Oracle Database 11*g*: SQL Fundamentals I

Volume II • Student Guide

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Contents

9

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

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Objective

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

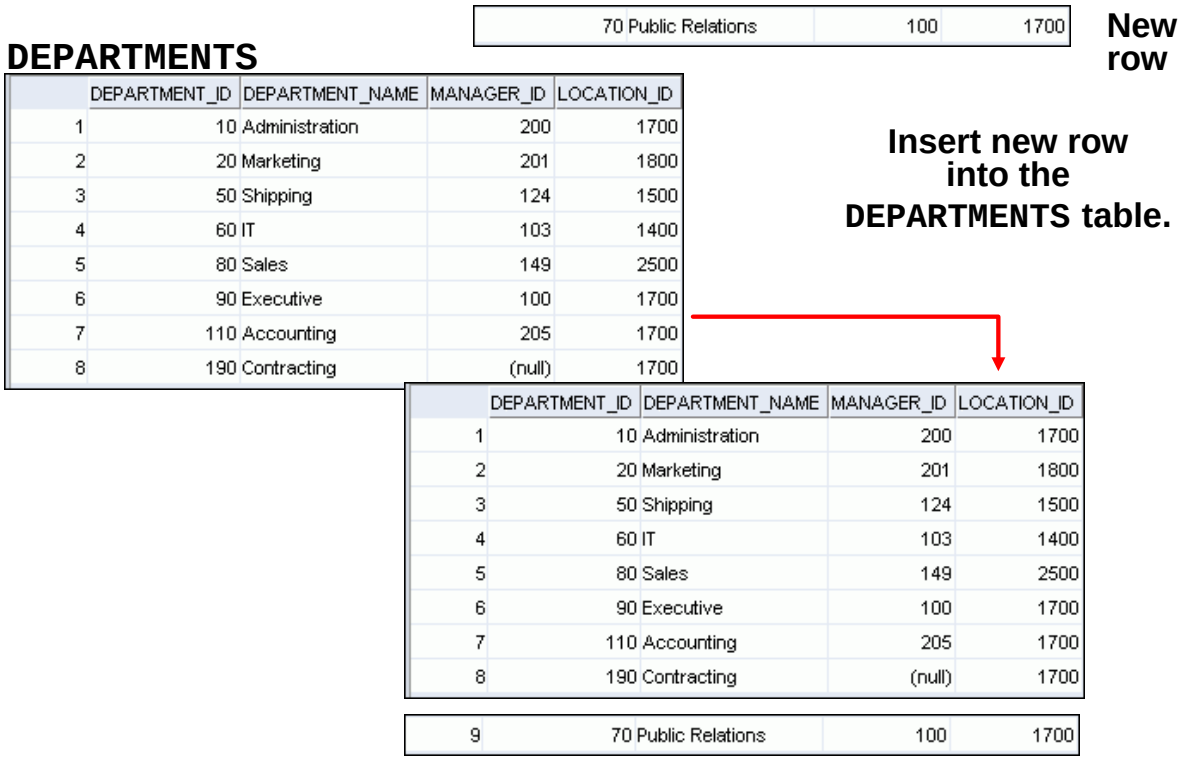
Data manipulation language (DML) is a core part of SQL. When you want to add, update, or delete data in the database, you execute a DML statement. A collection of DML statements that form a logical unit of work is called a *transaction*.

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



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.

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INSERT Statement Syntax

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.

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Inserting New Rows

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
```

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Inserting Rows with Null Values

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.

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 as 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
```

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Inserting Special Values

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	11-JUN-07	(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
114	Den	Raphealy	DRAPHEAL	515.127.4561	03-FEB-99	SA_REP	11000	0.2

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Inserting Specific Date and Time Values

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.

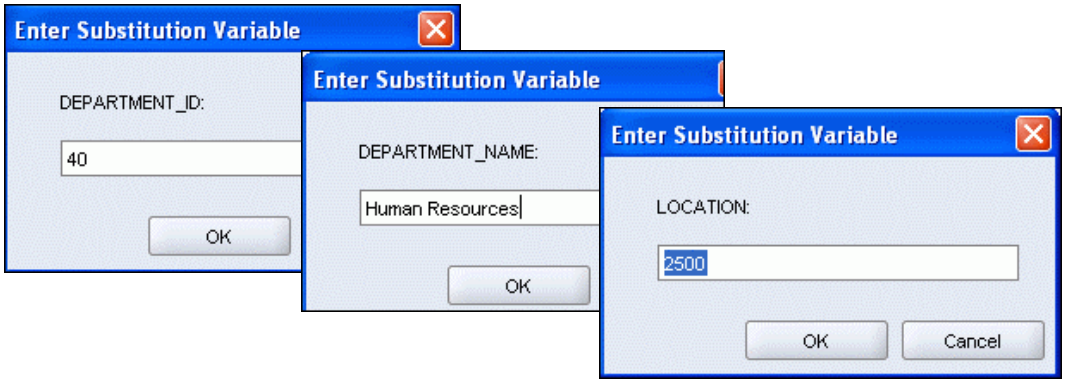
If a date must be entered in a format other than the default format (for example, with another century or a specific time), you must use the `TO_DATE` function.

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 & 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);
```



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Creating a Script

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.

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Copying Rows from Another Table

You can use the INSERT statement to add rows to a table where the values are derived from existing tables. In the slide example, 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 next 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
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- Read consistency
- FOR UPDATE clause in a SELECT statement

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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Changing Data in a Table

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

UPDATE Statement Syntax

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

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

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

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UPDATE Statement Syntax

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 the *Oracle Database SQL Language Reference 11g, Release 1 (11.1).*

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.

Updating Rows in a Table

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	King	110
2	Kochhar	110

...

For example, an employee who was a 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  = (SELECT  job_id
                    FROM    employees
                    WHERE   employee_id = 205),
         salary  = (SELECT  salary
                    FROM    employees
                    WHERE   employee_id = 205)
WHERE    employee_id    =  113;
```

```
1 rows updated
```

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Updating Two Columns with a Subquery

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
```

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Updating Rows Based on Another Table

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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Removing a Row from a Table

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];
```

DELETE Statement Syntax

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 (in the Script Output tab in SQL Developer)

For more information, see the section on "DELETE" in *Oracle Database SQL Language Reference 11g, Release 1 (11.1).*

Deleting Rows from a Table

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

```
DELETE FROM departments
WHERE  department_name = 'Finance';
1 rows deleted
```

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

```
DELETE FROM  copy_emp;
22 rows deleted
```

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Deleting Rows from a Table

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


Deleting Rows Based on Another Table

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

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

TRUNCATE Statement

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

```
TRUNCATE TABLE table_name;
```

- Example:

```
TRUNCATE TABLE copy_emp;
```

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TRUNCATE Statement

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 a subsequent lesson.

Lesson Agenda

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- FOR UPDATE clause in a SELECT statement

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Database Transactions

A database transaction consists of one of the following:

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

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Database Transactions

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

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

Transaction Types

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

Database Transactions: Start and End

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

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Database Transaction: Start and End

When does a database transaction start and end?

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

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

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

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

Advantages of COMMIT and ROLLBACK Statements

With COMMIT and ROLLBACK statements, you can:

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

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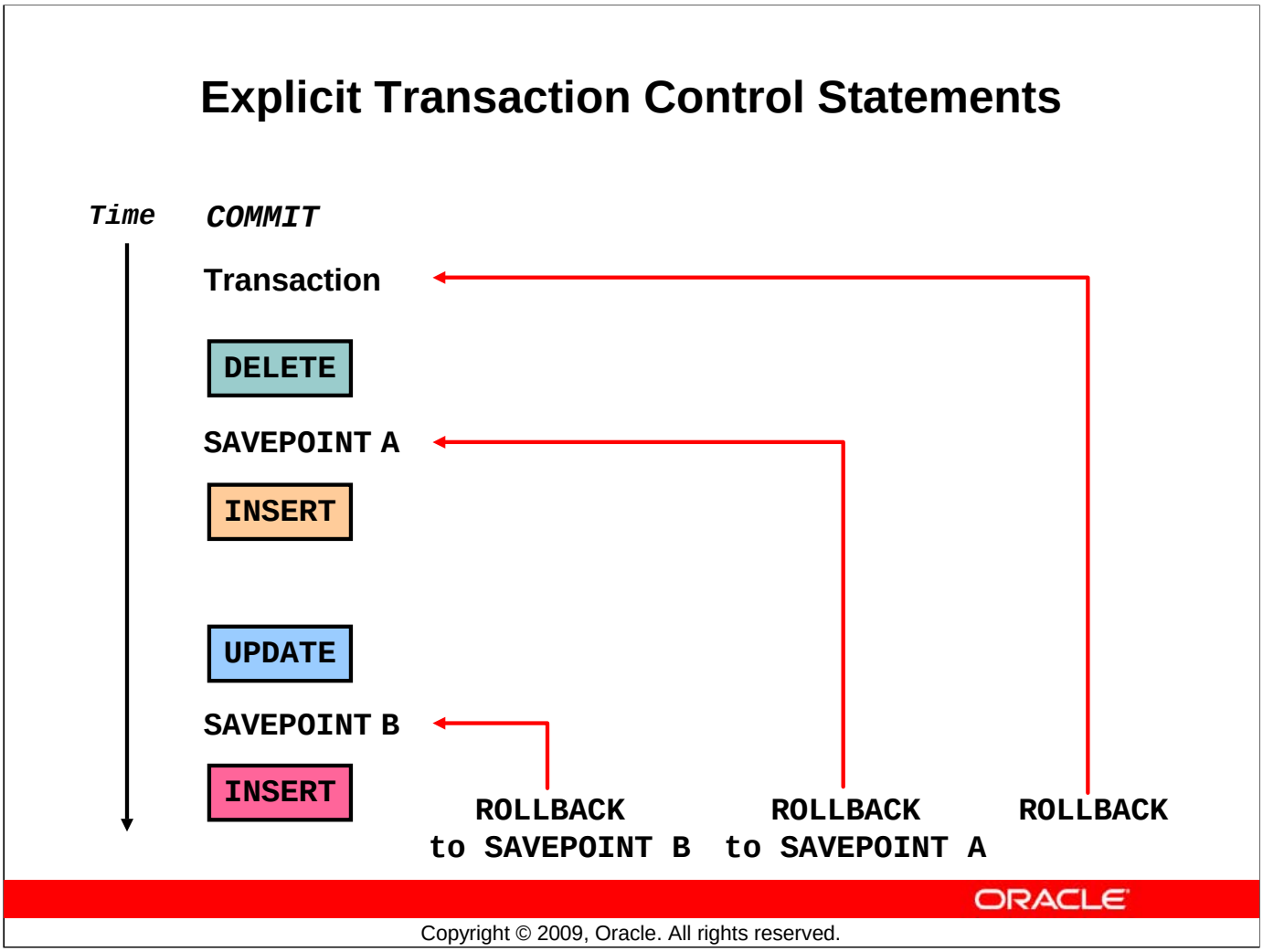
Advantages of COMMIT and ROLLBACK Statements

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	Ends the current transaction by making all pending data changes permanent
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.
```


Rolling Back Changes to a Marker

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, 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 is issued
  - A DCL statement is 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.

Implicit Transaction Processing

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.
- On the right pane, check the Autocommit in SQL Worksheet option. Click OK.

Implicit Transaction Processing (continued)

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.

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State of the Data Before COMMIT or ROLLBACK

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.

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State of the Data After COMMIT

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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Committing Data

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 ;
```

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State of the Data After 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.
```

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State of the Data After ROLLBACK: Example

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.

Statement-Level Rollback

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

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Read Consistency

Database users access the database in two ways:

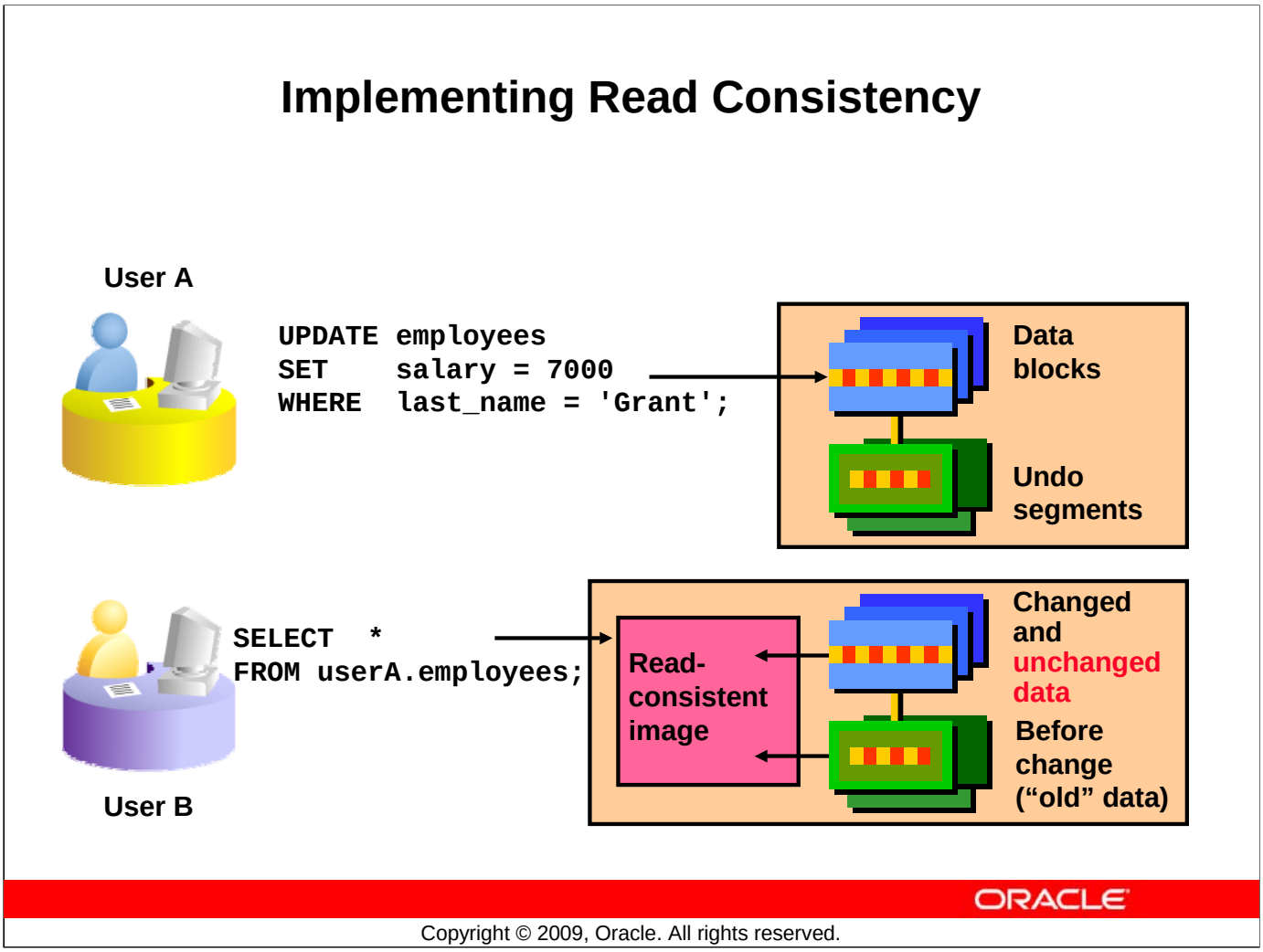
- Read operations (`SELECT` statement)
- Write operations (`INSERT`, `UPDATE`, `DELETE` statements)

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 login as 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, then the database waits until the row is available, and then returns the results of the SELECT statement.

FOR UPDATE Clause in a SELECT Statement

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.

FOR UPDATE Clause: Examples

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;
```

FOR UPDATE Clause: Examples (continued)

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;
```

1. True
2. False

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Answer: 2

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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Summary

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 9: Overview

This practice covers the following topics:

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

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Practice 9: Overview

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.

Practice 9

The HR department wants you to create SQL statements to insert, update, and delete employee data. As a prototype, you use the MY_EMPLOYEE table before giving the statements to the HR department.

Note: For all the DML statements, use the Run Script icon (or press [F5]) to execute the query. This way you get to see the feedback messages on the Script Output tab page. For SELECT queries, continue to use the Execute Statement icon or press [F9] to get the formatted output on the Results tab page.

Insert data into the MY_EMPLOYEE table.

1. Run the statement in the lab_09_01.sql script to build the MY_EMPLOYEE table used in this practice.
2. Describe the structure of the MY_EMPLOYEE table to identify the column names.

```
DESCRIBE MY_EMPLOYEE
Name                           Null     Type
------------------------------ -------- -------------
ID                             NOT NULL NUMBER(4)
LAST_NAME                               VARCHAR2(25)
FIRST_NAME                              VARCHAR2(25)
USERID                                  VARCHAR2(8)
SALARY                                  NUMBER(9,2)
```

3. Create an INSERT statement to add *the first row* of data to the MY_EMPLOYEE table from the following sample data. Do not list the columns in the INSERT clause. *Do not enter all rows yet.*

ID	LAST_NAME	FIRST_NAME	USERID	SALARY
1	Patel	Ralph	rpatel	895
2	Dancs	Betty	bdancs	860
3	Biri	Ben	bbiri	1100
4	Newman	Chad	cnewman	750
5	Ropeburn	Audrey	aropebur	1550

4. Populate the MY_EMPLOYEE table with the second row of the sample data from the preceding list. This time, list the columns explicitly in the INSERT clause.

Practice 9 (continued)

5. Confirm your addition to the table.

	ID	LAST_NAME	FIRST_NAME	USERID	SALARY
1	1	Patel	Ralph	rpatel	895
2	2	Dancs	Betty	bdancs	860

6. Write an `INSERT` statement in a dynamic reusable script file to load the remaining rows into the `MY_EMPLOYEE` table. The script should prompt for all the columns (`ID`, `LAST_NAME`, `FIRST_NAME`, `USERID`, and `SALARY`). Save this script to a `lab_09_06.sql` file.
7. Populate the table with the next two rows of the sample data listed in step 3 by running the `INSERT` statement in the script that you created.
8. Confirm your additions to the table.

	ID	LAST_NAME	FIRST_NAME	USERID	SALARY
1	1	Patel	Ralph	rpatel	895
2	2	Dancs	Betty	bdancs	860
3	3	Biri	Ben	bbiri	1100
4	4	Newman	Chad	cnewman	750

9. Make the data additions permanent.

Update and delete data in the `MY_EMPLOYEE` table.

10. Change the last name of employee 3 to Drexler.
11. Change the salary to $1,000 for all employees who have a salary less than $900.
12. Verify your changes to the table.

	ID	LAST_NAME	FIRST_NAME	USERID	SALARY
1	1	Patel	Ralph	rpatel	1000
2	2	Dancs	Betty	bdancs	1000
3	3	Drexler	Ben	bbiri	1100
4	4	Newman	Chad	cnewman	1000

13. Delete Betty Dancs from the `MY_EMPLOYEE` table.
14. Confirm your changes to the table.

	ID	LAST_NAME	FIRST_NAME	USERID	SALARY
1	1	Patel	Ralph	rpatel	1000
2	3	Drexler	Ben	bbiri	1100
3	4	Newman	Chad	cnewman	1000

Practice 9 (continued)

15. Commit all pending changes.

Control data transaction to the `MY_EMPLOYEE` table.

16. Populate the table with the last row of the sample data listed in step 3 by using the statements in the script that you created in step 6. Run the statements in the script.
17. Confirm your addition to the table.

	ID	LAST_NAME	FIRST_NAME	USERID	SALARY
1	1	Patel	Ralph	rpatel	1000
2	3	Drexler	Ben	bbiri	1100
3	4	Newman	Chad	cnewman	1000
4	5	Ropeburn	Audrey	aropebur	1550

18. Mark an intermediate point in the processing of the transaction.
19. Delete all the rows from the `MY_EMPLOYEE` table.
20. Confirm that the table is empty.
21. Discard the most recent `DELETE` operation without discarding the earlier `INSERT` operation.
22. Confirm that the new row is still intact.

	ID	LAST_NAME	FIRST_NAME	USERID	SALARY
1	1	Patel	Ralph	rpatel	1000
2	3	Drexler	Ben	bbiri	1100
3	4	Newman	Chad	cnewman	1000
4	5	Ropeburn	Audrey	aropebur	1550

23. Make the data addition permanent.

If you have the time, complete the following exercise:

24. Modify the `lab_09_06.sql` script such that the `USERID` is generated automatically by concatenating the first letter of the first name and the first seven characters of the last name. The generated `USERID` must be in lowercase. Hence, the script should not prompt for the `USERID`. Save this script to a file named `lab_09_24.sql`.
25. Run the script, `lab_09_24.sql` to insert the following record:

ID	LAST_NAME	FIRST_NAME	USERID	SALARY
6	Anthony	Mark	manthony	1230

26. Confirm that the new row was added with correct `USERID`.

ID	LAST_NAME	FIRST_NAME	USERID	SALARY
6	Anthony	Mark	manthony	1230

10

Using DDL Statements to Create and Manage Tables

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Objectives

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

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

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Objectives

In this lesson, you are introduced to the data definition language (DDL) statements. You are taught 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

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Database Objects

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
- Must be 1–30 characters long
- Must contain only A–Z, a–z, 0–9, _, $, and #
- Must not duplicate the name of another object owned by the same user
- Must not be an Oracle server–reserved word

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Naming Rules

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, then 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 section on *Schema Object Names and Qualifiers* in the *Oracle Database SQL Language Reference 11g, Release 1 (11.1).*

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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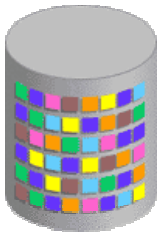
CREATE TABLE Statement

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

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

- You specify:
  - Table name
  - Column name, column data type, and column size



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CREATE TABLE Statement

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.

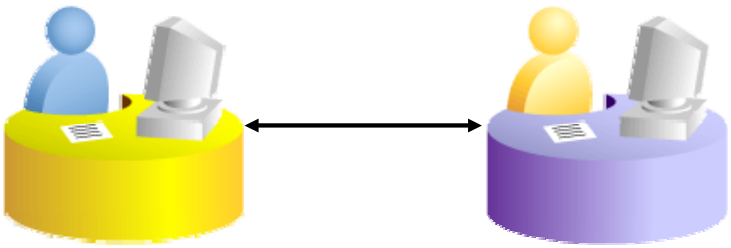
To create a table, a user must have the `CREATE TABLE` privilege and a storage area in which to create objects. The database administrator (DBA) uses data control language (DCL) statements to grant privileges to users.

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

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;
```

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Referencing Another User's Tables

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);
CREATE TABLE succeeded.
```

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DEFAULT Option

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);
```

```
CREATE TABLE succeeded.
```

- Confirm table creation:

```
DESCRIBE dept
```

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

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Creating Tables

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.

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

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

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Data Types

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 Types (continued)

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

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Datetime Data Types

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 11g: SQL Fundamentals II* course.

Also, for more information about the datetime data types, see the topics *TIMESTAMP Datatype*, *INTERVAL YEAR TO MONTH Datatype*, and *INTERVAL DAY TO SECOND Datatype* in *Oracle Database SQL Language Reference 11g, Release 1 (11.1).*

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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Including Constraints

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

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Constraints

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 deletion 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_C*n* format.
- Create a constraint at either of the following times:
  - At the same time as the creation of the table
  - After the creation of the table
- Define a constraint at the column or table level.
- View a constraint in the data dictionary.

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Constraint Guidelines

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_C*n*, 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 11g, Release 1 (11.1).*

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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Defining Constraints

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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Defining Constraints (continued)

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	EMAIL	HIRE_DATE	JOB_ID	COMMISSION_PCT
100	Steven	King	SKING	17-JUN-87	AD_PRES	(null)
101	Neena	Kochhar	NKOCHHAR	21-SEP-89	AD_VP	(null)
102	Lex	De Haan	LDEHAAN	13-JAN-93	AD_VP	(null)
103	Alexander	Hunold	AHUNOLD	03-JAN-90	IT_PROG	(null)
104	Bruce	Ernst	BERNST	21-MAY-91	IT_PROG	(null)
107	Diana	Lorentz	DLORENTZ	07-FEB-99	IT_PROG	(null)
124	Kevin	Mourgos	KMOURGOS	16-NOV-99	ST_MAN	(null)
141	Trenna	Rajs	TRAJS	17-OCT-95	ST_CLERK	(null)
142	Curtis	Davies	CDAVIES	29-JAN-97	ST_CLERK	(null)
143	Randall	Matos	RMATOS	15-MAR-98	ST_CLERK	(null)
144	Peter	Vargas	PVARGAS	09-JUL-98	ST_CLERK	(null)
149	Eleni	Zlotkey	EZLOTKEY	29-JAN-00	SA_MAN	0.2
174	Ellen	Abel	EABEL	11-MAY-96	SA_REP	0.3

...

