

Maurice Mignotte

# Mathematics for Computer Algebra

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# Mathematics For Computer Algebra

**Johannes Grabmeier, Erich  
Kaltofen, Volker Weispfenning**



## **Mathematics For Computer Algebra:**

Mathematics for Computer Algebra Maurice Mignotte, 1991-11-25 This book corresponds to a mathematical course given in 1986-87 at the University Louis Pasteur Strasbourg This work is primarily intended for graduate students The following are necessary prerequisites a few standard definitions in set theory the definition of rational integers some elementary facts in Combinatorics maybe only Newton's binomial formula some theorems of Analysis at the level of high schools and some elementary Algebra basic results about groups rings fields and linear algebra An important place is given to exercises These exercises are only rarely direct applications of the course More often they constitute complements to the text Mostly hints or references are given so that the reader should be able to find solutions Chapters one and two deal with elementary results of Number Theory for example the euclidean algorithm the Chinese remainder theorem and Fermat's little theorem These results are useful by themselves but they also constitute a concrete introduction to some notions in abstract algebra for example euclidean rings principal rings Algorithms are given for arithmetical operations with long integers The rest of the book chapters 3 through 7 deals with polynomials We give general results on polynomials over arbitrary rings Then polynomials with complex coefficients are studied in chapter 4 including many estimates on the complex roots of polynomials Some of these estimates are very useful in the subsequent chapters

**Mathematics for Computer Algebra** Maurice Mignotte, 2012-12-06 This book corresponds to a mathematical course given in 1986-87 at the University Louis Pasteur Strasbourg This work is primarily intended for graduate students The following are necessary prerequisites a few standard definitions in set theory the definition of rational integers some elementary facts in Combinatorics maybe only Newton's binomial formula some theorems of Analysis at the level of high schools and some elementary Algebra basic results about groups rings fields and linear algebra An important place is given to exercises These exercises are only rarely direct applications of the course More often they constitute complements to the text Mostly hints or references are given so that the reader should be able to find solutions Chapters one and two deal with elementary results of Number Theory for example the euclidean algorithm the Chinese remainder theorem and Fermat's little theorem These results are useful by themselves but they also constitute a concrete introduction to some notions in abstract algebra for example euclidean rings principal rings Algorithms are given for arithmetical operations with long integers The rest of the book chapters 3 through 7 deals with polynomials We give general results on polynomials over arbitrary rings Then polynomials with complex coefficients are studied in chapter 4 including many estimates on the complex roots of polynomials Some of these estimates are very useful in the subsequent chapters

**Computer Algebra Handbook** Johannes Grabmeier, Erich Kaltofen, Volker Weispfenning, 2012-12-06 Two ideas lie gleaming on the jeweler's velvet The first is the calculus the second the algorithm The calculus and the rich body of mathematical analysis to which it gave rise made modern science possible but it has been the algorithm that has made possible the modern world David Berlinski The Advent of the Algorithm First there was the

concept of integers then there were symbols for integers I II III 1 1 1 1 fttt what might be called a sticks and stones representation I II III IV V Roman numerals 1 2 3 4 5 Arabic numerals etc Then there were other concepts with symbols for them and algorithms sometimes for manipulating the new symbols Then came collections of mathematical knowledge tables of mathematical computations theorems of general results Soon after algorithms came devices that provided assistance for carrying out computations Then mathematical knowledge was organized and structured into several related concepts and symbols logic algebra analysis topology algebraic geometry number theory combinatorics etc This organization and abstraction lead to new algorithms and new fields like universal algebra But always our symbol systems reflected and influenced our thinking our concepts and our algorithms

**Algorithms for Computer Algebra** Keith O. Geddes, Stephen R. Czapor, George Labahn, 1992-09-30 Algorithms for Computer Algebra is the first comprehensive textbook to be published on the topic of computational symbolic mathematics The book first develops the foundational material from modern algebra that is required for subsequent topics It then presents a thorough development of modern computational algorithms for such problems as multivariate polynomial arithmetic and greatest common divisor calculations factorization of multivariate polynomials symbolic solution of linear and polynomial systems of equations and analytic integration of elementary functions Numerous examples are integrated into the text as an aid to understanding the mathematical development The algorithms developed for each topic are presented in a Pascal like computer language An extensive set of exercises is presented at the end of each chapter Algorithms for Computer Algebra is suitable for use as a textbook for a course on algebraic algorithms at the third year fourth year or graduate level Although the mathematical development uses concepts from modern algebra the book is self contained in the sense that a one term undergraduate course introducing students to rings and fields is the only prerequisite assumed The book also serves well as a supplementary textbook for a traditional modern algebra course by presenting concrete applications to motivate the understanding of the theory of rings and fields

