OCTOBER 1997

OPTIMA

Mathematical Programming Society Newsletter

No. 55

A *Fantastic* SYMPOSIUM!

Left to right: Dominique de Werra, George B. Dantzig and Tom Liebling at the opening session in the concert hall.

The Sixteenth International Symposium on Mathematical Programming, August 24-29, 1997, was hosted by École Polytechnique Fédérale de Lausanne (EPFL). Tom Liebling, Dominique de Werra and their team made a great effort to organize a symposium of supreme quality that was also the biggest one ever. Despite the size of the meeting, the organization ran as smoothly as for a small workshop. We thank them all!

The opening session was held on Monday, August 25 in the Métropole Concert Hall downtown Lausanne. Tom Liebling called the meeting to order. Welcome addresses were also given by A. Bidaud, President of the City Council of Lausanne, J.-C. Badoux, President of the EPFL, and Dominique de Werra, Vice-President of the EPFL and International Advisory Committee Chair. Plenary talks were given by George B. Dantzig: "How Linear Programming First Began," and John Dennis, Chairman of the Mathematical Programming Society: "An Essential Tool for Decision Support."

During the opening session the Beale-Orchard-Hays, Dantzig, Fulkerson and Tucker prizes were awarded or announced. The jury reports and the names of the prize winners can be found on the following pages.

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A FANTASTIC SYMPOSIUM!

The scientific program consisted of 446 parallel sessions divided over 25 different topics. Twenty-five semiplenary lectures were presented. The number of participants was the biggest ever: 2268 people from 63 countries. The following special sessions were organized:

Anthony V. Fiacco's 70th Birthday

Philip Wolfe's 70th Birthday

The Pivot Choice Challenge, with Love to George

Tucker Prize Session

Steven Vajda Memorial Session

The Mystical Power of Twoness: In Memoriam Eugene L. Lawler.

Equally well taken care of was the social program. On Tuesday evening, August 26, a Simplex Birthday Party was organized. The Master of Ceremonies was Dick Cottle, and speeches were given by Bob Bixby, Hans Kuenzi, Tom Magnanti, and Phil Wolfe. All these addresses are included in OPTIMA, beginning on Page 4. Wednesday evening featured a cruise and banquet on Lac Léman. The Collège de Cuivres de Suisse Romande provided beautiful musical intermezzi.

Clyde Monma (L) and Les Trotter, previous and current Society treasurers.

PRIZES

The 1997 Beale-Orchard-Hays Prize

The Beale-Orchard-Hays Prize is dedicated to the memory of Martin Beale and William Orchard-Hays, two pioneers in computational mathematical programming.

The Beale-Orchard-Hays Prize honors a paper or book on computational mathematical programming. There are three criteria that are important in selecting the winning nomination:

1. The magnitude of the contribution to the advancement of computational and experimental mathematical programming.
2. The originality of the ideas and methods.
3. The clarity and excellence of the exposition.

For the 1997 award, the work must have appeared in the open literature within the years 1993 through 1996.

After reviewing many excellent nominations, the prize committee decided to award the 1997 prize to **Steven Dirkse** (pictured, left) and **Michael Ferris** (right) for their paper: "The PATH Solver: A Nonmonotone Stabilization Scheme for Mixed Complementarity Problems" which appeared in the journal "Optimization Methods and Software" in 1995.

In their paper the authors propose a pivoting-based Newton's method for the mixed complementarity problem, a problem which is important since it includes several problems such as solving the KKT conditions for nonconvex nonlinear programming, finding equilibria of games both with linear and nonlinear structure, and solving variational inequalities. In extensive computational testing, the solver described in the paper dominates every other recent code in efficiency. It is also very robust. Furthermore, the authors have been instrumental in collecting the first comprehensive test set for this important class of problems. They have made this test set, called MCPLIB, as well as various algorithms, available for comparative testing at the University of Wisconsin.

–ACHIM BACHEM,
KARLA HOFFMAN,
PHILIPPE TOINT,
ROBERT J. VANDERBEI (CHAIR)

The 1997 Dantzig Prize

The George B. Dantzig Prize is jointly administered by the Mathematical Programming Society and the Society for Industrial and Applied Mathematics. This prize is awarded to one or more individuals for original research which, by virtue of its originality, breadth and depth, is having a major impact on the field of mathematical programming. The contributions eligible for consideration must be publicly available and may address any aspect of mathematical programming in its broadest sense.

The 1997 George B. Dantzig Prize was jointly awarded to **Roger Fletcher** and **Stephen M. Robinson** "for sustained, fundamental, and illuminating contributions to the area of mathematical programming ranging from stability theory and sensitivity analysis to broad algorithmic developments in nonlinear programming."

Roger Fletcher and Stephen M. Robinson are congratulated by Ellis Johnson (R).

Justification: It is the committee's unanimous judgment that the broad, sustained, and fundamental works of Roger Fletcher and Steve Robinson deserve the Dantzig Prize. One cannot consider the nonlinear part of mathematical programming without wondering why they have not already been recognized.

Roger Fletcher has made fundamental algorithmic contributions to almost all areas of nonlinear optimization. He is well-known for his contributions to the development of nonlinear conjugate gradient and variable-metric methods for unconstrained optimization, but his contributions have also had a profound impact on nonlinear least squares and nonlinearly constrained optimization. His influence on the development of optimization and its impact on applications is deep and far-reaching.

Steve Robinson's work has fundamentally affected the analysis of the solution, stability, and sensitivity of nonlinear optimization problems. In particular, he introduced generalized equations and the strong-regularity condition into optimization. His work has had a major impact in the analysis and development of algorithms for systems of nonlinear equations, nonlinear complementarity, variational inequalities, and nonlinearly constrained optimization.

Not only is their contribution important, but its sustained nature continues to impress us.

–CLOVIS C. GONZAGA,
ELLIS L. JOHNSON (CHAIR),
CLAUDE L. LEMARÉCHAL,
JORGE J. MORÉ

The D. Ray Fulkerson Prize

The D. Ray Fulkerson Prize in Discrete Mathematics was awarded at the opening session of the XVI International Symposium on Mathematical Programming held in Lausanne, Switzerland.

The committee for the 1997 prize consisted of Ron Graham, Ravi Kannan, and Éva Tardos (chair). To be eligible, papers had to be published in a recognized journal during the six calendar years preceding the year of the Symposium. The term *discrete mathematics* is intended to include graph theory, networks, mathematical programming, applied combinatorics, and related subjects. While research in these areas is usually not far removed from practical applications, the judging of papers is based on their mathematical quality and significance.

The 1997 Fulkerson prize was awarded to **Jeong Han Kim**, for the paper *The Ramsey Number $R(3,t)$ Has Order of Magnitude* $\frac{t^2}{\log t}$, which appeared in *Random Structures and Algorithms* vol 7 issue 3, 1995, pages 173-207.

The Ramsey number $R(s,t)$ is the minimum n such that every red-blue coloring of the edges of the complete graph K_n includes either a red complete graph on s nodes or a blue complete graph on t nodes. The Ramsey number was introduced by Erdös and Szekeres in a paper in 1935. The 1947 paper by Erdös on the symmetric Ramsey number $R(t,t)$ is generally viewed as the start of the probabilistic method in combinatorics. Since then developments in bounds on the Ramsey number have been intertwined with developments of the probabilistic method.

After the symmetric case, the Ramsey number $R(3,t)$ is the most studied. Erdös and Szekeres proved that $R(3,t)$ is $O(t^2)$, this upper bound was improved by Graver and Yackel in 1968 to $O\left(t^2 \frac{\log\log t}{\log t}\right)$, and then in 1990 by Ajtai, Komlòs, and Szemerédi to $O\left(\frac{t^2}{\log t}\right)$. The best known lower bound for $R(3,t)$ was $\Omega\left(\frac{t^2}{\log^2 t}\right)$ due to a 1961 paper by Erdös.

Jeong Han Kim's paper solves this 60-year-old problem by improving the Erdös lower bound to match the upper bound of Ajtai, Komlós, and Szemerédi. The paper is a veritable cornucopia of modern techniques in the probabilistic method; it uses martingales in a sophisticated way to obtain strong large deviation bounds.

PRIZES

The 1997 Tucker Prize

The jury examined 21 submitted papers. The '97 vintage is abundant, diversified and of high quality. It covers many fields of Mathematical Programming and gives encouraging evidence of the vitality of the Society.

The choice of three finalists was difficult. The jury solicited the advice of some renowned specialists. We would like to thank them for their anonymous but highly appreciated contributions. As one of them put it, "Phew, it was tough."

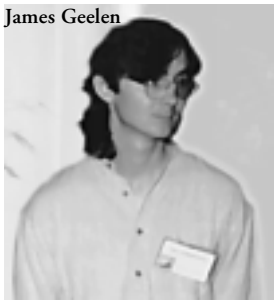
The three finalists are **David Karger**, **James Geelen**, and **Luis Vicente**.

The winner is David Karger. His thesis on "Random sampling in graph optimization problems" is at the crossroads of computer science and optimization. Karger showed that applying random sampling to traditional network optimization leads to surprisingly simple algorithms whose running times are asymptotically faster than previously known algorithms for these problems. In particular, he gives a linear time algorithm for computing a minimum cost spanning tree and an $O(n^2)$ algorithm for computing a global minimum cut. The jury found the contribution deep, original and elegant.

The second laureate is James Geelen for his work on "Matchings, matroids and unimodular matrices." In his thesis James Geelen generalizes the idea of unimodular matrices to square matrices, focusing on the principal minors. Just as matrices and their minors link with matroids, square matrices and their principal minors link

David Karger

James Geelen



Luis Vicente

with objects known as "Delta-matroids." Geelen obtained a nice generalization of results of Camion on unique representability and of Tutte on excluded minors. Some of his proof techniques have already been applied with success to solve other difficult problems.

