United International University (UIU)

Dept. of Computer Science & Engineering (CSE)

Mid Exam: Fall 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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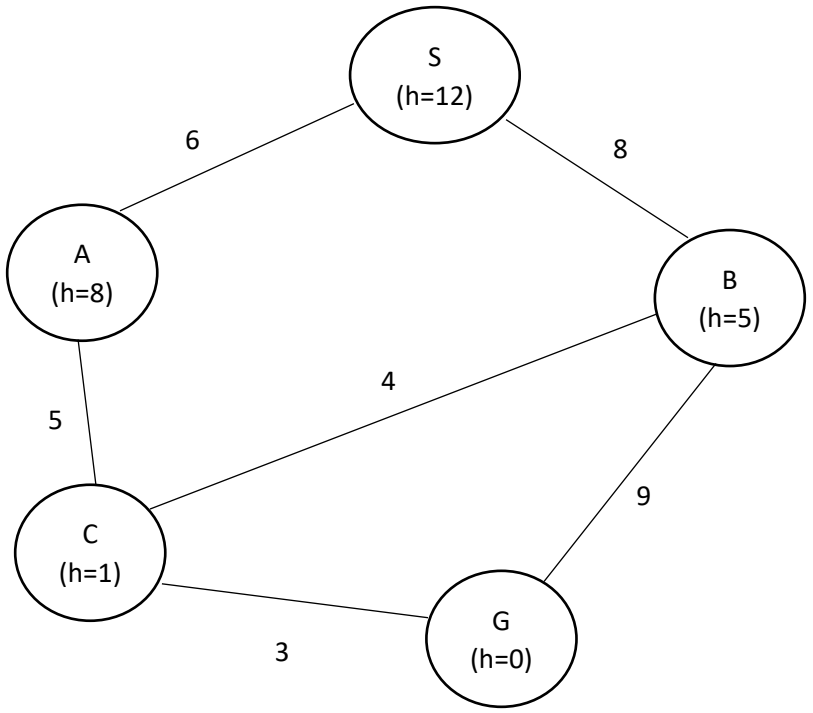
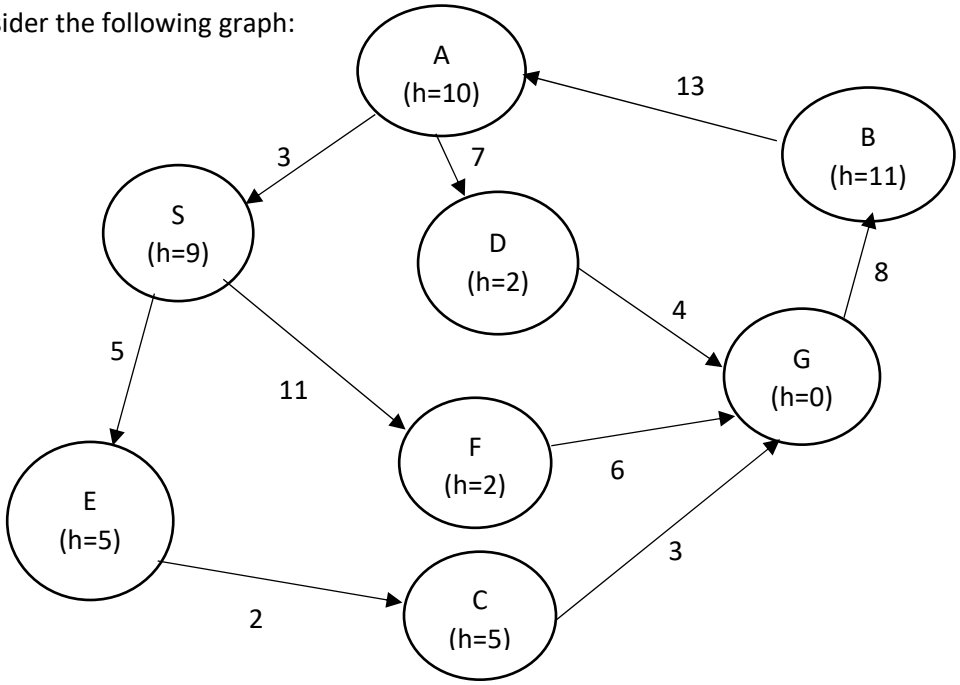
1. Suppose you are designing an artificially intelligent wall painting robot. The wall is divided into 144 squares in a 12 x 12 grid design. The robot can paint a single square in a singular action. It then moves the hand to the next square and paints. The job is finished when the whole wall is painted. Give a formal description of this problem as a search problem. What is the size of the state space? **[1.5+.5]**

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+2+2]**

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



3. 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. **[3]**

b. Suppose you have two heuristic functions **h1 and h2**, both of which are **admissible**. You have decided to create several new heuristic functions defined as follows:

- h3(n) = 0
- h4(n) = 2 × h1(n)
- h5(n) = h2(n)/2
- h6(n) = (h1(n)+h2(n))/2
- h7(n) = max(h1(n), h2(n))
- h8(n) = min(h1(n), h2(n))

Now answer the following questions: **[2]**

i. Which heuristic is possibly inadmissible?
ii. Among h5 and h6 which one is dominant?
iii. Which heuristic will expand the maximum number of nodes?
iv. In your opinion which heuristic is the best?

