OPTIMA

Nº 22

MATHEMATICAL PROGRAMMING SOCIETY NEWSLETTER

OCTOBER 1987

SECOND ANNOUNCEMENTS MAILED

13th International Symposium on Mathematical Programming

Chuo University, Tokyo, Japan
August 29-September 2, 1988

The organizers of the 13th Symposium have recently mailed a Second Announcement packet to all MPS members. Included are:

- A description of the meeting sessions
- Meeting Registration Form
- Abstract Form
- Hotel and Tour Registration Forms

The deadline for abstracts and meeting registration is May 1, 1988. The member advanced registration fee is 26,000 yen (U.S. $175). Hotel rates start at 6,800 yen and tours are available from 4,500 to 17,500 yen. Travel, hotel accommodations and tours are to be handled by:

Japan Travel Bureau, Inc.
Foreign Tourist Division
Convention Center (Ref. CD 8-7201-88)
1-13-1 Nihombashi, Chuo-ku
Tokyo 103, JAPAN
Telephone: 03-276-7885
Telex: 24418 TOURIST J
Fax: 03-271-4134

Nominations for 1988 Society Elections

The Constitution of the Society sets the term of office for all officers of the Society at three years. Elections for all offices (Chairman, Treasurer, and four at-large members of Council) are to be held four months prior to each triennial International Symposium. The thirteenth symposium will be held in Tokyo, August 29 - September 2, 1988, so the next election will be held in April 1988. The new members-at-large of the Council will take office at the time of the Symposium, while the Chairman-elect and Treasurer-elect will take office one year later.

It further states that the Chairman is to invite nominations. Candidates must be

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Conference Notes

Third SIAM Conference on Applied Linear Algebra

May 23-26, 1988
The Concourse Hotel
Madison, Wisconsin, USA

Conference Themes

- ❑ Large Scale Computing and Numerical Methods
- ❑ Inverse Eigenvalue Problems
- ❑ Qualitative and Combinatorial Analysis of Matrices
- ❑ Linear Systems and Control

Deadline for abstracts of contributed presentations and poster presentations: December 10, 1987.

For additional information contact:
SIAM Conference Coordinator
117 South 17th St., 14th Floor
Philadelphia, PA 19103-5052.
Telephone: (215)564–2929 or E–Mail to: SIAM @ Wharton, Upen.edu.

1988 Society Elections *from page one*

members of the Society. They may be proposed either by Council or by any six members of the Society. No proper nomination may be refused, provided the candidate agrees to stand. The Chairman decides the form of the ballot. It also states that the Council shall pass by-laws governing elections designed to promote international representation on the Council, which has not to date been done.

Accordingly, the Council has agreed to the following procedure:

(1) Nomination to any office is to be submitted to me by February 1, 1988. Such nomination is to be supported in writing by the nominator and at least five other members of the Society.

(2) In keeping with what seems to have become a tradition the next Chairman should be a North-American resident, so the membership is requested not to nominate for Chairman a resident of another continent.

(3) When the ballots are counted, the four at-large candidates for Council receiving the highest number of votes will be elected, except that not more than two members having permanent residence in the same country may be elected.

M. L. Balinski
Chairman 1986-1989
Laboratoire d'Econométrie
Ecole Polytechnique
75230 Paris Cedex 05
France

1989: Competition for Young Statisticians from Developing Countries

The International Statistical Institute (ISI) announces the Fourth Competition among young statisticians from developing countries who are invited to submit a paper on any topic within the broad field of statistics, for possible presentation at the 47th Session of ISI to be held in Paris, France, in 1989.

Participation in the competition is open to nationals of developing countries who are living in a developing country, who will not be older than 32 years of age in the year during which the Session is to be held.

Papers submitted must be unpublished, original works which may include university theses.

The papers submitted will be examined by an international Jury of distinguished statisticians who are to select the three best papers presented in the competition. Their decision will be final.

The authors of the winning papers will be invited to present personally their papers at the Session of ISI concerned, with all expenses paid (i.e. round trip airline ticket from his/her place of residence to Paris plus a lump sum to cover living expenses).

Manuscripts for the Competition should be submitted in time to reach the ISI not later than November 1, 1988.

The rules governing the preparation of papers, application forms and full details are available on request from the ISI Permanent Office to which interested individuals should write for further information. The address is as follows:

The Director
Permanent Office
International Statistical Institute
428 Prinses Beatrixlaan
2270 AZ Voorburg
The Netherlands

Nominations for the A.W. Tucker Prize Invited

The A.W. Tucker Prize for an outstanding paper authored by a student was established recently by the Mathematical Programming Society. The first award will be made at the 13th International Symposium of the Mathematical Programming Society to be held in Tokyo, August 29 - September 2, 1988. In advance of the Symposium the awards committee will screen the nominations and select at most three finalists. The finalists will be invited, but not required, to give oral presentations at a special session of the symposium. The awards committee will select the winner and announce the award prior to the conclusion of the symposium.

Eligibility The paper may concern any aspect of mathematical programming; it may be original research, an exposition or survey, a report on computer routines and computing experiments, or a presentation of a new and ingenious application. The paper must be solely authored and completed since January 1, 1985. The paper and the work on which it is based should have been undertaken and completed in conjunction with a degree program. All students, graduate or undergraduate, are eligible. Nominations of students who have not yet received the first university degree are especially welcome.

