Algorithms and Combinatorics

Editors: R. L. Graham, B. Korte, L. Lovász

Combinatorial mathematics has substantially influenced recent trends and developments in the theory of algorithms and its applications. Conversely, research on algorithms and their complexity has established new perspectives in discrete mathematics. This new series is devoted to the mathematics of these rapidly growing fields with special emphasis on their mutual interactions.

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Prospective readers of the series ALGORITHMS AND COMBINATORICS include scientists and graduate students working in discrete mathematics, operations research and computer science and their applications.

Volume 1

K. H. Borgwardt

The Simplex Method

A Probabilistic Analysis

1987. 42 figures in 115 separate illustrations. XI, 268 pages. ISBN 3-540-17096-0

Contents: Introduction. - The Shadow-Vertex Algorithm. - The Average Number of Pivot Steps. - The Polynomiality of the Expected Number of Steps. - Asymptotic Results. - Problems with Nonnegativity Constraints. - Appendix. - References. - Subject Index.

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Volume 2

M. Grötschel, L. Lovász, A. Schrijver

Geometric Algorithms and Combinatorial Optimization

1988. 23 figures. XII, 362 pages. ISBN 3-540-13624-X

This book develops geometric techniques for proving the polynomial time solvability of problems in convexity theory, geometry, and - in particular - combinatorial optimization. It offers a unifying approach based on two fundamental geometric algorithms:
- the ellipsoid method for finding a point in a convex set and
- the basis reduction method for point lattices.

The ellipsoid method was used by Khachiyan to show the polynomial time solvability of linear programming. The basis reduction method yields a polynomial time procedure for certain diophantine approximation problems.
A combination of these techniques makes it possible to show the polynomial time solvability of many questions concerning polyhedral - for instance, of linear programming problems having possibly exponentially many inequalities. Utilizing results from polyhedral combinatorics, it provides short proofs of the polynomial time solvability of many combinatorial optimization problems. For a number of these problems, the geometric algorithms discussed in this book are the only techniques known to derive polynomial time solvability.
This book is a continuation and extension of previous research of the authors for which they received the Fulkerson Prize, awarded by the Mathematical Programming Society and the American Mathematical Society.

Volume 3

K. Murota

Systems Analysis by Graphs and Matroids

Structural Solvability and Controllability

1987. 54 figures. IX, 282 pages. ISBN 3-540-17659-4

Contents: Introduction. - Preliminaries. - Graph-Theoretic Approach to the Solvability of a System of Equations. - Graph-Theoretic Approach to the Controllability of a Dynamical System. - Physical Observations for Faithful Formulations. - Matroid-Theoretic Approach to the Solvability of a System of Equations. - Matroid-Theoretic Approach to the Controllability of a Dynamical System. - Conclusion. - References. - Index.

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