Vita of Katta G. Murty

Name:	Katta Gopalakrishna Murty
Date of Birth:	9 September 1936
Citizenship:	U.S.A.
Marital Status:	Married, 2 daughters
Mailing Address:	Department of Industrial and Operations Engineering 1205 Beal Avenue The University of Michigan Ann Arbor, MI-48109-2117, USA Campus: 734-763-3513, Home: 734-995-3475, Fax: 734-764-3451 e-mail: murty@umich.edu Webpage: http://www-personal.engin.umich.edu/~ murty/
Wife's Name:	Vijaya

Education:

Ph.D.	Engineering Science (Operations Research), University of California, Berkeley, 1968 (Graduate Advisor: Professor David Gale of the IEOR Dept.)
M. Stat.	M.S. degree in Statistics, Indian Statistical Institute, Calcutta, India, 1957
B. Sc.(Honors)	Statistics, Madras University, India, 1955

Experience:

University of Michigan:	Professor, 1980 −; Associate Professor, 1973-1980; Assistant Professor, 1968-1972.
University of California,: Berkeley	Acting Instructor, 1967-1968; Junior Specialist, 1965-1967.
Case Inst. of Technology	Visiting Fulbright Scholar, 1961-1962.
Indian Statistical Institute	Assistant Professor and SQC and OR Consultant, 1957-1965

Visiting Professor Appointments

1974-75	Bell Laboratories, Holmdel, NJ; and Indian Statistical Institute, India
1981-82	University of Texas at Dallas, Richardson, TX; and Indian Statistical Institute, India
1988-89	King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia
1995-96, Summer 1997	Hong Kong University of Science and Technology, Clear Water Bay, Kowloon, Hong Kong
Summer 1999	American University of Armenia, Yeravan, Armenia
Summer 2002	NFFP participant at NASA, LaRC in Atmospheric Sciences.

Summer 2006, Winter 2007	Visit National Dong Hwa University, Hua Lin, Taiwan, on a Fulbright Senior Specialists Program grant.
Professional Societies:	Member of INFORMS (Institute for Operations Research and Management Sciences), and Mathematical Programming Society. Associate Editor for *Opsearch* (the Journal of the Operations Research Socirty of India), on The Editorial Advisory Board for *Algorithmic Operations Research*.
Research Interests:	Linear, integer, combinatorial, and nonlinear programming and their applications. Efficient algorithms for optimization problems and their applications
Honors and Awards:	Fulbright Scholar award 1961-62, for research at Case Institute of Technology, Cleveland (award received while I was a resident of India). American Institute of Indian Studies award 1974-75, for research at Indian Statistical Institute (award received when I was a resident of USA). *Most Outstanding Faculty Member Award, 1977-78*, by Alpha Pi Mu, the Industrial Engineering Honor Society. *Koopman Prize, 1999*, by the Military Applications Society of INFORMS, Outstanding paper award for the paper [65]. *INFORMS Case Competition Finalist*, for the paper [T27], 2001. Selected as a *Fellow of INFORMS* (Institute For operations Research and Management Science), 2003. *Edelman Finalist Award*, of INFORMS for work on decision support systems for daily operations at Hong Kong International Terminals Ltd., 2004 *Fulbright Senior Specialist award*, for 3 years; 2006, 2007 at National Dong Hwa University and National Taiwan University of Science and Technology, Taiwan; and 2009 at Institute of Polytechnic at Portelagre and University of Coimbra, Portugal. *2012 ASEE Meriam/Wiley Distinguished Author Award*, from American Society for Engineering Education.
Recent Consulting Work:	**Motorola**, 1994 -, Algorithms and software for the routing of calls in the Iridium Network (a low earth orbit satellite based personal communication system being built by Motorola). **US Army**, 1993 -, Application of linear, integer, location, routing, and scheduling models in designing systems for the training of National Guards, Army Reserves, and US Army.
Patents:	US Patent no. 5608721 "Communications network and method which implement diversified routing", awarded 4 March 1997, for the algorithm to route calls in the Iridium Network.
Recent Professional Service:	Program Chair for the 15th International Symposium on Mathematical Programming, Ann Arbor, 14 to 19 August 1994.

Vita of K.G. Murty contd. ...

