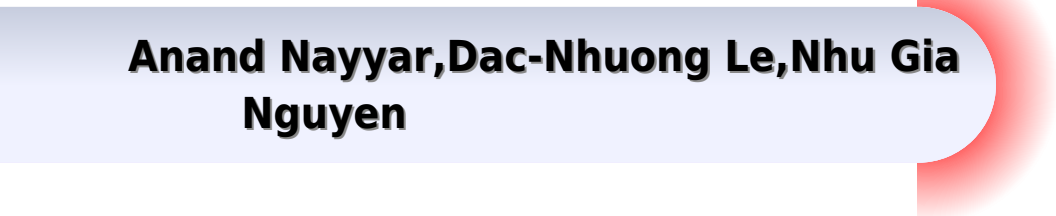


# Logic-Based Methods for Global Optimization

J. N. Hooker  
Carnegie Mellon University, USA  
November 2003

# Logic Based Methods For Optimization

**Anand Nayyar, Dac-Nhuong Le, Nhu Gia  
Nguyen**



## Logic Based Methods For Optimization:

**Logic-Based Methods for Optimization** John Hooker, 2011-09-28 A pioneering look at the fundamental role of logic in optimization and constraint satisfaction. While recent efforts to combine optimization and constraint satisfaction have received considerable attention, little has been said about using logic in optimization as the key to unifying the two fields. Logic Based Methods for Optimization develops for the first time a comprehensive conceptual framework for integrating optimization and constraint satisfaction, then goes a step further and shows how extending logical inference to optimization allows for more powerful as well as flexible modeling and solution techniques. Designed to be easily accessible to industry professionals and academics in both operations research and artificial intelligence, the book provides a wealth of examples as well as elegant techniques and modeling frameworks ready for implementation. Timely, original, and thought provoking, Logic Based Methods for Optimization demonstrates the advantages of combining the techniques in problem solving. Offers tutorials in constraint satisfaction, constraint programming, and logical inference. Clearly explains such concepts as relaxation, cutting planes, nonserial dynamic programming, and Bender's decomposition. Reviews the necessary technologies for software developers seeking to combine the two techniques. Features extensive references to important computational studies and much more.

Data Mining and Knowledge Discovery via Logic-Based Methods Evangelos Triantaphyllou, 2010-06-08 The importance of having efficient and effective methods for data mining and knowledge discovery (DM/KD) to which the present book is devoted grows every day, and numerous such methods have been developed in recent decades. There exists a great variety of different settings for the main problem studied by data mining and knowledge discovery, and it seems that a very popular one is formulated in terms of binary attributes. In this setting, states of nature of the application area under consideration are described by Boolean vectors defined on some attributes. That is, by data points defined in the Boolean space of the attributes. It is postulated that there exists a partition of this space into two classes which should be inferred as patterns on the attributes when only several data points are known, the so-called positive and negative training examples. The main problem in DM/KD is defined as finding rules for recognizing/classifying new data points of unknown class, i.e., deciding which of them are positive and which are negative. In other words, to infer the binary value of one more attribute called the goal or class attribute. To solve this problem, some methods have been suggested which construct a Boolean function separating the two given sets of positive and negative training data points.

*Logic-Based 0-1 Constraint Programming* Peter Barth, 2012-12-06 A logic view of 0-1 integer programming problems providing new insights into the structure of problems that can lead the researcher to more effective solution techniques depending on the problem class. Operations research techniques are integrated into a logic programming environment. The first monographic treatment that begins to unify these two methodological approaches. Logic-based methods for modelling and solving combinatorial problems have recently started to play a significant role in both theory and practice. The application of logic to combinatorial problems has a

dual aspect On one hand constraint logic programming allows one to declaratively model combinatorial problems over an appropriate constraint domain the problems then being solved by a corresponding constraint solver Besides being a high level declarative interface to the constraint solver the logic programming language allows one also to implement those subproblems that cannot be naturally expressed with constraints On the other hand logic based methods can be used as a constraint solving technique within a constraint solver for combinatorial problems modelled as 0 1 integer programs

*Encyclopedia of Optimization* Christodoulos A. Floudas, Panos M. Pardalos, 2008-09-04 The goal of the Encyclopedia of Optimization is to introduce the reader to a complete set of topics that show the spectrum of research the richness of ideas and the breadth of applications that has come from this field The second edition builds on the success of the former edition with more than 150 completely new entries designed to ensure that the reference addresses recent areas where optimization theories and techniques have advanced Particularly heavy attention resulted in health science and transportation with entries such as Algorithms for Genomics Optimization and Radiotherapy Treatment Design and Crew Scheduling

