BRAC UNIVERSITY
Department of Computer Science and Engineering

Examination: Semester Midterm | Semester: Fall 2023
Duration: 1 Hour 15 Minutes | Full Marks: 40

CSE 422: Artificial Intelligence

Answer the following questions.
Figures in the right margin indicate marks.

1. CO1 Suppose you are asked to generate a set of 5 real numbers in the range of -10 to 10 whose mean would be 2. Now, you have to solve this problem using Genetic Algorithm.

a. **Encode** the problem and deduce two parent chromosomes, PC1 and PC2. 3
b. **Define** a suitable fitness function for the problem and calculate the fitness of PC1 and PC2. 2
c. **Illustrate** a single-point crossover at any point you prefer between PC1 and PC2, then perform mutation. You can mutate only two numbers of your choosing. 2
d. **Explain** briefly the role of crossover in finding the optimal solution in such types of problems. 3

2. CO1

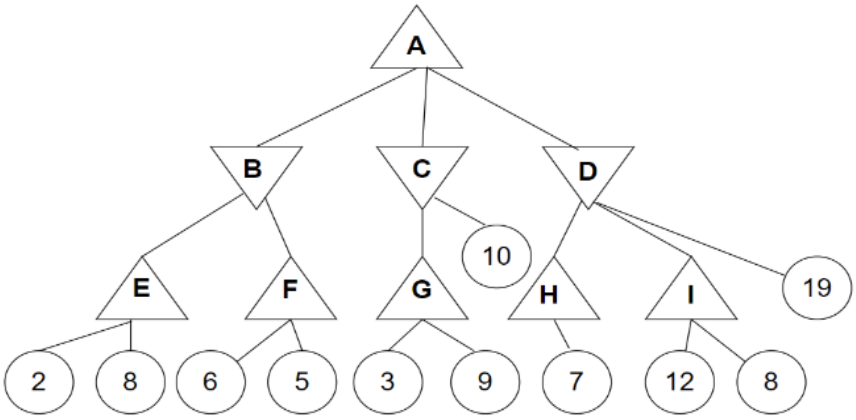
a. **Determine** which of the following statements are true or false. Give reasons behind your answers. 7.5
-A simple reflex agent is suitable to work in a partially observable environment
-A tic-tac-toe game is an example of a stochastic environment
-Hill Climbing allows backtracking
-For simulated annealing, the minimum value for $e^{\Delta E/T}$ is negative infinity
-Hill Climbing is guaranteed to find the global optima

b. **Define** what a local maxima is concerning the hill climbing algorithm. Then using a state space graph present a scenario that depicts a local maxima for the 8 puzzle problem. [Do not need to formulate the entire state space. Just show a subset of the state space graoh] 2.5

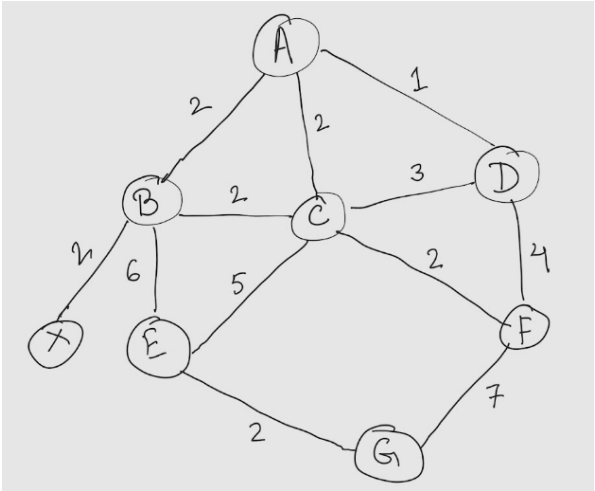
3. CO1

a. Minimax search is breadth-first: it processes all the nodes at a level before moving to a node in the next level. Is the statement True/False? **State** your reason 2
b. **State** whether it is possible that for a given search tree Minimax and Alpha-Beta Pruning will end up visiting an equal number of terminal nodes. [Yes/No] 1

c. Given the following snippet of state space tree of a two player game, **apply** alpha-beta pruning showing alpha,beta and node values for all the nodes. 7



4.CO1 In the graph below let, A, B, C, D, E, F, G, X denote different states of a problem space, where the edge between the states describes the action, and the number along the edge is the cost of the action to go from one state to another.



Let, A be your initial state and G be your goal. In the table below we give you the heuristic value to reach G from any given node, n in the graph.

n	A	B	C	D	E	F	X	G
h(n)	9	6	7	7	2	5	1	0

a. From looking at the graph, **find** the optimal path from A to G (DO NOT USE ANY SIMULATION), and show that the given heuristic for A is valid. 1

b. Using the given graph and the given values, **explain** why the Greedy best search does not guarantee an optimal solution. 4

c. For A* algorithm to be optimal, which condition on the heuristics should be imposed on the above graph. **Explain**. 1

d. **Check** if the heuristics for A, C and D satisfy the optimality condition of A* algorithm. Change the values of the heuristics for violating state(s), so that the condition is satisfied. 4