Our third laureate is Luis Vicente. His work entitled "Trust-region interior-point algorithms for a class of nonlinear programming problems" pertains to the domain of continuous optimization. By drawing on the most efficient known techniques such as sequential quadratic programming, trust regions and interior point algorithm, Luis Vicente proposes and analyzes new efficient methods to solve difficult nonlinear programming problems, in particular, those arising in the area of optimal control.

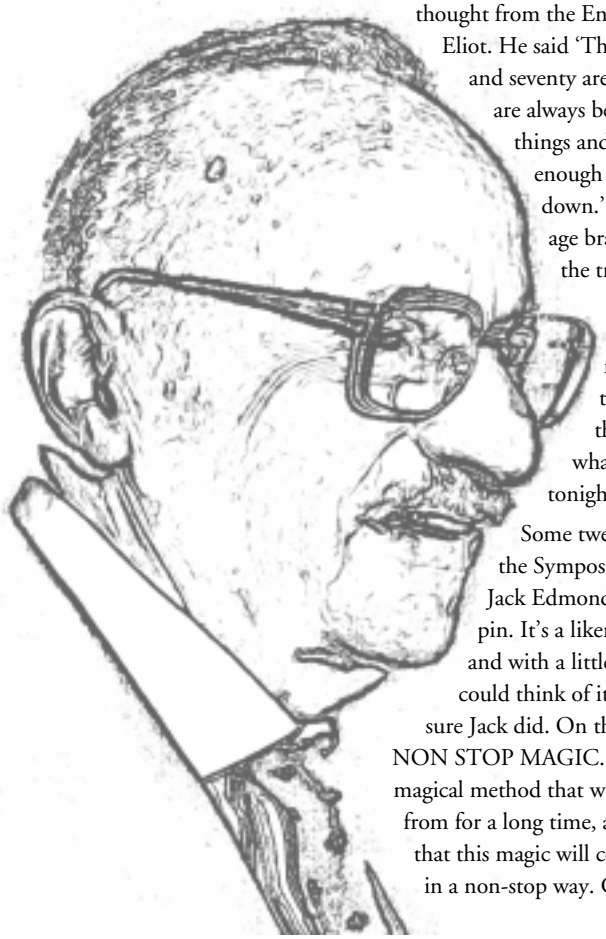
–KURT ANSTREICHER,
RAINER BURKARD,
JORGE NOCEDAL,
JEAN-PHILIPPE VIAL (CHAIR),
DAVID WILLIAMSON

COMMENTS ON THE

Master of Ceremonies Richard W. Cottle's Speech

"As you know, tonight we are here to celebrate the 50th birthday of the Simplex Method. It's the type of thing that some people call The Big Five-Oh. Sometimes it is an occasion to take stock and think about the half century that's passed and perhaps the half that might be coming. In any event, these have been fifty incredibly productive and happy years despite the appearance of certain upstarts [interior point methods] now in their teens.

One might ask what the future holds in store for the Simplex Method – will there be a mid-life crisis? Who knows? Here is a somewhat pessimistic thought from the English poet, T.S. Eliot. He said 'The years between fifty and seventy are the hardest. You are always being asked to do things and are not yet decrepit enough to turn them down.' Well, being in that age bracket, I can attest to the truth of that statement. However, I think there is a much more optimistic way of looking at things, and that is what we are here to do tonight.



Some twenty-one years ago at the Symposium in Budapest, Jack Edmonds gave me this little pin. It's a likeness of a polytope, and with a little generosity, you could think of it as a simplex – I'm sure Jack did. On this simplex is written NON STOP MAGIC. I think we've got a magical method that we've been benefiting from for a long time, and I prefer to think that this magic will continue to be here in a non-stop way. Certainly the inspir-

OCCASION

SIMPLEX OF THE BIRTHDAY PARTY

ing example set by its inventor, George Dantzig, gives a lot of support to this point of view.

Now I'd like to tell you what we have in store for the presentations this evening. We'll have four speakers, the first of whom I'll introduce in a moment. Once these talks are over, I think we should all participate in a nice singing of a certain song, and you may feel free to use the Simplex Method's first name in this.

So let me call forward the first of our speakers this evening. This is H.P. Kuenzi. I'd like to say just a word or two about him. For those of you who are not so acquainted with the scene here in Switzerland, he is a very important figure due in part to his early involvement in mathematical programming and operations research generally. He is a coauthor of a very well-known book on nonlinear programming. It was, for example – as I understand it – the first German language book on the subject ever published. He was a founder and a driving force in the formation of the Swiss OR Society, and you are probably aware of the fact that he subsequently had a career in politics and affairs of state. It is a great pleasure for me to introduce to you H.P. Kuenzi."

Hans Kuenzi's Speech

"It is a great honor for our country that the important and high-level International Symposium on Mathematical Programming is held in Switzerland at the EPFL. We are very happy that we have the unique opportunity to discuss with more than 1400 scientists from 62 different countries the large field of mathematical programming, which developed immensely during the past years. As president of the Support Committee of our Symposium I have also the honor to welcome you to Lausanne in the French-speaking part of Switzerland.

Ladies and gentlemen, before I turned to politics (as a member of the government of the Canton Zürich), I was professor of Mathematics of Operations Research at the University of Zürich. In this double function as politician and mathematician I am very glad about two important events: As a Swiss politician I am glad that the constitution of our state can celebrate its 150th birthday. As a mathematician I am also glad that we can celebrate the 50th Simplex Birthday Party at this exclusive Symposium.

At this occasion I remember the times when we in Switzerland began to study new methods for linear programming. I myself received a grant in 1958 from the Swiss national science foundation, which gave me the opportunity, as a young professor, to study the new field of operations research in the USA. There I had the grand opportunity to meet you, George Dantzig, at the Rand Corporation in Santa Monica, and I recall the interesting discussions with you about the theory and applications of linear programming in several domains, especially in economics. At the same time I became acquainted with Philip Wolfe whose works, especially on the theory of nonlinear programming, I appreciated very much.

When I returned to Switzerland, I gave my first courses in linear programming in Zürich and started writing my first book in German, also on Linear Programming, together with Professor Willhelm Krelle from the University of St Gallen. It was the first book on this topic that appeared in Switzerland. The reason this book was so popular among the students was surely the sympathetic 'Introductory Remarks of George B. Dantzig,' which he began with the words, *'In the brief span of one decade from its conception in 1947, in connection with the planning activities of the military, linear programming has come into wide use in industry. In academic circles, mathematicians and economists have written books on the subject. Interestingly enough, in spite of its wide applicability to everyday problems, linear programming was unknown except for isolated examples without influence before 1947...'* I am sure that this first book stimulated many students in Switzerland to study this interesting algorithm.

In the beginning of the sixties several chairs in operation research and computer science were created where, within the field of applied mathematics, the theory and practice of mathematical programming and the simplex algorithm were treated more and more.

Dear George Dantzig, with these short greetings I hope to have convinced you that, thanks to you, linear programming and the simplex method came to Switzerland. I thank you forty years later for this, and I am happy to be able to celebrate

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the 50th birthday of the Simplex Algorithm, whose father you are, together with you here.

As a little birthday gift I again give you the little book, written 40 years ago, entitled *Linear Programming*, with introductory remarks from George B. Dantzig, where you finally wrote, *'This paper is an introduction for German speaking readers to the basic ideas of linear programming and in particular to the simplex method. It is with great pleasure that I recommend this book to those interested in the subject.*

September 11, 1958 George B. Dantzig, The Rand Corporation, Santa Monica, California'"

Cottle:

"It's been suggested by a number of people that I have some jokes ready for this occasion, but as you see, there is no audio-visual equipment here, and I wouldn't be able to identify those jokes with slides that would tell you they're jokes; so I'm going to skip that and move along to the next speaker, who will be Phil Wolfe.

Phil Wolfe began his career at Princeton after graduating from Berkeley. He was there for a while and then joined the RAND Corporation where he worked in the field of mathematical programming for many years, developing an enormous number of ideas from which we all have derived great benefit. I'm happy to say that I've known him since 1961 and regard him as a good friend. It's a pleasure to introduce him to you now."

Phil Wolfe's Speech

(The editor has kindly allowed me to expand on the remarks I made at the banquet. What follows is what I would have said were it not that banquet diners, unlike readers, cannot skip paragraphs.)

"I was delighted at being invited to speak in celebration of the simplex method, since I owe the major part of my career to it. I hope that it will be heard as tribute to the simplex method and, even more, to George Dantzig and others who contributed so much to it.

In yesterday's plenary session George spoke of the excitement he and his colleagues felt about their work in the Air Force's Project SCOOP in the forties. While Washington was the best place to be, you didn't have to be there to share in that excitement, as I found.

The birth year of the simplex method was also that of the second edition of *Theory of Games and Economic Behavior* by von Neumann and Morgenstern. As a second-year graduate student in mathematics at Berkeley in the Fall of 1949, planning to work in the foundations of mathematics, I was unaware of both. My reading then included not only Hilbert and Ackerman's *Mathematische Logik* but Astounding Science Fiction Magazine. The October 1949 issue of the latter (price $0.25) changed my career. A short story, 'The Finan-Seer' by E.L. Locke, told how a group of university professors rescued their school's failing finances by using something called Game Theory to beat the stock market. Entranced, I got the book the story cited and started trying to understand this new kind of application of mathematics. Converted, I found a Berkeley professor, Edward Barankin, willing to guide work in that area.

