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Introduction to Linear Optimization *Handbook of Semidefinite Programming* Deterministic Operations Research **Network Optimization: Continuous and Discrete Models** *Urban Energy Systems* Anwendungen der stochastischen optimierung im Stromhandel und Gastransport Linear Algebra And Optimization With Applications To Machine Learning - Volume Ii: Fundamentals Of Optimization Theory With Applications To Machine Learning **Dynamic Programming and Optimal Control** Convex Optimization Algorithms **Convex Optimization Theory** Convex Analysis and Optimization Linear and Convex Optimization **Control Techniques for Complex Networks** *Design and Scheduling Problems in Planning Optical Networks Reinforcement Learning and Optimal Control* **Revenue Management with Flexible Products Encyclopedia of Optimization Optimization in Engineering** *Big Data Optimization: Recent Developments and Challenges* **Optimal Financial Decision Making under Uncertainty** Integer Programming and Combinatorial Optimization Numerik der Optimierung *Modeling and Optimization: Theory and Applications* Optimization in Renewable Energy Systems Robust Optimization in Electric Energy Systems Simulation and Optimization in Finance Nonlinear Programming **Optimization for Communications and Networks Abstract Dynamic Programming** *Rollout, Policy Iteration, and Distributed Reinforcement Learning* **Data Science for Mathematicians** *Nature-Inspired Optimization Algorithms Evolutionary Multi-Criterion Optimization Grundlagen der Mathematischen Optimierung* **Optimization Methods in Finance Optimization Methods in Metabolic Networks** *Introduction to Probability Cooperative Control of Distributed Multi-Agent Systems* **Linear and Nonlinear Programming Markov Chains and Stochastic Stability**

Introduction to Linear Optimization Nov 06 2022
Integer Programming and Combinatorial Optimization Feb 14 2021 This book constitutes the refereed proceedings of the 23rd International Conference on Integer Programming and Combinatorial Optimization, IPCO 2022, held in Eindhoven, The Netherlands, in June 2022. The 33 full papers presented were carefully reviewed and selected from 93 submissions addressing key techniques of document analysis. IPCO is under the auspices of the Mathematical Optimization Society, and it is an important forum for presenting the latest results of theory and practice of the various aspects of discrete optimization.
Control Techniques for Complex Networks Oct 25 2021 From foundations to state-of-the-art; the tools and philosophy you need to build network models.
Nature-Inspired Optimization Algorithms Mar 06 2020 Nature-Inspired Optimization Algorithms, Second Edition provides an introduction to all major nature-inspired algorithms for optimization. The book's unified approach, balancing algorithm introduction, theoretical background and practical implementation, complements extensive literature with case studies to illustrate how these algorithms work. Topics include particle swarm optimization, ant and bee algorithms, simulated annealing, cuckoo search, firefly algorithm, bat algorithm, flower algorithm, harmony search, algorithm analysis, constraint handling, hybrid methods, parameter tuning and control, and multi-objective optimization. This book can serve as an introductory book for graduates, for lecturers in computer science, engineering and natural sciences, and as a source of inspiration for new applications. Discusses and summarizes the latest developments in nature-inspired algorithms with comprehensive, timely literature Provides a theoretical understanding and practical implementation hints Presents a step-by-step introduction to each algorithm Includes four new chapters covering mathematical foundations, techniques for solving discrete and combination optimization problems, data mining techniques and their links to optimization algorithms, and the latest deep learning techniques, background and various applications
Urban Energy Systems Jul 02 2022 This book analyses the technical and social systems that satisfy these needs and asks how methods can be put into practice to achieve this.
Robust Optimization in Electric Energy Systems Oct 13 2020 This book covers robust optimization theory and applications in the electricity sector. The advantage of robust optimization with respect to other methodologies for decision making under uncertainty are first discussed. Then, the robust optimization theory is covered in a friendly and tutorial manner. Finally, a number of insightful short- and long-term applications pertaining to the electricity sector are considered. Specifically, the book includes: robust set characterization, robust optimization, adaptive robust optimization, hybrid robust-stochastic optimization, applications to short- and medium-term operations problems in the electricity sector, and applications to long-term investment problems in the electricity sector. Each chapter contains end-of-chapter problems, making it suitable for use as a text. The purpose of the book is to provide a self-contained overview of robust optimization techniques for decision making under uncertainty in the electricity sector. The targeted audience includes industrial and power engineering students and practitioners in energy fields. The young field of robust optimization is reaching maturity in many respects. It is also useful for practitioners, as it provides a number of electricity industry applications described up to working algorithms (in JuliaOpt).
Grundlagen der Mathematischen Optimierung Jan 04 2020 Das Buch stellt wesentliche Ansätze, Ergebnisse und Methoden der linearen und ganzzahligen Optimierung dar. Ziel ist es, eine solide mathematische Grundlage des Gebietes und seiner wichtigsten algorithmischen Ansätze zu entwickeln. Methodisch zentral ist der geometrische Zugang.
Dynamic Programming and Optimal Control Mar 30 2022 This is the leading and most up-to-date textbook on the far-ranging algorithmic methodology of Dynamic Programming, which can be used for optimal control, Markovian decision problems, planning and sequential decision making under uncertainty, and discrete/combinatorial optimization. The treatment focuses on basic unifying themes, and conceptual foundations. It illustrates the versatility, power, and generality of the method with many examples and applications from engineering, operations research, and other fields. It also addresses extensively the practical application of the methodology, possibly through the use of approximations, and provides an extensive treatment of the far-reaching methodology of Neuro-Dynamic Programming/Reinforcement Learning. Among its special features, the book 1) provides a unifying framework for sequential decision making, 2) treats simultaneously deterministic and stochastic control problems popular in modern control theory and Markovian decision popular in operations research, 3) develops the theory of deterministic optimal control problems including the Pontryagin Minimum Principle, 4) introduces recent suboptimal control and simulation-based approximation techniques (neuro-dynamic programming), which allow the practical application of dynamic programming to complex problems that involve the dual curse of large dimension and lack of an accurate mathematical model, 5) provides a comprehensive treatment of infinite horizon problems in the second volume, and an introductory treatment in the first volume.
Nonlinear Programming Aug 11 2020 This book provides a comprehensive and accessible presentation of algorithms for solving continuous optimization problems. It relies on rigorous mathematical analysis, but also aims at an intuitive exposition that makes use of visualization where possible. It places particular emphasis on modern developments, and their widespread applications in fields such as large-scale resource allocation problems, signal processing, and machine learning. The 3rd edition brings the book in closer harmony with the companion works Convex Optimization Theory (Athena Scientific, 2009), Convex Optimization Algorithms (Athena Scientific, 2015), Convex Analysis and Optimization (Athena Scientific, 2003), and Network Optimization (Athena Scientific, 1998). These works are complementary in that they deal primarily with convex, possibly nondifferentiable, optimization problems and rely on convex analysis. By contrast the nonlinear programming book focuses primarily on analytical and computational methods for possibly nonconvex differentiable problems. It relies primarily on calculus and variational analysis, yet it

