CSC 384 Test 1 on Search

Monday, September 26, 2022

Last Name: _____

First Name: _____

Student Number: _____

1. Definitions of AI (7 marks total)

1.1 (2 marks) Which of the following is/are the difference(s) between the **Cognitive Modeling** and the **Rational Agent** definitions of AI? Circle all of the correct answers.

A. Whether we measure success against humans or rationality

B. Whether we care about reasoning or behaviour

1.2 (5 marks) Which of the following justifies choosing the **Rational Agent** definition over the **Cognitive Modeling** definition of AI? Circle all of the correct answers.

A. Humans are one of the few examples of intelligence.

B. Studying humans scientifically is easier than studying rationality scientifically.

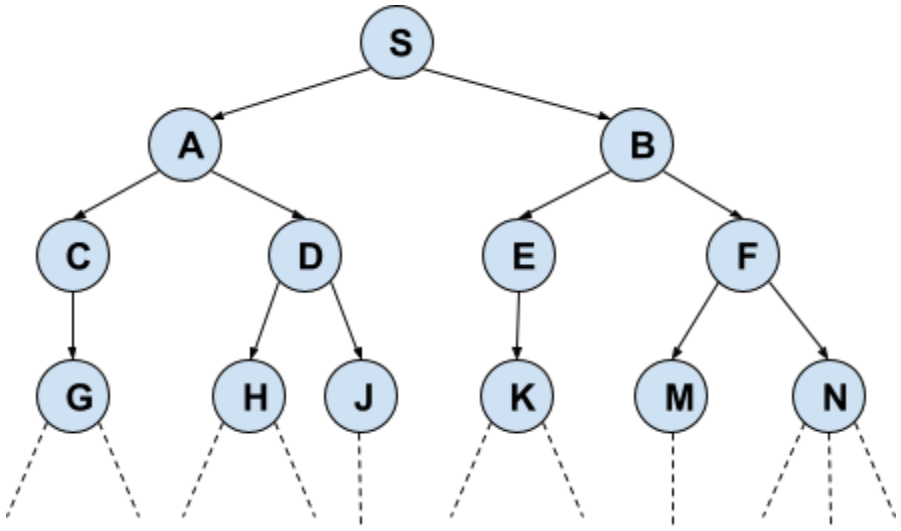
C. Humans always behave intelligently.

D. Rational behaviour cannot be mathematically defined.

E. Rational behaviour is more general than rational thought.

2. Uninformed Search (22 marks total)

2.1 (12 marks) Consider the search graph below.



(*search graph continues below this level*)

- **S** is the initial state.
- **D** and **E** are the goal states.

Fill in the table on the next page to show the execution of the **Iterative-Deepening Search.** Assume that this search algorithm **adds states** to the frontier in **reverse alphabetical** order and proceeds until it **terminates**. We have filled in the first few steps for you as an example.

For every step, list the following:

- The state that is being expanded,
- The state(s) being added to the frontier,
- The resulting states that are in the frontier.

If no states appear in a cell, write **None**. For the last step, indicate the state expanded and leave the other two cells in that row empty. Use as many rows in this table as you think you need.

Provide your answer to Question 2.1 here:

Step	Depth limit	Node to expand	Nodes to add	Frontier
1	0	None	S	S
2	0	S	None	None
3	1	None	S	S
4	1	S	B A	B A
5	1	B	None	A
6	1	A	None	None
7	2	None	S	S
8	2	S	B A	B A
9	2	B	F E	F E A
10	2	F	None	E A
11	2	E		
12				

2.2 (5 marks) Given the search graph from part 2.1, consider what would happen if **Breadth-First Search** was used instead of **Iterative-Deepening Search**.

Which of the following would be true? Circle ALL that apply.

A) The algorithm would work well with limited memory.

B) The algorithm would find the optimal solution.

C) If no solution existed, the algorithm would search every state.

D) The algorithm's performance is unaffected by graph cycles.

E) The algorithm's performance is unaffected by infinite paths.

2.3 (5 marks) Given the search graph from part 2.1, consider what would happen if **Depth-First Search** was used instead of **Iterative-Deepening Search**.

Which of the following would be true? Circle ALL that apply.

A) The algorithm would work well with limited memory.

B) The algorithm would find the optimal solution.

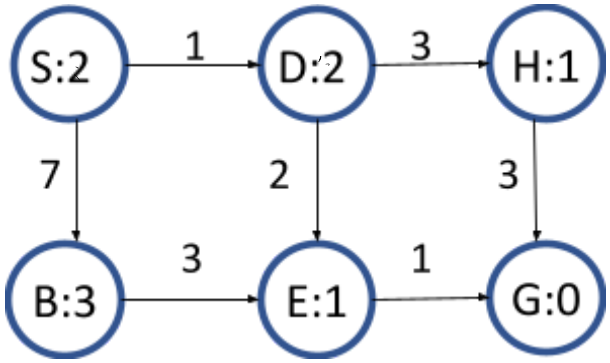
C) If no solution existed, the algorithm would search every state.

D) The algorithm's performance isn't affected by graph cycles.

E) The algorithm's performance is unaffected by infinite paths.

3. Heuristic Search (8 marks total)

The diagram on the right illustrates a city map, where each state is an intersection and the edges between states are roads that connect intersections. Each state has a label and a heuristic estimate h for getting from that state to the goal state G.



3.1 (6 marks) Fill in the table provided. Each step includes the state being expanded, the g value for the state, and the frontier including the states and their f values. The first step has been filled in for you as an example.

If at least two states on the frontier have the smallest f values, expand the states in **alphabetical** order. For the last step, fill in the state expanded and the g value for the state only.

Step	State Expanded	g(State)	Frontier (State + its f value)
1	S	0	D(3), B(10)
2	D	1	E(4), H(5), B(10)
3	E	3	G(1), H(5), B(10)
4	G	4	
5			
6			

3.2 (1 mark) If the h value for State E was changed from 1 to 5, what path would the A* algorithm find instead?

S → D → H → G

3.3 (1 mark) Why would changing State E's heuristic value cause the A* algorithm to find a suboptimal path?

since this would make the heuristic inadmissible ($h^*(E) = 1 < h(E) = 5$), thus A^* is not guaranteed to find an optimal solution.