Adam Noack
Intro AI
Hw #1
10/12/18

1. Describe four approaches (i.e., Thinking Humanly, Thinking Rationally, Acting Humanly, and Acting Rationally) of AI based on your understandings. Name one you prefer most. Why? If you have another approach, welcome to explain it in detail.
    a. Acting humanly: an AI is said being acting humanly if it is capable of understanding natural language (it must be able to communicate via the written or spoken word), knowledge representation (it is capable of storing new information that it acquires for use at another time), reasoning ability (conclusions must be able to be drawn from the stored knowledge by the AI), machine learning (the AI must be able to adapt to new circumstances, ie take its current understanding of the world and extrapolate to ascertain new conclusions about reality), computer vision and robotics (it must be able to sense and interact with reality effectively).
    b. Thinking humanly: we can understand the way that humans think by introspecting, watching humans behave and making assumptions about their mind's activity, and scanning the brain to determine which areas of the brain are active in any given moment. One can then express this theory of the human mind in a computer program. This AI would then be said to be thinking humanly.
    c. Thinking rationally: an AI is said to be acting rationally if it uses logic to solve the problems it is presented with. Using correct premises and logic, the AI can know with absolute certainty the validity of a statement that involves those premises.
    d. Acting rationally: a rational AI agent is one that, no matter the current state of the environment, takes the action that is likely to beget the best outcome. Acting rationally can involve making correct inferences about the environment, however some actions that are rational cannot be said to involve rational inference.
    e. My preference: I agree with the book that the rational agent approach is worth most of our time. Like the book says, the rational agent is unconstrained by human limitations (ie it makes no assumption that our ways of acting are somehow above criticism). The rational agent can develop along with our understandings of reality as the expand as the result of our scientific developments.
2. Describe the following potential agents using the PEAS format, and justify why or why not each is an agent:
    a. Google's AlphaGo Zero
        i. P: Winning the game, making the best move in any given board configuration, maximize space captured at the end of the game
        ii. E: The Go board game
        iii. A: The coordinates it outputs for the placement of its next stone

iv. S: The two neural networks it uses to interpret the game state at each turn

b. Siri
   i. P: Providing the correct answer, fast response time, providing the answer the user wants to hear, understandability of the response
   ii. E: The voice of the user and the noise of the user's surroundings, the internet, what's stored in the phone
   iii. A: The screen of the iPhone, the phone's speaker, the motor that vibrates the phone
   iv. S: The microphone, the camera, the light sensor, the connection to the internet

c. Mars Rover
   i. P: Landing successfully on Mars, fuel efficiency, returning samples to earth, number of places visited on Mars.
   ii. E: The Mars landscape, the solar system.
   iii. A: The robotic arms of the rover, the laser systems used to cut rocks, its lights.
   iv. S: The cameras, light sensors, heat sensors, robotic forceps for touch.

d. Ducks' Quarterback
   i. P: Number of touchdowns scored, turnovers, interceptions, games won, passing percentage
   ii. E: The football field, the football, teammates, opponents, the first down line, the weather, the gear and protective equipment.
   iii. A: The arms and legs of the QB, the QB's body in general.
   iv. S: The eyes and ears of the QB (other sensory systems might also be involved to a small degree).

3. a) In a particular uninformed search, the branching factor of an uninformed search tree is 4. The shallowest solution can be found at depth 5 in the rightmost node, though there is another one at depth 7 in the leftmost node. Assume the goal test is applied when a node is selected for expansion. If it is a goal, no need for further expansion. Give the exact total number (i.e., not just big O) of nodes expanded, the exact total number of nodes generated, as well as the maximum needed space requirements (i.e., the exactly maximum number of nodes stored in the memory) for each of the following uninformed searches:

	Nodes expanded	Nodes generated	Nodes stored
Breadth-first	1+4+16+64+256+1024-1 = 1364	4+16+64+256+1024+4096-4 = 5456	5457
Depth-first	7	7*4 = 28	29

