

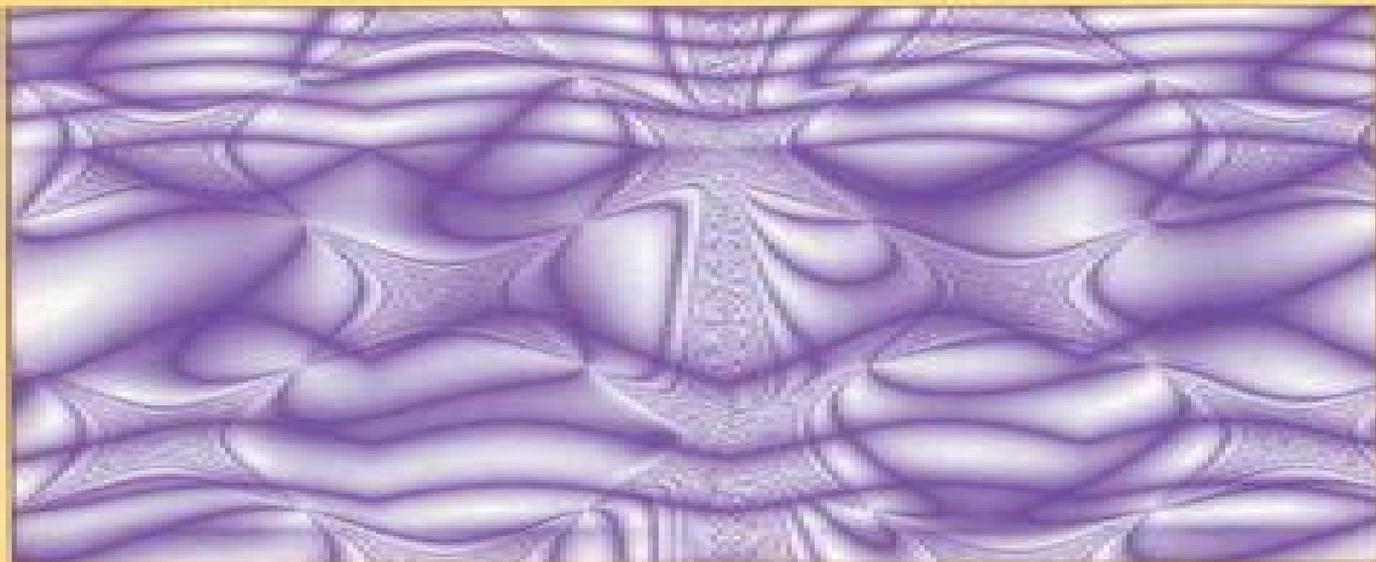
GENETIC PROGRAMMING AND DATA STRUCTURES

Genetic Programming + Data Structures =
Automatic Programming!

by

William B. Langdon

With a Foreword by John R. Koza



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Genetic Programming And Data Structures

Rick Riolo, Bill Worzel



Genetic Programming And Data Structures:

Genetic Programming and Data Structures W.B. Langdon, 1998-04-30 Computers that program themselves has long been an aim of computer scientists Recently genetic programming GP has started to show its promise by automatically evolving programs Indeed in a small number of problems GP has evolved programs whose performance is similar to or even slightly better than that of programs written by people The main thrust of GP has been to automatically create functions While these can be of great use they contain no memory and relatively little work has addressed automatic creation of program code including stored data This issue is the main focus of Genetic Programming and Data Structures Genetic Programming Data Structures Automatic Programming This book is motivated by the observation from software engineering that data abstraction e g via abstract data types is essential in programs created by human programmers This book shows that abstract data types can be similarly beneficial to the automatic production of programs using GP Genetic Programming and Data Structures Genetic Programming Data Structures Automatic Programming shows how abstract data types stacks queues and lists can be evolved using genetic programming demonstrates how GP can evolve general programs which solve the nested brackets problem recognises a Dyck context free language and implements a simple four function calculator In these cases an appropriate data structure is beneficial compared to simple indexed memory This book also includes a survey of GP with a critical review of experiments with evolving memory and reports investigations of real world electrical network maintenance scheduling problems that demonstrate that Genetic Algorithms can find low cost viable solutions to such problems Genetic Programming and Data Structures Genetic Programming Data Structures Automatic Programming should be of direct interest to computer scientists doing research on genetic programming genetic algorithms data structures and artificial intelligence In addition this book will be of interest to practitioners working in all of these areas and to those interested in automatic programming

