LBSC 690 Final Exam **Fall 2008**

Name: _____

You have 150 minutes to complete this exam. Do not begin until you are given the signal.

- You may use any material, including the text book, lecture slides, and notes.
- You may also use anything found on the Internet that existed before the exam started.
- You may NOT communicate with any other person during this exam, either in person or using electronic means. So that there is no misunderstanding, close all instant messengers now.

As strategies for completing the exam, keep the following in mind:

- If you find a question to be ambiguous, make reasonable assumptions as you see fit, but write down your assumptions.
- You are more likely to get partial credit for a wrong answer if you show your work.
- Be careful not to get carried away and run over the time limit by spending too much time on one question. Plan ahead, and don't devote more time to a question than it is worth.

Score Summary

Question	Possible points	Actual points
1	25	25
2	15	15
3	25	25
4	10	10
5	10	10
6	15	15
TOTAL	100	100

1. [25 points total] Networks.

Consider the following (simplified) routing table:

Destination	Next Hop
18.213.2.3	18.154.2.1
125.53.*.*	123.12.87.2
165.*.*.*	16.3.0.1

A. [2 points] When a packet arrives at this router with a destination of 18.213.2.3, where is the packet sent to next?

18.154.2.1

B. [2 points] When a packet arrives at this router with a destination of 125.53.5.102, where is the packet sent to next?

123.12.87.2

C. [7 points] Why are there wildcards (*) in the routing table?

One reason is size: there aren't sufficient resources to store routes to every possible destination. Another major reason is efficiency: you can use wildcards to route packets that are going to the same general area on the network.

D. [7 points] Do packets going to the same destination always take the same route through the network? What are some considerations that a router might take into account when deciding where to send a packet next?

No. Routes might depend on network traffic, for example.

E. [7 points] Why do packets sometime arrive out of order at a destination?

Two reasons: packets might take different routes. Some packets might be dropped and require retransmission.

2. [15 points total] HCI: horizontal vs. vertical navigation bars. For some Web sites, the navigation bar runs vertically along the left edge of the screen. For other Web sites, the navigation bar runs horizontally along the top edge of the screen. What are the advantages and disadvantages of either approach?

Organize your answer as claims of the form "One consideration that makes horizontal navigation bars better/worse than vertical navigation bars is…" Make sure you appropriately support or justify each claim. Make at least three such claims.

- One consideration that makes horizontal navigation bars worse than vertical navigation bars is the width of the screen, since horizontal scrolling is awkward. This constrains the number of possible items displayed.
- One consideration that makes vertical navigation bars better than horizontal navigation bars is that vertical navigation bars can show more items (vertical scrolling is much easier than horizontal scrolling).
- One consideration that makes vertical navigation bars better than horizontal navigation bars is that it is possible to nest items (e.g., a bulleted list). This is more difficult to accomplish in a horizontal layout.
- One consideration that makes horizontal navigation bars better than vertical navigation bars is that they can be made into familiar drop-down menus. With vertical navigation bars, the menu items would have to pop out from the left, which may be foreign to some users.
- One consideration that makes vertical navigation bars better than horizontal navigation bars is that they may take up less space. Horizontal navigation bars take up room at the top of the screen; vertical navigation bars take up room on the side. Since most screens are wider than they are tall, it can be argued that vertical navigation bars waste less space. Also, very long horizontal lines are difficult to scan as the eye moves back to pick up the next line, so one might prefer a layout with narrower text columns (using the space left over for a vertical navigation bar).

3. [25 points total] Databases. Design a simple inventory database to keep track of desktop computers at a local library. Here are the requirements:

- The database must keep track of the specifications of each computer (e.g., processor, RAM, hard drive)
- Each computer must be uniquely identified in the database by an inventory tag number.
- Each computer belongs in a particular location (e.g., reference, reading room, circulation, acquisitions, catalog, etc.). This information must be kept in the database.
- Each computer is designated for public use or use by a member of the library staff (e.g., a row of computers in the reading room is for the public to use; the computer at the circulation desk is for library staff only). This distinction must be recorded in the database.
- Multiple computers may have the same specification (e.g., if they were purchased together). This fact should be taken into account in the database design. However, the database does not need to record any information about the acquisition of the computers.

A. [13 points] Describe a database design that fulfills the above requirements. Sketch out your table structure. Identify primary/foreign keys. Make up sample data to fill in a few rows to illustrate your design.

