TECHNISCHE UNIVERSITÄT DRESDEN

Computational Logic ∴ Group

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Algorithmic Game Theory

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Exercises 8

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Problem 1.
Recall the Prisoner's Dilemma from the first problem sheet:

(Ann, Bob)	Confess	Silent
Confess	(3, 3)	(0, 5)
Silent	(5, 0)	(1, 1)

Suppose the Prisoner's Dilemma is played out $T = 7$ times in a row with the following strategies being played:

t	1	2	3	4	5	6	7
Ann	C	C	S	S	S	C	C
Bob	C	S	C	C	S	S	S

- Compute the overall payoffs of both players.
- Compute Ann 's regret w.r.t. the best (in hindsight) possible sequence of pure strategies, fixing Bob 's strategy for all rounds.
- Compute Bob 's regret w.r.t. the best (in hindsight) possible sequence of pure strategies, fixing Ann 's strategy for all rounds.
- Compute the average strategies $\bar{\pi}_i^7$ for every player i.

Problem 2.
Consider the following game:

(Player1, Player2)	C	K
C	(6, 6)	(2, 7)
K	(7, 2)	(0, 0)

- Find all mixed Nash equilibria and the corresponding payoffs.
- Argue without computations why the following correlated strategy is a correlated equilibrium:

(Player1,Player2)	C	K
C	(0)	$(\frac{1}{2})$
K	$(\frac{1}{2})$	(0)

- Show formally that the following correlated strategy is a correlated equilibrium:

(Player1,Player2)	C	K
C	$(\frac{1}{3})$	$(\frac{1}{3})$
K	$(\frac{1}{3})$	(0)

Problem 3.
Consider the following payoff table for Rock-Paper-Scissors (RPS):

(Player1,Player2)	Rock	Paper	Scissors
Rock	$(0,0)$	$(-1,1)$	$(1,-1)$
Paper	$(1,-1)$	$(0,0)$	$(-1,1)$
Scissors	$(-1,1)$	$(1,-1)$	$(0,0)$

Suppose we play RPS over two rounds where Player1 uses regret matching. Assume that Player1 plays the mixed strategy $(1/3, 1/3, 1/3)$ if no pure strategy has a positive accumulated regret.

- What is the accumulated regret for Player1 before the first round is played out?
- Assume that in the first round Player1 plays Rock and Player2 plays Paper. What is Player1's accumulated regret now? What strategy does regret matching suggest now?
- Suppose that in the second round, Player1 plays Paper and Player2 plays Scissors. What is the accumulated regret and the suggested strategy for Player1?

Problem 4.
Consider the payoff table for RPS from above. This time, assume that both players use regret matching.

Do the following over the course of three rounds:

- Initialize both player's strategies with mixed strategy (1/3, 1/3, 1/3);
- For each round, randomly generate the strategies being played out based on the respective mixed strategies;
- Calculate the cumulative regret of each player and update the strategy suggested by regret matching.
- Compute the average mixed strategy of every player after the three rounds.