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Mathematical Writing
Donald E. Knuth 1989 This book will help those wishing to teach a course in technical writing, or who wish to write themselves.

Algebraic Statistics for Computational Biology

Birational Geometry and Moduli Spaces
Elisabetta Colombo 2020-02-25 This volume collects contributions from speakers at the INdAM Workshop “Birational Geometry and Moduli Spaces”, which was held in Rome on 11-15 June 2018. The workshop was devoted to the interplay between birational geometry and moduli spaces and the contributions of the volume reflect the same idea, focusing on both these areas and their interaction. In particular, the book includes both surveys and original papers on irreducible holomorphic symplectic manifolds, Severi varieties.
degenerations of Calabi-Yau varieties, uniruled threefolds, toric Fano threefolds, mirror symmetry, canonical bundle formula, the Lefschetz principle, birational transformations, and deformations of diagrams of algebras. The intention is to disseminate the knowledge of advanced results and key techniques used to solve open problems. The book is intended for all advanced graduate students and researchers interested in the new research frontiers of birational geometry and moduli spaces.

**Experimental Mathematics**
V. I. Arnold 2015-07-14 One of the traditional ways mathematical ideas and even new areas of mathematics are created is from experiments. One of the best-known examples is that of the Fermat hypothesis, which was conjectured by Fermat in his attempts to find integer solutions for the famous Fermat equation. This hypothesis led to the creation of a whole field of knowledge, but it was proved only after several hundred years. This book, based on the author's lectures, presents several new directions of mathematical research. All of these directions are based on numerical experiments conducted by the author, which led to new hypotheses that currently remain open, i.e., are neither proved nor disproved. The hypotheses range from geometry and topology (statistics of plane curves and smooth functions) to combinatorics (combinatorial complexity and random permutations) to algebra and number theory (continuous fractions and Galois groups). For each subject, the author describes the problem and presents numerical results that led him to a particular conjecture. In the majority of cases there is an indication of how the readers can approach the formulated conjectures (at least by conducting more numerical experiments). Written in Arnold's unique style, the book is intended for a wide range of mathematicians, from high school students...
interested in exploring unusual areas of mathematics on their own, to college and graduate students, to researchers interested in gaining a new, somewhat nontraditional perspective on doing mathematics. In the interest of fostering a greater awareness and appreciation of mathematics and its connections to other disciplines and everyday life, MSRI and the AMS are publishing books in the Mathematical Circles Library series as a service to young people, their parents and teachers, and the mathematics profession. Titles in this series are co-published with the Mathematical Sciences Research Institute (MSRI).

**Differential Geometry of Curves and Surfaces** Victor Andreevich Toponogov 2006-09-10 Central topics covered include curves, surfaces, geodesics, intrinsic geometry, and the Alexandrov global angle comparison theorem. Many nontrivial and original problems (some with hints and solutions) Standard theoretical material is combined with more difficult theorems and complex problems, while maintaining a clear distinction between the two levels.

**Computations in Algebraic Geometry with Macaulay 2** David Eisenbud 2013-03-14 This book presents algorithmic tools for algebraic geometry, with experimental applications. It also introduces Macaulay 2, a computer algebra system supporting research in algebraic geometry, commutative algebra, and their applications. The algorithmic tools presented here are designed to serve readers wishing to bring such tools to bear on their own problems. The first part of the book covers Macaulay 2 using concrete applications; the second emphasizes details of the mathematics.

**Cartan for Beginners** Thomas Andrew Ivey 2003 This book is an introduction to Cartan's approach to differential geometry. Two central methods in Cartan's geometry are the theory of exterior differential...
systems and the method of moving frames. This book presents thorough and modern treatments of both subjects, including their applications to both classic and contemporary problems. It begins with the classical geometry of surfaces and basic Riemannian geometry in the language of moving frames, along with an elementary introduction to exterior differential systems. Key concepts are developed incrementally with motivating examples leading to definitions, theorems, and proofs. Once the basics of the methods are established, the authors develop applications and advanced topics. One notable application is to complex algebraic geometry, where they expand and update important results from projective differential geometry. The book features an introduction to $\mathbb{G}$-structures and a treatment of the theory of connections. The Cartan machinery is also applied to obtain explicit solutions of PDEs via Darboux's method, the method of characteristics, and Cartan's method of equivalence. This text is suitable for a one-year graduate course in differential geometry, and parts of it can be used for a one-semester course. It has numerous exercises and examples throughout. It will also be useful to experts in areas such as PDEs and algebraic geometry who want to learn how moving frames and exterior differential systems apply to their fields.

