CS127 Quiz #1

Date: October 16th, 2019

Your BannerID

BannerID: _____

Write your solutions on this piece of paper and hand it in.

Schema

The questions in this quiz will refer to the following database schema for a company:

$employee(\underline{emp\_id}, emp\_name, dept\_id, mgr\_id, salary)$

$department(\underline{dept\_id}, dept\_name)$.

The above database has the following global constraint:

```
check (
    not exists (
        select * from department d
        where not exists (
            select *
            from employee e
            where e.mgr_id IS NULL
            and d.dept_id = e.dept_id
        )
    )
)
```

Note: An employee is a manager if that employee has no mgr_id The check constraint in the above schema checks that every department has at least one manager

Question #1

True/False (15 points: 3 points each):

a. If R is decomposed to R1 and R2, and either $R1 \cap R2 \rightarrow R1$ or $R1 \cap R2 \rightarrow R2$, then the decomposition of R into R1 and R2 is lossy.

Solution: False. If the intersection of R1 and R2 functionally determines either R1 or R2, then the decomposition is lossless.

b. `R != SELECT * FROM R NATURAL JOIN R NATURAL JOIN R`

Solution: False. The result of the query is the same as R itself, since you used a NATURAL JOIN

c. Views (when not materialized) are always consistent with tables that they reference
Solution: True, since a view queries the underlying table each time that is is called

d. Given R = (A, B, C) and $A \rightarrow B$ and $B \rightarrow C$, the following decomposition is dependency preserving: (A, B), (B, C)
Solution: True, since there is no need to do any joins to check for integrity

e. A weak entity set's key is the set of its discriminating attributes
Solution: False. A weak entity set's key is the set of its discriminating attributes combined with the primary key of the identifying entity set

Question #2

(25 points)

a. Write a RA query to find the department names of departments that have managers who manage exactly one employee.

```
Solution:
t1 <-- RENAME mgr_id as emp_id (mgr_id G count(emp_id) as count (employee))
t2 <-- project dept_name(SELECT count = 1 (t1 NATURAL JOIN employee NATURAL JOIN department))
```

b. Write the above query in SQL

Solution:

```
Select department_name
from (Select mgr_id, count(emp_id) as count
from employee group by mgr_id) as A
join employee on A.mgr_id = employee.emp_id
natural join department
 where count = 1;
```

Question #3

(15 points)
Draw an ER diagram for the above schema. Use a recursive relationship to represent the manager/employee relationship

Solution:
Two entity sets:

EMPLOYEE(emp_id, name, salary), and DEPARTMENT(dept_id, name), connected by relationship set WORKS IN which has total participation from employee (since every employee has a dept_id) and total participation from department (since every department has at least one manager, as mentioned on the first page) and a many to one relationship from employee to department (since many employees may work for one manager).
Also a relationship set EMPLOYEE/MANGER which connects employee to itself, with one arrow to it marked as "supervisee" and the other arrow marked as "supervisor." One to many from manager to employee, since one manager may manage many employees

Question #4

(20 points: 4 points each)

a. Given the relation R = (A, B, C, D, E) with FD set $\{A \rightarrow BCD, B \rightarrow A, C \rightarrow D, D \rightarrow E\}$ is the following decomposition is in BCNF: (A, B, C, D), (D, E)? If not, change it to be in BCNF.
Solution: It's not in BCNF. Fix: (A, B, C), (D, E), (C, D)
Note: If student gave a different decomposition that is also in BCNF, give full credit.

b. If you decomposed in part a, is your decomposition dependency preserving? If you did not decompose in part a, is the given decomposition dependency preserving?
Explain your answer.
Solution: Yes. The dependencies $A \rightarrow BC$, $B \rightarrow A$, $C \rightarrow D$ and $D \rightarrow E$ are each contained in a single relation in the result, and all other dependencies are inferred from them.
Note: Grade based on whatever the student gave as their answer in part a.

c. What are the candidate key/s in R?
Solution: {A}, {B}

d. What is a canonical cover and why is it useful?
Solution: A non-redundant set of FDs that are functionally equivalent to F+. This is useful, since it gives a minimal set of FDs to check for integrity constraints, which is easier than checking every FD in F+.

Question #5

(3 points)
Miranda is a DBA for the company with the above DB schema of employees and departments. She wants to give her secretary access to employees' information, without giving the secretary access to the employees salaries. What can Miranda do?

Solution: Create a view that selects just emp_id, name, dept_id and mgr_id from employee, and give the secretary permissions on that view.

Question #6

(22 points)
Write the DDL for the employee and department schema along with types, primary and foreign keys, and the following constraints:

- each employee is in one department
- deleting or updating a department deletes or updates an employee's information
- an manager is also an employee
- deleting a manager's information sets managed employee's mgr_id to null
- updating a manager's emp_id updates employee's mgr_id
- employee and department names are not null
- employee salaries are >= 0
- department names are unique

Solution:

```
CREATE TABLE employee (
   emp_id INTEGER PRIMARY KEY,
   emp_name VARCHAR(60) NOT NULL,
   dept_id INTEGER NOT NULL REFERENCES department(dept_id) ON DELETE CASCADE ON UPDATE CASCADE,
   mgr_id INTEGER REFERENCES employee(emp_id) ON DELETE SET NULL ON UPDATE CASCADE,
   salary MONEY(or FLOAT) NOT NULL CHECK(salary >= 0)
)
CREATE TABLE department (
   dept_id INTEGER PRIMARY KEY,
   dept_name VARCHAR(60) NOT NULL UNIQUE
)
```