Matroid Theory And Its Applications In Electric Network Theory And In Statics Algorithms And Combinatorics

Topics in Matroid Theory provides a brief introduction to matroid theory with an emphasis on algorithmic consequences.Matroid theory is at the heart of combinatorial optimization and has attracted various pioneers such as Edmonds, Tutte, Cunningham and Lawler among others. Matroid theory encompasses matrices, graphs and other combinatorial entities under a common, solid algebraic framework, thereby providing the analytical tools to solve related difficult algorithmic problems. The monograph contains a rigorous axiomatic definition of matroids along with other necessary concepts such as duality, minors, connectivity and representability as demonstrated in matrices, graphs and transversals. The author also presents a deep decomposition result in matroid theory that provides a structural characterization of graphic matroids, and show how this can be extended to signed-graphic matroids, as well as the immediate algorithmic consequences.

Electrical, communication, transportation, computer, and neural networks are special kinds of nets. Designing these networks demands sophisticated mathematical models for their analysis. This book is the first to present a unified, comprehensive, and up-to-date treatment of net theory. It brings together elements of abstract graph theory and circuit analysis to network problems. Contents: Graphs and NetworksThe Shortest Directed Path ProblemMaximum Flows in NetworksMinimum Trees and Communication NetsFeasibility Theorems and Their ApplicationsApplications of Flow Theorems to Subgraph ProblemsSignal-Flow GraphsOther Net Applications Readership: Graduate students in electrical and electronic engineering.

Handbook of Combinatorics, Volume 1 focuses on basic methods, paradigms, results, issues, and trends across the broad spectrum of combinatorics. The selection first elaborates on the basic graph theory, connectivity and network flows, and matchings and extensions. Discussions focus on stable sets and claw free graphs, nonbipartite matching, multicommodity flows and disjoint paths, minimum cost circulations and flows, special proof techniques for paths and circuits, and Hamilton paths and circuits in digraphs. The manuscript then examines coloring, stable sets, and perfect graphs and embeddings and minors. The book takes a look at random graphs, hypergraphs, partially ordered sets, and matroids. Topics include geometric lattices, structural properties, linear extensions and correlation, dimension and posets of bounded degree, hypergraphs and set systems, stability, transversals, and matchings, and phase transition. The manuscript also reviews the combinatorial number theory, point lattices, convex polytopes and related complexes, and extremal problems in combinatorial geometry. The selection is a valuable reference for researchers interested in combinatorics.

Matroid Theory and Its Applications

Combinatorics: The Rota Way

Theory and Algorithms

Papers Dedicated to Jack Edmonds. 5th International Workshop, Aussois, France, March 5-9, 2001, Revised Papers

This friendly introduction helps undergraduate students understand and appreciate matroid theory and its connections to geometry.

Lectures: T.H. Brylawski: The Tutte polynomial.- D.J.A. Welsh: Matroids and combinatorial optimisation.- Seminars: M. Barnabei, A. Brini, G.-C. Rota: Un’introduzione alla teoria delle funzioni di Möbius.- A. Brini: Some remarks on the critical problem.- J. Oxley: On 3-connected matroids and graphs.- R. Peele: The poset of subpartitions and Cayley’s formula for the complexity of a complete graph.- A. Recski: Engineering applications of matroids.- T. Zaslavisky: Voltage-graphic matroids.

This book constitutes the proceedings of the 31st International Workshop on Combinatorial Algorithms which was planned to take place in Bordeaux, France, during June 8-10, 2020. Due to the COVID-19 pandemic the conference changed to a virtual format. The 30 full papers included in this book were carefully reviewed and selected from 62 submissions. They focus on algorithms design for the myriad of combinatorial problems that underlie computer applications in science, engineering and business.

Combinatorics with Emphasis on the Theory of Graphs

Combinatorial Optimization -- Eureka, You Shrink!

Computational Oriented Matroids

The Mathematical Theory of Coding

A matroid is an abstract mathematical structure that captures combinatorial properties of matrices. This book offers a unique introduction to matroid theory, emphasizing motivations from matrix theory and applications to systems analysis. This book serves also as a comprehensive presentation of the theory and application of mixed matrices, developed primarily by the present author in the 1990's. A mixed matrix is a convenient mathematical tool for systems analysis, compatible with the physical observation that "fixed constants" and "system parameters" are to be distinguished in the description of engineering systems. This book will be extremely useful to graduate students and researchers in engineering, mathematics and computer science. From the reviews: "...The book has been prepared very carefully, contains a lot of interesting results and is highly recommended for graduate and postgraduate students." András Recski, Mathematical Reviews Clippings 2000m:93006

Matroid theory is one of the deepest branches of combinatorics, and important to applications. Odd numbered chapters introduce mathematical results including many algorithms, which are then immediately applied in the even numbered chapters that follow. The application chapters contain the definitions of the engineering concepts to help mathematicians understand the applications. Matroid theory is, in a sense, a common generalization of graph theory, linear algebra, and geometry, new concepts are presented in the language of graphs, matrices, and geometrical objects wherever possible. The book is aimed at mathematicians and engineers.

Filling the gap between introductory and encyclopedic treatments, this book provides rich and appealing

material for a second course in combinatorial optimization. This book is suitable for graduate students as well as a reference for established researchers.

Equivalence Classes of Matrices Within a Natural Framework

31st International Workshop, IWOCA 2020, Bordeaux, France, June 8–10, 2020, Proceedings

Network Coding Theory

Matroid Decomposition

Now fully updated in a third edition, this is a comprehensive textbook on combinatorial optimization. It puts special emphasis on theoretical results and algorithms with provably good performance, in contrast to heuristics. The book contains complete but concise proofs, also for many deep results, some of which have not appeared in print before. Recent topics are covered as well, and numerous references are provided. This third edition contains a new chapter on facility location problems, an area which has been extremely active in the past few years. Furthermore there are several new sections and further material on various topics. New exercises and updates in the bibliography were added.

This volume deals with the applications of matroid theory to a variety of topics.

by Gian-Carlo Rota The subjects of mathematics, like the subjects of mankind, have finite lifespans, which the historian will record as he freezes history at one instant of time. There are the old subjects, loaded with distinctions and honors. As their problems are solved away and the applications reaped by engineers and other moneymen, ponderous treatises gather dust in library basements, awaiting the day when a generation as yet unborn will rediscover the lost paradise in awe. Then there are the middle-aged subjects. You can tell which they are by roaming the halls of Ivy League universities or the Institute for Advanced Studies. Their high priests haughtily refuse fabulous offers from eager provin cial universities while receiving special permission from the President of France to lecture in English at the College de France. Little do they know that the load of technicalities is already critical, about to crack and submerge their theorems in the dust of oblivion that once enveloped the dinosaurs. Finally, there are the young subjects-combinatorics, for instance. Wild eyed individuals gingerly pick from a mountain of intractable problems, chil dishly babbling the first words of what will soon be a new language. Child hood will end with the first Seminaire Bourbaki. It could be impossible to find a more fitting example than matroid theory of a subject now in its infancy. The telltale signs, for an unfailing diagnosis, are the abundance of deep theorems, going together with a paucity of theories.

Matrices and Matroids for Systems Analysis

Matroid Theory

Topics in Matroid Theory

Introduction to the Theory of Matroids

This volume contains the proceedings of the 1995 AMS-IMS-SIAM Joint Summer Research Conference on Matroid Theory held at the University of Washington, Seattle. The book features three comprehensive surveys that bring the reader to the forefront of research in matroid theory. Joseph Kung's encyclopedic treatment of the critical problem traces the development of this problem from its origins through its numerous links with other branches of mathematics to the current status of its many aspects. James Oxley's survey of the role of connectivity and structure theorems in matroid theory stresses the influence of the Wheels and Whirls Theorem of Tutte and the Splitter Theorem of Seymour. Walter Whiteley's article unifies applications of matroid theory to constrained geometrical systems, including the rigidity of bar-and-joint frameworks, parallel drawings, and splines. These widely accessible articles contain many new results and directions for further research and applications. The surveys are complemented by selected short research papers. The volume concludes with a chapter of open problems. Features self-contained, accessible surveys of three active research areas in matroid theory; many new results; pointers to new research topics; a chapter of open problems; mathematical applications; and applications and connections to other disciplines, such as computer-aided design and electrical and structural engineering.

Matroid theory has its origin in a paper by H. Whitney entitled "On the abstract properties of linear dependence" [35], which appeared in 1935. The main objective of the paper was to establish the essential (abstract) properties of the concepts of linear dependence and independence in vector spaces, and to use these for the axiomatic definition of a new algebraic object, namely the matroid. Furthermore, Whitney showed that these axioms are also abstractions of certain graph-theoretic concepts. This is very much in evidence when one considers the basic concepts making up the structure of a matroid: some reflect their linear algebraic origin, while others reflect their graph-theoretic origin. Whitney also studied a number of important examples of matroids. The next major development was brought about in the forties by R. Rado's matroid generalisation of P. Hall's famous "marriage" theorem. This provided new impulses for transversal theory, in which matroids today play an essential role under the name of "independence structures", cf. the treatise on transversal theory by L. Mirsky [26J. At roughly the same time R.P. Dilworth estab lished the connection between matroids and lattice theory. Thus matroids became an essential part of combinatorial mathematics. About ten years later W.T. Tutte [30] developed the funda mentals of matroids in detail from a graph-theoretic point of view, and characterised graphic matroids as well as the larger class of those matroids that are representable over any field.

Oriented matroids play the role of matrices in discrete geometry, when metrical properties, such as angles or distances, are neither required nor available. Thus they are of great use in such areas as graph theory, combinatorial optimization and convex geometry. The variety of applications corresponds to the variety of ways they can be defined. Each of these definitions corresponds to a differing data structure for an oriented matroid, and handling them requires computational support, best realised through a functional language. Haskell is used here, and, for the benefit of readers, the book includes a primer on it. The combination of concrete applications and computation, the profusion of illustrations, many

in colour, and the large number of examples and exercises make this an ideal introductory text on the subject. It will also be valuable for self-study for mathematicians and computer scientists working in discrete and computational geometry.
Combinatorial & Computational Mathematics

Connections in Combinatorial Optimization
Matroids: A Geometric Introduction
First comprehensive, accessible account; second edition has expanded bibliography and a new appendix surveying recent research.
Combinatorics and graph theory have mushroomed in recent years. Many overlapping or equivalent results have been produced. Some of these are special cases of unformulated or unrecognized general theorems. The body of knowledge has now reached a stage where approaches toward unification are overdue. To paraphrase Professor Gian-Carlo Rota (Toronto, 1967), "Combinatorics needs fewer theorems and more theory. " In this book we are doing two things at the same time: A. We are presenting a unified treatment of much of combinatorics and graph theory. We have constructed a concise algebraically based, but otherwise self-contained theory, which at one time embraces the basic theorems that one normally wishes to prove while giving a common terminology and framework for the develop ment of further more specialized results. B. We are writing a textbook whereby a student of mathematics or a mathematician with another specialty can learn combinatorics and graph theory. We want this learning to be done in a much more unified way than has generally been possible from the existing literature. Our most difficult problem in the course of writing this book has been to keep A and B in balance. On the one hand, this book would be useless as a textbook if certain intuitively appealing, classical combinatorial results were either overlooked or were treated only at a level of abstraction rendering them beyond all recognition.
This book describes and summarizes past work in important areas of combinatorics and computation, as well as gives directions for researchers working in these areas in the 21st century. It contains primarily survey papers and presents original research by Peter Fishburn, Jim Ho Kwak, Jaeun Lee, K H Kim, F W Roush and Susan Williams. The papers deal with some of the most exciting and promising developments in the areas of coding theory in relation to number theory, lattice theory and its applications, graph theory and its applications, topological techniques in combinatorics, symbolic dynamics and mathematical social science. Contents: Monte-Carlo and Quasi-Monte-Carlo Methods for Numerical Integration (H Faure); Theoretical Approaches to Judgement and Choice (P Fishburn); Combinatorial Aspects of Mathematical Social Science (K H Kim & F W Roush); Twelve Views of Matroid Theory (J P S Kung); Enumeration of Graph Coverings, Surface Branched Coverings and Related Group Theory (J H Kwak & J Lee); An Overview of the Poset of Irreducibles (G Markowsky); Number Theory and Public-Key Cryptography (D Pointcheval); Some Applications of Graph Theory (F Roberts); Duality and Its Consequences for Ordered Cohomology of Finite Type Subshifts (K H Kim et al.); Simple Maximum Likelihood Methods for the Optical Mapping Problem (V Danc k & M S Waterman). Readership: Researchers, graduate students and advanced undergraduates in combinatorics and computational mathematics."
Flows in Networks
Combinatorial Optimization
Matroid Theory and its Applications in Electric Network Theory and in Statics
Present and Future : Pohang, the Republic of Korea, 15-17 February 2000
This book is dedicated to Jack Edmonds in appreciation of his ground breaking work that laid the foundations for a broad variety of subsequent results achieved in combinatorial optimization.The main part consists of 13 revised full papers on current topics in combinatorial optimization, presented at Aussois 2001, the Fifth Aussois Workshop on Combinatorial Optimization, March 5-9, 2001, and dedicated to Jack Edmonds.Additional highlights in this book are an account of an Aussois 2001 special session dedicated to Jack Edmonds including a speech given by William R. Pulleyblank as well as newly typeset versions of three up-to-now hardly accessible classical papers:- Submodular Functions, Matroids, and Certain Polyhedranbsp;nbsp; by Jack Edmonds- Matching: A Well-Solved Class of Integer Linear Programsnbsp;nbsp; by Jack Edmonds and Ellis L. Johnson- Theoretical Improvements in Algorithmic Efficiency for Network Flow Problemsnbsp;nbsp; by Jack Edmonds and Richard M. Karp.
The theory of matroids connects disparate branches of combinatorial theory and algebra such as graph and lattice theory, combinatorial optimization, and linear algebra. This text describes standard examples and investigation results, and it uses elementary proofs to develop basic matroid properties before advancing to a more sophisticated treatment. 1976 edition.
I. The topics of this book The concept of a matroid has been known for more than five decades. Whitney (1935) introduced it as a common generalization of graphs and matrices. In the last two decades, it has become clear how important the concept is, for the following reasons: (1) Combinatorics (or discrete mathematics) was considered by many to be a collection of interesting, sometimes deep, but mostly unrelated ideas. However, like other branches of mathematics, combinatorics also encompasses some gen eral tools that can be learned and then applied, to various problems. Matroid theory is one of these tools. (2) Within combinatorics, the relative importance of algorithms has in creased with the spread of computers. Classical analysis did not even consider problems where "only" a finite number of cases were to be studied. Now such problems are not only considered, but their complexity is often analyzed in con siderable detail. Some questions of this type (for example, the determination of when the so called "greedy" algorithm is optimal) cannot even be answered without matroidal tools.
A Source Book in Matroid Theory
Networks and Matroids
AMS-IMS-SIAM Joint Summer Research Conference on Matroid Theory, July 2-6, 1995, University of Washington, Seattle
Lectures given at a Summer School of the Centro Internazionale Matematico Estivo (C.I.M.E.) held in Varenna (Como), Italy, August 24 - September 2, 1980
Matroid Theory and its Applications in Electric Network Theory and in StaticsSpringer
Compiled and edited by two of Gian-Carlo Rota's students, this book is based on notes from his influential combinatorics courses. Perceptive text examines shortest paths, network flows, bipartite and nonbipartite matching, matroids and the greedy algorithm, matroid intersections, and the matroid parity problems. Suitable for courses in combinatorial computing and concrete computational complexity.
The Application of Topology and Matroid Theory to the Analysis of Structures