still contains a detailed presentation of duality theory and its uses for both convex and nonconvex problems. This on-line edition contains detailed solutions to all the theoretical book exercises. Among its special features, the book: Provides extensive coverage of iterative optimization methods within a unifying framework Covers in depth duality theory from both a variational and a geometric point of view Provides a detailed treatment of interior point methods for linear programming Includes much new material on a number of topics, such as proximal algorithms, alternating direction methods of multipliers, and conic programming Focuses on large-scale optimization topics of much current interest, such as first order methods, incremental methods, and distributed asynchronous computation, and their applications in machine learning, signal processing, neural network training, and big data applications Includes a large number of examples and exercises Was developed through extensive classroom use in first-year graduate courses

Deterministic Operations Research Sep 04 2022 Uniquely blends mathematical theory and algorithm design for understanding and modeling real-world problems Optimization modeling and algorithms are key components to problem-solving across various fields of research, from operations research and mathematics to computer science and engineering. Addressing the importance of the algorithm design process. Deterministic Operations Research focuses on the design of solution methods for both continuous and discrete linear optimization problems. The result is a clear-cut resource for understanding three cornerstones of deterministic operations research: modeling real-world problems as linear optimization problem; designing the necessary algorithms to solve these problems; and using mathematical theory to justify algorithmic development. Treating real-world examples as mathematical problems, the author begins with an introduction to operations research and optimization modeling that includes applications form sports scheduling an the airline industry. Subsequent chapters discuss algorithm design for continuous linear optimization problems, covering topics such as convexity. Farkas' Lemma, and the study of polyhedral before culminating in a discussion of the Simplex Method. The book also addresses linear programming duality theory and its use in algorithm design as well as the Dual Simplex Method. Dantzig-Wolfe decomposition, and a primal-dual interior point algorithm. The final chapters present network optimization and integer programming problems, highlighting various specialized topics including label-correcting algorithms for the shortest path problem, preprocessing and probing in integer programming, lifting of valid inequalities, and branch and cut algorithms. Concepts and approaches are introduced by outlining examples that demonstrate and motivate theoretical concepts. The accessible presentation of advanced ideas makes core aspects easy to understand and encourages readers to understand how to think about the problem, not just what to think. Relevant historical summaries can be found throughout the book, and each chapter is designed as the continuation of the "story" of how to both model and solve optimization problems by using the specific problems-linear and integer programs-as guides. The book's various examples are accompanied by the appropriate models and calculations, and a related Web site features these models along with Maple™ and MATLAB® content for the discussed calculations. Thoroughly class-tested to ensure a straightforward, hands-on approach, Deterministic Operations Research is an excellent book for operations research of linear optimization courses at the upper-undergraduate and graduate levels. It also serves as an insightful reference for individuals working in the fields of mathematics, engineering, computer science, and operations research who use and design algorithms to solve problem in their everyday work.

Optimization in Renewable Energy Systems Nov 13 2020 Optimization in Renewable Energy Systems: Recent Perspectives covers all major areas where optimization techniques have been applied to reduce uncertainty or improve results in renewable energy systems (RES). Production of power with RES is highly variable and unpredictable, leading to the need for optimization-based planning and operation in order to maximize economies while sustaining performance. This self-contained book begins with an introduction to optimization, then covers a wide range of applications in both large and small scale operations, including optimum operation of electric power systems with large penetration of RES, power forecasting, transmission system planning, and DG sizing and siting for distribution and end-user premises. This book is an excellent choice for energy engineers, researchers, system operators, system regulators, and graduate students. Provides chapters written by experts in the field Goes beyond forecasting to apply optimization techniques to a wide variety of renewable energy system issues, from large scale to relatively small scale systems Provides accompanying computer code for related chapters

Encyclopedia of Optimization Jun 20 2021 The goal of the Encyclopedia of Optimization is to introduce the reader to a complete set of topics that show the spectrum of research, the richness of ideas, and the breadth of applications that has come from this field. The second edition builds on the success of the former edition with more than 150 completely new entries, designed to ensure that the reference addresses recent areas where optimization theories and techniques have advanced. Particularly heavy attention resulted in health science and transportation, with entries such as "Algorithms for Genomics", "Optimization and Radiotherapy Treatment Design", and "Crew Scheduling".