Depth-limited (Limited to a depth of 6)	1+4+16+64+256+1024-1 = 1364	4+16+64+256+1024+4096-4 = 5456	4*6+1=25
Iterative deepening	(5+1)1+5(4)+(5-1)(4^2)+(5-2)(4^3)+(5-3)(4^4)+(5-4)(4^5) = 1818	(5-1)*4^1+(5-2)*4^2+(5-3)*4^3+(5-4)*4^4 = 448	4*5 +1 = 21

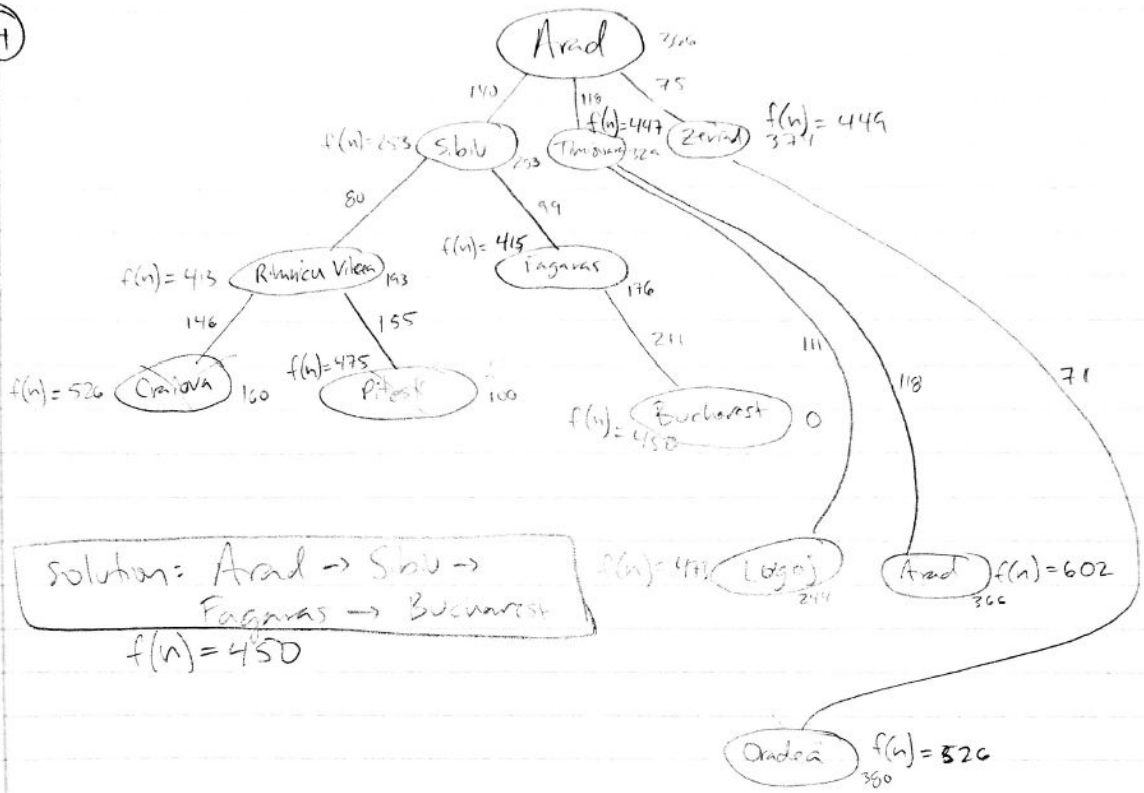
b) Which search appears to be the best for this problem? Which would be the best if the only solution was found following the rightmost child at every expansion, assuming an infinite depth?

The best one for this tree is the depth first search. Breadth first search would be best.

4. The information used for this problem is taken from the Romanian map (figure 3.2, pp. 68) and the straight-line distances to Bucharest (figure 3.22, pp. 93). In addition, the direct road from Rimnicu Vilcea to Pitesti has been destroyed by a flash flood, and the new traveling distance between them using a detour is 155. The flood also destroyed the direct road from Pitesti to Bucharest, and the new detour distance between them is 115.

