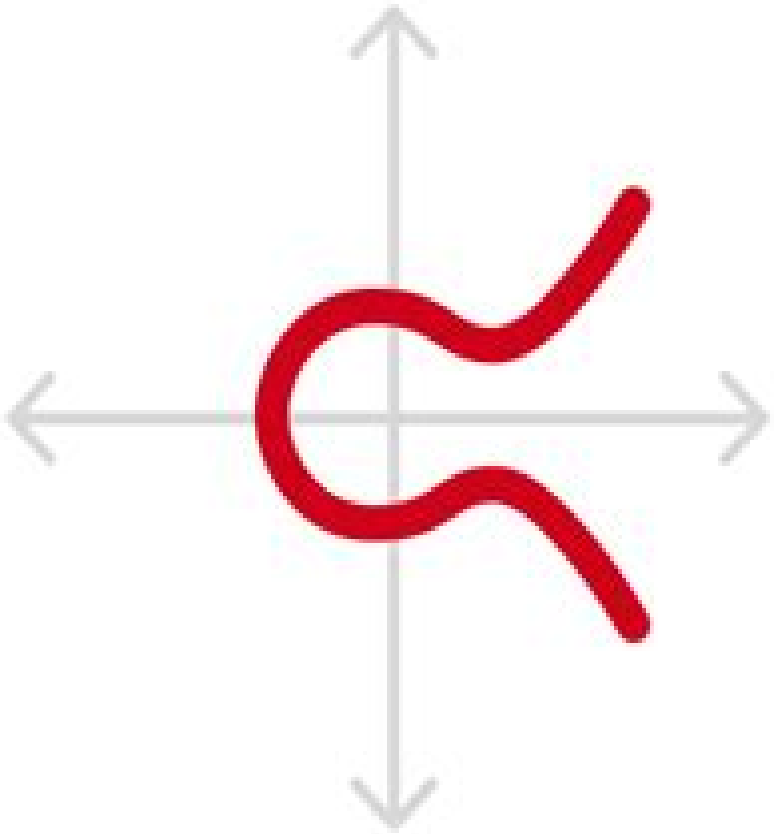

$$y^2=x^3+ax+b$$

Elliptic Curves

Scott C. Dulebohn

Elliptic Curves:

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 X DX while three appendices conclude the whole Elliptic Curves in Characteristics 2 and 3 Group Cohomology and an overview of more advanced topics

Rational Points on Elliptic Curves Joseph H. Silverman,John T. Tate,2015-06-02 The theory of elliptic curves involves a pleasing blend of algebra geometry analysis and number theory This volume stresses this interplay as it develops the basic theory thereby providing an opportunity for advanced undergraduates to appreciate the unity of modern mathematics At the same time every effort has been made to use only methods and results commonly included in the undergraduate curriculum This accessibility the informal writing style and a wealth of exercises make Rational Points on Elliptic Curves an ideal introduction for students at all levels who are interested in learning about Diophantine equations and arithmetic geometry Most concretely an elliptic curve is the set of zeroes of a cubic polynomial in two variables If the polynomial has rational coefficients then one can ask for a description of those zeroes whose coordinates are either integers or rational numbers It is this number theoretic question that is the main subject of Rational Points on Elliptic Curves Topics covered include the geometry and group structure of elliptic curves the Nagell Lutz theorem describing points of finite order the Mordell Weil theorem on the finite generation of the group of rational points the Thue Siegel theorem on the finiteness of the set of integer points theorems on counting points with coordinates in finite fields Lenstra s elliptic curve factorization algorithm and a discussion of complex multiplication and the Galois representations associated to torsion points Additional topics new to the second edition include an introduction to elliptic curve cryptography and a brief discussion of the stunning proof of Fermat s Last Theorem by Wiles et al via the use of elliptic curves **Elliptic Curves** Susanne Schmitt,Horst G. Zimmer,2003 The content is kept as elementary as possible and therefore the book differs significantly from the numerous textbooks on elliptic curves nowadays available The book is addressed to graduate students and researchers in both mathematics and computer science BOOK JACKET *Modern Cryptography and Elliptic Curves* Thomas R. Shemanske,2017-07-31 This book offers the beginning undergraduate student some of the vista of modern mathematics by developing and presenting the tools needed to gain an understanding of the arithmetic of elliptic curves over finite fields and their applications to modern cryptography This gradual introduction also makes a significant effort to teach students how to produce or discover a proof by presenting mathematics as an exploration and at the same time it provides the necessary mathematical underpinnings to investigate the

