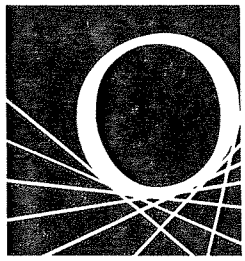
September
1 9 8 4
Number 13



OPTIMA
MATHEMATICAL PROGRAMMING SOCIETY NEWSLETTER

Boston Symposium Issues Call For Papers; Dantzig, Fulkerson Winners to Be Named

Tutorials and MP software demonstrations featured

The XII International Symposium on Mathematical Programming will be held August 5 to August 9, 1985, at the Massachusetts Institute of Technology in Cambridge, Massachusetts. The organizers are constructing a program that emphasizes applications and computation, as well as recent theoretical developments.

A call for papers will be mailed out in September, 1984. The deadline for submission of contributed paper titles is April 1, 1985; paper abstracts are due by June 1, 1985. In addition, invitations to present papers will be extended to a number of leading researchers and practitioners.

The program will be organized around more than a dozen parallel sessions covering topics on every aspect of mathematical programming. It will also contain approximately 15 tutorials, state-of-the-art surveys and mini-courses presented by leading experts in the field. The following is a partial list of topics:

- ★ Data Structures
- ★ Simulated Annealing
- ★ Vehicle Routing and Scheduling
- ★ State-of-the-art in Complementarity Theory
- ★ Mathematical Programming on Microcomputers
- ★ Mathematical Programming and Economic Theory
- ★ Stochastic Optimization
- ★ New Problems in Graph Theory
- ★ Mathematical Programming and Expert Systems
- ★ Methods of Model Generation

Arrangements are underway for extensive software demonstrations at the Symposium. Several commercial linear and mixed integer programming systems will be displayed, along with packages for scheduling and network optimization, and experimental codes of many types. Demonstrations will include microcomputer as well as mainframe systems. A mini-course will be offered on linear programming linked to spread sheet programs. Participants will be given "hands on" experience in using these programs on micros.

The winners of two prestigious awards, the George Dantzig Prize and the Ray Fulkerson Prize, will be announced at the Symposium's opening ceremonies. The Dantzig Prize is presented jointly with the Society for Industrial and Applied Mathematics (SIAM) for original work in the field of mathematical programming which, by its breadth and scope, constitutes an outstanding contribution to the field. The Fulkerson Prize is presented jointly with the American Mathematical Society (AMS) for an outstanding paper in the area of discrete mathematics. A new prize, the William OrchardHays Prize for mathematical programming computation will be awarded for the first time at the Symposium.

See Boston, page 2

IBM Prizes Awarded at TIMS XXVI

At the XXVI International Meeting of The Institute of Management Sciences (Copenhagen, June 1984), the $2000 IBM prize for "the best paper showing the role of computers in management science and operations research" was divided between two papers: one by Martin Grötschel, Michael Jünger and Gerhard Reinelt on a polyhedral approach to matrix triangulation and another by Robert E. Markland and Shawnee K. Vickery on an integer goal programming algorithm. Pekka Korhonen and Jukka Laakso received honorable mention for their work on interactive multicriteria decision making.

The prize was made available by IBM

See IBM Prizes, page 2

1985 Officers Election; Call for nominations

In accordance with the Constitution of the Society, the triennial election of officers will be held in March, 1985. All offices will be on the ballot: Chairman, Treasurer, and four Council members-at-large. The Nominating Committee (Alex Orden, Chairman) welcomes suggestions from the membership for nominees. Naturally, before a candidate is proposed, it should be determined that the member is in good standing with the Society and is willing to run.

The Nominating Committee will circulate the proposed names among the Council of the Society, which will choose the candidates. In addition, any person nominated in writing by at least six members of the Society, and who agrees to stand, will be placed on the ballot.

Suggestions should be sent by December 31, 1984, to the Chairman of the Society, Professor Alex Orden, Graduate School of Business, University of Chicago, 1101 East 58th Street, Chicago, Ill. 60637, U.S.A.

Boston from page one

The symposium will be held on the campus of the Massachusetts Institute of Technology. Dormitory rooms will be available to Symposium attendees and their families; blocks of rooms have also been reserved at nearby hotels. A range of social events has been planned including a reception at the New England Aquarium, and a banquet celebrating George Dantzig's 70th birthday to be held at one of Boston's leading hotels. Attendees and their families will also be able to choose from an assortment of summer activities organized by the social committee including: a New England clambake, harbor and whale-watching cruises, a visit to a Red Sox baseball game, and walking tours of historic Boston.

For further information, contact:

Jeremy F. Shapiro
Program Chairman
Operations Research Center
Massachusetts Institute of
Technology
Room E40-164
Cambridge, MA 02139
USA
(617-253-3601)

CONFERENCE NOTES

NATO ASI on Computational Mathematical Programming

A highly successful Advanced Study Institute on Computational Mathematical Programming was held July 23-August 2 in Bad Windsheim, F.R.G., under the sponsorship of NATO with additional support from NBS, NSF, and Deutscher Akademischer Autauschdienst. The meeting was organized by the MPS Committee on Algorithms (COAL) with Klaus Schittkowski as Director, Karla Hoffman and Jan Telgen as Co-Directors, Jochem Zowe in charge of arrangements, and Marlis Zowe as secretary.