*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.
curves, and shows how they are related to complex analysis. **The Mathematics of Chip-Firing** Caroline J. Klivans 2018-11-15 The Mathematics of Chip-firing is a solid introduction and overview of the growing field of chip-firing. It offers an appreciation for the richness and diversity of the subject. Chip-firing refers to a discrete dynamical system — a commodity is exchanged between sites of a network according to very simple local rules. Although governed by local rules, the long-term global behavior of the system reveals fascinating properties. The Fundamental properties of chip-firing are covered from a variety of perspectives. This gives the reader both a broad context of the field and concrete entry points from different backgrounds. Broken into two sections, the first examines the fundamentals of chip-firing, while the second half presents more general frameworks for chip-firing. Instructors and students will discover that this book provides a comprehensive background to approaching original sources. Features: Provides a broad introduction for researchers interested in the subject of chip-firing The text includes historical and current perspectives Exercises included at the end of each chapter About the Author: Caroline J. Klivans received a BA degree in mathematics from Cornell University and a PhD in applied mathematics from MIT. Currently, she is an Associate Professor in the Division of Applied Mathematics at Brown University. She is also an Associate Director of ICERM (Institute for Computational and Experimental Research in Mathematics). Before coming to Brown she held positions at MSRI, Cornell and the University of Chicago. Her research is in algebraic, geometric and topological combinatorics.

**Three-dimensional Geometry and Topology** WILLIAM P AUTOR THURSTON 1997 Every mathematician should be acquainted with the basic facts about the geometry of surfaces, of two-dimensional manifolds.
The theory of three-dimensional manifolds is much more difficult and still only partly understood, although there is ample evidence that the theory of three-dimensional manifolds is one of the most beautiful in the whole of mathematics. This excellent introductory work makes this mathematical wonderland remained rather inaccessible to non-specialists. The author is both a leading researcher, with a formidable geometric intuition, and a gifted expositor. His vivid descriptions of what it might be like to live in this or that three-dimensional manifold bring the subject to life. Like Poincaré, he appeals to intuition, but his enthusiasm is infectious and should make many converts for this kind of mathematics. There are good pictures, plenty of exercises and problems, and the reader will find a selection of topics which are not found in the standard repertoire. This book contains a great deal of interesting mathematics. 

Tensors

J. M. Landsberg

2011-12-14 Tensors are ubiquitous in the sciences. The geometry of tensors is both a powerful tool for extracting information from data sets, and a beautiful subject in its own right. This book has three intended uses: a classroom textbook, a reference work for researchers in the sciences, and an account of classical and modern results in (aspects of) the theory that will be of interest to researchers in geometry. For classroom use, there is a modern introduction to multilinear algebra and to the geometry and representation theory needed to study tensors, including a large number of exercises. For researchers in the sciences, there is information on tensors in table format for easy reference and a summary of the state of the art in elementary language. This is the first book containing many classical results regarding tensors. Particular applications treated in the book include the complexity of matrix multiplication, P versus NP, signal processing,
phylogenetics, and algebraic
statistics. For geometers, there
is material on secant varieties,
G-varieties, spaces with finitely
many orbits and how these
objects arise in applications,
discussions of numerous open
questions in geometry arising
in applications, and expositions
of advanced topics such as the
proof of the Alexander-
Hirschowitz theorem and of the
Weyman-Kempf method for
computing syzygies.

*Symmetry in Graph Theory*
Jose M. Rodriguez 2019-03-14
This book contains the
successful invited submissions
to a Special Issue of Symmetry
on the subject of “Graph
Theory”. Although symmetry
has always played an important
role in Graph Theory, in recent
years, this role has increased
significantly in several
branches of this field, including
but not limited to Gromov
hyperbolic graphs, the metric
dimension of graphs,
domination theory, and
topological indices. This
Special Issue includes
contributions addressing new
results on these topics, both
from a theoretical and an
applied point of view.

