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Database Programming with PL/SQL

3-3

Manipulating Data in PL/SQL

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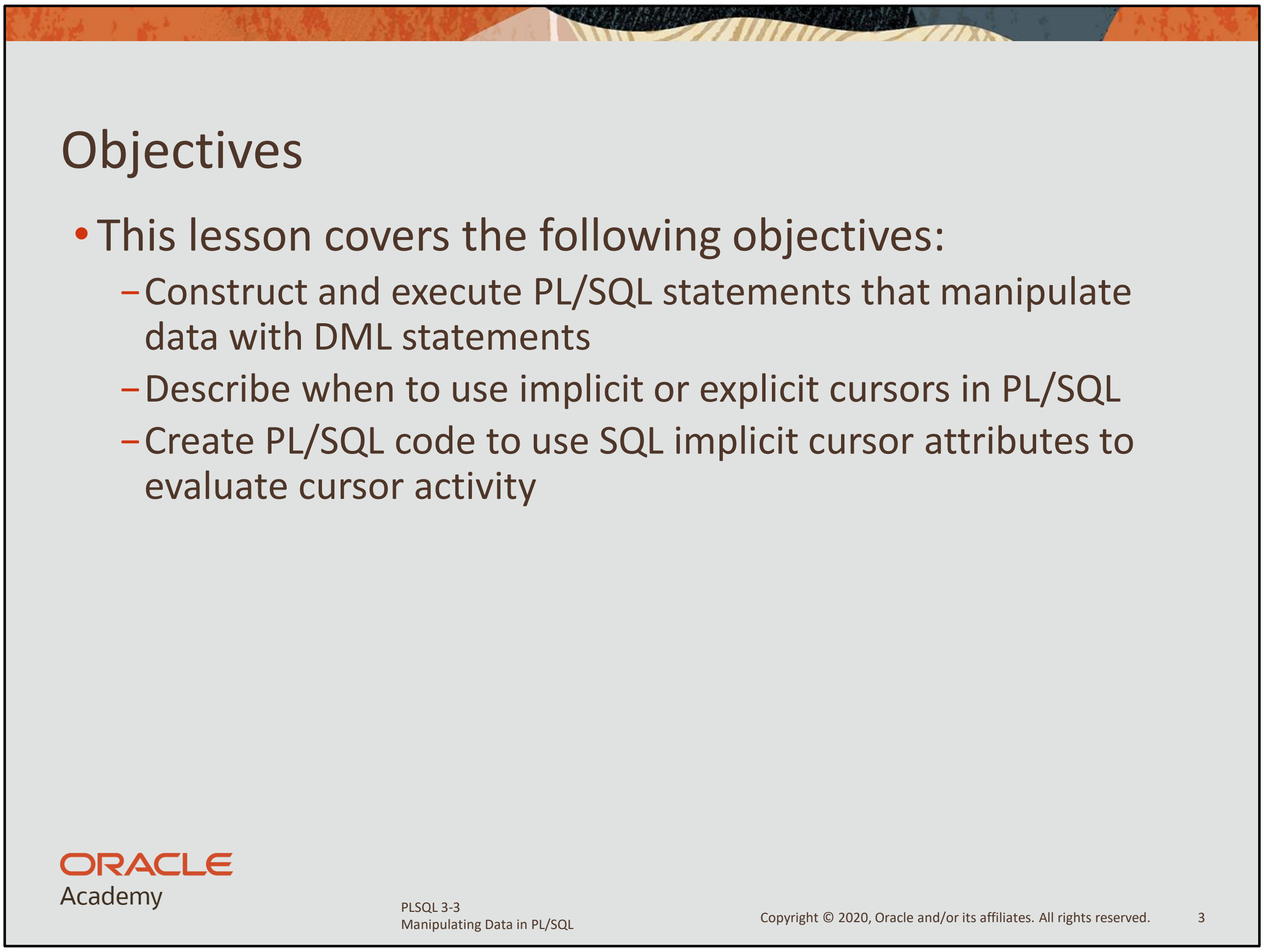

Objectives

- This lesson covers the following objectives:
  - Construct and execute PL/SQL statements that manipulate data with DML statements
  - Describe when to use implicit or explicit cursors in PL/SQL
  - Create PL/SQL code to use SQL implicit cursor attributes to evaluate cursor activity

Purpose

- You have learned that you can include SELECT statements that return a single row in a PL/SQL block
- The data retrieved by the SELECT statement must be held in variables using the INTO clause
- In this lesson, you learn how to include data manipulation language (DML) statements, such as INSERT, UPDATE, DELETE, and MERGE in PL/SQL blocks
- DML statements will help you perform a task on more than a single row

Create Copy of Original Table

- It is very important that you do NOT modify the existing tables (such as EMPLOYEES and DEPARTMENTS), because they will be needed later in the course
- The examples in this lesson use the COPY_EMP table
- If you haven't already created the COPY_EMP table, do so now by executing this SQL statement:

```
CREATE TABLE copy_emp
    AS SELECT *
    FROM employees;
```

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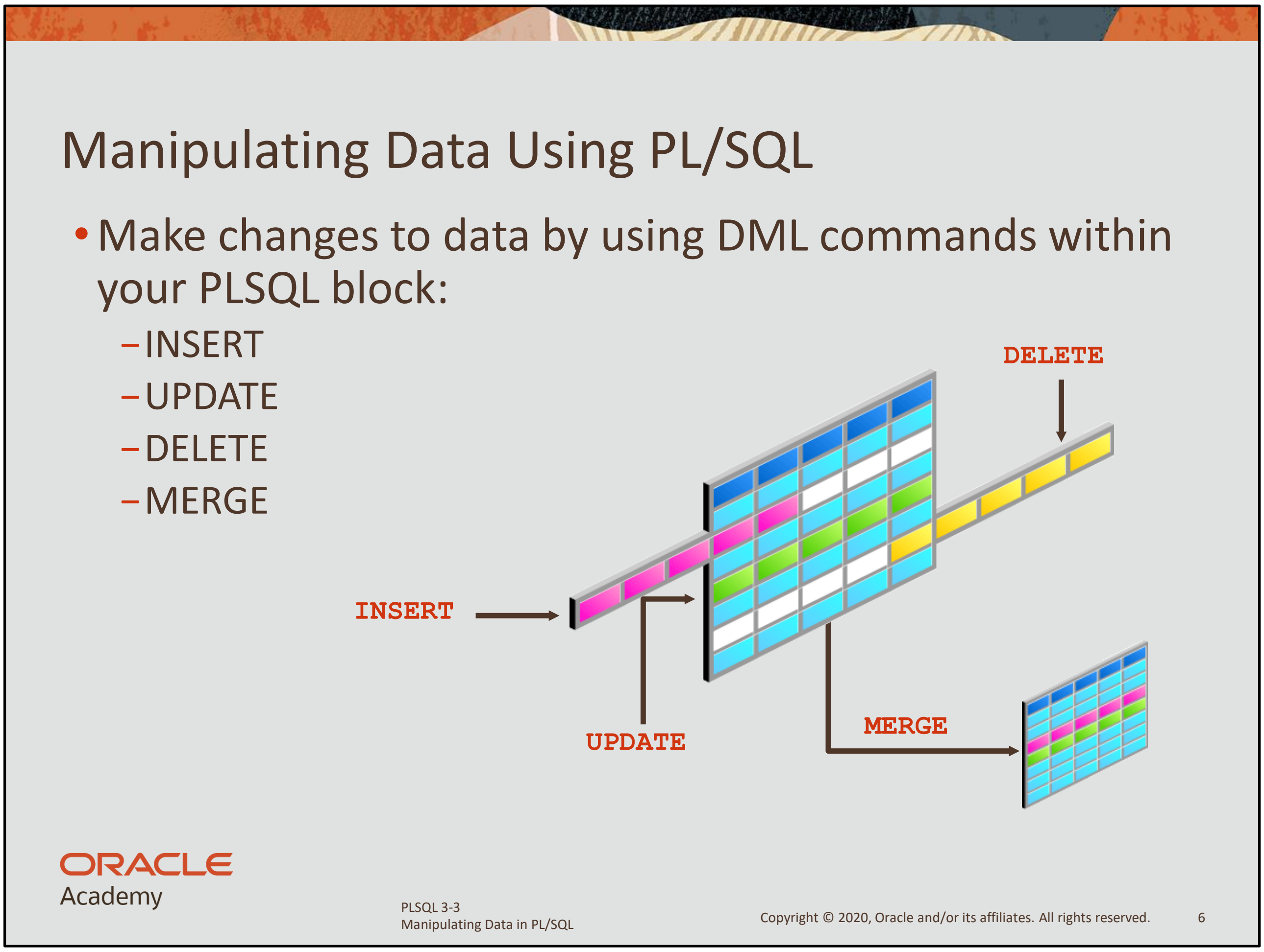
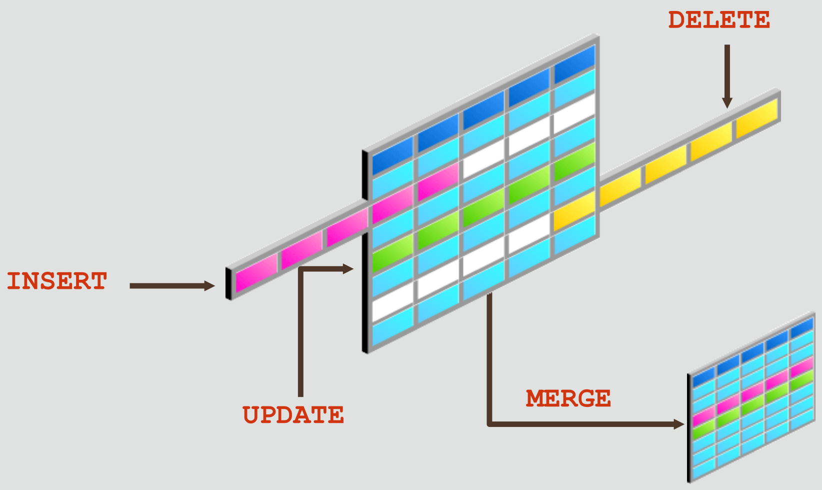