**Principles and Practice of Constraint Programming** Alan H. Borning, Alan Borning, 1994-10-12 This volume is the proceedings of the Second International Workshop on the Principles and Practice of Constraint Programming held at Rosario Orcas Island Washington USA in May 1994 in cooperation with AAAI and ALP The volume contains 27 full revised papers selected from 87 submissions as well as a summary of a panel session on commercial applications of constraint programming The contributions cover a broad range of topics including constraint programming languages algorithms for constraint satisfaction and entailment and constraints and their relation to fields such as artificial intelligence databases operations research problem solving and user interfaces

**Handbook of Satisfiability** A. Biere, M. Heule, H. van Maaren, 2009-01-29 Satisfiability SAT related topics have attracted researchers from various disciplines logic applied areas such as planning scheduling operations research and combinatorial optimization but also theoretical issues on the theme of complexity and much more they all are connected through SAT My personal interest in SAT stems from actual solving The increase in power of modern SAT solvers over the past 15 years has been phenomenal It has become the key enabling technology in automated verification of both computer hardware and software Bounded Model Checking BMC of computer hardware is now probably the most widely used model checking technique The counterexamples that it finds are just satisfying instances of a Boolean formula obtained by unwinding to some fixed depth a sequential circuit and its specification in linear temporal logic Extending model checking to software verification is a much more difficult problem on the frontier of current research One promising approach for languages like C with finite word length integers is to use the same idea as in BMC but with a decision procedure for the theory of bit vectors instead of SAT All decision procedures for bit vectors that I am familiar with ultimately make use of a fast SAT solver to handle complex formulas Decision procedures for more complicated theories like linear real and integer arithmetic are also used in program verification Most of them use powerful SAT solvers in an essential

way Clearly efficient SAT solving is a key technology for 21st century computer science I expect this collection of papers on all theoretical and practical aspects of SAT solving will be extremely useful to both students and researchers and will lead to many further advances in the field Edmund Clarke FORE Systems University Professor of Computer Science and Professor of Electrical and Computer Engineering at Carnegie Mellon University winner of the 2007 A M Turing Award      **Boolean Models and Methods in Mathematics, Computer Science, and Engineering** Yves Crama, Peter L. Hammer, 2010-06-28 A collection of papers written by prominent experts that examine a variety of advanced topics related to Boolean functions and expressions      **Logic and Integer Programming** H. Paul Williams, 2009-04-09 Paul Williams a leading authority on modeling in integer programming has written a concise readable introduction to the science and art of using modeling in logic for integer programming Written for graduate and postgraduate students as well as academics and practitioners the book is divided into four chapters that all avoid the typical format of definitions theorems and proofs and instead introduce concepts and results within the text through examples References are given at the end of each chapter to the more mathematical papers and texts on the subject and exercises are included to reinforce and expand on the material in the chapter Methods of solving with both logic and IP are given and their connections are described Applications in diverse fields are discussed and Williams shows how IP models can be expressed as satisfiability problems and solved as such

**Principles and Practice of Constraint Programming - CP 2001** Toby Walsh, 2003-06-30 This book constitutes the refereed proceedings of the 7th International Conference on Principles and Practice of Constraint Programming CP 2001 held in Paphos Cyprus in November December 2001 The 37 revised full papers 9 innovative applications presentations and 14 short papers presented were carefully reviewed and selected from a total of 135 submissions All current issues in constraint processing are addressed ranging from theoretical and foundational issues to advanced and innovative applications in a variety of fields      *Hybrid Optimization* Pascal van Hentenryck, Michela Milano, 2010-11-05 Hybrid Optimization focuses on the application of artificial intelligence and operations research techniques to constraint programming for solving combinatorial optimization problems This book covers the most relevant topics investigated in the last ten years by leading experts in the field and speculates about future directions for research This book includes contributions by experts from different but related areas of research including constraint programming decision theory operations research SAT artificial intelligence as well as others These diverse perspectives are actively combined and contrasted in order to evaluate their relative advantages This volume presents techniques for hybrid modeling integrated solving strategies including global constraints decomposition techniques use of relaxations and search strategies including tree search local search and metaheuristics Various applications of the techniques presented as well as supplementary computational tools are also discussed      **Scalable Uncertainty Management** Nahla Ben Amor, Benjamin Quost, Martin Theobald, 2019-12-02 This book constitutes the refereed proceedings of the 13th International Conference on Scalable

