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CURTIS CANTRELL

Nonlinear Dirac Equation: Spectral Stability of Solitary Waves Walter de Gruyter GmbH & Co KG
We live in a highly connected world with multiple self-interested agents interacting and myriad opportunities for conflict and cooperation. The goal of game theory is to understand these opportunities. This book presents a rigorous introduction to the mathematics of game theory without losing sight of the joy of the subject. This is done by focusing on theoretical highlights (e.g., at least six Nobel Prize winning results are developed from scratch) and by presenting exciting connections of game theory to other fields such as computer science (algorithmic game theory), economics (auctions and matching markets), social choice (voting theory), biology (signaling and evolutionary stability), and learning theory. Both classical topics, such as zero-sum games, and modern topics, such as sponsored search auctions, are covered. Along the way, beautiful mathematical tools used in game theory are introduced, including convexity, fixed-point theorems, and probabilistic arguments. The book is appropriate for a first course in game theory at either the undergraduate or graduate level, whether in mathematics, economics, computer science, or statistics. The importance of game-theoretic thinking transcends the academic setting—for every action we take, we must consider not only its direct effects, but also how it influences the incentives of others.
Tool Kit for Groupoid C∗ -Algebras American Mathematical Soc.
This book presents multiprecision algorithms used in number theory and elsewhere, such as extrapolation, numerical integration, numerical summation (including multiple zeta values and the Riemann-Siegel formula), evaluation and speed of convergence of continued fractions, Euler products and Euler sums, inverse Mellin transforms, and complex L L-functions. For each task, many algorithms are presented, such as Gaussian and doubly-exponential integration, Euler-MacLaurin, Abel-Plana, Lagrange, and Monien summation. Each algorithm is given in detail, together with a complete implementation in the free Pari/GP system. These implementations serve both to make even more precise the inner workings of the algorithms, and to gently introduce advanced features of the Pari/GP language. This book will be appreciated by anyone interested in number theory, specifically in practical implementations, computer experiments and numerical algorithms that can be scaled to produce thousands of digits of accuracy.
Linear and Quasilinear Parabolic Systems: Sobolev Space Theory American Mathematical Soc.
This book covers elementary discrete mathematics for computer science and engineering. It emphasizes mathematical definitions and proofs as well as applicable methods. Topics include formal logic notation, proof methods; induction, well-ordering; sets, relations; elementary graph theory; integer congruences; asymptotic notation and growth of functions; permutations and combinations, counting principles; discrete probability. Further selected topics may also be covered, such as recursive definition and structural induction; state machines and invariants; recurrences; generating functions.
Hilbert Schemes of Points and Infinite Dimensional Lie Algebras Cambridge University Press
Written by one of the founding fathers of Quantum Information, this book gives an accessible (albeit mathematically rigorous), self-contained introduction to quantum information theory. The central role is played by the concept of quantum channel and its entropic and information characteristics. In this revised edition, the main results have been updated to reflect the most recent developments in this very active field of research.
Sugawara Operators for Classical Lie Algebras American Mathematical Soc.
The connective topological modular forms spectrum, tmf, is in a sense initial among elliptic spectra, and as such is an important link between the homotopy groups of spheres and modular forms. A primary goal of this volume is to give a complete account, with full proofs, of the homotopy of tmf and several tmf-module spectra by means of the classical Adams spectral sequence, thus verifying, correcting, and extending existing approaches. In the process, folklore results are made precise and generalized. Anderson and Brown-Comenetz duality, and the corresponding dualities in homotopy groups, are carefully proved. The volume also includes an account of the homotopy groups of spheres through degree 44, with complete proofs, except that the Adams conjecture is used without proof. Also presented are modern stable proofs of classical results which are hard to extract from the literature. Tools used in this book include a multiplicative spectral sequence generalizing a construction of Davis and Mahowald, and computer software which computes the cohomology of modules over the Steenrod algebra and products therein. Techniques from commutative algebra are used to make the calculation precise and finite. The H-infinity ring structure of the sphere and of tmf are used to determine many differentials and relations.
The Dirichlet Space and Related Function Spaces Springer Nature
The celebrated Schur-Weyl duality gives rise to effective ways of constructing invariant polynomials on the classical Lie algebras. The emergence of the theory of quantum groups in the 1980s brought up special matrix techniques which allowed one to

extend these constructions beyond polynomial invariants and produce new families of Casimir elements for finite-dimensional Lie algebras. Sugawara operators are analogs of Casimir elements for the affine Kac-Moody algebras. The goal of this book is to describe algebraic structures associated with the affine Lie algebras, including affine vertex algebras, Yangians, and classical -algebras, which have numerous ties with many areas of mathematics and mathematical physics, including modular forms, conformal field theory, and soliton equations. An affine version of the matrix technique is developed and used to explain the elegant constructions of Sugawara operators, which appeared in the last decade. An affine analogue of the Harish-Chandra isomorphism connects the Sugawara operators with the classical -algebras, which play the role of the Weyl group invariants in the finite-dimensional theory.