*Tensor Categories*
Pavel Etingof 2016-08-05
Is there a
vector space whose dimension
is the golden ratio? Of course
not—the golden ratio is not an
integer! But this can happen
for generalizations of vector
spaces—objects of a tensor
category. The theory of tensor
categories is a relatively new
field of mathematics that
generalizes the theory of group
representations. It has deep
connections with many other
fields, including representation
theory, Hopf algebras, operator
algebras, low-dimensional
topology (in particular, knot
theory), homotopy theory,
quantum mechanics and field
theory, quantum computation,
theory of motives, etc. This
book gives a systematic
introduction to this theory and
a review of its applications.
While giving a detailed
overview of general tensor
categories, it focuses especially
on the theory of finite tensor
categories and fusion
categories (in particular,
braided and modular).
and discusses the main results about them with proofs. In particular, it shows how the main properties of finite-dimensional Hopf algebras may be derived from the theory of tensor categories. Many important results are presented as a sequence of exercises, which makes the book valuable for students and suitable for graduate courses. Many applications, connections to other areas, additional results, and references are discussed at the end of each chapter.

*Computational Topology*
Herbert Edelsbrunner 2010
Combining concepts from topology and algorithms, this book delivers what its title promises: an introduction to the field of computational topology. Starting with motivating problems in both mathematics and computer science and building up from classic topics in geometric and algebraic topology, the third part of the text advances to persistent homology. This point of view is critically important in turning a mostly theoretical field of mathematics into one that is relevant to a multitude of disciplines in the sciences and engineering. The main approach is the discovery of topology through algorithms. The book is ideal for teaching a graduate or advanced undergraduate course in computational topology, as it develops all the background of both the mathematical and algorithmic aspects of the subject from first principles. Thus the text could serve equally well in a course taught in a mathematics department or computer science department.

*Rings of Analytic Functions*
John Wermer 1957
*Exterior Differential Systems*
Robert L. Bryant 2013-06-29
This book gives a treatment of exterior differential systems. It will include both the general theory and various applications. An exterior differential system is a system of equations on a manifold defined by equating to zero a number of exterior differential forms. When all the forms are linear, it is called a pfaffian
Our object is to study its integral manifolds, i.e., submanifolds satisfying all the equations of the system. A fundamental fact is that every equation implies the one obtained by exterior differentiation, so that the complete set of equations associated to an exterior differential system constitutes a differential ideal in the algebra of all smooth forms. Thus the theory is coordinate-free and computations typically have an algebraic character; however, even when coordinates are used in intermediate steps, the use of exterior algebra helps to efficiently guide the computations, and as a consequence the treatment adapts well to geometrical and physical problems. A system of partial differential equations, with any number of independent and dependent variables and involving partial derivatives of any order, can be written as an exterior differential system. In this case we are interested in integral manifolds on which certain coordinates remain independent. The corresponding notion in exterior differential systems is the independence condition: certain pfaffian forms remain linearly independent. Partial differential equations and exterior differential systems with an independence condition are essentially the same object.

**The Mathematics of Data**
Michael W. Mahoney
2018-11-15 Nothing provided

**Flavors of Geometry**
Silvio Levy 1997-09-28 Lectures on hyperbolic geometry, dynamics in several complex variables, convex geometry, and volume estimation.

**The Shape of Inner Space**
Shing-Tung Yau 2010-09-07
String theory says we live in a ten-dimensional universe, but that only four are accessible to our everyday senses. According to theorists, the missing six are curled up in bizarre structures known as Calabi-Yau manifolds. In The Shape of Inner Space, Shing-Tung Yau, the man who mathematically proved that these manifolds exist, explores their implications for our understanding of the universe.
that not only is geometry fundamental to string theory, it is also fundamental to the very nature of our universe. Time and again, where Yau has gone, physics has followed. Now for the first time, readers will follow Yau’s penetrating thinking on where we’ve been, and where mathematics will take us next. A fascinating exploration of a world we are only just beginning to grasp, The Shape of Inner Space will change the way we consider the universe on both its grandest and smallest scales.

