

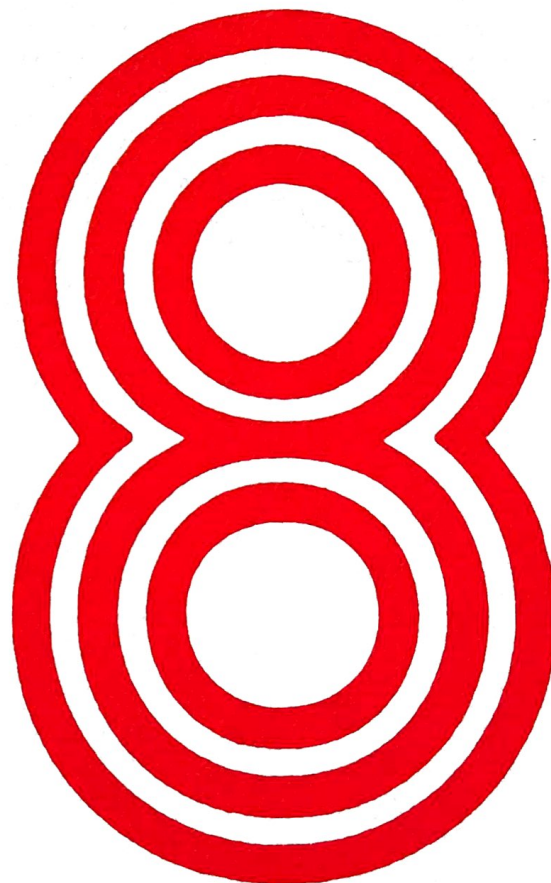
Symp. 321-2080

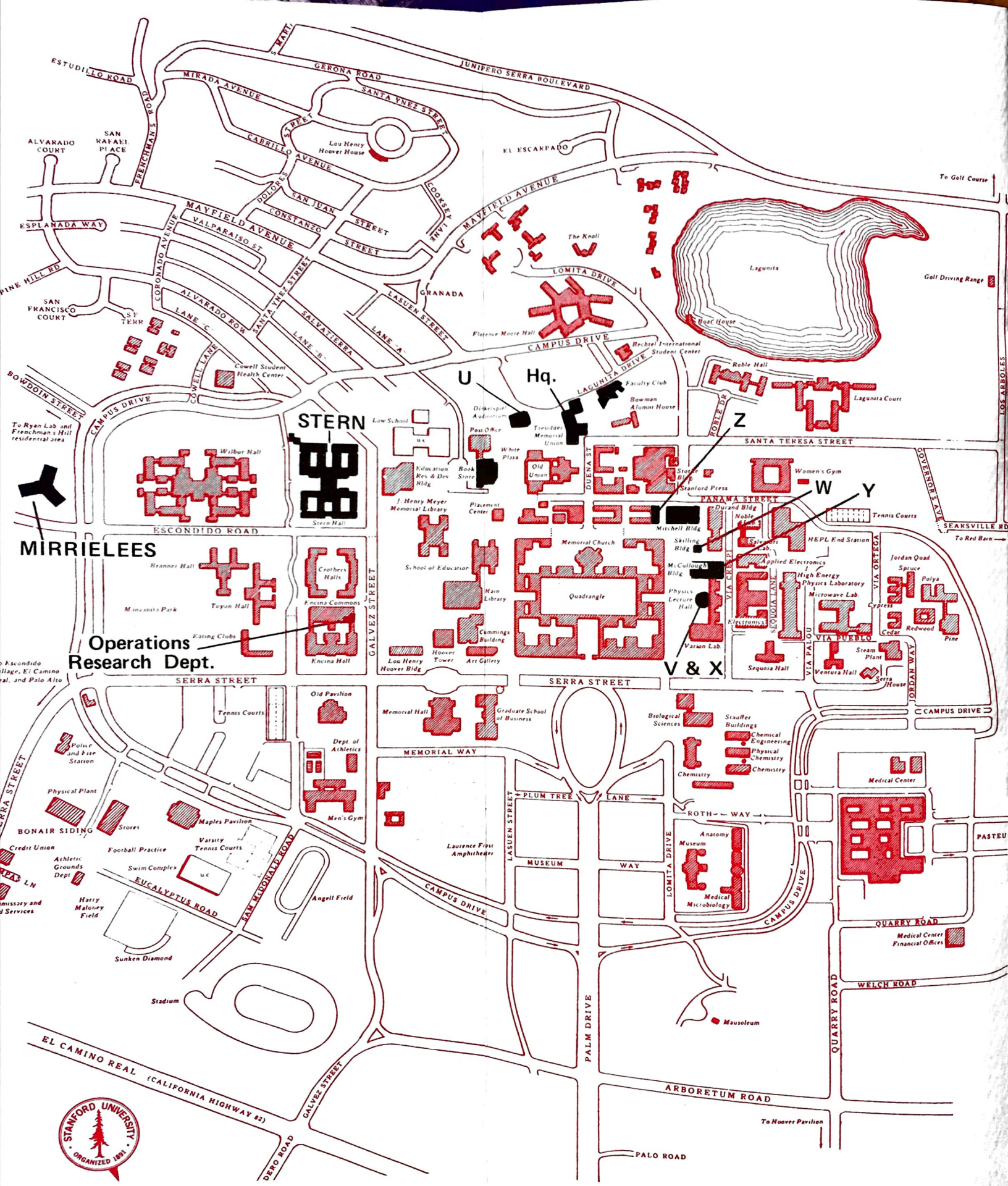
**OFFICIAL PROGRAM**

**VIII  
INTERNATIONAL  
SYMPOSIUM  
ON  
MATHEMATICAL  
PROGRAMMING**

STANFORD  
UNIVERSITY  
AUGUST 27-31, 1973

X 4095  
2923





**MIRRIELLEES**

**STERN**

**Operations Research Dept.**

**V & X**



## The Program Committee

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## SYMPOSIUM SPONSORS

International Business Machines Corporation  
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*The organizers gratefully acknowledge the cooperation  
of Stanford University and its staff  
in the presentation of the Symposium.*

## INFORMATION FOR PARTICIPANTS

**Symposium Headquarters** are located on the second floor of Tresidder Memorial Union.

The secretarial staff will take telephone calls, mail, and messages for participants (and their families) at Symposium Headquarters. The telephone number effective Sunday, August 26, through August 31 is 321-2080 (area code 415).

