ECS 170: Problem Set 1

January 11, 2017

Your answers should be succinct - our solutions for each problem are no more than a couple sentences.

Your submission should be a PDF. We make no guarantees we will grade submissions in other formats.

1. What is the difference among BFS, DFS, and uniform-cost search (Dijkstra's algorithm) with respect to their implementations in the generic tree search algorithm?

2. A coworker of yours has a graph search problem and is comparing the performance of different algorithms. Your coworker notices that depth first search will sometimes result in a smaller cost path than uniform cost search (where cost is the sum of the edge weights of the path). Your coworker is confused because they thought that uniform cost search was optimal. Assuming there aren't any programming bugs, what is the most likely reason uniform cost search will sometimes return a greater cost path than depth first search?

3. Your coworker runs the same experiment comparing A* and Dijkstra's Algorithm. Surprisingly, every time they run the two algorithms Dijkstra's Algorithm returns a path with smaller cost than A*. Your coworker is again confused because they were taught that A* is optimal. Given this information (and assuming there aren't any programming bugs) what is the most likely reason A* would return a greater cost path than Dijkstra's Algorithm?

4. Under what conditions are the following statements true:

   a) BFS is a special case of uniform cost search.

   b) uniform cost search is a special case of A*.

5. Sudoku (see figure 1) is a popular game in which the player tries to fill in all blank cells so that the resulting board contains 1 to 9 on each row, each column, and each of the 9 3×3 blocks. In other words, the player fills in blank cells such that no digit is repeated in any row, column or block.

5	3			7				
6			1	9	5			
	9	8					6	
8				6				3
4			8		3			1
7				2				6
	6					2	8	
			4	1	9			5
				8			7	9

Figure 1: A partially filled Sudoku puzzle

a) Formulate it as a graph search problem. What are the state space, goal state, successor function, and the path costs?

b) Assume we use uninformed search. Which method would you prefer? Why?

6. Consider the classic farmer, fox, goose, and grain problem. The farmer wants to move himself, the fox, the goose, and the edible grain from the west side to the east side of the river. Only he can row his small boat across the river, and he can only take one of his items with him at a time. If the fox is left with the goose, the goose will be eaten. If the goose is left with the grain, the grain will be eaten. The problem is to construct a series of actions such that everything reaches the other side of the river (without being eaten). It turns out that you can pose this as a graph search problem.

   a) Describe a representation of the state space for this problem. What would the goal state look like in this representation.

   b) What are the possible actions at a particular state?

   c) Our goal is to get everything to the other side in one piece, so what are the constraints on the state space that we need for the actions in part b?

   d) Suppose we want to use A* here. Describe a non-trivial (e.g. not simply 0 for all states) admissible heuristic that we could use.