



OPTIMA

MATHEMATICAL PROGRAMMING SOCIETY NEWSLETTER

January 1984

Number 11

Planning Underway for XII MPS Symposium

Jeremy F. Shapiro, Program Chairman, reports that the planning of activities for the next Symposium is beginning to take shape. The XII International meeting will be held August 5-9, 1985 on the M.I.T. campus, Cambridge, Mass.

A first call for papers will be issued in mid-1984 and the deadline for abstracts will be as late as possible in the Spring of 1985 in order to encourage contributors to present their most recent results. Sessions will be scheduled in all areas of mathematical programming theory, computational implementations, and applications.

Tentative plans call for approximately 10 of the popular state-of-the-art tutorials

delivered by prominent researchers. The tutorials, as at previous symposia, will be scheduled to minimize conflict with regular sessions.

A number of special events will be offered including a banquet in honor of George Dantzig.

Accommodations for participants will be available in M.I.T. dormitories as well as nearby hotels.

For further information contact Jeremy F. Shapiro, Room E40-165, Operations Research Center, Massachusetts Institute of Technology, Cambridge, MA 02139. Telephone 617-253-3603.

Call for Nominations for Society Prizes

Members of the Society are invited to submit nominations for both the Fulkerson Prize in Discrete Mathematics and the Dantzig Prize in Mathematical Programming, which will be awarded at the Twelfth International Symposium.

Papers eligible for the Fulkerson Prize should have been published in a recognized journal during the years 1979-84. The term *discrete mathematics* is intended to include graph theory, networks, mathematical programming, applied combinatorics, and related subjects. The selection committee consists of Alan J. Hoffman, Richard M. Karp (Chairman), and Laszlo Lovasz.

Contributions eligible for this second awarding of the Dantzig Prize must be publicly available and may belong to any aspect of mathematical programming. Some preference is given to the singly-authored work of "younger" researchers. The selection committee consists of Michel Balinski, George Nemhauser, Michael Powell and Roger Wets (Chairman).

For both prizes, letters of nomination, suggestions, and comments are welcome, and may be sent to any member of the appropriate committee by April, 1984.

MP Study to Honor George Dantzig

A special MATHEMATICAL PROGRAMMING STUDY is being planned to honor George B. Dantzig on the occasion of his 70th birthday (November 8, 1984). All topics normally embraced by the journal's editorial policy are eligible for consideration, but preference will be given to those closest to Professor Dantzig's interests. In keeping with established editorial policy, all manuscripts will be refereed. Contributions to this "Festschrift" should be identified as such and submitted in triplicate. For further information contact Richard W. Cottle, Department of Operations Research, Stanford University, Stanford, CA 94305 U.S.A. (Telephone: (415)-497-4032.)



Soviet Mathematicians at Bonn Symposium. This photograph from the XI Mathematical Programming Symposium, August, 1982 shows several prominent Soviet participants. In the foreground (each with a hand on the railing) are N.Z. Shor, W.S. Michalewicz, Kantorovich, and G. Rubinstein.

Climbing Puzzle See Page 8

CONFERENCE NOTES

Recent Matroid Workshop

From August 26 to September 2, 1983 an international workshop on matroids took place at the University of Bielefeld. It was organized by Walter Deuber, Andreas Dress (Bielefeld) and Bernhard Korte (Bonn).

About 40 participants presented surveys and contributed papers on matroids, greedoids and submodular functions. In order to initiate active research, problem sessions and informal discussions were organized during the workshop. This successful conference gave an excellent state of the art of the theory of matroids, its extensions and generalizations, as well as its applications in chemistry and engineering.

- A. Bachem, Bonn

OPTIMIZATION DAYS 1984

May 2-3-4, 1984

Concordia University
Montreal, Quebec

This meeting is jointly organized by Ecole Polytechnique, McGill University, Concordia University, the Université de Montréal, Ecole des Hautes Etudes Commerciales and Université du Québec à Montréal.

"Optimization Days" is an annual conference specializing in recent developments in Optimization Methods and Control Theory. Its aim is the interaction between theory and various areas of applications. Topics of interest include (but are not restricted to): Mathematical Programming; Optimal Control Theory; Numerical Methods of Optimization; Systems Theory, including Large Scale Systems; Statistical Methods; Estimation and Identification, as well as Applications to Engineering, Management Sciences, Transportation, Economics, Urban and Environmental Problems, Resource Management, Biology, etc.

Sessions will consist of invited and contributed talks. Papers presenting original developments as well as those of expository nature will be considered.

A 200-700 word summary (either in English or in French) which clearly defines the content of the paper should be forwarded by January 31, 1984 to: G. Pederzoli or C. L. Sandblom, Department of Quantitative Methods, Concordia University, 7141 Sherbrooke Street West, Montréal, Québec H4B 1R6, Canada.

Combinatorial Workshop

Bonn, West Germany

June 11-16, 1984

This Vth Bonn Workshop on Combinatorial Optimization is devoted primarily to recent research in the area of discrete optimization and related topics (graph theory, matroids, polyhedral combinatorics, analysis of algorithms, etc.).

The program committee consists of A. Bachem (Bonn), A. Frank (Budapest), M. Grötschel (Augsburg), and Co-Chairman B. Korte (Bonn), and L. Lovász (Budapest).

For further information, please write to U. Faigle, Bonn Workshop, Institut für Operations Research, Nassestr. 2, D-5300 Bonn 1, West Germany.