While not a fan of game theory, Ed was serious about the application of mathematics to industrial problems and had personal connections with Princeton University, with the Rand Corporation, with the Management Science Research Project at U.C.L.A., and with former Berkeley student George Dantzig. He had me read dozens of reports from those friends. I learned something of the simplex method and of the broad range of important problems that it and related techniques might address.

When I was looking for a job for the summer of 1951, Ed turned to George, and I was invited to work with Project SCOOP in Washington! His people were full of the excitement he spoke of. On arriving I visited each to learn about the work. One, after shaking my hand, said, 'My job is to make a detailed model of the American economy. You'll have to excuse me now, I'm terribly busy.' Others – George and Alex Orden especially – had time for me; and so have they in all the years afterward.

The work of SCOOP had attracted so much attention that the Air Force and the Bureau of Standards held the 'Symposium on Linear Inequalities and Programming' that June (which much later we designated the First Symposium on Mathematical Programming). There, at my first scientific meeting, I was thrilled to see people I had known only through their writings: George Forsythe, Theodore Motzkin, Albert Tucker.

At that time the possibility that degeneracy might make the simplex method fail was of concern. Alan Hoffman, at the Bureau of Standards, had just created the celebrated problem on which the method did indeed fail. George asked me to study the issue, although he had really resolved it already; a report by his student, Edmonston, showed that sufficiently small perturbations in the data of a problem would let the simplex method work. I found that the perturbations could be recast as a "lexicographic" ordering of the data. That, or perhaps just that word, taken from my German reading, was the contribution of my first technical paper.

Returning to Berkeley I split my time between the management science studies Barankin encouraged and my self-chosen thesis topic, a theory of games with no stop rule, in which each player would make an infinite sequence of moves. Barankin didn't like my subject much and judged it adequate only when a paper by David Gale and F.M. Stewart appeared on the same subject but with fewer results than I already had. Still, he wanted it to be only part of my dissertation and had me include the lexicography work as the other. Actually, neither games nor programs got a lot of respect at Berkeley then. A fellow graduate student wanted me to explain linear programming. 'You mean you are trying to find a certain vertex of a polyhedron,' he asked, 'and there are only finitely many vertices?' I answered, 'That's right.' 'But that's trivial!' he declared. That remark was easier to ignore than one by Griffith Evans, Chairman of the department, normally kindly, whose distinction awed us all. Toward the end of my thesis defense he said, 'This is all very well, Mr. Wolfe, but where is the mathematics?'

With Barankin's aid the defense succeeded. He performed one more invaluable service, helping me get an instructorship at Princeton University, where I arrived in the Fall of 1954. That was just when Albert Tucker, department chairman, needed an eager young man to run errands, teach calculus, and participate in his ONR Logistics Research Project, which had supported such luminaries as Shapley, Gale, and Kuhn. (Neither Al nor I could have guessed that a life-long friendship would begin there. Forty years later I told Al how a story in Astounding Science Fiction got me into game theory, and he told me that the author learned about it from a popular lecture of Al's. I find that wonderful.)

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Marguerite Frank was another member of the Logistics Project. Together we developed the basic idea of the 'Frank-Wolfe' algorithm, tying it closely (and probably unnecessarily) to the finding of Barankin and Robert Dorfman at Berkeley, that the solution of a convex quadratic programming problem is a 'complementary' extreme point solution in an appropriate simplex tableau. We submitted this work, naturally, to the Naval Research Logistics Quarterly. At the same time Harry Markowitz, at The Rand Corporation, had written his seminal paper modeling the portfolio problem and solving it as a parametric quadratic programming problem and sent it to the Quarterly. Our buddy Alan Hoffman was the editor, and economically sent our paper to Harry for refereeing, and his to me. Years later Harry and I confessed to each other that we had not really understood what we read, but felt it important, and approved it. They appeared back to back in the March-June, 1956 issue. I then determined to understand Harry's algebra. I didn't, but found that it could be modelled as basis changes in the simplex method. That suggested an algorithm that actually used the simplex method in the Barankin-Dorfman tableau with a special device to ensure complementarity. I wrote that up as 'A simplex method for quadratic programming' early in 1957 and rushed a copy to George, who had joined the Rand Corporation. His letter of January, 1957, said, 'Assuming validity of your proof, I am very much impressed...' It was valid, and I joined Rand in June, 1957.

It was hoped that I could replace Bill Orchard-Hays, who had just left Rand after writing a production simplex method routine for the IBM 704. Leola Cutler was able to adapt that code to quadratic programming, and the observation that only six instructions needed changing was great advertising–if you ignored the fact that you had to massively rearrange the punched-card input data. I became quite skilled at wiring the card reproducing machine. However, I found Bill's assembly language routine impenetrable and pioneered the use of FORTRAN at Rand, to the amusement of its professional programmers. With Leola's help the resulting simplex method package proved more effective than some in assembly language and, owing to the modular design the higher level language facilitated, highly flexible. It served as a vehicle for testing many computational variants of the simplex method and as a subroutine in other procedures. The latter aspect brought to Rand two visitors of great importance in my later life: Michel Balinski, for whom we programmed his new procedure for finding all the vertices of a polyhedron, and Ralph Gomory, who wanted it for his work in integer programming.

I could go on for hours about the excitement of working at Rand at that time amidst its stellar cast (and not even mention the sun-drenched beach a block away). Most important for me were Ray Fulkerson and, of course, George. I've been called a student of George's. I never was in the formal sense, but as a colleague I certainly studied his work and his methods. One result of careful attention to his attacks on several different large-scale linear programming problems was the realization that they had a common idea that could be formalized as what we called 'the decomposition principle.' That concept turned out to have great appeal – it made sense in specialties ranging from computer science to economics. I have been gratified ever since in the linkage of my name to George's in that work (and only mildly vexed at seeing a recent translation from Russian refer to 'Dantzig-Hulf').

Most of my work at Rand, until Gomory lured me to the IBM Research Center in 1966, was spent in testing and trying to improve variants of the simplex method; teaching the simplex method (UCLA and USC); extending the simplex method (the reduced gradient method); and using the simplex method practically (for example, to prescribe a minimum-cost diet every week for some California dairy herds). I even used some of the simplex method in a procedure I proposed for the solution of a system of nonlinear equations, a generalization of the secant method. It seemed good in practice and I tried hard to establish its convergence in general, and couldn't; indeed, a colleague showed later that it could blow up on nice-looking problems. Unknown to me, a distinguished predecessor proposed the method a long time ago. He wrote, 'The study of its convergence presents some difficulties.' I learned this from Ortega's book on nonlinear equations, where he writes of 'the method of Gauss and Wolfe.'

I must stop here, although I never stopped celebrating the simplex method: using it, teaching it, even defending it against the hilariously misunderstood threat of the ellipsoid algorithm (OPTIMA No. 1, June, 1980). I think I've said enough to justify declaring gratefully, Happy Birthday, Simplex Method!"

Cottle:

"The next speaker will be Tom Magnanti from MIT. It's difficult to summarize all the accomplishments that Tom has racked up over the years. He's been president of this and that, editor of this and that — Operations Research, for example. At MIT he is a professor at the Sloan School as well as the Department of Computer Science. He is member of the National Academy of Engineering. I'm delighted to say he is a graduate of my department at Stanford. In addition to that, he was of course a prize student of George Dantzig. It's a pleasure to welcome him to address you this evening."

Thomas L. Magnanti's Speech

"Thank you Dick. As I was sitting at the dinner table, I had an idea. I don't know if George Dantzig is up to this or not; I didn't ask him about it. But, it strikes me that in keeping with the celebration this evening, each of us should have a personal toast with George, and as we do this we could contribute $10 to the Dantzig Prize so we cannot only all jointly celebrate with George but also collect money for this important prize. We'll see if George is up to 1,400 toasts this evening! I think he's still pretty robust and probably can do it. (At this point, George Dantzig interrupts.) George just said he'd prefer to just contribute the money himself and forget about the toasts.

It is difficult to follow our previous speakers who have so much history of working with George Dantzig. Let me share one brief story with you, and then I'd like to do something a little bit different for this evening. The story goes back about 20 years, when George was visiting MIT and I had a few less gray hairs. On that occasion we were traveling in my car, which had very poor shocks, through some terrible roads, lined with one pothole after another, in Cambridge, Massachusetts. Sitting in the back seat of the car were George Dantzig, Bob Dorfman, and Saul Gass. As we would drive down the street, about every ten feet we'd hit a bump, jolting them all - indeed, it would seem that at each pothole one of them would rise and hit his head on the top of

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the car. We finally arrived safely at our destination. Later my wife Beverly said, 'You could have set back the history of linear programming completely by driving around Cambridge with these gentlemen; you could have killed them all off in this one evening.'

Some of you may think that the Simplex Method originated with George Dantzig, project SCOOP, and the Rand Corporation. But actually the Simplex Method started in New England. It originated late in the last century. There's a corporation in New England called the Simplex Wire and Cable Company. I don't know if you ever heard of this company. It used to have a facility right next to MIT. They're the company that installed the first transatlantic underground telephone cable. They developed the Simplex Method for putting cable underground. So I think that we must address a priority issue here as we undertake our celebration.

In graduate school, all of us develop keen friendships with our fellow students, who generally are the same age as us. In many cases, we develop life-long relationships with these individuals. Now I had the occasion of meeting a certain individual, about my age, a year before I enrolled in graduate school and this individual and I actually had one of these rare occurrences when we traveled from undergraduate to graduate school together. Occasionally, we get to meet the parents of the students who we study with and we develop lifelong relationships with them as well. Now my newfound friend was called Simplex. I had encountered this friend through a book that Saul Gass had written. My friend and I traveled to Stanford University to study. And what I'd like to do this evening is in honor of my friend Simplex's birthday, and as we sometimes do at birthday parties, to recall some of the events of the day when my friend was born. Hopefully, this recollection will put this 50th birthday celebration in some perspective: by reflecting on some of the events of 1947, we might be able to attain some sense of how historic it is to have a friend (method) who's reached such a ripe old age.

