United International University (UIU)

Dept. of Computer Science & Engineering (CSE)

Mid Exam: Fall 2023

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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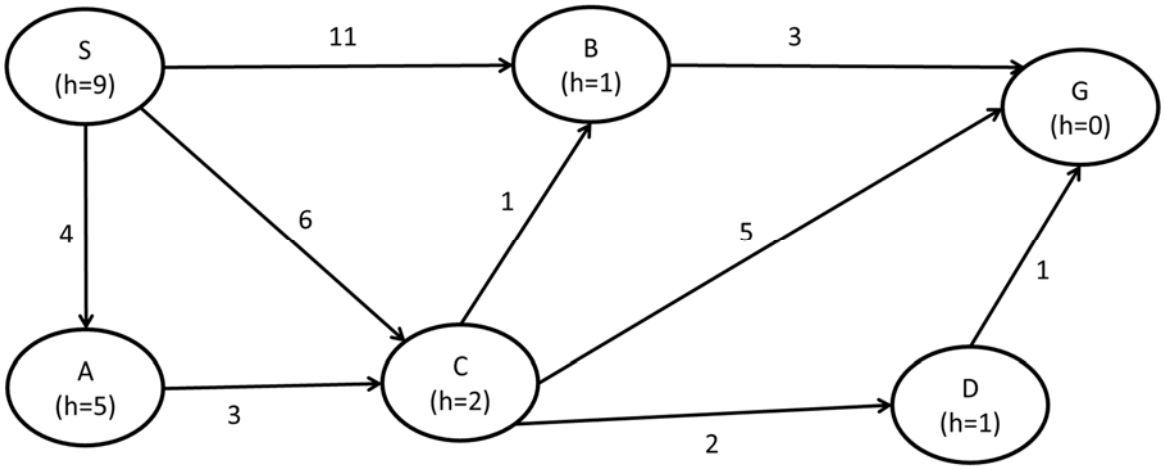
1. Consider a Coffee Making Robot which can make a cup of coffee based on voice command from user. Now write the PEAS description for it.
   Imagine you are designing an intelligent agent to plan the optimal route for a delivery drone to deliver packages in a city. Give a formal description of this problem as a search problem. **[2+2]**

2. Consider the following directed search space. S 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+1+1.5+1.5]**
   a. Uniform Cost Search
   b. Greedy Best First Search
   c. A* Tree Search
   d. A* Graph Search

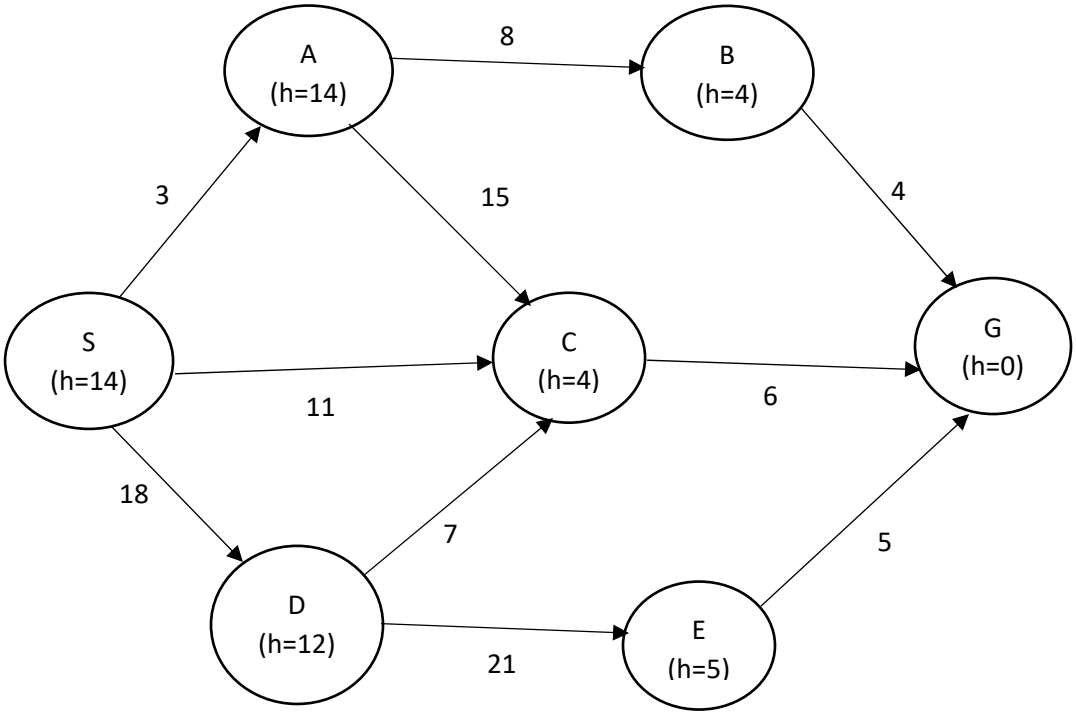


3. Consider the following 8 tiles. You need to fill each tile with one of the four colors: Red, Green, Blue, White in such a way that all the 8 tiles are distinguishable after assigning the colors (*Hint: Do not assign same color to adjacent tiles*).

1	3	4		8
2		6	5	7

However, some tiles have requirements that must be met:
Tile 6 must be colored with Red
Tile 2 must be colored with either White or Blue
Tile 8 must be colored with either Red or Blue
Now formulate this problem as a CSP. Draw the **constraint graph**. Show the steps followed by a backtracking search algorithm and derive a solution that **uses both Minimum remaining value and Least Constraining Value heuristics**. **[5]**

4. a. Consider the following graph:



Here **S** is the starting node and **G** is the goal node. Now change only the heuristic values of **any two** nodes so that the heuristic values become both admissible and consistent. Mention the updated values and corresponding node names. **[2.5]**

b. Suppose you have two heuristic functions h1, h2 and h3. h1 and h2 are admissible but h3 is inadmissible. Consider the following heuristics and answer the questions: **[1+1.5]**
h4(n)=max(h1, h2, h3)
h5(n)=min(h1, h2, h3)
h6(n)=(h1+h2)/2

i. Which heuristic is inadmissible?
ii. Propose a heuristic that will be better than h4, h5 and h6.

5. a. Consider the following two scheduling functions for simulated annealing: **[2]**

$T_k = \frac{A}{k}$ and $T_k = \frac{A}{2k}$ where A is a predefined constant.

In your opinion, which function will be better and why?

b. What is the advantage of using population based search over single state based search? **[1]**

c. 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) = (e+f+g+h)- (a+b+c+d)

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

x1 = 7 2 1 5 2 6 9 1

x2 = 1 4 1 3 6 5 0 9

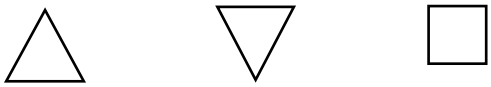
x3 = 2 1 9 6 1 3 8 5

x4 = 6 1 5 2 7 1 5 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. 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]**