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Cursors

Cursors

- To handle a result set inside a stored procedure, we use a cursor.
- A cursor allows us to iterate a set of rows returned by a query and process each row accordingly.
- The set of rows the cursor holds is referred to as the **active set**.

1. We can declare a cursor by using the DECLARE statement:

```
DECLARE cursor_name CURSOR FOR SELECT_statement;
```

- The cursor declaration must be after any variable declaration.
- A cursor must always be associated with a SELECT statement.

Cursors

2. Next, open the cursor by using the OPEN statement.

```
OPEN cursor_name;
```

3. Then, use the FETCH statement to retrieve the next row pointed by the cursor and move the cursor to the next row in the result set.

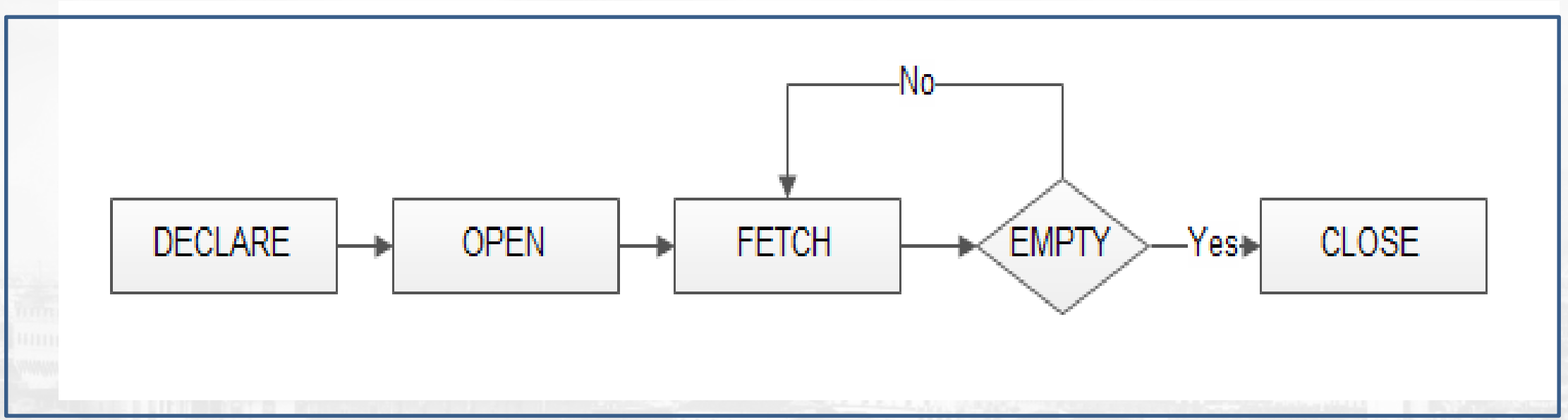
```
FETCH cursor_name INTO variables list;
```

4. Finally, call the CLOSE statement to deactivate the cursor and release the memory associated with it as follows:

```
CLOSE cursor_name;
```

Cursors

The following diagram illustrates how MySQL cursor works.



Example 1 - Cursors

1) **Retrieve employees one by one and print out a list of those employees currently working in the DEPARTMENT_ID = 80**

```
create procedure p_dept()
begin
declare done int default 0;
declare v_eno int;
declare v_ename varchar(10);
declare v_deptno int;
declare c1 cursor for select eno,ename,deptno from employee where deptno=80;
declare continue handler for not found set done =1;
open c1;
repeat
fetch c1 into v_eno,v_ename,v_deptno;
if done=0 then
select v_eno,v_ename,v_deptno;
end if;
until done end repeat;
close c1;
end;

mysql> call p_dept//
+-------+---------+----------+
| v_eno | v_ename | v_deptno |
+-------+---------+----------+
|     1 | Anil    |       80 |
+-------+---------+----------+
1 row in set (0.00 sec)
```

Example 2

2) **Use a cursor to retrieve employee numbers and names from employee table and populate a database table, TEMP_LIST, with this information.**

```
create procedure p_emp()
begin
declare done int default 0;
declare v_eno int;
declare v_ename varchar(10);
declare v_deptno int;
declare c1 cursor for select eno,ename,deptno from employee ;
declare continue handler for not found set done =1;
open c1;
repeat
fetch c1 into v_eno,v_ename,v_deptno;
if done=0 then
insert into temp_list values(v_eno,v_ename,v_deptno);
end if;
until done end repeat;
close c1;
end;

mysql> call p_emp()//
Query OK, 0 rows affected (0.53 sec)

mysql> select * from temp_list//
+------+----------+--------+
| eno  | ename    | deptno |
+------+----------+--------+
|    1 | Anil     |     80 |
|    2 | Anita    |     80 |
|    3 | Sunita   |     80 |
|    4 | Sumita   |     80 |
|    5 | Sushmita |     10 |
+------+----------+--------+
5 rows in set (0.00 sec)
```

