

CSCI-8994 Public Goods Games

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Course Overview

Research in the domain of public goods games has shown that both punishment and voluntary participation are required in order for cooperation to evolve in a population of agents [1]. The strategies employed in this research are stationary strategies that do not use the results of previous interactions to inform future decisions. Research in the domain of the donor-recipient game has shown that cooperation can take root in the absence of punishment if the agents employ non-stationary strategies that inform future decisions based on agent reputations [2][3]. In these studies, the agents follow social norms that dictate how an agent assigns reputations to other agents and how the agent selects an action given the reputation of its interaction partner.

In previous work, I applied the “leading eight” social norms used to promote cooperation in the donor-recipient game [2][3] to the public goods game. Simulation results showed that none of the social norms is evolutionary stable in the context of the public goods game. However, the results support the notion that voluntary participation improves the chances that cooperation will prevail.

In this directed research course, I propose to extend the work described in the previous paragraph. Some potential research topics that will be pursued include the following:

1. Richer reputation assessment rules - In the previous work, only the last action taken by an agent was considered when assessing the agent's reputation. It might be better to consider the agent's last N actions when assessing its reputation.
2. Voluntary association - In the previous work, agents were randomly assigned to groups. It would be interesting to consider the case where agents self-organize into groups.
3. Partial information about reputations - In the previous work, all agents had access to information about the actions taken by all other agents. It would be interesting to consider the case where agents only have partial information about the actions taken by other agents. This is similar to exploring a network that is partially hidden [4].
4. Economies of scale - In the previous work, the factor used to multiply contributions was fixed. It would be interesting to consider the case where the multiplicative factor varied based on group size. This would model the increasing returns that often accompany group activities.
5. Exploration/exploitation trade-off - Combining items 2, 3 and 4 might provide an interesting platform for investigating strategies that agents could use to trade off exploitation of current knowledge and exploring to discover new information.
6. Evolution of strategies - In the previous work, a fixed set of fully developed strategies was evaluated. This begs the question of how the strategies came to be in the first place. It would be interesting to consider the case where strategies evolve from an initial state consisting of agents following "randomly generated primitive strategies".

References

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- [2] Ohtsuki, H., and Y. Iwasa, "How should we define goodness? – reputation dynamics in indirect reciprocity," *Journal of Theoretical Biology*, vol. 231, pp. 107-120, 2004.
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- [4] Singla, A., E. Horvitz, P. Kohli, R. White, and A. Krause, "Information gathering in networks via active exploration," *IJCAI 2015*, pp 891-898.