

## **RAVINDRAN KANNAN**

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### **CURRENT POSITION**

William K. Lanman Jr. Professor of Computer Science and Professor of Applied Mathematics,  
Yale University.

### **EDUCATION**

Bachelor of Technology in Electrical Engineering, 1974, Indian Institute of Technology, Bombay, India.  
Master of Science, 1977, Cornell University, Ithaca, New York.  
Ph.D. in Operations Research, 1979, Cornell University, Ithaca, New York.

### **HONORS**

Fulkerson Prize in Discrete Mathematics, 1991, awarded jointly by the American Mathematical Society  
and the Mathematical Programming Society for

“A random polynomial time algorithm for estimating the volumes of convex bodies”, with Martin  
Dyer and Alan Frieze, Journal of the Association for Computing Machinery, pp 1-17, January  
1990.

Plenary Speaker, 35 th Annual IEEE Symposium on the Foundations of Computer Science, Santa Fe,  
October 22-24, 1994.

D. J. Gandhi Distinguished Visiting Professor, Indian Institute of Technology, Bombay, June, 2004.

Rosser Memorial Lecture, University of Wisconsin, Madison, Fall 2002.

Invited Speaker, International Congress of Mathematicians, Beijing, China, 2002.

### **POSITIONS HELD**

Carnegie-Mellon University, Professor of Computer Science and Mathematics, 1990-1997.

Bell Communications Research, Visitor, 1992-93.

Carnegie Mellon University, Associate Professor 1983-1990.

Massachusetts Institute of Technology, Associate Professor, Department of Mathematics, 1983. Assistant  
Professor, Department of Mathematics, 1980 - 1983.

University of California, Berkeley, Lecturer/Post Doctoral Fellow, 1979 - 1980.

Cornell University, Instructor, Summer 1977 and 1979. Teaching Assistant, 1975 - 1977.

University of Bonn, Wissenschaftlicher Assistant, 1978.

## **SERVICE**

Chair, Fulkerson Prize Committee, 1999-2000.

Member, Fulkerson Prize Committee, 1997-98.

Associate Editor, Annals of Applied Probability, 2003-.

Editor, SIAM Journal on Computing, 1984-1996.

Editor, Special Issue, Journal of Computer and System Sciences, 1987-88.

Associate Editor, Mathematics of Operations Research, 1987-1989.

Associate Editor, Transactions on Mathematical Software, ACM, 1983-1987

Member, Program Committee, Integer Programming and Combinatorial Optimization, 2003.

Member, Program Committee, 42 nd Annual Symposium on the Foundations of Computer Science, 2002.

Member, Program Committee, 38 th Annual Symposium on the Foundations of Computer Science, 1998.

Member, Program Committee, 33 rd Annual Symposium on the Foundations of Computer Science, 1992.

Member, Program Committee, Second conference on Integer Programming and Combinatorial Optimization, 1992.

Member, International Program Committee, 14 th International Symposium on Mathematical Programming, 1991.

Member Program Committee, First conference on Integer Programming and Combinatorial Optimization, 1990.

Member, Program Committee, Nineteenth Annual ACM Symposium on Theory of Computing, 1987

Member, Program Committee, 27 th Annual Symposium on the Foundations of Computer Science , 1986

Member, Program Committee, Fourteenth Annual ACM Symposium on Theory of Computing, 1982

## **Advisees / Postdocs**

Vijaya Chandhru, Ph.D., M.I.T. 1982.

Rex Dwyer, 1984-87 (Ph. D. completed 1988 under Prof. Daniel Sleator)

Thomas Mathies - CMU, Ph.D. Fall 1991.

David Applegate - CMU, Ph.D. Fall 1991.

John Mount - CMU, Ph.D. Spring, 1995.

Lotfi Tadj - Masters student, CMU, 1984.

Jeremy Horowitz - Masters Student.

Petros Drineas - Ph. D. 2002.

