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Algorithmic Game Theory

Summer Term 2026

Exercises 8

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Problem 1.

Recall the Prisoner's Dilemma from the first problem sheet:

(Eli, Fyn)	Cooperate	Defect
Cooperate	(3, 3)	(0, 5)
Defect	(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
Eli	C	C	D	D	D	C	C
Fyn	C	D	C	C	D	D	D

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

Problem 2.

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 $(\frac{1}{3}, \frac{1}{3}, \frac{1}{3})$ 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 3.

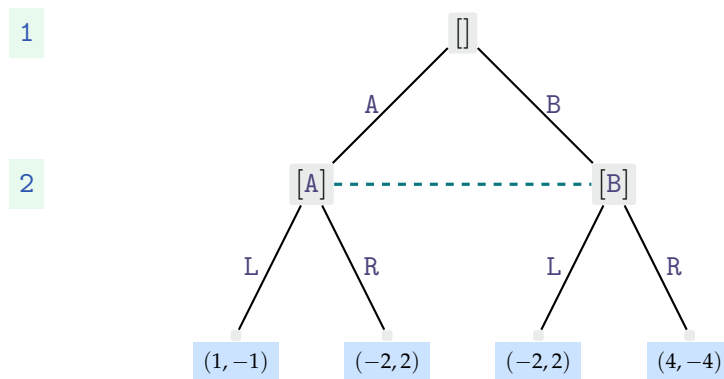
Consider the payoff table for RPS from above. This time, assume that both players use regret matching.

Do the following over the course of three rounds:

- Initialize both player's strategies with mixed strategy $(\frac{1}{3}, \frac{1}{6}, \frac{1}{2})$;
- 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.

Problem 4.

Consider the following two-player zero-sum extensive-form game:



- Apply the counterfactual regret minimisation algorithm for $T = 2$.
- Compute the average strategies obtained by CFR, taking into account $t = 1, 2, 3$.
- Transform the game into normal form and compute a mixed Nash equilibrium.