4. Answer the following questions:

a. Suppose you are trying to solve the 8 queens problem using greedy hill climbing search. How will the performance be affected if you allow sideways move (choose equal valued successors if better ones are not generated)? **[2]**

b. What is the difference between Randomly Restarting Hill Climbing Search k times and local beam search with a beam size of k? **[2]**

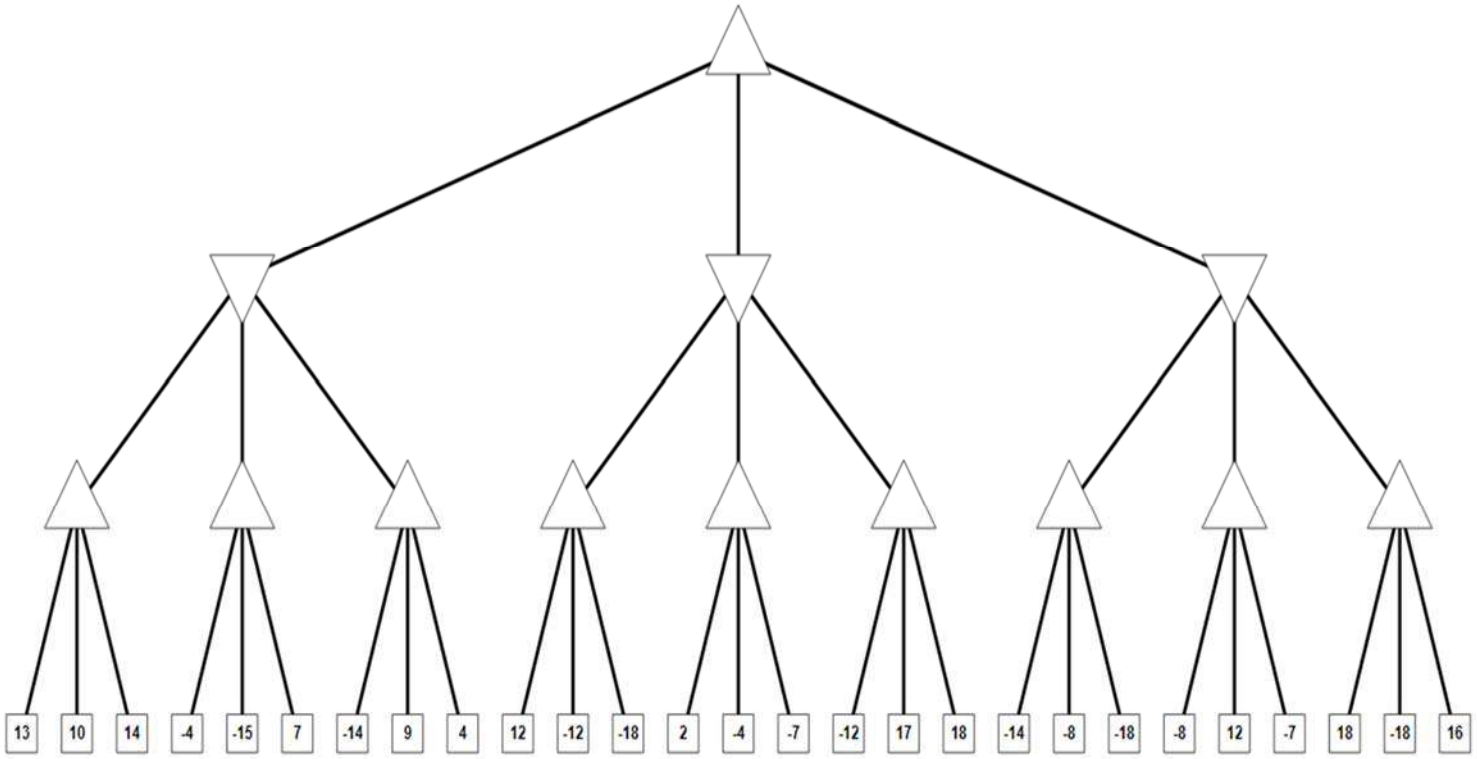
c. What will happen in the local beam search if we set the beam size(k) to be 1? **[1]**

d. What is the role of the temperature, T in Simulated Annealing? How do chances of taking bad moves change with the value of T? **[2]**

5. Consider the following game tree. **[4]**

Max Min

Apply minimax search and show which nodes will be pruned **if you use alpha-beta pruning**.



6. Consider the following map of Bangladesh where borders among the eight divisions have been marked. You need to color each of these divisions using three colors (Red/Green/Blue) such that two adjacent divisions do not receive the same color.
   Now **formulate** the problem as CSP, Show the **Constraint Graph** and solve the problem **must applying** both Minimum Remaining Values(MRV) and Least Constraining Value(LCV) heuristics. **[5]**