Evolutionary Multi-Criterion Optimization Feb 03 2020 This book constitutes the refereed proceedings of the 7th International Conference on Evolutionary Multi-Criterion Optimization, EMO 2013 held in Sheffield, UK, in March 2013. The 57 revised full papers presented were carefully reviewed and selected from 98 submissions. The papers are grouped in topical sections on plenary talks; new horizons; indicator-based methods; aspects of algorithm design; pareto-based methods; hybrid MCDA; decomposition-based methods; classical MCDA; exploratory problem analysis; product and process applications; aerospace and automotive applications; further real-world applications; and under-explored challenges.

Data Science for Mathematicians Apr 06 2020 Mathematicians have skills that, if deepened in the right ways, would enable them to use data to answer questions important to them and others, and report those answers in compelling ways. Data science combines parts of mathematics, statistics, computer science. Gaining such power and the ability to teach has reinvigorated the careers of mathematicians. This handbook will assist mathematicians to better understand the opportunities presented by data science. As it applies to the curriculum, research, and career opportunities, data science is a fast-growing field. Contributors from both academics and industry present their views on these opportunities and how to advantage them.

Design and Scheduling Problems in Planning Optical Networks Sep 23 2021 Durch massive technologische Veränderungen beanspruchen viele Dienstleistungen wie Fernsehen, Post und Telefonie mittlerweile weltweite Telekommunikationsnetzwerke, vor allem das Internet, wodurch die Anzahl der Kommunikationspartner und Bandbreitenanforderungen stark gewachsen sind. Diese Veränderungen resultieren in gestiegener Komplexität von Fragen wie der nach der Planung solcher Netzwerke. In „Design and Scheduling Problems in Planning Optical Networks" werden Fragestellungen in diesem Kontext untersucht; hierbei wird ein besonderes Augenmerk auf die spezielle Problematik der Glasfasernetzwerke gelegt. Die hauptsächlich benutzten Methoden umfassen ganzzahlige Programmierung, Dekompositionstechniken und kombinatorische Optimierung. Zu den untersuchten Planungsaspekten gehören sowohl die Planung der Netzwerke an sich, die Ausbauplanung, also die Frage, wie die geplanten Netzwerke über einen längeren Zeitraum realisiert werden sowie die Frequenzzuweisung der Lichtwege, wenn das Netzwerk in Betrieb ist. Es werden sowohl theoretischere Aspekte wie die Frage nach facettendefinierenden Ungleichungen der zugrundeliegenden Polytope wie auch praxisnähere Aspekte anhand von konkreten Implementierungen und Rechenexperimenten beleuchtet.

Optimal Financial Decision Making under Uncertainty Mar 18 2021 The scope of this volume is primarily to analyze from different methodological perspectives similar valuation and optimization problems arising in financial applications, aimed at facilitating a theoretical and computational integration between methods largely regarded as alternatives. Increasingly in recent years, financial management problems such as strategic asset allocation, asset-liability management, as well as asset pricing problems, have been presented in the literature adopting formulation and solution approaches rooted in stochastic programming, robust optimization, stochastic dynamic programming (including approximate SDP) methods, as well as policy rule optimization, heuristic approaches and others. The aim of the volume is to facilitate the comprehension of the modeling and methodological potentials of those methods, thus their common assumptions and peculiarities, relying on similar financial problems. The volume will address different valuation problems common in finance related to: asset pricing, optimal portfolio management, risk measurement, risk control and asset-liability management. The volume features chapters of theoretical and practical relevance clarifying recent advances in the associated applied field from different standpoints, relying on similar valuation problems and, as mentioned, facilitating a mutual and beneficial methodological and theoretical knowledge transfer. The distinctive aspects of the volume can be summarized as follows: Strong benchmarking

