

The Hebrew University of Jerusalem Introduction to Artificial Intelligence Problem Set 5- Game Theory Due Date: 5/7/21

Matrix form Nash Equilibrium and dominated strategies:

Problem 1 [30 points]

Rock-Paper-Scissors:

In the children's game of rock–paper–scissors each player reveals at the same time a choice of rock, paper, or scissors. Paper wraps rock, rock blunts scissors, and scissors cut paper.

1. Write the **matrix form** and find the **Nash Equilibria** of the Rock-Paper-Scissors game. Where: The utility 1 for a win, -1 for loss and 0 for a draw.
2. Familiarize yourself with the game rock–paper–scissors–lizard–spock.

<https://www.youtube.com/watch?v=x5Q6-wMx-K8&feature=youtu.be>

We will be using a different version of that game:

Spock beats rock, paper, and scissors; rock, paper, and scissors beat lizard; and lizard beats Spock. Write out the **payoff matrix** and find a **mixed-strategy** solution to this game.

Problem 2 [20 points]

- Show that a dominant strategy equilibrium is a Nash equilibrium, but not vice versa.

Problem 3 [25 points]

Consider the following normal form game:

Player 1 (row) can choose between actions A, B, and C, while Player 2 (column) can choose between a, b and c. The utility of an outcome is listed in the bottom left corner of the square for Player 1, and in the top right for Player 2.

	a	b	c
A	4 3	7 0	2 2
B	1 1	5 6	0 2
C	0 2	9 7	3 8

1. List all of the **pure strategy Nash Equilibrium** of this game
2. List all of the **dominated strategies** for either player in this game
3. Draw the game which results when all of the dominated strategies are removed

Decision Trees

Problem 4 [25 points]

Suppose we want to learn the predicate PlayTennis as a decision tree using up to 4 observable attributes Outlook (with possible values Sunny, Overcast, and Rainy), Temperature (with 3 possible values Hot, Mild, and Cool), Humidity (with 2 possible values High and Normal), and Wind (with two possible values Weak and Strong). We are given the following training set made of 14 examples:

Ex #	Outlook	Temperature	Humidity	Wind	PlayTennis
1	Sunny	Hot	High	Weak	False
2	Sunny	Hot	High	Strong	False
3	Overcast	Hot	High	Weak	True
4	Rainy	Mild	High	Weak	True
5	Rainy	Cool	Normal	Weak	True
6	Rainy	Cool	Normal	Strong	False
7	Overcast	Cool	Normal	Strong	True
8	Sunny	Mild	High	Weak	False
9	Sunny	Cool	Normal	Weak	True
10	Rainy	Mild	Normal	Weak	True
11	Sunny	Mild	Normal	Strong	True
12	Overcast	Mild	High	Strong	True
13	Overcast	Hot	Normal	Weak	True
14	Rainy	Mild	High	Strong	False

Run and build the complete decision tree using **the ID3 algorithm with Information gain ratio** to classify correctly all 14 examples in the training set.