

Ex.No.: 13

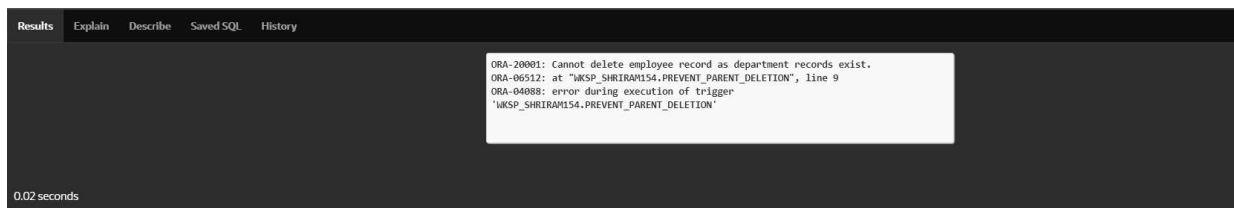
WORKING WITH TRIGGERS

Program 1

Write a code in PL/SQL to develop a trigger that enforces referential integrity by preventing the deletion of a parent record if child records exist.

```
CREATE OR REPLACE TRIGGER prevent_parent_deletion
BEFORE DELETE ON employees
FOR EACH ROW
DECLARE
    pl_dept_count NUMBER;
BEGIN
    SELECT COUNT(*)
    INTO pl_dept_count
    FROM department
    WHERE dept_id = :OLD.employee_id;
    IF pl_dept_count > 0 THEN
        RAISE_APPLICATION_ERROR(-20001, 'Cannot delete employee record as
department records exist.');
```

DELETE FROM employees
WHERE employee_id = 70;



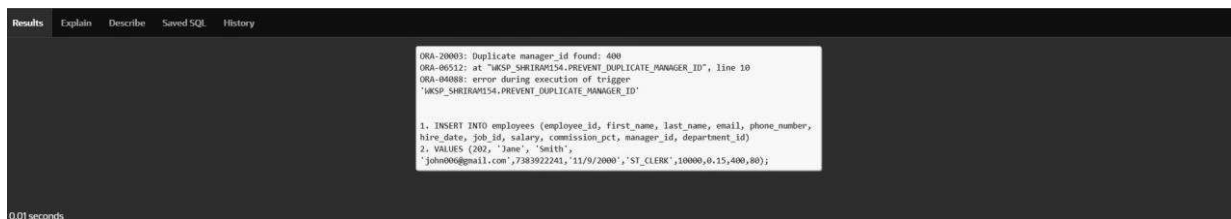
The screenshot shows the 'Results' tab in SQL Developer. It displays an error message in a white box on a dark background. The error message is: 'ORA-20001: Cannot delete employee record as department records exist. ORA-06512: at "WKSP_SHRIRAM154.PREVENT_PARENT_DELETION", line 9 ORA-04088: error during execution of trigger "WKSP_SHRIRAM154.PREVENT_PARENT_DELETION"'. Below the error message, it says '0.02 seconds'.

Program 2

Write a code in PL/SQL to create a trigger that checks for duplicate values in a specific column and raises an exception if found.

```
CREATE OR REPLACE TRIGGER prevent_duplicate_manager_id
BEFORE INSERT OR UPDATE ON employees
FOR EACH ROW
DECLARE
    pl_count NUMBER;
BEGIN
    SELECT COUNT(*)
    INTO pl_count
    FROM employees
    WHERE manager_id = :NEW.manager_id
    AND employee_id != :NEW.employee_id;
    IF pl_count > 0 THEN
        RAISE_APPLICATION_ERROR(-20003, 'Duplicate manager_id found: ' ||
:NEW.manager_id);
    END IF;
END;
```

```
INSERT INTO employees (employee_id, first_name, last_name, email, phone_number,
hire_date, job_id, salary, commission_pct, manager_id, department_id)
VALUES (202, 'Jane', 'Smith',
'john006@gmail.com', 7383922241, '11/9/2000', 'ST_CLERK', 10000, 0.15, 400, 80);
```

