OPTIMA №34

MATHEMATICAL PROGRAMMING SOCIETY NEWSLETTER *July 1991*

1991 MPS Election Results

Jan Karel Lenstra, *Eindhoven University of Technology professor and one of the organizers of the 14th MPS Symposium, has been elected Chairman of the Society for the period 1992-1995. He will be Vice Chairman until he replaces current chairman* **George Nemhauser** *of Georgia Tech in August of 1992. Joining Lenstra on the Council will be* **Leslie E. Trotter** *of Cornell who continues as Treasurer through August 1995. The four new Council Members-at-Large are* **Clovis C. Gonzaga,** *COPPE-Federal University of Rio de Janeiro;* **Masakazu Kojima,** *Tokyo Institute of Technology;* **Bernhard Korte,** *University of Bonn; and* **Stephen M. Robinson,** *University of Wisconsin. They will serve from the 14th Symposium until the 15th (August 1991 to August 1994).*

OPTIMA NUMBER 34

◆1992 SIAM Conference on Optimization

The next SIAM Conference on Optimization will be held May 11-13, 1992, in Chicago, Illinois. The conference is sponsored by the SIAM Activity Group on Optimization.

The major themes for the 1992 conference are:

- **Large-scale optimization**
- **Interior point methods**
- **Algorithms for optimization problems in control**
- **Network optimization methods**
- **Parallel algorithms for optimization problems**

The conference will be held at the Hyatt Regency Hotel, which is located near many of the cultural and gastronomical attractions of Chicago.

The call for papers will be mailed on July 19, 1991. Abstracts for presentations are due on October 11, 1991. Please make a note of the dates May 11-13, 1992. See you in Chicago!

Jorge Moré (Co-chair), Argonne National Laboratory

Jorge Nocedal (Co-chair), Northwestern University

Jane Cullem, IBM Thomas J. Watson Research Center

Donald Goldfarb, Columbia University

Society for Industrial and Applied Mathematics

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◆Workshop on Generalized Convexity

The Fourth International Workshop on Generalized Convexity will be held in Pécs, Hungary, August 31-September 2, 1992, and is organized by S. Komlósi, Pécs; T. Rapcsák, Budapest; and S. Schaible, Riverside, California.

Conference themes include:

- **Characterizations of various kinds of generalized convexity**
- **Generalized monotone maps**
- **Optimality and duality**
- **Fractional programming**
- **Multi-criteria optimization**
- **Numerical solution methods**
- **Applications in economics, business administration, and stochastic systems**

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◆*European Journal of Operational Research:* Special Issue on Lotsizing Models for Production Planning

The need for *lotsizing* emerges when, for technical or economic reasons, successive processes (such as production and consumption) are not or cannot be synchronized. Although technological developments have increased the capacity of industrial organizations to synchronize operations, lotsizing remains a very important coordination tool when full synchronization is impossible. *European Journal of Operational Research* (EJOR) devotes a special issue on *lotsizing models for production planning*. Submitted papers may focus on new theoretical developments concerning lotsizing models, but contributions discussing applications of lotsizing models and techniques in practice are especially welcomed. For example, contributions may deal with, but are not restricted to, the following topics:

1. Models and solution procedures for lotsizing in capacitated environments.

2. Procedures for reduction of setup time and costs.

3. Interaction between dynamic lotsizing and sequencing aspects.

4. Lotsizing and maintenance.

5. Interrelation between product line design and lotsizing.

6. Lotsizing and safety stocks in MRP or DRP systems.

7. Mathematical complexity results and mathematical programming-based algorithms for lotsizing problems.

8. Interaction between lead-times and batching/unbatching decisions.

9. Decision support systems for lotsizing.

10. Models and solution procedures for lotsizing in complex (multilevel) product structures.

11. Lotsizing and restrictions imposed by environmental constraints (e.g., pollution laws).

Guest editors for the special issue are Marc Salomon, Roelof Kuik, and Luk N. Van Wassenhove. Authors should follow standard guidelines for EJOR as stated in each issue of the journal. All papers will be evaluated using the EJOR standard review process. Four copies of the manuscript should be sent to:

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Deadline for submission of papers is March 1, 1992. Additional information concerning this special issue can also be obtained from Marc Salomon.

