Knowledge Engineering Review, 19(2) 185–186 2004 doi:10.1017/S026988890423020X,

# Genetic Algorithms–Principles and Perspectives A Guide to GA Theory, Kluwer Academic Publishers, 2003, pp332, ISBN 1-4020-7240-6, hardback, list price $120.00 Authors: Colin R. Reeves and Jonathan E. Rowe

W. B. Langdon

Computer Science, University College, Gower Street, London, WC1E 6BT, UK

Unlike some specialist books, Genetic Algorithms–Principles and Perspectives, does not fall into the common trap of expounding at length the authors' own work. While the authors certainly do include mention of their own research, GAPP is a very balanced read. This is nicely conveyed by the subtitle, *A Guide to GA Theory*. All the theoretical topics one would expect are included and are well described in a non-emotional style. We start with topics such as selection intensity. Then relate this to the speed at which every bit string in the population becomes identical (or nearly so). Various diversity maintenance schemes, which prevent or slow such convergence, then are described. Later chapters explain, without undue mathematics, schema theorems, Markov models, Walsh analysis, deception and the ever popular gray versus binary coding, No Free Lunch (NFL) and building block controversies. In addition many specialist GAs are summarised. It is nice to have them and their associated theory gather together in one place. In addition to the references (and index) at the back of the book, each chapter finishes with a small *Bibliographic Notes* section, which criticises the literature covered by the chapter and (for the unsatiated) indicating further reading. Many of us may delay this on first reading. Instead these notes may be more helpful when using GAPP as a reference work. To this end, it is a book which every self respecting computer science library should have.

The emphasis is entirely on using genetic algorithms for optimisation. Related evolutionary computation techniques (evolution strategies, genetic programming, etc.) get little mention. (There are already specialists books on the theory of these areas [Bäck, 1996; Langdon and Poli, 2002].) Similarly GAPP does not cover non-optimisation uses of evolutionary computation such as: artificial life, evolutionary art, design, invention or co-evolution.

Later in the book the authors also analyse population based search both as a dynamical system and by using statistical mechanics and other approximation schemes. Essentially, like experimental design, these hope to capture the bulk behaviour of the population with mathematical models that use low order cumulants (such as the mean and variance) and ignore higher order interactions. This is similar to approximations successfully used in other fields. Cf. Fourier analysis and Principle Component Analysis (PCA). However while ignoring high frequencies or "higher order effects" may make the maths feasible, it is still dif-

ficult to predict, even the average, path evolution will take. Chapters 6 and 7 are not for the faint hearted.

In keeping with GAPP's tradition of completeness, an appendix is included to define many of the toy problems so beloved by the GA community. Also each of the main chapters (except Chapter 4 on NFL) includes a page or so of exercises. The answers are not included, either in the back of the book, or, as far as I could see, on the Internet.

Drs. Reeve and Rowe are academics with complementary but highly mathematical skills. The down side of this is that their book is mathematical. While the prose explains the topics well, it is reinforced with a liberal sprinkling of mathematical symbols which are not defined. For example, are you happy with $f : \mathcal{X} \mapsto \mathcal{Y} \subset \mathbb{R}$ ? If the sight of it and similar hieroglyphics offends your eye, then this is not the book for you.

This is definitely a book for the specialist. While including exercises might suggest it was aimed at students, it is too expensive for most students. However teachers of evolutionary computing courses, will find the exercises useful.

Genetic algorithms have been widely used for some time. Its good that theory is catching up. But as Jon says "You can think up seven new algorithms before breakfast. And then spend a life time analysing just one of them." Section 10.4 "The Impact of Theory on Practice" explains why theory matters, including giving practical guidance to cover cases where previously people have misused GAs. However even today GA theory does not say how to build a genetic algorithm but *Genetic Algorithms–Principles and Perspectives* holds what is known.

## References


Bäck, 1996. Thomas Bäck. *Evolutionary Algorithms in Theory and Practice: Evolution Strategies, Evolutionary Programming, Genetic Algorithms.* Oxford University Press, New York, 1996.

Langdon and Poli, 2002. W. B. Langdon and Riccardo Poli. *Foundations of Genetic Programming.* Springer-Verlag, 2002.