Over 80 participants from 20 countries attended the 60 research seminars and the 16 featured lectures by Martin Beale, H.P. Williams, F.A. Lootsma, K. Hoffman, A. Rinnooy Kan, R.B. Schnabel, M. Rijckaert, J. Stoer, P.E. Gill, P. Toint, D. Kraft, R. Wets, and J. Zowe.

Also featured was a "software fair" in which both commercial software houses and reseachers provided information on the availability of their mathematical programming software.

The tutorial lectures will be published by Springer within a special NATO ASI series, and the research papers are being solicited for a Mathematical Programming Study to be edited by Karla Hoffman, Richard H.F. Jackson and Jan Telgen.

Social highlights of the meeting included excursions to Wurzburg and Rothenburg and a "Spanferkelessen" in Bad Windsheim.

- D. Hearn

Third Course: Optimization and Related Fields

September 17-30, 1984
Erice, Italy

This course is sponsored by the European Physical Society, the Italian Ministry of Education, the Italian Ministry for Scientific and Technological Research, the National Research Council, and the Sicilian Regional Government.

The aims of this course are to present both state-of-the-art summaries and research trends of optimization theory and methods. It will be structured with invited lectures and some contributed lectures as well. Special attention will be devoted to interactions between infinite and finite dimensional theory, method, and applications.

The closing date for application was June 30, 1984. Requests for information should be directed to Professor R. Conti, Instituto do Matematica, Universita di Firenze, Viale Morgagni, 67/A, 50/34 FIRENZE, Italy.

IBM Prizes from page one

World Trade Europe/Middle East/Africa and IBM Denmark. Twenty-four papers were submitted and considered by a jury consisting of Laureano F. Escudero (IBM Spain), Michael Florian (Université de Montréal), Francesco Maffioli (Politecnico di Milano), Bent Rosenkrands (IBM Denmark), and the two program chairmen of TIMS XXVI, Richard L. Francis (University of Florida, Gainesville) and Jan Karel Lenstra (Centre for Mathematics and Computer Science, Amsterdam). The citations of the selected papers are quoted below.

"Honorable mention is received by Pekka Korhonen and Jukka Laakso from the Helsinki School of Economics for the paper, *A Visual Interactive Method for Solving the Multiple Criteria Problem.* They are among the first ones to explore the combination of algorithms for multicriteria decision making and manmachine interaction by means of computer graphics. The jury feels that this is a very promising research direction, completely in the spirit of the prize, and hopes that this mention will stimulate the authors' continuing work along these lines.

"One prize is awarded to Robert E. Markland from the University of South Carolina and Shawnee K. Vickery from Michigan State University for the paper, *The Efficient Computer Implementation of a Large-Scale Integer Goal Programming Model.* They have developed a computational method for a set of production planning problems that are difficult on three counts: they are large scale, they have integer variables, and they are formulated in terms of goal programming. The method has been successfully implemented and evaluated in a practical context. The jury is impressed by the achievements reported in this paper.

"The other prize is awarded to Martin Grötschel, Michael Jünger and Gerhard Reinelt for the paper, *A Cutting Plane Algorithm for the Linear Ordering Problem.* They consider an important optimization problem that occurs, for example, in the triangulation of input-output matrices, and that has received insufficient attention so far. Their solution method is based on their earlier investigations of the facet structure of the integer polytope associated with the problem as well as on the use of a standard LP/ILP package as a subroutine. The resulting algorithm is very elegant and of practical relevance in the sense that it is the first one able to solve problems of the size as they occur in practical situations."

- Jan Karel Lenstra

BOOK REVIEWS

Homotopy Methods and Global Convergence
by B. C. Eaves, F. J. Gould, H. -O. Peitgen and M. J. Todd
Plenum, New York, 1983

This book is a collection of papers presented at the NATO Advanced Research Institute on Homotopy Methods and Global Convergence held in Porto Cervo, Sardinia, in 1981. Two papers should be of particular value to practitioners in that they present much useful material that, up to now, has circulated as part of the folklore of the subject. One of these is the paper by John B. Shoven discussing the interplay of mathematical and economic reasoning involved in applying homotopy and fixed point methods to general equilibrium modeling. The other is Layne T. Watson's paper in which he tells about his experiences in applying the Chow-Yorke algorithm to a variety of engineering problems.

The remaining papers are more theoretical in nature and present many new ideas that are only now beginning to be fully appreciated and exploited by workers in the field. Some of these are piecewise smooth homotopies, global Newton methods for stationary point problems, exploiting structure in large homotopy problems, and probabilistic analysis.

A final interesting feature of the collection is an appendix that presents descriptions of several current implementations of fixed point and homotopy procedures. I was, however, disappointed that no complementarity codes were included, although several excellent implementations are available.

