CS 4080-5080: Reinforcement Learniing

Home Work Assignment 1

Out: 09-13-2021, Due 09-29-2021

This assignment requires you to implement a simple reinforcement learning agent from scratch, i.e., you will not use any reinforcement learning library or framework. You can use any numeric processing library in the language you have chosen. You can program in any language of your choice.

Consider the simple maze we have been talking about in the class as we discuss concepts and algorithms in reinforcement learning. It is a 5×5 grid, with a single start state and a single goal state as shown in Figure 1. There is a barrier to movement covering four states in the third row. There is also a barrier to movement in the middle of the fifth row.

The agent needs to learn a policy that will take it from the start state to the goal state efficiently.

1. How would you represent the various components that are required to program this reinforcement learning agent? Discuss each component and how you implement it. Explain how you model the barriers, and how you make sure the agent does not fall off the edges.
2. You would initialize with a random policy where every action that is possible in a state is equally probable. What does this policy look like?

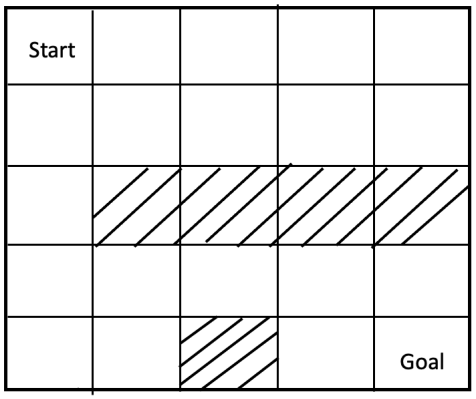

Figure 1: A Simple 5×5 Maze

3. Assume the agent uses a Monte Carlo method to learn an optimal policy starting with the equi-random policy. It involves improving the random policy slowly using a greedy approach and stopping when the policy does not improve any more.

Write the algorithm in terms of pseudocode and briefly explain with reference to lines in the pseudocode.

4. Implement the algorithm using any programming language of choice. Run the algorithm several times. Does it produce the same policy every time? Show the policy (policies) learned. Explain any differences if any. Change any relevant parameters and rerun a few times. Comment on how changes in parameter values changes learning.
5. Write a short paper giving details of what you have done, the results you have obtained, the problems you have faced, and how you have overcome the problems you have faced. Use the format you use for your semester project papers. The maximum number of pages is 4 for content, followed by an extra page for references, if necessary.
6. Extra credit may be given based on substantial additional work. For example, you can discuss and implement more than one Monte Carlo algorithm, based on limitations of the (first) approach that you try. You may also discuss metrics to measure how the agent learns and performs after learning, implement such metrics. This part of the homework is intentionally left open-ended.

You do not need to hand in soft copies of your programs for this assignment. Written answers in the paper to questions given or issues raised above are sufficient. You will have to demo your program the week it is due or before. Please upload copy of your paper on Canvas on the due date.