philosophy, with contributors explicitly asked to underline current limits and desirable developments in their areas. Theoretical contributions, aimed at advancing the state-of-the-art in the given domain with a clear potential for applications The inclusion of an algorithmic-computational discussion of issues arising on similar valuation problems across different methods. Variety of applications: rarely is it possible within a single volume to consider and analyze different, and possibly competing, alternative optimization techniques applied to well-identified financial valuation problems. Clear definition of the current state-of-the-art in each methodological and applied area to facilitate future research directions.
Handbook of Semidefinite Programming Oct 05 2022 Semidefinite programming (SDP) is one of the most exciting and active research areas in optimization. It has and continues to attract researchers with very diverse backgrounds, including experts in convex programming, linear algebra, numerical optimization, combinatorial optimization, control theory, and statistics. This tremendous research activity has been prompted by the discovery of important applications in combinatorial optimization and control theory, the development of efficient interior-point algorithms for solving SDP problems, and the depth and elegance of the underlying optimization theory. The Handbook of Semidefinite Programming offers an advanced and broad overview of the current state of the field. It contains nineteen chapters written by the leading experts on the subject. The chapters are organized in three parts: Theory, Algorithms, and Applications and Extensions.
Abstract Dynamic Programming Jun 08 2020 This is the 3rd edition of a research monograph providing a synthesis of old research on the foundations of dynamic programming (DP), with the modern theory of approximate DP and new research on semicontractive models. It aims at a unified and economical development of the core theory and algorithms of total cost sequential decision problems, based on the strong connections of the subject with fixed point theory. The analysis focuses on the abstract mapping that underlies DP and defines the mathematical character of the associated problem. The discussion centers on two fundamental properties that this mapping may have: monotonicity and (weighted sup-norm) contraction. It turns out that the nature of the analytical and algorithmic DP theory is determined primarily by the presence or absence of these two properties, and the rest of the problem's structure is largely inconsequential. New research is focused on two areas: 1) The ramifications of these properties in the context of algorithms for approximate DP, and 2) The new class of semicontractive models, exemplified by stochastic shortest path problems, where some but not all policies are contractive. The 3rd edition is very similar to the 2nd edition, except for the addition of a new chapter (Chapter 5), which deals with abstract DP models for sequential minimax problems and zero-sum games, The book is an excellent supplement to several of our books: Neuro-Dynamic Programming (Athena Scientific, 1996), Dynamic Programming and Optimal Control (Athena Scientific, 2017), Reinforcement Learning and Optimal Control (Athena Scientific, 2019), and Rollout, Policy Iteration, and Distributed Reinforcement Learning (Athena Scientific, 2020).
Numerik der Optimierung Jan 16 2021
Convex Analysis and Optimization Dec 27 2021 A uniquely pedagogical, insightful, and rigorous treatment of the analytical/geometrical foundations of optimization. The book provides a comprehensive development of convexity theory, and its rich applications in optimization, including duality, minimax/saddle point theory, Lagrange multipliers, and Lagrangian relaxation/nondifferentiable optimization. It is an excellent supplement to several of our books: Convex Optimization Theory (Athena Scientific, 2009), Convex Optimization Algorithms (Athena Scientific, 2015), Nonlinear Programming (Athena Scientific, 2016), Network Optimization (Athena Scientific, 1998), and Introduction to Linear Optimization (Athena Scientific, 1997). Aside from a thorough account of convex analysis and optimization, the book aims to restructure the theory of the subject, by introducing several novel unifying lines of analysis, including: 1) A unified development of minimax theory and constrained optimization duality as special cases of duality between two simple geometrical problems. 2) A unified development of conditions for existence of solutions of convex optimization problems, conditions for the minimax equality to hold, and conditions for the absence of a duality gap in constrained optimization. 3) A unification of the major constraint qualifications allowing the use of Lagrange multipliers for nonconvex constrained optimization, using the notion of constraint pseudonormality and an enhanced form of the Fritz John necessary optimality conditions. Among its features the book: a) Develops rigorously and comprehensively the theory of convex sets and functions, in the classical tradition of Fenchel and Rockafellar b) Provides a geometric, highly visual treatment of convex and nonconvex optimization problems, including existence of solutions, optimality conditions, Lagrange multipliers, and duality c) Includes an insightful and comprehensive presentation of minimax theory and zero sum games, and its connection with duality d) Describes dual optimization, the associated computational methods, including the novel incremental subgradient methods, and applications in linear, quadratic, and integer programming e) Contains many examples, illustrations, and exercises with complete solutions (about 200 pages) posted at the publisher's web site http://www.athenasc.com/convexity.html
Markov Chains and Stochastic Stability Jun 28 2019 New up-to-date edition of this influential classic on Markov chains in general state spaces. Proofs are rigorous and concise, the range of applications is broad and knowledgeable, and key ideas are accessible to practitioners with limited mathematical background. New commentary by Sean Meyn, including updated references, reflects developments since 1996.
Big Data Optimization: Recent Developments and Challenges Apr 18 2021 The main objective of this book is to provide the necessary background to work with big data by introducing some novel optimization algorithms and codes capable of working in the big data setting as well as introducing some applications in big data optimization for both academics and practitioners interested, and to benefit society, industry, academia, and government. Presenting applications in a variety of industries, this book will be useful for the researchers aiming to analyses large scale data. Several optimization algorithms for big data including convergent parallel algorithms, limited memory bundle algorithm, diagonal bundle method, convergent parallel algorithms, network analytics, and many more have been explored in this book.
Network Optimization: Continuous and Discrete Models Aug 03 2022 An insightful, comprehensive, and up-to-date treatment of linear, nonlinear, and discrete/combinatorial network optimization problems, their applications, and their analytical and algorithmic methodology. It covers extensively theory, algorithms, and applications, and it aims to bridge the gap between linear and nonlinear network optimization on one hand, and integer/combinatorial network optimization on the other. It complements several of our books: Convex Optimization Theory (Athena Scientific, 2009), Convex Optimization Algorithms (Athena Scientific, 2015), Introduction to Linear Optimization (Athena Scientific, 1997), Nonlinear Programming (Athena Scientific, 1999), as well as our other book on the subject of network optimization Network Flows and Monotropic Optimization (Athena Scientific, 1998).
Convex Optimization Algorithms Feb 26 2022 This book provides a comprehensive and accessible presentation of algorithms for solving convex optimization problems. It relies on rigorous mathematical analysis, but also aims at an intuitive exposition that makes use of visualization where possible. This is facilitated by the extensive use of analytical and algorithmic concepts of duality, which by nature lend themselves to geometrical interpretation. The book places particular emphasis on modern developments, and their widespread applications in fields such as large-scale resource allocation problems, signal processing, and machine learning. The book is aimed at students, researchers, and practitioners, roughly at the first year graduate level. It is similar in style to the author's 2009"Convex Optimization Theory" book, but can be read independently. The latter book focuses on convexity theory and optimization duality, while the present book focuses on algorithmic issues. The two books share notation, and together cover the entire finite-dimensional convex optimization methodology. To facilitate readability, the statements of definitions and results of the "theory book" are reproduced without proofs in Appendix B.
Linear and Convex Optimization Nov 25 2021 Discover the practical impacts of current methods of optimization with this approachable, one-stop resource Linear and Convex Optimization: A Mathematical Approach delivers a concise and unified treatment of optimization with a focus on developing insights in problem structure, modeling, and algorithms. Convex optimization problems are covered in detail because of their many applications and the fast algorithms that have been developed to solve them. Experienced researcher and undergraduate teacher Mike Veatch presents the main algorithms used in linear, integer, and convex optimization in a mathematical style with an emphasis on what makes a class of problems practically solvable and developing insight into algorithms geometrically. Principles of algorithm design and the speed of algorithms are discussed in detail, requiring no background in algorithms. The book offers a breadth of recent applications to demonstrate the many areas in which

