CAP 5636 – Midterm 1

Date: October 12, 2017

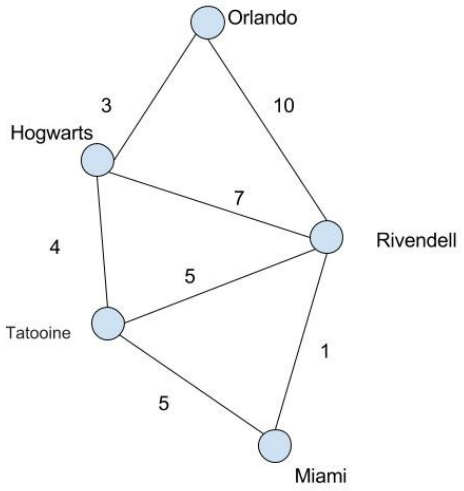
Name: ……

Instructions:

- This exam is open book and open notes. Textbooks and notes on tablet devices are acceptable but they must be put into airplane mode. No device with a keyboard is acceptable.
- Allotted time is 75 minutes.
- It is strongly recommended that you use a pencil, such that you can make corrections, if needed.
- You can continue a solution on the back of the page. Do not add new pages.
- Note that the points add up to 100 + 20 bonus points.

Problem 1 (30 pts)

Consider the map below. Let us assume that you want to go from Miami to Orlando. Trace the path planning process using **uniform cost graph search**. At each step, show the currently expanded node, the fringe and the closed set.
The format should be:
Step 79: Expanded: Dagobah:10, Fringe={Coruscant:34, Hoth:45}, Closed={Miami:0, …}
Where in the Planet:value, the value shows the current cost.



1. Fringe = {Miami:0}, Closed = {}
2. Expanded node: Miami:0, fringe = {Rivendell:1, Tatooine:5}, Closed = {Miami:0}

3. Expanded node: Rivendell:1, fringe = {Tatooine:5, Hogwarts=8, Orlando:11}, Closed = {Miami:0, Rivendell:1}
4. Expanded node: {Tatooine:5}, fringe = {Hogwarts:8, Hogwarts:9, Orlando:11}, Closed = {Miami:0, Rivendell:1, Tatooine:5}
5. Expanded node: Hogwarts:8, fringe = {Hogwarts:9, Orlando:11, Orlando:11}, Closed = {Miami:0, Rivendell:1, Tatooine:5, Hogwarts:8}
6. Expanded node: Hogwarts:9 skipped
7. Expanded node: Orlando:11

Problem 2 (30 pts)

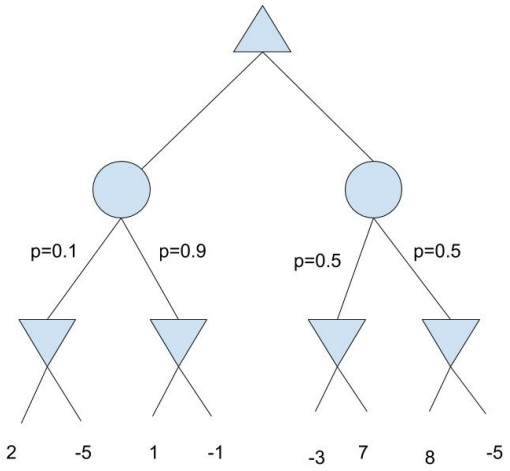
You are starting a new company where you plan to deliver packages door to door using your 1988 Honda Civic. You plan to use A* search to find the path that takes you to your destination in the shortest amount of time. Discuss the following proposed heuristics. Which are appropriate and which one is the best one?

- H1: h(x) = -1.
- H2: h(x) = 0
- H3: h(x) = whatever time-by-car Google Maps gives you from the current location to the destination
- H4 = H3 * 2

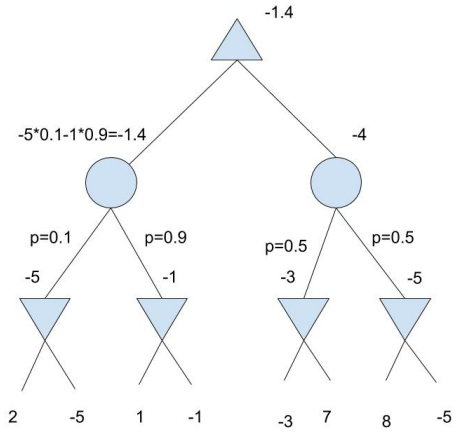
H1 negative heuristics, you will go in circles.
H2 = 0, this is an admissible and consistent heuristic, but not very efficient (one falls back to uniform cost search with it)
H3 = This is probably the exact value, there is no search with it. The best one.
H4 = Pessimistic heuristic, not admissible, will not find the optimal path

Problem 3: (30 pts)

Consider a game with the game tree and terminal utilities shown in the picture. First the MAX player makes a move that can be LEFT or RIGHT. Then follows a chance node, with the probabilities indicated in the figure. Finally, the MIN player makes her move of LEFT or RIGHT.



(a) Mark in the figure the expected utilities at each node.



(b) Assuming that both MAX and MIN are rational, describe what they are going to play in this game. Does this depend on the chance node?

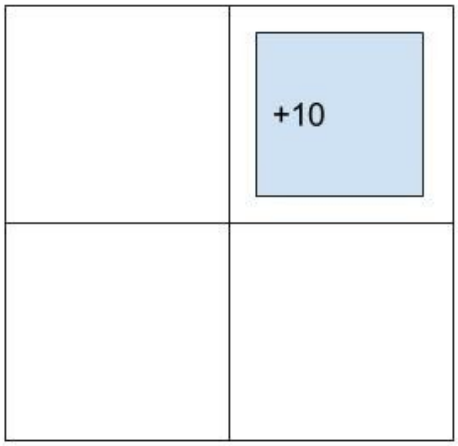
MAX is going to play LEFT. MIN is going to play RIGHT either way.
It does depend on the chance node, in general, only in this case it worked out that either way the RIGHT is better for MIN.

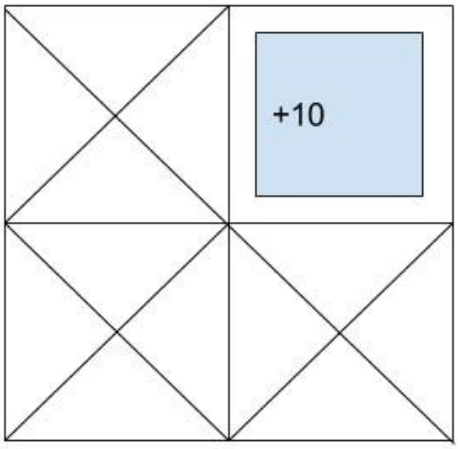
(c) Assuming that both MAX and MIN are rational, what is the expected value for MAX? What is the best she can get? What about the worst?

Expected value is -1.4. Best is -1. Worst is -5.

Problem 4 (30 pts)

Consider the following world, where an agent can take the actions North, South, East and West, except on the upper left corner, where the only action is Exit, which gives the reward +10. Every other action has a living reward of -1. Every action always succeeds (except when you run into a wall).





a) Fill in the state values in the left diagram.
b) Fill in the Q values in the right diagram.
c) Extract the policy from the Q-values (explain)