# United International **University (UIU)**

## **Dept. of Computer Science & Engineering (CSE)**

### **Mid Exam: Fall 2021**
**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. ]

1. Suppose you are designing an artificially intelligent rational agent that can build a specific structure using lego blocks. The agent looks at a picture of the structure to be built and follows the same pattern to build it. Determine the PEAS specification for the agent. Characterize the agent's environment as Fully vs. Partially Observable, Deterministic vs. Stochastic, Episodic vs. Sequential and Static vs. Dynamic.          **[2+2]**

2. Suppose there is a basket containing 10 balls, half of which are red in color. You are designing an agent whose job is to pick up balls from the basket one at a time. The solution is reached when 3 red balls have been picked up. So if a red ball is picked up, the agent moves to the next state and otherwise it remains in the same state. Give a formal description of this problem as a search problem.          **[2]**

3. Consider the following **directed search space**. **A** is the initial state. **G1** and **G2** are two states that satisfy the goal test. Find out the solution paths and costs returned by the following search algorithms:     **[2.5+2+2.5]**
      a. Uniform Cost Search          b. Greedy Best First Search          c. A* Tree Search
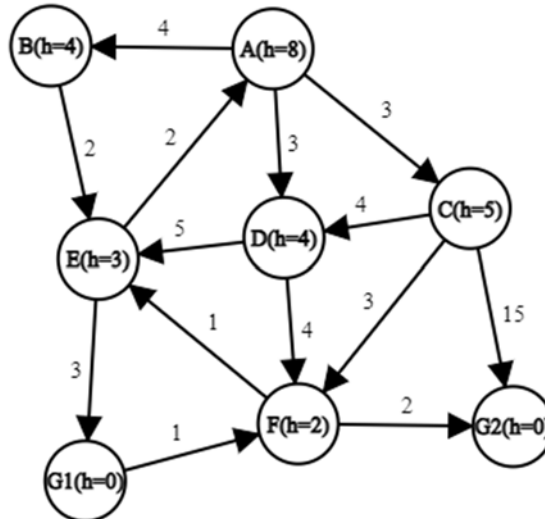


4. Briefly explain the reasoning behind the following statements:          **[1.5+1.5]**
      a. Uniform Cost Search is a special case of A* search.
      b. Breadth First Search (BFS) is a special case of Uniform Cost Search.

5. a. Suppose you have three heuristics, h1, h2 and h3. Among these h1 and h2 are admissible but h3 is not admissible. You decide to create three new heuristic functions defined as follows:
      i. $h4(n) = \max(h1(n), h2(n), h3(n))$
      ii. $h5(n) = 0.5 \times (h1(n)+h2(n))$
      iii. $h6(n) = \min(h1(n), 3 \times h2(n))$
For each of these three functions, label them as admissible or inadmissible.          **[1.5]**

b. Consider the following state space graph and the corresponding A* search tree. The heuristic values for each node are given in the graph and the f costs (f(n)=g(n)+h(n)) for each node are given in the tree. Find out the missing edge costs in the graph. Is the heuristic function admissible? Explain your reasoning.     **[2+1.5]**
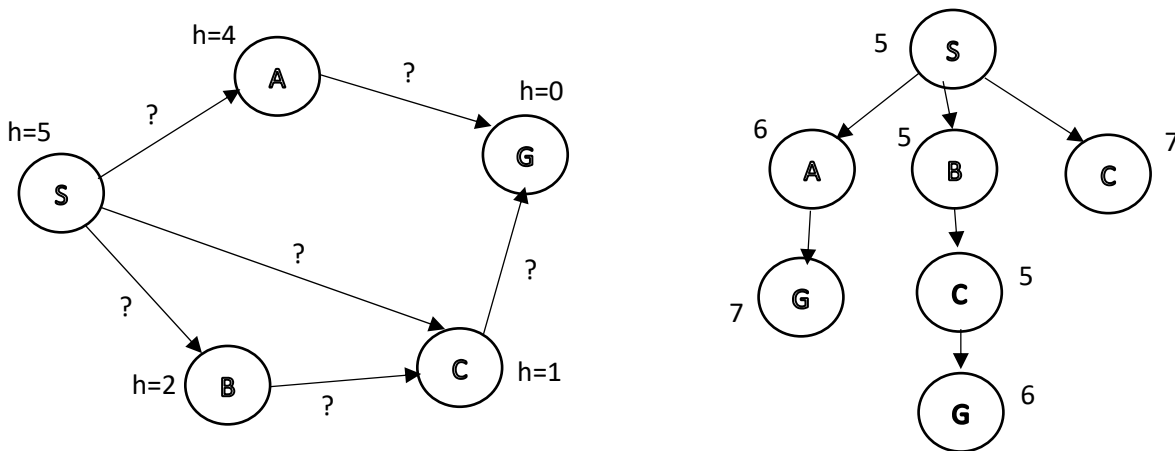


6.  a. "Local beam search with one initial state and no limit on the number of states retained resembles breadth-first search" – Is it true? Justify your answer.                                                                **[2]**

b. Suppose, the initial population of a 4-queen problem consist of four individuals as follows:

   x1 = 2 4 1 2        x2 = 1 1 2 2        x3 = 3 4 4 3        x4 = 1 4 2 3

Let the fitness of individual x be equal to the number of non-attacking pair.

   i. Evaluate the fitness of each individual, showing all your calculations.                      **[2]**
   ii. Perform crossover operation on the fittest two individuals at the middle point.              **[1]**

7.   For the following game tree.



                        Max                    Min            Terminal node

Show which nodes will be pruned if you use minimax search algorithm with alpha-beta pruning. Clearly show the values of each node.                                                                                             **[4]**