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Understanding Calculus - 2010
Calculus is the greatest mathematical breakthrough since the pioneering discoveries of the ancient Greeks. Without it, there would be no spaceflight, skyscrapers, jet planes, economic modeling, or accurate weather forecasting. One of the most powerful problem solving tools ever invented, calculus is a skill that can be learned. Its techniques are used to analyze situations involving change, to calculate optimum values, and to measure complex shapes. With crystal-clear explanations of the beautiful ideas of calculus, frequent study tips, pitfalls to avoid, and--best of all--hundreds of examples and practice problems that are specifically designed to explain and reinforce major concepts, this course will be a valuable guide to conquering calculus.
Understanding Calculus - 2013
"Calculus II is the payoff for mastering Calculus I. This second course in the calculus sequence introduces you to exciting new techniques and applications of one of the most powerful mathematical tools ever invented. Equipped with the skills of Calculus II, you can solve a wide array of problems in the physical, biological, and social sciences, engineering, economics, and other areas. Success at Calculus II also gives you a solid foundation for the further study of mathematics, and it meets the math requirement for many undergraduate majors"--Publisher's website.

Optimization and Optimal Control - Altannar Chinchuluun 2010-08-05
Optimization and optimal control are the main tools in decision making. Because of their numerous applications in various disciplines, research in these areas is accelerating at a rapid pace. “Optimization and Optimal Control: Theory and Applications” brings together the latest developments in these areas of research as well as presents applications of these results to a wide range of real-world problems. This volume can serve as a useful resource for researchers, practitioners, and advanced graduate students of mathematics and engineering working in research areas where results in optimization and optimal control can be applied.
The Linearization Method for Constrained Optimization - Boris N. Pshenichnyj 2012-12-06
Techniques of optimization are applied in many problems in economics, automatic control, engineering, etc. and a wealth of literature is devoted to this subject. The first computer applications involved linear programming problems with simp- le structure and comparatively uncomplicated nonlinear pro- blems: These could be solved readily with the computational power of existing machines, more than 20 years ago. Problems of increasing size and nonlinear complexity made it necessa- ry to develop a complete new arsenal of methods for obtai- ning numerical results in a reasonable time. The lineariza- tion method is one of the fruits of this research of the last 20 years. It is closely related to

Newton's method for solving systems of linear equations, to penalty function me- thods and to methods of nondifferentiable optimization. It requires the efficient solution of quadratic programming problems and this leads to a connection with conjugate gra- dient methods and variable metrics. This book, written by one of the leading specialists of optimization theory, sets out to provide - for a wide readership including engineers, economists and optimization specialists, from graduate student level on - a brief yet quite complete exposition of this most effective method of solution of optimization problems.

Nonsmooth Approach to Optimization Problems with Equilibrium Constraints - Jiri Outrata 2013-06-29

In the early fifties, applied mathematicians, engineers and economists started to pay c10se attention to the optimization problems in which another (lower-Ievel) optimization problem arises as a side constraint. One of the motivating factors was the concept of the Stackelberg solution in game theory, together with its economic applications. Other problems have been encountered in the seventies in natural sciences and engineering. Many of them are of practical importance and have been extensively studied, mainly from the theoretical point of view. Later, applications to mechanics and network design have lead to an extension of the problem formulation: Constraints in form of variation al inequalities and complementarity problems were also admitted. The term "generalized bi level programming problems" was used at first but later, probably in Harker and Pang, 1988, a different terminology was introduced: Mathematical programs with equilibrium constraints, or simply, MPECs. In this book we adhere to MPEC terminology. A large number of papers deals with MPECs but, to our knowledge, there is only one monograph (Luo et al. , 1997). This monograph concentrates on optimality conditions and numerical methods. Our book is oriented similarly, but we focus on those MPECs which can be treated by the implicit programming approach: the equilibrium constraint locally defines a certain implicit function and allows to convert the problem into a mathematical program with a nonsmooth objective.

Noniterative Coordination in Multilevel Systems - Todor Stoilov 2012-12-06

Multilevel decision theory arises to resolve the contradiction between increasing requirements towards the process of design, synthesis, control and management of complex systems and the limitation of the power of technical, control, computer and other executive devices, which have to perform actions and to satisfy requirements in real time. This theory rises suggestions how to replace the centralised management of the system by hierarchical co-ordination of sub-processes. All sub-processes have lower dimensions, which support easier management and decision making. But the sub-processes are interconnected and they influence each other. Multilevel systems theory supports two main methodological tools: decomposition and co-ordination. Both have been developed, and implemented in practical applications concerning design, control and management of complex systems. In general, it is always beneficial to find the best or optimal solution in processes of system design, control and management. The real tendency towards the best (optimal) decision requires to present all activities in the form of a definition and then the solution of an appropriate optimization problem. Every optimization process needs the mathematical definition and solution of a well stated optimization problem. These problems belong to two classes: static optimization and dynamic optimization. Static optimization problems are solved applying methods of mathematical programming: conditional and unconditional optimization. Dynamic optimization problems are solved by methods of variation calculus: Euler Lagrange method; maximum principle; dynamical programming.

