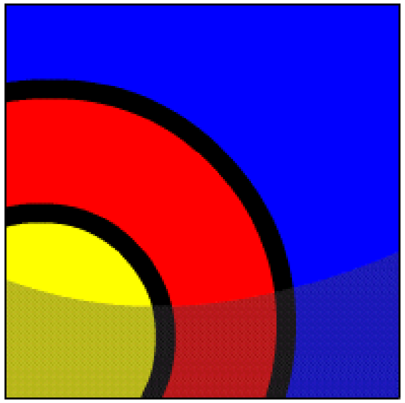
Creating DML Triggers: Part I

What Will I Learn?

In this lesson, you will learn to:

- Create a DML trigger
- List the DML trigger components
- Create a statement-level trigger
- Describe the trigger firing sequence options



Why Learn It?

Suppose you want to keep an automatic record of the history of changes to employees' salaries. This is not only important for business reasons, but is a legal requirement in many countries.

To do this, you create a DML trigger. DML triggers are the most common type of trigger in most Oracle databases.

In this and the next lesson, you learn how to create and use database DML triggers.

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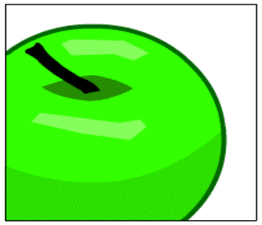

What Is a DML Trigger?

A DML trigger is a trigger that is automatically fired (executed) whenever an SQL DML statement (`INSERT`, `UPDATE`, or `DELETE`) is executed. You classify DML triggers in two ways:

• By when they execute: `BEFORE`, `AFTER`, or `INSTEAD OF` the triggering DML statement.

• By how many times they execute: Once for the whole DML statement (a statement trigger), or once for each row affected by the DML statement (a row trigger).

In this lesson, you learn about statement triggers.

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Creating DML Statement Triggers

```
CREATE [OR REPLACE] TRIGGER trigger_name
  timing
  event1 [OR event2 OR event3] ON object_name
trigger_body
```

timing:	When the trigger fires in relation to the triggering event. Values are `BEFORE`, `AFTER`, or `INSTEAD OF`.
event:	Which DML operation causes the trigger to fire. Values are `INSERT`, `UPDATE [OF column]`, and `DELETE`.
object_name:	The table or view associated with the trigger.
trigger_body:	The action(s) performed by the trigger are defined in an anonymous block.

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Statement Trigger Timing

When should the trigger fire?

- `BEFORE`: Execute the trigger body before the triggering DML event on a table.
- `AFTER`: Execute the trigger body after the triggering DML event on a table.
- `INSTEAD OF`: Execute the trigger body instead of the triggering DML event on a view.

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Trigger Timings and Events Examples

The first trigger executes immediately before an employee's salary is updated:

```
CREATE OR REPLACE TRIGGER sal_upd_trigg
BEFORE UPDATE OF salary ON employees
BEGIN ...   END;
```

The second trigger executes immediately after an employee is deleted:

```
CREATE OR REPLACE TRIGGER emp_del_trigg
AFTER DELETE ON employees
BEGIN ...   END;
```

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Trigger Timings and Events Examples (continued)

You can restrict an UPDATE trigger to updates of a specific column or columns:

```
CREATE OR REPLACE TRIGGER sal_upd_trigg
BEFORE UPDATE OF salary, commission_pct ON employees
BEGIN ...   END;
```

A trigger can have more than one triggering event:

```
CREATE OR REPLACE TRIGGER emp_del_trigg
AFTER INSERT OR DELETE OR UPDATE ON employees
BEGIN ...   END;
```

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How Often Does a Statement Trigger Fire?

A statement trigger:

- Fires only once for each execution of the triggering statement
- Is the default type of DML trigger
- Fires once even if no rows are affected

```
CREATE OR REPLACE TRIGGER log_emp_changes
AFTER UPDATE ON employees BEGIN
  INSERT INTO log_emp_table (who, when)
    VALUES (USER, SYSDATE);
END;
```

Now an UPDATE statement is executed:

```
UPDATE employees SET ... WHERE ...;
```

How many times does the trigger fire, if the UPDATE statement modifies three rows? Ten rows? One row? No rows?