A screenshot of a SQL IDE interface. The top bar has tabs for 'Results', 'Explain', 'Describe', 'Saved SQL', and 'History'. The main area displays an error message in a white box on a dark background. The error message is: 'ORA-20003: Duplicate manager_id found: 400', 'ORA-00512: at "WSP_SHRIRAM154.PREVENT_DUPLICATE_MANAGER_ID", line 10', 'ORA-04088: error during execution of trigger', 'WSP_SHRIRAM154.PREVENT_DUPLICATE_MANAGER_ID'. Below the error message, the SQL statement being executed is shown: '1. INSERT INTO employees (employee_id, first_name, last_name, email, phone_number, hire_date, job_id, salary, commission_pct, manager_id, department_id) 2. VALUES (202, 'Jane', 'Smith', 'john006@gmail.com', 7383922241, '11/9/2000', 'ST_CLERK', 10000, 0.15, 400, 80);'. At the bottom left, it says '0.01 seconds'.

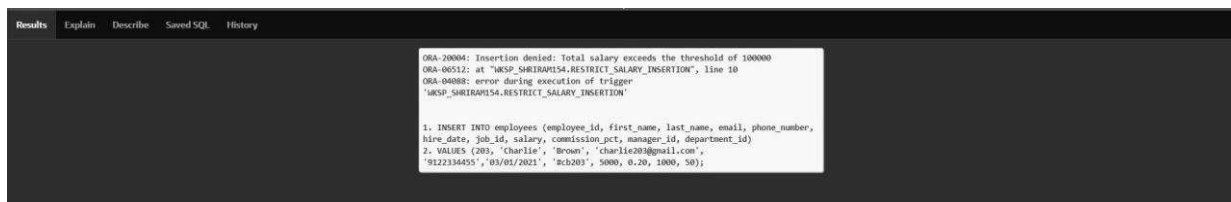
Program 3

Write a code in PL/SQL to create a trigger that restricts the insertion of new rows if the total of a column's values exceeds a certain threshold.

```
CREATE OR REPLACE TRIGGER restrict_salary_insertion
BEFORE INSERT ON employees
FOR EACH ROW
DECLARE
    total_salary NUMBER;
    threshold NUMBER := 100000;
BEGIN

    SELECT SUM(salary)
    INTO total_salary
    FROM employees;
    IF (total_salary + :NEW.salary) > threshold THEN
        RAISE_APPLICATION_ERROR(-20004, 'Insertion denied: Total salary exceeds the
threshold of ' || threshold);
    END IF;
END;
```

```
INSERT INTO employees (employee_id, first_name, last_name, email, phone_number,
hire_date, job_id, salary, commission_pct, manager_id, department_id)
VALUES (203, 'Charlie', 'Brown', 'charlie203@gmail.com', '9122334455', '03/01/2021',
'#cb203', 5000, 0.20, 1000, 50);
```

A screenshot of the SQL Developer interface. The top bar shows tabs for 'Results', 'Explain', 'Describe', 'Saved SQL', and 'History'. The main window displays an error message in a white box against a dark background. The error message is: 'ORA-20004: Insertion denied: total salary exceeds the threshold of 100000 ORA-00512: at "/>

PROGRAM 4

Write a code in PL/SQL to design a trigger that captures changes made to specific columns and logs them in an audit table.

```
CREATE OR REPLACE TRIGGER audit_changes
AFTER UPDATE OF salary, job_id ON employees
FOR EACH ROW
BEGIN
    IF :OLD.salary != :NEW.salary OR :OLD.job_id != :NEW.job_id THEN
        INSERT INTO employee_audit (
            employee_id,
            old_salary,
            new_salary,
            old_job_title,
            new_job_title,
            change_timestamp,
            changed_by
        ) VALUES (
            :OLD.employee_id,
            :OLD.salary,
            :NEW.salary,
            :OLD.job_id,
            :NEW.job_id,
            SYSTIMESTAMP,
            USER
        );
    END IF;
END;
```

```
UPDATE employees
SET salary = 55000, job_id = 'ST_CLERK'
WHERE employee_id = 176;
```

```
SELECT * FROM employee_audit;
```