Equilibrium Problems: Nonsmooth Optimization and Variational Inequality Models - F. Giannessi 2006-04-11

The aim of the book is to cover the three fundamental aspects of research in equilibrium problems: the statement problem and its formulation using mainly variational methods, its theoretical solution by means of classical and new variational tools, the calculus of solutions and applications in concrete cases. The book shows how many equilibrium problems follow a general law (the so-called user equilibrium condition). Such law allows us to express the problem in terms of variational

inequalities. Variational inequalities provide a powerful methodology, by which existence and calculation of the solution can be obtained.

Continuous Optimization - V. Jeyakumar 2006-03-09

Continuous optimization is the study of problems in which we wish to opti mize (either maximize or minimize) a continuous function (usually of several variables) often subject to a collection of restrictions on these variables. It has its foundation in the development of calculus by Newton and Leibniz in the 17*^ century. Nowadys, continuous optimization problems are widespread in the mathematical modelling of real world systems for a very broad range of applications. Solution methods for large multivariable constrained continuous optimiza tion problems using computers began with the work of Dantzig in the late 1940s on the simplex method for linear programming problems. Recent re search in continuous optimization has produced a variety of theoretical devel opments, solution methods and new areas of applications. It is impossible to give a full account of the current trends and modern applications of contin uous optimization. It is our intention to present a number of topics in order to show the spectrum of current research activities and the development of numerical methods and applications.

Music-Inspired Harmony Search Algorithm - Zong Woo Geem 2009-08-29

Calculus has been used in solving many scientific and engineering problems. For optimization problems, however, the differential calculus technique sometimes has a drawback when the objective function is step-wise, discontinuous, or multi-modal, or when decision variables are discrete rather than continuous. Thus, researchers have recently turned their interests into metaheuristic algorithms that have been inspired by natural phenomena such as evolution, animal behavior, or metallic annealing. This book especially focuses on a music-inspired metaheuristic algorithm, harmony search. Interestingly, there exists an analogy between music and optimization: each musical instrument corresponds to each decision variable; musical note corresponds to variable value; and harmony corresponds to solution vector. Just like musicians in Jazz improvisation play notes randomly or based on experiences in order to find fantastic harmony, variables in the harmony search algorithm have random values or previously-memorized good values in order to find optimal solution.

Structural Optimization - William R. Spillers 2009-06-10

Structural Optimization is intended to supplement the engineer’s box of analysis and design tools making optimization as commonplace as the finite element method in the engineering workplace. It begins with an introduction to structural optimization and the methods of nonlinear programming such as Lagrange multipliers, Kuhn-Tucker conditions, and calculus of variations. It then discusses solution methods for optimization problems such as the classic method of linear programming which leads to the method of sequential linear programming. It then proposes using sequential linear programming together with the incremental equations of structures as a general method for structural optimization. It is furthermore intended to give the engineer an overview of the field of structural optimization.

Optimal Quadratic Programming Algorithms - Zdenek Dostál 2009-04-03

Quadratic programming (QP) is one advanced mathematical technique that allows for the optimization of a quadratic function in several variables in the presence of linear constraints. This book presents recently developed algorithms for solving large QP problems and focuses on algorithms which are, in a sense optimal, i.e., they can solve important classes of problems at a cost proportional to the number of unknowns. For each algorithm presented, the book details its classical predecessor, describes its drawbacks, introduces modifications that improve its performance, and demonstrates these improvements through numerical experiments. This self-contained monograph can serve as an introductory text on quadratic programming for graduate students and researchers. Additionally, since the solution of many nonlinear problems can be reduced to the solution of a sequence of QP problems, it can also be used as a convenient introduction to nonlinear programming.

