United International University (UIU)

Dept. of Computer Science & Engineering (CSE)

Mid Exam: Summer 2022

Course Code: CSE 3811, Course Title: Artificial Intelligence

Total Marks: 30 Duration: 1 hour 45 minutes

Answer all 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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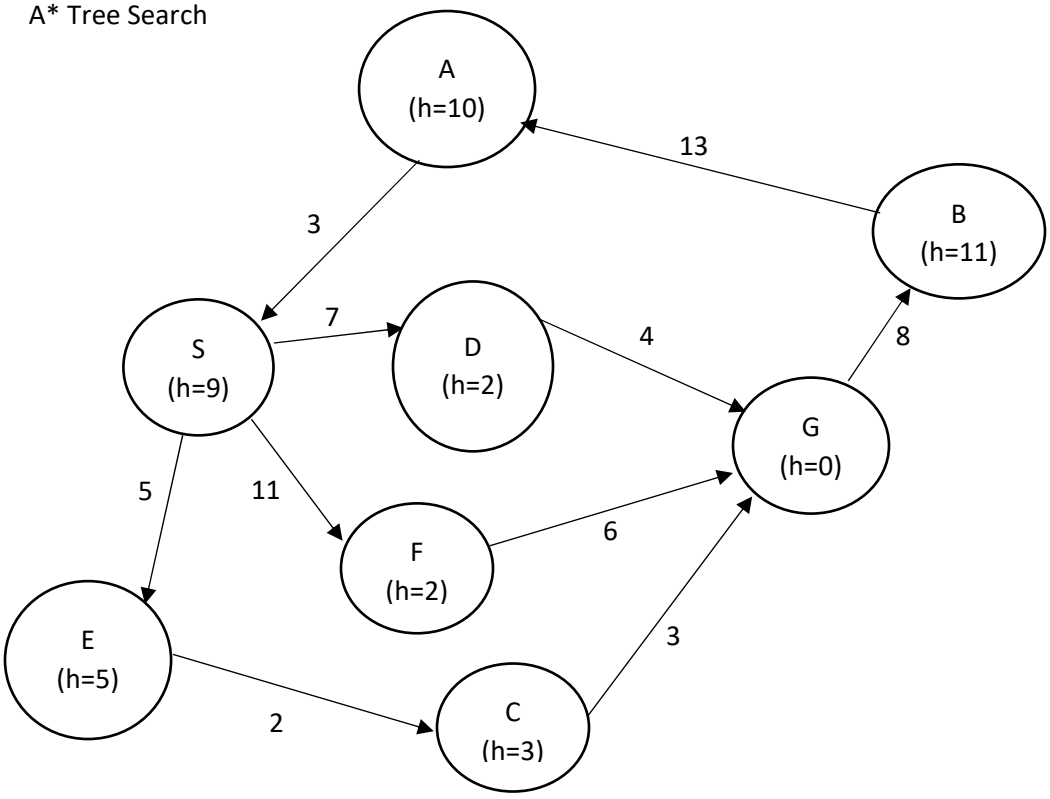
1. Suppose, you are going to design an intelligent AI tennis playing agent that can play tennis against an oponent on the other side of the court. The agent can track the opponent's movement and the ball's progress and can respond accordingly. Determine the PEAS specification for the agent. Characterize the agent's environment as Static vs. Dynamic and Discrete vs. Continuous. **[2+1]**

2. Suppose there is a 4X4 grid of squares and three of these squares contain a prize. You are designing an AI agent who will start at the southwest corner of the grid and navigate through the squares until it is able to obtain all three prizes. Give a formal description of this problem as a search problem. What is the size of the state space? **[1.5+.5]**

3. Consider the following **directed search space**. **A** is the initial state. **G** is a state that satisfy the goal test. Find out the solution paths and costs returned by the following search algorithms: **[2+2+2]**

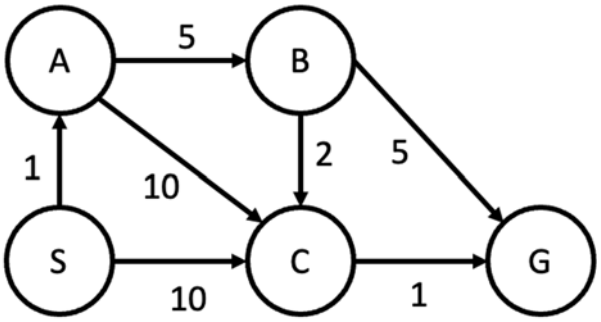
   a. Uniform Cost Search
   b. Greedy Best First Search
   c. A* Tree Search



4. Write True or false with reasoning: **[1+1]**
   a. *A** search algorithm using the heuristic $h(n) = c$ for some fixed constant $c > 0$ is guaranteed to find an *optimal* solution.
   b. Greedy Best-First search using an admissible heuristic is guaranteed to find an optimal solution.

5. Suppose following are two heuristic functions h1 and h2 for the ***N***-puzzle problem:
   h1 = ***N***-x, where x = the number of correctly placed tiles
   h2 = Manhattan distance heuristic
   h3 = (h1+h2)/2
   a. Is h1 admissible? Explain your answer briefly. **[1.5]**
   b. Is h3 admissible? Explain your answer briefly. **[1]**
   c. Does h2 dominate h1? Explain your answer briefly. **[1.5]**

6. Consider the following graph where S is the start state and G is the goal state. The values of three different heuristic functions h1, h2 and h3 are given. Label the three functions as "inadmissible", "admissible but inconsistent" or "admissible and consistent". Explain your reasoning very briefly. **[3]**



	S	A	B	C	G
h1	6	6	1	1	0
h2	8	7	1	1	0
h3	10	9	4	1	0

7. a. What will happen if we do the followings in a **maximization problem** with **simulated annealing algorithm** where probability of selecting a worse state is **exp(ΔE/T)** for temperature ***T***: **[1+1]**
   I. set T = **0**
   II. set T = **∞**
   b. What will happen in **local beam search algorithm** with beam size ***k*** if we do the followings: **[1+1]**
   I. set k = **1**
   II. start from a single initial state and set k = **∞** for later stages

   c. Consider the following population while applying genetic algorithm and carry out the following:**[1+1]**
   I. Calculate the fitness function value with the given function and select the two most fit members.
   II. Now perform crossover at the middle point of selected population to form next generation
   f = (a+b)-(c+d)
   q1 = 4 3 2 1
   q2 = 4 2 1 3
   q3 = 2 2 1 3
   q4 = 2 2 4 1

8. Consider the following game tree. △ Max ▽ Min ▭ Terminal node
Notice that three terminal nodes marked a, b, c and d have no values (? marked). Suppose that the circled nodes are pruned when you apply minimax search algorithm with alpha-beta pruning. Assign appropriate values to a, b, c and d that will result in such a pruning. **[4]**