

# CS 199 LBP: Mid-Term 2

April 11, 2007

Name:

## Instructions:

- Write your name in the box above.
- There are 19 questions on 7 pages (plus the cover page and an extra page at the end). Each page is printed on only one side.
- There is no penalty for guessing.
- Every problem is worth one point except where otherwise indicated.

**For each of the following 4 questions, answer True or False**

1. Multiprogramming is the technique of using multiple CPUs to run programs.
2. Batch Processing implies a high level of interaction between the user and the program.
3. A logical address specifies an actual location in main memory.
4. The Minimum Spanning Tree algorithm can be used to solve the ice-cream stand (dominating set) problem.
5. What does it mean for a scheduling system to be “preemptive”? Name a preemptive scheduling method, and a non-preemptive one.

6. Why do we say that users in a timesharing system have their own virtual machine?

7. What is a real-time system?

8. Give examples of 4 different file types. How are file types typically indicated?

9. Which takes the most time in a computer system: file I/O, cpu scheduling or context-switching? Explain your answer.

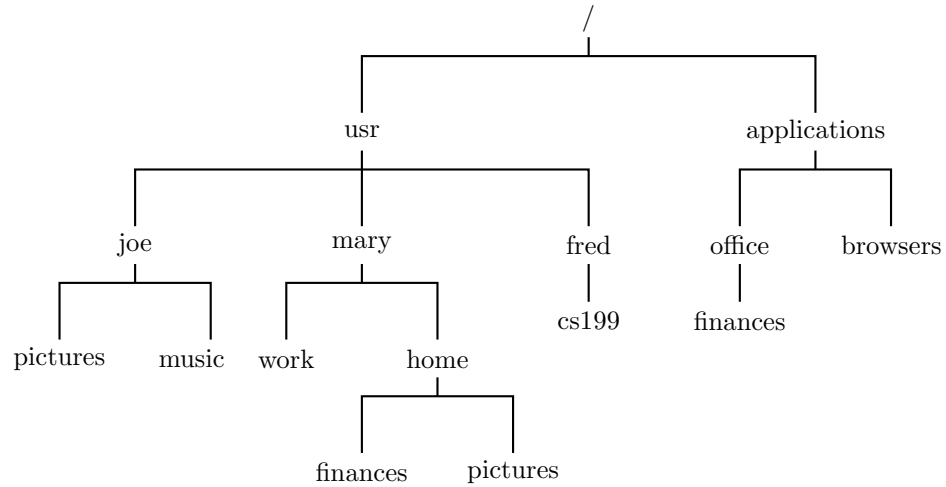
10. Suppose we have the following 5 processes, with running times indicated in brackets:

- Process A (5 minutes)
- Process B (10 minutes)
- Process C (8 minutes)
- Process D (6 minutes)
- Process E (12 minutes)

For each of the following scheduling algorithms, list the completion time of each job, and find the sum of the completion times of the jobs:

- (a) Shortest-Job-Next
- (b) Round Robin, with a time slice of 1 minute.

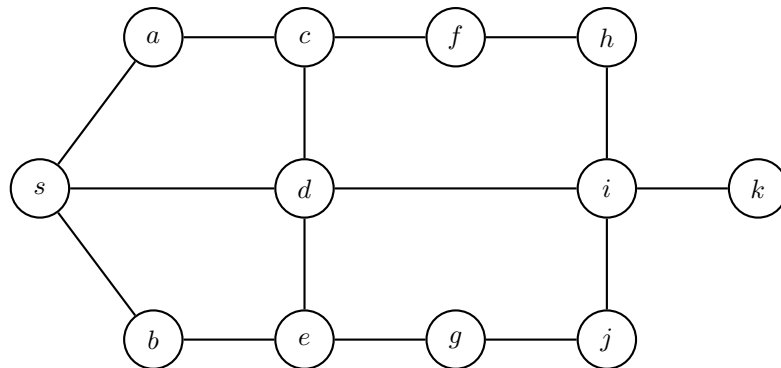
11. The directory structure of a computer is shown below:



