Evolutionary Computation Theory

Alden Wright

wright@cs.umt.edu
Computer Science, University of Montana, Missoula MT 59812 USA

Preface

Theory in evolutionary computation can lead to a deeper understanding of evolutionary algorithms. This can help researchers to propose better algorithms, problem representations, and test functions, and to better understand the strengths and weaknesses of evolutionary computation.

Many of the advances in evolutionary computation theory have come from the introduction of ideas from other fields of study into the field.

The paper by Yong Gao and Joseph Culberson discusses connections between recent work on phase transitions in combinatorial optimization problems and the study of landscapes in evolutionary computation theory. They present an overview of their recent work on the phase transition analysis of fitness landscapes.

The papers by Lothar Schmitt and Stefan Droste survey different approaches to convergence analysis in evolutionary algorithms. One approach, pioneered by Schmitt, makes minimal assumptions about the fitness function. This approach is similar to convergence analyses done for simulated annealing. Another approach applies techniques from algorithm analysis and theoretical computer science to find asymptotic bounds on the number of steps to convergence for specific evolutionary algorithm on limited classes of fitness functions. They propose that these two approaches can be combined to give a more unified theoretical framework for convergence of evolutionary algorithms.

The paper by Neal Richter et. al. presents the results of simulations of the dynamical system model of a simple mutation/selection genetic algorithm. These results empirically show that there are phase transitions in the behavior of this model as the mutation rate changes.

For a more general introduction to the theory of genetic algorithms, the book **Genetic Algorithms—Principles and Perspectives, A Guide to GA Theory** by Colin R. Reeves and Jonathan E. Rowe (Kluwer) is highly recommended. In addition, much of the best work in the field is published in the workshop proceedings **Foundations of Genetic Algorithms · 1** through **Foundations of Genetic Algorithms · 7**, published biennially by Morgan Kaufmann from 1989 to 2003.

The in addition to the presentation of the above papers, there will be additional talks by the organizers. There will also be a panel discussion. For further updates, check the workshop website http://www.cs.umt.edu/u/wright/geccotheory/.