The index to the collection is also disappointing. It lists, for example, only one reference to linear complementarity, although references to linear complementarity abound throughout the collection. Additionally, it would have been interesting if the editors had provided an introductory preface, giving their view of the field and placing the collection in context.

The papers contained in this collection represent valuable contributions and are interesting to read. Researchers and practitioners will both find this book a worthwhile investment.

- Philip C. Jones

Discrete Optimization Algorithms with Pascal Programs
By M. M. Syslo, N. Deo and J. S. Kowalik
Prentice-Hall, Englewood Cliffs, New Jersey, 1983

The purpose of this book on discrete optimization is to offer "a collection of ready-to-use computer programs together with their derivation and performance characteristics." The authors recommend its use as a supporting textbook in advanced undergraduate or graduate courses and as a software handbook.

There are four chapters. The first one deals with linear and integer programming, including the transportation problem. Chapter 2 discusses knapsack, set partitioning and set covering problems. Chapter 3 covers network optimization problems: paths and trees, maximum and minimum-cost flow, cardinality matching, and the traveling salesman problem. The final chapter presents a selection of coloring and scheduling algorithms.

The book would be quite useful as a supplementary text in courses on discrete optimization. It contains a lot of information, and the 28 Pascal codes are suitable for a quick and incidental use by students. We would hesitate, however, to describe the text as a software handbook. This is not because of the incomplete coverage of the area (excluded are topics like location, network design and matroid optimization), but because the selection criteria for the algorithms to be coded are not clear and because the codes themselves are not up to the current standards for production purposes. The choice of algorithms as well as the style of implementation seems to have been determined by the availability of existing material and by educational requirements of clarity and simplicity rather than by considerations of time and space efficiency. For example, Dinic's maximum flow algorithm in the version of "the three Indians" is conceptually very simple indeed but probably not the most efficient one -- even if the authors' implementation would be modified so as to attain the claimed cubic time bound. But let us repeat that the book could prove its value in supplying supporting material in courses based on the unified expositions by, e.g., Lawler and Papadimitriou and Steiglitz.

- B. J. Lageweg, J. K. Lenstra

Direct Methods for Sparse Matrices
By O. Østerby and Z. Zlatev
Springer, Berlin, 1983

This book is on the algorithmic solution of large sparse systems of linear equations. It explains the strategies implemented in a software package called Y12M, which is available at the Regional Computing Centre of the University of Copenhagen (RECKU).

Let $L \cdot U$ be a triangular decomposition of the square matrix A and x_o an approximate solution of $A \cdot x = b$. Then, if convergent, the process of iterative refinement

$$d_i := U^{-1} L^{-1} (b - Ax_i);$$
$$x_{i+1} := x_i + d_i$$

yields a very exact solution of the original problem, even if the decomposition $A = L \cdot U$ is fairly inexact.

The authors use sparse representations of the matrices involved. A large drop tolerance reduces fill-in during the process of Gaussian elimination and yields a crude but very sparse LU-decomposition. Subsequently, accuracy is retrieved by iterative refinement. Compared to direct solution methods, this approach results (for sparse problems) in a considerable reduction of computing time and storage requirements as well as in improved accuracy.

Chapter 1 gives an introduction and explains the classes of test matrices used in computational comparisons. Data structures for storing and manipulating sparse matrices are discussed in Chapter 2, and Chapter 3 covers (modified Markowitz) pivotal strategies to keep balance between sparsity and accuracy. Convergence results for the process of iterative refinement, considerations on the choice of the drop tolerance and computational comparisons are given in Chapter 4. Finally, Chapter 5 introduces a general computational scheme which extends these ideas to overdetermined systems and contains many well-known direct methods as special cases.

The book contains many tables with computational results and is clearly written. It can be recommended to everyone interested in efficient solution procedures for sparse linear systems.

- M. Bastian
-Technical University, Aachen

BOOK REVIEWS

Probability Theory and Computer Science
By G. Louchard and G. Latouche
Academic Press, London, 1982

This book presents lectures given at the "Université Libre de Bruxelles" during 1980/81 by D. P. Gaver, H. Kobayashi and R. Sedgewick. These lectures are intended as variations on the theme "Probability Theory and Computer Science."

Chapter I, written by D. P. Gaver, describes "Stochastic modeling: Ideas and Techniques" in detail. First, a review of probabilistic concepts is given; after this, e.g., Bernoulli trials, Poisson processes, Markov processes and renewal-theoretic modeling are presented. This chapter closes with some additional modeling topics.

Chapter II, written by H. Kobayashi, deals with "Stochastic modeling: Queueing models." First, discrete time queueing systems are investigated. Several models are described. Then diffusion approximations in queueing analysis is investigated, and, finally, computational algorithms for Markovian queueing networks are given.

Chapter III, written by R. Sedgewick, deals with "Mathematical analysis of combinatorial algorithms." Trees are considered; asymptotic approximations, asymtotics in the complex plane and probabilistic models are discussed.

