



DISCRETE MATHEMATICS AND ITS APPLICATIONS

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ELLIPTIC CURVES NUMBER THEORY AND CRYPTOGRAPHY SECOND EDITION

LAWRENCE C. WASHINGTON



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Elliptic Curves Number Theory And Cryptography Discrete Mathematics And Its Applications

Lawrence C. Washington



Elliptic Curves Number Theory And Cryptography Discrete Mathematics And Its Applications:

Elliptic Curves Lawrence C. Washington, 2003-05-28 Elliptic curves have played an increasingly important role in number theory and related fields over the last several decades most notably in areas such as cryptography factorization and the proof of Fermat's Last Theorem However most books on the subject assume a rather high level of mathematical sophistication and few are truly accessible to senior undergraduate or beginning graduate students Assuming only a modest background in elementary number theory groups and fields **Elliptic Curves Number Theory and Cryptography** introduces both the cryptographic and number theoretic sides of elliptic curves interweaving the theory of elliptic curves with their applications The author introduces elliptic curves over finite fields early in the treatment leading readers directly to the intriguing cryptographic applications but the book is structured so that readers can explore the number theoretic aspects independently if desired By side stepping algebraic geometry in favor an approach based on basic formulas this book clearly demonstrates how elliptic curves are used and opens the doors to higher level studies **Elliptic Curves** offers a solid introduction to the mathematics and applications of elliptic curves that well prepares its readers to tackle more advanced problems in cryptography and number theory

Elliptic Curves, 2008 Like its bestselling predecessor **Elliptic Curves Number Theory and Cryptography Second Edition** develops the theory of elliptic curves to provide a basis for both number theoretic and cryptographic applications With additional exercises this edition offers more comprehensive coverage of the fundamental theory techniques and applications of elliptic curves New to the Second Edition Chapters on isogenies and hyperelliptic curves A discussion of alternative coordinate systems such as projective Jacobian and Edwards coordinates along with related computational issues A more complete treatment of the Weil and Tate Lichtenbaum pairings Doud's analytic method for computing torsion on elliptic curves over \mathbb{Q} An explanation of how to perform calculations with elliptic curves in several popular computer algebra systems Taking a basic approach to elliptic curves this accessible book prepares readers to tackle more advanced problems in the field It introduces elliptic curves over finite fields early in the text before moving on to interesting applications such as cryptography factoring and primality testing The book also discusses the use of elliptic curves in Fermat's Last Theorem Relevant abstract algebra material on group theory and fields can be found in the appendices

Elliptic Curves Lawrence C. Washington, 2008-04-03 Like its bestselling predecessor **Elliptic Curves Number Theory and Cryptography Second Edition** develops the theory of elliptic curves to provide a basis for both number theoretic and cryptographic applications With additional exercises this edition offers more comprehensive coverage of the fundamental theory techniques and application

Number Theory and Its Applications Cheon Seoung Ryoo, 2020-11-04 Number theory and its applications are well known for their proven properties and excellent applicability in interdisciplinary fields of science Until now research on number theory and its applications has been done in mathematics applied mathematics and the sciences In particular number theory plays a fundamental and important role in mathematics and applied mathematics

This book is based on recent results in all areas related to number theory and its applications

Algebraic Geometry for Coding Theory and Cryptography Everett W. Howe, Kristin E. Lauter, Judy L. Walker, 2017-11-15 Covering topics in algebraic geometry coding theory and cryptography this volume presents interdisciplinary group research completed for the February 2016 conference at the Institute for Pure and Applied Mathematics IPAM in cooperation with the Association for Women in Mathematics AWM The conference gathered research communities across disciplines to share ideas and problems in their fields and formed small research groups made up of graduate students postdoctoral researchers junior faculty and group leaders who designed and led the projects Peer reviewed and revised each of this volume's five papers achieves the conference's goal of using algebraic geometry to address a problem in either coding theory or cryptography Proposed variants of the McEliece cryptosystem based on different constructions of codes constructions of locally recoverable codes from algebraic curves and surfaces and algebraic approaches to the multicast network coding problem are only some of the topics covered in this volume Researchers and graduate level students interested in the interactions between algebraic geometry and both coding theory and cryptography will find this volume valuable

