

# Create A Trigger

## Basic form(Triggers on Data Changes)

A trigger is a specification that the database should automatically execute a particular function whenever a certain type of operation is performed.

```
CREATE [ CONSTRAINT ] TRIGGER name { BEFORE | AFTER | INSTEAD OF } { event [ OR ... ] }  
ON table_name  
[ FROM referenced_table_name ]  
[ NOT DEFERRABLE | [ DEFERRABLE ] [ INITIALLY IMMEDIATE | INITIALLY DEFERRED ] ]  
[ REFERENCING { { OLD | NEW } TABLE [ AS ] transition_relation_name } [ ... ] ]  
[ FOR [ EACH ] { ROW | STATEMENT } ]  
[ WHEN ( condition ) ]  
EXECUTE { FUNCTION | PROCEDURE } function_name ( arguments )
```

**Tips:** `event` here could be one of follow

- INSERT
- UPDATE [ OF column\_name [, ...] ]
- DELETE
- TRUNCATE

## Classification

### 1. by location where triggers can be attached to

- tables (partitioned or not)
- views
- foreign tables

### 2. by which trigger affected on

- `row`: With a per-row trigger, the trigger function is invoked **once for each row** that is affected by the statement that fired the trigger
- `statement`: a per-statement trigger is invoked **only once** when an appropriate statement is executed, regardless of the number of rows affected by that statement. In particular, a statement that affects zero rows will still result in the execution of any applicable per-statement triggers

### 3. by whether they fire *before*, *after*, or *instead of* the operation

- `before`:
- `after`:
- `* instead of`: may only be defined on views, and only at row level; they fire immediately as each row in the view is identified as needing to be operated on.

Suitable uses summarizes

when	Event	Row-level	Statement-level
Before	INSERT/UPDATE/DELETE	Tables and foreign tables	Tables, views, and foreign tables
Before	TRUNCATE	-	Tables
AFTER	INSERT/UPDATE/DELETE	Tables and foreign tables	Tables
AFTER	TRUNCATE	-	Tables

## Trigger and Trigger Function

### Experiment 1:

创建trigger function

```
CREATE FUNCTION emp_stamp() RETURNS trigger
AS
$emp_stamp$
    BEGIN
        -- Check that salary are given
        IF NEW.name IS NULL THEN
            RAISE EXCEPTION 'emp_name cannot be null';
        END IF;
        IF NEW.salary IS NULL THEN
            RAISE EXCEPTION '% cannot have null salary', NEW.name;
        END IF;

        -- who works for us when they must pay for it?
        IF NEW.salary < 0 THEN
            RAISE EXCEPTION '% cannot have a negative salary', NEW.name;
        END IF;
    END;
$emp_stamp$ LANGUAGE plpgsql; 步骤语言
```

The trigger function must be defined before the trigger itself can be created. The trigger function must be declared as a function taking no arguments and returning type `trigger`.

The same trigger function can be used for multiple triggers.

The trigger function should be **written in procedure language(PL) or C, could not in pure SQL.**

### Tips:

- First comes trigger function, then triggers
- trigger function : triggers = 1 : n

## Data passed in Trigger procedure

When a PL/pgSQL function is called as a trigger, several special variables are **created automatically in the top-level block**. They are:

Variable	Data type	Detail
NEW	RECORD	variable holding the new database row for <code>INSERT / UPDATE</code> operations in row-level triggers. This variable is null in statement-level triggers and for <code>DELETE</code> operations.
OLD	RECORD	variable holding the old database row for <code>UPDATE/DELETE</code> operations in row-level triggers. This variable is null in statement-level triggers and for <code>INSERT</code> operations.
TG_NAME	name	variable holding the old database row for <code>UPDATE / DELETE</code> operations in row-level triggers. This variable is null in statement-level triggers and for <code>INSERT</code> operations.
TG_WHEN	text	a string of <code>BEFORE</code> , <code>AFTER</code> , or <code>INSTEAD OF</code> , depending on the trigger's definition.
TG_LEVEL	text	a string of either <code>ROW</code> or <code>STATEMENT</code> depending on the trigger's definition.
TG_OP	text	a string of <code>INSERT</code> , <code>UPDATE</code> , <code>DELETE</code> , or <code>TRUNCATE</code> telling for which operation the trigger was fired.