**After the Symposium**, correspondence may be addressed to Professor Richard W. Cottle, Department of Operations Research, Stanford University, Stanford, California 94305.

**Foreign exchange and check cashing:** There will be limited foreign currency exchange at the Wells Fargo Bank in Tresidder Memorial Union during the regular banking hours, 10 a.m. to 3 p.m. Registrants may use their Stanford Campus Courtesy Cards to cash personal checks drawn on U.S. banks in amounts up to \$100.

**Book display:** Participants are invited to examine a selection of books on mathematical programming, computer science, operations research, etc. in Room 270 (second floor) Tresidder Memorial Union.

**Photocopy facilities:** Participants wishing to use photocopy equipment may do so on a cash basis at the Department of Operations Research and at the Stanford Bookstore. Facilities are also available at Tresidder Memorial Union. Please consult the secretarial staff for assistance.

### SHUTTLE BUS SCHEDULE

<i>Departure Times</i>	<i>Morning (Monday through Friday)</i>
8:15, 9:00	Tiki Inn Motel (front)
8:17, 9:02	Flamingo Motel (along El Camino Real)
8:20, 9:05	Cabana Hyatt House (rear parking lot)
8:25, 9:10	Rickeys Hyatt House (front parking lot)
8:30, 9:15	Southeast corner of El Camino Real and Stanford Avenue
8:45, 9:30	Tresidder Memorial Union
	<i>Afternoon (Tuesday through Friday)</i>
5:15, 6:00, 6:45	Tresidder Memorial Union Tiki Inn Motel Flamingo Motel Cabana Hyatt House Rickeys Hyatt House

*Monday afternoon the departures from Tresidder are scheduled for 5:30, 6:15, and 7:00 p.m.*

## SOCIAL PROGRAM

Symposium participants and their families are cordially invited to a **wine and cheese tasting party** which will be held at the **FACULTY CLUB** on Monday, August 27, from 5:00 to 6:30 p.m. A nonalcoholic punch also will be served.

Two nearby points of interest will be the focus of an **outing primarily for ladies**. Planned for Tuesday afternoon, August 28, the trip will consist of a one-hour visit to the Sunset Magazine and Book Company headquarters at which the gardens and testing kitchens are traditional favorites. The group will then proceed to the charming Allied Arts Guild for tea and an opportunity to shop or browse in its interesting craft shops. A chartered bus will depart promptly at 1:25 p.m. from Lagunita Drive near Tresidder Memorial Union. The return is scheduled for about 5:15. There will be a \$3.00 charge for this event. Participation is limited to about 40 persons.

The **Symposium banquet** will be held at Rickeys Hyatt House in Palo Alto on Thursday evening, August 30. A nohost cocktail gathering will begin there at 6:30 p.m. Dinner will be served at 8:00 p.m. After dinner Ralph E. Gomory will deliver a talk on Models and Technology. Complimentary bus transportation between the Stanford campus and Rickeys Hyatt House will be provided. Banquet tickets are \$5.00 per person and should be purchased before 3:00 p.m. Tuesday, August 28.

In the **morning**, coffee, tea, and doughnuts will be served in the **LARGE LOUNGE** (second floor) at **Tresidder Memorial Union** from 8:30 to 11:10.

In the **afternoon**, coffee, tea, and cool beverages will be served on the **PATIO** of the **Mitchell (Earth Sciences) Building** from 3:30 to 4:30.

The interruptions in the program officially designated as coffee breaks are approximately 10:45 to 11:10 a.m. and 4:00 to 4:15 p.m.

## SCIENTIFIC PROGRAM

Monday morning, August 27

8:30-9:30 a.m.: Registration (*Tresidder*)PLENARY SESSION (*Dinkelspiel Auditorium*)

9:30-10:00 a.m.: Welcoming remarks  
 William F. Miller  
*Provost, Stanford University*  
 Introduced by G. B. Dantzig

10:00-10:50 a.m.: Keynote address  
 Albert W. Tucker  
 "Simplex Algorithm and Duality"  
 Introduced by H. W. Kuhn

Coffee Break

11:10-12:00 a.m.: Plenary Speaker  
 E.M.L. Beale  
 "The Current Algorithmic Scope of  
 Mathematical Programming Systems"  
 Introduced by P. Wolfe

12:00 noon Lunch

Monday afternoon, August 27

PARALLEL SESSIONS 1:30-5:00 p.m., approx.

ROOM: Physics Tank 100 (V) 1:30  
 SESSION: Nonlinear Programming: Theory  
 CHAIRMAN: E. Polak

\*R. T. Rockafellar Augmented Lagrange Multiplier  
 Functions and Duality in Noncon-  
 vex Programming

\*M. A. Pollatschek Generalized Duality Theory in  
 Nonlinear Programming

W. P. Pierskalla Quasi-Conjugacy and Nonlinear  
 H. J. Greenberg Surrogate Duality

P. S. Unger The Dual of the Dual as a Linear  
 Approximation of the Primal

\* denotes invited speaker

**Boldface:** Jointly authored papers to be presented by  
 person whose name is printed in boldface.

Coffee Break

CHAIRMAN: R. T. Rockafellar

R. A. Abrams Projections of Convex Programs

C. R. Bector Weaker Convex Programming

L. S. Jennings An Application of Penalty Func-  
 M.R. Osborne tions in the Calculation of Singular  
 Values

L. McLinden An Extension of Fenchel's Duality  
 Theorem to Saddle Functions and  
 Dual Minimax Problems

H. Sayama The Generalized Lagrangian Func-  
 Y. Kameyana tions for Mathematical Program-  
 H. Nakayama ming Problems  
 Y. Sawaragi

ROOM: Physics Tank 101 (X) 1:30  
 SESSION: Applications: Engineering and Natural Sciences  
 CHAIRMAN: R. J. Duffin

\*G. Maier Quadratic Programming in Elastic-  
 Plastic Analysis

A. M. Lesk Application of Interactive Computer  
 Graphics to the Phase Problems of  
 X-Ray Crystallography

G. T. Herman A Relaxation Method for Recon-  
 structing Objects from Noisy X Rays

S. W. Emery, Jr. Preliminary Deep Ocean Bulk  
 Carrier Design by Geometric  
 Programming

L. E. Westphal An MIP for Planning in Mechanical  
 Engineering: Specification and  
 Solution

ROOM: Skilling Auditorium (W) 1:30  
 SESSION: Integer Programming: Enumerative and Branch  
 and Bound Methods  
 CHAIRMAN: J. F. Shapiro