◆Special Issue of *Mathematical Programming B* on "Applications of Discrete Optimization in Computer Science"

Editor: Thomas Lengauer, University of Paderborn, Paderborn, Germany.

In recent years, there has been an impressive cross-fertilization between research in discrete optimization and related research in computer science. Methodological advances in computer science have revealed that many optimization problems reduce to classical questions discussed in the area of discrete optimization. On the other hand, new applications have propelled the progress in developing methods for solving large optimization problems.

This issue of Mathematical Programming B aims at presenting original contributions to the area of discrete optimization that arise from applications in computer science. A nonexclusive list of applications is

VLSI systems:

Layout design of VLSI circuits (e.g., floorplanning, placement, global routing, detailed routing, cell synthesis)

High-level synthesis of VLSI systems (e.g., scheduling and resource allocation)

VLSI architectures for solving discrete optimization problems

New developments in computing:

Code optimization for innovative architectures (RISC, VLIW)

Parallel algorithms and architectures for solving discrete optimization problems

Optimization problems in running parallel computers (e.g., resource allocation, load balancing, message distribution)

Submitted papers should present original research contributions, detail the optimization methods, but also discuss thoroughly the relevance of the models and results for the respective application. A validation of the research results normally will be composed of both theoretical analyses and experimental data about normal editorial process. All submissions will undergo the normal Mathematical Programming editorial process.

The final drafts of accepted papers must adhere to the format specified by Mathematical Programming B, described at the end of each issue. Four copies of submissions should be sent to:

Prof. Thomas Lengauer
Department of Computer Science and Mathematics (FB 17)
University of Paderborn
W-4790 Paderborn
Germany
Fax: +49 5251 60 3836
E-mail: tl@uni-paderborn.de

The deadline for submission is September 30, 1991. The final papers will be sent to the publisher in the fall of 1992. The issue is scheduled to appear in the first half of 1993.

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◆Special Issue of *Mathematical Programming B* on "Applications of Combinatorial Optimization"

We are planning to edit a *special issue* of MPB that will focus on real-world applications of combinatorial optimization. We seek contributions that address practical problems, describe their mathematical modeling, the theory developed for the structural understanding of the model, and the algorithms designed and implemented for solving the problem.

The latter may be exact optimization algorithms or problem-specific heuristics that take the special application into account. A report of the computational performance of the algorithms and the quality of the solutions obtained is indispensable. We are not interested in numerical studies on random problems. What counts is the theoretical and algorithmical treatment of practical instances from the real world.

Papers should be submitted to either one of us (addresses are listed below). The deadline for submission is December 31, 1991. All submitted papers will be refereed under the usual criteria of *Mathematical Programming*.

Rainer E. Burkard
Institut für Mathematik
Technische Universität Graz
Kopernikus-Gasse 24
8010 Graz, Austria
or
Martin Grötschel
Institut für Mathematik
Universität Augsburg
Universitätsstr. 8
8900 Augsburg, Germany

Reaching all Nordic MPS members by e-mail

You can now reach 27 of the Nordic MPS members by one e-mail message to mps@iok.unit.no

The idea is that other MPS members can inform Nordic MPS members about such items as

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If you plan to tour the region by giving talks at different universities, one message will put you in contact with almost all universities where mathematical programming is taught.

More precisely, you will reach leading researchers at the following institutions:

Norway: *The University of Bergen, The University of Trondheim, The Norwegian Computing Center - Oslo*

Sweden: *Linkoping University, The Royal Institute of Technology - Stockholm, University of Umea*

Finland: *Helsinki School of Economics*

Denmark: *University of Copenhagen, University of Aarhus, The Business School in Aarhus, The Technical University of Denmark*

Iceland: *The University of Iceland*

Stein W. Wallace, leader of the Nordic Section of MPS, may be reached via e-mail: sww@iok.unit.no or by phone: + 47-7-593609

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Technical Reports & Working Papers

S. Mizuno, M.J. Todd, Y. Ye: *"Anticipated Behavior of Long-Step Algorithms for Linear Programming,"* TR 882.

R. Barton and L.W. Schruben: *"Graphical Methods for the Design and Analysis of Simulation Experiments,"* TR 883.

R. Barton: *"Experiments in Computing Finite Difference Derivatives when Optimizing Low Accuracy Functions,"* TR 884.

J.S.B. Mitchell and C.H. Papadimitriou: *"The Weighted Region Problem: Finding Shortest Paths Through a Weighted Planar Subdivision,"* TR 885.