Computer Algebra and Polynomials Jaime Gutierrez, Josef Schicho, Martin Weimann, 2015-01-20 Algebra and number theory have always been counted among the most beautiful mathematical areas with deep proofs and elegant results However for a long time they were not considered that important in view of the lack of real life applications This has dramatically changed nowadays we find applications of algebra and number theory frequently in our daily life This book focuses on the theory and algorithms for polynomials over various coefficient domains such as a finite field or ring The operations on polynomials in the focus are factorization composition and decomposition basis computation for modules etc Algorithms for such operations on polynomials have always been a central interest in computer algebra as it combines formal the variables and algebraic or numeric the coefficients aspects The papers presented were selected from the Workshop on Computer Algebra and Polynomials which was held in Linz at the Johann Radon Institute for Computational and Applied Mathematics RICAM during November 25 29 2013 at the occasion of the Special Semester on Applications of Algebra and Number Theory

**Computer**

**Algebra** R. Albrecht, B. Buchberger, G.E. Collins, R. Loos, 2013-06-29 The journal Computing has established a series of supplement volumes the fourth of which appears this year Its purpose is to provide a coherent presentation of a new topic in a single volume The previous subjects were Computer Arithmetic 1977 Fundamentals of Numerical Computation 1980 and Parallel Processes and Related Automata 1981 the topic of this 1982 Supplementum to Computing is Computer Algebra This subject which emerged in the early nineteen sixties has also been referred to as symbolic and algebraic computation or formula manipulation Algebraic algorithms have been receiving increasing interest as a result of the recognition of the central role of algorithms in computer science They can be easily specified in a formal and rigorous way and provide solutions to problems known and studied for a long time Whereas traditional algebra is concerned with constructive methods computer algebra is furthermore interested in efficiency in implementation and in hardware and software aspects of the algorithms It develops that in deciding effectiveness and determining efficiency of algebraic methods many other tools recursion theory logic analysis and combinatorics for example are necessary In the beginning of the use of computers for symbolic algebra it soon became apparent that the straightforward textbook methods were often very inefficient Instead of turning to numerical approximation methods computer algebra studies systematically the sources of the inefficiency and searches for alternative algebraic methods to improve or even replace the algorithms *Computer Algebra and Symbolic Computation* Joel S. Cohen, 2002-07-19 This book provides a systematic approach for the algorithmic formulation and implementation of mathematical operations in computer algebra programming languages The viewpoint is that mathematical expressions represented by expression trees are the data objects of computer algebra programs and by using a few primitive operations that analyze and **Applicable Mathematics with Computer Algebra** Andrew Toon, 2002 *Computing in Algebraic Geometry* Wolfram Decker, Christoph Lossen, 2006-05-01 This book provides a quick access to computational tools for algebraic geometry the mathematical discipline which handles solution sets of polynomial equations Originating from a number of intense one week schools taught by the authors the text is designed so as to provide a step by step introduction which enables the reader to get started with his own computational experiments right away The authors present the basic concepts and ideas in a compact way Computer Algebra Systems Michael J. Wester, 1999-07-16 This thorough overview of the major computer algebra symbolic mathematical systems compares and contrasts their strengths and weaknesses and gives tutorial information for using these systems in various ways Compares different packages quantitatively using standard test suites Ideal for assessing the most appropriate package for a particular user or application Examines the performance and future developments from a user s and developer s viewpoint Internationally recognized specialists overview both the general and special purpose systems and discuss issues such as denesting nested roots complex number calculations efficiently computing special polynomials solving single equations and systems of polynomial equations computing limits multiple integration solving ordinary differential and nonlinear evolution equations code generation evaluation and computer

algebra in education The historical origins computer algebra resources and equivalents for many common operations in seven major packages are also covered By providing such a comprehensive survey the experienced user is able to make an informed decision on which system s he or she might like to use It also allows a user new to computer algebra to form an idea of where to begin Since each system looked at in this book uses a different language many examples are included to aid the user in adapting to these language differences These examples can be used as a guide to using the various systems once one understands the basic principles of one CAS The book also includes contributions which look at the broad issues of the needs of various users and future developments both from the user s and the developer s viewpoint The author is a leading figure in the development and analysis of mathematical software and is well known through the Wester test suite of problems which provide a bench mark for measuring the performance of mathematical software systems The book will help develop our range of titles for applied mathematicians The book will provide a unique fully up to date and independent assessment of particular systems and will be of interest to users and purchasers of CAS s     Computer Algebra and Differential Equations

