Extremal Combinatorics With Applications In Computer Science Texts In Theoretical Computer Science An Eatcs Series

Pattern Recognition on Oriented Matroids covers a range of innovative problems in combinatorics, poset and graph theories, optimization, and number theory that constitute a far-reaching extension of the arsenal of committee methods in pattern recognition. The groundwork for the modern committee theory was laid in the mid-1960s, when it was shown that the familiar notion of solution to a feasible system of linear inequalities has ingenious analogues which can serve as collective solutions to infeasible systems. A hierarchy of dialects in the language of mathematics, for instance, open cones in the context of linear inequality systems, regions of hyperplane arrangements, and maximal covectors (or topes) of oriented matroids, provides an excellent opportunity to take a fresh look at the infeasible system of homogeneous strict linear inequalities – the standard working model for the contradictory two-class pattern recognition problem in its geometric setting. The universal language of oriented matroid theory considerably simplifies a structural and enumerative analysis of applied aspects of the infeasibility phenomenon. The present book is devoted to several selected topics in the emerging theory of pattern recognition on oriented matroids: the questions of existence and applicability of matroidal generalizations of committee decision rules and related graph-theoretic constructions to oriented matroids with very weak restrictions on their structural properties; a study (in which, in particular, interesting subsequences of the Farey sequence appear naturally) of the hierarchy of the corresponding tope committees; a description of the three-tope committees that are the most attractive approximation to the notion of solution to an infeasible system of linear constraints; an application of convexity in oriented matroids as well as blocker constructions in combinatorial optimization and in poset theory to enumerative problems on tope committees; an attempt to clarify how elementary changes (one-element reorientations) in an oriented matroid affect the family of its tope committees; a discrete Fourier analysis of the important family of critical tope committees through rank and distance relations in the tope poset and the tope graph; the characterization of a key combinatorial role played by the symmetric cycles in hypercube graphs. Contents Oriented Matroids, the Pattern Recognition Problem, and Tope Committees Boolean Intervals Dehn–Sommerville Type Relations Farey Subsequences Blocking Sets of Set Families, and Absolute Blocking Constructions in Posets Committees of Set Families, and Relative Blocking Constructions in Posets Layers of Tope Committees Three-Tope Committees Halfspaces, Convex Sets, and Tope Committees Tope Committees and Reorientations of Oriented Matroids Topes and Critical Committees Critical Committees and Distance Signals Symmetric Cycles in the Hypercube Graphs

Combinatorics is a book whose main theme is the study of subsets of a finite set. It gives a thorough grounding in the theories of set systems and hypergraphs, while providing an introduction to matroids, designs, combinatorial probability and Ramsey theory for infinite sets. The gems of the theory are emphasized: beautiful results with elegant proofs. The book developed from a course at Louisiana State University and combines a careful presentation with the informal style of those lectures. It should be an ideal

text for senior undergraduates and beginning graduates.

Information Theory: Coding Theorems for Discrete Memoryless Systems presents mathematical models that involve independent random variables with finite range. This three-chapter text specifically describes the characteristic phenomena of information theory. Chapter 1 deals with information measures in simple coding problems, with emphasis on some formal properties of Shannon’s information and the non-block source coding. Chapter 2 describes the properties and practical aspects of the two-terminal systems. This chapter also examines the noisy channel coding problem, the computation of channel capacity, and the arbitrarily varying channels. Chapter 3 looks into the theory and practicality of multi-terminal systems. This book is intended primarily for graduate students and research workers in mathematics, electrical engineering, and computer science.

One of the great appeals of Extremal Set Theory as a subject is that the statements are easily accessible without a lot of mathematical background, yet the proofs and ideas have applications in a wide range of fields including combinatorics, number theory, and probability theory. Written by two of the leading researchers in the subject, this book is aimed at mathematically mature undergraduates, and highlights the elegance and power of this field of study. The first half of the book provides classic results with some new proofs including a complete proof of the Ahlswede-Khachatrian theorem as well as some recent progress on the Erdos matching conjecture. The second half presents some combinatorial structural results and linear algebra methods including the Deza-Erdos-Frankl theorem, application of Rodl's packing theorem, application of semidefinite programming, and very recent progress (obtained in 2016) on the Erdos-Szemeredi sunflower conjecture and capset problem. The book concludes with a collection of challenging open problems.