1. Developed an algorithm for ranking assignments of a linear assignment problem in increasing order of cost in 1962 (published in [7]). This is the basis for the well known branch and bound algorithm for the traveling salesman problem using the assignment relaxation, which first appeared in [T_1] and a revised version of which is published in [8]. The assignment ranking algorithm has now become the main tool for solving the *data association problem* in multitarget tracking, a breakthrough of commercial importance, as this problem arises in airplane tracking in the daily operations of air traffic controllers. Each plane appears as a blip on the radar screen. The data association problem is that of relating the blips in the screen of the previous instant to those of the current screen.

2. Developed an algorithm for ranking the basic feasible solutions of a linear program in increasing order of the objective function, and various applications for it in [10, T_4].

3. Initiated the geometric study of the LCP (linear complementarity problem) using complementary cones in my Ph.D. dissertation [T_3] and in [11].

4. Developed a principal pivoting algorithm which solves LCPs associated with P-matrices in finite time [18]. This approach has been extended by others to solve nonlinear complementarity problems and nonlinear programs.

5. Established that the computational requirements of complementary pivot methods for solving LCPs have exponential growth in the worst case [3, 21].

5. Established that the computational effort required to solve a parametric linear program is not bounded above by a polynomial in the size of the problem in the worst case [24].

6. Proved that a pair of simple convex polytopes which have the same two dimensional skeleton are isomorphic [17].

7. Established that checking degeneracy in a linear programming problem is NP-Complete [31].

8. With my graduate student C. Perin, developed efficient blossom algorithms for 1-matching/edge covering problems [27].

9. Established a systematic characterization for faces of all dimensions incident at a degenerate extreme point of a convex polyhedron specified by linear constraints. Used this characterization to develop an algorithm for enumerating all efficient faces of a multi-objective linear program [33].

10. Constructed the simplest nonconvex nonlinear program (a simple indefinite quadratic programming problem) in which checking whether the objective function is bounded over the feasible region, or whether a given feasible solution is a local minimum, are both Co-NP-Complete problems. Also established that checking whether a polynomial function is bounded over R^n, and whether a given point is an unconstrained local minimum for it, are both Co-NP-Complete problems. Developed realistic goals for algorithms in nonconvex programming [39].

11. Developed the gravitational method for linear programming, based on tracking the path of a heavy spherical drop inside the feasible region as it falls under the influence of a powerful gravitational force pulling everything in the direction of the negative gradient of the objective function [38, 41].

12 Defined CP-rays in simplicial cones and studied their geometry and applications to the linear complementarity problem [43].

13. Defined the concept of segments in convex polytopes, and developed an algorithm for enumerating all the faces of a convex polytope specified by a degenerate system of linear constraints; whose complexity is polynomial in terms of the size of the system, and the number of these faces [54].

14. Developed an $O(n^{2.5})$ algorithm for finding a perfect matching with specified number of edges of each color in a complete bipartite graph in which each edge is either red or blue [74].

15. Developed the algorithms and software for the routing of calls in the Iridium Satellite Network, in a worldwide personal communication system being built by Motorola, based on 66 low earth orbit (400 miles above the surface of the Earth) satellites circling the globe in 6 different orbits. A US patent (no. 5,608,721) has been awarded for this work in 1997.

16. Developing sphere methods that help solve LP models using matrix inversion operations sparingly, now extending them to NLP and 0-1 models.

Ph.D. Dissertations of Graduates Personally Supervised (as Chair or Co-Chair)

J. B. Sidney, "One Machine Deterministic Job-Shop Scheduling with Precedence Relations and Deferral costs", 1970 (Co-Chair with R. M. Thrall).

O. Merrill, "Applications and Extensions of an Algorithm that Computes Fixed Points of Certain Upper Semi-Continuous Point to Set Mappings", 1972.

R. L. Tobin, "Minimal Complete Matchings and Applications", 1973.

J. Etcheberry, "The Set Representation Problem", 1974.

E. J. Gainer, "Large Scale Convex Quadratic Programming", 1975.

Y. Fathi, "On the Computational Complexity of the Linear Complementarity Problem", 1979.

S. J. Chung, "Structural Complexity of Adjacency on 0–1 Convex Polytopes", 1980.

C. Perin, "Matching and Edge Covering Algorithms", 1980.

Z. Yakin, "An Augmented Lagrangian Algorithm for Inequality Constrained Nonlinear Programs", 1981.

A. Gana, "Studies in the Complementarity Problem", 1982.

P. J. Carstensen, "The Complexity of Some Problems in Linear and Combinatorial Programming", 1983 (Co-Chair with C. Simon).