Nominations Nominations must be made in writing to the chairman of the awards committee by a faculty member at the institution where the nominee was studying for a degree when the paper was completed. Letters of nomination must be accompanied by four copies each of: the student's paper; a separate summary of the paper's contributions, written by the nominee, and no more than two pages in length; and a brief biographical sketch of the nominee. The awards committee may request additional information. Nominations and the accompanying documentation are due January 15, 1988.

Selection The awards committee will select the finalists by May 15, 1988. The winner will be selected by the awards committee at the symposium, subsequent to the oral presentations by the finalists. Selection will be based on the significance of the contribution, the skillfulness of the development, and the quality of the exposition. The winner will receive an award of $750 (U.S.) and a certificate. The other finalists will also receive certificates. The society will pay partial travel expenses for each finalist to attend the symposium. A limit of $500 on travel reimbursements is likely. The institutions from which the nominations originate will be encouraged to assist any nominee selected as a finalist with additional travel expense reimbursement.

The members of the awards committee are: Robert G. Bland, Cornell University; Harold W. Kuhn, Princeton University; Alan C. Tucker, State University of New York at Stony Brook; and Laurence A. Wolsey, Université Catholique de Louvain. Nominations should be sent to: R.G. Bland, School of OR/IE, Upson Hall, Cornell University, Ithaca, NY 14853, USA.

Call for Nominations for the D.R. Fulkerson Prize

This is a call for nomination for the D. Ray Fulkerson Prize in discrete mathematics which will be awarded at the XIIIth International Symposium on Mathematical Programming to be held in Tokyo, Japan, August 29-September 2, 1988.

The specifications for the Fulkerson Prize read:

"Papers to be eligible for the Fulkerson Prize should have been published in a recognized journal during the six calendar years preceding the year of the Congress. This extended period is in recognition of the fact that the value of fundamental work cannot always be immediately assessed. The prizes will be given for single papers, not series of papers or books, and in the event of joint authorship the prize will be divided."

The term "discrete mathematics" is intended to include graph theory, networks, mathematical programming, applied combinatorics, and related subjects. While research work in these areas is usually not far removed from practical applications, the judging of papers will be based on their mathematical "quality and significance."

The nominations for the award will be presented by the Fulkerson Prize Committee (Manfred Padberg, Chairman, Martin Grötschel and Gian-Carlo Rota) to the Mathematical Programming Society and the American Mathematical Society.

Please send your nominations by January 15, 1988, to: Prof. Manfred Padberg, Tisch Hall, Room 517, New York University, 40 West 4th Street, New York, N.Y. 10003, U.S.A.

Technical Reports & Working Papers

The Johns Hopkins University Department of Electrical Engineering and Computer Science Baltimore, Maryland 21218

G.G.L. Meyer, *"Convergence of Relaxation Algorithms by Averaging,"* 86/06.

G.G.L. Meyer and L.J. Podrazik, *"A Parallel First-Order Linear Recurrence Solver,"* 86/07.

S. Suri, *"Computing the Geodesic Diameter of a Simple Polygon,"* 86/08.

J. Wang and W.J. Rugh, *"On Parameterized Linear Systems and Linearization Families for Nonlinear Systems,"* 86/11.

S.K. Ghosh, *"On Recognizing and Characterizing Visibility Graphs of Simple Polygons,"* 86/15.

Systems Research Center The University of Maryland and Harvard University College Park Campus Engineering Research Building (093) The University of Maryland College Park, Maryland 20742

A.L. Tits and E.R. Panier, *"A Superlinearly Convergent Feasible Method for the Solution of Inequality Constrained Optimization Problems,"* SRC TR 85–13.

A.L. Tits and E.R. Panier, *"A Superlinearly Convergent Method of Feasible Directions for Optimization Problems Arising in the Design of Engineering Systems,"* SRC TR 85–37.

A.L. Tits, J.N. Herskovits and E.R. Panier, *"A QP-Free, Globally Convergent Locally Superlinearly Convergent Algorithm for Inequality Constrained Optimization,"* SRC TR 86–65.

A.L. Tits and E.R. Panier, *"Globally Convergent Algorithms for Semi-Infinite Optimization Problems Arising in Engineering Design,"* SRC TR 87–28.

K. Nakajima, S. Masuda, T. Kashiwabara and T. Fujisawa, *"Efficient Algorithms for Finding Maximum Cliques of an Overlap Graph,"* SRC TR 86–58.

K. Nakajima and S. Masuda, *"An Optimal Algorithm for Finding a Maximum Independent Set of a Circular Arc Graph,"* SRC TR 86–68.

K. Nakajima, S. Masuda, T. Kashiwabara and T. Fujisawa, *"An NP-Hard Crossing Minimization Problem for Computer Network Layout,"* SRC TR 86–80.

K. Nakajima, N.J. Naclerio and S. Masuda, *"The Via Minimization Problem is NP–Complete,"* SRC TR 87–42.

K. Nakajima, S. Masuda, T. Kashiwabara and T. Fujisawa, *"Crossing Minimization in the Straight-Line Embedding of Graphs,"* SRC TR 87–43.

