
National Resource Laboratory
for the study of
Brain and Behavior

**Proceedings of the Workshop on
Genetic Programming: From Theory
to Real-World Applications**

Justinian P. Rosca, Editor

Technical Report 95.2
June 1995

UNIVERSITY OF

ROCHESTER

Proceedings of the Workshop on

**GENETIC PROGRAMMING:
FROM THEORY TO REAL-WORLD APPLICATIONS**

held in conjunction with

The Twelfth International Conference on Machine Learning

Tahoe City, California

July 9, 1995

Editor and Program Chair:

Justinian P. Rosca

CONTENTS

PREFACE	v
ACKNOWLEDGEMENTS	vi
THEORY AND ALGORITHM EXTENSIONS	
Byoung-Tak Zhang and Heinz Mühlenbein <i>Bayesian Inference, Minimum Description Length Principle and Learning by Genetic Programming</i>	1
Peter Nordin, Frank Francone and Wolfgang Banzhaf <i>Explicitly Defined Introns and Destructive Crossover in Genetic Programming</i>	6
Justinian P. Rosca <i>Entropy-Driven Adaptive Representation</i>	23
Peter A. Whigham <i>Gramatically-Based Genetic Programming</i>	33
Jürgen Schmidhuber <i>Beyond "Genetic Programming:" Incremental Self-Improvement</i>	42
APPLICATIONS	
Sašo Dzeroski, Ljupčo Todorovski and Igor Petrovski <i>Dynamical System Identification with Machine Learning</i>	50
Hitoshi Iba, Taisuke Sato and Hugo de Garis <i>Numerical Genetic Programming for System Identification</i>	64
Astro Teller and Manuela Veloso <i>The Discovery of Algorithms for Automatic Database Retrieval</i>	76
John R. Koza and David Andre <i>Automatic Discovery Using Genetic Programming of an Unknown-Sized Detector of Protein Motifs Containing Repeatedly-Used Subexpressions</i>	89
Simon Handley <i>Predicting Whether Or Not a 60-Base DNA Sequence Contains a Centrally-Located Splice Site Using Genetic Programming</i>	98
Stewart N. Taylor <i>Evolution by Genetic Programming of a Spatial Robot Juggling Control Algorithm</i>	104
IMPLEMENTATIONS	
David Andre and John R. Koza <i>Parallel Genetic Programming on a Network of Transputers</i>	111
Ronald L. Crepeau <i>Genetic Evolution of Machine Language Software</i>	121

PREFACE

This volume contains the papers selected for presentation at the workshop "GENETIC PROGRAMMING – FROM THEORY TO REAL-WORLD APPLICATIONS," held in conjunction with the Twelfth International Conference on Machine Learning.

Genetic Programming (GP) has a relatively short but exciting history. In his paper presented at the First International Conference on Genetic Algorithms (ICGA-85), Michael Cramer proposed a tree based genotype representation. John Koza defined the "Genetic Programming" approach as it is used today. His first book on GP practically defined the field, showing the huge potential of GP in a variety of Machine Learning applications. ICGA-93 hosted the first workshop on genetic programming. The result of the workshop was a successful book edited by Kim Kinnear in 1994. The same year John Koza authored a book on advanced GP techniques. The three GP books mentioned above, as well as the GP papers presented in several prestigious conferences since 1992, have brought a variety of influential theoretical and practical ideas. The interest in this field has been steadily growing.

The goal of this second GP workshop was to shed light onto the methodology for understanding, explaining, and controlling GP search and to show how these issues are reflected in GP frameworks and successful or innovative applications. The workshop brought together researchers from academia and industry interested in the theory and applications of genetic programming.

The workshop program committee, responsible for the review and selection of submitted papers included the following members:

Lee Altenberg	- Maui High Performance Computing Center
David Andre	- Stanford University
Peter Angeline	- Loral Federal Systems
Frederic Gruau	- Stanford University
Hitoshi Iba	- Electrotechnical Laboratory, Japan
Kim Kinnear	- Adaptive Computing Technologies
John Koza ¹	- Stanford University
UnaMay O'Reilly	- Santa Fe Institute and Carleton University
Justinian Rosca	- University of Rochester
Walter Tackett	- Neuromedia

Papers are organized into three thematic sections:

- Theory and algorithm extensions
- Applications
- Implementations.

These sections reflect the original call for papers which announced three directions of focus: Theoretical issues, GP algorithms, real-world and innovative applications. Additionally, the workshop scheduled two invited talks: "Future Directions for Genetic Programming" by Professor John Koza and "Mining the Genetic Program" by Dr. Walter Tackett.

Finally, I am happy to acknowledge the participation in this workshop of researchers from Australia, Europe, Japan and USA and the very good quality of the papers accepted. I hope that the work reported here will be a source of inspiration for further accomplishments in the area of genetic programming.

¹Prof. John Koza has not been involved with reviewing or selecting papers for the workshop.

ACKNOWLEDGMENTS

It is a great pleasure to thank all those who helped to create this volume. First of all I want to thank all the authors of the papers included in this volume. Without their hard work this event would not have been possible. I thank the members of the Program Committee whose cooperation and labor made everything easier. I particularly want to thank Professor John Koza for all his support. Without his steady encouragement and help the workshop would have remained just a nice idea. Professor Dana Ballard was magnificent in all his help, unwavering enthusiasm and friendship. Thanks also go to Peggy Meeker from the Computer Science Department of the University of Rochester who helped with the organization of the final manuscript. Sridhar Mahadevan provided organizational guidelines. Last but not least, I would like to thank to my wife Daniela for being always near.

Justinian Rosca
University of Rochester

Rochester, NY, June 1995.