HW1: Search

CS4300: Artificial Intelligence **Alan Kuntz**
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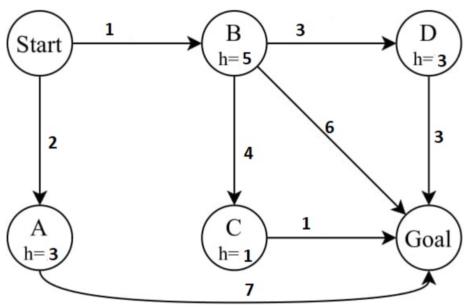
1 Graph Search

Alice the agent really wants to go skiing right after AI class is over. She starts in the lecture hall (the "start" state below) and wants to make it to Alta (the "goal" state) as soon as possible. There are several possible paths she can take denoted in the graph below:

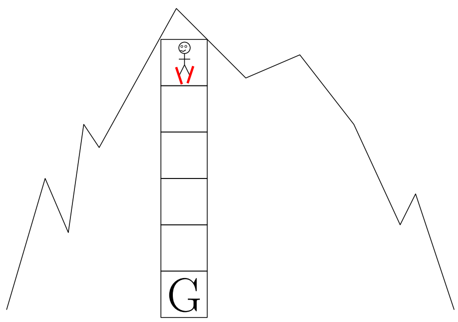


The available actions at each state are denoted by arrows with an edge cost label next to each arrow. For each of the following graph search strategies, figure out the order in which states are expanded as well as the path returned by graph search. When expanding states *add them to the data structure* in alphabetical order (i.e. when expanding from Start, put A into the data structure *before* B), using 'G' for the goal. Remember that in graph search, states are expanded only once.

1. Depth first search
2. Breadth first search
3. Uniform cost search
4. Greedy search with the heuristic values listed at each state
5. A* search with the heuristic values listed at each state

2 Downhill Skiing

After getting to Alta, Alice takes the lift up to the top of the mountain. The run is really rocky, so her only option is to go straight downhill. She begins with a velocity of 0 and can safely maintain a maximum velocity of V. At any state, she has three actions she can take: accelerate, decelerate or coast. If she accelerates, her velocity increases by 1; if she decelerates, it decreases by 1; if she coasts, it stays the same. *After* her velocity is adjusted by her action, she moves downhill an equal number of squares to her current velocity.



Consider the above figure. If Alice's first action is "accelerate" then she will end up in the second square down with a velocity of 1. If she then "coasts" then she will end up in the third square down with a velocity of 1. If she "accelerates" again, she will end up in the fifth square down with a velocity of 2.

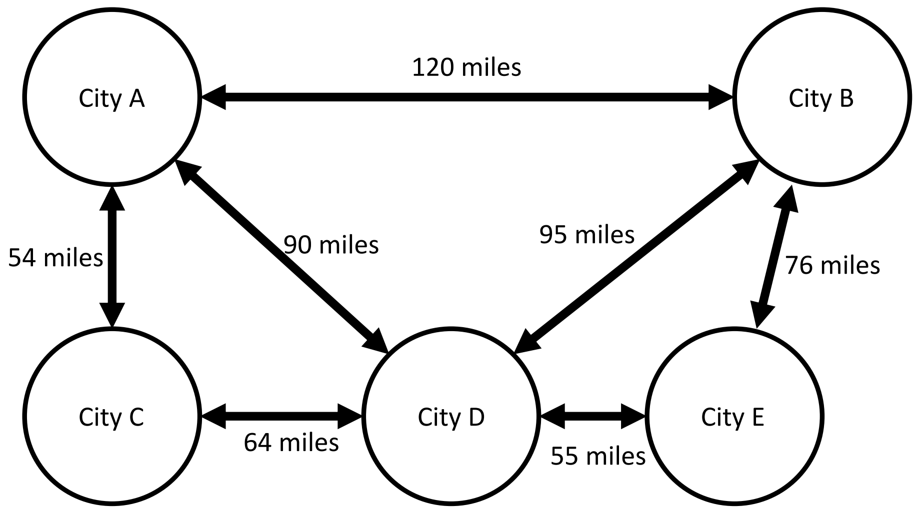
Alice's goal is to reach the chair lift (marked "G") with a velocity of zero. (No, Alice cannot have negative velocities). She would like to get there as quickly as possible. However, if she has a non-zero velocity at the goal, she skies into the parking lot and destroys her skis.

1. Describe the components that need to be included in the state space. Justify your answer. What are the start/goal states?
2. Give an example of a state that is not reachable.
3. Is Alice's current velocity an admissible heuristic? Why or why not?

3 Human-Centric Factors

For this section, we are asking for thoughtful consideration of the questions. Different answers can be correct, as long as they consider the algorithms in light of human-centric factors.

Consider the following graph, which shows the connectivity via roads between five cities. The edges and their labels represent the existence and length of the roadways in between the cities.



Jessie, who resides in City A, needs to travel to City B. Jessie has a medical condition that frequently produces life-threatening symptoms at unpredictable times that requires treatment in an emergency room. There are emergency rooms in each of the five cities, but medical care is non-existent on the roads themselves.

Please consider and thoughtfully answer the following questions:

1. Is shortest path the right cost function when considering the optimal route for Jessie from City A to City B? Why or why not?
2. Please describe an alternative cost function that may be appropriate for this problem and justify the choice.
3. What is an optimal path from A to B in the above graph under your alternative cost function?
4. Which, if any, of the search algorithms we've covered will still be optimal for your cost function, both for this specific graph and for an arbitrary graph? Justify your answer.
5. What is another example of a human-centric factor that demonstrates the complex nature of defining an "optimal" path in real life?