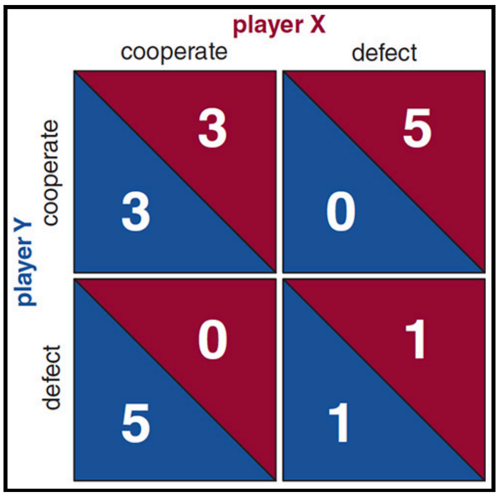
Tournament requirements

The tournament is based on the modified version of the Prisoner’s Dilemma, Iterated Prisoners Dilemma. The Iterated Prisoner's Dilemma is an extension of the general form, except the game is repeatedly played by the same participants. The main principle is that the participants, in our case, your algorithms, should get as many points as possible.



You should implement an algorithm that chooses one step at a time either to cooperate or to defect while playing together with another algorithm. So in a way, it’s a PvP (Player versus Player) with algorithms created by your other colleagues. You will play in rounds, and every round the program must make a choice: to deflect (0) or to cooperate (1). These choices will determine how many points you will receive. As shown in the image, the points will be given in the following way:

- cooperate together: receive both 3 points
- deflect together: receive both 1 point
- one deflects, one cooperates: who deflects gets 5 points, the one who tried to cooperate will get nothing 💀

How the algorithm will work is up to you: is it friendly and tries to cooperate, or is it retaliatory and gets mad really quickly if the opponent defects first. It may be a simple algorithm that alternates between the 0 and 1, or it can be a complex one that tries predicting how the opponent will react next. It might be nice to others and work toward cooperation, or it can be a nasty one and deflect each time. Again, it’s up to you how the algorithm will come out.

Based on these algorithms will be made a tournament, in order to find out the best performing algorithm(s). The requirements for this algorithm will be analyzed later in the current document.

The tournament will take place in 2 parts: first part **before the 17th of April**, second one after the Easter vacation.

Both parts will require the algorithm to run a fixed number of rounds against any other opponent algorithm. The rules for both parts will differ each time.

The deadline to submit your algorithm for the **first part** of the tournament is **6th of April, 23:59**. The submission link is the following: https://forms.gle/t7xLX16yosridYzu9

You will work alone, and will submit your GitHub with a README file that will explain a bit of the algorithm logic. In the end, your GitHub will contain 2 files with your algorithm, and 1 README. Our Algorithm Experts will analyze your algorithm and offer you feedback if needed. That's why you will have to complete the form to get in the tournament.

Requirements for the first part of the tournament

The first part of the tournament will happen in 2 stages, different number of rounds each. For this part, you will submit just one algorithm. The requirements for the first part are the following:

Submission file format

Each participant submits a single **file with *.py* extension**. It should contain **only their algorithm function, called *strategy***. No additional scripts, libraries, or external dependencies. No exception even for random module.

The file should follow the naming format :

algorithm_name.py

First goes algorithm name, all with only with small letters and underscores.

Examples: *tit_for_tat.py*; *my_strategy_name.py*, etc.

Participants should ensure that their code does not include:

- unnecessary comments
- debugging prints
- other things that might create difficulties during run time.

Before submission, they should thoroughly test their algorithm to ensure that it behaves as expected and does not crash under any conditions.

Function signature

In the file there should be only the function responsible for their algorithm. The function also must stick to a predifined format, which will ensure that it is compatible to play with other algorithms.

The function should be named ***strategy***, and it must accept 2 arguments for history of the game, named *my_history* and *opponent_history*, and also 1 argument called *rounds*, that might accept both None or integer values. Please, keep that in mind.

