DEPARTMENT OF
COMPUTER SCIENCE & ENGINEERING

CHANDIGARH UNIVERSITY

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Experiment - 7

Student Name: Ashlin James Chakkalakkal **UID:** 23BAI70722

Branch: BE-AIT-CSE **Section/Group:** 23AIT_KRG-G1_A

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Subject Name: ADBMS **Subject Code:** 23CSP-333

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:

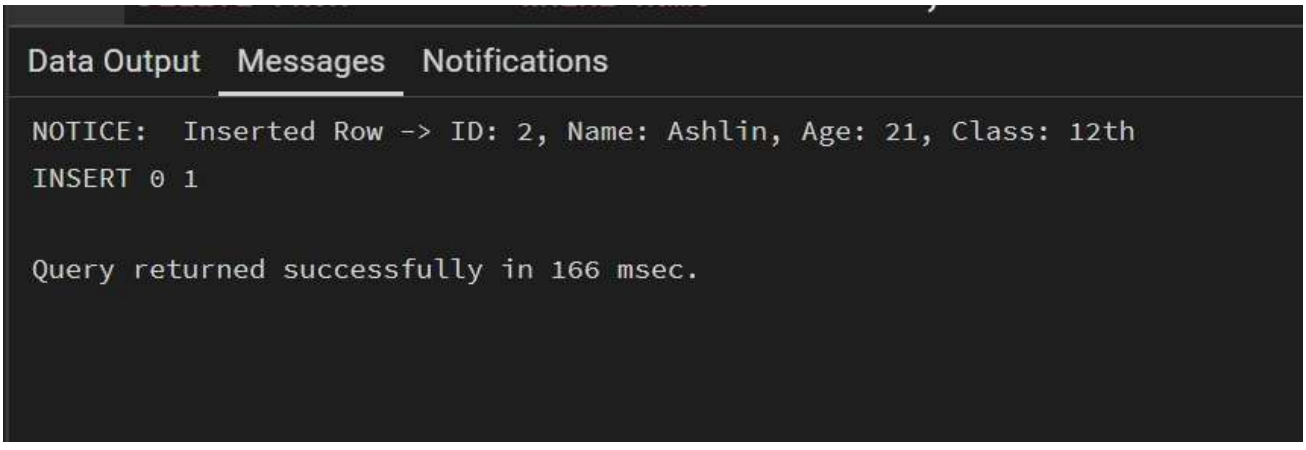
- Create or verify the student table with columns id (auto-generated), name, age, and class so the inserted row has an id available.
- Write a PL/pgSQL trigger function fn_student_audit() that checks TG_OP and uses RAISE NOTICE to print NEW.* on INSERT and OLD.* on DELETE, returning NEW for INSERT and 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.

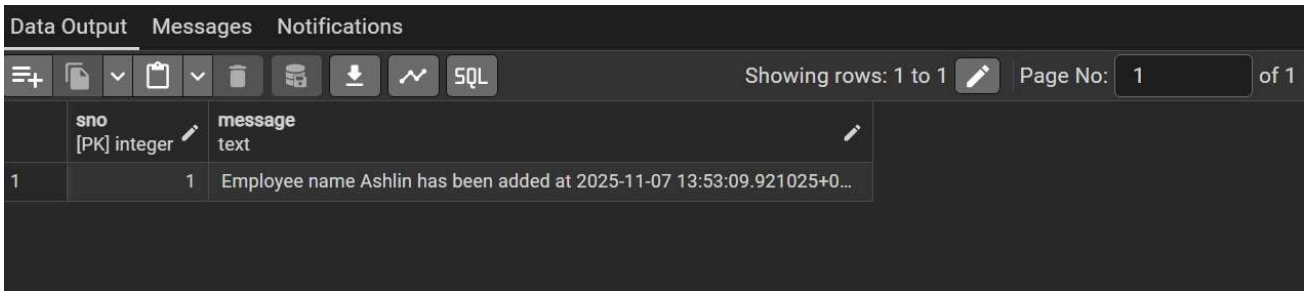
5. Code:

```
                -----Experiment 7 (Medium Level Solution)-----
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 ('Ashlin', 21, '12th');


-- Delete
DELETE FROM student WHERE name = 'Ashlin';


                -----Experiment 7 (Hard Level Solution)-----

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 ('Ashlin', 40000);
SELECT * FROM tbl_employee_audit;

-- Delete and verify audit
DELETE FROM tbl_employee WHERE emp_name = 'Ashlin';
SELECT * FROM tbl_employee_audit;
```

6. Output:





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.