AUDIT_ID	EMPLOYEE_ID	OLD_SALARY	NEW_SALARY	OLD_JOB_ID	NEW_JOB_ID	CHANGE_TIMESTAMP	CHANGED_BY
1	20	50000	55000	manager	manager	15-OCT-24 10.00.00.000000 AM	admin
2	122	60000	65000	Manager	Manager	15-OCT-24 10.15.00.000000 AM	admin
5	27	45000	47000	Analyst	Senior Analyst	15-OCT-24 10.30.00.000000 AM	user1
22	176	7500	55000	#ce005	ST_CLERK	16-OCT-24 04.25.06.252580 PM	APEX_PUBLIC_USER
3	9	70000	75000	Senior Developer	Lead Developer	15-OCT-24 10.45.00.000000 AM	user2
4	4	80000	85000	Team Lead	Project Manager	15-OCT-24 11.00.00.000000 AM	admin

6 rows returned in 0.00 seconds [Download](#)

PROGRAM 5

Write a code in PL/SQL to implement a trigger that records user activity (inserts, updates, deletes) in an audit log for a given set of tables.

```
CREATE OR REPLACE TRIGGER trg_audit_employees
AFTER INSERT OR UPDATE OR DELETE ON employees
FOR EACH ROW
DECLARE
    v_old_values CLOB;
    v_new_values CLOB;
BEGIN
    IF INSERTING THEN
        v_old_values := NULL;
        v_new_values := 'employee_id: ' || :NEW.employee_id || ', ' ||
            'first_name: ' || :NEW.first_name || ', ' ||
            'salary: ' || :NEW.salary;

        INSERT INTO audit_log (action, table_name, record_id, changed_by, new_values)
        VALUES ('INSERT', 'employees', :NEW.employee_id, USER, v_new_values);

    ELSIF UPDATING THEN
        v_old_values := 'employee_id: ' || :OLD.employee_id || ', ' ||
            'first_name: ' || :OLD.first_name || ', ' ||
            'salary: ' || :OLD.salary;
        v_new_values := 'employee_id: ' || :NEW.employee_id || ', ' ||
            'first_name: ' || :NEW.first_name || ', ' ||
            'salary: ' || :NEW.salary;

        INSERT INTO audit_log (action, table_name, record_id, changed_by, old_values,
new_values)
        VALUES ('UPDATE', 'employees', :NEW.employee_id, USER, v_old_values,
v_new_values);

    ELSIF DELETING THEN
        v_old_values := 'employee_id: ' || :OLD.employee_id || ', ' ||
            'first_name: ' || :OLD.first_name || ', ' ||
            'salary: ' || :OLD.salary;
        v_new_values := NULL;

        INSERT INTO audit_log (action, table_name, record_id, changed_by, old_values)
        VALUES ('DELETE', 'employees', :OLD.employee_id, USER, v_old_values);
    END IF;
END trg_audit_employees;
```

```
INSERT INTO employees (employee_id, first_name, salary)
VALUES (3, 'Ball', 50000);
```

Results	Explain	Describe	Saved SQL	History
1 row(s) inserted.				
0.12 seconds				

```
UPDATE employees
SET salary = 55000
WHERE employee_id = 3;
```

1 row(s) updated.				
0.06 seconds				

```
DELETE FROM employees
WHERE employee_id = 3;
```

```
SELECT * FROM audit_log;
```

AUDIT_ID	ACTION	TABLE_NAME	RECORD_ID	CHANGED_BY	CHANGE_TIMESTAMP	OLD_VALUES	NEW_VALUES
1	INSERT	employees	3	APEX_PUBLIC_USER	16-OCT-24 04:39:17/957308 PM	-	employee_id: 3, first_name: Ball, salary: 50000
3	DELETE	employees	3	APEX_PUBLIC_USER	16-OCT-24 04:41:49/077471 PM	employee_id: 3, first_name: Ball, salary: 55000	-
2	UPDATE	employees	3	APEX_PUBLIC_USER	16-OCT-24 04:40:03/93035 PM	employee_id: 3, first_name: Ball, salary: 50000	employee_id: 3, first_name: Ball, salary: 55000