This volume presents some of the research topics discussed at the 2014-2015 Annual Thematic Program Discrete Structures: Analysis and Applications at the Institute for Mathematics and its Applications during Fall 2014, when combinatorics was the focus. Leading experts have written surveys of research problems, making state of the art results more conveniently and widely available. The three-part structure of the volume reflects the three workshops held during Fall 2014. In the first part, topics on extremal and probabilistic combinatorics are presented; part two focuses on additive and analytic combinatorics; and part three presents topics in geometric and enumerative combinatorics. This book will be of use to those who research combinatorics directly or apply combinatorial methods to other fields.

Dr Alan J Hoffman is a pioneer in linear programming, combinatorial optimization, and the study of graph spectra. In his principal research interests, which include the fields of linear inequalities, combinatorics, and matrix theory, he and his collaborators have contributed fundamental concepts and theorems, many of which bear their names. This volume of Dr Hoffman's selected papers is divided into seven sections: geometry; combinatorics; matrix inequalities and eigenvalues; linear inequalities and linear programming; combinatorial optimization; greedy algorithms; graph spectra. Dr Hoffman has supplied background commentary and anecdotal remarks for each of the selected papers. He has also provided autobiographical notes showing how he chose mathematics as his profession, and the influences and motivations which shaped his career. Contents: The Variation of the

Spectrum of a Normal Matrix (with H W Wielandt); Integral Boundary Points of Convex Polyhedra (with J Kruskal); On Moore Graphs with Diameters 2 and 3 (with R R Singleton); Cycling in the Simplex Algorithm; On Approximate Solutions of Systems of Linear Inequalities; On the Polynomial of a Graph; Some Recent Applications of the Theory of Linear Inequalities of Extremal Combinatorial Analysis; On Simple Linear Programming Problems; Self-Orthogonal Latin Squares (with R K Brayton & D Coppersmith); On the Nonsingularity of Complex Matrices (with P Camion); A Generalization of Max Flow-Min Cut; A Characterization of Comparability Graphs and of Interval Graphs (with P C Gilmore); and 33 other papers. Readership: Researchers in linear programming and inequalities, combinatorics, combinatorial optimization, graph theory, matrix theory and operations research.

This is a concise, up-to-date introduction to extremal combinatorics for non-specialists. Strong emphasis is made on theorems with particularly elegant and informative proofs which may be called the gems of the theory. A wide spectrum of the most powerful combinatorial tools is presented, including methods of extremal set theory, the linear algebra method, the probabilistic method and fragments of Ramsey theory. A thorough discussion of recent applications to computer science illustrates the inherent usefulness of these methods.

Studies two algorithms in detail: the ellipsoid method and the simultaneous diophantine approximation method.

This is the second edition of a popular book on combinatorics, a subject dealing with ways of arranging and distributing objects, and which involves ideas from geometry, algebra and analysis. The breadth of the theory is matched by that of its applications, which include topics as diverse as codes, circuit design and algorithm complexity. It has thus become essential for workers in many scientific fields to have some familiarity with the subject. The authors have tried to be as comprehensive as possible, dealing in a unified manner with, for example, graph theory, extremal problems, designs, colorings and codes. The depth and breadth of the coverage make the book a unique guide to the whole of the subject. The book is ideal for courses on combinatorical mathematics at the advanced undergraduate or beginning graduate level. Working mathematicians and scientists will also find it a valuable introduction and reference.

This volume contains nine survey articles based on plenary lectures given at the 28th British Combinatorial Conference, hosted online by Durham University in July 2021. This biennial conference is a well-established international event, attracting speakers from around the world. Written by some of the foremost researchers in the field, these surveys provide up-to-date overviews of several areas of contemporary interest in combinatorics. Topics discussed include maximal subgroups of finite simple groups, Hasse–Weil type theorems and relevant classes of polynomial functions, the partition complex, the graph isomorphism problem, and Borel combinatorics. Representing a snapshot of current developments in combinatorics, this book will be of interest to researchers and graduate students in mathematics and theoretical computer science.

