CS 479: Introduction to Intelligent Agents Using Science Fiction

Homework 4

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Due: 11:59pm, November 2, 2023 (On Canvas)

Solve this homework individually and submit your answers in a pdf file; you do not need to submit your code.

Question 1. [100]

Your robot needs to traverse the grid shown in Figure 1 with the objective

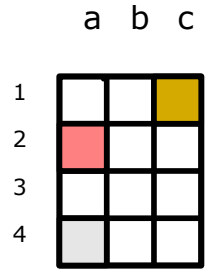

Figure 1: Left: Grid. Middle: Prohibited moves. Right: Shortest path

to reach cell $c1$. If the robot reaches cell $a2$, a short circuit will damage the robot. The robot can only move to the North or the East and making one action costs 1 unit of energy except in cell $c1$, where any action has a reward of 10, and in cell $a2$ where any action costs 10. For example, $R(b4, East, c4) = -1$ and $R(c1, North, x) = 10$. Every time the robot moves, there is a probability p of success and a probability of $(1 - p)$ of ending up to its left, that is, $T(b3, East, b2) = P(b2 \mid East, b3) = 1 - p$ and $T(b3, East, c3) = P(c3 \mid East, b3) = p$. If the robot hits a wall, he remains in the same cell; for instance, $T(c4, East, c4) = P(c4 \mid East, b4) = p$

a) Represent the problem as an MDP, i.e., define the set of states, the set of actions, the reward function, and the transition function. [10 points]

b) Assume $\gamma = 1$. Solve the MDP using Value Iteration when $p = 0.9$. Show the expected values for each state after convergence.[30 points]

c) Assume values need to be equal up to the fourth decimal, i.e., $9.99001 = 9.99002$ and $9.9988 \neq 9.9998$. How many iterations did it take to converge? [10 points]

d) What is the optimal policy? that is, what is the best action to take in each cell?[30 points]

e) Now assume $p = 0.99$ did the policy change? How about with $p = 0.8$? [20 points]