-D. Kalin
Universität Ulm

Complementary Pivoting on a Pseudomanifold Structure with Applications in the Decision Sciences
By F. J. Gould and J. W. Tolle
Heldermann Verlag, Berlin, 1983

A unified framework is presented in the book in which the so-called complementary pivoting algorithms can fit. Contrary to the standard analytical algorithms, such as the simplex algorithm or a gradient algorithm, a complementary pivoting algorithm is a combinatorial method which does not proceed by generating a monotone sequence of approximate solutions to the underlying problem. Instead of that, a complementary pivoting algorithm labels each element in a collection of sets of n elements, e.g. indices or vertices of simplices of a triangulation (so that each subset of n-1 elements of a set is contained in at most one other set of n elements) with an integer out of the set [1,...,n] s.t. a completely labelled set whose n elements are differently labelled yields an approximate solution to the underlying problem.

Starting from an a priori known subset of n-1 differently labelled elements contained in only one set of n elements or from an artificial completely labelled set of n elements the algorithm generates in general by complementary pivoting a unique path of adjacent sets of which the common elements are differently labelled until a completely labelled set of n elements is found. Conditions on the underlying problem must guarantee the finite termination of the algorithm. The description of the several possibilities of a path is given in a very clear way.

The complementary pivoting algorithm is applied to solve the linear complementarity problem (LCP) to approximate fixed points of continuous functions and of upper semi-continuous point-to-set mappings, and to find approximate solutions for unconstrained non-differentiable minimization and non-differentiable programming. In almost all applications the problem is piecewise linearized with respect to a triangulation and the corresponding problem is solved by the complementary pivot algorithm. When the accuracy of the approximating solution found by the algorithm is not sufficient, the algorithm is restarted in the approximate solution with a triangulation having a smaller mesh in order to increase the accuracy. The accuracy of an approximate solution is discussed in detail.

The authors succeed in presenting in clear and simple terms a unifying exposition of complementary pivot theory. Moreover, the reader gets a good idea how this theory can be applied to solve many highly non-linear problems arising in the decision sciences. Extensive references to earlier work on these problems are given and each chapter is concluded with interesting exercises.

- A. J. J.Talman
Tilburg University

Convex Analysis: An Introductory Text
By Jan van Tiel
John Wiley, Chichester, 1983

This book gives a nice introduction into the theory of convex sets and convex functions in finite and in infinite-dimensional spaces. It is suitable for either self-study or for classroom work at the undergraduate level for students whose mathematical background includes the basic facts of calculus, linear algebra, and some basic material from general topology and functional analysis.

The book is written in a clear, easily readable style. The basic concepts and the characteristic methods of classical convex analysis (such as separation, subgradient, conjugate function, convex optimization) are developed step by step and presented in a self-contained approach. A large number of exercises at the end of each chapter (with hints and answers at the end of the book) helps understand the concepts employed. Some historical remarks and additional material related to that covered in the text are collected in bibliographical notes. These notes should be useful to the interested reader for further study. The book is organized as follows: Chapter 1 summarizes the essentials of the theory of convex functions on the real line. Algebraic properties of convex sets in a linear space are studied in chapter 2. Chapters 3 and 4 develop the theory of separation in a linear space and in R^n, respectively. Chapter 5 studies convex functions on a linear space. The concept of duality for convex functions is introduced in chapter 6, and chapter 7 presents some basic facts from convex optimization (such as Kuhn-Tucker conditions and Fenchel's duality theorem).

- J. Zowe
Universitat Bayreuth

Nonlinear Programming - Theory, Algorithms and Applications
By G.P. McCormick
John Wiley, New York, 1983

As a rule the books on optimization in finite dimensional spaces concentrate either on theory or on algorithms and rarely treat adequately the construction of optimization models. A distinguishing feature of McCormick's book consists of harmonizing theoretical and numerical aspects with mathematical modeling.

The book provides a rigorous development of first and second order optimality conditions, up-to-date treatment of algorithms for single-variable, unconstrained n-variable, linearly constrained and nonlinearly constrained problems together with carefully chosen and elaborated mathematical models of real world problems that can be solved by nonlinear programming

methodology. It contains several topics not usually covered in books on nonlinear programming. The most notable example is a chapter on a computationally-oriented way of representing nonlinear functions of several variables intended to provide the interface between computer-coded algorithms and the algebraic representation of nonlinear programming problems.

To summarize, the book gives a balanced up-to-date treatment of various aspects of optimization in finite dimensional spaces with a certain emphasis on the numerical aspects. It represents a valuable addition to the existing literature on the subject.

-M. Vlach
Charles University, Prague

Nonlinear Optimization in R^n
By H. Th. Jongen, P. Jonker and F. Twilt
Peter Lang, Frankfurt - Bern - New York, 1983

Among various approaches to the theory of nonlinear optimization this seems to be the first textbook attempt of a systematical use of topological methods. In particular, Morse theory is applied in order to study critical points of differentiable functions on differentiable manifolds in R^n.

After an introduction into the basic concepts of optimization, Morse theory, and some notions of general topology and matrix theory, real valued C^r-functions f on R^n are studied, the focus being on the connnection between the existence and number of critical points and the behavior of the lower level sets of f.