Variational Analysis and Set Optimization - Akhtar A. Khan 2019-06-07

This book contains the latest advances in variational analysis and set /

vector optimization, including uncertain optimization, optimal control and bilevel optimization. Recent developments concerning scalarization techniques, necessary and sufficient optimality conditions and duality statements are given. New numerical methods for efficiently solving set optimization problems are provided. Moreover, applications in economics, finance and risk theory are discussed. Summary The objective of this book is to present advances in different areas of variational analysis and set optimization, especially uncertain optimization, optimal control and bilevel optimization. Uncertain optimization problems will be approached from both a stochastic as well as a robust point of view. This leads to different interpretations of the solutions, which widens the choices for a decision-maker given his preferences. Recent developments regarding linear and nonlinear scalarization techniques with solid and nonsolid ordering cones for solving set optimization problems are discussed in this book. These results are useful for deriving optimality conditions for set and vector optimization problems. Consequently, necessary and sufficient optimality conditions are presented within this book, both in terms of scalarization as well as generalized derivatives. Moreover, an overview of existing duality statements and new duality assertions is given. The book also addresses the field of variable domination structures in vector and set optimization. Including variable ordering cones is especially important in applications such as medical image registration with uncertainties. This book covers a wide range of applications of set optimization. These range from finance, investment, insurance, control theory, economics to risk theory. As uncertain multi-objective optimization, especially robust approaches, lead to set optimization, one main focus of this book is uncertain optimization. Important recent developments concerning numerical methods for solving set optimization problems sufficiently fast are main features of this book. These are illustrated by various examples as well as easy-to-follow-steps in order to facilitate the decision process for users. Simple techniques aimed at practitioners working in the fields of mathematical programming, finance and portfolio selection are presented. These will help in the decision-making process, as well as give an overview of nondominated solutions to choose from.

Optimization and Dynamical Systems - Uwe Helmke 2012-12-06

This work is aimed at mathematics and engineering graduate students and researchers in the areas of optimization, dynamical systems, control sys tems, signal processing, and linear algebra. The motivation for the results developed here arises from advanced engineering applications and the emer gence of highly parallel computing machines for tackling such applications. The problems solved are those of linear algebra and linear systems the ory, and include such topics as diagonalizing a symmetric matrix, singular value decomposition, balanced realizations, linear programming, sensitivity minimization, and eigenvalue assignment by feedback control. The tools are those, not only of linear algebra and systems theory, but also of differential geometry. The problems are solved via dynamical sys tems implementation, either in continuous time or discrete time , which is ideally suited to distributed parallel processing. The problems tackled are indirectly or directly concerned with dynamical systems themselves, so there is feedback in that dynamical systems are used to understand and optimize dynamical systems. One key to the new research results has been the recent discovery of rather deep existence and uniqueness results for the solution of certain matrix least squares optimization problems in geomet ric invariant theory. These problems, as well as many other optimization problems arising in linear algebra and systems theory, do not always admit solutions which can be found by algebraic methods.

Variational Methods in Shape Optimization Problems - Dorin Bucur 2006-09-13

Shape optimization problems are treated from the classical and modern perspectives Targets a broad audience of graduate students in pure and applied mathematics, as well as engineers requiring a solid mathematical basis for the solution of practical problems Requires only a standard knowledge in the calculus of variations, differential equations, and functional analysis Driven by several good examples and illustrations Poses some open questions.

Optimization in the Real World - Katsuki Fujisawa 2015-09-09

This book clearly shows the importance, usefulness, and powerfulness of current optimization technologies, in particular, mixed-integer programming and its remarkable applications. It is intended to be the definitive study of state-of-the-art optimization technologies for students, academic researchers, and non-professionals in industry. The chapters of this book are based on a collection of selected and extended papers from the “IMI Workshop on Optimization in the Real World” held in October 2014 in Japan.

Turnpike Phenomenon and Symmetric Optimization Problems - Alexander J. Zaslavski 2022-04-11

Written by a leading expert in turnpike phenomenon, this book is devoted to the study of symmetric optimization, variational and optimal control problems in infinite dimensional spaces and turnpike properties of their approximate solutions. The book presents a systematic and comprehensive study of general classes of problems in optimization, calculus of variations, and optimal control with symmetric structures from the viewpoint of the turnpike phenomenon. The author establishes generic existence and well-posedness results for optimization problems and individual (not generic) turnpike results for variational and optimal control problems. Rich in impressive theoretical results, the author presents applications to crystallography and discrete dispersive dynamical systems which have prototypes in economic growth theory. This book will be useful for researchers interested in optimal control, calculus of variations turnpike theory and their applications, such as mathematicians, mathematical economists, and researchers in crystallography, to name just a few.