One-Dimensional Turbulence and the Stochastic Burgers Equation American Mathematical Soc.

The classification of finite simple groups is a landmark result of modern mathematics. The multipart series of monographs which is being published by the AMS (Volume 40.1–40.7 and future volumes) represents the culmination of a century-long project involving the efforts of scores of mathematicians published in hundreds of journal articles, books, and doctoral theses, totaling an estimated 15,000 pages. This part 7 of the series is the middle of a trilogy (Volume 40.5, Volume 40.7, and forthcoming Volume 40.8) treating the Generic Case, i.e., the identification of the alternating groups of degree at least 13 and most of the finite simple groups of Lie type and Lie rank at least 4. Moreover, Volumes 40.4–40.8 of this series will provide a complete treatment of the simple groups of odd type, i.e., the alternating groups (with two exceptions) and the groups of Lie type defined over a finite field of odd order, as well as some of the sporadic simple groups. In particular, this volume completes the construction, begun in Volume 40.5, of a collection of neighboring centralizers of a particularly nice form. All of this is then applied to complete the identification of the alternating groups of degree at least 13. The book is suitable for graduate students and researchers interested in the theory of finite groups.

Numerical Algorithms for Number Theory: Using Pari/GP American Mathematical Soc.

Nilsystems play a key role in the structure theory of measure preserving systems, arising as the natural objects that describe the behavior of multiple ergodic averages. This book is a comprehensive treatment of their role in ergodic theory, covering development of the abstract theory leading to the structural statements, applications of these results, and connections to other fields. Starting with a summary of the relevant dynamical background, the book methodically develops the theory of cubic structures that give rise to nilpotent groups and reviews results on nilsystems and their properties that are scattered throughout the literature. These basic ingredients lay the groundwork for the ergodic structure theorems, and the book includes numerous formulations of these deep results, along with detailed proofs. The structure theorems have many applications, both in ergodic theory and in related fields; the book develops the connections to topological dynamics, combinatorics, and number theory, including an overview of the role of nilsystems in each of these areas. The final section is devoted to applications of the structure theory, covering numerous convergence and recurrence results. The book is aimed at graduate students and researchers in ergodic theory, along with those who work in the related areas of arithmetic combinatorics, harmonic analysis, and number theory.

Ordinary Differential Operators Oxford University Press

Introduced by Peter Scholze in 2011, perfectoid spaces are a bridge between geometry in characteristic 0 and characteristic p, and have been used to solve many important problems, including cases of the weight-monodromy conjecture and the association of Galois representations to torsion classes in cohomology. In recognition of the transformative impact perfectoid spaces have had on the field of arithmetic geometry, Scholze was awarded a Fields Medal in 2018. This book, originating from a series of lectures given at the 2017 Arizona Winter School on perfectoid spaces, provides a broad introduction to the subject. After an introduction with insight into the history and future of the subject by Peter Scholze, Jared Weinstein gives a user-friendly and utilitarian account of the theory of adic spaces. Kiran Kedlaya further develops the foundational material, studies vector bundles on Fargues–Fontaine curves, and introduces diamonds and shtukas over them with a view toward the local Langlands correspondence. Bhargav Bhatt explains the application of perfectoid spaces to comparison isomorphisms in p-adic Hodge theory. Finally, Ana Caraiani explains the application of perfectoid spaces to the construction of Galois representations associated to torsion classes in the cohomology of locally symmetric spaces for the general linear group. This book will be an invaluable asset for any graduate student or researcher interested in the theory of perfectoid spaces and their applications.

Quantum Information Theory American Mathematical Society

The book is an introductory textbook mainly for students of computer science and mathematics. Our guiding phrase is "what every theoretical computer scientist should know about linear programming". A major focus is on applications of linear programming, both in practice and in theory. The book is concise, but at the same time, the main results are covered with complete proofs and in sufficient detail, ready for presentation in class. The book does not require more prerequisites than basic linear algebra, which is summarized in an appendix. One of its main goals is to help the reader to see linear programming "behind the scenes".

