

Alexander Schrijver A Course In Combinatorial Optimization

This book is an elegant and rigorous presentation of integer programming, exposing the subject's mathematical depth and broad applicability. Special attention is given to the theory behind the algorithms used in state-of-the-art solvers. An abundance of concrete examples and exercises of both theoretical and real-world interest explore the wide range of applications and ramifications of the theory. Each chapter is accompanied by an expertly informed guide to the literature and special topics, rounding out the reader's understanding and serving as a gateway to deeper study. Key topics include: formulations polyhedral theory cutting planes decomposition enumeration semidefinite relaxations Written by renowned experts in integer programming and combinatorial optimization, *Integer Programming* is destined to become an essential text in the field.

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 Baumrith 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 G del 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 Sloan Foundation Fellow. Dr. Spencer has written more than 200 published articles and is the coauthor of *Ramsey Theory*, Second Edition, also published by Wiley.

Discrete Mathematics and theoretical computer science are closely linked research areas with strong impacts on applications and various other scientific disciplines. Both fields deeply cross fertilize each other. One of the persons who particularly contributed to building bridges between these and many other areas is László Lovász, whose outstanding scientific work has defined and shaped many research directions in the past 40 years. A number of friends and colleagues, all top authorities in their fields of expertise gathered at the two conferences in August 2008 in Hungary, celebrating Lovász' 60th birthday. It was a real fete of combinatorics and computer science. Some of these plenary speakers submitted their research or survey papers prior to the conferences. These are included in the volume "Building Bridges". The other speakers were able to finish their contribution only later, these are collected in the present volume.

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.

Analysis, Algorithms, and Engineering Applications

Multigent Systems

A Theory Revolutionizing Technology and Science

Fete of Combinatorics and Computer Science

Understanding and Using Linear Programming

While "topological combinatorics" might have the ring of a venerable discipline, it actually names a newly consolidated subject that pulls together results mostly from recent decades. This new branch of mathematics nevertheless features ample content accessible to undergraduates. Only specialists will guess the purview from the title alone, namely deducing combinatorial (especially graph-theoretic) results using tools from algebraic topology. Elementary algebraic topology suffices, and the appendices comprising the last third of the present volume offer a crash course. In the book's four main chapters, Longueville (Univ. of Applied Sciences, Germany) addresses fair-division problems; graph coloring; graph property evasiveness; and embeddings and mappings. Chapter 4 contains a high point: the best available introduction to the famous and notoriously difficult half-century-old *Thackle* conjecture of J. H. Conway. "Thackle" means a graph drawing where adjacent edges do not cross but independent edges cross exactly once; Conway simply hazards that *thackable* graphs never have more edges than vertices. Basic results of algebraic topology already have powerful consequences for analysis, but the subject's arcanas can look like art for art's sake. The author's charting of a novel application domain for a core subject makes this book an essential acquisition. **Summing Up:** Essential. Upper-division undergraduates and above. Upper-division Undergraduates; Graduate Students; Researchers/Faculty; Professionals/Practitioners. Reviewed by D. V. Feldman. This book offers a gentle introduction to the mathematics of both sides of game theory: combinatorial and classical. The combination allows for a dynamic and rich tour of the subject united by a common theme of strategic reasoning. Designed as a textbook for an undergraduate mathematics class and with ample material and limited dependencies between the chapters, the book is adaptable to a variety of situations and a range of audiences. Instructors, students, and independent readers alike will appreciate the flexibility in content choices as well as the generous sets of exercises at various levels.

A complete, highly accessible introduction to one of today's most exciting areas of applied mathematics One of the youngest, most vital areas of applied mathematics,combinatorial optimization integrates techniques fromcombinatorics, linear programming, and the theory of algorithms.Because of its success in solving difficult problems in areas fromtelecommunications to VLSI, from product distribution to airlinescrew scheduling, the field has seen a ground swell of activity overthe past decade. Combinatorial Optimization is an ideal introduction to thismathematical discipline for advanced undergraduates and graduatestudents of discrete mathematics, computer science, and operationsresearch. Written by a team of recognized experts, the text offers a thorough, highly accessible treatment of both classical conceptsand recent results. The topics include: * Network flow problems * Optimal matching * Integrality of polyhedra * Matroids * NP-completeness Featuring logical and consistent exposition, clear explanations ofbasic and advanced concepts, many real-world examples, and helpful,skill-building exercises, Combinatorial Optimization is certain tobecome the standard text in the field for many years to come.

