United International University (UIU)

Dept. of Computer Science & Engineering (CSE)

Mid Exam: Fall 2024

Course Code: CSE 3811, Course Title: Artificial Intelligence

Total Marks: **30** Duration: **1 hour 30 minutes**

Answer all the six questions. Marks are indicated in the right side of each question.

[Any examinee found adopting unfair means will be expelled from the trimester/program as per UIU disciplinary rules]

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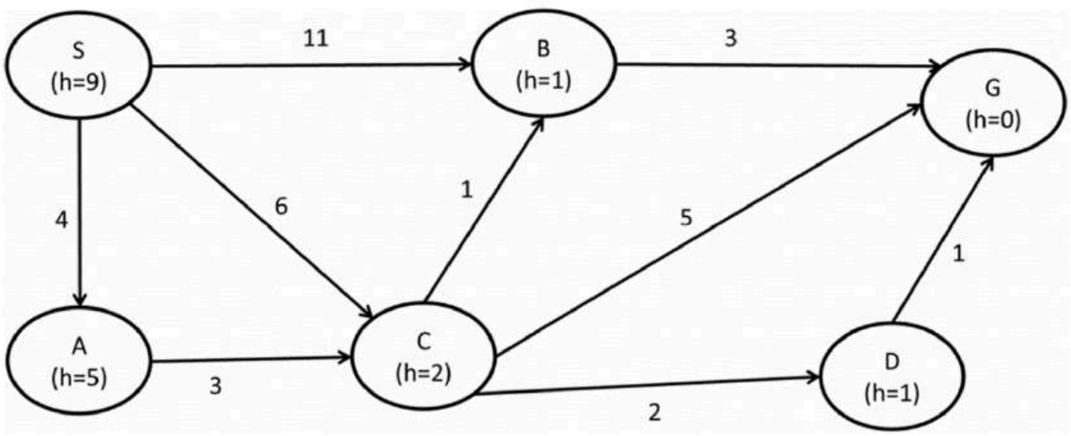
1. A chessboard consists of 64 squares, and a chess game can have an astronomical number of possible positions (estimated to be more than 10^{120}). Despite this, grandmasters and AI systems like AlphaZero can play optimally, making moves to maximize their chances of victory. Each turn in chess offers up to 218 possible moves depending on the position. Suppose you are designing an AI system that plays chess optimally. Write down the PEAS description for this AI system. You may assume that the system you are building is a physical robot. **[2]**

2. Consider the following directed Search Space, where **S** is the **Initial** State and **G** is the **Goal** State:



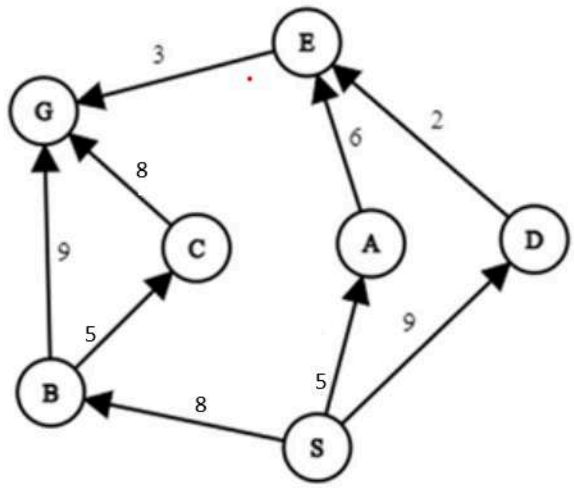
a) Simulate the following algorithms (In case of ties, consider alphabetical order): **[2X2=4]**

i. A* Tree Search

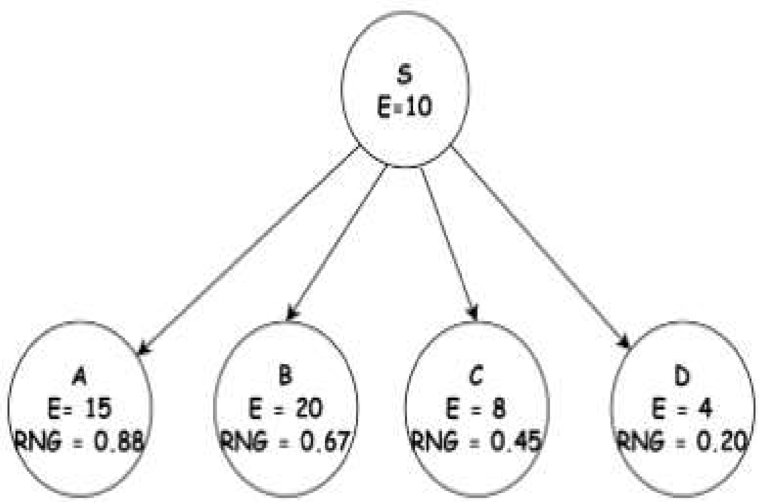
ii. A* Graph Search

b) Suppose you are trying to solve a search problem with a search tree having branching factor b, maximum depth m, shallowest solution depth s. Suppose the root is considered as level 0 and the shallowest goal is the leftmost node on depth s. Now **which search strategy** will you use so that you are guaranteed to expand fewer nodes. Find out how many nodes it needs to explore in the worst case if b=4, m=10 and s = 3. **[3]**

