algebra curves

Unveiling the Elegant World of Algebraic Curves: A Comprehensive Guide

Introduction:

Have you ever gazed at a beautifully intricate design and wondered about the mathematics behind its creation? Algebraic curves, far from being dry theoretical concepts, are the mathematical backbone of stunning visual patterns and powerful computational tools. This comprehensive guide delves into the fascinating world of algebraic curves, exploring their definition, properties, classification, and applications. We'll move beyond the abstract, providing intuitive explanations and illustrative examples to help you grasp this captivating area of mathematics. Prepare to be amazed by the elegance and power hidden within these seemingly simple equations. This post promises a deep dive, covering everything from fundamental definitions to advanced applications, making it a valuable resource for students, researchers, and anyone with a curiosity for the beauty of mathematics.

1. Defining Algebraic Curves: Beyond the Equation

An algebraic curve, at its core, is the set of points (x, y) that satisfy a polynomial equation in two variables. This seemingly simple definition opens the door to a vast landscape of shapes and forms. For instance, the equation $x^2 + y^2 = r^2$ describes a circle with radius r. Similarly, $y = x^3 - 3x$ represents a cubic curve with distinctive features. The degree of the polynomial equation dictates the complexity of the curve. Lower-degree polynomials generate simpler curves, while higher-degree polynomials can produce intricate and fascinating shapes with multiple loops, cusps, and self-intersections. Understanding the degree is crucial for classifying and analyzing the curve's properties. We'll explore different types of curves and their corresponding equations to provide a firm foundation.

1. Exploring Key Properties: Tangents, Singularities, and Genus

Beyond their visual appeal, algebraic curves possess several crucial mathematical properties. The concept of a tangent line at a point on the curve is fundamental. The tangent line provides local information about the curve's behavior at that specific point. Singularities, points where the curve is not "smooth" (e.g., cusps or self-intersections), are also significant features, offering insights into the curve's global structure. The genus of a curve, a topological invariant, provides a measure of its "complexity" – essentially the number of "holes" in the curve when considered as a surface. Understanding these properties is key to analyzing and classifying algebraic curves. We'll illustrate these concepts with concrete examples and visual representations.

1. Classification and Types of Algebraic Curves: A Diverse Family

Algebraic curves are not a monolithic entity; they come in a diverse range of types, each with unique characteristics. We'll explore various classifications, including:

Conics: These second-degree curves (degree 2) encompass circles, ellipses, parabolas, and hyperbolas—geometric shapes familiar from elementary mathematics.
Cubics: Third-degree curves (degree 3) exhibit significantly greater complexity, potentially featuring loops and cusps. Examples include elliptic curves, which are crucial in cryptography and number theory.
Higher-degree curves: As the degree increases, the complexity explodes, leading to curves with increasingly intricate shapes and topological properties. The exploration of these curves often involves advanced algebraic geometry techniques.

We'll discuss the defining equations and distinctive features of each type, highlighting their unique properties and applications.

1. Applications of Algebraic Curves: Beyond Theoretical Elegance

Algebraic curves are not just theoretical curiosities; they have profound applications across diverse fields:

Computer-aided design (CAD): Curve representations are fundamental in CAD software, enabling the creation and manipulation of smooth, complex shapes in engineering and design applications.
Cryptography: Elliptic curves form the basis of modern elliptic curve cryptography (ECC), a widely used technique for securing online transactions and communication.
Coding theory: Algebraic curves play a critical role in constructing efficient error-correcting codes used in data transmission and storage.
Physics: Algebraic curves appear in various areas of physics, including the study of classical mechanics and general relativity.

We’ll delve deeper into these applications, providing concrete examples and highlighting the impact of algebraic curves in real-world scenarios.

1. Advanced Topics: Riemann Surfaces and Beyond

For those seeking a deeper understanding, we'll briefly touch upon more advanced concepts:

Riemann surfaces: These are complex manifolds that provide a powerful tool for visualizing and analyzing algebraic curves.
Algebraic geometry: This field provides a rigorous framework for studying algebraic curves and their

properties.

This section will serve as a gateway to further exploration for those interested in pursuing advanced studies in this field.

Book Outline: "A Journey Through Algebraic Curves"

Introduction: Defining algebraic curves, historical context, and the scope of the book.
Chapter 1: Fundamental Concepts: Polynomial equations, degrees, and basic curve properties.
Chapter 2: Key Properties and Classifications: Tangents, singularities, genus, conics, cubics, and higher-degree curves.
Chapter 3: Applications in Various Fields: CAD, cryptography, coding theory, and physics.
Chapter 4: Advanced Topics: Riemann surfaces, algebraic geometry, and future directions.
Conclusion: Summary of key concepts and directions for further exploration.