Genetic Programming and Data Structures William B. Langdon, 2012-12-06 Computers that program themselves has long been an aim of computer scientists Recently genetic programming GP has started to show its promise by automatically evolving programs Indeed in a small number of problems GP has evolved programs whose performance is similar to or even slightly better than that of programs written by people The main thrust of GP has been to automatically create functions While these can be of great use they contain no memory and relatively little work has addressed automatic creation of program code including stored data This issue is the main focus of Genetic Programming and Data Structures Genetic Programming Data Structures Automatic Programming This book is motivated by the observation from software engineering that data abstraction e g via abstract data types is essential in programs created by human programmers This book shows that abstract data types can be similarly beneficial to the automatic production of programs using GP Genetic Programming and Data Structures Genetic Programming Data Structures Automatic Programming shows how abstract data types stacks queues and lists can be evolved using genetic programming

demonstrates how GP can evolve general programs which solve the nested brackets problem recognises a Dyck context free language and implements a simple four function calculator In these cases an appropriate data structure is beneficial compared to simple indexed memory This book also includes a survey of GP with a critical review of experiments with evolving memory and reports investigations of real world electrical network maintenance scheduling problems that demonstrate that Genetic Algorithms can find low cost viable solutions to such problems Genetic Programming and Data Structures Genetic Programming Data Structures Automatic Programming should be of direct interest to computer scientists doing research on genetic programming genetic algorithms data structures and artificial intelligence In addition this book will be of interest to practitioners working in all of these areas and to those interested in automatic programming

Genetic Programming and Data Structures W.B. Langdon,2012-10-29 Computers that program themselves has long been an aim of computer scientists Recently genetic programming GP has started to show its promise by automatically evolving programs Indeed in a small number of problems GP has evolved programs whose performance is similar to or even slightly better than that of programs written by people The main thrust of GP has been to automatically create functions While these can be of great use they contain no memory and relatively little work has addressed automatic creation of program code including stored data This issue is the main focus of Genetic Programming and Data Structures Genetic Programming Data Structures Automatic Programming This book is motivated by the observation from software engineering that data abstraction e g via abstract data types is essential in programs created by human programmers This book shows that abstract data types can be similarly beneficial to the automatic production of programs using GP Genetic Programming and Data Structures Genetic Programming Data Structures Automatic Programming shows how abstract data types stacks queues and lists can be evolved using genetic programming demonstrates how GP can evolve general programs which solve the nested brackets problem recognises a Dyck context free language and implements a simple four function calculator In these cases an appropriate data structure is beneficial compared to simple indexed memory This book also includes a survey of GP with a critical review of experiments with evolving memory and reports investigations of real world electrical network maintenance scheduling problems that demonstrate that Genetic Algorithms can find low cost viable solutions to such problems Genetic Programming and Data Structures Genetic Programming Data Structures Automatic Programming should be of direct interest to computer scientists doing research on genetic programming genetic algorithms data structures and artificial intelligence In addition this book will be of interest to practitioners working in all of these areas and to those interested in automatic programming [Genetic Programming and Data Structure](#) ,1996 *Genetic Programming Theory and Practice* Rick Riolo,Bill Worzel,2003-11-30 Genetic Programming Theory and Practice explores the emerging interaction between theory and practice in the cutting edge machine learning method of Genetic Programming GP The material contained in this contributed volume was developed from a workshop at the University of Michigan s Center for the Study of

Complex Systems where an international group of genetic programming theorists and practitioners met to examine how GP theory informs practice and how GP practice impacts GP theory The contributions cover the full spectrum of this relationship and are written by leading GP theorists from major universities as well as active practitioners from leading industries and businesses Chapters include such topics as John Koza s development of human competitive electronic circuit designs David Goldberg s application of competent GA methodology to GP Jason Daida s discovery of a new set of factors underlying the dynamics of GP starting from applied research and Stephen Freeland s essay on the lessons of biology for GP and the potential impact of GP on evolutionary theory The book also includes chapters on the dynamics of GP the selection of operators and population sizing specific applications such as stock selection in emerging markets predicting oil field production modeling chemical production processes and developing new diagnostics from genomic data Genetic Programming Theory and Practice is an excellent reference for researchers working in evolutionary algorithms and for practitioners seeking innovative methods to solve difficult computing problems

