CMSC 671 (Introduction to AI) – Fall 2022

Homework 1: AI, Agents, Agents, Search I

Turnin: Blackboard.

Submit:
- Parts I-IV together as a **single PDF file** named *yourlastname*_hw1_text.pdf. Please clearly delineate individual sections of the homework.

Notes:
- These are individual assignments, not group work.
- All files must start with your last name.

PART I. BEING INTELLIGENT (40 PTS)

Reading: Read Chapter 27.1 and 27.2 in our textbook.

Assignment: Answer all of the following in a single short, coherent **essay** (roughly 500 words):

- Do you think an artificial agent can be 'intelligent'? Why or why not?
  - Discuss your answer in terms of the traditional arguments against thinking machines—do you agree with one or more of those arguments? Why or why not?
- Consider the list of tasks Alan Turing wrote that a machine would never be able to accomplish.
  - Which of these do you think will be **hardest** for machines to accomplish, and why?
  - Do you think an AI will eventually be able to accomplish it? Why or why not?

PART II. AGENTS AND SEARCH (16 PTS)

Fill out the following PEAS table for agents doing these tasks. This is a design question – how would you design this agent? What would you use from the environment? What would you consider a 'good' performance? (Create your own table.)

System	Performance measure	Environment	Actuators	Sensors
Example: *Robot Soccer Player*	*Winning games, scoring goals for team, blocking goals against team*	*Field, ball, teammates, other team, own body*	*Kickers (legs), movement (legs or wheels)*	*Camera, touch sensors, orientation sensors, wheel/joint encoders*
(a) Checkers player				
(b) Netflix movie recommender system				
(c) Robot playing table tennis against a wall				
(d) Robot playing tennis against an opponent				

PART III. SEARCH ALGORITHMS (20 PTS)

Description: For the tree in Figure 1, S is the start state, and any node with a double line is a goal state. Actual arc costs are given on the arc (in *blue*). Table 1 gives the value of a heuristic function for each node.

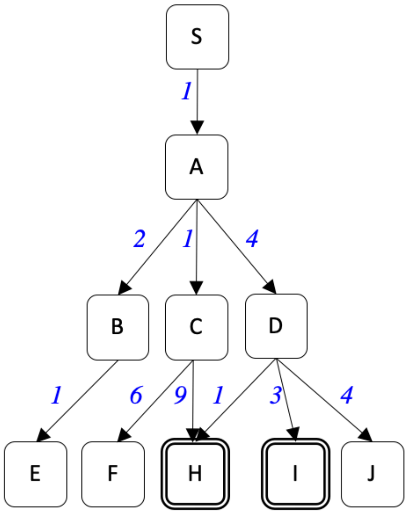


Figure 1: A simple search tree

1) For each of the following algorithms, *at each timestep*, please give the **current node** plus **all nodes on the frontier** in order, using the same notation as we used in class.

a) Depth-first

b) Breadth-first search

h(S)	=	2
h(A)	=	3
h(B)	=	5
h(C)	=	8
h(D)	=	9
h(E)	=	∞
h(F)	=	∞
h(H)	=	0
h(I)	=	0
h(J)	=	∞

Table 1: Values of some heuristic function applied to the nodes of that tree.

c) Uniform-cost search

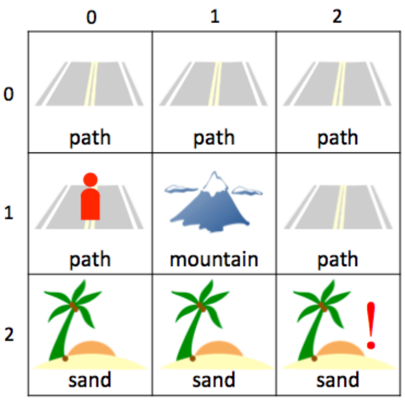
d) A* search

Part IV. Navigating (Search Spaces and States) (30 pts)

The General Idea

Consider navigating a 3 x 3 space, shown right. There are three kinds of terrain[1], each of which takes some amount of effort to traverse: entering a "path" cell costs 10 calories, entering a "sand" cell costs 50 calories, and entering a "mountain" cell costs 200 calories. Your agent starts at coordinates **(1,0)**, as shown, and is trying to reach square (2,2) (marked !) via an optimal path (the path that costs the fewest possible calories). The agent cannot move diagonally.

Assignment: Answer the following questions about the representation of this specific puzzle.



2) How would you represent this as a search problem? (10 pts)

a) Describe the **state space**. (What information is needed to describe any given state an agent may be in while solving one?)

b) Provide a table of **actions/operators**, including **constraints**. Spell these out—don't provide "classes" of actions or constraints.

c) What is your **goal test**?

3) What is the (worst-case) branching factor *b* for an *n* x *n* puzzle? (5 pts)

4) How many **unique, legal, reachable** states are there in this search space? (5 pts)

5) If you were using heuristic search: (10 pts)

a) Describe a good admissible heuristic function *h*(*n*) for this problem.

b) Explain how you know it is admissible.

[1] Image credits: pixabay.com/en/road-crossing-crosswalk-street-304283, pixabay.com/en/sand-beach-island-palm-sun-tree-304525, pixabay.com/en/mountain-peak-snow-summit-304054