



DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING

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Experiment - 7

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1. Aim:

MEDIUM LEVEL PROBLEM:

Design a PostgreSQL trigger such that whenever an insertion occurs on the *student* table, the currently inserted or deleted row details (ID, Name, Age, Class) should be printed exactly as they are in the output console.

HARD LEVEL PROBLEM:

Design a PostgreSQL trigger system where:

- When a new employee is inserted into *tbl_employee*, a record is added to *tbl_employee_audit* with the message:
“Employee name <emp_name> has been added at <current_time>”.
- When an employee is deleted from *tbl_employee*, a record is added to *tbl_employee_audit* with the message:
“Employee name <emp_name> has been deleted at <current_time>”.

2. Objective:

- To understand the concept and working of triggers in PostgreSQL.
- To learn how to create and implement trigger functions using PL/pgSQL.
- To utilize OLD and NEW records for handling row data before and after triggering events.
- To design automated auditing systems using triggers for data changes like INSERT and DELETE.

3. Theory:

A trigger in PostgreSQL is a special function that is automatically executed or fired in response to certain events on a table or view. These events can be **INSERT**, **UPDATE**, **DELETE**, or **TRUNCATE** operations. Triggers help automate tasks, maintain data integrity, and perform complex business logic directly within the database.

In PostgreSQL, a trigger function is written in the **PL/pgSQL** language and is always associated with a table. The trigger function executes each time the specified event occurs on that table. There are two main types of triggers based on their timing: **BEFORE** triggers and **AFTER** triggers.

- A **BEFORE** trigger executes before the event occurs and can be used to validate or modify data.
- An **AFTER** trigger executes after the event has occurred and is often used for logging, auditing, or maintaining related tables.

Triggers can also be defined as **ROW-level** or **STATEMENT-level**. A **ROW-level** trigger fires once for each affected row, whereas a **STATEMENT-level** trigger executes once per SQL statement, regardless of how many rows are affected.

4. Procedure:

Medium Level Solution:

- Create or verify the student table with columns id (auto-generated), name, age, and class so the inserted row has an id available.
- Write a PL/pgSQL trigger function fn_student_audit() that checks TG_OP and uses RAISE NOTICE to print NEW.* on INSERT and OLD.* on DELETE, returning NEW for INSERT and OLD for DELETE.
- Create an AFTER trigger on student for INSERT OR DELETE, FOR EACH ROW, executing fn_student_audit() so a message is emitted for each affected row.
- Test by inserting and deleting a row from student; ensure client_min_messages allows NOTICE to display in your client.

Hard Level Solution:

- Create or verify the student table with columns id (auto-generated), name, age, and class so the inserted row has an id available.
- Write a PL/pgSQL trigger function fn_student_audit() that checks TG_OP and uses RAISE NOTICE to print NEW.* on INSERT and OLD.* on DELETE, returning NEW for INSERT and OLD for DELETE.
- Create an AFTER trigger on student for INSERT OR DELETE, FOR EACH ROW, executing fn_student_audit() so a message is emitted for each affected row.
- Test by inserting and deleting a row from student; ensure client_min_messages allows NOTICE to display in your client.

5. Code:

-- Experiment - 7 (Medium Level Problem)

```
CREATE TABLE IF NOT EXISTS student (
```

```
    id SERIAL PRIMARY KEY,
```

```
    name VARCHAR(100),
```

```
    age INT,
```

```
    class VARCHAR(20)
```

```
);
```

```
CREATE OR REPLACE FUNCTION fn_student_audit()
```

```
RETURNS TRIGGER
```

```
LANGUAGE plpgsql
```

```
AS $$
```

```
BEGIN
```

```
    IF TG_OP = 'INSERT' THEN
```

```
        RAISE NOTICE 'Inserted Row -> ID: %, Name: %, Age: %, Class: %',
```

```
            NEW.id, NEW.name, NEW.age, NEW.class;
```

```
    RETURN NEW;
```

```
ELSIF TG_OP = 'DELETE' THEN
```

```
    RAISE NOTICE 'Deleted Row -> ID: %, Name: %, Age: %, Class: %',
```

```

        OLD.id, OLD.name, OLD.age, OLD.class;

    RETURN OLD;

END IF;


RETURN NULL;

END;

$$;


DROP TRIGGER IF EXISTS trg_student_audit ON student;


CREATE TRIGGER trg_student_audit
AFTER INSERT OR DELETE
ON student
FOR EACH ROW
EXECUTE FUNCTION fn_student_audit();


-- Insert

INSERT INTO student (name, age, class) VALUES ('Priyanka', 20, '11th');


-- Delete

DELETE FROM student WHERE name = 'Priyanka';


-- Experiment - 7 (Hard Level Solution)

DROP TABLE IF EXISTS tbl_employee_audit;

DROP TABLE IF EXISTS tbl_employee;

CREATE TABLE IF NOT EXISTS tbl_employee (