Detailed Explanation of Book Outline Points:

(Introduction): This chapter will provide a gentle introduction to the world of algebraic curves, starting with the basic definition and providing historical context. It sets the stage for the rest of the book, outlining the key concepts and applications that will be explored.

(Chapter 1: Fundamental Concepts): This chapter focuses on the fundamental mathematical concepts underlying algebraic curves. It will cover polynomial equations, how the degree of a polynomial affects the curve's shape, and the basic properties such as intercepts and symmetry. Simple examples and illustrations will be used throughout.

(Chapter 2: Key Properties and Classifications): This chapter delves into more advanced properties of algebraic curves, including tangents, singularities (cusps, nodes), and the topological invariant known as genus. Different classifications of algebraic curves will be introduced, such as conics (circles, ellipses, parabolas, hyperbolas), cubics (including elliptic curves), and higher-degree curves. The chapter will include numerous visual examples to aid understanding.

(Chapter 3: Applications in Various Fields): This chapter showcases the practical applications of algebraic curves in various fields. We will explore their role in computer-aided design (CAD), cryptography (specifically elliptic curve cryptography), coding theory (error-correcting codes), and physics (applications in various areas). Each application will be explained clearly, with relevant examples provided.

(Chapter 4: Advanced Topics): This chapter provides a brief introduction to more advanced concepts, including Riemann surfaces, which offer a powerful way to visualize and understand algebraic curves, and a glimpse into the broader field of algebraic geometry. This chapter is intended for readers seeking a deeper understanding and will point to further resources for continued learning.

(Conclusion): The concluding chapter summarizes the key concepts and findings presented throughout the book, reiterating the importance of algebraic curves in mathematics and its wide range of applications. It will also provide directions for future exploration and resources for continued learning.

FAQs:

1. What is the simplest algebraic curve? A line, represented by a linear equation (degree 1).
2. What makes elliptic curves so important in cryptography? Their unique mathematical properties allow for the creation of robust and efficient cryptographic systems.
3. How are algebraic curves used in CAD software? They provide a mathematical framework for representing and manipulating smooth, complex shapes.
4. Can algebraic curves have infinite points? Yes, many algebraic curves extend infinitely.
5. What is the genus of a circle? The genus of a circle is 0.
6. What is a singular point on an algebraic curve? A point where the curve is not smooth (e.g., a cusp or self-intersection).
7. Are all algebraic curves closed shapes? No, some extend infinitely.
8. How does the degree of a polynomial equation affect the curve? Higher degrees lead to more complex curves with more intricate shapes.
9. Where can I learn more about Riemann surfaces? Advanced texts on algebraic geometry and complex analysis are good resources.

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8. Singularities of Algebraic Curves: A detailed exploration of singular points and their properties.

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algebra curves: Algebraic Curves William Fulton, 2008 The aim of these notes is to develop the theory of algebraic curves from the viewpoint of modern algebraic geometry, but without excessive prerequisites. We have assumed that the reader is familiar with some basic properties of rings, ideals and polynomials, such as is often covered in a one-semester course in modern algebra; additional commutative algebra is developed in later sections.

algebra curves: Algebraic Curves and One-Dimensional Fields Fedor Bogomolov, Tihomir Petrov, 2002 This text covers the essential topics in the geometry of algebraic curves, such as line and vector bundles, the Riemann-Roch Theorem, divisors, coherent sheaves, and zeroth and first cohomology groups. It demonstrates how curves can act as a natural introduction to algebraic geometry.

algebra curves: Introduction to Plane Algebraic Curves Ernst Kunz, 2007-06-10 * Employs proven conception of teaching topics in commutative algebra through a focus on their applications to algebraic geometry, a significant departure from other works on plane algebraic curves in which the topological-analytic aspects are stressed *Requires only a basic knowledge of algebra, with all necessary algebraic facts collected into several appendices * Studies algebraic curves over an algebraically closed field K and those of prime characteristic, which can be applied to coding theory and cryptography * Covers filtered algebras, the associated graded rings and Rees rings to deduce basic facts about intersection theory of plane curves, applications of which are standard tools of computer algebra * Examples, exercises, figures and suggestions for further study round out this fairly self-contained textbook

algebra curves: Rational Algebraic Curves J. Rafael Sendra, Franz Winkler, Sonia Pérez-Diaz, 2007-12-10 The central problem considered in this introduction for graduate students is the determination of rational parametrizability of an algebraic curve and, in the positive case, the computation of a good rational parametrization. This amounts to determining the genus of a curve: its complete singularity structure, computing regular points of the curve in small coordinate fields, and constructing linear systems of curves with prescribed intersection multiplicities. The book discusses various optimality criteria for rational parametrizations of algebraic curves.