Dynamics and Randomness

Alejandro Maass 2012-12-06
This book contains the lectures given at the Conference on Dynamics and Randomness held at the Centro de Modelamiento Matematico of the Universidad de Chile from December 11th to 15th, 2000. This meeting brought together mathematicians, theoretical physicists and theoretical computer scientists, and graduate students interested in fields related to probability theory, ergodic theory, symbolic and topological dynamics. We would like to express our gratitude to all the participants of the conference and to the people who contributed to its organization. In particular, to Pierre Collet, Bernard Host and Mike Keane for their scientific advise. We want to thank especially the authors of each chapter for their well prepared manuscripts and the stimulating conferences they gave at Santiago. We are also indebted to our sponsors and supporting institutions, whose interest and help was essential to organize this meeting: ECOS-CONICYT, FONDAP Program in Applied Mathematics, French Cooperation, Fundacion Andes, Presidential Fellowship and Universidad de Chile. We are grateful to Ms. Gladys Cavallone for their excellent work during the preparation of the meeting as well as for the considerable task of unifying the typography of the different chapters of this book.

Introduction to Tropical Geometry

Diane Maclagan 2021-12-13
is a combinatorial shadow of algebraic geometry, offering new polyhedral tools to compute invariants of algebraic varieties. It is based on tropical algebra, where the sum of two numbers is their minimum and the product is their sum. This turns polynomials into piecewise-linear functions, and their zero sets into polyhedral complexes. These tropical varieties retain a surprising amount of information about their classical counterparts. Tropical geometry is a young subject that has undergone a rapid development since the beginning of the 21st century. While establishing itself as an area in its own right, deep connections have been made to many branches of pure and applied mathematics. This book offers a self-contained introduction to tropical geometry, suitable as a course text for beginning graduate students. Proofs are provided for the main results, such as the Fundamental Theorem and the Structure Theorem. Numerous examples and explicit computations illustrate the main concepts. Each of the six chapters concludes with problems that will help the readers to practice their tropical skills, and to gain access to the research literature. This wonderful book will appeal to students and researchers of all stripes: it begins at an undergraduate level and ends with deep connections to toric varieties, compactifications, and degenerations. In between, the authors provide the first complete proofs in book form of many fundamental results in the subject. The pages are sprinkled with illuminating examples, applications, and exercises, and the writing is lucid and meticulous throughout. It is that rare kind of book which will be used equally as an introductory text by students and as a reference for experts. —Matt Baker, Georgia Institute of Technology Tropical geometry is an exciting new field, which requires tools from various parts of mathematics and has connections with many areas. A short definition is given by
Maclagan and Sturmfels: “Tropical geometry is a marriage between algebraic and polyhedral geometry”. This wonderful book is a pleasant and rewarding journey through different landscapes, inviting the readers from a day at a beach to the hills of modern algebraic geometry. The authors present building blocks, examples and exercises as well as recent results in tropical geometry, with ingredients from algebra, combinatorics, symbolic computation, polyhedral geometry and algebraic geometry. The volume will appeal both to beginning graduate students willing to enter the field and to researchers, including experts. —Alicia Dickenstein, University of Buenos Aires, Argentina

Bounded Cohomology of Discrete Groups Roberto Frigerio 2017-11-21 The theory of bounded cohomology, introduced by Gromov in the late 1980s, has had powerful applications in geometric group theory and the geometry and topology of manifolds, and has been the topic of active research continuing to this day. This monograph provides a unified, self-contained introduction to the theory and its applications, making it accessible to a student who has completed a first course in algebraic topology and manifold theory. The book can be used as a source for research projects for master's students, as a thorough introduction to the field for graduate students, and as a valuable landmark text for researchers, providing both the details of the theory of bounded cohomology and links of the theory to other closely related areas. The first part of the book is devoted to settling the fundamental definitions of the theory, and to proving some of the (by now classical) results on low-dimensional bounded cohomology and on bounded cohomology of topological spaces. The second part describes applications of the theory to the study of the simplicial volume of manifolds, to the classification of circle actions, to the author
maximal representations of surface groups, and to the study of flat vector bundles with a particular emphasis on the possible use of bounded cohomology in relation with the Chern conjecture. Each chapter ends with a discussion of further reading that puts the presented results in a broader context.

