Evolving complex networks for population topologies in evolutionary computation

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Complex networks are very common in nature. They exist in many different domains such as biological systems, human societies and the World Wide Web. Algorithms from evolutionary computation use a population to search for a solution for a problem. This search can be to find the optimal for a given function (e.g., the correct proportion of ingredients for a chemical component, the configuration for a telecommunication.s antenna or the optimal feeding of a bacteria) or to learn a given task (e.g., to control a robot to perform a given task, to learn how to correctly classify data).

Evolutionary computation algorithms work by the interaction of the individuals in the population. This interaction often involves selecting a certain number of individuals from a subset of the population that will interact to generate a new solution or modify an existing one. Studies indicate that the panmictic model suffers from problems of premature convergence; these problems are usually mitigated by other means, the most common of which is an increase in the population size.

This proposal involves studying the properties of the relationships between the members of the population (represented as a graph). Specifically, we are interested in understanding the evolution of the population and its relationships and its ability to solve problems.

Scale free networks are characterized by the power law distribution of the degree of the vertices in the graph. In these networks, most nodes have a very small degree while a small subset of the population is connected to many vertices. These configurations can help subsets of the population search for different solutions while hubs convey information from these relatively isolated parts of the population to the rest of the individuals.

There are several models that are used in statistical mechanics to study complex networks. These models allow researchers to grow graphs according to very simple rules whose statistics exhibit power law distribution of degree.

Goals

The main goal of this project is to study the evolution of networks that represent the population of evolutionary computation algorithms. The structure

of the population is evolved while the population is solving the problem. The population is evolving while the problem is being solved. This evolution means that individuals are being created and destroyed and edges are being created, destroyed or rerouted during evolution.

The goal of the study is to understand the relationship between the evolution of the population structure and the ability of the population to solve problems.

Supervisor

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Research unit

Computer Science and Technology Center (Centro de Ciias e Tecnologias de Computa, CCTC) is the University of Minho research unit in Informatics. The research activities cover a wide range of fundamental and applied research topics related to computer science and technology, organized into projects and with strong international partnerships. The knowledge and technology amassed in these projects are disseminated by means of scientific publication, prototype development, and preparation of new generations of young scientists.