National University of Computer and Emerging Sciences, Lahore Campus
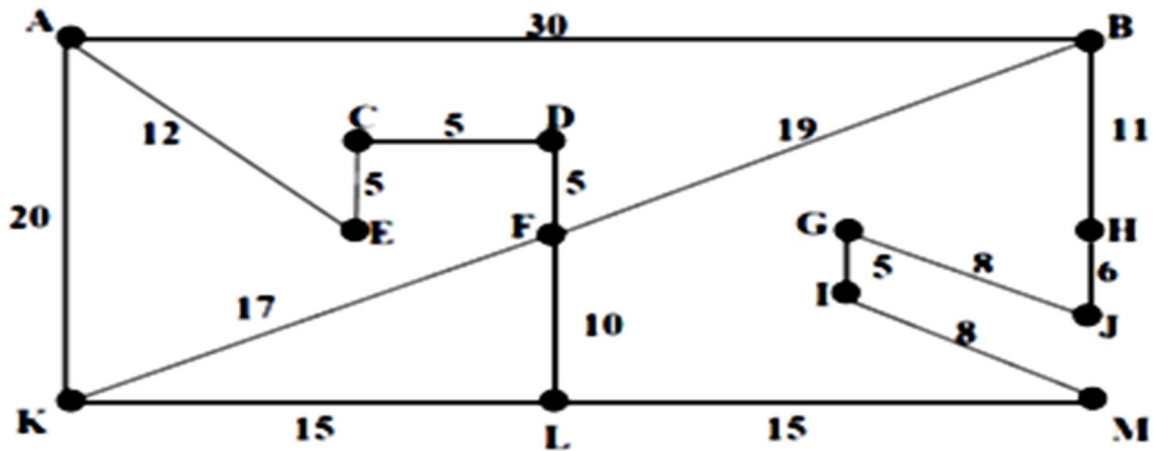
Course Name:	Artificial Intelligence	Course Code:	CS 401
Program:	BS (Computer Science)	Semester:	Spring 2019
Duration:	60 Minutes	Total Marks:	50
Paper Date:	26-2-2019	Weight	15
Section:	For all sections	Page(s):	6
Exam Type:	Mid I		

Student Name:

Registration #:

Q1. A* Search Algorithm: **(10 + 8 + 2 Marks)**

Consider the following map (not drawn to scale)

Part a) Use A* algorithm to work out a route from town A to town M. Use the following cost functions

g(n) = Total cost of reaching from town A to town n (step cost of each move is given on the map)

h(n) = Straight line distance between town n and town M These costs are given in the table below.
h(n) can be used as an estimated distance to M

Town	Distance
A	56
B	22
C	30
D	29
E	29
F	30
G	14

Town	Distance
H	10
I	8
J	5
K	30
L	15
M	0

i)   **Showing the order of nodes expanded by A* (Show complete working on the next page)**

ii)   **What path/route would be found by A* using this heuristic function?**

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Part b) Repeat the above question for the following heuristic function

Town	Distance
A	80
B	10
C	50
D	20
E	10
F	30
G	60

| Town	Distance
H	30
I	20
J	50
K	60
L	20
M	0

Part c) Comment on the optimality of the two runs of A* algorithm in the first two parts. How would you account for the different routes returned by the two runs?

Q2. Run MINIMAX algorithm with Alpha-Beta pruning on the given game tree. Start state is for MAX and the values given at the bottom are the values of corresponding states for max player. **(8 + 7 mark).**

On the figure clearly show

- value of each node as found by the minimax algorithm
- the branches that will be pruned by the algorithm and the values of alpha and beta at the time of pruning

4   3   6   2   2   1   9   5   3   1   5   4   7   5
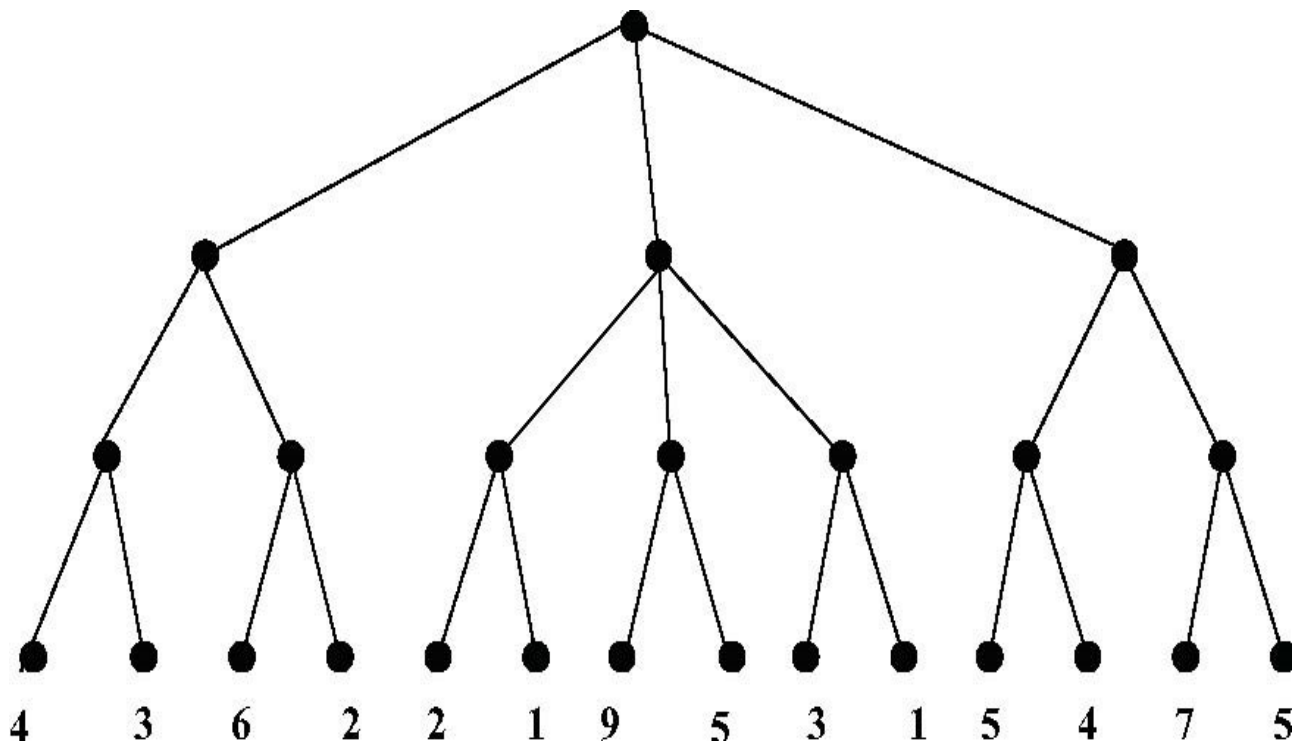
Q3. While solving eight puzzle we want to reach the state shown on right (**GOAL**) from the state shown on the left (**INITIAL STATE**) [**5 + 5 + 5 Marks**]

Initial State

2	8	3
1		4
7	6	5

Goal State

1	2	3
8		4
7	6	5

a) In the form of a tree, show all states processed by iterative deepening algorithm while finding the solution.

b) Specify the path found by iterative deepening algorithm.

c) Also show the number of times each node is processed/expanded by iterative deepening.

You must assume that the basic DFS has been implemented such that it always process the four possible moves in LEFT, UP, RIGHT and DOWN order i.e. the node generated by moving the space down is pushed onto the stack first followed by the node generated by moving the space right and so on.

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Good Luck