This book contains revised and extended versions of selected papers from the 5th International Conference on Pattern Recognition, ICPRAM 2016, held in Rome, Italy, in February 2016. The 13 full papers were carefully reviewed and selected from 125 initial submissions and describe up-to-date applications of pattern recognition techniques to real-world problems, interdisciplinary research, experimental and/or theoretical studies yielding new insights that advance pattern recognition methods.

Optimization Tools for Logistics

Matt DeVos and Deborah A. Kent

Advances in Applied and Computational Topology

Rational Generating Functions and Lattice Point Sets

Iterative Methods in Combinatorial Optimization

Optimization Tools for Logistics covers the theory and practice of the main principles of operational research and the ways it can be applied to logistics and decision support with regards to common software. The book is supported by worked problems and examples from industrial case studies, providing a comprehensive tool for readers from a variety of industries. Covers simple explanations of the mathematical theories related to logistics Contains many problems and examples from industrial case studies Includes coverage of the use of readily available software: spreadsheets, project managers, flows simulators

This book introduces readers to the field of conformance checking as a whole and outlines the fundamental relation between modelled and recorded behaviour. Conformance checking interrelates the modelled and recorded behaviour of a given process and provides techniques and methods for comparing and analysing observed instances of a process in the presence of a model, independent of the model's origin. Its goal is to provide an overview of the essential techniques and methods in this field at an intuitive level, together with precise formalisations of its underlying principles. The book is divided into three parts, that are meant to cover different perspectives of the field of conformance checking. Part I presents a comprehensive yet accessible overview of the essential concepts used to interrelate modelled and recorded behaviour. It also serves as a reference for assessing how conformance checking efforts could be applied in specific domains. Next, Part II provides readers with detailed insights into algorithms for conformance checking, including the most commonly used formal notions and their instantiation for specific analysis questions. Lastly, Part III highlights applications that help to make sense of conformance checking results, thereby providing a necessary next step to increase the value of a given process model. They help to interpret the outcomes of conformance checking and incorporate them by means of enhancement and repair techniques. Providing the core building blocks of conformance checking and describing its main applications, this book mainly addresses students specializing in business process management, researchers entering process mining and conformance checking for the first time, and advanced professionals whose work involves process evaluation, modelling and optimization.

The first edition won the award for Best 1990 Professional and Scholarly Book in Computer Science and Data Processing by the Association of American Publishers. There are books on algorithms that are rigorous but incomplete and others that cover masses of material but lack rigor. Introduction to Algorithms combines rigor and comprehensiveness. The book covers a broad range of algorithms in depth, yet makes their design and analysis accessible to all levels of readers. Each chapter is relatively self-contained and can be used as a unit of study. The algorithms are described in English and in a pseudocode designed to be readable by anyone who has done a little programming. The explanations have been kept elementary without sacrificing depth of coverage or mathematical rigor. The first edition became the standard reference for professionals and a widely used text in universities worldwide. The second edition features new chapters on the role of algorithms, probabilistic analysis and randomized algorithms, and linear programming, as well as extensive revisions to virtually every section of the book. In a subtle but important change, loop invariants are introduced early and used throughout the text to prove algorithm correctness. Without changing the mathematical and analytic focus, the authors have moved much of the mathematical foundations material from Part I to an appendix and have included additional motivational material at the beginning.

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.

American Mathematical Society Short Course on Computational Topology, January 4-5, 2011, New Orleans, Louisiana

Trust Region Methods

5th International Conference, ICPRAM 2016, Rome, Italy, February 24-26, 2016, Revised Selected Papers

Theory of Linear and Integer Programming

The Design of Competitive Online Algorithms Via a Primal-Dual Approach

This book is intended to introduce the rapidly developing subjects of NP theories, for students and researchers in model theory. Combinatorial reciprocity is a very interesting phenomenon, which can be described as follows: A polynomial, whose values at positive integers count combinatorial objects of some sort, may give the number of combinatorial objects of a different sort when evaluated at negative integers (and suitably normalized). Such combinatorial reciprocity theorems occur in connections with graphs, partially ordered sets, polyhedra, and more. Using the combinatorial reciprocity theorems as a leitmotif, this book unfolds central ideas and techniques in enumerative and geometric combinatorics. Written in a friendly writing style, this is an accessible graduate textbook with almost 300 exercises, numerous illustrations, and pointers to the research literature. Topics include concise introductions to partially ordered sets, polyhedral geometry, and rational generating functions, followed by highly original chapters on subdivisions, geometric realizations of partially ordered sets, and hyperplane arrangements.

