United International University (UIU)

Dept. of Computer Science & Engineering (CSE)

Mid Exam: Fall 2019

Course Code: CSI 341, 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.

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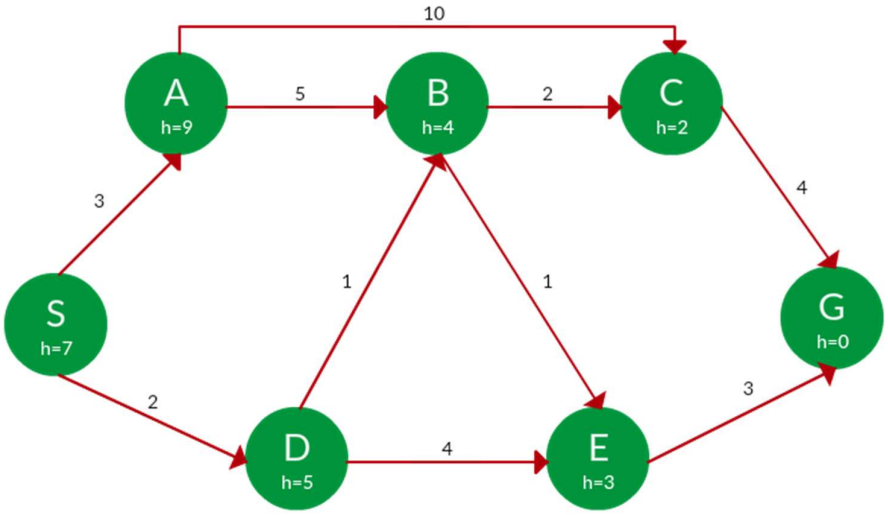
1. For the following state space graph, show the solution paths and the associated actual path costs for the following search algorithms. Heuristics are labeled on the nodes and actual costs on the arcs. In case of ties during removing from fringe, use alphabetical order. [8]
    a. A* Tree Search
    b. Uniform Cost Search
    c. Greedy Heuristic Search
    d. A* Graph Search

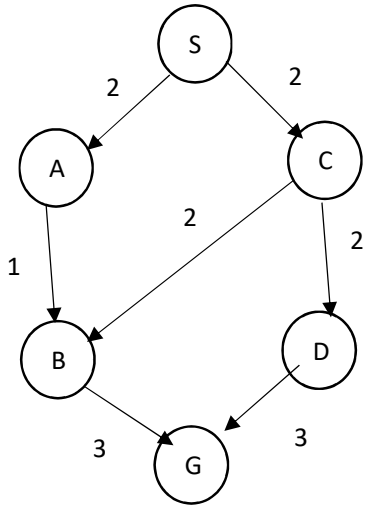


2. Consider the following problem: You have three jugs with capacities 4, 5 and 6 litters respectively. Initially all of the jugs contain 2 litters of water. At any time-step, you can either remove 1 litter of water from any 2 jugs or add 1 litter to any 1 jug. You have to continue the process until the jugs contain 8 or more litters of water in total. The target is to reach the goal within minimum number of steps. Answer the following:
    a. How many variables are required to mathematically represent the states of the problem? [0.5]
    b. What is the size of the state-space? Explain your calculation. [1]
    c. List any 30 goal states. [1]
    d. Will a DFS find optimal solution for this problem? What about a BFS? Which one would you go for, and why? [1.5]

3. Consider a device that assists drivers in moments of distress. It can be a sub-component in a semi-self-driving car. This device tracks diver's face, detects subtle expressions, and uses this information along with other factors (can be driver's previous mental or physical health related issues) for sensing when the driver is in need of medical assistance, informs him and also makes an emergency call to 911 if required. Give PEAS description for this Agent. Characterize the agent's environment as Episodic vs. Sequential and Single vs. Multi-agent.
[2+1=3]

4. a. Define heuristic admissibility. In route finding problem, straight line distance between cities is used as an admissible heuristic. Explain why it is admissible. Is it consistent? [3]

   b. Consider the following state space graph and the three different heuristic function values.



	S	A	B	C	D	G
h1	6	4	4	6	2	0
h2	6	4	1	3	1	0
h3	6	3	2	4	2	0

Label each heuristic function as either "Inadmissible", "Admissible and consistent" or "Admissible but not consistent". In each case, explain your reasoning. [3]

5. a. Suppose you are using simulated annealing to solve a problem with the following scheduling function:

$$T_k = T_{k-1}(1 - \alpha)$$

You have two values of α to choose from: 0.8 and 0.9. Which value will you choose and why? [2]

b. Suppose a genetic algorithm uses individuals of the form x = abcdefgh with a fixed length of eight digits. Each digit can be between 0 and 9. Let the fitness of individual x be calculated as:

f(x) = (a + b) − (c + d) + (e + f) − (g + h)

and let the initial population consist of four individuals as follows:

x1 = 6 5 4 1 3 5 3 2

x2 = 8 7 1 2 6 6 0 1

x3 = 2 3 9 2 1 2 8 5

x4 = 4 1 8 5 2 0 9 4

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]

6. Consider the following game tree.

△ Max ▽ Min ▭ Terminal node

a. Show the value of each node by applying the minimax search algorithm without pruning. [2]

b. Now draw the tree again showing which nodes will be pruned if you use alpha-beta pruning. [2]