K. Nakajima, N.J. Naclerio and S. Masuda, *"Via Minimization for Gridless Routing,"* SRC TR 87–46.

Institut fur Okonometrie und Operations Research Fheinische Friedrich-Wilhelms-Universitat Nassestrasse 2 D-5300 Bonn, West Germany

H.J. Prömel, *"Counting Unlabeled Structures,"* WP 86409-OR.

H.J. Prömel, *"Partition Properties of q–Hypergraphs,"* WP 86410-OR.

Y.Yamamoto, *"Orientability of a Pseudomanifold and Generalizations of Sperner's Lemma,"* WP 86411-OR.

H.J. Prömel and B. Voigt, *"A Partition Theorem for [0,1],"* WP 86412-OR.

B. Korte and L. Lovász, *"The Intersection of Matroids and Antimatroids,"* WP 86413-OR.

W. Cook, *"Cutting-Plane Proofs in Polynomial Space,"* WP 86414-OR.

Y. Yamamoto, *"A Path Following Algorithm for Stationary Point Problems,"* WP 86415-OR.

L. Babai, *"A Las Vegas-NC Algorithm for Isomorphism of Graphs with Bounded Multiplicity of Eigenvalues,"* WP 86416-OR.

R. Schrader, *"Structural Theory of Discrete Greedy Procedures,"* WP 86417-OR.

R.v. Randow, *"On an Optimal Location Problem in a Triangle,"* WP 86418-OR.

A. Frank, *"On Connectivity Properties of Eulerian Digraphs,"* WP 86419-OR.

R.E. Bixby and D.K. Wagner, *"A Note on Detecting Simple Redundancies in Linear Systems,"* WP 86420-OR.

N. Korte and R.H. Möhring, *"A Simple Linear-Time Algorithm to Recognize Interval Graphs,"* WP 86421-OR.

A.J.J. Talman and Y. Yamamoto, *"A Globally Convergent Simplicial Algorithm for Stationary Point Problems of Polytopes,"* WP 86422-OR.

O. Goecke, *"A Greedy Algorithm for Hereditary Set Systems and a Generalization of the Rado-Edmonds Characterization of Matroids,"* WP 86423-OR.

U. Faigle and G. Gierz, *"The Bandwidth of Planar Distributive Lattices,"* WP 86424-OR.

H.J. Prömel, *"Almost Bipartite-Making Graphs,"* WP 86425-OR.

U. Faigle, O. Goecke and R. Schrader, *"Church-Rosser Decomposition in Combinatorial Structures,"* WP 86426-OR.

R. Kannan and L. Lovász, *"Covering Minima and Lattice Point Free Convex Bodies,"* WP 86427-OR.

U. Faigle and R. Schrader, *"On the Convergence of Stationary Distributions in Simulated Annealing,"* WP 86428-OR.

K. Cameron and H. Sachs, *"Monotone Path Systems in Simple Regions,"* WP 86429-OR.

U. Faigle and R. Schrader, *"Simulated Annealing - eine Fallstudie,"* WP 86430-OR.

C.R. Coullard, J.G. del Greco and D.K. Wagner, *"Representations of Bicircular Matroids,"* WP 86431-OR.

Technical Reports & Working Papers *continued*

P. Erdös, L. Lovász and K. Vesztergombi, *"On the Graph of Large Distances,"* WP 86432-OR.

U. Faigle, R. Schrader and R. Suletzki, *"A Cutting-Plane Algorithm for Optimal Graph Partitioning,"* WP 86433-OR.

D. Lejuan and Y. Minyi, *"On a Generalization of the Rado-Hall Theorem to Greedoids,"* WP 86434-OR.

O. Goecke and R. Schrader, *"Minor Characterization of Branching Greedoids - a Short Proof,"* WP 86435-OR.

G.J. Chang, *"MPP-Greedoids,"* WP 86436-OR.

R.E. Bixby and R. Fourer, *"Finding Embedded Network Rows in Linear Programs I: Extraction Heuristics,"* WP 86437-OR.

G.J. Chang, *"Total Domination in Block Graphs,"* WP 86438-OR.

G.J. Chang and C.-S. Wu, *"Graphs Whose Cycles Are of Length t Modulus k,"* WP 86439-OR.

O. Holland and M. Grötschel, *"A Cutting Plane Algorithm for Minimum Perfect 2-Matchings,"* WP 86440-OR.

B. Korte and R. Möhring, *"Zur Bedeutung der Diskreten Mathematik für die Konstruktion Hochintegrierter Schaltkreise,"* WP 86441-OR.

G.J. Chang, *"Problems in Sun-Free Chordal Graphs,"* WP 86442-OR,

H.J. Prömel, *"Aspects of Asymptotic Graph Theory,"* WP 86443-OR.

W. Cook, R. Kannan and A. Schrijver, *"An Analogue of Chvátal Cutting-Plane Proofs for Mixed Integer Programming Problems,"* WP 86444-OR.

A.B. Gamble, A.R. Conn and W.R. Pulleyblank, *"The Network Penalty Method,"* WP 86445-OR.

A.M.H. Gerards and A. Sebö, *"Total Dual Integrality Implies Local Strong Unimodularity,"* WP 86446-OR.

H.J. Prömel and B. Voigt, *"Ramsey Theorems for Finite Graphs,"* WP 86447-OR.