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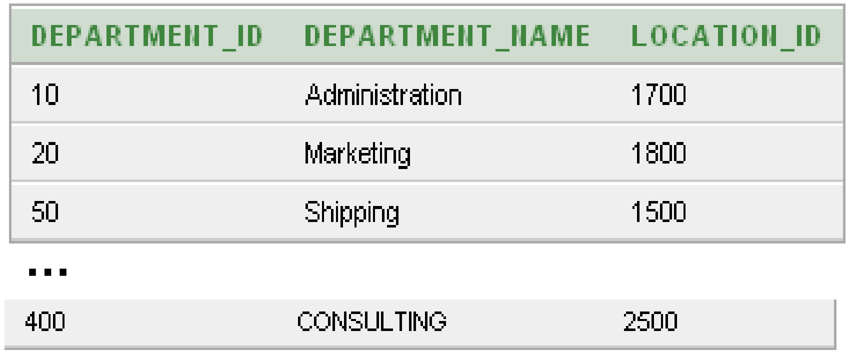
And When Does the Statement Trigger Fire?

This slide shows the firing sequence for a statement trigger associated with the event `INSERT INTO departments`:

```
INSERT INTO departments
  (department_id,department_name, location_id)
VALUES (400, 'CONSULTING', 2500);
```

Triggering action

→ **BEFORE statement trigger**



DEPARTMENT_ID	DEPARTMENT_NAME	LOCATION_ID
10	Administration	1700
20	Marketing	1800
50	Shipping	1500
...		
400	CONSULTING	2500

→ **AFTER statement trigger**

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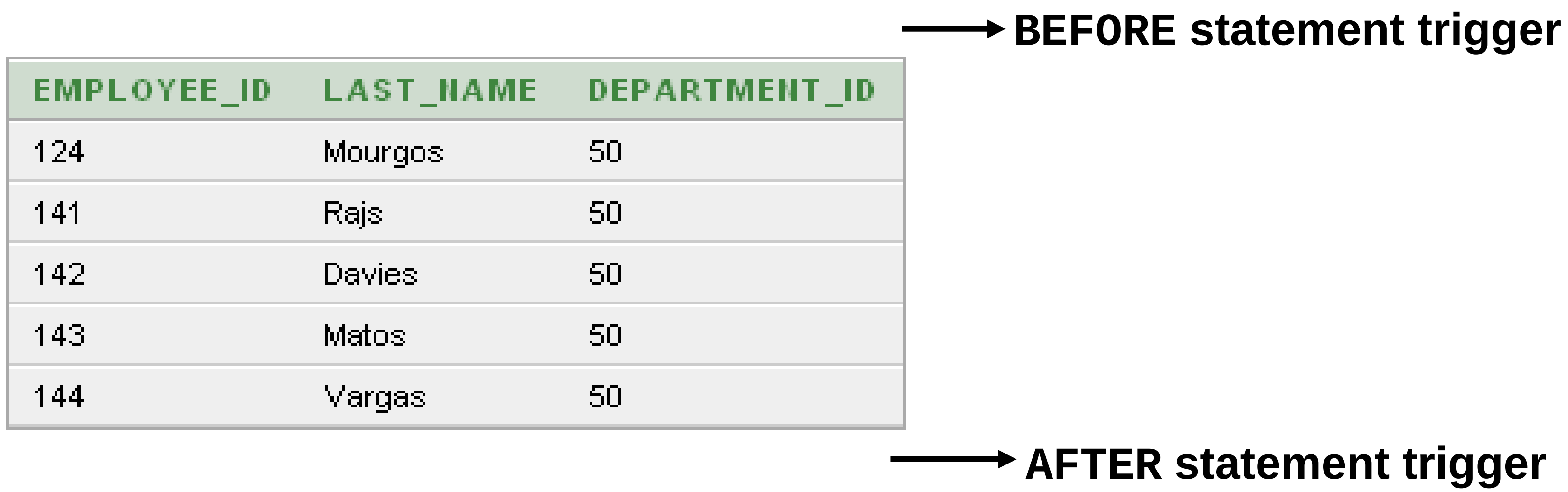
Trigger-Firing Sequence