Ravi Montenegro - Ph. D., 2002.

Karhan Ackoglu - Ph. D., 2002.

Andreas Nolte - Visiting Postdoc 1997-98.

Michael Mahoney - Applied Mathematics Gibbs Instructor 2002-2003.

Kevin Chang - Current

Pradipta Mitra - Current

Hadi Salmasian - Current

### **SELECTED INVITED TALKS**

Sampling on the Fly, Optimization Day, Columbia University, July 2003.

Low-rank Approximations and Applications, Joint meeting of the American Mathematical Society and Indian Mathematicians, Bangalore, India, December 2003.

Solving Max-CSP Problems, Oberwolfach Seminar on Approximation Algorithms, 2004.

What can you do with one or two passes ?, Theory Day, New York University, March 2, 2001.

Constructive versions of the Regularity Lemma and applications, Invited Course, Research Institute, EIDMA, Eindhoven University, Netherlands, May 1999.

Linear Algebra and Information Retrieval, Distinguished Lecture, Department of Computer Science, University of Texas, Austin, October 1999.

*Fast Linear Algebra Algorithms and applications*, Foundations of Computational Mathematics, Oxford, July 1999.

*Fast randomized algorithms for Linear Algebra and Applications*, Second Ann Arbor conference on Mathematics and its Applications, May 1999.

*Low-rank approximations to matrices and algorithmic applications*, Microsurveys in Discrete Probability, Institute of Advanced Study, Princeton, June 1997.

*Geometric Isoperimetric inequalities*, in the Workshop on Discrete Isoperimetric Inequalities, Institute of Advanced Study, Princeton, Nov., 1995.

*Learning Theory and Operations Research*, Mini course in the Annual Operations conference of the Dutch Operations Research Society, Dec., 1995.

*Learning the intersection of half-spaces*, Geometry Day, Courant Institute, New York University, Spring 1993.

*Rapidly Mixing Markov chains*, Institute of Mathematical Statistics Workshop “Directions in Probability”, University of Minnesota, August, 1993.

*Randomized algorithms for convex sets*, Theory Day, Columbia University, Fall 1992.

*Random Walks in convex sets*, 25 th Anniversary of the Department of Combinatorics and Optimization, University of Waterloo, June 1992.

*Multivariate Sampling, Integration and Computing Volumes*, Sixth SIAM Conference on Discrete Mathematics, June 1992.

*A Stochastic Optimization problem*, Mathematisches Institut, Oberwolfach, Germany, January 1992.

*Parametric Integer Programming*, Summer Meeting of the Canadian Mathematical Society, 1991.

*Geometry and Algorithms* 600 th Anniversary of Cologne University, Cologne, Germany, November 1988

*Recent results in Geometry of Numbers*, AMS-SIAM joint summer research conference, Bowdoin College, Maine, July 9-16, 1988

*Convex Hull of randomly chosen points from a polytope*, International Workshop on Parallel Algorithms and Architectures, Suhl, E.Germany, May 1987

*Covering Minima and lattice point free convex bodies*, Foundations of Software Technology and Theoretical Computer Science, Sixth Conference, New Delhi, India December 1986

*Lattice Algorithms and their applications* Organizer, Mini-symposium at the SIAM National Meeting, Pittsburgh June 1985

*Complexity issues in Linear Algebra* , Janos Bolyai Mathematical Society , Budapest July 1984

*Polynomial Algorithms for the Smith and Hermite Normal Forms*, Tenth International Symposium on Mathematical Programming, Montreal, September 1979.

*Polynomial-Time Aggregation of Integer Programs*, Operations Research Society of America Conference, Houston, Texas, October 1981.