Constraint Satisfaction Problems (CSPs) are natural computational problems that appear in many areas of theoretical computer science. Exploring which CSPs are solvable in polynomial time and which are NP-hard reveals a surprising link with central questions in universal algebra. This monograph presents a self-contained introduction to the universal-algebraic approach to complexity classification, treating both finite and infinite-domain CSPs. It includes the required background from logic and combinatorics, particularly model theory and Ramsey theory, and explains the recently discovered link between Ramsey theory and topological dynamics and its implications for CSPs. The book will be of interest to graduate students and researchers in theoretical computer science and to mathematicians in logic, combinatorics, and dynamics who wish to learn about the applications of their work in complexity theory.

An introduction to computational complexity theory, its connections and interactions with mathematics, and its central role in the natural and social sciences, technology, and philosophy Mathematics and Computation provides a broad, conceptual overview of computational complexity theory—the mathematical study of efficient computation. With important practical applications to computer science and industry, computational complexity theory has evolved into a highly interdisciplinary field, with strong links to most mathematical areas and to a growing number of scientific endeavors. Avi Wigderson takes a sweeping survey of complexity theory, emphasizing the field's insights and challenges. He explains the ideas and motivations leading to key models, notions, and results. In particular, he looks at algorithms and complexity, computations and proofs, randomness and interaction, quantum and arithmetic computation, and cryptography and learning, all as parts of a cohesive whole with numerous cross-influences. Wigderson illustrates the immense breadth of the field, its beauty and richness, and its diverse and growing interactions with other areas of mathematics. He ends with a comprehensive look at the theory of computation, its methodology and applications, and the unique and fundamental ways in which it has shaped and will further shape science, technology, and society. For further reading, an extensive bibliography is provided for all topics covered. Mathematics and Computation is useful for undergraduate and graduate students in mathematics, computer science, and related fields, as well as researchers and teachers in these fields. Many parts require little background, and serve as an invitation to newcomers seeking an introduction to the theory of computation. Comprehensive coverage of computational complexity theory, and beyond High-level, intuitive exposition, which brings conceptual clarity to this central and dynamic scientific discipline Historical accounts of the evolution and motivations of central concepts and models A broad view of the theory of computation's influence on science, technology, and society Extensive bibliography

Lectures on Modern Convex Optimization

Functional Analysis with Applications

Combinatorial Optimization

Optimization Over Integers

Pattern Recognition Applications and Methods

An overview of the rapidly growing field of ant colony optimization that describes theoretical findings, the major algorithms, and current applications. The complex social behaviors of ants have been much studied by science, and computer scientists are now finding that these behavior patterns can provide models for solving difficult combinatorial optimization problems. The attempt to develop algorithms inspired by one aspect of ant behavior, the ability to find what computer scientists would call shortest paths, has become the field of ant colony optimization (ACO), the most successful and widely recognized algorithmic technique based on ant behavior. This book presents an overview of this rapidly growing field, from its theoretical inception to practical applications, including descriptions of many available ACO algorithms and their uses. The book first describes the translation of observed ant behavior into working optimization algorithms. The ant colony metaheuristic is then introduced and viewed in the general context of combinatorial optimization. This is followed by a detailed description and guide to all major ACO algorithms and a report on current theoretical findings. The book surveys ACO applications now in use, including routing, assignment, scheduling, subset, machine learning, and bioinformatics problems. AntNet, an ACO algorithm designed for the network routing problem, is described in detail. The authors conclude by summarizing the progress in the field and outlining future research directions. Each chapter ends with bibliographic material, bullet points setting out important ideas covered in the chapter, and exercises. Ant Colony Optimization will be of interest to academic and industry researchers, graduate students, and practitioners who wish to learn how to implement ACO algorithms.

The latest edition of the essential text and professional reference, with substantial new material on such topics as vEB trees, multithreaded algorithms, dynamic programming, and edge-based flow. Some books on algorithms are rigorous but incomplete; others cover masses of material but lack rigor. Introduction to Algorithms uniquely combines rigor and comprehensiveness. The book covers a broad range of algorithms in depth, yet makes their design and analysis accessible to all levels of readers. Each chapter is relatively self-contained and can be used as a unit of study. The algorithms are described in English and in a pseudocode designed to be readable by anyone who has done a little programming. The explanations have been kept elementary without sacrificing depth of coverage or mathematical rigor. The first edition became a widely used text in universities worldwide as well as the standard reference for professionals. The second edition featured new chapters on the role of algorithms, probabilistic analysis and randomized algorithms, and linear programming. The third edition has been revised and updated throughout. It includes two completely new chapters, on van Emde Boas trees and multithreaded algorithms, substantial additions to the chapter on recurrence (now called "Divide-and-Conquer"), and an appendix on matrices. It features improved treatment of dynamic programming and greedy algorithms and a new notion of edge-based flow in the material on flow networks. Many exercises and problems have been added for this edition. The international paperback edition is no longer available; the hardcover is available worldwide.