Strongly regular graphs lie at the intersection of statistical design, group theory, finite geometry, information and coding theory, and extremal combinatorics. This monograph collects all the major known results together for the first time in book form, creating

an invaluable text that researchers in algebraic combinatorics and related areas will refer to for years to come. The book covers the theory of strongly regular graphs, polar graphs, rank 3 graphs associated to buildings and Fischer groups, cyclotomic graphs, two-weight codes and graphs related to combinatorial configurations such as Latin squares, quasi-symmetric designs and spherical designs. It gives the complete classification of rank 3 graphs, including some new constructions. More than 100 graphs are treated individually. Some unified and streamlined proofs are featured, along with original material including a new approach to the (affine) half spin graphs of rank 5 hyperbolic polar spaces.

This text provides a theoretical background for several topics in combinatorial mathematics, such as enumerative combinatorics (including partitions and Burnside's lemma), magic and Latin squares, graph theory, extremal combinatorics, mathematical games and elementary probability. A number of examples are given with explanations while the book also provides more than 300 exercises of different levels of difficulty that are arranged at the end of each chapter, and more than 130 additional challenging problems, including problems from mathematical olympiads. Solutions or hints to all exercises and problems are included. The book can be used by secondary school students preparing for mathematical competitions, by their instructors, and by undergraduate students. The book may also be useful for graduate students and for researchers that apply combinatorial methods in different areas.

This is the first book devoted to the systematic study of sparse graphs and sparse finite structures. Although the notion of sparsity appears in various contexts and is a typical example of a hard to define notion, the authors devised an unifying classification of general classes of structures. This approach is very robust and it has many remarkable properties. For example the classification is expressible in many different ways involving most extremal combinatorial invariants. This study of sparse structures found applications in such diverse areas as algorithmic graph theory, complexity of algorithms, property testing, descriptive complexity and mathematical logic (homomorphism preservation,fixed parameter tractability and constraint satisfaction problems). It should be stressed that despite of its generality this approach leads to linear (and nearly linear) algorithms. Jaroslav Nešet?il is a professor at Charles University, Prague; Patrice Ossona de Mendez is a CNRS researcher et EHESS, Paris. This book is related to the material presented by the first author at ICM 2010.

The book shows that the analytic combinatorics (AC) method encodes the combinatorial problems of multiple object tracking--without information loss--into the derivatives of a generating function (GF). The book lays out an easy-to-follow path from theory to practice and includes salient AC application examples. Since GFs are not widely utilized amongst the tracking community, the book takes the reader from the basics of the subject to applications of theory starting from the simplest problem of single object tracking, and advancing chapter by chapter to more challenging multi-object tracking problems. Many established tracking filters (e.g., Bayes-Markov, PDA, JPDA, IPDA, JIPDA, CPHD, PHD, multi-Bernoulli, MBM, LMBM, and MHT) are derived in this manner with simplicity, economy, and considerable clarity. The AC method gives significant and fresh insights into the modeling assumptions of these filters and, thereby, also shows the potential utility of various approximation methods that are well

established techniques in applied mathematics and physics, but are new to tracking. These unexplored possibilities are reviewed in the final chapter of the book.

According to the great mathematician Paul Erdös, God maintains perfect mathematical proofs in The Book. This book presents the authors candidates for such "perfect proofs," those which contain brilliant ideas, clever connections, and wonderful observations, bringing new insight and surprising perspectives to problems from number theory, geometry, analysis, combinatorics, and graph theory. As a result, this book will be fun reading for anyone with an interest in mathematics.

These notes were first used in an introductory course team taught by the authors at Appalachian State University to advanced undergraduates and beginning graduates. The text was written with four pedagogical goals in mind: offer a variety of topics in one course, get to the main themes and tools as efficiently as possible, show the relationships between the different topics, and include recent results to convince students that mathematics is a living discipline.