In Chapter 3 differentiable functions on differentiable manifolds with generalized boundaries are studied under the same aspects. An important class of such manifolds are so-called regular constraint sets. So the theory being developed in this chapter can be applied immediately to nonlinear optimization problems and gives a considerable insight into their topology features.

In Chapter 4 an application of Morse theory is made to certain Chebychev approximation problems.

The final chapter of the book is devoted to the description of a singular homology theory and its application to the study of critical points of differentiable functions on differentiable manifolds. The primary aim of the authors as expressed in the preface is to give a good insight into nonlinear phenomenae of optimization. This aim has been achieved by a very clear and concise representation of the subject and by various geometrical illustrations which help to understand better the underlying ideas.

- W. Krabs
Technical University, Darmstadt

Advances in Data Base Theory, Volume 2
By H. Gallaire, J. Mincker and J. -M. Nicolas
Plenum Press, New York, 1984

This book includes 13 of the most interesting and reviewed papers of the 27 talks given at the 3rd 'Workshop on Logical Bases for Data Bases' held in Toulouse (France), December 14 - 17, 1982. The papers cover different topics in database theory reflected in the several chapters of the proceedings: database scheme design, integrity constraints, incomplete information, abstract datatypes for formal specifications and views, and query language theory. These papers are discussed briefly below in the same sequence as in the proceedings.

The major part of the proceedings is the section on database scheme design which deals mainly with acyclic database schemes that form one of the most interesting aspects in design theory.

Biskup and Bruggemam give a method to design acyclic, synthesized 3NF-database schemes that join the desirable properties of synthesized and acyclic database schemes.

Ausiello, D'Atri, and Moscarini define three different concepts of minimal coverings in a given hypergraph and study the degrees of acyclicity of the associated database schemes as well as the complexity of their determination. Hanatani shows that database schemes described by a single cyclic join dependency are useful, if the database schemes are simple, i.e. there exists an acyclic database scheme satisfying the same multivalued dependencies.

Gyssens and Paredaens introduce a methodology to decompose every decomposable, acyclic and cyclic join dependency into a non-redundant set of smaller cyclic and acyclic join dependencies.

The only paper not dealing with acyclic database schemes is the paper of De Bra and Paredaens. They introduce the concept of horizontical decomposition of relations in contrast to the well-known vertical decomposition of a relation into its projections. Horizontical decompositions are useful to treat exceptions of constraints. This is formalized by defining functional dependencies and two related normal forms.

The second chapter of this book deals with integrity constraints. Henschen et al. propose and justify a method for translating semantical constraints expressed in first order logic into programs for testing a priori the validity of database updates. These programs are generated at design time and they are applied before updating the database.

Paige presents a new approach to improve the enforcement of integrity constraints by finite differencing. He defines a special class of predicates that can be monitored efficiently by differencing.

Casanova and Furtado introduce transition constraints restricting sequences of database states. Several classes of languages based on temperal logic are defined to describe transition constraints, and various results on related decision problems are given.

The third chapter deals with incomplete information. Bossu and Siegel introduce a system of non-monotonic reasoning in order to check the validity of database transactions. It includes integrity rules as well as transaction rules, and it is shown that the presented proof procedure is complete and correct with respect to incomplete information.

Imielinsky favours the bottom-up 'algebraic' method in contrast to the topdown proof theoretic strategy for answering queries in databases with incomplete information. Theorem proving methods are only used for a required refinement of queries, where the extended relational algebra methods yield to an approximation answer. This yields to a two-phase technique for query evaluations.

The fourth chapter deals with abstract data types for formal specifications and views in database system. Veloso and Furtado present a multistep methodology for the formal specification of databases based on the algebraic approach of abstract data structures. The proposed strategy realises a stepwise refinement method, where each step is within a single algebraic formalism itself.

Paolini and Zicary give a precise algebraic model to formalize the relationship of databases and views. Databases as well as views are modeled as algebras, i.e. sets of possible valid states and possible operations. The relationship between databases and

views are expressed by morphisms between both of these classes of abstractions. This provided formalism is used to classify views.

The last chapter on query language theory consists of a single paper of Imielinsky and Lipsky on undecidable equivalence problems for relational expressions. Two versions of relational algebras are considered, and the undecidability of the equivalence and finite equivalence problem for various restricted expressions are shown. These results are minimal in the sense that further restrictions yield to the decidability of the mentioned problems.

- H. Noltemeier, D. Ruland
-Universität Würzburg

Matrix Computations
By G. Golub and C. F. van Loan
North Oxford Academic Publishing Company
Oxford, 1984

This book provides a comprehensive, advanced survey of the field of numerical linear algebra as needed by scientists and engineers working in many different areas. Although modern developments of the lively field are discussed in survey articles and some specializing books are available, the broad and nevertheless in-depth-treatment given will be highly appreciated.