Manipulating Data Using PL/SQL

- Make changes to data by using DML commands within your PLSQL block:
  - INSERT
  - UPDATE
  - DELETE
  - MERGE



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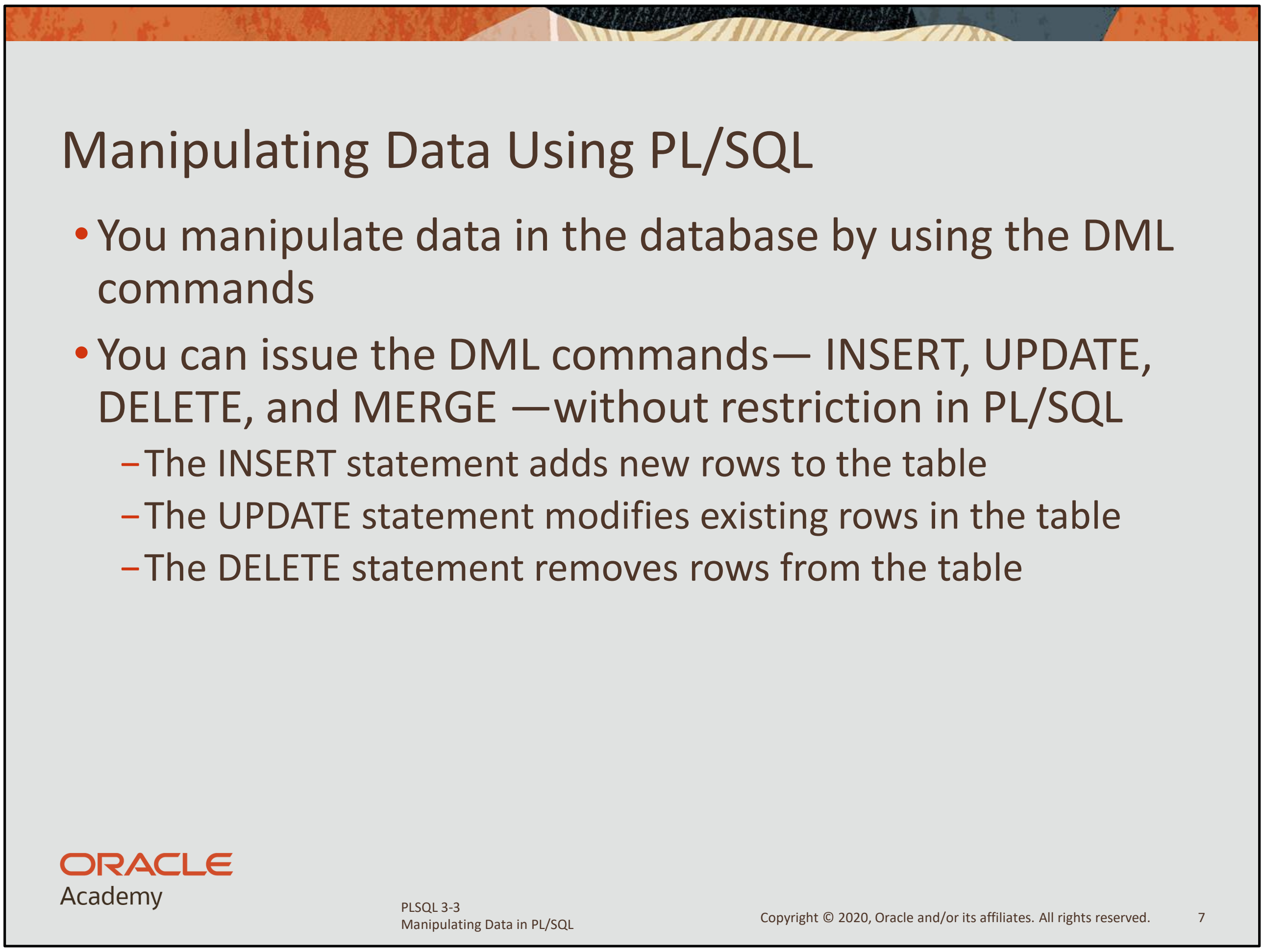
A DML statement within a PL/SQL block can modify many rows (unlike a SELECT statement, which must read exactly one row).



Manipulating Data Using PL/SQL

- You manipulate data in the database by using the DML commands
- You can issue the DML commands— INSERT, UPDATE, DELETE, and MERGE —without restriction in PL/SQL
  - The INSERT statement adds new rows to the table
  - The UPDATE statement modifies existing rows in the table
  - The DELETE statement removes rows from the table

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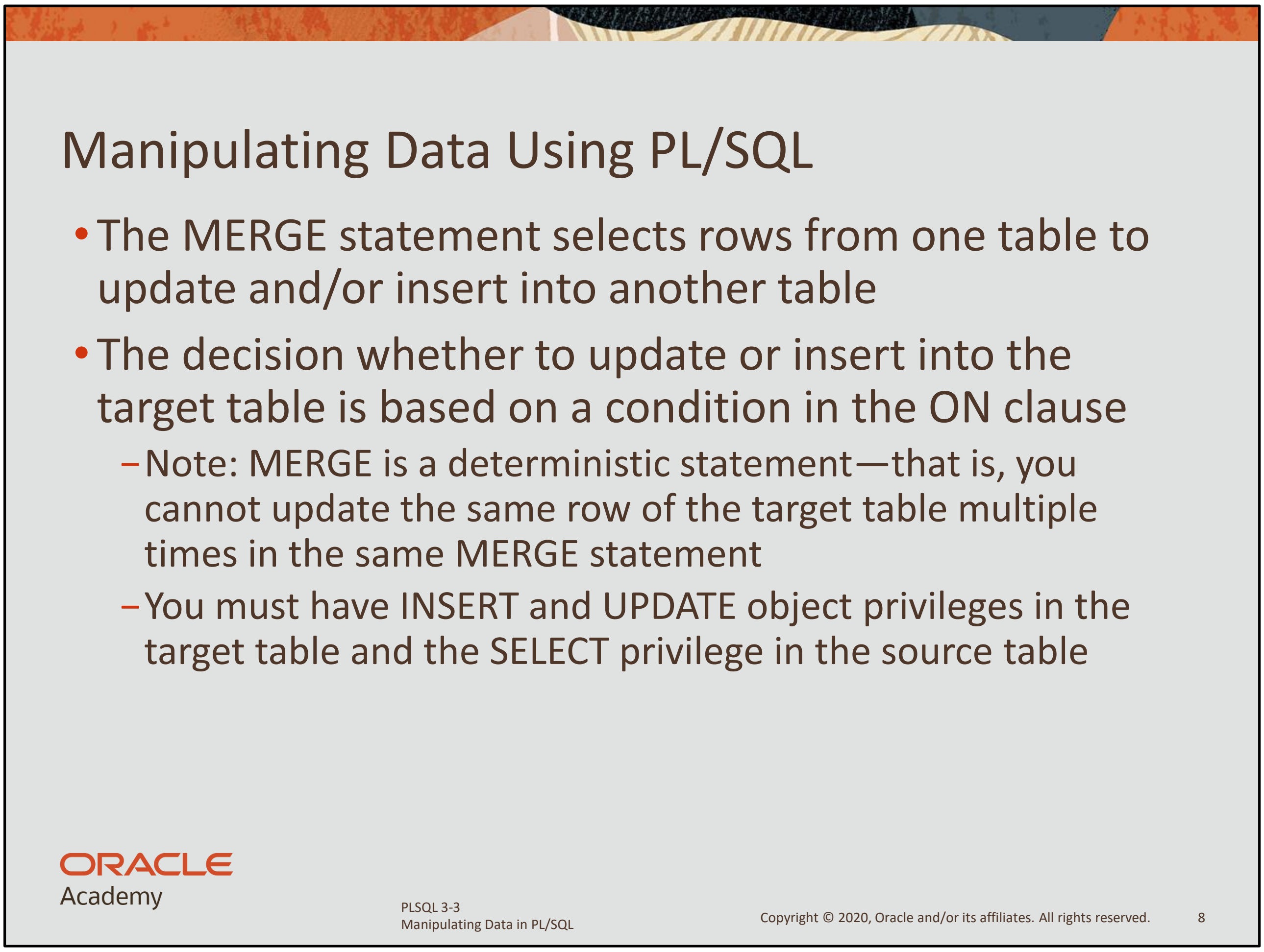