Extremal CombinatoricsWith Applications in Computer ScienceSpringer Science & Business Media

Extremal Finite Set Theory surveys old and new results in the area of extremal set system theory. It presents an overview of the main techniques and tools (shifting, the cycle method, profile polytopes, incidence matrices, flag algebras, etc.) used in the different subtopics. The book focuses on the cardinality of a family of sets satisfying certain combinatorial properties. It covers recent progress in the subject of set systems and extremal combinatorics. Intended for graduate students, instructors teaching extremal combinatorics and researchers, this book serves as a sound introduction to the theory of extremal set systems. In each of the topics covered, the text introduces the basic tools used in the literature. Every chapter provides detailed proofs of the most important results and some of the most recent ones, while the proofs of some other theorems are posted as exercises with hints. Features: Presents the most basic theorems on extremal set systems Includes many proof techniques Contains recent developments The book’s contents are well suited to form the syllabus for an introductory course About the Authors: Dániel Gerbner is a researcher at the Alfréd Rényi Institute of Mathematics, Hungarian Academy of Sciences in Budapest, Hungary. He holds a Ph.D. from Eötvös Loránd University, Hungary and has contributed to numerous publications. His research interests are in extremal combinatorics and search theory. Balázs Patkós is also a researcher at the Alfréd Rényi Institute of Mathematics, Hungarian Academy of Sciences. He holds a Ph.D. from Central European University, Budapest and has authored several research papers. His research interests are in extremal and probabilistic combinatorics.

This book is a concise, self-contained, up-to-date introduction to extremal combinatorics for nonspecialists. There is a strong emphasis on theorems with particularly elegant and informative proofs, they may be called gems of the theory. The author presents a wide spectrum of the most powerful combinatorial tools together with impressive applications in computer science: methods of extremal set theory, the linear algebra method, the probabilistic method, and fragments of Ramsey theory. No special knowledge in combinatorics or computer science is assumed – the text is self-contained and the proofs can be enjoyed by undergraduate students in mathematics and computer science. Over 300 exercises of varying difficulty, and hints to their solution, complete the text. This second edition has been extended with substantial new material, and has been revised and updated throughout. It offers three new chapters on expander graphs and eigenvalues, the polynomial method and error-correcting codes. Most of the remaining chapters also include new material, such as the Kruskal—Katona theorem on shadows, the Lovász—Stein theorem on coverings, large cliques in dense graphs without induced 4-cycles, a new lower bounds argument for

monotone formulas, Dvir's solution of the finite field Kakeya conjecture, Moser's algorithmic version of the Lovász Local Lemma, Schöning's algorithm for 3-SAT, the Szemerédi—Trotter theorem on the number of point-line incidences, surprising applications of expander graphs in extremal number theory, and some other new results.

The aim of this book is to introduce a range of combinatorial methods for those who want to apply these methods in the solution of practical and theoretical problems. Various tricks and techniques are taught by means of exercises. Hints are given in a separate section and a third section contains all solutions in detail. A dictionary section gives definitions of the combinatorial notions occurring in the book. Combinatorial Problems and Exercises was first published in 1979. This revised edition has the same basic structure but has been brought up to date with a series of exercises on random walks on graphs and their relations to eigenvalues, expansion properties and electrical resistance. In various chapters the author found lines of thought that have been extended in a natural and significant way in recent years. About 60 new exercises (more counting sub-problems) have been added and several solutions have been simplified.

In the tradition of EuroComb'01 (Barcelona), Eurocomb'03 (Prague), EuroComb'05 (Berlin), Eurocomb'07 (Seville), Eurocomb'09 (Bordeaux), and Eurocomb'11 (Budapest), this volume covers recent advances in combinatorics and graph theory including applications in other areas of mathematics, computer science and engineering. Topics include, but are not limited to: Algebraic combinatorics, combinatorial geometry, combinatorial number theory, combinatorial optimization, designs and configurations, enumerative combinatorics, extremal combinatorics, ordered sets, random methods, topological combinatorics.

