

Combinatorial Optimization Algorithms And Complexity Dover Books On Computer Science

Combinatorial Optimization Integer and Combinatorial Optimization Approximation Algorithms Approximation and Optimization Progress in Combinatorial Optimization Combinatorial Optimization in Communication Networks Complexity and Approximation Algorithmics for Hard Problems Combinatorial Optimization Graphs and Algorithms Local Search in Combinatorial Optimization Application of Optimization Algorithms in Chemistry Combinatorial Optimization An Introduction to Information Theory Introductory Discrete Mathematics Handbook of Graph Theory, Combinatorial Optimization, and Algorithms CATBox Minimax and Applications Approximation, Randomization, and Combinatorial Optimization. Algorithms and Techniques Paradigms of Combinatorial Optimization Turing (A Novel about Computation) Computer Science - Theory and Applications Bioinspired Computation in Combinatorial Optimization Combinatorial Optimization Problems in Planning and Decision Making A First Course in Combinatorial Optimization Handbook of Combinatorial Optimization Algorithms for Minimization Without Derivatives Advances in Combinatorial Optimization Phase Transitions in Combinatorial Optimization Problems Geometric Algorithms and Combinatorial Optimization Combinatorial Optimization and Graph Algorithms Convex Optimization Recent Advances and Historical Development of Vector Optimization Combinatorial Optimization Combinatorial Optimization Algebraic and Geometric Ideas in the Theory of Discrete Optimization Combinatorial Optimization Iterative Methods in Combinatorial Optimization Handbook of Approximation Algorithms and Metaheuristics Combinatorial Optimization

Combinatorial Optimization

This is the joint refereed proceedings of the 9th International Workshop on Approximation Algorithms for Combinatorial Optimization Problems, APPROX 2006 and the 10th International Workshop on Randomization and Computation, RANDOM 2006. The book presents 44 carefully reviewed and revised full papers. Among the topics covered are design and analysis of approximation algorithms, hardness of approximation problems, small spaces and data streaming algorithms, embeddings and metric space methods, and more.

Integer and Combinatorial Optimization

A concise, comprehensive introduction to the topic of statistical physics of combinatorial optimization, bringing together theoretical concepts and algorithms from computer science with analytical methods from physics. The result bridges the gap between statistical physics and combinatorial optimization, investigating problems taken from theoretical computing, such as the vertex-cover problem, with the concepts and methods of theoretical physics. The authors cover rapid developments and analytical methods that are both extremely complex and spread by word-of-mouth, providing all the necessary basics in required detail. Throughout, the algorithms are shown with examples and calculations, while the

proofs are given in a way suitable for graduate students, post-docs, and researchers. Ideal for newcomers to this young, multidisciplinary field.

Approximation Algorithms

The book focuses on the next fields of computer science: combinatorial optimization, scheduling theory, decision theory, and computer-aided production management systems. It also offers a quick introduction into the theory of PSC-algorithms, which are a new class of efficient methods for intractable problems of combinatorial optimization. A PSC-algorithm is an algorithm which includes: sufficient conditions of a feasible solution optimality for which their checking can be implemented only at the stage of a feasible solution construction, and this construction is carried out by a polynomial algorithm (the first polynomial component of the PSC-algorithm); an approximation algorithm with polynomial complexity (the second polynomial component of the PSC-algorithm); also, for NP-hard combinatorial optimization problems, an exact subalgorithm if sufficient conditions were found, fulfilment of which during the algorithm execution turns it into a polynomial complexity algorithm. Practitioners and software developers will find the book useful for implementing advanced methods of production organization in the fields of planning (including operative planning) and decision making. Scientists, graduate and master students, or system engineers who are interested in problems of combinatorial optimization, decision making with poorly formalized overall goals, or a multiple regression construction will benefit from this book.