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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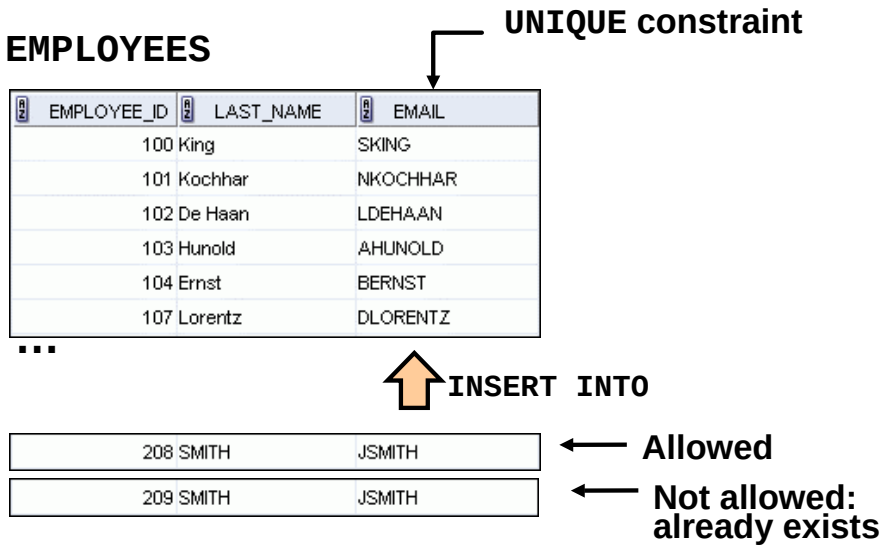
NOT NULL Constraint

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



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));
```

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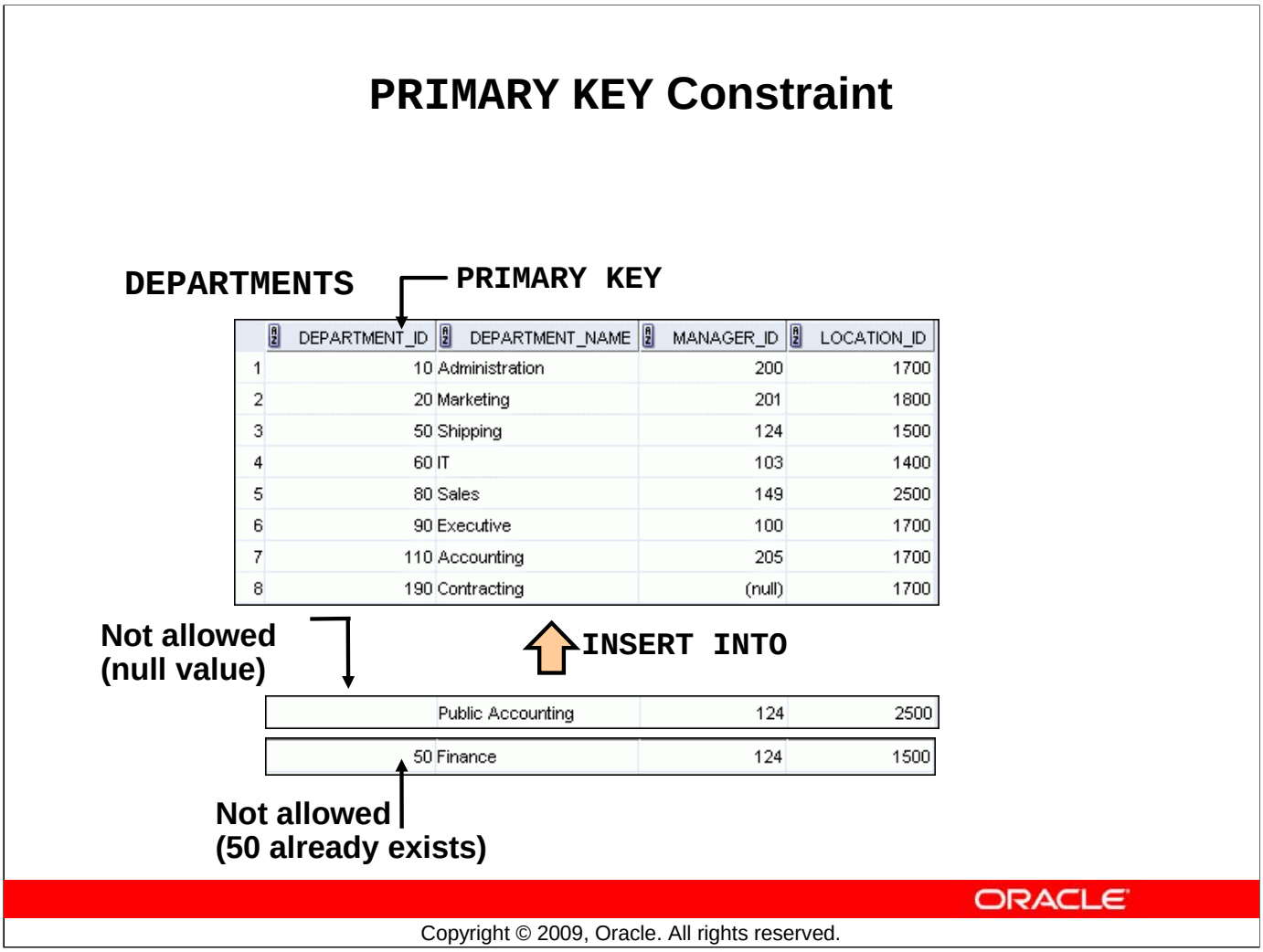
UNIQUE Constraint (continued)

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.

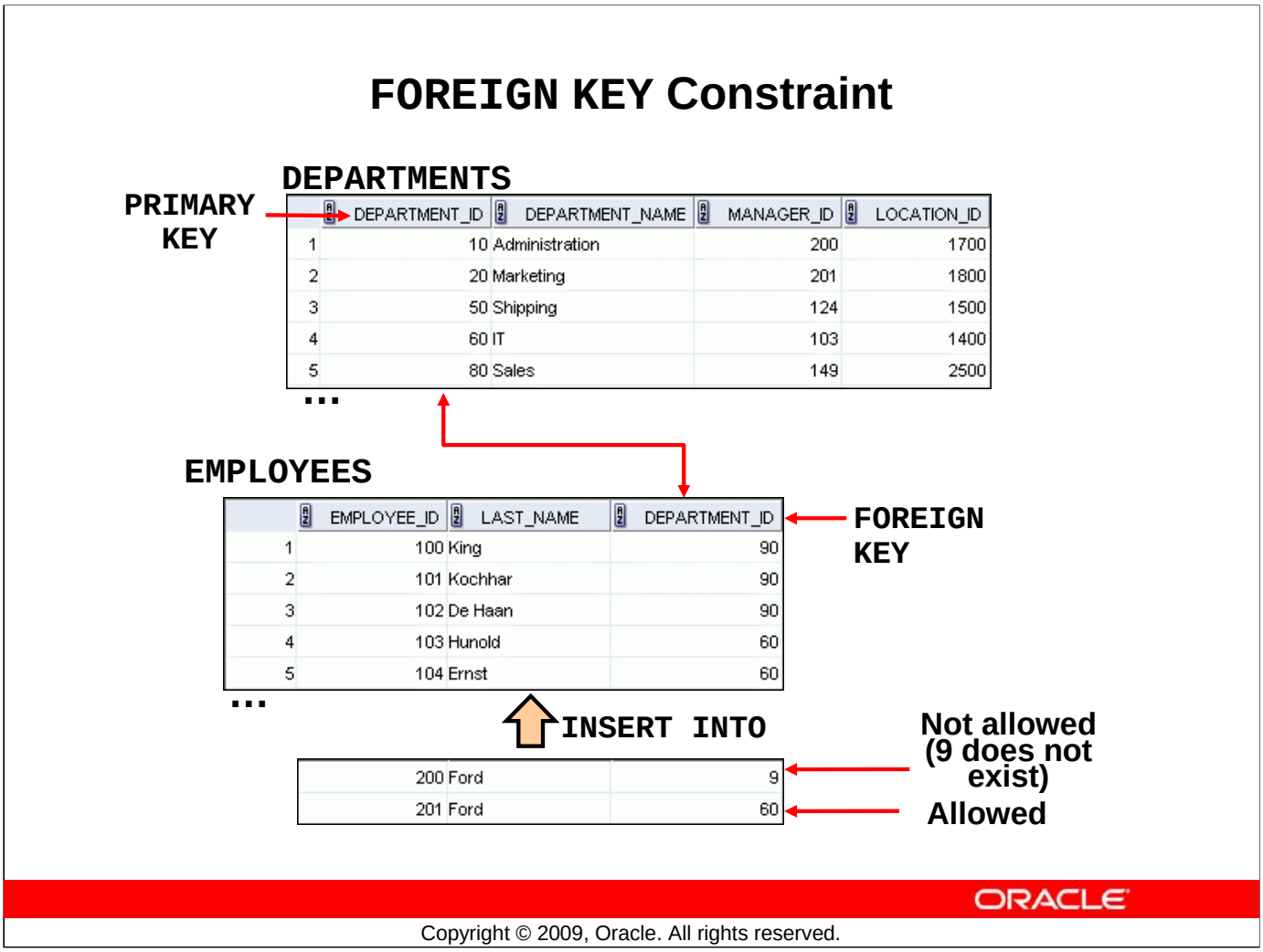
Note: The Oracle server enforces the UNIQUE constraint by implicitly creating a unique index on the unique key column or columns.



PRIMARY KEY Constraint

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

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

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

Guidelines

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

FOREIGN KEY Constraint

Defined at either the table level or the column level:

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

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FOREIGN KEY Constraint (continued)

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

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FOREIGN KEY Constraint: Keywords

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),...
```

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CHECK Constraint

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));
```


CREATE TABLE: Example

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 (ORA16.EMP_DEPT_FK) violated - parent key not found
02291. 00000 - "integrity constraint (%s.%s) violated - parent key not found"
*Cause:    A foreign key value has no matching primary key value.
*Action:   Delete the foreign key or add a matching primary key.
```

Department 55 does not exist.

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Violating Constraints

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 (ORA16.EMP_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.
```


Violating Constraints (continued)

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

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

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

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

```
1 rows deleted
```

Lesson Agenda

- Database objects
  - Naming rules
- 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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Creating a Table Using a Subquery

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

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

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

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Creating a Table Using a Subquery

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;
```

```
CREATE TABLE succeeded.
```

```
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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Creating a Table Using a Subquery (continued)

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:3 Column:6
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
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- DROP TABLE statement

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ALTER TABLE Statement

Use the ALTER TABLE statement to:

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

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ALTER TABLE Statement

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;
```

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Read-Only Tables

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 10g SQL Fundamentals II*.

Lesson Agenda

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- Data types
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- 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;
```

```
DROP TABLE dept80 succeeded.
```

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Dropping a Table

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 11g: SQL Fundamentals II*.

Quiz

You can use constraints to do the following:

1. Enforce rules on the data in a table whenever a row is inserted, updated, or deleted.
2. Prevent the deletion of a table.
3. Prevent the creation of a table.
4. Prevent the creation of data in a table.

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Answer: 1, 2, 4

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

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Summary

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 10: 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

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Practice 10: Overview

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 tab page. For SELECT queries, continue to click the Execute Statement icon or press [F9] to get the formatted output on the Results tab page.

Practice 10

1. Create the DEPT table based on the following table instance chart. Save the statement in a script called lab_10_01.sql, and then execute the statement in the script to create the table. Confirm that the table is created.

Column Name	ID	NAME
Key Type	Primary key	
Nulls/Unique		
FK Table		
FK Column		
Data type	NUMBER	VARCHAR2
Length	7	25

```
Name                          Null     Type
----------------------------- -------- ---------------
ID                            NOT NULL NUMBER(7)
NAME                                   VARCHAR2(25)
```

2. Populate the DEPT table with data from the DEPARTMENTS table. Include only columns that you need.
3. Create the EMP table based on the following table instance chart. Save the statement in a script called lab_10_03.sql, and then execute the statement in the script to create the table. Confirm that the table is created.

Column Name	ID	LAST_NAME	FIRST_NAME	DEPT_ID
Key Type				
Nulls/Unique				
FK Table				DEPT
FK Column				ID
Data type	NUMBER	VARCHAR2	VARCHAR2	NUMBER
Length	7	25	25	7

```
Name                          Null     Type
----------------------------- -------- ---------------
ID                                     NUMBER(7)
LAST_NAME                              VARCHAR2(25)
FIRST_NAME                             VARCHAR2(25)
DEPT_ID                                NUMBER(7)
```

Practice 10 (continued)

4. Create the EMPLOYEES2 table based on the structure of the EMPLOYEES table. Include only the EMPLOYEE_ID, FIRST_NAME, LAST_NAME, SALARY, and DEPARTMENT_ID columns. Name the columns in your new table ID, FIRST_NAME, LAST_NAME, SALARY, and DEPT_ID, respectively.
5. Alter the EMPLOYEES2 table status to read-only.
6. Try to insert the following row in the EMPLOYEES2 table:

ID	FIRST_NAME	LAST_NAME	SALARY	DEPT_ID
34	Grant	Marcie	5678	10

You get the following error message:

```
Error starting at line 1 in command:
INSERT INTO employees2
VALUES (34, 'Grant','Marcie',5678,10)
Error at Command Line:1 Column:12
Error report:
SQL Error: ORA-12081: update operation not allowed on table "ORA16"."EMPLOYEES2"
12081. 00000 -  "update operation not allowed on table \"%s\".\"%s\""
*Cause:    An attempt was made to update a read-only materialized view.
*Action:   No action required. Only Oracle is allowed to update a
           read-only materialized view.
```

7. Revert the EMPLOYEES2 table to the read/write status. Now, try to insert the same row again. You should get the following messages:

```
ALTER TABLE employees2 succeeded.
1 rows inserted
```

8. Drop the EMPLOYEES2 table.

11

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

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Objectives

In this lesson, you are introduced to the view, sequence, synonym, and index objects. You are taught 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

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Database Objects

There are several other objects in a database in addition to tables. In this lesson, you learn about the views, sequences, indexes, and synonyms.

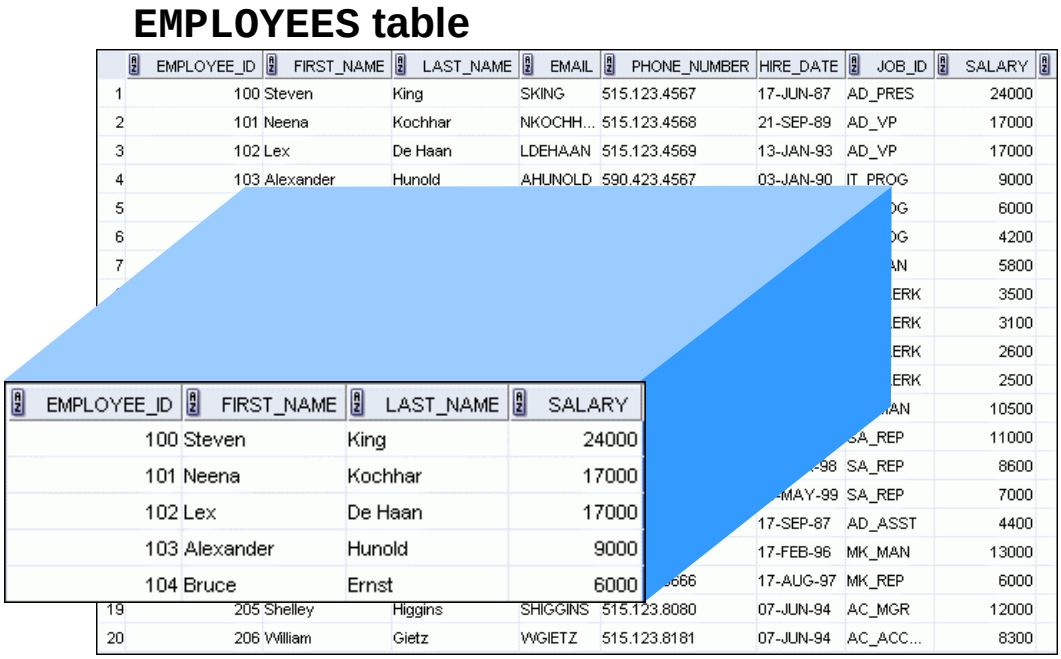
With views, you can present and hide data from the tables.

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.

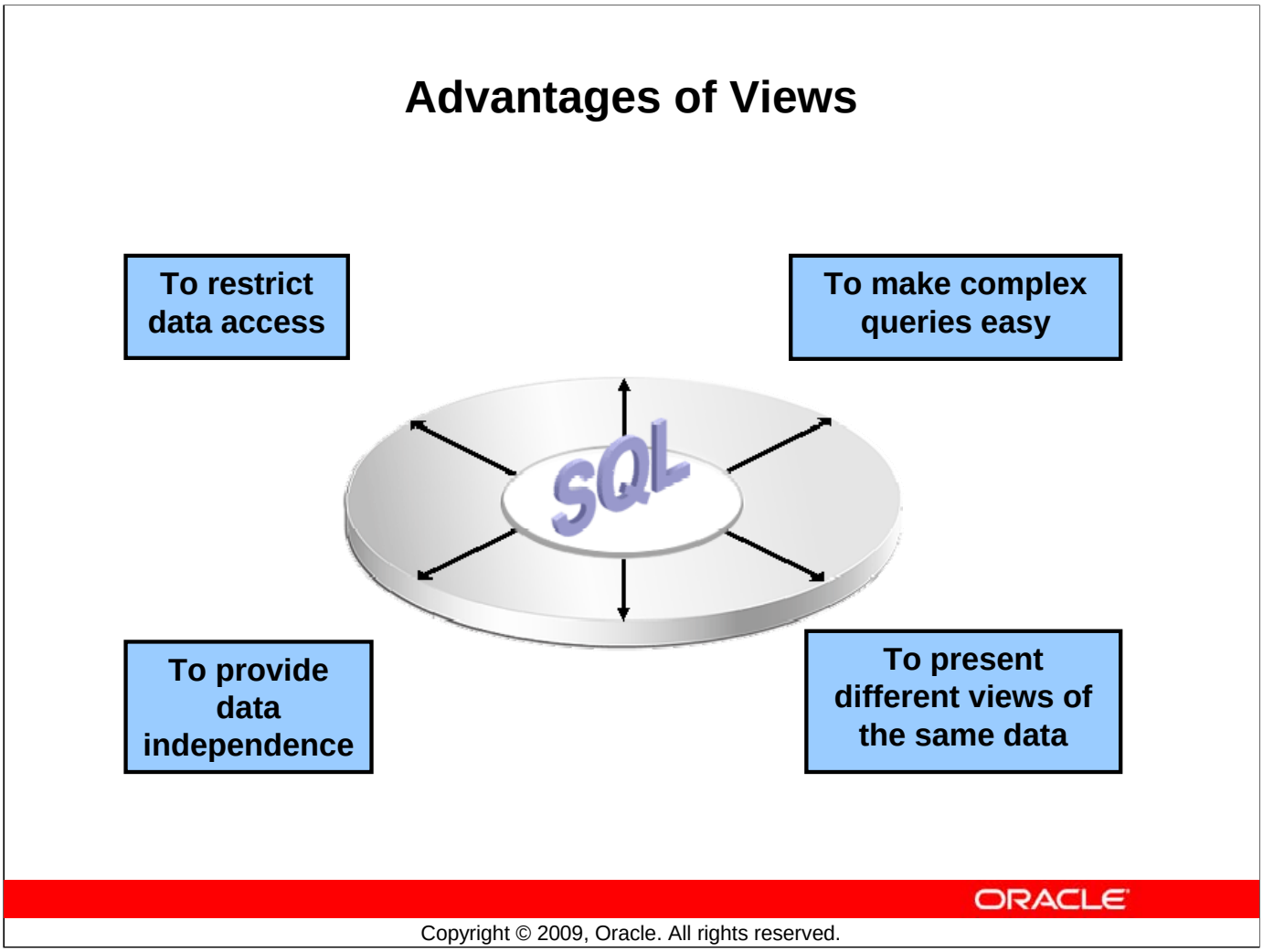
You can provide alternative names for objects by using synonyms.

What Is a View?



What Is a View?

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 section on "`CREATE VIEW`" in the *Oracle Database SQL Language Reference 11g, Release 1 (11.1).*

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

Simple Views and Complex Views

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.

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Creating a View

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;
CREATE VIEW succeeded.
```

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

```
DESCRIBE empvu80
```

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Creating a View (continued)

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;
CREATE VIEW succeeded.
```

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

Creating a View (continued)

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;
```

```
CREATE VIEW succeeded.
```

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

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Retrieving Data from a View

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;
CREATE OR REPLACE VIEW succeeded.
```

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

Modifying a View

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;
CREATE OR REPLACE VIEW succeeded.
```

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Creating a Complex View

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	19333.33333333333333333...
5	Shipping	2500	5800	3500
6	Sales	8600	11000	10033.33333333333333333...
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

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Rules for Performing DML Operations on a View

- 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

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Rules for Performing DML Operations on a View (continued)

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

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Rules for Performing DML Operations on a View (continued)

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 section on "`CREATE VIEW`" in *Oracle Database SQL Language Reference 11g, Release 1 (11.1).*

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 ;
CREATE OR REPLACE VIEW succeeded.
```

- 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.

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Using the WITH CHECK OPTION Clause

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.

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Denying DML Operations

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 ;
CREATE OR REPLACE VIEW succeeded.
```

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Denying DML Operations (continued)

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;
DROP VIEW empvu80 succeeded.
```


Removing a View

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. On the other hand, 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 11: 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

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Practice 11: Overview of Part 1

Part 1 of this lesson's practice provides you with a variety of exercises in creating, using, and removing views. Complete questions 1–6 at the end of this lesson.

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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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

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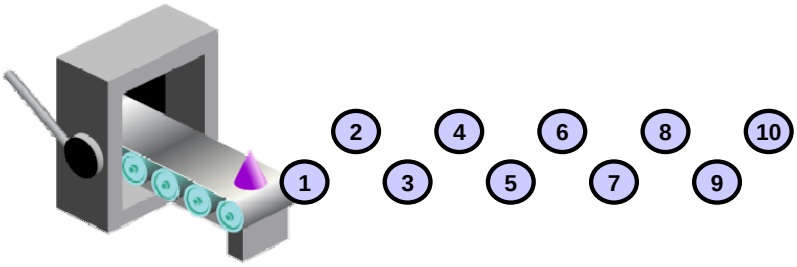
Sequences

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



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Sequences (continued)

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}];
```

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CREATE SEQUENCE Statement: Syntax

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;
```

```
CREATE SEQUENCE succeeded.
```

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Creating a Sequence (continued)

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 section on "CREATE SEQUENCE" in the *Oracle Database SQL Language Reference 11g, Release 1 (11.1).*

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.

NEXTVAL and CURRVAL Pseudocolumns

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.

NEXTVAL and CURRVAL Pseudocolumns (continued)

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 sections on "Pseudocolumns" and "CREATE SEQUENCE" in *Oracle Database SQL Language Reference 11g, Release 1 (11.1).*

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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Using a Sequence

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 slide example. 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

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Caching Sequence Values

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;
```

```
ALTER SEQUENCE dept_deptid_seq succeeded.
```

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Modifying a Sequence

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 11g, Release 1 (11.1).*

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;
DROP SEQUENCE dept_deptid_seq succeeded.
```

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Guidelines for Modifying a Sequence

- 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

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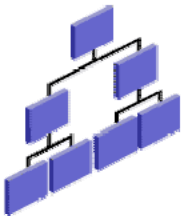
Indexes

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
- May 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 independent of the table that it indexes
- Is used and maintained automatically by the Oracle server



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Indexes (continued)

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, then 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 11g, Release 1 (11.1).*

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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How Are Indexes Created?

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);
CREATE INDEX succeeded.
```

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Creating an Index

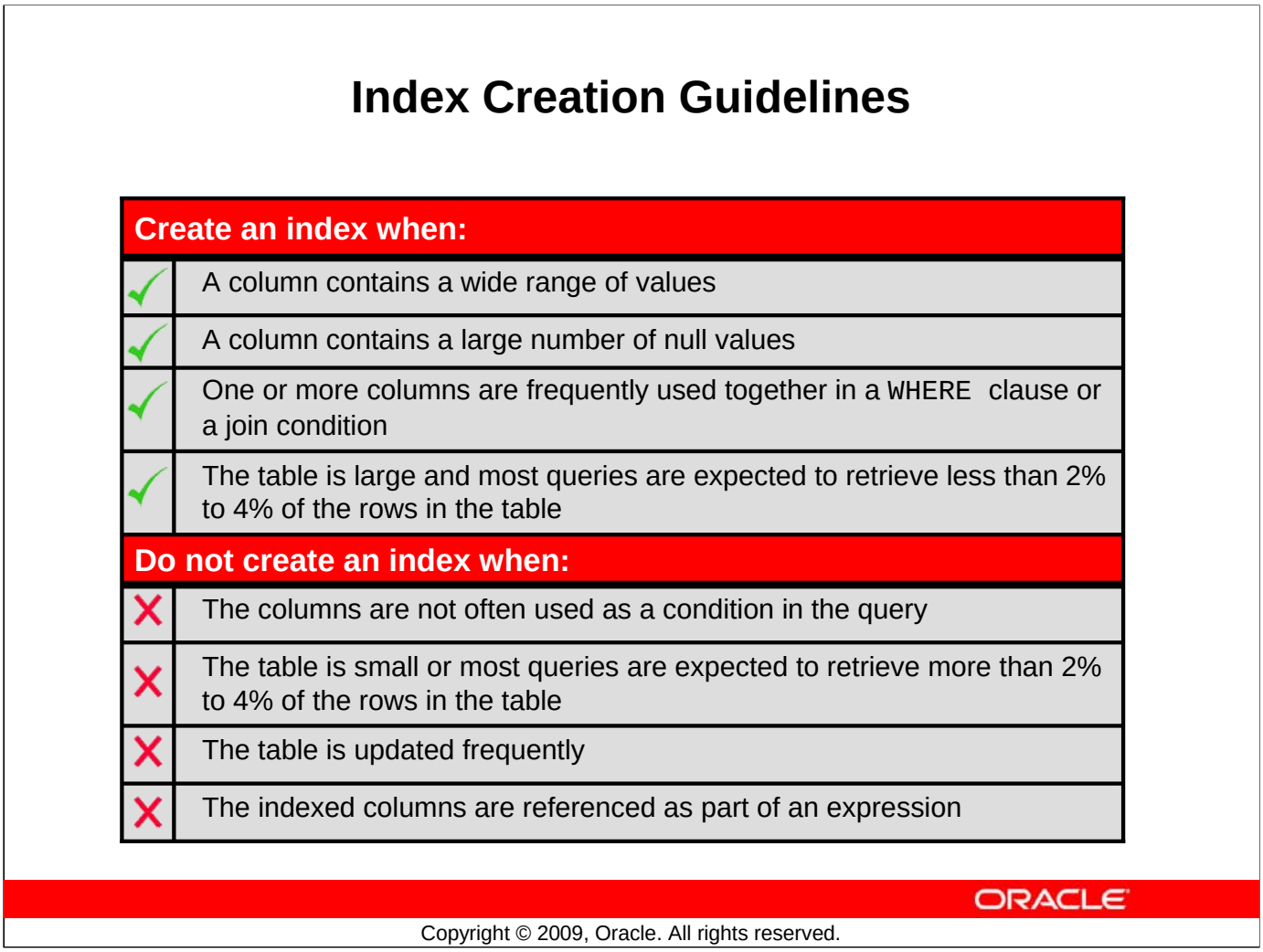
Create an index on one or more columns by issuing the `CREATE INDEX` statement.

