting	1700	Seattle
7	20	Marketing	1800	Toronto
8	80	Sales	2500	Oxford

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In the example in the slide, the `LOCATIONS` table is joined to the `DEPARTMENTS` table by the `LOCATION_ID` column, which is the only column of the same name in both the tables. Table aliases are used to qualify the columns and avoid ambiguity.

Additional Search Conditions Using the AND Operator

```
SELECT  d.department_id, d.department_name, l.city
FROM    departments d, locations l
WHERE   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

In addition to the join, you may have criteria for your WHERE clause to restrict the rows under consideration for one or more tables in the join. The example in the slide limits the rows of output to those with a department ID equal to 20 or 50:

For example, to display employee Matos' department number and department name, you need an additional condition in the WHERE clause.

```
SELECT  e.last_name, e.department_id,
        d.department_name
FROM    employees e, departments d
WHERE   e.department_id = d.department_id
AND     last_name = 'Matos';
```

	LAST_NAME	DEPARTMENT_ID	DEPARTMENT_NAME
1	Matos	50	Shipping

Joining More than Two Tables

EMPLOYEES

	LAST_NAME	DEPARTMENT_ID
1	King	90
2	Kochhar	90
3	De Haan	90
4	Hunold	60
5	Ernst	60
6	Lorentz	60
7	Mourgos	50
8	Rajs	50
9	Davies	50
10	Matos	50

...

DEPARTMENTS

	DEPARTMENT_ID	LOCATION_ID
1	10	1700
2	20	1800
3	50	1500
4	60	1400
5	80	2500
6	90	1700
7	110	1700
8	190	1700

LOCATIONS

	LOCATION_ID	CITY
1	1400	Southlake
2	1500	South San Francisco
3	1700	Seattle
4	1800	Toronto
5	2500	Oxford

To join *n* tables together, you need a minimum of n–1 join conditions. For example, to join three tables, a minimum of two joins is required.

Sometimes you may need to join more than two tables. For example, to display the last name, the department name, and the city for each employee, you have to join the `EMPLOYEES`, `DEPARTMENTS`, and `LOCATIONS` tables.

```
SELECT e.last_name, d.department_name, l.city
FROM   employees e, departments d, locations l
WHERE  e.department_id = d.department_id
AND    d.location_id = l.location_id;
```

	LAST_NAME	DEPARTMENT_NAME	CITY
1	Abel	Sales	Oxford
2	Davies	Shipping	South San Francisco
3	De Haan	Executive	Seattle
4	Ernst	IT	Southlake
5	Fay	Marketing	Toronto

...

Nonequijoins

EMPLOYEES

	LAST_NAME	SALARY
1	Whalen	4400
2	Hartstein	13000
3	Fay	6000
4	Higgins	12000
5	Gietz	8300
6	King	24000
7	Kochhar	17000
8	De Haan	17000
9	Hunold	9000
10	Ernst	6000
...		
19	Taylor	8600
20	Grant	7000

JOB_GRADES

	GRADE_LEVEL	LOWEST_SAL	HIGHEST_SAL
1	A	1000	2999
2	B	3000	5999
3	C	6000	9999
4	D	10000	14999
5	E	15000	24999
6	F	25000	40000

JOB_GRADES table defines LOWEST_SAL and HIGHEST_SAL range of values for each GRADE_LEVEL. Therefore, the GRADE_LEVEL column can be used to assign grades to each employee.

A nonequijoin is a join condition containing something other than an equality operator.

The relationship between the EMPLOYEES table and the JOB_GRADES table is an example of a nonequijoin. The SALARY column in the EMPLOYEES table ranges between the values in the LOWEST_SAL and HIGHEST_SAL columns of the JOB_GRADES table. Therefore, each employee can be graded based on the salary. The relationship is obtained using an operator other than the equality operator (=).

Retrieving Records with Nonequijoins

```
SELECT e.last_name, e.salary, j.grade_level
FROM   employees e, job_grades j
WHERE  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	Mourgos	5800	B
8	Ernst	6000	C
9	Fay	6000	C
10	Grant	7000	C

...