3 rows returned in 0.00 seconds [Download](#)

PROGRAM 6

Write a code in PL/SQL to implement a trigger that automatically calculates and updates a running total column for a table whenever new rows are inserted.

```
CREATE TABLE transactions (  
    transaction_id NUMBER PRIMARY KEY,  
    amount NUMBER,  
    running_total NUMBER  
);  
  
CREATE OR REPLACE TRIGGER update_running_total  
FOR INSERT ON transactions  
COMPOUND TRIGGER  
  
    TYPE amount_array IS TABLE OF NUMBER INDEX BY PLS_INTEGER;  
    new_amounts amount_array;  
  
    BEFORE EACH ROW IS  
    BEGIN  
        new_amounts(:NEW.transaction_id) := :NEW.amount;  
    END BEFORE EACH ROW;  
  
    AFTER STATEMENT IS  
    BEGIN  
        DECLARE  
            v_total NUMBER;  
        BEGIN  
            SELECT NVL(MAX(running_total), 0)  
            INTO v_total  
            FROM transactions;  
  
            FOR i IN new_amounts.FIRST .. new_amounts.LAST LOOP  
                v_total := v_total + new_amounts(i);  
                UPDATE transactions  
                SET running_total = v_total  
                WHERE transaction_id = i;  
            END LOOP;  
        END;  
    END AFTER STATEMENT;  
  
END update_running_total;  
  
INSERT INTO transactions (transaction_id, amount)
```

VALUES (1, 10000);

INSERT INTO transactions (transaction_id, amount)
VALUES (2, 20000);

Results Explain Describe Saved SQL History		
TRANSACTION_ID	AMOUNT	RUNNING_TOTAL
1	10000	10000
2	20000	30000
2 rows returned in 0.01 seconds Download		

PROGRAM 7

Write a code in PL/SQL to create a trigger that validates the availability of items before allowing an order to be placed, considering stock levels and pending orders.

```
CREATE TABLE inventory (  
    item_id NUMBER PRIMARY KEY,  
    item_name VARCHAR2(100),  
    stock_level NUMBER  
);
```

```
CREATE TABLE orders (  
    order_id NUMBER PRIMARY KEY,  
    item_id NUMBER,  
    quantity NUMBER,  
    order_status VARCHAR2(20),  
    CONSTRAINT fk_item FOREIGN KEY (item_id) REFERENCES inventory(item_id)  
);
```

```
CREATE OR REPLACE TRIGGER validate_stock_before_order  
BEFORE INSERT ON orders  
FOR EACH ROW  
DECLARE  
    v_stock_level NUMBER;  
    v_pending_orders NUMBER;  
BEGIN  
    SELECT stock_level  
    INTO v_stock_level  
    FROM inventory  
    WHERE item_id = :NEW.item_id;  
    SELECT NVL(SUM(quantity), 0)  
    INTO v_pending_orders  
    FROM orders  
    WHERE item_id = :NEW.item_id  
    AND order_status = 'Pending';  
    IF (:NEW.quantity + v_pending_orders) > v_stock_level THEN  
        RAISE_APPLICATION_ERROR(-20001, 'Insufficient stock for item: ' || :NEW.item_id);  
    END IF;  
END;
```

INSERT INTO orders (order_id, item_id, quantity, order_status)
VALUES (1, 101, 5, 'Pending');

```
1 row(s) inserted.  
  
0.03 seconds
```

INSERT INTO orders (order_id, item_id, quantity, order_status)
VALUES (2, 103, 20, 'Pending');

ITEM_ID	ITEM_NAME	STOCK_LEVEL
101	hp_laptop	10
102	keyboard	20
105	mouse	15
rows returned in 0.01 seconds Download		

ORDER_ID	ITEM_ID	QUANTITY	ORDER_STATUS
1	101	5	Pending
1 rows returned in 0.01 seconds Download			