optimization is successfully and frequently used, while the process of formulating optimization problems is addressed throughout. Linear and Convex Optimization contains a wide variety of features, including: Coverage of current methods in optimization in a style and level that remains appealing and accessible for mathematically trained undergraduates Enhanced insights into a few algorithms, instead of presenting many algorithms in cursory fashion An emphasis on the formulation of large, data-driven optimization problems Inclusion of linear, integer, and convex optimization, covering many practically solvable problems using algorithms that share many of the same concepts Presentation of a broad range of applications to fields like online marketing, disaster response, humanitarian development, public sector planning, health delivery, manufacturing, and supply chain management Ideal for upper level undergraduate mathematics majors with an interest in practical applications of mathematics, this book will also appeal to business, economics, computer science, and operations research majors with at least two years of mathematics training. Software to accompany the text can be found here: https://www.gordon.edu/michaelveatch/optimization

Reinforcement Learning and Optimal Control Aug 23 2021 This book considers large and challenging multistage decision problems, which can be solved in principle by dynamic programming (DP), but their exact solution is computationally intractable. We discuss solution methods that rely on approximations to produce suboptimal policies with adequate performance. These methods are collectively known by several essentially equivalent names: reinforcement learning, approximate dynamic programming, neuro-dynamic programming. They have been at the forefront of research for the last 25 years, and they underlie, among others, the recent impressive successes of self-learning in the context of games such as chess and Go. Our subject has benefited greatly from the interplay of ideas from optimal control and from artificial intelligence, as it relates to reinforcement learning and simulation-based neural network methods. One of the aims of the book is to explore the common boundary between these two fields and to form a bridge that is accessible by workers with background in either field. Another aim is to organize coherently the broad mosaic of methods that have proved successful in practice while having a solid theoretical and/or logical foundation. This may help researchers and practitioners to find their way through the maze of competing ideas that constitute the current state of the art. This book relates to several of our other books: Neuro-Dynamic Programming (Athena Scientific, 1996), Dynamic Programming and Optimal Control (4th edition, Athena Scientific, 2017), Abstract Dynamic Programming (2nd edition, Athena Scientific, 2018), and Nonlinear Programming (Athena Scientific, 2016). However, the mathematical style of this book is somewhat different. While we provide a rigorous, albeit short, mathematical account of the theory of finite and infinite horizon dynamic programming, and some fundamental approximation methods, we rely more on intuitive explanations and less on proof-based insights. Moreover, our mathematical requirements are quite modest: calculus, a minimal use of matrix-vector algebra, and elementary probability (mathematically complicated arguments involving laws of large numbers and stochastic convergence are bypassed in favor of intuitive explanations). The book illustrates the methodology with many examples and illustrations, and uses a gradual expository approach, which proceeds along four directions: (a) From exact DP to approximate DP: We first discuss exact DP algorithms, explain why they may be difficult to implement, and then use them as the basis for approximations. (b) From finite horizon to infinite horizon problems: We first discuss finite horizon exact and approximate DP methodologies, which are intuitive and mathematically simple, and then progress to infinite horizon problems. (c) From deterministic to stochastic models: We often discuss separately deterministic and stochastic problems, since deterministic problems are simpler and offer special advantages for some of our methods. (d) From model-based to model-free implementations: We first discuss model-based implementations, and then we identify schemes that can be appropriately modified to work with a simulator. The book is related and supplemented by the companion research monograph Rollout, Policy Iteration, and Distributed Reinforcement Learning (Athena Scientific, 2020), which focuses more closely on several topics related to rollout, approximate policy iteration, multiagent problems, discrete and Bayesian optimization, and distributed computation, which are either discussed in less detail or not covered at all in the present book. The author's website contains class notes, and a series of videolectures and slides from a 2021 course at ASU, which address a selection of topics from both books.

