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Discrete Geometry and Optimization



 Springer

Discrete Geometry And Optimization Fields Institute Communications

**Marston D. E. Conder, Antoine
Deza, Asia Ivić Weiss**



Discrete Geometry And Optimization Fields Institute Communications:

Discrete Geometry and Optimization Károly Bezdek, Antoine Deza, Yinyu Ye, 2013-07-09 Optimization has long been a source of both inspiration and applications for geometers and conversely discrete and convex geometry have provided the foundations for many optimization techniques leading to a rich interplay between these subjects The purpose of the Workshop on Discrete Geometry the Conference on Discrete Geometry and Optimization and the Workshop on Optimization held in September 2011 at the Fields Institute Toronto was to further stimulate the interaction between geometers and optimizers This volume reflects the interplay between these areas The inspiring Fejes Th Lecture Series delivered by Thomas Hales of the University of Pittsburgh exemplified this approach While these fields have recently witnessed a lot of activity and successes many questions remain open For example Fields medalist Stephen Smale stated that the question of the existence of a strongly polynomial time algorithm for linear optimization is one of the most important unsolved problems at the beginning of the 21st century The broad range of topics covered in this volume demonstrates the many recent and fruitful connections between different approaches and features novel results and state of the art surveys as well as open problems

Discrete Geometry and Algebraic Combinatorics Alexander Barg, Oleg R. Musin, 2014-08-28 This volume contains the proceedings of the AMS Special Session on Discrete Geometry and Algebraic Combinatorics held on January 11 2013 in San Diego California The collection of articles in this volume is devoted to packings of metric spaces and related questions and contains new results as well as surveys of some areas of discrete geometry This volume consists of papers on combinatorics of transportation polytopes including results on the diameter of graphs of such polytopes the generalized Steiner problem and related topics of the minimal fillings theory a survey of distance graphs and graphs of diameters and a group of papers on applications of algebraic combinatorics to packings of metric spaces including sphere packings and topics in coding theory In particular this volume presents a new approach to duality in sphere packing based on the Poisson summation formula applications of semidefinite programming to spherical codes and equiangular lines new results in list decoding of a family of algebraic codes and constructions of bent and semi bent functions

Convexity from the Geometric Point of View Vitor Balestro, Horst Martini, Ralph Teixeira, 2024-07-14 This text gives a comprehensive introduction to the common core of convex geometry Basic concepts and tools which are present in all branches of that field are presented with a highly didactic approach Mainly directed to graduate and advanced undergraduates the book is self contained in such a way that it can be read by anyone who has standard undergraduate knowledge of analysis and of linear algebra Additionally it can be used as a single reference for a complete introduction to convex geometry and the content coverage is sufficiently broad that the reader may gain a glimpse of the entire breadth of the field and various subfields The book is suitable as a primary text for courses in convex geometry and also in discrete geometry including polytopes It is also appropriate for survey type courses in Banach space theory convex analysis differential geometry and applications of

measure theory Solutions to all exercises are available to instructors who adopt the text for coursework Most chapters use the same structure with the first part presenting theory and the next containing a healthy range of exercises Some of the exercises may even be considered as short introductions to ideas which are not covered in the theory portion Each chapter has a notes section offering a rich narrative to accompany the theory illuminating the development of ideas and providing overviews to the literature concerning the covered topics In most cases these notes bring the reader to the research front The text includes many figures that illustrate concepts and some parts of the proofs enabling the reader to have a better understanding of the geometric meaning of the ideas An appendix containing basic and geometric measure theory collects useful information for convex geometers

Facets of Combinatorial Optimization Michael Jünger, Gerhard Reinelt, 2013-07-03 Martin Gr tsel is one of the most influential mathematicians of our time He has received numerous honors and holds a number of key positions in the international mathematical community He celebrated his 65th birthday on September 10 2013 Martin Gr tsel s doctoral descendant tree 1983 2012 i e the first 30 years features 39 children 74 grandchildren 24 great grandchildren and 2 great great grandchildren a total of 139 doctoral descendants This book starts with a personal tribute to Martin Gr tsel by the editors Part I a contribution by his very special predecessor Manfred Padberg on Facets and Rank of Integer Polyhedra Part II and the doctoral descendant tree 1983 2012 Part III The core of this book Part IV contains 16 contributions each of which is coauthored by at least one doctoral descendant The sequence of the articles starts with contributions to the theory of mathematical optimization including polyhedral combinatorics extended formulations mixed integer convex optimization super classes of perfect graphs efficient algorithms for subtree telecenters junctions in acyclic graphs and preemptive restricted strip covering as well as efficient approximation of non preemptive restricted strip covering Combinations of new theoretical insights with algorithms and experiments deal with network design problems combinatorial optimization problems with submodular objective functions and more general mixed integer nonlinear optimization problems Applications include VLSI layout design systems biology wireless network design mean risk optimization and gas network optimization Computational studies include a semidefinite branch and cut approach for the max k cut problem mixed integer nonlinear optimal control and mixed integer linear optimization for scheduling and routing of fly in safari planes The two closing articles are devoted to computational advances in general mixed integer linear optimization the first by scientists working in industry the second by scientists working in academia These articles reflect the scientific facets of Martin Gr tsel who has set standards in theory computation and applications