SIAM Conference on Numerical Optimization

June 12-14, 1984

Boulder, Colorado

On June 12-14, 1984 SIAM will conduct a conference on numerical optimization at the Broker Inn, Boulder, Colorado, on the edge of the University of Colorado campus. The conference will address computational aspects of nonlinear optimization including unconstrained problems; problems with nonlinear, linear, equality and inequality constraints; nonlinear least squares; and general nonlinear systems of equations. Topics to be emphasized are mathematical software for optimization, techniques for dealing with nonlinear constraints, and algorithms for finding global extrema.

Invited presentations will include "Issues in Computational Testing" by David M. Gay (Bell Laboratories), "Design and Implementation of Optimization Codes" by Walter Murray (System Optimization Laboratory, Stanford University), "The Degradation of Constrained Optimization Codes on Difficult Problems" by Michael J. D. Powell (Cambridge), "Methods for Nondifferentiable Optimization" by Andrew R. Conn (Waterloo), "Penalty Functions for Constrained Optimization" by Roger Fletcher (Dundee), "Recent Developments in GRG and SLP Algorithms" by Leon S. Lasdon (Texas), "Stochastic Methods for Global Optimization" by Alexander H. G. Rinnooy-Kan (Erasmus), "A 'Tunneling' Algorithm for Global Optimization" by Alejandro Velasco Levy (University of Mexico).

Contributions (200 words or less)

should be submitted on a SIAM abstract form available from SIAM, 117 South 17th Street, Suite 1405, Philadelphia, PA 19103 (telephone 215-564-2929). Abstract deadline: February 1, 1984. SIAM plans to publish a proceedings of the conference consisting of the papers of the invited speakers and a selection of the contributed papers.

A short course on current methodologies in numerical optimization will be conducted on June 11. It will provide an overview of the state-of-the-art in numerical optimization specifically for users of optimization techniques and for applied mathematicians desiring an introduction to the field. In particular, it will focus on two principal topics of the conference-optimization software and nonlinear constraints. The course will be conducted by Paul T. Boggs (National Bureau of Standards) and Robert B. Schnabel (University of Colorado).

9th Symposium on Operations Research

Universitat Osnabrück

August 27-29, 1984

The 9th Symposium on Operations Research is the annual meeting of the German Society for Mathematics, Economics and Operations Research. It will give to theoretical and practical specialists in Operations Research, Mathematical Economics and related topics an opportunity to discuss problems and to present their recent results of their field of research.

Topics of the Symposium include: Nonlinear Optimization, Linear and Discrete Optimization, Interface with Computer Science, Mathematical Economics and Equilibrium Theory, Stochastics, Statistics, Econometrics, Optimal Control Theory, Game Theory, and Applications in Management. For further information please write to the address below, before February 15, 1984.

Presentation of contributed papers is limited to twenty minutes. If you intend to present a paper, please obtain further information before sending an abstract. Since abstracts will be published in advance, the deadline for submission of them will be June 15, 1984. All accepted papers will be published in a proceedings volume. Contact:

Prof. Dr. P. Brucker, Universität Osnabrück
Fachbereich Mathematik, Postfach 44 69 D
4500 Osnabrück, West Germany.

Technical Reports & Working Papers

Cornell University
School of Operations Research
and Industrial Engineering
Upson Hall
Ithaca, NY 14853

- L. Schruben and D. Goldsman, "Asymptotic Properties of Some Confidence Interval Estimators for Simulation Output," TR 544.
- W. Vervaat, "Sample Path Properties of Self-Similar Processes with Stationary Increments," TR 545.
- N. U. Prabhu and C.M. Harris, "Stochastic Comparison of Single Server Queues," TR 546.
- M. Todd, "Complementarity in Oriented Matroids," TR 547.
- J. Muckstadt, "A Multi-Echelon Model for Indentured Consumable Items," TR 548.
- R. Smith and H. Taylor, "Models for Fiber-Matrix Composites with Local Load Sharing," TR 549.
- W. Vervaat and G. O'Brien, "Marginal Distributions of Self-Similar Processes with Stationary Increments," TR 550.
- G. Chang and G. Nemhauser, "Covering, Packing and Generalized Perfection Processes with Stationary Increments," TR 551.
- C. Jennison, "Equal Probability of Correct Selection for Certain Bernoulli and Multinomial Selection Procedures," TR 552.
- N. U. Prabhu, "Wiener-Hopf Factorization of Markov Semigroups - I. The Countable State Space Case," TR 553.
- L. E. Trotter, Jr. and O. Marcotte, "An Application of Matroid Polyhedral Theory to Unit-Execution Time, Tree-Precedence Job Scheduling," TR 554.
- J. Bloom, "Long Range Generation Planning with Limited Energy and Storage Plants - Parts I and II," TR 557.
- L. Billera, "Polyhedral Theory and Commutative Algebra," TR 559.
- R. Bechhofer and T. Frisardi, "A Monte Carlo Study of the Performance of a Closed Adaptive Sequential Procedure for Selecting the Best Bernoulli Population," TR 560.
- W. Maxwell and J. Muckstadt, "Establishing Consistent and Realistic Reorder Intervals in Production-Distribution Systems," TR 561.
- J. Muckstadt, M. Lambrecht and R. Luyten, "Protective Stocks in Multi-Stage Production Systems," TR 562.
- T. Mitchell and B. Turnbull, "A Computer Program for the Statistical Analysis of Disease Prevalence Data from Survival/Sacrifice Experiments," TR 564.
- M. Todd, "Linear and Quadratic Programming in Oriented Matroids," TR 565.
- M. Taqqu and J. Levy, "Using Renewal Processes to Generate Long-Range Dependence and High Variability," TR 566.
- R. Bechhofer and A. Tamhane, "Optimal Sample Size Allocation for Selecting the Best of Several Normal Populations with Known, Unequal Variances," TR 567.
- M. Todd, "Quasi-Newton Updates in Abstract Vector Spaces," TR 569.
- P. Jackson, "What to do Until Your Ship Comes In: Ship Up to S Allocation Policies in a Two-Echelon Distribution System," TR 570.
- A. Tamhane, "Some Sequential Procedures for Selecting the Better Bernoulli Treatment Using a Matched Samples Design," TR 571.
- C. Jennison and B. Turnbull, "Repeated Confidence Intervals for Group Sequential Clinical Trials," TR 572.
- A. Mandelbaum and M. Taqqu, "Invariance Principle for Symmetric Statistics," TR 573.
- A. Tamhane, "Data Reconciliation and Gross Error Detection in Chemical Process Networks," TR 574.
- T. Santner and R. Tenga, "Testing Goodness-of-Fit to the Increasing Failure Rate Family," TR 575.
- G. O'Brien and W. Vervaat, "Self-Similar Processes with Stationary Increments Generated by Point Processes," TR 576.
- T. Santner and R. Tenga, "Testing Goodness-of-Fit to the Increasing Failure Rate Family with Censored Data," TR 577.