Manipulating Data Using PL/SQL

- The MERGE statement selects rows from one table to update and/or insert into another table
- The decision whether to update or insert into the target table is based on a condition in the ON clause
  - Note: MERGE is a deterministic statement—that is, you cannot update the same row of the target table multiple times in the same MERGE statement
  - You must have INSERT and UPDATE object privileges in the target table and the SELECT privilege in the source table

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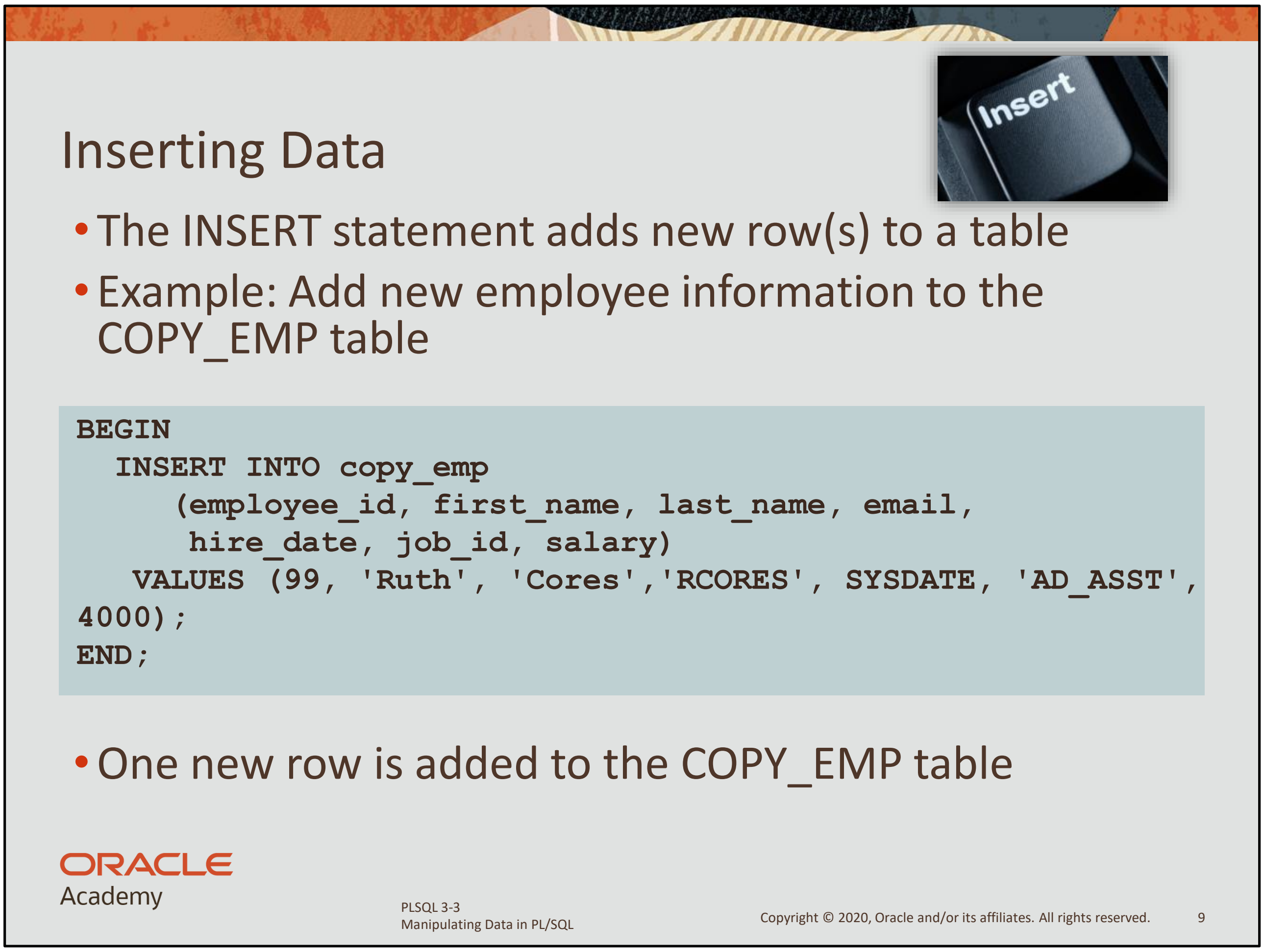

Inserting Data

- The INSERT statement adds new row(s) to a table
- Example: Add new employee information to the COPY_EMP table

```
BEGIN
  INSERT INTO copy_emp
     (employee_id, first_name, last_name, email,
      hire_date, job_id, salary)
   VALUES (99, 'Ruth', 'Cores','RCORES', SYSDATE, 'AD_ASST',
4000);
END;
```