Modeling and Optimization: Theory and Applications Luis F. Zuluaga, Tamás Terlaky, 2013-11-22 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 July 30 August 1 2012 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

New Trends in Intuitive Geometry Gergely Ambrus, Imre Bárány, Károly J. Böröczky, Gábor Fejes Tóth, János Pach, 2018-11-03 This volume contains 17 surveys that cover many recent developments in Discrete Geometry and related fields Besides presenting the state of the art of classical research subjects like packing and covering it also offers an introduction to new topological algebraic and computational methods in this very active research field The readers will find a variety of modern topics and many fascinating open problems that may serve as starting points for research

Circles, Spheres and Spherical Geometry Hiroshi Maehara, Horst Martini, 2024-08-09 This textbook focuses on the geometry of circles spheres and spherical geometry Various classic themes are used as introductory and motivating topics The book begins very simply for the reader in the first chapter discussing the notions of inversion and stereographic projection Here various classical topics and theorems such as Steiner cycles inversion Soddy's hexlet stereographic projection and Poncelet's porism are discussed The book then delves into Bend formulas and the relation of radii of circles focusing on Steiner circles mutually tangent four circles in the plane and other related notions Next some fundamental concepts of graph theory are explained The book then proceeds to explore orthogonal cycle representation of quadrangulations giving detailed discussions of the Brightwell Scheinerman theorem an extension of the Koebe Andreev Thurston theorem Newton's 13 balls problem Casey's theorem an extension of Ptolemy's theorem and its generalizations The remainder of the book is devoted to spherical geometry including a chapter focusing on geometric probability on the sphere The book also contains new results of the authors and insightful notes on the existing literature bringing the reader closer to the research front Each chapter concludes with related exercises of varying levels of difficulty Solutions to selected exercises are provided This book is suitable to be used as textbook for a geometry course or alternatively as basis for a seminar for both advanced undergraduate and graduate students alike

Discrete Geometry and Symmetry Marston D. E. Conder, Antoine Deza, Asia Ivić Weiss, 2018-06-11 This book consists of contributions from experts presenting a fruitful interplay between different approaches to discrete geometry Most of the chapters were collected at the conference Geometry and Symmetry in Veszprém Hungary from 29 June to 3 July 2015 The conference was dedicated to Károly Bezdek and Egon Schulte on the occasion of their 60th birthdays acknowledging their highly regarded contributions in these fields While the classical problems of discrete geometry have a strong connection to geometric analysis coding theory symmetry groups and number theory their connection to combinatorics and optimization has become of particular importance The last decades have seen a revival of interest in discrete geometric structures and their symmetry The rapid development of abstract polytope theory has resulted in a rich theory featuring an attractive interplay of methods and tools from discrete geometry

group theory and geometry combinatorial group theory and hyperbolic geometry and topology This book contains papers on new developments in these areas including convex and abstract polytopes and their recent generalizations tiling and packing zonotopes isoperimetric inequalities and on the geometric and combinatorial aspects of linear optimization The book is a valuable resource for researchers both junior and senior in the field of discrete geometry combinatorics or discrete optimization Graduate students find state of the art surveys and an open problem collection Algorithms - ESA 2014

Andreas S. Schulz,Dorothea Wagner,2014-08-16 This book constitutes the refereed proceedings of the 22st Annual European Symposium on Algorithms ESA 2014 held in Wroc aw Poland in September 2014 as part of ALGO 2014 The 69 revised full papers presented were carefully reviewed and selected from 269 initial submissions 57 out of 221 in Track A Design and Analysis and 12 out of 48 in Track B Engineering and Applications The papers present original research in the areas of design and mathematical analysis of algorithms engineering experimental analysis and real world applications of algorithms and data structures *Novel Approaches to Hard Discrete Optimization* Panos M. Pardalos, Henry Wolkowicz,2003 During the last decade many novel approaches have been considered for dealing with computationally difficult discrete optimization problems Such approaches include interior point methods semidefinite programming techniques and global optimization More efficient computational algorithms have been developed and larger problem instances of hard discrete problems have been solved This progress is due in part to these novel approaches but also to new computing facilities and massive parallelism This volume contains the papers presented at the workshop on Novel Approaches to Hard Discrete Optimization The articles cover a spectrum of issues regarding computationally hard discrete problems *Design and Analysis of Approximation Algorithms* Ding-Zhu Du,Ker-I Ko,Xiaodong Hu,2011-11-18 This book is intended to be used as a textbook for graduate students studying theoretical computer science It can also be used as a reference book for researchers in the area of design and analysis of approximation algorithms Design and Analysis of Approximation Algorithms is a graduate course in theoretical computer science taught widely in the universities both in the United States and abroad There are however very few textbooks available for this course Among those available in the market most books follow a problem oriented format that is they collected many important combinatorial optimization problems and their approximation algorithms and organized them based on the types or applications of problems such as geometric type problems algebraic type problems etc Such arrangement of materials is perhaps convenient for a researcher to look for the problems and algorithms related to his her work but is difficult for a student to capture the ideas underlying the various algorithms In the new book proposed here we follow a more structured technique oriented presentation We organize approximation algorithms into different chapters based on the design techniques for the algorithms so that the reader can study approximation algorithms of the same nature together It helps the reader to better understand the design and analysis techniques for approximation algorithms and also helps the teacher to present the ideas and techniques of approximation algorithms in a more unified way **Discrete**