M. Bartusch and R.H. Möhring, *"Scheduling Project Networks with Resource Constraints and Time Windows,"* WP 86448-OR.

H.J. Prömel and B.Voigt, *"A Short Proof of the Restricted Ramsey Theorem for Finite Set-Systems,"* WP 86449-OR.

Department of Geography and Environmental Engineering
The Johns Hopkins University
Baltimore, Maryland 21218

J. Current, C. ReVelle and J. Cohon, *"The Minimum Covering/Shortest Path Problem,"* #86–03.

J. Current, C. ReVelle and J. Cohon, *"An Interactive Approach to Identify the Best Compromise Solution for two Objective Shortest Path Problems,"* #86–04.

J. Current, C. ReVelle and J. Cohon, *"The Median Shortest Path Problem: A Multiobjective Approach to Analyze Cost vs. Accessibility in the Design of Transportation Networks,"* #86–05.

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R. Chandrasekaran, J-S. Pang and R. E. Stone, *"Two Counterexamples on the Polynomial Solvability of the Linear Complementarity Problem."*

A.H.G. Rinnooy Kan and G.T. Timmer, *"Stochastic Global Optimization Methods. Part I: Clustering Methods."*

A.H.G. Rinnooy Kan and G.T. Timmer, *"Stochastic Global Optimization Methods. Part II: Multi Level Methods."*

G. deGhellinck and J.-Ph Vial, *"An Extension of Karmarkar's Algorithm for Solving a System of Linear Homogeneous Equations on the Simplex.*

P.H. Calamai and J.J. More, *"Projected Gradient Methods for Linearly Constrained Problems."*

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K.G. Murty, *"Some NP-Complete Problems in Quadratic and Nonlinear Programming."*

L.S. Lasdon, J. Plummer, B. Buehler and A.D. Waren, *"Optimal Design of Efficient Acoustic Antenna Arrays."*

P.L. Jackson and D.F. Lynch, *"Revised Dantzig-Wolfe Decomposition for Staircase-Structured Linear Programs."*

I. Diener, *"On the Global Convergence of Path-Following Methods to Determine all Solutions to a System of Nonlinear Equations."*

A.B. Poore and C.A. Tiahrt, *"Bifurcation Problems in Nonlinear Parametric Programming."*

M.E. Posner and H. Suzuki, *"A Dual Approach for the Continuous Collapsing Knapsack Problem."*

M. Guignard and S. Kim, *"Lagrangean Decomposition: A Model Yielding Stronger Lagrangean Bounds."*

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BOOK REVIEWS

Data Structures and Network Algorithms

By R. E. Tarjan
SIAM, Philadelphia, 1983
ISBN 0-89871-187-8

This is a beautiful book which I recommend to anyone who is interested in data structures or graph algorithms. The author gives a grand tour of tree based data structures and their applications to efficient graph algorithms.

In each chapter R. E. Tarjan describes and analyses the most efficient and recent solutions to the problem at hand. The presentation is very elegant and readable. The reader is not only introduced to important algorithmic paradigms but also to the techniques of analysis of algorithms. The author also gives a survey of advanced results which are not treated in the book. The book is most valuable to the active researcher, but it can also be used as a graduate text. It deserves a prominent place on our bookshelves.

-K. Mehlhorn

Algorithms

By R. Sedgewick
Addison Wesley, New York, 1983
ISBN 0-201-06672-6

This is a good sophomore text for computer algorithms and data structures. It is clearly written and involves good intuition on the structure of algorithms. There are numerous practical algorithms described in the book, many in recently developed areas. These include pseudo random number generation, curve fitting, string matching, convex hull, polynomial interpolation, graph algorithms and more. Some of the content appears for the first time in textbook form - the RSA cryptosystem and the Rabin Karp string matching algorithm which is beautifully explained here but generally not well known.

Most of the algorithms are compactly described using Pascal-like programs. This enables implementation of the algorithms without much further work. The emphasis throughout is on practical algorithms, that is, fast and relatively non-complex algorithms. This philosophy of exposition is well justified in the introductory remarks

Journals & Studies

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R.E. Bixby, O.M.-C. Marcotte and L.E. Trotter, Jr., *"Packing and Covering with Integral Feasible Flows in Integral Supply-Demand Networks."*

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A. Ramanathan and C.J. Colbourn, *"Counting Almost Minimum Cutsets with Reliability Applications."*

A. Balakrishnan, *"LP Extreme Points and Cuts for the Fixed-Charge Network Design Problem."*

J. Kyparisis and A.V. Fiacco, *"Generalized Convexity and Concavity of the Optimal Value Function in Nonlinear Programming."*

Y. Ye and M. Kojima, *"Recovering Optimal Dual Solutions in Karmarkar's Polynomial Algorithm for Linear Programming."*

C. Michelot and O. Lefebvre, *"A Primal-Dual Algorithm for the Fermat-Weber Problem Involving Mixed Gauges."*

A.R. Mahjoub, *"On the Stable Set Polytope of a Series-Parallel Graph."*

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J.F. Bard, *"Convex Two-Level Optimization."*

H. Imai, *"On the Convexity of the Multiplicative Version of Karmarkar's Potential Function."*

R.L. Tobin, *"A Variable Dimension Solution Approach for the General Spatial Price Equilibrium Problem."*

G.G.L. Meyer, *"Convergence of Relaxation Algorithms by Averaging."*

J. Renegar, *"A Polynomial-Time Algorithmn, Based on Newton's Method, for Linear Programming."*

R.W. Chaney, *"Second-Order Necessary Conditions in Semismooth Optimization."*

BOOK REVIEWS

by the author. It also sets the tone for the book as a text primarily for practitioners. There are some references for state-of-the-art developments in the field, numerous good exercises and overall more material than one could hope to cover in a term.

