CPSC 304 Midterm 1
Oct 11, 2006
Total: 20 points

Question 1 (7 points) You are hired to set up a relational database for a small community hospital. The first thing you do is to go to the hospital and find out the attributes that need to be stored, and their inter-relationships. Here are your findings:

- Every room has a unique room number (integer).
- Every room has one designated usage (char [40]), but different rooms may have the same usage.
- Every patient is assigned a room, but many patients may be assigned to the same room.
- Every patient has a unique patient number (integer)
- Every patient has a name (char[40]) which is not necessarily unique.
- A patient may be treated by more than one doctor, and a doctor may attend to more than one patient.
- Every doctor has a unique doctor number (integer) and a unique phone (char[10]).

a) (3 points) Draw an entity-relationship diagram to represent the information described above.
(Instead of drawing the diagram, I outline below the key features to be shown in the diagram.)
Entity set: room with room number as the primary key and usage as the other attribute.
Entity set: patient with patient number as the primary key and name as the other attribute.
Relationship set: assignment 1-to-many from room to patients, with patient number as the primary key.
Entity set: doctor with doctor number or phone number as the primary key.
Relationship set: treatment many-to-many between patient and doctor with patient number and doctor number (or phone number) as the primary key
(Notice that there is not any explicit statement about participation constraints. So the grading is the same whether you apply participation constraints or not.)

b) (4 points) Suppose every entity set and every relationship set is to be represented by a different relation. Give the SQL data definition (i.e., create table statements) for those relations representing relationship sets.
Create table assignment
(roomNumber integer, patientNumber integer,
primary key (patientNumber),
foreign key patientNumber references patient(patientNumber),
foreign key roomNumber references room(roomNumber))

Create table treatment
(doctorNumber integer, patientNumber integer,
primary key (doctorNumber,patientNumber),

foreign key patientNumber references patient(patientNumber),
foreign key doctorNumber references doctor(doctorNumber))

Question 2 (6 points) Consider the following create table statement:

```
CREATE TABLE r1
( a1 INTEGER, a2 INTEGER, a3 INTEGER, a4 INTEGER, a5 INTEGER,
 PRIMARY KEY (a1, a2),
 UNIQUE (a3,a4),
 FOREIGN KEY (a5) REFERENCES r2(a5) )
```

a) (2 points) List all the non-trivial functional dependencies pertaining to the attributes of r1 that can be inferred from the create table statement.
a1, a2 determines a3, a4, a5.
a3, a4 determines a1, a2, a5.

b) (2 points) Is r1 in BCNF? Give a brief explanation.
Yes, it is in BCNF because both {a1, a2} and {a3, a4} are the only non-trivial functional determinants, and both of them are superkeys.

c) (2 points) Is r1 in 3NF? Give a brief explanation.
Yes, this is because if a relation is in BCNF, it is automatically in 3NF.

Question 3 (3 points) Consider the following relation instance:

A	B	C
John	1	Van
John	2	Rmd
Jane	3	Rmd
Jane	3	Rmd
Jill	4	Bby
Jill	5	Cql

Observe that $B \rightarrow A$ appears to hold with respect to the given instance. Check to see if all of the following dependencies hold with respect to the instance and explain why:

a) $A \rightarrow B$
No because, for instance, the A-value John has different B-values 1 and 2.

b) $B \rightarrow C$
Yes. The only B-value 3 that can possibly violate the FD has the same C-value Rmd.

c) $C \rightarrow A$

No because the C-value Rmd has different A-values John and Jane.

Question 4 (4 points) Use the following three axioms:

- (reflexivity) if $\beta \subseteq \alpha$, then $\alpha \rightarrow \beta$
- (augmentation) if $\alpha \rightarrow \beta$, then $\alpha\ \gamma \rightarrow \beta\ \gamma$
- (transitivity) if $\alpha \rightarrow \beta$ and $\beta \rightarrow \gamma$, then $\alpha \rightarrow \gamma$

to determine if the following two statements are true or false. If you think it is true, give a proof; otherwise, give a counter-example.

(a) (2 points) if $\alpha \rightarrow \beta\ \gamma$, then $\alpha \rightarrow \beta$

1. *$\beta\ \gamma \rightarrow \beta$ (reflexivity)*
2. *$\alpha \rightarrow \beta$ (transitivity on 1 and the given fd)*

(b) (2 points)) if $\alpha \rightarrow \beta$ and $\beta\ \gamma \rightarrow \delta$, then $\alpha\ \gamma \rightarrow \delta$

1. *$\alpha\ \gamma \rightarrow \beta\ \gamma$ (augmentation on the given fd $\alpha \rightarrow \beta$)*
2. *$\alpha\ \gamma \rightarrow \delta$ (transitivity on 1 and the given fd $\beta\ \gamma \rightarrow \delta$)*

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