CALIFORNIA STATE SCIENCE FAIR
2008 PROJECT SUMMARY

Name(s)

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Project Number

S1304

Project Title

Determining the Optimal Iterated Prisoner's Dilemma Strategy

Abstract

Objectives/Goals

The goal of the project was to determine, through computer simulation, which strategy performed best on average against all other strategies in the Iterated Prisoner#s Dilemma. The Prisoner#s Dilemma is a classic situation that illustrates the main points of Game Theory, a recently developed branch of mathematics.

Methods/Materials

There were seven strategies tested including Random, Cooperate, Defect, Unforgiving, Perfect Memory, Tit for Tat, and Tit for Two Tats. Each strategy employed a different method of choosing when to defect or cooperate based on its own mechanics and the previous actions of its opponent. Depending on its action and its opponent#s action, each node scored a certain number of points. The goal was to get the most points on average.

Each test consisted of two nodes in the virtual playing field interacting with each other. A node of each strategy played against a node of every strategy, including itself. Each trial ran for 20,000 time steps, or ticks. During this amount of time, the two nodes interacted thousands of times. After each trial, the average score for each node was recorded in the data table. For all seven strategies to interact with each other, a total of twenty-eight trials were required. Each trial was performed three times.

Results

On average, the Perfect Memory strategy performed most optimally. As can be seen in Table 4, it had an average score of 2.637127245. Following Perfect Memory in order of highest to lowest average score came Tit for Tat with 2.568127949, Unforgiving with 2.428539477, Tit for Two Tats with 2.319091081, Cooperate with 2.098350741, Random with 1.948382486, and Defect with 1.850758917. All strategies except for Random had an average deviation of less than 2%.

Conclusions/Discussion

The hypothesis was supported and the Perfect Memory strategy was the most optimal. The reason for this may have been that Perfect Memory was equipped with the ability to detect an opponent#s strategy and counter it accordingly. It had an average score of 2.637127245. The least optimal strategy was defect with an average score of 1.850758917. The percent deviations for all data were relatively low. This allowed the conclusion to be made that the data was significant and Perfect Memory was truly the most optimal strategy.

Summary Statement

Using computer simulation to test many proposed strategies for the Prisoner's Dilemma, a conernerstone of Game Theory, against one another.

Help Received