This book includes very little analysis and is not suited for a theory or analysis of algorithms course. It is almost a cookbook type, but a very good one at that. For people who are looking for an update of Aho, Hopcroft and Ullman, this is not the one. However, for all the objectives set up by the author, it is an excellent, up-to-date reference. It is highly recommended for the purpose of developing intuition for the way good computer algorithms work.

-D. Hochbaum

Polyhedral Combinatorics and the Acyclic Subdigraph Problem

By Michael Jünger
Heldermann, Berlin, 1985
ISBN 3-88538-207-5
and

The Linear Ordering Problem: Algorithms and Applications

By Gerhard Reinelt
Heldermann, Berlin, 1985
ISBN 3-88538-208-3

One of the most promising approaches available to cope with NP-complete combinatorial linear optimization problems is based on insights into the structure of the associated polytope. As it is unlikely to obtain a complete, computationally manageable linear description of the polytope whose vertices correspond in a 1-1 manner to the feasible solutions of the combinatorial optimization problem, we have to restrict ourselves to partial descriptions. Their embodiment in algorithms based on linear programming techniques, however, lead to impressive computational results. But it is neither a trivial task to find "good" relaxations nor to provide an efficient separation algorithm, if it is possible at all for the relaxed polytope, since results do not simply carry over from other problems.

These two books contain the result of a joint study of the Acyclic Subdigraph Problem (ASP), which is NP-complete and equivalent to many important problems in combinatorial optimization and economics (e.g. Linear Ordering Problem, Matrix Triangulation, Paired Comparison Ranking).

The book of Michael Jünger presents an elaborate investigation of the polyhedral structure of the ASP. After reviewing fundamental results of related topics and providing an almost self-containing introduction into the field of Polyhedral Combinatorics, the Acyclic Subdigraph Problem and a series of related problems are proven to be NP-complete. The partial non-redundant linear description of the polytope associated with the ASP consisting of new classes of facet-inducing inequalities - namely Dicycles, Möbius Ladders and Fences - developed in this book leads to a polynomial separation algorithm for weakly acyclic digraphs. From this and the ellipsoid method, it follows that the corresponding optimization problem for weakly acyclic digraphs can be solved in polynomial time.

Employing these results, an LP-based cutting plane algorithm for the Linear Ordering Problem has been developed by Gerhard Reinelt which allowed the solution of problems which had been intractable before. The algorithm mainly consists of two parts. The first part iteratively determines a partial linear description of the Linear Ordering Polytope using those subclasses of facet-inducing inequalities of the type mentioned above for which efficient cutting-plane recognition procedures had been developed. If this process ends with an integral solution - which happened with almost all tested problems - the optimum for the complete problem has been found. Otherwise, an upper bound and an LP-relaxation has been found which together with a heuristically determined lower bound are taken as input for a branch and bound procedure which guarantees that an optimum will be found. The code, despite being theoretically non-polynomial and neither trivial to implement nor to test, turned out to be efficient on all of a large set of real-world problems (triangulation of I/O-Tables), which are considered to be important in economic analysis as well as on randomly generated problems.

These two books present in a clear, comprehensive and compact style the theoretical and computational results of a complex joint project of the two authors together with Martin Grötschel. It should be of great value for those working on related topics and for those interested in the economic results as well as for everyone who is interested in an introduction to the advanced techniques of Polyhedral Combinatorics.

-O. Holland

Numerical Optimization 1984

Edited by P. T. Boggs, R. H. Byrd and R. B. Schnabel
SIAM, Philadelphia, 1985
ISBN 0-89871-054-5

This volume contains some selected papers presented at the SIAM Conference on Numerical Optimization.

Section 1 includes seven papers about "Nonlinearly Constrained Optimization." A. R. Conn and R. Fletcher, respectively, discuss how to overcome some disadvantages of the sequential quadratic programming method. Instead of using a solution to the quadratic subproblem to determine a search direction, followed by a line search on the L_1 penalty function, Fletcher uses an L_1 penalty formulation for the quadratic programming problem in conjunction with a trust region strategy. A. R. Conn gives the details of a method that derives the search direction directly from the L_1 merit function.

In his paper L. S. Lasdon presents the generalized reduced gradient algorithm and the successive linear programming algorithm and discusses several applications of these methods. Most of the results are well known.

The following four papers describe new approaches for some well-known methods like a trust region strategy for nonlinear equal-

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BOOK REVIEWS

ity constrained optimization, sequential truncated quadratic programming methods, and inexact quasi-Newton methods.

Section 2 consists of four papers dealing with "Optimization Software." The contents of the article of Gill, Murray, Saunders and Wright can essentially be found in the monograph, "Practical Optimization," of the authors. Rather new are some details of the program NPSOL, which is one of the best implementations of the SQP method.

Powell reports about numerical results of two SQP methods for constrained optimization that are applied to some "difficult" test problems. He draws attention to some inefficiencies of the SQP methods having been reported in the articles of Conn and Fletcher too.