Vector Variational Inequalities and Vector Optimization - Qamrul Hasan Ansari 2017-10-31

This book presents the mathematical theory of vector variational inequalities and their relations with vector optimization problems. It is the first-ever book to introduce well-posedness and sensitivity analysis for vector equilibrium problems. The first chapter provides basic notations and results from the areas of convex analysis, functional analysis, set-valued analysis and fixed-point theory for set-valued maps, as well as a brief introduction to variational inequalities and equilibrium problems. Chapter 2 presents an overview of analysis over cones, including continuity and convexity of vector-valued functions. The book then shifts its focus to solution concepts and classical methods in vector optimization. It describes the formulation of vector variational inequalities and their applications to vector optimization, followed by separate chapters on linear scalarization, nonsmooth and generalized vector variational inequalities. Lastly, the book introduces readers to vector equilibrium problems and generalized vector equilibrium problems. Written in an illustrative and reader-friendly way, the book offers a valuable resource for all researchers whose work involves optimization and vector optimization.

Fast Solution of Discretized Optimization Problems - Karl-Heinz Hoffmann 2012-12-06

A collection of articles summarizing the state of knowledge in a large portion of modern homotopy theory. This welcome reference for many new results and recent methods is addressed to all mathematicians interested in homotopy theory and in geometric aspects of group theory.

Fractional and Multivariable Calculus - A.M. Mathai 2017-07-25

This textbook presents a rigorous approach to multivariable calculus in the context of model building and optimization problems. This comprehensive overview is based on lectures given at five SERC Schools from 2008 to 2012 and covers a broad range of topics that will enable readers to understand and create deterministic and nondeterministic models. Researchers, advanced undergraduate, and graduate students in mathematics, statistics, physics, engineering, and biological sciences will find this book to be a valuable resource for finding appropriate models to describe real-life situations. The first chapter begins with an introduction to fractional calculus moving on to discuss fractional integrals, fractional derivatives, fractional differential equations and their solutions. Multivariable calculus is covered in the second chapter and introduces the fundamentals of multivariable calculus (multivariable functions, limits and continuity, differentiability, directional derivatives and expansions of multivariable functions). Illustrative examples, input-

output process, optimal recovery of functions and approximations are given; each section lists an ample number of exercises to heighten understanding of the material. Chapter three discusses deterministic/mathematical and optimization models evolving from differential equations, difference equations, algebraic models, power function models, input-output models and pathway models. Fractional integral and derivative models are examined. Chapter four covers non-deterministic/stochastic models. The random walk model, branching process model, birth and death process model, time series models, and regression type models are examined. The fifth chapter covers optimal design. General linear models from a statistical point of view are introduced; the Gauss–Markov theorem, quadratic forms, and generalized inverses of matrices are covered. Pathway, symmetric, and asymmetric models are covered in chapter six, the concepts are illustrated with graphs.

Optimization with PDE Constraints - Michael Hinze 2008-10-16

Solving optimization problems subject to constraints given in terms of partial d- ferential equations (PDEs) with additional constraints on the controls and/or states is one of the most challenging problems in the context of industrial, medical and economical applications, where the transition from model-based numerical si- lations to model-based design and optimal control is crucial. For the treatment of such optimization problems the interaction of optimization techniques and num- ical simulation plays a central role. After proper discretization, the number of op- 3 10 timization variables varies between 10 and 10 . It is only very recently that the enormous advances in computing power have made it possible to attack problems of this size. However, in order to accomplish this task it is crucial to utilize and f- ther explore the speci?c mathematical structure of optimization problems with PDE constraints, and to develop new mathematical approaches concerning mathematical analysis, structure exploiting algorithms, and discretization, with a special focus on prototype applications. The present book provides a modern introduction to the rapidly developing ma- ematical ?eld of optimization with PDE constraints. The ?rst chapter introduces to the analytical background and optimality theory for optimization problems with PDEs. Optimization problems with PDE-constraints are posed in in?nite dim- sional spaces. Therefore, functional analytic techniques, function space theory, as well as existence- and uniqueness results for the underlying PDE are essential to study the existence of optimal solutions and to derive optimality conditions.

Geometric Methods and Optimization Problems - Vladimir Boltyanski 2013-12-11

VII Preface In many fields of mathematics, geometry has established itself as a fruitful method and common language for describing basic phenomena and problems as well as suggesting ways of solutions. Especially in pure mathematics this is ob vious and well-known (examples are the much discussed interplay between lin ear algebra and analytical geometry and several problems in multidimensional analysis). On the other hand, many specialists from applied mathematics seem to prefer more formal analytical and numerical methods and representations. Nevertheless, very often the internal development of disciplines from applied mathematics led to geometric models, and occasionally breakthroughs were b~ed on geometric insights. An excellent example is the Klee-Minty cube, solving a problem of linear programming by transforming it into a geomet ric problem. Also the development of convex programming in recent decades demonstrated the power of methods that evolved within the field of convex geometry. The present book focuses on three applied disciplines: control theory, location science and computational geometry. It is our aim to demonstrate how methods and topics from convex geometry in a wider sense (separation theory of convex cones, Minkowski geometry, convex partitionings, etc.) can help to solve various problems from these disciplines.