practical and implementation side of elliptic curve cryptography ECC Elements of abstract algebra number theory and affine and projective geometry are introduced and developed and their interplay is exploited Algebra and geometry combine to characterize congruent numbers via rational points on the unit circle and group law for the set of points on an elliptic curve arises from geometric intuition provided by B zout s theorem as well as the construction of projective space The structure of the unit group of the integers modulo a prime explains RSA encryption Pollard s method of factorization Diffie Hellman key exchange and ElGamal encryption while the group of points of an elliptic curve over a finite field motivates Lenstra s elliptic curve factorization method and ECC The only real prerequisite for this book is a course on one variable calculus other necessary mathematical topics are introduced on the fly Numerous exercises further guide the exploration **Elliptic Curves (Second Edition)** James S Milne,2020-08-20 This book uses the beautiful theory of elliptic curves to introduce the reader to some of the deeper aspects of number theory It assumes only a knowledge of the basic algebra complex analysis and topology usually taught in first year graduate courses An elliptic curve is a plane curve defined by a cubic polynomial Although the problem of finding the rational points on an elliptic curve has fascinated mathematicians since ancient times it was not until 1922 that Mordell proved that the points form a finitely generated group There is still no proven algorithm for finding the rank of the group but in one of the earliest important applications of computers to mathematics Birch and Swinnerton Dyer discovered a relation between the rank and the numbers of points on the curve computed modulo a prime Chapter IV of the book proves Mordell s theorem and explains the conjecture of Birch and Swinnerton Dyer Every elliptic curve over the rational numbers has an L series attached to it Hasse conjectured that this L series satisfies a functional equation and in 1955 Taniyama suggested that Hasse s conjecture could be proved by showing that the L series arises from a modular form This was shown to be correct by Wiles and others in the 1990s and as a consequence one obtains a proof of Fermat s Last Theorem Chapter V of the book is devoted to explaining this work The first three chapters develop the basic theory of elliptic curves For this edition the text has been completely revised and updated **Elliptic Functions and Elliptic Curves** Patrick Du Val,1973-08-02 A comprehensive treatment of elliptic functions is linked by these notes to a study of their application to elliptic curves This approach provides geometers with the opportunity to acquaint themselves with aspects of their subject virtually ignored by other texts The exposition is clear and logically carries themes from earlier through to later topics This enthusiastic work of scholarship is made complete with the inclusion of some interesting historical details and a very comprehensive bibliography *Elliptic Curves* Anthony W. Knapp,2018-06-05 An elliptic curve is a particular kind of cubic equation in two variables whose projective solutions form a group Modular forms are analytic functions in the upper half plane with certain transformation laws and growth properties The two subjects elliptic curves and modular forms come together in Eichler Shimura theory which constructs elliptic curves out of modular forms of a special kind The converse that all rational elliptic curves arise this way is called the Taniyama Weil Conjecture and is known to imply

Fermat s Last Theorem Elliptic curves and the modeular forms in the Eichler Shimura theory both have associated L functions and it is a consequence of the theory that the two kinds of L functions match The theory covered by Anthony Knapp in this book is therefore a window into a broad expanse of mathematics including class field theory arithmetic algebraic geometry and group representations in which the concidence of L functions relates analysis and algebra in the most fundamental ways Developing with many examples the elementary theory of elliptic curves the book goes on to the subject of modular forms and the first connections with elliptic curves The last two chapters concern Eichler Shimura theory which establishes a much deeper relationship between the two subjects No other book in print treats the basic theory of elliptic curves with only undergraduate mathematics and no other explains Eichler Shimura theory in such an accessible manner