\*E. Balas On the Use of Intersection Cuts and  
 Outer Polars in Branch and Bound

Monday, Aug. 27 - afternoon

Integer Programming: Enumeration and Branch and Bound (cont'd)

\*K. Spielberg Minimal Preferred Inequalities, Penalties, and Structure in Zero-One Programming

\*J. P. Barthes A Formalism for Branching Methods of Combinatorial Optimization  
D. J. Wilde

Coffee Break

CHAIRMAN: F. Glover

P. Ghilardotti Geoffrion's O-1 Programming Method Revisited: An Extension to Integer Programming

H. P. Williams Experiments in the Formulation of Integer Programming Problems

A. S. Goncalves An Explicit Solution for the Integer Linear Programming Problem

ROOM: McCullough 134 (Y) 1:30

SESSION: Dynamic Programming and Control Theory

CHAIRMAN: H. Wagner

L. E. Schwartz A Fixed Point Algorithm for Distributed Control Systems of Retarded Type

J. J. Dinkel Dynamic and Geometric Programming

S. P. Sethi Generalized Programming and the Bounded-State Optimal Control Problem  
G. B. Dantzig  
R. E. Davis

J. L. Burroughs Sequencing Targets of a MIRV Missile with a Discrete Dynamic Programming Algorithm  
J. L. Getschman

Coffee Break

CHAIRMAN: J. Meditch

H. G. Bergendorff An Algorithm for Solving Linear-Quadratic Control Problems with Linear Inequality Constraints  
C. R. Blitzer  
H. K. Kim

J. T. Buchanan Path Restriction and Functional Representation in Dynamic Programming

Monday, Aug. 27 - afternoon

ROOM: Engineering 550A (Z) 1:30  
SESSION: Quadratic Programming  
CHAIRMAN: B. Mond

F. Giannessi Global Optimization in Nonconvex Quadratic Programming and Integer Programs  
E. Tomasin

P. F. Kough Global Solution of the Indefinite Quadratic Programming Problem

D. Hearn Dual Approaches to Quadratically Constrained Quadratic Programming  
W. D. Randolph

R. E. Burkard A Perturbation Method for Solving Quadratic Assignment Problems

Coffee Break

CHAIRMAN: B. C. Eaves

J. G. Ecker A Dual Algorithm for Quadratically-Constrained Quadratic Programs via a Modified Penalty Function Technique  
R. D. Niemi

J. Philip An Algorithm for Combined Quadratic and Multiobjective Programming

G. Gallo Bilinear Programming: A Vertex Following Algorithm  
A. Ulkucu

Tuesday morning, August 28

PARALLEL SESSIONS 9:00-10:50 a.m., approx.

ROOM: Physics Tank 100 (V) 9:00  
SESSION: Applications: Economics  
CHAIRMAN: G. J. Lieberman

D. Liggins Applications of Integer Programming in National Economic Planning

T. Tsukahara, Jr. An Analysis of the Work Incentive Effects of the Negative Income Tax: A Nonlinear Programming Approach  
H. Brumm, Jr.

J. Schechtman      Some Application of Competitive Prices to Dynamic Programming Problems under Uncertainty

P. Hansen  
M. Picavet      Capacity Expansion with Storable Output

\*W.R.S. Sutherland      The Target Method for the Gale-Koopmans Model of Economic Development

ROOM: Skilling Auditorium (W)      9:00

SESSION: Integer Programming: Enumerative and Branch and Bound Methods

CHAIRMAN: E. Balas

R. D. Armstrong  
P. Sinha      Improved Penalty Calculations for a Mixed Integer Branch and Bound Algorithm

K. B. Haley  
A. N. Elshafei      On Solving the Capacitated Facilities Location Problem with Concave Cost Functions

S. Arunkumar      Optimal Synthesis of Computer-Communication Networks

\*M. L. Fisher  
W. D. Northup  
J. F. Shapiro      Computational Experience with Dual Methods in Discrete Optimization

ROOM: Physics Tank 101 (X)      8:50

SESSION: Convex Polytopes and Linear Programming

CHAIRMAN: E. L. Johnson

J. L. Goffin      On the Finite Convergence of the Relaxation Method for Solving Systems of Linear Inequalities

E. C. Duesing      Determining the Convex Hull of a Finite Set of Points

I. Adler      Enumeration of All Vertices of a Polyhedral Set

\*K. G. Murty      On the Uses of 2-Dimensional Faces in Studying Polytopes

\*M. L. Balinski      The Hirsch Conjecture for Some Transportation Polytopes

ROOM: McCullough 134 (Y)      8:50

SESSION: Least Squares and Curve Fitting

CHAIRMAN: G. Golub

M. Raghavachari      Efficiency of Least Square Estimates Relative to Best Linear Estimates in Regression Model

C. Kim  
S. Fromovitz  
R. Hallsman      An Algorithm for Nonlinear Curve Fitting

C. K. Liew      The Stability Condition of the Inequality Constrained Least-Squares Estimation

N. N. Abdelmalek      On the Discrete Linear  $L_1$  Approximation and  $L_1$  Solutions of Over-determining Linear Equations

H. Ramsin  
P. A. Wedin      Numerical Treatment of the Non-linear Least Squares Problem

\*L. Tornheim      Percentile Curves

ROOM: Engineering 550A (Z)      9:00

SESSION: Mathematical Programming: General

CHAIRMAN: A.F. Veinott, Jr.

G. Hatfield      The Theory and Application of Linear Decision Programming

S. S. Oren      On the Selection of Parameters in Self-Scaling Variable Metric Algorithms

M. J. Rijckaert  
L. J. Hellinckx      Computer Implementation of a Dual Geometric Programming Algorithm

T. Cheung      Approximate Solution for Systems of Nonlinear Volterra Integral Equations

\*R. J. Duffin      On Fourier's Analysis of Linear Inequality Systems

Coffee Break

**PLENARY SESSION/11:10-12:00/Dinkelspiel Auditorium**

D. Gale Interest Rates and Efficient Production Programs  
Introduced by M. Kurz

**Tuesday afternoon, August 28**

**PLENARY SESSION/1:30-2:20/Dinkelspiel Auditorium**

V. Klee Convex Polytopes and Mathematical Programming  
Introduced by A. Hoffman

**PARALLEL SESSIONS 2:30-6:00 p.m., approx.**

**ROOM: Physics Tank 100 (V) 2:30**  
**SESSION: Nonlinear Programming: Theory**  
**CHAIRMAN: F. J. Gould**

\*K. Arrow A General Saddle-Point Result for Constrained Maximization  
F. J. Gould  
S. M. Howe

\*D. M. Topkis Monotone Solutions of Extremal Problems on Lattices  
A. F. Veinott, Jr.

