“Complicated” SQL Practice

```
CREATE TABLE Class (
 dept VARCHAR(50),
 number INT,
 title VARCHAR(50),
 PRIMARY KEY (dept, number));

CREATE TABLE Instructor (
 username VARCHAR(50) PRIMARY KEY,
 fname VARCHAR(50),
 lname VARCHAR(50),
 started_on CHAR(10));

CREATE TABLE Teaches
  username VARCHAR(50) REFERENCES Instructor,
 dept VARCHAR(50),
 number INT,
 PRIMARY KEY (username, dept, number),
 FOREIGN KEY (dept, number) REFERENCES Class);
```

1. How many classes are being taught by at least one instructor?
    - By the nature of our data, we know that any class that appears in Teaches must be taught by at least 1 teacher. Thus, if we categorize the tuples in Teaches by dept and number (the primary key), we can get our answer by counting the number of groups. The sticking point of this query is how to count the number of groups. The easy solution is to wrap the grouping query in a count(*) query.

```
SELECT COUNT(*)
  FROM (SELECT 1
          FROM Teaches
         GROUP BY dept, number);
```

2. Which instructors teach more than 1 class? Give the username, first name, and last name of these instructors. Do NOT use a correlated subquery (although that is a good place to start). ● There are a few ways of thinking about this query. One is that for each teacher we can see how many classes they teach. If you follow this thinking you can check the number of courses taught in the Teaches table in a subquery.

```
SELECT IN.username, IN.fname, IN.lname
  FROM Instructor IN
 WHERE 1 < (SELECT COUNT(*)
              FROM Teaches T
             WHERE T.username = IN.username);
```

- This pattern lends itself nicely to a GROUP BY on username.

```
SELECT I.username, I.fname, I.lname
```

```
  FROM Instructor I, Teaches T
 WHERE I.username = T.username
 GROUP BY I.username, I.fname, I.lname
HAVING COUNT(*) > 1;
```

3. Which CSE courses do neither Dr. Levy (username 'levy') nor Dr. Wetherall (username 'djw') teach? Give the department, number, and title of these courses.

- The framing of this question is a negated existential. This hints that a simple SELECT-FROM-WHERE query (monotonic query) will not work.
- A gut reaction, if you think of filtering out tuples with levy or djw, might lead to the query below.

This query is **wrong**! Imagine we have a course taught by levy. You can see that if we have a course taught by djw or levy with another instructor, that tuple will end up in the answer even though it shouldn't `SELECT C.dept, C.number, C.title`

```
  FROM Class C, Teaches T
 WHERE C.dept = 'CSE' AND C.dept = T.dept AND C.number = T.number
        AND T.username != 'levy' AND T.username != 'djw';
```

- The tricky part of this problem is that more than one instructor may teach a single course. But this problem can be solved with subqueries easily. A negated existential problem can be translated directly into SQL via the NOT IN keywords.

```
SELECT C.dept, C.number, C.title
  FROM Class C
 WHERE C.dept = 'CSE'
       AND C.number NOT IN
                 (SELECT C1.number
                    FROM Class C1, Teaches T
                   WHERE C1.dept = T.dept AND C.number = T.number
                    AND (T.username = 'levy' OR T.username = 'djw'));
```

● Alternatively, you might take a different approach: to compute classes in CSE, then subtract those taught by levy or djw. This decorrelated version uses *set difference*. `SELECT C.dept, C.number, C.title`

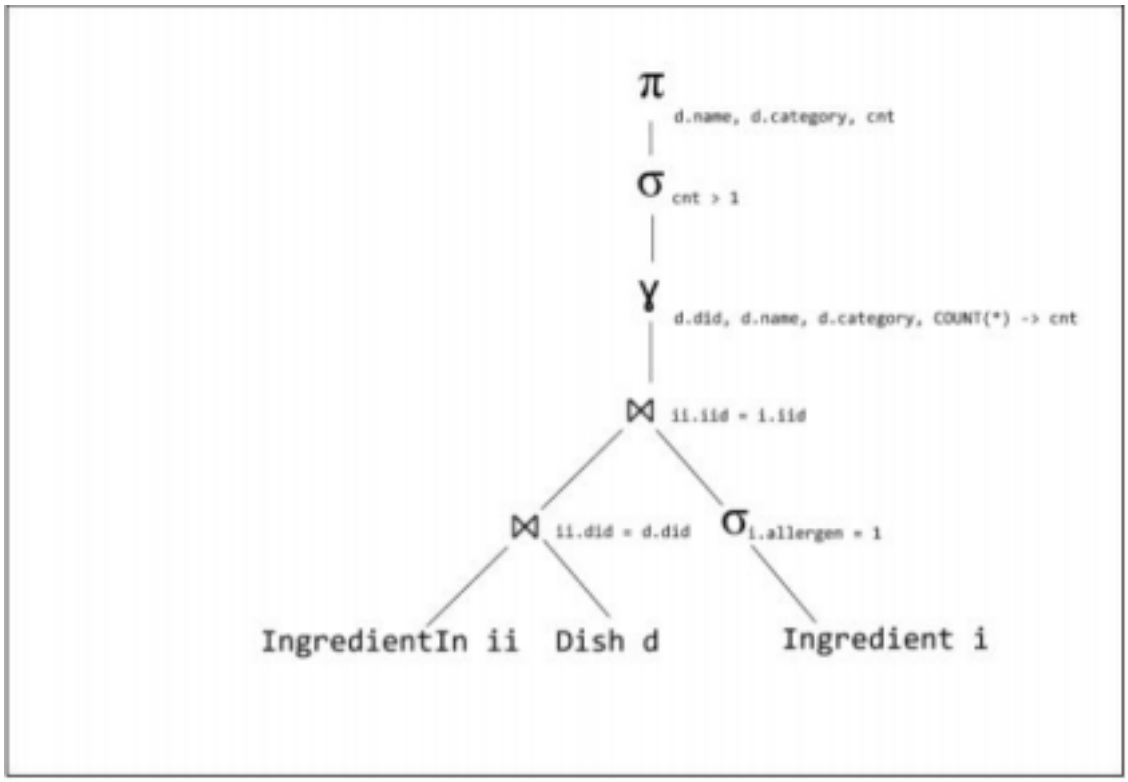
```
FROM Class C
WHERE C.dept = 'CSE'
EXCEPT
SELECT C.dept, C.number, C.title
FROM Class C, Teaches T
WHERE C.dept = 'CSE' AND C.dept = T.dept AND C.number = T.number AND
(T.username = 'djw' OR T.username = 'levy');
```