S. Rachev and S. Resnick: "Max-Geometric Infinite Divisibility and Stability," TR 886.

A.G. Loerch and J.A. Muckstadt: "An Approach to Production Planning, Scheduling, and Due-Date Quotation in Cyclically Scheduled Manufacturing Systems," TR 887.

D.M. Ryan: *"The Solution of Massive Generalized Set Partitioning Problems in Aircrew Rostering,"* TR 889.

M. Todd and L. Khachiyan: *"On the Complexity of Approximating the Maximal Inscribed Ellipsoid for a Polytope,"* TR 893.

E.M. Arkin, S. Khuller and J. Mitchell: *"Optimal Enclosure Problems,"* TR 895.

J. Mitchell and E. Wynters: *"Optimal Motion of Covisible Points Among Obstacles in the Plane,"* TR 896.

E.C. Sewell and L.E. Trotter, Jr.: *"Stability Critical Graphs and Even Subdivisions of K_4,"* TR 897.

P.L. Jackson and J.A. Muckstadt: *"Llenroc Plastics: Market Driven Integration of Manufacturing and Distribution Systems,"* TR 898.

L. Tuncel: *"On the Complexity of Preflow-Push Algorithms for Maximum Flow Problems,"* TR 901.

R. Barton: *"Graphical Tools for Experiment Design: A Brief Survey,"* TR 902.

M. Todd: *"A Low Complexity Interior-point Algorithm for Linear Programming,"* TR 903.

E. Sewell: *"Stability Critical Graphs and the Stable Set Polytope,"* TR 905.

M. Todd: *"Combining Phase I and Phase II in a Potential Reduction Algorithm for Linear Programming,"* TR 907.

C. Ko and R. Bland: *"Characterizations of Camion Trees and Depth-first Search Trees by Excluded Configurations,"* TR 909.

P.J. Heffernan: *"Linear-Time Algorithms for Weakly-Monotone Polygons,"* TR910.

Y. Herer: *"Submodularity and the Travelling Salesman Problem,"* TR 915.

Y. Herer and R. Roundy: *"Heuristics for a One Warehouse Multi-Retailer Distribution Problem with Performance Bounds,"* TR 916.

L. Liao and C. Shoemaker: *"The Proof of the Quadratic Convergence of Differential Dynamic Programming,"* TR 917.

D.B. Shmoys and E. Tardos: *"Computational Complexity,"* TR 918.

C.N. Potts, D.B. Shmoys and D.P. Williamson: *"Permutation vs. Non-permutation Flow Shop Schedules,"* TR 919.

J.S.B. Mitchell, G. Rote, G. Woeginger: *"Minimum-Link Paths Among Obstacles in the Plane,"* TR 920.

D.B. Shmoys, C. Stein, J. Wein: *"Improved Approximation Algorithms for Shop Scheduling Problems,"* TR 921.

J. Renegar: "Computational Complexity of Solving Real Algebraic Formulae," TR 922.

A.W.J. Kolen and J.K. Lenstra: *"Combinatorics in OR,"* TR 925.

D. Gusfield and E. Tardos: *"A Faster Parametric Minimum Cut Algorithm,"* TR 926.

C. Ko: *"An Algorithm to Find a 2-Isomorphic Depth-First Search Image of a Tree,"* TR 927.

M.A. Hariga and P.L. Jackson: *"Time Variant Lot Sizing Models for the Warehouse Scheduling Problem,"* TR 930.

M.A. Hariga and P.L. Jackson: *"Time Invariant Lot Sizing Models for the Warehouse Scheduling Problem,"* TR 931.