M. H. Partovi, "A study of Degeneracy in the Simplex Algorithm for Linear Programming and Network Flow Problems", 1984.

Y. Alyahya, "Matching and Covering Algorithms", 1984.

G. R. R. Waissi, "Acyclic Network Generation and Maximal Flow Algorithms for Single Commodity Flow", 1985 (Co-Chair with D. Cleveland).

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S. Y. Chang, "The Steepest Descent Gravitational Method for Linear Programming", 1988.

K. Yang, "New Iterative Methods for Linear Inequalities", 1990.

K. S. Al-Sultan, "Nearest Point Problems: Theory and Algorithms", 1990.

J. C. Arantes, "Resolution of Degeneracy in Generalized Networks and Penalty Methods for Linear Programs", 1991 (Co-Chair with J. Birge).

T. Yi, "Bipartite Matchings with Specified Values for a 0–1 Linear Function", 1994.

A. Y. Alfakih, " Facets of an Assignment Problem With a $0-1$ Side Constraint", 1996.

T. H. Chu, "On a Class of Strictly Semimonotone Matrices in a Linear Complementarity Problem", 2001.

M. E. H. Petering, "Design, Analysis, and Real-Time Control of Material Handling Systems", 2007.

Printed Publications

Textbooks

[1] *Linear and Combinatorial Programming*, 567 pages, Wiley 1976, Krieger 1985.
[2] *Linear Programming*, 482 pages, Wiley, 1983.
[3] *Linear Complementarity, Linear and Nonlinear Programming*, 629 pages, Heldermann Verlag, Berlin, 1988 (now out of print, Latex files of all the chapters can be downloaded from: http://www-personal.engin.umich.edu/ murty/).
[4] *Network Programming*, 623 pages , Prentice-Hall, 1992.
[5] *Operations Research: Deterministic Optimization Models*, 581 pages, Prentice-Hall, 1995.
[6] *Optimization for Decision Making: Linear and Quadratic Models*, 482 page MS-level textbook, Springer, 2009.
[$W1$] *Sophomore level Self-Teaching Webbook for Computational & Algorithmic Linear Algebra & n-Dimensional Geometry*, Full text available at the website: http://ioe.engin.umich.edu/people/fac/books/murty/algorithmic_linear_algebra/
[$W2$] *Junior Level Optimization Models for Decision Making, Vol. 1,* available at: http://ioe.engin.umich.edu/people/fac/books/murty/opti_model/

Papers in Refereed Journals or Other Refereed Publications

[7] "An Algorithm for Ranking All the Assignments of the Assignment Problem in Increasing Order of Cost", *Operations Research*, 16, no. 3(May-June 1968)682-687.
[8] "An Algorithm for the Traveling Salesman Problem", with J. D. C. Little, C. Karel, and D. Sweeney, *Operations Research*, 11(Dec. 1963)972-989.
[9] "Linear Programming Under uncertainty - A Basic Property of the Optimal Solution", *Z. Wahrscheinlichkeitstheorie Verw. Geb.*, 10(1968)284-288.
[10] "Solving the Fixed Charge Problem by Ranking the Extreme Points", *Operations Research*, 16(1968)268-279.

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[11] "On the Tours of a Traveling Salesman", *SIAM J. Control*, 7, no. 1(Feb. 1969)122-131.

[12] "On the Number of Solutions to the Complementarity Problem and Spanning Properties of Complementary Cones", *Linear Algebra and its Applications*, 5(Jan. 1972)65-108.

[13] "On a Characterization of P-Matrices", *SIAM J. Applied Mathematics*, 20, no. 3(May 1971)378-384.

[14] "Adjacency on Convex Polyhedra", *SIAM Review*, 13, no. 3(July 1971)377-386.

[15] "A Fundamental Problem in Linear Inequalities With Application to the Traveling Salesman Problem", *Mathematical Programming*, 2, no. 3(June 1972)296-308.

[16] "On the Set Representation and Set Covering Problems", *Proceedings of the Symposium on Scheduling*, held in Raleigh, North Carolina, 15-17 May 1972, Springer-Verlag.

[17] "The Graph of an Abstract Polytope", *Mathematical Programming*, 4(1973)336-346.

[18] "Note on a Bard-Type Scheme for Solving the Complementarity Problem", *Opsearch*, 11, nos. 2-3(June-Sept. 1974)123-130.

