

# Jay Sethuraman

## EDUCATION

- Massachusetts Institute of Technology, Cambridge, MA  
PhD in Operations Research, August 1999  
Thesis title: Scheduling Job Shops and Multiclass Queueing Networks  
using Fluid and Semidefinite Relaxations
- Indian Institute of Science, Bangalore, India  
M.Sc. in Computer Science and Engineering, May 1994  
Thesis title: Essays in Applied Combinatorics
- Birla Institute of Technology and Science, Pilani, India  
B.E. (Honors) in Electrical and Electronics Engineering, May 1991  
Thesis title: Studies in Combinatorial Coding Theory

## APPOINTMENTS

- Columbia University  
Associate Professor  
July 2005 - present
- Assistant Professor  
January 2000 - June 2005
- Massachusetts Institute of Technology  
Teaching Assistant for the graduate-level course *Introduction to mathematical programming*,  
and the junior-level course *Probabilistic systems analysis*.
- Technical Instructor for the executive MBA course “Data, Models, and Decisions.”
- Research Assistant*, Sloan School of Management, January 1996 - May 1999.

## RESEARCH INTERESTS

- Dynamic optimization; applications to computer and manufacturing systems.
- Scheduling theory and its applications
- Algorithmic and strategic questions in matching markets
- Applications of optimization methods in economics
- Logistics management

## RESEARCH GRANTS

- IBM Faculty Award (2005-2006), \$20,000
- IBM University Partnership Award (2002-2003), \$30,000
- NSF CAREER Award (2001-2006), \$375,000
- IBM University Partnership Award (2001-2002), \$10,000
- IBM University Partnership Award (1999-2000), \$40,000

## HONORS and AWARDS

- Meritorious Service Award, *Operations Research*, 2001.
- Honorable Mention, George Nicholson student paper competition, 2000
- Participant, INFORMS Doctoral Colloquium, 1998
- IBM Cooperative Fellowship, 1998
- Writing and Humanistic Studies Prize, 1997

## PATENTS

- (with C. C. Aggarwal, M. Squillante, J. Wolf, and P. Yu) Optimizing profits in the broadcast delivery of multimedia products, patent filed, January 1999.

## SERVICE

- Program Committee member, SODA 2006
- Associate Editor, *Management Science*, June 2004-present.
- Editorial Review Board, *Production and Operations Management*, January 2004-present.
- Cluster chair for Scheduling, INFORMS Atlanta meeting, 2003.
- Associate Editor for *Networks*, December 2002-present
- Sophomore adviser, 2001-present
- Referee for *Mathematics of Operations Research*, *Mathematical Programming*, *Operations Research*, *Naval Research Logistics*, *Networks*, *IIE Transactions*, *Management Science*, *IEEE Transactions on Automatic Control*, *SIAM Journal on Discrete Mathematics*, *Journal of Algorithms*, *Journal of Heuristics*, *Discrete Mathematics*, and various conferences.

## SYNERGISTIC ACTIVITIES

- Collaborative work with IBM research on various scheduling problems.
- Participant, Teaching seminar, Massachusetts Institute of Technology, September-December 1998.
- Survey article “Linear Programming brings Marital Bliss” based on joint research with C-P. Teo on stable marriage problems; invited to appear in a mathematical magazine for college students in Singapore.

## TEACHING

IEOR 6400 Scheduling: Deterministic Models (G)  
IEOR 6610 Approximation Algorithms (G)  
IEOR 3402 Production-Inventory Planning and Control (UG)  
IEOR 4003 Industrial Economics (UG)  
IEOR 4004 Introduction to Operations Research: Deterministic Models (G)  
IEOR 6401 Scheduling: Stochastic Models (G)  
IEOR 6609 Dynamic Programming (G)  
IEOR 4405 Production Scheduling (UG)  
IEOR 4505 O.R. in Public Policy (G)

**LIST OF DOCTORAL STUDENTS :** Anton Riabov (Graduated; joint with Dan Bienstock), Akshay-Kumar Katta (Graduated), Stergios Athanassoglou (Current), Fei Li (Current).