Handbook of Elliptic and Hyperelliptic Curve Cryptography Henri Cohen, Gerhard Frey, Roberto Avanzi, Christophe Doche, Tanja Lange, Kim Nguyen, Frederik Vercauteren, 2005-07-19 The discrete logarithm problem based on elliptic and hyperelliptic curves has gained a lot of popularity as a cryptographic primitive The main reason is that no subexponential algorithm for computing discrete logarithms on small genus curves is currently available except in very special cases Therefore curve based cryptosystems require much smaller key sizes than RSA to attain the same security level This makes them particularly attractive for implementations on memory restricted devices like smart cards and in high security applications The Handbook of Elliptic and Hyperelliptic Curve Cryptography introduces the theory and algorithms involved in curve based cryptography After a very detailed exposition of the mathematical background it provides ready to implement algorithms for the group operations and computation of pairings It explores methods for point counting and constructing curves with the complex multiplication method and provides the algorithms in an explicit manner It also surveys generic methods to compute discrete logarithms and details index calculus methods for hyperelliptic curves For some special curves the discrete logarithm problem can be transferred to an easier one the consequences are explained and suggestions for good choices are given The authors present applications to protocols for discrete logarithm based systems including bilinear structures and explain the use of elliptic and hyperelliptic curves in factorization and primality proving Two chapters explore their design and efficient implementations in smart cards Practical and theoretical aspects of side channel attacks and countermeasures and a chapter devoted to pseudo random number generation round off the exposition The broad coverage of all important areas makes this book a complete handbook of elliptic and hyperelliptic curve cryptography and an invaluable reference to anyone interested in this exciting field

The Arithmetic of Elliptic Curves Joseph H. Silverman, 2009-04-20 The theory of elliptic curves is distinguished

by its long history and by the diversity of the methods that have been used in its study This book treats the arithmetic approach in its modern formulation through the use of basic algebraic number theory and algebraic geometry Following a brief discussion of the necessary algebro geometric results the book proceeds with an exposition of the geometry and the formal group of elliptic curves elliptic curves over finite fields the complex numbers local fields and global fields Final chapters deal with integral and rational points including Siegels theorem and explicit computations for the curve $Y^2 = X^3 + DX$ while three appendices conclude the whole Elliptic Curves in Characteristics 2 and 3 Group Cohomology and an overview of more advanced topics

Handbook of Discrete and Computational Geometry Csaba D. Toth, Joseph O'Rourke, Jacob E. Goodman, 2017-11-22 The Handbook of Discrete and Computational Geometry is intended as a reference book fully accessible to nonspecialists as well as specialists covering all major aspects of both fields The book offers the most important results and methods in discrete and computational geometry to those who use them in their work both in the academic world as researchers in mathematics and computer science and in the professional world as practitioners in fields as diverse as operations research molecular biology and robotics Discrete geometry has contributed significantly to the growth of discrete mathematics in recent years This has been fueled partly by the advent of powerful computers and by the recent explosion of activity in the relatively young field of computational geometry This synthesis between discrete and computational geometry lies at the heart of this Handbook A growing list of application fields includes combinatorial optimization computer aided design computer graphics crystallography data analysis error correcting codes geographic information systems motion planning operations research pattern recognition robotics solid modeling and tomography

Guide to Pairing-Based Cryptography Nadia El Mrabet, Marc Joye, 2017-01-06 This book is devoted to efficient pairing computations and implementations useful tools for cryptographers working on topics like identity based cryptography and the simplification of existing protocols like signature schemes As well as exploring the basic mathematical background of finite fields and elliptic curves Guide to Pairing Based Cryptography offers an overview of the most recent developments in optimizations for pairing implementation Each chapter includes a presentation of the problem it discusses the mathematical formulation a discussion of implementation issues solutions accompanied by code or pseudocode several numerical results and references to further reading and notes Intended as a self contained handbook this book is an invaluable resource for computer scientists applied mathematicians and security professionals interested in cryptography

