

ECE 752/493 Tournament

Due on Monday March. 16th

You will design an agent that repeatedly plays the following game with two other agents. In each round, the three agents collaborate on a joint project. Your objective is to maximize your agent's total reward by the end of the game. The reward depends both on your individual effort and on the group's total effort.

Carefully read the description of the game below and propose a strategy that you believe will maximize your total utility.

The Game

Three agents collaborate on a single project over multiple rounds. The total number of rounds is random. After each round, the game ends with probability $1 - \delta$ and continues to the next round with probability δ , where $\delta \in (0, 1)$ is fixed and is revealed to all agents before the start of the game.

At each round $r \in \{1, \dots, R\}$, agent $i \in \{1, 2, 3\}$ chooses an effort level

$$a_{i,r} \in [0, 1],$$

where $a_{i,r}$ represents the amount of agent i 's contribution to the project in round r .

Contributing effort is costly. Specifically, if agent i chooses effort $a_{i,r}$, they incur a cost

$$C_i(a_{i,r}) = \frac{2}{3} a_{i,r}^2.$$

Let $a_r = (a_{1,r}, a_{2,r}, a_{3,r})$ denote the effort profile in round r , and define the total group effort in round r as $A_r = a_{1,r} + a_{2,r} + a_{3,r}$.

Project Surplus and Immediate Rewards

In each round, the project generates a surplus reward that depends on the total group effort:

$$S(A_r) = \sqrt{A_r}.$$

The surplus is divided as follows:

- A fraction $\frac{3}{4}$ of the surplus is distributed immediately and equally among the three agents. Thus, each agent receives

$$\frac{1}{4} S(A_r)$$

in that round.

- The remaining $\frac{1}{4}S(A_r)$ is given as bonus to the agent with the lowest effort level in that round. If more than one agent is tied for the lowest effort level, the remaining surplus is divided equally among those agents.

Let $B_i(a_r)$ denote the bonus received by agent i for action profile a_r . Agent i 's total utility is therefore

$$U_i = \sum_{r=1}^R \left(\frac{1}{4} \sqrt{A_r} - \frac{2}{3} a_{i,r}^2 + B_i(a_r) \right).$$

Your task is to design a strategy for choosing $a_{i,r}$ in each round so as to maximize U_i .

Getting Started

Visit the tournament page at <http://maslab-hps1.uwaterloo.ca/tournament> to get started (you will need to use the university VPN if you are not on campus).

1. Download the file `strategy_template.py` from the sidebar on the webpage.
2. Implement the function `strategy()`. This is the only part of the code you need to modify. Your implementation must complete its execution within 4 seconds.
3. Use the **Create Test Session** page to create a test session and verify that your strategy works correctly before the tournament.

The template file and detailed instructions for running your client are provided on the server.

The Tournament

We will announce the final tournament rules soon. Currently, the plan is to follow a format similar to the *FIFA World Cup*. The tournament will consist of two stages. In the first stage (the *group stage*), agents are divided into groups, and every agent in a group plays against every other agent in the same group. In the second stage (the *knockout stage*), agents that advance from the group stage compete in elimination rounds. In each round, losing agents are eliminated until a single overall winner remains.

We are planning to run the tournament during the lecture on Tuesday, March 17.