- One new row is added to the COPY_EMP table

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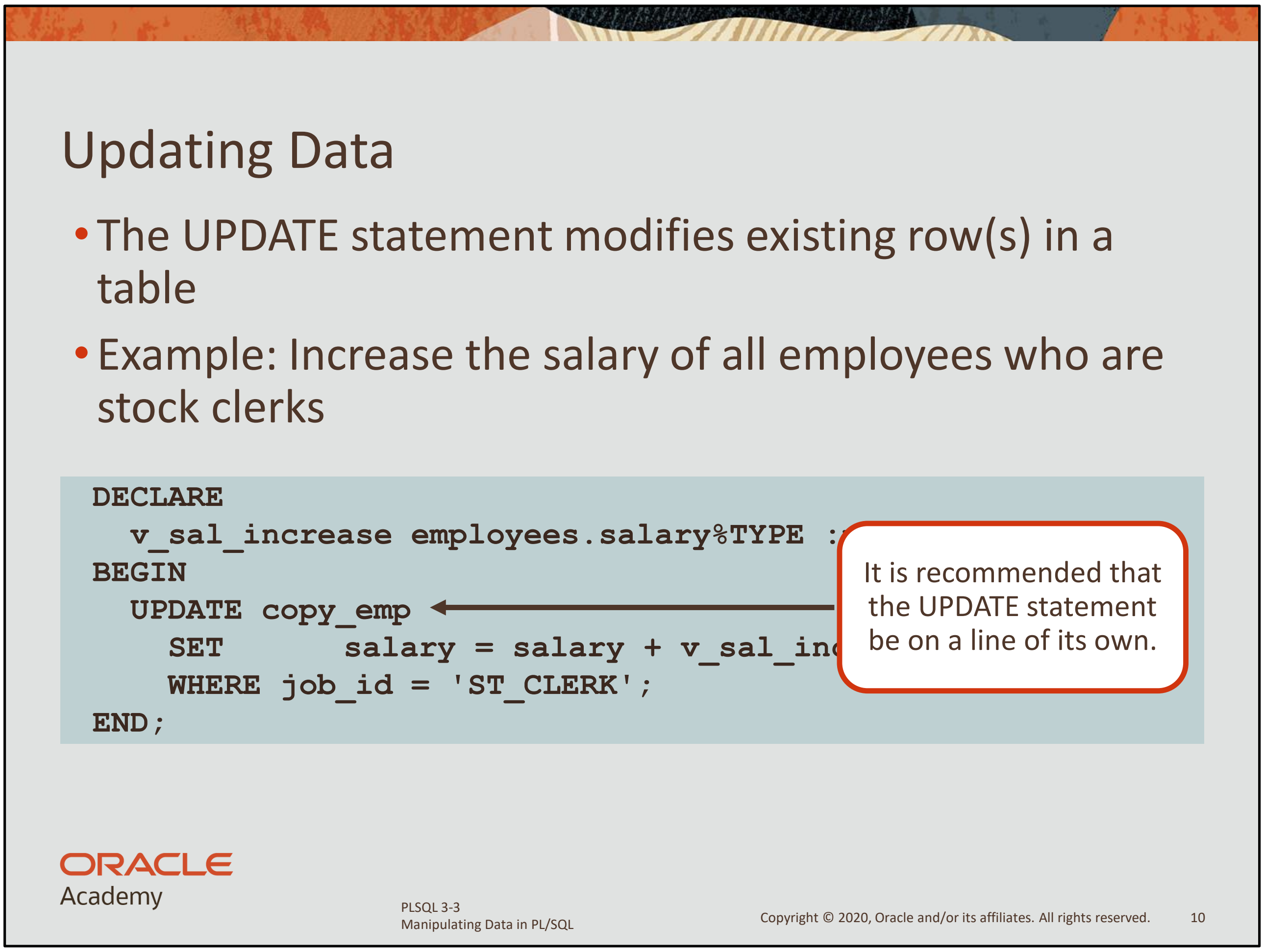
Important Note: The data in the EMPLOYEES table needs to remain unchanged for later in the course. Therefore we use the COPY_EMP table in all these DML examples.

If you haven't already created the COPY_EMP table, do so now by executing this SQL statement:

```
CREATE TABLE copy_emp
   AS SELECT *
   FROM employees;
```



Updating Data

- The UPDATE statement modifies existing row(s) in a table
- Example: Increase the salary of all employees who are stock clerks

```
DECLARE
  v_sal_increase employees.salary%TYPE :
BEGIN
  UPDATE copy_emp
    SET       salary = salary + v_sal_inc
    WHERE job_id = 'ST_CLERK';
END;
```

It is recommended that the UPDATE statement be on a line of its own.

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There may be ambiguity in the SET clause of the UPDATE statement because although the identifier on the left of the assignment operator is always a database column, the identifier on the right can be either a database column or a PL/SQL variable. Recall that if column names and identifier names are identical in the WHERE clause, then the Oracle server looks to the database first for the name.

PL/SQL variable assignments always use :=, and SQL column assignments always use =.

Although we are using the copy_emp table, it is ok to use the original table for the definition of the variable datatype employees.salary%TYPE.

Deleting Data

- The DELETE statement removes row(s) from a table
- Example: Delete rows that belong to department 10 from the COPY_EMP table

```
DECLARE
  v_deptno   employees.department_id%TYPE := 10;
BEGIN
  DELETE FROM copy_emp
    WHERE  department_id = v_deptno;
END;
```

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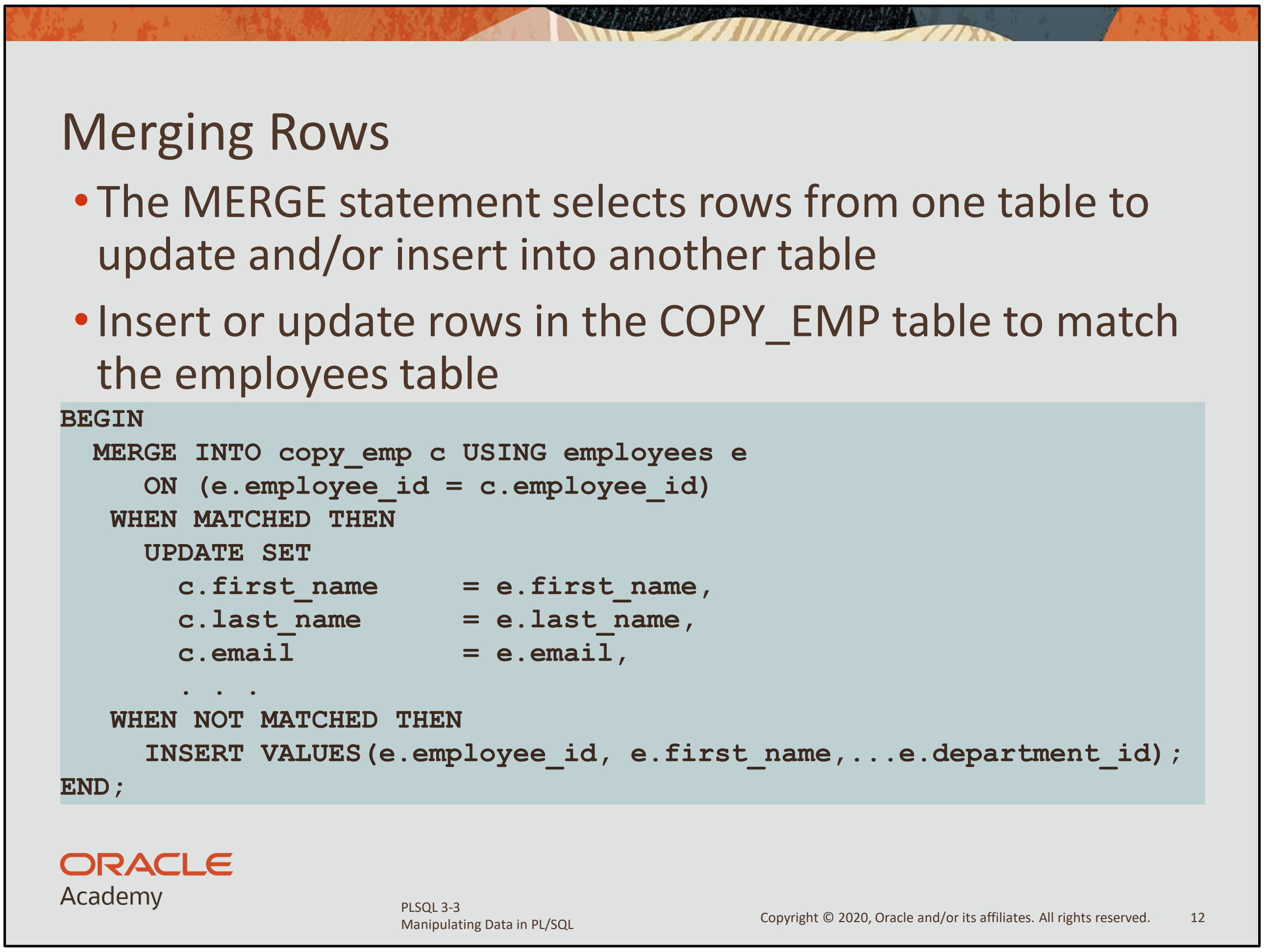
The DELETE statement removes unwanted rows from a table. If the WHERE clause is not used, then all the rows in a table will be removed, provided that no integrity constraints are violated.