K. O. Kortanek Classifying Convex Extremum Problems

R. J. Hillestad A Useful Characterization for Nonconvex Feasible Regions Defined by Concave Constraints

*Coffee Break*

**CHAIRMAN: A. Ben Israel**

\*B. Martos Sufficiency vs. Necessity of Smoothness and Convexity Conditions: A Challenge

P. Mazzoleni Nonlinear Programming with Fractional Objective Function

W. A. Farr Continuous-Time Programming  
M. A. Hanson

H. M. Massam The Various Definitions of the Derivative in Mathematical Programming  
S. Zlobec

S. Sunder A Dual for a Generalized Linear and Linear Fractional Program

**ROOM: Skilling Auditorium (W) 2:30**  
**SESSION: Integer Programming: Enumerative and Branch and Bound Methods**  
**CHAIRMAN: J. Forrest**

\*A. C. Williams Some Modeling Principles for MIP's

R. R. Trippi A Branch and Bound Algorithm for Optimal Replacement with Fixed-Charge Investment Costs  
S. I. Drobniec

R. Jaikumar A "Proximal Preference" Algorithm for Large Multi-Criteria Resource Constrained 0-1 Problems

E. Brocklehurst An Algorithm for Finding Approximate Solutions to Integer Linear Programs

*Coffee Break*

**CHAIRMAN: F. S. Hillier**

L. F. Escudero The Cutting Stock Problem: Application of Combinatorial Technique and Mixed Integer Programming

J. Delorme Set Covering Problems by Linear Programming and Branch and Bound Algorithms  
E. Heurigon

**ROOM: Physics Tank 101 (X) 2:30**  
**SESSION: Convex Polytopes and Linear Programming**  
**CHAIRMAN: M. Held**

\*A. Orden Probabilistic Estimation of the Efficiency of Versions of the Simplex Method

H. D. Scolnik A New Approach to Linear Programming

R. R. Rosander Multiple Pricing and Suboptimization in Algorithms

*Coffee Break*



**Tuesday, Aug. 28 - afternoon**

*Convex Polytopes and Linear Programming (cont'd)*

**CHAIRMAN: A. Orden**

- T. M. Liebling      On the Number of Iterations of the Simplex Method
- C.L.J. Vandermeer  
P. J. Peters      Two-parametric Linear Programming: A Construction Problem
- G. Appa            Some New Approaches for Problems Arising from Degeneracy in Linear Programming
- R. Carvajal        On the Relationship between Pattern Separation and the Measure of a Cone

**ROOM: McCullough 134 (Y)**

**2:30**

**SESSION: Numerical Methods**

**CHAIRMAN: W. Murray**

- \*J. A. Tomlin      On Scaling Linear Programming Problems
- R. K. Brayton  
F. G. Gustavson  
E. L. Johnson      LU Update of the GUB Simplex Algorithm
- \*E. Hellerman  
D. C. Rarick      The Partitioned Preassigned Pivot Procedure ( $P^4$ ) for Sparse Matrix Inversion
- S. Powell          A Development of the Product Form Algorithm for the Simplex Method Using Reduced Transformation Vectors

*Coffee Break*

**CHAIRMAN: K. Ritter**

- \*P. E. Gill  
W. Murray      The Simplex Method Using the LQ Factorization
- C. C. Paige      Stability of Matrix Updating in Mathematical Programming
- S. Gaunt          Computational Experience with the Parallel Theory for Matrices and Network Systems

**Tuesday, Aug. 28 - afternoon**

- G. W. Stewart      A Stable Implementation of the Second Method for Solving Systems of Nonlinear Equations
- D. B. Bandy        A Comparison of Cycling Algorithms

**ROOM: Physics Tank 101 (Z)**

**2:30**

**SESSION: Applications: Engineering Systems**

**CHAIRMAN: C.R. Glassey**

- C. R. Gagnon  
S.L.S. Jacoby  
J. S. Kowalik  
R. W. Hicks      A Nonlinear Programming Approach to a Large Scale Hydroelectric System Optimization
- G. Silverman      Equipment Location in Remotely Piloted Vehicles by Integer Programming
- M. Florian  
J. Ferland  
L. Nastanky  
G. Guerin  
G. Bushell      The Engine Scheduling Problem in a Railway Network

*Coffee Break*

**CHAIRMAN: P. Davis**

- S. C. Littlechild  
G. F. Thompson      Optimal Aircraft Landing Facilities and Fees
- G. E. Blau          Model Building and Parameter Evaluation by Nonlinear Optimization with an Application to the Distribution of Chemicals in an Ecosystem
- J. Krarup  
Y. Goertz  
M. Lilholt          Dimensioning of a Water Supply System

Wednesday morning, August 29

PARALLEL SESSIONS 9:00-10:50 a.m., approx.

**ROOM: Physics Tank 100 (V) 9:00**  
**SESSION: Nonlinear Programming: Algorithms**  
**CHAIRMAN: M. R. Osborne**

J. L. Kreuser      Some Quadratically Convergent  
 Methods for the Nonlinearly Con-  
 strained Optimization Problem

J. May  
 R. Miffilin      A Superlinearly Convergent Non-  
 derivative Method for Linearly  
 Constrained Minimization

R.W.H. Sargent      Convergence Properties of Projec-  
 tion Methods for Nonlinear Pro-  
 gramming

H. Schultz      Newton Projection

\*D. G. Luenberger      Some Results on the Convergence  
 Rates of Nonlinear Programming  
 Algorithms

**ROOM: Skilling Auditorium (W) 9:00**  
**SESSION: Integer Programming: Group Theory and Cutting  
 Plane Methods**  
**CHAIRMAN: T. C. Hu**