*Algebraic Geometry over the Complex Numbers* Donu Arapura 2012-02-15 This is a relatively fast paced graduate level introduction to complex algebraic geometry, from the basics to the frontier of the subject. It covers sheaf theory, cohomology, some Hodge theory, as well as some of the more algebraic aspects of algebraic geometry. The author frequently refers the reader if the treatment of a certain topic is readily available elsewhere but goes into considerable detail on topics for which his treatment puts a twist or a more transparent viewpoint. His cases of exploration and are chosen very carefully and deliberately. The textbook achieves its purpose of taking new students of complex algebraic geometry through this a deep yet broad introduction to a vast subject, eventually bringing them to the forefront of the topic via a non-intimidating style.

*Combinatorial and Computational Geometry* cob E. Goodman 2005-08-08 This 2005 book deals with interest topics in Discrete and Algorithmic aspects of Geometry.

*Lectures on Spaces of Nonpositive Curvature* Werner Ballmann 2012-12-06 Singular spaces with upper curvature bounds and, in particular, spaces of nonpositive curvature, have been of interest in many fields, including geometric (and combinatorial) group theory, topology, dynamical systems and probability theory. In the first two chapters of the book, a concise introduction into these spaces is given, culminating in the Hadamard-Cartan theorem and the discussion of the ideal boundary at infinity for simply connected complete spaces of
nonpositive curvature. In the third chapter, qualitative properties of the geodesic flow on geodesically complete spaces of nonpositive curvature are discussed, as are random walks on groups of isometries of nonpositively curved spaces. The main class of spaces considered should be precisely complementary to symmetric spaces of higher rank and Euclidean buildings of dimension at least two (Rank Rigidity conjecture). In the smooth case, this is known and is the content of the Rank Rigidity theorem. An updated version of the proof of the latter theorem (in the smooth case) is presented in Chapter IV of the book. This chapter contains also a short introduction into the geometry of the unit tangent bundle of a Riemannian manifold and the basic facts about the geodesic flow. In an appendix by Misha Brin, a self-contained and short proof of the ergodicity of the geodesic flow of a compact Riemannian manifold of negative curvature is given. The proof is elementary and should be accessible to the non-specialist. Some of the essential features and problems of the ergodic theory of smooth dynamical systems are discussed, and the appendix can serve as an introduction into this theory.

Differential Geometry Loring W. Tu 2017-06-01

This text presents a graduate-level introduction to differential geometry for mathematics and physics students. The exposition follows the historical development of the concepts of connection and curvature with the goal of explaining the Chern–Weil theory of characteristic classes on a principal bundle. Along the way we encounter some of the high points in the history of differential geometry, for example, Gauss' Theorema Egregium and the Gauss–Bonnet theorem. Exercises throughout the book test the reader’s understanding of the material and sometimes illustrate extensions of the theory. Initially, the prerequisites for the reader include a passing familiarity with linear algebra.
with manifolds. After the first chapter, it becomes necessary to understand and manipulate differential forms. A knowledge of de Rham cohomology is required for the last third of the text. Prerequisite material is contained in author's text An Introduction to Manifolds, and can be learned in one semester. For the benefit of the reader and to establish common notations, Appendix A recalls the basics of manifold theory. Additionally, in an attempt to make the exposition more self-contained, sections on algebraic constructions such as the tensor product and the exterior power are included. Differential geometry, as its name implies, is the study of geometry using differential calculus. It dates back to Newton and Leibniz in the seventeenth century, but it was not until the nineteenth century, with the work of Gauss on surfaces and Riemann on the curvature tensor, that differential geometry flourished and its modern foundation was laid. Over the past one hundred years, differential geometry has proven indispensable to an understanding of the physical world, in Einstein's general theory of relativity, in the theory of gravitation, in gauge theory, and now in string theory. Differential geometry is also useful in topology, several complex variables, algebraic geometry, complex manifolds, and dynamical systems, among other fields. The field has even found applications to group theory as in Gromov's work and to probability theory as in Diaconis's work. It is not too far-fetched to argue that differential geometry should be in every mathematician's arsenal.