Create a diagram of the search tree from Arad to Bucharest (similar to part f in figure 3.24, pp 94) which shows the final expansion of the search tree using the A* search algorithm and the straight-line heuristic. Each node should have the name of the city, the value of the f=g+h function, and the order in which the node was expanded. (i.e., the root node of the tree would have the name "Arad", the values "366=0+366", and the value "1," since it is the first node expanded.)

(4)


Arad
366
140
118
75
f(n)=447
f(n)=449
f(n)=253
Sibiu
Timisoara
Zerind
253
80
99
f(n)=415
f(n)=413
Rimnicu Vilcea
Fagaras
193
176
146
155
211
111
118
71
f(n)=526
Craiova
f(n)=475
Pitesti
f(n)=450
Bucharest
160
100
0
Solution: Arad → Sibiu →
Fagaras → Bucharest
f(n)=450
Lugoj
Arad
f(n)=602
244
366
Oradea
f(n)=526
380

5. Prove that Greedy best-first search is not optimal.

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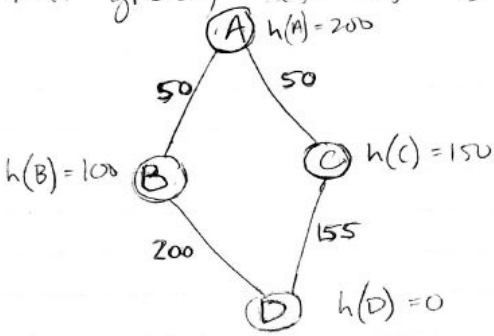
(5) Prove that greedy best-first is non-optimal:

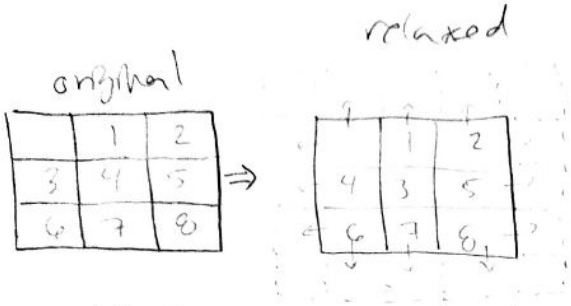


$h(A) < 205 < 250$
$h(B) < 200$
$h(C) < 155$
$h(D) = 0$
*showing heuristics are va

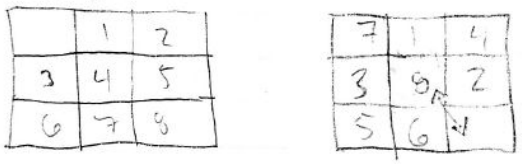
1) Assume A is the starting point and D is the objective.
2) Assume Greedy Best First search is optimal $\Rightarrow$ the solution found by this algorithm will be the best possible.
3) Perform search: (using the graph above)
   ① Start at A
   ② Load successor nodes onto queue in order of increasing heuristic value.
   ③ B is selected from queue and expanded because its heuristic value is lower than C's.
   ④ D is successor of C. D is the goal node and therefore the solution. A → B → C is returned.
   ⑤ Notice that $(A \to C \to D = 205) < (A \to B \to D = 2$
   $\therefore A \to B \to D$ is non optimal.
   ⑥ Therefore, GBFS is non optimal.

6. Create another two admissible heuristics for the 8-puzzle problem. Explain why they are admissible.

(6)



h_3 : assume any border tile can move off of the board — essentially cache itself — while the other tiles are manipulated and reinserted whenever desired to complete the puzzle. The cost of an optimal solution in this case is a heuristic because this solution involves relaxing the original rules.



h_4 : assume that the middle tile can at any time be swapped with the blank square, If it is the case that the middle tile is the blank tile, only the moves valid in the original problem are options. The cost of an optimal solution in this case is a heuristic because the solution involves "relaxing" the rules, ie adding the ability to make moves that weren't previously allowed.

Turn in by emails/Canvas: If you are in **CIS 471**, submit your answers on Canvas. If you are in **CIS 571**, send them to **dou@cs.uoregon.edu**. We prefer that you send in a pdf file. If you use Word, please convert your word file into a pdf file, then send.