Data Mining Using Grammar Based Genetic Programming and Applications Man Leung Wong, Kwong Sak Leung, 2005-12-02 Data mining involves the non trivial extraction of implicit previously unknown and potentially useful information from databases Genetic Programming GP and Inductive Logic Programming ILP are two of the approaches for data mining This book first sets the necessary backgrounds for the reader including an overview of data mining evolutionary algorithms and inductive logic programming It then describes a framework called GGP Generic Genetic Programming that integrates GP and ILP based on a formalism of logic grammars The formalism is powerful enough to represent context sensitive information and domain dependent knowledge This knowledge can be used to accelerate the learning speed and or improve the quality of the knowledge induced A grammar based genetic programming system called LOGENPRO The LOGic grammar based GENetic PROgramming system is detailed and tested on many problems in data mining It is found that LOGENPRO outperforms some ILP systems We have also illustrated how to apply LOGENPRO to emulate Automatically Defined Functions ADFs to discover problem representation primitives automatically By employing various knowledge about the problem being solved LOGENPRO can find a solution much faster than ADFs and the computation required by LOGENPRO is much smaller than that of ADFs Moreover LOGENPRO can emulate the effects of Strongly Type Genetic Programming and ADFs simultaneously and effortlessly Data Mining Using Grammar Based Genetic Programming and Applications is appropriate for researchers practitioners and clinicians interested in genetic programming data mining and the extraction of data from databases

Genetic Programming Wolfgang Banzhaf, 1998 To order this title for shipment to Austria Germany or Switzerland please contact dpunkt verlag directly The authors have performed a remarkable double service with this excellent book on genetic programming First they give an up to date view of the rapidly growing field of automatic creation of computer programs by means of evolution and second they bring together their own innovative and formidable work on evolution of assembly

language machine code and linear genomes John R Koza Since the early 1990s genetic programming GP a discipline whose goal is to enable the automatic generation of computer programs has emerged as one of the most promising paradigms for fast productive software development GP combines biological metaphors gleaned from Darwin s theory of evolution with computer science approaches drawn from the field of machine learning to create programs that are capable of adapting or recreating themselves for open ended tasks This unique introduction to GP provides a detailed overview of the subject and its antecedents with extensive references to the published and online literature In addition to explaining the fundamental theory and important algorithms the text includes practical discussions covering a wealth of potential applications and real world implementation techniques Software professionals needing to understand and apply GP concepts will find this book an invaluable practical and theoretical guide

Genetic Programming Sebastian Ventura Soto,2012-10-18 Genetic programming GP is a branch of Evolutionary Computing that aims the automatic discovery of programs to solve a given problem Since its appearance in the earliest nineties GP has become one of the most promising paradigms for solving problems in the artificial intelligence field producing a number of human competitive results and even patentable new inventions And as other areas in Computer Science GP continues evolving quickly with new ideas techniques and applications being constantly proposed The purpose of this book is to show recent advances in the field of GP both the development of new theoretical approaches and the emergence of applications that have successfully solved different real world problems The volume is primarily aimed at postgraduates researchers and academics although it is hoped that it may be useful to undergraduates who wish to learn about the leading techniques in GP

Illustrating Evolutionary Computation with Mathematica Christian Jacob,2001 Part 1 Fascinating Evolution Part 2 Evolutionary Computation Part 3 If Darwin was a Programmer Part 4 Evolution of Developmental Programs

Genetic Algorithms + Data Structures = Evolution Programs Zbigniew Michalewicz,2013-06-29 What does your Master teach asked a visitor Nothing said the disciple Then why does he give discourses He only points the way he teaches nothing Anthony de Mello One Minute Wisdom During the last three decades there has been a growing interest in algorithms which rely on analogies to natural processes The emergence of massively par allel computers made these algorithms of practical interest The best known algorithms in this class include evolutionary programming genetic algorithms evolution strategies simulated annealing classifier systems and neural net works Recently 1 3 October 1990 the University of Dortmund Germany hosted the First Workshop on Parallel Problem Solving from Nature 164 This book discusses a subclass of these algorithms those which are based on the principle of evolution survival of the fittest In such algorithms a popu lation of individuals potential solutions undergoes a sequence of unary muta tion type and higher order crossover type transformations These individuals strive for survival a selection scheme biased towards fitter individuals selects the next generation After some number of generations the program converges the best individual hopefully represents the optimum solution There are many different algorithms in this category To underline

the similarities between them we use the common term evolution programs

Engineering Design Synthesis Amaresh Chakrabarti, 2013-03-09 This book is an attempt to bring together some of the most influential pieces of research that collectively underpin today's understanding of what constitutes and contributes to design synthesis and the approaches and tools for supporting this important activity The book has three parts Part 1 Understanding is intended to provide an overview of some of the major findings as to what constitutes design synthesis and some of its major influencing factors Part 2 Approaches provides descriptions of some of the major prescriptive approaches to design synthesis that together influenced many of the computational tools described in the final part Part 3 Tool is a selection of the diverse range of computational approaches being developed to support synthesis in the major strands of synthesis research composition retrieval adaptation and change In addition the book contains an editorial introduction to the chapters and the broader context of research it represents and a supplementary bibliography to help locate this broader expanse of work With the wide variety of methods and tools covered this book is intended primarily for graduate students and researchers in product design and development but it will also be beneficial for educators and practitioners of engineering design for whom it should act as a valuable sourcebook of ideas for teaching or enhancing design creativity