The following two articles discuss the development of high level modeling systems which do not expect the user to be familiar with the details of NLP algorithms. In his essay Nazareth is concerned with some fundamental aspects. Brooke, Drud and Meeraus describe a general algebraic modeling system and explain the key features of their modeling language.

Section 3 deals with "Global Optimization." "The computation of the global minimum of an objective function is a rather hard problem. Only a few solution methods have been developed so far. This section contains four quite different approaches to this problem.

Levy and Gomez present the tunneling method. This algorithm is composed of a sequence of cycles. Each cycle consists of two phases, a minimization phase to find a local minimum and a tunneling phase to obtain a good starting point for the next minimization phase. Unfortunately, there is no guarantee for getting the global solution, and no error bounds are given. So the method is at best of some heuristic value.

Rinnooy Kan and Timmer review global optimization methods, with special emphasis on stochastic methods. Most stochastic methods consist of two phases. In the global phase, the objective function is evaluated at a number of randomly sampled points. In the local phase, the sample points are manipulated, to yield a candidate global minimum. There is no absolute guarantee of success. However, the global phase can yield an asymptotic guarantee in a stochastic sense. Comparing the computational behaviour of various methods, the so-called multilevel method turns out to be the most promising.

Rosen considers the problem of finding the global minimum of a concave quadratic function with many linear variables. Using the special structure of the problem he presents an efficient branch and bound method, which gives lower and upper bounds on the minimum objective function value. Some computational results on a variety of test problems are reported.

Walster, Hansen and Sengupta report results of numerical testing of a global unconstrained minimization algorithm. This algorithm has been presented by Hansen [Numer. Math. 34 (1980), 247-270]. It uses interval arithmetic to obtain bounds on the global minimum and the solution points.

-Wilhelm Forst

A Source Book on Matroid Theory

Edited by Joseph P.S. Kung
Birkhäuser, Stuttgart, 1986
ISBN 0-8176-3173-9

This volume contains 18 important papers in matroid theory from the period 1932-1982, all but one reprinted in full. The editor acknowledges that this anthology is not enclyclopedic in its coverage of matroid theory. Nevertheless, he believes "that the papers included give a balanced picture of the structural theory of matroids and ... indicate some of the most exciting connections of matroid theory with other areas of mathematics."

In the introduction, the editor has compiled a list of books, lecture notes, and expository papers in matroid theory. This list contains 31 items. The five chapters of the book are entitled: Origins and Basic Concepts, Linear Representation of Matroids, Enumeration in Geometric Lattices, The Tutte Decomposition, and Recent Advances. Each chapter begins with an editorial commentary on the papers it contains. These commentaries summarize the main definitions and theorems of the papers and comment on the relation between the terminology used there and current usage. In addition, the editor lists related work and, in the case of the older papers, comments on those concepts and results that have spawned the most follow-up work. The commentary on the first chapter also contains a complete survey of all the matroid literature that appeared before 1945. For those works from this period that are not reprinted in full, a short review is included emphasizing those aspects of the work that have so far proved of most importance.

The earliest papers reprinted in this volume are by Whitney, Birkhoff, and MacLane. Five papers of these three men are reproduced. Three of these are from Volumes 57 (1935) and 58 (1936) of the American Journal of Mathematics: Whitney's seminal paper "On the Abstract Properties of Linear Dependence," Birkhoff's paper that establishes the fundamental link between simple matroids and geometric lattices, and MacLane's paper that shows the existence of non-representable matroids.

The most recent papers represented in this volume are Seymour's "Decomposition of Regular Matroids" [J. Combin. Theory Ser. B 28 (1980), 305-354] and Kahn's and Kung's "Varieties of Combinatorial Geometries" [Trans. Amer. Math. Soc. 271 (1982), 485-499].

Some care has evidently been taken over the physical details of the production of this book, and a fine product has resulted. The one minor criticism one can make here is that the print in Rota's paper on Möbius functions is a little faint in parts. This book is a very valuable addition to the matroid literature that all who work in or near the subject will want to own.

-James Oxley

BOOK REVIEWS

An Introduction to Linear Programming

By G. R. Walsh
Wiley, Chichester, 1985
ISBN 0-471-90719-7

This book is a second edition of an extended version of a course of lectures that Walsh gave to second-year mathematics students at the University of York. The major change from the first edition is the addition of chapter 5 devoted to the Ellipsoid Algorithm. The first four chapters cover an Introduction to Linear Programming, the Simplex Method, Duality and the Revised Simplex Method, and Applications.

The level of presentation of this material is difficult to characterize; it is too dense with equations and proofs to be appreciated by an American Operations Research undergraduate student but not truly advanced enough for a graduate scholar. My opinion is that this is an ideal reference book for the instructor of an introductory Linear Programming course. The proofs are presented clearly and with such detail that they would be a valuable aid for any teacher trying to organize his/her lectures. There are very few typographical errors and the examples and exercises are excellent in probing to the heart of the subject matter at hand.

