# Class 6 BigQuery

Elements of Databases

Sep 29, 2023

# Reminder: Midterm 1

- When: Next class (10/06 at 2pm)
- Where: WEL 1.316
- Duration: 90 minutes
- How: On Paper
- Format:
  - T/F section (~12 questions)
  - MC section (~12 questions)
  - Coding section (~5 questions)
- Review session: Tues 10/3 from 3pm - 4pm on Zoom
- Practice Exam: Will be shared on Ed before review session

PAI
GH
POB
WEL
GEB
GDC
WCH

**Exam Rules:**
- Closed book
- No electronic devices
- 1 cheat sheet

## Views

- Return a table of results from a SQL query
- Saved in the database as named query
- Defined by `CREATE VIEW` statement

Employee(empid, fname, lname, job_function, level, title, manager_id, start_date,
salary, dob, ssn, emergency_contact)

```
CREATE VIEW Direct_Manager_Org AS
    SELECT empid, fname, lname, job_function, level, title,
              manager_id, start_date, salary, dob
    FROM Employee
    WHERE manager_id = 'abc'
    ORDER BY empid;
```

```
SELECT empid, fname, lname
FROM Direct_Manager_Org
WHERE start_date < '2020-01-01'
AND title = 'Data Engineer'
```

## What’s wrong with these queries?

Employee(empid, fname, lname, job_function, level, title, manager_id, start_date,
salary, dob, ssn, emergency_contact)

```
CREATE VIEW Director_Org AS
   SELECT empid, fname, lname, job_function, level
   FROM Employee
   WHERE level NOT IN ('SVP', 'VP', 'CEO')
   ORDER BY empid;

 SELECT empid, fname, lname
 FROM Director_Org
 WHERE salary > 300000
 AND level = 'Director';
```

```
CREATE VIEW Senior_Manager_Org AS
   SELECT empid, fname, lname, job_function, level,
           start_date, salary
   FROM Director_Org
   WHERE level != 'Director'
   AND manager_id = 123
   ORDER BY empid;

 SELECT empid, fname, lname
 FROM Senior_Manager_Org
 WHERE start_date < '2020-01-01'
 AND job_function = 'ENG';
```

## Exercise 1: Views

*Create a view named v_enrollments that returns the cno, and the corresponding enrollment count.*

*The view should filter out all classes which have fewer than two students taking them.*

*The view should also sort the records by enrollment count in descending order.*

**Database Schema:**

Student(sid, fname, lname, dob, status)

Class(cno, cname, credits)

Instructor(tid, name, dept)

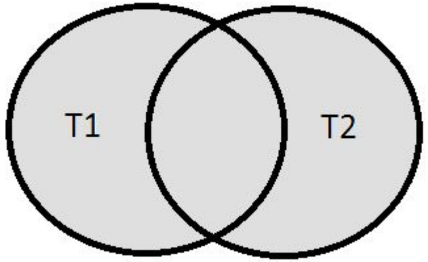
Takes(sid, cno, grade)

Teaches(tid, cno)

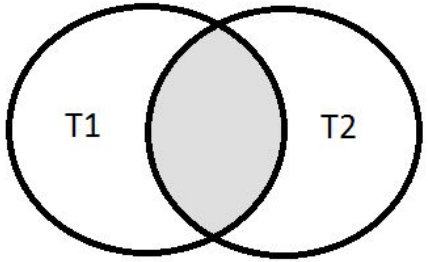
Optional Readings: Chapter 6 from Learning SQL.

## Set Operations

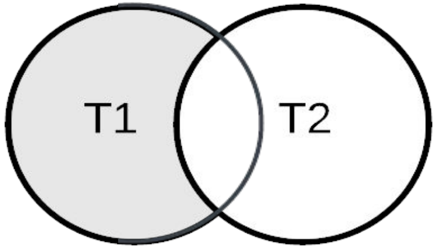
```
SELECT a, b, c FROM T1
UNION ALL | DISTINCT
SELECT a, b, c FROM T2;
```



```
SELECT a, b, c FROM T1
INTERSECT DISTINCT
SELECT a, b, c FROM T2;
```



```
SELECT a, b, c FROM T1
EXCEPT DISTINCT
SELECT a, b, c FROM T2;
```



Optional Readings: Chapter 9 from Learning SQL.