**Differential and Symplectic Topology of Knots and Curves**

Serge Tabachnikov

1999 This book presents a collection of papers on two related topics: topology of knots and knot-like objects (such as curves on surfaces) and topology of Legendrian knots and links in 3-dimensional contact manifolds. Featured is the work of international experts in knot theory.
theory (quantum knot invariants, knot invariants of finite type), in symplectic and contact topology, and in singularity theory. The interplay of diverse methods from these fields makes this volume unique in the study of Legendrian knots and knot-like objects such as wave fronts. A particularly enticing feature of the volume is its international significance. The volume successfully embodies a fine collaborative effort by worldwide experts from Belgium, France, Germany, Israel, Japan, Poland, Russia, Sweden, the U.K., and the U.S.

**Combinatorics of Train Tracks** R. C. Penner 1992

Measured geodesic laminations are a natural generalization of simple closed curves in surfaces, and they play a decisive role in various developments in two- and three-dimensional topology, geometry, and dynamical systems. This book presents a self-contained and comprehensive treatment of the rich combinatorial structure of the space of measured geodesic laminations in a fixed surface. Families of measured geodesic laminations are described by specifying a train track in the surface, and the space of measured geodesic laminations is analyzed by studying properties of train tracks in the surface. The material is developed from first principles, the techniques employed are essentially combinatorial, and only a minimal background is required on the part of the reader. Specifically, familiarity with elementary differential topology and hyperbolic geometry is assumed. The first chapter treats the basic theory of train tracks as discovered by W. P. Thurston, including recurrence, transverse recurrence, and the explicit construction of a measured geodesic lamination from a measured train track. The subsequent chapters develop certain material from R. C. Penner's thesis, including a natural equivalence relation on measured train tracks and standard models for the equivalence classes of train tracks.
used to analyze the topology and geometry of the space of measured geodesic laminations), a duality between transverse and tangential structures on a train track, and the explicit computation of the action of the mapping class group on the space of measured geodesic laminations in the surface.

*Testimonios: Stories of Latinx and Hispanic Mathematicians*

Pamela E. Harris 2021-08-16

Testimonios brings together first-person narratives from the vibrant, diverse, and complex Latinx and Hispanic mathematical community. Starting with childhood and family, the authors recount their own individual stories, highlighting their upbringing, education, and career paths. Their particular stories, told in their own voices, from their own perspectives, give visibility to some of the experiences of Latinx/Hispanic mathematicians. Testimonios seeks to inspire the next generation of Latinx and Hispanic mathematicians by featuring the stories of people like them, holding a mirror up to our own community. It also aims to provide a window for mathematicians (and aspiring mathematicians) from all ethnicities, with the hope of inspiring a better understanding of the diversity of the mathematical community.

**Combinatorial Reciprocity Theorems: An Invitation to Enumerative Geometric Combinatorics** Matthias Beck 2018-12-12

Combinatorial reciprocity is a very interesting phenomenon, which can be described as follows: A polynomial, whose values at positive integers count combinatorial objects of some sort, may give the number of combinatorial objects of a different sort when evaluated at negative integers (and suitably normalized). Such combinatorial reciprocity theorems occur in connections with graphs, partially ordered sets, polyhedra, and more. Using the combinatorial reciprocity theorems as a leitmotif, this book unfolds central ideas and techniques.
enumerative and geometric combinatorics. Written in a friendly writing style, this is an accessible graduate textbook with almost 300 exercises, numerous illustrations, and pointers to the research literature. Topics include concise introductions to partially ordered sets, polyhedral geometry, and rational generating functions, followed by highly original chapters on subdivisions, geometric realizations of partially ordered sets, and hyperplane arrangements.