- P. Jackson, "Measurable Extreme Point Strategies in Markov Decision Processes," TR 578.
- P. Jackson, W. Maxwell and J. Muckstadt, "The Joint Replenishment Problem with a Powers-of-Two Restriction," TR 579.
- R. Bechhofer, C. Dummett and A. Tamhane, "Multiple Comparisons and Subset Selection with Respect to a Control: Optimal Allocations of Observations and Two-Stage Procedures with Associated Tables," TR 583.
- M. Todd, "Solutions to Certain Matrix Optimization Problems," TR 584.
- C. Jones, P. Domich, W. Maxwell and J. Dill, "Scheduling with Interactive Computer Graphics," TR 585.
- W. Lucas, "Game Theory and Accounting," TR 586.
- W. Lucas, "Game Theory and Productivity," TR 587.
- G. Chang and G. Nemhauser, "Graphs with K-Balanced Closed Neighborhood Matrices," TR 588.
- M. Todd, "J: A New Triangulation of R^n ," TR 589.

Stichting Mathematisch Centrum
Kruislaan 413 1098 SJ Amsterdam
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- J. K. Lenstra, A. H. G. Rinnooy Kan and P. van Emde Boas, "An Appraisal of Computational Complexity for Operations Researchers," BW 159.
- H. Nijmeijer, "Observability of Autonomous Discrete-Time Nonlinear Systems: A Geometric Approach," BW 160.
- J. C. P. Bus, "A Differential Geometric Approach to Optimal Control," BW 161.
- H. Nijmeijer, "Invertibility of Affine Nonlinear Control Systems: A Geometric Approach," BW 162.
- A. W. J. Kolen, "Solving Covering Problems and the Uncapacitated Plant Location Problem on Trees," BW 163.
- J. H. van Schuppen, "The Strong Finite Stochastic Realization Problem; Preliminary Results," BW 164.
- A. J. Hoffman, A. W. J. Kolen and M. Sakarovitch, "Totally-Balanced and Greedy Matrices," BW 165.
- J. Labetoulle, E. L. Lawler, J. K. Lenstra, e.a., "Preemptive Scheduling of Uniform Machines Subject to Release Dates," BW 166.
- J. H. van Schuppen, "Adaptive Stochastic Filtering Problems; the Continuous Time Case," BW 167.
- A. Marchetti Spaccamela, A. H. G. Rinnooy Kan and L. Stougie, "Hierarchical Vehicle Routing Problems," BW 168.
- H. Nijmeijer, "Feedback Decomposition of Nonlinear Control Systems," BW 169.
- J. K. Lenstra and A. H. G. Rinnooy Kan, "Two Open Problems in Precedence Constrained Scheduling," BW 170.
- H. Nijmeijer, "The Triangular Decoupling Problem for Nonlinear Control Systems," BW 171.
- J. P. C. Blanc, "Asymptotic Analysis of a Queueing System with a Two-Dimensional State Space," BW 172.
- E. A. van Doorn, "On Oscillation Properties and the Interval of Orthogonality of Orthogonal Polynomials," BW 173.
- E. A. van Doorn, "Conditions for Exponential Ergodicity and Bounds for the Decay Parameters of a Birth-Death Process," BW 174.
- J. C. P. Bus, "The Lagrange Multiplier Rule on Manifolds and Optimal Control of Nonlinear Systems," BW 175.
- J. H. van Schuppen, "Convergence Results for Continuous-Time Adaptive Stochastic Filtering Algorithms," BW 176.
- J. B. G. Frenk, A. H. G. Rinnooy Kan and L. Stougie, "A Hierarchical Scheduling Problem with a Well-Solvable Second Stage," BW 177.
- M. Hazewinkel, S. I. Marcus and H. J. Sussman, "Nonexistence of Finite Dimensional Filters for Conditional Statistics of the Cubic Sensor Problem," BW 178.

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E. A. van Doorn, "A Note on the Overflow Process from a Finite Markovian Queue," BW 179.

J. K. Lenstra, A. H. G. Rinnooy Kan and L. Stougie, "A Framework for the Probabilistic Analysis of Hierarchical Planning Systems," BW 180.

J. C. P. Bus, "The Infinite Horizon Optimal Control Problem on Manifolds," BW 181.

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Laboratoire de Calcul
59655 Villeneuve d'Ascq, Cedex, France

P. Huard, "A General Reduced Gradient Algorithm," ANO 112.

Systems Optimization Laboratory
Department of Operations Research
Stanford University
Stanford, CA 94305

P.G. Abrahamson, "A Nested Decomposition Approach for Solving Staircase Linear Problems," SOL 83-4.

