Repeated Prisoner’s Dilemma: The Axelrod Tournament

Timeline

• Trial Tournament Strategies due: Thu, April 25, 2013 @ 3 pm
• Trial Tournament Results posted: Tue, April 30, 2013
• Final Team Tournament Strategies due: Fri, May 3, 2013 @ 5 pm
• Final Team Tournament Results posted: Mon, May 6, 2013
• Final Individual Tournament Strategies due: Fri, May 10, 2013 @ 12 pm
• Final Individual Tournament Results posted: Mon, May 13, 2013

Overview

There will be three tournaments of indefinitely repeated Prisoner’s Dilemma, following closely in format the original such tournament run by Robert Axelrod\(^1\). The first tournament is a trial run, meant to be a training ground for testing your ideas. The second tournament is a team effort and the final tournament is an individual effort. The objective, described further below, is to maximize the tournament-average per-game payoff of your submitted strategy.

Teams

The class has been divided into about 25 teams of two (or three). Each team must submit exactly one strategy for the indefinitely repeated Prisoner’s Dilemma. For the list of teams and their members, see [https://www2.bc.edu/samson-alva/ec308s13/RPD/teams.html](https://www2.bc.edu/samson-alva/ec308s13/RPD/teams.html)

The Indefinitely Repeated Game with a Demon

The repeated game is between two players.

The stage game that is repeated over a random number of rounds is the Prisoner’s Dilemma with the stage payoffs used by Axelrod. In this stage game, each player has two actions, \(^1\)See his book “The Evolution of Cooperation” for an extensive discussion of the tournament and strategies submitted.
Cooperate and Defect. In any particular round, players may play randomize over the two actions.

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\begin{array}{c|cc}
 & P1 & P2 \\
\hline
C & 3,3 & 0,5 \\
D & 5,0 & 1,1 \\
\end{array}
\]

A game will consist of 100 rounds with certainty. After 100 rounds, the game will end with probability 0.005 (0.5%). For every subsequent round, there will be a 1 in 200 chance (0.5%) that the game will end, and so 199 times out of 200 there will be another round played. Thus, games will be of varying length, with a minimum length of 100 and an average length of 300.

Payoffs are not discounted, so a payoff of 1 in a round is worth the same as a payoff of 1 in any other round.

There is a demon. In every round, there is a 1% chance (independent of everything) that the demon switches your chosen action. So, if the demon strikes you, it will change a chosen C to D, or a chosen D to C. Your opponent will not be able to tell whether the demon has struck you, and you will not be able to tell whether your opponent has been struck by the demon either.

Because of the existence of the demon, there is some imperfect information across rounds. While there is the commonly observed sequence of actions in each round that determine the stage payoffs, there is also for each player a sequence of intended actions, which do not always coincide with the observed sequence by that player. The intended sequence of actions of a player is only known to that player. Therefore, a strategy can take into account the fact that the demon struck in the last (or some other previous) round. But a strategy cannot condition on what the opponent intended, since this will be unknown.

The Tournament

Each pair of teams/strategies will play three separate repeated games, which is called a match. Between any two games in a match, everything is reset, so strategies will not have access to any information about previously played games.

Each strategy will play a match with every other strategy (including itself). This is called an season. Thus, if there are 25 teams, then each team will play a match against every team, including itself, for a total of 25 matches in the season.

There will be 2,000 seasons in a tournament. Thus, pair of strategies will end up playing 2,000 matches with each other, which translates to 6,000 games per pair. Then, if there are 25 teams, there will be \(25 \times 6,000 = 150,000\) games played by a submitted strategy.
Strategies cannot vary across games or matches, since no information survives across games.

The Prizes

There are two performance metrics: the tournament-average payoff per game and the tournament-total number of wins. The tournament average is computed by taking the sum of the payoffs in each game (remember that this is the undiscounted sum of the stage payoffs of that game) played in the tournament (which if there are 25 teams will be 150,000) and dividing it by the number of games actually played against all opponents. A player wins a game against another player when this player outscore his or her opponent (in the games against one’s own strategy, there is no winning or losing, but only tying).

The results of the tournament will yield two rankings of teams/individuals, based on each of the performance metrics above. Grades for this tournament will be assigned based on the Final Tournament Team and Individual results, according to the tournament-average metric. For each ranking, there is a bonus for being the highest-ranked team.

Constructing and Submitting Your Strategy

Pay attention to the deadlines above for strategy submission. I will provide you with details on how I want your strategies submitted. Remember that a strategy must be able to provide an action to be played for EVERY possible history/contingency. So, be sure that you know what your strategy is supposed to do for any possible realization of play in the game. Your strategy can be simple or can be complicated. However, the more complicated your strategy, the more likely you will specify an incomplete strategy (one that doesn’t always tell me what the choice of action should be), so be sure to consult with me.

If you know how to program in Python, awesome! Let me know and I’m happy to let you program your own strategy. I will furnish you with the details about how your strategy will have to interact with the tournament program.

For the your Final Team and your Final Individual Submission, I want you to write a brief report on why you went with the strategy you did. Try to cite any sources of your strategic reasoning when possible and not too burdensome.

Miscellaneous

Absolutely NO COLLUSION! This is a punishable offense. The punishment if I detect collusion is a zero on this assignment. So, do not attempt to coordinate strategies with another team (or individual for the individual tournament).

Feel free to use books or the Internet. Google, Google, Google!