CALIFORNIA STATE SCIENCE FAIR
2010 PROJECT SUMMARY

Name(s)
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Project Number
S1617

Project Title
Cooperation and Punishment: A Look at the General Phenomenon of Retribution through Evolved Strategies for a Modified Pr

Abstract

Objectives/Goals
The model of the Iterated Prisoner's Dilemma has been studied closely by many researchers in how it applies to the development of cooperation. In sociology this has been extended to how punishment - essentially hurting your opponent at a smaller cost to yourself - works to maintain cooperation. This project takes a more concrete approach, evolving strategies in an effort to see whether retribution is a robust phenomenon like cooperation has been shown to be.

Methods/Materials
This is an entirely computer-based experiment. It uses a cellular-automata based simulation (coded in C++) to model interactions between hundreds of "organisms" playing the Prisoner's Dilemma over and over again. Strategies evolved based on which were the most successful
Data analysis was done in MATLAB, looking at the strategies of many different organisms over time in a number of sophisticated ways using tools developed by the author.

Results
Punishment was not used in any clear strategies for any extended period of time in any of the runs under a variety of conditions.

Conclusions/Discussion
Part of the reason punishment did not arise may have been because of the volatile environment that was created. However, we can conclude with almost complete certainty that retribution is not a robust phenomenon, and does not arise simply from a situation in which players attempt to maintain cooperation.

Summary Statement
This project uses an evolutionary simulation to understand whether the general phenomenon of retribution can be explained easily through game theory.

Help Received
Prof. Christoph Adami and Dr. Arend Hintze (both of Caltech and Keck Graduate Institute) provided advice and mentorship; Father (Prof. Alan Weinstein of Caltech) provided remote use of a supercomputer at Caltech