### **Selected Colloquia, Seminars**

Massachusetts Institute of Technology, Stanford University

Cornell University, University of California, Berkeley

Yale University, Princeton University

Indian Institute of Technology, New Delhi, Tata Institute of Fundamental Research, Bombay, India

Indian Institute of Technology, Madras, Indian Institute of Science, Bangalore, India

Purdue University, University of Chicago

Georgia Institute of Technology, University of Kentucky

Rutgers University, Bell Laboratories, New York University

New York City College, Bell CORE, University of Southern California

Oxford University, Edinborough University, U.K.

University of Bonn, University of Frankfurt, W.Germany

University of Koln, University of Augsburg, W.Germany

Mathematical Institute of the Hungarian Academy of Sciences, Budapest  
University College, London, Cambridge University, U.K.

## PUBLICATIONS

- “Polynomial Algorithms for the Smith and Hermite Normal Forms of an Integer Matrix” (with Achim Bachem), *SIAM Journal on Computing*, Vol. 8, November 1979, pp. 499-507.
- “A Polynomial Algorithm for the Two-Variable Integer Programming Problem,” *Journal of the Association for Computing Machinery*, Vol. 27, No. 1, January 1980, pp. 118-122.
- “A Characterization of Threshold Matroids” (with Rick Giles), *Discrete Mathematics* 30 (1980), pp. 181-184.
- “On the Computational Complexity of Integer Programming Problems” (with Clyde L. Monma), in *Optimization and Operations Research, Lecture Notes in Economics and Mathematical Systems*, Vol. 157 (R. Henn, B. Korte, W. Oettli, eds.), Springer-Verlag, 1978, pp. 161-172.
- “Minimum Number of Upsets in Round Robin Tournaments” (with Robert E. Bixby), Technical Report No. 324, School of Operations Research, Cornell University, January 1977.
- “Exponential Lower Bounds on a Class of Knapsack Algorithms” (with Dirk Hausmann and Bernard Korte), *Mathematics of Operations Research*, Vol. 6, No. 2, May 1981.
- “Approximative Combinatorial Algorithms” (with Bernhard Korte), in *Mathematical Programming : Proceedings of the International Congress on Mathematical Programming*, Rio de Janeiro, Brazil, April 1981 eds. R.Cottle, M.L.Kelmanson and B.Korte, pp 195-248
- “Polynomial-time algorithm for the orbit problem” (with R.J.Lipton), *Journal of the Association for Computing Machinery*, Vol. 33, No. 4, October 1986, pp 808-821
- “Towards Separating Nondeterministic Time from Deterministic Time”, Special issue of *Mathematical System Theory*, 17, pp29-45 (1984)
- “Polynomial-Time Aggregation of Integer Programming Problems,” *Journal of the Association for Computing Machinery*, Vol. 30, No. 1, January 1983, pp. 133-145.
- “Applications of Polynomial Smith Normal Form Calculations” (with Achim Bachem). In *Numerische Methoden bei graphentheoretischen und kombinatorischen Problemen, Band 2* (L. Collatz, G. Meinardus, W. Wetterline, eds.), Birkhauser Verlag, Basel, 1979.
- “Solving Systems of Linear Equations Over Polynomials,” *Theoretical Computer Science*, 39 (1985) pp 69-88
- “Alternation and the Power of Nondeterminism,” *Proceedings of the 15th ACM Symposium on the Theory of Computing* (1983), pp. 344-347.
- “Circuit-Size Lower Bounds and Non-Reducibility to Sparse Sets,” *Information and Control*, Vol.55, Nos.1,2,3 (1982) pp40-56
- “Polynomial factorization and non-randomness of bits of algebraic and some transcendental numbers ” (with A.K.Lenstra and L. Lovász), *Mathematics of Computation* Vol. 50, No. 181, pp (1988) pp 235-250

