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### ALGEBRAIC INTEGRABILITY, PAINLEVÉ GEOMETRY AND LIE ALGEBRAS

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[Springer Science & Business Media](#) This **Ergebnisse** volume is aimed at a wide readership of mathematicians and physicists, graduate students and professionals. The main thrust of the book is to show how algebraic geometry, Lie theory and Painlevé analysis can be used to explicitly solve integrable differential equations and construct the algebraic tori on which they linearize; at the same time, it is, for the student, a playing ground to applying algebraic geometry and Lie theory. The book is meant to be reasonably self-contained and presents numerous examples. The latter appear throughout the text to illustrate the ideas, and make up the core of the last part of the book. The first part of the book contains the basic tools from Lie groups, algebraic and differential geometry to understand the main topic.

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### INTEGRABLE SYSTEMS

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### TWISTORS, LOOP GROUPS, AND RIEMANN SURFACES

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[Oxford University Press](#) Designed to give graduate students an understanding of integrable systems via the study of Riemann surfaces, loop groups, and twistors, this book has its origins in a lecture series given by the internationally renowned authors. Written in an accessible, informal style, it fills a gap in the existing literature.

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### 4-MANIFOLDS

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[Oxford University Press](#) This book presents the topology of smooth 4-manifolds in an intuitive self-contained way, developed over a number of years by Professor Akbulut. The text is aimed at graduate students and focuses on the teaching and learning of the subject, giving a direct approach to constructions and theorems which are supplemented by exercises to help the reader work through the details not covered in the proofs. The book contains a hundred colour illustrations to demonstrate the ideas rather than providing long-winded and potentially unclear explanations. Key results have been selected that relate to the material discussed and the author has provided examples of how to analyse them with the techniques developed in earlier chapters.

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### ARITHMETIC GEOMETRY: COMPUTATION AND APPLICATIONS

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[American Mathematical Soc.](#) For thirty years, the biennial international conference AGC T (Arithmetic, Geometry, Cryptography, and Coding Theory) has brought researchers to Marseille to build connections between arithmetic geometry and its applications, originally highlighting coding theory but more recently including cryptography and other areas as well. This volume contains the proceedings of the 16th international conference, held from June 19-23, 2017. The papers are original research articles covering a large range of topics, including weight enumerators for codes, function field analogs of the Brauer-Siegel theorem, the computation of cohomological invariants of curves, the trace distributions of algebraic groups, and applications of the computation of zeta functions of curves. Despite the varied topics, the papers share a common thread: the beautiful interplay between

abstract theory and explicit results.

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## QUANTUM FIELD THEORY AND MANIFOLD INVARIANTS

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*American Mathematical Society, IAS/Park City Mathematics Institute* This volume contains lectures from the Graduate Summer School “Quantum Field Theory and Manifold Invariants” held at Park City Mathematics Institute 2019. The lectures span topics in topology, global analysis, and physics, and they range from introductory to cutting edge. Topics treated include mathematical gauge theory (anti-self-dual equations, Seiberg-Witten equations, Higgs bundles), classical and categorified knot invariants (Khovanov homology, Heegaard Floer homology), instanton Floer homology, invertible topological field theory, BPS states and spectral networks. This collection presents a rich blend of geometry and topology, with some theoretical physics thrown in as well, and so provides a snapshot of a vibrant and fast-moving field. Graduate students with basic preparation in topology and geometry can use this volume to learn advanced background material before being brought to the frontiers of current developments. Seasoned researchers will also benefit from the systematic presentation of exciting new advances by leaders in their fields.

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## TEACHING AND RESEARCH IN MATHEMATICS

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### A GUIDE WITH APPLICATIONS TO INDUSTRY

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*CRC Press* This insightful Guide is meant to serve any and all interested in pursuing a career in mathematics education and research. The author’s goal and the book’s theme is to help students and others make a smooth transition to teachers and researchers of mathematics. Part I presents helpful techniques on teaching and conducting research. This innovative book also offers strategies on how to observe from and develop research methods, carry out research, and begin writing research papers. It includes an introduction to LaTeX, the most widely used mathematics typesetting and rendering computer program. Part II introduces some modern research in mathematics in various industries. The aim is to expose the reader to modern applications and help him/her become acquainted with research papers and how to read and understand them. Authored by a young teacher and researcher, also beginning her career, this book is written by and for young mathematicians. Most graduate students as she experienced, are not given a proper transitory introduction to research and are not taught the “how” in teaching, attending conferences and collaborating. The book is based on the author’s own observations and on techniques she has found effective. Mathematics graduate students and those in related fields will find assistance to help them reflect on and advance their career pursuits. Advisors and mentors might also find useful suggestions here.