Some Events in 1947

Monumental Events

- India and Pakistan become independent.
- Hungary becomes a Soviet satellite. Romania becomes a Communist state.
- At the Harvard commencement exercises June 5, U.S. Secretary of State George C. Marshall proposes the Marshall Plan to give financial aid to European countries 'willing to assist in the task of recovery.' Congress authorized some $12 billion in the next 4 years.
- President Truman asked Congress to aid Greece and Turkey to combat Communist terrorism March 12. Congress approves the Truman Doctrine on May 15.
- United Nations Security Council voted unanimously April 2 to place under U.S. trusteeship the Pacific islands formerly mandated to Japan.

Social and Economic Events

- The U.S. Congress passes Taft-Hartley Act, over President Truman's veto, to curb strikes.
- The major world powers sign the General Agreement on Tariffs and Trade (GATT) to significantly lower tariff barriers, end some tariff discrimination, and help revitalize world trade.
- On April 11, Jackie Robinson and the Brooklyn Dodgers break the color barrier in major league baseball.
- Levittown, nearly identical prefab housing, goes up on Long Island to meet the booming post World War II housing demand.
- Ronald Reagan becomes President-yes he does! Of the Screen Actors Guild.
- Minute Maid Corporation has its beginnings as the Vacuum Foods Company (more on orange juice later!).
- Sony Corporation begins as the Tokyo Telecommunications Company.
- Hollywood black list of alleged communist sympathizers compiled.
- Paris couturier Christian Dior introduces the 'New Look' design.

Scientific Inventions/Products

- Transistor.
- Long Playing Records.
- B.F. Goodrich introduces the first tubeless automobile tires.
- Reddi-Wip, Inc., introduces Reddi-Wip, the first major U.S. aerosol food product. Founder Marcus Lipsky advertises aerated 'real' whipped cream inpressurized cans.
- Colgate-Palmolive-Peet introduces Ajax cleanser.
- The Raytheon Company introduces the first commercial microwave oven.
- MSG (monosodium glutamate) is produced commercially for the first time.
- Almond Joy was introduced to augment the popular Mounds bar.
- Variable pitch propeller.
- The Polaroid Land Camera develops its own films within its body - in 60 seconds.
- Subatomic particle pion.
- Willard Frank Libby discovers the atomic time clock (carbon 14 dating).
- Joshua Lederberg and Edward Lawrie Tatum find that sexual reproduction occurs in bacteria - leads to the field, bacterial genetics.
- OR pioneer and British physics Nobel Laureate Patrick Maynard Stuart Blackett advances the theory that 'all massive rotating bodies are magnetic.' (He has previously worked on cosmic rays and especially on the electrical particles known as 'mesons.')
- Flying a U.S. Bell X-1 rocket plane, U.S. Air Force captain Chuck Yeager breaks the sound barrier.

The Arts

- Tennessee Williams' *A Streetcar Named Desire* wins the Pulitzer Prize as does W.H. Auden's, *The Age of Anxiety*.
- Albert Camus publishes *The Plague*.
- Thomas Mann publishes *Doctor Faustus*.

Born

- Tom Clancy
- Stephen King
- David Mamet
- Salman Rushdie
- Kareem-Abdul Jabbar
- Johnny Bench
- Dick Fosbury (of the Fosbury Flop)
- Nolan Ryan
- Elton John
- Farrah Fawcett
- Arnold Schwarzenegger (counterpoint to Farrah Fawcett?)
- Steven Spielberg
- Hillary Rodham Clinton
- Dan Quayle (Republican offset to Hillary Rodham Clinton?)
- O. J. Simpson

And, one other very important thing happened in 1947: **A young fellow by the name of George Dantzig develops a mathematical model called linear programming. He discovers a clever method of solution, my friend Simplex.**

I hope that looking back upon the events of the day in 1947 gives all of us some sense of the historic nature of your birthday, Simplex. As we look back upon these scientific discoveries, the

SIMPLEX

important economic events of the day, and the important artistic achievements of the day, I think that the Simplex Method stands shoulder to shoulder against any of those accomplishments - in terms of its intellectual and scientific contribution, its economic contribution, and perhaps, most importantly for all of us, its artistry. Thank you very much."

Cottle:

"To round out this quartet of speakers we have Bob Bixby, professor at Rice University, also known as Mr. CPLEX, the man who gave us the bag — or we could say the bag man, I'm not sure. He's going to reflect on the past and, I believe, also on the future of linear programming and the simplex method. Ladies and gentlemen, here is Bob Bixby."

Bob Bixby's Speech

"I thank the organizers very much for this invitation. It's a great honor.

It was trying to think how to start. One of my friends suggested something, and I decided it was not a bad idea. He suggested I start out by saying, 'The Simplex Method: she has been veery, veery good to me.'

Indeed, it's true. All of us here owe a great deal to the Simplex Method. I among all of us probably owe the most. I'm simply thankful that George hasn't asked me to pay up!

I decided that I would say just a few short words about the development of computation in the Simplex Method. I will try to keep it short. I have a stack of about 200 slides over there in case anybody wants to hear more.

So, as I was preparing this talk – of course, I want to emphasize that I was not around when the early codes on linear programming were being written, so – I had to ask people!

If you go back to about 1952, '53, the very first codes were being written at The Rand Corporation by Orchard-Hays in collaboration with George Dantzig. In those days they could solve, after a couple of years of work, problems on card programmable computers, problems with about twenty-six constraints. And 'solve' you have to take with a grain of salt. It took them eight hours to solve one such problem, and somebody had to be standing there feeding the cards through the machine. That was 1953.

You get into the sixties, '62 through the mid sixties, and the first commercially successful codes were being developed. That is what John Tomlin told me: LP90 and LP94, which ran on IBM 7090, 7094 computers. These codes could solve problems with up to one thousand rows. Of course, there was a small problem as I understand it. These machines had ten tape drives on them. Now, as I say, I wasn't around, so I don't really know what a tape drive is, but I can imagine. Apparently a problem took eleven tape drives to actually run, so somebody had to stand there.

I also talked to Milt Gutterman who, many of you may know, was an important figure in the development of computer codes for linear programming in the late sixties, early seventies, and beyond. He related to me a story from when he started his first real job – in about 1960. He walked in the door, as a freshly trained OR analyst, and there was somebody standing with stacks of cards, picking them up, walking a few steps and putting them down, waiting, picking them up, walking a few steps, putting them down, ... And he asked this young man what he was doing. He said 'solving a linear program.'

So it was a big step from there to the early 1970s and the first real codes, ones that could be used on a wide variety of problems. It was actually quite a remarkable collection of codes that were developed in the late sixties and early seventies, culminating with the development of a code called MPS3 with Whizard, which originally was written by Dennis Rarick, John Tomlin, Jim Welsh, with a number of other people making important contributions. That code, which was based upon super sparsity, an idea that emerged around 1971, is still, to this day in my opinion, quite a good code. The problem is that it was written in the tradition of the day. It was written for a specific machine. It was written in machine language. It was not flexible.

Those codes: MPS3, MPS3 with Whizard, MPSX, MPSX/370 and a number of other codes brought us into the eighties. The early eighties is when I started to get into the subject. Up to that point, I had been working on something called matroids – which are not related to hemorrhoids! How many of you know what matroids are? (Comment – a show of a few hands.)

When I first learned about linear programming in 1965, of course, we worked with those things called tableaus, and I liked them so much that between 1965 and 1982, I couldn't face a linear program. But right about then, in the early eighties, personal computers came out and I was lucky enough to be at Northwestern University, together with a fellow named Bob Fourer, who had been at Stanford where all this activity in linear programming was going on. The pilot models had been developed there, and Bob just knew a lot about the practice of linear programming. I knew nothing about it.

Fourer showed up at Northwestern and proceeded to painstakingly inform me about how one should really write a linear programming code. And then Tom Baker, a good friend of mine who started Chesapeake Decision Sciences, proceeded to prod me for two years to take this code that I had started writing and develop it further.

So I got started in linear programming in the early eighties, and it was a perfect time to get started. Integer programming was flowering. Machines were becoming available in which memory was essentially unlimited. Really, if you look back at the codes that were available before, if they had had unlimited memory, they could have been written to be as good as those we have today.

That brings me to 1984, a very exciting time. That was when Karmarkar published his work. It seemed like competition was in the air, with new and larger problems constantly being solved. I remember working on a problem together with Irv Lustig, John Gregory, Dave Shanno, and Roy Marsten. The problem arose from airline crew scheduling and had 837 rows and some 13 million columns. It would have been unimaginable just a few years before to solve, even the LP made up of the first 30,000 columns of that model, and we solved the full LP in about 6 minutes using a special-purpose simplex method. Today we can solve that model on a workstation in about two and a half minutes using standard LP tools.