Mathematics and Computation Springer Science & Business Media

This book completes a trilogy (Numbers 5, 7, and 8) of the series The Classification of the Finite Simple Groups treating the generic case of the classification of the finite simple groups. In conjunction with Numbers 4 and 6, it allows us to reach a major milestone in our series—the completion of the proof of the following theorem: Theorem O: Let G be a finite simple group of odd type, all of whose proper simple sections are known simple groups. Then either G is an alternating group or G is a finite group of Lie type defined over a field of odd order or G is one of six sporadic simple groups. Put another way, Theorem O asserts that any minimal counterexample to the classification of the finite simple groups must be of even type. The work of Aschbacher and Smith shows that a minimal counterexample is not of quasithin even type, while this volume shows that a minimal counterexample cannot be of generic even type, modulo the treatment of certain intermediate configurations of even type which will be ruled out in the next volume of our series.

Attractors Under Autonomous and Non-autonomous Perturbations Princeton University Press

This book constitutes the refereed proceedings of the 14th Latin American Symposium on Theoretical Informatics, LATIN 2020, held in Sao Paulo, Brazil, in January 2021. The 50 full papers

presented in this book were carefully reviewed and selected from 136 submissions. The papers are grouped into these topics: approximation algorithms; parameterized algorithms; algorithms and data structures; computational geometry; complexity theory; quantum computing; neural networks and biologically inspired computing; randomization; combinatorics; analytic and enumerative combinatorics; graph theory. Due to the Corona pandemic the event was postponed from May 2020 to January 2021.

Algebraic Geometry Codes: Advanced Chapters American Mathematical Soc.

This book is the ninth volume in a series whose goal is to furnish a careful and largely self-contained proof of the classification theorem for the finite simple groups. Having completed the classification of the simple groups of odd type as well as the classification of the simple groups of generic even type (modulo uniqueness theorems to appear later), the current volume begins the classification of the finite simple groups of special even type. The principal result of this volume is a classification of the groups of bicharacteristic type, i.e., of both even type and of p-type for a suitable odd prime p. It is here that the largest sporadic groups emerge, namely the Monster, the Baby Monster, the largest Conway group, and the three Fischer groups, along with six finite groups of Lie type over small fields, several of which play a major role as subgroups or sections of these sporadic groups.

Geometric Set Theory American Mathematical Soc.

Monoidal category theory serves as a powerful framework for describing logical aspects of quantum theory, giving an abstract language for parallel and sequential composition, and a conceptual way to understand many high-level quantum phenomena. This text lays the foundation for this categorical quantum mechanics, with an emphasis on the graphical calculus which makes computation intuitive. Biproducts and dual objects are introduced and used to model superposition and entanglement, with quantum teleportation studied abstractly using these structures. Monoids, Frobenius structures and Hopf algebras are described, and it is shown how they can be used to model classical information and complementary observables. The CP construction, a categorical tool to describe probabilistic quantum systems, is also investigated. The last chapter introduces higher categories, surface diagrams and 2-Hilbert spaces, and shows how the language of duality in monoidal 2-categories can be used to reason about quantum protocols, including quantum teleportation and dense coding. Prior knowledge of linear algebra, quantum information or category theory would give an ideal background for studying this text, but it is not assumed, with essential background material given in a self-contained introductory chapter. Throughout the text links with many other areas are highlighted, such as representation theory, topology, quantum algebra, knot theory, and probability theory, and nonstandard models are presented, such as sets and relations. All results are stated rigorously, and full proofs are given as far as possible, making this book an invaluable reference for modern techniques in quantum logic, with much of the material not available in any other textbook.

The Adams Spectral Sequence for Topological Modular Forms American Mathematical Soc.

This book is a continuation of Asymptotic Geometric Analysis, Part I, which was published as volume 202 in this series. Asymptotic geometric analysis studies properties of geometric objects, such as normed spaces, convex bodies, or convex functions, when the dimensions of these objects increase to infinity. The asymptotic approach reveals many very novel phenomena which influence other fields in mathematics, especially where a large data set is of main concern, or a number of parameters which becomes uncontrollably large. One of the important features of this new theory is in developing tools which allow studying high parametric families. Among the topics covered in the book are measure concentration, isoperimetric constants of log-concave measures, thin-shell estimates, stochastic localization, the geometry of Gaussian measures, volume inequalities for convex bodies, local theory of Banach spaces, type and cotype, the Banach-Mazur compactum, symmetrizations, restricted invertibility, and functional versions of geometric notions and inequalities.

