

**CS585**  
**Database Systems**  
**Spring 2013**  
**Exam I**

Name: \_\_\_\_\_  
Student ID: \_\_\_\_\_

	Maximum	Received
Problem 1	20	
Problem 2	20	
Problem 3	20	
Problem 4	10	
Problem 5	20	
Problem 6	10	
Total	100	

2hr exam. One 8.5X11 cheat sheet allowed.

1) 20 pts

Indicate whether each of the following statements is true or false (T/F):

   F    Conceptual schema describes how users see the data.

   F    Table constraints can only involve a single table whereas an assertion may involve multiple tables.

   T    Foreign key constraints can negatively impact the performance of a relational database

   T    Some constraints cannot be expressed in the ER model

   T    Expressions in group-qualification must have a single value per group

   T    In SQL, 'INTERSECT' can be used to compute the intersection of any two union-compatible sets of tuples.

   F    Since an R-tree is a height balanced tree it guarantees a search to be completed in  $O(\log n)$  time, where  $n$  is the number of objects in the tree.

   F    An ORDBMS automatically generates a map function for an object if none is defined by the user.

   T    An RDBMS has an advantage in performance over an ORDBMS in that query optimization can be more optimal in an RDBMS

   F    Using views one can update derived attributes

2) 20 pts

You have been asked to design a database for the university administration, which records the following information:

1. All students necessarily have a unique student ID, a name, and a university email address.
2. Each student is also either an undergraduate or a graduate student.
3. Each graduate student has an advisor.

4. Each undergraduate student has a major.
  5. Students take courses. A student may take one course, multiple courses, or no courses.
  6. Each course has a course number, course name, and days of the week the course is scheduled.
  7. Each course has exactly one head TA, who is a graduate student.
  8. Every head TA has an office where he or she holds office hours.
- (a) Draw an ER diagram for this application. Apply all constraints that can be applied in ER. Decide the key attributes and identify them on the diagram. State any assumptions you make in your answers. (16 points)

(b) Map your ER diagram to the relational model.

Students(studentID, name, email)

Undergraduate (studentID, major)  
studentID is a FK referencing Students

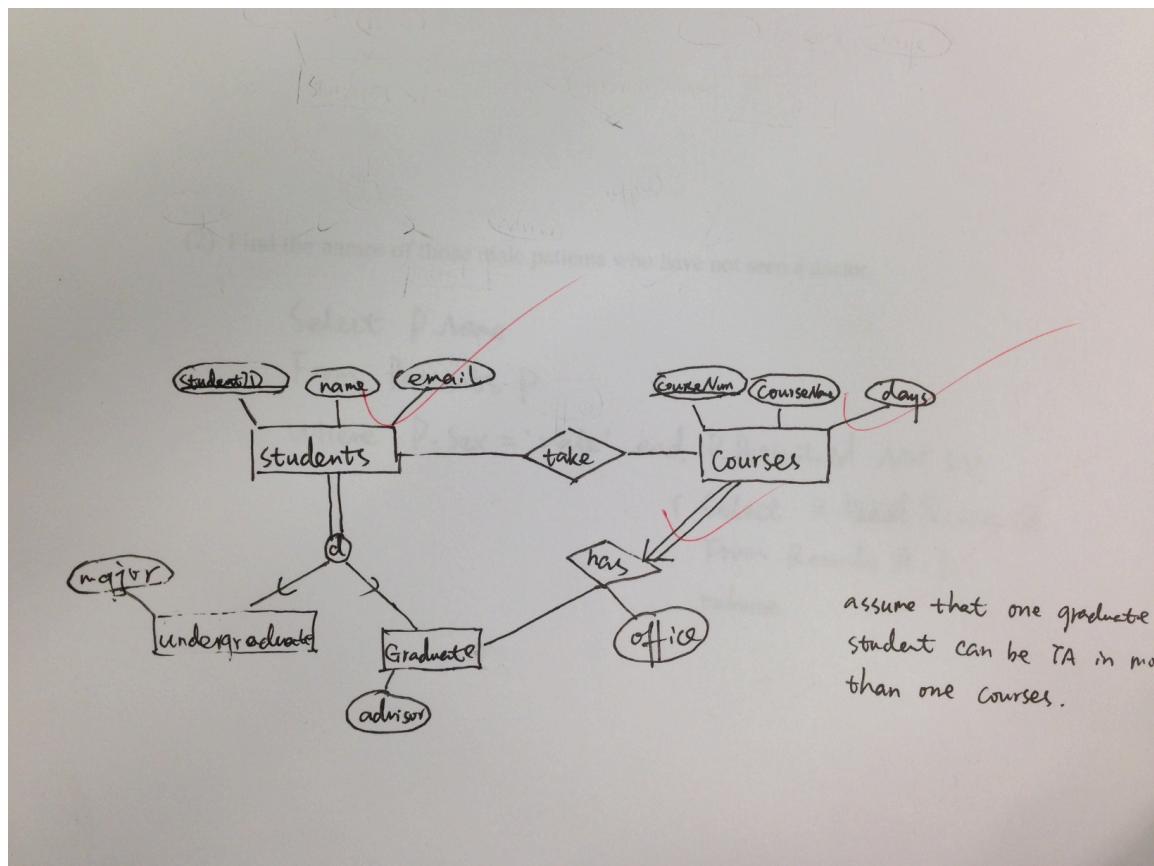
Graduate (studentID, advisor)  
studentID is a FK referencing Students  
Here needs an assertion that every student in Students should be either in Undergraduate or Graduate

Courses (CourseNum, CourseName, days)

takeCourse (studentID, CourseNum)  
studentID is a FK referencing Students  
CourseNum is a FK referencing Courses

hasTA (CourseNum, StudentID, office)  
CourseNum is a FK referencing Courses  
StudentID is a FK referencing Students

(b) Map your ER diagram to the relational model.