S. T. McCormick, "A Combinatorial Approach to Some Sparse Matrix Problems," SOL 83-5.

P.E. Gill, W. Murray, M.A. Saunders and M.H. Wright, "Documentation for FCALC and FDCORE," SOL 83-6.

P.E. Gill, W. Murray, M.A. Saunders and M.H. Wright, "User's Guide for SOL/QPSOL: A Fortran Package for Quadratic Programming," SOL 83-7.

M.N. Broadie, "Computational Experience with the Octahedral Algorithm and Related Results," SOL 83-8.

M.N. Broadie, "Octasolv User's Guide," SOL 83-9.

A.N. Rosenberg, "Numerical Solution of Systems of Simultaneous Polynomial Equations," SOL 83-10.

B.C. Eaves, "Subdivisions from Primal and Dual Cones and Polytopes," SOL 83-11.

P.E. Gill, W. Murray, M.A. Saunders and M.H. Wright, "User's Guide for SOL/NPSOL: A Fortran Package for Nonlinear Programming," SOL 83-12.

M.N. Broadie and R.W. Cottle, "A Note on Triangulating the 5-Cube," SOL 83-13.

M.N. Broadie, "Subdivisions and Antiprisms for PL Homotopy Algorithms," SOL 83-14.

M.N. Broadie, "A Theorem About Antiprisms," SOL 83-15.

B. Avi-Itzhak and P.H. McAllister, "The Commercial Buildings Energy Services Model of the Pilot System," SOL 83-16.

G. B. Dantzig, A. J. Hoffman, and T. C. Hu, "Triangulations (Tilings) and Certain Block Triangular Matrices," SOL 83-17.

K.M. Anstreicher, "Generation of Feasible Descent Directions in Continuous Time Linear Programming," SOL 83-18.

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F.A. Al-Khayyal, "Linear, Quadratic, and Bilinear Programming Approaches to the Linear Complementarity Problem," School of Industrial and Systems Engineering Report Series No. J-83-5.

F.A. Al-Khayyal, "An Implicit Enumeration Procedure for Solving All Linear Complementarity Problems," School of Industrial and Systems Engineering Report Series No. J-83-7.

J. J. Bartholdi, III, L. K. Platzman, R. L. Collins and W. H. Warden, III, "A Minimal Technology Routing System," PDRC 83-01, School of Industrial and Systems Engineering.

J. J. Bartholdi, III and L. K. Platzman, "Spacefilling Curves and Routing Problems in the Plane," PDRC 83-02, School of Industrial and Systems Engineering.

J.J. Bartholdi, III and L.K. Platzman, "A Fast Heuristic Based on Spacefilling Curves for Minimum-Weight Matching in the Plane," PDRC 83-03, School of Industrial and Systems Engineering.

J.J. Bartholdi, III, L. K. Platzman, R. L. Collins and W. H. Warden, III, "How to Implement a Simple Routing System," PDRC 83-04, School of Industrial and Systems Engineering.

Y. A. Bozer and J. A. White, "Travel Time Models for Automated Storage/Retrieval Systems," PDRC 82-06, School of Industrial and Systems Engineering.

K.-J. Chung and M.J. Sobel, "Risk-Sensitive Markov Decision Processes," College of Management.

Y. Fathi and C.A. Tovey, "Affirmative Action Algorithms," School of Industrial and Systems Engineering.

M. Goetschalckx and H. D. Ratliff, "Shared Versus Dedicated Storage Policies," PDRC 83-08, School of Industrial and Systems Engineering.

R. J. Graves and L. F. McGinnis, "The Outfit Planning Problem: Production Planning in Shipbuilding," PDRC 82-17, School of Industrial and Systems Engineering.

T.P. Hill and R.P. Kertz, "Stop Rule Inequalities for Uniformly Bounded Sequences of Random Variables," School of Mathematics.

J. J. Jarvis, H. D. Ratliff and D. Y. Su, "Aggregate Production Planning Models for Bethlehem Steel," PDRC 82-21, School of Industrial and Systems Engineering.

J.J. Jarvis and O. Kirca, "A Heuristic for the Pallet Movement Problem in Naval Supply," PDRC 83-10, School of Industrial and Systems Engineering.

J.J. Jarvis and H.D. Ratliff, "System for Closure Optimization Planning and Evaluation (SCOPE)," PDRC 83-06, School of Industrial and Systems Engineering.

R. G. Jeroslow, "The Polynomial Hierarchy and a Simple Model for Competitive Analysis," College of Management and Inst. f. Okon. u. OR, Universitat Bonn.

R. G. Jeroslow and J. K. Lowe, "Experimental Results on the New Techniques for Integer Programming Formulations," College of Management.

D. F. Karney, J. N. Morse and A. Ben-Israel, "Specifying the Systematic Risk of Portfolios: A Closed Form Solution," College of Management Technical Report No. MS-83-3.

L. F. McGinnis, "Project Scheduling with Resource Consideration," PDRC 82-16, School of Industrial and Systems Engineering.

U. Passy and E. Z. Prisman, "Conjugacy in Quasi Convex Programming," College of Management and School of Industrial and Systems Engineering.

U. Passy and E. Z. Prisman, "Duality in Quasi Convex Programming," College of Management and School of Industrial and Systems Engineering.

U. Passy and E. Z. Prisman, "Saddle Function and Min Max Problems: The Quasi Convex-Concave Case," College of Management and School of Industrial and Systems Engineering.

