

CSCI 8920 Decision Making Under Uncertainty

Assignment 3: Multiagent Decision Making

General Information

Deadline: as shown on eLC

Worth: 60 pts + 10 bonus pts

The Assignment

The purpose of this assignment is to understand and become familiar with advanced concepts and methods in game theory and decision-theoretic frameworks in multi-agent settings. Your grade will be based on the correctness of the solutions. Please be as specific as possible while writing the answers.

Note: This assignment is not a group project and everybody should work on it individually.

In order to complete this assignment successfully, you must first carefully read Chapter 17 of Russell & Norvig, Chapters 5 and 6 of Shoham & Leyton-Brown, and your class notes.

Problems

1. (20 points) Consider the two-player game in extensive form as shown in Fig. 1.
 - (a) Write this game in normal form.
 - (b) Find all the strategies that remain after iterated elimination of strictly dominated strategies.
 - (c) Find all Nash equilibria in pure strategies.
 - (d) Is the game exhibiting perfect recall?

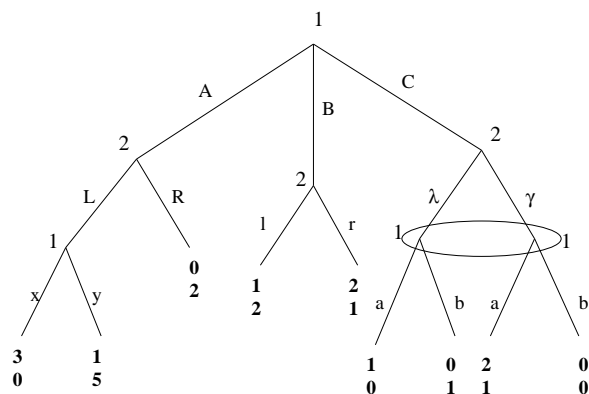


Figure 1: An extensive form game.

2. (15 points) Consider a variant of the Battle of the Sexes game. Suppose the payoffs of the husband are common knowledge, but the payoffs of the wife are known only to herself. The husband believes that there are two possibilities; either the wife wants to go with him, or she doesn't want to go with him.

	O	F
O	2,1	0,0
F	0,0	1,2

(a)

	O	F
O	0,1	2,0
F	1,0	0,2

(b)

Figure 2: (a) Wife likes to go with husband; (b) wife does not like to go with husband.

In the payoff matrices, the wife chooses a row and the husband chooses a column. In each cell, the first number represents the payoff to the wife and the second number represents the payoff to the husband. Game in Fig. 2(a) results when the wife likes to go with the husband, while the game in Fig. 2(b) results when the wife does not like to go with the husband. Let p be the probability, provided by nature, that the wife prefers to go with the husband. Find all ex-interim Bayes-Nash equilibria in this game. If $p = 0.5$, what are the specific equilibria that result?

3. (10 points) Consider an infinitely repeated game involving I players with s^*

as the Nash equilibrium of the stage game. Show that the strategies “each player i plays s_i^* from now on” are a subgame-perfect equilibrium.

4. (15 points) Consider the *rock-paper-scissors game* shown below.

	Rock	Paper	Scissors
Rock	0,0	-1,1	1,-1
Paper	1,-1	0,0	-1,1
Scissors	-1,1	1,-1	0,0

Let us assume that the initial belief of each player is (0.5,0.25,0.25) for the other player’s two pure strategies. Show how the players’ actions change as they engage in *fictitious play* of the rock-paper-scissors game. Please draw a table showing the round of play, each player’s action and each player’s belief.

Does the empirical distribution of the player’s joint actions converge to any Nash equilibria of the game? If so, which one? Please show your steps.

5. (**Bonus** - 10 points) Read the engaging survey article enclosed with this assignment, “Recursively Modeling Other Agents for Decision Making: A Research Perspective”, which presents a historical evolution of the research investigations into recursively modeling other agents and its role in multi-agent decision making. Give three ways in which the Recursive Modeling Method and Interactive POMDPs are similar, and list three points of distinction between them.

What and how to hand it in

You’ll submit the *typed* answers to the instructor by the deadline. Please be sure to indicate the question numbers alongside the answers. The document should include your name, student id, and all the answers.

Assignments that are **late** but within a day of the deadline will be penalized 33% of the total number of points. Assignments submitted later than one day will not be accepted.