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G. Hiss (Eds.)

# Algorithmic Algebra and Number Theory



Springer

# Algorithmic Algebra

**Arjeh M. Cohen, Hans Cuypers, Hans  
Sterk**



## **Algorithmic Algebra:**

*Fundamental Problems of Algorithmic Algebra* Chee-Keng Yap, 2000 Popular computer algebra systems such as Maple Macsyma Mathematica and REDUCE are now basic tools on most computers Efficient algorithms for various algebraic operations underlie all these systems Computer algebra or algorithmic algebra studies these algorithms and their properties and represents a rich intersection of theoretical computer science with classical mathematics *Fundamental Problems of Algorithmic Algebra* provides a systematic and focused treatment of a collection of core problems the computational equivalents of the classical Fundamental Problem of Algebra and its derivatives Topics covered include the GCD subresultants modular techniques the fundamental theorem of algebra roots of polynomials Sturm theory Gaussian lattice reduction lattices and polynomial factorization linear systems elimination theory Grobner bases and more Features Presents algorithmic ideas in pseudo code based on mathematical concepts and can be used with any computer mathematics system Emphasizes the algorithmic aspects of problems without sacrificing mathematical rigor Aims to be self contained in its mathematical development Ideal for a first course in algorithmic or computer algebra for advanced undergraduates or beginning graduate students

**Algorithmic Algebra** Bhubaneswar Mishra, 2012-12-06 *Algorithmic Algebra* studies some of the main algorithmic tools of computer algebra covering such topics as Grobner bases characteristic sets resultants and semialgebraic sets The main purpose of the book is to acquaint advanced undergraduate and graduate students in computer science engineering and mathematics with the algorithmic ideas in computer algebra so that they could do research in computational algebra or understand the algorithms underlying many popular symbolic computational systems Mathematica Maple or Axiom for instance Also researchers in robotics solid modeling computational geometry and automated theorem proving community may find it useful as symbolic algebraic techniques have begun to play an important role in these areas The book while being self contained is written at an advanced level and deals with the subject at an appropriate depth The book is accessible to computer science students with no previous algebraic training Some mathematical readers on the other hand may find it interesting to see how algorithmic constructions have been used to provide fresh proofs for some classical theorems The book also contains a large number of exercises with solutions to selected exercises thus making it ideal as a textbook or for self study

**Algorithmic Algebra and Number Theory** B.Heinrich Matzat, Gert-Martin Greuel, Gerhard Hiss, 2012-12-06 This book contains 22 lectures presented at the final conference of the German research program Schwerpunktprogramm Algorithmic Number Theory and Algebra 1991-1997 sponsored by the Deutsche Forschungsgemeinschaft The purpose of this research program and of the meeting was to bring together developers of computer algebra software and researchers using computational methods to gain insight into experimental problems and theoretical questions in algebra and number theory The book gives an overview on algorithmic methods and on results obtained during this period This includes survey articles on the main research projects within the program algorithmic number theory emphasizing class

field theory constructive Galois theory computational aspects of modular forms and of Drinfeld modules computational algebraic geometry including real quantifier elimination and real algebraic geometry and invariant theory of finite groups computational aspects of presentations and representations of groups especially finite groups of Lie type and their Hecke algebras and of the isomorphism problem in group theory Some of the articles illustrate the current state of computer algebra systems and program packages developed with support by the research program such as KANT and LiDIA for algebraic number theory SINGULAR RED LOG and INVARI for commutative algebra and invariant theory respectively and GAP SYSPHOS and CHEVIE for group theory and representation theory

Algebraic Operads Murray R. Bremner, Vladimir Dotsenko, 2016-04-06 This book presents a systematic treatment of Grobner bases in several contexts The book builds up to the theory of Grobner bases for operads due to the second author and Khoroshkin as well as various applications of the corresponding diamond lemmas in algebra Throughout the book both the mathematical theory and computational methods are emphasized and numerous algorithms examples and exercises are provided to clarify and illustrate the concrete meaning of abstract theory