V. J. Bowman, Jr.  
 J. Starr      Ordinal Cuts and Zero-One Pro-  
 gramming

H. M. Salkin  
 A. Tamir      An Exposition of Group Theory in  
 Integer Programming

R. G. Jeroslow      New Techniques and Algorithms for  
 Zero-One Integer Programming

A. Korsak      Homological Integer Programming:  
 Optimal Chains of Simplicial  
 Complexes

\*E. L. Johnson  
 C. A. Burdet      A Subadditive Approach to the  
 Group Problem of Integer Pro-  
 gramming

**ROOM: Physics Tank 101 (X) 9:00**  
**SESSION: Optimization in Networks**  
**CHAIRMAN: E. L. Lawler**

✓D. Klingman      Implementation and Computational  
 D. Karney      Study on Start Procedures Basis  
 F. Glover      Change Criteria for a Primal Network

J. D. Pearson      Allocating Motive Power to Railroad  
 W.C. Mylander, III      Schedules

M. S. Bazaraa      An Infeasibility Pricing Algorithm  
 R. Langley      for the Multi-Commodity Minimum  
 Cost Flow Problem

R. C. Dorsey      A Network Approach to a  
 T. J. Hodgson      Multi-Facility, Multi-Product  
 H. D. Ratliff      Scheduling Problem with Back-  
 Ordering

\*G. L. Thompson      Rim, Cost, Bound, and Weight  
 V. Balachandran      Operations for the Generalized  
 Transportation Problem

**ROOM: McCullough 134 (Y) 9:00**  
**SESSION: Applications: Economics**  
**CHAIRMAN: A. Whinston**

H. Talpaz      A Population and Control Simula-  
 W. Vincent      tion of U.S. Hog Production

P. Nicholson      Inventory Models with Two-Sided  
 B. Halachmi      Demand

D. A. Walker      Effects of Imperfectly Competitive  
 Loan and Security Markets on Bank  
 Asset Management

M. Christen      The Derivation of Train Shunting  
 Tables for the Paris Metro

\*J. L. Balintfy      Nonlinear Programming and the  
 Food Price Index

*Coffee Break*

**PLENARY SESSION/11:10-12:00/Dinkelspiel Auditorium**

S. Vajda      Sufficiency and Necessity Theorems in  
 Mathematical Programming  
 Introduced by E.M.L. Beale

Stanford University

August 27 - 31, 1973

MONDAY, Aug. 27	TUESDAY, Aug. 28	WEDNESDAY, Aug. 29	THURSDAY, Aug. 30	FRIDAY, Aug. 31
<p>8:30-9:30 a.m. Registration at Tresidder</p> <p><b>Official Welcome:</b> (U) W.F. Miller, Provost</p> <p><b>Keynote Address:</b> (U) A.W. Tucker</p> <p><b>Plenary Session:</b> (U) 11:10-12:00 a.m. E.M.L. Beale, <i>speaker</i></p>	<p><b>PARALLEL SESSIONS</b> 8:50-10:50 a.m.</p> <p>Polytopes and Linear Programming (X)</p> <p>Least Squares and Curve Fitting (Y)</p> <p>9:00-10:50 a.m.</p> <p>Applications: Economic (V)</p> <p>Integer Programming: (W) Branch and Bound Methods</p> <p>Mathematical Programming: (Z) General</p> <p><b>PLENARY SESSION</b> 11:10-12:00 a.m. (U) D. Gale</p>	<p style="text-align: center;"><b>M O R N I N G S</b></p> <p><b>PARALLEL SESSIONS</b> 9:00-10:50 a.m.</p> <p>Nonlinear Programming: (V) Algorithms</p> <p>Integer Programming: (W) Cutting Plane Methods</p> <p>Optimization in Networks (X) Applications: Economic (Y)</p> <p><b>PLENARY SESSION</b> 11:10-12:00 a.m. (U) S. Vajda</p>	<p><b>PARALLEL SESSIONS</b> 8:40-10:50 a.m.</p> <p>Computer Software and Mathematical Programming (V)</p> <p>9:00-10:50 a.m.</p> <p>Graphs and Combinatorics (W)</p> <p>Unconstrained Optimization (X)</p> <p>Nonlinear Programming: (Y) Algorithms</p> <p><b>PLENARY SESSION</b> 11:10-12:00 a.m. (U) D.R. Fulkerson</p>	<p><b>PARALLEL SESSIONS</b> 8:20-10:50 a.m.</p> <p>Graphs and Combinatorics (W)</p> <p>9:00-10:50 a.m.</p> <p>Nonlinear Programming: (V) Theory</p> <p>Large Scale Systems (X)</p> <p>Applications: (Y) Urban and Educational</p> <p><b>PLENARY SESSION</b> 11:10-12:00 a.m. (U) A.M. Geoffrion</p>
<p><b>PARALLEL SESSIONS</b> 1:30-5:00 p.m.</p> <p>Nonlinear Programming: (V) Theory</p> <p>Integer Programming: (W) Branch and Bound Methods</p> <p>Applications: Scientific (X)</p> <p>Dynamic Programming (Y) and Control Theory</p> <p>Quadratic Programming (Z)</p> <p>5:00-6:30 p.m. Wine and Cheese Tasting at the Faculty Club</p>	<p><b>PLENARY SESSION</b> 1:30-2:20 p.m. (U) V. Klee</p> <p><b>PARALLEL SESSIONS</b> 2:30-6:00 p.m.</p> <p>Nonlinear Programming: (V) Theory</p> <p>Integer Programming: (W) Branch and Bound Methods</p> <p>Polytopes and Linear Programming (X)</p> <p>Numerical Methods (Y)</p> <p>Applications: (Z) Engineering Systems</p>	<p style="text-align: center;"><b>A F T E R N O O N S</b></p> <p><b>PLENARY SESSION</b> 1:30-2:20 p.m. (U) M. Maschler</p> <p><b>PARALLEL SESSIONS</b> 2:30-6:00 p.m.</p> <p>Nonlinear Programming: (V) Algorithms</p> <p>Integer Programming: (W) Cutting Plane Methods</p> <p>Optimization in Networks (X)</p> <p>Game Theory (Y)</p> <p>Stochastic Programming (Z)</p> <p><i>6-10:30 p.m. Banquet</i> <i>7:30 Dantzig</i></p>	<p><b>PLENARY SESSION</b> 1:30-2:20 p.m. (U) J.B. Rosen</p> <p><b>PARALLEL SESSIONS</b> 2:30-6:00 p.m.</p> <p>Panel Discussion: (U) Implementation</p> <p>SIGMAP sessions (V)</p> <p>Optimization in Networks (W)</p> <p>Unconstrained Optimization (X)</p> <p>Complementarity and Fixed Points (Y)</p> <p>Nonlinear Programming: (Z) Algorithms</p> <p>6:30 p.m. - Banquet at Rickeys Hyatt House Speaker: R. Gomory</p>	<p><b>PLENARY SESSION</b> 1:30-2:20 p.m. (U) G.B. Dantzig</p> <p><b>PARALLEL SESSIONS</b> 2:30-6:00 p.m.</p> <p>Nonlinear Programming: (V) Algorithms</p> <p>Graphs and Combinatorics (W)</p> <p>Large Scale Systems (X)</p> <p>Integer Programming: (Y) Branch and Bound Methods</p>