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 11g, Release 1 (11.1).*



Index Creation Guidelines

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;
DROP INDEX emp_last_name_idx succeeded.
```

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

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Removing an Index

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:
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- Overview of synonyms
  - Creating, dropping synonyms

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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

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Synonyms

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;
```

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Creating a Synonym for an 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 11g, Release 1 (11.1).*

Creating and Removing Synonyms

- Create a shortened name for the DEPT_SUM_VU view:

```
CREATE SYNONYM  d_sum
FOR  dept_sum_vu;
```

```
CREATE SYNONYM succeeded.
```

- Drop a synonym:

```
DROP SYNONYM d_sum;
```

```
DROP SYNONYM d_sum succeeded.
```

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Creating and Removing Synonyms

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
```

```
CREATE SYNONYM succeeded.
```

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 11g, Release 1 (11.1).*

Quiz

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

1. True
2. False

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Answer: 2

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

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Summary

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

Practice 11: Overview of Part 2

This practice covers the following topics:

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

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Practice 11: Overview of Part 2

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.

Complete questions 7–10 at the end of this lesson.

Practice 11

Part 1

1. The staff in the HR department wants to hide some of the data in the EMPLOYEES table. They want a view called EMPLOYEES_VU based on the employee numbers, employee names, and department numbers from the EMPLOYEES table. They want the heading for the employee name to be EMPLOYEE.
2. Confirm that the view works. Display the contents of the EMPLOYEES_VU view.

	EMPLOYEE_ID	EMPLOYEE	DEPARTMENT_ID
1	100	King	90
2	101	Kochhar	90
3	102	De Haan	90
4	103	Hunold	60
5	104	Ernst	60

▪ ▪ ▪

19	205	Higgins	110
20	206	Gietz	110

3. Using your EMPLOYEES_VU view, write a query for the HR department to display all employee names and department numbers.

	EMPLOYEE	DEPARTMENT_ID
1	King	90
2	Kochhar	90
3	De Haan	90
4	Hunold	60
5	Ernst	60

▪ ▪ ▪

19	Higgins	110
20	Gietz	110

Practice 11 (continued)

4. Department 50 needs access to its employee data. Create a view named `DEPT50` that contains the employee numbers, employee last names, and department numbers for all employees in department 50. You have been asked to label the view columns `EMPNO`, `EMPLOYEE`, and `DEPTNO`. For security purposes, do not allow an employee to be reassigned to another department through the view.
5. Display the structure and contents of the `DEPT50` view.

```
Name                          Null     Type
----------------------------- -------- ------------
EMPNO                         NOT NULL NUMBER(6)
EMPLOYEE                      NOT NULL VARCHAR2(25)
DEPTNO                                 NUMBER(4)
```

	EMPNO	EMPLOYEE	DEPTNO
1	124	Mourgos	50
2	141	Rajs	50
3	142	Davies	50
4	143	Matos	50
5	144	Vargas	50

6. Test your view. Attempt to reassign Matos to department 80.

Practice 11 (continued)

Part 2

7. You need a sequence that can be used with the `PRIMARY KEY` column of the `DEPT` table. The sequence should start at 200 and have a maximum value of 1,000. Have your sequence increment by 10. Name the sequence `DEPT_ID_SEQ`.
8. To test your sequence, write a script to insert two rows in the `DEPT` table. Name your script `lab_11_08.sql`. Be sure to use the sequence that you created for the ID column. Add two departments: Education and Administration. Confirm your additions. Run the commands in your script.
9. Create a nonunique index on the `NAME` column in the `DEPT` table.
10. Create a synonym for your `EMPLOYEES` table. Call it `EMP`.

A: Practice Solutions

Solutions for Practice I: Introduction

The solutions for the "Introduction" lesson practices are discussed below.

Run through the Oracle SQL Developer Demo: Creating a database connection

1. Access the Demo: "Creating a database connection" at:
   http://st-curriculum.oracle.com/tutorial/SQLDeveloper/html/module2/mod02_cp_newdbconn.htm

Starting Oracle SQL Developer

2. Start up Oracle SQL Developer using the "sqldeveloper" desktop icon.
   1. Double-click the "sqldeveloper" desktop icon.

   Note: When you start SQL Developer for the first time, you need to provide the path to the `java.exe` file. This is already done for you as a part of the classroom setup. In any case, if you are prompted, enter the following path:

   `D:\app\Administrator\product\11.1.0\client_1\jdevstudio\jdk\bin`

Creating a New SQL Developer Database Connection

3. To create a new database connection, in the Connections Navigator, right-click Connections. Select New Connection from the menu. The New/Select Database Connection dialog box appears.

4. Create a database connection using the following information:

   a. Connection Name: `myconnection`

   b. Username: `oraxx`, where `xx` is the number of your PC (Ask your instructor to assign you one ora account out of the ora1- ora20 range of accounts.)

   c. Password: `oraxx`

   d. Hostname: Enter the host name of the machine where your database server is running.

   e. Port: 1521

   f. SID: ORCL

   g. Select the Save Password check box.

Testing and Connecting Using the SQL Developer Database Connection

5. Test the new connection.

    1. Click the Test button in the New/Select Database Connection window.

6. If the Status is Success, connect to the database using this new connection.

    1. If the status is Success, click the Connect button.

Browsing the Tables in the Connections Navigator

7. In the Connections Navigator, view the objects available to you under the Tables node. Verify that the following tables are present:

```
COUNTRIES
DEPARTMENTS
EMPLOYEES
JOB_GRADES
JOB_HISTORY
JOBS

LOCATIONS
REGIONS
```

    1. Expand the `myconnection` connection by clicking the plus sign next to it.

    2. Expand the Tables icon by clicking the plus sign next to it.

8. Browse the structure of the `EMPLOYEES` table.

    1. To display the structure of the `EMPLOYEES` table, click `EMPLOYEES`, and by default the Columns tab is the active tab showing the structure of the table.

9. View the data of the `DEPARTMENTS` table.

    1. Click the `DEPARTMENTS` table.

    2. Click the Data tab. The tables data is displayed.

Opening a SQL Worksheet

10. Open a new SQL Worksheet. Examine the shortcut icons available for the SQL Worksheet.

    1. To open a new SQL Worksheet, from the Tools menu, select SQL Worksheet.

    2. Alternatively, right-click `myconnection` and select Open SQL Worksheet.

3. View the shortcut icons in the SQL Worksheet. Specifically look for the Execute Statement and Run Script icons.

Solutions for Practice 1: Retrieving Data Using the SQL SELECT Statement

Part 1

Test your knowledge:

1. The following SELECT statement executes successfully:

```
SELECT last_name, job_id, salary AS Sal
FROM   employees;
```

True/False

2. The following SELECT statement executes successfully:

```
SELECT *
FROM   job_grades;
```

True/False

3. There are four coding errors in this statement. Can you identify them?

```
SELECT    employee_id, last_name
sal x 12  ANNUAL SALARY
FROM      employees;
```

- **The EMPLOYEES table does not contain a column called sal. The column is called SALARY.**
- **The multiplication operator is *, not x, as shown in line 2.**
- **The ANNUAL SALARY alias cannot include spaces. The alias should read ANNUAL_SALARY or should be enclosed within double quotation marks.**
- **A comma is missing after the LAST_NAME column.**

Part 2

Note the following points before you begin with the practices:

- Save all your lab files at the following location: *D:\labs\SQL1\labs*.
- Enter your SQL statements in a SQL Worksheet. To save a script in SQL Developer, from the File menu, select Save As or right-click in the SQL Worksheet and select Save file to save your SQL statement as a lab_<lessonno>_<stepno>.sql script. To modify an existing script, use File > Open to open the script file, make changes and then make sure you use Save As to save it with a different filename.
- To run the query, click the Execute Statement icon (or press [F9]) in the SQL Worksheet. For DML and DDL statements, click the Run Script icon (or press [F5]).
- After you have executed a saved script, make sure that you do not enter your next query in the same worksheet. Open a new worksheet.

Solutions for Practice 1: Retrieving Data Using the SQL SELECT Statement (continued)

You have been hired as a SQL programmer for Acme Corporation. Your first task is to create some reports based on the data from the Human Resources tables.

4. Your first task is to determine the structure of the DEPARTMENTS table and its contents.

    a. To determine the DEPARTMENTS table structure:

```
DESCRIBE departments
```

    b. To view the data contained by the DEPARTMENTS table:

```
SELECT *
FROM   departments;
```

5. You need to determine the structure of the EMPLOYEES table.

```
DESCRIBE employees
```

    The HR department wants a query to display the last name, job ID, hire date, and employee ID for each employee, with the employee ID appearing first. Provide an alias STARTDATE for the HIRE_DATE column. Save your SQL statement to a file named lab_01_05.sql so that you can dispatch this file to the HR department.

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

6. Test your query in the file lab_01_05.sql to ensure that it runs correctly.

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

7. The HR department wants a query to display all unique job IDs from the EMPLOYEES table.

```
SELECT DISTINCT job_id
FROM   employees;
```

Solutions for Practice 1: Retrieving Data Using the SQL SELECT Statement (continued)

Part 3

If you have the time, complete the following exercises:

8. The HR department wants more descriptive column headings for its report on employees. Copy the statement from `lab_01_05.sql` to a new SQL Worksheet. Name the column headings `Emp #`, `Employee`, `Job`, and `Hire Date`, respectively. Then run your query again.

```
SELECT employee_id "Emp #", last_name "Employee",
       job_id "Job", hire_date "Hire Date"
FROM   employees;
```

9. The HR department has requested a report of all employees and their job IDs. Display the last name concatenated with the job ID (separated by a comma and space) and name the column `Employee and Title`.

```
SELECT last_name||', '||job_id "Employee and Title"
FROM   employees;
```

If you want an extra challenge, complete the following exercise:

10. To familiarize yourself with the data in the `EMPLOYEES` table, create a query to display all the data from the `EMPLOYEES` table. Separate each column output with a comma. Name the column as `THE_OUTPUT`.

```
SELECT employee_id || ',' || first_name || ',' || last_name
       || ',' || email || ',' || phone_number || ','|| job_id
       || ',' || manager_id || ',' || hire_date || ','
       || salary || ',' || commission_pct || ',' || department_id
       THE_OUTPUT
FROM   employees;
```

Solutions for Practice 2: Restricting and Sorting Data

The HR department needs your assistance in creating some queries.

1. Because of budget issues, the HR department needs a report that displays the last name and salary of employees earning more than $12,000. Save your SQL statement as a file named `lab_02_01.sql`. Run your query.

```
SELECT  last_name, salary
FROM    employees
WHERE   salary > 12000;
```

2. Open a new SQL Worksheet. Create a report that displays the last name and department number for employee number 176.

```
SELECT  last_name, department_id
FROM    employees
WHERE   employee_id = 176;
```

3. The HR departments needs to find employees with high salary and low salary. Modify `lab_02_01.sql` to display the last name and salary for all employees whose salary is not in the range of $5,000 to $12,000. Save your SQL statement as `lab_02_03.sql`.

```
SELECT  last_name, salary
FROM    employees
WHERE   salary NOT BETWEEN 5000 AND 12000;
```

4. Create a report to display the last name, job ID, and hire date for employees with the last names of Matos and Taylor. Order the query in ascending order by hire date.

```
SELECT   last_name, job_id, hire_date
FROM     employees
WHERE    last_name IN ('Matos', 'Taylor')
ORDER BY hire_date;
```

5. Display the last name and department ID of all employees in departments 20 or 50 in ascending alphabetical order by name.

```
SELECT   last_name, department_id
FROM     employees
WHERE    department_id IN (20, 50)
ORDER BY last_name ASC;
```

Solutions for Practice 2: Restricting and Sorting Data (continued)

6. Modify `lab_02_03.sql` to list the last name and salary of employees who earn between $5,000 and $12,000, and are in department 20 or 50. Label the columns `Employee` and `Monthly Salary`, respectively. Resave `lab_02_03.sql` as `lab_02_06.sql`. Run the statement in `lab_02_06.sql`.

```
SELECT   last_name "Employee", salary "Monthly Salary"
FROM     employees
WHERE    salary  BETWEEN 5000 AND 12000
AND      department_id IN (20, 50);
```

7. The HR department needs a report that displays the last name and hire date for all employees who were hired in 1994.

```
SELECT   last_name, hire_date
FROM     employees
WHERE    hire_date LIKE '%94';
```

8. Create a report to display the last name and job title of all employees who do not have a manager.

```
SELECT   last_name, job_id
FROM     employees
WHERE    manager_id IS NULL;
```

9. Create a report to display the last name, salary, and commission for all employees who earn commissions. Sort data in descending order of salary and commissions. Use the column's numeric position in the `ORDER BY` clause.

```
SELECT   last_name, salary, commission_pct
FROM     employees
WHERE    commission_pct IS NOT NULL
ORDER BY 2 DESC, 3 DESC;
```

10. Members of the HR department want to have more flexibility with the queries that you are writing. They would like a report that displays the last name and salary of employees who earn more than an amount that the user specifies after a prompt. (You can use the query created in practice exercise 1 and modify it.) Save this query to a file named `lab_02_10.sql`.

    a. Enter 12000 when prompted for a value in a dialog box. Click OK.

```
SELECT  last_name, salary
FROM    employees
WHERE   salary > &sal_amt;
```

11. The HR department wants to run reports based on a manager. Create a query that prompts the user for a manager ID and generates the employee ID, last name, salary, and department for that manager's employees. The HR department wants the ability to sort the report on a selected column. You can test the data with the following values:

    manager _id = 103, sorted by last_name

    manager_id = 201, sorted by salary

    manager_id = 124, sorted by employee_id

```
SELECT employee_id, last_name, salary, department_id
FROM employees
WHERE manager_id = &mgr_num
ORDER BY &order_col;
```

If you have the time, complete the following exercises:

12. Display all employee last names in which the third letter of the name is "a."

```
SELECT   last_name
FROM     employees
WHERE    last_name LIKE '__a%';
```

13. Display the last names of all employees who have both an "a" and an "e" in their last name.

```
SELECT   last_name
FROM     employees
WHERE    last_name LIKE '%a%'
AND      last_name LIKE '%e%';
```

If you want an extra challenge, complete the following exercises:

14. Display the last name, job, and salary for all employees whose job is that of a sales representative or a stock clerk, and whose salary is not equal to $2,500, $3,500, or $7,000.

```
SELECT   last_name, job_id, salary
FROM     employees
WHERE    job_id IN ('SA_REP', 'ST_CLERK')
AND      salary NOT IN (2500, 3500, 7000);
```

15. Modify `lab_02_06.sql` to display the last name, salary, and commission for all employees whose commission amount is 20%. Resave `lab_02_06.sql` as `lab_02_15.sql`. Rerun the statement in `lab_02_15.sql`.

```
SELECT   last_name "Employee", salary "Monthly Salary",
         commission_pct
FROM     employees
WHERE    commission_pct = .20;
```

Solutions for Practice 3: Using Single-Row Functions to Customize Output

1. Write a query to display the system date. Label the column `Date`.

   Note: If your database is remotely located in a different time zone, the output will be the date for the operating system on which the database resides.

```
SELECT  sysdate "Date"
FROM    dual;
```

2. The HR department needs a report to display the employee number, last name, salary, and salary increased by 15.5% (expressed as a whole number) for each employee. Label the column `New Salary`. Save your SQL statement in a file named `lab_03_02.sql`.

```
SELECT  employee_id, last_name, salary,
        ROUND(salary * 1.155, 0) "New Salary"
FROM    employees;
```

3. Run your query in the file `lab_03_02.sql`.

```
SELECT  employee_id, last_name, salary,
        ROUND(salary * 1.155, 0) "New Salary"
FROM    employees;
```

4. Modify your query `lab_03_02.sql` to add a column that subtracts the old salary from the new salary. Label the column `Increase`. Save the contents of the file as `lab_03_04.sql`. Run the revised query.

```
SELECT  employee_id, last_name, salary,
        ROUND(salary * 1.155, 0) "New Salary",
        ROUND(salary * 1.155, 0) - salary "Increase"
FROM    employees;
```

5. Write a query that displays the last name (with the first letter in uppercase and all the other letters in lowercase) and the length of the last name for all employees whose name starts with the letters “J,” “A,” or “M.” Give each column an appropriate label. Sort the results by the employees’ last names.

```
SELECT  INITCAP(last_name) "Name",
        LENGTH(last_name) "Length"
FROM    employees
WHERE   last_name LIKE 'J%'
OR      last_name LIKE 'M%'
OR      last_name LIKE 'A%'
ORDER BY last_name ;
```

Solutions for Practice 3: Using Single-Row Functions to Customize Output (continued)

Rewrite the query so that the user is prompted to enter a letter that starts the last name. For example, if the user enters H (capitalized) when prompted for a letter, then the output should show all employees whose last name starts with the letter "H."

```
SELECT  INITCAP(last_name) "Name",
        LENGTH(last_name) "Length"
FROM    employees
WHERE   last_name LIKE '&start_letter%'
ORDER BY last_name;
```

Modify the query such that the case of the entered letter does not affect the output. The entered letter must be capitalized before being processed by the SELECT query.

```
SELECT  INITCAP(last_name) "Name",
LENGTH(last_name) "Length"
FROM    employees
WHERE   last_name LIKE UPPER('&start_letter%' )
ORDER BY last_name;
```

6. The HR department wants to find the duration of employment for each employee. For each employee, display the last name and calculate the number of months between today and the date on which the employee was hired. Label the column MONTHS_WORKED. Order your results by the number of months employed. Round the number of months up to the closest whole number.

   Note: Because this query depends on the date when it was executed, the values in the MONTHS_WORKED column will differ for you.

```
SELECT last_name, ROUND(MONTHS_BETWEEN(
       SYSDATE, hire_date)) MONTHS_WORKED
FROM   employees
ORDER BY months_worked;
```

If you have the time, complete the following exercises:

7. Create a query to display the last name and salary for all employees. Format the salary to be 15 characters long, left-padded with the $ symbol. Label the column SALARY.

```
SELECT last_name,
       LPAD(salary, 15, '$') SALARY
FROM   employees;
```

Solutions for Practice 3: Using Single-Row Functions to Customize Output (continued)

8. Create a query that displays the first eight characters of the employees' last names and indicates the amounts of their salaries with asterisks. Each asterisk signifies a thousand dollars. Sort the data in descending order of salary. Label the column EMPLOYEES_AND_THEIR_SALARIES.

```
SELECT rpad(last_name, 8)||' '||
       rpad(' ', salary/1000+1, '*')
                EMPLOYEES_AND_THEIR_SALARIES
FROM  employees
ORDER BY salary DESC;
```

9. Create a query to display the last name and the number of weeks employed for all employees in department 90. Label the number of weeks column as TENURE. Truncate the number of weeks value to 0 decimal places. Show the records in descending order of the employee's tenure.
   a. **Note:** The TENURE value will differ as it depends on the date when you run the query.

```
SELECT last_name, trunc((SYSDATE-hire_date)/7) AS TENURE
FROM   employees
WHERE  department_id = 90
ORDER BY TENURE DESC
```

Solutions for Practice 4: Using Conversion Functions and Conditional Expressions

1. Create a report that produces the following for each employee:
   <*employee last name*> earns <*salary*> monthly but wants <*3 times salary.*>. Label the column as `Dream Salaries`.

```
SELECT  last_name || ' earns '
        || TO_CHAR(salary, 'fm$99,999.00')
        || ' monthly but wants '
        || TO_CHAR(salary * 3, 'fm$99,999.00')
        || '.' "Dream Salaries"
FROM    employees;
```

2. Display each employee's last name, hire date, and salary review date, which is the first Monday after six months of service. Label the column `REVIEW`. Format the dates to appear in the format similar to "Monday, the Thirty-First of July, 2000."

```
SELECT last_name, hire_date,
       TO_CHAR(NEXT_DAY(ADD_MONTHS(hire_date, 6),'MONDAY'),
       'fmDay, "the" Ddspth "of" Month, YYYY') REVIEW
FROM    employees;
```

3. Display the last name, hire date, and day of the week on which the employee started. Label the column as `DAY`. Order the results by the day of the week, starting with Monday.

```
SELECT last_name, hire_date,
       TO_CHAR(hire_date, 'DAY') DAY
FROM     employees
ORDER BY TO_CHAR(hire_date - 1, 'd');
```

4. Create a query that displays the employees' last names and commission amounts. If an employee does not earn commission, show "No Commission." Label the column as `COMM`.

```
SELECT last_name,
       NVL(TO_CHAR(commission_pct), 'No Commission') COMM
FROM   employees;
```

Solutions for Practice 4: Using Conversion Functions and Conditional Expressions (continued)

5. Using the DECODE function, write a query that displays the grade of all employees based on the value of the JOB_ID column, using the following data:

Job	*Grade*
AD_PRES	A
ST_MAN	B
IT_PROG	C
SA_REP	D
ST_CLERK	E
None of the above	0

```
SELECT job_id, decode (job_id,
                       'ST_CLERK',  'E',
                       'SA_REP',    'D',
                       'IT_PROG',   'C',
                       'ST_MAN',    'B',
                       'AD_PRES',   'A',
                       '0')GRADE
FROM employees;
```

6. Rewrite the statement in the preceding exercise using the CASE syntax.

```
SELECT job_id, CASE job_id
               WHEN 'ST_CLERK' THEN 'E'
               WHEN 'SA_REP'   THEN 'D'
               WHEN 'IT_PROG'  THEN 'C'
               WHEN 'ST_MAN'   THEN 'B'
               WHEN 'AD_PRES'  THEN 'A'
               ELSE '0'  END  GRADE
FROM employees;
```

Solutions for Practice 5: Reporting Aggregated Data Using the Group Functions

Determine the validity of the following three statements. Circle either True or False.

1. Group functions work across many rows to produce one result per group.
   True/False

2. Group functions include nulls in calculations.
   True/**False**

3. The `WHERE` clause restricts rows before inclusion in a group calculation.
   True/False

The HR department needs the following reports:

4. Find the highest, lowest, sum, and average salary of all employees. Label the columns `Maximum`, `Minimum`, `Sum`, and `Average`, respectively. Round your results to the nearest whole number. Save your SQL statement as `lab_05_04.sql`. Run the query.

```
SELECT ROUND(MAX(salary),0) "Maximum",
       ROUND(MIN(salary),0) "Minimum",
       ROUND(SUM(salary),0) "Sum",
       ROUND(AVG(salary),0) "Average"
FROM   employees;
```

5. Modify the query in `lab_05_04.sql` to display the minimum, maximum, sum, and average salary for each job type. Resave `lab_05_04.sql` as `lab_05_05.sql`. Run the statement in `lab_05_05.sql`.

```
SELECT job_id, ROUND(MAX(salary),0) "Maximum",
               ROUND(MIN(salary),0) "Minimum",
               ROUND(SUM(salary),0) "Sum",
               ROUND(AVG(salary),0) "Average"
FROM   employees
GROUP BY job_id;
```

6. Write a query to display the number of people with the same job.

```
SELECT job_id, COUNT(*)
FROM   employees
GROUP BY job_id;
```

   Generalize the query so that the user in the HR department is prompted for a job title. Save the script to a file named `lab_05_06.sql`. Run the query. Enter `IT_PROG` when prompted and click OK.

```
SELECT job_id, COUNT(*)
FROM   employees
WHERE  job_id = '&job_title'
GROUP BY job_id;
```

Solutions for Practice 5: Reporting Aggregated Data Using the Group Functions (continued)

7. Determine the number of managers without listing them. Label the column as `Number of Managers`. *Hint: Use the `MANAGER_ID` column to determine the number of managers.*

```
SELECT COUNT(DISTINCT manager_id) "Number of Managers"
FROM   employees;
```

8. Find the difference between the highest and lowest salaries. Label the column as `DIFFERENCE`.

```
SELECT   MAX(salary) - MIN(salary) DIFFERENCE
FROM     employees;
```

If you have the time, complete the following exercises:

9. Create a report to display the manager number and the salary of the lowest-paid employee for that manager. Exclude anyone whose manager is not known. Exclude any groups where the minimum salary is $6,000 or less. Sort the output in descending order of salary.

```
SELECT   manager_id, MIN(salary)
FROM     employees
WHERE    manager_id IS NOT NULL
GROUP BY manager_id
HAVING   MIN(salary) > 6000
ORDER BY MIN(salary) DESC;
```

If you want an extra challenge, complete the following exercises:

10. Create a query that will display the total number of employees and, of that total, the number of employees hired in 1995, 1996, 1997, and 1998. Create appropriate column headings.

```
SELECT  COUNT(*) total,
        SUM(DECODE(TO_CHAR(hire_date, 'YYYY'),1995,1,0))"1995",
        SUM(DECODE(TO_CHAR(hire_date, 'YYYY'),1996,1,0))"1996",
        SUM(DECODE(TO_CHAR(hire_date, 'YYYY'),1997,1,0))"1997",
        SUM(DECODE(TO_CHAR(hire_date, 'YYYY'),1998,1,0))"1998"
FROM    employees;
```

Solutions for Practice 5: Reporting Aggregated Data Using the Group Functions (continued)

11. Create a matrix query to display the job, the salary for that job based on the department number, and the total salary for that job, for departments 20, 50, 80, and 90, giving each column an appropriate heading.