The starting point of this book is Sperner's theorem, which answers the question: What is the maximum possible size of a family of pairwise (with respect to inclusion) subsets of a finite set? This theorem stimulated the development of a fast growing theory dealing with external problems on finite sets and, more generally, on finite partially ordered sets. This book presents Sperner theory from a unified point of view, bringing combinatorial techniques together with methods from programming, linear algebra, Lie-algebra representations and eigenvalue methods, probability theory, and enumerative combinatorics. Researchers and graduate students in discrete mathematics, optimisation, algebra, probability theory, number theory, and geometry will find many powerful new methods arising from Sperner theory.

Praise for the Third Edition “Researchers of any kind of extremal combinatorics or theoretical computer science will welcome the new edition of this book.” - MAA Reviews Maintaining a standard of excellence that establishes The Probabilistic Method as the leading reference on probabilistic methods in combinatorics, the Fourth Edition continues to feature a clear writing style, illustrative examples, and illuminating exercises. The new edition includes numerous updates to reflect the most recent developments and advances in discrete mathematics and the connections to other areas in mathematics, theoretical computer science, and statistical physics. Emphasizing the methodology and techniques that enable problem-solving, The Probabilistic Method, Fourth Edition begins with a description of tools applied to probabilistic arguments, including basic techniques that use expectation and variance as well as the more advanced applications of martingales and correlation inequalities. The authors explore where probabilistic techniques have been applied successfully and also examine topical coverage such as discrepancy and random graphs, circuit complexity, computational geometry, and derandomization of randomized algorithms. Written by two well-known authorities in the field, the Fourth Edition features: Additional exercises throughout with hints and solutions to select problems in an appendix to help readers obtain a deeper understanding of the best methods and techniques New coverage on topics such as the Local Lemma, Six Standard Deviations result in Discrepancy Theory, Property B, and graph limits Updated sections to reflect major developments on the newest topics, discussions of the hypergraph container method, and many new references and

improved results The Probabilistic Method, Fourth Edition is an ideal textbook for upper-undergraduate and graduate-level students majoring in mathematics, computer science, operations research, and statistics. The Fourth Edition is also an excellent reference for researchers and combinatorists who use probabilistic methods, discrete mathematics, and number theory. Noga Alon, PhD, is Baumritter Professor of Mathematics and Computer Science at Tel Aviv University. He is a member of the Israel National Academy of Sciences and Academia Europaea. A coeditor of the journal Random Structures and Algorithms, Dr. Alon is the recipient of the Polya Prize, The Gödel Prize, The Israel Prize, and the EMET Prize. Joel H. Spencer, PhD, is Professor of Mathematics and Computer Science at the Courant Institute of New York University. He is the cofounder and coeditor of the journal Random Structures and Algorithms and is a Sloane Foundation Fellow. Dr. Spencer has written more than 200 published articles and is the coauthor of Ramsey Theory, Second Edition, also published by Wiley.

Additive combinatorics is the theory of counting additive structures in sets. This theory has seen exciting developments and dramatic changes in direction in recent years thanks to its connections with areas such as number theory, ergodic theory and graph theory. This graduate-level 2006 text will allow students and researchers easy entry into this fascinating field. Here, the authors bring together in a self-contained and systematic manner the many different tools and ideas that are used in the modern theory, presenting them in an accessible, coherent, and intuitively clear manner, and providing immediate applications to problems in additive combinatorics. The power of these tools is well demonstrated in the presentation of recent advances such as Szemerédi's theorem on arithmetic progressions, the Kakeya conjecture and Erdos distance problems, and the developing field of sum-product estimates. The text is supplemented by a large number of exercises and new results.