Example 3

3. Create a PL/SQL block that determines the top employees with respect to salaries. Accept a number n from the user where n represents the number of top n earners from the EMPLOYEES table. For example, to view the top five earners, enter 5. Test a variety of special cases, such as n = 0 or where n is greater than the number of employees in the EMPLOYEES table. The output shown represents the five highest salaries in the EMPLOYEES table.

Cont..

```
create procedure p_top(v_n int)
begin
declare done int default 0;
declare v_eno int;
declare v_ename varchar(10);
declare v_deptno int;
declare v_salary int;
declare v_cnt int default 0;
declare c1 cursor for select eid,ename,dno,salary from emp order by salary desc;
declare continue handler for not found set done =1;
open c1;
repeat
fetch c1 into v_eno,v_ename,v_deptno,v_salary;
if done=0 AND v_cnt<v_n then
select v_eno,v_ename,v_salary;
end if;
set v_cnt=v_cnt+1;
until done end repeat;
close c1;
end;
```

Example 4

4. **Update all the rows in deptsal simultaneously.**

First, let's reset the totalsalary in deptsal to zero.

```
mysql> update deptsal set totalsalary = 0;
Query OK, 0 rows affected (0.00 sec)
Rows matched: 3  Changed: 0  Warnings: 0

mysql> select * from deptsal;
+---------+-------------+
| dnumber | totalsalary |
+---------+-------------+
|       1 |           0 |
|       2 |           0 |
|       3 |           0 |
+---------+-------------+
3 rows in set (0.00 sec)
```

Cont..

```
mysql> delimiter $$
mysql> drop procedure if exists updateSalary$$
Query OK, 0 rows affected (0.00 sec)

mysql> create procedure updateSalary()
    -> begin
    ->          declare done int default 0;
    ->          declare current_dnum int;
    ->          declare dnumcur cursor for select dnumber from deptsal;
    ->          declare continue handler for not found set done = 1;
    ->
    ->          open dnumcur;
    ->
    ->          repeat
    ->                fetch dnumcur into current_dnum;
    ->                update deptsal
    ->                set totalsalary = (select sum(salary) from employee
    ->                                   where dno = current_dnum)
    ->                where dnumber = current_dnum;
    ->          until done
    ->          end repeat;
    ->
    ->          close dnumcur;
    -> end$$
Query OK, 0 rows affected (0.00 sec)

mysql> delimiter ;
```

Drop the old procedure

Use cursor to iterate the rows

Cont..

- Call procedure :

```
mysql> select * from deptsal;
+---------+-------------+
| dnumber | totalsalary |
+---------+-------------+
|       1 |           0 |
|       2 |           0 |
|       3 |           0 |
+---------+-------------+
3 rows in set (0.01 sec)

mysql> call updateSalary;
Query OK, 0 rows affected (0.00 sec)

mysql> select * from deptsal;
+---------+-------------+
| dnumber | totalsalary |
+---------+-------------+
|       1 |      100000 |
|       2 |       50000 |
|       3 |      130000 |
+---------+-------------+
3 rows in set (0.00 sec)
```

Example 5

5. **Create a procedure to give a rise to all employees**

```
mysql> select * from emp;
+----+--------+---------+--------+------------+------+
| id | name   | superid | salary | bdate      | dno  |
+----+--------+---------+--------+------------+------+
|  1 | john   |       3 | 100000 | 1960-01-01 |    1 |
|  2 | mary   |       3 |  50000 | 1964-12-01 |    3 |
|  3 | bob    |    NULL |  80000 | 1974-02-07 |    3 |
|  4 | tom    |       1 |  50000 | 1978-01-17 |    2 |
|  5 | bill   |    NULL |   NULL | 1985-01-20 |    1 |
|  6 | lucy   |    NULL |  90000 | 1981-01-01 |    1 |
|  7 | george |    NULL |  45000 | 1971-11-11 | NULL |
+----+--------+---------+--------+------------+------+
7 rows in set (0.00 sec)
```

