Genetic Programming and Evolvable Machines, 5, 319–320, 2004


# Book Review: Foundations of Genetic Programming

**Published by:** Springer Verlag, Berlin, Hardcover, 2002, 260 pages
ISBN: 3540424512, list price: $34.95
**Authors:** William Langdon and Riccardo Poli

Neats and scruffies—two names ascribed, respectively, to those who prefer to develop theoretical foundations of artificial intelligence (AI) and those who prefer to focus on making things work. As a subfield of AI, evolutionary computation (EC) has had both veins running through it, although EC has been dominated by the scruffies. Foundations of Genetic Programming falls in the neat vein, although it does have a little scruffie in it. Langdon and Poli do a very good job of summarizing and explaining the current state of schema theories for genetic programming (GP) and genetic algorithms (GAs), two sub-areas within EC. Schema theorems predict changes in schemata frequency from one iteration (generation) of a GP/GA to the next. Schemata are templates that match a set of GP trees or GA strings. If this sounds complicated, it is. Hence, this book is not for EC neophytes; instead, this technical monograph is recommended for a researcher or would be researcher in EC, who has a firm grasp of evolutionary concepts and some exposure to EC theory.

The monograph is comprised of twelve chapters, which can be divided into four conceptual sections: introduction and conclusion (chapters 1, 2, and 12), schema theories and theorems (chapters 3–6), examples (chapters 7–10), and GP bloat (chapter 11). The schema chapters are the best of the book and cover a range of theoretical results including Price's theorem and many schema theories and theorems developed by Holland, Koza, Altenberg, O'Reilly, Whigham, Rosca, Stephens and Waelbroeck, and Langdon and Poli. These chapters provide a generally clear path, with good examples, through the theoretical results, including proofs of many of the theorems. References to the literature are provided for the remaining proofs. Missing from the theory chapters is a complete discussion of Markov based EC theory. Such a discussion comparing schema theories with Markov based theories would be useful.

For readers interested in the practical applications of the schema theories, chapter 6 does a nice job outlining some practical applications of the schema theorems to GP. Chapters 7 and 8 provide an empirical and analytical analysis of the GP search space. Chapters 9 and 10 present empirical studies of the artificial ant and max problems. Chapter 11 discusses GP bloat.

The authors directly acknowledge the attacks on schema theories, but claim that such attacks are not warranted for the modern schema theories. Whether that claim is met will depend on one's view of schema theories. For those who find schema theories useful for explaining GA/GP behavior, this monograph will confirm their usefulness. For those who are skeptical of the usefulness of such theories, this book will show that the modern exact

schema theories are more powerful than the earlier theorems, but may not convince them of their usefulness.

This technical monograph presents theoretical explanations of GA/GP mechanisms. It also shows that GA/GP theoretical work is advancing rapidly and illuminates the work that is still to be done. The book is recommended for EC researchers.

**Richard J. Povinelli**