MIDTERM

Computer Science 422

Summer 2003 NAME:_____

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1. Consider a database keeping track of information about votes taken in the US Senate. For each senator, the database stores their name, the state he or she represents, and the political party he or she belongs to. For each bill, the database stores the name of the bill, the date of the vote on the bill, whether the bill passed or failed, and the sponsor(s) of the bill[1]. Finally, the database also keeps track of how each senator voted on each bill, which could be *Yes*, *No*, *Abstain*, or *Absent*.

   (a) (20pt) Draw an ER diagram for this database.

   (b) (10pt) Convert your ER diagram to relations.

[1] The *sponsors* of a bill are the senators who proposed the bill.

2. Given the following suppliers-parts-projects database:

```
S: (SID, SNAME, RATING, CITY)
P: (PID, PNAME, COLOR, WEIGHT, CITY)
J: (JID, JNAME, CITY)
SPJ: (SID, PID, JID, QTY)
```

- `S` represents suppliers. Each supplier has a unique id, a name, a rating, and a location. We assume that each supplier is located in exactly one city.
- `P` represents parts. Each kind of part is described by its unique id, name, color, weight, and the location where parts of that kind are stored. We assume that each kind of part comes in exactly one color and is stored in a warehouse in exactly one city.
- `J` represents projects. Each project has a unique id, a name, and a location where the project takes place. Again we assume that each project takes place in exactly one city.
- `SPJ` represents shipments. Each tuple in this relation represents a shipment of part `PID` from supplier `SID` to project `JID` in quantity `QTY`.

Write *relational algebra expressions* for the following queries:

(a) (4pt) Find the names of all the blue parts .

(b) (5pt) Find the names of all the suppliers that provide parts to project J2.

(c) (5pt) Find the names of all the suppliers that are located in the same city as project J2.

(d) (8pt) Find the total weight of parts provided by supplier S1 to project J2.

(e) (8pt) Find the number of suppliers for each project, and order the results by the number of suppliers.

3. Given the following relations:

```
MALE(x)
FEMALE(x)
PARENT(x,y)
```

Write *datalog programs* to compute the following relations:

(a) (5pt) `FATHER(x,y)`, where `x` is `y`'s father.

(b) (5pt) `MOTHER(x,y)`, where `x` is `y`'s mother.

(c) (5pt) `BROTHER(x,y)`, where `x` is `y`'s brother.

(d) (5pt) `SISTER(x,y)`, where `x` is `y`'s sister.

(e) (5pt) `GRANDCHILD(x,y)`, where `x` is `y`'s grandchild.

(f) (5pt) `ANCESTOR(x,y)` where `x` is `y`'s ancestor.

4. Consider the following *Books* relation:

Title	ISBN	Format	Used	Price	AuID	AuName	AuPhone	PubID	PubName	PubAddr

where

- `Title`, `ISBN`, and `Price` are the title, ISBN, and price of a book.
- `Format` of a book can be either *hardcover* or *softcover*, and the value for the `Used` attribute can be either *true* or *false*.
- `AuID`, `AuName` and `AuPhone` are the id, name, and phone number of the book author. We assume that the id of an author is unique, but an author may have multiple phone numbers (cell phone, office phone etc.). Also note that one book may have multiple authors.
- `PubID`, `PubName`, and `PubAddr` are the id, name, and address of the book publisher. The id of a publisher is unique.

(a) (10pt) List a minimal basis of the FDs for this relation.

(b) (10pt) List the key(s) of the relation.

(c) (10pt) Decompose the relation into 3NF or BCNF relations as appropriate.

(d) (10pt) For each relation in (c), state whether it's 3NF, BCNF, or 4NF. If it is not 4NF, decompose it into 4NF relations.

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