Illinois Institute of Technology
Department of Computer Science

Homework Assignment 1

CS 480 Artificial Intelligence: Planning and Control
Fall Semester, 2018

Please type up your answers neatly and submit in a PDF file on Blackboard. Name your file `<yourCWID>-<yourname>.pdf`.

1. (10 points): Does a finite state space always lead to a finite search tree? How about a finite state space that is a tree? Can you specify precisely what types of state spaces always lead to finite search trees?

2. (10 points each): Give the initial state, goal test, successor function, and cost function for each of the following. Choose a formulation that is precise enough to be implemented. NOTE: Do not solve the task - **formulate** the problem precisely as a search problem.

   (a) Color a planar map using only four colors, in such a way that no two adjacent regions have the same color.

   (b) 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) 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 on to the ground. You need to measure out exactly one gallon.

3. (10 points each) We said in class that we would not consider problems with negative step costs. In this exercise, we explore this issue in more depth.

   (a) Suppose actions can have arbitrarily large negative costs. Why would this force any **optimal** algorithm to explore the whole state space?

   (b) Does it help if we insist that step costs must be greater than or equal to some negative constant c? Consider both state spaces that are trees and those that are full graphs.

(c) Suppose there is a set of operators that form a loop, so that executing them in some order results in no net change to the state. If all of these operators have negative cost, what does this imply about the optimal behavior for an agent in such an environment?

(d) One can easily imagine operators with high negative cost, even in domains such as route finding. For example, some stretches of road might have such beautiful scenery as to far outweigh the normal costs in terms of time and fuel. Explain, within the context of state-space search, why humans do not drive around scenic loops indefinitely. How could such an idea be formalized in operators for route finding so that artificial agents can also avoid looping?