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## REPRESENTATIONS OF LIE ALGEBRAS

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### AN INTRODUCTION THROUGH GLN

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*Cambridge University Press* This bold and refreshing approach to Lie algebras assumes only modest prerequisites (linear algebra up to the Jordan canonical form and a basic familiarity with groups and rings), yet it reaches a major result in representation theory: the highest-weight classification of irreducible modules of the general linear Lie algebra. The author’s exposition is focused on this goal rather than aiming at the widest generality and emphasis is placed on explicit calculations with bases and matrices. The book begins with a motivating chapter explaining the context and relevance of Lie algebras and their representations and concludes with a guide to further reading. Numerous examples and exercises with full solutions are included. Based on the author’s own introductory course on Lie algebras, this book has been thoroughly road-tested by advanced undergraduate and beginning graduate students and it is also suited to individual readers wanting an introduction to this important area of mathematics.

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## FINITE SIMPLE GROUPS: THIRTY YEARS OF THE ATLAS AND BEYOND

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*American Mathematical Soc.* Classification of Finite Simple Groups, one of the most monumental accomplishments of modern mathematics, was announced in 1983 with the proof completed in 2004. Since then, it has opened up a new and powerful strategy to approach and resolve many previously inaccessible problems in group theory, number theory, combinatorics, coding theory, algebraic geometry, and other areas of mathematics. This strategy crucially utilizes various information about finite simple groups, part of which is catalogued in the Atlas of Finite Groups (John H. Conway et al.), and in An Atlas of Brauer Characters (Christoph Jansen et al.). It is impossible to overestimate the roles of the Atlases and the related computer algebra systems in the everyday life of researchers in many areas of contemporary mathematics. The main objective of the conference was to

discuss numerous applications of the Atlases and to explore recent developments and future directions of research, with focus on the interaction between computation and theory and applications to number theory and algebraic geometry. The papers in this volume are based on talks given at the conference. They present a comprehensive survey on current research in all of these fields.

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### LECTURES ON MORSE HOMOLOGY

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[Springer Science & Business Media](#) This book offers a detailed presentation of results needed to prove the Morse Homology Theorem using classical techniques from algebraic topology and homotopy theory. The text presents results that were formerly scattered in the mathematical literature, in a single reference with complete and detailed proofs. The core material includes CW-complexes, Morse theory, hyperbolic dynamical systems (the Lamba-Lemma, the Stable/Unstable Manifold Theorem), transversality theory, the Morse-Smale-Witten boundary operator, and Conley index theory.

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### DIRECTIONS IN NUMBER THEORY

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### PROCEEDINGS OF THE 2014 WIN3 WORKSHOP

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[Springer](#) Exploring the interplay between deep theory and intricate computation, this volume is a compilation of research and survey papers in number theory, written by members of the Women In Numbers (WIN) network, principally by the collaborative research groups formed at Women In Numbers 3, a conference at the Banff International Research Station in Banff, Alberta, on April 21-25, 2014. The papers span a wide range of research areas: arithmetic geometry; analytic number theory; algebraic number theory; and applications to coding and cryptography. The WIN conference series began in 2008, with the aim of strengthening the research careers of female number theorists. The series introduced a novel research-mentorship model: women at all career stages, from graduate students to senior members of the community, joined forces to work in focused research groups on cutting-edge projects designed and led by experienced researchers. The goals for Women In Numbers 3 were to establish ambitious new collaborations between women in number theory, to train junior participants about topics of current importance, and to continue to build a vibrant community of women in number theory. Forty-two women attended the WIN3 workshop, including 15 senior and mid-level faculty, 15 junior faculty and postdocs, and 12 graduate students.

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### QUANTUM THEORY, GROUPS AND REPRESENTATIONS

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#### AN INTRODUCTION

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[Springer](#) This text systematically presents the basics of quantum mechanics, emphasizing the role of Lie groups, Lie algebras, and their unitary representations. The mathematical structure of the subject is brought to the fore, intentionally avoiding significant overlap with material from standard physics courses in quantum mechanics and quantum field theory. The level of presentation is attractive to mathematics students looking to learn about both quantum mechanics and representation theory, while also appealing to physics students who would like to know more about the mathematics underlying the subject. This text showcases the numerous differences between typical mathematical and physical treatments of the subject. The latter portions of the book focus on central mathematical objects that occur in the Standard Model of particle physics, underlining the deep and intimate connections between mathematics and the physical world. While an elementary physics course of some kind would be helpful to the reader, no specific background in physics is assumed, making this book accessible to students with a grounding in multivariable calculus and linear algebra. Many exercises are provided to develop the reader's understanding of and facility in quantum-theoretical concepts and calculations.

