CS 235 Midterm Examination

Thursday, November 1, 2001, 1:30-2:50pm

Directions

The exam is open book/notes; any written material may be used.
There are 7 questions in this exam plus one extra credit question.
You have 80 minutes; there are 75 points + 5 extra credit points.

Please, give concise answers!

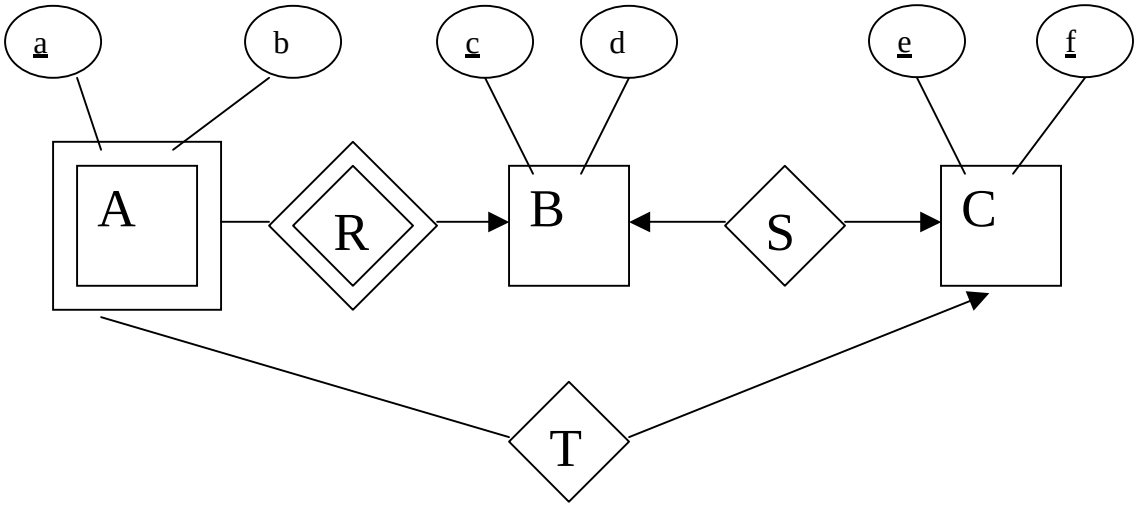
You don't need to explain how you get your answer. However, you can show your work on the back of the pages (but indicate that on the front) for partial credit but be aware that we will award partial credit in rare situations.

You must work on this exam individually without giving or receiving any assistance from/to other students. Please, acknowledge and accept this by signing your name below:

Print your name here:

Good luck!

Question 1 (15 pts): Consider the following E/R diagram:



(a) Convert the E/R diagram to a relational schema.

(b) For each relation in your schema show all completely nontrivial functional dependencies that hold.

Question 2 (15 pts): Consider a relation R(A, B, C, D, E) with functional dependencies $A \rightarrow B$, $BC \rightarrow D$, and $E \rightarrow C$.

(a) What are the keys for R?

(b) Which of the following functional dependencies do *not necessarily* hold in R. Circle the answer(s).

- $AC \rightarrow D$
- $AE \rightarrow C$
- $BC \rightarrow B$
- $CE \rightarrow D$

(c) If we project R onto S(B, C, D, E), which of the following functional dependencies hold in S and *also* do not violate the BCNF condition for S. Circle the answer(s).

- $BC \rightarrow D$
- $BE \rightarrow C$
- $B \rightarrow E$
- $E \rightarrow C$

Question 3 (10 pts): Rewrite the following SQL queries without using subqueries:

(a)
```
SELECT DISTINCT A
FROM R
WHERE A >= ALL
     (SELECT A
      FROM R)
```

(b)
```
(SELECT A,B FROM R)
EXCEPT
(SELECT R1.A,R1.B
 FROM R R1, R R2
 WHERE R1.A = R2.A
 AND R1.B < R2.B)
```

Question 4 (3 points for each correct answer, -1 point for each incorrect answer, and 0 points for no answer): For each pair of queries, indicate whether they are equivalent or not by circling YES or NO respectively.

(a) Given relations R(A,B) and S(B,C):

$R \bowtie S$ and $R \underset{R.B=S.B}{\bowtie} S$

YES NO

(b) Given relations R(A,B) and S(B,C):

$\sigma_{A=1}(R \bowtie S)$ and $(\sigma_{A=1}(R)) \bowtie S$

YES NO

(c) Given relations R(A,B) and S(B,C):

```
SELECT R.A FROM R,S WHERE R.B = S.B;
```
and

```
SELECT R.A FROM R,S WHERE R.B IN (SELECT B FROM S);
```

YES NO

(d) Given relation R(A,B,C):

```
SELECT DISTINCT * FROM R;
```
and

```
(SELECT * FROM R) INTERSECT (SELECT * FROM R);
```

YES NO

(e) Given relation R(A,B,C):

```
SELECT DISTINCT * FROM R;
```
and

```
SELECT * FROM R GROUP BY A,B,C;
```

YES NO

Question 5 (5 pts): Relation R(A,B,C) satisfies the multivalued dependency $A \rightarrow\rightarrow B$ and has (possibly among others) the following tuples in its current instance: (0,1,2), (0,3,4), and (1,5,2). What other tuples must be in the current instance of R?

Question 6 (5 pts): Consider the following declarations:

```
CREATE TABLE Books(
     title CHAR(100) PRIMARY KEY,
     pages INT,
     price INT
);


CREATE TRIGGER Mystery
AFTER UPDATE OF price ON Books
REFERENCING
     OLD ROW AS OldTuple,
     NEW ROW AS NewTuple
FOR EACH ROW
WHEN (NewTuple.price  > OldTuple.pages)
     UPDATE Books
     SET price = OldTuple.pages
     WHERE title = NewTuple.title;
```

Describe in English, as concisely as possible, what is the purpose of the Mystery trigger.

Question 7 (10 pts): Consider the following declarations:

```
CREATE TABLE T (
     a INT PRIMARY KEY,
     b INT );

CREATE TABLE S (
     c INT PRIMARY KEY,
     d INT REFERENCES T(a) CHECK(d < ANY
          (SELECT b FROM T)));
```

The current instance of relation T has 3 tuples: (1,0), (3,6), and (5,3).

The current instance of relation S has 3 tuples: (1,1), (2,1), and (3,5).

For each of the following modifications indicate whether it will cause some constraint to be violated, by circling its corresponding letter.

(a) `DELETE FROM T WHERE b = 6;`

(b) `DELETE FROM T WHERE b = 3;`

(c) `INSERT INTO S VALUES(1,2);`

(d) `INSERT INTO S VALUES(4,8);`

Extra credit (5 pts): Given the declarations and current instances of Question 7, in how many orders can the six tuples be deleted from their respective relations without causing any constraint violations.

Extra, extra credit (0 pts): What is your instructor's favorite beer?