

CS 4700: Foundations of Artificial Intelligence
Homework 2
Due: Friday, February 23, 2018 1:25pm

1. (30 points) Imagine you have a state space where a state is represented by a tuple of three positive integers (i,j,k) , and you have three actions: decrease i by 1 (as long as $i > 0$), decrease j by 1 (as long as $j > 0$), and decrease k by 1 (as long as $k > 0$). The goal state is $(0,0,0)$. Assume that a given search method does not revisit states it has already seen, and that whenever there are multiple successors for a given state it first expands the state you get from the action of decreasing i by 1 (if possible), then the action of decreasing j by 1, then k .
 - a. (1 point) What is the branching factor for this problem?
 - b. (2 points) Is this state space a graph or a tree?
 - c. If the initial state is $(2,2,2)$:
 - i. (3 points) Draw the subset of the state space that you can reach from this state.
 - ii. (3 points) Label the states with the numbers 1, 2, 3, ..., to show the order in which they would be expanded by depth-first search.
 - iii. (3 points) Label the states with the upper-case letters A, B, C, ..., to show the order in which they would be expanded by breadth-first search.
 - iv. (3 points) Label the states with the lower-case letters a, b, c, ..., to show the order in which they would be expanded by iterative deepening search.
 - d. If the initial state is (i,j,k) , what is the time complexity, as a function of i , j , and k , of:
 - i. (3 points) Depth-first search
 - ii. (3 points) Breadth-first search
 - iii. (3 points) Iterative deepening search
 - e. (3 points) Would your answers to c change if the search method did *not* check for revisiting states (in other words, if you get to a state you've already been to you don't realize it and simply expand it again)?
 - f. (3 points) Give an admissible heuristic for this problem.
2. (10 points) Formulate Sudoku as a search problem. What are the states, actions, initial state, and goal condition?
3. (10 points) If $h(s)$ is an admissible heuristic:
 - a. (5 points) Is $h_1(s) = h(s)^{0.7}$ an admissible heuristic?
 - b. (5 points) Is $h_2(s) = h(s)^{1.7}$ an admissible heuristic?Please explain your answers.