Merging Rows

- The MERGE statement selects rows from one table to update and/or insert into another table
- Insert or update rows in the COPY_EMP table to match the employees table

```
BEGIN
  MERGE INTO copy_emp c USING employees e
     ON (e.employee_id = c.employee_id)
   WHEN MATCHED THEN
     UPDATE SET
       c.first_name     = e.first_name,
       c.last_name      = e.last_name,
       c.email          = e.email,
       . . .
   WHEN NOT MATCHED THEN
     INSERT VALUES(e.employee_id, e.first_name,...e.department_id);
END;
```

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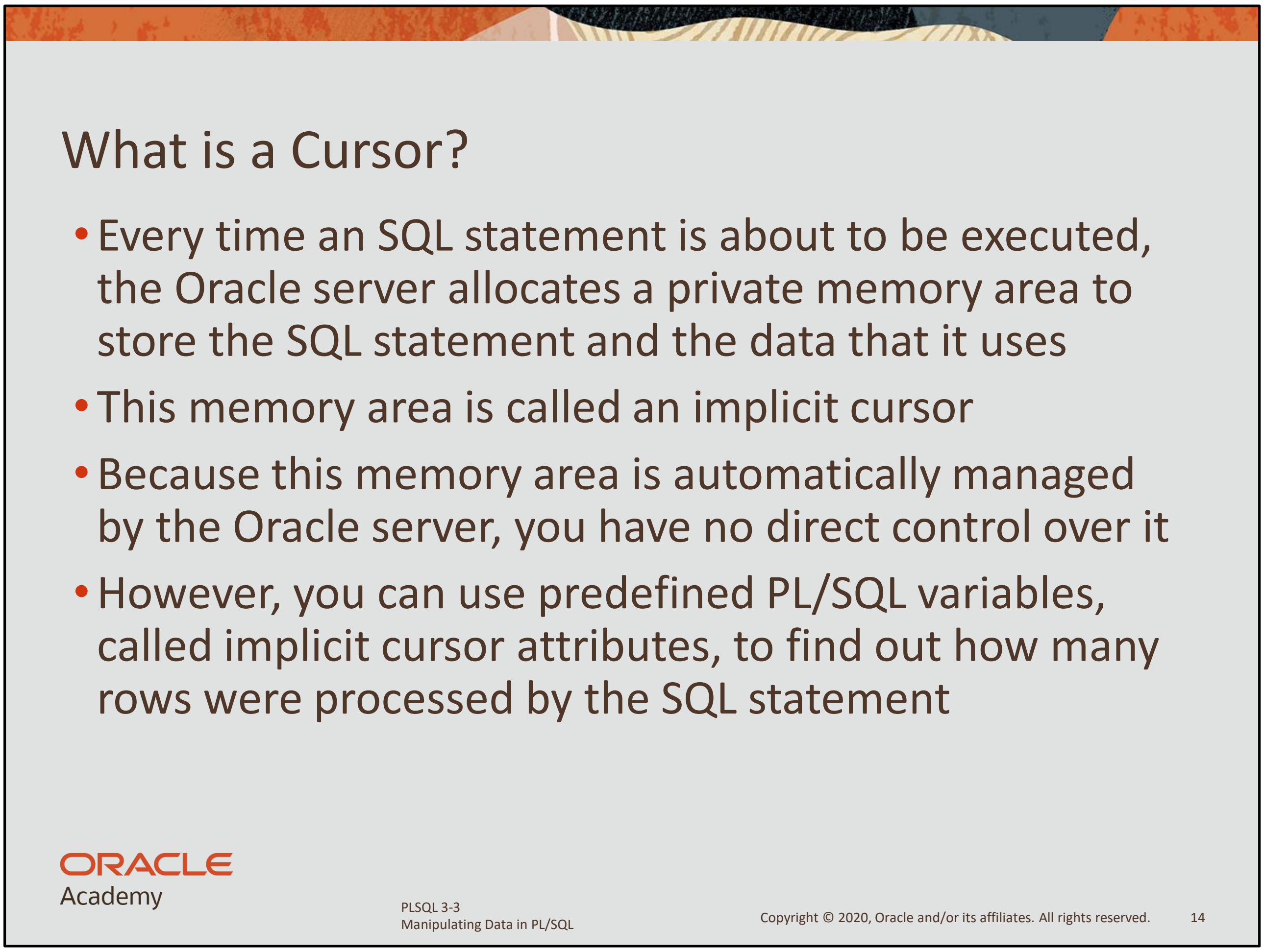
The example shown matches the employee_id in the COPY_EMP table to the employee_id in the EMPLOYEES table. If a match is found, then the row is updated to match the row in the EMPLOYEES table. If the row is not found, then it is inserted into the copy_emp table.

Getting Information From a Cursor

- Look again at the DELETE statement in this PL/SQL block

```
DECLARE
  v_deptno   employees.department_id%TYPE := 10;
BEGIN
  DELETE FROM copy_emp
    WHERE department_id = v_deptno;
END;
```

- It would be useful to know how many COPY_EMP rows were deleted by this statement
- To obtain this information, we need to understand cursors



What is a Cursor?

- Every time an SQL statement is about to be executed, the Oracle server allocates a private memory area to store the SQL statement and the data that it uses
- This memory area is called an implicit cursor
- Because this memory area is automatically managed by the Oracle server, you have no direct control over it
- However, you can use predefined PL/SQL variables, called implicit cursor attributes, to find out how many rows were processed by the SQL statement

The word “cursor” has several meanings in Oracle. It is sometimes used to mean a pointer to the private memory area, rather than the memory area itself. It is also used to refer to an area of shared memory. In this course, we focus only on its meaning in the PL/SQL environment.

Implicit and Explicit Cursors

- There are two types of cursors:
  - Implicit cursors: Defined automatically by Oracle for all SQL data manipulation statements, and for queries that return only one row
    - An implicit cursor is always automatically named "SQL"
  - Explicit cursors: Defined by the PL/SQL programmer for queries that return more than one row

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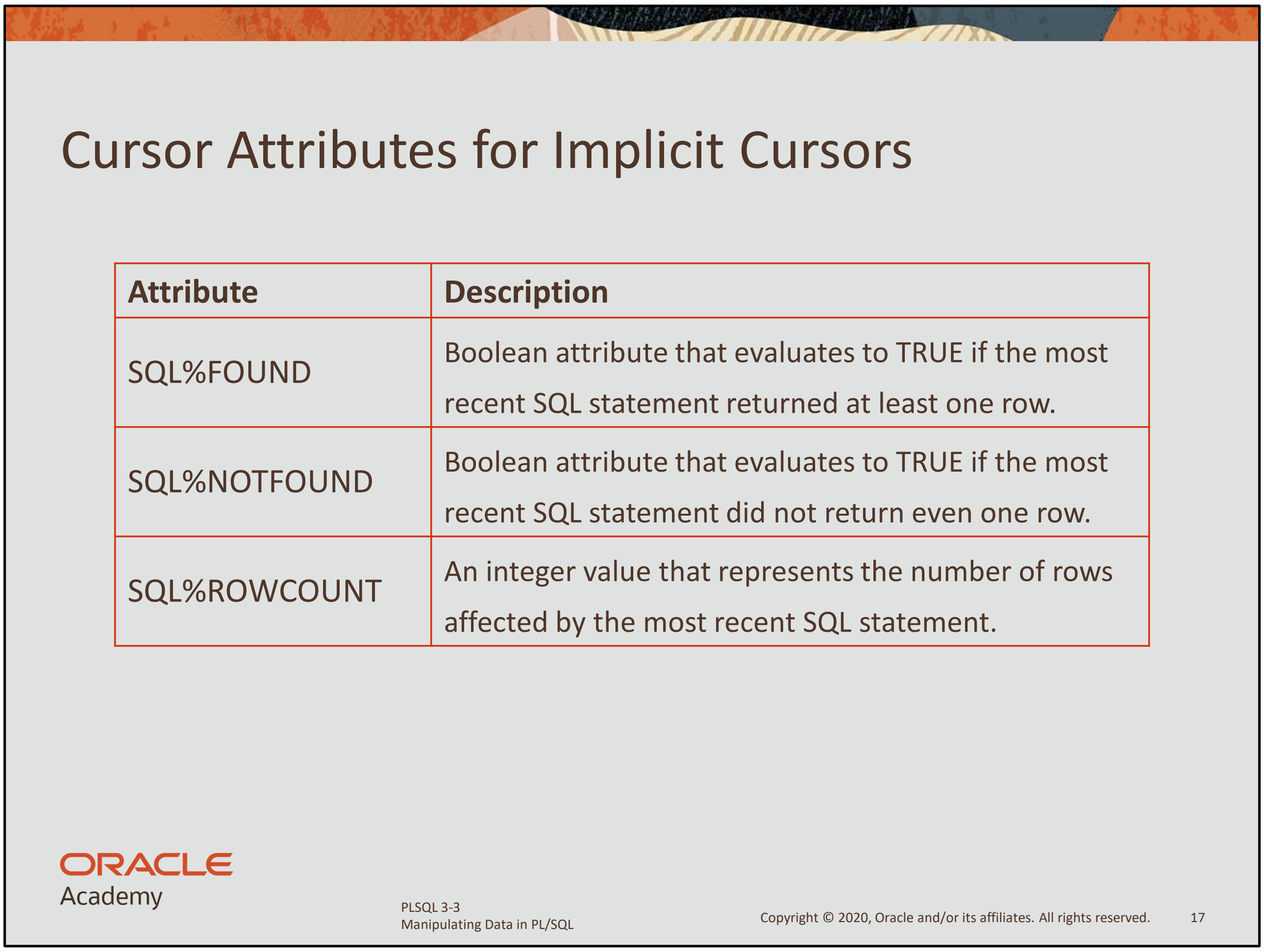
Implicit cursors: Implicit cursors are created and managed by the Oracle server. Oracle uses an implicit cursor for each SELECT, UPDATE, DELETE, or INSERT statement you execute in a program. The Oracle server creates such a cursor when it has to execute a SQL statement. The remaining pages in this lesson discuss implicit cursors.

