TECHNISCHE UNIVERSITÄT DRESDEN

Computational Logic ∴ Group

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Algorithmic Game Theory

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Exercises 6

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Problem 1.
Explain the two ways, with either Player1 or Player2 moving first, of representing an $m \times n$ two-player normal-form game as an extensive-form game that has the given game as its strategic form. In both cases, how many decision nodes do the players have? What is the number of terminal nodes of the game tree? Why do we need information sets here?

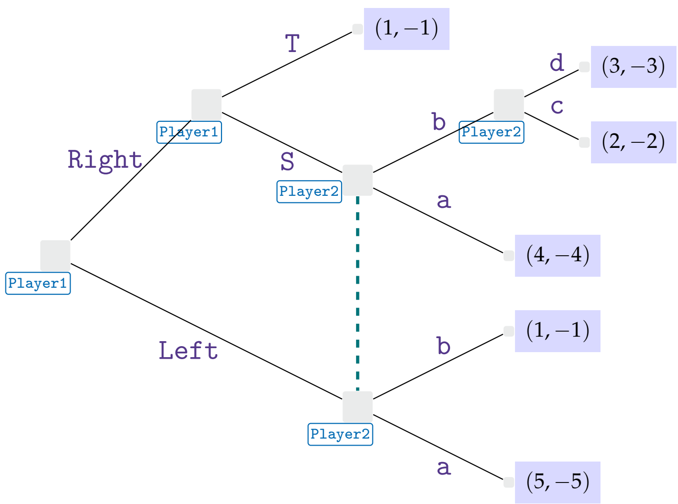
You can work with the following example that illustrates a 2×3 game:

(Player1,Player2)	a	b	c
T	(0,0)	(1,1)	(2,2)
B	(3,3)	(4,4)	(5,5)

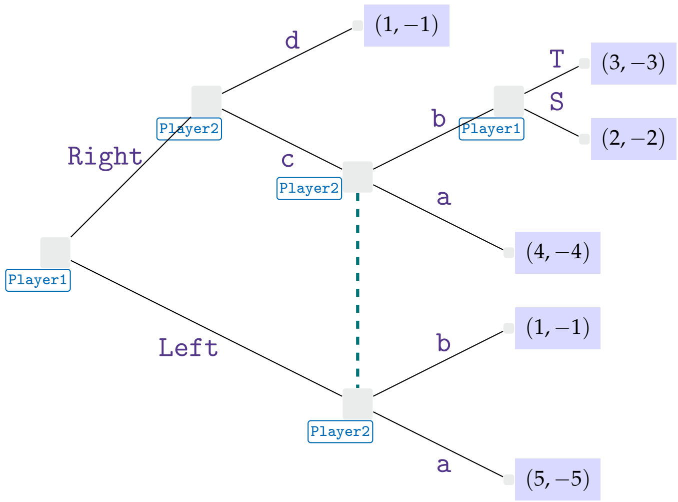
Problem 2.
Which of the following extensive-form games have perfect recall and if not, why not?

For each extensive-form game with perfect recall, find all its equilibria in pure strategies. You can work with reduced strategies.

Game 1:



Game 2:



Problem 3.
The base rate fallacy is a cognitive bias in which individuals tend to ignore or undervalue the prior probability or base rate of an event, instead focussing primarily on specific diagnostic information or individual characteristics when making probability judgments.

Suppose there is a rare disease called "Xyzitis" that affects 0.1% of the population. There is a diagnostic test available to detect Xyzitis, which has a sensitivity of 99% and a specificity of 97%. This means that if a person has Xyzitis, the test will correctly identify them as positive 99% of the time (sensitivity), and if a person does not have Xyzitis, the test will correctly identify them as negative 97% of the time (specificity). Now, imagine you're given a group of 10,000 people, and you randomly select one person from the group to test for Xyzitis using the diagnostic test. The test result comes back positive.

Given the information provided, what is the probability that the person actually has Xyzitis?
Problem 4.
Consider the following zero-sum game, a simplified version of Poker adapted from Kuhn (1950). A deck has three cards (of rank High, Middle, and Low), and each player is dealt a card. All deals are equally likely, and of course the players get different cards. A player does not know the card dealt to the other player. After seeing his hand, player I has the option to Raise (R) or to Fold (F). When he folds, he loses one unit to player II. When he raises, player II has the option to meet (m) or pass (p). When player II chooses "pass", she has to pay one unit to player I. When player II chooses "meet", the higher card wins, and the player with the lower card has to pay two units to the winning player.

Draw a game in extensive form that models this game, with information sets, and payoffs to player I as the leaves. Moreover, label each edge where *Nature* performs a move with its respective probability.

What changes under the assumption that the first card by player 1 is chosen by chance, and only afterwards (if player 1 has not folded) the second card is given to player 2.