Handbook of Graph Theory, Second Edition Jonathan L. Gross, Jay Yellen, Ping Zhang, 2013-12-17 In the ten years since the publication of the best selling first edition more than 1 000 graph theory papers have been published each year Reflecting these advances Handbook of Graph Theory Second Edition provides comprehensive coverage of the main topics in pure and applied graph theory This second edition over 400 pages longer than its predecessor incorporates 14 new sections Each chapter includes lists of essential definitions and facts accompanied by examples tables remarks and in some cases conjectures and open problems A bibliography at the

end of each chapter provides an extensive guide to the research literature and pointers to monographs In addition a glossary is included in each chapter as well as at the end of each section This edition also contains notes regarding terminology and notation With 34 new contributors this handbook is the most comprehensive single source guide to graph theory It emphasizes quick accessibility to topics for non experts and enables easy cross referencing among chapters

Democratizing Cryptography Rebecca Slayton,2022-08-25 In the mid 1970s Whitfield Diffie and Martin Hellman invented public key cryptography an innovation that ultimately changed the world Today public key cryptography provides the primary basis for secure communication over the internet enabling online work socializing shopping government services and much more While other books have documented the development of public key cryptography this is the first to provide a comprehensive insiders perspective on the full impacts of public key cryptography including six original chapters by nine distinguished scholars The book begins with an original joint biography of the lives and careers of Diffie and Hellman highlighting parallels and intersections and contextualizing their work Subsequent chapters show how public key cryptography helped establish an open cryptography community and made lasting impacts on computer and network security theoretical computer science mathematics public policy and society The volume includes particularly influential articles by Diffie and Hellman as well as newly transcribed interviews and Turing Award Lectures by both Diffie and Hellman The contributed chapters provide new insights that are accessible to a wide range of readers from computer science students and computer security professionals to historians of technology and members of the general public The chapters can be readily integrated into undergraduate and graduate courses on a range of topics including computer security theoretical computer science and mathematics the history of computing and science and technology policy *Computational Number Theory*

Abhijit Das,2016-04-19 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 pract *Introduction to Combinatorics* Walter D. Wallis,John C. George,2016-12-12 What Is Combinatorics Anyway

Broadly speaking combinatorics is the branch of mathematics dealing with different ways of selecting objects from a set or arranging objects It tries to answer two major kinds of questions namely counting questions how many ways can a selection or arrangement be chosen with a particular set of properties and structural questions does there exist a selection or arrangement of objects with a particular set of properties The authors have presented a text for students at all levels of preparation For some this will be the first course where the students see several real proofs Others will have a good background in linear algebra will have completed the calculus stream and will have started abstract algebra The text starts by briefly discussing several examples of typical combinatorial problems to give the reader a better idea of what the subject covers The next chapters explore enumerative ideas and also probability It then moves on to enumerative functions and the

relations between them and generating functions and recurrences Important families of functions or numbers and then theorems are presented Brief introductions to computer algebra and group theory come next Structures of particular interest in combinatorics posets graphs codes Latin squares and experimental designs follow The authors conclude with further discussion of the interaction between linear algebra and combinatorics Features Two new chapters on probability and posets Numerous new illustrations exercises and problems More examples on current technology use A thorough focus on accuracy Three appendices sets induction and proof techniques vectors and matrices and biographies with historical notes Flexible use of Maple™ and Mathematica™

Cryptography In The Information Society Boris Ryabko, Andrey Fionov, 2021-01-04

This textbook describes the main techniques and features of contemporary cryptography but does so using secondary school mathematics so that the concepts discussed can be understood by non mathematicians The topics addressed include block ciphers stream ciphers public key encryption digital signatures cryptographic protocols elliptic curve cryptography theoretical security blockchain and cryptocurrencies issues concerning random numbers and steganography The key results discussed in each chapter are mathematically proven and the methods are described in sufficient detail to enable their computational implementation Exercises are provided