The Arithmetic of Elliptic Curves Joseph H. Silverman,2013-03-09 The preface to a textbook frequently contains the author s justification for offering the public another book on the given subject For our chosen topic the arithmetic of elliptic curves there is little need for such an apologia Considering the vast amount of research currently being done in this area the paucity of introductory texts is somewhat surprising Parts of the theory are contained in various books of Lang especially La 3 and La 5 and there are books of Koblitz Kob and Robert Rob now out of print which concentrate mostly on the analytic and modular theory In addition survey articles have been written by Cassels Ca 7 really a short book and Tate Ta 5J which is beautifully written but includes no proofs Thus the author hopes that this volume will fill a real need both for the serious student who wishes to learn the basic facts about the arithmetic of elliptic curves and for the research mathematician who needs a reference source for those same basic facts Our approach is more algebraic than that taken in say La 3 or La 5 where many of the basic theorems are derived using complex analytic methods and the Lefschetz principle For this reason we have had to rely somewhat more on techniques from algebraic geometry However the geom etry of smooth curves which is essentially all that we use does not require a great deal of machinery Rational Points on Elliptic Curves Joseph H. Silverman,John Tate,2013-04-17 In 1961 the second author deliv1lred a series of lectures at Haverford Col lege on the subject of Rational Points on Cubic Curves These lectures intended for junior and senior mathematics majors were recorded tran scribed and printed in mimeograph form Since that time they have been widely distributed as photocopies of ever decreasing legibility and por tions have appeared in various textbooks Husemoller 1 Chahal 1 but they have never appeared in their entirety In view of the recent inter est in the theory of elliptic curves for subjects ranging from cryptogra phy Lenstra 1 Koblitz 2 to physics Luck Moussa Waldschmidt 1 as well as the tremendous purely mathematical activity in this area it seems a propitious time to publish an expanded version of those original notes suitable for presentation to an advanced undergraduate audience We have attempted to maintain much of the informality of the orig inal Haverford lectures Our main goal in doing this has been to write a textbook in a technically difficult field which is readable by the average undergraduate mathematics major We hope we have succeeded in this goal The most obvious drawback to such an approach is that we have

not been entirely rigorous in all of our proofs In particular much of the foundational material on elliptic curves presented in Chapter I is meant to explain and convince rather than to rigorously prove **Elliptic Curves** S. Lang,1978-11-01 It is possible to write endlessly on elliptic curves This is not a threat We deal here with diophantine problems and we lay the foundations especially for the theory of integral points We review briefly the analytic theory of the Weierstrass function and then deal with the arithmetic aspects of the addition formula over complete fields and over number fields giving rise to the theory of the height and its quadraticity We apply this to integral points covering the inequalities of diophantine approximation both on the multiplicative group and on the elliptic curve directly Thus the book splits naturally in two parts The first part deals with the ordinary arithmetic of the elliptic curve The transcendental parametrization the p adic parametrization points of finite order and the group of rational points and the reduction of certain diophantine problems by the theory of heights to diophantine inequalities involving logarithms The second part deals with the proofs of selected inequalities at least strong enough to obtain the finiteness of integral points *Rational Points on Modular Elliptic Curves* Henri Darmon,2004 The book surveys some recent developments in the arithmetic of modular elliptic curves It places a special emphasis on the construction of rational points on elliptic curves the Birch and Swinnerton Dyer conjecture and the crucial role played by modularity in shedding light on these two closely related issues The main theme of the book is the theory of complex multiplication Heegner points and some conjectural variants The first three chapters introduce the background and prerequisites elliptic curves modular forms and the Shimura Taniyama Weil conjecture complex multiplication and the Heegner point construction The next three chapters introduce variants of modular parametrizations in which modular curves are replaced by Shimura curves attached to certain indefinite quaternion algebras The main new contributions are found in Chapters 7 9 which survey the author s attempts to extend the theory of Heegner points and complex multiplication to situations where the base field is not a CM field Chapter 10 explains the proof of Kolyvagin s theorem which relates Heegner points to the arithmetic of elliptic curves and leads to the best evidence so far for the Birch and Swinnerton Dyer conjecture **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 **Advanced Topics in the Arithmetic of Elliptic Curves** Joseph H. Silverman,2013-12-01 In the introduction to the first volume of The Arithmetic of Elliptic Curves Springer Verlag 1986 I observed that the theory of elliptic curves is rich varied and amazingly vast and as a consequence many important topics had to be omitted I included a brief introduction to ten additional topics as an appendix to the first volume with the tacit understanding that eventually there might be a second volume containing the details You are now holding that second volume it turned out that even those ten topics would not fit Unfortunately into a single book so I was forced to make