Approximation and Optimization

Covering the basic techniques used in the latest research work, the author consolidates progress made so far, including some very recent and promising results, and conveys the beauty and excitement of work in the field. He gives clear, lucid explanations of key results and ideas, with intuitive proofs, and provides critical examples and numerous illustrations to help elucidate the algorithms. Many of the results presented have been simplified and new insights provided. Of interest to theoretical computer scientists, operations researchers, and discrete mathematicians.

Progress in Combinatorial Optimization

Historically, there is a close connection between geometry and optimization. This is illustrated by methods like the gradient method and the simplex method, which are associated with clear geometric pictures. In combinatorial optimization, however, many of the strongest and most frequently used algorithms are based on the discrete structure of the problems: the greedy algorithm, shortest path and alternating path methods, branch-and-bound, etc. In the last several years geometric methods, in particular polyhedral combinatorics, have played a more and more profound role in combinatorial optimization as well. Our book discusses two recent geometric algorithms that have turned out to have particularly interesting consequences in combinatorial optimization, at least from a theoretical point of view. These algorithms are able to utilize the rich body of results in

polyhedral combinatorics. The first of these algorithms is the ellipsoid method, developed for nonlinear programming by N. Z. Shor, D. B. Yudin, and A. S. Nemirovskii. It was a great surprise when L. G. Khachiyan showed that this method can be adapted to solve linear programs in polynomial time, thus solving an important open theoretical problem. While the ellipsoid method has not proved to be competitive with the simplex method in practice, it does have some features which make it particularly suited for the purposes of combinatorial optimization. The second algorithm we discuss finds its roots in the classical "geometry of numbers", developed by Minkowski. This method has had traditionally deep applications in number theory, in particular in diophantine approximation.

Combinatorial Optimization in Communication Networks

Clearly written graduate-level text considers the Soviet ellipsoid algorithm for linear programming; efficient algorithms for network flow, matching, spanning trees, and matroids; the theory of NP-complete problems; approximation algorithms, local search heuristics for NP-complete problems, more.

"Mathematicians wishing a self-contained introduction need look no further." — American Mathematical Monthly. 1982 edition.

Complexity and Approximation

Handbook of Approximation Algorithms and Metaheuristics, Second Edition reflects the tremendous growth in the field, over the past two decades. Through contributions from leading experts, this handbook provides a comprehensive introduction to the underlying theory and methodologies, as well as the various applications of approximation algorithms and metaheuristics. Volume 1 of this two-volume set deals primarily with methodologies and traditional applications. It includes restriction, relaxation, local ratio, approximation schemes, randomization, tabu search, evolutionary computation, local search, neural networks, and other metaheuristics. It also explores multi-objective optimization, reoptimization, sensitivity analysis, and stability. Traditional applications covered include: bin packing, multi-dimensional packing, Steiner trees, traveling salesperson, scheduling, and related problems. Volume 2 focuses on the contemporary and emerging applications of methodologies to problems in combinatorial optimization, computational geometry and graphs problems, as well as in large-scale and emerging application areas. It includes approximation algorithms and heuristics for clustering, networks (sensor and wireless), communication, bioinformatics search, streams, virtual communities, and more. About the Editor Teofilo F. Gonzalez is a professor emeritus of computer science at the University of California, Santa Barbara. He completed his Ph.D. in 1975 from the University of Minnesota. He taught at the University of Oklahoma, the Pennsylvania State University, and the University of Texas at Dallas, before joining the UCSB computer science faculty in 1984. He spent sabbatical leaves at the Monterrey Institute of Technology and Higher Education and Utrecht University. He is known for his highly cited pioneering research in the hardness of approximation; for his sublinear and best possible approximation algorithm for k-TMM clustering; for introducing the open-shop scheduling problem as well as algorithms for its solution that have found applications in numerous research areas; as well as for his research on problems in the areas of job scheduling, graph algorithms, computational geometry, message

communication, wire routing, etc.