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.

Returning Records with No Direct Match with Outer Joins

DEPARTMENTS

	DEPARTMENT_NAME	DEPARTMENT_ID
1	Administration	10
2	Marketing	20
3	Shipping	50
4	IT	60
5	Sales	80
6	Executive	90
7	Accounting	110
8	Contracting	190

EMPLOYEES

	DEPARTMENT_ID	LAST_NAME
1	10	Whalen
2	20	Hartstein
3	20	Fay
4	110	Higgins
5	110	Gietz
6	90	King
7	90	Kochhar
8	90	De Haan
9	60	Hunold
10	60	Ernst
...		
18	80	Abel
19	80	Taylor

There are no employees in department 190.

If a row does not satisfy a join condition, the row does not appear in the query result. For example, in the equijoin condition of the `EMPLOYEES` and `DEPARTMENTS` tables, department ID 190 does not appear because there are no employees with that department ID recorded in the `EMPLOYEES` table. Similarly, there is an employee whose `DEPARTMENT_ID` is set to `NULL`, so this row will also not appear in the query result of an equijoin. To return the department record that does not have any employees, or to return the employee record that does not belong to any department, you can use the outer join.

Outer Joins: Syntax

- You use an outer join to see rows that do not meet the join condition.
- The outer join operator is the plus sign (+).

```
SELECT table1.column, table2.column
FROM   table1, table2
WHERE  table1.column(+) = table2.column;
```

```
SELECT table1.column, table2.column
FROM   table1, table2
WHERE  table1.column = table2.column(+);
```


Missing rows can be returned if an *outer join* operator is used in the join condition. The operator is a plus sign enclosed with parentheses (+), and is placed on the "side" of the join that is deficient in the information. This operator has the effect of creating one or more null rows, to which one or more rows from the nondeficient table can be joined.

In the syntax:

table1.column =	Is the condition that joins (or relates) the tables together
table2.column (+)	Is the outer join symbol, which can be placed on either side of the WHERE clause condition, but not on both sides (Place the outer join symbol following the name of the column in the table without the matching rows.)

Using Outer Joins

```
SELECT e.last_name, e.department_id, d.department_name
FROM   employees e, departments d
WHERE  e.department_id(+) = d.department_id ;
```

	LAST_NAME	DEPARTMENT_ID	DEPARTMENT_NAME
1	Whalen	10	Administration
2	Hartstein	20	Marketing
3	Fay	20	Marketing
4	Davies	50	Shipping
5	Vargas	50	Shipping
6	Rajs	50	Shipping
7	Mourgos	50	Shipping
8	Matos	50	Shipping
9	Hunold	60	IT
10	Ernst	60	IT
...			
19	Gietz	110	Accounting
20	(null)	(null)	Contracting

The example in the slide displays employee last names, department IDs, and department names. The Contracting department does not have any employees. The empty value is shown in the output.

Outer Join Restrictions

- The outer join operator can appear only on *one* side of the expression—the side in which the information is missing. It returns those rows, from one table, that have no direct match in the other table.
- A condition involving an outer join cannot use the `IN` operator or be linked to another condition by the `OR` operator.

Note: Oracle's join syntax does not have an equivalent for the `FULL OUTER JOIN` of the SQL:1999– compliant join syntax.

