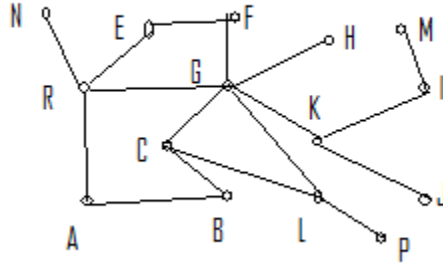


COP 3503 Recitation Worksheet: DFS, BFS, Top Sort, Greedy Review Solutions

Use this graph for questions 1 and 2:



1) Show the order in which the vertices in the following graph get visited in a breadth first search, starting at vertex A. Any time multiple vertices are being added into the queue, add them in alphabetical order.

A, B, R, C, E, G, N, L, F, H, K, P, I, J, M

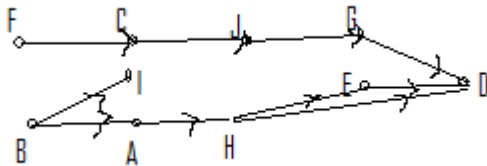
2) Show the order in which the vertices in the following graph get visited in a depth first search, starting at vertex A. Any time multiple vertices are being added into the queue, add them in alphabetical order.

A, B, C, G, F, E, R, N, H, K, I, M, J, L, P

3) Johnny has to perform the tasks A, B, C, D, E, F, G, H, I and J today. However, there are some restrictions. Each of the following ordered pairs imposes an order between the two tasks. For example, the ordered pair (F, C) means that task F has to be completed before task C. Here is a complete list of the restrictions:

- | | | | | | | |
|--------|--------|--------|--------|--------|--------|--------|
| (F, C) | (B, A) | (C, J) | (B, I) | (J, G) | (E, D) | (H, D) |
| (G, D) | (A, H) | (H, E) | | | | |

(a) Draw the corresponding directed graph that models this situation.



(b) Determine the valid ordering of these tasks obtained by running a topological sort on the graph. Your sort should go through the vertices in alphabetical order (for the starting points of the DFS). Any time you have a choice between multiple vertices in the DFS, go to the one that comes first alphabetically first.

F, C, J, G, B, I, A, H, E, D

4) In a BFS of the Eight Puzzle problem shown in class, which are the board positions that can be reached from the following position:

6	8	1
4		7
5	2	3

There are four pieces, 8, 4, 7 or 2 that can slide into the open position, so here are the reachable board positions from the one drawn (an underscore is being used for a blank square):

6	_	1	6	8	1	6	8	1	6	8	1
4	8	7	_	4	7	4	7	_	4	2	7
5	2	3	5	2	3	5	2	3	5	_	3

5) Your secretary brings you various papers which you place on stacks on your desk as he hands them to you. The rule is that you can only place a paper on an existing stack if its priority is at least as high as the paper on the top of the stack currently. If no such stack exists, you must form a new stack. Your goal, since you want your desk to look as tidy as possible, is to minimize the number of stacks used. The priority of each paper is designated by a letter from A to Z. A represents the highest priority and Z represents the lowest priority. For the following sequence of papers (given in the order in which you receive them), determine the number of stacks you'll need to form to store them all. Please show the contents of each of your stacks. To get full credit, you must follow the appropriate greedy algorithm discussed in class. (Note: You may not use all the stacks drawn.)

C, C, B, G, J, D, J, D, J, D, N, G, H, D, N, D, S, D, F, E, F, H, T, Y, D, S, J, A, N, D, H, F, H, A

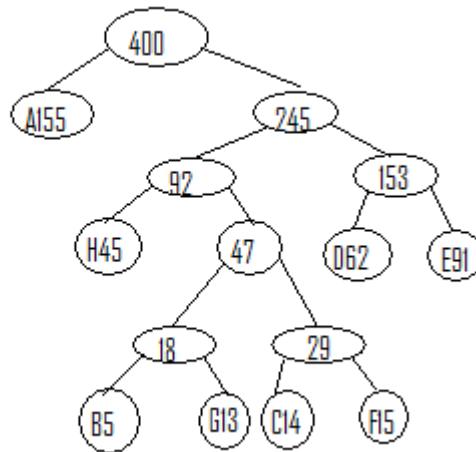
	D									
	D									
	D	E								
A	D	F								
A	D	G	F	H						
B	D	J	F	H	J					
C	D	J	H	H	S	N				
C	G	J	N	N	S	T	Y			
Stack1	Stack2	Stack3	Stack4	Stack5	Stack6	Stack7	Stack8	Stack9	Stack10	

Answer: 8

6) Consider creating a Huffman code for a file with eight distinct characters, 'A' through 'H'. Given the character frequencies below, create a Huffman tree, determine valid Huffman codes and calculate the number of bits saved (not counting the storage of the code) by the code if the old fixed-length storage scheme used 3-bits per character.

Character	Frequency	Code	Character	Frequency	Code
A	155	0	E	91	111
B	5	10100	F	15	10111
C	14	10110	G	13	10101
D	62	110	H	45	100

Huffman Tree:



Bits Saved Calculation:

$$\text{Old Code} = 3 \times 400 = 1200$$

$$\text{New Code} = 155 + 5 \times 5 + 5 \times 14 + 3 \times 62 + 3 \times 91 + 5 \times 15 + 5 \times 13 + 3 \times 45 = 984$$

Bits Saved: **216**