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### ARITHMETIC OF L-FUNCTIONS

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[American Mathematical Soc.](#) The overall theme of the 2009 IAS/PCMI Graduate Summer School was connections between special values of  $L$ -functions and arithmetic, especially the Birch and Swinnerton-Dyer Conjecture and Stark's Conjecture. These conjectures are introduced and discussed in depth, and progress made over the last 30 years is described. This volume contains the written versions of the graduate courses delivered at the summer school. It would be a suitable text for advanced graduate topics courses on the Birch and Swinnerton-Dyer Conjecture and/or Stark's Conjecture. The book will also serve as a reference volume for experts in the field.

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## ARITHMETIC GEOMETRY

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### LECTURES GIVEN AT THE C.I.M.E. SUMMER SCHOOL HELD IN CETRARO, ITALY, SEPTEMBER 10-15, 2007

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[Springer](#) **Arithmetic Geometry** can be defined as the part of Algebraic Geometry connected with the study of algebraic varieties through arbitrary rings, in particular through non-algebraically closed fields. It lies at the intersection between classical algebraic geometry and number theory. A C.I.M.E. Summer School devoted to arithmetic geometry was held in Cetraro, Italy in September 2007, and presented some of the most interesting new developments in arithmetic geometry. This book collects the lecture notes which were written up by the speakers. The main topics concern diophantine equations, local-global principles, diophantine approximation and its relations to Nevanlinna theory, and rationally connected varieties. The book is divided into three parts, corresponding to the courses given by J-L Colliot-Thelene, Peter Swinnerton Dyer and Paul Vojta.

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## PERVERSE SHEAVES AND APPLICATIONS TO REPRESENTATION THEORY

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[American Mathematical Soc.](#) Since its inception around 1980, the theory of perverse sheaves has been a vital tool of fundamental importance in geometric representation theory. This book, which aims to make this theory accessible to students and researchers, is divided into two parts. The first six chapters give a comprehensive account of constructible and perverse sheaves on complex algebraic varieties, including such topics as Artin's vanishing theorem, smooth descent, and the nearby cycles functor. This part of the book also has a chapter on the equivariant derived category, and brief surveys of side topics including étale and  $l$ -adic sheaves, D-modules, and algebraic stacks. The last four chapters of the book show how to put this machinery to work in the context of selected topics in geometric representation theory: Kazhdan-Lusztig theory; Springer theory; the geometric Satake equivalence; and canonical bases for quantum groups. Recent developments such as the  $p$ -canonical basis are also discussed. The book has more than 250 exercises, many of which focus on explicit calculations with concrete examples. It also features a 4-page "Quick Reference" that summarizes the most commonly used facts for computations, similar to a table of integrals in a calculus textbook.

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## MOTIVIC HOMOTOPY THEORY AND REFINED ENUMERATIVE GEOMETRY

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[American Mathematical Soc.](#) This volume contains the proceedings of the Workshop on Motivic Homotopy Theory and Refined Enumerative Geometry, held from May 14-18, 2018, at the Universität Duisburg-Essen, Essen, Germany. It constitutes an accessible yet swift introduction to a new and active area within algebraic geometry, which connects well with classical intersection theory. Combining both lecture notes aimed at the graduate student level and research articles pointing towards the manifold promising applications of this refined approach, it broadly covers refined enumerative algebraic geometry.

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## HOMOTOPY THEORY OF FUNCTION SPACES AND RELATED TOPICS

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[American Mathematical Soc.](#) This volume contains the proceedings of the Workshop on Homotopy Theory of Function Spaces and Related Topics, which was held at the Mathematisches Forschungsinstitut Oberwolfach, in Germany, from April 5-11, 2009. This volume contains fourteen original research articles covering a broad range of topics that include: localization and rational homotopy theory, evaluation subgroups, free loop spaces, Whitehead products, spaces of algebraic maps, gauge groups, loop groups, operads, and string topology. In addition to reporting on various topics in the area, this volume is supposed to facilitate the exchange of ideas within Homotopy Theory of Function Spaces, and promote crossfertilization between Homotopy Theory of Function Spaces and other areas. With these latter aims in mind, this volume includes a survey article which, with its extensive bibliography, should help bring researchers and graduate students up to speed on activity in this field as well as a problems list, which is an expanded and edited version of problems discussed in sessions held at the conference. The problems list is intended to suggest directions for future work.