The ever-expanding field of extremal graph theory encompasses a diverse array of problem-solving methods, including applications to economics, computer science, and optimization theory. This volume, based on a series of lectures delivered to graduate students at the University of Cambridge, presents a concise yet comprehensive treatment of extremal graph theory. Unlike most graph theory treatises, this text features complete proofs for almost all of its results. Further insights into theory are provided by the numerous exercises of varying degrees of difficulty that accompany each chapter. Although geared toward mathematicians and research students, much of Extremal Graph Theory is accessible even to undergraduate students of mathematics. Pure mathematicians will find this text a valuable resource in terms of its unusually large collection of results and proofs, and professionals in other fields with an interest in the applications of graph theory will also appreciate its precision and scope.

Combinatorial research has proceeded vigorously in Russia over the last few decades, based on both translated Western sources and original Russian material. The present volume extends the extremal approach to the solution of a large class of problems, including some that were hitherto regarded as exclusively algorithmic, and broadens the choice of theoretical bases for modelling real phenomena in order to solve practical problems. Audience: Graduate students of mathematics and engineering interested in the thematics of extremal problems and in the field of combinatorics in general. Can be used both as a textbook and as a reference handbook.

Finite Geometries stands out from recent textbooks about the subject of finite geometries by having a broader scope. The authors thoroughly explain how the subject of finite geometries is a central part of discrete mathematics. The text is suitable for undergraduate and graduate courses. Additionally, it can be used as reference material on recent works. The authors examine how finite geometries’ applicable nature led to solutions of open problems in different fields, such as design theory, cryptography and extremal combinatorics. Other areas covered include proof techniques using polynomials in case of Desarguesian planes, and applications in extremal combinatorics, plus, recent material

and developments. Features: Includes exercise sets for possible use in a graduate course Discusses applications to graph theory and extremal combinatorics Covers coding theory and cryptography Translated and revised text from the Hungarian published version
Introduction to Enumerative and Analytic Combinatorics fills the gap between introductory texts in discrete mathematics and advanced graduate texts in enumerative combinatorics. The book first deals with basic counting principles, compositions and partitions, and generating functions. It then focuses on the structure of permutations, graph enumeration, and extremal combinatorics. Lastly, the text discusses supplemental topics, including error-correcting codes, properties of sequences, and magic squares. Strengthening the analytic flavor of the book, this Second Edition: Features a new chapter on analytic combinatorics and new sections on advanced applications of generating functions Demonstrates powerful techniques that do not require the residue theorem or complex integration Adds new exercises to all chapters, significantly extending coverage of the given topics Introduction to Enumerative and Analytic Combinatorics, Second Edition makes combinatorics more accessible, increasing interest in this rapidly expanding field. Outstanding Academic Title of the Year, Choice magazine, American Library Association.
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.
Recently, it became apparent that a large number of the most interesting structures and phenomena of the world can be described by networks. To develop a mathematical theory of very large networks is an important challenge. This book describes one recent approach to this theory, the limit theory of graphs which has emerged over the last decade.
The lectures concentrate on highlights in Combinatorial (ChaptersII and III) and Number Theoretical (ChapterIV) Extremal Theory, in particular on the solution of famous problems which were open for many decades. However, the organization of the lectures in six chapters does neither follow the historic developments nor the connections between ideas in several cases. With the speci?ed auxiliary results in ChapterI on Probability Theory, Graph Theory, etc., all chapters can be read and taught independently of one another. In addition to the 16 lectures organized in 6 chapters of the main part of the book, there is supplementary material for most of them in the Appendix. In parti- lar, there are applications and further exercises, research problems, conjectures, and even research programs. The following books and reports [B97], [ACDKPSWZ00], [A01], and [ABCABDM06], mostly of the authors, are frequently cited in this book, especially in the Appendix, and we therefore mark them by short labels as [B], [N], [E], and [G]. We emphasize that there are also “Exercises” in [B], a “Problem Section” with contributions by several authors on pages 1063–1105 of [G], which are often of a combinatorial nature, and “Problems and Conjectures” on pages 172–173 of [E].
In this thesis, we apply modern probabilistic and algebraic techniques to different problems in extremal combinatorics. One of the most recent algebraic techniques is the new polynomial method which Croot, Lev and Pach introduced in 2016. This method has lead to the spectacular

