CMPT 310, Spring 2019, Written Assignment 01

Due date: January 14, 2019

Problem 1. Suppose that the performance measure is concerned with just the first T time steps of the environment and ignores everything thereafter. Show that a rational agent's action may depend not just on the state of the environment but also on the time step is has reached.

Problem 2. For each of the following activities, give a PEAS description of the task environments and characterize it in terms of properties.

(a) Exploring the subsurface oceans of Titan.

(b) Playing a tennis match.

(c) Practicing tennis against a wall.

(d) Knitting a sweater.

Problem 3. Your goal is to navigate a robot out of a maze. The robot starts in the center of the maze facing north. You can turn the robot to face north, east, south, or west. You can direct the robot to move forward a certain distance, although it will stop before hitting a wall.

(a) Formulate this problem. How large is the state space?

(b) In navigation a maze, the only place we need to turn is at the intersection of two or more corridors. Reformulate this problem using this observation. How large is the state space now?

(c) From each point in the maze, we can move in any of the four directions until we reach a turning point, and this is the only action we need to do. Reformulate the problem using these actions. Do we need to keep track of the robot's orientation now?

(d) In our initial description of the problem we already abstracted from the real world, restricting actions and removing details. List three such simplifications we made.

Problem 4. Give a complete problem formulation for each of the following. Choose a formulation that is precise enough to be implemented.

(a) 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) 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 a program that outputs the message "illegal input record" when fed a certain file of input records. You know that processing of each record is independent of the other records. You want to discover what record is illegal.

(d) 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.

Problem 5. Considering the decision of not exploring negative path costs, answer the following items.

(a) Suppose that actions can have arbitrarily large negative costs: explain why this possibility would force any optimal algorithm to explore the entire 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 trees and graphs.

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

(d) One can easily imagine actions 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 overweight the normal costs in terms of time and fuel. Explain, in precise terms, within the context of state-space search, why humans do not drive around scenic loops indefinitely, and explain how to define the state space and sections for route finding so the artificial agents can also avoid looping.

(e) Can you think of a real domain in which step costs are such as to cause looping?