- “Unravelling k-page graphs” *Information and Control* Vol. 66, No. 1/2 July/August (1985) pp 1-5
- “Sub linear parallel algorithm for computing the greatest common divisor of two integers ” (with G.L.Miller and L.Rudolph) *SIAM Journal on Computing*, Vol. 16, No. 1 February 1986, pp 7-17
- “Reconstructing truncated integer variables satisfying linear congruences”, with A.Frieze, J.Hastad, J.C.Lagarias and A.Shamir, *SIAM Journal on Computing* Vol. 17, No. 2, April 1988, pp 262-280
- “Minkowski’s convex body theorem and Integer Programming”, *Mathematics of Operations Research*, Vol. 12 No. 3, August 1987 pp 415-440
- “Hermite normal form computation using modulo arithmetic”, with P.D.Domich and L.E.Trotter, *Mathematics of Operations Research*, Vol. 12 No. 1, February 1987 pp 50-59
- “Succinct certificates for almost all subset sum problems” (with M.L.Furst), *SIAM Journal on Computing*, Vol. 18, No. 3, pp 550-558, June 1989.
- “On nontrivial separators for k-page graphs and simulation of k-tape nondeterministic Turing machines by 1-tape machines” with Z.Galil and E.Szemerédi, *Journal of Computer and System Sciences*, Vol. 38, No. 1, (1989) pp 134-149
- “On 3-pushdown graphs with large separators”, with Z.Galil and E.Szemerédi, *Combinatorica*, **9** (1) (1989) pp 9-19.
- “Basis reduction and evidence of transcendence of certain numbers” with Lyle McGeogh in the *Proceedings of the Sixth Conference on Foundations of Software Technology and Theoretical Computer Science*, New Delhi, India, December (1986) - published as *Springer Lecture Notes in Computer Science*, 241, ed. K.V.Nori, pp263-270
- “Covering Minima and lattice point free convex bodies” with L.Lovász, *Annals of Mathematics*, 128, (1988) pp 577-602.
- “Algorithmic Geometry of Numbers” in *Annual Review of Computer Science* eds. Traub, Grosz, Lampson and Nilsson, Vol. 2 (1987), pp 231-267 Publish. Annual Reviews Inc.
- “Chvatal Closures for mixed Integer Programming problems”, with W.Cook and A.Schrijver, *Mathematical Programming* 47 (1990), pp 155-174.
- “The shapes of polyhedra”, (with L.Lovász and H.Scarf), *Mathematics of Operations Research*, Vol. 15, No. 2, May 1990.
- “A random polynomial time algorithm for estimating the volumes of convex bodies”, with Martin Dyer and Alan Frieze, *Journal of the Association for Computing Machinery*, pp 1-17, January 1990.
- “On integer points in polyhedra”, with W.Cook, M.Hartman and C.McDiarmid, *Combinatorica* **12** (1) (1992) pp 27-37.
- “Lattice translates of a polytope and the Frobenius problem”, *Combinatorica*, **12** (2) (1992), pp 161-177.
- “Test sets for Integer Programs,  $\forall\exists$  Sentences”, *DIMACS Series in Discrete Mathematics and Theoretical Computer Science* Volume 1, (1990), pp 39-47 Publish. American Mathematical Society
- “Sampling and Integration of near log-concave functions”, with D. Applegate in 23 rd annual Symposium on the Theory of Computing, 1991.