U = Dinkelspiel Auditorium  
W = Skilling Auditorium  
Y = McCullough 134  
V = Physics Tank 100  
X = Physics Tank 101  
Z = 550A (Engineering)

Wednesday afternoon, August 29

PLENARY SESSION/1:30-2:20/Dinkelspiel Auditorium

M. Maschler      The Theory of the Bargaining Sets of Cooperative Games  
Introduced by M.L. Balinski

PARALLEL SESSIONS 2:30-6:00 p.m., approx.

ROOM: Physics Tank 100 (V)      2:30  
SESSION: Nonlinear Programming: Algorithms  
CHAIRMAN: E.L. Peterson

\*P. Wolfe      Validation of Subgradient Optimization  
M. Held

M. Best      An Accelerated Conjugate Direction Method to Solve Linearly Constrained Minimization Problems  
K. Ritter

D. Goldfarb      Numerically Stable Variable Metric Methods for Linearly Constrained Optimization Problems

Coffee Break

CHAIRMAN: D.G. Luenberger

\*P. E. Gill      Quasi-Newton Methods for Linearly Constrained Optimization  
W. Murray

W. Forster      On Constrained Nonlinear Optimization Problems with the Fixed Point Property

D. A. Pierre      Multiplier Algorithms for Non-linear Programming

*Beales, Tom*  
ROOM: Skilling Auditorium (W)      2:30  
SESSION: Integer Programming: Group Theory and Cutting Plane Methods  
CHAIRMAN: K. Spielberg

\*A. Whinston      Primal Integer Optimization  
J. Thurber

M. Gondran      An Efficient Cutting-Plane Algorithm by "The Method of Decreasing Congruences"

A.A.J.M. vanden Hooven  
D. Kijne      A Labeling Method to Find All Solutions of an Integer Programming Problem by Group Minimization

A. Majthay      Facet "Stripping," Cuts, and the Quasiconcave Minimization Problem

Coffee Break

CHAIRMAN: G. Nemhauser

\*G. H. Bradley      Coefficient Reduction for Inequalities in 0-1 Variables  
P. L. Hammer  
L. Wolsey

M. Guignard      Systematic Combination of Inequalities in 0-1 Programming

D. McDaniel      Alternative Relaxation Schemes for Benders Partitioning Approach to Mixed Integer Programming  
M. Devine

R. R. Meyer      On the Existence of Optimal Solutions to Integer and Mixed-Integer Programming Problems

ROOM: Physics Tank 101 (X)      2:30  
SESSION: Optimization in Networks  
CHAIRMAN: G. L. Thompson

\*F. Glover      Extensions of the Augmented Predecessor Index Method to Generalized Network Problems  
D. Klingman  
J. Stutz

C. J. McCallum, Jr.      A Generalized Upper Bounding Approach to a Communications Network Flow Problem

P. B. Bansal      An Algorithm for Optimizing Network Flow Capacity under Economics-of-scale  
S. E. Jacobsen

I. Dragan      A Primal Algorithm for Solving the Minimum-cost Flow Problem in a Network with Gains

Coffee Break



Thursday morning, August 30

PARALLEL SESSIONS 9:00-10:50 a.m., approx.

ROOM: Physics Tank 100 (V) 8:40  
 SESSION: Computer Software and Mathematical Programming  
 CHAIRMAN: W. P. Drews

- S.N.T. Shen Computer Solution of Linear Programming Problems Stated in English
- G. Mitra Analysis of Mathematical Programming Problems Prior to Applying the Simplex Method  
 A. L. Brearley  
 H. P. Williams
- D. C. Rarick An Algorithm for Solving Revised Models Efficiently  
 D. L. Linkin
- \*C. A. Haverly New MAGEN/PDS
- \*J. C. Dickson On Keeping Both Storage and I/O Requirements Low in Linear Programming
- \*W. Orchard-Hays Problems and Principles in the Evolution of Mathematical Programming Systems

ROOM: Skilling Auditorium (W) 9:00  
 SESSION: Graphs and Combinatorics  
 CHAIRMAN: D. Walkup

- \*P. L. Hammer Reducing Packing and Covering Problems in a Knapsack Problem  
 V. Chvatal
- \*A. J. Hoffman On Combinatorial Problems and Linear Inequalities
- \*T. C. Hu Combinatorial Optimization
- \*J. Edmonds Facets of Combinatorial Polyhedra

ROOM: Physics Tank 101 (X) 9:00  
 SESSION: Unconstrained Optimization  
 CHAIRMAN: M.J.D. Powell

- D. F. Shanno Quasi-Newton Methods and Brown's Method

- R. W. Chaney A Modified Conjugate-Gradient Method for the Minimization of Exterior Penalty Functions
- J. Van Remortel Asymmetric Minimization with a Convex Fourth Degree Approximation  
 D. J. Wilde
- J. Stein The Gram-Schmidt Conjugate Direction Method and the Method of Parallel Planes
- \*K. Ritter Accelerating Procedures for Methods of Conjugate Directions

ROOM: McCullough 134 (Y) 9:00  
 SESSION: Nonlinear Programming: Algorithms  
 CHAIRMAN: M. Grigoriadis

- J. Elzinga The Central Cutting Plane Algorithm  
 T. Moore
- R. L. Staha Constrained Optimization via Moving Exterior Truncations  
 D. M. Himmelblau
- U. M. Garcia-Palomares Superlinearly Convergent Quasi-Newton Algorithms for Nonlinearly Constrained Problems  
 O.L. Mangasarian
- E. Leuenberger Transcendental Programming  
 D. J. Wilde
- \*E.M.L. Beale Global Optimization Using Special Ordered Sets  
 J.J.H. Forrest