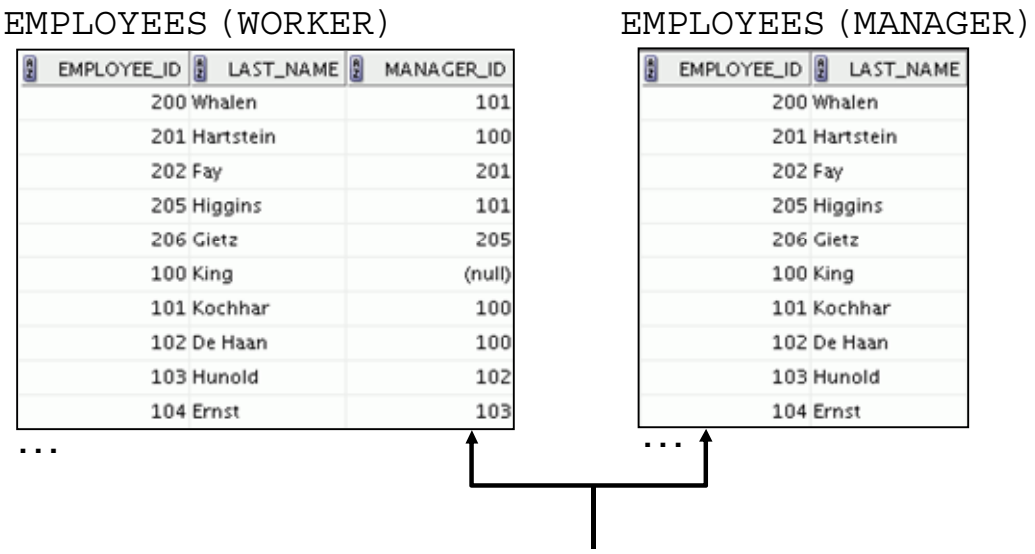
Outer Join: Another Example

```
SELECT e.last_name, e.department_id, d.department_name
FROM   employees e, departments d
WHERE  e.department_id = d.department_id(+) ;
```

	LAST_NAME	DEPARTMENT_ID	DEPARTMENT_NAME
1	Whalen	10	Administration
2	Fay	20	Marketing
3	Hartstein	20	Marketing
4	Vargas	50	Shipping
5	Matos	50	Shipping
...			
16	Kochhar	90	Executive
17	King	90	Executive
18	Gietz	110	Accounting
19	Higgins	110	Accounting
20	Grant	(null)	(null)

The query in the example in the slide retrieves all rows in the `EMPLOYEES` table, even if there is no match in the `DEPARTMENTS` table.

Joining a Table to Itself



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. For example, to find the name of Ernst's manager, you need to:

- Find Ernst in the EMPLOYEES table by looking at the LAST_NAME column
- Find the manager number for Ernst by looking at the MANAGER_ID column. Ernst's manager number is 103.
- Find the name of the manager with EMPLOYEE_ID 103 by looking at the LAST_NAME column. Hunold's employee number is 103, so Hunold is Ernst's manager.

In this process, you look in the table twice. The first time you look in the table to find Ernst in the LAST_NAME column and the MANAGER_ID value of 103. The second time you look in the EMPLOYEE_ID column to find 103 and the LAST_NAME column to find Hunold.

Self-Join: Example

```
SELECT worker.last_name || ' works for '
       || manager.last_name
FROM   employees worker, employees manager
WHERE  worker.manager_id = manager.employee_id;
```

	WORKER.LAST_NAME||'WORKSFOR'||MANAGER.LAST_NAME
1	Hunold works for De Haan
2	Fay works for Hartstein
3	Gietz works for Higgins
4	Lorentz works for Hunold
5	Ernst works for Hunold
6	Zlotkey works for King
7	Mourgos works for King
8	Kochhar works for King
9	Hartstein works for King
10	De Haan works for King

...

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 number matches the employee number for the manager.”

Summary

In this appendix, you should have learned how to use joins to display data from multiple tables by using Oracle-proprietary syntax.

There are multiple ways to join tables.

Types of Joins

- Equijoins
- Nonequijoins
- Outer joins
- Self-joins

Cartesian Products

A Cartesian product results in a display of all combinations of rows. This is done by omitting the `WHERE` clause.

Table Aliases

- Table aliases speed up database access.
- Table aliases can help to keep SQL code smaller by conserving memory.

Practice E: Overview

This practice covers the following topics:

- Joining tables by using an equijoin
- Performing outer and self-joins
- Adding conditions

This practice is intended to give you practical experience in extracting data from more than one table using the Oracle join syntax.