M.A. Hariga and P.L. Jackson: *"The Warehouse Scheduling Problem Formulation and Algorithms,"* TR 932.

C. Akkan, M. Fret, D.C. Heath, P.L. Jackson, K. Levesque, and S. Tlakula: *"Chip Assignment Algorithms for Dynamic Wafer Design in Semiconductor Manufacturing,"* TR 935.

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J. Muckstadt and R. Bowman: *"Stochastic Analysis of Cyclic Schedules,"* TR941.

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H. Cohen: *"The Wild Card Option in Treasury Bond Futures is Relatively Worthless,"* TR 943.

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J. Muckstadt and R. Bowman: *"Stochastic Analysis of Cyclic Schedules, Algorithms and Examples,"* TR 945.

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S. Tayur: *"Controlling Serial Production Lines with Yield Losses Using Kanbans,"* TR 947.

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M.J. Todd: *"Projected Scaled Steepest Descent in Kojima-Mizuno-Yoshise's Potential Reduction Algorithm for the Linear Complementarity Problem,"* TR 950.

M.J. Todd and J.-P. Vial: *"Todd's Low-Complexity Algorithm is a Predictor-Corrector Path-Following Method,"* TR 952.

J. Mitchell: *"An Optimal Algorithm for Computing Visibility in the Plane,"* TR 953.

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L.J.J. Bruggen, J.K. Lenstra, P.C. Schuur, *"A Variable Depth Approach for the Single-Vehicle and Delivery Problem with Time,"* Memorandum COSOR 90-48 Technische Universiteit Eindhoven, Faculteit Wiskunde en 1990.

G.A.P. Kindervater, J.K. Lenstra, M.W.P. Savelsbergh, *"Sequential and Parallel Local Search for the Time-Constrained Traveling Salesman,"* Report EUR-CS-90-06, Erasmus Universiteit Rotterdam; Memorandum COSOR 90-41.

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J. van den Berg, R. Meester, *"Stability Properties of a Flow Process in Graphs,"* Report 90-58, TU Delft.

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A.M.H. Gerards, *"On Tutte's Characterization of Graphic Matroids - a Graphic Proof,"* CWI Report BS R9028.

F.B. Shepherd, *"Near-Perfect Matrices,"* CWI Report BS R9034.

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G. Ding, A. Schrijver, P.D. Seymour, *"Disjoint Cycles in Directed Graphs on the Torus and the Klein Bottle,"* CWI Report BS R9013.

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S.L. van de Velde, *"Duality-Based Algorithms for Scheduling Unrelated Parallel Machines,"* CWI Report BS R 9010.

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J.A. Hoogeveen, *"Analysis of Christofides' Heuristic: Some Paths are More Difficult than Cycles,"* CWI Report BS R 9005.

J.A. Hoogeveen, S.L. van de Velde, *"Polynomial-Time Algorithms for Single-Machine Multicriteria Scheduling,"* CWI Report BS R 9008.

A.W.J. Kolen, J.K. Lenstra, *"Combinatorics in Operations Research,"* CWI Report BS R9024 Research memorandum RM 90-27, Rijksuniversiteit Limburg; Memorandum COSOR 90-28.

J.A. Hoogeveen, S.L. van de Velde, *"A New Lower Bound Approach for Single-Machine Multicriteria Scheduling,"* CWI Report BS R9026.

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D.M. Bakker, *"Two Nonparametric Estimators of the Survival Function of Bivariate Right Censored Observations,"* CWI Report BS R9035.

V.V. Korolyuk, *"Central Limit Theorem for Non-Homogeneous Processes with Independent Increments,"* CWI Report AM R9026.

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A.J. Baddeley, R.P.C. Rodgers, *"Nested Monte Carlo Study of Random Packing on the Sphere,"* CWI Report BS R9023.