Optimization Methods in Metabolic Networks Nov 01 2019 Provides a tutorial on the computational tools that use mathematical optimization concepts and representations for the curation, analysis and redesign of metabolic networks Organizes, for the first time, the fundamentals of mathematical optimization in the context of metabolic network analysis Reviews the fundamentals of different classes of optimization problems including LP, MILP, MLP and MINLP Explains the most efficient ways of formulating a biological problem using mathematical optimization Reviews a variety of relevant problems in metabolic network curation, analysis and redesign with an emphasis on details of optimization formulations Provides a detailed treatment of bilevel optimization techniques for computational strain design and other relevant problems

Cooperative Control of Distributed Multi-Agent Systems Aug 30 2019 The paradigm of ‘multi-agent’ cooperative control is the challenge frontier for new control system application domains, and as a research area it has experienced a considerable increase in activity in recent years. This volume, the result of a UCLA collaborative project with Caltech, Cornell and MIT, presents cutting edge results in terms of the “dimensions” of cooperative control from leading researchers worldwide. This dimensional decomposition allows the reader to assess the multi-faceted landscape of cooperative control. Cooperative Control of Distributed Multi-Agent Systems is organized into four main themes, or dimensions, of cooperative control: distributed control and computation, adversarial interactions, uncertain evolution and complexity management. The military application of autonomous vehicles systems or multiple unmanned vehicles is primarily targeted; however much of the material is relevant to a broader range of multi-agent systems including cooperative robotics, distributed computing, sensor networks and data network congestion control. Cooperative Control of Distributed Multi-Agent Systems offers the reader an organized presentation of a variety of recent research advances, supporting software and experimental data on the resolution of the cooperative control problem. It will appeal to senior academics, researchers and graduate students as well as engineers working in the areas of cooperative systems, control and optimization.

Simulation and Optimization in Finance Sep 11 2020 An introduction to the theory and practice of financial simulation and optimization In recent years, there has been a notable increase in the use of simulation and optimization methods in the financial industry. Applications include portfolio allocation, risk management, pricing, and capital budgeting under uncertainty. This accessible guide provides an introduction to the simulation and optimization techniques most widely used in finance, while at the same time offering background on the financial concepts in these applications. In addition, it clarifies difficult concepts in traditional models of uncertainty in finance, and teaches you how to build models with software. It does this by reviewing current simulation and optimization methodology-along with available software-and proceeds with portfolio risk management, modeling of random processes, pricing of financial derivatives, and real options applications. Contains a unique combination of finance theory and rigorous mathematical modeling emphasizing a hands-on approach through implementation with software Highlights not only classical applications, but also more recent developments, such as pricing of mortgage-backed securities Includes models and code in both spreadsheet-based software (@RISK, Solver, Evolver, VBA) and mathematical modeling software (MATLAB) Filled with in-depth insights and practical advice, Simulation and Optimization Modeling in Finance offers essential guidance on some of the most important topics in financial management.

Linear and Nonlinear Programming Jul 30 2019 The 5th edition of this classic textbook covers the central concepts of practical optimization techniques, with an emphasis on methods that are both state-of-the-art and popular. One major insight is the connection between the purely analytical character of an optimization problem and the behavior of algorithms used to solve that problem. End-of-chapter exercises are provided for all chapters. The material is organized into three separate parts. Part I offers a self-contained introduction to linear programming. The presentation in this part is fairly conventional, covering the main elements of the underlying theory of linear programming, many of the most effective numerical algorithms, and many of its important special applications. Part II, which is independent of Part I, covers the theory of unconstrained optimization, including both derivations of the appropriate optimality conditions and an introduction to basic algorithms. This part of the book explores the general properties of algorithms and defines various notions of convergence. In turn, Part III extends the concepts developed in the second part to constrained optimization problems. Except for a few isolated sections, this part is also independent of Part I. As such, Parts II and III can easily be used without reading Part I and, in fact, the book has been used in this way at many universities. New to this edition are popular topics in data science and machine learning, such as the Markov Decision Process, Farkas’ lemma, convergence speed analysis, duality theories and applications,

various first-order methods, stochastic gradient method, mirror-descent method, Frank-Wolf method, ALM/ADMM method, interior trust-region method for non-convex optimization, distributionally robust optimization, online linear programming, semidefinite programming for sensor-network localization, and infeasibility detection for nonlinear optimization.

Rollout, Policy Iteration, and Distributed Reinforcement Learning May 08 2020 The purpose of this book is to develop in greater depth some of the methods from the author's Reinforcement Learning and Optimal Control recently published textbook (Athena Scientific, 2019). In particular, we present new research, relating to systems involving multiple agents, partitioned architectures, and distributed asynchronous computation. We pay special attention to the contexts of dynamic programming/policy iteration and control theory/model predictive control. We also discuss in some detail the application of the methodology to challenging discrete/combinatorial optimization problems, such as routing, scheduling, assignment, and mixed integer programming, including the use of neural network approximations within these contexts. The book focuses on the fundamental idea of policy iteration, i.e., start from some policy, and successively generate one or more improved policies. If just one improved policy is generated, this is called rollout, which, based on broad and consistent computational experience, appears to be one of the most versatile and reliable of all reinforcement learning methods. In this book, rollout algorithms are developed for both discrete deterministic and stochastic DP problems, and the development of distributed implementations in both multiagent and multiprocessor settings, aiming to take advantage of parallelism. Approximate policy iteration is more ambitious than rollout, but it is a strictly off-line method, and it is generally far more computationally intensive. This motivates the use of parallel and distributed computation. One of the purposes of the monograph is to discuss distributed (possibly asynchronous) methods that relate to rollout and policy iteration, both in the context of an exact and an approximate implementation involving neural networks or other approximation architectures. Much of the new research is inspired by the remarkable AlphaZero chess program, where policy iteration, value and policy networks, approximate lookahead minimization, and parallel computation all play an important role.