Cont..

```
mysql> delimiter |
mysql> create procedure giveRaise (in amount double)
    -> begin
    ->         declare done int default 0;
    ->         declare eid int;
    ->         declare sal int;
    ->         declare emprec cursor for select id, salary from employee;
    ->         declare continue handler for not found set done = 1;
    ->
    ->         open emprec;
    ->         repeat
    ->                 fetch emprec into eid, sal;
    ->                 update employee
    ->                 set salary = sal + round(sal * amount)
    ->                 where id = eid;
    ->         until done
    ->         end repeat;
    -> end |
Query OK, 0 rows affected (0.00 sec)
```

Cont..

```
mysql> delimiter ;
mysql> call giveRaise(0.1);
Query OK, 0 rows affected (0.00 sec)

mysql> select * from employee;
+----+------+---------+--------+------------+------+
| id | name | superid | salary | bdate      | dno  |
+----+------+---------+--------+------------+------+
|  1 | john |       3 | 110000 | 1960-01-01 |    1 |
|  2 | mary |       3 |  55000 | 1964-12-01 |    3 |
|  3 | bob  |    NULL |  88000 | 1974-02-07 |    3 |
|  4 | tom  |       1 |  55000 | 1978-01-17 |    2 |
|  5 | bill |    NULL |   NULL | 1985-01-20 |    1 |
+----+------+---------+--------+------------+------+
5 rows in set (0.00 sec)
```

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Triggers

Triggers

- A **trigger** is a statement that is executed automatically by the system as a side effect of a modification to the database i.e. when changes are made to the table.
- To monitor a database and take a corrective action when a condition occurs
- Examples:
  - Charge $10 overdraft fee if the balance of an account after a withdrawal transaction is less than $500
  - Limit the salary increase of an employee to no more than 5% raise
- SQL triggers provide an alternative way to check the integrity of data.

Triggering Events and Actions in SQL

- A trigger can be defined to be invoked either before or after the data is changed by **INSERT**, **UPDATE** or **DELETE** .
- MySQL allows you to define maximum six triggers for each table.
  - BEFORE INSERT – activated before data is inserted into the table.
  - AFTER INSERT- activated after data is inserted into the table.
  - BEFORE UPDATE – activated before data in the table is updated.
  - AFTER UPDATE - activated after data in the table is updated.
  - BEFORE DELETE – activated before data is removed from the table.
  - AFTER DELETE – activated after data is removed from the table.

MySQL Trigger Syntax

```
1 CREATE TRIGGER trigger_name trigger_time trigger_event
2  ON table_name
3  FOR EACH ROW
4  BEGIN
5  ...
6  END;
```

Cont..

- In a trigger defined for INSERT, you can use NEW keyword only. You cannot use the OLD keyword.
- However, in the trigger defined for DELETE, there is no new row so you can use the OLD keyword only.
- In the UPDATE trigger, OLD refers to the row before it is updated and NEW refers to the row after it is updated.

Example 1 - Trigger

1. Create a trigger to simulate Recycle Bin for employee table. If any row gets deleted from Emp, same row must get stored in temp_emp

Emp(Eno,Ename,Salary)

temp_emp(Eno,Ename,Salary)

```
create trigger t_bin
before delete on emp for each row
begin
insert into temp_emp values(OLD.eid,OLD.ename,OLD.dno,OLD.salary);
end;

mysql> delete from emp where eid=1//
Query OK, 1 row affected (0.16 sec)

mysql> select * from temp_emp//
+------+-------+------+--------+
| eid  | ename | dno  | salary |
+------+-------+------+--------+
|    1 | Anil  |   10 |  10900 |
+------+-------+------+--------+
1 row in set (0.00 sec)
```

Example 2

2. Create a BEFORE UPDATE trigger that is invoked before a change is made to the table.

Suppose we have created a table named **sales_info** as follows:

```
CREATE TABLE sales_info (
    id INT AUTO_INCREMENT,
    product VARCHAR(100) NOT NULL,
    quantity INT NOT NULL DEFAULT 0,
    fiscalYear SMALLINT NOT NULL,
    CHECK(fiscalYear BETWEEN 2000 and 2050),
    CHECK (quantity >=0),
    UNIQUE(product, fiscalYear),
    PRIMARY KEY(id)
);
```