algebra curves: *Complex Algebraic Curves* Frances Clare Kirwan, 1992-02-20 This development of the theory of complex algebraic curves was one of the peaks of nineteenth century mathematics. They have many fascinating properties and arise in various areas of mathematics, from number theory to theoretical physics, and are the subject of much research. By using only the basic techniques acquired in most undergraduate courses in mathematics, Dr. Kirwan introduces the theory, observes the algebraic and topological properties of complex algebraic curves, and shows how they are related to complex analysis.

algebra curves: Plane Algebraic Curves Gerd Fischer, 2001 This is an excellent introduction to algebraic geometry, which assumes only standard undergraduate mathematical topics: complex analysis, rings and fields, and topology. Reading this book will help establish the geometric intuition that lies behind the more advanced ideas and techniques used in the study of higher-dimensional varieties.

algebra curves: Vertex Algebras and Algebraic Curves Edward Frenkel, David Ben-Zvi, 2004-08-25 Vertex algebras are algebraic objects that encapsulate the concept of operator product expansion from two-dimensional conformal field theory. Vertex algebras are fast becoming ubiquitous in many areas of modern mathematics, with applications to representation theory, algebraic geometry, the theory of finite groups, modular functions, topology, integrable systems, and combinatorics. This book is an introduction to the theory of vertex algebras with a particular emphasis on the relationship with the geometry of algebraic curves. The notion of a vertex algebra is introduced in a coordinate-independent way, so that vertex operators become well defined on arbitrary smooth algebraic curves, possibly equipped with additional data, such as a vector bundle. Vertex algebras then appear as the algebraic objects encoding the geometric structure of various moduli spaces associated with algebraic curves. Therefore they may be used to give a geometric interpretation of various questions of representation theory. The book contains many original results, introduces important new concepts, and brings new insights into the theory of vertex algebras. The authors have made a great effort to make the book self-contained and accessible to readers of all backgrounds. Reviewers of the first edition anticipated that it would have a long-lasting influence on this exciting field of mathematics and would be very useful for graduate students and researchers interested in the subject. This second edition, substantially improved and expanded, includes several new topics, in particular an introduction to the Beilinson-Drinfeld theory of factorization algebras and the geometric Langlands correspondence.

algebra curves: *Algebraic Curves and Riemann Surfaces* Rick Miranda, 1995 In this book, Miranda takes the approach that algebraic curves are best encountered for the first time over the complex numbers, where the reader's classical intuition about surfaces, integration, and other concepts can be brought into play. Therefore, many examples of algebraic curves are presented in the first chapters. In this way, the book begins as a primer on Riemann surfaces, with complex charts and meromorphic functions taking centre stage. But the main examples come fromprojective curves, and slowly but surely the text moves toward the algebraic category. Proofs of the Riemann-Roch and Serre Dualtiy Theorems are presented in an algebraic manner, via an adaptation of the adelic proof, expressed completely in terms of solving a Mittag-Leffler problem. Sheaves andcohomology are introduced as a unifying device in the later chapters, so that their utility and naturalness are immediately obvious. Requiring a background of one term of complex variable theory and a year of abstract algebra, this is an excellent graduate textbook for a second-term course in complex variables or a year-long course in algebraic geometry.

algebra curves: Arithmetic of Algebraic Curves Serguei A. Stepanov, 1994-12-31 Author S.A. Stepanov thoroughly investigates the current state of the theory of Diophantine equations and its related methods. Discussions focus on arithmetic, algebraic-geometric, and logical aspects of the problem. Designed for students as well as researchers, the book includes over 250 excercises accompanied by hints, instructions, and references. Written in a clear manner, this text does not require readers to have special knowledge of modern methods of algebraic geometry.

