

Song Y. Yan

Number Theory for Computing

2nd Edition



Springer

Number Theory For Computing

Marty Lewinter, Jeanine Meyer



Number Theory For Computing:

Number Theory for Computing Song Y. Yan, 2013-11-11 Modern cryptography depends heavily on number theory with primality testing factoring discrete logarithms indices and elliptic curves being perhaps the most prominent subject areas Since my own graduate study had emphasized probability theory statistics and real analysis when I started working in cryptography around 1970 I found myself swimming in an unknown murky sea I thus know from personal experience how inaccessible number theory can be to the uninitiated Thank you for your efforts to ease the transition for a new generation of cryptographers Thank you also for helping Ralph Merkle receive the credit he deserves Diffie Rivest Shamir Adleman and I had the good luck to get expedited review of our papers so that they appeared before Merkle's seminal contribution Your noting his early submission date and referring to what has come to be called Diffie Hellman key exchange as it should Diffie Hellman Merkle key exchange is greatly appreciated It has been gratifying to see how cryptography and number theory have helped each other over the last twenty five years Number theory has been the source of numerous clever ideas for implementing cryptographic systems and protocols while cryptography has been helpful in getting funding for this area which has sometimes been called the queen of mathematics because of its seeming lack of real world applications Little did they know Stanford 30 July 2001 Martin E Hellman Preface to the Second Edition Number theory is an experimental science

Number Theory with Computer Applications Ramanujachary Kumanduri, Cristina Romero, 1998 Appropriate for most courses in Number Theory This book effectively integrates computing algorithms into the number theory curriculum using a heuristic approach and strong emphasis on proofs Its in depth coverage of modern applications considers the latest trends and topics such as elliptic curves a subject that has seen a rise in popularity due to its use in the proof of Fermat's Last Theorem **Algorithmic Number Theory: Efficient algorithms** Eric Bach, Jeffrey Outlaw Shallit, 1996 Volume 1

Elementary Number Theory with Programming Marty Lewinter, Jeanine Meyer, 2015-05-06 A highly successful presentation of the fundamental concepts of number theory and computer programming Bridging an existing gap between mathematics and programming Elementary Number Theory with Programming provides a unique introduction to elementary number theory with fundamental coverage of computer programming Written by highly qualified experts in the fields of computer science and mathematics the book features accessible coverage for readers with various levels of experience and explores number theory in the context of programming without relying on advanced prerequisite knowledge and concepts in either area Elementary Number Theory with Programming features comprehensive coverage of the methodology and applications of the most well known theorems problems and concepts in number theory Using standard mathematical applications within the programming field the book presents modular arithmetic and prime decomposition which are the basis of the public private key system of cryptography In addition the book includes Numerous examples exercises and research challenges in each chapter to encourage readers to work through the discussed concepts and ideas Select solutions

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polynomial of degree n with integer coefficients that has smallest possible supremum norm on the unit interval Littlewood's Problem Find a polynomial of degree n with coefficients in the set $[-1, 1]$ that has smallest possible supremum norm on the unit disk The Prouhet-Tarry-Escott Problem Find a polynomial with integer coefficients that is divisible by $z^n - 1$ and has smallest possible L^1 norm That L^1 is the sum of the absolute values of the coefficients is minimal Lehmer's Problem Show that any monic polynomial $p(z) = z^n + a_{n-1}z^{n-1} + \dots + a_0$ with integer coefficients that is irreducible and that is not a cyclotomic polynomial has Mahler measure at least $1 + 1/62$ All of the above problems are at least forty years old all are presumably very hard certainly none are completely solved and all lend themselves to extensive computational explorations The techniques for tackling these problems are various and include probabilistic methods combinatorial methods the circle method and Diophantine and analytic techniques Computationally the main tool is the LLL algorithm for finding small vectors in a lattice The book is intended as an introduction to a diverse collection of techniques

Cryptology and Computational Number Theory Carl

Pomerance, Shafi Goldwasser, 1990 In the past dozen or so years cryptology and computational number theory have become increasingly intertwined Because the primary cryptologic application of number theory is the apparent intractability of certain computations these two fields could part in the future and again go their separate ways But for now their union is continuing to bring ferment and rapid change in both subjects This book contains the proceedings of an AMS Short Course in Cryptology and Computational Number Theory held in August 1989 during the Joint Mathematics Meetings in Boulder Colorado These eight papers by six of the top experts in the field will provide readers with a thorough introduction to some of the principal advances in cryptology and computational number theory over the past fifteen years In addition to an extensive introductory article the book contains articles on primality testing discrete logarithms integer factoring knapsack cryptosystems pseudorandom number generators the theoretical underpinnings of cryptology and other number theory based cryptosystems Requiring only background in elementary number theory this book is aimed at nonexperts including graduate students and advanced undergraduates in mathematics and computer science

