CS 4080-5080: Reinforcement Learniing

Home Work Assignment 2
Out: 10-11-2021, Due 10-27-2021

This assignment requires you to implement a 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 a simplified "parking lot" with 8 parking spots marked P, and one entrance marked E. It is described in terms of a 6×7 grid, with a single, as in Figure 1. There is barrier to movement between the two rows of parking.

A car agent can move only forward, backward, or sideways. For a simple car, we make the assumption that there is no angular steering. A car cannot drive over parking spots on its way to a goal parking spot.

The agent needs to learn a policy or a number of policies that will take it from the entrance to any of the parking spots. Assume all grid cells are of equal size and a car fits well inside any of the cells. We assume that the car is a square and the grid cells are squares as well.

1. The parking lot diagram given in the figure is a starting point. You can make changes if you like to make it better represent an actual parking lot, within the constraints of the homework. Do not go overboard, since time is short. How would you represent the various components that are required to program the car to learn to park in any of the parking spots? Discuss each component. Explain how you model the barriers, and how you make sure the agent does not fall off the edges.

2. You are asked to implement Q-learning algorithm and at least one variant of it such as the Double Q-learning algorithm and the Self-correcting Q-learning algorithm.

   Write the algorithms you implement in terms of pseudocode and briefly explain with reference to lines in the pseudocode. Discuss how the base algorithm is improved by the other algorithm(s).

3. Implement the algorithms using any programming language of choice. Run the algorithms several times. Show one or more of the policies learned. Change any relevant parameters and rerun a few times. Comment on how changes in parameter values change learning. It is a good idea to include graphs or tables for such analysis.

4. The agent can learn from scratch every time, or use simple transfer learning. Transfer learning would involve learning the Q-table for one case, and using the learned Q-table as knowledge to seed the learning for another case. Perform transfer learning experiments, discuss and comment on your findings.
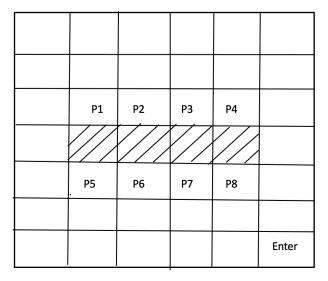
Figure 1: A Simplified Parking Lot

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. 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.

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.