United International University (UIU)

Dept. of Computer Science & Engineering (CSE)

Mid Exam

Course Code: CSI 341 Course Title: Artificial Intelligence

Total Marks: **30** Duration: 1 hour 45 minutes

There are 10 questions. **Answer all questions**. Marks are indicated in the right side of each question.

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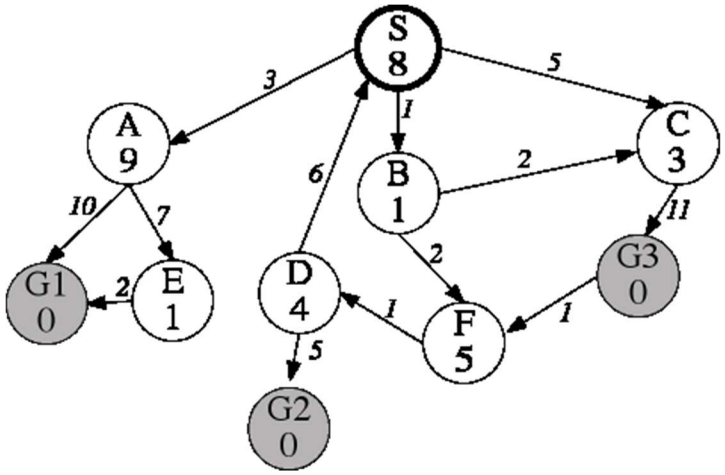
1. Give PEAS description for a Robot Soccer Player Agent. Characterize the agent's environment as Fully vs. Partially Observable, Deterministic vs. Stochastic, Episodic vs. Sequential and Single vs. Multiagent. [2+2=4]

2. Consider the following problem: You have four six-sided dice (with faces from 1 to 6). Initially, all the dice have the faces with 1 up. At any time-step, you can choose one of the dies, and roll it to some random face. You have to continue the process until the values of the four faces are all even numbers. Answer the following:
   a. How many variables are required to mathematically represent the states of the problem? [1]
   b. How many successors does a state have? Explain your calculation. [1]
   c. What is the size of the state-space? Explain your calculation. [1]
   d. How many goal states are there? Explain your calculation. [1]

3. Consider the following state-space graph with Start State S and Goal states G1, G2, and G3, heuristic function values and path costs as given in the figure (The number below the name of each node represents the heuristic function values):



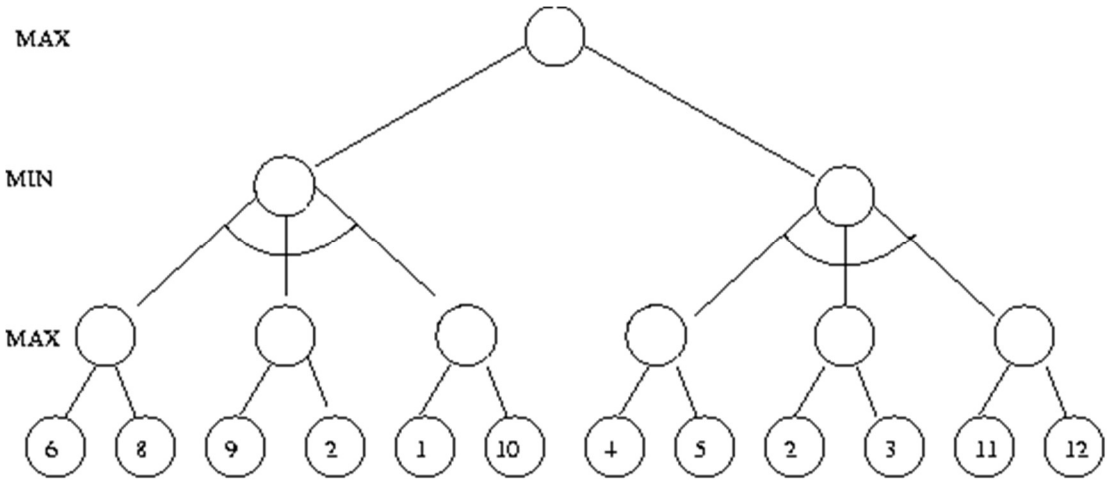
Assuming that successor states are generated in alphabetical order and ties are broken in alphabetical order, find out the solution paths and costs returned by each of the following tree search algorithms.

a. Uniform Cost Search [1.5]
b. Greedy Best-First Search [1]
c. A* Search [1.5]

4. State whether the following statements are true or false and justify your answer: [2]
    a. Breadth First Search is a special case of Uniform Cost Search algorithm.
    b. Uniform Cost Search is a special case of A* Search algorithm.

5. When applying alpha-beta pruning to minimax game trees, which of the following statements are true or false? Assume the max player acts first. Explain your answer. [1+1+1]
    a. When using alpha-beta pruning, the children of the root node will return the same value as they return in a minimax search.
    b. When using alpha-beta pruning, the children of the root node are never pruned.
    c. Pruning nodes does not change the value of the root to the max player.

6. Show the result of carrying out alpha-beta pruning on the game tree shown below. [3]



7. Answer the following questions
    a. In a simulated annealing somebody is using the following equation for update the temperature in each iteration:

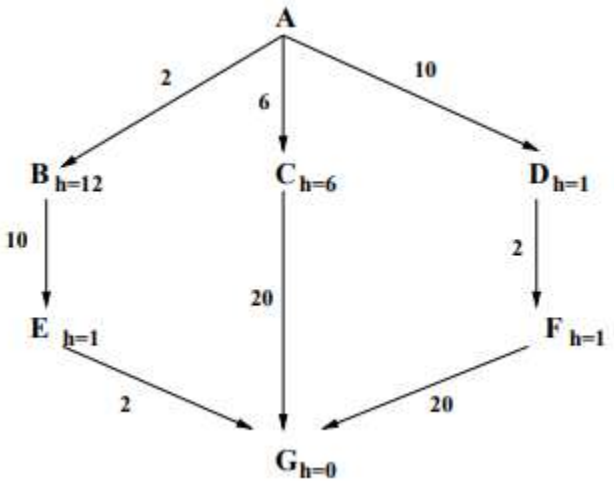
        $T = T - \Delta T$

        Suppose he is using a large positive number as ΔT. What could be the effect of this selection of ΔT? [1.5]

b. Suppose, you have to solve the problem of routine assignment problem for CSE department. There are 250 sections of different courses offered in Spring 2019. Total number of faculty members is 50. No faculty member can take less than 4 courses and more than 6 courses. You have to assign course sections to faculty members in a way so that no two sections have any conflicts. Now, what algorithm do you suppose to use and why? [1.5]

c. In genetic algorithms, how does crossover affect diversification and intensification in the search space? [1]

8. Consider the following graph:



Is the heuristic h admissible? Is it consistent? [2]

9. Suppose you decide to do a A* search using the following function f(n) = (1 − w)g(n) + w h(n). Assuming that h(n) is admissible, what are the values of w that guarantee the algorithm will find an optimal solution? Justify your answer. [2]

10. Suppose you have two admissible heuristics, h1 and h2. You decide to create the following new heuristic functions defined as follows:
    i. h3(n) = max(h1(n), h2(n))
    ii. h4(n) = max(h1(n), 1.1 × h2(n))
    iii. h5(n) = min(h1(n), 3 × h2(n))
    iv. h6(n) = (h1(n) + h2(n))/2

    Among these four which are admissible heuristics? [2]