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Database Programming with PL/SQL

13-1
Introduction to Triggers

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Objectives

This lesson covers the following objectives:

- Describe database triggers and their uses
- Define a database trigger
- Recognize the difference between a database trigger and an application trigger
- List two or more guidelines for using triggers
- Compare and contrast database triggers and stored procedures

Purpose

- In this lesson, you learn about a database trigger.
- Triggers allow specified actions to be performed automatically within the database, without having to write extra application code.
- Triggers increase the power of the database, and the power of your application.
- You will learn more about triggers in the following lessons.

Need For A Trigger

- Let’s start with an example: A business rule states that whenever an employee’s salary is changed, the change must be recorded in a logging table.
- You could create two procedures to do this: UPD_EMP_SAL to update the salary, and LOG_SAL_CHANGE to insert the row into the logging table.
- You could invoke LOG_SAL_CHANGE from within UPD_EMP_SAL, or invoke LOG_SAL_CHANGE separately from the calling environment.

Need For A Trigger

- But you do not have to do this.
- Instead, you create a trigger.
- The next slide shows how.

Example of a Simple Trigger

- From now on, whenever an SQL statement updates a salary, this trigger executes automatically, inserting the row into the logging table.

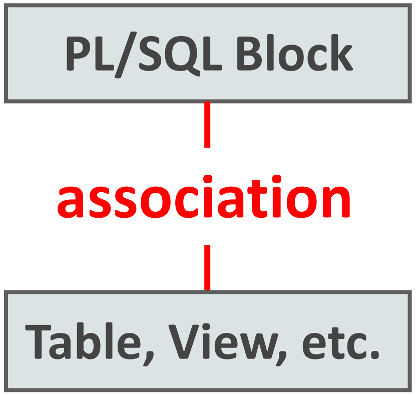
```
CREATE OR REPLACE TRIGGER log_sal_change_trigg
AFTER UPDATE OF salary ON employees
BEGIN
  INSERT INTO log_table (user_id, logon_date)
    VALUES (USER, SYSDATE);
END;
```

- You say that the trigger automatically fires (that is, executes) whenever the triggering event (updating a salary) occurs.
- Cause and effect: The event occurs, and the trigger fires.

What Is a Trigger?

A database trigger:

- Is a PL/SQL block associated with a specific action (an event) such as a successful logon by a user, or an action taken on a database object such as a table or view
- Executes automatically whenever the associated action occurs
- Is stored in the database
- In the example on the previous slide, the trigger is associated with this action: UPDATE OF salary ON employees



Database Triggers Compared to Application Triggers

- Database triggers execute automatically whenever a data event (such as DML or DDL) or a system event (such as a user connecting or the DBA shutting down the database) occurs on a schema or database.
- Database triggers are created and stored in the database just like PL/SQL procedures, functions, and packages.
- Application triggers execute whenever a particular event occurs within an application.
- They may lead to a database event, but they are not part of the database.

Which Events Can Cause a Database Trigger to Fire?

The following events in the database can cause a trigger to fire:

- DML operations on a table
- DML operations on a view, with an INSTEAD OF trigger
- DDL statements, such as CREATE and ALTER
- Database system events, such as when a user logs on or the DBA shuts down the database

Possible Uses for Triggers

You can use triggers to:

- Enhance complex database security rules
- Create auditing records automatically
- Enforce complex data integrity rules
- Create logging records automatically
- Prevent tables from being accidentally dropped
- Prevent invalid DML transactions from occurring

Possible Uses for Triggers

You can use triggers to:

- Generate derived column values automatically
- Maintain synchronous table replication
- Gather statistics on table access
- Modify table data when DML statements are issued against views

Example 1: Creating Logging Records Automatically

- The Database Administrator wants to keep an automatic record (in a database table) of who logs onto the database, and when.
- He/she could create the log table and a suitable trigger as follows:

```
CREATE TABLE log_table (
  user_id         VARCHAR2(30),
  logon_date      DATE);

CREATE OR REPLACE TRIGGER logon_trigg
AFTER LOGON ON DATABASE
BEGIN
  INSERT INTO log_table (user_id, logon_date)
    VALUES (USER, SYSDATE);
END;
```

Example 2: Enforcing Complex Data Integrity Rules

Imagine a business rule that states no employee’s job can be changed to a job that the employee has already done in the past.

```
CREATE OR REPLACE TRIGGER check_sal_trigg
BEFORE UPDATE OF job_id ON employees
FOR EACH ROW
DECLARE
  v_job_count     INTEGER;
BEGIN
  SELECT COUNT(*) INTO v_job_count
    FROM job_history
    WHERE employee_id = :OLD.employee_id
    AND job_id = :NEW.job_id;
  IF v_job_count > 0 THEN
    RAISE_APPLICATION_ERROR
      (-20201,'This employee has already done this job');
  END IF;
END;
```

Guidelines for Triggers

- Do not define triggers to duplicate or replace actions you can do easily in other ways.
- For example, implement simple data integrity rules using constraints, not triggers.
- Excessive use of triggers can result in complex interdependencies, which can be difficult to maintain.
- Use triggers only when necessary and be aware of recursive and cascading effects.
- Avoid lengthy trigger logic by creating stored procedures or packaged procedures that are invoked in the trigger body.

Comparison of Database Triggers and Stored Procedures

Triggers	Procedures
Defined with CREATE TRIGGER	Defined with CREATE PROCEDURE
Data Dictionary contains source code in USER_TRIGGERS	Data Dictionary contains source code in USER_SOURCE
Implicitly invoked	Explicitly invoked
COMMIT, SAVEPOINT, and ROLLBACK are not allowed	COMMIT, SAVEPOINT, and ROLLBACK are allowed

Terminology

Key terms used in this lesson included:

- Application triggers
- Database triggers
- Triggers

Summary

In this lesson, you should have learned how to:

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