Algorithmics for Hard Problems

In vector optimization one investigates optimization problems in an abstract setting which have a not necessarily real-valued objective function. This scientific discipline is closely related to multi-objective optimization and multi-criteria decision making. This book contains refereed contributions to the "International Conference on Vector Optimization" held at the Technical University of Darmstadt from August 4-7, 1986. This meeting was an interdisciplinary forum devoted to new results in the theory, to applications as well as to the solution of vector optimization problems which are relevant in practice. Because of the great variety of topics covered by the contributions, the 25 articles of this volume are organized in different sections: Historical retrospect, mathematical theory, goal setting and decision making, engineering applications, and related topics. The papers of the invited State-of-the-Art Tutorials given by Professors J.M. Borwein, H. Eschenauer, W. Stadler and P.L. Yu are also included.

Combinatorial Optimization

A First Course in Combinatorial Optimization is a text for a one-semester introductory graduate-level course for students of operations research, mathematics, and computer science. It is a self-contained treatment of the subject, requiring only some mathematical maturity. Topics include: linear and integer programming, polytopes, matroids and matroid optimization, shortest paths, and network flows. Central to the exposition is the polyhedral viewpoint, which is the key principle underlying the successful integer-programming approach to combinatorial-optimization problems. Another key unifying topic is matroids. The author does not dwell on data structures and implementation details, preferring to focus on the key mathematical ideas that lead to useful models and algorithms. Problems and exercises are included throughout as well as references for further study.

Graphs and Algorithms

Combinatorial optimization is a multidisciplinary scientific area, lying in the interface of three major scientific domains: mathematics, theoretical computer science and management. The three volumes of the Combinatorial Optimization series aim to cover a wide range of topics in this area. These topics also deal with fundamental notions and approaches as with several classical applications of combinatorial optimization. "Paradigms of Combinatorial Optimization" is divided into two parts: • Paradigmatic Problems, that handles several famous combinatorial optimization problems as max cut, min coloring, optimal satisfiability tsp, etc., the study of which has largely contributed to both the development, the legitimization and the establishment of the Combinatorial Optimization as one of the most active actual scientific domains; • Classical and New Approaches, that presents the several methodological approaches that fertilize and are fertilized by Combinatorial optimization such as: Polynomial Approximation, Online Computation, Robustness, etc., and, more recently, Algorithmic Game Theory.

Local Search in Combinatorial Optimization

Bioinspired computation methods such as evolutionary algorithms and ant colony optimization are being applied successfully to complex engineering problems and to problems from combinatorial optimization, and with this comes the requirement to more fully understand the computational complexity of these search heuristics. This is the first textbook covering the most important results achieved in this area. The authors study the computational complexity of bioinspired computation and show how runtime behavior can be analyzed in a rigorous way using some of the best-known combinatorial optimization problems -- minimum spanning trees, shortest paths, maximum matching, covering and scheduling problems. A feature of the book is the separate treatment of single- and multiobjective problems, the latter a domain where the development of the underlying theory seems to be lagging practical successes. This book will be very valuable for teaching courses on bioinspired computation and combinatorial optimization. Researchers will also benefit as the presentation of the theory covers the most important developments in the field over the last 10 years. Finally, with a focus on well-studied combinatorial optimization problems rather than toy problems, the book will also be very valuable for practitioners in this field.

Application of Optimization Algorithms in Chemistry

Graph algorithms are easy to visualize and indeed there already exists a variety of packages to animate the dynamics when solving problems from graph theory. Still it can be difficult to understand the ideas behind the algorithm from the dynamic display alone. CATBox consists of a software system for animating graph algorithms and a course book which we developed simultaneously. The software system presents both the algorithm and the graph and puts the user always in control of the actual code that is executed. In the course book, intended for readers at advanced undergraduate or graduate level, computer exercises and examples replace the usual static pictures of algorithm dynamics. For this volume we have chosen solely algorithms for classical problems from combinatorial optimization, such as minimum spanning trees, shortest paths, maximum flows, minimum cost flows, weighted and unweighted matchings both for bipartite and non-bipartite graphs. Find more information at <http://schliep.org/CATBox/>.