U. Passy and E. Z. Prisman, "Secant Relation vs. Positive Definiteness in Quasi Newton Methods," College of Management and School of Industrial and Systems Engineering.

V. V. Rao and L. F. McGinnis, "Lot Sizing in Acyclic Production Systems: Some Empirical Results," PDRC 83-07, School of Industrial and Systems Engineering.

R. Shonkwiler, "Simulating the Outcome of a Birth and Death Process," School of Mathematics.

M.J. Sobel, "Dynkin's Stopping Game," College of Management.

J.E. Spingarn, "Applications of the Method of Partial Inverses to Convex Programming," School of Mathematics.

J.E. Spingarn, "A Primal-Dual Projection Method for Solving Systems of Linear Inequalities," School of Mathematics.

C.A. Tovey and M.A. Trich, "An $O(m^4d)$ Algorithm for the Maximum Polymatroidal Flow Problem," School of Industrial and Systems Engineering.

C.A. Tovey, "On the Performance of Local Improvement Algorithms," School of Industrial and Systems Engineering.

J. A. White and J. Matson, "The Analysis of Selected Unit Load Storage Systems," PDRC 82-18, School of Industrial and Systems Engineering.

- "Annual Report 1982," WP 83255-OR.
S. Fujishige, "A Decomposition of Distributive Lattices," WP 83256-OR.
W. H. Cunningham, "Minimum Cuts, Modular Functions and Matroid Polyhedra," WP 83257-OR.
U. Faigle, "Matroids on Ordered Sets and the Greedy Algorithm," WP 83258-OR.
S. Fujishige, "Submodular Systems and Related Topics," WP 83259-OR.
U. Faigle, "Integral Matroids and the Greedy Algorithm for Discrete Optimization Problems," WP 83260-OR.
U. Derigs and R. Schrader, "A Short Note on w -Optimal Assignable Sets and Allocation Problems," WP 83261-OR.
U. Faigle, "A Vector Exchange Property of Submodular Systems," WP 83262-OR.
U. Derigs, "Solving Matching Problems via Shortest Path Techniques," WP 83263-OR.
F. Barahona, M. Groetschel and A. R. Mahjoub, "Facets of the Bipartite Subgraph Polytope," WP 83264-OR.
U. Derigs and B. Huenten, "Magic Graphs - A New Characterization," WP 83265-OR.
S. Fujishige, "A System of Linear Inequalities with a Submodular Function," WP 83266-OR.
U. Derigs, "Efficiency and Time-Cost-Tradeoffs in Transportation Problems," WP 83267-OR.
F. Harary, E. Kolasinska and M. M. Syslo, "Cycle Basis Interpolation Theorems," WP 83268-OR.
U. Faigle, "Orthogonal Sets, Matroids, and Theorems of the Alternative," WP 83269-OR.
R. G. Jeroslow and J. Lowe, "Modelling with Integer Variables," WP 83270-OR.
F. Barahona and A. R. Mahjoub, "On the Cut Polytope," WP 83271-OR.
R. G. Jeroslow, "The Polynomial Hierarchy and a Simple Model for Competitive Analysis," WP 83272-OR.
F. Barahona, "On Some Weakly Bipartite Graphs," WP 83273-OR.
B. Korte and L. Lovász, "Shelling Structures, Convexity and a Happy End," WP 83274-OR.
A. Bachem and W. Kern, "Polyhedral Theory in Oriented Matroids," WP 83275-OR.
U. Derigs, "On Three Basic Methods for Solving Bottleneck Transportation Problems," WP 83276-OR.
R. Schrader, "The Ellipsoid Method and Its Implications," WP 83277-OR.
B. Korte and L. Lovász, "Posets, Matroids and Greedoids," WP 83278-OR.
M. M. Syslo, "Series-Parallel Graphs and Depth-First Search Trees," WP 83279-OR.
U. Derigs, "On the Use of Confidence Limits for the Global Optimum in Combinatorial Optimization Problems," WP 83280-OR.
U. Faigle and B. Sands, "A Size-Width Inequality for Distributive Lattices," WP 83281-OR.
U. Faigle, "On Ordered Languages and the Optimization of Linear Functions by Greedy Algorithms," WP 83282-OR.
S. Fujishige, "A Characterization of a Base Polyhedron Associated with a Submodular System," WP 83283-OR.
U. Faigle, "A Construction for Strongly Greedy Ordered Sets," WP 83284-OR.
B. Korte and L. Lovász, "Greedoids and Linear Objective Functions," WP 83285-OR.
F. Barahona and W. H. Cunningham, "A Submodular Network Simplex Method," WP 83286-OR.
C. E. Blair and R. G. Jeroslow, "Extensions of a Theorem of Balas," WP 83287-OR.
M. M. Syslo, "Minimizing the Jump Number for Ordered Sets: A Graph-Theoretic Approach," WP 83288-OR.
U. Derigs, "An Efficient Dijkstra-Like Labelling Method for Computing Shortest Odd/Even Paths," WP 83289-OR.
R. G. Jeroslow and J. Lowe, "Experimental Results on the New Techniques for Integer Programming Formulations," WP 83290-OR.
M. M. Syslo, "On Two Problems Related to the Travelling Salesman Problem on Halin Graphs," WP 83291-OR.
U. Derigs, "Alternate Strategies for Solving Bottleneck Assignment Problems," WP 83292-OR.
U. Derigs, "A Short Note on the 'Near Equivalence' of Two Partition Strategies for Determining the Set of k Best Solutions of a Combinatorial Optimization Problem," WP 83293-OR.
M. M. Syslo, "NP-Complete Problems on Some Tree-Structured Graphs: A Review," WP 83294-OR.
U. Derigs, "Some Basic Exchange Properties in Combinatorial Optimization and Their Application to Constructing the k Best Solutions," WP 83295-OR.
M. M. Syslo, "A Solvable Case of the Set Partitioning Problem," WP 83296-OR.
U. Faigle, G. Gierz and R. Schrader, "Algorithmic Approaches to Setup Minimization," WP 83297-OR.
G. Turan, "The Critical Complexity of Graph Properties," WP 83298-OR.
G. Turan, "On Models of Computation for Graph Theoretic Problems," WP 83299-OR.
B. Korte and L. Lovász, "Polymatroid Greedoids," WP 83300-OR.