```
SELECT   job_id "Job",
         SUM(DECODE(department_id , 20, salary)) "Dept 20",
         SUM(DECODE(department_id , 50, salary)) "Dept 50",
         SUM(DECODE(department_id , 80, salary)) "Dept 80",
         SUM(DECODE(department_id , 90, salary)) "Dept 90",
         SUM(salary) "Total"
FROM     employees
GROUP BY job_id;
```

Solutions for Practice 6: Displaying Data from Multiple Tables

1. Write a query for the HR department to produce the addresses of all the departments. Use the LOCATIONS and COUNTRIES tables. Show the location ID, street address, city, state or province, and country in the output. Use a NATURAL JOIN to produce the results.

```
SELECT location_id, street_address, city, state_province, country_name
FROM   locations
NATURAL JOIN  countries;
```

2. The HR department needs a report of all employees. Write a query to display the last name, department number, and department name for all the employees.

```
SELECT last_name, department_id, department_name
FROM   employees
JOIN   departments
USING (department_id);
```

3. The HR department needs a report of employees in Toronto. Display the last name, job, department number, and department name for all employees who work in Toronto.

```
SELECT e.last_name, e.job_id, e.department_id, d.department_name
FROM   employees e JOIN departments d
ON     (e.department_id = d.department_id)
JOIN   locations l
ON     (d.location_id = l.location_id)
WHERE LOWER(l.city) = 'toronto';
```

4. Create a report to display employees' last names and employee number along with their managers' last names and manager number. Label the columns Employee, Emp#, Manager, and Mgr#, respectively. Save your SQL statement as lab_06_04.sql. Run the query.

```
SELECT w.last_name "Employee", w.employee_id "EMP#",
       m.last_name "Manager", m.employee_id  "Mgr#"
FROM   employees w join employees m
ON     (w.manager_id = m.employee_id);
```

5. Modify lab_06_04.sql to display all employees including King, who has no manager. Order the results by the employee number. Save your SQL statement as lab_06_05.sql. Run the query in lab_06_05.sql.

```
SELECT w.last_name "Employee", w.employee_id "EMP#",
       m.last_name "Manager", m.employee_id  "Mgr#"
FROM   employees w
LEFT   OUTER JOIN employees m
ON     (w.manager_id = m.employee_id)
ORDER BY 2;
```

6. Create a report for the HR department that displays employee last names, department numbers, and all the employees who work in the same department as a given employee. Give each column an appropriate label. Save the script to a file named `lab_06_06.sql`. Run the query.

```
SELECT e.department_id department, e.last_name employee,
       c.last_name colleague
FROM   employees e JOIN employees c
ON     (e.department_id = c.department_id)
WHERE  e.employee_id <> c.employee_id
ORDER BY e.department_id, e.last_name, c.last_name;
```

7. The HR department needs a report on job grades and salaries. To familiarize yourself with the `JOB_GRADES` table, first show the structure of the `JOB_GRADES` table. Then create a query that displays the name, job, department name, salary, and grade for all employees.

```
DESC JOB_GRADES

SELECT e.last_name, e.job_id, d.department_name,
       e.salary, j.grade_level
FROM   employees e JOIN departments d
ON     (e.department_id = d.department_id)
JOIN   job_grades j
ON    (e.salary BETWEEN j.lowest_sal AND j.highest_sal);
```

If you want an extra challenge, complete the following exercises:

8. The HR department wants to determine the names of all employees who were hired after Davies. Create a query to display the name and hire date of any employee hired after employee Davies.

```
SELECT e.last_name, e.hire_date
FROM   employees e JOIN employees davies
ON     (davies.last_name = 'Davies')
WHERE  davies.hire_date < e.hire_date;
```

9. The HR department needs to find the names and hire dates for all employees who were hired before their managers, along with their managers' names and hire dates. Save the script to a file named `lab_06_09.sql`.

```
SELECT w.last_name, w.hire_date, m.last_name, m.hire_date
FROM   employees w JOIN employees m
ON    (w.manager_id = m.employee_id)
WHERE    w.hire_date <  m.hire_date;
```

Solutions for Practice 7: Using Subqueries to Solve Queries

1. The HR department needs a query that prompts the user for an employee last name. The query then displays the last name and hire date of any employee in the same department as the employee whose name they supply (excluding that employee). For example, if the user enters `Zlotkey`, find all employees who work with Zlotkey (excluding Zlotkey).

```
UNDEFINE Enter_name

SELECT last_name, hire_date
FROM   employees
WHERE  department_id = (SELECT department_id
                        FROM   employees
                        WHERE  last_name = '&&Enter_name')
AND    last_name <> '&Enter_name';
```

2. Create a report that displays the employee number, last name, and salary of all employees who earn more than the average salary. Sort the results in order of ascending salary.

```
SELECT employee_id, last_name, salary
FROM   employees
WHERE  salary > (SELECT AVG(salary)
                 FROM   employees)
ORDER BY salary;
```

3. Write a query that displays the employee number and last name of all employees who work in a department with any employee whose last name contains a "u." Save your SQL statement as `lab_07_03.sql`. Run your query.

```
SELECT employee_id, last_name
FROM   employees
WHERE  department_id IN (SELECT department_id
                         FROM   employees
                         WHERE  last_name like '%u%');
```

4. The HR department needs a report that displays the last name, department number, and job ID of all employees whose department location ID is 1700.

```
SELECT last_name, department_id, job_id
FROM   employees
WHERE  department_id IN (SELECT department_id
                         FROM   departments
                         WHERE  location_id = 1700);
```

Modify the query so that the user is prompted for a location ID. Save this to a file named `lab_07_04.sql`.

```
SELECT last_name, department_id, job_id
FROM   employees
WHERE  department_id IN (SELECT department_id
                         FROM   departments
                         WHERE  location_id = &Enter_location);
```

5. Create a report for HR that displays the last name and salary of every employee who reports to King.

```
SELECT last_name, salary
FROM   employees
WHERE  manager_id = (SELECT employee_id
                     FROM   employees
                     WHERE  last_name = 'King');
```

6. Create a report for HR that displays the department number, last name, and job ID for every employee in the Executive department.

```
SELECT department_id, last_name, job_id
FROM   employees
WHERE  department_id IN (SELECT department_id
                         FROM   departments
                         WHERE  department_name = 'Executive');
```

If you have the time, complete the following exercise:

7. Modify the query in `lab_07_03.sql` to display the employee number, last name, and salary of all employees who earn more than the average salary and who work in a department with any employee whose last name contains a "u." Resave `lab_07_03.sql` to `lab_07_07.sql`. Run the statement in `lab_07_07.sql`.

```
SELECT employee_id, last_name, salary
FROM   employees
WHERE  department_id IN (SELECT department_id
                         FROM   employees
                         WHERE  last_name like '%u%')
AND    salary > (SELECT AVG(salary)
                 FROM   employees);
```

Solutions for Practice 8: Using the Set Operators

1. The HR department needs a list of department IDs for departments that do not contain the job ID ST_CLERK. Use the set operators to create this report.

```
SELECT department_id
FROM   departments
MINUS
SELECT department_id
FROM   employees
WHERE  job_id = 'ST_CLERK';
```

2. The HR department needs a list of countries that have no departments located in them. Display the country ID and the name of the countries. Use the set operators to create this report.

```
SELECT country_id,country_name
FROM countries
MINUS
SELECT l.country_id,c.country_name
FROM locations l JOIN countries c
ON (l.country_id = c.country_id)
JOIN departments d
ON d.location_id=l.location_id;
```

3. Produce a list of jobs for departments 10, 50, and 20, in that order. Display job ID and department ID using the set operators.

```
SELECT distinct job_id, department_id
FROM employees
WHERE department_id = 10
UNION ALL
SELECT DISTINCT job_id, department_id
FROM employees
WHERE department_id = 50
UNION ALL
SELECT DISTINCT job_id, department_id
FROM employees
WHERE department_id = 20
```

4. Create a report that lists the employee IDs and job IDs of those employees who currently have a job title that is the same as their job title when they were initially hired by the company (that is, they changed jobs but have now gone back to doing their original job).

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

5. The HR department needs a report with the following specifications:

   - Last name and department ID of all the employees from the EMPLOYEES table, regardless of whether or not they belong to a department
   - Department ID and department name of all the departments from the DEPARTMENTS table, regardless of whether or not they have employees working in them

   Write a compound query to accomplish this.

```
SELECT last_name,department_id,TO_CHAR(null)
FROM   employees
UNION
SELECT TO_CHAR(null),department_id,department_name
FROM  departments;
```

Solutions for Practice 9: Manipulating Data

The HR department wants you to create SQL statements to insert, update, and delete employee data. As a prototype, use the MY_EMPLOYEE table before giving the statements to the HR department.

Note: For all the DML statements, click the Run Script icon (or press [F5]) to execute the query. 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.

Insert data into the MY_EMPLOYEE table.

1. Run the statement in the lab_09_01.sql script to build the MY_EMPLOYEE table used in this practice.

    a. From File menu, select Open. In the Open dialog box, navigate to D:\labs\sql1\labs folder, double-click lab_09_01.sql.

    b. After the statement is opened in a SQL Worksheet, click the Run Script icon to run the script. You get a Create Table succeeeded message on the Script Output tabbed page.

2. Describe the structure of the MY_EMPLOYEE table to identify the column names.

```
DESCRIBE my_employee
```

3. Create an INSERT statement to add *the first row* of data to the MY_EMPLOYEE table from the following sample data. Do not list the columns in the INSERT clause.

ID	LAST_NAME	FIRST_NAME	USERID	SALARY
1	Patel	Ralph	rpatel	895
2	Dancs	Betty	bdancs	860
3	Biri	Ben	bbiri	1100
4	Newman	Chad	cnewman	750
5	Ropeburn	Audrey	aropebur	1550

```
INSERT INTO my_employee
  VALUES (1, 'Patel', 'Ralph', 'rpatel', 895);
```

4. Populate the MY_EMPLOYEE table with the second row of the sample data from the preceding list. This time, list the columns explicitly in the INSERT clause.

```
INSERT INTO my_employee (id, last_name, first_name,
                         userid, salary)
  VALUES (2, 'Dancs', 'Betty', 'bdancs', 860);
```

5. Confirm your additions to the table.

```
SELECT   *
FROM     my_employee;
```

6. Write an insert statement in a dynamic reusable script file to load the remaining rows into the MY_EMPLOYEE table. The script should prompt for all the columns (ID, LAST_NAME, FIRST_NAME, USERID and SALARY). Save this script to a file named lab_09_06.sql.

```
INSERT INTO my_employee
VALUES (&p_id, '&p_last_name', '&p_first_name',
        '&p_userid', &p_salary);
```

7. Populate the table with the next two rows of sample data listed in step 3 by running the INSERT statement in the script that you created.

```
INSERT INTO my_employee
VALUES (&p_id, '&p_last_name', '&p_first_name',
       '&p_userid', &p_salary);
```

8. Confirm your additions to the table.

```
SELECT   *
FROM my_employee;
```

9. Make the data additions permanent.

```
COMMIT;
```

Solutions for Practice 9: Manipulating Data (continued)

Update and delete data in the MY_EMPLOYEE table.

10. Change the last name of employee 3 to Drexler.

```
UPDATE  my_employee
SET     last_name = 'Drexler'
WHERE   id = 3;
```

11. Change the salary to $1,000 for all employees with a salary less than $900.

```
UPDATE  my_employee
SET     salary = 1000
WHERE   salary < 900;
```

12. Verify your changes to the table.

```
SELECT  *
FROM    my_employee;
```

13. Delete Betty Dancs from the MY_EMPLOYEE table.

```
DELETE
FROM  my_employee
WHERE last_name = 'Dancs';
```

14. Confirm your changes to the table.

```
SELECT  *
FROM    my_employee;
```

15. Commit all pending changes.

```
COMMIT;
```

Control data transaction to the MY_EMPLOYEE table.

16. Populate the table with the last row of the sample data listed in step 3 by using the statements in the script that you created in step 6. Run the statements in the script.

```
INSERT INTO my_employee
VALUES (&p_id, '&p_last_name', '&p_first_name',
   '&p_userid', &p_salary);
```

17. Confirm your addition to the table.

```
SELECT  *
FROM    my_employee;
```

18. Mark an intermediate point in the processing of the transaction.

```
SAVEPOINT step_17;
```

19. Delete all the rows from the MY_EMPLOYEE table.

```
DELETE
FROM  my_employee;
```

20. Confirm that the table is empty.

```
SELECT *
FROM   my_employee;
```

21. Discard the most recent DELETE operation without discarding the earlier INSERT operation.

```
ROLLBACK TO step_17;
```

22. Confirm that the new row is still intact.

```
SELECT *
FROM   my_employee;
```

23. Make the data addition permanent.

```
COMMIT;
```

If you have time, complete the following exercise:

24. Modify the lab_09_06.sql script such that the USERID is generated automatically by concatenating the first letter of the first name and the first seven characters of the last name. The generated USERID must be in lowercase. Hence, the script should not prompt for the USERID. Save this script to a file named lab_09_24.sql.

```
SET ECHO OFF
SET VERIFY OFF
INSERT INTO my_employee
VALUES (&p_id, '&&p_last_name', '&&p_first_name',
   lower(substr('&p_first_name', 1, 1) ||
   substr('&p_last_name', 1, 7)), &p_salary);
SET VERIFY ON
SET ECHO ON
UNDEFINE p_first_name
UNDEFINE p_last_name
```

25. Run the script `lab_09_24.sql` to insert the following record:

ID	LAST_NAME	FIRST_NAME	USERID	SALARY
6	Anthony	Mark	manthony	1230

26. Confirm that the new row was added with the correct `USERID`.

```
SELECT *
FROM my_employee
WHERE ID='6';
```

Solutions for Practice 10: Using DDL Statements to Create and Manage Tables

Note: For all the DDL and DML statements, click the Run Script icon (or press [F5]) to execute the query. 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.

1. Create the DEPT table based on the following table instance chart. Save the statement in a script called lab_10_01.sql, and then execute the statement in the script to create the table. Confirm that the table is created.

```
CREATE TABLE dept
 (id   NUMBER(7)CONSTRAINT department_id_pk PRIMARY KEY,
  name VARCHAR2(25));
```

   a. To confirm that the table was created and to view its structure, issue the following command:

```
DESCRIBE dept
```

2. Populate the DEPT table with data from the DEPARTMENTS table. Include only those columns that you need.

```
INSERT INTO dept
  SELECT  department_id, department_name
  FROM    departments;
```

3. Create the EMP table based on the following table instance chart. Save the statement in a script called lab_10_03.sql, and then execute the statement in the script to create the table. Confirm that the table is created.

```
CREATE TABLE  emp
  (id           NUMBER(7),
   last_name     VARCHAR2(25),
   first_name    VARCHAR2(25),
   dept_id       NUMBER(7)
     CONSTRAINT emp_dept_id_FK REFERENCES dept (id)
   );
```

   a. To confirm that the table was created and to view its structure:

```
DESCRIBE emp
```

4. Create the EMPLOYEES2 table based on the structure of the EMPLOYEES table. Include only the EMPLOYEE_ID, FIRST_NAME, LAST_NAME, SALARY, and DEPARTMENT_ID columns. Name the columns in your new table ID, FIRST_NAME, LAST_NAME, SALARY, and DEPT_ID, respectively.

```
CREATE TABLE employees2 AS
  SELECT  employee_id id, first_name, last_name, salary,
          department_id dept_id
  FROM    employees;
```

Solutions for Practice 10: Using DDL Statements to Create and Manage Tables (continued)

5. Alter the EMPLOYEES2 table status to read-only.

```
ALTER TABLE employees2 READ ONLY
```

6. Try to insert the following row in the EMPLOYEES2 table.

    a. Note, you will get "Update operation not allowed on table" error message. Hence, you will not be allowed to insert any row into the table because it is assigned a read only status.

```
INSERT INTO employees2
VALUES (34, 'Grant','Marcie',5678,10)
```

7. Revert the EMPLOYEES2 table to the read/write status. Now try to insert the same row again.

    a. Now, because the table is assigned a READ WRITE status, you will be allowed to insert a row into the table.

```
ALTER TABLE employees2 READ WRITE

INSERT INTO employees2
VALUES (34, 'Grant','Marcie',5678,10)
```

8. Drop the EMPLOYEES2 table.

    a. **Note:** You can even drop a table that is in the READ ONLY mode. To test this, alter the table again to READ ONLY status and then issue the DROP TABLE command. The table EMPLOYEES2 will be dropped.

```
DROP TABLE employees2;
```

Solutions for Practice 11: Creating Other Schema Objects
Part 1

1. The staff in the HR department wants to hide some of the data in the EMPLOYEES table. They want a view called called EMPLOYEES_VU based on the employee numbers, employee last names, and department numbers from the EMPLOYEES table. They want the heading for the employee name to be EMPLOYEE.

```
CREATE OR REPLACE VIEW employees_vu AS
    SELECT employee_id, last_name employee, department_id
    FROM employees;
```

2. Confirm that the view works. Display the contents of the EMPLOYEES_VU view.

```
SELECT   *
FROM     employees_vu;
```

3. Using your EMPLOYEES_VU view, write a query for the HR department to display all employee names and department numbers.

```
SELECT   employee, department_id
FROM     employees_vu;
```

4. Department 50 needs access to its employee data. Create a view named DEPT50 that contains the employee numbers, employee last names, and department numbers for all employees in department 50. They have requested that you label the view columns EMPNO, EMPLOYEE, and DEPTNO. For security purposes, do not allow an employee to be reassigned to another department through the view.

```
CREATE VIEW dept50 AS
   SELECT   employee_id empno, last_name employee,
            department_id deptno
   FROM     employees
   WHERE    department_id = 50
   WITH CHECK OPTION CONSTRAINT emp_dept_50;
```

5. Display the structure and contents of the DEPT50 view.

```
DESCRIBE dept50

SELECT   *
FROM     dept50;
```

6. Test your view. Attempt to reassign Matos to department 80.

```
UPDATE   dept50
SET      deptno = 80
WHERE    employee = 'Matos';
```

The error is because the DEPT50 view has been created with the WITH CHECK OPTION constraint. This ensures that the DEPTNO column in the view is protected from being changed.

Solutions for Practice 11: Creating Other Schema Objects (continued)
Part 2

7. You need a sequence that can be used with the primary key column of the DEPT table. The sequence should start at 200 and have a maximum value of 1,000. Have your sequence increment by 10. Name the sequence `DEPT_ID_SEQ`.

```
CREATE SEQUENCE dept_id_seq
  START WITH 200
  INCREMENT BY 10
  MAXVALUE 1000;
```

8. To test your sequence, write a script to insert two rows in the `DEPT` table. Name your script `lab_11_08.sql`. Be sure to use the sequence that you created for the ID column. Add two departments: Education and Administration. Confirm your additions. Run the commands in your script.

```
INSERT INTO dept
VALUES (dept_id_seq.nextval, 'Education');

INSERT INTO dept
VALUES (dept_id_seq.nextval, 'Administration');
```

9. Create a nonunique index on the `NAME` column in the `DEPT` table.

```
CREATE INDEX dept_name_idx ON dept (name);
```

10. Create a synonym for your `EMPLOYEES` table. Call it `EMP`.

```
CREATE SYNONYM emp FOR EMPLOYEES;
```

Solutions for Practice C: Oracle Join Syntax

1. Write a query for the HR department to produce the addresses of all the departments. Use the `LOCATIONS` and `COUNTRIES` tables. Show the location ID, street address, city, state or province, and country in the output. Run the query.

```
SELECT location_id, street_address, city, state_province, country_name
FROM   locations, countries
WHERE  locations.country_id = countries.country_id;
```

2. The HR department needs a report of all employees. Write a query to display the last name, department number, and department name for all employees. Run the query.

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

3. The HR department needs a report of employees in Toronto. Display the last name, job, department number, and department name for all employees who work in Toronto.

```
SELECT e.last_name, e.job_id, e.department_id, d.department_name
FROM   employees e, departments d , locations l
WHERE  e.department_id = d.department_id
AND    d.location_id = l.location_id
AND    LOWER(l.city) = 'toronto';
```

4. Create a report to display the employee last name and the employee number along with the last name of the employee's manager and manager number. Label the columns `Employee`, `Emp#`, `Manager`, and `Mgr#`, respectively. Save your SQL statement as `lab_c_04.sql`.

```
SELECT w.last_name "Employee", w.employee_id "EMP#",
       m.last_name "Manager", m.employee_id  "Mgr#"
FROM   employees w, employees m
WHERE  w.manager_id = m.employee_id;
```

5. Modify `lab_c_04.sql` to display all employees including King, who has no manager. Order the results by the employee number. Save the SQL statement as `lab_c_05.sql`. Run the query in `lab_c_05.sql`.

```
SELECT w.last_name "Employee", w.employee_id "EMP#",
       m.last_name "Manager", m.employee_id  "Mgr#"
FROM   employees w, employees m
WHERE  w.manager_id  = m.employee_id (+);
```

Solutions for Practice C: Oracle Join Syntax (continued)

6. Create a report for the HR department that displays employee last names, department numbers, and all the employees who work in the same department as a given employee. Give each column an appropriate label. Save the script to a file named `lab_c_06.sql`.

```
SELECT e1.department_id department, e1.last_name employee,
       e2.last_name colleague
FROM   employees e1, employees e2
WHERE  e1.department_id = e2.department_id
AND    e1.employee_id <> e2.employee_id
ORDER BY e1.department_id, e1.last_name, e2.last_name;
```

7. The HR department needs a report on job grades and salaries. To familiarize yourself with the `JOB_GRADES` table, first show the structure of the `JOB_GRADES` table. Then create a query that displays the name, job, department name, salary, and grade for all employees.

```
DESC JOB_GRADES

SELECT e.last_name, e.job_id, d.department_name,
       e.salary, j.grade_level
FROM   employees e, departments d, job_grades j
WHERE  e.department_id = d.department_id
AND    e.salary BETWEEN j.lowest_sal AND j.highest_sal;
```

If you want an extra challenge, complete the following exercises:

8. The HR department wants to determine the names of all employees hired after Davies. Create a query to display the name and hire date of any employee hired after employee Davies.

```
SELECT e.last_name, e.hire_date
FROM   employees e , employees davies
WHERE  davies.last_name = 'Davies'
AND    davies.hire_date < e.hire_date;
```

9. The HR department needs to find the names and hire dates for all employees who were hired before their managers, along with their managers' names and hire dates. Label the columns `Employee`, `Emp Hired`, `Manager`, and `Mgr Hired`, respectively. Save the script to a file named `lab_c_09.sql`.