E. Tournier,1994-03-03 Selected papers from the Computer Algebra and Differential Equations meeting held in France in June 1992     *Some Tapas of Computer Algebra* Arjeh M. Cohen,Hans Cuypers,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     **Computer Algebra** Edmund A. Lamagna,2019-01-15 The goal of Computer

Algebra Concepts and Techniques is to demystify computer algebra systems for a wide audience including students faculty and professionals in scientific fields such as computer science mathematics engineering and physics Unlike previous books the only prerequisites are knowledge of first year calculus and a little programming experience a background that can be assumed of the intended audience The book is written in a lean and lively style with numerous examples to illustrate the issues and techniques discussed It presents the principal algorithms and data structures while also discussing the inherent and practical limitations of these systems     *Applications of Computer Algebra* Richard Pavelle,2012-12-06 Today certain

computer software systems exist which surpass the computational ability of researchers when their mathematical techniques are applied to many areas of science and engineering These computer systems can perform a large portion of the calculations seen in mathematical analysis Despite this massive power thousands of people use these systems as a routine resource for everyday calculations These software programs are commonly called Computer Algebra systems They have names such as MACSYMA MAPLE muMATH REDUCE and SMP They are receiving credit as a computational aid with in creasing regularity in articles in the scientific and engineering literature When most people think about computers and scientific research these

days they imagine a machine grinding away processing numbers arithmetically It is not generally realized that for a number of years computers have been performing non numeric computations This means for example that one inputs an equation and obtains a closed form analytic answer It is these Computer Algebra systems their capabilities and applications which are the subject of the papers in this volume

**Applications of Computer Algebra** Ilias S. Kotsireas, Edgar

Martínez-Moro, 2017-07-26 The Applications of Computer Algebra ACA conference covers a wide range of topics from Coding Theory to Differential Algebra to Quantum Computing focusing on the interactions of these and other areas with the discipline of Computer Algebra This volume provides the latest developments in the field as well as its applications in various domains including communications modelling and theoretical physics The book will appeal to researchers and professors of computer algebra applied mathematics and computer science as well as to engineers and computer scientists engaged in research and development

**Computer Algebra and Symbolic Computation** Joel S. Cohen, 2003-01-03 Mathematica

Maple and similar software packages provide programs that carry out sophisticated mathematical operations Applying the ideas introduced in Computer Algebra and Symbolic Computation Elementary Algorithms this book explores the application of algorithms to such methods as automatic simplification polynomial decomposition and polynomial

**Computer Algebra**

Wolfram Koepf, 2021 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

**Computer Algebra Recipes** Richard H. Enns, George C. McGuire, 2006-03-15 Contains

computer algebra worksheets or recipes designed using MAPLE System 10 no prior knowledge of MAPLE is assumed Effective computational science text for first and second year undergraduates in mathematics physics engineering chemistry economics biology and pre medicine Examples and problems provide basis for both self study and on line course

*Computer Algebra* James Harold Davenport, Y. Siret, E. Tournier, 1988 Mathematics of Computing Numerical Analysis

Computer Algebra in Quantum Field Theory Carsten Schneider, Johannes Blümlein, 2013-10-05 The book focuses on advanced computer algebra methods and special functions that have striking applications in the context of quantum field theory It presents the state of the art and new methods for infinite multiple sums multiple integrals in particular Feynman integrals difference and differential equations in the format of survey articles The presented techniques emerge from interdisciplinary fields mathematics computer science and theoretical physics the articles are written by mathematicians and physicists with the goal that both groups can learn from the other field including most recent developments Besides that the collection of articles also serves as an up to date handbook of available algorithms software that are commonly used or might be useful in the fields of mathematics physics or other sciences



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