Coffee Break

PLENARY SESSION/11:10-12:00/Dinkelspiel Auditorium

- D. R. Fulkerson Results on Blocking Pairs of Matrices Introduced by J. Edmonds

## Thursday afternoon, August 30

## PLENARY SESSION/1:30-2:20/Dinkelspiel Auditorium

J. B. Rosen Interactive Computer Graphics and  
Mathematical Programming  
Introduced by R. W. Cottle

## PARALLEL SESSIONS 2:30-6:00 p.m., approx.

ROOM: Dinkelspiel (U) 2:30  
SESSION: Panel: Implementation of Mathematical  
Programming Algorithms  
CHAIRMAN: J. A. Tomlin

## PANEL MEMBERS:

W. Orchard-Hays  
E. Hellerman  
J. Cord  
J. Forrest  
M. Saunders

ROOM: Physics Tank 100 (V) 2:30  
SESSION: SIGMAP: Computational Aspects of Nonlinear  
Programming  
CHAIRMAN: O.L. Mangasarian

\*G. P. McCormick Computable Methods for Obtaining  
Global Solutions to Nonconvex Pro-  
gramming Problems Which Are  
Factorable

\*J. E. Dennis, Jr. A Characterization of Superlinear  
Convergence and Its Application to  
Quadi-Newton Methods

S. M. Robinson Convex Processes and Mathematical  
Programming

## Coffee Break

ROOM: Physics Tank 100 (V) 2:30  
SESSION: SIGMAP: Computer Hardware and Mathematical  
Programming  
CHAIRMAN: R. Van Slyke

\*W. W. White Interactive Use of a Large Mathe-  
matical Programming System

C. H. Johnson TIMPS/ASC—An MPS Implementa-  
tion on a Pipeline Computer  
E. P. Willard

J. Lermitt A Linear Programming Implementa-  
tion of ILLIACA IV

G.S. Thomas A Blending Problem Using Integer  
J. C. Jennings Programming on Line

ROOM: Skilling Auditorium (W) 2:30  
SESSION: Optimization in Networks  
CHAIRMAN: R. Karp

V. Srinivasan Choosing Modes of Transportation  
G. L. Thompson to Minimize Total Costs and Aver-  
age Shipment Times

R. L. Sielken, Jr. A Transportation Problem Involving  
Source-Location Optimization

W. W. Hogan Single Commodity Network Prob-  
lems with Resource Constraints

L. Kaufman A Primal-Dual Algorithm for the  
P. Hansen Three-Dimensional Assignment  
Problem

## Coffee Break

CHAIRMAN: Harold Greenberg

P. Krolak A Multi-Terminal Truck Dispatch-  
J. Nelson ing Algorithm

G. A. Wicklund Computer Experience in Generating  
Transportation Problems with the  
"More for Less" Paradox

J. Stutz A Program for Generating Large  
D. Klingman (UN) Capacitated Assignment,  
A. Napier Transportation, and Minimum  
Cost Flow Network Problems

ROOM: Physics Tank 101 (X) 2:30  
SESSION: Unconstrained Optimization  
CHAIRMAN: M. A. Hanson

\*E. Polak A Modified Secant Method for Un-  
constrained Minimization

R. Mifflin A Superlinearly Convergent Algo-  
rithm for Minimization without  
Evaluating Derivatives

M. L. Lenard      Practical Convergence Conditions  
for the Davidon-Fletcher-Powell  
Method

R. D. Shapiro      Sequential Minimax Search with  
D. J. Wilde      Unequal Block Size

Coffee Break

CHAIRMAN: G. P. McCormick

W.C. Mylander, III      Computational Experience with  
J. D. Pearson      the Sequential Unconstrained  
Minimization Technique (SUMT)

G. F. Schrack      Optimized Relative Step Size  
M. D. Choit      Random Searches

P. M. Ghare      A Computational Comparison of  
W. C. Turner      Incomplete Relaxation-multistep  
Algorithms for Unconstrained  
Optimization with Other Search  
Methods

ROOM: McCullough 134 (Y)      2:30

SESSION: Complementarity and Fixed Points

CHAIRMAN: C. E. Lemke

\*H. W. Kuhn      The Sandwich Method for Com-  
J. G. MacKinnon      puting Fixed Points

\*B. C. Eaves      Solving Systems of Convex Equa-  
tions

\*R. Saigal      A Comparative Study of Two Algo-  
D. Solow      rithms that Compute Fixed Points  
L. Wolsey      in Unbounded Regions

Coffee Break

CHAIRMAN: H. Scarf

\*M. L. Fisher      An Algorithm for the Nonlinear  
F. J. Gould      Complementarity Problem

\*R. Chandrasekaran      On the Nonlinear Complementarity  
A. Tamir      Problem

R. J. Wilmuth      A Comparison of Fixed Point  
Algorithms

H. Nishino      On Applying a Complementary  
M. Kohima      Algorithm to Nonlinear Program-  
I. Kaneko      ming

ROOM: 550A Engineering (Z)      2:30

SESSION: Nonlinear Programming: Algorithms

CHAIRMAN: W. Oettli

\*L. S. Lasdon      One Dimensional Search and  
A. D. Waren      Penalty Method—Some Theoretical  
R. Fox      and Computational Results

K. R. Gehner      The Structure of Feasible Direc-  
tion Algorithms

I. J. Weinstein      Solution Procedure for a Concave  
O. S. Yu      Maximization Problem with a Sepa-  
rable Objective Function Having  
Interrelated Components

Coffee Break

CHAIRMAN: D.J. Wilde

G. V. Reklaitis      Degeneracy in Mathematical Pro-  
D. J. Wilde      gramming Algorithms Using Im-  
plicit Variable Elimination

J. Abrham      A Numerical Method for a Class of  
L. S. Luboobi      Continuous Concave Programming  
Problems

R. P. O'Neill      Generalized Linear Programming  
with Nonlinear Subproblems

Thursday evening, August 30

SYMPOSIUM BANQUET/6:30/Rickeys Hyatt House

R. E. Gomory      Models and Technology  
Introduced by K. J. Arrow



## Friday morning, August 31

PARALLEL SESSIONS 9:00-10:50 a.m., approx.