A few critical remarks though are in order. The way the equations are presented and referred to makes reading some of the material a laborious chore. In various places terms are used without definition and results are presented without reference, which also adds confusion. Certain material is covered too quickly, for example, the two-phase variant of the Simplex Method. I did not always agree with the choice of starred material (optional for the first reading), for example, the Dual Simplex Method and Sensitivity Analysis are starred while the Revised Simplex Method using artificial variables is not. While certain results, e.g. the Fundamental Theorem of Duality, are presented with organized and clear proofs, others, e.g. Konig's Theorem and the Integrality of the Assignment Polytope, are proven using nonstandard and nonrigorous methods. It is too bad that Walsh decided to write this new edition so soon before the breakthrough of Karmarkar's method. In light of all the new research produced in the last 18 months, the large number of pages devoted to the Ellipsoid Algorithm seems a bit overdone. However, it is perhaps the clearest presentation of this work now available for the new student.

In summary, as I stated earlier, I would recommend this book for any instructor of Linear Programming and for introductory students who desire a reference book that provides more rigor than most textbooks of today.

-Donna Crystal Llewellyn

Mathematical Programming Techniques

By N. S. Kambo
EWP, New Delhi, 1984

This is a comprehensive volume dealing with the available methods in mathematical programming (or optimization techniques), which are commonly adopted nowadays. It consists of 16 chapters with headings: (1) Introduction, (2) Convex Sets and Functions, (3) Linear Programming, (4) Duality in Linear Programming, (5) Transportation and Assignment Algorithms, (6) Methods for Special Linear Programs and Integer Programming, (7) Kuhn-Tucker Optimality Conditions, (8) Convex Programs and Duality, (9) Unconstrained and Transformation Optimization Techniques, (10) Quadratic Programming and Complementarity Problems, (11) Nonlinear Programming Methods, (12) Geometric Programming, (13) Goal Programming, (14) Stochastic Linear Programming, (15) Dynamic Programming, and (16) Game Theory, respectively.

As a whole, the materials contained are well chosen and also well arranged so that they can be used as a one-year course or two one-semester courses of basic study for those in operations research and engineering, as well as for those graduate students specializing in optimization techniques.

More precisely, Chapter 1 gives a general description of the mathematical programming problem and displays 11 interesting special examples that can be formulated as mathematical programming problems. Chapter 2 may be regarded as a brief introduction to convexity analysis that is certainly an indispensable tool for the study of optimization techniques. Chapters 3, 4, 5 and 6 treat the most frequently used linear programming methods and some useful special algorithms.

Although the treatment of linear programming techniques forms an important portion of the book, the most attractive and readable part seems to be those chapters from 7 to 13 dealing with various nonlinear problems and techniques. Especially, the treatment of Kuhn-Tucker optimality conditions (Chapter 7) with particular emphasis on convex programs (Chapter 8) appears both concise and inspiring.

Chapter 14 introduces the chance-constrained linear programming techniques initiated by A. Charnes and W. Cooper in the 1960s. This chapter may easily be read and understood by any student who knows the elements of probability theory or mathematical statistics.

Chapters 15 and 16 may be viewed as very concise introductions to Richard Bellman's dynamic programming and John von Neumann's elements of game theory, respectively. Consistent with the main objective and the presentation style of the whole book, these two chapters are concerned with techniques and processes for solving some problems of practical interest. Actually, Chapter 16 deals only with two-person games and finite matrix games.

As may be observed, this book has several notable features, namely the clear exposition of all those basic concepts that are needed in the formulation of problems and techniques, the proper proportionality of the materials displayed in each chapter in accordance with their own importance and usefulness for applications, and the consid-

continues on page ten

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erable variety of worked examples illustrating various important techniques, algorithms and applications. By and large, theorems and proofs are stated precisely and rigorously and are also easily accessible to beginners. Moreover, each chapter ends with a good number of exercises that are undoubtedly very useful for students as well as for the self-taught.

This book contains an appendix which may be omitted in reading by those who have already learned calculus and linear algebra. However, the references and further reading containing about 190 items at the end of the book seem to be of high reference value for teachers and researchers.

It is known that some important ideas used in mathematical programming techniques are actually suggested or implied by each other, e.g. conjugate gradient methods and Powell's method, etc. Also, some useful methods are frequently generated or derived from some old ones or their suitable combinations by avoiding certain weakpoints. These facts, as the reviewer sees it, have not been well explained in this book. Moreover, comparisons between the advantages and shortcomings of various methods are also seen to be lacking or not adequately discussed.

Some expressions displayed in the book may be obviously simplified or shortened. For example, the derivation on pages 41 and 42 is simplified by using the symmetry in y_i and y_j. There are also numerous typographical errors observed in various parts of the book.

Generally, the reviewer has the opinion that this volume is not only a textbook for students and teachers but also a useful reference book for applied mathematicians and technicians who are using optimization techniques in their research. The reviewer sincerely hopes that the future edition of this book will eliminate all the typographical errors, and if possible, add some brief historical remarks or references to each chapter.

-L. C. Hsu

Computational Geometry. An Introduction

By F. P. Preparata and M. I. Shamos
Springer, Berlin, 1985

After reading the first pages of this book, I was impressed by the authors' well-done work. On one hand they use a very lively style for their explanations while on the other hand there is the endeavor to be precise, clear and lucid.

So it is not surprising that in Chapter 1 of this book the basic definitions which are used later are carefully introduced. One learns here the history and definition of computational geometry as well as fundamentals of algorithms and geometry. Furthermore, a model of computation (primitives, transformability, algebraic decision tree), which remains undefined in many other books, is formulated. This model forms the basis for all subsequent investigations of the complexity of an algorithm. Generalizing this author's procedure one can observe that the book is self-contained. This fact is of particular importance since the authors intended to give an introduction (as stated in the subtitle) to computational geometry. Moreover, it was originally conceived as an early undergraduate textbook.

