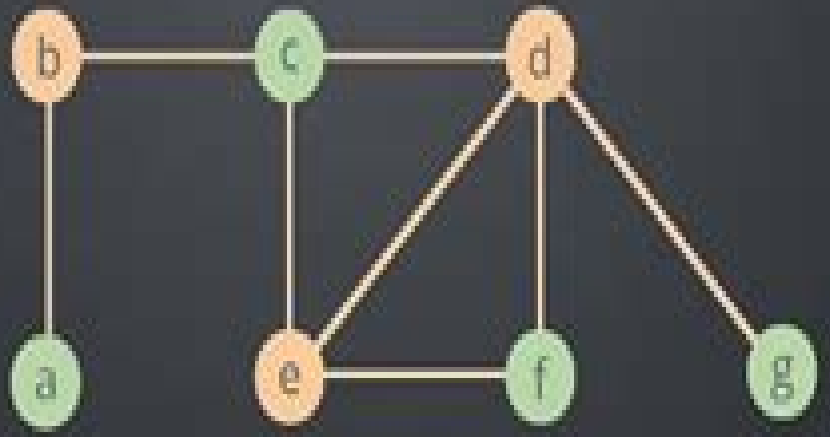
Example: Minimum Vertex Cover

- Here is a 2-approximation algorithm, given a graph $G(V, E)$:
  - let $E' = E, C = \{\}$
  - while E' is nonempty:
    - pick an edge (u, v) from E' and add u and v to C
    - remove any edge in E' that is connected to either u or v
  - return C



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Approximation Algorithms Vijay V. Vazirani,2013-03-14 Most natural optimization problems including those arising in important application areas are NP hard Therefore under the widely believed conjecture that P NP their exact solution is prohibitively time consuming Charting the landscape of approximability of these problems via polynomial time algorithms therefore becomes a compelling subject of scientific inquiry in computer science and mathematics This book presents the theory of approximation algorithms This book is divided into three parts Part I covers combinatorial algorithms for a number of important problems using a wide variety of algorithm design techniques Part II presents linear programming based algorithms These are categorized under two fundamental techniques rounding and the primal dual schema Part III covers four important topics the first is the problem of finding a shortest vector in a lattice the second is the approximability of counting as opposed to optimization problems the third topic is centered around recent breakthrough results establishing hardness of approximation for many key problems and giving new legitimacy to approximation algorithms as a deep theory and the fourth topic consists of the numerous open problems of this young field This book is suitable for use in advanced undergraduate and graduate level courses on approximation algorithms An undergraduate course in algorithms and the theory of NP completeness should suffice as a prerequisite for most of the chapters This book can also be used as supplementary text in basic undergraduate and graduate algorithms courses **Combinatorial Optimization and Graph Algorithms** Takuro Fukunaga,Ken-ichi Kawarabayashi,2017-10-02 Covering network designs discrete convex analysis facility location and clustering problems matching games and parameterized complexity this book discusses theoretical aspects of combinatorial optimization and graph algorithms Contributions are by renowned researchers who attended NII Shonan meetings on this essential topic The collection contained here provides readers with the outcome of the authors research and productive meetings on this dynamic area ranging from computer science and mathematics to operations research Networks are ubiquitous in today s world the Web online social networks and search and query click logs can lead to a graph that consists of vertices and edges Such networks are growing so fast that it is essential to design algorithms to work for these large networks Graph algorithms comprise an area in computer science that works to design efficient algorithms for networks Here one can work on theoretical or practical problems where implementation of an algorithm for large networks is needed In two of the chapters recent results in graph matching games and fixed parameter tractability are surveyed Combinatorial optimization is an intersection of operations research and mathematics especially discrete mathematics which deals with new questions and new problems attempting to find an optimum object from a finite set of objects Most problems in combinatorial optimization are not tractable i e NP hard Therefore it is necessary to design an approximation algorithm for them To tackle these problems requires the development and combination of ideas and techniques from diverse mathematical areas including complexity theory algorithm theory and matroids as well as graph