Combinatorial Optimization

Progress in Combinatorial Optimization provides information pertinent to the fundamental aspects of combinatorial optimization. This book discusses how to determine whether or not a particular structure exists. Organized into 21 chapters, this book begins with an overview of a polar characterization of facets of polyhedra obtained by lifting facets of lower dimensional polyhedra. This text then discusses how to obtain bounds on the value of the objective in a graph partitioning problem in terms of spectral information about the graph. Other chapters consider the notion of a triangulation of an oriented matroid and show that oriented matroid triangulation yield triangulations of the underlying polytopes. This book discusses as well the selected results and problems on perfect and imperfect graphs. The final chapter deals with the weighted parity problem for gammoids, which can be

reduced to the weighted graphic matching problem. This book is a valuable resource for mathematicians and research workers.

An Introduction to Information Theory

Techniques and principles of minimax theory play a key role in many areas of research, including game theory, optimization, and computational complexity. In general, a minimax problem can be formulated as $\min_x \max_y f(x, y)$ (1) where $f(x, y)$ is a function defined on the product of X and Y spaces. There are two basic issues regarding minimax problems: The first issue concerns the establishment of sufficient and necessary conditions for equality $\min_x \max_y f(x, y) = \max_y \min_x f(x, y)$. (2) The classical minimax theorem of von Neumann is a result of this type. Duality theory in linear and convex quadratic programming interprets minimax theory in a different way. The second issue concerns the establishment of sufficient and necessary conditions for values of the variables x and y that achieve the global minimax function value $f(x^*, y^*) = \min_x \max_y f(x, y)$. (3) There are two developments in minimax theory that we would like to mention.

Introductory Discrete Mathematics

Outstanding text for graduate students and research workers proposes improvements to existing algorithms, extends their related mathematical theories, and offers details on new algorithms for approximating local and global minima.

Handbook of Graph Theory, Combinatorial Optimization, and Algorithms

This book constitutes the proceedings of the 14th International Computer Science Symposium in Russia, CSR 2019, held in Novosibirsk, Russia, in July 2019. The 31 full papers were carefully reviewed and selected from 71 submissions. The papers cover a wide range of topics such as algorithms and data structures; computational complexity; randomness in computing; approximation algorithms; combinatorial optimization; constraint satisfaction; computational geometry; formal languages and automata; codes and cryptography; combinatorics in computer science; applications of logic to computer science; proof complexity; fundamentals of machine learning; and theoretical aspects of big data.

CATBox

This book gives a comprehensive presentation of cutting-edge research in communication networks with a combinatorial optimization component. The objective of the book is to advance and promote the theory and applications of combinatorial optimization in communication networks. Each chapter is written by an expert dealing with theoretical, computational, or applied aspects of combinatorial optimization.

Minimax and Applications

In recent years, many new techniques have emerged in the mathematical theory of discrete optimization that have proven to be effective in solving a number of hard problems. This book presents these recent advances, particularly those that arise from algebraic geometry, commutative algebra, convex and discrete geometry, generating functions, and other tools normally considered outside of the standard curriculum in optimization. These new techniques, all of which are presented with minimal prerequisites, provide a transition from linear to nonlinear discrete optimization. This book can be used as a textbook for advanced undergraduates or first-year graduate students in mathematics, computer science or operations research. It is also appropriate for mathematicians, engineers, and scientists engaged in computation who wish to gain a deeper understanding of how and why algorithms work.

