Evolutionary Computation in Practice

With 133 Figures and 29 Tables

Springer
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Preface

Evolutionary Computation in Practice (ECP) has been a special track at the Genetic and Evolutionary Computation Conference (GECCO) since 2003. This track is dedicated to the discussion of issues related to the practical application of EC-related technologies. During the past four years, members from industry, governmental agencies and other public sectors have participated in presentations and discussions describing how evolution-related technologies are being used to solve real-world problems. They have also engaged in intense dialogue on bridging academic training and real-world usage of EC together.

This book compiles papers from practitioners who have presented their work at ECP. These contributing chapters discuss various aspects of EC projects, including:

- Real-world application success stories;
- Real-world application lessons learned;
- Academic case studies of real-world applications;
- Technology transfer to solve real-world problems.

We would like to thank Janusz Kacprzyk for inviting us to edit this book for Springer’s Studies in Computational Intelligence Series. During the one-year period of book preparation, Thomas Ditzinger and Heather King at Springer have been very supportive to our needs. Dino Oliva has proofread many chapters of the book, which helped relieve some of the stress. We also thank the distinguished individuals who wrote foreword and back quotes for the book. Finally, the support of SIGEVO to this book project is greatly appreciated.

Tina Yu, Lawrence Davis, Cem Baydar, Rajkumar Roy
Foreword

Give Evolutionary Algorithms a chance! Put them to work! But do it smart.

This book demonstrates not only that Evolutionary Algorithms (EAs) are now a mature technology that can (and should) be applied to solve large complex real-world optimization problems, but also that the diffusion between cutting edge research and outstandingly efficient (i.e. billion-dollars-saving) applications can be very fast indeed: the most recent algorithmic advances can be quickly put to work in domains that a priori seemed rather far from any Computer Lab.

The main characteristic of EAs that makes this possible – and clearly appears in all the chapters of this book – is their flexibility. Flexibility to explore non-standard search spaces: many representations used in the works described here involved both discrete and continuous variables, many are variable-length representations, and twisting the problem so that the use of more classical optimization algorithms would dramatically reduce the space of possible solutions. Along the same line, approaches pertaining to recently proposed embryogenic representations can be found here, together with revisited older ideas of indirect representations that had been used in scheduling for 20 years. Flexibility to optimize highly irregular and/or very expensive fitness functions, using specifically tailored flavors of EAs: hierarchical algorithms, surrogate models. Flexibility to efficiently handle very different types of constraints, in the representation itself, as well as in the morphogenetic process – the possibly complex mapping between genotypes and phenotypes – or in the fitness itself.

Of course, this flexibility has a cost: because EAs offer so many possible ways to achieve the same goal, there are many choices to make, ranging from their setup to the choice of representation and variation operators (crossover, mutation, and the like) and the tedious task of parameter tuning (as no general method yet exists to fully automatize this process). This leads to a situation that can be described in a way that is familiar to EA practitioners: when applying EA to real-world problems, too, there are no free lunches! Success stories such
as those described in this book can only be obtained thanks to the close cooperation of open-minded experts in the application domain and smart evolutionary algorithmicists.

But in the end, such collaboration will pay off, by allowing what seems more and more necessary today when it comes to automatize repetitive complex tasks, and eventually try to improve on human operators: the re-introduction of the human factor. This goes from choosing representations that leave room for creativity (as there is nothing called artificial creativity, there are only creative programmers!), to letting human selection replace “natural” selection, what is done in the interactive evolution framework, and to designing optimized procedures that will be adapted to the user/customer (e.g. taking into account, when optimizing a delivery system, that Joe and Louis like to have lunch at Martin’s Place . . .).

So, even if we will not unveil here the address of Martin’s Place, you must read this book, whether you are an EA practitioner wishing to start working on challenging problems that you will not find described in any textbook (and eventually willing to earn a few dollars at the same time), or an engineer willing to hear true success stories involving colleagues (or competitors!).

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