*Algorithmic and Combinatorial Algebra* L.A. Bokut', G.P.. Kukin, 1994-05-31 Even three decades ago the words combinatorial algebra contrasting for instance the words combinatorial topology were not a common designation for some branch of mathematics The collocation combinatorial group theory seems to appear first as the title of the book by A Karras W Magnus and D Solitar 182 and later on it served as the title of the book by R C Lyndon and P Schupp 247 Nowadays specialists do not question the existence of combinatorial algebra as a special algebraic activity The activity is distinguished not only by its objects of research that are effectively given to some extent but also by its methods effective to some extent To be more exact we could approximately define the term combinatorial algebra for the purposes of this book as follows So we call a part of algebra dealing with groups semi groups associative algebras Lie algebras and other algebraic systems which are given by generators and defining relations in the first and particular place free groups semigroups algebras etc j a part in which we study universal constructions viz free products HNN extensions etc j and finally a part where specific methods such as the Composition Method in other words the Diamond Lemma see 49 are applied Surely the above explanation is far from covering the full scope of the term compare the prefaces to the books mentioned above

*Algorithmic and Experimental Methods in Algebra, Geometry, and Number Theory* Gebhard Böckle, Wolfram Decker, Gunter Malle, 2018-03-22 This book presents state of the art research and survey articles that highlight work done within the Priority Program SPP 1489 Algorithmic and Experimental Methods in Algebra Geometry and Number Theory which was established and generously supported by the German Research Foundation DFG from 2010 to 2016 The goal of the program was to substantially advance algorithmic and experimental methods in the aforementioned disciplines to combine the different methods where necessary and to apply them to central questions in theory and practice Of particular concern was the further development of freely available open source computer algebra systems and their interaction in order

to create powerful new computational tools that transcend the boundaries of the individual disciplines involved The book covers a broad range of topics addressing the design and theoretical foundations implementation and the successful application of algebraic algorithms in order to solve mathematical research problems It offers a valuable resource for all researchers from graduate students through established experts who are interested in the computational aspects of algebra geometry and or number theory

**Computer Algebra** Wolfram Koepf,2021-07-11 This textbook offers an algorithmic introduction to the field of computer algebra A leading expert in the field the author guides readers through numerous hands on tutorials designed to build practical skills and algorithmic thinking This implementation oriented approach equips readers with versatile tools that can be used to enhance studies in mathematical theory applications or teaching Presented using Mathematica code the book is fully supported by downloadable sessions in Mathematica Maple and Maxima Opening with an introduction to computer algebra systems and the basics of programming mathematical algorithms the book goes on to explore integer arithmetic A chapter on modular arithmetic completes the number theoretic foundations which are then applied to coding theory and cryptography From here the focus shifts to polynomial arithmetic and algebraic numbers with modern algorithms allowing the efficient factorization of polynomials The final chapters offer extensions into more advanced topics simplification and normal forms power series summation formulas and integration Computer Algebra is an indispensable resource for mathematics and computer science students new to the field Numerous examples illustrate algorithms and their implementation throughout with online support materials to encourage hands on exploration Prerequisites are minimal with only a knowledge of calculus and linear algebra assumed In addition to classroom use the elementary approach and detailed index make this book an ideal reference for algorithms in computer algebra

**Algorithms in Real Algebraic Geometry** Saugata Basu,Richard Pollack,Marie-Françoise Roy,2006-07-06 This is the first graduate textbook on the algorithmic aspects of real algebraic geometry The main ideas and techniques presented form a coherent and rich body of knowledge Mathematicians will find relevant information about the algorithmic aspects Researchers in computer science and engineering will find the required mathematical background Being self contained the book is accessible to graduate students and even for invaluable parts of it to undergraduate students This second edition contains several recent results on discriminants of symmetric matrices and other relevant topics

Formal and Adaptive Methods for Automation of Parallel Programs Construction: Emerging Research and Opportunities Doroshenko, Anatoliy,Yatsenko, Olena,2020-08-28 Emerging scientific and industrial applications in today s world require significant computing power Modern software tools are available for such platforms but are relatively complex and require the use of innovative programming models One promising area in modern software design is the development analysis and implementation of algorithms and adaptive methods These advancements in programming are promising but lack relevant research and understanding Formal and Adaptive Methods for Automation of Parallel Programs Construction Emerging

Research and Opportunities is an essential reference source that solves the problem of the development of efficient models methods and tools for parallel programming automation based on the algebra of algorithms term rewriting and auto tuning paradigms The results of this book will help to further develop and improve existing research on design synthesis and optimization of sequential and parallel algorithms and programs Featuring research on topics such as auto tuning methods graphics processing and algorithmic language this book is ideally designed for mathematicians software engineers data scientists researchers academicians and students seeking coverage on developing tools for automated design and parallel programs