Call for Papers

Mathematical Programming Study on Probabilistic Analysis of the Simplex and Related Methods

Papers are solicited for a Mathematical Programming Study on the topic mentioned above. We are looking for papers that deal with the probabilistic analysis of the simplex method, its variants and homotopy methods like Lemke's algorithm and complementary pivoting methods of fixed point theory. Also, papers dealing with random polytopes and their statistical properties, as well as a probabilistic or statistical analysis of the pivoting process are also welcome. Please submit your contributions to one of us listed below:

Professor R. Saigal
Department of Industrial Engineering
and Management Sciences
Northwestern University
Evanston, IL 60201

Professor Ilan Adler
Department of Industrial Engineering
and Operations Research
University of California
Berkeley, CA 94720

A Fortran Subroutine for Quadratic Programming

M. J. D. Powell (DAMTP, Silver Street, Cambridge CB3 9EW, England) will be pleased to send to any member of the Mathematical Programming Society a listing of a Fortran subroutine that he developed recently. It applies the Goldfarb and Idnani algorithm (Math. Prog., Vol. 27, p. 1, 1983) for convex quadratic programming, it includes some iterative refinement to give good accuracy, it has 401 instructions and no auxiliary routines, but it is only suitable for small problems because all matrices are treated as full.

- M. J. D. Powell

Redundancy in Mathematical Programming
by H. Karwan, V. Lotfi, J. Telgen, S. Zionts
Lecture Notes in Economics and Mathematical Systems, Vol. 206
Springer-Verlag
Berlin, Heidelberg, New York, Tokyo 1983

Redundancy Theory mainly deals with constraints, in problem formulations, that may be removed without affecting the set of solutions of the problem. There are two aspects of redundancy that attracted the interest of researchers. Redundancy can be an indicator for overcapacity in some sense, and therefore its detection could lead to savings by alternative use of this free capacity. However this possibility becomes evident anyway when solving the problem, being indicated by positive slacks of some constraints. The other aspect is a computational one. It was believed that a notable amount of solution time can be saved by first removing redundancy from a problem. But in most cases the computational effort to detect redundancy is greater than the saving from the reduction of problem size. This book provides an exhaustive definition and description of redundancy in mathematical programming, its causes, as well as its possible consequences. Some theory concerning redundancy in linear programming is presented in an easily readable way. The initial reader will find it a convenient introduction.

In the following ten chapters the original approaches of several authors are presented, dealing with methods to detect and remove redundancy from linear programming problems. Aspects of some of these are extended to integer programming or nonlinear programming. All these methods are classified with respect to some criteria such as capability to find all redundancy in a problem or the possibility to determine whether a particular constraint is redundant or not.

In Chapter 13 the authors describe the implementation of some of these methods and two sets of test problems, the first consisting of 30 small randomly generated LP's, while the second contains thirteen structured problems of moderate size (96 constraints, 79 variables at most). In the following two chapters the behaviour of the programmed methods when solving the test problems is reported. Not only a summary of solution times is given, but also the amount of identified constraints is visualized as a function of solution time for the several methods. Thereby comparisons of the efficiencies of these methods versus time are achieved. The application of statistical tests to some hypotheses seems somewhat strange because of the small number of examples involved.

In Chapters 16, 17 the authors propose and test three methods for redundancy handling that arose from their computational experience with the above methods. Indeed an improved behaviour of these compound methods was found.

The description of the methods as well as proofs are written in an understandable way such that initial readers will be able to follow it without great problems. Practitioners will possibly miss more elaborate considerations about the value of redundancy-checking at all, if one is not interested in the structural aspect of redundancy, but only in a quick solution of a linear program.

-F. Gotterbarm, University of Bonn

Semi-Infinite Programming and Applications
An International Symposium, Austin, Texas 1981
edited by A. V. Fiacco and K. D. Kortanak
Lecture Notes in Economics and Mathematical Systems, Vol. 215
Springer-Verlag
Berlin, Heidelberg, New York, Tokyo, 1983

In semi-infinite programming the classical fields of linear and non-linear programming are extended to the case of an infinite set of constraints. This is a natural and useful generalization since there are many practical problems with constraints on a continuum. The situation is similar to the familiar case of problems which can be described more suitably by differential equations than by difference equations.

This volume contains 20 selected contributions (from a total of 70) to the Symposium on Semi-Infinite Programming and Applications, which

was held in Austin, Texas, in September 1981. The Symposium was the second international meeting on this subject, the first taking place in Bad Honnef, Germany, in 1978.

The 20 papers of these proceedings are arranged in four parts. Part I on duality theory includes 6 papers, mostly on linear problems, on analogies to the finite theory, and on new phenomena in the infinite case. In part II on algorithmic developments (7 papers) and part III on problem analysis and modelling (4 papers), the origin of semi-infinite problems and their numerical solution are discussed.