After three short introductory chapters on the necessary background from linear algebra, chapter 4 discusses Gaussian elimination including roundoff error analysis. Chapter 5 on special linear systems is devoted to the question of how to exploit inherent special structures, e.g., positive definitness, bounded systems, block triagonal structure, Vandermonde and Toeplitz systems. Chapter 6 discusses orthogonalization and least squares with special attention to rank deficiency. Chapter 7 addresses the unsymmetric eigenvalue problem and develops in detail the QR algorithm followed by invariant subspace calculations. Further, the QZ algorithm for generalized eigenvalue problems is considered. Chapter 8 covers the symmetric eigenvalue problem. Besides the QR algorithm and its variant for singular value decomposition, some special procedures are described. In view of parallel computing, the Jacobi method is discussed too. Chapters 9 and 10 are devoted to the treatment of large, sparse, symmetric systems. The lanczos method and the conjugate gradient method are presented with applications to linear equations and least squares. Chapters 11 and 12 discuss special problems/applications which can be solved using algorithms from previous chapters. Chapter 11 on functions of matrices discusses eigenvalues, approximation and the matrix exponential. Chapter 12 contains mainly applications of the singular decomposition technique.

Every section of a chapter closes with some exercises and annotated references. A bibliography with more than 400 papers is included.

The book may serve as an advanced text book for preparing courses in numerical linear algebra as well as an up-to-date reference book for research and teaching in areas using matrix computations, e.g., mathematical programming or computational engineering. We highly recommend the book for everyone working on related subjects.

- U. Zimmermann
University of Cologne

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, W. Germany.

JOURNALS & STUDIES

Vol. 30 No. 1

E. Balas and J. B. Mazzola, *"Nonlinear 0-1 Programming: I. Linearization Techniques."*

E. Balas and J. B. Mazzola, *"Nonlinear 0-1 Programming: II. Dominance Relations and Algorithms."*

A. Hordijk and L. C. M. Kallenberg, *"Transient Policies in Discrete Dynamic Programming: Linear Programming Including Suboptimality Tests and Additional Constraints."*

M. J. Best, *"Equivalence of Some Quadratic Programming Algorithms."*

J. Beck and J. Spencer, *"Integral Approximation Sequences."*

L. Nazareth, *"An Alternative Variational Principle for Variable Metric Updating."*

P. T. Harker, *"A Variational Inequality Approach for the Determination of Oligopolistic Market Equilibrium."*

Mustafa Akgül, *"On Polyhedral Extension of Some LP Theorems."*

Vol. 30 No. 2

U. Passy and E. Z. Prisman, *"Conjugacy in Quasi-Convex Programming."*

J.-L. Goffin, *"Variable Metric Relaxation Methods, Part II: The Ellipsoid Method."*

M. Fukushima, *"A Descent Algorithm for Non-Smooth Convex Optimization."*

P. E. Gill, N. I. M. Gould, W. Murray, M. A. Saunders, and M. H. Wright, *"Weighted Gram-Schmidt Method for Convex Quadratic Programming."*

G. van der Laan and L. P. Seelen, *"Efficiency and Implementation of Simplicial Zero Point Algorithms."*

J. Mandel, *"Convergence of the Cyclical Relaxation Method for Linear Inequalities."*

D. M. Topkis, *"Adjacency in Polymatroids."*

J.-Ch. Pomerol, *"A Note on Limiting Infisup Theorems."*

Technical Reports & Working Papers

Stichting Mathematisch Centrum
Kruislaan 413 1098 SJ Amsterdam
Postbus 4079 1009 AB Amsterdam
THE NETHERLANDS

E. A. van Doorn, *"On Orthogonal Polynomials on a Half Line and the Associated Kernel Polynomials,"* BW 182.

E. A. van Doorn, *"Some Analytical Aspects of the Peakedness Concept,"* BW 183.

G. Picci and J. H. van Schuppen, *"On the Weak Finite Stochastic Realization Problem,"* BW 184.

H. Hazewinkel, J. H. Lewis and C. Martin, *"Symmetric Systems with Semi-Simple Structure Algebra: The Quarternionic Case,"* BW 185.

E. A. van Doorn, *"Connectivity of Circulant Digraphs,"* BW 186.

P. S. Krishnaprasad, S. I. Marcus and M. Hazewinkel, *"Current Algebras and the Identification Problem,"* BW 187.

J. K. Lenstra and A. H. G. Rinnooy Kan, *"Scheduling Theory Since 1981: An Annotated Bibligraphy,"* BW 188.

G. A. P. Kindervater and J. K. Lenstra, *"Parallel Algorithms Optimization: An Annotated Bibligraphy,"* BW 189.

E. A. van Doorn, *"A Note on Delbrouck's Approximate Solution to the Heterogeneous Blocking Problem,"* BW 190.

J. H. van Schuppen, *"The Weak Stochastic Realization Problem for Discrete-Time Counting Processes,"* BW 191.

J. P. C. Blanc, *"The Relaxation Time of Two Queueing Systems in Series,"* BW 192.

C. van Putten and J. H. van Schuppen, *"Invariance Properties of the Conditional Independence Relation,"* BW 193.

A. Bensoussan and J. H. van Schuppen, *"Optimal Control of Partially Observable Stochastic Systems with an Exponential-of-Integral Performance Index,"* BW 194.