algebra curves: Algebraic Curves and Their Applications Lubjana Beshaj, Tony Shaska, 2019-02-26 This volume contains a collection of papers on algebraic curves and their applications. While algebraic curves traditionally have provided a path toward modern algebraic geometry, they also provide many applications in number theory, computer security and cryptography, coding theory, differential equations, and more. Papers cover topics such as the rational torsion points of elliptic curves, arithmetic statistics in the moduli space of curves, combinatorial descriptions of semistable hyperelliptic curves over local fields, heights on weighted projective spaces, automorphism groups of curves, hyperelliptic curves, dessins d'enfants, applications to Painlevé equations, descent on real algebraic varieties, quadratic residue codes based on hyperelliptic curves, and Abelian varieties and cryptography. This book will be a valuable resource for people interested in algebraic curves and their connections to other branches of mathematics.

algebra curves: Algebraic Functions and Projective Curves David Goldschmidt, 2006-04-06 This book gives an introduction to algebraic functions and projective curves. It covers a wide range of material by dispensing with the machinery of algebraic geometry and proceeding directly via valuation theory to the main results on function fields. It also develops the theory of singular curves by studying maps to projective space, including topics such as Weierstrass points in characteristic p, and the Gorenstein relations for singularities of plane curves.

algebra curves: Pythagorean-Hodograph Curves: Algebra and Geometry Inseparable Rida T Farouki, 2007-10-11 By virtue of their special algebraic structures, Pythagorean-hodograph (PH) curves offer unique advantages for computer-aided design and manufacturing, robotics, motion control, path planning, computer graphics, animation, and related fields. This book offers a comprehensive and self-contained treatment of the mathematical theory of PH curves, including algorithms for their construction and examples of their practical applications. It emphasizes the interplay of ideas from algebra and geometry and their historical origins and includes many figures, worked examples, and detailed algorithm descriptions.

algebra curves: A Guide to Plane Algebraic Curves Keith Kendig, 2011-12-31 An accessible introduction to plane algebraic curves that also serves as a natural entry point to algebraic geometry.

algebra curves: Algebraic Curves, the Brill and Noether Way Eduardo Casas-Alvero, 2019-11-30 The book presents the central facts of the local, projective and intrinsic theories of complex algebraic plane curves, with complete proofs and starting from low-level prerequisites. It includes Puiseux series, branches, intersection multiplicity, Bézout theorem, rational functions, Riemann-Roch theorem and rational maps. It is aimed at graduate and advanced undergraduate students, and also at anyone interested in algebraic curves or in an introduction to algebraic geometry via curves.

algebra curves: Singular Algebraic Curves Gert-Martin Greuel, Christoph Lossen, Eugenii Shustin, 2018-12-30 Singular algebraic curves have been in the focus of study in algebraic geometry from the very beginning, and till now remain a subject of an active research related to many modern developments in algebraic geometry, symplectic geometry, and tropical geometry. The monograph suggests a unified approach to the geometry of singular algebraic curves on algebraic surfaces and their families, which applies to arbitrary singularities, allows one to treat all main questions concerning the geometry of equisingular families of curves, and, finally, leads to results which can be viewed as the best possible in a reasonable sense. Various methods of the cohomology vanishing theory as well as the patchworking construction with its modifications will be of a special interest for experts in algebraic geometry and singularity theory. The introductory chapters on zero-dimensional schemes and global deformation theory can well serve as a material for special courses and seminars for graduate and post-graduate students.Geometry in general plays a leading role in modern mathematics, and algebraic geometry is the most advanced area of research in geometry. In turn, algebraic curves for more than one century have been the central subject of algebraic geometry both in fundamental theoretic questions and in applications to other fields of mathematics and mathematical physics. Particularly, the local and global study of singular algebraic curves involves a variety of methods and deep ideas from geometry, analysis, algebra, combinatorics and suggests a number of hard classical and newly appeared problems which inspire further development in this research area.

algebra curves: *Algebraic Curves over a Finite Field* J. W. P. Hirschfeld, Gabor Korchmaros, Fernando Torres, 2013-03-25 This book provides an accessible and self-contained introduction to the theory of algebraic curves over a finite field, a subject that has been of fundamental importance to mathematics for many years and that has essential applications in areas such as finite geometry, number theory, error-correcting codes, and cryptology. Unlike other books, this one emphasizes the algebraic geometry rather than the function field approach to algebraic curves. The authors begin by developing the general theory of curves over any field, highlighting peculiarities occurring for positive characteristic and requiring of the reader only basic knowledge of algebra and geometry. The special properties that a curve over a finite field can have are then discussed. The geometrical theory of linear series is used to find estimates for the number of rational points on a curve, following the theory of Stöhr and Voloch. The approach of Hasse and Weil via zeta functions is explained, and then attention turns to more advanced results: a state-of-the-art introduction to maximal curves over finite fields is provided; a comprehensive account is given of the automorphism group of a curve; and some applications to coding theory and finite geometry are described. The book includes many examples and exercises. It is an indispensable resource for researchers and the ideal textbook for graduate students.

