

TJHSST Computer Systems Lab Senior
Research Project
Prisoner's Dilemma with N participants and
Optional Cooperation
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Matt Lee

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Abstract

Prisoner's Dilemma is a non-zero sum game that is applicable to game theory. The game is played between two participants or 'prisoners' and the goal is to maximize their own individual payoff at the end of the game. It is normally iterated to play through a number of rounds to determine a winner, while all the prisoners do is determine what their decisions will be with the goal of maximum payoff.

This relatively simplistic game has been through numerous variations. While the classic game itself has only two participants, some have more than two, perhaps "N" participants. My goal is not much different from creating a variation of Prisoner's Dilemma, but I'd like to expand further on the idea of cooperation. Prisoner's Dilemma reveals a potential that can be applied to cooperation as a whole. Since the two prisoners both affect each other's decisions, they not only would have to anticipate their opponent's moves, but also 'cooperate' if they want to maximize their own payoff. However, this is only one possible situation out of a countless many.

Therefore, I would like to create Prisoner's Dilemma to implement a number of parameters including the use of "N" prisoners, enabling cooperation to be known amongst others, and initiating a form of "morality". Alongside that, I would also like to find a general solution to certain scenarios.

Keywords: Prisoner's Dilemma, Agent Based Modeling.

1 Introduction - Elaboration on the problem statement, purpose, and project scope

1.1 Scope of Study

This project will require research into numerous variations of Prisoner's Dilemma and numerous strategies applied. There are numerous variations to the game with a number of strategies that have been used or have been successful in the game, and it is essential to understand that to see the full potential of cooperation. Variations for this game to fully understand cooperation must be based on the ability to cooperate with other participants, being able to use N-participants to play the game, and the use of the broad scope of strategies in the game.

I want to develop a simulation of Prisoner's Dilemma that will be able to emulate a number of scenarios. Cooperative scenarios where a person may choose to cooperate or defect happens to us all the time, which Prisoner's Dilemma can't emulate by itself due to a restriction in variables. I want to make this version of PD to emulate as many possibilities as I can, and to see how participants will cooperate depending on who is cooperating with them and how many are 'playing' the game.

1.2 Expected results

The results I expect from this are the strategies and settings that will determine the maximum output for this variation of Prisoner's Dilemma. I want to find out what kind of situation plays out best for certain strategies and how a program can reach optimum payoff using a certain strategy. I expect my program to show a visual display of the results of all the participants in this variation of Prisoner's Dilemma and show the results and choices of the participants to better visualize and keep track of payouts.

I want to do this project because I want to better understand the psychology of cooperation and see what types of scenarios favor certain strategies for defecting and cooperating. I also want to understand this on a larger, broader scope over the traditional two person Prisoner's Dilemma.

1.3 Type of research

This type of research falls under applied research, although it has some aspects of user inspired research.

2 Background and review of current literature and research

I have looked into Robert Axelrod's 'Evolution of Cooperation' to gain an understanding of how Prisoner's Dilemma operates and understanding the optimal strategy tit for tat. This has been my main source of research and literature review as of this time, and I plan to continue to refer to the text for aid and reference. Prisoner's Dilemma and the psychology of cooperation are explored very well here, therefore it is an excellent text to use as a reference and an aid.

Alongside this, I have also looked into a paper that ran a similar experiment to my own. This project enabled the participants to use a variety of strategies in several environments, as well as the ability to 'evolve' into a culture, allowing their strategy to change. Their goal was to find an overall optimal strategy for the given environments, and they determined that a participant must look back about six turns to make the optimal move and in the end, earn a high payout.

3 Procedures and Methodology

A visual will be constructed to show the current payouts of the prisoners playing and their choices made per turn. It will be designed to show statistics of current players, their standing strategies, and their payoff at the specific point in the game.

Testing and analysis is done by running the program and determining outputs based on certain strategies. Since strategies have now become available, the testing will come in the form of pitting a prisoner with a specific strategy against another prisoner with a specific strategy. To ensure that the results are projected correctly, the results gained will be compared to those from previous runs as well as those stated from sites on the internet.

Analysis will be done by comparing end payouts of each prisoner to their

opponents. At the end of each game, the payoffs of each prisoner will be compared to determine which strategy works best for the game. I also plan to monitor payoffs during 'mid game' to see which strategies could possibly work best in other situations.

The testing that will be used for verification is by dynamic testing.

Requirements and specifications are currently being discussed.

Algorithms I intend to use are variations of Tit for Tat and a variation of a N-Participant Prisoner's Dilemma program that was run on Netlogo. The project has the participants moving about freely in a universe, but the interactions between two individual participants are done through a game of Prisoner's Dilemma.

4 Expected Results

The results I obtain from this project will be not only a simulation that can aid in just about any Prisoner's Dilemma scenario and the real world. With the dilemma of cooperation, on whether you should cooperate or defect, being predominant in just about every point in life, I believe this can help determine what strategy will bring about the best output. The payouts given determined by strategy will give an idea of what kinds of strategies to follow for certain scenarios.

I believe this can be a contribution to seniors for next year's tech. lab.

5 Sources

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