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## MINIMAL SURFACES FROM A COMPLEX ANALYTIC VIEWPOINT

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[Springer Nature](#) This monograph offers the first systematic treatment of the theory of minimal surfaces in Euclidean spaces by complex analytic methods, many of which have been developed in recent decades as part of the theory of Oka manifolds (the  $h$ -principle in complex analysis). It places particular emphasis on the study of the global theory of minimal surfaces with a given complex structure. Advanced methods of holomorphic approximation, interpolation, and homotopy classification of manifold-valued maps, along with elements of convex integration theory, are implemented for the first time in the theory of minimal surfaces. The text also presents newly developed methods for constructing minimal surfaces in minimally convex domains of  $\mathbb{R}^n$ , based on the Riemann-Hilbert boundary value problem adapted to minimal surfaces and holomorphic null curves. These methods also

provide major advances in the classical Calabi-Yau problem, yielding in particular minimal surfaces with the conformal structure of any given bordered Riemann surface. Offering new directions in the field and several challenging open problems, the primary audience of the book are researchers (including postdocs and PhD students) in differential geometry and complex analysis. Although not primarily intended as a textbook, two introductory chapters surveying background material and the classical theory of minimal surfaces also make it suitable for preparing Masters or PhD level courses.

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### GEOMETRIC FLOWS AND THE GEOMETRY OF SPACE-TIME

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[Springer](#) This book consists of two lecture notes on geometric flow equations (O. Schnürer) and Lorentzian geometry - holonomy, spinors and Cauchy Problems (H. Baum and T. Leistner) written by leading experts in these fields. It grew out of the summer school "Geometric flows and the geometry of space-time" held in Hamburg (2016) and provides an excellent introduction for students of mathematics and theoretical physics to important themes of current research in global analysis, differential geometry and mathematical physics

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### A COURSE IN TOPOLOGICAL COMBINATORICS

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[Springer Science & Business Media](#) While "topological combinatorics" might have the ring of a venerable discipline, it actually names a newly consolidated subject that pulls together results mostly from recent decades. This new branch of mathematics nevertheless features ample content accessible to undergraduates. Only specialists will guess the purview from the title alone, namely deducing combinatorial (especially graph-theoretic) results using tools from algebraic topology. Elementary algebraic topology suffices, and the appendixes comprising the last third of the present volume offer a crash course. In the book's four main chapters, Longueville (Univ. of Applied Sciences, Germany) addresses fair-division problems; graph coloring; graph property evasiveness; and embeddings and mappings. Chapter 4 contains a high point: the best available introduction to the famous and notoriously difficult half-century-old thrackle conjecture of J. H. Conway. "Thrackle" means a graph drawing where adjacent edges do not cross but independent edges cross exactly once; Conway simply hazards that thrackable graphs never have more edges than vertices. Basic results of algebraic topology already have powerful consequences for analysis, but the subject's arcana can look like art for art's sake. The author's charting of a novel application domain for a core subject makes this book an essential acquisition. Summing Up: Essential. Upper-division undergraduates and above. Upper-division Undergraduates; Graduate Students; Researchers/Faculty; Professionals/Practitioners. Reviewed by D. V. Feldman.

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### BANACH SPACES OF CONTINUOUS FUNCTIONS AS DUAL SPACES

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[Springer](#) This book gives a coherent account of the theory of Banach spaces and Banach lattices, using the spaces  $C_0(K)$  of continuous functions on a locally compact space  $K$  as the main example. The study of  $C_0(K)$  has been an important area of functional analysis for many years. It gives several new constructions, some involving Boolean rings, of this space as well as many results on the Stonean space of Boolean rings. The book also discusses when Banach spaces of continuous functions are dual spaces and when they are bidual spaces.

