Optimization Algorithms Inspired by Social Interactions

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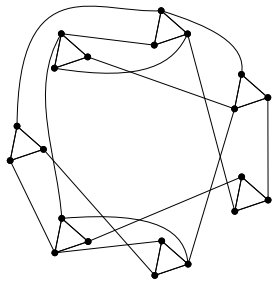
In the thesis we joined knowledge of social network analysis and social epidemics together with evolutionary algorithms from optimization search field. We designed a new algorithm based on human interactions in social networks. The algorithm brings new ideas and is open to various extensions.

Motivation

- The goal is to solve a general optimization task
- Plenty of existing algorithms are inspired by nature
- For example we can observe ants how they are looking for food and use that specific behaviour to help us to solve our optimization problem
- There exist ant colony algorithm, bee colony algorithm, firefly algorithm and more
- The dominant animal species in most of the real world are humans
- So we decided to explore human behaviour and design a new optimization algorithm

Social Network Structure

- Graph where vertices represent individuals
- Two individuals are connected when they are "friends"
- Social network graphs have the following properties. They are:
  - **Sparse** (low number of connections)
  - **Highly clustered** (there are small groups in which everybody knows each other. Like families, school classes, etc.)
  - **Low average distance** (six degree of separation phenomenon)



Theoretical Results

- The most significant factor in time complexity of an algorithm is the number of iterations. Other factors are overwhelmed by this factor
- The social interaction algorithm using regular graph with N individuals can run effectively in parallel using asymptotically √N threads

Social Interaction Algorithm

- Population based algorithm using a graph of population
- Every individual has a set of YES/NO opinions that represents his solution
- Two "friends" can meet, have a discussion and influence each others opinions
- Single individual can change opinion by himself (e.g. he reads something)
- Two actions above occur repeatedly in the population until a solution of a good quality is explored or the number of iterations reaches the limit

Distinction

- Our algorithm distincts from other evolutionary algorithms in the following
  - **Allow various infrastructures** (with different computational properties)
  - **No explicit selection** (interactions are given just by the infrastructure)
  - **Individuality** (individuals can have a unique goal and behave differently)
- These distinctions open new possibilities that are not easily achievable by other algorithms

Experimental Results

- Algorithm performs the best when we use graphs with similar structural properties to social network graphs
- Some results corresponds to observations about real social networks
- The social interaction algorithm can converge further than other algorithms of similar type (see black and blue lines, zero is the optimum value)