Applied Combinatorics with Problem Solving

Bradley W. Jackson and
Dmitri Thoro
Addison-Wesley, 1990
ISBN 0-201-12908-6

No one would deny the important role combinatorics plays in contemporary mathematics, though its position is not always easy. Pure theoretists don't want to see deep theorems there, while practical computer scientists find combinatorics too theoretical. Nevertheless, or better just because of this, I agree with the authors that each student of mathematics or computer science should pass at least one semester of combinatorics during his or her university curriculum. The book under review is a good introductory test which contains basic and most important combinational and graph theoretical notions and approaches and is accompanied by 885 problems. It can be fruitfully used for courses at junior level for students of mathematics and at junior or senior level for students of computer science or other engineering sciences (a combinatorics course for senior students of mathematics should contain deeper theorems).

The book consists of 10 chapters, each of which is divided into two to six sections. Two groups of problems (called Problems and Advanced Problems) are presented at the end of each section; most difficult problems are marked by asterisks. Another group of review problems, a brief summary and bibliography conclude each chapter. Solutions or hints to odd numbered problems are provided at the end of the book. As a result of this 'parity revealing strategy', there are a few nontrivial problems left without hints which, on the other hand, may provide good influence on the students while forcing them to work a bit harder. However, the majority of the problems are more or less straightforward and should be suitable for all students. Special exercises for computer oriented students (called Supplementary Computer Projects) conclude many of the sections.

The subjects covered by the book are the following (SCP in parentheses indicates presence of Supplementary Computer Projects in the particular section):

1 **Combinatorial Problem Solving** 1.1. Deduction (SCP), 1.2 Induction (SCP), 1.3 Sets and Relations (SCP), 1.4 Functions (SCP) (Pigeonhole principle);

2 **Basic Counting Principles** 2.1 Sequential Counting, 2.2 Case-by-case Counting, 2.3 Selections (SCP) (Permutations and combinations without repetition), 2.4 Selections with Unlimited Repetition (Permutations and combinations with repetition, and distributions), 2.5 Binomial Coefficients (Pascal's triangle), 2.6 Permutations of Nondistinct Objects;

3 **The Principle of Inclusion-Exclusion** 3.1 The Union of Overlapping Sets (SCP), 3.2 Counting Restricted Arrangements (Derangements, combinations with limited repetition, Euler's phi function), 3.3 Distributions (SCP) (Distributions of distinct/identical objects to distinct/similar recipients);

4 **Combinatorial Algorithms** 4.1 Algorithms (SCP), 4.2 Asymptotic Analysis of Algorithms, 4.3 Enumerating Permutations and Combinations (SCP) (Lexicographic order);

5 **Graphs** 5.1 Graph Models (SCP) (Basic notions, degree sequence), 5.2 Paths and Connectedness, 5.3 Circuits and cycles (SCP) (Eulerian trails and circuits, Hamiltonian paths and cycles), 5.4 Planar Graphs (Euler's formula and Kuratowski's theorem), 5.5 Graph Colorings (SCP) (Five color theorem, chromatic polynomial);

6 **Graph Algorithms and Searching** 6.1 Breadth First Search (SCP) (Shortest path, bipartite graphs), 6.2 Trees (SCP) (Depth first search, spanning trees, Cayley's theorem), 6.3 Tree Algorithms (SCP) (Binary search, minimum-weight spanning tree, sorting);

7 **Generating Functions** 7.1 Generating Function Models, 7.2 Calculating Coefficients (SCP), 7.3 Partitions (SCP), 7.4 Exponential Generating Functions;

8 **Recurrence Relations** 8.1 Recurrence Relation Models (SCP) (Fibonacci and Catalan numbers), 8.2 Homogeneous Linear Recurrences (SCP) (Solving linear recurrences via characteristic equation), 8.3 Nonhomogeneous Linear Recurrence Relations (SCP);

9 **The Polya Theory of Counting** 9.1 Symmetry Groups and Burnside's Theorem, 9.2 The Cycle Index;

10 **Graph and Network Algorithms** 10.1 Directed Graphs (SCP) (Tournaments, directed Euler tours), 10.2 Networks (The earliest starting time algorithm, critical path analysis, compaction of an integrated circuit design), 10.3 Network Flows (The labeling algorithm, matchings and Hall's marriage theorem).

