Computational Biology

Mathematical model of ‘comparative development of social health in communities’ using Prisoner’s Dilemma

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Background:

The paper derives its motivation from the tournament conducted by a political scientist Robert Axelrod, who pioneered research to find out the optimal strategy in the late1970’s. Axelrod used the Prisoner's Dilemma to find the optimal strategy.

This work is an extension of “Study of the growth of a particular strategy in the pool of strategies” written by Miss Komal Gujarathi (self) and Miss Snehal More which won 1st place in ”Credenz” paper presentation competition organized by PVG Engineering college.

Abstract:

Our Society contains different groups of individuals called the community which varies from family to nation. Individuals from a community interact with the individuals in the same community (intra-community) as well as with the individuals prevailing from different communities (inter-community). Social health of any community depends upon outcomes of these interactions. This paper does not actually deal with ethics or etiquette nor does it aim to compete with philosophers and preachers. Rather this paper tries to model strategic behavior and its impact on the social health of community.

Interactions in a society can be thought of any nature like ‘always assist the other individual’, ‘always cheat the other individual’, ‘co-operate sometimes and defect sometimes’ etc. Robert Axelrod while working on ‘The Evolution Of Co-operation’ modeled these interactions as strategies namely ‘Co-operate’, ‘Defect’, and many others which he represented using Prisoner’s Dilemma (PD). He organized the tournament to find out the best evolving strategy among all the strategies that participated. Paper extends the Axelrod’s work on strategies for the find out the relative development of social health of different communities using PD iteratively i.e. IPD.

Now health can broadly be classified as physical health and social health. Physical health merely refers to the absence of disease. But we are not really the topic of our interest here.

We are really concerned of the health of families, health of cities, health of states, health of nations as a whole (collectively referred as a social health). Aim of writing this paper is to study the development (can be progressive or can be declination in the progress) of some society models. This health of the society can be studied by actually thinking about the interactions among the individuals in the community. Paper creates the virtual society in itself which considers the individuals following only three representative strategies (among the strategies represented by Robert Axelrod) namely ‘Co-operate’ (which always assists), ‘Defect’ (which always cheats) and ‘Tit For Tat’ (which cooperates for the first time and further cooperates with cooperator and defects with defector.

Paper assumes that the cooperation among the individuals in an interaction leads to the incremental development in the social health while society as a whole has to suffer its outcomes if at-least one of the two individuals participating in an interaction defects. This is validated by creating the mathematical model of the society to quantitatively cross check the results.