University of Bonn
Department of Operations Research
Nassestr. 2
D-5300 Bonn 1, West Germany

M. Skowronska, M. M. Syslo and C. Zamfirescu, *"An Algorithmic Characterization of Total Digraphs,"* WP 83302-OR.

U. Faigle and R. Schrader, *"Minimizing Completion Time for a Class of Scheduling Problems,"* WP 83303-OR.

B. Korte and L. Lovász, *"Relations Between Subclasses of Greedoids,"* WP 83304-OR.

U. Derigs, *"Über eine Anwendung statistischer Schranken in der kombinatorischen Optimierung,"* WP 83305-OR.

U. Faigle and R. Schrader, *"Zur Maschinenbelegungsplanung unter TNI-geordneten Restriktionen,"* WP 83306-OR.

S. Holm, *"Dual Price Function v. Dual Prices for the Capital Budgeting Problem,"* WP 83307-OR.

U. Faigle and R. Schrader, *"Comparability Graphs and Order Invariants,"* WP 83308-OR.

M. A. Gurgel and Y. Wakabayaschi, *"A Result on Hamilton-Connected Graphs,"* WP 83309-OR.

G. Cornuéjols and W. H. Cunningham, *"Compositions for Perfect Graphs,"* WP 83310-OR.

A. Bachem and W. Kern, *"Adjoints of Oriented Matroids,"* WP 83311-OR.

M. Vlach, *"On the Three-Planar Sums Transportation Polytope,"* WP 83312-OR.

U. Derigs, *"Exchange Properties and K-best Strategies in Combinatorial Optimization,"* WP 83313-OR.

G. Turán, *"On the Greedy Algorithm for an Edge-Partitioning Problem,"* WP 83314-OR.

Technical University Graz
Institut für Mathematik
Kopernikusgasse 24
A-8010 Graz
AUSTRIA

R. E. Burkard and F. Rendl, *"A Thermodynamically Motivated Simulation Procedure for Combinatorial Optimization Problems,"* 83-12.

R. E. Burkard, J. Krarup and P. M. Pruzan, *"Some Relationships Between Multicriteria and Parametric Discrete Optimization Problems with Bottleneck Objectives,"* 83-13.

R. E. Burkard, *"Quadratic Assignment Problems,"* 83-20.

R. A. Cuninghame-Green and R. E. Burkard, *"Eigenfunctions and Optimal Orbits,"* 83-30.

R. E. Burkard, *"Locations with Spatial Interactions - Quadratic Assignment Problems,"* 83-31.

R. E. Burkard, H. W. Hamacher and J. Tind, *"On General Decomposition Schemes in Mathematical Programming,"*

Universita' di Pisa
Dipartimento di Ricerca Operativa
e Scienze Statistiche
Pisa, ITALY

A. Maugeri, *"Applicazioni delle disequazioni variazionali a problemi di traffico su reti,"* 1983, No. 96.

A. Volpentesta, *"Row Circular Matrices and Related Polyedra,"* 1983, No. 97.

A. Cambini, *"Sulla regolarirà nei problemi di estremo vettoriale,"* 1983, No. 98.

P. Favati and M. Pappalardo, *"Sulla reciprocità nei problemi di estremo vettoriale,"* 1983, No. 99.

L. Pellegrini, *"Scomposizione di problemi di estremo vincolato mediante la teoria della dualità,"* 1983, No. 100.

O. Ferrero, *"Sulla convessità della restrizione di una forma quadratica su un poliedro ed alcune applicazioni,"* 1983, No. 101.

G. Giorgi and S. Mititelu, *"Extremum Conditions in Quasi-Convex Programming,"* 1983, No. 102.

GALLIMAUFRY

Alexander H.G. Rinnooy Kan will be spending the fall semester of 1984 at the Sloan School of Management (M.I.T.) and the spring semester of 1985 at the Department of Industrial Engineering and Operations Research at the School of Business Administration of the University of California at Berkeley. . .**H.P. (Paul) Williams** has moved from the Chair of Management Science at Edinburgh University to the Chair of Operational Research at Southhampton University. . .The MP Study based on research papers at the recent NATO ASI (see article, page 2) has a submission deadline of November 15, 1984. Submission is **not** limited to papers from the meeting, but is open to everyone. Title of the Study will be Computational Mathematical Programming. . .**Ralph E. Gomory**, Vice President and Director of Research at IBM, was awarded the John von Neumann Theory Prize by ORSA/TIMS at the May meeting in San Francisco. Dr. Gomory was cited for his contributions in Integer Programming, especially the cutting plane methods and papers on special problems such as the knapsack, traveling salesman, and cutting stock problems.

Deadline for the next OPTIMA is December 1, 1984.

New Superfast LP Method?