algebra curves: Algebraic Functions and Projective Curves David Goldschmidt, 2003 This book grew out of a set of notes for a series of lectures I orginally gave at the Center for Communications Research and then at Princeton University. The motivation was to try to understand the basic facts about algebraic curves without the modern prerequisite machinery of algebraic geometry. Of course, one might well ask if this is a good thing to do. There is no clear answer to this question. In short, we are trading off easier access to the facts against a loss of generality and an impaired understanding of some fundamental ideas. Whether or not this is a useful tradeoff is something you will have to decide for yourself. One of my objectives was to make the exposition as self-contained as possible. Given the choice between a reference and a proof, I usually chose the latter. - though I worked out many of these arguments myself, I think I can con?dently predict that few, if any, of them are novel. I also made an effort to cover some topics that seem to have been somewhat neglected in the expository literature.

algebra curves: Algebraic Geometry and Arithmetic Curves Qing Liu, Reinie Erne, 2006-06-29 This book is a general introduction to the theory of schemes, followed by applications to arithmetic surfaces and to the theory of reduction of algebraic curves. The first part introduces basic objects such as schemes, morphisms, base change, local properties (normality, regularity, Zariski's Main Theorem). This is followed by the more global aspect: coherent sheaves and a finiteness theorem for their cohomology groups. Then follows a chapter on sheaves of differentials, dualizing sheaves, and Grothendieck's duality theory. The first part ends with the theorem of Riemann-Roch and its application to the study of smooth projective curves over a field. Singular curves are treated through a detailed study of the Picard group. The second part starts with blowing-ups and desingularisation (embedded or not) of fibered surfaces over a Dedekind ring that leads on to intersection theory on arithmetic surfaces. Castelnuovo's criterion is proved and also the existence of the minimal regular model. This leads to the study of reduction of algebraic curves. The case of elliptic curves is studied in detail. The book concludes with the funadmental theorem of stable reduction of Deligne-Mumford. The book is essentially self-contained, including the necessary material on commutative algebra. The prerequisites are therefore few, and the book should suit a graduate student. It contains many examples and nearly 600 exercises.

algebra curves: *Introduction to Algebraic Curves* Phillip A. Griffiths, This book is an ideal introductory text as it provides a solid foundation to proceed to more advanced texts in general algebraic geometry, complex manifolds, and Riemann surfaces, as well as algebraic curves. It includes numerous exercises.

algebra curves: *Conics and Cubics* Robert Bix, 2006-11-22 Conics and Cubics offers an accessible and well illustrated introduction to algebraic curves. By classifying irreducible cubics over the real numbers and proving that their points form Abelian groups, the book gives readers easy access to the study of elliptic curves. It includes a simple proof of Bezout’s Theorem on the number of intersections of two curves. The subject area is described by means of concrete and accessible examples. The book is a text for a one-semester course.

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algebra curves: *Algebraic Curves Over a Finite Field* J. W. P. Hirschfeld, Gabor Korchmaros, F. Torres, Fernando Torres, 2008-03-23 This title provides a self-contained introduction to the theory of algebraic curves over a finite field, whose origins can be traced back to the works of Gauss and Galois on algebraic equations in two variables with coefficients modulo a prime number.

algebra curves: Rational Algebraic Curves J. Rafael Sendra, Franz Winkler, Sonia Pérez-Diaz, 2007-10-19 The central problem considered in this introduction for graduate students is the determination of rational parametrizability of an algebraic curve and, in the positive case, the computation of a good rational parametrization. This amounts to determining the genus of a curve: its complete singularity structure, computing regular points of the curve in small coordinate fields, and constructing linear systems of curves with prescribed intersection multiplicities. The book discusses various optimality criteria for rational parametrizations of algebraic curves.

