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

IEOR Department, Columbia University

- Vice Chair
  July 2015 - present
- Professor
  July 2013 - present
- Associate Professor
  July 2005- June 2013
- Assistant Professor
  January 2000 - June 2005

Research Interests

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

Honors and Awards

- Great Teacher Award, 2017
- IBM Faculty Award, 2005
- Meritorious Service Award, *Operations Research*, 2001
- NSF CAREER Award, 2000
- Honorable Mention, George Nicholson student paper competition, 2000
- IBM University Partnership award, 1999, 2001, 2002
- Participant, INFORMS Doctoral Colloquium, 1998
- IBM Cooperative Fellowship, 1998
- Writing and Humanistic Studies Prize, MIT, 1997

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. L. Wolf, P. S. Yu, J. Turek, and M. S. 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. V. Vohra) Integer Programming and Arrovian Social Welfare Functions, *Mathematics of Operations Research*, 28(2):309–326, 2003.

J8. (with E. G. Coffman Jr. and V. 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 A-K. 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 L. Fleischer) Efficient Algorithms for SCLP: the Multicommodity Flow Problem with Holding Cost and Extensions, *Mathematics of Operations Research*, 30(4):916–938, 2005.

J13. (with C-P. Teo and R. V. Vohra) Anonymous and Monotonic Social Welfare Functions, *Journal of Economic Theory*, 128:232–254, 2006.

J14. (with A-K. Katta) A solution to the random assignment problem on the full preference domain, *Journal of Economic Theory*, 131(1):231–250, 2006.

J15. (with C-P. Teo and L. Qian) Many-to-one stable matching: Geometry and Fairness, *Mathematics of Operations Research*, 31(3):581–596, 2006.

J16. (with J. N. Tsitsiklis) Stochastic search in a forest revisited, *Mathematics of Operations Research*, 32(3):589–593, 2007.

J17. (with U. G. Rothblum) Stochastic scheduling in an in-forest, *Discrete Optimization*, 5(2):457–466, 2008.

J18. (with Stergios Athanassoglou and Steven J. Brams) "A Note on the Inefficiency of Bidding over the Price of a Share," *Mathematical Social Sciences*, 60(3):191–195, 2010.

J19. (with Parag Pathak) "Lotteries in student assignment: An equivalence result," *Theoretical Economics*, 6(1):1–17, 2011.

J20. (with Stergios Athanassoglou) "House Allocation with Fractional Endowments," *International Journal of Game Theory*, 40(3):481–514, 2011.

J21. (with O. Bochet, R. Ilkilic, and H. Moulin) "Balancing Supply and Demand under Bilateral Constraints," *Theoretical Economics*, 7(3):395–423, 2012.

J22. (with L. Jez, F. Li, and Cliff Stein) "Online Scheduling of Packets with Agreeable Deadlines," *ACM Transactions on Algorithms*, 9(1):5, 2012.

J23. (with Thiam Lee) "Equivalence results in the allocation of indivisible objects: A unified view," Accepted (pending minor revision), *Mathematics of Operations Research*.

J24. (with H. Moulin) "The Bipartite Rationing Problem," *Operations Research*, 61(5):1087–1100, 2013.

J25. (with D. Saban) "A note on object allocation under lexicographic preferences," *Journal of Mathematical Economics*, 50(C), 283–289, 2014.

J26. (with D. Saban) "The Complexity of Computing the Random Priority Allocation Matrix," *Mathematics of Operations Research*, 40(4):1005–1014, 2015.

J27. (with C. Ye) "A Note on the Assignment Problem with Uniform Preferences," *Operations Research Letters*, 43(3):283–287, 2015.

J28. (with V. Venkatasubramanian and Y. Luo) "How much inequality in income is fair? A microeconomic game-theoretic perspective," *Physica A*, 435:120–138, 2015.

J29. "An alternative proof of a characterization of the TTC mechanism," *Operations Research Letters*, 44(1):107–108, 2016.

J30. (with I. Feigenbaum and C. Ye) "Approximately Optimal Mechanisms for Strategyproof Facility Location: Minimizing L_p Norm of Costs," *Mathematics of Operations Research*, 42(2), 434–447, 2017.

J31. (with S. He, X. Wang, and J. Zhang) "Analysis of a Simple Cost Allocation Rule for Joint Replenishment," *Operations Research*, 65(6), 1562–1573, 2017.

J32. (with Shyam Chandramouli) "Group Strategyproofness of the Egalitarian Mechanism for Constrained Rationing Problems," *Mathematical Social Sciences*, Special Issue in Honor of H. Moulin, 90, 111-118, 2017.

J33. (with Yash Kanoria and Daniela Saban) "Convergence of the Core in Assignment Markets," *Operations Research*, forthcoming.

Refereed Conferences:

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. S. 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. S. 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. S. Squillante, J. L. Wolf, and P. S. 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 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.

C8. (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.