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### SUPERSYMMETRIC FIELD THEORIES

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[Cambridge University Press](#) Adopting an elegant geometrical approach, this advanced pedagogical text describes deep and intuitive methods for understanding the subtle logic of supersymmetry while avoiding lengthy computations. The book describes how complex results and formulae obtained using other approaches can be significantly simplified when translated to a geometric setting. Introductory chapters describe geometric structures in field theory in the general case, while detailed later chapters address specific structures such as parallel tensor fields,  $G$ -structures, and isometry groups. The relationship between structures in supergravity and periodic maps of algebraic manifolds, Kodaira-Spencer theory, modularity, and the arithmetic properties of supergravity are also addressed. Relevant geometric concepts are introduced and described in detail, providing a self-contained toolkit of useful techniques, formulae and constructions. Covering all the material necessary for the application of supersymmetric field theories to fundamental physical questions, this is an outstanding resource for graduate students and researchers in theoretical physics.

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### HANDBOOK OF DIFFERENTIAL GEOMETRY

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[Elsevier](#) In the series of volumes which together will constitute the "Handbook of Differential Geometry" we try to give a rather complete survey of the field of differential geometry.

The different chapters will both deal with the basic material of differential geometry and with research results (old and recent). All chapters are written by experts in the area and contain a large bibliography. In this second volume a wide range of areas in the very broad field of differential geometry is discussed, as there are Riemannian geometry, Lorentzian geometry, Finsler geometry, symplectic geometry, contact geometry, complex geometry, Lagrange geometry and the geometry of foliations. Although this does not cover the whole of differential geometry, the reader will be provided with an overview of some its most important areas. . Written by experts and covering recent research . Extensive bibliography . Dealing with a diverse range of areas . Starting from the basics

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### **CATEGORY THEORY IN CONTEXT**

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[Courier Dover Publications](#) Introduction to concepts of category theory – categories, functors, natural transformations, the Yoneda lemma, limits and colimits, adjunctions, monads – revisits a broad range of mathematical examples from the categorical perspective. 2016 edition.

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### **COMBINATORIAL RECIPROCITY THEOREMS: AN INVITATION TO ENUMERATIVE GEOMETRIC COMBINATORICS**

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[American Mathematical Soc.](#) 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 in 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.

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### **$\mathbb{P}$ -ADIC ANALYSIS, ARITHMETIC AND SINGULARITIES**

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[American Mathematical Society](#) This volume contains the proceedings of the 2019 Lluís A. Santaló Summer School on  $\mathbb{P}$ -Adic Analysis, Arithmetic and Singularities, which was held from June 24-28, 2019, at the Universidad Internacional Menéndez Pelayo, Santander, Spain. The main purpose of the book is to present and analyze different incarnations of the local zeta functions and their multiple connections in mathematics and theoretical physics. Local zeta functions are ubiquitous objects in mathematics and theoretical physics. At the mathematical level, local zeta functions contain geometry and arithmetic information about the set of zeros defined by a finite number of polynomials. In terms of applications in theoretical physics, these functions play a central role in the regularization of Feynman amplitudes and Koba-Nielsen-type string amplitudes, among other applications. This volume provides a gentle introduction to a very active area of research that lies at the intersection of number theory,  $\mathbb{P}$ -adic analysis, algebraic geometry, singularity theory, and theoretical physics. Specifically, the book introduces  $\mathbb{P}$ -adic analysis, the theory of Archimedean,  $\mathbb{P}$ -adic, and motivic zeta functions, singularities of plane curves and their Poincaré series, among other similar topics. It also contains original contributions in the aforementioned areas written by renowned specialists. This book is an important reference for students and experts who want to delve quickly into the area of local zeta functions and their many connections in mathematics and theoretical physics.

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### **GEOMETRY AND TOPOLOGY OF MANIFOLDS: SURFACES AND BEYOND**

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[American Mathematical Soc.](#) This book represents a novel approach to differential topology. Its main focus is to give a comprehensive introduction to the classification of manifolds, with special attention paid to the case of surfaces, for which the book provides a complete classification from many points of view: topological, smooth, constant curvature, complex, and conformal. Each chapter briefly revisits basic results usually known to graduate students from an alternative perspective, focusing on surfaces. We provide full proofs of some remarkable results that sometimes are missed in basic courses (e.g., the construction of triangulations on surfaces, the classification of surfaces, the Gauss-Bonnet theorem, the degree-genus formula for complex plane curves, the existence of constant curvature metrics on conformal surfaces), and we give hints to questions about higher dimensional manifolds. Many examples and remarks are scattered through the book. Each chapter ends with an exhaustive collection of problems and a list of topics for further study. The book is primarily addressed to graduate students who did take standard introductory courses on algebraic topology, differential and Riemannian geometry, or algebraic geometry, but have not seen their deep interconnections, which permeate a modern approach to geometry and topology of manifolds.