Analytic Methods in Arithmetic Geometry Alina Bucur, David

Zureick-Brown, 2019-11-22 In the last decade or so analytic methods have had great success in answering questions in arithmetic geometry and number theory The School provided a unique opportunity to introduce graduate students to analytic methods in arithmetic geometry The book contains four articles Alina C Cojocaru's article introduces sieving techniques to study the group structure of points of the reduction of an elliptic curve modulo a rational prime via its division fields Harald A Helfgott's article provides an introduction to the study of growth in groups of Lie type with SL_2 F_q and some of its subgroups as the key examples The article by tienne Fouvry Emmanuel Kowalski Philippe Michel and Will Sawin describes how a systematic use of the deep methods from adic cohomology pioneered by Grothendieck and Deligne and further developed by Katz and Laumon help make progress on various classical questions from analytic number theory The last article by Andrew V Sutherland introduces Sato Tate groups and explores their relationship with Galois representations motivic L functions and Mumford Tate groups

Handbook of Applied Cryptography Alfred J. Menezes, Paul C. van Oorschot, Scott A.

Vanstone, 2018-12-07 Cryptography in particular public key cryptography has emerged in the last 20 years as an important discipline that is not only the subject of an enormous amount of research but provides the foundation for information security in many applications Standards are emerging to meet the demands for cryptographic protection in most areas of data communications Public key cryptographic techniques are now in widespread use especially in the financial services industry in the public sector and by individuals for their personal privacy such as in electronic mail This Handbook will serve as a valuable reference for the novice as well as for the expert who needs a wider scope of coverage within the area of cryptography It is a necessary and timely guide for professionals who practice the art of cryptography The Handbook of

Applied Cryptography provides a treatment that is multifunctional. It serves as an introduction to the more practical aspects of both conventional and public key cryptography. It is a valuable source of the latest techniques and algorithms for the serious practitioner. It provides an integrated treatment of the field while still presenting each major topic as a self-contained unit. It provides a mathematical treatment to accompany practical discussions. It contains enough abstraction to be a valuable reference for theoreticians while containing enough detail to actually allow implementation of the algorithms discussed. Now in its third printing, this is the definitive cryptography reference that the novice as well as experienced developers, designers, researchers, engineers, computer scientists, and mathematicians alike will use. *Handbook of Linear Algebra* Leslie Hogben, 2006-11-02 The Handbook of Linear Algebra provides comprehensive coverage of linear algebra concepts, applications, and computational software packages in an easy-to-use handbook format. The esteemed international contributors guide you from the very elementary aspects of the subject to the frontiers of current research. The book features an accessible *Bent Functions* Sihem Mesnager, 2016-08-09 This book gives a detailed survey of the main results on bent functions over finite fields, presents a systematic overview of their generalizations, variations, and applications, considers open problems in classification and systematization of bent functions, and discusses proofs of several results. This book uniquely provides a necessary comprehensive coverage of bent functions. It serves as a useful reference for researchers in discrete mathematics, coding, and cryptography. Students and professors in mathematics and computer science will also find the content valuable, especially those interested in mathematical foundations of cryptography. It can be used as a supplementary text for university courses on discrete mathematics, Boolean functions, or cryptography, and is appropriate for both basic classes for undergraduate students and advanced courses for specialists in cryptography and mathematics. **Secure Integrated Circuits and Systems** Ingrid M.R. Verbauwhede, 2010-04-05 On any advanced integrated circuit or system on chip, there is a need for security. In many applications, the actual implementation has become the weakest link in security, rather than the algorithms or protocols. The purpose of the book is to give the integrated circuits and systems designer an insight into the basics of security and cryptography from the implementation point of view. As a designer of integrated circuits and systems, it is important to know both the state of the art attacks as well as the countermeasures. Optimizing for security is different from optimizations for speed, area, or power consumption. It is therefore difficult to attain the delicate balance between the extra cost of security measures and the added benefits. **Bijjective Combinatorics** Nicholas Loehr, 2011-02-10 Bijective proofs are some of the most elegant and powerful techniques in all of mathematics. Suitable for readers without prior background in algebra or combinatorics, *Bijjective Combinatorics* presents a general introduction to enumerative and algebraic combinatorics that emphasizes bijective methods. The text systematically develops the mathematical

Elliptic Curves Number Theory And Cryptography Discrete Mathematics And Its Applications Book Review: Unveiling the Power of Words

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



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