

CS 4811 Artificial Intelligence Homework 2 — Search

Due: Tuesday, February 24, 2009, beginning of class

(Assigned: Tuesday, February 17, 2009)

Reminder: This is an individual assignment. All the work should be the author's and in accordance with the university's academic integrity policies. You are allowed to use any previously written source in preparing your answers, but if you use any other source than the textbook and the class notes, you should specify it on your assignment.

Question 1 (*10 points*).

Assume that a processor can process 100,000 nodes per second, and each node is stored on 100 bytes, and the (average) branching factor of the search tree is 4. Show the memory and time requirements of a complete depth-first search and breadth-first search for trees of depth 5, 10, 20, 30, 40, and 50. Show these on a table and express in the biggest units possible. Note that if we assume that the depth of a tree is d , we assume that the nodes at depth d do not have any children.

Question 2 (*10 points*).

Suppose that $\text{LEGAL-ACTIONS}(s)$ denotes the set of actions that are legal in state s , and $\text{RESULT}(a, s)$ denotes the state that results from performing a legal action a in state s . Define SUCCESSOR-FN in terms of LEGAL-ACTIONS and RESULT . Define LEGAL-ACTIONS and RESULT in terms of SUCCESSOR-FN .

Question 3 (*40 points*).

Give the initial state, goal test, successor function, and cost function for the following. Choose a formulation that is precise enough to be implemented, and write the pseudocode.

- a. You have three jugs, measuring 12 gallons, 8 gallons, and 3 gallons, and a water faucet. You can fill the jugs up or empty them out from one to another or onto the ground. You need to measure out exactly one gallon.
- b. You have to color a planar map using only four colors, in such a way that no two adjacent regions have the same color.

Question 4 (10 points). Draw and describe a hypothetical search tree and goal where each of the following conditions are satisfied. Assign names to nodes and show the f , g , and h values for A^* .

- Depth-first search performs much better than breadth-first search.
- Breadth-first search performs much better than depth-first search.
- A^* search performs much better than breadth-first search.
- Depth-first search performs much better than A^* search.

Question 5 (10 points). Recall that a heuristic function for A^* consists of two parts for node n : $f(n) = g(n) + h(n)$ where $g(n)$ is the **actual** cost incurred so far, and $h(n)$ is the **estimated** cost to reach the goal. Explain why we need the $g(n)$ part. In others words, why can't we base the search on the estimated cost only?

Question 6 (20 points).

Perform an alpha-beta prune to the following state space. Show all the alpha (for MAX) and beta (for MIN) values you use. Mark the branches that are pruned and write the names of the nodes that will not be expanded.