I am very much involved in research on the Traveling Salesman Problem, a problem that serves as a good indication of what is being done in integer programming these days. And integer programming, in my opinion, is the place where the sim-

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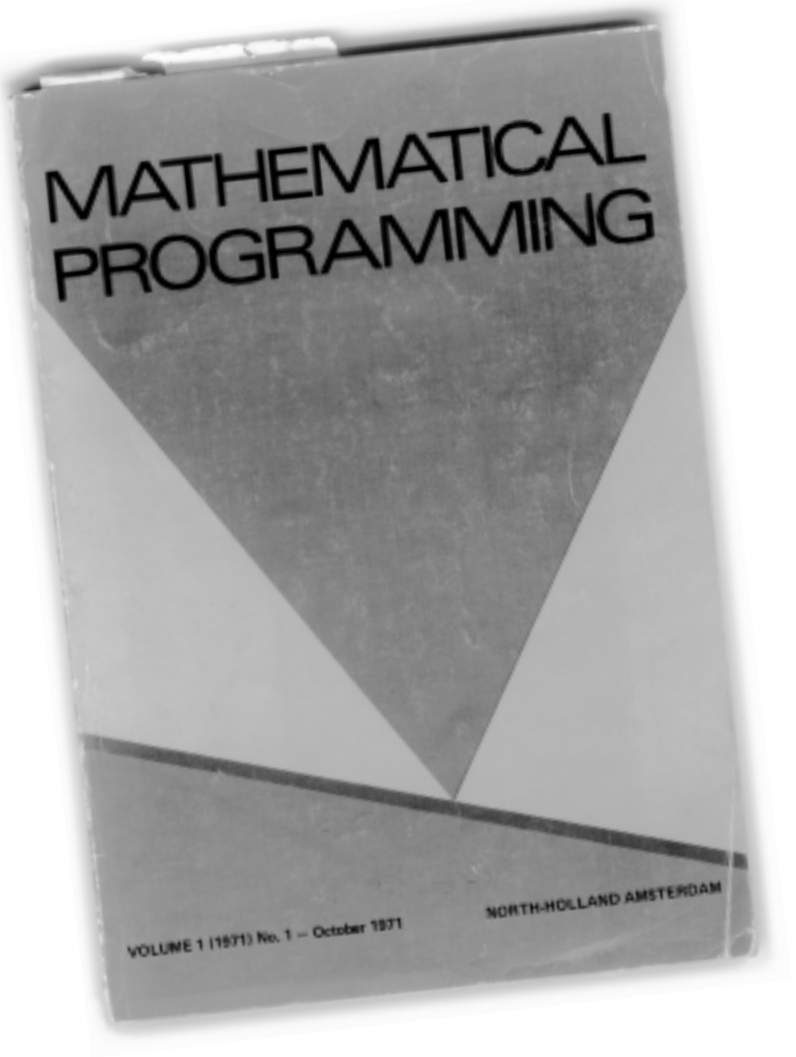
plex method has found its home. We are solving problems in which we solve sequences of thousands of linear programming problems, each of them having on the order of fifteen thousand constraints, thirty thousand variables, and three or four hundred thousand nonzeros, and we don't think even a minute about it. We just let it run.

By the way, something we have Don Goldfarb to thank for is the Dual Steepest Edge Algorithm, which has really carried the Simplex Method forward into this generation.

There are numerous new applications of linear programming that lie ahead of us. We've all seen the explosion in the airline industry. That's nothing compared to what we're about to see in supply-chain optimization, and in other, as yet undiscovered, areas of application.

Finally, I would just like to close with a remark that I am going to attribute to John Forrest. He made it at the end of a talk a few years ago, in which, after putting up a bunch of tables, he said, 'So, we see that the Simplex Method is ten times faster than the Simplex Method.'"

ORIGINAL PHOTOGRAPHS BY A. HERZOG.
HYBRID PHOTO ILUSTRATIONS BY E. DRAKE.



Mathematical Programming's Cover

Several colleagues asked me about the origin of the now familiar cover design of ***Mathematical Programming*** at the 16th Symposium in Lausanne. The story is simple though.

There were a number of technical points to negotiate with our publisher when the journal was launched in 1971 on the basis of the pool of papers presented at the 7th Symposium held in the Hague in 1970. Among these were the cover, the density (or number of words per page), and others. I dealt with these, the Society having only come into existence some time after the journal.

North-Holland's dictum was clear: simple, one color, though two tones of the one color would be acceptable. I felt two features needed to be pictured: extreme point and separation. Indeed, the attractive logo of the Lausanne Symposium elicits similar ideas. I toyed with drawings myself but soon realized that angles aesthetic to the eyes are not trivialities, so a professional hand was needed. I posed the problem to an outstanding architect (and an old and dear friend) Philetus Holt of Princeton, NJ. He solved it and graciously gave it to me for the cover.

- MICHEL BALINSKI

Chair's Column

John Dennis

The Mathematical Programming Society is in fine fettle. Our treasury is plush, the journal continues in the forefront and the backlogs are manageable. We have just elected an outstanding slate of officers. The meeting in Lausanne was the largest ever, the organization was superb, the talks were great, the lake cruise was beautiful, the weather was nice, and the hotel prices were not as high as some of our members feared they might be. Tom Liebling and his committee did a wonderful job. I think special thanks are in order for the polite and helpful young people in the information T-shirts. The challenge is there for Georgia Tech, host of the 2000 meeting, to meet.

By MPS tradition, the 2000 meeting will be in North America. As you know, our society does not have a conference staff, and our meetings are organized and held at the university that submits the most compelling proposal. This means that we count on the local organizers to make our meeting work. This is one reason why I am very excited about having a meeting at GaTech. This major international center for mathematical programming, operations research, and systems engineering is one of the premier US engineering schools. GaTech has some fine new facilities as a result of the recent Olympic Games held in Atlanta, and Atlanta is a beautiful city with interesting restaurants in every price range.

You know by now that the Councils of both organizations have approved a contract for SIAM to provide the MPS membership services we were previously paying ISI (International Statistical Institute) to provide. In choosing a provider, we were limited for practical reasons to other professional organizations large enough to have a permanent staff. The only serious candidates were INFORMS and SIAM. The bids were similar, and both were more attractive than our existing arrangement. Our choice of SIAM was influenced by their outstanding use of the Internet in delivering member services and by the consideration that there would be less of a perception that MPS was being "taken over" by a larger society –INFORMS – with which it has so many common interests.

Some of you have told me that fear of "takeover" makes you uneasy about this change, but all agree that a change from the current arrangement was needed and that the concern about a takeover would have been greater had we hired INFORMS instead of SIAM. I appreciate your expressions of concern since it demonstrates the loyalty that we all feel for MPS, with its informal (but committed) volunteer governance, its single-minded emphasis on research, and its strong international flavor. We have no intention of becoming a SIAM "Activity Group" for Math Programming; nor does SIAM have any interest in blurring the distinction between our two societies. We on the Council and Executive Committee simply feel that the professional staff of SIAM can handle our member services more ably than the available alternatives. Our firm intention is that you will see a difference only in better service. Some noticeable changes that we expect to see include an up-to-date address list, accessible and updateable through the Web.

There is more change afoot; we are now seeking bids for a new journal publisher. Our goals are to make an agreement that will halve our library subscription price, to keep the journal free to our members, to increase the Society's share of subscription revenues, and to keep abreast of developments in electronic publishing as an alternate or additional distribution system. Several members have told us of rescuing our journal from their library "cut" list where it was placed because of the high library subscription price. There is no reason why we should tolerate being out of line in our subscription price. I have named an ad hoc committee of Steve Wright, Jan Karel Lenstra, and Bob Bixby to study the issues and recommend a new publisher. SIAM, INFORMS, Wiley, and Springer have all submitted preliminary bids. The current publisher also submitted a bid but, unlike the other bidders, they have expressed reluctance to lower the subscription price.

The MPS owns the title and MPS logo/cover art and the copyright of all but the first volume, so though the format will certainly change to have less of that expensive white empty space, Math Programming A&B will still be recognizable to its loyal readers, and we will keep the same editorial systems in place. As an aside, you will enjoy Michel Balinski's article in this issue on how the cover art came to be. Also, I really enjoyed Richard Cottle's talk in the Phil Wolfe birthday session in which he solved the "MPS Problem" he derived from the MPS logo.

I felt at this symposium that we have been around long enough now to have a proud history. Tony Fiacco, Alan Hoffman, Phil Wolfe, and, of course, George Dantzig, were active at the symposium. I only wish, as I am sure many of you do, that Garth McCormick had been there and that Martin Beale could have been there. I want my students to have the experience that I had as a young researcher; I was inspired by the presence at meetings of the "legends."

Finally, I want to end this column with a tribute to Jan Karel Lenstra and Don Hearn. Don is Mr. OPTIMA. He has given years of valuable service to making OPTIMA a fine newsletter. Karen Aardal will become editor and Don, who is taking on administrative duties at the University of Florida, will continue as publisher. Jan Karel is Mr. MPS. He embodies all the values that make ours such a fine society, and he is the repository of a vital store of knowledge of the Society. He is unselfish in his devotion to MPS, and he gives great advice. I owe him more than I can possibly say here. Jan Karel, Clyde Monma, and Steve Wright were crucial in the big decisions we have made, and they and Chair-Elect Jean Phillipe Vial will be counted on for the big ones we will make. Thanks, Jan Karel, and do not think we are going to stop trying to take advantage of all you have to offer just because your term has ended.

At the business meeting in Lausanne, John Dennis (Chairman), Jan Karel Lenstra (Vice-Chairman), and Steve Wright (Chairman, Executive Committee) reported on the following items:

Lausanne Symposium

Election results

Editors, *Mathematical Programming* Series A and B, and OPTIMA

Change of membership administration from ISI to SIAM

Location of next international symposium

Location of IPCO meetings in '98 and '99

Suggested revision of the constitution.

The Chairman-Elect Jean-Philippe Vial also had the opportunity to address the members at the business meeting.

Lausanne Symposium

The Lausanne Symposium was a huge success! The Chairman of the Local Organizing Committee, Thomas Liebling, reported on the number of sessions and participants and some financial aspects of the meeting. Tom and the whole Lausanne team received an enthusiastic applause for their fantastic effort.