Approximation, Randomization, and Combinatorial Optimization. Algorithms and Techniques

Covering network designs, discrete convex analysis, facility location and clustering problems, matching games, and parameterized complexity, this book discusses theoretical aspects of combinatorial optimization and graph algorithms. Contributions are by renowned researchers who attended NII Shonan meetings on this essential topic. The collection contained here provides readers with the outcome of the authors' research and productive meetings on this dynamic area, ranging from computer science and mathematics to operations research. Networks are ubiquitous in today's world: the Web, online social networks, and search-and-query click logs can lead to a graph that consists of vertices and edges. Such networks are growing so fast that it is essential to design algorithms to work for these large networks. Graph algorithms comprise an area in computer science that works to design efficient algorithms for networks. Here one can work on theoretical or practical problems where implementation of an algorithm for large networks is needed. In two of the chapters, recent results in graph matching games and fixed parameter tractability are surveyed. Combinatorial optimization is an intersection of operations research and mathematics, especially discrete mathematics, which deals with new questions and new problems, attempting to find an optimum object from a finite set of objects. Most problems in combinatorial optimization are not tractable (i.e., NP-hard). Therefore it is necessary to design an approximation algorithm for them. To tackle these problems requires the development and combination of ideas and techniques from diverse mathematical areas including complexity theory, algorithm theory, and matroids as well as graph theory, combinatorics, convex and nonlinear optimization, and discrete and convex geometry. Overall, the book presents recent progress in facility location, network design, and discrete convex analysis.

Paradigms of Combinatorial Optimization

In the past three decades, local search has grown from a simple heuristic idea into a mature field of research in combinatorial optimization that is attracting ever-increasing attention. Local search is still the method of choice for NP-hard problems as it provides a robust approach for obtaining high-quality solutions to problems of a realistic size in reasonable time. Local Search in Combinatorial

Optimization covers local search and its variants from both a theoretical and practical point of view, each topic discussed by a leading authority. This book is an important reference and invaluable source of inspiration for students and researchers in discrete mathematics, computer science, operations research, industrial engineering, and management science. In addition to the editors, the contributors are Mihalis Yannakakis, Craig A. Tovey, Jan H. M. Korst, Peter J. M. van Laarhoven, Alain Hertz, Eric Taillard, Dominique de Werra, Heinz Mühlenbein, Carsten Peterson, Bo Söderberg, David S. Johnson, Lyle A. McGeoch, Michel Gendreau, Gilbert Laporte, Jean-Yves Potvin, Gerard A. P. Kindervater, Martin W. P. Savelsbergh, Edward J. Anderson, Celia A. Glass, Chris N. Potts, C. L. Liu, Peichen Pan, Iiro Honkala, and Patric R. J. Östergård.

Turing (A Novel about Computation)

This concise, undergraduate-level text focuses on combinatorics, graph theory with applications to some standard network optimization problems, and algorithms. More than 200 exercises, many with complete solutions. 1991 edition.

Computer Science - Theory and Applications

Behind the familiar surfaces of the telephone, radio, and television lies a sophisticated and intriguing body of knowledge known as information theory. This is the theory that has permeated the rapid development of all sorts of communication, from color television to the clear transmission of photographs from the vicinity of Jupiter. Even more revolutionary progress is expected in the future. To give a solid introduction to this burgeoning field, J. R. Pierce has revised his well-received 1961 study of information theory for an up-to-date second edition. Beginning with the origins of the field, Dr. Pierce follows the brilliant formulations of Claude Shannon and describes such aspects of the subject as encoding and binary digits, entropy, language and meaning, efficient encoding, and the noisy channel. He then goes beyond the strict confines of the topic to explore the ways in which information theory relates to physics, cybernetics, psychology, and art. Mathematical formulas are introduced at the appropriate points for the benefit of serious students. A glossary of terms and an appendix on mathematical notation are provided to help the less mathematically sophisticated. J. R. Pierce worked for many years at the Bell Telephone Laboratories, where he became Director of Research in Communications Principles. He is currently affiliated with the engineering department of the California Institute of Technology. While his background is impeccable, Dr. Pierce also possesses an engaging writing style that makes his book all the more welcome. An Introduction to Information Theory continues to be the most impressive non-technical account available and a fascinating introduction to the subject for laymen. "An uncommonly good study. . . . Pierce's volume presents the most satisfying discussion to be found." Scientific American.