Explicit cursors: Explicit cursors are declared by the programmer. Explicit cursors are discussed in a later lesson.

Cursor Attributes for Implicit Cursors

- Cursor attributes are automatically declared variables that allow you to evaluate what happened when a cursor was last used
- Attributes for implicit cursors are prefaced with “SQL”
- Use these attributes in PL/SQL statements, but not in SQL statements
- Using cursor attributes, you can test the outcome of your SQL statements



Cursor Attributes for Implicit Cursors

Attribute	Description
SQL%FOUND	Boolean attribute that evaluates to TRUE if the most recent SQL statement returned at least one row.
SQL%NOTFOUND	Boolean attribute that evaluates to TRUE if the most recent SQL statement did not return even one row.
SQL%ROWCOUNT	An integer value that represents the number of rows affected by the most recent SQL statement.

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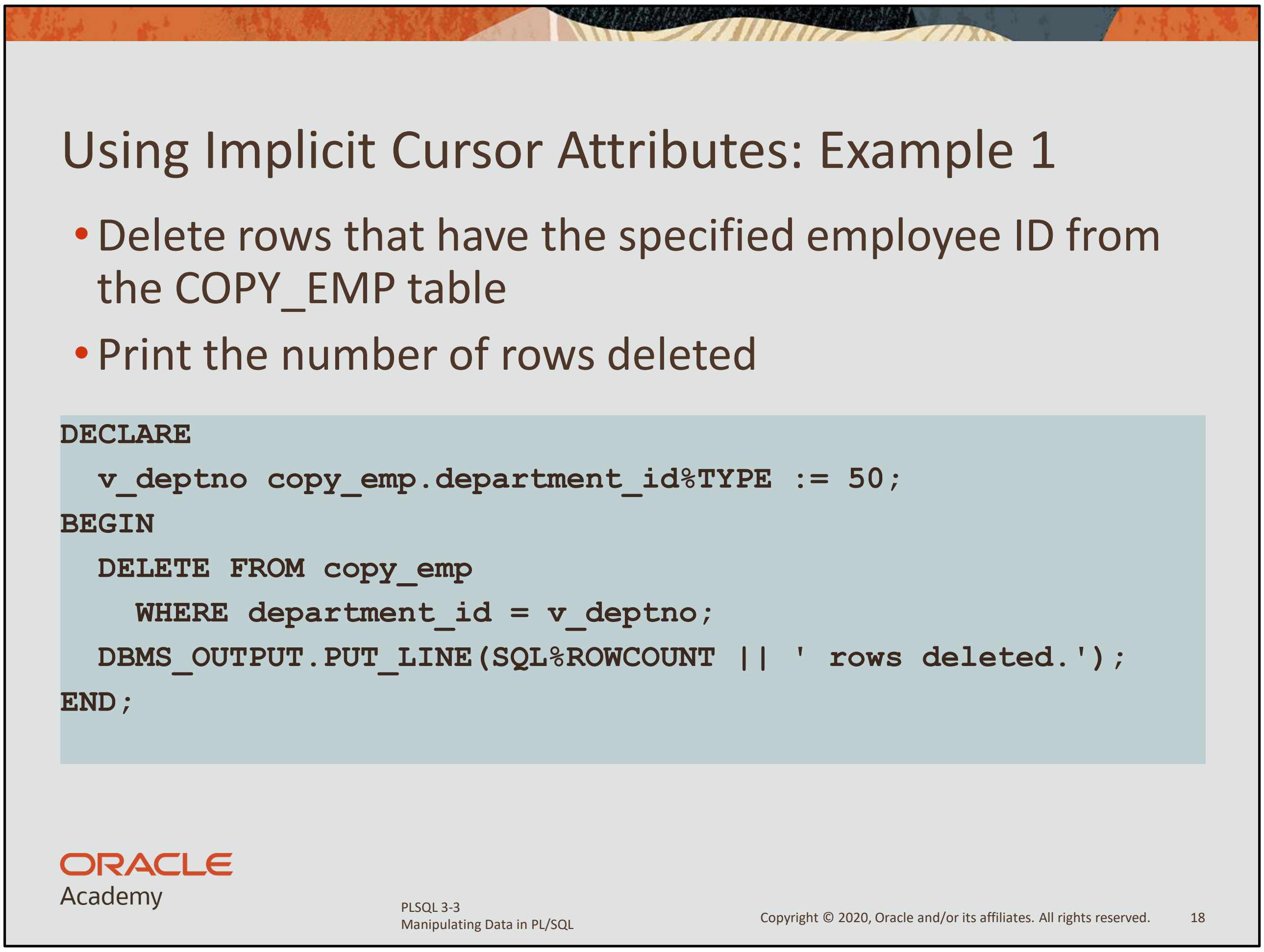
You can test the attributes — SQL%ROWCOUNT, SQL%FOUND, and SQL%NOTFOUND — in the executable section of a block to gather information after the appropriate command.

The SQL%NOTFOUND attribute is opposite to SQL%FOUND. This attribute may be used as the exit condition in a loop. It is useful in UPDATE or DELETE statements when no rows are changed because exceptions are not returned in these cases.



Using Implicit Cursor Attributes: Example 1

- Delete rows that have the specified employee ID from the COPY_EMP table
- Print the number of rows deleted

```
DECLARE
  v_deptno copy_emp.department_id%TYPE := 50;
BEGIN
  DELETE FROM copy_emp
    WHERE department_id = v_deptno;
  DBMS_OUTPUT.PUT_LINE(SQL%ROWCOUNT || ' rows deleted.');
END;
```