1. *Autumn 2019 midterm (Problem 2)*

a) (13 points) The restaurant is trying to have more allergy-friendly dishes for their customers at all meals. They wrote the following query to find the number of allergens in their dishes in various categories:

```
SELECT d.name, d.category, COUNT(*) AS cnt
FROM Ingredient i, Dish d, IngredientIn ii
WHERE i.iid = ii.iid
AND d.did = ii.did
AND i.allergen = 1
GROUP BY d.did, d.name, d.category
HAVING COUNT(*) > 1;
```

Write a Relational Algebra expression in the form of a logical query plan (you may draw a tree) that is equivalent to the SQL query.

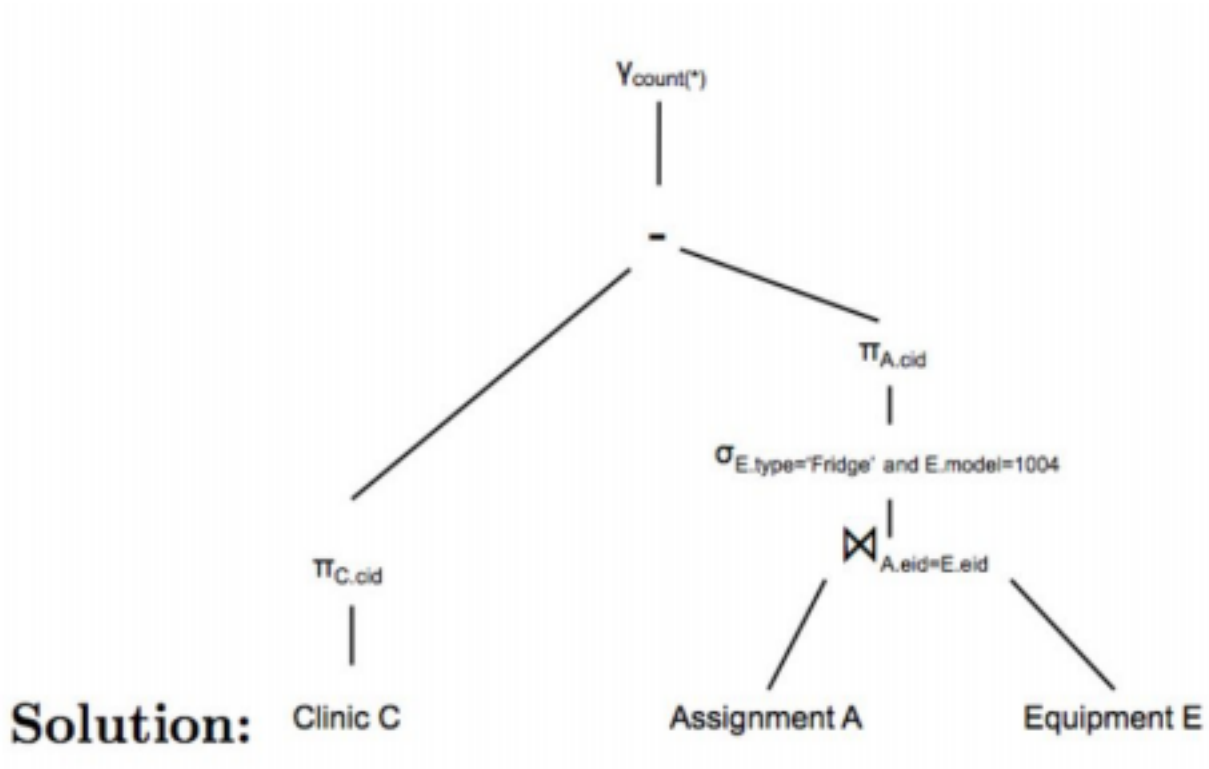


2. SQL to Relational Algebra. Write an expression in the form of a logical query plan (i.e., draw a tree) that is equivalent to each of the SQL query below:

a. Clinic(cid, name, street, state)
Equipment(eid, type, model)
Assignment(cid, eid)