Bioinspired Computation in Combinatorial Optimization

This is a supplementary volume to the major three-volume Handbook of Combinatorial Optimization set. It can also be regarded as a stand-alone volume

presenting chapters dealing with various aspects of the subject in a self-contained way.

Combinatorial Optimization Problems in Planning and Decision Making

Rave reviews for INTEGER AND COMBINATORIAL OPTIMIZATION "This book provides an excellent introduction and survey of traditional fields of combinatorial optimization . . . It is indeed one of the best and most complete texts on combinatorial optimization . . . available. [And] with more than 700 entries, [it] has quite an exhaustive reference list."-Optima "A unifying approach to optimization problems is to formulate them like linear programming problems, while restricting some or all of the variables to the integers. This book is an encyclopedic resource for such formulations, as well as for understanding the structure of and solving the resulting integer programming problems."-Computing Reviews "[This book] can serve as a basis for various graduate courses on discrete optimization as well as a reference book for researchers and practitioners."-Mathematical Reviews "This comprehensive and wide-ranging book will undoubtedly become a standard reference book for all those in the field of combinatorial optimization."-Bulletin of the London Mathematical Society "This text should be required reading for anybody who intends to do research in this area or even just to keep abreast of developments."-Times Higher Education Supplement, London Also of interest . . . INTEGER PROGRAMMING Laurence A. Wolsey Comprehensive and self-contained, this intermediate-level guide to integer programming provides readers with clear, up-to-date explanations on why some problems are difficult to solve, how techniques can be reformulated to give better results, and how mixed integer programming systems can be used more effectively. 1998 (0-471-28366-5) 260 pp.

A First Course in Combinatorial Optimization

This eBook is dedicated to Prof. William L. Hase, who passed away on Monday, March 23, 2020.

Handbook of Combinatorial Optimization

This graduate-level text considers the Soviet ellipsoid algorithm for linear programming; efficient algorithms for network flow, matching, spanning trees, and matroids; the theory of NP-complete problems; local search heuristics for NP-complete problems, more. 1982 edition.

Algorithms for Minimization Without Derivatives

This book focuses on the development of approximation-related algorithms and their relevant applications. Individual contributions are written by leading experts and reflect emerging directions and connections in data approximation and optimization. Chapters discuss state of the art topics with highly relevant applications throughout science, engineering, technology and social sciences. Academics, researchers, data science practitioners, business analysts, social sciences investigators and graduate students will find the number of illustrations,

applications, and examples provided useful. This volume is based on the conference Approximation and Optimization: Algorithms, Complexity, and Applications, which was held in the National and Kapodistrian University of Athens, Greece, June 29–30, 2017. The mix of survey and research content includes topics in approximations to discrete noisy data; binary sequences; design of networks and energy systems; fuzzy control; large scale optimization; noisy data; data-dependent approximation; networked control systems; machine learning ; optimal design; no free lunch theorem; non-linearly constrained optimization; spectroscopy.

Advances in Combinatorial Optimization

This monograph presents the main complexity theorems in convex optimization and their corresponding algorithms. It begins with the fundamental theory of black-box optimization and proceeds to guide the reader through recent advances in structural optimization and stochastic optimization. The presentation of black-box optimization, strongly influenced by the seminal book by Nesterov, includes the analysis of cutting plane methods, as well as (accelerated) gradient descent schemes. Special attention is also given to non-Euclidean settings (relevant algorithms include Frank-Wolfe, mirror descent, and dual averaging), and discussing their relevance in machine learning. The text provides a gentle introduction to structural optimization with FISTA (to optimize a sum of a smooth and a simple non-smooth term), saddle-point mirror prox (Nemirovski's alternative to Nesterov's smoothing), and a concise description of interior point methods. In stochastic optimization it discusses stochastic gradient descent, mini-batches, random coordinate descent, and sublinear algorithms. It also briefly touches upon convex relaxation of combinatorial problems and the use of randomness to round solutions, as well as random walks based methods.