What are the contents of computational geometry and how have they been explained by this book? The first systematic investigations in this field emerged at the same time as the ensuing fields of applications became more relevant: computer-aided design or engineering, computer graphics and robotics. In these investigations some problem classes of a particularly fundamental character have crystalized. These problem classes, all covered by the book, are: geometric searching and retrieval, convex hull constructions, proximity, intersection, and the geometry of rectangles. In the treatment of these subjects the main interest of the authors lies not only in the presentation of readily usable techniques and programs but in the declaration of the interactions between design and analysis leading to the result: "good" algorithms. For that purpose the book contains the descriptions of the most important methods for solving every problem ending with the optimal algorithms. In some places this procedure may be long-winded. However, in most cases these lectures on the importance of different data structures or on one of the fundamental elements of computational geometry, are very interesting. The fundamental elements of computational geometry are binary search, divide and conquer, Voronoi-diagrams and sweep algorithms. In the foreground of the analysis of algorithms are, as usual, the respective worst-case behavior and only in a few cases the average behavior. Let it be noted, in addition, that there are three performance measures (preprocessing time, processing time, storage) used simultaneously.

Regarding the valid assertion for this area, "At this time it is typical of computational geometry, the planar problems are well understood, while very little is known in R^3 and even less for higher number of dimensions", this book illustrates impressively that so far many questions could be solved by an optimal algorithm. In the explanation of those 2- or 3-dimensional optimal solutions, a lot of figures make it possible for the reader to easily understand very complicated and complex details. Because of this, it is very pleasant to read the book.

Every chapter is extended by Notes and Comments. Here not only are additional alternatives of algorithms given but also historical background, recent developments and points for further investigations noted. Finally, concluding each chapter are some exercises closely related to the chapter.

This book is not easy to criticize, but I should make two comments. Linear programming is also a central problem in computational geometry. Thus I was disappointed and surprised that the results of Megiddo, 1984 (in which for arbitrary but fixed dimension a linear algorithm for linear programs is given) are not worked out. Furthermore, in some places the authors are not successful in finding serious helpful applications. There are a few misprints which can be easily corrected.

In summary, this book is well written and thoroughly and didactically reasoned. I would recommend it to every instructor as an educational handbook as well as to those who want a reference book on computational geometry, since it is singular in this field and up to date. It includes titles of references up through 1985.

-A. Wanka

BOOK REVIEWS

Handbook of Mathematical Economics, Volume III

Edited by K. J. Arrow and M. D. Intriligator
North-Holland, Amsterdam, 1986
ISBN 0-444-86128-9

The third and last volume of the Handbook covers mathematical approaches to welfare economics and to economic organization and planning. These topics are organized into the following five chapters: Social Choice Theory by Amartya Sen, Agency and the Market by Kenneth J. Arrow, the Theory of Optimal Taxation by J. A. Mirrlees, Positive Second Best Theory: A Brief Survey of the Theory of Ramsey Pricing by Eytan Sheshinski, and Optimal Economic Growth, Turnpike Theorems and Comparative Dynamics by Lionel W. McKenzie. The material on mathematical approaches to economic organization and planning is divided into three chapters, namely Organization Design by Thomas A. Marschak, Incentive Aspects of Decentralization by Leonid Hurwicz, and Planning by Geoffrey Heal.

Elaboration of various chapters differ widely. One finds 100 pages of a very comprehensive and detailed account of social choice theory at one extreme and 10 pages of a brief sketch of some ideas from the literature on the economic theory of the principal-agent relation at the other extreme.

Despite the diversity of elaboration on various parts of mathematical economics, which is almost inevitable in a book by more than 30 authors, the Handbook is a treasure for researchers and graduate students because of its unique coverage of the state of the art as of the late 1970s. I believe it will serve for many years as a definitive source, reference, and teaching supplement for the field of mathematical economics.

-Milan Vlach

Gallimaufry

Siegfried Schaible, formerly of the University of Alberta, has moved to the Graduate School of Management, University of California, Riverside...The EURO IX – TIMS XXVIII joint conference will be in Paris, July 6-8, 1988...1985 ORSA Lanchester Prize Honorable Mentions were awarded to **Vasek Chvatal** for his book on *Linear Programming* and to **Mordecai Haimovich** and **Alexander Rinnooy Kan** for their paper "Bounds and Heuristics for Capacitated Routing Problems"...**Rinnooy Kan** and **Peter Hammer** received 1986 EURO Gold Medals for their contributions to combinatorial analysis...**Richard Karp** has been named the John von Neumann Lecturer at the 35th SIAM Anniversary Meeting in Denver.

Deadline for the next O P T I M A is January 1, 1988.

Books for review should be sent to the Book Review Editor, Prof. Dr. Achim Bachem, Mathematiches Institute der Universität zu Köln, Weyertal 86-90, D-5000 Köln, West Germany.

Journal contents are subject to change by the publisher.

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Achim Bachem, Associate Editor
Published by the Mathematical Programming Society and Publication Services of the College of Engineering, University of Florida.

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