```
SELECT w.last_name, w.hire_date, m.last_name, m.hire_date
FROM   employees w , employees m
WHERE  w.manager_id = m.employee_id
AND    w.hire_date <  m.hire_date;
```

B

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)

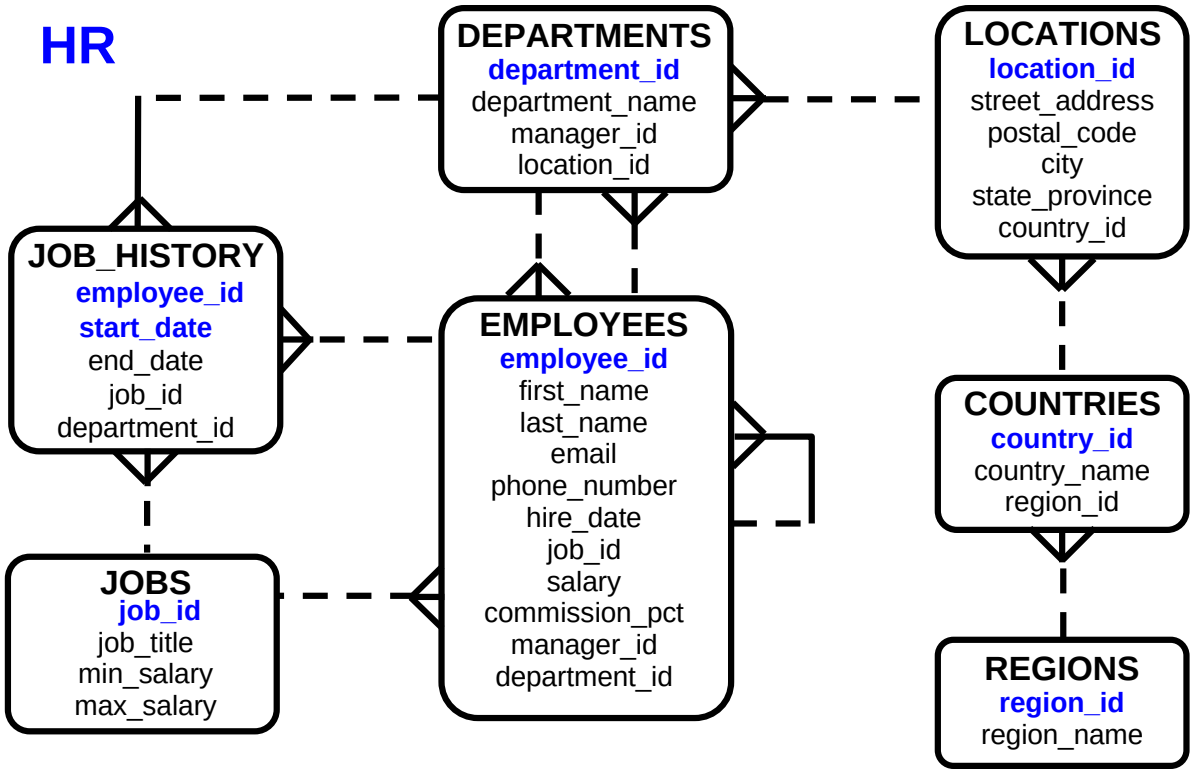
This is the schema that is used in this course. In the Human Resource (HR) records, each employee has an identification number, email address, job identification code, salary, and manager. Some employees earn commissions in addition to their salary.

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.

The HR Entity Relationship Diagram



The 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

The Human Resources (HR) Table Descriptions (continued)

```
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

The Human Resources (HR) Table Descriptions (continued)

```
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_N...	LAST_N...	EMAIL	PHONE_NUMBER	HIRE_DATE	JOB_ID	SALARY	COMMI...	MANAGER_ID	DEPARTMENT_ID
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	011.44.1344.429018	29-JAN-00	SA_MAN	10500	0.2	100	80
13	174	Ellen	Abel	EABEL	011.44.1644.429267	11-MAY-96	SA_REP	11000	0.3	149	80
14	176	Jonathon	Taylor	JTAYLOR	011.44.1644.429265	24-MAR-98	SA_REP	8600	0.2	149	80
15	178	Kimberely	Grant	KGRANT	011.44.1644.429263	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_ACC...	8300	(null)	205	110

The Human Resources (HR) Table Descriptions (continued)

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

The Human Resources (HR) Table Descriptions (continued)

```
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

The Human Resources (HR) Table Descriptions (continued)

```
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

The Human Resources (HR) Table Descriptions (continued)

```
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

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

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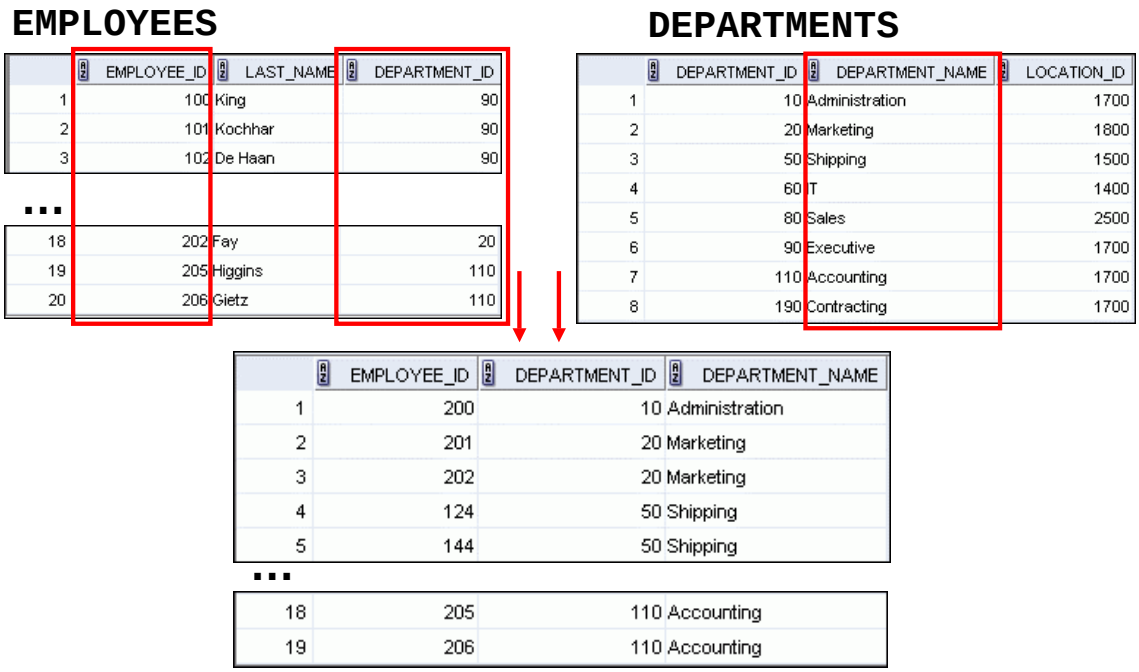
Objectives

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 on joins is found in the section on "SQL Queries and Subqueries: Joins" in *Oracle Database SQL Language Reference 11g, Release 1 (11.1).*

Obtaining Data from Multiple Tables



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Obtaining Data from Multiple Tables

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.

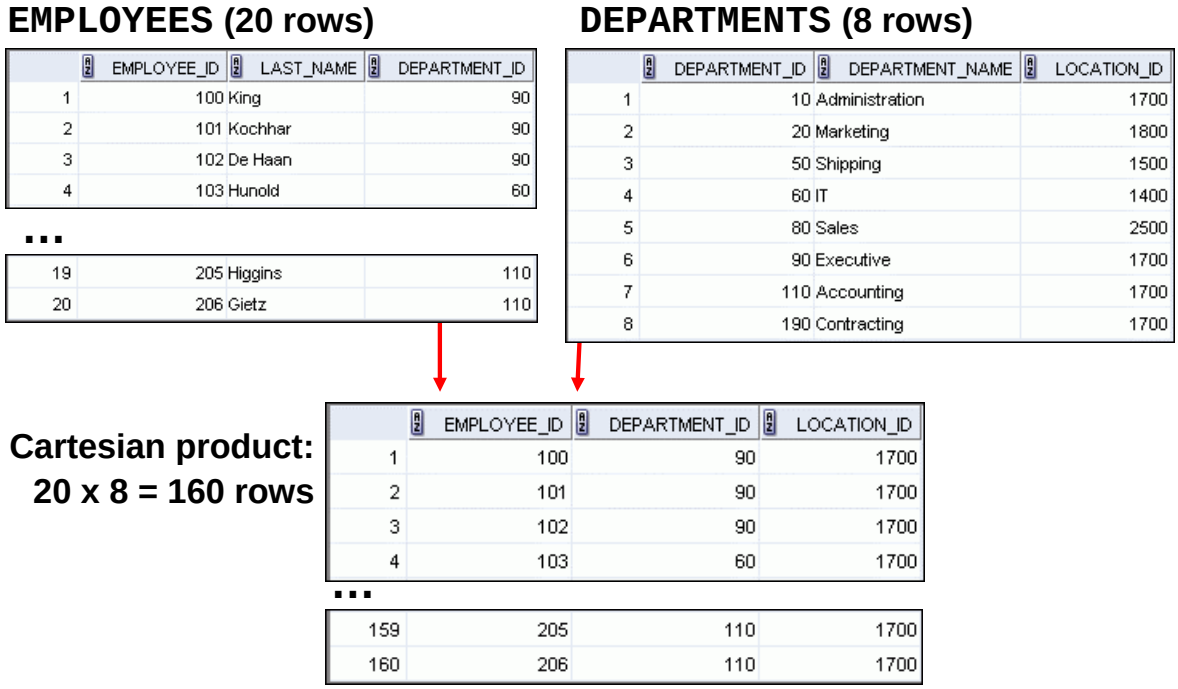
Cartesian Products

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



	EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID
1	100	King	90
2	101	Kochhar	90
3	102	De Haan	90
4	103	Hunold	60
...			
19	205	Higgins	110
20	206	Gietz	110

	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

	EMPLOYEE_ID	DEPARTMENT_ID	LOCATION_ID
1	100	90	1700
2	101	90	1700
3	102	90	1700
4	103	60	1700
...			
159	205	110	1700
160	206	110	1700

Generating a Cartesian Product

A Cartesian product is generated when a join condition is omitted. The example in the slide displays the employee last name and the department name from the EMPLOYEES and DEPARTMENTS tables. 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	DEPT_NAME
1	Abel	Administration
2	Davies	Administration
3	De Haan	Administration
4	Ernst	Administration
5	Fay	Administration
...		
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.

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Joining Tables Using Oracle Syntax

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.
- Instead of full table name prefixes, use table aliases.
- 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.

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Qualifying Ambiguous Column Names

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.

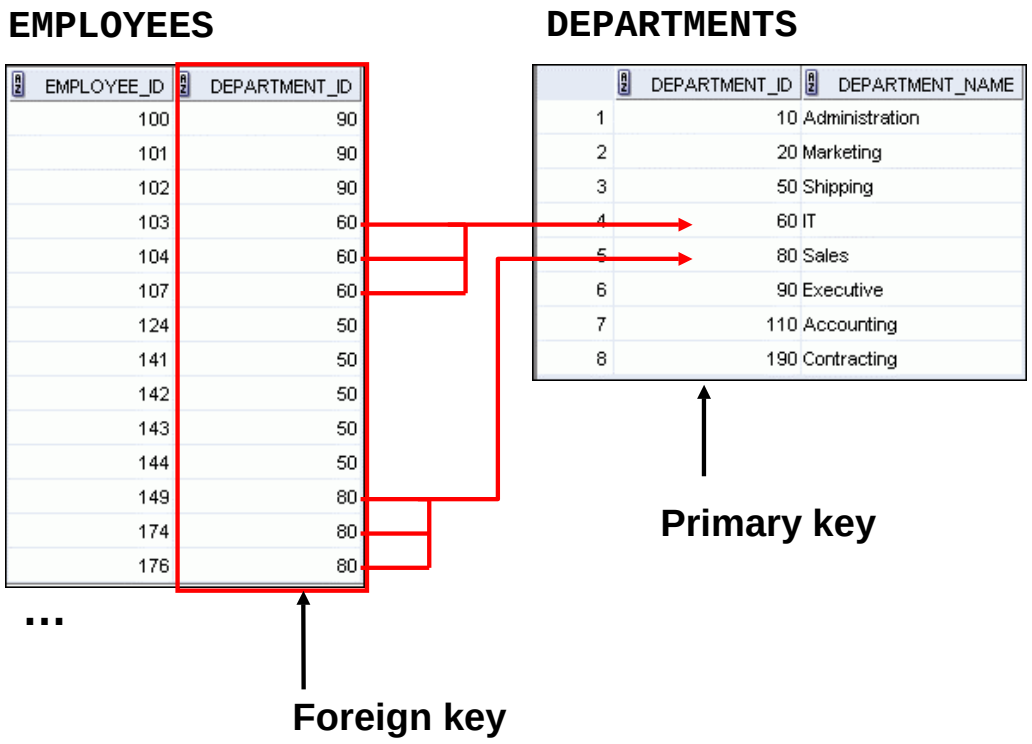
Qualifying column names with table names can be very time consuming, particularly if table names are lengthy. Therefore, you can use *table aliases* instead of table names. Just as a column alias gives a column another name, a table alias gives a table another name. Table aliases help to keep SQL code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



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	124	Mourgos	50	50	1500
5	144	Vargas	50	50	1500
6	143	Matos	50	50	1500
7	142	Davies	50	50	1500
8	141	Rajs	50	50	1500
9	107	Lorentz	60	60	1400
10	104	Ernst	60	60	1400

...

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Retrieving Records with Equijoins

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: 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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Retrieving Records with Equijoins: Example

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

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Additional Search Conditions Using the AND Operator

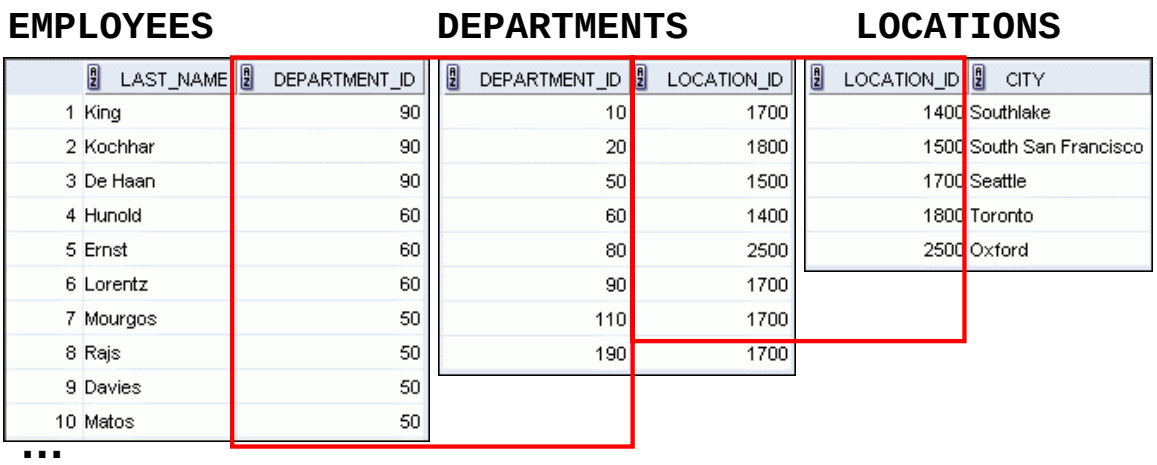
In addition to the join, you may have criteria for your WHERE clause to restrict the rows under consideration for one or more tables in the join. The example in the slide limits the rows of output to those with a department ID equal to 20 or 50:

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



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.

Joining More than Two Tables

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	King	24000
2	Kochhar	17000
3	De Haan	17000
4	Hunold	9000
5	Ernst	6000
6	Lorentz	4200
7	Mourgos	5800
8	Rajs	3500
9	Davies	3100
10	Matos	2600
...		
19	Higgins	12000
20	Gietz	8300

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. Hence, the GRADE_LEVEL column can be used to assign grades to each employee.

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Nonequijoins

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

...

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Retrieving Records with Nonequijoins

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.

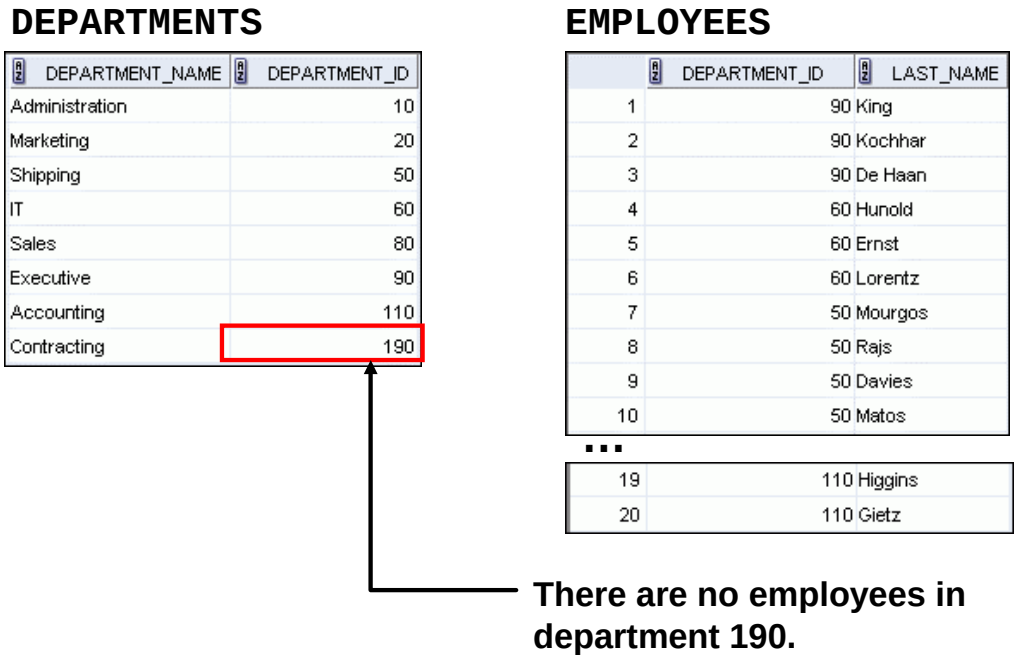
It is important to note that all employees appear exactly once when this query is executed. No employee is repeated in the list. There are two reasons for this:

- 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



Returning Records with No Direct Match with Outer Joins

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(+);
```

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Outer Joins: Syntax

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

Using Outer Joins

The slide example 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 on only *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

...

17	King	90	Executive
18	Gietz	110	Accounting
19	Higgins	110	Accounting
20	Grant	(null)	(null)

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Outer Join: Another Example

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

Joining a Table to Itself

EMPLOYEES (WORKER)

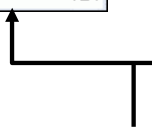
	EMPLOYEE_ID	LAST_NAME	MANAGER_ID
1	100	King	(null)
2	101	Kochhar	100
3	102	De Haan	100
4	103	Hunold	102
5	104	Ernst	103
6	107	Lorentz	103
7	124	Mourgos	100
8	141	Rajs	124
9	142	Davies	124
10	143	Matos	124

...

EMPLOYEES (MANAGER)

EMPLOYEE_ID	LAST_NAME
100	King
101	Kochhar
102	De Haan
103	Hunold
104	Ernst
107	Lorentz
124	Mourgos
141	Rajs
142	Davies
143	Matos

...



MANAGER_ID in the WORKER table is equal to EMPLOYEE_ID in the MANAGER table.

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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 Lorentz's manager, you need to:

- Find Lorentz in the EMPLOYEES table by looking at the LAST_NAME column
- Find the manager number for Lorentz by looking at the MANAGER_ID column. Lorentz'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 Lorentz's manager.

In this process, you look in the table twice. The first time you look in the table to find Lorentz 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

...

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Self-Join: Example

The slide example 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.

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Summary

There are multiple ways to join tables.

Types of Joins

- Cartesian products
- 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 C: Overview

This practice covers the following topics:

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

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Practice C: Overview

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

Practice C

1. Write a query for the HR department to produce the addresses of all the departments. Use the `LOCATIONS` and `COUNTRIES` tables. Show the location ID, street address, city, state or province, and country in the output. Run the query.

	LOCATION_ID	STREET_ADDRESS	CITY	STATE_PROVINCE	COUNTRY_NAME
1	1400	2014 Jabberwocky Rd	Southlake	Texas	United States of America
2	1500	2011 Interiors Blvd	South San Francisco	California	United States of America
3	1700	2004 Charade Rd	Seattle	Washington	United States of America
4	1800	460 Bloor St. W.	Toronto	Ontario	Canada
5	2500	Magdalen Centre, The ...	Oxford	Oxford	United Kingdom

2. The HR department needs a report of all employees. Write a query to display the last name, department number, and department name for all employees. Run the query.

	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

▪ ▪ ▪

18	Higgins	110	Accounting
19	Gietz	110	Accounting

Practice C (continued)

3. The HR department needs a report of employees in Toronto. Display the last name, job, department number, and department name for all employees who work in Toronto.

	LAST_NAME	JOB_ID	DEPARTMENT_ID	DEPARTMENT_NAME
1	Hartstein	MK_MAN	20	Marketing
2	Fay	MK_REP	20	Marketing

4. Create a report to display the employees' last names and employee number along with their managers' last names and manager number. Label the columns `Employee`, `Emp#`, `Manager`, and `Mgr#`, respectively. Save your SQL statement as `lab_c_04.sql`.

	Employee	EMP#	Manager	Mgr#
1	Kochhar	101	King	100
2	De Haan	102	King	100
3	Hunold	103	De Haan	102
4	Ernst	104	Hunold	103
5	Lorentz	107	Hunold	103
6	Mourgos	124	King	100
7	Rajs	141	Mourgos	124
8	Davies	142	Mourgos	124
9	Matos	143	Mourgos	124
10	Vargas	144	Mourgos	124

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15	Whalen	200	Kochhar	101
16	Hartstein	201	King	100
17	Fay	202	Hartstein	201
18	Higgins	205	Kochhar	101
19	Gietz	206	Higgins	205

Practice C (continued)

5. Modify `lab_c_04.sql` to display all employees including King, who has no manager. Order the results by the employee number. Save your SQL statement as `lab_c_05.sql`. Run the query in `lab_c_05.sql`.

	Employee	EMP#	Manager	Mgr#
1	Hunold	103	De Haan	102
2	Fay	202	Hartstein	201
3	Gietz	206	Higgins	205
4	Lorentz	107	Hunold	103
5	Ernst	104	Hunold	103
6	Hartstein	201	King	100
7	Zlotkey	149	King	100
8	Mourgos	124	King	100
9	De Haan	102	King	100
10	Kochhar	101	King	100

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17	Grant	178	Zlotkey	149
18	Taylor	176	Zlotkey	149
19	Abel	174	Zlotkey	149
20	King	100	(null)	(null)

6. Create a report for the HR department that displays employee last names, department numbers, and all employees who work in the same department as a given employee. Give each column an appropriate label. Save the script to a file named `lab_c_06.sql`.

	DEPARTMENT	EMPLOYEE	COLLEAGUE
1	20	Fay	Hartstein
2	20	Hartstein	Fay
3	50	Davies	Matos
4	50	Davies	Mourgos
5	50	Davies	Rajs
6	50	Davies	Vargas
7	50	Matos	Davies
8	50	Matos	Mourgos
9	50	Matos	Rajs
10	50	Matos	Vargas

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42	110	Higgins	Gietz

Practice C (continued)

7. The HR department needs a report on job grades and salaries. To familiarize yourself with the JOB_GRADES table, first show the structure of the JOB_GRADES table. Then create a query that displays the name, job, department name, salary, and grade for all employees.

```
DESC JOB_GRADES
Name                           Null     Type
------------------------------ -------- --------------
GRADE_LEVEL                             VARCHAR2(3)
LOWEST_SAL                              NUMBER
HIGHEST_SAL                             NUMBER