Phase Transitions in Combinatorial Optimization Problems

This book constitutes the thoroughly refereed post-conference proceedings of the 5th International Symposium on Combinatorial Optimization, ISCO 2017, held in Marrakesh, Marocco, in April 2018. The 35 revised full papers presented in this book were carefully reviewed and selected from 75 submissions. The symposium aims to bring together researchers from all the communities related to combinatorial optimization, including algorithms and complexity, mathematical programming and operations research.

Geometric Algorithms and Combinatorial Optimization

Generalities about graphs. The shortest path problem in a graph. Path algebras. Trees and arborescences. Flows and transportation networks. Flows with gains. Multicommodity flows. Matchings and b-matchings. Eulerian and hamiltonian walks. Matroids. Non-polynomial problems. Branch and bound algorithms. Approximate algorithms. Linear programming. Integer linear programming. Lagrangean relaxation and solving the dual problem. Dynamic programming. Minimum ratio problems.

Combinatorial Optimization and Graph Algorithms

This book documents the state of the art in combinatorial optimization, presenting approximate solutions of virtually all relevant classes of NP-hard optimization problems. The wealth of problems, algorithms, results, and techniques make it an indispensable source of reference for professionals. The text smoothly integrates numerous illustrations, examples, and exercises.

Convex Optimization

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.

Recent Advances and Historical Development of Vector Optimization

Christos H. Papadimitriou and Kenneth Steiglitz have combined the theory of computational complexity developed by computer scientists, and the foundations of mathematical programming developed by the operations research community. This text will be useful to students with a wide range of backgrounds, including computer science, operations research, and electrical engineering.

Combinatorial Optimization

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.

Combinatorial Optimization

' Combinational optimization (CO) is a topic in applied mathematics, decision science and computer science that consists of finding the best solution from a non-exhaustive search. CO is related to disciplines such as computational complexity theory and algorithm theory, and has important applications in fields such as operations research/management science, artificial intelligence, machine learning, and software engineering. Advances in Combinatorial Optimization presents a generalized framework for formulating hard combinatorial optimization problems (COPs) as polynomial sized linear programs. Though developed based on the "traveling salesman problem" (TSP), the framework allows for the formulating of many of the well-known NP-Complete COPs directly (without the need to reduce them to other COPs) as linear programs, and demonstrates the same for three

other problems (e.g. the "vertex coloring problem" (VCP)). This work also represents a proof of the equality of the complexity classes "P" (polynomial time) and "NP" (nondeterministic polynomial time), and makes a contribution to the theory and application of "extended formulations" (EFs). On a whole, Advances in Combinatorial Optimization offers new modeling and solution perspectives which will be useful to professionals, graduate students and researchers who are either involved in routing, scheduling and sequencing decision-making in particular, or in dealing with the theory of computing in general. Contents: Introduction Basic IP Model Using the TSP Basic LP Model Using the TSP Generic LP Modeling for COPs Non-Symmetry of the Basic (TSP) Model Non-Applicability of Extended Formulations Theory Illustrations for Other NP-Complete COPs Readership: Professionals, graduate students and researchers who are either involved in routing, scheduling and sequencing decision-making in particular, or in dealing with the theory of computing in general. Key Features: The book offers a new proof of the equality of the complexity classes "P" and "NP" Although our approach is developed using the framework of the TSP, it has natural analogs for the other problems in the NP-Complete class thus providing a unified framework for modeling many combinatorial optimization problems (COPs) The book makes a contribution to the theory and application of Extended Formulations (EFs) refining the notion of EFs by separating the case in which that notion is degenerate from the case in which the notion of EF is well defined/meaningful. It separates the case in which the addition of redundant constraints and variables (for the purpose of establishing EF relations) matters from the case in which the addition of redundant constraints and variables does not matter Keywords: Linear Programming; Convex Optimization; Combinatorial Optimization; Traveling Salesman Problem; NP-Complete Problems; P versus NP'