The function must be defined as:

def strategy(my_history: list[int], opponent_history: list[int], , rounds: int | None) → int:

This style will ensure fair evaluation for each algorithm.
Do not name your algorithm function any other than *strategy*.

Parameter *my_history*:

A list of integers (0 or 1) representing the player's own past moves. This allows the strategy to take into account its own previous decisions when making a new choice.

Parameter *opponent_history*:

A list of integers (0 or 1) representing the opponent’s past moves. This provides insight into the opponent's behavior, enabling adaptive strategies.

Parameter *rounds*:

An integer representing the total number of rounds to be played in the current phase of the competition. The output can be chosen based on the number of rounds, the current round is the number of elements in the history at the moment of call. Sometimes it can get a None value, so your algorithm should be prepared for this (mandatory!). It can use the history inputs for the decision-making.

The return value:

The function must return 1 for cooperation or 0 for defection.

Example of inputs:

```
my_history = [1, 0, 1, 1, 0]
opponent_history = [1, 1, 0, 1, 1]
rounds = 100
```

Because the number of rounds is an integer, the program can decide the output based on the history inputs and on the number of rounds (not mandatory, the program can ignore the number of rounds if your algorithm is built that way).

```
my_history = [1, 1, 0, 0, 1, 1]
opponent_history = [1, 0, 1, 1, 0, 1]
rounds = None
```

Because the number of rounds is None, the program does pick the output based only on its own and opponent's history.
Please consider this detail when creating your algorithm!

Rules and code constraits

To keep it fair and simple, there are some rules and constraints you should stick to.
Rules:

1. The function should only base its decision on the history inputs and, optionally, on the number of rounds for the first part of the competition. Your algorithm should adapt to None case as well.
2. The function should not modify *history,* both of them.
3. No external data sources (additional libraries), file access, or network usage.

Code constraints:

1. Execution time per call should not exceed *200ms* to prevent infinite loops or overly complex computations.
2. Memory usage should stay within *50MB*, ensuring that no strategy monopolizes system resources.

❗We kindly request you to consider seriously these rules and constraints. Based on that, we will have the possibility to run our tournament with little trouble.

Requirements for the second part of the tournament

The second part will happen similar to what happened in 1 stage, but with modified rules.
The algorithm stays the same, but now your algorithm will have the possibility to choose the algorithms it will work with.

What does this mean? *Let me explain using an example:* Let's imagine you have 500 rounds and 50 algorithms. In the previous part, you could play a fixed number of rounds with each algorithm, but just once. Now, you have the possibility to play a fixed number of rounds, with any algorithm you want! The only constraint is the maximum number of rounds you can play with an algorithm, let's consider 100 rounds max. That means you can play with 5 players, 100 rounds each. Or you could play with all 50 of them, 10 rounds each. Or you can select opponents with prime number ID and play with them. You can select the most collaborative algorithms and work to the maximum with them. Or you could find some friendly algorithm and ~~gaslight them~~ defect as much as possible. Your algorithm chooses who to play with. The only requirement: do not get over the max limit, use the same algorithm as in the last part, and get the most points out of this.

Submission file format

Each participant submits a single **file with *.py* extension**. It should contain **only their algorithm function, called *strategy_round_3***. No additional scripts, libraries, or external dependencies. No exception even for random module. The file should be also contained in the GitHub (the one you registered with in the form). So, again, there must be 2 files in one GitHub repository that you submited, one file for the first part, one file for the second part.

The file should follow the naming format :

algorithm_name_round_3.py

First goes algorithm name, all with only with small letters and underscores.

Examples: *tit_for_tat_round_3.py*; *my_strategy_name_round_3.py*, etc.

Participants should ensure that their code does not include:

- unnecessary comments
- debugging prints
- other things that might create difficulties during run time.

Before submission, they should thoroughly test their algorithm to ensure that it behaves as expected and does not crash under any conditions. We will provide at the end of the document a link to GitHub that contains a program that tests your algorithm.