[19] "Existence of A-Avoiding Paths in Abstract Polytopes", *Mathematical Programming Study*, 1(1974)41-42.

[20] "Complementarity Problems", article in Vol. 5 of *Encyclopedia of Computer Science and Technology*, J. Belzer, A. G. Holzman, and A. Kent (eds.), Marcel Dekker, 1976.

[21] "Computational Complexity of Complementary Pivot Methods", *Mathematical Programming Study*, 7(1978)61-73.

[22] "A Note on an Estimation Problem", PP 80-81 in *Urn Models and Their Application*, by N. L. Johnson and S. Kotz, Wiley, 1977.

[23] "On the Linear Complementarity Problem", PP 425-439 in *Proceedings of the Third Symposium on Operations Research, Band 31: Continuous Optimization*, W. Oettli, and F. Steffens (eds.), Athenaum/Hain/Scriptor/Hanstein, 1978.

[24] "Computational Complexity of Parametric Linear Programming", *Mathematical Programming*, 19, no. 2(Sept. 1980)213-219.

[25] "Nonlinear Optimization", PP14.3.1 to 14.3.19 in *Handbook of Industrial Engineering*, G. Salvendy (ed.), Wiley-Interscience, 1982.

[26] "Polynomially Bounded Ellipsoid Algorithms for Convex Quadratic Programming", with S. J. Chung, *Methods of Operations Research*, 40(1980)63-66.

[27] "Edge Covering Algorithms and Their Applications", with C. Perin, *Methods of Operations Research*, 40(1980)379-383.

[28] "Polynomially Bounded Ellipsoid Algorithms for Convex Quadratic Programming", with S. J. Chung, PP 439-485 in *Nonlinear Programming 4*, Academic Press, 1981.

[29] "A 1-Matching Blossom Type Algorithm for Edge Covering Problems", with C. Perin, *Networks*, 12(1982)379-391.

[30] "A Critical Index Algorithm for Nearest Point Problems on Simplicial Cones", with Y. Fathi, *Mathematical Programming*, 23(1982)206-215.

[31] "Some NP-Complete Problems in Linear Programming", with R. Chandrasekaran and S. N. Kabadi, *Operations Research Letters*, 1, no.3(July 1982)101-104.

[32] "A Feasible Direction Method for Linear Programming", with Y. Fathi, *Operations Research Letters*, 3, no.3(Aug. 1984)121-127.

[33] "Faces of a Polyhedron", *Mathematical Programming Study*, 24(Oct. 1985)30-42.

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[34] "Intermediate Feasibility in $0-1$ Integer Linear Systems", with P. J. Carstensen and C. Perin, *Mathematical Programming Study* 24(Oct. 1985)219-224.

[35] "A Finite Characterization of K-Matrices in Dimension Less Than Four", with J. T. Fredricksen and L. T. Watson, *Mathematical Programming*, 35(1986)17-31.

[36] "On K^{Δ}, with S. J. Chung and S. Y. Chang, *Discrete Applied Mathematics*, 15(1986)199-211.

[37] "Vehicle Routing at Quality Stores", with T. Chan, T. Cutter, L. Kaplan, D. McGettingan, and C. Yano, *Interfaces*, 17, no. 2(Mar.-Apr. 1987)52-63.

[38] "The Gravitational Method for Linear Programming", *Opsearch*, 23, no. 4(1986)206-214.

[39] "Some NP-Complete Problems in Quadratic and Nonlinear Programming", with S. N. Kabadi, *Mathematical Programming*, 39(1987)117-129.

[40] "A Correction to a Result in Linear Programming", *Discrete Applied Mathematics*, 20(1988)177-180.

[41] "The Steepest Descent Gravitational Method for Linear Programming", with S. Y. Chang, *Discrete Applied Mathematics*, 25(1989)211-239.

[42] "Computational Behavior of a Feasible Direction Method for Linear Programming", with Y. Fathi, *European Journal Of Operational Research*, 40(1989)322-328.

[43] "CP-Rays in Simplicial Cones", with L. Kelly and L. T. Watson,*Mathematical Programming*, 48(1990)387-414.

[44] "On Checking Unboundedness of Functions", with P. M. Camarini and S. J. Chung, *Arabian Journal of Science and Engineering*, 16, no. 2B(1991)255-262.