The September, 1984 issue of **Science** contains an article by Gina Kolata on a new method for linear programming developed at AT&T Bell Laboratories. According to the article, **Narendra Karmarkar** has developed a polynominal time algorithm which approaches the optimal vertex by creating a sequence of spheres inside the feasible region. Preliminary computational results show the method to be 50 times faster than an IBM code of the simplex method on problems with 5000 viariables.

-D. Hearn

This public document was promulgated at a cost of $426.15 or $0.61 per copy to inform researchers in mathematical programming of recent research results.

OPTIMA
303 Weil Hall
College of Engineering
University of Florida
Gainesville, Florida 32611

FIRST CLASS MAIL

C A L E N D A R

This Calendar lists noncommercial meetings specializing in mathematical programming or one of its subfields in the general area of optimization and applications, whether or not the Society is involved. (The meetings are not necessarily 'open'.) Any one knowing of a meeting that should be listed here is urged to inform Dr. Philip Wolfe, IBM Research 33-2, POB 218, Yorktown Heights, NY 10598, U.S.A; Telephone 914-945-1642, Telex 137456.

Some of these meetings are sponsored by the Society as part of its world-wide support of activity in mathematical programming. Under certain guidelines the Society can offer publicity, mailing lists and labels, and the loan of money to the organizers of a qualified meeting.

Substantial portions of meetings of other societies such as SIAM, TIMS, and the many national OR societies are devoted to mathematical programming, and their schedules should be consulted.

1984

August 27-29: 9th Symposium on Operations Research, Osnabrück, Federal Republic of Germany. Contact: Professor Dr. P. Brucker, Universität Osnabrück, Fachbereich Mathematik, Postfach 4469, D-4500 Osnabrück, F.R.G. Telephone 0541 608 2564. Sponsored by the German Society for Mathematics, Economics, and Operations Research.

September 10-17: 'International Symposium on Stochastic Optimization', Kiev, U.S.S.R. Contact: Professor Andrzej Wierzbicki, International Institute for Applied Systems Analysis, A-2361 Laxenburg, Austria. Telephone 02236 71521, Telex 079137 iiasa a. Cosponsored by the Society through the Committee on Stochastic Programming.

October 10-12: Symposium on Multi-objective Optimization, University of Nebraska-Lincoln, Nebraska, U.S.A. Contact: Ann Bleed, 310 Agricultural Hall, University of Nebraska, Lincoln, NE 68583. Telephone 402-472-3305.

October 11-12: Fifth Mathematical Programming Symposium Japan, Fukuoka, Kyushu, Japan. Recent Topics in Mathematical Programming, Stochastic Programming, and Applications. Contact: Professor Masao Iri (General Chairman), Faculty of Engineering, University of Tokyo, Bunkyo-ku, Tokyo 113, or Professor Nasata Furukawa (Program Chairman), Department of Mathematics, Kyushu University, Fukuoka 812, Japan.

December 12-14: 23d IEEE Conference on Decision and Control, Las Vegas, Nevada, U.S.A. Contact: Abraham Haddad, School of Electrical Engineering, Georgia Institute of Technology, Atlanta, GA 30332, U.S.A. Telephone 404-894-3930.

1985

June 11-14: 5th IFAC Workshop on Control Applications of Nonlinear Programming and Optimization, Capri, Italy. Contact: Professor G. Di Pillo, Dipartimento di Informatica e Sistemistica, Università degli Studi di Roma 'La Sapienza', Via Eudossiana 18, 00184 Roma, Italy. Telephone (39) 6-484441.

August 5-9: Twelfth International Symposium on Mathematical Programming in Cambridge, Massachusetts, U.S.A. Contact: Professor Jeremy Shapiro, Sloan School of Management, Massachusetts Institute of Technology, Cambridge, MA 02139, U.S.A. Telephone 617-253-7165. Official triennial meeting of the MPS.

Application for membership

Mail to: MATHEMATICAL PROGRAMMING SOCIETY, INC.
c/o International Statistical Institute
428 Prinses Beatrixlaan
2270 AZ Voorburg, The Netherlands

Cheques or money orders should be made payable to The Mathematical Programming Society, Inc. in one of the currencies indicated below.

My subscription(s) is (are) for my personal use and not for the benefit of any library or other institution.

☐ I wish to enroll as a member of the Society. My dues payment for 1984, which covers subscription to volumes 28-30 of MATHEMATICAL PROGRAMMING is enclosed: Dfl. 94.00 (or $32.00 or £20.00 or Sw.Fr. 68.00 or FF 250.00 or DM 81.00).

☐ As a member of the Society I wish to subscribe to the serial edition of MATHEMATICAL PROGRAMMING STUDIES, volumes 23, 24. Payment is enclosed: Dfl. 20.00 (or $10.00 or £6.25 or Sw.Fr. 22.25 or FF 77.00 or DM 26.00).

Name (printed): . . . . . .Signature: . . . . . .

Mailing address (please print): . . . . . .

. . . . . .

Student Applications: Dues are one-half the above rates. Have a faculty member verify your student status below and send application with dues to the above address.

Faculty verifying status . . . . . .Institution . . . . . .