Analytic Combinatorics
Philippe Flajolet 2009-01-15
Analytic combinatorics aims to enable precise quantitative predictions of the properties of large combinatorial structures. The theory has emerged over recent decades as essential both for the analysis of algorithms and for the study of scientific models in many disciplines, including probability theory, statistical physics, computational biology, and information theory. With a careful combination of symbolic enumeration methods and complex analysis, drawing heavily on generating functions, results of sweeping generality emerge that can be applied in particular to fundamental structures such as permutations, sequences, strings, walks, paths, trees, graphs and maps. This account is the definitive treatment of the topic. The authors give full coverage of the underlying mathematics and a thorough treatment of both classical and modern applications of the theory. The text is complemented with exercises, examples, appendices and notes to aid understanding. The book can be used for an advanced undergraduate or a graduate course, or for self-study.

Image Processing and Analysis
Tony F. Chan 2005-09-01
This book develops the mathematical foundation of modern image processing and low-level computer vision, bridging contemporary mathematics with state-of-the-art methodologies in modern image processing, whilst organizing content...
literature into a coherent and logical structure. The authors have integrated the diversity of modern image processing approaches by revealing the few common threads that connect them to Fourier and spectral analysis, the machinery that image processing has been traditionally built on. The text is systematic and well organized: the geometric, functional, and atomic structures of images are investigated, before moving to a rigorous development and analysis of several image processors. The book is comprehensive and integrative, covering the four most powerful classes of mathematical tools in contemporary image analysis and processing while exploring their intrinsic connections and integration. The material is balanced in theory and computation, following a solid theoretical analysis of model building and performance with computational implementation and numerical examples.

Math from Three to Seven

Aleksandr Kalmanovich Zvonkin 2011

This book is a captivating account of a professional mathematician's experiences conducting a math circle for preschoolers in his apartment in Moscow in the 1980s. As anyone who has taught or raised young children knows, mathematical education for little kids is a real mystery. What are they capable of? What should they learn first? How hard should they work? Should they even "work" at all? Should we push them, or just let them be? There are no correct answers to these questions, and the author deals with them in classic math-circle style: he doesn't ask and then answer a question, but shows us a problem--be it mathematical or pedagogical--and describes to us what happened. His book is a narrative about what he did, what he tried, what worked, what failed, but most important, what the kids experienced. This book does not purport to show you how to create precocious high achievers. It is just one
person's story about things he tried with a half-dozen young children. Mathematicians, psychologists, educators, parents, and everybody interested in the intellectual development in young children will find this book to be an invaluable, inspiring resource. In the interest of fostering a greater awareness and appreciation of mathematics and its connections to other disciplines and everyday life, MSRI and the AMS are publishing books in the Mathematical Circles Library series as a service to young people, their parents and teachers, and the mathematics profession. Titles in this series are co-published with the Mathematical Sciences Research Institute (MSRI).

Critical Issues in Mathematics Education
Bharath Sriraman 2009-06-01
The word "critical" in the title of this collection has three meanings, all of which are relevant. One meaning, as applied to a situation or problem, is "at a point of crisis". A second meaning is "expressing adverse or disapproving comments or judgments". A third is related to the verb "to critique", meaning "to analyze the merits and faults of". The authors contributing to this book pose challenging questions, from multiple perspectives, about the roles of mathematics in society and the implications for education. Traditional reasons for teaching mathematics include: preparing a new generation of mathematics researchers and a cadre of technically competent users of mathematics; training students to think logically; and because mathematics is as much part of cultural heritage as literature or music. These reasons remain valid, though open to critique, but a deeper analysis is required that recognizes the roles of mathematics in framing many aspects of contemporary society, that will connect mathematics education to the lived experiences of students, their communities, and society in general, and that acknowledges the global ethical responsibilities of
mathematicians and mathematics educators. The book is organized in four sections (1) Mathematics education: For what and why? (2) Globalization and cultural diversity, (3) Mathematics, education, and society and (4) Social justice in, and through, mathematics education. The chapters address fundamental issues such as the relevance of school mathematics in people's lives; creating a sense of agency for the field of mathematics education, and redefining the relationship between mathematics as discipline, mathematics as school subject and mathematics as part of people's lives.