C9. (with M. S. Squillante) Analysis of Parallel-Server Queues under Spacesharing and Timesharing Disciplines. *Matrix Analytic Methods in Stochastic Models*, Adelaide, Australia, July 2002.

C10. (with L. Fleischer) Approximately Optimal Control of Fluid Networks. *Proceedings of the Fourteenth Annual ACM-SIAM Symposium On Discrete Algorithms*, pp. 56–65, January 2003.

C11. (with C-P. Teo) Effective Routing and Scheduling in Adversarial Queueing Networks, *Proceedings of RANDOM-APPROX 2003*, LNCS 2764, 153–164, August 2003.

C12. (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*, pp. 801-802, January 2005.

C13. (with F. Li and C. Stein) Better online buffer management, to appear in the *Proceedings of the Sixteenth Annual ACM-SIAM Symposium On Discrete Algorithms*, pp. 191–208, January 2007.

C14. (with R. Khandekar, K. Hildrum, S. Parekh, D. Rajan and J. L. Wolf) "Bounded Graph Clustering with Applications to Stream Processing," *FSTTCS 2009*, 275–386.

C15. (with H. Moulin) "Loss-calibarated Methods for Bipartite Rationing Problems," *ACM conference on Electronic Commerce*, 697–714, June 2013.

C16. (with Daniela Saban) "Hose Allocation with Indifferences: A generalization and a Unified View," *ACM conference on Electronic Commerce*, 803–820, June 2013.

C17. (with Daniela Saban) "The complexity of computing the Random Priority Allocation Matrix," *WINE*, 421, December 2013.

C18. (with Yash Kanoria and Daniela Saban) "The Size of the Core in Assignment Markets," *Proceedings of the Annual ACM-SIAM Symposium On Discrete Algorithms*, pp. 1916–1924, January 2015.

C19. (with Itai Feigenbaum, Yash Kanoria, Irene Lo) "The Magician's Shuffle: Reusing Lottery Numbers for School Seat Redistribution," *WINE*, December 2016.

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*, Kluwer Academic Publishers, January 2000.

E3. "Convex Relaxations in Scheduling," *Handbook of Scheduling*, CRC press, January 2004.

E4. "Mechanism Design for House Allocation Problems: A Short Introduction," *Optima*, 82, 2010.

E5. (with Herve Moulin) "Rationing Problems in Bipartite Networks," *ACM SIGecom Exchanges*, 11(1):9–17, June 2012.

E6. (with Douglas Shier) "Matchings and Assignments," *Handbook of Graph Theory*, CRC Press, August 2013.

E7. "Stochastic Scheduling," *Encyclopedia of Algorithms*, Springer, April 2015.

Submitted for publication:

S1. (with A-K. Katta) "Cooperation in Queues," Submitted to *Games and Economic Behavior*.

S2. (with A-K. Katta) "Pricing strategies and service differentiation in an M/M/1 queue: A profit maximization perspective," Submitted to *Operations Research*.

S3. (with Shyam Chandramouli) "Strategyproof and Consistent Rules for Bipartite Flow Problems," Submitted for publication.

S4. (with Shyam Chandramouli) "A note on rationing divisible and indivisible goods in a general network," Submitted for publication.

S5. (with Daniela Saban) "House Allocation with Indifferences: A generalization and a unified view," Submitted for publication. (Journal version of an EC 2013 conference paper.)

S6. (with Itai Feigenbaum) "Strategyproof Mechanisms for One-Dimensional Hybrid and Obnoxious Facility Location Problems," Submitted for publication.

S7. (with H. Moulin) "Loss calibrated Rationing Methods in Bipartite Networks," Submitted for publication. (Journal version of an EC 2013 conference paper.)

S8. (with D. Bienstock and C. Ye) "Approximation Algorithms for the Incremental Knapsack Problem via Disjunctive Programming," Submitted for publication.

S9. (with T. Herrera) "An Optimal Randomized Mechanism for Kidney Exchange with Two Agents," Submitted for publication.

S10. (with A. Capponi and W. Allen Cheng) "Clearinghouse Default Waterfalls: Risk-sharing, Incentives, and Systemic Risk," Submitted to *Operations Research*, March 2018.

S11. (with Itai Feigenbaum, Yash Kanoria, Irene Lo) "Dynamic Matching in School Choice: Efficient Seat Reallocation After Late Cancellations," *Submitted*. (Journal version of a WINE 2016 paper.)

S12. (with A. Capponi, B. Bernard, G. Iyengar, H. Alsabah) "Multimarket Oligopoly with Inventory Carryover," *Submitted*, February 2018.

Working papers:

P1. "A new solution to the house allocation problem with existing tenants," 2001; updated in 2007.

P2. "School choice with indifferences," June 2007.

P3. (with Jiawei Zhang) "The serial cost sharing rule for group-buying," April 2012.

P4. (with Parag Pathak) "A matching problem in school assignment," April 2013.