3) 20 pts

Consider the following relational database schema:

Doctors (Dr\_id, Name, Specialty, Telephone, Years\_of\_experience)

Patients (Patient\_id, Name, Sex, Address, Age, Dr\_id)

Records (Dr\_id, Patient\_id, Date, Diagnosis)

The primary key of each table is underlined. The Dr\_id in the Patients table is used to indicate the primary physician of a patient. Each tuple in the Record table indicates that a doctor has seen a patient on the given date.

(1) Find the doctor's name who is a primary physician of a patient who is over 60

```
Select D.name  
From Doctors D, Patients P  
Where D.Dr_id = P.Dr_id  
And P.Age > 60
```

(2) Find the names of those male patients who have not seen a doctor.

```
Select P.Name  
From Patients P  
Where P.sex = 'Male'  
And not exists  
(  
    Select * from Records R  
    Where R.Patient_id = P.Patient_id  
)
```

(3) Find the names of doctors who experienced more than 10 years and not primary physician of any female patient.

```
Select D.Name  
From Doctors D  
Where D.Year_of_experience > 10  
And not exists  
(  
    Select *  
    From Patients P  
    Where P.Dr_id = D.Dr_id  
)
```

(4) Find Dr\_id's of those doctors who are the primary physician of at least one patient

```
Select D.Dr_id  
From Doctors D  
Where D.Dr_id in  
(  
    Select Dr_id  
    From Patients  
)
```

Or

```
Select Distinct Dr_id from Patients
```

4) 10 pts

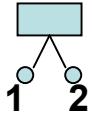
The following 6 points are inserted into a spatial DBMS that uses an R-Tree of size (2,4) as an index structure to store points. Show the R-Tree after each insert in the given order. Use the linear time algorithm described in class for splitting MBRs.

<u>Point #</u>	<u>X</u>	<u>Y</u>
1	2.	3.
2	1.	2.
3	3.	3.
4	1.	4.
5	3.	2.
6	2.	1.

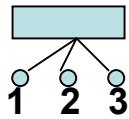
**Step1**

1  
.

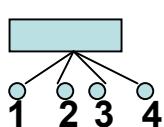
**Step2**



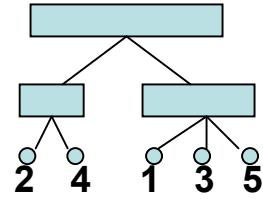
**Step3**



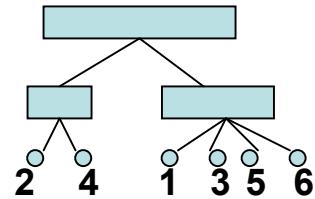
**Step4**



**Step5**



**Step6**



*Each step 1 to step 4 (1 points)*

*Each step 5 and step 6 (3 points)*

*- split to other ways (-1 points)*

*- e.g. (1,2,3) (4,5,6)*

Some other alternative solutions are possible at step 5

At step 5, 4 and 5 are two points at two extremes according to the linear time algorithm described in the class. Therefore, 4 and 5 should not be in the same partition. For other nodes, just use the minimal enlargement principle to add them into the two partitions accordingly.

For example, another answer for step 5 and step 6 can be

Step 5

Partition 1 (1, 2, 4)  
Partition 2 (3, 5)

Step 6

Partition 1 (1, 2, 4, 6)  
Partition 2 (3, 5)

According to minimal enlargement principle

Point 6 should be assigned to partition 1.

If we add point 6 to partition 1, enlargement would be 1  
If we add point 6 to partition 2, enlargement would be 2

5) 20 pts

Briefly describe each of the following terms as they relate to the topics in our CS585 course.

a- Eager loading

When loading the records, you also load the related data at the same time.

b- Referential integrity

Any field in a table that is declared a foreign key can contain either a null value, or only values from a parent table's primary key or a candidate key.

c- Object table

Store only objects. In an object table, each row represents an object, which is referred to as a row object.

d- JDBC-ODBC bridge

It is a database driver implementation that employs the ODBC driver to connect to the database. The driver converts JDBC method calls into ODBC function calls.

e- kd-tree

A k-d tree (short for k-dimensional tree) is a space-partitioning data structure for organizing points in a k-dimensional space. k-d trees are a special case of binary space partitioning trees.

6) 10 pts

Answer the following questions based on the schema below

**Person(facebook\_id, name, sex, relationshipStatus, birthyear)**

**Friends(facebook\_id, friend\_facebook\_id)**

**facebook\_id and friend\_facebook\_id are both foreign keys referencing Person**

**create view Senior(sname, sex, birthyear) as**

**select distinct name as sname, sex, birthyear from Person where birthyear < 1950;**

a- 4 points

Explain what will happen (and why) if you execute the following SQL statement:

**insert into Senior values('John McCain', 'male', 1936);**

The insertion will be rejected because there is no way to insert a tuple into Person to cause this tuple to appear in Senior; the key of Person cannot be null.

b- 6 points

Assume that all of your tables are empty and you want to insert some new tuples into Person and Friend, and write the script below. Is it correct? Why or why not?

```
insert into Person values (12, 'Barack Obama', 'male', 'married', 1961);
insert into Friends values (12, 14);
insert into Person values (14, 'Mitt Romney', 'male', 'married', 1947);
insert into Person values (12, 'Joe Biden', 'male', 'married', 1942);
```

1 correct

2 incorrect

3 correct

4 incorrect

You violate a foreign key constraint in the "insert into Friends..." statement because 14 is not already in Person. You then violate a key constraint in the last "insert into Person..." statement because 12 is already the facebook\_id for Barack Obama.

Additional space

Additional space