CS 7642: Reinforcement Learning and Decision Making **Homework #6**

Rock, Paper, Scissors

1 Problem

1.1 Description

Rock, Paper, Scissors is a popular game among kids. It is also a good game to study Game Theory, Nash Equilibrium, Mixed Strategies, and Linear Programming.

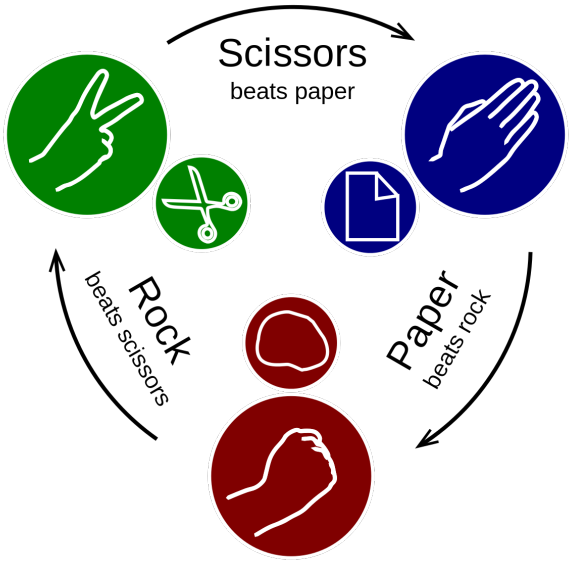

Figure 1: The rules of Roshambo

1.2 Procedure

For this assignment, you are asked to compute the Nash equilibrium for the given zero sum games. You will be given the reward matrix for Player A. Player B's reward matrix will be the opposite of Player A's matrix. You need to find the ideal mixed strategy for the game. While there are different ways to calculate this we will use Linear Programming in the hopes of preparing you for your final project. Use a Linear Programming solver – such as CVXOPT – to create a program that can solve arbitrary Rock, Paper, Scissors games. You will submit the strategy found by your Linear Program as a list of floating point numbers. Much like the previous assignments, answers will be graded to a 0.001 precision.

1.3 Examples

	Rock	Paper	Scissor
Rock	0	1	-1
Paper	-1	0	1
Scissors	1	-1	0

Strategy: $\pi_{Rock} = 0.333, \pi_{Paper} = 0.333, \pi_{Scissor} = 0.333$

	Rock	Paper	Scissor
Rock	0	2	-1
Paper	-2	0	1
Scissors	1	-1	0

Strategy: $\pi_{Rock} = 0.250, \pi_{Paper} = 0.250, \pi_{Scissor} = 0.500$

Note: Output probabilities must be of the form 0.XYZ, as shown in the examples, with a leading 0 before the decimal point, and exactly 3 digits after the decimal point

1.4 Resources

1.4.1 Lectures

- Lesson 11A: Game Theory
- Lesson 11B: Game Theory Reloaded

1.4.2 Readings

- Littman-1994.pdf Littman 1994
- Littman-Stone-2003.pdf Littman and Stone 2005

1.5 Submission Details

The due date is indicated on the Canvas page for this assignment.

Make sure you have set your timezone in Canvas to ensure the deadline is accurate. To complete the assignment calculate answers to the specific problems given and submit results to Canvas.

References

[Lit94] Michael L Littman. "Markov games as a framework for multi-agent reinforcement learning". In: *Machine learning proceedings 1994*. Elsevier, 1994, pp. 157–163.

[LS05] Michael L Littman and Peter Stone. "A polynomial-time Nash equilibrium algorithm for repeated games". In: *Decision Support Systems* 39.1 (2005), pp. 55–66.