3 rows selected
```

	LAST_NAME	JOB_ID	DEPARTMENT_NAME	SALARY	GRADE_LEVEL
1	Vargas	ST_CLERK	Shipping	2500	A
2	Matos	ST_CLERK	Shipping	2600	A
3	Davies	ST_CLERK	Shipping	3100	B
4	Rajs	ST_CLERK	Shipping	3500	B
5	Lorentz	IT_PROG	IT	4200	B
6	Whalen	AD_ASST	Administration	4400	B
7	Mourgos	ST_MAN	Shipping	5800	B
8	Ernst	IT_PROG	IT	6000	C
9	Fay	MK_REP	Marketing	6000	C
10	Gietz	AC_ACCOUNT	Accounting	8300	C

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18	De Haan	AD_VP	Executive	17000	E
19	King	AD_PRES	Executive	24000	E

Practice C (continued)

If you want an extra challenge, complete the following exercises:

8. The HR department wants to determine the names of all employees who were hired after Davies. Create a query to display the name and hire date of any employee hired after employee Davies.

	LAST_NAME	HIRE_DATE
1	Lorentz	07-FEB-99
2	Mourgos	16-NOV-99
3	Matos	15-MAR-98
4	Vargas	09-JUL-98
5	Zlotkey	29-JAN-00
6	Taylor	24-MAR-98
7	Grant	24-MAY-99
8	Fay	17-AUG-97

9. The HR department needs to find the names and hire dates for all employees who were hired before their managers, along with their managers' names and hire dates. Save the script to a file named `lab_c_09.sql`.

	LAST_NAME	HIRE_DATE	LAST_NAME_1	HIRE_DATE_1
1	Whalen	17-SEP-87	Kochhar	21-SEP-89
2	Hunold	03-JAN-90	De Haan	13-JAN-93
3	Vargas	09-JUL-98	Mourgos	16-NOV-99
4	Matos	15-MAR-98	Mourgos	16-NOV-99
5	Davies	29-JAN-97	Mourgos	16-NOV-99
6	Rajs	17-OCT-95	Mourgos	16-NOV-99
7	Grant	24-MAY-99	Zlotkey	29-JAN-00
8	Taylor	24-MAR-98	Zlotkey	29-JAN-00
9	Abel	11-MAY-96	Zlotkey	29-JAN-00

D

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 output using SQL*Plus commands
- Interact with script files

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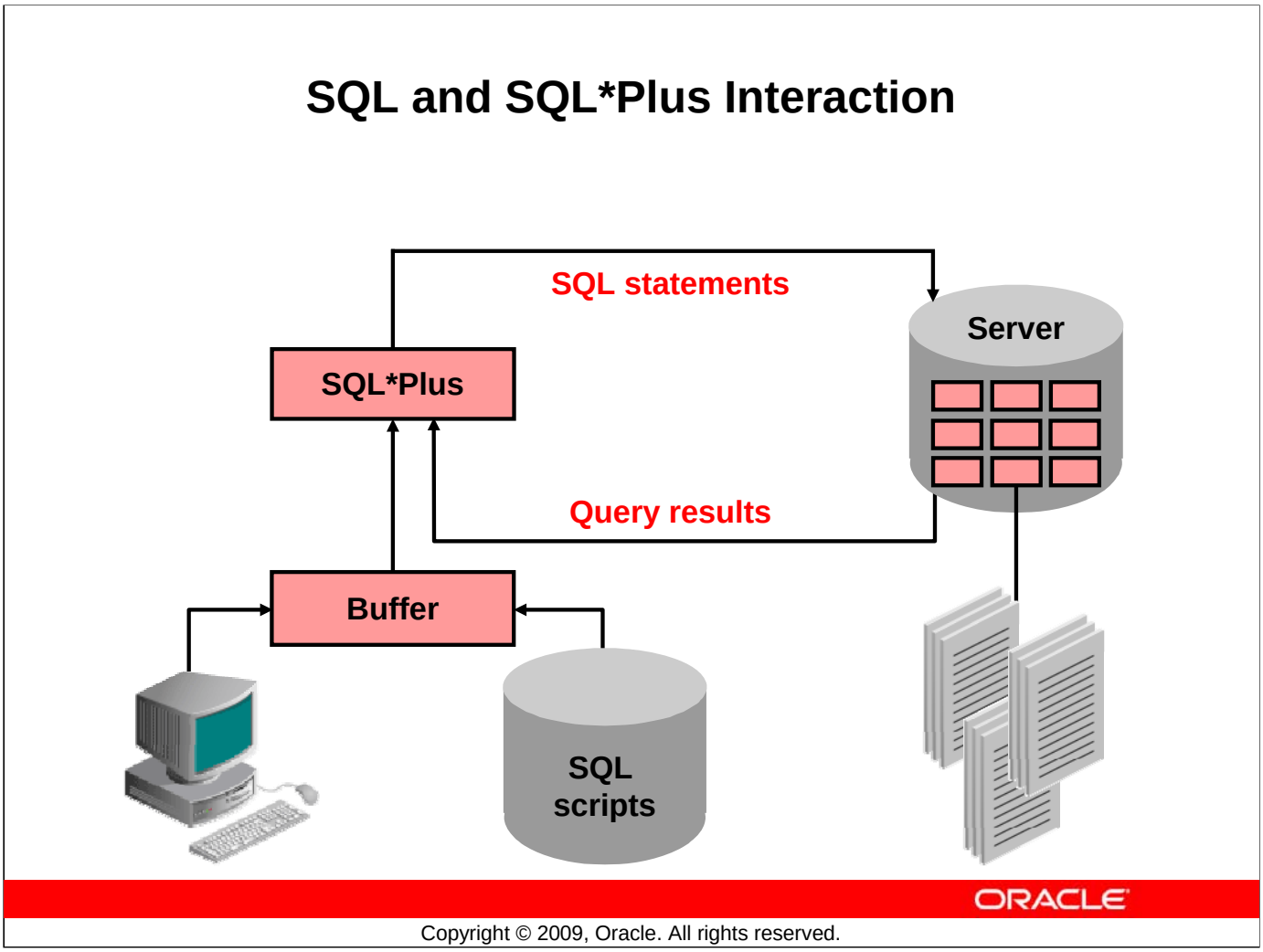
Objectives

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

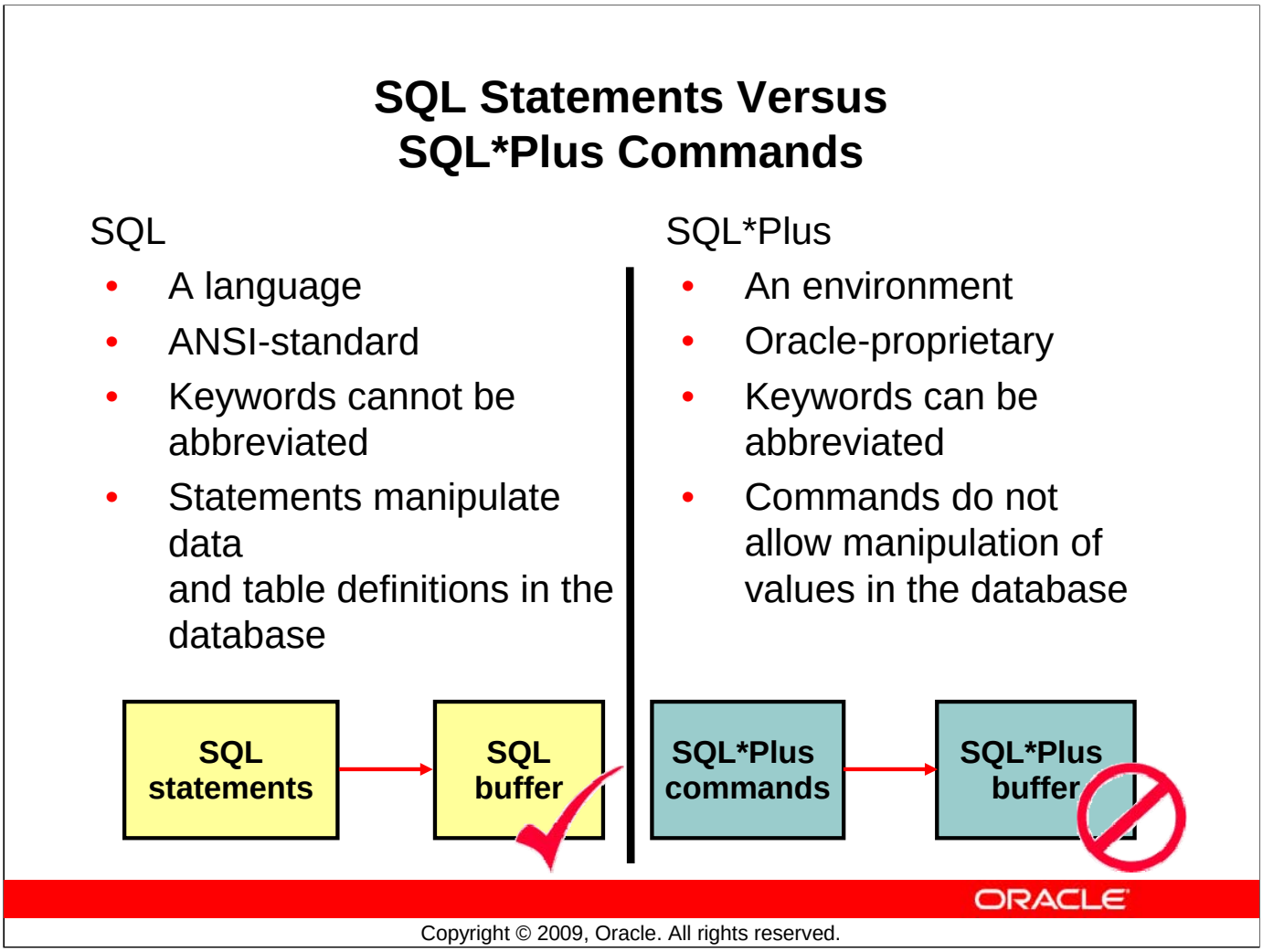
SQL is a command language used for communication with the Oracle server from any tool or application. Oracle SQL contains many extensions. When you enter a SQL statement, it is stored in a part of memory called the *SQL buffer* and remains there until you enter a new SQL statement. SQL*Plus is an Oracle 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 and SQL*Plus (continued)

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 file to buffer to edit.

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SQL*Plus

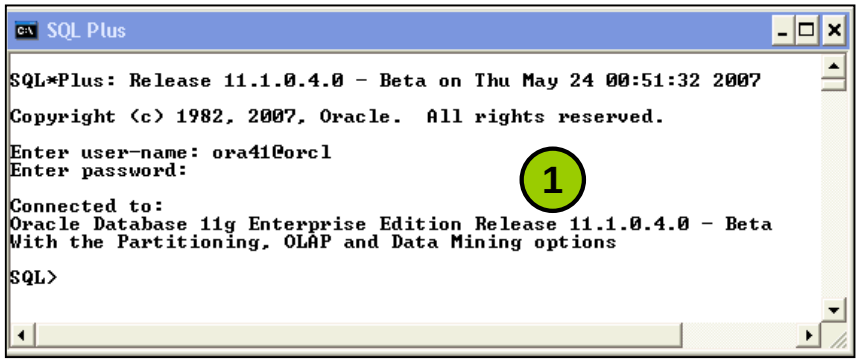
SQL*Plus is an environment in which you can:

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

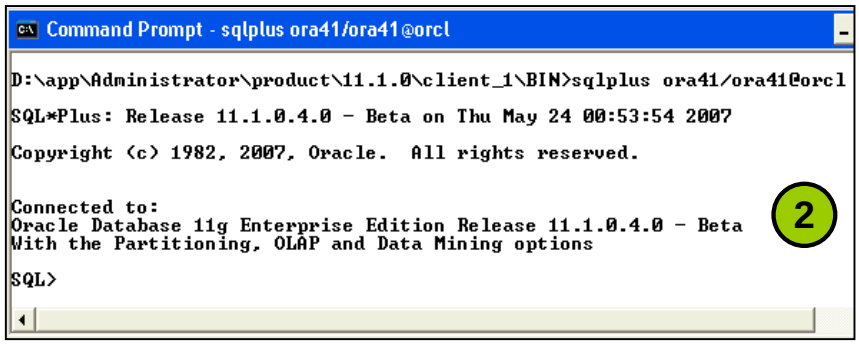
SQL*Plus commands can be divided into the following main categories:

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

Logging In to SQL*Plus




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



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Logging In to SQL*Plus

How you invoke SQL*Plus depends on which type of operating system or Windows environment you are running.

To log in from a Windows environment:

1. Select Start > Programs > Oracle > Application Development > SQL*Plus.
2. Enter the username, password, and database name.

To log in from a command-line environment:

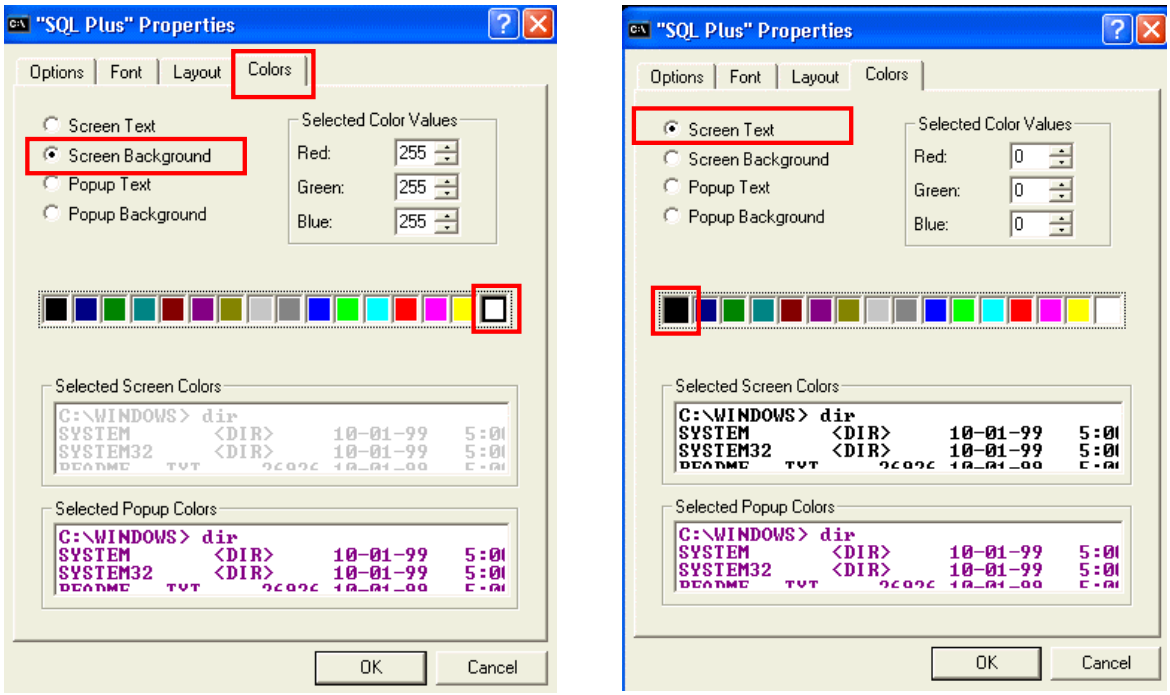
1. Log on to your machine.
2. Enter the `sqlplus` command shown in the slide.

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.

Changing the Settings of SQL*Plus Environment



Changing Settings of SQL*Plus Environment

You can optionally change the look of the SQL*Plus environment by using the SQL*Plus Properties dialog box.

In the SQL*Plus window, right-click the title bar and in the shortcut menu that appears, select Properties. You can then use the Colors tab of the SQL*Plus Properties dialog box to set Screen Background and Screen Text.

Displaying Table Structure

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

```
DESC[RIBE] tablename
```

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Displaying Table Structure

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 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)
```


Displaying Table Structure (continued)

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 Editing Commands

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 then 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*

SQL*Plus Editing Commands (continued)

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
```

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Using LIST, n, and APPEND

- 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
```


Using the CHANGE Command

- 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*Plus File Commands

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, and EDIT 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.
```


Using the SAVE, START, and EDIT Commands

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.

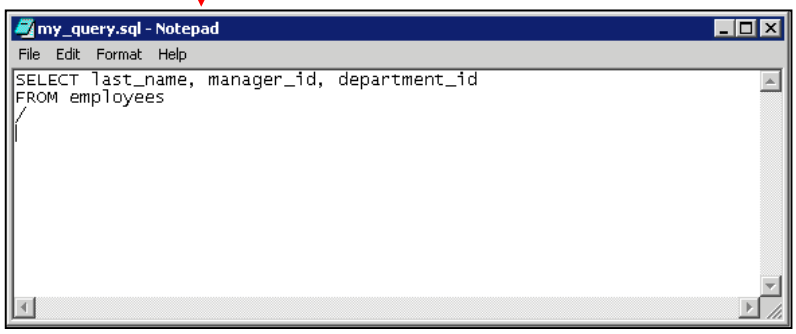
START

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

```
@my_query
```

Using the SAVE, START, and EDIT Commands

```
EDIT my_query
```



Using the SAVE, START, and EDIT Commands (continued)

EDIT

Use the EDIT command to edit an existing script. This opens an editor with the script file in it. When you have made the changes, quit the editor to return to the SQL*Plus command line.

Note: The "/" is a delimiter that signifies the end of the statement. When encountered in a file, SQL*Plus runs the statement prior to this delimiter. The delimiter must be the first character of a new line immediately following the statement.

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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SERVEROUTPUT Command

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 the *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

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Using the SQL*Plus SPOOL Command

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 quotes 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

- Displays a report after the successful execution of SQL DML statements such as SELECT, INSERT, UPDATE, or DELETE
- May optionally include the query execution path and execution statistics