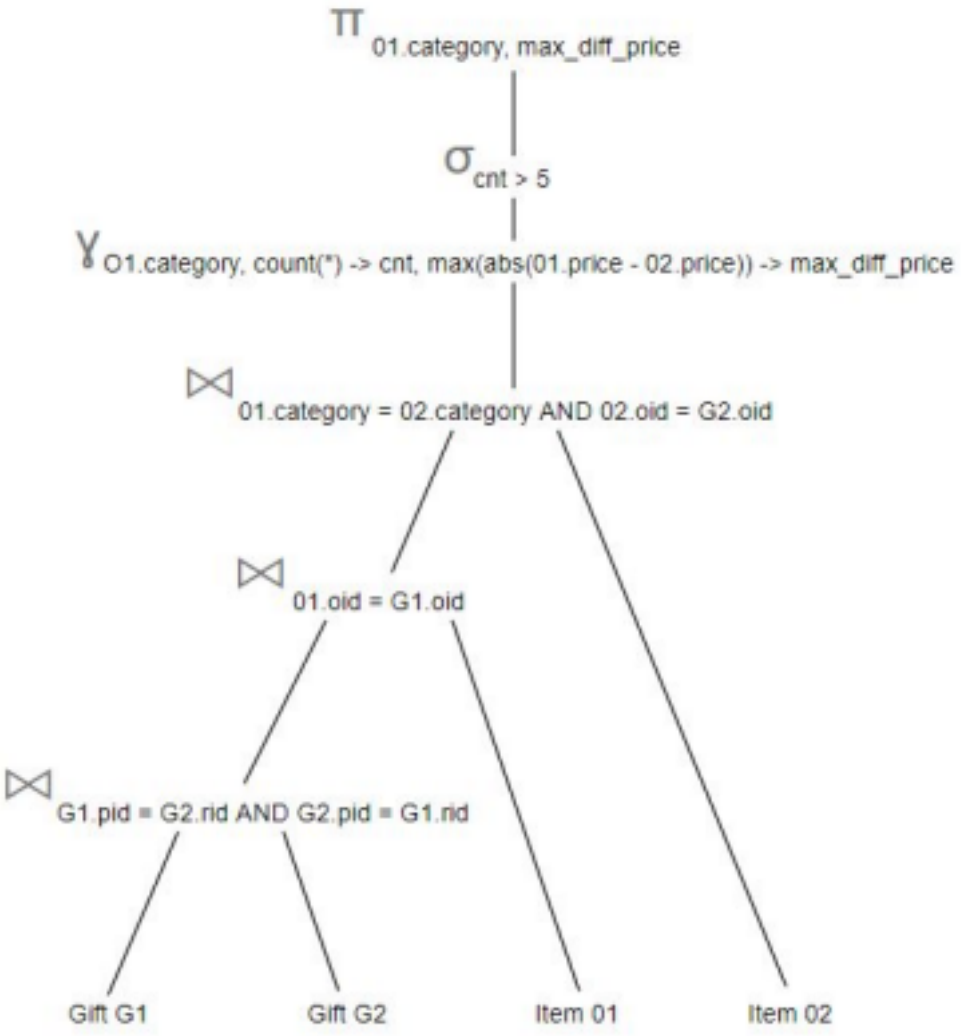
```
SELECT COUNT(*)
FROM Clinic C
WHERE NOT EXISTS (
      SELECT *
      FROM Assignment A, Equipment E
      WHERE C.cid = A.cid
```

```
        AND A.eid = E.eid
        AND E.type = 'Fridge'
        AND E.model = 1004 );
```



b. Item(oid, category, price)
Gift(pid, rid, oid)

```
SELECT O1.category, max(abs(O1.price - O2.price))
FROM Gift G1, Gift G2, Item O1, Item O2
WHERE G1.pid = G2.rid
  AND G2.pid = G1.rid
  AND O1.oid = G1.oid
  AND O2.oid = G2.oid
  AND O1.category = O2.category
GROUP BY O1.category
HAVING count(*) > 5;
```



3. **RA**

Winter 2016 #2a, b

Consider the following database about a picture tagging website: `Member(mid, name, age)`
`Picture(pid, year)`
`Tagged(mid, pid)`

(a) Write a Relational Algebra expression in the form of a logical query plan (i.e., draw a tree) that is equivalent to the SQL query below. Your query plan does not have to be necessarily "optimal": however, points will be taken off for overly complex solutions.

```
SELECT w.year, max(w.c) as m
FROM (SELECT x.name, z.year, COUNT(*) as c
      FROM Member x, Tagged y, Picture z
      WHERE x.mid = y.mid
        AND y.pid = z.pid
        AND age < 20
     GROUP BY x.name, z.year) AS w
```

```
GROUP BY w.year
HAVING SUM(w.c) > 100;
```

Solution: