CS 143 Homework 4

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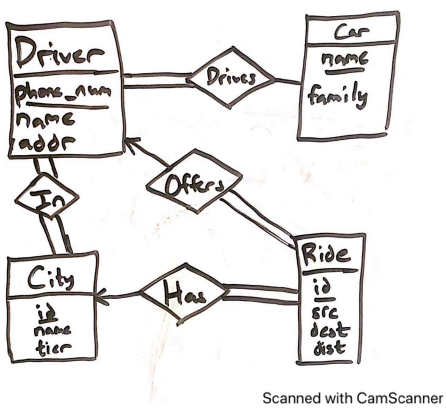
Problem 1

a) Draw an E/R diagram for Nevertaxi.



The assumptions I made were: driver phone numbers are unique, car names are unique, all IDs are unique, all drivers must drive a car and be located in a city, all cities must have a driver, and all rides must be offered by a driver.

b) Write a CREATE TABLE expression for each relation in the E/R diagram.

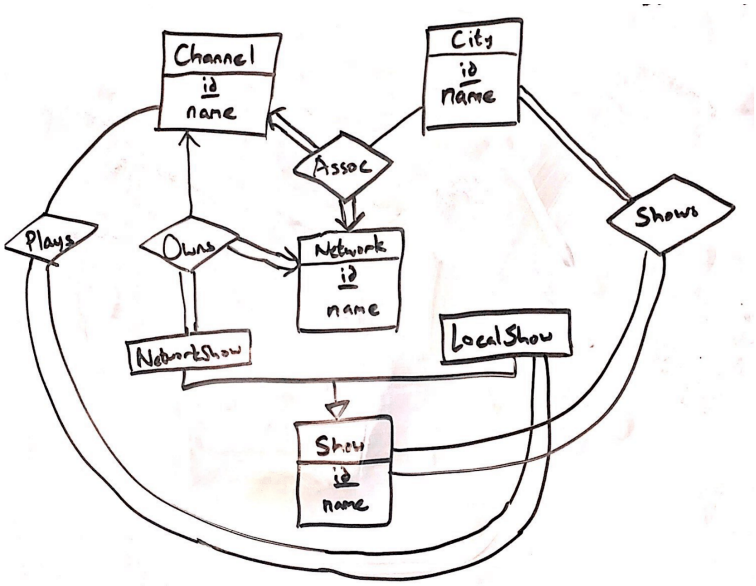
```
Driver(phone_num, name, addr)
Car(name, family)
City(id, name, tier)
Ride(id, src, dest, dist)
Drives(driver_id, car_id)
In(driver_id, city_id)
Has(ride_id, city_id)
Offers(driver_id, ride_id)

CREATE TABLE Driver (phone_num VARCHAR(10), name VARCHAR(20),
            addr VARCHAR(50)), PRIMARY KEY (phone_num);
CREATE TABLE Car (name VARCHAR(20), family VARCHAR(20)),
            PRIMARY KEY (name);
```

```
CREATE TABLE City (id INT, name VARCHAR(20), tier VARCHAR(20)),
             PRIMARY KEY (id);
CREATE TABLE Ride (id INT, src VARCHAR(20), dest VARCHAR(20),
             dist INT), PRIMARY KEY (id);
CREATE TABLE Drives (driver_id VARCHAR(10), car_id VARCHAR(20));
CREATE TABLE In (driver_id VARCHAR(10), city_id INT);
CREATE TABLE Has (ride_id INT, city_id INT), PRIMARY KEY (ride_id);
CREATE TABLE Offers (driver_id VARCHAR(10), ride_id INT),
             PRIMARY KEY (ride_id);
```

Problem 2

Design an E/R model for a database that maintains information for producing a weekly TV guide for a given region.



The assumptions I made were: networks can span multiple cities and channels only span a single city.

Problem 3

Convert the given E/R model to relations.

```
Programmer(name)
Leads(name, team_name, project)
TeamLeader(name, team_name)
```

Problem 4

If we decompose the schema $R(A, B, C, D, E, F)$ into (A, B, C, F) and (A, D, E), is the decomposition lossless, given $F = \{A \rightarrow BC, CD \rightarrow E, B \rightarrow D, E \rightarrow A\}$?

In order for the decomposition to be lossless, the shared attribute, A in this case, has to be a key for either one of the resultant relations. With the FDs given, we can see that $A+ = \{A, B, C, D, E\}$. Since $A \rightarrow D$ and $A \rightarrow E$, we know that A is a key for the second relation, and therefore, this decomposition is lossless.

Problem 5

Given the following relation, list non-trivial functional dependencies.

A	B	C
a_1	b_1	c_2
a_1	b_1	c_2
a_2	b_1	c_1
a_2	b_1	c_3

$F = \{C \longrightarrow AB\}$

Problem 6

Assume the Student and Class relations from class, and a relation Take(sid, dept, cnum).

a) How can FDs be used to indicate a one-to-one relationship between Student and Class?

With the FDs $\{sid \rightarrow (dept, cnum), (dept, cnum) \rightarrow sid\}$, we indicate that Student and Class have a one-to-one relationship, as one table's key implies the other's, meaning a student can only take a single class or vice versa.

b) How can FDs be used to indicate a many-to-one relationship between Student and Class?

With the FD $sid \rightarrow (dept, cnum)$, we indicate that Student and Class have a many-to-one relationship, as the Student table's key implies the Class table's key, meaning a student can only engage in a relationship with one class, but classes have no such restriction, as sid is not functionally dependent on $(dept, cnum)$.

Problem 7

Assume the FDs $F = \{A \rightarrow BC, CD \rightarrow E, B \rightarrow D, E \rightarrow A\}$ hold for the relation $R(A, B, C, D, E)$.

a) Is A a key for R?

A is a key for R, because $A+ = \{A, B, C, D, E\}$, which means the attribute set closure of A contains all of R's attributes.

b) Is BC a key for R?

BC is a key for R, because $BC+ = \{A, B, C, D, E\}$, which means the attribute set closure of BC contains all of R's attributes.

Problem 8

Assume the FDs $F = \{A \longrightarrow BC, C \longrightarrow E, B \longrightarrow D\}$ hold for the relation $R(A, B, C, D, E, F)$. Is this in BCNF? If not, normalize it into a set of relations in BCNF.

$A+ = \{A, B, C, D, E\}$
$C+ = \{C, E\}$
Since C is not a key of R, we must decompose R into $R_1(A, B, C, D)$ and $R_2(C, E)$.
$B+ = \{B, D\}$ Since B is not a key of R_1, we must decompose R_1 into $R_3(A, B, C)$ and $R_4(B, D)$.

$\{R_2(C, E), R_3(A, B, C), R_4(B, D)\}$