The 3 papers in part IV on optimality conditions and variational principles refer to theoretical questions as well as to practical problems.

Since the field of semi-infinite programming is still in an early stage of development, it can be expected that a number of papers from these proceedings will be fundamental for future research. Thus this volume can be considered as an indispensable collection for the expert and as a useful source of information for everyone who is interested in semi-infinite programming.

- W. Wetterling, Enschede

Introductory Combinatorics
by K. P. Bogart
Pitman
Boston, 1983

Bogart's book presents a broad and comprehensive survey on modern combinatorics at an introductory level. Its contents can be divided into three parts.

Part I discusses enumeration problems. Fundamental concepts of combinatorics are introduced in this context in Chapter 1. The enumeration methods which are described include counting the number of equivalence classes of an equivalence relation (Chapter 2), the presentation of the inclusion/exclusion principle, and generating functions (Chapter 3).

Part II covers basic material of graph theory (Chapter 4) and its applications to computer science and operations research problems. Matching, network flow, and matroid problems are combinatorial problems discussed in Chapter 5.

Part III introduces experimental designs and posets. Latin squares, block designs, and - as a generalization of both topics - projective planes are presented (Chapter 6). Chapter 7 introduces posets by looking at various applications and Mobius functions.

The book is highly recommendable as an undergraduate text or for readers who want to extend their combinatorics knowledge by self-study. Many examples and helpful exercise problems make Bogart's book easy to read and to understand.

But since this review appears in a publication of the Mathematical Programming Society, the potential reader of this book should realize that only 40 out of some 400 pages are devoted to combinatorial optimization problems. Hence "Introductory Combinatorics" is not a main reference for this subject (and was probably not intended to be), and readers mainly interested in this topic should choose a different textbook.

- Horst Hamacher, University of Florida

Computer Algebra. Symbolic and Algebraic Computation
edited by B. Buchberger, G. E. Collins, R. Loos with R. Albrecht
Springer-Verlag
Wein, New York, 1982

The book contains excellent articles on symbolic and algebraic computation which form a comprehensive survey of the entire field. The authors of all papers have made the introductions and descriptions of the problems self-contained and precise to assist the uninitiated reader, yet managed to survey the topics fully. The analysis of the algorithms using the notions of computational complexity is a welcome addition to the field. While algebraic computation will remain fairly esoteric as a field (being unclear as to whether it "belongs" to Mathematics or Computer Science), the book does well to bring these articles within the reach of both communities.

- Ravi Kannan, Carnegie-Mellon

Vol. 27 No. 2

- Ge Ren-pu and M. J. D. Powell, "The Convergence of Variable Metric Matrices in Unconstrained Optimization".
- R. G. Jeroslow, "Uniform Duality in Semi-Infinite Convex Optimization".
- A. Buckley and A. LeNir, "QN-Like Variable Storage Conjugate Gradients".
- T. Steihaug, "Local and Superlinear Convergence for Truncated Iterated Projection Methods".
- R. W. Cottle and R. E. Stone, "On the Uniqueness of Solutions to Linear Complementarity Problems".
- J. B. Orlin, "Maximum-Throughput Dynamic Network Flows".
- J. A. Tomlin and J. S. Welch, "Formal Optimization of Some Reduced Linear Programming Problems".

Vol. 27 No. 3

- S. Smale, "On the Average Number of Steps of the Simplex Method of Linear Programming".
- C. B. Garcia and F. J. Gould, "An Application of Homotopy to Solving Linear Programs".
- J. K. Ho and E. Loute, "Computational Experience with Advanced Implementation of Decomposition Algorithms for Linear Programming".
- M. V. Golitschek, U. G. Rothblum, and H. Schneider, "A Conforming Decomposition Theorem, a Piecewise Linear Theorem of the Alternative, and Scalings of Matrices Satisfying Lower and Upper Bounds".
- M. A. Lopez and E. Vercher, "Optimality Conditions for Non-Differentiable Convex Semi-Infinite Programming".
- K. C. Kiwiel, "An Aggregate Subgradient Method for Nonsmooth Convex Minimization".
- J. -P. Crouzeix, J. A. Ferland, and S. Schaible, "Duality in Generalized Fractional Linear Programming".
- M. E. Dyer and J. Walker, "A Note on Bicriterion Programming".

(Journal contents are subject to change by publisher)

Vol. 28 No.1

- G. van der Laan, "On the Existence and Approximation of Zeroes".
- A. Griewank and Ph. L. Toint, "On the Existence of Convex Decompositions of Partially Separable Functions".
- R. Mifflin, "Stationarity and Superlinear Convergence of an Algorithm for Univariate Locally Lipschitz Constrained Minimization".
- J. Dupacova, "Stability in Stochastic Programming with Recourse - Estimated Parameters".
- R. Rhode and R. Weber, "The Range of the Efficient Frontier in Multiple Objective Linear Programming".
- G. Pierra, "Decomposition Through Formalization in a Product Space".
- T. Fujimoto, "An Extension of Tarski's Fixed Point Theorem and its Application to Isotone Complementarity Problems".