[45] "Constrained Assignment Problem" with A. B. Hadj-Alouane, *Arabian Journal of Science and Engineering*, 16, no. 2B(1991)233-238.

[46] "Nearest Points in Nonsimplicial Cones and LCPs with PSD Symmetric Matrices", with K. S. Al-Sultan, PP 199-212 in *Recent Developments in Mathematical Programming*, S. Kumar (ed.), Gordon Breach, Melbourne, Australia, 1991.

[47] "Surrogate Constraint Methods for Linear Inequalities", with K. Yang, *Combinatorial Optimization*, M. Akgul, H. Hamacher, and S. Tufekci (eds.), NATO ASI Series F82(1992)19-38.

[48] "New Iterative Methods for Linear Inequalities", with K. Yang, *Journal of Optimization Theory and Applications*, 72, no. 1(1992)163-185.

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[50] "Exterior Point Algorithms for Nearest Points and Convex Quadratic Programs", with K. S. Al-Sultan, *Mathematical Programming*, 57(1992)145-161.

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[52] "Studies of Lexicography in the Generalized Network Simplex Method", with J. C. Arantes and J. R. Birge, *Annals of Operations Research*, 47(1993)237-248.

[53] "Combinatorial Optimization Problems with Max-Linear Objective Functions", with S. J. Chung, H. W. Hamacher, and F. Maffioli, 42(1993)139-145.

[54] "Segments in Enumerating Faces", with S. J. Chung, *Mathematical Programming*, 70(1995)27-45.

[55] "The Army training Mix Model", with P. Djang, W. Butler, and R. Laferriere, *Journal of the Operational Research Society*, 46(1995)294-303.

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[56] "Quadratic Programming", PP 529-535 in *Encyclopedia of Operations Research and Management Science*, S. I. Gass and C. M. Harris (eds.), Kluwer, 1996.

[57] "Clustering Problems in Optimization Models", with C. Spera and S. N. Kabadi, *Computational Economics*, 9(1996)229-239.

[58] "On the Complexity of Finding Stationary Points of Nonconvex Quadratic Programs", with J. Judice, *Opsearch*, 33(1996)162-166.

[59] "Optimizing the Radial Component Insertion Operations on PCBs", , with S. Y. Chang and H. C. Hwang, PP 1–19 in G. Yu (ed.), *Industrial Applications of Combinatorial Optimization*, Kluwer, 1997.

[60] "Convergence of the Steepest Descent Method for Minimizing Quasiconvex Functions", with K. C. Kiwiel, *Journal of Optimization Theory and Applications*, 89, no. 1 (April 1996)221-226..

[61] "On the Convergence of the Block Principal Pivoting Algorithm for the LCP", with S. Takriti, *European Journal of Operational Research*, 102(1997)657-666.

[62] "Adjacency on the Constrained Assignment Problem", with A. Y. Alfakih, *Discrete Applied Mathematics*, 87(1998)269-274.

[63] "Complexity of Degeneracy", to appear in *Encyclopaedia of Optimization*, C. A. Floudas and P. M. Pardalos (eds.), Kluwer.

[64] "Second Order Optimaliy Conditions in Nonlinear Optimization" to appear in *Encyclopaedia of Optimization*, C. A. Floudas and P. M. Pardalos (eds.), Kluwer.

[65] "The US Army National Guard's Mobile Training Simulators Location and Routing Problem", with P. Djang, *Operations Research*, 47, no. 2 (March-April 1999)175-182.

[66] "A Hybrid Genetic/Optimization Algorithm for a Task Allocation Problem, with A. Ben Hadj-Alouane and J. Bean*Journal of Scheduling*, 2(1999)189-201.

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[73] "Tool Path Optimization in Layered Manufacturing", with P. K. Wah, A. Joneja, and L. C. Chiu, *IIE Transactions*' 34(no. 4, 2002)335-347.

[74] "Matchings in Colored Bipartite Networks", with T. Yi, and C. Spera, *Discrete Applied Mathematics*, 121(2002)261-278.

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[75] "Rubber tired gantry crane deployment for container yard operation", with R. Linn, J. Liu, Y. Wan, and C. Zhang, *Computers and Industrial Engineering*, 45(issue 3, Oct 2003)429-442.

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[81] "An i-DMSS Based on Bipartite Matching and Heuristics for Rental Bus Allocation", with W. J. Kim, a Chapter in *Intelligent Decision Making Support Systems*, edited by Gupta, Mora, and Forgionne, Springer Verlag, 2006.