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/>.

Mathematics of Computing -- General

Introduction to Algorithms, 3rd edition

Theory and Algorithms

Relating Processes and Models

Geometric Algorithms and Combinatorial Optimization

The Probabilistic Method

What is the shape of data? How do we describe flows? Can we count by integrating? How do we plan with uncertainty? What is the most compact representation? These questions, while unrelated, become similar when recast into a computational setting. Our input is a set of finite, discrete, noisy samples that describes an abstract space. Our goal is to compute qualitative features of the unknown space. It turns out that topology is sufficiently tolerant to provide us with robust tools. This volume is based on lectures delivered at the 2011 AMS Short Course on Computational Topology, held January 4-5, 2011 in New Orleans, Louisiana. The aim of the volume is to provide a broad introduction to recent techniques from applied and computational topology. Afra Zomorodian focuses on topological data analysis via efficient construction of combinatorial structures and recent theories of persistence. Marian Mrozek analyzes asymptotic behavior of dynamical systems via efficient computation of cubical homology. Justin Curry, Robert Ghrist, and Michael Robinson present Euler Calculus, an integral calculus based on the Euler characteristic, and apply it to sensor and network data aggregation. Michael Erdmann explores the relationship of topology, planning, and probability with the strategy complex. Jeff Erickson surveys algorithms and hardness results for topological optimization problems.

Here is a book devoted to well-structured and thus efficiently solvable convex optimization problems, with emphasis on conic quadratic and semidefinite programming. The authors present the basic theory underlying these problems as well as their numerous applications in engineering, including synthesis of filters, Lyapunov stability analysis, and structural design. The authors also discuss the complexity issues and provide an overview of the basic theory of state-of-the-art polynomial time interior point methods for linear, conic quadratic, and semidefinite programming. The book's focus on well-structured convex problems in conic form allows for unified theoretical and algorithmical treatment of a wide spectrum of important optimization problems arising in applications.

Extends the primal-dual method to the setting of online algorithms, and shows its applicability to a wide variety of fundamental problems.

Volume 2 begins with an introduction and 4 chapters implementing software tools on cases of practical applications and it ends with a conclusion: The various tools used in this volume Operational research with a spreadsheet Dashboards with spreadsheets and pivot tables Scheduling and planning with a project manager The traffic simulation

The conclusion shows the new features that are expected to emerge on spreadsheets as well as project managers, developments and convergences between traffic simulators and new infrastructure that are emerging on road networks. Annex 1 focuses on the installation Solver in Microsoft Excel and Annex 2 focuses on the installation of the Java Development Kit.

Dashboards, Traffic Planning and Management

CATBox

Lectures on Polytopes

Algorithms for Convex Optimization

Since the publication of the first edition of our book, geometric algorithms and combinatorial optimization have kept growing at the same fast pace as before. Nevertheless, we do not feel that the ongoing research has made this book outdated. Rather, it seems that many of the new results build on the models, algorithms, and theorems presented here. For instance, the celebrated Dyer-Frieze-Kannan algorithm for approximating the volume of a convex body is based on the oracle model of convex bodies and uses the ellipsoid method as a preprocessing technique. The polynomial time equivalence of optimization, separation, and membership has become a commonly employed tool in the study of the complexity of combinatorial optimization problems and in the newly developing field of computational convexity. Implementations of the basis reduction algorithm can be found in various computer algebra software systems. On the other hand, several of the open problems discussed in the first edition are still unsolved. For example, there are still no combinatorial polynomial time algorithms known for minimizing a submodular function or finding a maximum clique in a perfect graph. Moreover, despite the success of the interior point methods for the solution of explicitly given linear programs there is still no method known that solves implicitly given linear programs, such as those described in this book, and that is both practically and theoretically efficient. In particular, it is not known how to adapt interior point methods to such linear programs.