Here we use following tables to be attached to

```
create table dept(  
  id int primary key,  
  name varchar(40),  
  office varchar(40) default 'Nanshan'  
);  
  
insert into dept values(1, '开发部', 'Bao'an');  
insert into dept values(2, '测试部', 'Bao'an');  
insert into dept values(3, '财务部');  
insert into dept values(4, '市场部', 'Bao'an');  
insert into dept values(5, '总经办');  
insert into dept values(6, '生产部', 'Bao'an');  
  
create table emp(  
  id int primary key,  
  name varchar(10),  
  salary numeric(7,2) default 0.0,
```

```
deptId int,
constraint fk_emp3_dept foreign key(deptId) references dept(id)
);
```

```
insert into emp values
    (001, '张三', 15000, 1),
    (002, '李四', 25000, 1),
    (003, '王五', 10000, 2),
    (004, '赵六', 6000, 6),
    (005, '庄七', 5000, 6),
    (006, '郝八', 12000, 3),
    (007, '段九', 7500, 3),
    (008, '殷十', 15000, 4),
    (009, '周一', 15000, 4),
    (010, '范二', 25000, 5),
    (011, '何玲', 15000, 5),
    (012, '李雷', 7000, 6),
    (013, '刘小毛', 4500, 6),
    (014, '张大壮', 6000, 6);
```

## Experiment 2 : Create a trigger function

```
-- record the
CREATE TABLE emp_log(
    operation      char(1)    NOT NULL,
    stamp          timestamp NOT NULL,
    userid         text       NOT NULL,
    level          text       NOT NULL,
    when_trigger   text       NOT NULL,
    id             integer    ,
    name           varchar(10) ,
    salary numeric
);

CREATE OR REPLACE FUNCTION process_emp_check() RETURNS TRIGGER AS $emp_check$
BEGIN
    --
    -- Create a row in emp_audit to reflect the operation performed on emp,
    -- making use of the special variable TG_OP to work out the operation.
    --
    IF (TG_OP = 'DELETE') THEN
        INSERT INTO emp_log SELECT 'D', now(), user, TG_LEVEL, TG_WHEN,
OLD.id, OLD.name, OLD.salary;--
    ELSIF (TG_OP = 'UPDATE') THEN
        INSERT INTO emp_log SELECT 'U', now(), user, TG_LEVEL, TG_WHEN,
NEW.id, NEW.name, NEW.salary;
    ELSIF (TG_OP = 'INSERT') THEN
        INSERT INTO emp_log SELECT 'I', now(), user, TG_LEVEL, TG_WHEN,
NEW.id, NEW.name, NEW.salary;
    END IF;
    RETURN NULL; -- result is ignored since this is an AFTER trigger
END;
$emp_check$ LANGUAGE plpgsql;
```

**Tips** : Row-level triggers fired `BEFORE` can return null to signal the trigger manager to skip the rest of the operation for this row (i.e., subsequent triggers are not fired, and the `INSERT / UPDATE / DELETE` does not occur for this row). If a nonnull value is returned then the operation proceeds with that row value.

**Tips**: You can also return the value of **New** or **Old**.

## Experiment 3: after + each row + table

```
CREATE TRIGGER check_after
  AFTER INSERT OR UPDATE OR DELETE ON emp
  FOR EACH ROW
  EXECUTE FUNCTION process_emp_check();

--test, and see result in emp_log
insert into emp values (017,'贺小山', 7000, 1);
UPDATE emp set salary=8000 where id=017;
delete from emp where id=017;
```

## Experiment 4: before + each row + table

```
CREATE TRIGGER check_before
  BEFORE INSERT OR UPDATE OR DELETE ON emp
  FOR EACH ROW
  EXECUTE FUNCTION process_emp_check();

--test, and see result in emp_log
insert into emp values (017,'贺小山', 7000, 1);
UPDATE emp set salary=8000 where id=017;
delete from emp where id=017;
```