```
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
```


Using the AUTOTRACE Command

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, see the *Oracle Database PL/SQL Packages and Types Reference 11g* guide.
- For additional information about the EXPLAIN PLAN, *see the Oracle Database SQL Reference 11g*.
- For additional information about Execution Plans and the statistics, see the *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 output
- Interact with script files

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Summary

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 SQL Developer

Objectives

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

- List the key features of Oracle SQL Developer
- Install Oracle SQL Developer 1.2.1
- Identify 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
- Install and use Oracle SQL Developer 1.5.3

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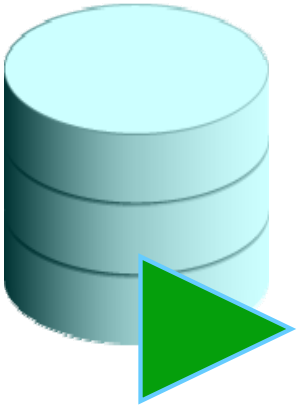
Objectives

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

What Is Oracle SQL Developer?

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



SQL Developer

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What Is Oracle 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, 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.

Note: The SQL Developer 1.2 release is called the *Migration release* because it 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 you can 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

- Developed in Java
- Supports Windows, Linux, and Mac OS X platforms
- Default connectivity by using the JDBC Thin driver
- Does not require an installer
  - Unzip the downloaded SQL Developer kit and double-click `sqldeveloper.exe` to start SQL Developer.
- Connects to Oracle Database version 9.2.0.1 and later
- Freely downloadable from the following link:
  - http://www.oracle.com/technology/products/database/sql_developer/index.html
- Needs JDK 1.5 installed on your system that can be downloaded from the following link:
  - http://java.sun.com/javase/downloads/index_jdk5.jsp

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Specifications of SQL Developer

Oracle 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. You can install SQL Developer on the Database Server and connect remotely from your desktop, thus avoiding client/server network traffic.

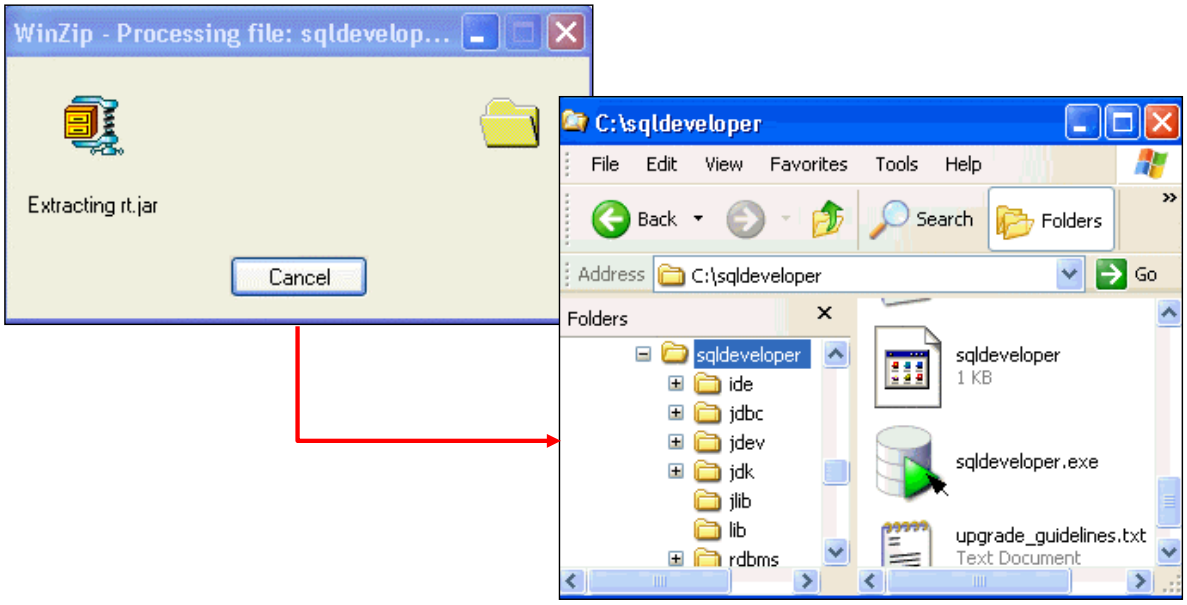
Default connectivity to the database is through the Java Database Connectivity (JDBC) Thin driver, and therefore, no Oracle Home is required. SQL Developer does not require an installer and you need to simply unzip the downloaded file. With SQL Developer, users can connect to Oracle Databases 9.2.0.1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

SQL Developer can be downloaded with the following packaging options:

- Oracle SQL Developer for Windows (option to download with or without JDK 1.5)
- Oracle SQL Developer for Multiple Platforms (you should have JDK 1.5 already installed)
- Oracle SQL Developer for Mac OS X platforms (you should have JDK 1.5 already installed)
- Oracle SQL Developer RPM for Linux (you should have JDK 1.5 already installed)

Installing SQL Developer

Download the Oracle SQL Developer kit and unzip into any directory on your machine.



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Installing SQL Developer

Oracle SQL Developer does not require an installer. To install SQL Developer, you need an unzip tool.

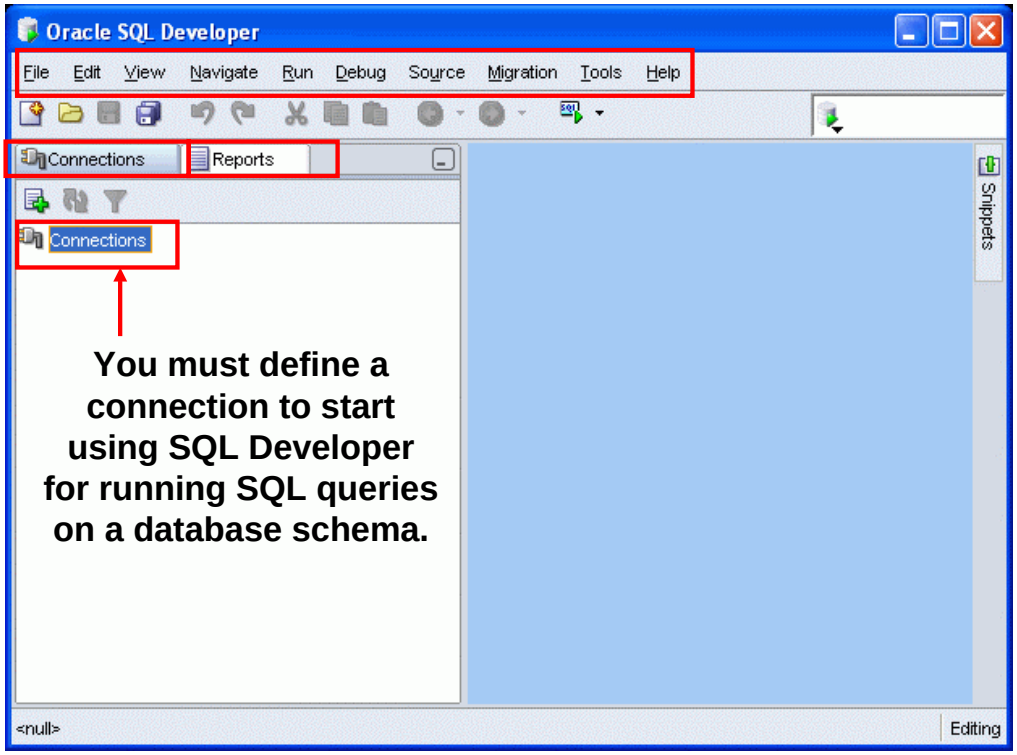
To install SQL Developer, perform the following steps:

1. Create a folder as `<local drive>:\SQL Developer`.
2. Download the SQL Developer kit from http://www.oracle.com/technology/products/database/sql_developer/index.html.
3. Unzip the downloaded SQL Developer kit into the folder created in step 1.

To start SQL Developer, go to `<local drive>:\SQL Developer`, and double-click `sqldeveloper.exe`.

Notes: SQL Developer 1.2 is already installed on the classroom machine. The installation kit for SQL Developer 1.5.3 is also on the classroom machine. You may use either version of SQL Developer in this course. Instructions for installing SQL Developer version 1.5.3 are available at the end of this appendix.

SQL Developer 1.2 Interface



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SQL Developer 1.2 Interface

SQL Developer 1.2 has two main navigation tabs:

- **Connections Navigator:** By using this, you can browse database objects and users to which you have access.
- **Reports tab:** By using this tab, you can run predefined reports or create and add your own reports.

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. 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 in the execution of subprograms
- **Run:** Contains the Run File and Execution Profile options that are relevant when a function or procedure is selected
- **Debug:** Contains options that are relevant when a function or procedure is selected for debugging
- **Source:** Contains options for use when you edit functions and procedures
- **Migration:** Contains options related to migrating third-party databases to Oracle
- **Tools:** Invokes SQL Developer tools such as SQL*Plus, Preferences, and SQL Worksheet

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.

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.

Creating a Database Connection

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.

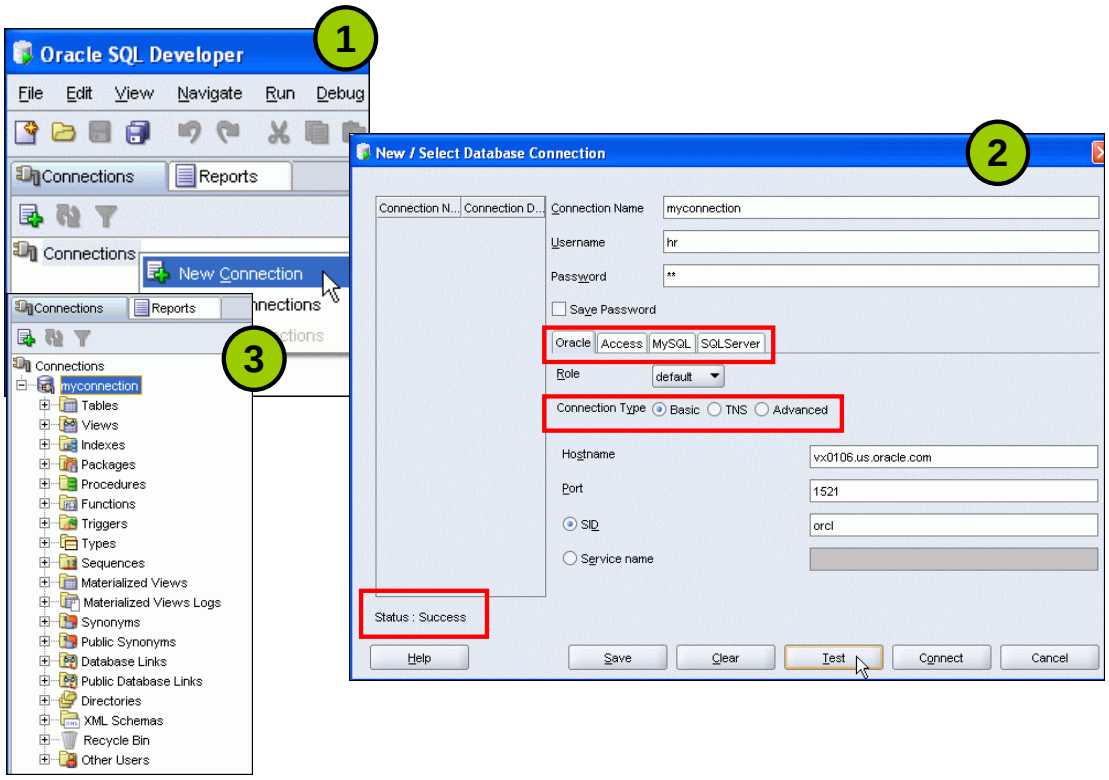
By default, the `tnsnames.ora` file is located in the `$ORACLE_HOME/network/admin` directory, but it can also be in the directory specified by the `TNS_ADMIN` environment variable or registry value. When you start SQL Developer and display the Database Connections dialog box, SQL Developer automatically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

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

Creating a Database Connection



Creating a Database Connection (continued)

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.
    1. From the Role drop-down box, you can select either *default* or SYSDBA (you choose SYSDBA for the `sys` user or any user with database administrator privileges).
    2. You can select the connection type as:
        - **Basic:** In this type, enter hostname and SID for the database you want to connect to. Port is already set to 1521. Or 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.
        - **Advanced:** You can define a custom Java Database Connectivity (JDBC) URL to connect to the database.
    3. Click Test to ensure that the connection has been set correctly.
    4. Click Connect.

Creating a Database Connection (continued)

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.

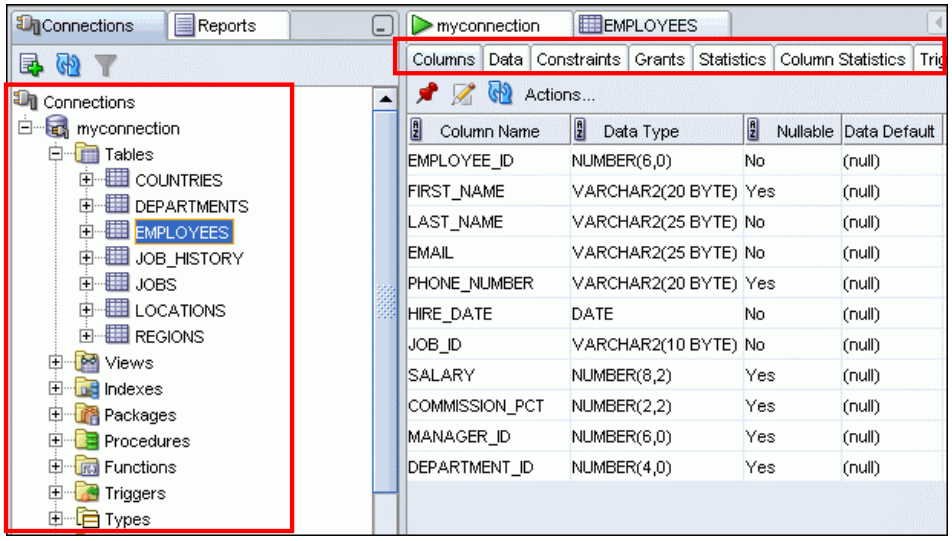
3. The connection gets added in the Connections Navigator. You can expand the connection to view the database objects and view object definitions, for example, dependencies, details, statistics, and so on.

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



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Browsing Database Objects

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.

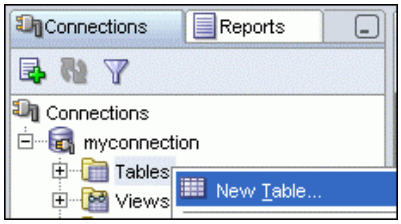
You can see the definition of the objects broken into tabs of information that is pulled out of the data dictionary. For example, if you select a table in the Navigator, the details about columns, constraints, grants, statistics, triggers, and so on are displayed on an easy-to-read tabbed page.

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.

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 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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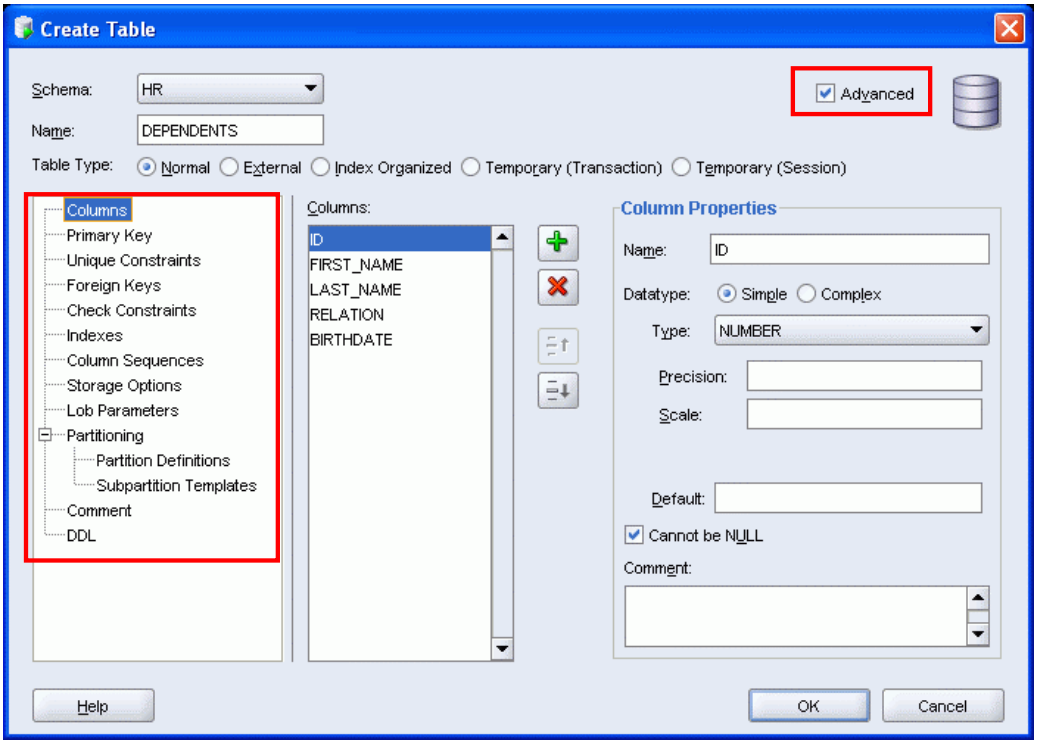
Creating a Schema Object

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 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



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.

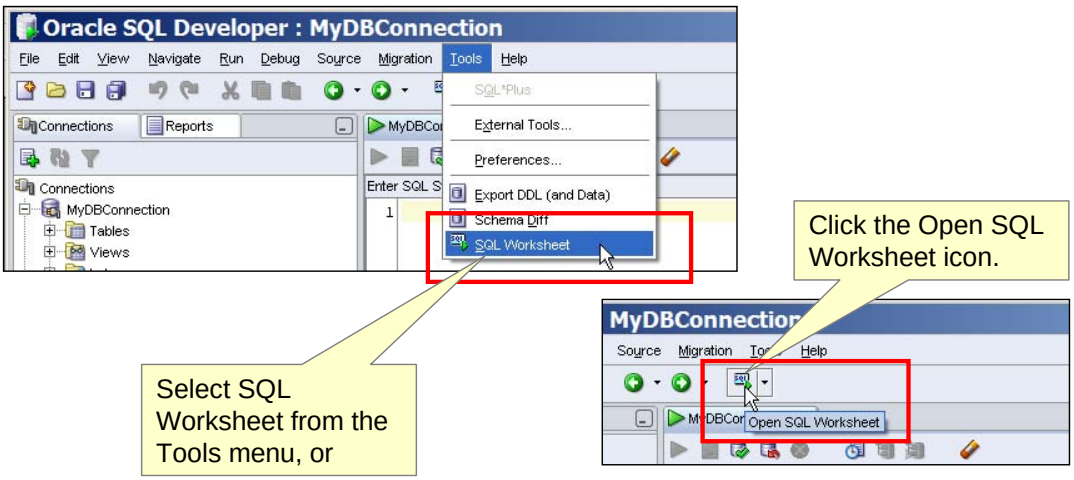
To create a new table, perform the following steps:

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

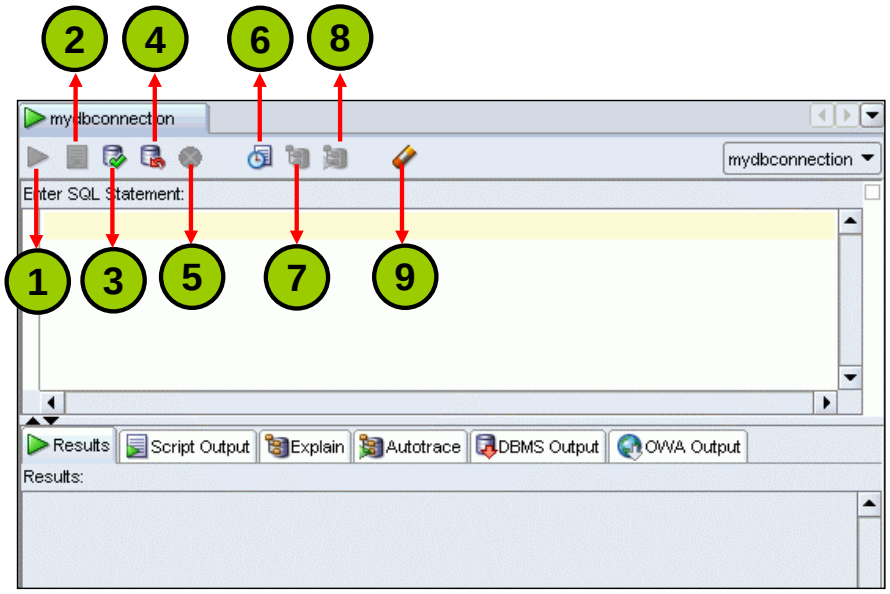
You can specify actions that can be processed by the database connection associated with the worksheet, such as:

- 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



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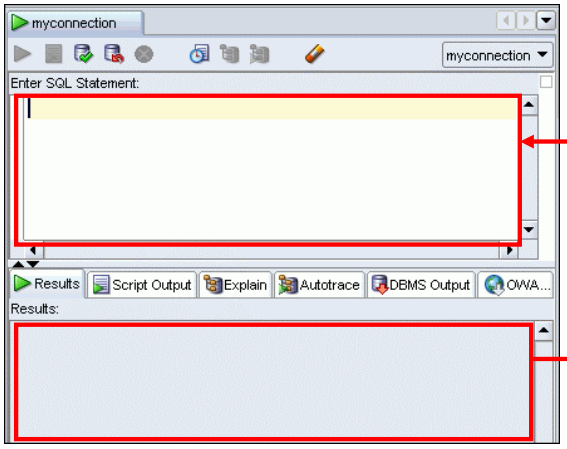
Using the SQL Worksheet (continued)

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. **Execute 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. **Commit:** Writes any changes to the database and ends the transaction
4. **Rollback:** Discards any changes to the database, without writing them to the database, and ends the transaction
5. **Cancel:** Stops the execution of any statements currently being executed
6. **SQL History:** Displays a dialog box with information about SQL statements that you have executed
7. **Execute Explain Plan:** Generates the execution plan, which you can see by clicking the Explain tab
8. **Autotrace:** Generates trace information for the statement
9. **Clear:** Erases the statement or statements in the Enter SQL Statement box

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.



Using the SQL Worksheet (continued)

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.

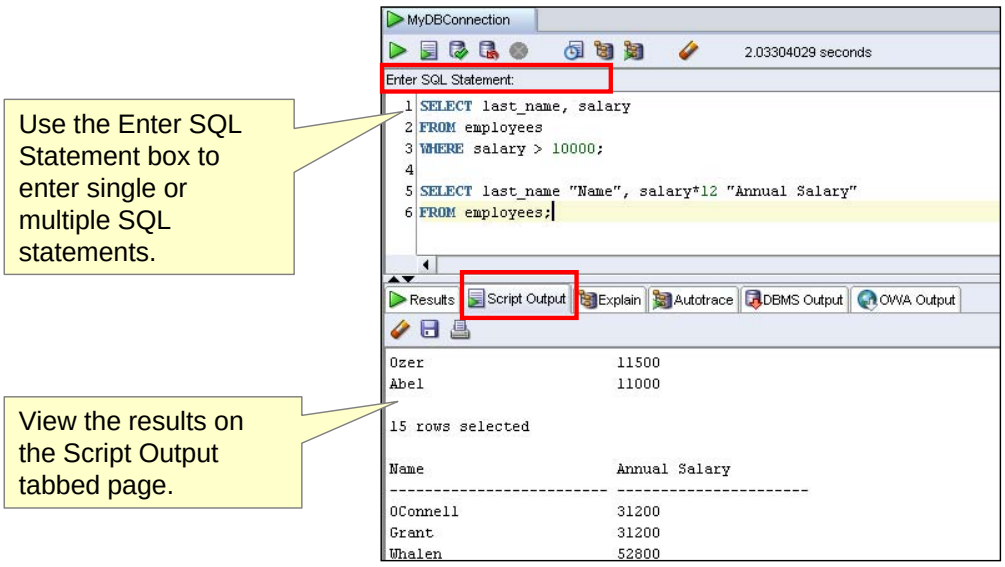
The SQL Worksheet currently supports a number of SQL*Plus commands. Commands not supported by the SQL Worksheet are ignored and are not sent to the Oracle database. Through the SQL Worksheet, you can execute SQL statements and some of the SQL*Plus commands.

You can display a SQL Worksheet by using any of the following two 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.



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Executing SQL Statements

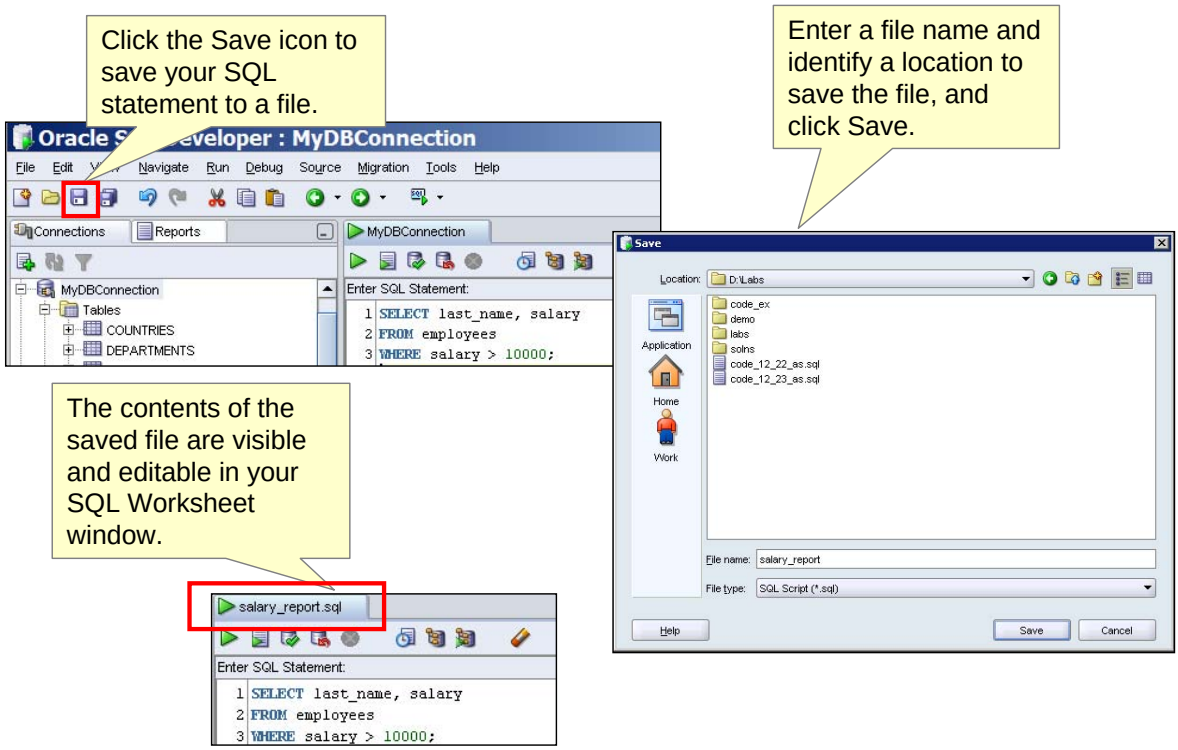
In the SQL Worksheet, you can use the Enter SQL Statement box to enter single or multiple SQL statements. For a single statement, the semicolon at the end is optional.

When you enter the statement, the SQL keywords are automatically highlighted. To execute a SQL statement, ensure that your cursor is within the statement and click the Execute Statement icon. Alternatively, you can press the F9 key.

To execute multiple SQL statements and see the results, click the Run Script icon. Alternatively, you can press the F5 key.

In the example in the slide, because there are multiple SQL statements, the first statement is terminated with a semicolon. The cursor is in the first statement, and therefore, when the statement is executed, results corresponding to the first statement are displayed in the Results box.

Saving SQL Scripts



