

Nearly Final SQL: Triggers; WITH; Views

Important Midterm Announcement

If your Uni ends in an odd digit (1, 3, 5, 7, 9):

Go to **312 Math** for the Midterm

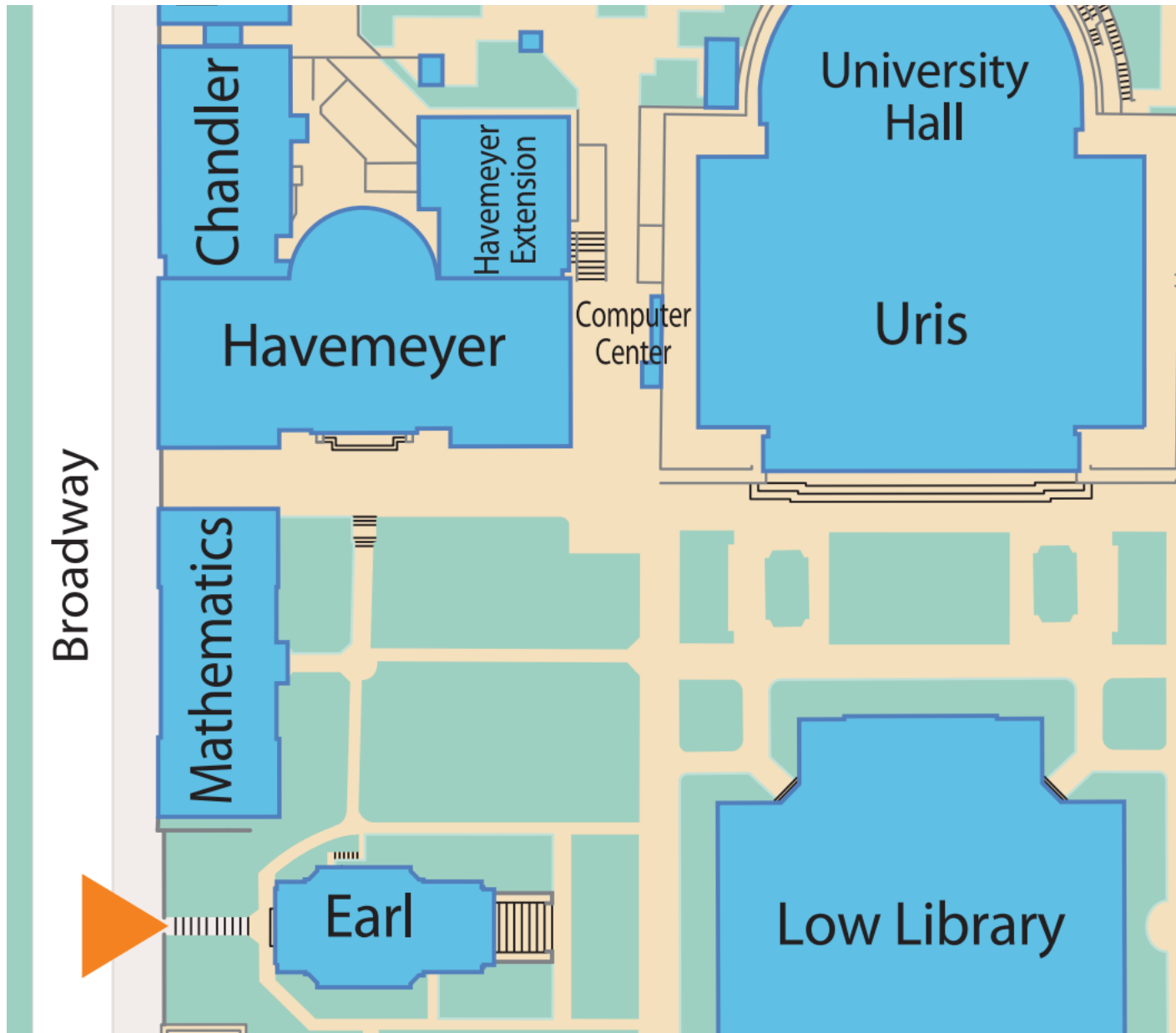
In Math, up stairs, turn right

(This is to give you more space)

Notes: One 8.5x11" sheet, both sides

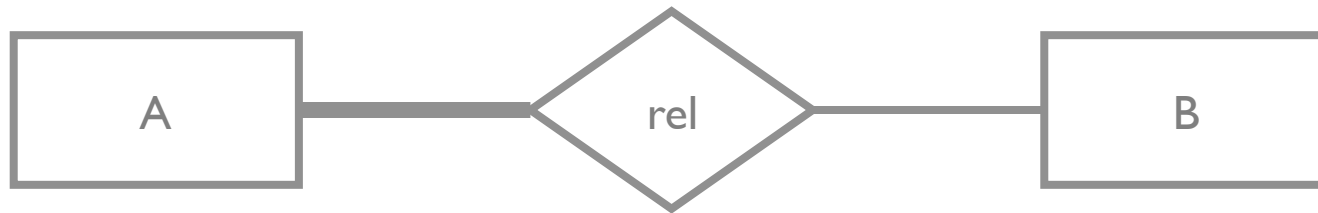
Starts at 8:40 ends at 9:55

Review today and Thursday



Many things we can't express

Nested queries in CHECK constraints



Triggers

Procedure that runs automatically if specified changes in DBMS happen

```
CREATE TRIGGER name
```