**Algorithmic Algebraic Number Theory** M. Pohst, H. Zassenhaus, 1997-09-25 Now in paperback this classic book is addressed to all lovers of number theory On the one hand it gives a comprehensive introduction to constructive algebraic number theory and is therefore especially suited as a textbook for a course on that subject On the other hand many parts go beyond an introduction and make the user familiar with recent research in the field For experimental number theoreticians new methods are developed and new results are obtained which are of great importance for them Both computer scientists interested in higher arithmetic and those teaching algebraic number theory will find the book of value

Algorithmic Number Theory: Efficient algorithms Eric Bach, Jeffrey Outlaw Shallit, 1996 Volume 1 *Information and Communication Technologies in Education, Research, and Industrial Applications* Vadim Ermolayev, Frédéric Mallet, Vitaliy Yakovyna, Heinrich C. Mayr, Aleksander Spivakovsky, 2020-01-18 This book contains extended versions of the best papers presented at the 15th International Conference on Information and Communication Technologies in Education Research and Industrial Applications ICTERI 2019 held in Kherson Ukraine in June 2019 The 19 revised full papers included in this volume were carefully reviewed and selected from 416 initial submissions The papers are organized in the following topical sections advances in ICT and IS research ICT in teaching learning and education management applications of ICT in industrial and public practice

Artificial Intelligence and Symbolic Computation Bruno Buchberger, John A. Campbell, 2004-12-13 AISC 2004 the 7th International Conference on Artificial Intelligence and Symbolic Computation was the latest in the series of specialized biennial conferences founded in 1992 by Jacques Calmet of the Universitat Karlsruhe and John Campbell of University College London with the initial title Artificial Intelligence and Symbolic Mathematical Computing AISMC The M disappeared from the title between the 1996 and 1998 conferences As the editors of the AISC 1998 proceedings said the organizers of the current meeting decided to drop the adjective mathematical and to emphasize that the conference is concerned with all aspects of symbolic computation in AI mathematical foundations implementations and applications including applications in industry and academia This remains the intended profile of the series and will figure in the call for papers for AISC 2006 which is intended to take place in China The distribution of papers in the present volume over all the areas of AISC happens to be rather noticeably mathematical an effect that emerged because we were concerned to select the best relevant papers that were offered to us in 2004 irrespective of their particular topics hence the title on the cover

Nevertheless we encourage researchers over the entire spectrum of AISC as expressed by the 1998 quotation above to be in touch with us about their interests and the possibility of eventual submission of papers on their work for the next conference in the series The papers in the present volume are evidence of the health of the field of AISC Additionally there are two reasons for optimism about the continuation of this situation

Some Tapas of Computer Algebra Arjeh M. Cohen, Hans Cuyppers, Hans Sterk, 1998-12-15 This book presents the basic concepts and algorithms of computer algebra using practical examples that illustrate their actual use in symbolic computation A wide range of topics are presented including Groebner bases real algebraic geometry lie algebras factorization of polynomials integer programming permutation groups differential equations coding theory automatic theorem proving and polyhedral geometry This book is a must read for anyone working in the area of computer algebra symbolic computation and computer science

**Advances in Information Systems Science** Julius T. Tou, 2012-12-06 Engineering has long been thought of by the public as a profession traditionally categorized into such branches as electrical mechanical chemical industrial civil etc This classification has served its purpose for the past half century but the last decade has witnessed a tremendous change A continuous transition from the practical to the theoretical has made technology overlap with science and the enlargement of scope and broadened diversification have smeared the boundaries between traditional engineering and scientific fields Engineering is rapidly becoming a diversified multidisciplinary field of scientific endeavor This has prompted us to regard modern engineering as a science which has as its ingredients materials energy and information In our complex and technologically oriented society organizations are flooded with an enormous amount of management information We are now faced with problems concerning the efficient use of communicated knowledge The steady growth in the magnitude and complexity of information systems necessitates the development of new theories and techniques for solving these information problems We demand instant access to previously recorded information for decision making and we require new methods for analysis recognition processing and display As a consequence information science has evolved out of necessity Concerned with the theoretical basis of the organization control storage retrieval processing and communication of information both by natural and artificial systems information science is multidisciplinary in character It covers a vast area of subject matter in the physical and biological sciences

