Name: David Jolly

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Exam 1

Instructions:

- You have 50 minutes to complete the exam.
- Read each question carefully.
- Scrap paper is available if you need.
- Do not erase significant parts of your work. If you make a mistake, put a line through the work and then continue onward.
- If you must make an assumption, please write that assumption clearly.
- If you think you found a typo, please inform Dr. Jiawei Yuan, especially if you think it alters the interpretation of an exam question.

Get to it and best of luck.

	Available	Awarded
Problem #1	**15**	
Problem #2	**30**	
Problem #3	**40**	
Problem #4	**15**	
Grand Total	**100**	

Problem #1 [15 points]

a. What is the difference between data types **CHAR(n)** and **VARCHAR(n)?**

VARCHAR(n) can hold up to 256 characters

b. A table (relation) can have multiple ___4X -3___
   A. **PRIMARY KEY**
   B. **UNIQUE** attribute(s)
   C. **Both of Them**
   D. **None of Them**

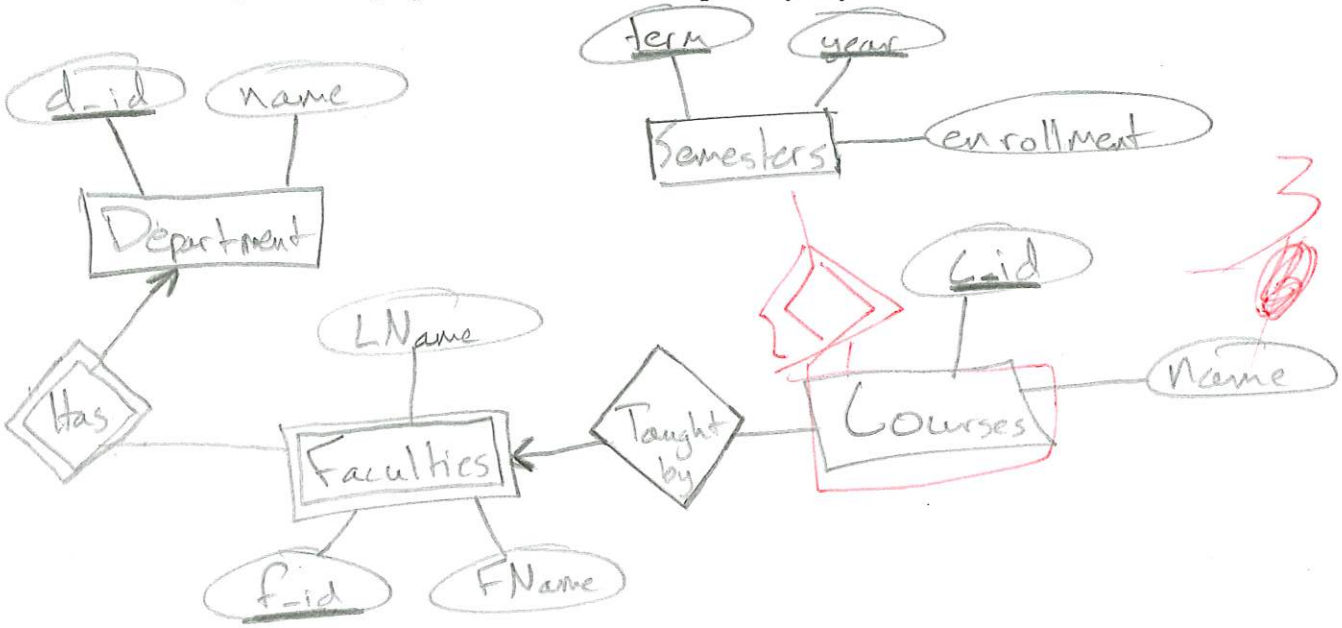
c. ___E___ cannot have NULLs
   E. **PRIMARY KEY** attribute(s)
   F. **UNIQUE** attribute(s)
   G. **Both of Them**
   H. **None of Them**

Problem #2 [30 points] We now would like to design a course registration database for college of engineering. The database will be used by multiple departments, and each department has multiple courses. Specifically, our database will have the following the following entities:

1. **Departments**, with 2 attributes: d_id and name. Each department has a number of faculties
2. **Semesters,** with 3 attributes: term, year, enrollment
3. **Courses**, with 2 attributes: c_id (e.g., cs317), name. Several courses can be taught by the same faculty.
4. **Faculties**, with 3 attributes: f_id, FName, LName.