As seen from the contents, most of the basic areas of combinatorics and graph theory are covered. On the other hand, some sections might be richer even at this introductory level, e.g. Chapter 7 should reveal a few examples of using differentiation when evaluating generating functions. Some Ramsey theory

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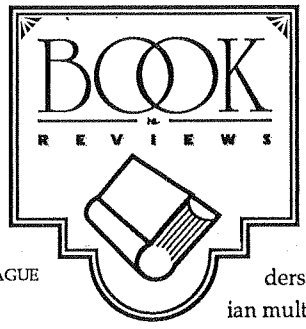
should be included, for instance, as an extension of the pigeonhole principle in Section 1.4. Though the book is written mainly for computer science students, it contains just a brief note about NP-completeness theory, without definitions and without examples of reductions between problems from NP. A very few formulations occur which are not completely correct from the formal point of view; namely, the proof of Burnside's theorem (Section 9.1) is incorrect.

–JAN KRATOCHVÍL, PRAGUE



Handbooks in Operations Research and Management Science, Vol. 1 Optimization

G. L. Nemahuser, A. H. G. Rinnoy Kan and M. J. Todd, Editors
North-Holland, 1989
ISBN 0-444-87284-1

This is the first volume of a series of books dedicated to optimization methods. It is very appropriately called a handbook, since it possesses the principal characteristics of this type of text; it contains the fundamental arguments of the discipline which are treated with much clarity. On the other hand, it is much more than a handbook because it presents simply a number of recent and important acquisitions to the discipline.

The choice of optimization as the subject of the first volume is suitable because, as the authors themselves maintain, optimization models have often been demonstrated to be the key for many applications of mathematics in various fields like engineering, economics, industrial management of services, transportation, communication.

The presence in the book of models and methods, whether of continuous or combinatorial optimization, underlines the necessity of their wider interaction at both didactic and research levels. Stochastic programming, either as models or as an approach for treating complex deterministic models is most welcome as are multi-objective models.

The first chapter is devoted to unconstrained optimization. Based on classic methods, such as Taylor approximations and Newton-type methods, it contains recent approaches like the one which uses trust regions. Special attention is paid to computing aspects, including large-scale problems, data-fitting applications, and parallel computation.

The second chapter contains an updated exposition of the main topics of linear programs and related problems. Besides the classic simplex method, which is presented also in a very attractive geometrical way, two recently proposed polynomial algorithms are described: Khachian's ellipsoid method and Karmarkar's projective one. As in the preceding chapter, techniques for handling large-scale problems are discussed.

The third chapter deals with constrained nonlinear programming, with both equality and inequality constraints and, in particular, the quadratic case. The reader is led to rapid understanding of the main approaches, like those based on Lagrangian multiplers, penalty, augmented Lagrangian and barrier-function methods. Special attention is devoted to numerical aspects.

Chapter four treats network flow optimization problems which have been shown to be instrumental in several operations research applications. The attention is focused on the three fundamental topics of this field, namely the shortest path, the maximum flow, and the minimum cost flow problems. The computational complexity of the algorithms is discussed.

The fifth chapter leads the reader through the important and complex subject of polyhedral combinatorics, whose aim is to reduce the feasible region as an integer linear problem to a polyhedron so that the combinatorial problem collapses to a linear program. Min-max relations receive special attention, as well as several other important topics, like polarity, blocking and antiblocking.

The sixth chapter contains the main tools for solving integer programs whose polyhedral properties have been investigated above. Principal attention is devoted to cutting plane methods, in particular Gomory fractional cuts. Several other fundamental topics are discussed, e.g. duality, computational complexity, and methods for handling large-scale problems, such as branch-and-bound.

Chapter seven treats those optimization problems where differentiability of the involved functions is not guaranteed. The first part seeks to motivate such a theory, showing classic and recent situations where the assumption of differentiability would lead to rough approximations. Then two main approaches for handling nondifferentiable optimization, i.e. subgradient and bundle methods, are described. Remarks on directions for future developments, which close the chapter, are very suitable because of the fast development of this subject.

