Beyond Tit-for-Tat: A repeated prisoner's dilemma computer tournament

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1. The Roles Assigned To Each Member

Through a collective effort, our group has managed to program the code for the computer tournament fully. Even though the exact specification of the game's rules (for example, number of iterations, number of strategies, imperfect information regarding number of iterations etc.) has not yet been finalised, our model's flexibility allows for effortless adjustment of the rules.

In the next phase, all members will collectively investigate the intricacies surrounding different strategies under divergent circumstances to narrow our research question and potentially submit a competitive strategy of our own design for the tournament.

2. What is the Prisoner's Dilemma?

A prisoner's dilemma is a non-zero-sum game in which players attempt to maximise their advantage without concern for the well-being of the other players. Each player has two choices, either cooperate or defect. The players have no way of communicating their intentions. In equilibrium, each prisoner chooses to defect even though the joint payoff would be higher by cooperating. Unfortunately for the prisoners, each is incentivised to cheat even after promising to cooperate. This is the heart of the dilemma.

3. Our (Preliminary) Plan

This paper conducts a computer tournament to study effective choice in the iterated prisoner's dilemma game. Drawing from Axelrod (1980)'s computer tournament, we will distinguish between two types of

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games, one in which the number of rounds played is known by each player (or strategy) beforehand, (Round 1) and the other where it is determined probabilistically, effectively purging some minor end-game effects (Round 2). Both games allow for mutual gains from cooperation and possible exploitation of a strategy by another strategy. A preliminary observation is that there is no one best strategy. Table 3.1 provides a summary of some of the most competitive strategies that have been played.

Table 3.1: Some strategies played in past computer tournaments

Strategy	Description
Tit-for-Tat (TFT)	Begins by cooperating and then simply repeats the last moves made by the opponent.
Generous TFT	Same as TFT but 'forgives' defections in 1/3 of cases.
Tit-for-Two-Tat	Like TFT but only retaliates after two defections rather than one.
DOWNING	Based on outcome maximization principle, if other player is responsive to DOWNING, it will cooperate, if not, will defect.
JOSS	This strategy plays Tit For Tat, always defecting if the opponent defects but cooperating when the opponent cooperates with probability .9.
AllC	Always cooperates.
AllD	Always defects.
Alternate	Randomly cooperate or defect (prob = 1/2) on the 1st round then alternates regardless of what the opponent does.
Grudger	Cooperates until the opponent defects and then defects forever.
Random	This strategy plays randomly (prob = 1/2) disregarding the history of play.
Detective	Cooperates, defects, cooperates and cooperates again. If the opponent doesn't relatilates in the 3rd round, defects all the time;otherwise plays Tit-for-Tat.
Win-Stay-Lose-Shift	Cooperates first then, if the opponent cooperated on the last round, repeat last move; otherwise, switch.

Note:

There are many more prominent strategies that have proven to be effective, and will be considered in the final simulation of the tournament.

For Round 1, in which the number of rounds is known, the programmed strategies play against each other. Each program has information on the history of past interactions and can make choices based on this. Axelrod (1980)'s computer tournament found that the properties of 'being nice' and 'being forgiving' positively influences the utility points 'scored' by each strategy. A 'friendly' means that a strategy is not the first to defect before the last few moves, and being forgiving means that a process has a propensity to cooperate after another strategy playing defect. Axelrod & others (1987) found defection to be the best strategy when playing the prisoner's dilemma with a fixed, finite, and known number of rounds. This is because there are end game effects by which players have an incentive to defect to gain an extra payoff. The Tit-for-Tat strategy came out on top as the winner. These results are, however, not definitive.

For Round 2, the end game effects will be effectively eliminated as the game's length was determined probabilistically. The players will be assumed to know which strategies performed well in Round 1. In addition, each program has information on the history of past plays and analysis of Round 1. As in Round 1, the 'being nice' property positively correlates with how well a strategy performed. Again, in Axelrod (1980)'s tournament, the Tit-for-Tat strategy came out on top as the winner. There is said to be no best rule independent of the environment. Tit-for-Tat is a very robust strategy as it combines being nice, retaliatory, forgiving and clear.

References

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