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[84] "Linear Equations, Inequalities, Linear Programs (LP); and An Efficient New Algorithm", a Chapter in *Tutorial in OR* , INFORMS 2006, 1-36.

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[88] "Forecasting for Supply Chain and Portfolio Management", Chapter 14 in *Mathematical Programming and Game Theory for Decsion Making*, Edited by S. K. Neogy, R. B. Bapat, A. K. Das, & T. Parthasarathy,Vol. 1, of a series of books prepared for the Platinum Jubilee celebrations of the Indian Statistical Institute; World Scientific Publishing Co., Singapore, 2008, 231-255.

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[90] ""Note on Implementing the New Sphere Method for LP Using Matrix Inversions Sparingly", with M. R. Oskoorouchi, *Optimization Letters*, 3, 2009, 137-160.

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[91] “”Effect of block length and YC Deployment systems on performance at a seaport container terminal” , with M. E. H. Petering, *Computers & OR*, , 36 (2009) 1711-1725.
[92] “New Sphere Methods for LP”, to appear in *Tutorials in OR 2009*, INFORMS.
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[94] “How Effective is Aggregation for Solving 0-1 Models” with Archana Khurana, *Opsearch*, 49, 1, 2012, 78-85.

Edited Books, and Theme Issues of Journals

[$E1$] *“Theme Issues on Optimization: Theory and Engineering Applications” of Arabian Journal for Science and Engineering*, with A. Raouf, S. Z. Selim, and S. O. Duffuaa, Vol 15, no. 4B, October 1990; and Vol 16, no. 2B, April 1991.
[$E2$] *Mathematical Programming: State of the Art 1994*, with J. R. Birge.
[$E3$] *“Theme Issue on Optimization Theory and Applicatons” of Arabian Journal for Science and Engineering*, with H. D. Sherali, Shokri Z. Selim, Sadiq M. Sait, M. Bettayeb and H. Youssef, Vol. 25, no. 1C, June 2000.

Community development articles at public websites

“The benefits of shifting to CNG for fuel”; http://seekingalpha.com/article/87234-the-benefits-of-shifting-to-cng-for-fuel

Technical Reports, etc.

[$T1$] “Traveling Salesman Problem: Solution by a Method of Ranking Assignments”, with C. Karel and J. D. C. Little, Case Institute of Technology, 1962 (unpublished, the very first paper on the branch and bound method for the traveling salesman problem).
[$T2$] “The Symmetric Assignment Problem”, ORC67-12, University of California, Berkeley, 1967.
[$T3$] “On the Number of Solutions to the Complementary Quadratic Programming Problem”, Ph. D. dissertation, ORC68-17, University of California, Berkeley, 1968.
[$T4$] “Some Applications of the Algorithm for Ranking the Extreme Points”, IE Dept., University of Michigan, Ann Arbor, 1970.
[$T5$] “On Two Related Classes of Complementary Cones”, IE Dept., University of Michigan, Ann Arbor, 1970.
[$T6$] “The Generalization of Euler Property to Abstract Polytopes of Dimension 3”, IE Dept., University of Michigan, Ann Arbor, 1970.
[$T7$] “On the Finite Nature of Quadratic Programming: A Note on R. K. Mueller’s Paper”, IE Dept., University of Michigan, Ann Arbor, 1971.
[$T8$] “On the Parametric Complementarity Problem”, IE Dept., University of Michigan, Ann Arbor, 1971.

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[$T9$] "Algorithm for finding All the Feasible Complementary Bases for a Linear Complementarity Problem", IE Dept., University of Michigan, Ann Arbor, 1972.

[$T10$] "Ranking the Policies in a Multiple Choice Problem in Increasing order of Cost", with R. Saigal and P. Unger, Bell Labs., 1974.

[$T11$] "An Algorithm for Ranking the Spanning Trees in a Network in Increasing Order of Cost", with R. Saigal and J. Suurballe, Bell Labs., 1974.

[$T12$] "Convexity of Piecewise Linear Functions", IE Dept., University of Michigan, Ann Arbor, 1980.

[$T13$] "Parametric Specified Cardinality 1-Matching/Covering Problem and Intermediate Feasibility Property", with P. J. Carstensen and C. Perin, IE Dept., University of Michigan, Ann Arbor, 1983.

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