Structure of Approximate Solutions of Optimal Control Problems - Alexander J. Zaslavski 2013-08-04

This title examines the structure of approximate solutions of optimal control problems considered on subintervals of a real line. Specifically at the properties of approximate solutions which are independent of the

length of the interval. The results illustrated in this book look into the so-called turnpike property of optimal control problems. The author generalizes the results of the turnpike property by considering a class of optimal control problems which is identified with the corresponding complete metric space of objective functions. This establishes the turnpike property for any element in a set that is in a countable intersection which is open everywhere dense sets in the space of integrands; meaning that the turnpike property holds for most optimal control problems. Mathematicians working in optimal control and the calculus of variations and graduate students will find this book useful and valuable due to its presentation of solutions to a number of difficult problems in optimal control and presentation of new approaches, techniques and methods.

Topics in Nonconvex Optimization - Shashi K. Mishra 2011-05-21
Nonconvex Optimization is a multi-disciplinary research field that deals with the characterization and computation of local/global minima/maxima of nonlinear, nonconvex, nonsmooth, discrete and continuous functions. Nonconvex optimization problems are frequently encountered in modeling real world systems for a very broad range of applications including engineering, mathematical economics, management science, financial engineering, and social science. This contributed volume consists of selected contributions from the Advanced Training Programme on Nonconvex Optimization and Its Applications held at Banaras Hindu University in March 2009. It aims to bring together new concepts, theoretical developments, and applications from these researchers. Both theoretical and applied articles are contained in this volume which adds to the state of the art research in this field. Topics in Nonconvex Optimization is suitable for advanced graduate students and researchers in this area.

Large-scale Optimization - Vladimir Tsurkov 2013-03-09
Decomposition methods aim to reduce large-scale problems to simpler problems. This monograph presents selected aspects of the dimension-reduction problem. Exact and approximate aggregations of multidimensional systems are developed and from a known model of input-output balance, aggregation methods are categorized. The issues of loss of accuracy, recovery of original variables (disaggregation), and compatibility conditions are analyzed in detail. The method of iterative aggregation in large-scale problems is studied. For fixed weights, successively simpler aggregated problems are solved and the convergence of their solution to that of the original problem is analyzed. An introduction to block integer programming is considered. Duality theory, which is widely used in continuous block programming, does not work for the integer problem. A survey of alternative methods is presented and special attention is given to combined methods of decomposition. Block problems in which the coupling variables do not enter the binding constraints are studied. These models are worthwhile because they permit a decomposition with respect to primal and dual variables by two-level algorithms instead of three-level algorithms. Audience: This book is addressed to specialists in operations research, optimization, and optimal control.

Constrained Optimization In The Calculus Of Variations and Optimal Control Theory - J Gregory 2018-01-18
The major purpose of this book is to present the theoretical ideas and the analytical and numerical methods to enable the reader to understand and efficiently solve these important optimizational problems.The first half of this book should serve as the major component of a classical one or two semester course in the calculus of variations and optimal control theory. The second half of the book will describe the current research of the authors which is directed to solving these problems numerically. In particular, we present new reformulations of constrained problems which leads to unconstrained problems in the calculus of variations and new general, accurate and efficient numerical methods to solve the reformulated problems. We believe that these new methods will allow the reader to solve important problems.

Linear Optimization and Extensions - Dimitris Alevras 2012-12-06
Books on a technical topic - like linear programming - without exercises ignore the principal beneficiary of the endeavor of writing a book, namely the student - who learns best by doing course. Books with

exercises - if they are challenging or at least to some extent so exercises, of - need a solutions manual so that students can have recourse to it when they need it. Here we give solutions to all exercises and case studies of M. Padberg's Linear Optimization and Exten sions (second edition, Springer-Verlag, Berlin, 1999). In addition we have included several new exercises and taken the opportunity to correct and change some of the exercises of the book. Here and in the main text of the present volume the terms "book", "text" etc. designate the second edition of Padberg's LPbook and the page and formula references refer to that edition as well. All new and changed exercises are marked by a star * in this volume. The changes that we have made in the original exercises are inconsequential for the main part of the original text where several ofthe exercises (especiallyin Chapter 9) are used on several occasions in the proof arguments. None of the exercises that are used in the estimations, etc. have been changed.