Vol. 28 No. 2

- P. Hammer, P. Hansen and B. Simeone, "Roof Duality, Complementarity and Persistency in Quadratic 0-1 Optimization."
- H. Kuhn, Z. Wang and S. Xu, "On The Cost of Computing Roots of Polynomials."
- R. Saigal, "Computational Complexity of a Piecewise Linear Homotopy Algorithm."
- S. Dafermos and A. Nagurney, "Sensitivity Analysis for The Asymmetric Network Equilibrium Problem."
- J. Borwein and J. Nieuwenhuis, "Two Kinds of Normality in Vector Optimization."
- Y. Yamamoto, "A Unifying Model Based on Retraction for Fixed Point Algorithms."
- S. Martello and P. Toth, "Worst-Case Analysis of Greedy Algorithms for the Subset-Sum Problem."
- R. Giese and P. Jones, "An Economic Model of Short-Rotation Forestry."
- M. Fisher and A. Krieger, "Analysis of a Linearization Heuristic for Single-Machine Scheduling to Maximize Profit."
- K. Chew and E. Choo, "Pseudolinearity and Efficiency."

Answer to Climbing Route Puzzle

(see page 8)

This is the classic Dantzig route on the Distorted Cube. It was first climbed in 1972 by Victor Klee and George Minty. Klee is a mountaineer from the Cascade region best known for his uncanny meteorological predictions, which have saved more than one party: he only climbs when the signs are stable. Minty comes from the midwest, and has made many contributions to artificial climbing with his special hardware, including the notorious "claw", though several of his first-ascents have been done claw-free. Variations on the climb have been added by Avis-Chvatal in 1978 and Goldfarb-Sit in 1979, and a very intriguing modification of the route was made in a solo ascent by Jeroslow in 1973. The route can be completed in seven hours by a strong party; indeed all the ascents cited above took exactly this long.

THE MATHEMATICAL PROGRAMMING SOCIETY ENROLLMENT

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George Nemhauser (Cornell) is spending the 1983-84 academic year at the Center for Operations Research and Econometrics of the Catholic University of Louvain, Belgium... Leslie E. Trotter, Jr. has been appointed Director of the School of Operations Research and Industrial Engineering at Cornell... The 1984 Design Automation Conference will be held Oct. 7-11, 1984 in Cambridge, Mass. Contact Professor P. Papalambros, MEAM Dept., University of Michigan, Ann Arbor, MI 48109... The Administrative Sciences Association of Canada has established a new journal *The Canadian Journal of Administrative Sciences*, Ronald Burke, Editor. Address: Faculty of Administrative Sciences, York University, 4700 Keele Street, Downsview, Ontario, Canada M3J 1R6.

Richard Bellman (Southern California) and David Gale (Berkeley) have been elected to membership in the National Academy of Sciences... Karl-Heinz Borgwardt of Kaiserslautern, W. Germany was awarded the Lanchester prize at the November, 1983 meeting of ORSA/TIMS for his papers on the average number of pivots of the Simplex Method which appeared in *Mathematics of Operations Research* and *Zeitschrift für Operations Research* in 1982.

For Sale: Math. Programming 1974-80 (Vols. 6-19), Math. Progr. Studies No. 2-12 (except No. 3), Math. of O.R. 1976-77 (Vols. 1-2), O.R. 1977 (Vol. 25), also several volumes of SIAM Jour. on Optimization and Control, SIAM Review and Math. Reviews available. All unbound. Make an offer to S. Schaible, Fac. of Business, U. of Alberta, Edmonton, Canada T6G 2G1 (403) 432-2350.

Deadline for the next OPTIMA is April 1, 1984.

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.

Here is a riddle for those mathematical programmers who have also done some mountain climbing: identify the following route and the crag on which it is to be found. (The answer is not geographical - it is related to mathematical programming.)

Start below the southwest corner of the peak, directly below the summit. Ascend a ramp on the south face until a delicate move onto the eastern face can be made. Traverse up and to the right to the north face. Move around onto this and ascend a dihedral leading up and right to the northwest edge. A short vertical pitch leads to a fork. The arête to the right leads directly to the summit. Instead follow the easy-angled arête to the left until overlooking the vertical east face. Then climb directly to the lowest point on the summit ridge, and ascend this to the summit.

This route involves no face climbing, and its greatest difficulty lies in the tortuous route-finding. The climbing is very exposed and extreme when moving from one face to the next. (Solution on page 7.)

- Mike Todd, Cornell

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FIRST CLASS MAIL

C A L E N D A R

Calendar of mathematical programming meetings
as of 1 January 1984

Maintained by the Mathematical Programming Society (MPS)

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

May 14,15: 'Sixth Symposium on Mathematical Programming with Data Perturbations', The George Washington University, Washington, D.C., U.S.A. Contact: Professor Anthony V. Fiacco, Department of Operations Research, School of Engineering and Applied Science, The George Washington University, Washington, D.C. 20052, U.S.A.; telephone 202-676-7511. Deadline for abstracts, 16 March 1983.

June 12-14: SIAM Conference on Numerical Optimization, Boulder, Colorado, U.S.A. Contact: Hugh B. Hair, SIAM Services Manager, 1405 Architects Building, 117 South 17 Street, Philadelphia, Pennsylvania 19103, U.S.A. Telephone 215-564-2929.

June 11-16: Fifth Bonn Workshop on Combinatorial Optimization, Bonn, Federal Republic of Germany. Contact: U. Faigle, Bonn Workshop, Institut für Operations Research, Nassestraße 2, D-5300 Bonn 1, Federal Republic of Germany; Telex 886657 unibo d, Telephone (0228) 739285.

July 23 - August 2: NATO Advanced Study Institute on Computational Mathematical Programming, Bad Windsheim, Federal Republic of Germany. Contact: Dr. Klaus Schittkowski, Institut für Informatik, Azenbergerst. 12, 7000 Stuttgart 1, Federal Republic of Germany. Telephone 0711 2078 335. Sponsored by the Society through the Committee on Algorithms.

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. September 10-17: 'Stochastic programming', 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.

1985

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.