Uncertainty Management SUM 2019 which was held in Compi gne France in December 2019 The 25 full 4 short 4 tutorial 2 invited keynote papers presented in this volume were carefully reviewed and selected from 44 submissions The conference is dedicated to the management of large amounts of complex uncertain incomplete or inconsistent information New approaches have been developed on imprecise probabilities fuzzy set theory rough set theory ordinal uncertainty representations or even purely qualitative models

Boolean Functions Yves Crama, Peter L. Hammer, 2011-05-16 Written by prominent experts in the field this monograph provides the first comprehensive unified presentation of the structural algorithmic and applied aspects of the theory of Boolean functions The book focuses on algebraic representations of Boolean functions especially disjunctive and conjunctive normal form representations This framework looks at the fundamental elements of the theory Boolean equations and satisfiability problems prime implicants and associated short representations dualization an in depth study of special classes of Boolean functions quadratic Horn shellable regular threshold read once functions and their characterization by functional equations and two fruitful generalizations of the concept of Boolean functions partially defined functions and pseudo Boolean functions Several topics are presented here in book form for the first time Because of the depth and breadth and its emphasis on algorithms and applications this monograph will have special appeal for researchers and graduate students in discrete mathematics operations research computer science engineering and economics

*Advances in Swarm Intelligence for Optimizing Problems in Computer Science* Anand Nayyar, Dac-Nhuong Le, Nhu Gia Nguyen, 2018-10-03 This book provides comprehensive details of all Swarm Intelligence based Techniques available till date in a comprehensive manner along with their mathematical proofs It will act as a foundation for authors researchers and industry professionals This monograph will present the latest state of the art research being done on varied Intelligent Technologies like sensor networks machine learning optical fiber communications digital signal processing image processing and many more

*Formal Techniques, Modelling and Analysis of Timed and Fault-Tolerant Systems* Yassine Lakhnech, Sergio Yovine, 2004-12-07 This volume contains the proceedings of the joint conference on Formal Modelling and Analysis of Timed Systems FORMATS and Formal Techniques in Real Time and Fault Tolerant Systems FTRTFT held in Grenoble France on September 22-24 2004 The conference united two previously independently organized conferences FORMATS and FTRTFT FORMATS 2003 was organized

as a satellite workshop of CONCUR 2003 and was related to three independently started workshop series MTCS held as a satellite event of CONCUR 2000 and CONCUR 2002 RT TOOLS held as a satellite event of CONCUR 2001 and FLoC 2002 and TPTS held at ETAPS 2002 FTRTFT is a symposium that was held seven times before in Warwick 1988 Nijmegen 1992 Lu beck 1994 Uppsala 1996 Lyngby 1998 Pune 2000 and Oldenburg 2002 The proceedings of these symposia were published as volumes 331 571 863 1135 1486 1926 and 2469 in the LNCS series by Springer This joint conference is dedicated to the advancement of the theory and practice of the modelling design and analysis of real time and fault tolerant systems

Indeed computersystemsarebecomingincreasinglywidespreadinreal timeand safety critical applications such as embedded systems Such systems are char terized by the crucial need to manage their complexity in order to produce reliable designs and implementations The importance of timing aspects p formance and fault tolerance is continuously growing Formal techniques o er a foundation for systematic design of complex systems They have bene cial plications throughout the engineering process from the capture of requirements through speci cation design coding and compilation down to the hardware that embeds the system into its environment

**Integration of AI and OR Techniques in Constraint Programming for Combinatorial Optimization Problems** Jean-Charles Régim,Michel Rueher,2004-05-17 This volume contains the proceedings of the First International Conference on

IntegrationofAIandORTEchniquesinConstraintProgrammingforCombina rialOptimisation Problems This new conferencefollows the seriesof CP AI OR International Workshops on Integration of AI and OR Techniques in Constraint Programming for Combinatorial Optimisation Problems held in Ferrara 1999 Paderborn 2000 Ashford 2001 Le Croisic 2002 and Montreal 2003 The success of the previous workshops has demonstrated that CP AI OR is bec ing a major forum for exchanging ideas and methodologiesfrom both elds The aim of this new conference is to bring together researchersfrom AI and OR and to give them the opportunity to show how the integration of techniques from AI and OR can lead to interesting results on large scale and complex problems The integration of techniques from Arti cial Intelligence and Operations search has provided e ective algorithms for tackling complex and large scale combinatorial problems with signi cant improvements in terms of e ciency scalability and optimality The bene t of this integration has been shown in applications such as hoist scheduling rostering dynamic scheduling and vehicle routing At the programming and modelling levels most constraint languages embed OR techniques to reason about collections of constraints so calledglobal constraints Some languages also provide support for hybridization allowing the programmer to build new integrated algorithms The resulting multi paradigm programmingframeworkcombines the exibility and modelling facilities of C straint Programming with the special purpose and e cient methods from erations Research