The 1997 election results, as announced on July 3, 1997, are as follows:

Chairman-Elect: **Jean-Philippe Vial (Switzerland)**

Treasurer: **Clyde Monma (USA)**

Council Members-at-Large: **Karen Aardal (The Netherlands), Kurt Anstreicher (USA), David Shmoys (USA), Uwe Zimmermann (Germany)**

Jean-Philippe Vial will act as Vice-Chairman until August 1998 when he will become Chairman. In August 1998 our current Chairman John Dennis will become Vice-Chairman, a position that he will keep until the Symposium in year 2000.

Editors

Don Goldfarb and John Birge will continue as editors of *Mathematical Programming* A and B respectively. Don Hearn will end his term as editor of OPTIMA and will act as "publisher." Karen Aardal will replace Don as editor. Don Hearn is the founding editor of OPTIMA and has acted as editor since the start in 1980. His work has been very much appreciated by the members, and he was thanked with warm applause by everyone at the meeting.

SIAM to handle MPS member services

Membership services for the Mathematical Programming Society will be handled by the Society for Industrial and Applied Mathematics (SIAM), effective January 1, 1998, upon termination of the current contract with the International Statistical Institute (ISI). The agreement with SIAM was approved by MPS Council in December, 1996.

Under the terms of the agreement, SIAM will handle traditional membership services such as maintenance of the membership address list, provision of the address list to the publishers of *Mathematical Programming* and OPTIMA, annual distribution of the list to MPS members, and annual membership renewal. SIAM personnel will also handle routine queries about membership, address changes, and missed copies of the journal.

The agreement also enhances the services currently provided by ISI in a number of ways. The online, searchable membership list (currently maintained on an informal basis by Steve Wright) will be integrated with the official MPS membership list and maintained professionally by SIAM. MPS members will appear in the Combined Membership Listing for the Mathematical Sciences, alongside members of SIAM, MAA, and other societies. (MPS members can purchase the Listing by checking a box on their annual renewal.) Reminder notices for membership renewal will now be sent up to five times, in contrast to the current single notice. Membership can be renewed quickly and conveniently through the World-Wide Web.

In approving the new agreement with SIAM, the MPS Council took into account the excellent level of service provided by SIAM to its own members, the quality of the SIAM Web site, and the attractive financial terms of the agreement. The many MPS members who are also members of SIAM are familiar with the high standards of this organization and the many shared interests of the two societies. We look forward to a productive relationship in the years ahead.

Location of next International Symposium

The International Symposium on Mathematical Programming in year 2000 will be hosted by Georgia Institute of Technology. George Nemhauser and Martin Savelsbergh will share the responsibility of the organization. We wish them the best of luck and look forward to Atlanta 2000!

Location of IPCO meetings in 1998 and 1999

The 1998 IPCO meeting will be held in Houston. Andy Boyd will be chairing the Local Organizing Committee, and Bob Bixby will be the Chairman of the Program Committee. The 1999 meeting will be held in Graz with Reiner Burkard as Local Chair and Gerard Cornuéjols as Program Chair.

Suggested Revision of the Constitution

A few revisions to the Constitution of the Mathematical Programming Society were suggested. The suggestions were approved at the business meeting. The current Constitution is printed in full on the following page.

Constitution of the Mathematical Programming Society

Adopted 27 July 1978 Adopted in revised form 29 August 1997

I. Name

The society is an international organization to be called 'Mathematical Programming Society'. It will henceforth, in these statutes, be referred to as the Society.

II. Objectives

Its objectives are the communication of knowledge of the theory, applications, and computational aspects of mathematical programming and related areas and the stimulation of their development. In order to realize these objectives, the Society publishes a journal, holds International Symposia and sponsors such other activities consistent with the objectives as may be directed by the Council.

III. Membership

The membership of the Society consists of individual members and of corporate members. Individual members as well as corporate members join the Society by application in a form prescribed by the Council.

IV. Council

1. The elected members of the Council of the Society are the Chairman, the Vice-Chairman, the Treasurer, and four at-large members. The Editors-in-chief of the journal and the Chairman of the Executive Committee shall be invited to all Council meetings and shall be included on all Council correspondence. All must be members of the Society.

2. The Chairman chairs the meetings of the Council. The Council votes by majority of the elected members present, with the Chairman having a casting vote.

3. The Chairman will submit a report on the activities of the Society when he relinquishes his office, and his report will be published in the journal or in a newsletter of the Society. He will chair a business meeting on the occasion of any International Symposium held during his term of office.

4. The Vice-Chairman replaces the Chairman whenever the necessity arises.

5. The Treasurer is responsible for the administration of the funds of the Society, as directed by the Council. The Treasurer shall make a financial report to the Society at the International Symposium held within his term of office.

6. The Editors-in-chief of the journal are appointed by the Council subject to the terms of the contract in force with publishers of the journal. They are responsible for implementing the directives of the Council, in the organization of the journal, and for carrying out its policy.

7. At each International Symposium there will be a meeting of the outgoing Council and of the incoming Council. These meetings may be combined at the discretion of the Chairman. An additional meeting must be held at the request of at least three members of the Council. The place of such a meeting is decided by the Chairman. The Chairman makes arrangements for the taking of minutes at meetings of the Council and business meetings of the Society.

8. The policies of the Council are carried out by the Executive Committee. The Chairman of the Executive Committee is nominated by the Chairman of the Society and is appointed by the Council. He is responsible for executing the executive directives of the Council, for advising the Council, and for organizing the Executive Committee. The Chairman of the Society and the Treasurer are ex officio members of the Executive Committee. The Chairman of the Executive Committee may appoint additional members with the concurrence of the Chairman of the Society.

9. The Council appoints such other committees as it finds necessary to carry out the business of the Society or to further its objectives. The Chairman of the Society and the Chairman of the Executive Committee are ex officio members of all such committees.

V. International Symposia

1. International Symposia are sponsored by the Society at intervals of between 24 and 48 months. The Chairman of the Society nominates and the Council elects the Chairman for the organization of the next International Symposium.

2. Fees for the International Symposium are fixed by the local organizing committee, in consultation with the Chairman of the Society. The Council shall adopt guidelines regarding the financial obligations between the Society and the organizing committee.

3. In the following section on **elections** the word 'term' is defined to be the period from the end of the business meeting held during the International Symposium to the end of the business meeting of the following International Symposium.

VI. Elections

1. Elections for the Offices of Chairman, Treasurer and the four at-large members of Council are held four months prior to each International Symposium. The elected Chairman serves on Council for the two terms following his election. He is the Chairman from one year after the beginning of his first term until one year after the beginning of his second term. He takes the office of Vice-Chairman during the remainder of his period of service. The Treasurer takes office one year after the beginning of the term following his election and he serves until one year after the beginning of the next term. At-large members of Council serve for the term following their election. If the office of Chairman becomes vacant, it is filled automatically by the Vice-Chairman. The Chairman, after consultation with Council, may appoint a member of the Society to fill any other office that becomes vacant until the next election. No one may serve for more than two consecutive terms as an elected at-large member of Council.

2. The Chairman invites nominations for all elections, giving at least two months notice through the journal of the Society of the closing date for the receipt of nominations. Candidates must be members of the Society. They may be proposed either by Council or by any six members of the Society. No nomination that is in accordance with the constitution may be refused, provided that the candidate agrees to stand. The Chairman decides the form of the ballot.

VII. Secretariat

1. The Council is assisted by a Secretariat, which is supervised by the Chairman of the Executive Committee and Treasurer.

2. The Secretariat will keep an up-to-date list of members of the Society, and a list of past and present members of the Council, with an indication of their functions.

VIII. Fees

The membership fee is fixed by Council, and may differ for individual and for corporate members. A member who has not paid his dues before the end of the current year will be deemed to have left the Society.

IX. Journal

The Journal is distributed free of any charge addition to the membership fee to all members of the Society, to their last known address.

X. Agents

Council may approve the payments of membership fees, or of subscription fees for the journal, in national currency, to local agents in countries where it is difficult for individual members to obtain convertible currency.

XI. Other activities

In addition to International Symposia, the Society may sponsor conferences and seminars. The organization of such sponsored meetings is subject to directives by the Chairman of the Society.

XII. Amendment of the Constitution

If proposed by at least ten of the membership of the Society, or by vote of the Council the constitution may be amended by a majority of voters, either at a business meeting of the society on the occasion of an International Symposium, or by a written ballot. Proposals must reach the Vice-Chairman at least two months before the voting takes place.

XIII. Bylaws

1. In order to carry out the obligation as set forth in this constitution and to conduct the business of the Society, the Council shall adopt bylaws. The bylaws may be adopted, annulled, or amended by an affirmative vote of at least four members of the Council. The Council shall have the authority to interpret the bylaws.

2. Council shall pass bylaws governing elections designed to promote and maintain international representation of the Council and Executive Committee.

CONFERENCE NOTES

Algorithms and Experiments (ALEX98) Building Bridges Between Theory and Applications
Trento, Italy
Feb. 9-11, 1998

ICM98
Berlin, Germany
Aug. 18-27, 1998

International Conference on Nonlinear Programming and Variational Inequalities
Hong Kong
Dec. 15-18, 1998

CALL FOR PAPERS

student

THE NICHOLSON PRIZE

1998
George Nicholson
Student Paper
Competition

The INFORMS Student Affairs Committee announces the 1998 George Nicholson Competition for this year's best OR/MS papers written by a student. There are four conditions for eligibility:

1) The entrant must have been a student on or after January 1, 1997;

2) The paper must present original research results;

3) The research must have been conducted while the entrant was a student; and

4) The paper must be written by the entrant with only minor outside editorial assistance. One or more advisors may appear as co-authors of a paper, but the student must be the 'first author'.

Prizes will be awarded at the INFORMS Montreal Meeting, April 26-29, 1998. Winners will be invited to present their papers at the meeting.

