Due: 03/21/2023 23:59

Foundations of Artificial Intelligence: Homework 1

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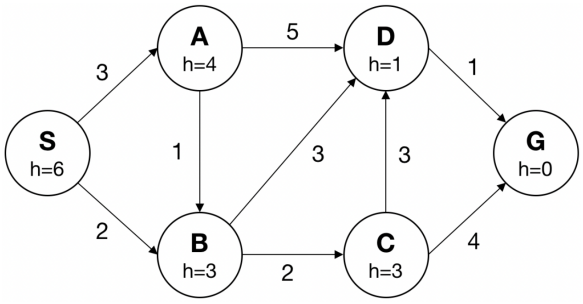
Problem 1 (14 points)



In the above graph, the start and goal states are S and G, respectively. Write down the order of state expansion and the final path returned by each of the graph search (as oppose to tree search) algorithms below. You can assume ties are resolved alphabetically.

a) Depth-first search.

b) Breadth-first search.

c) Uniform cost search.

d) Greedy search with the heuristic h shown on the graph.

e) A^* search with the same heuristic.

f) Is the heuristic in the graph admissible? If not, can you make it admissible by changing the cost of an edge?

g) Is the heuristic in the graph consistent? If not, can you make it consistent by changing the cost of an edge?

Problem 2 (10 points)

Suppose the heuristic overestimates the shortest path from any state to the goal by a factor of at most ϵ, where $\epsilon > 1$. Prove that the cost of the path found by A* tree search is at most ϵ times the cost of the optimal path.

Problem 3 (10 points)

You are scheduling for 5 classes on the same day taught by 3 instructors. Of course, each instructor can only teach one class at a time.

The classes are:

- Class 1 - Intro to Programming: 8:00-9:00am
- Class 2 - Intro to Artificial Intelligence: 8:30-9:30am
- Class 3 - Natural Language Processing: 9:00-10:00am
- Class 4 - Computer Vision: 9:00-10:00am
- Class 5 - Machine Learning: 10:30-11:30am

The instructors are:

- Instructor A - Can teach Classes 1, 2, and 5.
- Instructor B - Can teach Classes 3, 4, and 5.
- Instructor C - Can teach Classes 1, 3, and 4.

(1) Formulate this problem as a CSP. Describe the variables, domains and constraints.

(2) Draw the constraint graph associated with your CSP.

(3) Show the domains of the variables after running arc-consistency on this initial graph (after having already enforced any unary constraints).

(4) Give one solution to this CSP.

(5) Your CSP should look nearly tree-structured. Briefly explain (one sentence or less) why we might prefer to solve tree-structures CSPs.

Problem 4 (6 points)

Alice, Bob, Chris, and David are ordering food from pizza, quesadillas, ramen, and sushi. They have some strict preferences:

1. Chris will not order sushi.
2. Alice and Bob want to order different food.
3. Bob will only order pizza or ramen.
4. Alice and Chris want to order the same dish as each other but different from the remaining two people.
5. David will not order quesadillas.

a) Draw the constraint graph for this CSP.

b) Run the basic backtracking search. Use alphabetical order to both select unassigned variables and iterate over values. Write down the food assignment.

c) Assume that no variables have been assigned values yet. When running one iteration of forward checking, which value(s) will be removed for each variable if we assign "pizza" to Alice. Write down "None" if no values will be removed.