Proceedings of the 2024 6th International Conference on Economic Management and Model Engineering (ICEMME 2024) Lina Zhong,Tang Yao,Chee Yoong Liew,Hongbo Li,2025-05-24 This is an open access book We extend a warm invitation to you to participate in 2024 6th International Conference on Economic Management and Model Engineering which will be held November 22 24 2024 in Dalian The preceding four conferences 2020 2023 were effectively conducted drawing in professionals academics and business executives from all over the world and making a substantial contribution to the development of model engineering and economic management research The past conferences advanced innovation and development in the fields of economic management and model engineering accomplishing outstanding feats in academia and industry from 2020 to 2023 Congratulations to everyone who took part and the organizers for their amazing work The conference this year will explore innovations and challenges in applying emerging technologies to

real world scenarios with a particular focus on how big data and artificial intelligence affect model engineering and economic management. Additionally, it will foster a deeper integration between academic research and industry practice. Economic management and model engineering face unprecedented opportunities and challenges as the global economy grows more complex and uncertain and big data and artificial intelligence technologies develop at a rapid pace. This calls for collaborative exploration between academia and industry. The conference's objectives are to create a global forum for collaboration and exchange with an emphasis on current research and its applications in the real world to further the development of economic management theories and model engineering methods and to improve the efficiency and creativity of international economic management practices.

**Algebraic Modeling Systems** Josef Kallrath, 2012-02-16 This book Algebraic Modeling Systems Modeling and Solving Real World Optimization Problems deals with the aspects of modeling and solving real world optimization problems in a unique combination. It treats systematically the major algebraic modeling languages AMLs and modeling systems AMLs used to solve mathematical optimization problems. AMLs helped significantly to increase the usage of mathematical optimization in industry. Therefore it is logical consequence that the GOR Gesellschaft für Operations Research Working Group Mathematical Optimization in Real Life had a second meeting devoted to AMLs which after 7 years followed the original 71st Meeting of the GOR Gesellschaft für Operations Research Working Group Mathematical Optimization in Real Life which was held under the title Modeling Languages in Mathematical Optimization during April 23-25 2003 in the German Physics Society Conference Building in Bad Honnef Germany. While the first meeting resulted in the book Modeling Languages in Mathematical Optimization this book is an offspring of the 86th Meeting of the GOR working group which was again held in Bad Honnef under the title Modeling Languages in Mathematical Optimization.

**Principles and Practice of Constraint Programming - CP 2010** David Cohen, 2010-09-07 The 16th annual International Conference on the Principles and Practice of Constraint Programming CP 2010 was held in St Andrews Scotland during September 6-10 2010. We would like to thank our sponsors for their generous support of this event. This conference is concerned with all aspects of computing with constraints including theory algorithms applications environments languages models and systems. We received a wide variety of submissions each of which was reviewed by at least three referees. Referees were chosen for each submission by an initial bidding process where Program Committee members chose papers from their area of interest. The range of expertise represented by the large Program Committee meant that almost all submissions were reviewed by subject experts on the Program Committee or by colleagues chosen by members of the Program Committee for their particular expertise. Papers were solicited either as long 15 page or short 8 page submissions. Short paper submissions were refereed to exactly the same high standards as long paper submissions but naturally were expected to contain a smaller quantity of new material. Thus there is no distinction in these proceedings between short and long papers. I used the excellent EasyChair conference management system to support this process of reviewing and for the collation and organization of



these proceedings Submissions were made either to the applications track or to the research track There were 101 23 short research track submissions of which 36 8 short were accepted which is a 36% 35% of short acceptance rate Application track submissions received special consideration and the acceptance rate was significantly higher than for the research track

**Acta Numerica 2004: Volume 13** Arieh Iserles, 2004-06-03 An annual volume presenting substantive survey articles in numerical mathematics and scientific computing **Algorithms and Theory of Computation Handbook, Volume 1** Mikhail J. Atallah, Marina Blanton, 2009-11-20 Algorithms and Theory of Computation Handbook Second Edition General Concepts and Techniques provides an up to date compendium of fundamental computer science topics and techniques It also illustrates how the topics and techniques come together to deliver efficient solutions to important practical problems Along with updating and revising many

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