- “A circuit-based proof of Toda’s theorem” with H.Venkateshwareen, V.Vinay and A.C.Yao, Information and Computation, Vol. 104, No. 2, June 1993, pp 271-276.
- “A Randomized Algorithm for the component commonality problem” with J. Mount and S. Tayur, Mathematics of Operations Research, Vol 20, No 3, pp 529-549 1995.
- “A mildly exponential algorithm for estimating the number of knapsack solutions”, with M. Dyer, A. Frieze, A. Kapoor, L. Perkovic, and U.V. Vazirani, Combinatorics, Probability and Computing (1993) 2, pp 271-284.
- “Sampling from log-concave distributions”, with A. Frieze and N. Polson, The Annals of Applied Probability, Vol. 4, No. 3, (1994) pp 812-837.
- “Learning the intersection of a constant number of halfspaces over a uniform distribution”, with A. Blum, in the 34 th annual IEEE Symposium on the Foundations of Computer Science, 1993. Journal of Computer and System Sciences, Vol 54, No. 2, April (1997) pp 371-380.
- “Sampling contingency tables” with M. Dyer and J. Mount, Random Structures and Algorithms, **10** pp 487-506 (1997).
- “ Random walks and an  $O(n^5)$  time algorithm for volumes of convex bodies”, (with L. Lovász and M. Simonovits), Random Structures and Algorithms **11** (1997) 1-50.
- “Isoperimetric problems for convex sets”, (with L.Lovász and M. Simonovits), Discrete and Computational Geometry 13:541-549 (1995).
- “A polynomial time algorithm for learning noisy linear threshold functions” (with A. Blum, A. M. Frieze and S. Vempala) in the Proceedings of the IEEE Symposium on the Foundations of Computer Science, 1996. Algorithmica (1998)22 : pp 35-52.
- “Learning Linear Transformations” (with A. M. Frieze and M. Jerrum) in the Proceedings of the IEEE Symposium on the Foundations of Computer Science, 1996.
- “The regularity lemma and approximation schemes for dense problems” (with A. M. Frieze) in the Proceedings of the IEEE Symposium on the Foundations of Computer Science, 1996.
- “Sampling according to the multivariate normal density” (with Guanxing Li) in the Proceedings of the IEEE Symposium on the Foundations of Computer Science, 1996.
- “Simple Markov-Chain algorithms for generating bipartite graphs” (with S. Vempala and P. Tetali) in the Proceedings of the ACM Symposium on Discrete Algorithms, (1997)
- “Sampling lattice points” (with S. Vempala) to appear in the Proceedings of the ACM Symposium on the Theory of Computing (1997)
- “Quick Approximations to matrices and applications” (with A. M. Frieze), Combinatorica, **19**(2) (1999) pp 175-220.
- “Fast Monte-Carlo algorithms for finding low-rank approximations” with A. Frieze, S. Vempala in Proceedings of the IEEE Annual Symposium on the Foundations of Computer Science, 1998. pp 370-378.
- “Clustering in large graphs and matrices” with P. Drineas, A. Frieze, S. Vempala and V. Vinay in the proceedings of the Symposium on Discrete Algorithms, 1999.

- “Clustering : good, bad and spectral” with S. Vempala and A. Vetta, in the Proceedings of the 41 st IEEE Annual Symposium on the Foundations of Computer Science, 2000.
- “Approximation of Radii and norm-maxima : No need to randomize” with A. Brieden, P. Gritzman, V. Klee, L. Lovász and M. Simonovits in the Proceedings of the ACM Symposium on the Theory of Computing, 1998.
- “Local search in smooth convex sets” with A. Nolte in the Proceedings of the IEEE Symposium on the Theory of Computing, 1998.
- “Faster mixing via average conductance” with L. Lovász in the proceedings of the ACM Symposium on the Theory of Computing, 1999.
- “Fast Monte-Carlo Algorithms for approximate matrix multiplication” with P. Drineas, Proceedings of the Annual Symposium on the Foundations of Computing, 2001.
- “A simple randomized algorithm for convex optimization”, with M. Dyer and L. Stougie, Reports in Statistics, Probability and Operations Research, Eindhoven University of Technology, the Netherlands. (2001)
- “Learning Mixtures of arbitrary Gaussians”. with S. Arora, in the Proceedings of the ACM Symposium on Theory of Computing, 2001. To appear in the Annals of Applied Probability.
- “Pass efficient algorithms”, with P. Drineas, in SIAM Symposium on Discrete Algorithms, (2003).
- “Random sampling and approximation of max-CSP problems” with N. Alon, M. Karpinski and W.F. de laVega, in Symposium on Theory of Computation, (2002).