Information and Communication Technologies in Education, Research, and Industrial Applications Grigoris Antoniou, Vadim Ermolayev, Vitaliy Kobets, Vira Liubchenko, Heinrich C. Mayr, Aleksander Spivakovsky, Vitaliy Yakovyna, Grygoriy Zholtkevych, 2023-11-30 This book constitutes the proceedings of the 18th International Conference ICTERI 2023 held in Ivano Frankivsk Ukraine during September 18-22 2023 The 21 full papers included in this volume were carefully reviewed and selected from 90 submissions The volume focuses on research advances in ICT business or academic applications of ICT and design and deployment of ICT infrastructures

*Applied Wavelet Analysis with S-PLUS* Andrew Bruce, Hong-Ye Gao, 1996-06-20 Using a visual data analysis approach wavelet concepts are explained in a way that is

intuitive and easy to understand Furthermore in addition to wavelets a whole range of related signal processing techniques such as wavelet packets local cosine analysis and matching pursuits are covered and applications of wavelet analysis are illustrated including nonparametric function estimation digital image compression and time frequency signal analysis This book and software package is intended for a broad range of data analysts scientists and engineers While most textbooks on the subject presuppose advanced training in mathematics this book merely requires that readers be familiar with calculus and linear algebra at the undergraduate level

**Ideals, Varieties, and Algorithms** David A. Cox, John Little, Donal O'Shea, 2015-05-13 This text covers topics in algebraic geometry and commutative algebra with a strong perspective toward practical and computational aspects The first four chapters form the core of the book A comprehensive chart in the Preface illustrates a variety of ways to proceed with the material once these chapters are covered In addition to the fundamentals of algebraic geometry the elimination theorem the extension theorem the closure theorem and the Nullstellensatz this new edition incorporates several substantial changes all of which are listed in the Preface The largest revision incorporates a new Chapter ten which presents some of the essentials of progress made over the last decades in computing Gröbner bases The book also includes current computer algebra material in Appendix C and updated independent projects Appendix D The book may serve as a first or second course in undergraduate abstract algebra and with some supplementation perhaps for beginning graduate level courses in algebraic geometry or computational algebra Prerequisites for the reader include linear algebra and a proof oriented course It is assumed that the reader has access to a computer algebra system Appendix C describes features of Maple™ Mathematica and Sage as well as other systems that are most relevant to the text Pseudocode is used in the text Appendix B carefully describes the pseudocode used From the reviews of previous editions The book gives an introduction to Buchberger's algorithm with applications to syzygies Hilbert polynomials primary decompositions There is an introduction to classical algebraic geometry with applications to the ideal membership problem solving polynomial equations and elimination theory The book is well written The reviewer is sure that it will be an excellent guide to introduce further undergraduates in the algorithmic aspect of commutative algebra and algebraic geometry Peter Schenzel zbMATH 2007 I consider the book to be wonderful The exposition is very clear there are many helpful pictures and there are a great many instructive exercises some quite challenging offers the heart and soul of modern commutative and algebraic geometry The American Mathematical Monthly Logics of Programs Workshop, Yorktown Heights, New York, May 1981 Dexter Kozen, 1982

**Algorithmic Number Theory**, 2004

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**Algorithmic Algebra :**

A Soldier's Story A Soldier's Story is a 1984 American mystery drama film directed and produced by Norman Jewison, adapted by Charles Fuller from his Pulitzer Prize-winning A ... A Soldier's Story (1984) Alone, far from home, and far from justice, he has three days to learn the truth about a murder...and the truth is a story you won't forget. A Soldier's Story Captured and convicted of various crimes against the State, he spent much of the 1970s in prison, escaping twice. After each escape, he went underground and ... A Soldier's Play The story takes place at the United States Army's Fort Neal, Louisiana, in 1944 during the time when the military was racially segregated. In the opening scene, ... A Soldier's Story A black Army investigator (Howard E. Rollins Jr.) travels to a remote military base in the heart of the Louisiana backwoods to look into the mysterious murder ... Watch A Soldier's Story | Prime Video When a sergeant of an all-black unit in Louisiana during WWII is murdered, an Army lawyer investigates if the crime was an act of extreme white bigotry or ... A Soldier's Story - Denzel Washington Set in WW2, set in African-American troop training facilities, then a murder. Twist and turns solving the mystery. A Soldier's Story - Full Cast & Crew A black soldier is murdered on a racially divided military base in 1940s Louisiana. An

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