algebra curves: *Algebraic Curves* Maxim E. Kazaryan, Sergei K. Lando, Victor V. Prasolov, 2019-01-21 This book offers a concise yet thorough introduction to the notion of moduli spaces of complex algebraic curves. Over the last few decades, this notion has become central not only in algebraic geometry, but in mathematical physics, including string theory, as well. The book begins by studying individual smooth algebraic curves, including the most beautiful ones, before addressing families of curves. Studying families of algebraic curves often proves to be more efficient than studying individual curves: these families and their total spaces can still be smooth, even if there are singular curves among their members. A major discovery of the 20th century, attributed to P. Deligne and D. Mumford, was that curves with only mild singularities form smooth compact moduli spaces. An unexpected byproduct of this discovery was the realization that the analysis of more complex curve singularities is not a necessary step in understanding the geometry of the moduli spaces. The book does not use the sophisticated machinery of modern algebraic geometry, and most classical objects related to curves – such as Jacobian, space of holomorphic differentials, the Riemann-Roch theorem, and Weierstrass points – are treated at a basic level that does not require a profound command of algebraic geometry, but which is sufficient for extending them to vector bundles and other geometric objects associated to moduli spaces. Nevertheless, it offers clear information on the construction of the moduli spaces, and provides readers with tools for practical operations with this notion. Based on several lecture courses given by the authors at the Independent University of Moscow and Higher School of Economics, the book also includes a wealth of problems, making it suitable not only for individual research, but also as a textbook for undergraduate and graduate coursework

algebra curves: Geometry of Algebraic Curves Enrico Arbarello, Maurizio Cornalba, Phillip Griffiths, Joseph Daniel Harris, 2013-11-11 In recent years there has been enormous activity in the theory of algebraic curves. Many long-standing problems have been solved using the general techniques developed in algebraic geometry during the 1950's and 1960's. Additionally, unexpected and deep connections between algebraic curves and differential equations have been uncovered, and these in turn shed light on other classical problems in curve theory. It seems fair to say that the theory of algebraic curves looks completely different now from how it appeared 15 years ago; in particular, our current state of knowledge repre sents a significant advance beyond the legacy left by the classical geometers such as Noether, Castelnuovo, Enriques, and Severi. These books give a presentation of one of the central areas of this recent activity; namely, the study of linear series on both a fixed curve (Volume I) and on a variable curve (Volume II). Our goal is to give a comprehensive and self-contained account of the extrinsic geometry of algebraic curves, which in our opinion constitutes the main geometric core of the recent advances in curve theory. Along the way we shall, of course, discuss appli cations of the theory of linear series to a number of classical topics (e.g., the geometry of the Riemann theta divisor) as well as to some of the current research (e.g., the Kodaira dimension of the moduli space of curves).

algebra curves: Algebraic Curves and Finite Fields Harald Niederreiter, Alina Ostafe, Daniel Panario, Arne Winterhof, 2014-08-20 Algebra and number theory have always been counted among the most beautiful and fundamental mathematical areas with deep proofs and elegant results. However, for a long time they were not considered of any substantial importance for real-life applications. This has dramatically changed with the appearance of new topics such as modern cryptography, coding theory, and wireless communication. Nowadays we find applications of algebra and number theory frequently in our daily life. We mention security and error detection for internet banking, check digit systems and the bar code, GPS and radar systems, pricing options at a stock market, and noise suppression on mobile phones as most common examples. This book collects the results of the workshops Applications of algebraic curves and Applications of finite fields of the

RICAM Special Semester 2013. These workshops brought together the most prominent researchers in the area of finite fields and their applications around the world. They address old and new problems on curves and other aspects of finite fields, with emphasis on their diverse applications to many areas of pure and applied mathematics.

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algebra curves: *Geometry of Algebraic Curves* Enrico Arbarello, Maurizio Cornalba, Phillip Griffiths, Joseph Daniel Harris, 2013-08-30 In recent years there has been enormous activity in the theory of algebraic curves. Many long-standing problems have been solved using the general techniques developed in algebraic geometry during the 1950's and 1960's. Additionally, unexpected and deep connections between algebraic curves and differential equations have been uncovered, and these in turn shed light on other classical problems in curve theory. It seems fair to say that the theory of algebraic curves looks completely different now from how it appeared 15 years ago; in particular, our current state of knowledge repre sents a significant advance beyond the legacy left by the classical geometers such as Noether, Castelnuovo, Enriques, and Severi. These books give a presentation of one of the central areas of this recent activity; namely, the study of linear series on both a fixed curve (Volume I) and on a variable curve (Volume II). Our goal is to give a comprehensive and self-contained account of the extrinsic geometry of algebraic curves, which in our opinion constitutes the main geometric core of the recent advances in curve theory. Along the way we shall, of course, discuss appli cations of the theory of linear series to a number of classical topics (e.g., the geometry of the Riemann theta divisor) as well as to some of the current research (e.g., the Kodaira dimension of the moduli space of curves).

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