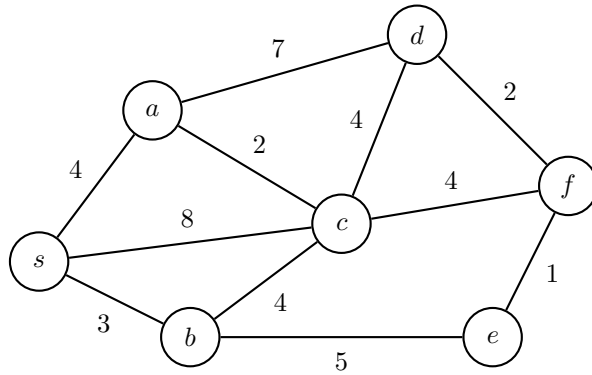
Suppose we are currently in Mary's directory (so a command to move to her work directory would be "cd work". For each of the following directories, give both the absolute and relative pathnames:

- (a) Mary's finances directory
- (b) Joe's pictures directory

12. If we run a breadth-first search in the following graph beginning at  $s$ , in what order are the other vertices discovered?



13. Run Dijkstra's algorithm on the following graph, starting at vertex  $s$ . Show the contents of set  $S$  (the "blob") after each step of the algorithm. Finally, list the length of the shortest path from  $s$  to each other vertex.



14. At the company party, you are assigned the job of splitting the employees into two teams. The sum of the weights of the players on the first team must be equal to the sum of the weights of the players on the second team. Suppose you try every possible way of splitting the employees up into teams (there are  $2^n$  possibilities if there are  $n$  employees), and you have access to a computer that can try 1 million possibilities each second. What is the largest number of employees for which your algorithm will finish in 3 hours?

15. Suppose the CEO of a company wanted to invite all his employees to a party at his house. Unfortunately, he knows that not all of his employees get along with each other. If he invites two employees who dislike each other to the same party, they might quarrel, ruining the party. On the other hand, having lots of different parties is both tiring and expensive. What he would really like is to have as few parties as possible, while ensuring that every employee gets invited to one of the parties, and no two employees who dislike each other are invited to the same party. You can assume that he already knows, for every pair of employees, whether they get along or not.

Explain why the CEO's problem is like graph coloring.

16. Suppose you worked for the power company, and it was your job to decide where to put the power lines that supply electricity to each house in a town. (The town power generator is located in your backyard.) For every pair of houses in the town, you know how far apart they are, and so you know how much it would cost to connect them with a power line. You have to make sure that every house in town is connected to the power supply, and you want to do this without spending too much money for the power cables.

One possible solution to the problem would be to string one line from your house to each other house in the town but there may be situations where this will spend far too much money on the power lines. (For example, if there are only 4 houses in the town, and all three of the others are next to each other, and a mile away from your house, this solution would pay for 3 miles of power lines. A much better solution would be to install a one-mile line from your house to one of the others, and then pay for the very short lines that can connect that house to the two others.)

If you would like to *minimize* the amount of money spent on the power lines, which of the algorithms that we have seen in class could we use to solve the problem? Justify your answer.

17. What is printed by the following Python program?

```
x = 5
y = 2
for i in range (0,2):
    x = x * y
print x
```

- (a) 2
- (b) 20
- (c) 40
- (d) 80

18. Look at the following Python code:

```
a = input('Enter a positive number a')
b = input('Enter another positive number b')
while (a >= b):
    a = a - b
r = a
```

Give a one-sentence description of what  $r$  is, in terms of the values  $a$  and  $b$  that the user inputs.

19. Suppose you have an array  $a$  that contains some integers.

- (a) Write a Python program that checks if the value 5 is in the array. If it is, your program should print “The array contains 5”. If it is not, your program should print “The array does not contain 5”.
- (b) Write a Python program that checks if the value 5 is in one of the even-numbered locations of the array. That is, if one of the 0th, 2nd, 4th, . . . values in the array is 5, your program should print “The array contains 5 in an even-numbered location”; otherwise, it should print “The array does not contain 5 in an even-numbered location”. For example, if  $a = [1,4,5,6,8]$ , your program should say “The array contains 5 in an even-numbered location” because 5 occurs in location 2. If  $a = [1,2,6,5,8,9,7]$ , your program should say “The array does not contain 5 in an even-numbered location”, because 5 occurs only in location 3.

(Extra blank page)