Applying the Classification of Finite Simple Groups: A User's Guide American Mathematical Society

This book concentrates on first boundary-value problems for fully nonlinear second-order uniformly elliptic and parabolic equations with discontinuous coefficients. We look for solutions in Sobolev classes, local or global, or for viscosity solutions. Most of the auxiliary results, such as Aleksandrov's elliptic and parabolic estimates, the Krylov–Safonov and the Evans–Krylov theorems, are taken from old sources, and the main results were obtained in the last few years. Presentation of these results is based on a generalization of the Fefferman–Stein theorem, on Fang-Hua Lin's like estimates, and on the so-called "ersatz" existence theorems, saying that one can slightly modify "any" equation and get a "cut-off" equation that has solutions with bounded derivatives. These theorems allow us to prove the solvability in Sobolev classes for equations that are quite far from the ones which are convex or concave with respect to the Hessians of the unknown functions. In studying viscosity solutions, these theorems also allow us to deal with classical approximating solutions, thus avoiding sometimes heavy constructions from the usual theory of viscosity solutions.

Perfectoid Spaces American Mathematical Society

The communication complexity of a function f(x, y) measures the number of bits that two players, one who knows x and the other who knows y, must exchange to determine the value f(x, y). Communication complexity is a fundamental measure of complexity of functions. Lower bounds on this measure lead to lower bounds on many other measures of computational complexity. This monograph surveys lower bounds in the field of communication complexity. Our focus is on lower bounds that work by first representing the communication complexity measure in Euclidean space. That is to say, the first step in these lower bound techniques is to find a geometric complexity measure, such as rank or trace norm, that serves as a lower bound to the underlying communication complexity measure. Lower bounds on this geometric complexity measure are then found using algebraic and geometric tools.

Quantum Systems, Channels, Information Springer

This monograph presents a systematic theory of weak solutions in Hilbert-Sobolev spaces of initial-boundary value problems for parabolic systems of partial differential equations with general essential and natural boundary conditions and minimal hypotheses on coefficients. Applications to quasilinear systems are given, including local existence for large data, global existence near an attractor, the Leray and Hopf theorems for the Navier-Stokes equations and results concerning invariant regions. Supplementary material is provided, including a self-contained treatment of the calculus of Sobolev functions on the boundaries of Lipschitz domains and a thorough discussion of measurability considerations for elements of Bochner-Sobolev spaces. This book

will be particularly useful both for researchers requiring accessible and broadly applicable formulations of standard results as well as for students preparing for research in applied analysis. Readers should be familiar with the basic facts of measure theory and functional analysis, including weak derivatives and Sobolev spaces. Prior work in partial differential equations is helpful but not required.

Categories for Quantum Theory American Mathematical Soc. Integrable models in statistical mechanics and quantum field theory constitute a rich research field at the crossroads of modern mathematics and theoretical physics. An important issue to understand is the space of local operators in the system and, ultimately, their correlation functions and form factors. This book is the first published monograph on this subject. It treats integrable lattice models, notably the six-vertex model and the XXZ Heisenberg spin chain. A pair of fermions is introduced and used to create a basis of the space of local operators, leading to the result that all correlation functions at finite distances are expressible in terms of two transcendental functions with rational coefficients. Step-by-step explanations are given for all materials necessary for this construction, ranging from algebraic Bethe ansatz, representations of quantum groups, and the Bazhanov-Lukyanov-Zamolodchikov construction in conformal field theory to Riemann surfaces and their Jacobians. Several examples and applications are given along with numerical results. Going through the book, readers will find themselves at the forefront of this rapidly developing research field.

The Cremona Group and Its Subgroups Oxford University Press This book studies the foundations of quantum theory through its relationship to classical physics. This idea goes back to the Copenhagen Interpretation (in the original version due to Bohr and Heisenberg), which the author relates to the mathematical formalism of operator algebras originally created by von Neumann. The book therefore includes comprehensive appendices on functional analysis and C*-algebras, as well as a briefer one on logic, category theory, and topos theory. Matters of foundational as well as mathematical interest that are covered in detail include symmetry (and its "spontaneous" breaking), the measurement problem, the Kochen-Specker, Free Will, and Bell Theorems, the Kadison-Singer conjecture, quantization, indistinguishable particles, the quantum theory of large systems, and quantum logic, the latter in connection with the topos approach to quantum theory. This book is Open Access under a CC BY licence.