## Subqueries

```
SELECT a, b, c
FROM T1
WHERE a =
      (SELECT x FROM T2 ...)
```

Comparison Operators:

=

!=

>

<

<=

>=

- Subqueries can be attached to nearly every clause of a query
- Two major types of subqueries:  uncorrelated and correlated
- Parenthesis around subquery required

## Subqueries in the `WHERE` clause

```
SELECT a, b, c
FROM T1
WHERE d IN
      (SELECT x FROM T2 ...)
```

List Membership Operators:

**`IN`**

**`NOT IN`**

Comparison Operators:

**`=, !=, >, <, <=, >=`**

## Exercise 2: Subqueries

*Who are the oldest students?*

**Database Schema:**

Student(sid, fname, lname, dob,
status)

Class(cno, cname, credits)

Instructor(tid, fname, lname, dept)

Takes(sid, cno, grade)

Teaches(tid, cno)

## Exercise 3: Set Operation

*Who takes* CS327E ***and*** CS331E?

Return the sid, first and last names of students who take both classes.

Order the results by sid.

**Database Schema:**

Student(<u>sid</u>, fname, lname, dob, status)

Class(<u>cno</u>, cname, credits)

Instructor(<u>tid</u>, fname, lname, dept)

Takes(<u>sid</u>, <u>cno</u>, grade)

Teaches(<u>tid</u>, <u>cno</u>)

## Exercise 4: Subqueries

*Who does **not** take CS327E?*

Return the sid, first and last names of students who don't take the class.

Order the results by sid.

**Database Schema:**

Student(<u>sid</u>, fname, lname, dob, status)

Class(<u>cno</u>, cname, credits)

Instructor(<u>tid</u>, fname, lname, dept)

Takes(<u>sid</u>, <u>cno</u>, grade)

Teaches(<u>tid</u>, <u>cno</u>)

## Subqueries in the `FROM` and `JOIN` clauses

```
SELECT a, b, c
FROM (SELECT a, b, c FROM U ...)
[WHERE ...]
[ORDER BY ...]

SELECT a, b, c, d, e, f
FROM (SELECT a, b, c FROM U ...) JOIN T
ON a = d
[WHERE ... ORDER BY ...]
```

# Subqueries in HAVING clause

```
SELECT a, b, c <aggregate functions>
FROM T1
[WHERE <boolean condition>]
GROUP BY a, b, c
HAVING <aggregate function> = (SELECT x
                               FROM T2 ...)
```

Comparison Operators: **= , !=, >, <, <=, >=**

## Exercise 5: Subqueries

*Which classes have a higher enrollment than the overall average enrollment per class?*

*Return the cno and the enrollment count for those classes.*

**Database Schema:**

Student(sid, fname, lname, dob, status)

Class(cno, cname, credits)

Instructor(tid, fname, lname, dept)

Takes(sid, cno, grade)

Teaches(tid, cno)

*No need to account for classes with zero enrollment.*

## Correlated Subqueries in the `WHERE` clause

```
SELECT a, b, c
FROM T
WHERE c > (SELECT d FROM U WHERE U.e = T.b)
```

Comparison Operators: `=`, `!=`, `>`, `<`, `<=`, `>=`

List Membership Operators: `IN`, `NOT IN`

# Subqueries in the `SELECT` clause

```
SELECT a, b, c, (SELECT aggr. FROM U [WHERE U.e = T.b])
FROM T
[WHERE ... ]
```

**Example:**

```
select distinct sid,
    (select min(grade) from
     college.Takes u
     where u.sid = t.sid)
from college.Takes t;
```

**Database Schema:**

Student(<u>sid</u>, fname, lname, dob,
    status)

Class(<u>cno</u>, cname, credits)

Instructor(<u>tid</u>, fname, lname, dept)

Takes(<u>sid</u>, <u>cno</u>, grade)

Teaches(<u>tid</u>, <u>cno</u>)

## Exercise 6: Subqueries

*Which instructors earn a higher salary than the average salary of their department?*

*Return the instructor's name, department, and salary.*

*Order the results by salary in descending order.*

**Database Schema:**

Student(sid, fname, lname, dob, status)

Class(cno, cname, credits)

Instructor(tid, name, dept, **sal**)

Takes(sid, cno, grade)

Teaches(tid, cno)