Theory of Linear and Integer Programming Alexander Schrijver Centrum voor Wiskunde en Informatica, Amsterdam, The Netherlands This book describes the theory of linear and integer programming and surveys the algorithms for linear and integer programming problems, focusing on complexity analysis. It aims at complementing the more practically oriented books in this field. A special feature is the author's coverage of important recent developments in linear and integer programming. Applications to combinatorial optimization are given, and the author also includes extensive historical surveys and bibliographies. The book is intended for graduate students and researchers in operations research, mathematics and computer science. It will also be of interest to mathematical historians. Contents 1 Introduction and preliminaries; 2 Problems, algorithms, and complexity; 3 Linear algebra and complexity; 4 Theory of lattices and linear diophantine equations; 5 Algorithms for linear diophantine equations; 6 Diophantine approximation and basis reduction; 7 Fundamental concepts and results on polyhedra, linear inequalities, and linear programming; 8 The structure of polyhedra; 9 Polarity, and blocking and anti-blocking polyhedra; 10 Sizes and the theoretical complexity of linear inequalities and linear programming; 11 The simplex method; 12 Primal-dual, elimination, and relaxation methods; 13 Khachiyan's method for linear programming; 14 The ellipsoid method for polyhedra more generally; 15 Further polynomially results in linear programming; 16 Introduction to integer linear programming; 17 Estimates in integer linear programming; 18 The complexity of integer linear programming; 19 Totally unimodular matrices: Fundamental properties and examples; 20 Recognizing total unimodularity; 21 Further theory related to total unimodularity; 22 Integer polyhedra and total dual integrality; 23 Cutting planes; 24 Further methods in integer linear programming; Historical and further notes on integer linear programming; References; Notation index; Author index; Subject index

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

Integer solutions for systems of linear inequalities, equations, and congruences are considered along with the construction and theoretical analysis of integer programming algorithms. The complexity of algorithms is analyzed dependent upon two parameters: the dimension, and the maximal modulus of the coefficients describing the conditions of the problem. The analysis is based on a thorough treatment of the qualitative and quantitative aspects of integer programming, in particular on bounds obtained by the author for the number of extreme points. This permits progress in many cases in which the traditional approach—which regards complexity as a function only of the length of the input—leads to a negative result.

Complexity of Infinite-Domain Constraint Satisfaction

A Guide to NP Theories

A Course in Topological Combinatorics

A Mathematical View of Interior-point Methods in Convex Optimization

Graphs, Networks and Algorithms

Revised throughout Includes new chapters on the network simplex algorithm and a section on the five color theorem Recent developments are discussed

In the last few years, Algorithms for Convex Optimization have revolutionized algorithm design, both for discrete and continuous optimization problems. For problems like maximum flow, maximum matching, and submodular function minimization, the fastest algorithms involve essential methods such as gradient descent, mirror descent, interior point methods, and ellipsoid methods. The goal of this self-contained book is to enable researchers and professionals in computer science, data science, and machine learning to gain an in-depth understanding of these algorithms. The text emphasizes how to derive key algorithms for convex optimization from first principles and how to establish precise running time bounds. This modern text explains the success of these algorithms in problems of discrete optimization, as well as how these methods have significantly pushed the state of the art of convex optimization itself.

This book on functional analysis covers all the basics of the subject (normed, Banach and Hilbert spaces, Lebesgue integration and spaces, linear operators and functionals, compact and self-adjoint operators, small parameters, fixed point theory) with a strong focus on examples, exercises and practical problems, thus making it ideal as course material but also as a reference for self-study.

Based on a graduate course at the Technische Universität, Berlin, these lectures present a wealth of material on the modern theory of convex polytopes. The straightforward exposition features many illustrations, and complete proofs for most theorems. With only linear algebra as a prerequisite, it takes the reader quickly from the basics to topics of recent research. The lectures introduce basic facts about polytopes, with an emphasis on methods that yield the results, discuss important examples and elegant constructions, and show the excitement of current work in the field. They will provide interesting and enjoyable reading for researchers as well as students.

A Course in Combinatorial Optimization

Conformance Checking

An Interactive Course in Combinatorial Optimization

Ant Colony Optimization

Mathematics and Computation

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.

A Course in Combinatorial OptimizationTheory of Linear and Integer ProgrammingJohn Wiley & Sons

Volume 1 presents successively an introduction followed by 10 chapters and a conclusion: A logistic approach an overview of operations research The basics of graph theory calculating optimal routes Dynamic programming planning and scheduling with PERT and MPM the waves of calculations in a network spanning trees and touring linear programming modeling of road traffic

This is the first comprehensive introduction to multiagent systems and contemporary distributed artificial intelligence that is suitable as a textbook.

Qualitative topics in integer linear programming

Integer Programming

Modeling and Simulation of Logistics Flows 2

Combinatorial Reciprocity Theorems: An Invitation to Enumerative Geometric Combinatorics

Theory and Fundamentals