A Computational Introduction to Number

Theory and Algebra Victor Shoup, 2005-04-28 This introductory book emphasises algorithms and applications such as cryptography and error correcting codes

Introduction to Number Theory with Computing R. B. J. T. Allenby, E. J. Redfern, 1989-01-01 This introduction to number theory has been written specifically for mathematics and computing undergraduates Computer programs in BASIC are accompanied by basic text which explains the subject and demonstrates how computers have opened up new horizons for number theorists

Quantum Computational Number Theory Song Y. Yan, 2015-12-26 This book provides a comprehensive introduction to advanced topics in the computational and algorithmic aspects of number theory focusing on applications in cryptography Readers will learn to develop fast algorithms including quantum algorithms to solve various classic and modern number theoretic problems Key problems include prime number generation primality testing integer factorization discrete logarithms elliptic curve arithmetic conjecture and numerical

verification The author discusses quantum algorithms for solving the Integer Factorization Problem IFP the Discrete Logarithm Problem DLP and the Elliptic Curve Discrete Logarithm Problem ECDLP and for attacking IFP DLP and ECDLP based cryptographic systems Chapters also cover various other quantum algorithms for Pell's equation principal ideal unit group class group Gauss sums prime counting function Riemann's hypothesis and the BSD conjecture Quantum Computational Number Theory is self contained and intended to be used either as a graduate text in computing communications and mathematics or as a basic reference in the related fields Number theorists cryptographers and professionals working in quantum computing cryptography and network security will find this book a valuable asset

Computational Number Theory Abhijit Das, 2013-03-18 Developed from the author's popular graduate level course Computational Number Theory presents a complete treatment of number theoretic algorithms Avoiding advanced algebra this self contained text is designed for advanced undergraduate and beginning graduate students in engineering It is also suitable for researchers new to the field and practitioners of cryptography in industry Requiring no prior experience with number theory or sophisticated algebraic tools the book covers many computational aspects of number theory and highlights important and interesting engineering applications It first builds the foundation of computational number theory by covering the arithmetic of integers and polynomials at a very basic level It then discusses elliptic curves primality testing algorithms for integer factorization computing discrete logarithms and methods for sparse linear systems The text also shows how number theoretic tools are used in cryptography and cryptanalysis A dedicated chapter on the application of number theory in public key cryptography incorporates recent developments in pairing based cryptography With an emphasis on implementation issues the book uses the freely available number theory calculator GP PARI to demonstrate complex arithmetic computations The text includes numerous examples and exercises throughout and omits lengthy proofs making the material accessible to students and practitioners

Finite Fields: Theory and Computation Igor

Shparlinski, 2013-03-09 This book is mainly devoted to some computational and algorithmic problems in finite fields such as for example polynomial factorization finding irreducible and primitive polynomials the distribution of these primitive polynomials and of primitive points on elliptic curves constructing bases of various types and new applications of finite fields to other areas of mathematics For completeness we include two special chapters on some recent advances and applications of the theory of congruences optimal coefficients congruential pseudo random number generators modular arithmetic etc and computational number theory primality testing factoring integers computation in algebraic number theory etc The problems considered here have many applications in Computer Science Coding Theory Cryptography Numerical Methods and so on There are a few books devoted to more general questions but the results contained in this book have not till now been collected under one cover In the present work the author has attempted to point out new links among different areas of the theory of finite fields It contains many very important results which previously could be found only in widely scattered