Entrants should submit six (6) copies of one paper comprised of no more than 25 double-spaced pages. The entries must be accompanied by a letter signed by both a faculty advisor and the entrant attesting that the four eligibility conditions have been satisfied. These entries should be delivered no later than January 15, 1998, to the chair of the prize committee:

Garrett J. van Ryzin
Graduate School of Business
412 Uris Hall
Columbia University
New York, NY 10027
212-854-4280
gjv1@columbia.edu

International Congress of Mathematicians

Berlin, Germany
August 18-27, 1998

The Organizing Committee is pleased to announce that the next International Congress of Mathematicians will take place in Berlin, Germany, from Tuesday, August 18, through Thursday, August 27, 1998.

It will be held under the auspices of the International Mathematical Union (IMU) and sponsored by many other institutions.

Mathematical Program

Responsibility for the scientific program lies with the Program Committee appointed by IMU. There will be about 20 one-hour Plenary Lectures covering recent developments in the major areas of mathematics and about 170 45-minute Invited Lectures in 19 sections. The sections are as follows:

1. Logic
2. Algebra
3. Number Theory and Arithmetic Algebraic Geometry
4. Algebraic Geometry
5. Differential Geometry and Global Analysis
6. Topology
7. Lie Groups and Lie Algebras
8. Analysis
9. Ordinary Differential Equations and Dynamical Systems
10. Partial Differential Equations
11. Mathematical Physics
12. Probability and Statistics
13. Combinatorics
14. Mathematical Aspects of Computer Science
15. Numerical Analysis and Scientific Computing
16. Applications
17. Control Theory and Optimization
18. Teaching and Popularization of Mathematics
19. History of Mathematics

Every registered participant (traditionally called Ordinary Member) of the Congress will have the opportunity to give a short presentation, either during a poster session or in the form of a 15-minute lecture. A formal call for such presentations will be issued in the Second Announcement. Informal mathematical seminars may be organized at the initiative of groups of participants. English, French, German, and Russian are the official languages of the Congress.

All Plenary and Invited Lectures will be published in the Proceedings of ICM'98; after the Congress, a complimentary copy of these Proceedings will be sent to each Ordinary Member. Abstracts of all lectures and of all short presentations will be distributed free of charge to Ordinary Members at Congress check-in.

The Fields Medals and the Nevanlinna Prize will be awarded during the Opening Ceremony on the first day of the Congress. This will take place in the International Congress Center Berlin (ICC); all other scientific events will be held at Technische Universitaet Berlin. No scientific activities are scheduled for Sunday, August 23.

In an effort to reach out to a wider audience, the ICM'98 organizers have initiated several cultural activities related to mathematics that are attractive to the general public. In particular, there will be a VideoMath Festival, software demonstrations, talks about mathematics and its relations to other subjects, several exhibitions (Mathematics in the Arts, etc.), and other events (Mathematics and Music, etc.).

Special consideration will be given to the impact of the Nazi regime on mathematics in Berlin and Germany.

Social Events: On August 18 there will be a buffet-banquet for all registered participants of ICC. During the Congress, a number of guided tours of Berlin, visits to museums, and walking tours will be offered. On Sunday, August 23, it will be possible to choose from several excursions. For that evening tickets have been reserved for the opera, The Magic Flute, at the Deutsche Opera. Registered participants may purchase tickets in advance for these events as well as for many day trips and pre- or post-congress tours to places of interest in the vicinity of Berlin.

Organization: Up-to-date information about all aspects of ICM'98 is available on the following website: http://elib.zib.de/ICM98. This includes information about registration, abstract submission, etc. Correspondence should be directed to: icm98@zib.de. It will be forwarded to an appropriate member of the Organizing Committee. If electronic communication is not available, you may also write to the ICM'98 Secretary Prof.Dr. J. Winkler at the address below.

Registration and Accommodation:

DER-CONGRESS, a professional congress and tour organizer, has been appointed by the Organizing Committee to handle all non-scientific matters for individual participants: registration to the Congress and the social events, hotel reservations, tourist program, collection of registration fees, etc. The formal registration procedure for the Congress will be described in the Second Announcement (below).

Participants will be housed in several hotels in Berlin; the necessary reservations have already been made by DER-CONGRESS. In addition, DER-CONGRESS will make student residences available and will provide a certain number of private accommodations at an inexpensive rate for participants willing to accept less comfort. Detailed information on locations and rates will be provided in the Second Announcement.

Forms for registration and accommodation requests will be made available on the ICM'98 server in January 1998.

SECOND ANNOUNCEMENT

The Second Announcement of ICM'98 will describe the activities of the Congress in more detail and give instructions on how to complete the registration process and obtain accommodations. It will provide more, although not complete, information on the scientific program, contain a call for contributed short presentations, and give instructions regarding the submission of abstracts.

The Second Announcement will also include advice on how to proceed upon arrival at airports and train stations, and it will be accompanied by a brochure describing the day trips and tours organized by DER-CONGRESS.

Several conferences of a more specialized nature are scheduled immediately before and after ICM'98. The Second Announcement will also contain a list of such "satellite conferences."

To receive the Second Announcement, fill out the form on the ICM'98 server (http://elib.zib.de/ICM98). Alternatively, send an empty e-mail to icm98@zib.de with 'Second Announcement' in the 'SUBJECT' line to receive an e-mail form or contact the ICM'98 Secretary Prof. Winkler at the address below.

The Second Announcement will be mailed from Berlin at the beginning of 1998. Electronic Information on ICM'98 at URL: http://elib.zib.de/ICM98 (with request form for Second Announcement)

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International Conference on Nonlinear Programming and Variational Inequalities

Hong Kong

December 15-18, 1998

First Announcement

The conference aims to review and discuss recent advances and promising research trends in some areas of Nonlinear Programming and Variational Inequalities.

Topics Include:

Nonlinear Complementarity Problems

Variational Inequality Problems

Nonsmooth Optimization Problems

Minimax Problems

Multi-level Optimization Problems

Structured Optimization Problems

Quadratic and Nonquadratic Methods

Invited Speakers Include:

O. Burdakov (CERFACS, France)

S. Dempe (Freiberg Univ. of Mining and Tech., Germany)

F. Facchinei (University of Roma, Italy)

S.C. Fang (North Carolina State University, USA)

M. Fukushima (Kyoto University, Japan)

L. Lasdon (University of Texas at Austin, USA)

Z.Q. Luo (McMaster University, Canada)

J.M. Martínez (University of Campinas, Brazil)

J.J. Moré (Argonne National Laboratory, USA)

S. Nash (George Mason University, USA)

J.S. Pang (Johns Hopkins University, USA)

P.P. Pardalos (University of Florida, USA)

E. Polak (University of California at Berkeley, USA)

D. Ralph (University of Melbourne, Australia)

R.T. Rockafellar (University of Washington, USA)

E. Spedicato (University of Bergamo, Italy)

K.L. Teo (Curtin University of Technology, Australia)

P. Tseng (University of Washington, USA)

R.J.B. Wets, (University of California at Davis, USA)

H. Yabe (Science University of Tokyo, Japan)

Y. Yuan (Chinese Academy of Sciences, China)

Conference Chairs:

L. Qi (University of New South Wales, Sydney, Australia), Email: l.qi@unsw.edu.au

J. Zhang (City University of Hong Kong, Hong Kong), Email: mazhang@cityu.edu.hk

Organizing Committee:

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C. Xu (Xi'an Jiao Tong University, China)

X. Zhang (Chinese Academy of Sciences, China)

Call for Papers

Titles and abstracts of contributed papers must be received by July 31, 1998. The abstracts should be typed in Latex, not exceed one page, and be sent to maopt@cityu.edu.hk by email.

Special Arrangements

Conference proceedings, special issues of some journals, tours and economical hotel accommodations will be indicated in the Second Announcement.

Further Information:

Email: maopt@cityu.edu.hk

Home page: http://www.cityu.edu.hk/ma/

or contact Conference Chairs.

Reviews

Visualization and Optimization

by Christopher V. Jones
Kluwer Academic Publishers
Dordrecht, 1996

ISBN 0-7923-9672-3

Have you ever looked at a contour plot of a nonlinear function? Have you ever looked at the feasible region of a 2-variable linear program? Have you ever looked at a Gantt chart to analyze the solution to a scheduling problem? Have you ever looked at a plot of the nonzero entries in a matrix? Have you ever seen the farthest inserting algorithm in action? Have you ever seen the Lin-Kernighan edge-exchange algorithm in action? Have you ever seen Edmond's matching algorithm in action?

Visualization is, and rightfully so, an important tool in the toolkit of an optimizer. It helps to gain insight into a problem, an algorithm, or a solution. The above examples and many more are discussed in the new book *Visualization and Optimization* by Chris Jones.

The book is not the prototypical example of a text in operations research or mathematical programming. It does not discuss a specific problem or a specific methodology; instead, it focuses solely on how visualization can be used to support building and understanding optimization models, algorithms and their solutions.

The book takes the point of view that techniques from visualization, when applied appropriately, can improve our ability to solve people's problems. The purpose of visualization is much the same as the purpose of optimization: to provide insight into complex problems. Optimization uses sophisticated algorithms to uncover optimal solutions to complex problems. Visualization uses carefully designed representations to help people understand complex problems. The book also issues a warning: visualization, like optimization, can easily be misused.

The book covers a lot of material. It presents basic background material from cognitive psychology and other fields relevant to visualization; it provides guidance for those seeking to visualize their problems, models, and algorithms; it discusses existing research and practice on using visualization to support optimization analysis; it surveys research that has applied optimization to creating visualizations; and it suggests research directions for those interested in pursuing research on visualization applied to optimization.