ROOM: Physics Tank 100 (V) 9:00  
 SESSION: Nonlinear Programming: Theory  
 CHAIRMAN: D.M. Topkis

M.A.H. Dempster A Minimal Kuhn-Tucker Theorem  
 in Convex Spaces

\*E. L. Peterson Decomposition in Geometric  
 Programming

\*O. L. Mangasarian Unconstrained Lagrangians in  
 Nonlinear Programming

\*C. R. Glassey Explicit Duality for Convex  
 Homogeneous Programs

ROOM: Skilling Auditorium (W) 8:20  
 SESSION: Graphs and Combinatorics  
 CHAIRMAN: P. L. Hammer

R. L. Tobin Minimal Complete Matchings and  
 Negative Cycles

P. Koutas Shortest String Containing All  
 T. C. Hu Permutations

L. E. Trotter Set Partitioning and Chain Decom-  
 G. L. Nemhauser position

\*G. L. Nemhauser Properties of Vertex Packing and  
 L. E. Trotter Independence Systems Polyhedra

\*D. W. Matula A Provably Efficient Branch and  
 Bound Search for the Maximum Sub-  
 graph Connectivity

\*R. Van Slyke Network Reliability: A Case Study  
 H. Frank in Applied Computational Com-  
 A. Kershenbaum plexity

ROOM: Physics Tank 101 (X) 9:00  
 SESSION: Large Scale Systems  
 CHAIRMAN: E. Hellerman

R. S. Dembo Modular Design by Decomposition

J. A. Battiega Relaxed Benders' Decomposition  
 and Degeneralized Fixed Charge  
 Problems

R. F. Hauck The POLYPLEX Method: An All-  
 Primal Extreme-Point Decomposi-  
 tion Method for Large Scale Linear  
 Programs of All Structures

M. Diamond The Solution of a Quadratic Pro-  
 gramming Problem Using Fast  
 Methods to Solve Systems of Linear  
 Equations

\*M. D. Grigoriadis A Framework for the Experimental  
 W. W. White Study of Partitioning Methods for  
 Structured Linear Programs

ROOM: McCullough 134 (Y) 9:00  
 SESSION: Applications: Urban and Educational Planning  
 CHAIRMAN: W. Blattner

C. Cohen Design of an Optimization System  
 M. Reagan for University Research and Teach-  
 J. Stein ing  
 J. Yozallinas

L. Lundqvist Mathematical Models for Urban  
 Planning

T.K. Kumar Determination of Preference Func-  
 J. M. David tion and Optimum Utilization of  
 Resources in a University Under  
 Uncertain Alternatives

*Coffee Break*

PLENARY SESSION/11:20-12:00/Dinkelspiel Auditorium

A. M. Geoffrion Integer Programming and Facility  
 Location: Lessons on One  
 I've Learned from the Other  
 Introduced by J. Abadie

## Friday afternoon, August 31

## PLENARY SESSION/1:30-2:20/Dinkelspiel Auditorium

G. B. Dantzig On Systems Optimization Laboratories  
Introduced by G. Zoutendijk

## PARALLEL SESSIONS 2:30-6:00 p.m.

ROOM: Physics Tank 100 (V) 2:30  
SESSION: Nonlinear Programming: Algorithms  
CHAIRMAN: A. C. Williams

A. Whinston A Class of Mathematical Programming Algorithms  
J. Thurber  
S. Schaible On Nonlinear Fractional Programming Transformations, Quality, and Algorithms  
G.G.L. Meyer Inner Loops in Interior Methods

*Coffee Break*

CHAIRMAN: H. J. Greenberg

A. R. Conn A Penalty Function Method Converging Directly to Constrained Optimum  
T. Pietrzykowski  
J. L. Burroughs Mathematical Programming Techniques for Solving Weapon Allocation Problems  
G. Mall

ROOM: Skilling Auditorium (W) 2:30  
SESSION: Graphs and Combinatorics  
CHAIRMAN: J. Krarup

\*A. F. Veinott, Jr. Meet-Representation of Sub-semilattices and Sublattices of Product Spaces  
D. M. Topkis  
M. W. Padberg Perfect Zero-One Matrices  
D.L. Adolphson Optimal Linear Arrangement and Optimal Linear Ordering Problems  
T. C. Hu  
M.R. Rao The Traveling Salesman Problem and a Class of Polyhedra of Diameter Two  
M. W. Padberg

*Coffee Break*

CHAIRMAN: K. G. Murty

D. B. Weinberger On the Blocking Polyhedron of the Intersection of Two Matroids  
S. Schindler Scheduling Schemata  
U. R. Rothblum On the Number of Complementary Trees in a Graph  
R. E. Tarjan Analysis of Algorithms for Finding Minimum Spanning Trees and Optimum Branching

ROOM: Physics Tank 101 (X) 2:30  
SESSION: Large Scale Systems  
CHAIRMAN: W. Orchard-Hays

\*G. W. Graves Factorization in Large-Scale Linear Programming  
R. D. McBride  
J. K. Reid Sparse Linear Programming Using the Bartels-Golub Decomposition  
S. F. Maier Decomposition of Linear Programs with a Staircase Structure—An Approach for Finding Near Optimal Primal Feasible Solutions  
C. A. Burdet Experimental Results in Large Scale Integer Programming: Some Branching and Bounding Strategies  
R. Brey

*Coffee Break*

CHAIRMAN: R. B. Wilson

J. Ho Nested Decomposition for Dynamic Models  
A. S. Manne  
C.-L. Sandblom Theoretical Properties and Numerical Tests of an Efficient Nonlinear Decomposition Algorithm  
R. S. Sacher On the Solution of Large, Structured Linear Complementarity Problems

Friday, Aug. 31 - afternoon

ROOM: McCullough 134 (Y)

2:30

SESSION: Integer Programming: Enumerative and Branch  
and Bound Methods

CHAIRMAN: J. Kalan

- |                                   |   |
|-----------------------------------|---|
| I. Pohl                           | A Model for Evaluating Enumerative Techniques   |
| J. Doran<br>S. Powell             | Some Relationships Between Heuristic Search Over Directed Graphs, Branch and Bound Methods, and Integer Programming |
| V. C. Ueing<br>J. P. Barthes      | Application of Branch and Bound Methods to Solve Continuous Non-convex Optimization Problems                        |
| A. S. Vincentelli<br>M. Somalvico | Formalization and Properties of State Space Approach to Problem Solving   |