Chapter XXI
Optimizing Society: The Social Impact Theory Based Optimizer

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ABSTRACT

A novel binary optimization technique is introduced called Social Impact Theory based Optimizer (SITO), which is based on social psychology model of social interactions. The algorithm is based on society of individuals. Each individual holds a set of its attitudes, which encodes a candidate solution of a binary optimization problem. Individuals change their attitudes according to their spatial neighbors and their fitness, which leads to convergence to local (or global) optimum. This chapter also tries to demonstrate different aspects of the SITO’s behavior and to give some suggestions for potential user. Further, a comparison to similar techniques – genetic algorithm and binary particle swarm optimizer – is discussed and some possibilities of formal analysis are briefly presented.

INTRODUCTION

This chapter focuses on a novel binary optimization method called Social Impact Theory based Optimizer (SITO). One of its precursors is social psychology. However, evolutionary computation, cellular automata or artificial life can be also understood as precursors of the method. The algorithm is based on a population of simple cells. These cells are inhabited by individuals representing candidate solutions - binary vectors. Each such binary vector is a counterpart to set of binary attitudes held by real people. These attitudes are changed over time according to external influences and internal processes. This process leads to a convergence and optimization.

In the chapter, we first describe a background of the method and its several precursors. After, the SITO algorithm is introduced. The main part of the chapter discusses various aspects of the algorithm and its parameters on the basis of experimental results. Next, the relationship between SITO and other selected methods is examined and finally some sources and inspirations for theoretical approach are suggested. The main objective of the chapter is to present the SITO method and to give advices how to set its parameters.
BACKGROUND

The connections between social and natural sciences have mostly laid in the use of natural sciences for a formal description of social phenomena. A particular case is the use of physical and mathematical models of society and social interaction, whose historical roots date back to 17th century (Ball, 2002).

The main source of inspiration for the SITO development comes from the area of models of social interactions. One of characteristics shared by these models is the presence of many, more or less simple, individuals representing the participants of the social processes. These individuals, sometimes called agents, form an artificial society. They are very often situated in an environment which could be defined as a medium separate from the agents, on which the agents operate and with which they interact (Epstein, 1996). There is wide variety of such models differing in their purpose or structure of agents and environment.

Epstein and Axtell describe a number of experiments with a virtual ecosystem (Epstein, 1996). The computer simulation techniques are presented, which show how social structure and group behaviors arise from simple local interactions of simple individuals. They follow a particular instance of the artificial society concept that has come to be known as “The Sugarscape Model”. Actually, it is a two-dimensional grid on which agents interact and move on the basis of agent’s rules. Such model of artificial society is an example of analysis study, which could help the social scientists to model and explore the behavior of a society from the bottom-up point of view. However the sugarscape model is not the first agent-based computer model of social interactions.

The first computer simulation of social interaction was the checkerboard model introduced by Sakoda (Sakoda, 1971). The checkerboard represented an environment (a square lattice) on which two groups of individuals (checkers) are situated. The individuals have different attributes to members of their own group and different attitudes to members of the other group. The individuals are moving on the board on basis of positive, neutral or negative attitudes toward one another. The model has been capable of demonstrating the intimate connection between attitudes of group members toward their own group and toward others to a social interactional process and to the resulting social structure. The resulting social structure is a consequence of local interactions defined by simple attitude combinations. Another model, very similar to the Sakoda’s one, is the Schelling’s model of segregation (Schelling, 1969). The two types of individuals prefer that at least some fraction of their neighbors is of their own group. If this condition is not met, the individuals move to the nearest site where it is. The results explain and describe the emergence of segregation.

In this chapter, the main inspiration comes from social interaction models slightly differing from that described above. The individuals are scattered over a grid that defines their environment. However, contrary to previously mentioned model, the individuals are not movable and one individual occupied one cell of the grid for the whole time of simulation. Moreover, each individual change their properties on bases of some rules taking into account the individual’s neighborhood. These features can be found not only in models from social sciences. In physics, the Ising model of ferromagnetic interactions deals with a grid of different interacting spins. Similar to Ising spins, people can sometimes choose between two different opinions. This perspective has been used in some economical applications (e.g. Da Silva, 2001).

Another very wide area connected with such models is study of opinion dynamics, where computer simulation can be used as tool for theory construction and validation (Schnell, 1992). An example is the computer simulation of dynamic theory of social impact known from social psychology. According to Latané (1981a), social impact is any of a great variety of changes in physiological states and subjective feelings, motives and emotions, cognitions and beliefs, values and behavior, that occur in an individual, human or animal, as a result of the real, implied, or imagined presence or actions of other individuals. The social impact theory formulates a mathematical model concerning how social processes operate at a given point in time. It specifies principles how individuals are affected by the society Social impact theory has been applied to various social processes (Latané, 1981b; Jackson, 1981). Dynamic social impact theory is based on a view of society as a self-organizing complex system composed of interacting individuals each obeying simple principles of social impact. It tries to describe and predict the diffusion of beliefs through social systems. It views society as a self-organizing complex system composed of interacting individuals each obeying simple principles of social impact. It states that the likelihood that a person will respond to social influence will increase with three factors: strength, immediacy and number. Strength is a property of influencing individuals which indicates how important the influencing individual is to...
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