Algebraic and Geometric Ideas in the Theory of Discrete Optimization

With the advent of approximation algorithms for NP-hard combinatorial optimization problems, several techniques from exact optimization such as the primal-dual method have proven their staying power and versatility. This book describes a simple and powerful method that is iterative in essence and similarly useful in a variety of settings for exact and approximate optimization. The authors highlight the commonality and uses of this method to prove a variety of classical polyhedral results on matchings, trees, matroids and flows. The presentation style is elementary enough to be accessible to anyone with exposure to basic linear algebra and graph theory, making the book suitable for introductory courses in combinatorial optimization at the upper undergraduate and beginning graduate levels. Discussions of advanced applications illustrate their potential for future application in research in approximation algorithms.

Combinatorial Optimization

This well-written textbook on combinatorial optimization puts special emphasis on theoretical results and algorithms with provably good performance, in contrast to heuristics. The book contains complete (but concise) proofs, as well as many deep results, some of which have not appeared in any previous books.

Iterative Methods in Combinatorial Optimization

The fusion between graph theory and combinatorial optimization has led to theoretically profound and practically useful algorithms, yet there is no book that currently covers both areas together. Handbook of Graph Theory, Combinatorial Optimization, and Algorithms is the first to present a unified, comprehensive treatment of both graph theory and c

Handbook of Approximation Algorithms and Metaheuristics

Algorithmic design, especially for hard problems, is more essential for success in solving them than any standard improvement of current computer technologies. Because of this, the design of algorithms for solving hard problems is the core of current algorithmic research from the theoretical point of view as well as from the practical point of view. There are many general text books on algorithmics, and several specialized books devoted to particular approaches such as local search, randomization, approximation algorithms, or heuristics. But there is no textbook that focuses on the design of algorithms for hard computing tasks, and that systematically explains, combines, and compares the main possibilities for attacking hard algorithmic problems. As this topic is fundamental for computer science, this book tries to close this gap. Another motivation, and probably the main reason for writing this book, is connected to education. The considered area has developed very dynamically in recent years and the research on this topic discovered several profound results, new concepts, and new methods. Some of the achieved contributions are so fundamental that one can speak about paradigms which should be included in the education of every computer science student. Unfortunately, this is very far from reality. This is because these paradigms are not sufficiently known in the computer science community, and so they are insufficiently communicated to students and practitioners.

Combinatorial Optimization

The world of computation according to Turing, an interactive tutoring program, as told to star-crossed lovers: a novel. Our hero is Turing, an interactive tutoring program and namesake (or virtual emanation?) of Alan Turing, World War II code breaker and father of computer science. In this unusual novel, Turing's idiosyncratic version of intellectual history from a computational point of view unfolds in tandem with the story of a love affair involving Ethel, a successful computer executive, Alexandros, a melancholy archaeologist, and Ian, a charismatic hacker. After Ethel (who shares her first name with Alan Turing's mother) abandons Alexandros following a sundrenched idyll on Corfu, Turing appears on Alexandros's computer screen to unfurl a tutorial on the history of ideas. He begins with the philosopher-mathematicians of ancient Greece—"discourse, dialogue, argument, proof can only thrive in an egalitarian society"—and the Arab scholar in ninth-century Baghdad who invented algorithms; he moves on to many other topics, including cryptography and artificial intelligence, even economics and developmental biology. (These lessons are later critiqued amusingly and developed further in postings by a fictional newsgroup in the book's afterword.) As Turing's lectures progress, the lives of Alexandros, Ethel,

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and Ian converge in dramatic fashion, and the story takes us from Corfu to Hong Kong, from Athens to San Francisco—and of course to the Internet, the disruptive technological and social force that emerges as the main locale and protagonist of the novel. Alternately pedagogical and romantic, Turing (A Novel about Computation) should appeal both to students and professionals who want a clear and entertaining account of the development of computation and to the general reader who enjoys novels of ideas.

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