Triggers

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What is a Trigger?

- A trigger is a PL/SQL block that is automatically called when certain events occur in the database.
- Triggers can be made to run when rows are inserted, deleted or updated.
- Triggers can be run before or after the action.
- Triggers can be run once per statement or once per row affected.

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General Form of a Trigger

```
CREATE [or REPLACE] TRIGGER trig_name
{BEFORE | AFTER | INSTEAD OF}
{DELETE | INSERT | UPDATE [of column [,
    column] ...] }
    [or {DELETE | INSERT | UPDATE [of column
    [, column] ...]  } ...]

on {table_name | view_name}

[FOR EACH ROW]
[WHEN (condition)]

PL/SQL block
```

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Creating Triggers

- Trigger timing
  - For table: BEFORE, AFTER
  - For view: INSTEAD OF
- Triggering event: INSERT, DELETE or UPDATE (possibly of specific columns)
- On table or view
- Trigger type: Row or statement
- When clause: Restricts when trigger is run
- Trigger body: PL/SQL block

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Before/After/Instead of Trigger

- Trigger timing: When should the trigger fire?
- BEFORE: Execute the trigger body before the triggering DML event on a table.
- AFTER: Execute the trigger body after the triggering DML event on a table.
- INSTEAD OF: Execute the trigger body instead of the the triggering statement. Used for VIEWS that are not otherwise modifiable.

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Row/Statement Trigger

- Should the trigger body execute for each row the statement affects or only once?
- Statement: The trigger body executes once for the triggering event. This is the default.
- Row: The trigger body executes once for each row affected by the triggering event.
- Is it possible that a Statement trigger will run more times than a row trigger?

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Backing Up Data

```
create table sailors(
       sid   number,
       sname VARCHAR2(30),
       rating number check(rating <= 10),
       age number
);
```

```
create table sailors_audit(
       who   varchar2(30),
       when_changed date,
       sid   number,
       old_rating number,
       new_rating number
);
```

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Backing Up Data

```
CREATE or REPLACE TRIGGER
backup_sailors_trig
AFTER UPDATE of Rating on Sailors
FOR EACH ROW WHEN (old.rating < new.rating)
BEGIN

INSERT INTO sailors_audit
VALUES (USER, SYSDATE, :old.sid,
       :old.rating, :new.rating);

END;
/
```

- What happens if update fails?
- Why AFTER Trigger?

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Ensuring Upper Case

```
CREATE or REPLACE TRIGGER sname_trig
BEFORE INSERT or UPDATE of sname
on Sailors
FOR EACH ROW
BEGIN

:new.sname := UPPER(:new.sname);

END;
/
```

- Why BEFORE Trigger?

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Instead Of Trigger

```
create view sailors_reserves as
select sailors.*, reserves.bid, reserves.day
from sailors, reserves
where sailors.sid = reserves.sid;
```

```
CREATE or REPLACE TRIGGER view_trig
INSTEAD OF INSERT
on sailors_reserves
FOR EACH ROW
BEGIN
INSERT INTO sailors values(:new.sname,
:new.sid, :new.rating,:new.age);
INSERT INTO reserves values(:new.sid,
:new.bid, :new.day);
END;
/
```

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Statement Trigger

```
CREATE or REPLACE TRIGGER shabbat_trig
BEFORE INSERT or DELETE or UPDATE
on reserves
DECLARE
    shabbat_exception EXCEPTION;

BEGIN
    if (TO_CHAR (sysdate,'DY')='SAT') then
      raise shabbat_exception;
    end if;

END;
/
```

- What happens if exception is thrown?
- Why BEFORE Trigger?

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Mutating Table

- You cannot select/insert/delete/update a table in a trigger, that is currently being affected by the DML operation
- Such a table (that is currently affected) is said to be "mutating"

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Bad Trigger

```
CREATE or REPLACE TRIGGER mutating_trig
BEFORE DELETE
on reserves
DECLARE
    empty_table_exception EXCEPTION;
    cnt NUMBER;
BEGIN
    SELECT count(*)
    INTO cnt
    FROM reserves;

    if (cnt = 1) then
      raise empty_table_exception;
    end if;
END;
/
```

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Additional Types of Triggers

- Can also define triggers for
  - logging in and off
  - create/drop table events
  - system errors
  - etc.

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