A statement trigger fires only once even if the triggering DML statement affects many rows:

```
UPDATE employees
  SET salary = salary * 1.1
  WHERE department_id = 50;
```



EMPLOYEE_ID	LAST_NAME	DEPARTMENT_ID
124	Mourgos	50
141	Rajs	50
142	Davies	50
143	Matos	50
144	Vargas	50

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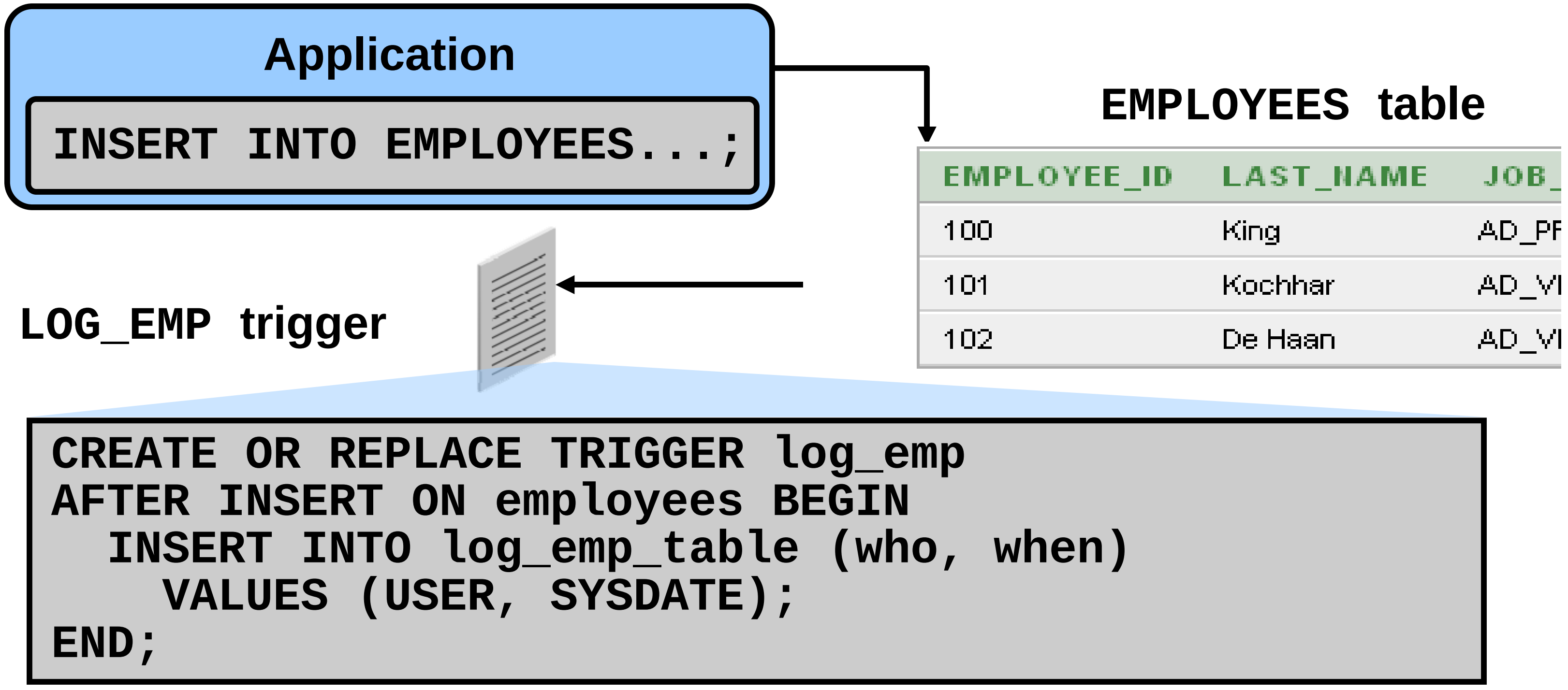
DML Statement Triggers Example 1



```
INSERT INTO EMPLOYEES...;
```