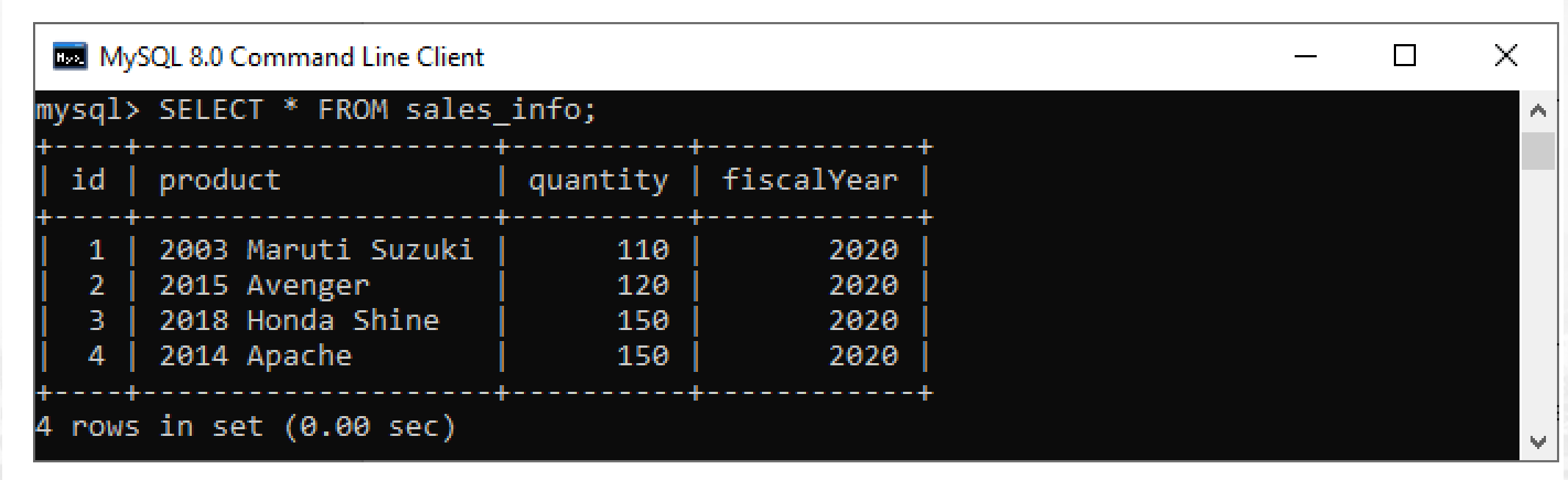
Contd..

Next, we will insert some records into the sales_info table as follows:

```
INSERT INTO sales_info(product, quantity, fiscalYear)
VALUES
    ('2003 Maruti Suzuki',110, 2020),
    ('2015 Avenger', 120,2020),
    ('2018 Honda Shine', 150,2020),
    ('2014 Apache', 150,2020);
```

Contd..

Then, execute the **SELECT statement** to see the table data as follows:



Contd..

Next, we will use a **CREATE TRIGGER** statement to create a BEFORE UPDATE trigger. This trigger is invoked automatically before an update event occurs in the table.

```
DELIMITER $$

CREATE TRIGGER before_update_salesInfo
BEFORE UPDATE
ON sales_info FOR EACH ROW
BEGIN
   DECLARE error_msg VARCHAR(255);
   SET error_msg = ('The new quantity cannot be greater than 2 times the current quantity');
   IF new.quantity > old.quantity * 2 THEN
   SIGNAL SQLSTATE '45000'
   SET MESSAGE_TEXT = error_msg;
   END IF;
END $$

DELIMITER ;
```

Contd..

The trigger produces an error message and stops the updation if we update the value in the quantity column to a new value two times greater than the current value.

First, we can use the following statements that update the quantity of the row whose id = 2:

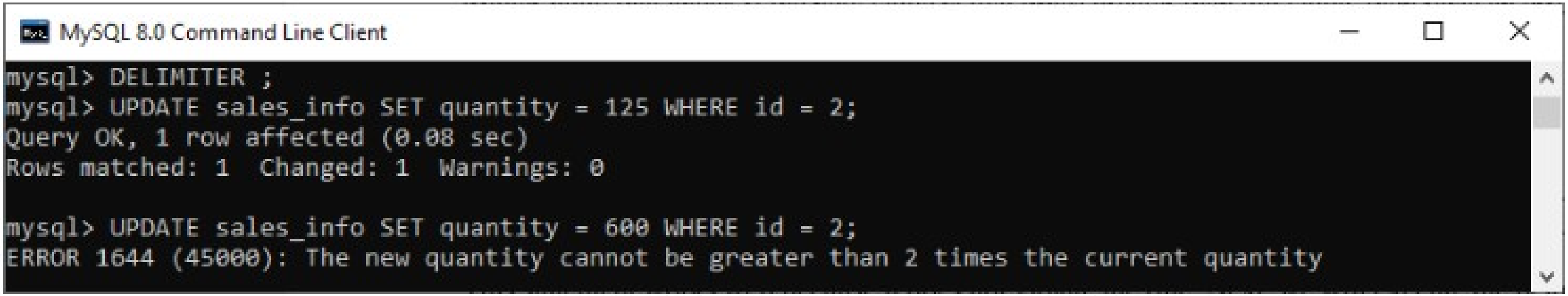
```
mysql> UPDATE sales_info SET quantity = 125 WHERE id = 2;
```

This statement works well because it does not violate the rule. Next, we will execute the below statements that update the quantity of the row as 600 whose id = 2

```
mysql> UPDATE sales_info SET quantity = 600 WHERE id = 2;
```

Contd..

It will give the error as follows because it violates the rule. See the below output.



Example 3

3. We want to create a trigger to update the total salary of a department when a new

```
mysql> select * from employee;
+----+-------+----------+--------+--------------+-------+
| id | name  | superid  | salary | bdate        | dno   |
+----+-------+----------+--------+--------------+-------+
|  1 | john  |        3 | 100000 | 1960-01-01   |     1 |
|  2 | mary  |        3 |  50000 | 1964-12-01   |     3 |
|  3 | bob   |     NULL |  80000 | 1974-02-07   |     3 |
|  4 | tom   |        1 |  50000 | 1970-01-17   |     2 |
|  5 | bill  |     NULL |   NULL | 1985-01-20   |     1 |
+----+-------+----------+--------+--------------+-------+
5 rows in set (0.00 sec)

mysql> select * from deptsal;
+---------+-------------+
| dnumber | totalsalary |
+---------+-------------+
|       1 |      100000 |
|       2 |       50000 |
|       3 |      130000 |
+---------+-------------+
3 rows in set (0.00 sec)
```

Cont..

Create a trigger to update the total salary of a department when a new employee is hired.

```
mysql> delimiter !
mysql> create trigger update_salary
    -> after insert on employee
    -> for each row
    -> begin
    ->       if new.dno is not null then
    ->           update deptsal
    ->           set totalsalary = totalsalary + new.salary
    ->           where dnumber = new.dno;
    ->       end if;
    -> end !
Query OK, 0 rows affected (0.06 sec)

mysql> delimiter ;
```

- The keyword “new” refers to the new row inserted

Cont..

```
mysql> select * from deptsal;
+---------+-------------+
| dnumber | totalsalary |
+---------+-------------+
|       1 |      100000 |
|       2 |       50000 |
|       3 |      130000 |
+---------+-------------+
3 rows in set (0.00 sec)

mysql> insert into employee values (6,'lucy',null,90000,'1981-01-01',1);
Query OK, 1 row affected (0.08 sec)

mysql> select * from deptsal;
+---------+-------------+
| dnumber | totalsalary |
+---------+-------------+
|       1 |      190000 |
|       2 |       50000 |
|       3 |      130000 |
+---------+-------------+
3 rows in set (0.00 sec)

mysql> insert into employee values (7,'george',null,45000,'1971-11-11',null);
Query OK, 1 row affected (0.02 sec)

mysql> select * from deptsal;
+---------+-------------+
| dnumber | totalsalary |
+---------+-------------+
|       1 |      190000 |
|       2 |       50000 |
|       3 |      130000 |
+---------+-------------+
3 rows in set (0.00 sec)

mysql> drop trigger update_salary;
Query OK, 0 rows affected (0.00 sec)
```

totalsalary increases by 90K

totalsalary did not change

Trigger

- To list all the triggers we have created: mysql> show triggers;

```
1  SHOW TRIGGERS;
```

Trigger	Event	Table	Statement	Timing	Created	sql_mode	Definer
before_employee_update	UPDATE	employees	BEGIN INSERT INTO employ...	BEFORE	2015-11-14 21:39:09.08	STRICT_TRANS_TABLES,NO_AUTO_CREATE_U...	root@localhost

- To drop a trigger
  mysql> drop trigger <trigger name>