The book is divided into three parts. Part I: "A Framework for Visualization and Optimization." It presents relevant background material from cognitive psychology, computer graphics, visual design, and other areas. Part II: "Visualization and the Modeling Life-Cycle." It discusses how visualization has been or might productively be used to support distinct phases of the modeling life cycle. Part III: "Visualization for Optimization." It focuses on how different representation formats have been or could be used to support optimization.

The book is a pleasure to read and contains a wealth of information, including many informative illustrations. Even so, it becomes clear that the area of visualization and optimization is still in its infancy. It has not yet lived up to its potential. Visualization offers an opportunity to make optimization even more enjoyable, understandable, and accessible. It can enhance our ability to deliver optimization to students as well as practitioners.

- M. SAVELSBERGH

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Primal-Dual Interior-Point Methods

by Stephen J. Wright
SIAM, Philadelphia, 1996

ISBN 0-89871-382-X

Since Karmarkar's method for linear programs appeared in 1984, numerous interior-point methods have been proposed and studied for various problems. Among others, primal-dual interior-point methods have been harmoniously developed both in theory and in practice. Now they are known to be very efficient and powerful numerical methods for solving large scale linear programs. This book covers both theory and practice of primal-dual interior-point methods for linear programs and briefly mentions their extensions to other mathematical programs. The book is well-organized, comprehensive, and easy to read for experts, graduate students and even good undergraduate students who want to study this subject for the first time.

Chapter 1 gives an overview of this book introducing fundamental ideas and various important issues on primal-dual interior-point methods. This chapter itself is a nice self-contained survey on the subject. Chapters 2 and 3 serve as preliminaries and background. They are devoted to the standard form linear program, the duality theory, the fundamental ideas of primal-dual interior point methods, the complexity theory of algorithms, etc. Chapters 4, 5 and 6 are the major theoretical part of this book. These three chapters present full theoretical complexity analyses of the most important primal-dual interior-point methods, i.e., potential-reduction methods, path-following methods and infeasible-interior-point algorithms, respectively. Chapters 7 and 9 discuss some further theoretical issues on primal-dual interior-point methods; superlinear convergence and finite termination in Chapter 7, and a homogeneous self-dual formulation of primal-dual interior-point algorithms which incorporates a mechanism of getting infeasibility information in Chapter 9. Chapter 8 describes extensions of primal-dual interior-point methods from linear programs to some other types of problems such as convex quadratic programs, convex programs, linear and nonlinear monotone complementarity problems, and semidefinite programs. The last two chapters place much emphasis on practical aspects of primal-dual interior-point methods. Chapter 10 presents Mehrotra's predictor-corrector algorithm on which many current software packages are based, and in Chapter 11 there are some computational issues involved in efficiently and stably solving large sparse systems of linear equations for primal-dual search directions. Finally, several software packages, some of which are free and available through the Internet, are listed in the appendix.

- MASAKAZU KOJIMA

Stochastic Models

by H.C. Tijms
John Wiley, Chichester, 1994

ISBN 0-471095123-4

Stochastic Models is a modernized version of the author's previous book that also appeared with Wiley, under the title *Stochastic Modeling and Analysis*.

It contains four chapters:

1. Renewal Theory with Applications
2. Markov Chains: Theory and Applications
3. Markov Decision Processes and their Applications
4. Algorithmic Analysis of Queueing Models

Each chapter is concluded with a section, Bibliographic Notes, and a well-sized section of References.

Chapter 1 provides the basics of renewal theory, the Poisson process and renewal reward processes. Further, it contains two larger sections on Reliability and Inventory in which the theoretical results are applied.

Chapter 2 gives a very complete presentation of discrete and continuous time Markov chains and uses the applications to illustrate the modeling aspects. It is concluded with sections on Transient Analysis and the Phase Method.

Chapter 3 is devoted to the average reward Markov decision processes. It treats Policy Iteration, Linear Programming and Value Iteration. We also find an interesting section on tailor-made policy iteration algorithms that exploit the specific structure of the application of interest.

Chapter 4 starts with the more advanced queuing models as the ordinary M/G/1 queue, the M/G/1 queue with batch arrivals and the G/G/1 queue. After that it continues with a thorough and extensive algorithmic analysis of multi-server queues including finite capacity models. As for most of the models treated in this chapter, analytical results are very limited; the emphasis is on approximations, particularly for the distribution of the waiting time.

As the titles of the chapters clearly indicate (applications, algorithmic), the book is an attempt to help the reader to become an engineer in stochastic modeling. Although, as the author remarks, we all know that the only way to become a modeler in this difficult area is by doing. This book with the many examples in the text and over a hundred interesting exercises, is an excellent way to start.

Each of these chapters can very well be used as the basis for a course. The chapters are to a large extent independent. Chapter 2 can be studied without almost any knowledge of the renewal theory in Chapter 1, and Chapters 3 and 4 require only a very basic knowledge of Markov chains. Each chapter starts with the basic material which requires little background and only a limited amount of intuition but then continues with more advanced topics which ask for a higher level of understanding. Particularly, Chapter 4 is very interesting but not so simple.

In the preface we read that this book is more directed to students than to researchers, in contrast to the previous version. I agree with that; it is definitely one of the best books for students who want to get acquainted with stochastic modeling, but it is a lot more than another set of lecture notes.

In all four chapters we discover special topics in which we recognize the author's research. We find many important and useful approximations which take us one step further than analysis could. The emphasis is on applications and approximations which are useful for the engineer. But at the same time, these sections are important for researchers who are treating problems for which no standard models exist.

For me that is just what makes *Stochastic Models* so much more attractive than most of the books in this area. Therefore, I can recommend it to anyone who is interested in Stochastic Operations Research.

- J. VAN DER WAL

New Editorial Staff

At the Symposium, OPTIMA changed editorial staff. Don Hearn, who founded OPTIMA in 1980, has been the editor since the start. He will now help the new editor, Karen Aardal, with several publication aspects. The editorial structure will be slightly different from previous years. Karen will as editor continue with her previous task as "Features Editor." To get news on developments in our field, including software, and also to assist Karen in suggesting and attracting Feature articles, OPTIMA will have two "Area Editors"; Mary Beth Hribar, Rice University, for Continuous Optimization, and Sebastian Ceria, Columbia University, for Discrete Optimization. Book reviews will, of course, continue to form an important section of OPTIMA. The new Book Review Editor is Robert Weismantel, ZIB-Berlin. You will find the addresses of all editors on the last page of OPTIMA. In the next issue of OPTIMA there will be a short presentation of all of them. The new staff hopes that the members of MPS will continue to provide OPTIMA with Feature articles, software information, conference notes, and all possible ideas and suggestions!

Thank You Don!

As the new editor of OPTIMA, I would like to extend a warm THANK YOU to my predecessor Don Hearn for his fantastic job with producing OPTIMA since 1980. I also would like to thank the secretarial staff at the Center for Applied Optimization at the University of Florida in Gainesville for all their assistance through the years. Elsa Drake at Gator Engineering Publication Services has given OPTIMA its distinguished professional style. Fortunately they will all continue to help with preparing and publishing OPTIMA! Thanks as well to Don's wife Joyce who has spent numerous hours on editing and proofreading OPTIMA. Also, many thanks to the previous associate editors Faiz Al-Khayyal, Software and Computation Editor, and Dolf Talman, Book Review Editor, for all their efforts.

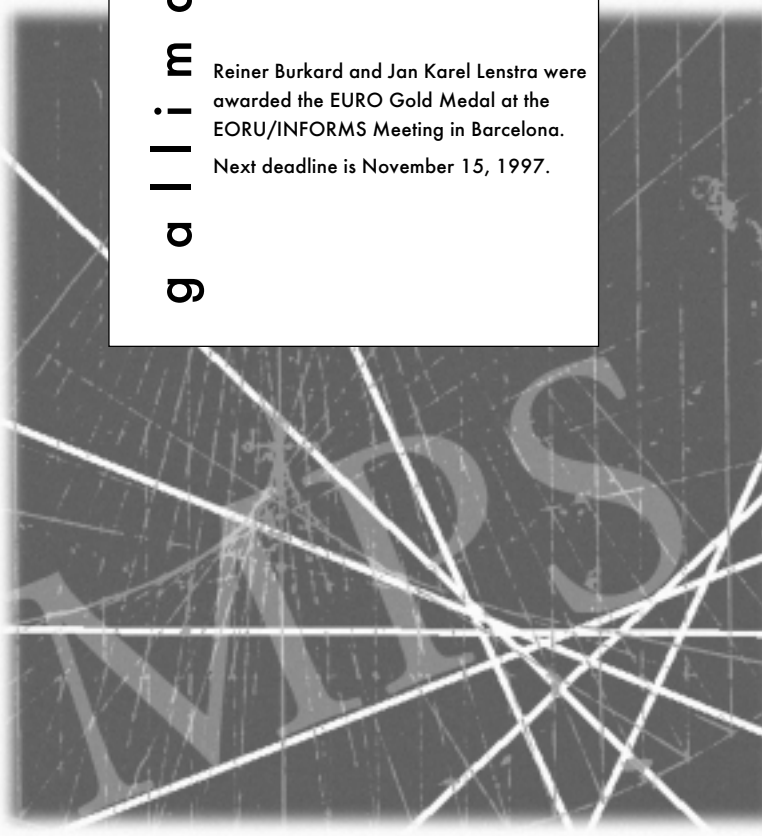
In the next issue of OPTIMA there will be an interview with Don, where he tells us about both his work with OPTIMA and his scientific activities.

–KAREN AARDAL

gallimaufry

Reiner Burkard and Jan Karel Lenstra were awarded the EURO Gold Medal at the EORU/INFORMS Meeting in Barcelona.

Next deadline is November 15, 1997.



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