The eighth chapter is concerned with stochastic programming, i.e. optimization problems where some of the data are random variables. The first part is dedicated to the motivation of stochastic models. Indeed, in recent years we have seen, from economics to physics, from biology to engineering, an increasing demand for a stochastic approach to real problems, some of these initially handled as deterministic ones. The main tools of stochastic programming are thus presented here in an appropriate position. Anticipative and

adaptive models are described in detail. Then we meet recourse problems and optimality conditions. The last part contains approximations, solution procedures, stability, and incomplete information.

The ninth chapter deals with global optimization, i.e. methods for finding a global extremum in an optimization problem. The several available approaches to this difficult task are discussed, in particular, partition and search as a generalization of branch-and-bound methods, approximation and search, generating random directions, and techniques for improving local optima.

The tenth chapter deals with optimization problems having more than one objective function. Starting from a survey of useful results on binary relations, the chapter introduces a variety of approaches drawn from multiobjective optimization, including goal programming, interactive methods, utility functions, and special simplex methods for the linear case.

–F. GIANNESSI

Global Optimization

by R. Horst and H. Tuy
Springer, 1990
ISBN 3-540-52368-5

The concern of this excellent book is to consider the global optimization problems for which standard nonlinear programming techniques fail because of the existence of local minima that are not global. These global optimization problems are called multiextremal global optimization problems. The authors emphasize that the solution methods for the multiextremal global optimization have to be significantly different from standard nonlinear programming techniques which can at most locate local minima and cannot decide whether a local solution is global. For these reasons they provide useful tools for transcending local optimality restrictions. Particularly important is special emphasis placed on the systematical clarification and unification of various approaches for solving global optimization problems. Such various approaches and a large number of algorithms are the consequences of the recent rapid expansion in computer technology.

First of all, this original and interesting book gives a survey of the most important methods and results in the theory and practice of global optimization. Moreover, authors provide many of their own new results. Several methods are interpreted as applications and combinations of certain recent basic approaches serving as suggestions for the development of new procedures. The book also presents the state of the art in certain deterministic concepts used in most of the methods for solving multiextremal global optimization problems that authors believe to be promising for further research. These concepts are applied to derive algorithms for solving wide classes of problems that are often encountered in applications.

The book is divided into three main parts with 11 chapters. Each chapter starts with a summary of its contents.

Following the lines of the authors a short review of the contents of these three parts is given below.

Part A, "Introduction and Basic Techniques" (chapters I-IV), deals with the main classes of global optimization problems and develops some of their basic properties and applications. Some fundamental concepts that unify the various general methods of solutions such as outer approximation, concavity and branch and bound are reviewed there.

A thorough study of methods for solving concave minimization problems and some related problems having reverse convex constraints is the topic of Part B, "Concave Minimization" (chapters V-IX). Three main categories of the methods for concave minimization - cutting methods, successive approximation methods and successive partition methods - are studied in detail in this part. The authors emphasize the fact that cutting planes play a dominant role in cutting methods. Relaxation and restriction are the main aspects of successive approximation, and branch and bound concepts usually serve as a framework for successive partition. Moreover, they also discuss decomposition approaches to large scale problems and specialized methods adapted to problems with a particular structure such as quadratic problems, separable problems, bilinear programming, complementarity problems and concave network problems.

Part C, "General Nonlinear Problems" (chapters X-XI), concentrates on the study of methods of solution for very general global optimization problems. Several outer approximation algorithms, branch and bound procedures and their combinations are developed for solving d.c. programming (d.c. is an abbreviation for the difference of two convex functions) and Lipschitzian optimization problems. Finally, the authors discuss many interesting applications.

In summary, the motivation and the presentation of the topics are of excellent clarity. Thus this book could be highly recommended for research in global optimization as well as for engineers having to solve practical multiextremal optimization problems. It is of interest to students and researchers alike.

–ANNA RYCERZ

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Gallimaufry

Jon Lee (OR Department, Yale) will spend the 1991-92 academic year at CORE. ¶**Clyde Monma** has been promoted to division manager of Bellcore's mathematics, information sciences and operations research division. ¶**Patrick Harker** has become the youngest faculty member in Wharton's history to achieve the rank of professor. He has also been named a White House Fellow by President Bush for the period September 1991-August 1992. ¶Deadline for the next OPTIMA is October 1, 1991.

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.

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