**Tropical Geometry and Mirror Symmetry** Mark Gross 2011-01-20 Tropical geometry provides an explanation for the remarkable power of mirror symmetry to connect complex and symplectic geometry. The main theme of this book is the interplay between tropical geometry and mirror symmetry, culminating in a description of the recent work of Gross and Siebert using log geometry to understand how the tropical world relates the A- and B-models in mirror symmetry. The text starts with a detailed introduction to the notions of tropical curves and manifolds, and then gives a thorough description of both sides of mirror symmetry for projective space, bringing together material which so far can only be found scattered throughout the literature. Next follows an introduction to the log geometry of Fontaine-Illusie and Kato, as needed for Nishinou and Siebert's proof of Mikhalkin's tropical curve counting formulas. This latter proof is given in the fourth chapter. The fifth chapter considers the mirror, B-model side, giving recent results of the author showing how tropical geometry can be used to evaluate the oscillatory integrals appearing. The final chapter surveys reconstruction results of the author and Siebert for ``integral tropical manifolds." A complete version of the argument is given in two dimensions.
Topological Modular Forms
Christopher L. Douglas
2014-12-04 The theory of topological modular forms is an intricate blend of classical algebraic modular forms and stable homotopy groups of spheres. The construction of this theory combines an algebro-geometric perspective on elliptic curves over finite fields with techniques from algebraic topology, particularly stable homotopy theory. It has applications to and connections with manifold topology, number theory, and string theory. This book provides a careful, accessible introduction to topological modular forms. After a brief history and an extended overview of the subject, the book proper commences with an exposition of classical aspects of elliptic cohomology, including background material on elliptic curves and modular forms, a description of the moduli stack of elliptic curves, an explanation of the exact functor theorem for constructing cohomology theories, and an exploration of sheaves in stable homotopy theory. There follows a treatment of more specialized topics, including localization of spectra, the deformation theory of formal groups, and Goerss-Hopkins obstruction theory for multiplicative structures on spectra. The book then proceeds to more advanced material, including discussions of the string orientation, the sheaf of spectra on the moduli stack of elliptic curves, the homotopy of topological modular forms, and an extensive account of the construction of the spectrum of topological modular forms. The book concludes with the three original, pioneering and enormously influential manuscripts on the subject, by Hopkins, Miller, and Mahowald.

Persistence Theory: From Quiver Representations to Data Analysis
Steve Y. Oudot
2017-05-17 Persistence theory emerged in the early 2000s as a new theory in the area of applied and computational topology. This book provides a broad and modern view of the
subject, including its algebraic, topological, and algorithmic aspects. It also elaborates on applications in data analysis. The level of detail of the exposition has been set so as to keep a survey style, while providing sufficient insights into the proofs so the reader can understand the mechanisms at work. The book is organized into three parts. The first part is dedicated to the foundations of persistence and emphasizes its connection to quiver representation theory. The second part focuses on its connection to applications through a few selected topics. The third part provides perspectives for both the theory and its applications. The book can be used as a text for a course on applied topology or data analysis.

**Algebraic Geometry and Geometric Modeling**
Mohamed Elkadi 2006-11-02

This book spans the distance between algebraic descriptions of geometric objects and the rendering of digital geometric shapes based on algebraic models. These contrasting points of view inspire a thorough analysis of the key challenges and how they are met. The articles focus on important classes of problems: implicitization, classification, and intersection. Combining illustrative graphics, computations and review articles this book helps the reader gain a firm practical grasp of these subjects.

**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 so-far best evidence for the Birch and Swinnerton-Dyer conjecture. *Tropical Algebraic Geometry* Ilia Itenberg 2009-05-30 These notes present a polished introduction to tropical geometry and contain some applications of this rapidly developing and attractive subject. It consists of three chapters which complete each other and give a possibility for non-specialists to make the first steps in the subject which is not yet well represented in the literature. The notes are based on a seminar at the Mathematical Research Center in Oberwolfach in October 2004. The intended audience is graduate, post-graduate, and Ph.D. students as well as established researchers in mathematics.