emp中不会出现该条信息 但会有一条before出现在emp\_log :  
所以后两条UPDATE DELETE并未执行 但没有报错

对于一个before trigger来说 function的返回值会有两种可能  
一种是OLD 一种是NEW 则操作可以执行  
但如果是NULL 操作不能执行

```
CREATE TRIGGER check_before_insert
  BEFORE INSERT ON emp
  FOR EACH ROW
  EXECUTE FUNCTION process_emp_check();
```

```
CREATE TRIGGER check_before_update
  BEFORE UPDATE ON emp
  FOR EACH ROW
  EXECUTE FUNCTION process_emp_check();
```

```
CREATE TRIGGER check_before_delete
  BEFORE DELETE ON emp
  FOR EACH ROW
  EXECUTE FUNCTION process_emp_check();
```

```
--test
insert into emp values (017,'贺小山', 7000, 1);
UPDATE emp set salary=8000 where id=017;
delete from emp where id=017;

UPDATE emp set salary=salary*1.2;
```

但如果是after trigger 无论是否为NULL 都可以执行

```
delete from emp where id=013;
```

删除trigger: drop trigger [name] on [table\_name]

## Experiment 5: after + each row + table.col

```
CREATE TRIGGER check_update_col
AFTER UPDATE OF salary ON emp 将trigger施加到一个表的某一行上
FOR EACH ROW
--WHEN (OLD.salary IS DISTINCT FROM NEW.salary)
EXECUTE FUNCTION process_emp_check();

--test
UPDATE emp set deptId = 1 where id=12;
UPDATE emp set salary=salary*1.2 where id=13;
```

## Experiment 6: after + each row + table.col + when, the trigger function is executed when col has in fact changed value

```
CREATE TRIGGER check_update_col_when
AFTER UPDATE OF salary ON emp
FOR EACH ROW
WHEN (OLD.salary IS DISTINCT FROM NEW.salary)
EXECUTE FUNCTION process_emp_check();

--test
UPDATE emp set deptId = 6 where id=12;
UPDATE emp set salary=salary*0.9 where id=13;
```

## Experiment 7: after + each row + table + when, the trigger function is executed when table has in fact changed value, you can test yourself

```
CREATE TRIGGER check_update_col_when
AFTER UPDATE ON emp
FOR EACH ROW
WHEN (OLD.* IS DISTINCT FROM NEW.*)
EXECUTE FUNCTION process_emp_check();
```

## Experiment 8: after + each statement + table

```
CREATE TRIGGER check_after_statement
  AFTER INSERT OR UPDATE OR DELETE ON emp
  FOR EACH STATEMENT
  EXECUTE FUNCTION process_emp_check();

--test
insert into emp values (017,'贺小山', 7000, 1);
UPDATE emp set salary=8000 where id=017;
delete from emp where id=017;

UPDATE emp set salary=salary*1.15; 语句级：处理了多行 但只有一条log
```

## Experiment 9: before + each statement + table

```
CREATE TRIGGER check_before_statement
  BEFORE INSERT OR UPDATE OR DELETE ON emp
  FOR EACH STATEMENT
  EXECUTE FUNCTION process_emp_check();

--test
insert into emp values (017,'贺小山', 7000, 1);
UPDATE emp set salary=8000 where id=017;
delete from emp where id=017;

UPDATE emp set salary=salary*0.95;
```

**Notice:** triggers on view and other situations, please read example in following reference

ref:<http://postgres.cn/docs/11/plpgsql-trigger.html>

## Show Trigger information

You can get trigger's/triggers' information by following query

```
select *
from pg_catalog.pg_trigger;
```

**Tips:** You should carefully determine to delete the function/trigger

# Event Trigger

## Basic Form

```
CREATE EVENT TRIGGER name
  ON event
  [ WHEN filter_variable IN (filter_value [, ... ]) [ AND ... ] ]
  EXECUTE { FUNCTION | PROCEDURE } function_name()
```

## Experiment 10

```
CREATE OR REPLACE FUNCTION event_tr() RETURNS event_trigger AS $$
BEGIN
    RAISE NOTICE 'Operation here: % %', tg_event, tg_tag;
END;
$$ LANGUAGE plpgsql;

CREATE EVENT TRIGGER tr_fun_event ON ddl_command_start EXECUTE FUNCTION
event_tr();

create table test(
    test1 int,
    test2 int
);
drop table test;
```

## classification

- ddl\_command\_start
- ddl\_command\_end
- sql\_drop
- table\_rewrite