Optimization E. Boros, P.L. Hammer, 2003-03-19 One of the most frequently occurring types of optimization problems involves decision variables which have to take integer values From a practical point of view such problems occur in countless areas of management engineering administration etc and include such problems as location of plants or warehouses scheduling of aircraft cutting raw materials to prescribed dimensions design of computer chips increasing reliability or capacity of networks etc This is the class of problems known in the professional literature as discrete optimization problems While these problems are of enormous applicability they present many challenges from a computational point of view This volume is an update on the impressive progress achieved by mathematicians operations researchers and computer scientists in solving discrete optimization problems of very large sizes The surveys in this volume present a comprehensive overview of the state of the art in discrete optimization and are written by the most prominent researchers from all over the world This volume describes the tremendous progress in discrete optimization achieved in the last 20 years since the publication of Discrete Optimization 77 Annals of Discrete Mathematics volumes 4 and 5 1979 Elsevier It contains surveys of the state of the art written by the most prominent researchers in the field from all over the world and covers topics like neighborhood search techniques lift and project for mixed 0 1 programming pseudo Boolean optimization scheduling and assignment problems production planning location bin packing cutting planes vehicle routing and applications to graph theory mechanics chip design etc Key features state of the art surveys comprehensiveness prominent authors theoretical computational and applied aspects This book is a reprint of Discrete Applied Mathematics Volume 23 Numbers 1 3

Numerical Analysis and Optimization Mehiddin Al-Baali, Anton Purnama, Lucio Grandinetti, 2021-12-01 This book gathers selected peer reviewed contributions presented at the Fifth International Conference on Numerical Analysis and Optimization NAO V which was held at Sultan Qaboos University Oman on January 6 9 2020 Each chapter reports on developments in key fields such as numerical analysis numerical optimization numerical linear algebra numerical differential equations optimal control approximation theory applied mathematics derivative free optimization methods programming models and challenging applications that frequently arise in statistics econometrics finance physics medicine biology engineering and industry Many real world complex problems can be formulated as optimization tasks and can be characterized further as large scale unconstrained constrained non convex nondifferentiable or discontinuous and therefore require adequate computational methods algorithms and software tools These same tools are often employed by researchers working in current IT hot topics such as big data optimization and other complex numerical algorithms in the cloud devising special techniques for supercomputing systems This interdisciplinary view permeates the work included in this volume The NAO conference series is held every three years at Sultan Qaboos University with the aim of bringing together a group of international experts and presenting novel and advanced applications to facilitate interdisciplinary studies among pure scientific and applied knowledge It is a venue where prominent scientists gather to share innovative ideas and know how relating to new scientific

methodologies to promote scientific exchange to discuss possible future cooperations and to promote the mobility of local and young researchers *Handbooks in Operations Research and Management Science* K. Aardal, George L. Nemhauser, R.

Weismantel, 2005-12-08 The chapters of this Handbook volume cover nine main topics that are representative of recent theoretical and algorithmic developments in the field In addition to the nine papers that present the state of the art there is an article on the early history of the field The handbook will be a useful reference to experts in the field as well as students and others who want to learn about discrete optimization **Elements of Classical and Geometric Optimization**