3. Consider the following graph and assign **heuristic values** to the nodes so that the heuristic function is **both admissible and consistent**: **[6]**



4. Future Gadget lab is considering the following graph for Simulated Annealing on a minimization problem: S is the parent node. A, B, C, and D are its neighbors.



The neighbors are generated in alphabetical order. The temperature function is given by:

$$T = \frac{1}{10} e^{10-t} \text{ unit [t=timestep] (For example, at t = 0, } T = \frac{e^{10}}{10} \text{)}$$

If nodes' energy/utility values are denoted by "E", find which neighbor will be selected given the Random Number Generator (RNG) values for each neighbor for the following timesteps. Show the calculation steps.

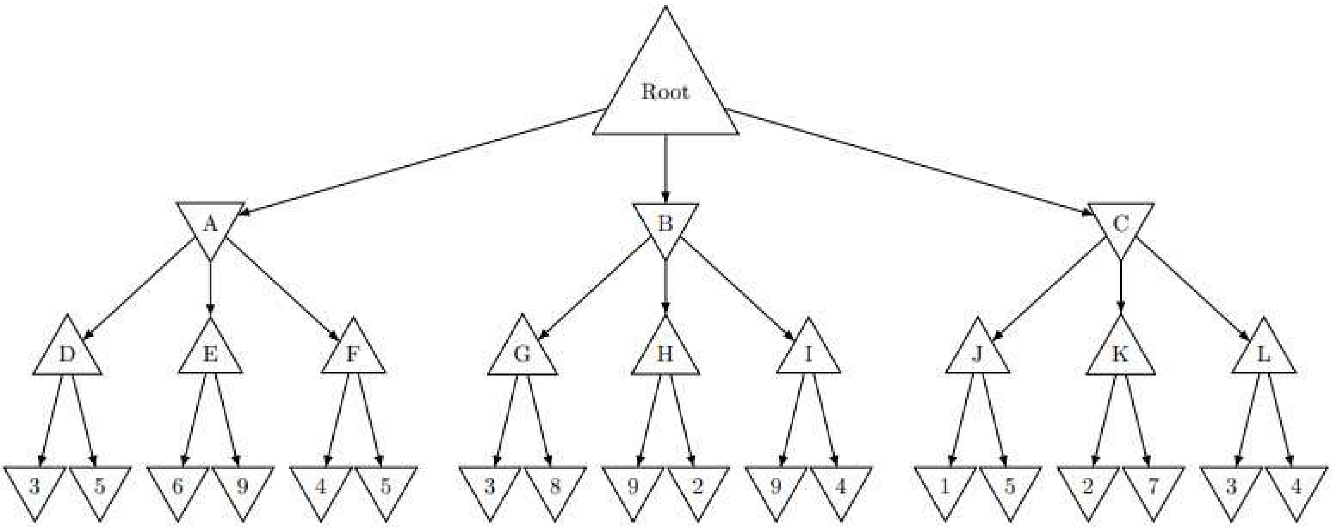
a. At timestep, t = 0 **[2]**

b. At timestep, t = 5 **[2]**

c. At timestep, t $\rightarrow \infty$ (infinity) **[1]**

[Hint: Probability for taking a bad move is e- ΔE/T(minimization problem).
Here: $\Delta E = E(neighbor) - E(current)$ .Random Generator generates values between 0 and 1 inclusive.]

5.



Redraw the Tree excluding the branches which can be removed through alpha-beta pruning. (You can do either left first or right first traversal) **[4]**

6. A team of six employees is planning the seating arrangement for a new office layout. They are to be seated in any of the four departments – Finance, Marketing, HR, or IT. The following constraints apply:

- Employee A and Employee D want to be in the same department.
- Employee C prefers to work in the Finance department.
- Employees B and E are not on good terms and want to work in different departments.
- Employee D dislikes the Marketing department and will not sit there.
- Employee E is open to working only in HR or Finance
- Employee F must work in the same department as Employee C but in a different department from Employee E.

Formulate the problem as a CSP, clearly defining the variables, domains, and constraints, and solve the problem by applying both **Minimum Remaining Values(MRV) and Least Constraining Value(LCV) heuristics.** **[6]**