Event activates the trigger

Condition tests if triggers should run

Action what to do

Triggers: Uses

Constraints (e.g. at least one)

Copy/fill data based on other tables (e.g. purchase an item; copy the current price into the purchase)

Record history of every update

Triggers: Capabilities

Prevent an insert/update/delete (constraint)

Change the value being updated

Execute arbitrary user defined functions

Triggers

```
CREATE TRIGGER name  
    [BEFORE | AFTER | INSTEAD OF] event_list ON table
```

Event activates the trigger

Condition tests if triggers should run

Action what to do

Triggers

```
CREATE TRIGGER name  
    [BEFORE | AFTER | INSTEAD OF] event_list ON table  
  
    WHEN trigger_qualifications
```

Event activates the trigger

Condition tests if triggers should run

Action what to do

Triggers

```
CREATE TRIGGER name  
    [BEFORE | AFTER | INSTEAD OF] event_list ON table  
    [FOR EACH ROW]  
    WHEN trigger_qualifications  
    EXECUTE PROCEDURE procedure
```

Event activates the trigger

Condition tests if triggers should run

Action what to do

Copy updates into log table

```
CREATE TABLE log(  
    sid int NOT NULL REFERENCES Sailors,  
    t timestamp NOT NULL,  
    oldAge int NOT NULL,  
    newAge int NOT NULL  
);
```

Copy updates into log table

```
CREATE FUNCTION logFunc() RETURNS trigger AS
$$
BEGIN
    INSERT INTO log VALUES
        (NEW.sid, now(), OLD.age, NEW.age);
    RETURN NEW;
END;
$$ LANGUAGE plpgsql;
```

Copy updates into log table

```
CREATE TRIGGER logChanges  
AFTER UPDATE OF age ON Sailors  
FOR EACH ROW EXECUTE PROCEDURE logFunc();
```

Copy updates into log table

sid	t	oldage	newage
1	2016-02-27 18:14:47.792261	22	23

(1 row)

Triggers

Can be complicated to reason about

Triggers may cause other triggers to run (recursive)
(e.g. trigger on sailors inserts into sailors?)

If >1 trigger match an action, which is run first?

¯_(\ツ)_/¯

Arbitrary code: can't be optimized by DB

Triggers vs Constraints

Constraint

Statement about state of database

Doesn't modify the database state

Somewhat “understood” by the database

Triggers

Operational: X should run when Y

Very flexible

Must be executed on every matching statement

WITH (Common Table Expressions)

Large queries can get very complicated

Useful to name parts of these queries

(Rare but useful to know this exists)

WITH

```
WITH RedBoats(bid, count) AS
    (SELECT    B.bid, count(*)
     FROM      Boats B, Reserves R
     WHERE     R.bid = B.bid AND B.color = 'red'
     GROUP BY  B.bid)
SELECT    name, count
FROM      Boats AS B, RedBoats AS RB
WHERE     B.bid = RB.bid AND count < 2
```

Names of unpopular red boats

Views

```
CREATE VIEW view_name  
AS select_statement
```

“tables” defined as query results rather than inserted base data

Development: continue to run old apps

Security: Grant limited access

References to *view_name* replaced with *select_statement*

Similar to WITH, lasts longer than one query

Updates: Tricky (Postgres: not permitted without triggers)

Names of popular boats

```
CREATE VIEW boat_counts
AS SELECT      bid, count(*)
   FROM        Reserves R
   GROUP BY    bid
   HAVING      count(*) > 10
```

Used like a normal table

```
SELECT B.name
FROM   boat_counts bc, Boats B
WHERE  bc.bid = B.bid
```

```
SELECT B.name
FROM
    (SELECT bid, count(*)
     FROM Reserves R
     GROUP BY bid
     HAVING count(*) > 10) bc,
    Boats B
WHERE  bc.bid = B.bid
```

Names of popular boats

Rewritten expanded query

CREATE TABLE AS

Create table from a query

```
CREATE TABLE <table_name> AS  
    <SELECT STATEMENT>
```

```
CREATE TABLE used_boats1 AS  
    SELECT r.bid  
    FROM    Sailors s,  
            Reservations r  
    WHERE   s.sid = r.sid  
  
used_boats1(bid int)
```

```
CREATE TABLE used_boats2 AS  
    SELECT r.bid as foo  
    FROM    Sailors s,  
            Reservations r  
    WHERE   s.sid = r.sid  
  
used_boats2(foo int)
```

How is this different than views?

What if we insert a new record into Reservations?