Optimization on Solution Sets of Common Fixed Point Problems - Alexander J. Zaslavski 2021-08-09

This book is devoted to a detailed study of the subgradient projection method and its variants for convex optimization problems over the solution sets of common fixed point problems and convex feasibility problems. These optimization problems are investigated to determine good solutions obtained by different versions of the subgradient projection algorithm in the presence of sufficiently small computational errors. The use of selected algorithms is highlighted including the Cimmino type subgradient, the iterative subgradient, and the dynamic string-averaging subgradient. All results presented are new. Optimization problems where the underlying constraints are the solution sets of other problems, frequently occur in applied mathematics. The reader should not miss the section in Chapter 1 which considers some examples arising in the real world applications. The problems discussed have an important impact in optimization theory as well. The book will be useful for researches interested in the optimization theory and its applications.

Analysis and Optimization of Differential Systems - Viorel Barbu 2013-06-05

Analysis and Optimization of Differential Systems focuses on the qualitative aspects of deterministic and stochastic differential equations. Areas covered include: Ordinary and partial differential systems; Optimal control of deterministic and stochastic evolution equations; Control theory of Partial Differential Equations (PDE's); Optimization methods in PDE's with numerous applications to mechanics and physics; Inverse problems; Stability theory; Abstract optimization problems; Calculus of variations; Numerical treatment of solutions to differential equations and related optimization problems. These research fields are under very active development and the present volume should be of interest to students and researchers working in applied mathematics or in system engineering. This volume contains selected contributions presented during the International Working Conference on Analysis and Optimization of Differential Systems, which was sponsored by the International Federation for Information Processing (IFIP) and held in Constanta, Romania in September 2002. Among the aims of this conference was the creation of new international contacts and collaborations, taking advantage of the new developments in Eastern Europe, particularly in Romania. The conference benefited from the support of the European Union via the EURROMMAT program.

A Collection of Test Problems for Constrained Global Optimization Algorithms - Christodoulos A. Floudas 1990-09-15

Significant research activity has occurred in the area of global optimization in recent years. Many new theoretical, algorithmic, and computational contributions have resulted. Despite the major importance of test problems for researchers, there has been a lack of representative nonconvex test problems for constrained global optimization algorithms. This book is motivated by the scarcity of global optimization test problems and represents the first systematic collection of test problems for evaluating and testing constrained global optimization algorithms. This collection includes problems arising in a variety of engineering applications, and test problems from published computational reports.

Foundations of Optimization - Osman Güler 2010-08-03

This book covers the fundamental principles of optimization in finite dimensions. It develops the necessary material in multivariable calculus both with coordinates and coordinate-free, so recent developments such as semidefinite programming can be dealt with.
Understanding Calculus - Bruce H. Edwards 2017-07-21

Young Measures and Compactness in Measure Spaces - Liviu C. Florescu 2012-05-29
Many problems in science can be formulated in the language of optimization theory, in which case an optimal solution or the best response to a particular situation is required. In situations of interest, such classical optimal solutions are lacking, or at least, the existence of such solutions is far from easy to prove. So, non-convex optimization problems may not possess a classical solution because approximate solutions typically show rapid oscillations. This phenomenon requires the extension of such problems' solution often constructed by means of Young measures. This book is written to introduce the topic to postgraduate students and may also serve as a reference for more experienced researchers.
Multi-Objective Optimization Problems - Fran Sérgio Lobato 2017-07-03
This book is aimed at undergraduate and graduate students in applied mathematics or computer science, as a tool for solving real-world design problems. The present work covers fundamentals in multi-objective optimization and applications in mathematical and engineering system design using a new optimization strategy, namely the Self-Adaptive Multi-objective Optimization Differential Evolution (SA-MODE) algorithm. This strategy is proposed in order to reduce the number of evaluations of the objective function through dynamic update of canonical Differential Evolution parameters (population size, crossover probability and perturbation rate). The methodology is applied to solve mathematical functions considering test cases from the literature and various engineering systems design, such as cantilevered beam design, biochemical reactor, crystallization process, machine tool spindle design, rotary dryer design, among others.