**DOCTORAL COMMITTEES SERVED:**

- Aliza Heching (Business)
- Yiqing Lin (IEOR)
- Fernando Bernstein (Business)
- Itir Karaesmen (Business)
- Haicho Hu (IEOR)
- Ben Wang (Business)
- Pankaj Batra (Electrical Engineering)
- Zheng Wang (IEOR)

**PUBLICATIONS**

**Journals:**

- J1. (with C-P. Teo) The geometry of fractional stable matchings and its applications. *Mathematics of Operations Research*, 23(4):874–891, November 1998.
- J2. (with C. P. Teo) A cutting-plane algorithm for the stable roommates problem and its applications. *European Journal of Operational Research*, 123(1):195–205, 2000.
- J3. (with C-P. Teo and W-P. Tan) Gale-Shapley stable marriage problem revisited: Strategic issues and applications. *Management Science*, 47(9):1252–1267, September 2001.
- J4. (with J. Wolf, P. S. Yu, J. Turek, and M. Squillante) Scheduling algorithms for the broadcast delivery of digital products. *IEEE Transactions on Knowledge and Data Engineering*, 13(5):721–741, September/October 2001.
- J5. (with C-P. Teo) A polynomial-time algorithm for the bistable roommates problem. *Journal of Computer and Systems Sciences*, 63(3):486–497, 2001.
- J6. (with D. Bertsimas) From fluid relaxations to practical algorithms for job shop scheduling: the makespan objective. *Mathematical Programming*, 92(1):61–102, 2002.
- J7. (with C-P. Teo and R. Vohra) Integer Programming and Arrovian Social Welfare Functions, *Mathematics of Operations Research*, 28(2):309–326, 2003.
- J8. (with Ed Coffman and Vadim Timkovsky) Ideal preemptive scheduling on two processors, *Acta Informatica*, 39(8):597–612, 2003.
- J9. (with D. Bertsimas and D. Gamarnik) From fluid relaxations to practical algorithms for job shop scheduling: the holding cost objective, *Operations Research*, 51(5):798–813, 2003.
- J10. (with Akshay-Kumar Katta) A note on bandits with a twist, *SIAM Journal on Discrete Mathematics*, 18(1):110–113, 2005.
- J11. (with C-P. Teo) Effective Scheduling and Routing in Adversarial Queueing Networks, *Algorithmica*, 43(1-2):133–146, 2005.
- J12. (with C-P. Teo and R. Vohra) Anonymous and Monotonic Social Welfare Functions, *Journal of Economic Theory*, (to appear).
- J13. (with Lisa Fleischer) Efficient Algorithms for SCLP: the Multicommodity Flow Problem with Holding Cost and Extensions, *Mathematics of Operations Research*, 30(4):916–938, 2005.
- J14. (with Akshay-Kumar Katta) A solution to the random assignment problem on the full preference domain, *Journal of Economic Theory*, (to appear).