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## **\$P\$-ADIC GEOMETRY**

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### **LECTURES FROM THE 2007 ARIZONA WINTER SCHOOL**

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*American Mathematical Soc.* In recent decades,  $p$ -adic geometry and  $p$ -adic cohomology theories have become indispensable tools in number theory, algebraic geometry, and the theory of automorphic representations. The Arizona Winter School 2007, on which the current book is based, was a unique opportunity to introduce graduate students to this subject. Following invaluable introductions by John Tate and Vladimir Berkovich, two pioneers of non-archimedean geometry, Brian Conrad's chapter introduces the general theory of Tate's rigid analytic spaces, Raynaud's view of them as the generic fibers of formal schemes, and Berkovich spaces. Samit Dasgupta and Jeremy Teitelbaum discuss the  $p$ -adic upper half plane as an example of a rigid analytic space and give applications to number theory (modular forms and the  $p$ -adic Langlands program). Matthew Baker offers a detailed discussion of the Berkovich projective line and  $p$ -adic potential theory on that and more general Berkovich curves. Finally, Kiran Kedlaya discusses theoretical and computational aspects of  $p$ -adic cohomology and the zeta functions of varieties. This book will be a welcome addition to the library of any graduate student and researcher who is interested in learning about the techniques of  $p$ -adic geometry.

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## **ALGEBRAIC GEOMETRY**

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### **2005 SUMMER RESEARCH INSTITUTE, JULY 25-AUGUST 12, 2005, UNIVERSITY OF WASHINGTON, SEATTLE, WASHINGTON**

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*American Mathematical Soc.* The 2005 AMS Summer Institute on Algebraic Geometry in Seattle was an enormous event. With over 500 participants, including many of the world's leading experts, it was perhaps the largest conference on algebraic geometry ever held. These two proceedings volumes present research and expository papers by some of the most outstanding speakers at the meeting, vividly conveying the grandeur and vigor of the subject. The most exciting topics in current algebraic geometry research receive very ample treatment. For instance, there is enlightening information on many of the latest technical tools, from jet schemes and derived categories to algebraic stacks. Numerous papers delve into the geometry of various moduli spaces, including those of stable curves, stable maps, coherent sheaves, and abelian varieties. Other papers discuss the recent dramatic advances in higher-dimensional birational geometry, while still others trace the influence of quantum field theory on algebraic geometry via mirror symmetry, Gromov-Witten invariants, and symplectic geometry. The proceedings of earlier algebraic geometry AMS Institutes, held at Woods Hole, Arcata, Bowdoin, and Santa Cruz, have become classics. The present volumes promise to be equally influential. They present the state of the art in algebraic geometry in papers that will have broad interest and enduring value.

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## **PROBABILITY THEORY**

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### **A COMPREHENSIVE COURSE**

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*Springer Nature* This popular textbook, now in a revised and expanded third edition, presents a comprehensive course in modern probability theory. Probability plays an increasingly important role not only in mathematics, but also in physics, biology, finance and computer science, helping to understand phenomena such as magnetism, genetic diversity and market volatility, and also to construct efficient algorithms. Starting with the very basics, this textbook covers a wide variety of topics in probability, including many not usually found in introductory books, such as: limit theorems for sums of random variables martingales percolation Markov chains and electrical networks construction of stochastic processes Poisson point process and infinite divisibility large deviation principles and statistical physics Brownian motion stochastic integrals and stochastic differential equations. The presentation is self-contained and mathematically rigorous, with the material on probability theory interspersed with chapters on measure theory to better illustrate the power of abstract concepts. This third edition has been carefully extended and includes new features, such as concise summaries at the end of each section and additional questions to encourage self-reflection, as well as updates to the figures and computer simulations. With a wealth of examples and more than 290 exercises, as well as biographical details of key mathematicians, it will be of use to students and researchers in mathematics, statistics, physics, computer science, economics and biology.

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## **INTERSECTION COHOMOLOGY, SIMPLICIAL BLOW-UP AND RATIONAL HOMOTOPY**

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*American Mathematical Soc.* Let  $X$  be a pseudomanifold. In this text, the authors use a simplicial blow-up to define a cochain complex whose cohomology with coefficients in a field, is isomorphic to the intersection cohomology of  $X$ , introduced by M. Goresky and R. MacPherson. The authors do it simplicially in the setting of a filtered version of face sets, also

called simplicial sets without degeneracies, in the sense of C. P. Rourke and B. J. Sanderson. They define perverse local systems over filtered face sets and intersection cohomology with coefficients in a perverse local system. In particular, as announced above when  $X$  is a pseudomanifold, the authors get a perverse local system of cochains quasi-isomorphic to the intersection cochains of Goresky and MacPherson, over a field. We show also that these two complexes of cochains are quasi-isomorphic to a filtered version of Sullivan's differential forms over the field  $\mathbb{Q}$ . In a second step, they use these forms to extend Sullivan's presentation of rational homotopy type to intersection cohomology.

