Homework #2

Due Apr 26 by 11:59pm **Points** 20 **Submitting** a file upload
Available Apr 17 at 12am - Apr 28 at 11:59pm

This assignment was locked Apr 28 at 11:59pm.

1. (6 points) Give complete problem formulation for each of the following, i.e., define the states, actions, and the initial state. Represent the transition model and the goal test in precise notation.
a. (2 points) Using only four colors, you have to color a planar map in such a way that no two adjacent regions have the same color.
b. (2 points) A 3-foot-tall monkey is in a room where some bananas are suspended from the 8-foot ceiling. He would like to get the bananas. The room contains two stackable, movable, climbable, 3-foot-high crates.
c. (2 points) You have 3 jugs measuring 12, 8, and 3 gallons, and a water faucet. You can fill the jugs up or empty them out from one to the other or onto the ground. You need to measure out exactly 1 gallon.

2. (5 points) Consider a state space where the start state is number 1 and each state k has two successors: numbers 2k and 2k+1.
a. Draw the portion of the state space from 1 to 15.
b. Suppose the goal state is 11. List the order in which states will be visited for breadth first search, depth limited search with limit 3 and iterative-deepening search.
c. How well does bidirectional search work in this problem? What is the branching factor in each direction of the bidirectional search?
d. Does answer to c suggest a reformulation of the problem that would allow you to solve the problem of getting from state 1 to any given goal state with almost no search?
e. Call the action going from k to 2k 'Left' and the action going to 2k+1 'Right'. Give an algorithm that outputs the solution to this problem without any search at all.

3. (9 points) n vehicles occupy squares (1,1) through (n,1) (i.e., the bottom row) of an grid. The vehicles must be moved to the top row but in reverse order; so the vehicle that starts in (i,1) must end up in (n-i+1,n). On each time step , every one of the vehicles can move one square up, down, left or right or stay put; but if a vehicle stays put, one other adjacent vehicle (but not more than one) can hop over it. No two vehicles can occupy the same square.
a. (1 point) Calculate the size of the state space as a function of n.
b. (1 point) Calculate the branching factor as a function of n.
c. (1 point) Suppose that the vehicle i is at location (x,y). Write a non-zero admissible heuristic h_i for the number of moves it will require to get to its goal location (n-i+1, n), assuming no other vehicles are on the grid.

d. (6 points) Which of the following heuristics are admissible for the problem of moving all n vehicles to their destinations? Explain.

$(a) \sum_i h_i$

$(b) \max_i h_i$

$(c) \min_i h_i$