Well-Posed Optimization Problems - Assen L. Dontchev 2006-11-15
This book presents in a unified way the mathematical theory of well-posedness in optimization. The basic concepts of well-posedness and the links among them are studied, in particular Hadamard and Tykhonov well-posedness. Abstract optimization problems as well as applications to optimal control, calculus of variations and mathematical programming are considered. Both the pure and applied side of these topics are presented. The main subject is often introduced by heuristics, particular cases and examples. Complete proofs are provided. The expected knowledge of the reader does not extend beyond textbook (real and functional) analysis, some topology and differential equations and basic optimization. References are provided for more advanced topics. The book is addressed to mathematicians interested in optimization and related topics, and also to engineers, control theorists, economists and applied scientists who can find here a mathematical justification of practical procedures they encounter.
Convex Optimization with Computational Errors - Alexander J. Zaslavski 2020-01-31
The book is devoted to the study of approximate solutions of optimization problems in the presence of computational errors. It contains a number of results on the convergence behavior of algorithms in a Hilbert space, which are known as important tools for solving optimization problems. The research presented in the book is the continuation and the further development of the author's (c) 2016 book Numerical Optimization with Computational Errors, Springer 2016. Both books study the algorithms taking into account computational errors which are always present in practice. The main goal is, for a known computational error, to find out what an approximate solution can be obtained and how many iterates one needs for this. The main difference between this new book and the 2016 book is that in this present book the discussion takes into consideration the fact that for every algorithm, its iteration consists of several steps and that computational errors for different steps are generally, different. This fact, which was not taken into account in the previous book, is indeed important in practice. For example, the

subgradient projection algorithm consists of two steps. The first step is a calculation of a subgradient of the objective function while in the second one we calculate a projection on the feasible set. In each of these two steps there is a computational error and these two computational errors are different in general. It may happen that the feasible set is simple and the objective function is complicated. As a result, the computational error, made when one calculates the projection, is essentially smaller than the computational error of the calculation of the subgradient. Clearly, an opposite case is possible too. Another feature of this book is a study of a number of important algorithms which appeared recently in the literature and which are not discussed in the previous book. This monograph contains 12 chapters. Chapter 1 is an introduction. In Chapter 2 we study the subgradient projection algorithm for minimization of convex and nonsmooth functions. We generalize the results of [NOCE] and establish results which has no prototype in [NOCE]. In Chapter 3 we analyze the mirror descent algorithm for minimization of convex and nonsmooth functions, under the presence of computational errors. For this algorithm each iteration consists of two steps. The first step is a calculation of a subgradient of the objective function while in the second one we solve an auxiliary minimization problem on the set of feasible points. In each of these two steps there is a computational error. We generalize the results of [NOCE] and establish results which has no prototype in [NOCE]. In Chapter 4 we analyze the projected gradient algorithm with a smooth objective function under the presence of computational errors. In Chapter 5 we consider an algorithm, which is an extension of the projection gradient algorithm used for solving linear inverse problems arising in signal/image processing. In Chapter 6 we study continuous subgradient method and continuous subgradient projection algorithm for minimization of convex nonsmooth functions and for computing the saddle points of convex-concave functions, under the presence of computational errors. All the results of this chapter has no prototype in [NOCE]. In Chapters 7-12 we analyze several algorithms under the presence of computational errors which were not considered in [NOCE]. Again, each step of an iteration has a computational errors and we take into account that these errors are, in general, different. An optimization problems with a composite objective function is studied in Chapter 7. A zero-sum game with two-players is considered in Chapter 8. A predicted decrease approximation-based method is used in Chapter 9 for constrained convex optimization. Chapter 10 is devoted to minimization of quasiconvex functions. Minimization of sharp weakly convex functions is discussed in Chapter 11. Chapter 12 is devoted to a generalized projected subgradient method for minimization of a convex function over a set which is not necessarily convex. The book is of interest for researchers and engineers working in optimization. It also can be useful in preparation courses for graduate students. The main feature of the book which appeals specifically to this audience is the study of the influence of computational errors for several important optimization algorithms. The book is of interest for experts in applications of optimization to engineering and economics.

An Introduction to Optimization - Edwin K. P. Chong 2011-09-23 Praise from the Second Edition "...an excellent introduction to optimization theory..." (Journal of Mathematical Psychology, 2002) "A textbook for a one-semester course on optimization theory and methods at the senior undergraduate or beginning graduate level." (SciTech Book News, Vol. 26, No. 2, June 2002) Explore the latest applications of optimization theory and methods Optimization is central to any problem involving decision making in many disciplines, such as engineering, mathematics, statistics, economics, and computer science. Now, more than ever, it is increasingly vital to have a firm grasp of the topic due to the rapid progress in computer technology, including the development and availability of user-friendly software, high-speed and parallel processors, and networks. Fully updated to reflect modern developments in the field, An Introduction to Optimization, Third Edition fills the need for an accessible, yet rigorous, introduction to optimization theory and methods. The book begins with a review of basic definitions and notations and also provides the related fundamental background of linear algebra, geometry, and calculus. With this foundation, the authors explore the essential topics of unconstrained optimization problems,

