

# MIDTERM<sup>1</sup>

Computer Science 422

Summer 2005

NAME: \_\_\_\_\_

---

1. Analyze the the sample email below and design a database schema for storing emails.

From: John Smith <jm@spammer.net>  
Reply-to: nobody <nobody@spammer.net>  
To: John Doe <jd@hotmail.com>  
Doe, Jane <janedoe@hotmail.com>  
CC: jm@yahoo.com  
Date: 09:01PM 7/24/2005  
Subject: CONGRATULATIONS

Dear Winner:

You have won the International Lottery. Please send us your name, birthday, credit card number, and other personal information you want to share.

- (a) (10pt) Draw an ER diagram for this database.
- (b) (10pt) Convert your ER diagram to relations.

---

<sup>1</sup>The total of the midterm is 90pt. Anything above 90pt is considered extra credit.

2. Given the following database schema:

```
Suppliers( sid, sname, address )
Parts( pid, pname, color )
Catalog( sid, pid, price )
```

Write *relational algebra expressions* for the following queries:

- (a) (5pt) Find the names of the suppliers who supply red parts.
- (b) (5pt) Find the names of the suppliers who supply *all* red parts.
- (c) (5pt) Find the names of the products which are supplied by at least two different suppliers.
- (d) (5pt) For each product, list the name(s) of the supplier(s) who supply that product for the lowest price.

3. Given the following database schema:

```
Employees( id, name, birthday )
Manages( employee_id, manager_id )
```

Assume that one employee may have multiple managers. Write *datalog programs* for the following queries:

- (a) (5pt) Find the birthday of Joe.
- (b) (5pt) Find the name of Joe's manager.
- (c) (5pt) Find the names of the employees who are managed (directly or indirectly) by Joe.
- (d) (5pt) Find the names of the employees who are managed (directly or indirectly) by Joe but not managed (directly or indirectly) by Sue.
- (e) (5pt) For the datalog query in (d), draw a dependency graph and show that the recursion is *stratified*.

4. Consider relation  $R(A, B, C, D, E)$  with FD's  $AB \rightarrow C$ ,  $C \rightarrow A$ ,  $C \rightarrow D$ , and MVD's  $C \twoheadrightarrow E$ .
- (a) (5pt) Find the key(s) of  $R$ .
  - (b) (5pt) Is  $R$  in 3NF? If not, decompose it into 3NF.
  - (c) (5pt) Are the relations you get in (b) in BCNF? For the ones that are not, decompose them into BCNF.
  - (d) (5pt) Are the relations you get in (c) in 4NF? For the ones that are not, decompose them into 4NF.

5. A small online computer retailer uses a database to store product information. At the beginning, the database consists of only one relation

```
Products( pid, description, price )
```

As the business grows, the retailer decides to hire you to redesign the database to support more features.

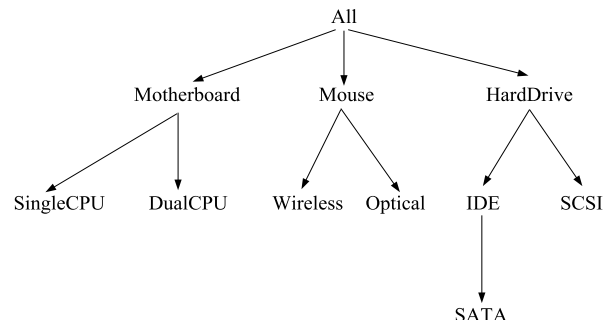


Figure 1: Category Hierarchy

- (a) (10pt) Revise the database schema to store hierarchical category information as shown in Figure 1, and the information about which category(s) a product belongs to. Note that a product may belong to more than one category, e.g. a mouse can be both “Wireless” and “Optical”.
- (b) (10pt) The price of a product often changes because of market conditions and/or sales promotions. Further revise the database schema you get in (a) so that the database not only keeps the current price for each product, but also past and future prices as well.

[empty page]