Data Mining Using Grammar Based Genetic Programming and Applications Man Leung Wong, Kwong Sak Leung, 2014-01-15 *Advances in Nature and Biologically Inspired Computing* Nelishia Pillay, Andries P. Engelbrecht, Ajith Abraham, Mathys C. du Plessis, Václav Snášel, Azah Kamilah Muda, 2015-12-01 World Congress on Nature and Biologically Inspired Computing NaBIC is organized to discuss the state of the art as well as to address various issues with respect to Nurturing Intelligent Computing Towards Advancement of Machine Intelligence This Volume contains the papers presented in the Seventh World Congress NaBIC 15 held in Pietermaritzburg South Africa during December 01-03 2015 The 39 papers presented in this Volume were carefully reviewed and selected The Volume would be a valuable reference to researchers students and practitioners in the computational intelligence field

Evolutionary Intelligence S. Sumathi, T. Hamsapriya, P. Surekha, 2008-05-15 This book provides a highly accessible introduction to evolutionary computation It details basic concepts highlights several applications of evolutionary computation and includes solved problems using MATLAB software and C/C++ This book also outlines some ideas on when genetic algorithms and genetic programming should be used The most difficult part of using a genetic algorithm is how to encode the population and the author discusses various ways to do this

Reconstruction of Software Component Architectures and Behaviour Models Using Static and Dynamic Analysis Klaus Krogmann, 2014-07-30 Model based performance prediction systematically deals with the evaluation of software performance to avoid for example bottlenecks estimate execution environment sizing or identify scalability limitations for new usage scenarios Such performance predictions require up to date software performance models This book describes a new integrated reverse engineering approach for the reconstruction of parameterised software performance models software component

architecture and behaviour Knowledge Incorporation in Evolutionary Computation Yaochu Jin,2004-10-20 Incorporation of a priori knowledge such as expert knowledge meta heuristics and human preferences as well as domain knowledge acquired during evolutionary search into evolutionary algorithms has received increasing interest in the recent years It has been shown from various motivations that knowledge incorporation into evolutionary search is able to significantly improve search efficiency However results on knowledge incorporation in evolutionary computation have been scattered in a wide range of research areas and a systematic handling of this important topic in evolutionary computation still lacks This edited book is a first attempt to put together the state of art and recent advances on knowledge incorporation in evolutionary computation within a unified framework Existing methods for knowledge incorporation are divided into the following five categories according to the functionality of the incorporated knowledge in the evolutionary algorithms 1 Knowledge incorporation in representation population initialization combination and mutation 2 Knowledge incorporation in selection and reproduction 3 Knowledge incorporation in fitness evaluations 4 Knowledge incorporation through life time learning and human computer interactions 5 Incorporation of human preferences in multi objective evolutionary computation The intended readers of this book are graduate students researchers and practitioners in all fields of science and engineering who are interested in evolutionary computation The book is divided into six parts Part I contains one introductory chapter titled A selected introduction to evolutionary computation by Yao which presents a concise but insightful introduction to evolutionary computation **Genetic Algorithms and Genetic Programming** Michael Affenzeller,Stefan Wagner,Stephan Winkler,Andreas Beham,2009-04-09 Genetic Algorithms and Genetic Programming Modern Concepts and Practical Applications discusses algorithmic developments in the context of genetic algorithms GAs and genetic programming GP It applies the algorithms to significant combinatorial optimization problems and describes structure identification using HeuristicLab as a platform for all Genetic Programming Mauro Castelli,Lukas Sekanina,Mengjie Zhang,Stefano Cagnoni,Pablo García-Sánchez,2018-03-23 This book constitutes the refereed proceedings of the 21st European Conference on Genetic Programming EuroGP 2018 held in Parma Italy in April 2018 co located with the Evo 2018 events EvoCOP EvoMUSART and EvoApplications The 11 revised full papers presented together with 8 poster papers were carefully reviewed and selected from 36 submissions The wide range of topics in this volume reflects the current state of research in the field Thus we see topics and applications including analysis of feature importance for metabolomics semantic methods evolution of boolean networks generation of redundant features ensembles of GP models automatic design of grammatical representations GP and neuroevolution visual reinforcement learning evolution of deep neural networks evolution of graphs and scheduling in heterogeneous networks Evolutionary Algorithms and Intelligent Tools in Engineering Optimization William Annicchiarico,2005 Evolutionary algorithms are very powerful techniques used to find solutions to real world search and optimisation problems In this text a large spectrum of innovative evolutionary and intelligence methods are presented

and used for solving various application problems

Genetic Programming ,2003

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