Convex Optimization Theory Jan 28 2022 An insightful, concise, and rigorous treatment of the basic theory of convex sets and functions in finite dimensions, and the analytical/geometrical foundations of convex optimization and duality theory. Convexity theory is first developed in a simple accessible manner, using easily visualized proofs. Then the focus shifts to a transparent geometrical line of analysis to develop the fundamental duality between descriptions of convex functions in terms of points, and in terms of hyperplanes. Finally, convexity theory and abstract duality are applied to problems of constrained optimization, Fenchel and conic duality, and game theory to develop the sharpest possible duality results within a highly visual geometric framework. This on-line version of the book, includes an extensive set of theoretical problems with detailed high-quality solutions, which significantly extend the range and value of the book. The book may be used as a text for a theoretical convex optimization course; the author has taught several variants of such a course at MIT and elsewhere over the last ten years. It may also be used as a supplementary source for nonlinear programming classes, and as a theoretical foundation for classes focused on convex optimization models (rather than theory). It is an excellent supplement to several of our books: Convex Optimization Algorithms (Athena Scientific, 2015), Nonlinear Programming (Athena Scientific, 2017), Network Optimization(Athena Scientific, 1998), Introduction to Linear Optimization (Athena Scientific, 1997), and Network Flows and Monotropic Optimization (Athena Scientific, 1998).

Modeling and Optimization: Theory and Applications Dec 15 2020 This volume contains a selection of contributions that were presented at the Modeling and Optimization: Theory and Applications Conference (MOPTA) held at Lehigh University in Bethlehem, Pennsylvania, USA on August 18-20, 2010. The conference brought together a diverse group of researchers and practitioners, working on both theoretical and practical aspects of continuous or discrete optimization. Topics presented included algorithms for solving convex, network, mixed-integer, nonlinear, and global optimization problems, and addressed the application of optimization techniques in finance, logistics, health, and other important fields. The contributions contained in this volume represent a sample of these topics and applications and illustrate the broad diversity of ideas discussed at the meeting.

Anwendungen der stochastischen optimierung im Stromhandel und Gastransport Jun 01 2022 In der Dissertation werden Anwendungen der stochastischen Optimierung im Stromhandel und beim Erdgastransport vorgestellt. Ziel ist es, mathematische Modelle zu entwickeln, die die konkreten Fragestellungen hinreichend genau abbilden und gleichzeitig optimale Entscheidungen unter Ungewissheit noch berechenbar machen. Dabei sind die in den Problemen vorkommenden Nichtlinearitäten geeignet zu approximieren, um gemischt-ganzzahlige lineare Probleme zu erhalten, die vergleichsweise gut zu lösen sind. Zunächst werden einige Grundlagen der zweistufigen stochastischen Optimierung vorgestellt und verschiedene Lösungsverfahren benannt. Ausführlich wird auf einen Algorithmus zur zweistufigen stochastischen Optimierung gemischt-ganzzahliger linearer Probleme eingegangen. Mittels Szenariodekomposition über eine Lagrange-Relaxation der Nicht-Antizipativitätsbedingungen und in Kombination mit einem Branch-and-Bound-Verfahren macht er sich die Struktur der betrachteten sehr großen Optimierungsprobleme zu Nutze. Dieser Algorithmus dient zur Lösung der Anwendungen. In der ersten Anwendung geht es um die simultane Optimierung der Stromproduktion mit einem hydrothermischen Kraftwerkssystem und des Stromhandels eines Preisführers an einer Vortagesbörse, d. h. eines Marktteilnehmers, der die Preise spürbar beeinflussen kann. Vorgestellt wird ein gemischt-ganzzahliges lineares Modell zur optimalen Blockauswahl für ein Erzeugungssystem. Einige Nichtlinearitäten werden geeignet approximiert. Für den Börsenhandel wird ein ebenfalls gemischt-ganzzahliges lineares Modell entwickelt, welches das Produktionsmodell erweitert. Ziel ist es, die Kosten für die Produktion und den hinzugekauften Strom zu minimieren sowie die Einnahmen aus dem Stromverkauf zu maximieren – unter der Ungewissheit über die Gebote der anderen Marktteilnehmer. Der leitungsgebundene Erdgastransport bei ungewissem Bedarf wird als zweite Anwendung der zweistufigen stochastischen Optimierung behandelt. Gegeben ist ein Erdgastransportsystem, mit dessen Hilfe Gas über große Entfernungen zu Verbrauchsregionen befördert wird. Das Strömungsverhalten des Gases in den Leitungen sowie seine Kompression in Verdichtern stellen aufgrund der Nichtlinearitäten und der Betrachtung von Zeitperioden eine besondere Herausforderung bei der Modellierung und Lösung dar. In den Verdichtern und beim Schalten von Systemelementen entstehen zu minimierende Kosten. Es wird eine gemischt-ganzzahlige lineare Beschreibung des Problems entwickelt. Insgesamt gelingt es, geeignete Modellierungen für zwei Optimierungsprobleme aus der Energiewirtschaft zu finden. Sie werden mit dem praxisnahen Ansatz der zweistufigen stochastischen Optimierung – optimale Entscheidungen unter Ungewissheit – verbunden. Die Optimierungsprobleme werden aufgrund der Modellierung und dank der Nutzung moderner mathematischer Algorithmen und Software für konkrete reale Anwendungsbeispiele in praxistauglichen Rechenzeiten gelöst.

