

# The Design of Approximation Algorithms



David P. Williamson  
David B. Shmoys

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# The Design Of Approximation Algorithms

**ACM Special Interest Group for  
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## **The Design Of Approximation Algorithms:**

**The Design of Approximation Algorithms** David P. Williamson,David B. Shmoys,2011-04-26 Discrete optimization problems are everywhere from traditional operations research planning scheduling facility location and network design to computer science databases to advertising issues in viral marketing Yet most such problems are NP hard unless P NP there are no efficient algorithms to find optimal solutions This book shows how to design approximation algorithms efficient algorithms that find provably near optimal solutions The book is organized around central algorithmic techniques for designing approximation algorithms including greedy and local search algorithms dynamic programming linear and semidefinite programming and randomization Each chapter in the first section is devoted to a single algorithmic technique applied to several different problems with more sophisticated treatment in the second section The book also covers methods for proving that optimization problems are hard to approximate Designed as a textbook for graduate level algorithm courses it will also serve as a reference for researchers interested in the heuristic solution of discrete optimization problems *The Design of Approximation Algorithms* David P. Williamson,David B. Shmoys,2011-04-26 Discrete optimization problems are everywhere from traditional operations research planning problems such as scheduling facility location and network design to computer science problems in databases to advertising issues in viral marketing Yet most such problems are NP hard Thus unless P NP there are no efficient algorithms to find optimal solutions to such problems This book shows how to design approximation algorithms efficient algorithms that find provably near optimal solutions The book is organized around central algorithmic techniques for designing approximation algorithms including greedy and local search algorithms dynamic programming linear and semidefinite programming and randomization Each chapter in the first part of the book is devoted to a single algorithmic technique which is then applied to several different problems The second part revisits the techniques but offers more sophisticated treatments of them The book also covers methods for proving that optimization problems are hard to approximate Designed as a textbook for graduate level algorithms courses the book will also serve as a reference for researchers interested in the heuristic solution of discrete optimization problems **The Design of Approximation Algorithms** David P. Williamson,2011 Discrete optimization problems are everywhere from traditional operations research planning problems such as scheduling facility location and network design to computer science problems in databases to advertising issues in viral marketing Yet most such problems are NP hard Thus unless P NP there are no efficient algorithms to find optimal solutions to such problems This book shows how to design approximation algorithms efficient algorithms that find provably near optimal solutions The book is organized around central algorithmic techniques for designing approximation algorithms including greedy and local search algorithms dynamic programming linear and semidefinite programming and randomization Each chapter in the first part of the book is devoted to a single algorithmic technique which is then applied to several different problems The second part revisits the techniques but offers more sophisticated treatments

of them The book also covers methods for proving that optimization problems are hard to approximate Designed as a textbook for graduate level algorithms courses the book will also serve as a reference for researchers interested in the heuristic solution of discrete optimization 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 *On the Design of Approximation Algorithms for a Class of Graph Problems* David Paul Williamson,1993 Proceedings of the Fifth Annual ACM-SIAM Symposium on Discrete Algorithms ,1994-01-01 The January 1994 Symposium was jointly sponsored by the ACM Special Interest Group for Automata and Computability Theory and the SIAM Activity Group on Discrete Mathematics Among the topics in 79 unrefereed papers comparing point sets under projection on line search in a simple polygon low degree tests maximal empty ellipsoids roots of a polynomial and its derivatives dynamic algebraic algorithms fast comparison of evolutionary trees an efficient algorithm for dynamic text editing and tight bounds for dynamic storage allocation No index Annotation copyright by Book News Inc Portland OR **The Design of Competitive Online Algorithms Via a Primal-Dual Approach** Niv Buchbinder,Joseph Naor,2009 Extends the primal dual method to the setting of online algorithms and shows its applicability to a wide variety of fundamental problems Generalized Network Design Problems Petrica C. Pop,2012-10-30 Combinatorial optimization is a fascinating topic Combinatorial optimization problems arise in a wide variety of important fields such as transportation telecommunications computer networking location planning distribution problems etc Important and significant results have been obtained on the theory algorithms and applications over the last few decades In combinatorial optimization many network design problems can be generalized in a natural way by considering a related problem on a clustered graph where the original problem's feasibility constraints are expressed in

terms of the clusters i e node sets instead of individual nodes This class of problems is usually referred to as generalized network design problems GNDPs or generalized combinatorial optimization problems The express purpose of this monograph is to describe a series of mathematical models methods propositions algorithms developed in the last years on generalized network design problems in a unified manner The book consists of seven chapters where in addition to an introductory chapter the following generalized network design problems are formulated and examined the generalized minimum spanning tree problem the generalized traveling salesman problem the railway traveling salesman problem the generalized vehicle routing problem the generalized fixed charge network design problem and the generalized minimum vertex biconnected network problem The book will be useful for researchers practitioners and graduate students in operations research optimization applied mathematics and computer science Due to the substantial practical importance of some presented problems researchers in other areas will find this book useful too *Proceedings of the ...ACM Symposium on Theory of Computing* ,2007 *Proceedings of the Sixth Annual ACM-SIAM Symposium on Discrete Algorithms* ,1995-01-01 The proceedings of the January 1995 symposium sponsored by the ACM Special Interest Group on Algorithms and Computation Theory and the SIAM Activity Group on Discrete Mathematics comprise 70 papers Among the topics on line approximate list indexing with applications finding subsets maximizing minimum structures register allocation in structured programs and splay trees for data compression No index Annotation copyright by Book News Inc Portland OR