theory combinatorics convex and nonlinear optimization and discrete and convex geometry Overall the book presents recent progress in facility location network design and discrete convex analysis *Theoretical Aspects of Computer Science* Gholamreza B. Khosrovshahi,2002-02-27 This book presents the revised final versions of eight lectures given by leading researchers at the First Summer School on Theoretical Aspects of Computer Science in Tehran Iran in July 2000 The lectures presented are devoted to quantum computation approximation algorithms self testing correction algebraic modeling of data the regularity lemma multiple access communication and combinatorial designs graph theoretical methods in computer vision and low density parity check codes **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 inapproximibility 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 Proceedings of the Fourteenth Annual ACM-SIAM Symposium on Discrete Algorithms ,2003-01-01 From the January 2003 symposium come just over 100 papers addressing a range of topics related to discrete algorithms Examples of topics covered include packing Steiner trees counting inversions in lists directed scale free graphs quantum property testing and improved results for directed multicut The papers were not formally refereed but attempts were made to verify major results Annotation c 2003 Book News Inc Portland OR booknews com **Approximation Algorithms for the Multi-level Facility Location Problem** Nathan John Edwards,2001 **Encyclopedia of Algorithms** Ming-Yang Kao,2008-08-06 One of Springer s renowned Major Reference Works this awesome achievement provides a comprehensive set of solutions to important algorithmic problems for students and researchers interested in quickly locating useful information This first edition of the reference focuses on high impact solutions from the most recent decade while later editions will widen the scope of the work All entries have been written by experts while links to Internet sites that outline their research work are provided The entries have all been peer reviewed This defining reference is published both in print and on line **Proceedings of the Twelfth Annual ACM-SIAM Symposium on Discrete Algorithms** SIAM Activity Group on Discrete Mathematics,2001-01-01 Contains 130 papers which were selected based on originality technical contribution and relevance Although the papers were not formally refereed every attempt was made to verify the main claims It is expected that most will appear in more complete form in scientific journals The proceedings also includes the paper presented by invited plenary speaker Ronald Graham as well as a portion of the papers presented by invited plenary speakers Udi Manber and Christos Papadimitriou Algorithms - ESA 2003 Giuseppe Di Battista,Uri Zwick,2003-09-15 This book

constitutes the refereed proceedings of the 11th Annual European Symposium on Algorithms ESA 2003 held in Budapest Hungary in September 2003 The 66 revised full papers presented were carefully reviewed and selected from 165 submissions The scope of the papers spans the entire range of algorithmics from design and mathematical analysis issues to real world applications engineering and experimental analysis of algorithms **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

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McGregor and Suresh Venkatasubramanian Session 8B FPTAS for Mixed Integer Polynomial Optimization with a Fixed Number of Variables J A De Loera R Hemmecke M K ppe and R Weismantel Linear Programming and Unique Sink Orientations Bernd G rtner and Ingo Schurr Generating All Vertices of a Polyhedron is Hard Leonid Khachiyan Endre Boros Konrad Borys Khaled Elbassioni and Vladimir Gurvich A Semidefinite Programming Approach to Tensegrity Theory and Realizability of Graphs Anthony Man Cho So and Yinyu Ye Ordering by Weighted Number of Wins Gives a Good Ranking for Weighted Tournaments Don Coppersmith Lisa Fleischer and Atri Rudra Session 8C Weighted Isotonic Regression under L1 Norm Stanislav Angelov Boulos Harb Sampath Kannan and Li San Wang Oblivious String Embeddings and Edit Distance Approximations Tugkan Batu Funda Ergun and Cenk Sahinalp0898716012 This comprehensive book not only introduces the C and C programming languages but also shows how to use them in the numerical solution of partial differential equations PDEs It leads the reader through the entire solution process from the original PDE through the discretization stage to the numerical solution of the resulting algebraic system The well debugged and tested code segments implement the numerical methods efficiently and transparently Basic and advanced numerical methods are introduced and implemented easily and efficiently in a unified object oriented approach **Approximation Algorithms for Combinatorial Optimization** ,2004

Proceedings of the ... Annual Conference on Computational Learning Theory ,1999 *Proceedings of the ...ACM Symposium on Theory of Computing* ,2007 **Algorithms for Clustering Problems** Moses Samson Charikar,2000

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