Net Theory and Its Applications
Theory of Matroids
Handbook of Combinatorics Volume 1

The theory of matroids is unique in the extent to which it connects such disparate branches of combinatorial theory and algebra as graph theory, lattice theory, design theory, combinatorial optimization, linear algebra, group theory, ring theory and field theory. Furthermore, matroid theory is alone among mathematical theories because of the number and variety of its equivalent axiom systems. Indeed, matroids are amazingly versatile and the approaches to the subject are varied and numerous. This book is a primer in the basic axioms and constructions of matroids. The contributions by various leaders in the field include chapters on axiom systems, lattices, basis exchange properties, orthogonality, graphs and networks, constructions, maps, semi-modular functions and an appendix on cryptomorphisms. The authors have concentrated on giving a lucid exposition of the individual topics; explanations of theorems are preferred to complete proofs and original work is thoroughly referenced. In addition, exercises are included for each topic.

Covers combinatorics in graph theory, theoretical computer science, optimization, and convexity theory, plus applications in operations research, electrical engineering, statistical mechanics, chemistry, molecular biology, pure mathematics, and computer science.

The Mathematical Theory of Coding focuses on the application of algebraic and combinatoric methods to the coding theory, including linear transformations, vector spaces, and combinatorics. The publication first offers information on finite fields and coding theory and combinatorial constructions and coding. Discussions focus on self-dual and quasicyclic codes, quadratic residues and codes, balanced incomplete block designs and codes, bounds on code dictionaries, code invariance under permutation groups, and linear transformations of vector spaces over finite fields. The text then takes a look at coding and combinatorics and the structure of semisimple rings. Topics include structure of cyclic codes and semisimple rings, group algebra and group characters, rings, ideals, and the minimum condition, chains and chain groups, dual chain groups, and matroids, graphs, and coding. The book ponders on group representations and group codes for the Gaussian channel, including distance properties of group codes, initial vector problem, modules, group algebras, andrepresentations, orthogonality relationships and properties of group characters, and representation of groups. The manuscript is a valuable source of data for mathematicians and researchers interested in the mathematical theory of coding.

Matroid Theory and Its Application to Combinatorial Optimization
Matroid Applications
Combinatorial Algorithms
III Ciclo 1980, Villa Monastero, Varenna-Como

This new in paperback version of the classic Matroid Theory by James Oxley provides a comprehensive introduction to matroid theory, covering the basics to more advanced topics. With over 500 exercises and proofs of major theorems this book is the ideal reference and class text for academics and graduate students in mathematics and computer science.

Provides a tutorial on the basics of network coding theory. Divided into two parts, this book presents a unified framework for understanding the basic notions and fundamental results in network coding. It is aimed at students, researchers and practitioners working in networking research.

Handbook of Combinatorics
Matroid Theory and Its Applications in Electric Network Theory and in Statics
Oriented Matroids