```

```
emp_id SERIAL PRIMARY KEY,  
emp_name VARCHAR(100) NOT NULL,  
emp_salary NUMERIC  
);
```

```
CREATE TABLE IF NOT EXISTS tbl_employee_audit (  
sno SERIAL PRIMARY KEY,  
message TEXT NOT NULL  
);
```

```
CREATE OR REPLACE FUNCTION audit_employee_changes()  
RETURNS TRIGGER  
LANGUAGE plpgsql  
AS $$  
BEGIN  
IF TG_OP = 'INSERT' THEN  
INSERT INTO tbl_employee_audit(message)  
VALUES ('Employee name ' || NEW.emp_name || ' has been added at ' ||  
NOW());  
RETURN NEW;  
  
ELSIF TG_OP = 'DELETE' THEN  
INSERT INTO tbl_employee_audit(message)  
VALUES ('Employee name ' || OLD.emp_name || ' has been deleted at ' ||  
NOW());  
RETURN OLD;  
END IF;
```

```
RETURN NULL;
```

```
END;
```

```
$$;
```

```
DROP TRIGGER IF EXISTS trg_employee_audit ON tbl_employee;
```

```
CREATE TRIGGER trg_employee_audit
```

```
AFTER INSERT OR DELETE
```

```
ON tbl_employee
```

```
FOR EACH ROW
```

```
EXECUTE FUNCTION audit_employee_changes();
```

```
-- Insert and verify audit
```

```
INSERT INTO tbl_employee (emp_name, emp_salary) VALUES ('Priyanka', 50000);
```

```
SELECT * FROM tbl_employee_audit;
```

```
-- Delete and verify audit
```

```
DELETE FROM tbl_employee WHERE emp_name = 'Priyanka';
```

```
SELECT * FROM tbl_employee_audit;
```

6. Output:

Data Output	Messages	Notifications
Showing rows: 1 to 2		
	sno [PK] integer	message text
1	1	Employee name Priyanka has been added at 2025-11-05 14:27:50.35425+05:...
2	2	Employee name Priyanka has been deleted at 2025-11-05 14:27:50.35425+05:...

```
19 FIRST TG_OP = 'DELETE' THEN
```

Data Output Messages Notifications

```
NOTICE: trigger "trg_student_audit" for relation "student" does not exist, skipping
NOTICE: Inserted Row -> ID: 1, Name: Priyanka, Age: 20, Class: 11th
NOTICE: Deleted Row -> ID: 1, Name: Priyanka, Age: 20, Class: 11th
DELETE 1
```

7. Learning Outcomes:

- Explain what PostgreSQL triggers are, when they fire (INSERT, UPDATE, DELETE, TRUNCATE), and how timing types (BEFORE vs AFTER) affect behavior and use cases.
- Implement PL/pgSQL trigger functions that correctly use TG_OP along with NEW and OLD records to access row states for different events.
- Create and bind row-level triggers to tables using CREATE TRIGGER with the proper timing, events, and FOR EACH ROW vs FOR EACH STATEMENT semantics.
- Build practical auditing solutions: emit RAISE NOTICE messages showing affected row data, and persist human-readable audit logs to an audit table on INSERT and DELETE.
- Enforce business rules with BEFORE triggers to validate or block operations, and use RETURN NEW/OLD or NULL appropriately to allow or prevent changes.
- Test and troubleshoot triggers end-to-end, including verifying NOTICE visibility and confirming audit entries after DML operations.