Optimization Methods in Finance Dec 03 2019 Optimization methods play a central role in financial modeling. This textbook is devoted to explaining how state-of-the-art optimization theory, algorithms, and software can be used to efficiently solve problems in computational finance. It discusses some classical mean–variance portfolio optimization models as well as more modern developments such as models for optimal trade execution and dynamic portfolio allocation with transaction costs and taxes. Chapters discussing the theory and efficient solution methods for the main classes of optimization problems alternate with chapters discussing their use in the modeling and solution of central problems in mathematical finance. This book will be interesting and useful for students, academics, and practitioners with a background in mathematics, operations research, or financial engineering. The second edition includes new examples and exercises as well as a more detailed discussion of mean–variance optimization, multi-period models, and additional material to highlight the relevance to finance.

Introduction to Probability Oct 01 2019 An intuitive, yet precise introduction to probability theory, stochastic processes, statistical inference, and probabilistic models used in science, engineering, economics, and related fields. This is the currently used textbook for an introductory probability course at the Massachusetts Institute of Technology, attended by a large number of undergraduate and graduate students, and for a leading online class on the subject. The book covers the fundamentals of probability theory (probabilistic models, discrete and continuous random variables, multiple random variables, and limit theorems), which are typically part of a first course on the subject. It also contains a number of more advanced topics, including transforms, sums of random variables, a fairly detailed introduction to Bernoulli, Poisson, and Markov processes, Bayesian inference, and an introduction to classical statistics. The book strikes a balance between simplicity in exposition and sophistication in analytical

reasoning. Some of the more mathematically rigorous analysis is explained intuitively in the main text, and then developed in detail (at the level of advanced calculus) in the numerous solved theoretical problems.

Revenue Management with Flexible Products Jul 22 2021 This book analyzes revenue management (RM) problems with flexible products and RM in broadcasting companies. It presents models and methods that explicitly take the implications of flexibility into account. In addition, it contains descriptions of algorithms to generate stochastic demand data streams for general RM problems. To help readers with their own simulation studies, it provides an implementation as a Microsoft Windows executable file.

Optimization for Communications and Networks Jul 10 2020 This book provides an introduction to optimization theory and its applications. It is written for senior undergraduate students and first-year graduate students of telecommunication and related fields. Most applications pertain to communication and network problems. The book has practical examples to accompany rigorous discussion so that the reader may develop intuitive understanding on relevant concepts. The materials have been developed from course notes. By attempting to cover convex, linear, and integer optimization for a one-semester course, the author focuses on fundamental concepts and techniques rather than trying to be comprehensive. Infact, the book is written with the main intention to serve as a bridge for students with no prior background in optimization to be able to access more advanced books on the subject later on.

Optimization in Engineering May 20 2021 This textbook covers the fundamentals of optimization, including linear, mixed-integer linear, nonlinear, and dynamic optimization techniques, with a clear engineering focus. It carefully describes classical optimization models and algorithms using an engineering problem-solving perspective, and emphasizes modeling issues using many real-world examples related to a variety of application areas. Providing an appropriate blend of practical applications and optimization theory makes the text useful to both practitioners and students, and gives the reader a good sense of the power of optimization and the potential difficulties in applying optimization to modeling real-world systems. The book is intended for undergraduate and graduate-level teaching in industrial engineering and other engineering specialties. It is also of use to industry practitioners, due to the inclusion of real-world applications, opening the door to advanced courses on both modeling and algorithm development within the industrial engineering and operations research fields.

Linear Algebra And Optimization With Applications To Machine Learning - Volume Ii: Fundamentals Of Optimization Theory With Applications To Machine Learning Apr 30 2022 Volume 2 applies the linear algebra concepts presented in Volume 1 to optimization problems which frequently occur throughout machine learning. This book blends theory with practice by not only carefully discussing the mathematical under pinnings of each optimization technique but by applying these techniques to linear programming, support vector machines (SVM), principal component analysis (PCA), and ridge regression. Volume 2 begins by discussing preliminary concepts of optimization theory such as metric spaces, derivatives, and the Lagrange multiplier technique for finding extrema of real valued functions. The focus then shifts to the special case of optimizing a linear function over a region determined by affine constraints, namely linear programming. Highlights include careful derivations and applications of the simplex algorithm, the dual-simplex algorithm, and the primal-dual algorithm. The theoretical heart of this book is the mathematically rigorous presentation of various nonlinear optimization methods, including but not limited to gradient decent, the Karush-Kuhn-Tucker (KKT) conditions, Lagrangian duality, alternating direction method of multipliers (ADMM), and the kernel method. These methods are carefully applied to hard margin SVM, soft margin SVM, kernel PCA, ridge regression, lasso regression, and elastic-net regression. Matlab programs implementing these methods are included.