Table: Configurations (Primary key = ConfigID)

ConfigID	Processor	RAM	Disk
1	2.0 GHz	4 GB	200 GB
2	2.5 GHz	8 GB	500 GB
3	3.0 GHz	32 GB	750 GB

Table: Inventory (Primary key = Tag, Foreign key = ConfigID)

Tag	Location	ConfigID	Use
1	Reading Room	1	Public
2	Reading Room	1	Public
3	Circulation	2	Private
4	Reference	1	Private
5	Machine Room	3	Private

Note how configurations are kept in a separate table. This allows multiple computers to have the same configuration without unnecessary duplication of information.

B. [4 points] I am looking for the inventory tag numbers of all the computers in the reading room. Write a database query to provide this information, given your design in part A. Either an SQL statement or a query in terms of conceptual operators (join, project, restrict) are acceptable.

SELECT Tag FROM Inventory WHERE Location = "Reading Room"

C. [4 points] I am looking for the specifications (processor, RAM, and hard drive) of all the computers in the reading room. Write a database query to provide this information, given your design in part A. Either an SQL statement or a query in terms of conceptual operators (join, project, restrict) are acceptable.

SELECT Processor, RAM, Disk FROM Configurations, Inventory
WHERE Inventory.ConfigID == Configurations.ConfigID and
   Location = "Reading Room"

D. [4 points] I am looking for all computers that have more than 16 GB of RAM. Where in the library (if anywhere) can I find such machines? Write a database query to provide this information, given your design in part A. Either an SQL statement or a query in terms of conceptual operators (join, project, restrict) are acceptable.

SELECT Tag, Location FROM Configurations, Inventory
WHERE Inventory.ConfigID == Configurations.ConfigID and
  RAM > "16 GB"

4. [10 points total] Search. In class, we discussed how polysemy is a problem in search. Is this problem more or less severe for multi-word queries, compared to single word queries? Explain.

Polysemy is the phenomenon where one word can have multiple meanings. For example, bat can be either a wooden stick used in baseball or a flying mammal. Polysemy is less of a problem in multi-word queries because other query terms may disambiguate the intent of the user. For example, "little league bat" is probably asking about baseball bats, whereas "bat flying night" probably refers to the flying mammal.

5. [10 points total] Multimedia.

A. [5 points] Check out the following picture:

http://www.umiacs.umd.edu/~jimmylin/images/photos/stata-graduation.jpg

It's a picture from my graduation, where I was decked out in MIT regalia. Pretty neat colors, huh? The image is 800 by 600 pixels in 24-bit color (8 bits for R, 8 bits for G, and 8 bits for B, per pixel). To store all the information contained in this image without any compression, how much space would you need?

800 x 600 x 3 = 1,440,000 bytes

B. [5 points] In digitally-encoded video clips, do certain types of scenes require more storage than others? Explain. Assume you want constant quality.

Remember that video encoding is primarily based on storing frame differences, i.e., changes in pixel from frame to frame. Therefore, videos with lots of scene changes might take more room.

6. [15 points total] Programming JavaScript. The funny operator % (called "modulo") gives you the remainder of a division operation. For example:

- 4 % 3 = 1, since you get one left over when you divide 3 into 4
- 5 % 3 = 2, since you get two left over when you divide 3 into 5
- 6 % 3 = 0, since 3 divides evenly into 6

A. [5 points] Consider the following code:

```
var i = 0;

for ( i=1; i<=6; i++ ) {
  if ( i % 2 == 0 ) {
     document.writeln("tock\n");
  } else {
     document.writeln("tick\n");
  }
}
```

Its output is:
tick
tock
tick
tock
tick
tock

Make minimal changes to the above program so that the output becomes:
tock
tick
tock
tick
tock
tick

```
for ( i=1; i<=6; i++ ) {
  if ( i % 2 == 1 ) {
     document.writeln("tock\n");
  } else {
     document.writeln("tick\n");
  }
}
```

B. [5 points] Using the code in part A as a starting point, write a program that outputs the following:

tic

tac

toe

tic

tac

toe

Your code **must** preserve the loop structure. Hint: this question only involves modifying the conditional structure.

```
for ( i=1; i<=6; i++ ) {
    if ( i % 3 == 1 ) {
        document.writeln("tic\n");
    } else if ( i % 3 == 2 ) {
        document.writeln("tac\n");
    } else {
        document.writeln("toe\n");
    }
}
```

C. [5 points] Consider the following code, taken from one of the examples in the class session on programming:

```
var i=prompt("How many scoops of ice cream would you like?", "")

while (i > 0){
    document.write("Here is a scoop of ice cream!<br>");
    i--;
}
```

What is the importance of the statement "i--;"? What would happen to the behavior of the program if this line were removed?

The statement decrements the variable i by one. If the statement were removed, the program would loop infinitely, since the variable i would always be greater than zero.