EMPLOYEE_ID	LAST_NAME	JOB_
100	King	AD_P
101	Kochhar	AD_V
102	De Haan	AD_V

```
CREATE OR REPLACE TRIGGER log_emp
AFTER INSERT ON employees BEGIN
  INSERT INTO log_emp_table (who, when)
    VALUES (USER, SYSDATE);
END;
```

This statement trigger automatically inserts a row into a logging table every time one or more rows are successfully inserted into EMPLOYEES.

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DML Statement Triggers Example 2

```
CREATE OR REPLACE TRIGGER log_dept_changes
AFTER INSERT OR UPDATE OR DELETE ON DEPARTMENTS
BEGIN
  INSERT INTO log_dept_table (which_user, when_done)
    VALUES (USER, SYSDATE);
END;
```

This statement trigger automatically inserts a row into a logging table every time a DML operation is successfully executed on the DEPARTMENTS table.

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DML Statement Triggers Example 3

This example shows how you can use a DML trigger to enforce complex business rules that cannot be enforced by a constraint.

You want to allow `INSERT`s into the `EMPLOYEES` table during normal working days (Monday through Friday), but prevent `INSERT`s on the weekend (Saturday and Sunday).

If a user attempts to insert a row into the `EMPLOYEES` table during the weekend, then the user sees an error message, the trigger fails, and the triggering statement is rolled back.

The next slide shows the trigger code needed for this example.

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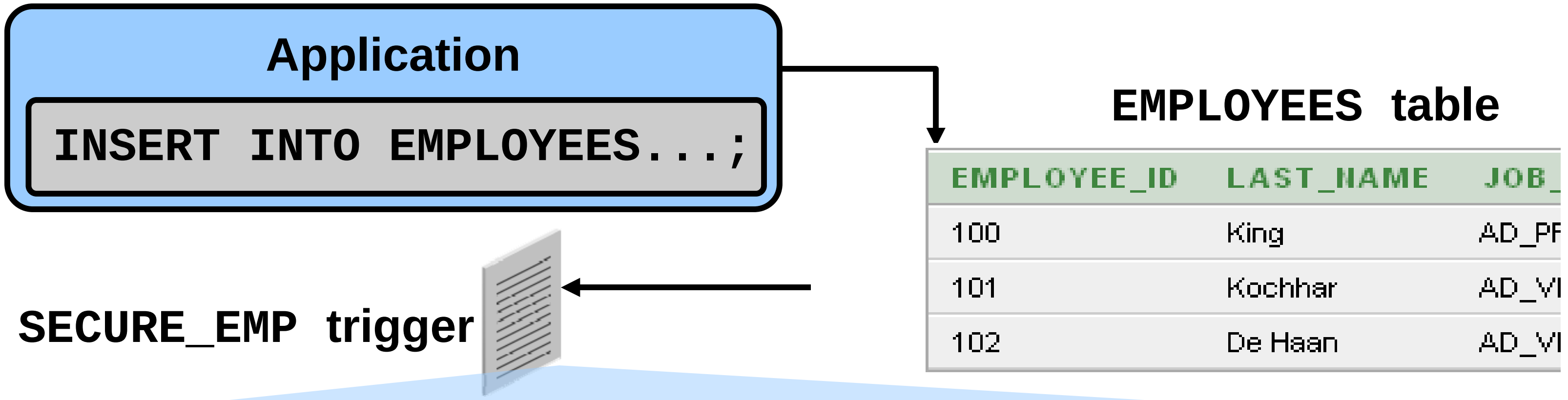
DML Statement Triggers: Example 3 (continued)