and hardly available conference proceedings and journals In particular we extensively review results which originally appeared only in Russian and are not well known to mathematicians outside the former USSR **Primes and Programming**,1993 Number Theory in Science and Communication M.R. Schroeder,2005-11-03 Number Theory in Science and Communication introduces non mathematicians to the fascinating and diverse applications of number theory This best selling book stresses intuitive understanding rather than abstract theory This revised fourth edition is augmented by recent advances in primes in progressions twin primes prime triplets prime quadruplets and quintuplets factoring with elliptic curves quantum factoring Golomb rulers and baroque integers **Primes and Programming** P. J. Giblin,1993 *Number Theory in Science and Communication* Manfred Schroeder,2008-11-06 Number Theory in Science and Communication is a well known introduction for non mathematicians to this fascinating and useful branch of applied mathematics It stresses intuitive understanding rather than abstract theory and highlights important concepts such as continued fractions the golden ratio quadratic residues and Chinese remainders trapdoor functions pseudo primes and primitive elements Their applications to problems in the real world are one of the main themes of the book This revised fifth edition is augmented by recent advances in coding theory permutations and derangements and a chapter in quantum cryptography From reviews of earlier editions I continue to find Schroeder s Number Theory a goldmine of valuable information It is a marvelous book in touch with the most recent applications of number theory and written with great clarity and humor Philip Morrison Scientific American A light hearted and readable volume with a wide range of applications to which the author has been a productive contributor useful mathematics outside the formalities of theorem and proof Martin Gardner Finite Fields: Theory and Computation Igor Shparlinski,1999-05-31 This book is mainly devoted to some computational and algorithmic problems in finite fields such as for example polynomial factorization finding irreducible and primitive polynomials the distribution of these primitive polynomials and of primitive points on elliptic curves constructing bases of various types and new applications of finite fields to other areas of mathematics For completeness we include two special chapters on some recent advances and applications of the theory of congruences optimal coefficients congruential pseudo random number generators modular arithmetic etc and computational number theory primality testing factoring integers computation in algebraic number theory etc The problems considered here have many applications in Computer Science Coding Theory Cryptography Numerical Methods and so on There are a few books devoted to more general questions but the results contained in this book have not till now been collected under one cover In the present work the author has attempted to point out new links among different areas of the theory of finite fields It contains many very important results which previously could be found only in widely scattered and hardly available conference proceedings and journals In particular we extensively review results which originally appeared only in Russian and are not well known to mathematicians outside the former USSR **Computers in Number Theory** Donald D. Spencer,1982

Unveiling the Magic of Words: A Review of "**Number Theory For Computing**"

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Table of Contents Number Theory For Computing

1. Understanding the eBook Number Theory For Computing
 - The Rise of Digital Reading Number Theory For Computing
 - Advantages of eBooks Over Traditional Books
2. Identifying Number Theory For Computing
 - Exploring Different Genres
 - Considering Fiction vs. Non-Fiction
 - Determining Your Reading Goals
3. Choosing the Right eBook Platform
 - Popular eBook Platforms
 - Features to Look for in an Number Theory For Computing
 - User-Friendly Interface
4. Exploring eBook Recommendations from Number Theory For Computing
 - Personalized Recommendations
 - Number Theory For Computing User Reviews and Ratings
 - Number Theory For Computing and Bestseller Lists

5. Accessing Number Theory For Computing Free and Paid eBooks
 - Number Theory For Computing Public Domain eBooks
 - Number Theory For Computing eBook Subscription Services
 - Number Theory For Computing Budget-Friendly Options
6. Navigating Number Theory For Computing eBook Formats
 - ePub, PDF, MOBI, and More
 - Number Theory For Computing Compatibility with Devices
 - Number Theory For Computing Enhanced eBook Features
7. Enhancing Your Reading Experience
 - Adjustable Fonts and Text Sizes of Number Theory For Computing
 - Highlighting and Note-Taking Number Theory For Computing
 - Interactive Elements Number Theory For Computing
8. Staying Engaged with Number Theory For Computing
 - Joining Online Reading Communities
 - Participating in Virtual Book Clubs
 - Following Authors and Publishers Number Theory For Computing
9. Balancing eBooks and Physical Books Number Theory For Computing
 - Benefits of a Digital Library
 - Creating a Diverse Reading Collection Number Theory For Computing
10. Overcoming Reading Challenges
 - Dealing with Digital Eye Strain
 - Minimizing Distractions
 - Managing Screen Time
11. Cultivating a Reading Routine Number Theory For Computing
 - Setting Reading Goals Number Theory For Computing
 - Carving Out Dedicated Reading Time
12. Sourcing Reliable Information of Number Theory For Computing
 - Fact-Checking eBook Content of Number Theory For Computing
 - Distinguishing Credible Sources
13. Promoting Lifelong Learning

- Utilizing eBooks for Skill Development
- Exploring Educational eBooks

14. Embracing eBook Trends

- Integration of Multimedia Elements
- Interactive and Gamified eBooks

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