New Generation Iterative Prisoner's Dilemma: Keep your enemies closer and be loud about it

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1 Introduction

How can we encourage and sustain cooperation? Humans dominate their environments thanks to our ability to cooperate flexibly and at scale, as argued by Harari [5]. To study the conditions necessary for cooperation to flourish we need a suitable model of an activity with temptations to defect and punishments for doing so.

In 1950, Albert Tucker named a particular two-player exchange game "The Prisoner's Dilemma" [6]. This game elegantly captures the difficulty of the decision between cooperation and defection in a single choice. Despite being so simple compared to the complexity of the problem it is representing, it was used to model many aspects of behaviour in systems of selfish individuals; and, according to Axelrod [1], for "discovery of the precise conditions that are necessary and sufficient for cooperation to emerge".

In the case of a one-off exchange, there being no opportunity for a follow-up punishment, the rational behaviour is defection. (This extends to all rounds for a fixed-length game, inductively [1].) The interesting behaviour arises if there is no end; or, at least, if there is no way for the participants of the game to know when the game ends or even if there is an end. One has to expect that even a single defection can be infinitely punished by never again cooperating with the culprit [3]. Such a risk may just not be worth it.

The defectors can, naturally, only be punished if they can be identified and known to others. This is why services like Ebay or Airbnb have a rating system in place. Presence of a reputation system has been shown to strongly boost cooperation, as shown by Stahl [7] and Camera and Casari [2]. These studies used groups of volunteers as game participants and explored the effects of various information being public - from only the latest move of the current opponent, to full histories of all moves taken by every participant.

These studies were limited by their use of humans as game participants and were thus limited to relatively small groups with few rounds; they also used external infrastructure for information passing: therefore eliminating noise, delays, and deliberately wrong information. As shown by Gevers and Yorke-Smith [4], not all strategies that perform well in noise-less environments can do so under the presence of noise.

Using external infrastructure for passing information also meant that the transmission speed was uniform for all participants receiving all necessary information in time for their next round of the game. These are non-trivial idealizations: relaxing them would yield a model closer to real-world systems and could change the results drastically.

In this paper we explore the feasibility of such a solution; we look at how well a local reputation system sustains cooperation and under what conditions does it yield optimal results. We evaluate the approach under varying gossip range and memory length; and conclude the effectiveness of local reputation in enforcing cooperation in spatial prisoner's dilemma.

References

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