EMPLOYEE_ID	LAST_NAME	JOB_
100	King	AD_P
101	Kochhar	AD_V
102	De Haan	AD_V

```
CREATE OR REPLACE TRIGGER secure_emp
BEFORE INSERT ON employees
BEGIN
  IF TO_CHAR(SYSDATE,'DY') IN ('SAT','SUN') THEN
    RAISE_APPLICATION_ERROR(-20500,
         'You may insert into EMPLOYEES'
       ||' table only during business hours');
  END IF;
END;
```

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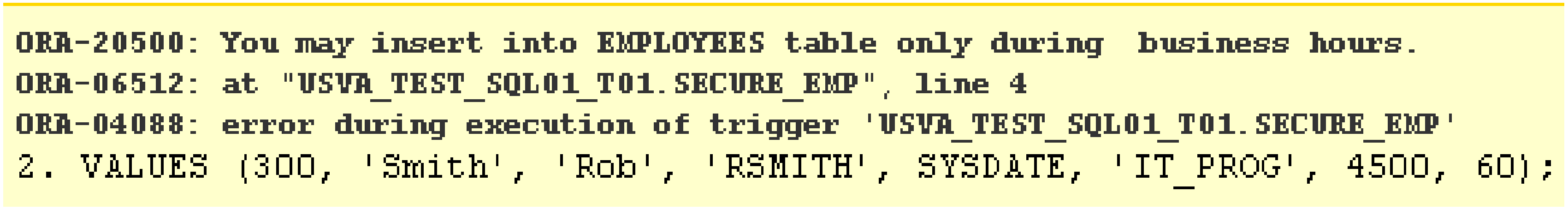
Testing SECURE_EMP

A user tries to `INSERT` a row on the weekend:

```
INSERT INTO employees (employee_id, last_name,
        first_name, email, hire_date,
        job_id, salary, department_id)
VALUES (300, 'Smith', 'Rob', 'RSMITH', SYSDATE,
        'IT_PROG', 4500, 60);
```



```
ORA-20500: You may insert into EMPLOYEES table only during  business hours.
ORA-06512: at "USVA_TEST_SQL01_T01.SECURE_EMP", line 4
ORA-04088: error during execution of trigger 'USVA_TEST_SQL01_T01.SECURE_EMP'
2. VALUES (300, 'Smith', 'Rob', 'RSMITH', SYSDATE, 'IT_PROG', 4500, 60);
```

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A Final Example:

```
CREATE OR REPLACE TRIGGER log_dept_changes
AFTER INSERT OR UPDATE OR DELETE ON DEPARTMENTS
BEGIN
  INSERT INTO log_dept_table (which_user, when_done)
    VALUES (USER, SYSDATE);
  COMMIT;
END;
```

This trigger does not compile successfully. Why not?

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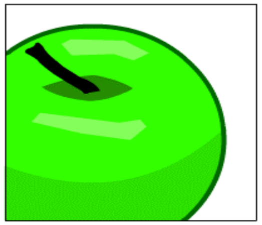

Terminology

Key terms used in this lesson include:

DML trigger

Statement trigger

Row trigger

Summary

In this lesson, you learned to:

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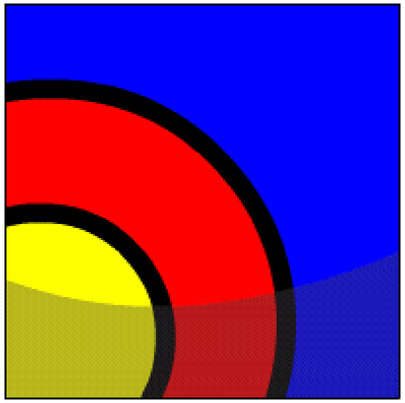

Try It / Solve It

The exercises in this lesson cover the following topics:

- Creating a DML trigger
- Listing the DML trigger components
- Creating a statement-level trigger
- Describing the trigger firing sequence options