

Department of Electrical and Computer Engineering

CSE 440: Artificial Intelligence

Assignment 01

Total Marks: 45

Instructor: Dr. Mohammad Mahmudul Alam

Semester: Fall 2025

Due date: November 15<sup>th</sup>, 2025

Section: 02

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Instructions:

1. Submit a single PDF file containing your answers in consecutive order.
2. Keep your responses concise and relevant - only answer what is asked.
3. This is an open-book assignment; however, copying another student's work is strictly prohibited and will not be tolerated.
4. PDFs will be reviewed to determine whether the answers were generated using AI tools (e.g., ChatGPT, DeepSeek).

Question 1 (12 Marks):



[https://www.gymlibrary.dev/environments/toy\\_text/frozen\\_lake/](https://www.gymlibrary.dev/environments/toy_text/frozen_lake/)

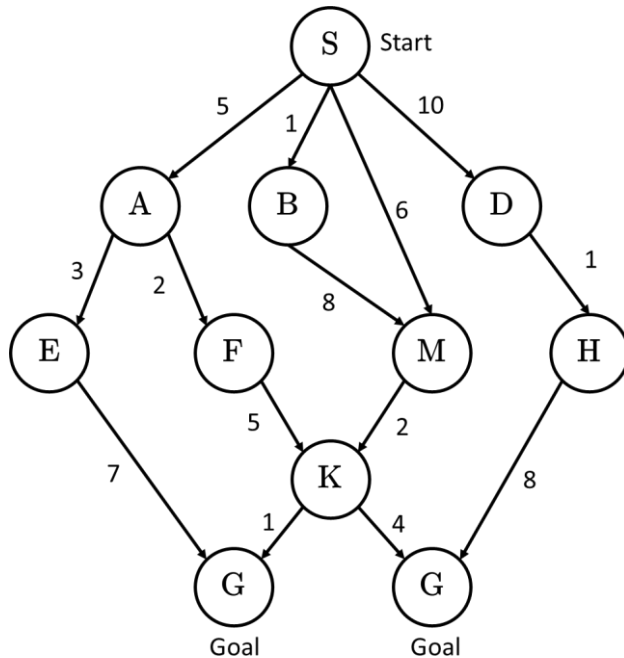
Consider the classic Frozen Lake problem. In this scenario, an agent must navigate across a frozen lake from the starting position (0,0) to the destination (3,3) **without falling into any holes**. Due to the slippery nature of the ice, the agent may not always move in the intended direction. The agent can only move left, right, up, or down - diagonal movement is not allowed.

- Describe the state space of this problem. (3)
- Provide the action space with constraints in a table. (3)
- Explain the worst-case branching factor for this problem. (3)
- Write down the characteristics of the environment in the table: (3)

Observable/ Partially Observable	Deterministic/ Stochastic	Static/ Dynamic	Discrete/ Continuous	Episodic/ Sequential	Single-agent/ Multi-agent

Question 2 (16 Marks):

The search tree below contains two valid goal (G) nodes. An agent can reach either goal node to form a solution path. The table provides the Straight-Line Distance (SLD) heuristic  $h(n)$  for each node:



Node	$h(n)$
S	12
A	8
B	9
D	11
E	7
F	5
M	7
H	6
K	2
G	0

For each time step, record the current node and all nodes on the frontier while searching from the initial state S to the goal state G using the following algorithms:

- A. Depth First Search (DFS) (4)
- B. Breadth First Search (BFS) (4)
- C. Uniform Cost Search (UCS) (4)
- D. A\* Search (4)

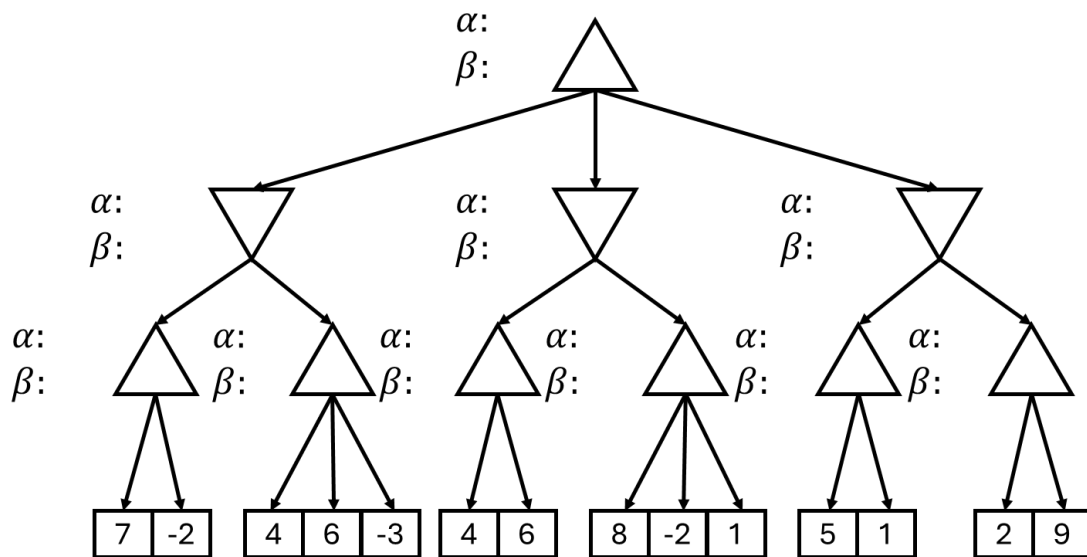
Write down the solution path and total cost for each algorithm. Explain if each algorithm is complete and admissible.

Directions: Write down your solution in a table in the following manner.

Time Step	Current Node	Frontier
1		S
2	S	{list of nodes}
3	Current node based on algorithm	{list of nodes}
4	Current node based on algorithm	{list of nodes}

Question 3 (17 Marks):

Consider the following game tree where the MAX player  $\Delta$  and MIN player  $\nabla$  alternate turns. The leaf nodes contain evaluation values.



- Draw a new game tree and assign values to each node using the Minimax algorithm. (5)
- Apply Alpha-Beta pruning to the tree. Create your own version of the tree for calculations and clearly indicate the final values of  $\alpha$  and  $\beta$  on the diagram. Mark the branches that are pruned. (12)