

CAP5512 : Homework 2

The Evolution of Cooperation

http://ivan.research.ucf.edu/classes/CAP5512_Spring2007/

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Ivan I. Garibay
School of Electrical Engineering and Computer Science
University of Central Florida

1 Objective

The primary goal of this assignment is to gain familiarity on how to use a GA to solve an interesting problem.

2 Preliminaries

Please read the attached description [1] of Axelrod's original work on using a genetic algorithm to evolve strategies for the Iterated Prisoner's Dilemma [2].

3 Problem Statement

Use the GA you implemented for Homework 1 to search strategies to play the Iterated Prisoner's Dilemma. Each strategy is a GA individual. You can use the representation Axelrod used [1] or any other one that you may design. Each strategy remembers the three previous turns with a given player. The fitness of a strategy in the population is defined as the average cumulative score the strategy will obtain after playing 100 times with itself and with every other member of the population. For instance, if you are using a population size 20, you will have to average 20 cumulative scores obtained by playing against each of the 20 population members.

Each one of these cumulative scores is obtained by adding the payoffs obtained over the 100 games played with a particular opponent. Use a population of 20 strategies, tournament selection with tournament size 4 and $P_t = 0.9$, two-point crossover with $P_c = 0.7$, and bit-flip mutation with $P_m = 0.001$.

1. See if you can replicate Axelrod's qualitative results: do 40 runs of 50 generations each and examine the results carefully to find out how the best-performing strategies work and how they change from generation to generation. Provide a detailed description.
2. Produce the standard plots (averages over the 40 runs) for best fitness, average fitness and standard deviation versus generations for the previous step. Record the overall best fitness obtained in each run and the generation on which was obtained. Use these values to compute the average overall best fitness and the average number of generations to reach the best fitness.
3. Turn off crossover (set $P_c = 0$) and repeat the experiment above. What is the effect on the average overall best fitness and the average number of generations to reach the best fitness?
4. Let the fitness of a strategy be its cumulative score in 100 games with TIT FOR TAT. Can the GA evolve strategies to beat TIT FOR TAT?

4 Deliverables

- Write up:
 1. Include all the graphs/plots
 2. State your observations and conclusions about the strategies evolved by the GA in each of the settings.
- Output files for each scenario and parameter configuration files.

5 Grading

Plots/graphs of different scenarios: 50%
Interpretation : 50%

References

- [1] Melanie Mitchell **An Introduction to Genetic Algorithms**, The MIT Press, 1996.
- [2] Robert M. Axelrod **The Evolution of Cooperation**, Basic Books, 1984.