Popular science abstract

The scientific objective of the project is to introduce new mechanisms that are based on linkage learning (LL) into Evolutionary Algorithms multi- and many-objective optimization. The propositions of new, more effective EAs will be the main effect of the project.

Multi-objective problems are the problems in which we wish to optimize, not one, but two or three results quality measures. The optimization of such problems is a difficult task because, usually, when we find a solution that improves the value of one objective, then the value of the rest objectives is worsened. Thus, in multi-objective optimization, an important issue is the dominance relation. If we have two solutions A and B such that A is better than B for at least one objective is not worse than B for all other objectives, then we state that solution A dominates solution B. In multi-objective optimization, as a result of the optimization process, we expect to obtain a set of solutions that are non-dominated.

Many-objective problems are the multi-objective problems that have four or more objectives. They were specified as a separate type of problems because their features are different from multi-objective problems because of the combinatorial explosion caused by the number of objectives. The influence of the number of objectives is significant. For instance, EAs that are effective in solving multi-objective problems usually perform poorly for many-objective problems.

The objective of this project is to propose better tools for solving multi- and many-objective problems because they frequent in practice. Solving them well may significantly influence every day's life of us all. The examples of important multi- and many-objective problems may be: scheduling the lessons plan for a school, or a production plan in a factory, proposing the route set that shall be used by public transport in a modern city, and even… the appropriate arrangement of seats at tables for wedding guests.

Evolutionary Computation (EC) is devoted to proposing optimization methods. Darwin's theory is the core idea of EC. Note that the objective of the first evolutionary algorithms implementations (so-called genetic algorithms) was to simulate the evolutionary process so we can better understand it. The base of this process was the genetic recombination that takes place for any offspring (the genotype of any offspring is a composite of the genotypes of its parents and a random factor). However, it was soon noticed that if the genotype represents an encoded solution to some optimization problem, then the simulator of evolution becomes an excellent optimization tool. Evolutionary algorithms turned to be effective in solving hard computational problems, for which the classical algorithms can find high-quality results. As mentioned above, such problems are common for any branch of science, technology, and the problems that come up in the world around us.

Evolutionary computation delivers highly-effective optimizers for other branches of science and technology. Thus, improving the effectiveness of evolutionary algorithms is important and influences the state of all science branches that use such tools. This is the objective of the proposed project.