### Conferences (with proceedings):

- C1. (with C-P. Teo) LP based approach to optimal stable matchings. *Proceedings of the Eighth Annual ACM-SIAM Symposium On Discrete Algorithms*, pp. 710–719, January 1997.
- C2. (with M. Squillante) Optimal scheduling of multiclass parallel machines. *Proceedings of the Tenth Annual ACM-SIAM Symposium On Discrete Algorithms*, pp. 963–964, January 1999.
- C3. (with M. Squillante) Optimal stochastic scheduling in multiclass parallel queues. *Proceedings of the ACM SIGMETRICS conference on measurement and modeling of computer systems*, pp. 93–102, May 1999.
- C4. (with C-P. Teo and W-P. Tan) Gale-Shapley stable marriage problem revisited: Strategic issues and applications. *Seventh Conference on Integer Programming and Combinatorial Optimization*, pp. 429–438, June 1999.
- C5. (with C. C. Aggarwal, M. Squillante, J. Wolf, and P. Yu) Optimizing profits in the broadcast delivery of multimedia products. *Proceedings of the fifth International Workshop on Multimedia Information Systems*, Indian Wells, pp. 88–95, October 1999.
- C6. (with M. Dawande and J. Kalagnanam) Variable-sized bin packing with color constraints. Brazilian Symposium on Graphs, Algorithms and Combinatorics, Extended abstract in *Electronic Notes in Discrete Mathematics*, 7, 2001.
- C7. (with A. Riabov) Scheduling Periodic Task Graphs with Communication Delays. Third Workshop on MAThematical performance Modeling and Analysis, June 2001. Extended abstract in *Performance Evaluation Review*, 2002.
- C8. (with C-P. Teo and R. V. Vohra) Integer Programming and Arrovian Social Welfare Functions. *Ninth Conference on Integer Programming and Combinatorial Optimization*, LNCS 2337, 194–211, May 2002.
- C9. (with J. L. Wolf, L. Ozsen, M. S. Squillante, and P. S. Yu) Optimal Crawling Strategies for Web Search Engines. *Eleventh International World Wide Web Conference*, 136–147, May 2002.
- C10. (with M. Squillante) Analysis of Parallel-Server Queues under Spacesharing and Timesharing Disciplines. *Matrix Analytic Methods in Stochastic Models*, Adelaide, Australia, July 2002.
- C11. (with L. Fleischer) Approximately Optimal Control of Fluid Networks. *Proceedings of the Fourteenth Annual ACM-SIAM Symposium On Discrete Algorithms*, January 2003.
- C12. (with C-P. Teo) Effective Routing and Scheduling in Adversarial Queueing Networks, *Proceedings of RANDOM-APPROX 2003*, LNCS 2764, 153–164, August 2003.
- C13. (with F. Li and C. Stein) An optimal online algorithm for packet scheduling with agreeable deadlines, *Proceedings of the Sixteenth Annual ACM-SIAM Symposium On Discrete Algorithms*, January 2005.

### Expository/Survey:

- E1. (with C-P. Teo) Linear programming brings marital bliss. *Singapore Mathematical Medley*, January 1999. A preliminary version of this essay was awarded the writing and humanistic studies prize (second place) at MIT.
- E2. (with D. Bertsimas and I. Popescu) Moment problems and semidefinite optimization. *Handbook on Semidefinite Programming: Theory, Algorithms, and Applications*, Klumer Academic Publishers, January 2000.
- E3. Convex Relaxations in Scheduling. *Handbook of Scheduling*, CRC press, January 2004.

**Submitted for publication:**

- S1. (with P. Batra and A. Eleftheriadis) Alternative formulations for bit allocation with dependent quantization, Submitted to *IEEE Transactions on Image Processing*.
- S2. (with C-P. Teo and Liwen-Qian) Many-to-one stable matching: Geometry and Fairness, Submitted to *Mathematics of Operations Research*.
- S3. (with Akshay-Kumar Katta) Cooperation in Queues, Submitted to *Mathematics of Operations Research*.
- S4. (with Akshay-Kumar Katta) Pricing strategies and service differentiation in an M/M/1 queue: A profit maximization perspective, Submitted to *Operations Research*.
- S5. (with John Tsitsiklis) Stochastic search in a forest revisited, Submitted to *Mathematics of Operations Research*.
- S6. (with Uri Rothblum) Stochastic scheduling in an inforest, Submitted to *Discrete Applied Mathematics*.

**Working papers:**

- P1. (with F. Avram and D. Bertsimas) An efficient algorithm for optimal control of a fluid tandem network.
- P2. (with J. C. M. Janssen) Algorithmic aspects of list colorings.
- P3. Scheduling stochastic job shops using fluid relaxations.
- P4. A new solution to the house allocation problem with existing tenants.
- P5. Efficient and Fair allocation of indivisible goods without money.
- P6. (with Fei Li and Cliff Stein) "A  $\phi$ -competitive online algorithm for packet buffering," April 2005.

