Preface

The 8th Workshop on the Foundations of Genetic Algorithms, FOGA-8, was held at the University of Aizu in Aizu-Wakamatsu City, Japan, January 5–9, 2005. This series of workshops was initiated in 1990 to encourage further research on the theoretical aspects of genetic algorithms, and the workshops have been held biennially ever since. The papers presented at these workshops are revised, edited and published as volumes during the year following each workshop. This series of (now eight) volumes provides an outstanding source of reference for the theoretical work in this field.

At the same time this series of volumes provides a clear picture of how the theoretical research has grown and matured along with the field to encompass many evolutionary computation paradigms including evolution strategies (ES), evolutionary programming (EP), and genetic programming (GP), as well as the continuing growth in interactions with other fields such as mathematics, physics, and biology.

A tradition of these workshops is organize them in such a way as to encourage lots of interaction and discussion by restricting the number of papers presented and the number of attendees, and by holding the workshop in a relaxed and informal setting. This year's workshop was no exception. Thirty-two researchers met for 3 days to present and discuss 16 papers. The local organizer was Lothar Schmitt who, together with help and support from his university, provided the workshop facilities.

After the workshop was over, the authors were given the opportunity to revise their papers based on the feedback they received from the other participants. It is these revised papers that are included in this volume and follow the order in which they were presented at the workshop. In addition to these 16 papers, there were 2 invited talks: an opening presentation by Alden Wright and a closing presentation by Kenneth De Jong. These slides-only presentations are not included in this volume, but can be obtained from the authors upon request. A brief summary of these presentations is provided here.

Alden Wright opened the workshop with a presentation titled "Can Evolutionary Computation Theory Have Significance Outside of EC?" and subtitled "Can EC Theory Help Us To Understand Evolution?". The field of artificial life has been successful in reaching a wide audience with claims that artificial life experiments can give insight into natural evolution. Wright asked if EC theory can do the same? He proposed that EC theory might be relevant to some challenges in evolutionary research[1]. These included:

- Analysis of the evolution of rates of mutation and recombination. Do "optimal" rates evolve?
- Analysis of the evolution of the information content of genomes.

[1] Some of these challenges came from the website:
`http://evonet.sdsc.edu/evoscisociety/chall_and_oppors_in_e_res.htm`

- Analysis of genic selection and of conflict within genomes (e.g., segregation distortion, evolution of gene expression, etc.).
- How does evolution maintain the great complexity of organisms while also allowing "rapid" evolution in some areas?
- How is it possible that phenotypic variations do not destroy brittle interactions between the subsystems of an organism while still allowing for the variablity that allows for evolutionary innovations?

Wright suggested that investigation of the genotype-phenotype map might give insight into the last two challenges.

Kenneth De Jong closed the workshop with a presentation titled "Unifying EC Theory." In this presentation he argued that developing a more unified framework for EC theory was important for further progress in the field. This was based on the observation that historically the field has evolved around a number of EA demes (GAs, ESs, etc.), resulting in deme-specific terminology and theory. We now have deme-independent EC toolkits that provide creative mixing and matching of EA components, but we have no theory to guide EA design at this level.

De Jong outlined a strategy for developing such a theory. He suggested that we need to clearly distinguish between EAs as dynamical systems and EAs as problem solvers. Adopting a dynamical systems view allows us to answer questions about trajectories, fixed points, etc., and makes contact with a large body of existing theoretical work in evolutionary biology, evolutionary game theory, and dynamical systems theory. Adopting a problem-solving view allows us to answer questions about the effectiveness of EAs for optimization, search, machine learning, etc., and makes contact with a large body of existing theoretical work from computer science, operations research, and artificial intelligence.

De Jong argued that in both of these areas it is important to find a middle ground between theories that are too abstract to be helpful and too specific to be applicable to new situations. He gave several examples of how that might be done using a top-down strategy. He concluded by noting that several of the papers presented were nice examples of this middle theoretical ground, and expressed the hope that he would see more of them at the next FOGA.

In between those 2 presentations 16 papers were presented on a wide range of theoretical evolutionary computation topics. We hope that you find them as interesting and provocative as we did. We fully expect that these papers will serve as a catalyst for further progress to be reported at the next FOGA workshop in 2007.

March 2005

Alden Wright
Michael Vose
Kenneth De Jong
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