CSE317 DESIGN & ANALYSIS OF ALGORITHMS
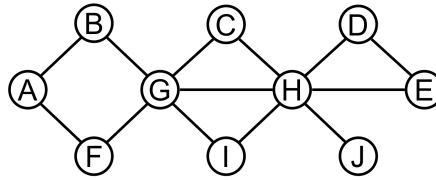## First Term Examination – Spring'16

Max Marks: 30   Time Allowed: 90 minutes

> *Attempt all questions. Be to the point. Show your work.*

1. Consider the following undirected graph.

   (a) [1 mark] Write adjacency list representation of the above graph.

   (b) [1 mark] What is the sum of degrees of all nodes in the above graph?

   (c) [4 marks] Clearly indicate the following trees in the above graph. Break all ties by picking the vertices in alphabetical order. (You do not need to show the intermediate steps, just give the required trees)

      i. A DFS tree rooted at A

      ii. A BFS tree rooted at A

2. [5 marks] Let G be a connected undirected graph. Write pseudocode of an $O(n+m)$ time algorithm to find a cycle in G. If there there are multiple cycles in G, your algorithm should output any one of them and report if no cycle exists in G.

   Hint: Think of a suitable $O(n + m)$ time algorithm we have learned in the lectures and modify it.

3. [5 marks] Consider the following set of intervals.
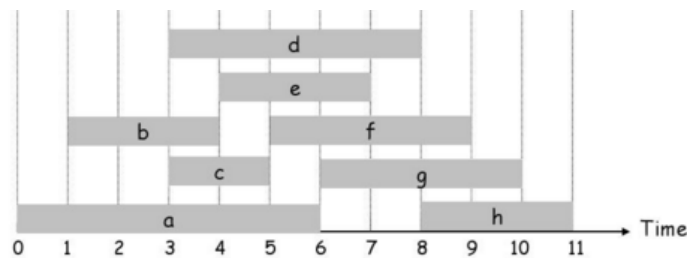
   Each interval has a start time and a finish time. These intervals for instance represent jobs for a machine. Find a subset of mutually compatible jobs using the following greedy strategies.

   (a) Shortest job first

   (b) Earliest finish time first

   (c) Fewest conflict job first

4. (a) [3 marks] For the following directed graph G. Is G strongly connected? If not then what is the minimum number of edges you must add to G to make it strongly connected?
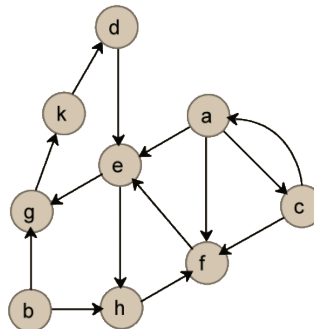
(b) [1 mark] For a DAG G on n nodes. Exactly how many strongly connected components it has?

(c) [1 mark] True or False? In a DAG there cannot be a node such that all other nodes are reachable from it. Briefly justify your answer.

5. Inspired by stable matchings, you decide to design a similar system for FYP allocation at IBA. The idea is that each senior student first provides her preferences over list of FYPs approved for the next semester. Then the univerity assigned a FYP to each student depending on her CGPA, that is, a student with higher CGPA will be prefered.

(a) [2 marks] How would you define *stability* in this scenario?

(b) [4 marks] IBA FCS has approved FYPs A, B, and C for Fall 2016. Assume that each FYP will be assigned to group of size exactly two. Illustrate your adaptation of Gale-Shapley algorithm for FYP allocation problem given the following preferences of 6 students.

ERP	CGPA	Preferences		
1	3.00	A	C	B
2	2.50	A	C	B
3	3.39	B	A	C
4	2.25	C	A	B
5	2.20	C	A	B
6	2.75	A	B	C

6. [3 marks] For each pair of expressions (A, B) below, indicate whether A is O, Ω, or Θ of B. Your answer should be in the form of table with "yes" or "no" written in each box.

	A	B	O	Ω	Θ
(a)	$\sqrt{n}$	$\log(n^2)$			
(b)	10	$\log(10)$			
(c)	$4n \log n + n$	$(n^2 - n)/2$			