**SELECTED PRESENTATIONS:**

- "LP-based approach to stable matching problems," Symposium on Discrete Algorithms, January 1997.
- "The Geometry of Fractional Stable Matchings and its Applications," IBM TJ Watson Research Center, August 1997.
- "Fundamental Results on Space-Sharing and Time-Sharing in Parallel Computer Systems," IBM TJ Watson Research Center, August 1997.
- "Scheduling Issues in Parallel Computer Systems," IBM TJ Watson Research Center, July 1998.
- "Fundamental Results on Space-Sharing and Time-Sharing in Parallel Computer Systems," IBM TJ Watson Research Center, August 1998.
- "Asymptotically Optimal Schedules to minimize Holding Costs in Job Shops," INFORMS meeting, Seattle, October 1998.
- "Optimal Scheduling of Multiclass Parallel Machines," Symposium on Discrete Algorithms, Baltimore, January 1999.
- "Near-Optimal Scheduling using Fluid Relaxations," Kellogg School of Management, February 1999.
- "Near-Optimal Scheduling using Fluid Relaxations," School of Business, Rutgers University, February 1999.
- "Near-Optimal Scheduling using Fluid Relaxations," IEOR Department, Columbia University, February 1999.
- "Near-Optimal Scheduling using Fluid Relaxations," Systems Engineering department, University of Pennsylvania, March 1999.
- "Near-Optimal Scheduling using Fluid Relaxations," IBM TJ Watson Research Center, March 1999.

- “Gale-Shapley stable marriage problem revisited: strategic issues and applications,” INFORMS meeting, Philadelphia, November 1999.
- “Fluid relaxations in scheduling: an overview,” Center for Mathematical Sciences, University of Wisconsin, July 2000.
- “Fluid relaxations in scheduling: an overview,” International Symposium on Mathematical Programming, Atlanta, August 2000.
- “Fluid relaxations in (Broadcast) Scheduling,” IEMS Department, Northwestern University, April 2001.
- “Scheduling using Fluid Relaxations: old & new results,” INFORMS Applied Probability Conference, New York, July 2001.
- “Scheduling periodic task graphs with communication delays,” Workshop of New Trends in Scheduling Parallel and Distributed Systems (CIRM), Luminy-Marseille, October 2001
- “Integer Programming and Arrovian Social Welfare Functions,” Graduate School of Industrial Administration, Carnegie-Mellon University, March 2002.
- “Optimal crawling strategies for web search engines,” Eleventh International World Wide Web Conference, Honolulu, May 2002.
- “Scheduling and Routing in Adversarial Queueing Networks,” Dagstuhl seminar on scheduling in communication and manufacturing systems, June 2002.
- “An Integer Programming approach to Social Choice,” IBM TJ Watson Research Center, Hawthorne, September 2002.
- “Stable Admissions and Related Polyhedra,” IBM TJ Watson Research Center, Yorktown Heights, September 2002.
- “Scheduling and Routing in Adversarial Queueing Networks,” NYU (Stern school), November 2002.
- “Scheduling and Routing in Adversarial Queueing Networks,” National University of Singapore, January 2003.
- “Effective Routing and Scheduling in Adversarial Queueing Networks,” APPROX ’03, August 2003.
- “Scheduling and Routing in Adversarial Queueing Networks,” INFORMS Annual Meeting, October 2003.
- “Optimal crawling strategies for web search engines,” INFORMS Annual Meeting, October 2003.
- “Many-to-one marriages via linear programming,” NJIT (Computer science colloquium), December 2003.
- “A solution to the random assignment problem on the complete domain,” Game Theory and Social Choice conference, Wallis Institute of Political economy, Rochester, April 2004.
- “Fair allocation,” O.R. Center, M.I.T, April 2004.
- “Integer Programming and Arrovian Social Choice Functions,” Guest lecture in a course on *Game Theory, Algorithms, and the Internet*, Columbia University, April 2004.
- “Random Assignment with Indifferences,” Economics Department, Rice University, September 2004.
- “Cooperation in queues,” Midwest Economic Theory Conference, Vanderbilt University, April 2005.
- “Pricing strategies and service differentiation in queues—A profit maximization perspective,” Allerton Conference, October 2005.
- “Pricing strategies and service differentiation in queues—A profit maximization perspective,” University of Illinois at Urbana-Champaign, October 2005.
- “Packet scheduling with agreeable deadlines,” INFORMS Annual meeting, November 2005.
- “Cooperation in queues,” INFORMS Annual meeting, November 2005.
- “Many-to-one stable matchings,” Duke University, December 2005.