some choices The following material is covered in this book I Elliptic and modular functions for the full modular group II Elliptic curves with complex multiplication III Elliptic surfaces and specialization theorems IV Neron models Kodaira Neron classification of special fibers Tate s algorithm and Ogg s conductor discriminant formula V Tate s theory of q curves over p adic fields VI Neron s theory of canonical local height functions **Elliptic Curves, Modular Forms, and Their L-functions** Álvaro Lozano-Robledo,2011 Many problems in number theory have simple statements but their solutions require a deep understanding of algebra algebraic geometry complex analysis group representations or a combination of all four The original simply stated problem can be obscured in the depth of the theory developed to understand it This book is an introduction to some of these problems and an overview of the theories used nowadays to attack them presented so that the number theory is always at the forefront of the discussion Lozano Robledo gives an introductory survey of elliptic curves modular forms and L functions His main goal is to provide the reader with the big picture of the surprising connections among these three families of mathematical objects and their meaning for number theory As a case in point Lozano Robledo explains the modularity theorem and its famous consequence Fermat s Last Theorem He also discusses the Birch and Swinnerton Dyer Conjecture and other modern conjectures The book begins with some motivating problems and includes numerous concrete examples throughout the text often involving actual numbers such as 3 4 5 frac 3344161 747348 and frac 224403517704336969924557513090667486316094847204 1 89123322689288595880255351789671635700164808 30 The theories of elliptic curves modular forms and L functions are too vast to be covered in a single volume and their proofs are outside the scope of the undergraduate curriculum However the primary objects of study the statements of the main theorems and their corollaries are within the grasp of advanced undergraduates This book concentrates on motivating the definitions explaining the statements of the theorems and conjectures making connections and providing lots of examples rather than dwelling on the hard proofs The book succeeds if after reading the text students feel compelled to study elliptic curves and modular forms in all their glory **Elliptic Curves** A. Robert,1973 **Introduction to Elliptic Curves and Modular Forms** Neal I. Koblitz,2012-12-06 This textbook covers the basic properties of elliptic curves and modular forms with emphasis on certain connections with number theory The ancient congruent number problem is the central motivating example for most of the book My purpose is to make the subject accessible to those who find it hard to read more advanced or more algebraically oriented treatments At the same time I want to introduce topics which are at the forefront of current research Down to earth examples are given in the text and exercises with the aim of making the material readable and interesting to mathematicians in fields far removed from the subject of the book With numerous exercises and answers included the textbook is also intended for graduate students who have completed the standard first year courses in real and complex analysis and algebra Such students would learn applications of techniques from those courses thereby solidifying their under standing of some basic tools used throughout mathematics Graduate stu dents wanting to work in number theory

or algebraic geometry would get a motivational example oriented introduction In addition advanced under graduates could use the book for independent study projects senior theses and seminar work *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 *Elliptic Curves in Cryptography* Ian F. Blake,G. Seroussi,N. Smart,1999-07-08 This book summarizes knowledge built up within Hewlett Packard over a number of years and explains the mathematics behind practical implementations of elliptic curve systems Due to the advanced nature of the mathematics there is a high barrier to entry for individuals and companies to this technology Hence this book will be invaluable not only to mathematicians wanting to see how pure mathematics can be applied but also to engineers and computer scientists wishing or needing to actually implement such systems *Elliptic Curves and Related Topics* H. Kisilevsky,Maruti Ram Murty,1994-01-01 This book represents the proceedings of a workshop on elliptic curves held in St Adele Quebec in February 1992 Containing both expository and research articles on the theory of elliptic curves this collection covers a range of topics from Langlands s theory to the algebraic geometry of elliptic curves from Iwasawa theory to computational aspects of elliptic curves This book is especially significant in that it covers topics comprising the main ingredients in Andrew Wiles s recent result on Fermat s Last Theorem **The Arithmetic of Elliptic Curves** Joseph H. Silverman,2009-05-29 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 X DX while three appendices conclude the whole Elliptic Curves in Characteristics 2 and 3 Group Cohomology and an overview of more advanced topics

Decoding **Elliptic Curves**: Revealing the Captivating Potential of Verbal Expression

In a period characterized by interconnectedness and an insatiable thirst for knowledge, the captivating potential of verbal expression has emerged as a formidable force. Its power to evoke sentiments, stimulate introspection, and incite profound transformations is genuinely awe-inspiring. Within the pages of "**Elliptic Curves**," a mesmerizing literary creation penned by a celebrated wordsmith, readers attempt an enlightening odyssey, unraveling the intricate significance of language and its enduring effect on our lives. In this appraisal, we shall explore the book is central themes, evaluate its distinctive writing style, and gauge its pervasive influence on the hearts and minds of its readership.

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