Solutions Guide – Homework 1

1. A finite state space with cycles can lead to an infinite search tree (if duplicates are not removed).

If the space is a finite directed tree, then the search tree is also finite.

The effective space must be a finite directed tree to lead to a finite search tree.

2. .

a. Initial state: No regions colored.

Goal test: All regions colored, and no two adjacent regions have the same color.

Successor function: Assign a color to a region.

Cost function: Number of assignments.

b. Initial state: As described in the text.

Goal test: Monkey has bananas.

Successor function / operators:

* Climb on crate;
* Climb off crate;
* Push crate from one spot to another;
* Stack crate on other crate if nearby;
* Walk from one spot to another;
* Grab bananas (if high enough).

Cost function: Number of actions. (Or total time taken, or something reasonable.)

c. Initial state: jugs have values [0, 0, 0].

Goal test: At least one jug has the value 1.

Successor function: given values [x,y,z],

* fill one jug to generate [12,y,z], [x, 8,z], or [x,y, 3];
* empty one jug to generate [0,y,z], [x, 0,z], [x,y, 0];
* for any two jugs with current values x and y, pour y into x – this changes the jug with x to the minimum of x + y and the capacity of the jug, and decrements the jug with y by the amount gained by the first jug.

Cost function: Number of actions. (Or number of gallons poured, or something else reasonable.)

3.

a. Any path, no matter how bad it appears, might lead later to an arbitrarily large reward (i.e., negative cost). Therefore, one would need to exhaust all possible paths to be sure of finding the best one.

b. Suppose the greatest possible reward is c. Then if we also know the maximum depth of the state space (e.g. when the state space is a tree), then any path with d levels remaining can be improved by at most cd, so any paths worse than cd less than the best path can be pruned. For state spaces with loops, this guarantee doesn’t help, because it is possible to go around a loop any number of times, picking up c reward each time.

c. The agent should plan to go around this loop forever (unless it can find another loop with even better reward).

d. The value of a scenic loop in reality is lessened each time one revisits it; a novel scenic sight is a great reward, but seeing the same one for the tenth time in an hour gets tedious, not rewarding. To accommodate this, we would have to expand the state space to include a memory—a state is now represented not just by the current location, but by a current location and a bag of already-visited locations. The reward for visiting a new location is now a (diminishing) function of the number of times it has been seen before.