Debasish Roy, G Visweswara Rao, 2024-01-25 This comprehensive textbook covers both classical and geometric aspects of optimization using methods deterministic and stochastic in a single volume and in a language accessible to non mathematicians It will help serve as an ideal study material for senior undergraduate and graduate students in the fields of civil mechanical aerospace electrical electronics and communication engineering The book includes Derivative based Methods of Optimization Direct Search Methods of Optimization Basics of Riemannian Differential Geometry Geometric Methods of Optimization using Riemannian Langevin Dynamics Stochastic Analysis on Manifolds and Geometric Optimization Methods This textbook comprehensively treats both classical and geometric optimization methods including deterministic and stochastic Monte Carlo schemes It offers an extensive coverage of important topics including derivative based methods penalty function methods method of gradient projection evolutionary methods geometric search using Riemannian Langevin dynamics and stochastic dynamics on manifolds The textbook is accompanied by online resources including MATLAB codes which are uploaded on our website The textbook is primarily written for senior undergraduate and graduate students in all applied science and engineering disciplines and can be used as a main or supplementary text for courses on classical and geometric optimization **Computational Optimization** Jong-Shi Pang, 2012-12-06 Computational Optimization A Tribute

to Olvi Mangasarian serves as an excellent reference providing insight into some of the most challenging research issues in the field This collection of papers covers a wide spectrum of computational optimization topics representing a blend of familiar nonlinear programming topics and such novel paradigms as semidefinite programming and complementarity constrained nonlinear programs Many new results are presented in these papers which are bound to inspire further research and generate new avenues for applications An informal categorization of the papers includes Algorithmic advances for special classes of constrained optimization problems Analysis of linear and nonlinear programs Algorithmic advances B stationary points of mathematical programs with equilibrium constraints Applications of optimization Some mathematical topics Systems of nonlinear equations Positive Polynomials and Sums of Squares Murray Marshall, 2008 The study of positive polynomials brings together algebra geometry and analysis The subject is of fundamental importance in real algebraic geometry when studying the properties of objects defined by polynomial inequalities Hilbert's 17th problem and its solution in the first half of the 20th century were landmarks in the early days of the subject More recently new connections to

the moment problem and to polynomial optimization have been discovered The moment problem relates linear maps on the multidimensional polynomial ring to positive Borel measures This book provides an elementary introduction to positive polynomials and sums of squares the relationship to the moment problem and the application to polynomial optimization The focus is on the exciting new developments that have taken place in the last 15 years arising out of Schmüdgen's solution to the moment problem in the compact case in 1991 The book is accessible to a well motivated student at the beginning graduate level The objects being dealt with are concrete and down to earth namely polynomials in n variables with real coefficients and many examples are included Proofs are presented as clearly and as simply as possible Various new simpler proofs appear in the book for the first time Abstraction is employed only when it serves a useful purpose but at the same time enough abstraction is included to allow the reader easy access to the literature The book should be essential reading for any beginning student in the area

Geometry of Cuts and Metrics Michel Marie Deza, Monique Laurent, 2009-11-12 Cuts and metrics are well known objects that arise independently but with many deep and fascinating connections in diverse fields in graph theory combinatorial optimization geometry of numbers combinatorial matrix theory statistical physics VLSI design etc This book presents a wealth of results from different mathematical disciplines in a unified comprehensive manner and establishes new and old links which cannot be found elsewhere It provides a unique and invaluable source for researchers and graduate students From the Reviews This book is definitely a milestone in the literature of integer programming and combinatorial optimization It draws from the Interdisciplinarity of these fields With knowledge about the relevant terms one can enjoy special subsections without being entirely familiar with the rest of the chapter This makes it not only an interesting research book but even a dictionary The longer one works with it the more beautiful it becomes Optima 56 1997

Mean Field Models for Spin Glasses Michel Talagrand, 2011-08-14 This is a new completely revised updated and enlarged edition of the author's *Ergebnisse* vol 46 Spin Glasses A Challenge for Mathematicians in two volumes this is the 2nd volume In the eighties a group of theoretical physicists introduced several models for certain disordered systems called spin glasses These models are simple and rather canonical random structures of considerable interest for several branches of science statistical physics neural networks and computer science The physicists studied them by non rigorous methods and predicted spectacular behaviors This book introduces in a rigorous manner this exciting new area to the mathematically minded reader It requires no knowledge whatsoever of any physics The present Volume II contains a considerable amount of new material in particular all the fundamental low temperature results obtained after the publication of the first edition

Topics in Semidefinite and Interior-Point Methods Panos M. Pardalos, Henry Wolkowicz, 1998 This volume presents refereed papers presented at the workshop Semidefinite Programming and Interior Point Approaches for Combinatorial Problems held at The Fields Institute in May 1996 Semidefinite programming SDP is a generalization of linear programming LP in that the non negativity constraints on the variables is replaced by a positive semidefinite constraint on matrix variables Many of the

elegant theoretical properties and powerful solution techniques follow through from LP to SDP In particular the primal dual interior point methods which are currently so successful for LP can be used to efficiently solve SDP problems In addition to the theoretical and algorithmic questions SDP has found many important applications in combinatorial optimization control theory and other areas of mathematical programming The papers in this volume cover a wide spectrum of recent developments in SDP The volume would be suitable as a textbook for advanced courses in optimization It is intended for graduate students and researchers in mathematics computer science engineering and operations

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