breakthrough of Ellenberg and Gijswijt on the cap-set problem, and has had many more applications in additive number theory and extremal combinatorics. In Chapter 2, we use various tools that resulted from the Croot-Lev-Pach polynomial method, combined with probabilistic and combinatorial arguments, to prove new upper bounds on the Erdos-Ginzburg-Ziv constant of F_p^n for a fixed prime p \geq 5 and large n. Chapter 3 also relies on developments arising from the Croot-Lev-Pach polynomial method as well as new combinatorial ideas. We prove a polynomial bound relating the parameters in Green's arithmetic k-cycle removal lemma in F_p^n for all k \geq 3. The special case of k = 3 was previously proved by Fox and Lovasz and is used as the base case of an induction on k in our proof for all k \geq 3. In Chapter 4, we use methods from algebraic geometry (and basic differential topology) to prove an asymptotically tight lower bound for the number of graphs of a certain form where the edges are defined algebraically by the signs of a finite list of polynomials. We present many applications of this result, in particular to counting intersection graphs and containment orders for various families of geometric objects (e.g. segments of disks in the plane). Using probabilistic methods, we prove the so-called Edge-statistics conjecture of Alon, Hefetz, Krivelevich and Tyomkyn in Chapter 5. In a certain range of the parameters, this conjecture already follows from a result of Kwan, Sudakov and Tran. We solve the other cases, and thereby establish the full conjecture. Finally, in Chapter 6 we prove a conjecture of Erdos, Faudree, Rousseau and Schelp from 1990 concerning subgraphs of minimum degree k.

WINNER of a CHOICE Outstanding Academic Title Award for 2006! As linear orders, as elements of the symmetric group, modeled by matrices, modeled by graphs...permutations are omnipresent in modern combinatorics. They are omnipresent but also multifaceted, and while several excellent books explore particular aspects of the subject, no one book has covered them all. Even the classic results are scattered in various resources. Combinatorics of Permutations offers the first comprehensive, up to date treatment of both enumerative and extremal combinatorics and looks at permutation as linear orders and as elements of the symmetric group. The author devotes two full chapters to the young but active area of pattern avoidance. He explores the quest for the Stanley-Wilf conjecture and includes the recent and spectacular Marcus-Tardos proof of this problem. He examines random permutations and Standard Young Tableaux and provides an overview of the very rich algebraic combinatorics of permutations. The final chapter takes an in-depth look at combinatorial sorting algorithms. The author's style is relaxed, entertaining, and clearly reflects his enthusiasm for the "serious fun" the subject holds. Filled with applications from a variety of fields and exercises that draw upon recent research results, this book serves equally well as a graduate-level text and a reference for combinatorics researchers.

This book represents a comprehensive overview of the present state of progress in three related areas of combinatorics. It comprises selected papers from a conference held at the University of Montreal. Topics covered in the articles include association schemes, extremal problems, combinatorial geometrics and matroids, and designs. All the papers contain new results and many are extensive surveys of particular areas of research. Particularly valuable will be Ivanov's paper on recent Soviet research in these areas. Consequently this volume will be of great attraction to all researchers in combinatorics and to research students requiring a rapid introduction to some of the open problems in the subject.

This book is a gentle introduction to the enumerative part of combinatorics suitable for study at the advanced undergraduate or

beginning graduate level. In addition to covering all the standard techniques for counting combinatorial objects, the text contains material from the research literature which has never before appeared in print, such as the use of quotient posets to study the Möbius function and characteristic polynomial of a partially ordered set, or the connection between quasisymmetric functions and pattern avoidance. The book assumes minimal background, and a first course in abstract algebra should suffice. The exposition is very reader friendly: keeping a moderate pace, using lots of examples, emphasizing recurring themes, and frankly expressing the delight the author takes in mathematics in general and combinatorics in particular.

Contains a collection of clever mathematical applications of linear algebra, mainly in combinatorics, geometry, and algorithms. Each chapter covers a single main result with motivation and full proof in at most ten pages and can be read independently of all other chapters (with minor exceptions), assuming only a modest background in linear algebra. --from publisher description