Reg. No_____ Section_____

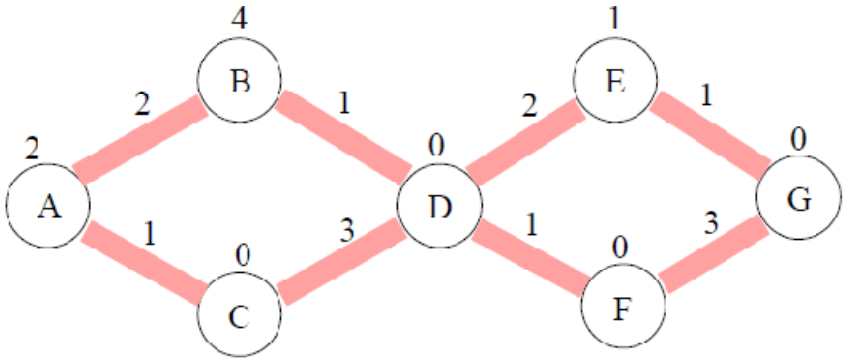
National University of Computer and Emerging Sciences, Lahore Campus

Course:	Artificial Intelligence	Course Code:	CS401
Program:	BS(Computer Science)	Semester:	Spring 2017
Duration:	60 Min	Total Marks:	25
Paper Date:	21-2-2018	Weight	12.5%
Section:	A, B and C	Page(s):	6
Exam:	Mid-I	Reg. No	----------

Instruction/Notes:
- This is a closed book closed notes exam.
- Calculators are allowed
- Write your final answers on the provided space only.
- Show your working on the back of these sheets or attach any extra sheets, containing your working, with this paper.
- Write your ID and section on every page

Problem 1:

The following is a state-space search graph of a problem with nodes labeled using alphabets, edges are the thick shaded lines. The number above each edge giving the transition cost *(e.g., cost(C,D) = 3)* of the corresponding action and the number above each node is its heuristic value of that node *(e.g., h(A) = 2)*. The node labeled **A** is the initial state and that labeled as **G** is the goal state.



a) List, in order, the nodes that will be expanded if A* algorithm is used to find a path from the initial state to the goal state. [2 Points]

b) What path (if any) would be found by A* algorithm in part a. [2 Point]

c) What would be the state (nodes in it) of frontier/queue when the goal is found by A* algorithm in part b. [1 Point]

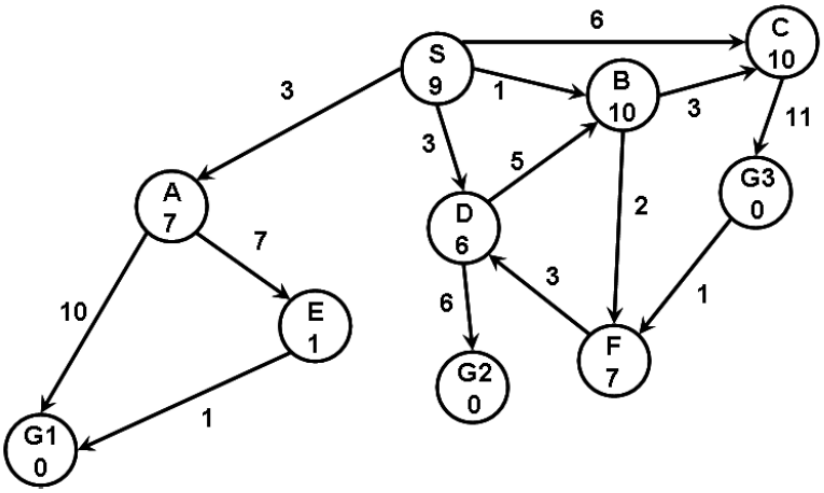
d) In one of my implementation of A* I made an interesting mistake. My implementation was identical to the correct A*, except that when it visits a node **n** that has already been expanded, it immediately skips **n** instead of checking if it needs to reinsert **n** into the priority queue. What path would be found by my erroneous implementation of A* in the search problem given in part a above. Also **comment** on the **effects of this change** on **completeness** and **optimality** of A* algorithm. [3 Points]

e) One FAST- student suggested an early termination strategy for A* algorithm. He suggested that A* must be stopped as soon as the first goal node G is found in some successor list instead of waiting until G is popped off the priority queue. What path would be found by his version of A*for the state-space search problem given in **part a**. Also **comment** on the **effects of this change** on **completeness** and **optimality** of A* algorithm. [3 Points]

f) Prove or disprove that the heuristic given in above problem is consistent. [1 Point]

Problem 2: **[1 +1 +1 +1 Points]**

For the state space search graph below, where **S** is the initial state and G_1, G_2, and G_3 are goal states. Arcs are labeled with the cost of associated actions and the heuristic cost to a goal is shown inside the nodes. Mark the all goal states that might be returned by each of the following search algorithms.



DFS	€ G_1	€ G_2	€ G_3
BFS	€ G_1	€ G_2	€ G_3
Uniform Cost Search	€ G_1	€ G_2	€ G_3
A*	€ G_1	€ G_2	€ G_3

Problem 3: **[2 + 1 + 1 Points]**

a) If h_1, h_2, h_3 and h_4 is average of these four heuristics also admissible? Prove or disprove

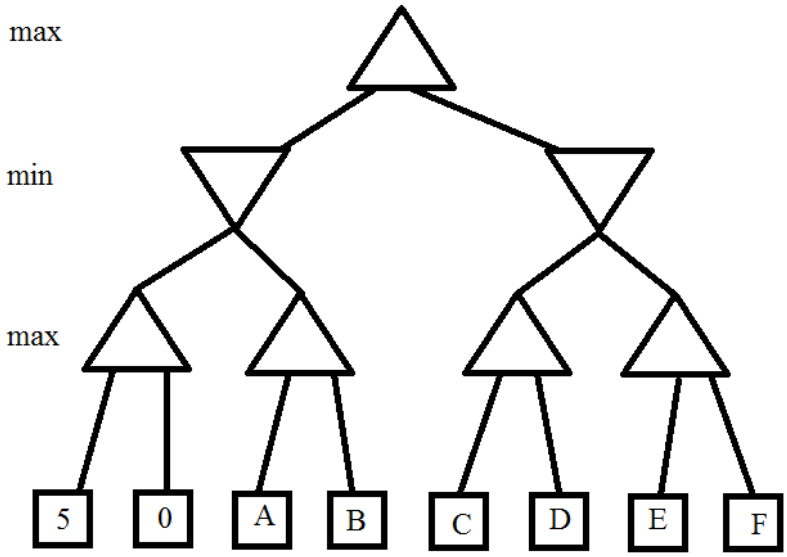
b) Which search algorithm is guaranteed to return optimal solution of step cost is a positive constant, but not otherwise?

c) Which of the following search algorithms are complete if goal is on finite depth and branching factor is also finite (chose all the apply)

€ DFS € BFS € Uniform Cost Search

Problem 4: **[1 + 1 + 1 + 2 Points]**

Consider the game tree picture below where A-F represent some real values. Assume the nodes are explored from left to right and standard alpha beta pruning is used.



a. Give a value of A such that B is pruned.

b. True or False: There are SOME values of A and B such that the sub-tree containing C and D is pruned?

c. Assuming that B = 5 and A = 5, give a value of C and D such that the sub-tree containing E and F is pruned.

d. If you are allowed to assign A-F arbitrarily, what is the MAXIMUM number of leaves that can be pruned? also specify the pruned leaves.