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## DIFFERENTIAL GEOMETRY

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### BUNDLES, CONNECTIONS, METRICS AND CURVATURE

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[Oxford University Press](#) Bundles, connections, metrics and curvature are the lingua franca of modern differential geometry and theoretical physics. Supplying graduate students in mathematics or theoretical physics with the fundamentals of these objects, this book would suit a one-semester course on the subject of bundles and the associated geometry.

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### ALGEBRAIC AND COMBINATORIAL ASPECTS OF TROPICAL GEOMETRY

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[American Mathematical Soc.](#) This volume contains the proceedings of the CIEM workshop on Tropical Geometry, held December 12-16, 2011, at the International Centre for Mathematical Meetings (CIEM), Castro Urdiales, Spain. Tropical geometry is a new and rapidly developing field of mat

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### THE GOLDEN ANNIVERSARY CELEBRATION OF THE NATIONAL ASSOCIATION OF MATHEMATICIANS

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[American Mathematical Soc.](#) This volume is put together by the National Association of Mathematicians to commemorate its 50th anniversary. The articles in the book are based on lectures presented at several events at the Joint Mathematics Meeting held from January 16-19, 2019, in Baltimore, Maryland, including the Claytor-Woodard Lecture as well as the NAM David Harold Blackwell Lecture, which was held on August 2, 2019, in Cincinnati, Ohio.

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### A TOUR OF REPRESENTATION THEORY

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[American Mathematical Soc.](#) Representation theory investigates the different ways in which a given algebraic object--such as a group or a Lie algebra--can act on a vector space. Besides being a subject of great intrinsic beauty, the theory enjoys the additional benefit of having applications in myriad contexts outside pure mathematics, including quantum field theory and the study of molecules in chemistry. Adopting a panoramic viewpoint, this book offers an introduction to four different flavors of representation theory: representations of algebras, groups, Lie algebras, and Hopf algebras. A separate part of the book is devoted to each of these areas and they are all treated in sufficient depth to enable and hopefully entice the reader to pursue research in representation theory. The book is intended as a textbook for a course on representation theory, which could immediately follow the standard graduate abstract algebra course, and for subsequent more advanced reading courses. Therefore, more than 350 exercises at various levels of difficulty are included. The broad range of topics covered will also make the text a valuable reference for researchers in algebra and related areas and a source for graduate and postgraduate students wishing to learn more about representation theory by self-study.

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### SETS, MODELS AND PROOFS

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[Springer](#) This textbook provides a concise and self-contained introduction to mathematical logic, with a focus on the fundamental topics in first-order logic and model theory. Including examples from several areas of mathematics (algebra, linear algebra and analysis), the book illustrates the relevance and usefulness of logic in the study of these subject areas. The authors start with an exposition of set theory and the axiom of choice as used in everyday mathematics. Proceeding at a gentle pace, they go on to present some of the first important results in model theory, followed by a careful exposition of Gentzen-style natural deduction and a detailed proof of Gödel's completeness theorem for first-order logic. The book then explores the formal axiom system of Zermelo and Fraenkel before concluding with an extensive list of suggestions for further study. The present volume is primarily aimed at mathematics students who are already familiar with basic analysis, algebra and linear algebra. It contains numerous exercises of varying difficulty and can be used for self-study, though it is ideally suited as a text for a one-semester university course in the second or third year.

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## TOPICS IN SEVERAL COMPLEX VARIABLES

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*American Mathematical Soc.* This volume contains the proceedings of the Special Session on Several Complex Variables, which was held during the first USA-Uzbekistan Conference on Analysis and Mathematical Physics from May 20-23, 2014, at California State University, Fullerton. This volume covers a wide variety of topics in pluripotential theory, symplectic geometry and almost complex structures, integral formulas, holomorphic extension, and complex dynamics. In particular, the reader will find articles on Lagrangian submanifolds and rational convexity, multidimensional residues, S-parabolic Stein manifolds, Segre varieties, and the theory of quasianalytic functions.