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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, follow these steps:

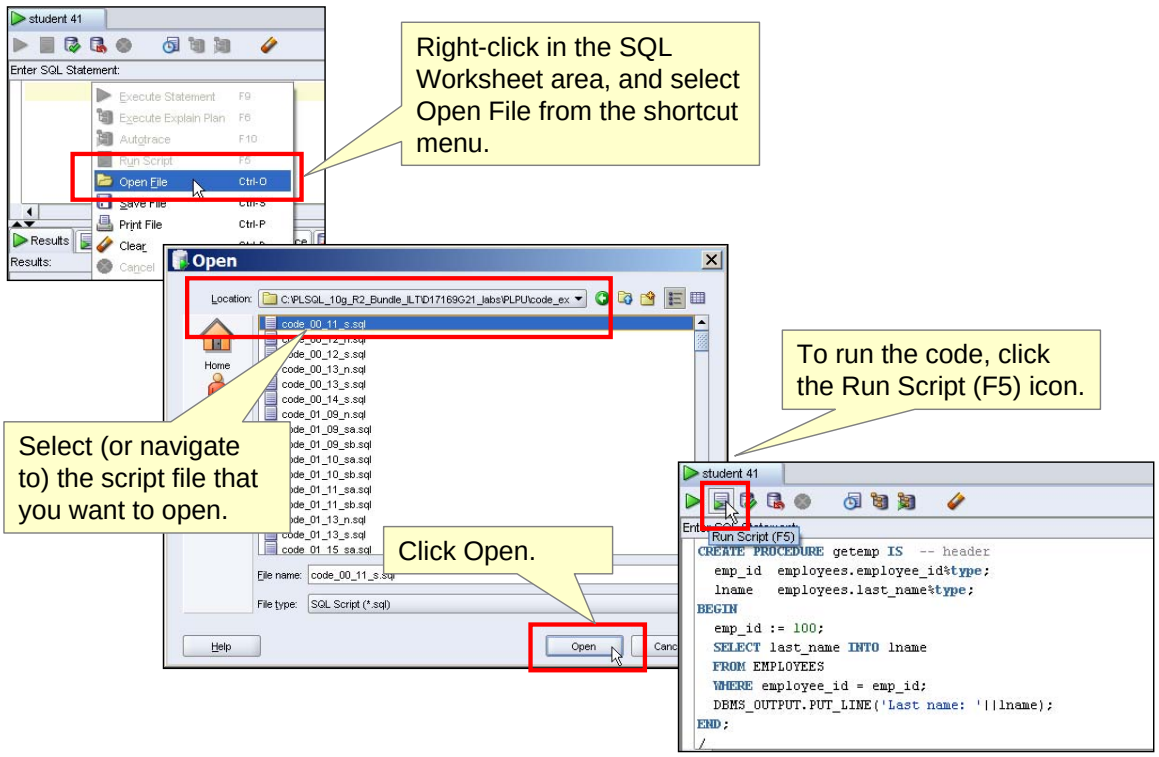
1. Click the Save icon or use the File > Save menu item.
2. In the Windows Save dialog box, enter a file name and the location where you want the file saved.
3. Click Save.

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

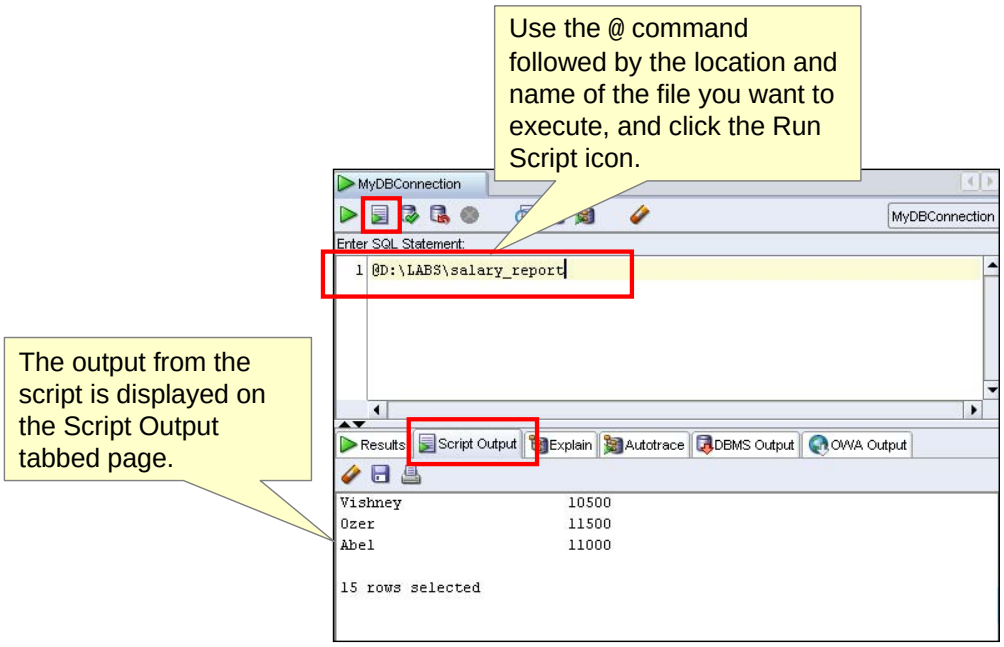


Executing Saved Script Files: Method 1

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

1. Right-click in the SQL Worksheet area, and select Open File from the menu. 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. To run the code, click the Run Script (F5) icon on the SQL Worksheet toolbar.

Executing Saved Script Files: Method 2



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Executing Saved Script Files: Method 2

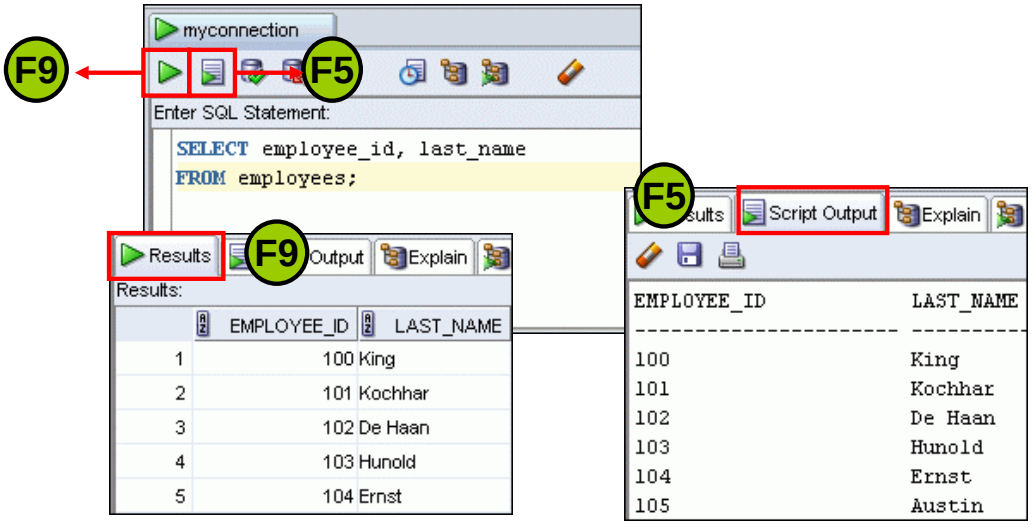
To run a saved SQL script, perform the following:

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 Windows File Save dialog box appears and you can identify a name and location for your file.

Executing SQL Statements

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



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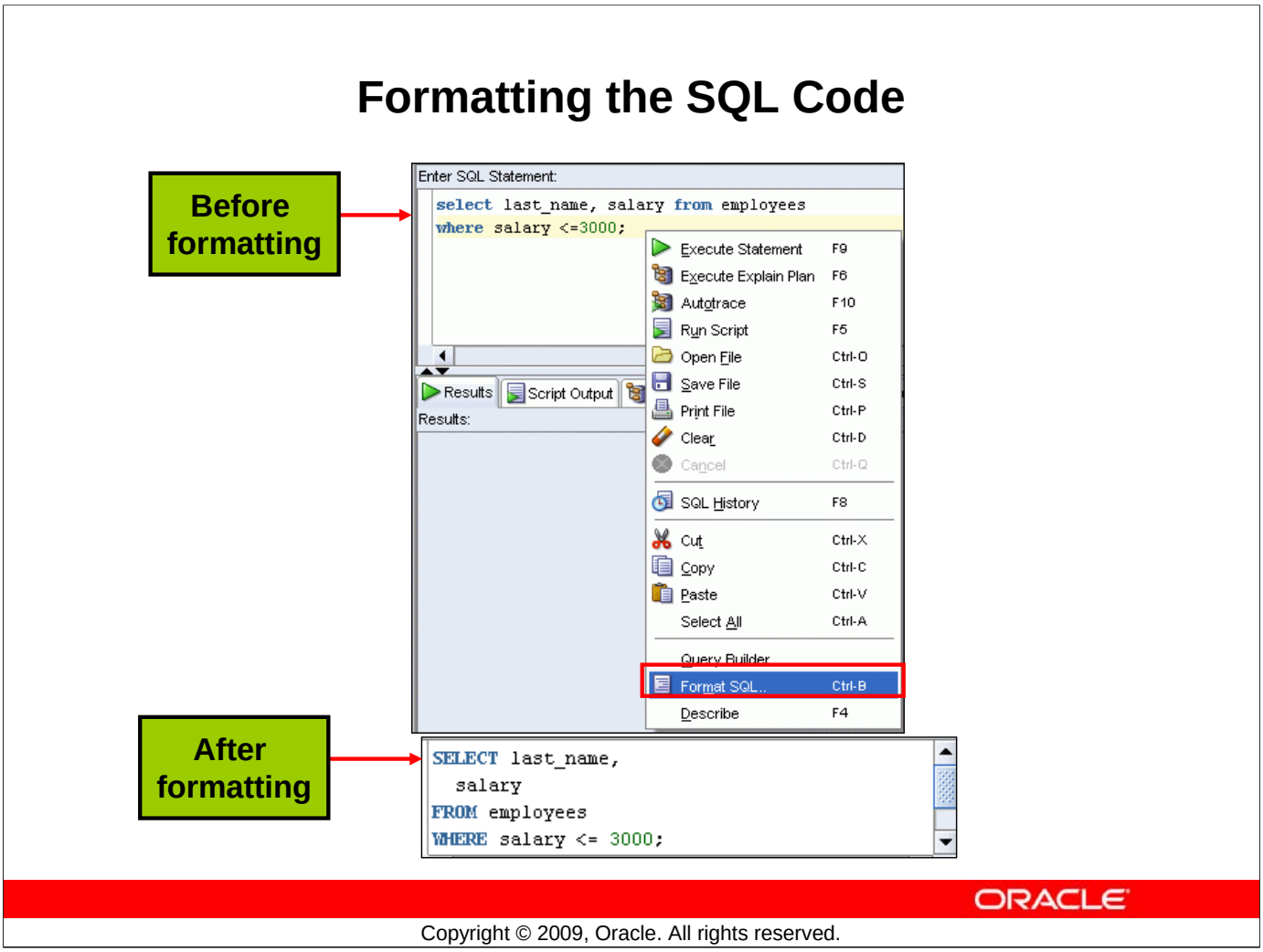
Executing SQL Statements

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.



Formatting the SQL Code

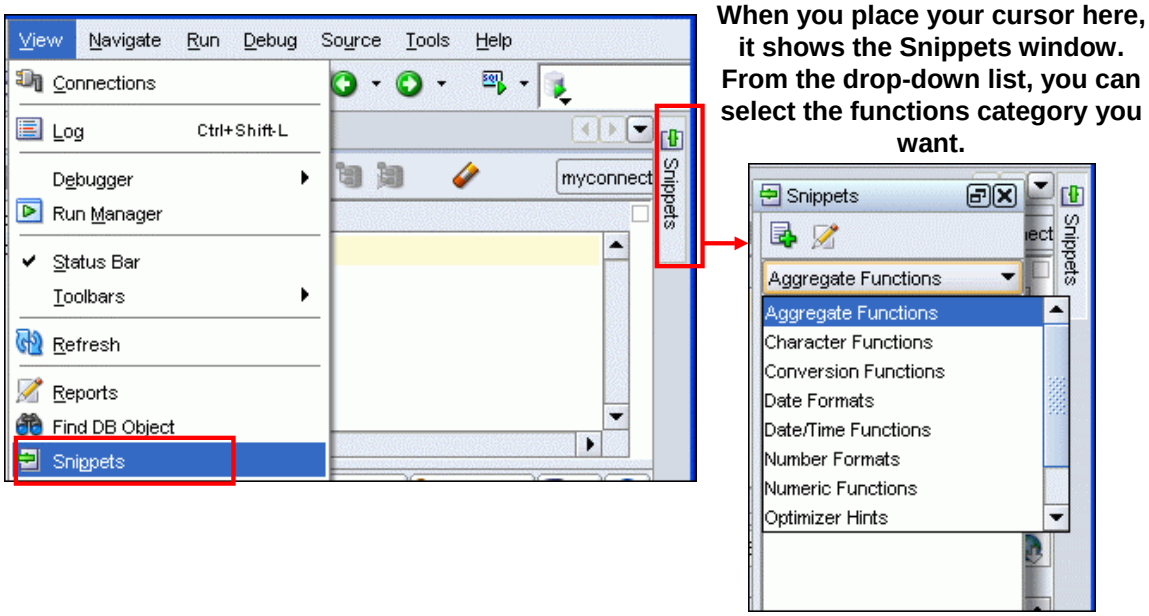
You may want to beautify the indentation, spacing, capitalization, and line separation of the SQL code. SQL Developer has a feature for formatting SQL code.

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

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.



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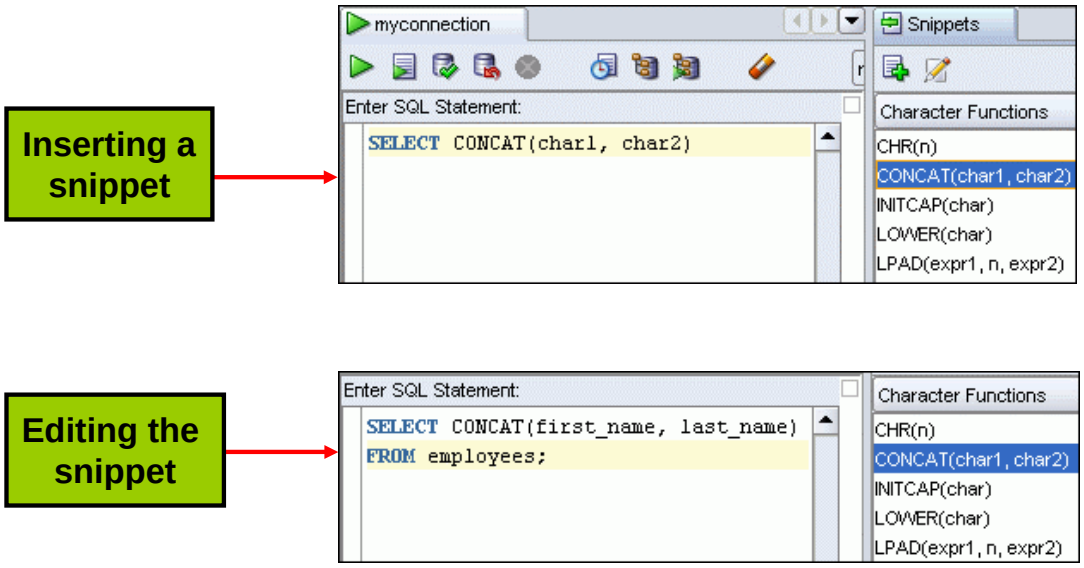
Using Snippets

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

Using Snippets: Example



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Using Snippets: Example

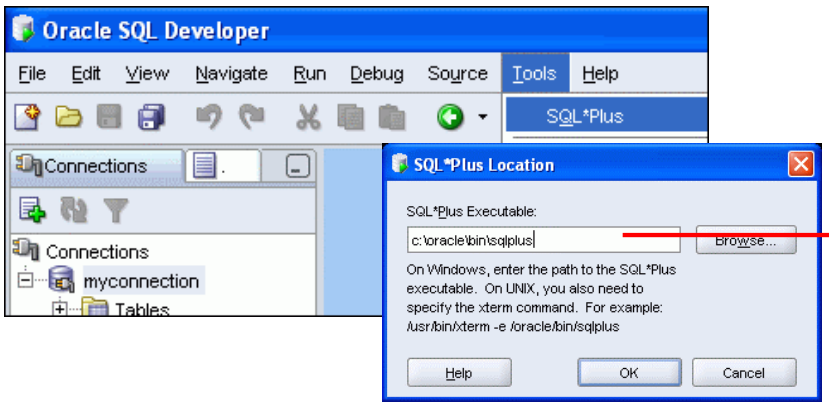
To insert a Snippet into your code in a SQL Worksheet or in a PL/SQL function or procedure, drag the snippet from the Snippets window into the desired place in your code. Then you can edit the syntax so that the SQL function is valid in the current context. To see a brief description of a SQL function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

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

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

Using SQL*Plus

- You can invoke the SQL*Plus command-line interface from SQL Developer.
- Close all the SQL Worksheets to enable the SQL*Plus menu option.



Provide the location of the `sqlplus.exe` file only the first time you invoke SQL*Plus.

Using SQL*Plus

The SQL Worksheet supports most of the SQL*Plus statements. SQL*Plus statements must be interpreted by the SQL Worksheet before being passed to the database; any SQL*Plus statements that are not supported by the SQL Worksheet are ignored and not passed to the database. To display the SQL*Plus command window, from the Tools menu, select **SQL*Plus**. To use this feature, the system on which you use SQL Developer must have an Oracle home directory or folder, with a SQL*Plus executable under that location. If the location of the SQL*Plus executable is not already stored in your SQL Developer preferences, you are asked to specify its location.

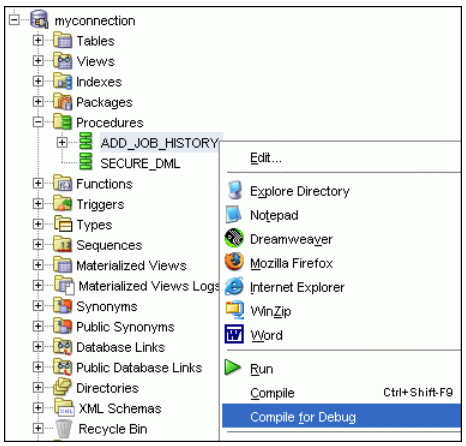
For example, some of the SQL*Plus statements that are not supported by SQL Worksheet are:

- `append`
- `archive`
- `attribute`
- `break`

For the complete list of SQL*Plus statements that are either supported or not supported by SQL Worksheet, refer to the *SQL*Plus Statements Supported and Not Supported in SQL Worksheet* topic in the SQL Developer online Help.

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 Debug menu options to set breakpoints, and to perform step into, step over tasks.



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Debugging Procedures and Functions

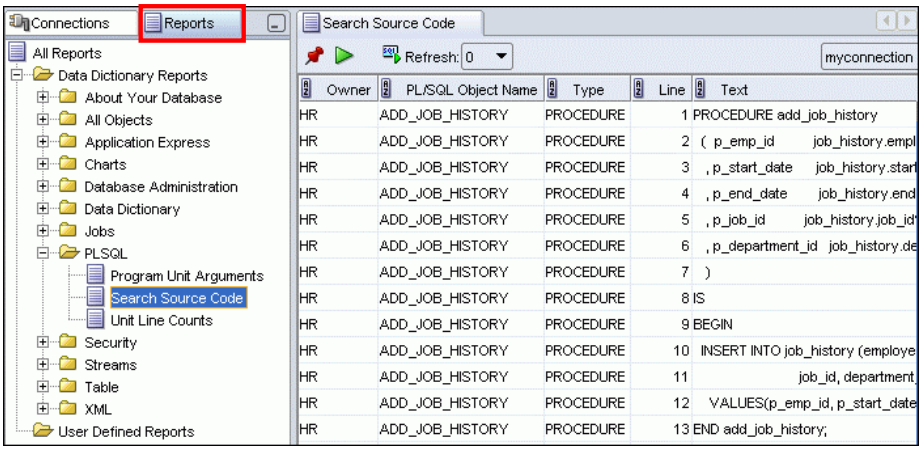
In SQL Developer, you can debug PL/SQL procedures and functions. Using the Debug menu options, you can perform the following debugging tasks:

- **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 in 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 in the debugging toolbar.

Database Reporting

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



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Database Reporting

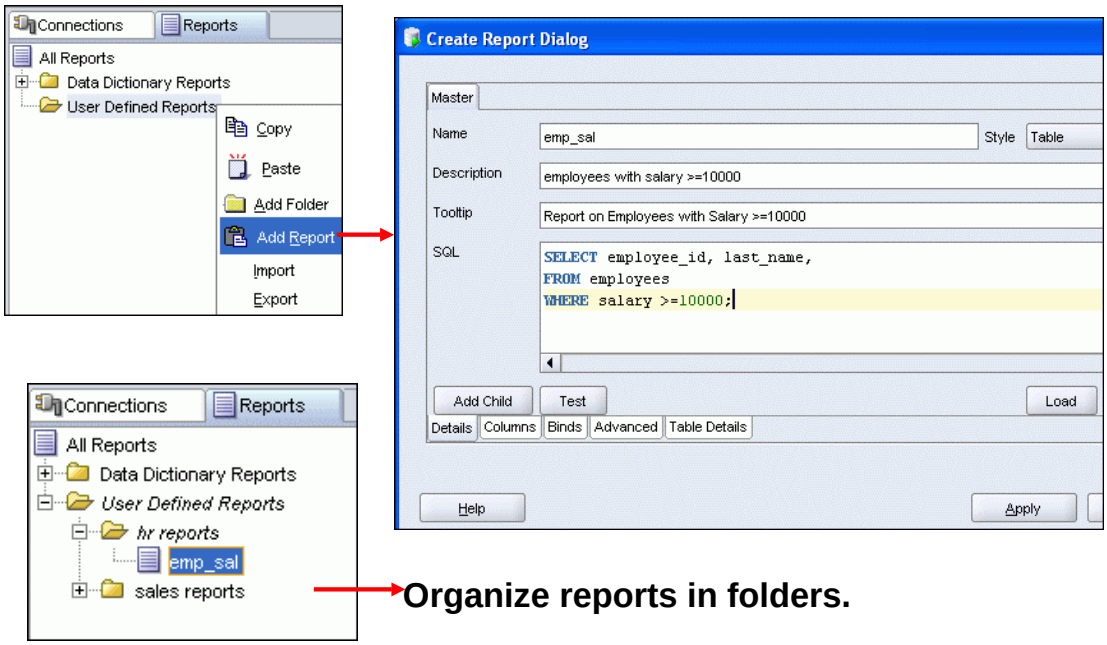
SQL Developer provides many reports about the database and its objects. These reports can be grouped into the following categories:

- 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 side of the window. Individual reports are displayed in tabbed panes at the right side 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.



Creating a User-Defined Report

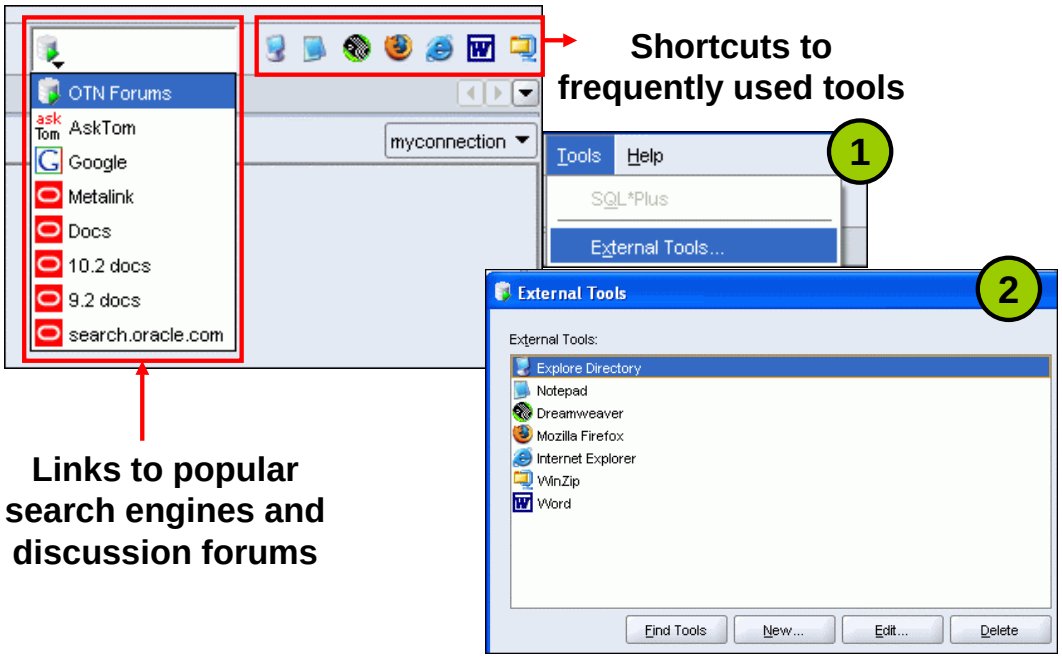
User-defined reports are reports created by SQL Developer users. To create a user-defined report, perform the following steps:

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



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Search Engines and External Tools

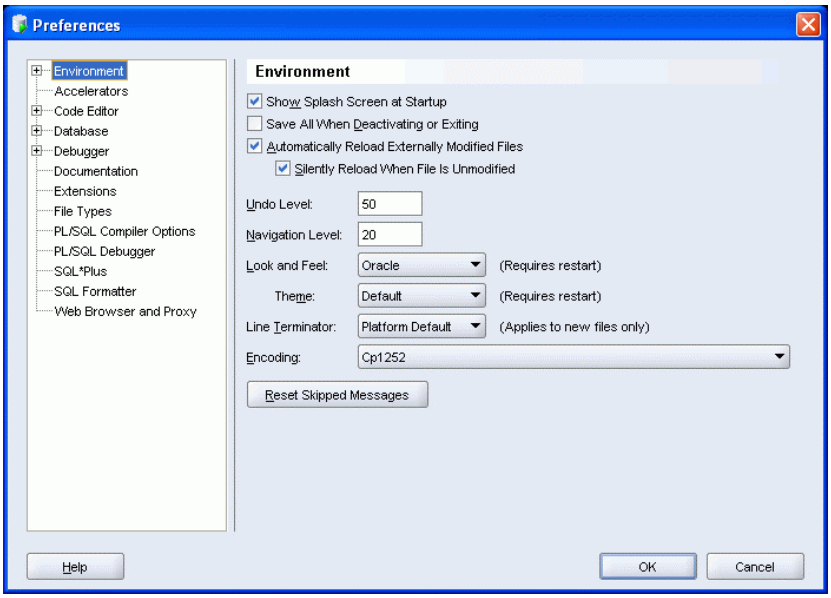
To enhance productivity of the SQL developers, SQL Developer has added quick links to popular search engines and discussion forums such as AskTom, Google, and so on. Also, you have shortcut icons to some of the frequently used tools such as Notepad, Microsoft Word, and Dreamweaver, available to you.

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:

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

Setting Preferences

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



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Setting 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
- Accelerators (Keyboard shortcuts)
- Code Editors
- Database
- Debugger
- Documentation
- Extensions
- File Types
- Migration
- PL/SQL Compilers
- PL/SQL Debugger, and so on.

Specifications of SQL Developer 1.5.3

- SQL Developer 1.5.3 is the first translation release, and is a patch to Oracle SQL Developer 1.5.
- New feature list is available at:
  - http://www.oracle.com/technology/products/database/sql_developer/files/newFeatures_v15.html
- Supports Windows, Linux, and Mac OS X platforms
- To install, unzip the downloaded SQL Developer kit, which includes the required minimum JDK (JDK1.5.0_06).
- To start, double-click `sqldeveloper.exe`
- Connects to Oracle Database version 9.2.0.1 and later
- Freely downloadable from the following link:
  - http://www.oracle.com/technology/products/database/sql_developer/index.html

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Specifications of SQL Developer 1.5.3

SQL Developer 1.5.3 is also available, as it is the latest version of the product that was available at the time of the release of this of course

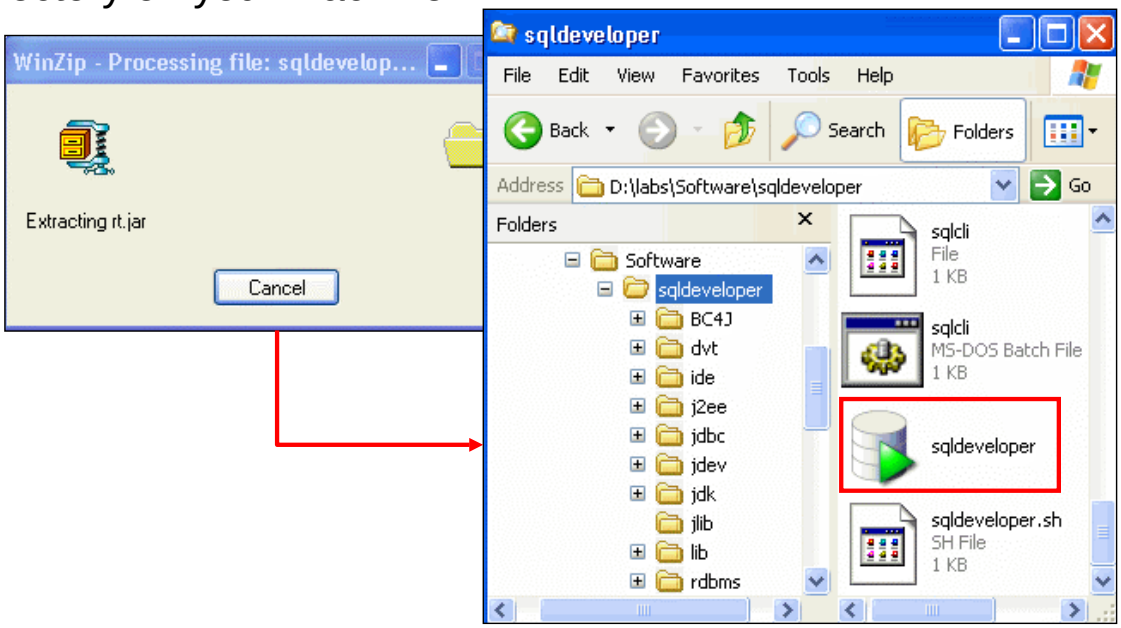
Like version 1.2, SQL Developer 1.5.3 is developed in Java leveraging the Oracle JDeveloper integrated development environment (IDE). Therefore, it is a cross-platform tool. The tool runs on Windows, Linux, and Mac operating system (OS) X platforms. You can install SQL Developer on the Database Server and connect remotely from your desktop, thus avoiding client/server network traffic.

Default connectivity to the database is through the Java Database Connectivity (JDBC) Thin driver, and therefore, no Oracle Home is required. The JDBC drivers that are shipped with version 1.5.3 support 11g R1. Therefore, users will no longer be able to connect to an Oracle 8.1.7 database.

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.

Installing SQL Developer 1.5.3

Download the Oracle SQL Developer kit and unzip into any directory on your machine.



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Installing SQL Developer 1.5.3

Oracle SQL Developer does not require an installer. To install SQL Developer, you need an unzip tool.

To install SQL Developer, perform the following steps:

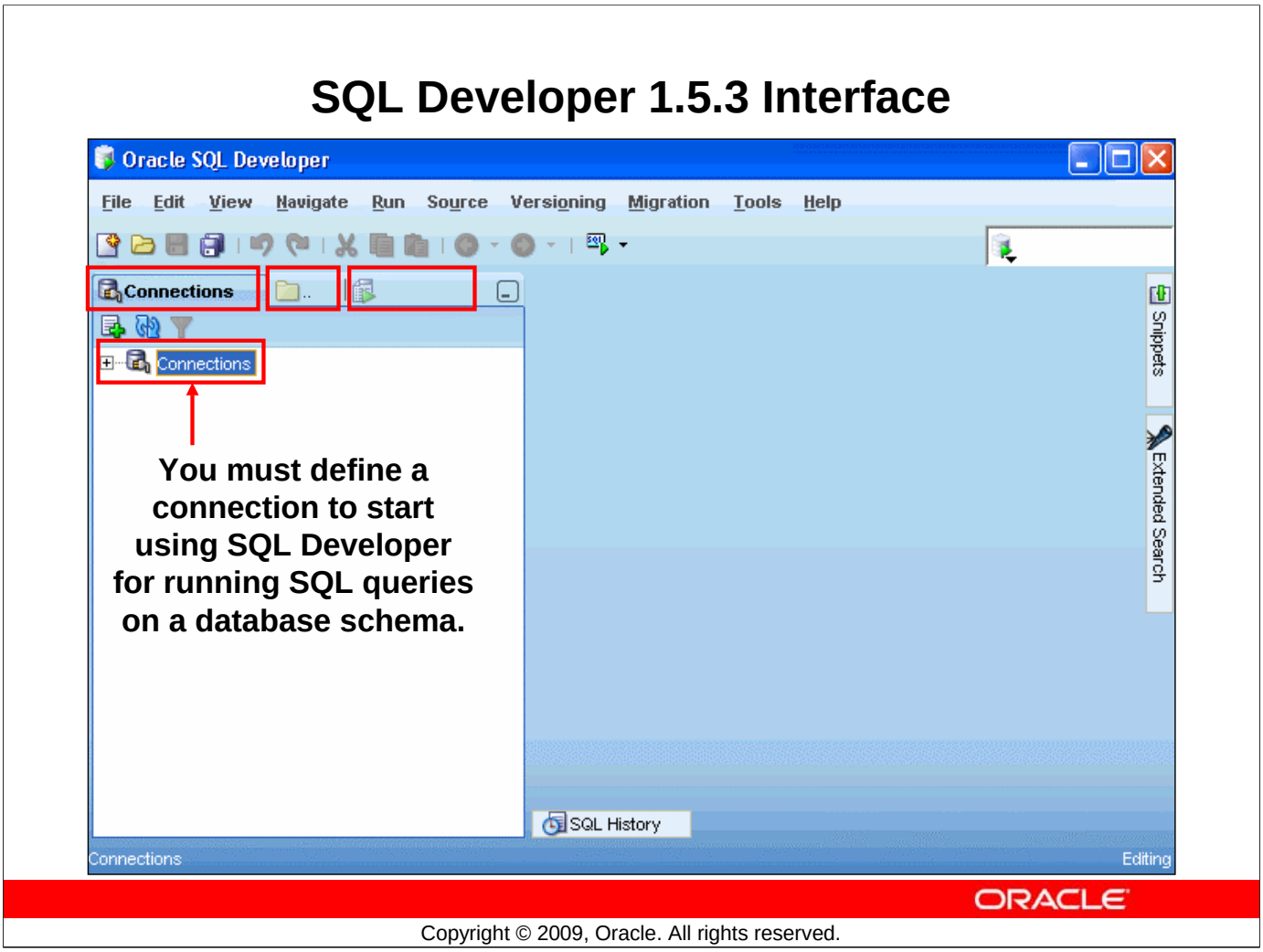
1. Create a folder. For example: `<local drive>:\software`
2. Download the SQL Developer kit from http://www.oracle.com/technology/products/database/sql_developer/index.html.
3. Unzip the downloaded SQL Developer kit into the folder created in step 1.

Starting SQL Developer

To start SQL Developer, go to `<local drive>:\software\sqldeveloper`, and double-click `sqldeveloper.exe`.

Note

- The SQL Developer 1.5.3 kit, named sqldeveloper-5783.zip, is located in is `d:\labs\software` on your classroom machine.
- When you open SQL Developer 1.5.3 for the first time, select **No** when prompted to migrate settings from a previous release.



SQL Developer 1.5.3 Interface

The SQL Developer 1.5.3 interface contains all of the features found in version 1.2, and also some additional features.

Version 1.5.3 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.
- **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.
- **Reports tab:** Identified by the Reports icon, this tab enables you to run predefined reports or create and add your own reports.

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.

The features and functions that have been covered previously in this lesson for version 1.2, such as Creating a Connection, Browsing Database Objects, Creating Schema Objects, Using the SQL Worksheet, Using Snippets, Creating Reports, and Setting Preferences, are equivalent in the 1.5.3 interface.

Note: As with version 1.2, 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.

SQL Developer 1.5.3 Interface (continued)

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 in the execution of subprograms
- **Run:** Contains the Run File and Execution Profile options that are relevant when a function or procedure is selected, and also debugging options.
- **Source:** Contains options for use when you edit functions and procedures
- **Versioning:** Provides integrated support for the following versioning and source control systems: CVS (Concurrent Versions System) and Subversion.
- **Migration:** Contains options related to migrating third-party databases to Oracle
- **Tools:** Invokes SQL Developer tools such as SQL*Plus, Preferences, and SQL Worksheet

Note: The Run menu also contains options that are relevant when a function or procedure is selected for debugging. These are the same options that are found in the Debug menu in version 1.2.

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

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Summary

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.

Version 1.2 is the default version set up for this class. Version 1.5.3 is also available on the classroom machine for use with all examples, demos, and practices.

Index