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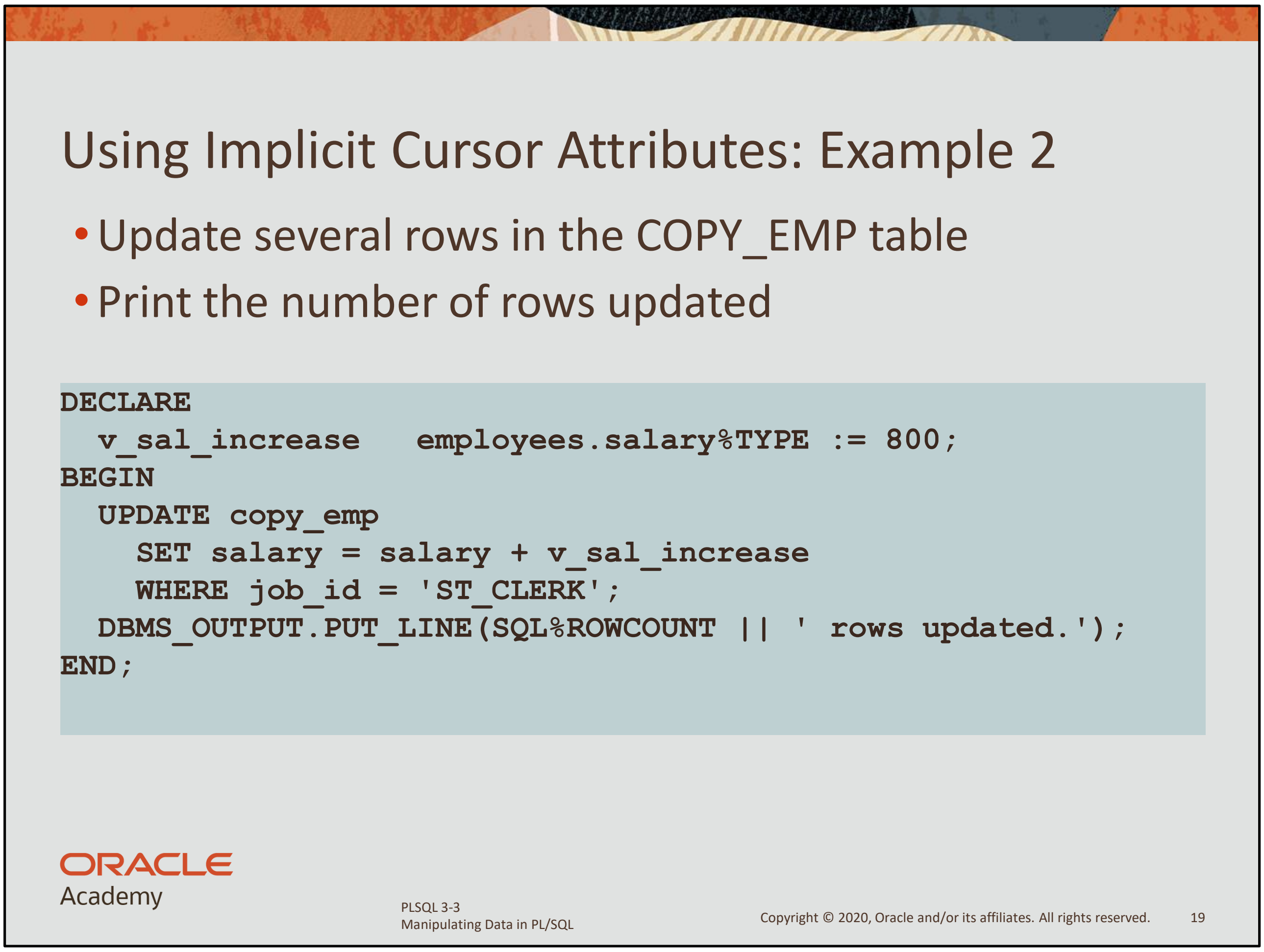
The example in the slide deletes all rows with department_id 50 from the copy_emp table. Using the SQL%ROWCOUNT attribute, you can display the number of rows deleted.



Using Implicit Cursor Attributes: Example 2

- Update several rows in the COPY_EMP table
- Print the number of rows updated

```
DECLARE
  v_sal_increase   employees.salary%TYPE := 800;
BEGIN
  UPDATE copy_emp
    SET salary = salary + v_sal_increase
    WHERE job_id = 'ST_CLERK';
  DBMS_OUTPUT.PUT_LINE(SQL%ROWCOUNT || ' rows updated.');
END;
```

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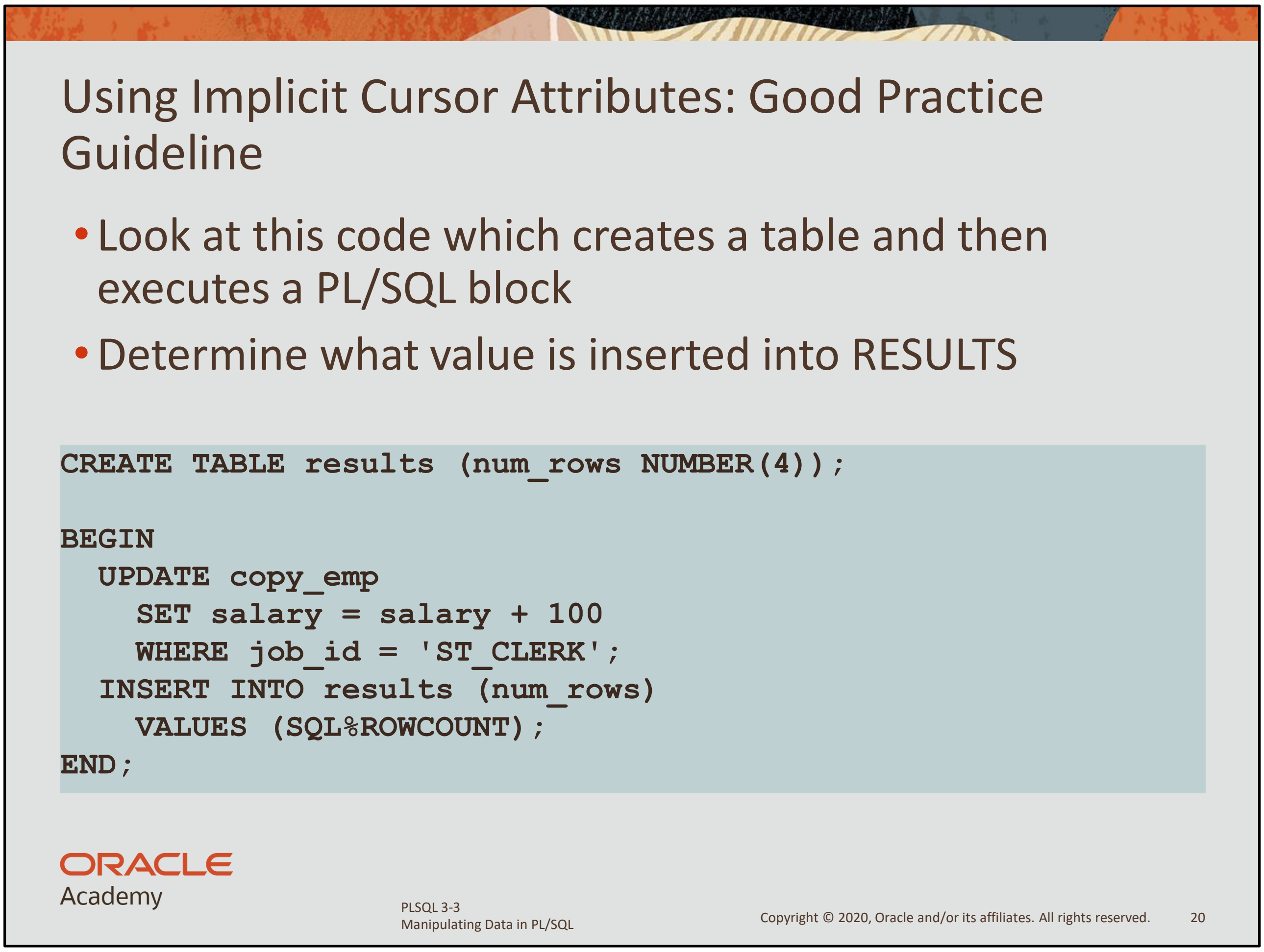

Using Implicit Cursor Attributes: Good Practice Guideline

- Look at this code which creates a table and then executes a PL/SQL block
- Determine what value is inserted into RESULTS

```
CREATE TABLE results (num_rows NUMBER(4));

BEGIN
  UPDATE copy_emp
    SET salary = salary + 100
    WHERE job_id = 'ST_CLERK';
  INSERT INTO results (num_rows)
    VALUES (SQL%ROWCOUNT);
END;
```

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No value is inserted into RESULTS table.

The goal of the code in the slide is to store the number of rows updated by the UPDATE statement in the RESULTS table. What actually happens, though, is an error. Upon starting the INSERT statement, the previous cursor attributes are "erased." Until the INSERT statement completes, there are no new cursor attributes, so there is no value to be inserted into the RESULTS table.