Note that: different semesters can have the same course.

a. [17 points] Design and **Draw** the E/R diagram of the above database.
Note:
Make sure you use right notation (shape) for each item in your E/R diagram.
Make sure you mark all possible many-one, many-many, one-one relationship clearly.
Make sure you select proper attributes to be the primary key of each table.



b. [8 points] Convert the above E/R diagram to relation schemas.

Department(d_id, name)
Semesters(term, year, enrollment)
Faculties(f_id, FName, LName)
dependant on Department → Faculties(f_id, FName, LName, Department.d_id)
Courses(c_id, name)
depadant on Faculties → Courses(c_id, name, Faculties.f_id, Department.d_id)

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c. [5 points] Create table **Faculties** using SQL scripts. Here, we use f_id as the primary key.

```
CREATE TABLE Faculties(
    f_id INT PRIMARY KEY,
    FName VARCHAR(12),
    LName VARCHAR(12)
);
DROP TABLE Faculties;
```

Problem #3 [40 points] Considering the following 4 tables from a bank database:

```
Branch (branch_name  VARCHAR(20),
        branch_city VARCHAR (20)
 );

Customer (
        customer_name VARCHAR(20) PRIMARY KEY,
        address VARCHAR (20),
        customer_city VARCHAR (20)
);

Account (
        branch_name  VARCHAR (20),
        account_number INT,
        customer_name VARCHAR (20),
        balance DOUBLE,
        PRIMARY KEY (branch_name, account_number)
);

Borrow (
        branch_name  VARCHAR (20),
        loan_number INT,
        customer_name VARCHAR (20),
        amount DOUBLE,
        PRIMARY KEY (branch_name, loan_number)
);
```

Write the following SQL queries:

a. [10 points] Find names of customers who have an account at some branches, where customer "Bob" also has an account.

```
SELECT customer_name
FROM Account
WHERE branch_name IN
(SELECT branch_name FROM Account WHERE customer_name = 'Bob')
```

b. [10 points] Find names of customers who have an account at branch "Best-Bank", but do not have any borrow account.

```
SELECT Account, customer_name
FROM Account, (SELECT customer_name FROM Borrow WHERE branch_name = 'Best-Bank') Q
WHERE branch_name = 'Best-Bank' AND customer_name <> Q.customer_name
```

c. [10 points] Find all loan numbers for borrow accounts at branch "Best-Bank", which have an amount greater than 100,000

```
SELECT loan_number
FROM Borrow
WHERE branch_name = 'Best-Bank' AND amount > 100000
```

d. [10 points] Add attribute "**Contact**" to table **Branch**, with default value as '123-456-7890'

ALTER TABLE Branch ADD Contact VARCHAR(12) DEFAULT '123-456-7890'

Problem #4 [15 points] Consider the relation schema R(A,B,C,D,E) with functional dependencies: A→BC, CE→D. Is R in BCNF? Why or why not? If not, decompose R according to BCNF. Show all your work, not just final decomposed results.

R(A,B,C,D,E) A→BC CE→D key: {A, E} violates, key not in all relations

R1(A,B,C) R2(A,D,E)

R1(A,B,C) A→BC key {A} ✓

R2(A,D,E) CE→D key {A,C,E} X

R3(C,E,D) R4(C,G,A)

R3(C,D,E) CE→D key {C,E} ✓

R4(A,C,E) CE→D key {C,E,A} X

R5(C,G,D) R6(C,G,A)

R5(C,D,E) CE→D key {C,E} ✓

R6(A,C,E) A→BC CE→D key {A,C,E} ✓

R1 R3 R5 R6

R1(A,B,C) R3(C,D,E) R6(A,C,E)