HW1: Search

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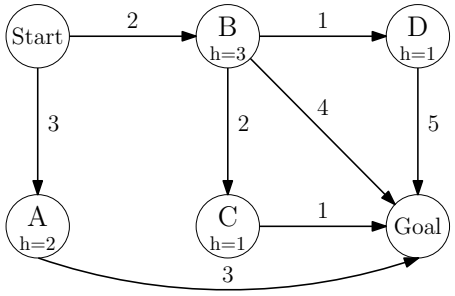
1 Graph Search

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:

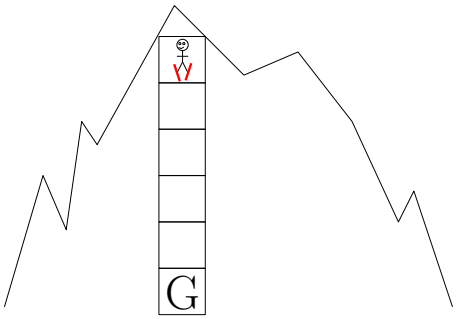


The available actions at each state are denoted by arrows with a path cost label above each arrow. For each of the following graph search strategies, figure out the order in which states are expanded as well as the path returned by graph search. When choosing an arbitrary order of state expansions (to break ties), use an alphabetical ordering. Remember that in graph search, states are expanded only once.

1. Greedy search using the instantaneous transition costs
2. Depth first search
3. Breadth first search
4. Uniform cost search
5. Greedy search with the heuristic values listed at each state
6. 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 the 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. If the mountain is N units tall (eg., it is $N = 6$ units tall in the figure), what is the size of the state space? Justify your answer. (You may ignore "unreachable" states.) What are the start/goal states?

2. Give an example of a state that is not reachable. Suppose that Alice cannot coast (she must either accelerate or decelerate): does this yield *more* unreachable states? If so, give an example of one and justify your answer either way.

3. Is Alice's current elevation (i.e., distance from the chair lift) an admissible heuristic? Why or why not?

4. State and justify a non-trivial, admissible heuristic for this problem which is *not* current elevation.