Using Implicit Cursor Attributes: Good Practice Guideline

- To INSERT the value in the RESULTS table - we must save the SQL%ROWCOUNT value in a declared variable
- The value is displayed using PUT_LINE

```
DECLARE
 v_rowcount    INTEGER;
BEGIN
UPDATE  copy_emp
 SET   salary = salary + 100
 WHERE   job_id = 'ST_CLERK';
 DBMS_OUTPUT.PUT_LINE(SQL%ROWCOUNT || ' rows in COPY_EMPupdated.');
 v_rowcount := SQL%ROWCOUNT;
 INSERT INTO results (num_rows)
 VALUES (v_rowcount);
 DBMS_OUTPUT.PUT_LINE(SQL%ROWCOUNT || ' rows in RESULTS updated.');
END;
```

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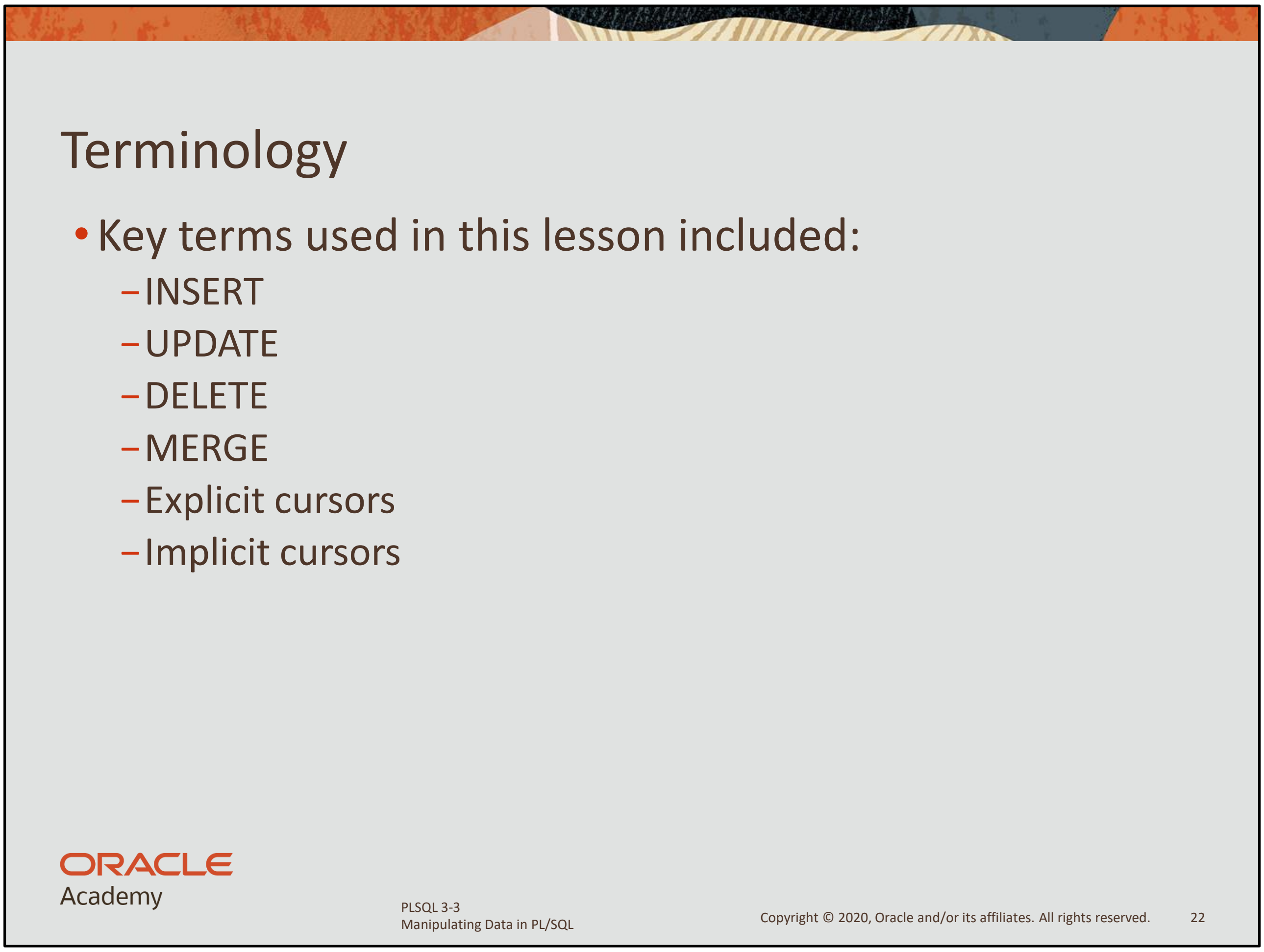

Terminology

- Key terms used in this lesson included:
  - INSERT
  - UPDATE
  - DELETE
  - MERGE
  - Explicit cursors
  - Implicit cursors

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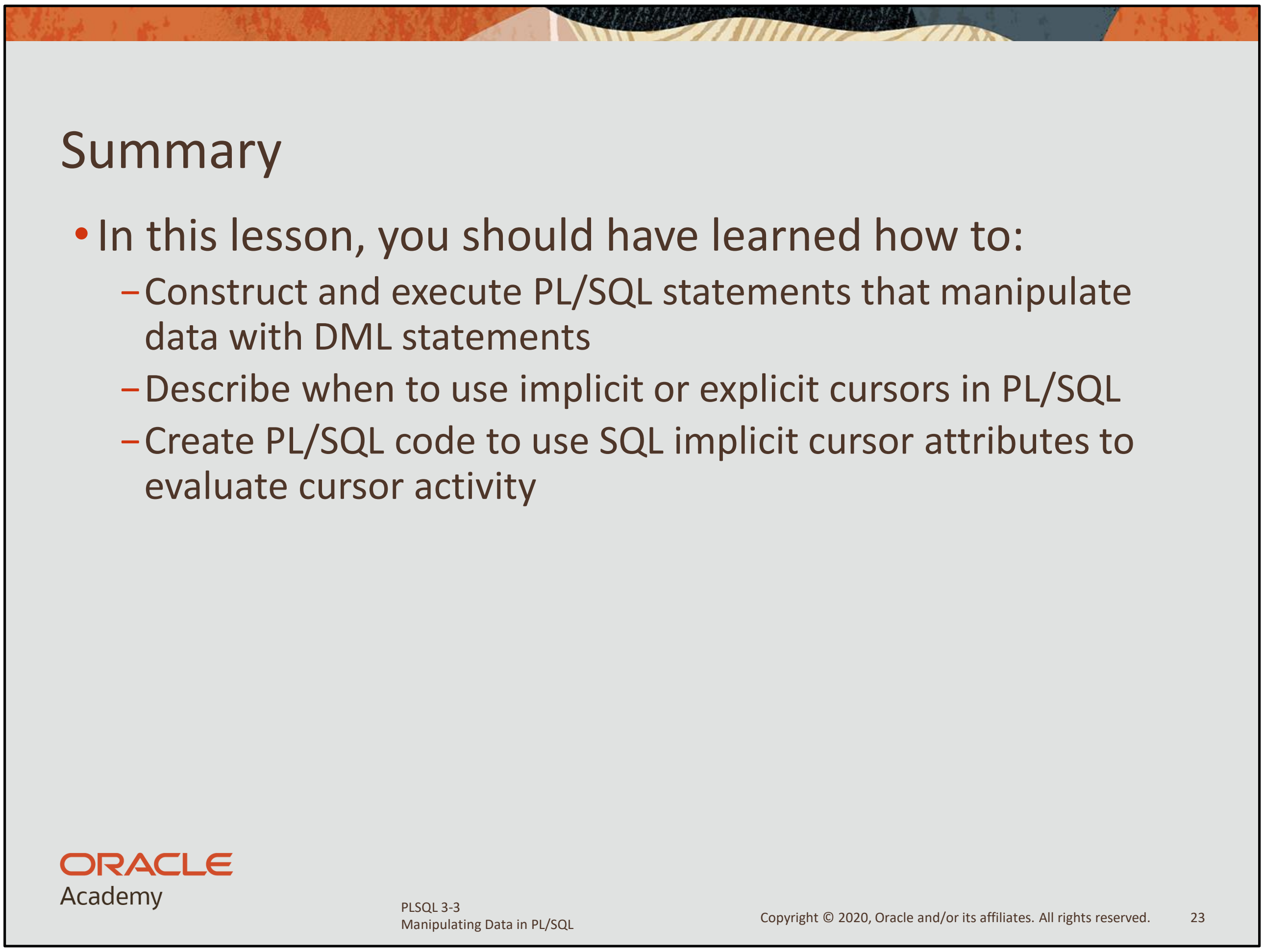
- INSERT - Statement adds new rows to the table.
- UPDATE - Statement modifies existing rows in the table.
- DELETE - Statement removes rows from the table.
- MERGE - Statement selects rows from one table to update and/or insert into another table. The decision whether to update or insert into the target table is based on a condition in the ON clause.
- Explicit cursors: Defined by the programmer for queries that return more than one row.
- Implicit cursors: Defined automatically by Oracle for all SQL data manipulation statements, and for queries that return only one row.



Summary

- In this lesson, you should have learned how to:
  - Construct and execute PL/SQL statements that manipulate data with DML statements
  - Describe when to use implicit or explicit cursors in PL/SQL
  - Create PL/SQL code to use SQL implicit cursor attributes to evaluate cursor activity

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