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## ROBERT BIERI AND RALPH STREBEL

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*American Mathematical Soc.* Richard Thompson's famous group  $F$  has the striking property that it can be realized as a dense subgroup of the group of all orientation-preserving homeomorphisms of the unit interval, but it can also be given by a simple 2-generator-2-relator presentation, in fact as the fundamental group of an aspherical complex with only two cells in each dimension. This monograph studies a natural generalization of  $F$  that also includes Melanie Stein's generalized  $F$ -groups. The main aims of this monograph are the determination of isomorphisms among the generalized  $F$ -groups and the study of their automorphism groups. This book is aimed at graduate students (or teachers of graduate students) interested in a class of examples of torsion-free infinite groups with elements and composition that are easy to describe and work with, but have unusual properties and surprisingly small presentations in terms of generators and defining relations.

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## RANDOM SETS AND INVARIANTS FOR (TYPE II) CONTINUOUS TENSOR PRODUCT SYSTEMS OF HILBERT SPACES

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*American Mathematical Soc.* In a series of papers Tsirelson constructed from measure types of random sets or (generalised) random processes a new range of examples for continuous tensor product systems of Hilbert spaces introduced by Arveson for classifying  $E_0$ -semigroups upto cocycle conjugacy. This paper starts from establishing the converse. So the author connects each continuous tensor product system of Hilbert spaces with measure types of distributions of random (closed) sets in  $[0,1]$  or  $\mathbb{R}_+$ . These measure types are stationary and factorise over disjoint intervals. In a special case of this construction, the corresponding measure type is an invariant of the product system. This shows, completing in a more systematic way the Tsirelson examples, that the classification scheme for product systems into types  $\mathrm{I}_n$ ,  $\mathrm{II}_n$  and  $\mathrm{III}$  is not complete. Moreover, based on a detailed study of this kind of measure types, the author constructs for each stationary factorising measure type a continuous tensor product system of Hilbert spaces such that this measure type arises as the before mentioned invariant.

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## LIE GROUPS, LIE ALGEBRAS, AND REPRESENTATIONS

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### AN ELEMENTARY INTRODUCTION

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*Springer* This textbook treats Lie groups, Lie algebras and their representations in an elementary but fully rigorous fashion requiring minimal prerequisites. In particular, the theory of matrix Lie groups and their Lie algebras is developed using only linear algebra, and more motivation and intuition for proofs is provided than in most classic texts on the subject. In addition to its accessible treatment of the basic theory of Lie groups and Lie algebras, the book is also noteworthy for including: a treatment of the Baker-Campbell-Hausdorff formula and its use in place of the Frobenius theorem to establish deeper results about the relationship between Lie groups and Lie algebras motivation for the machinery of roots, weights and the Weyl group via a concrete and detailed exposition of the representation theory of  $\mathfrak{sl}(3;\mathbb{C})$  an unconventional definition of semisimplicity that allows for a rapid development of the structure theory of semisimple Lie algebras a self-contained construction of the representations of compact groups, independent of Lie-algebraic arguments The second edition of Lie Groups, Lie Algebras, and Representations contains many substantial improvements and additions, among them: an entirely new part devoted to the structure and representation theory of compact Lie groups; a complete derivation of the main properties of root systems; the construction of finite-dimensional representations of semisimple Lie algebras has been elaborated; a treatment of universal enveloping algebras, including a proof of the Poincaré-Birkhoff-Witt theorem and the existence of Verma modules; complete proofs of the Weyl character formula, the Weyl dimension formula and the Kostant multiplicity formula. Review of the first edition: This is an excellent book. It deserves to, and undoubtedly will, become the standard text for early graduate courses in Lie group theory ... an important addition to the textbook literature ... it is highly recommended. — The Mathematical Gazette

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**COMPUTER ALGEBRA IN SCIENTIFIC COMPUTING**

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**24TH INTERNATIONAL WORKSHOP, CASC 2022, GEBZE, TURKEY, AUGUST 22-26, 2022, PROCEEDINGS**

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[Springer Nature](#) This book constitutes the proceedings of the 24th International Workshop on Computer Algebra in Scientific Computing, CASC 2022, which took place in Gebze, Turkey, in August 2022. The 20 full papers included in this book were carefully reviewed and selected from 32 submissions. They focus on the theory of symbolic computation and its implementation in computer algebra systems as well as all other areas of scientific computing with regard to their benefit from or use of computer algebra methods and software.