**Approximation Algorithms for Combinatorial Optimization** Klaus Jansen, Samir Khuller, 2003-07-31 This book constitutes the refereed proceedings of the Third International Workshop on Approximation Algorithms for Combinatorial Optimization Problems APPROX 2000 held in Saarbrcken Germany in September 2000 The 22 revised full papers presented together with four invited contributions were carefully reviewed and selected from 68 submissions The topics dealt with include design and analysis of approximation algorithms inapproximability results on line problems randomization techniques average case analysis approximation classes scheduling problems routing and flow problems coloring and partitioning cuts and connectivity packing and covering geometric problems network design and various applications

**Journal of the ACM.** ,2001 *Approximation, Randomization and Combinatorial Optimization. Algorithms and Techniques* Klaus Jansen, Sanjeev Khanna, José D. P. Rolim, Dana Ron, 2004-10-20 This book constitutes the joint refereed proceedings of the 7th International Workshop on Approximation Algorithms for Combinatorial Optimization Problems APPROX 2004 and the 8th International Workshop on Randomization and Computation RANDOM 2004 held in Cambridge MA USA in August 2004 The 37 revised full papers presented were carefully reviewed and selected from 87 submissions Among the issues addressed are design and analysis of approximation algorithms inapproximability results approximation classes online problems graph algorithms cuts geometric computations network design and routing packing and covering scheduling game theory design and analysis of randomised algorithms randomized complexity theory pseudorandomness derandomization probabilistic proof systems error

correcting codes and other applications of approximation and randomness      *Approximation Algorithms* Vijay V. Vazirani, 2002-12-05 Covering the basic techniques used in the latest research work the author consolidates progress made so far including some very recent and promising results and conveys the beauty and excitement of work in the field He gives clear lucid explanations of key results and ideas with intuitive proofs and provides critical examples and numerous illustrations to help elucidate the algorithms Many of the results presented have been simplified and new insights provided Of interest to theoretical computer scientists operations researchers and discrete mathematicians      *Proceedings of the Twenty-sixth Annual ACM Symposium on the Theory of Computing*, 1994      **Algorithmics for Hard Problems** Juraj Hromkovič, 2013-03-14 Algorithmic design especially for hard problems is more essential for success in solving them than any standard improvement of current computer technologies Because of this the design of algorithms for solving hard problems is the core of current algorithmic research from the theoretical point of view as well as from the practical point of view There are many general text books on algorithmics and several specialized books devoted to particular approaches such as local search randomization approximation algorithms or heuristics But there is no textbook that focuses on the design of algorithms for hard computing tasks and that systematically explains combines and compares the main possibilities for attacking hard algorithmic problems As this topic is fundamental for computer science this book tries to close this gap Another motivation and probably the main reason for writing this book is connected to education The considered area has developed very dynamically in recent years and the research on this topic discovered several profound results new concepts and new methods Some of the achieved contributions are so fundamental that one can speak about paradigms which should be included in the education of every computer science student Unfortunately this is very far from reality This is because these paradigms are not sufficiently known in the computer science community and so they are insufficiently communicated to students and practitioners      *Approximation, Randomization and Combinatorial Optimization. Algorithms and Techniques* Chandra Chekuri, 2005-08-08 This book constitutes the joint refereed proceedings of the 8th International Workshop on Approximation Algorithms for Combinatorial Optimization Problems APPROX 2005 and the 9th International Workshop on Randomization and Computation RANDOM 2005 held in Berkeley CA USA in August 2005 The volume contains 41 carefully reviewed papers selected by the two program committees from a total of 101 submissions Among the issues addressed are design and analysis of approximation algorithms hardness of approximation small space and data streaming algorithms sub linear time algorithms embeddings and metric space methods mathematical programming methods coloring and partitioning cuts and connectivity geometric problems game theory and applications network design and routing packing and covering scheduling design and analysis of randomized algorithms randomized complexity theory pseudorandomness and derandomization random combinatorial structures random walks Markov chains expander graphs and randomness extractors probabilistic proof systems random projections and embeddings error correcting codes average case analysis property

testing computational learning theory and other applications of approximation and randomness      **Proceedings of the Thirty-ninth Annual ACM Symposium on Theory of Computing** ACM Special Interest Group for Algorithms and Computation Theory, 2007      *Approximation Algorithms for NP-hard Problems* Dorit S. Hochbaum, 1997 This is the first book to fully address the study of approximation algorithms as a tool for coping with intractable problems. With chapters contributed by leading researchers in the field this book introduces unifying techniques in the analysis of approximation algorithms. APPROXIMATION ALGORITHMS FOR NP HARD PROBLEMS is intended for computer scientists and operations researchers interested in specific algorithm implementations as well as design tools for algorithms. Among the techniques discussed the use of linear programming primal dual techniques in worst case analysis semidefinite programming computational geometry techniques randomized algorithms average case analysis probabilistically checkable proofs and inapproximability and the Markov Chain Monte Carlo method. The text includes a variety of pedagogical features definitions exercises open problems glossary of problems index and notes on how best to use the book      **Algorithms for Network Routing, Multicasting, Switching, and Design** Ashish Goel, 1999

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