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Extremal Combinatorics
Extremal Combinatorics With Applications in Computer Science. 2001, XVII, 375 pp., 36 Figs., 315 exercises Springer-Verlag, ISBN 3-540-66313-4 For the 2nd edition see here. Ordering information: Springer -Heidelberg, Amazon.com, Amazon.de, Barnes & Noble

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Extremal combinatorics - Wikipedia
Extremal Combinatorics: With Applications in Computer Science (Texts in Theoretical Computer Science. An EATCS Series): Amazon.co.uk: Jukna, Stasys: 9783642173639: Books. £74.99.

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Combinatorics is an area of mathematics primarily concerned with counting, both as a means and an end in obtaining results, and certain properties of finite structures. It is closely related to many other areas of mathematics and has many applications ranging from logic to statistical physics, from evolutionary biology to computer science, etc. The full scope of combinatorics is not universally agreed upon. According to H.J. Ryser, a definition of the subject is difficult because it crosses so m

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.

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.

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.

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.

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.

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.

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.

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.

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.