linear programming problems, and nonlinear constrained optimization. An optimization perspective on global search methods is featured and includes discussions on genetic algorithms, particle swarm optimization, and the simulated annealing algorithm. In addition, the book includes an elementary introduction to artificial neural networks, convex optimization, and multi-objective optimization, all of which are of tremendous interest to students, researchers, and practitioners. Additional features of the Third Edition include: New discussions of semidefinite programming and Lagrangian algorithms A new chapter on global search methods A new chapter on multipleobjective optimization New and modified examples and exercises in each chapter as well as an updated bibliography containing new references An updated Instructor's Manual with fully worked-out solutions to the exercises Numerous diagrams and figures found throughout the text complement the written presentation of key concepts, and each chapter is followed by MATLAB exercises and drill problems that reinforce the discussed theory and algorithms. With innovative coverage and a straightforward approach, An Introduction to Optimization, Third Edition is an excellent book for courses in optimization theory and methods at the upper-undergraduate and graduate levels. It also serves as a useful, self-contained reference for researchers and professionals in a wide array of fields.

Understanding Calculus - Bruce H. Edwards 2010

Nonsmooth Equations in Optimization - Diethard Klatte 2006-04-11

Many questions dealing with solvability, stability and solution methods for va- ational inequalities or equilibrium, optimization and complementarity problems lead to the analysis of certain (perturbed) equations. This often requires a - formulation of the initial model being under consideration. Due to the specific of the original problem, the resulting equation is usually either not differ- tiable (even if the data of the original model are smooth), or it does not satisfy the assumptions of the classical implicit function theorem. This phenomenon is the main reason why a considerable analytical inst- ment dealing with generalized equations (i.e., with finding zeros of multivalued mappings) and nonsmooth equations (i.e., the defining functions are not c- tinuously differentiable) has been developed during the last 20 years, and that under very different viewpoints and assumptions. In this theory, the classical hypotheses of convex analysis, in particular, monotonicity and convexity, have been weakened or dropped, and the scope of possible applications seems to be quite large. Briefly, this discipline is often called nonsmooth analysis, sometimes also variational analysis. Our book fits into this discipline, however, our main intention is to develop the analytical theory in close connection with the needs of applications in optimization and related subjects. Main Topics of the Book 1. Extended analysis of Lipschitz functions and their generalized derivatives, including ”Newton maps” and regularity of multivalued mappings. 2. Principle of successive approximation under metric regularity and its - plication to implicit functions.

Numerical Optimization with Computational Errors - Alexander J. Zaslavski 2016-04-22

This book studies the approximate solutions of optimization problems in the presence of computational errors. A number of results are presented on the convergence behavior of algorithms in a Hilbert space; these algorithms are examined taking into account computational errors. The author illustrates that algorithms generate a good approximate solution, if computational errors are bounded from above by a small positive constant. Known computational errors are examined with the aim of determining an approximate solution. Researchers and students interested in the optimization theory and its applications will find this book instructive and informative. This monograph contains 16 chapters; including a chapters devoted to the subgradient projection algorithm, the mirror descent algorithm, gradient projection algorithm, the Weiszfelds method, constrained convex minimization problems, the convergence of a proximal point method in a Hilbert space, the continuous subgradient method, penalty methods and Newton’s method.

Variational Calculus with Elementary Convexity - J.L. Troutman 2012-12-06

The calculus of variations, whose origins can be traced to the works of

Aristotle and Zenodoros, is now Ii vast repository supplying fundamental tools of exploration not only to the mathematician, but-as evidenced by current literature-also to those in most branches of science in which mathematics is applied. (Indeed, the macroscopic statements afforded by variational principles may provide the only valid mathematical formulation of many physical laws.) As such, it retains the spirit of natural philosophy common to most mathematical investigations prior to this century. How ever, it is a discipline in which a single symbol (b) has at times been assigned almost mystical powers of operation and discernment, not readily subsumed into the formal structures of modern mathematics. And it is a field for which it is generally supposed that most questions motivating interest in the subject will probably not be answerable at the introductory level of their formulation. In earlier articles,1,2 it was shown through several examples that a complete characterization of the solution of optimization problems may be available by elementary methods, and it is the purpose of this work to explore further the convexity which underlay these individual successes in the context of a full introductory treatment of the theory of the variational calculus. The required convexity is that determined through Gateaux variations, which can be defined in any real linear space and which provide an unambiguous foundation for the theory.