Function signature

In the file there should be only the function responsible for their algorithm. The function also must stick to a predifined format, which will ensure that it is compatible to play with other algorithms. Same thing as in previous part.

The function should be named ***strategy_round_3.*** It will take 3 arguments: *opponent_id, my_history*, *opponents_history.*

Thus, the function must be defined as:

def strategy_round_3(opponent_id: int, my_history: dict[int, list[int]], opponents_history: dict[int, list[int]]) -> tuple[int, int]:

This style will ensure fair evaluation for each algorithm.
Do not name your algorithm function any other than *strategy_round_3*.

Parameter *opponent_id*:

An integer representing the ID of the opponent the player is currently facing.

Parameter *opponents_history*:

A dictionary where keys are player IDs (int), and values are lists of 0s and 1s representing the opponents' past moves against the player.

Parameter *my_history*:

A dictionary where keys are player IDs (int), and values are lists of 0s and 1s representing the player's past interactions with those specific opponents.

The return value:

The function must return a tuple (*move*, *next_opponent*), where:

- *move* (int): 0 for defect or 1 for cooperate in the current round.
- *next_opponent* (int): The ID of the player the function wants to challenge next.

Example of return value:

```
(1, 2)
```

This means 1 (for cooperating) and choose player 2 as the next opponent. Next, you can pick a player you have not played yet or the same opponent.

Example of inputs:

```
my_history = { 1: [1, 0, 1, 1],
               2: [0, 0, 1],
               3: [1, 1, 0, 1, 0]
               4: [] }
```

These represent how you played against other players (strategies). Played 4 rounds against player 1, played 3 rounds against player 2, played 5 rounds against player 3, etc.

```
opponents_history = { 1: [0, 1, 1, 1],
                      2: [1, 0, 0],
                      3: [1, 0, 1, 0, 1],
                      4: [] }
```

These represent how other algorithms played against you: Player 1's actions against you, player 2's actions against you, player 3's actions against you, etc.

```
opponent_id = 3
```

This represents who you play right now, with this value you get from the dictionary of your and opponent's history.

Game rules and code constraits

Rules:

1. The function must not exceed **200 rounds total** with any individual player (i.e., the length of any list in *my_history* or *opponents_history* will not exceed 200)
2. Before selecting the next opponent, the algorithm must exclude from potential opponents any algorithm with which it has already played the maximum allowed rounds (200). In other words, do not allow the algorithm play more than it should with any algorithm.
3. The function should **only use the provided arguments** (*opponent_id*, *my_history*, *opponents_history*).
4. No external data sources(additional libraries), file access, or network usage.

Code constraints:

1. Execution time per call should not exceed *200ms* to prevent infinite loops or overly complex computations.
2. Memory usage should stay within *50MB*, ensuring that no strategy monopolizes system resources.

❗ *Please, consider the rules and constraints we provided to you, in order to have fair competition between the algorithms!*

Next page you will find some useful information during your development that might ease a bit the process.

Useful resources and links

We know that you might be confused how you should test such algorithms, thus we created a short program that might help you understand and test your program: GitHub - IsStephy/AA_competition_test
You can take this code, insert your algorithms (be aware where you put the functions!) and test how everything works. Hope it will help you. Random function is used for opponent example algorithm, so do not use it for yourself or delete it. Do not submit your code together with the test code! In your file should be contained only your strategy function!

Since some of you might be not understanding what is happening here, or you want to refresh your mind, we decided to provide some useful links that might help you during the development.

- https://www.youtube.com/watch?v=mScpHTIi-kM&t=27s
- https://www.youtube.com/watch?v=BOvAbjfJ0x0
- https://faculty.sites.iastate.edu/tesfatsi/archive/econ308/tesfatsion/axeltmts.pdf

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In case if you need some help understanding the requirements provided, or you have some useful feedback that will make the tournament even better, you can contact the following people and they will help you:

- Mihalevschi Alexandra, FAF-232, alexandra.mihalevschi@isa.utm.md
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