P5. (with Itai Feigenbaum) "The school choice problem with weak priorities," February 2014.

P6. (with A. Smilgins) "Two-sided matching with objects," January 2015.

Research Grants

- Columbia Provost teaching grant to develop a hybrid class on Mathematical Programming, $5,000.
- NSF grant (Axiomatic Approach to Matching) (2012-2014), $264,000 (approx.)
- NSF grant (Mechanism Design) (2009-2012), $354,639
- 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

Selected Presentations

- Invited Speaker, *New Trends in Mechanism Design*, Copenhagen, August 2015.
- Lead Discussant for Paul Milgrom's Arrow lecture on "Prices and Decentralization without Convexity,", Columbia University, November 2014.
- Invited Speaker, COST Workshop, Maastricht, April 2014.
- International Symposium on Mathematical Programming: 2000, 2003, 2015 (July)
- Invited Speaker, *New Trends in Mechanism Design*, Aarhus University, June 2013.
- Invited Speaker, Frontiers of Market Design, Ascona, May 2012.
- Game Theory and Social Choice conference, Wallis Institute of Political Economy, Rochester, 2004.
- Conference on Resource allocation and Game Theory, Wallis Institute of Political Economy, Rochester, 2006.
- Mini-course on Combinatorial Optimization and its applications to Economics, Yonsei University, Summer 2009.
- Workshop on Matching Theory and Mechanism Design, March 2010.
- NSF conference on Behavioral and Quantitative Game Theory, May 2010.
- Matching Conference in Celebration of the 20th anniversary of Roth and Sotomayor (1990), Duke University, May 2010.
- Seminar on scheduling in communication and manufacturing systems, Dagstuhl, June 2002.
- INFORMS Applied Probability Conference, 2001
- Invited seminars at Northwestern (IEMS), Northwestern (Kellogg), Rutgers, Columbia, Penn, Wisconsin (Math), Carnegie-Mellon, NYU, Rice (Economics), MIT, Caltech (Economics), Rochester (Economics), Boston College (Economics), Vanderbilt (Economics), University of Montreal (Economics), Berkeley, UT Austin, USC, Chicago (Business), University of Illinois, Duke, Maryland, Georgia Tech, Ohio State, National University of Singapore, Indian Institute of Science, Tata Institute of Fundamental Research, Indian Institute of Technology (Chennai), and IBM T. J. Watson Research center.

Administrative Service

- Vice Chair, July 2015-present
- Chair, IEOR Faculty Search, 2014-15, 2016-17
- Director, PhD Program, 2013-present
- Member, IDSE Foundations Committee, 2012-present.
- COI Representative, 2010-present
- Chair, PhD Admissions committee, 2010-present
- Member of the PhD committee, 2005-2011
- Member of the Undergraduate curriculum committee, 2003-2006, 2009-present
- IEOR/DRO seminar series coordinator, 2001-2003
- Academic adviser for 3-2 students, 2001-present
- Sophomore adviser, 2000-present

Professional Service

- Associate Editor, *Management Science*, June 2004-December 2008, January 2018-present.
- Associate Editor, *Operations Research*, January 2012-present.
- Associate Editor, *IEEE Transactions on Automation Science and Engineering*, January 2012-December 2016.
- Associate Editor, *Networks*, December 2002-present
- Editorial Review Board, *Production and Operations Management*, January 2004-present.
- Program Committee member, MATCH-UP conference, 2015, 2017
- Senior Program Committee member, EC 2018
- Program Committee member, EC 2012-2017
- Program Committee member, Conference on Economic Design, 2017
- Organizing Committee member, MAM7, 2011
- Program Committee member, SODA 2006
- Organizing Committee member, IPCO 2004
- Judge, Junior Faculty Interest Group paper competition, INFORMS
- Judge, Nicholson student paper paper competition, INFORMS
- External Reviewer, South Carolina Department of Defense
- External Reviewer, U.S. Civilian Research and Development Foundation
- External Reviewer, Israeli Science Foundation
- External Reviewer, Research Grants Council, Hong-Kong.
- Panelist, National Science Foundation
- Cluster chair for Scheduling, INFORMS Atlanta meeting, 2003
- Referee for *ACM Transactions on Internet Technology*, *American Mathematical Monthly*, *Annals of Operations Research*, *Discrete Mathematics*, *Discrete Optimization*, *Econometrica*, *Games and Economic Behavior*, *IEEE Transactions on Automatic Control*, *IEEE Transactions on Signal Processing*, *IIE Transactions*, *International Journal of Game Theory*, *Journal of Algorithms*, *Journal of Economic Theory*, *Journal of Heuristics*, *Journal of Mathematical Economics*, *Journal of Scheduling*, *Management Science*, *Mathematical Programming*, *Mathematical Social Sciences*, *Mathematics of Operations Research*, *Naval Research Logistics*, *Networks*, *Operations Research*, *Operations Research Letters*, *Performance Evaluation*, *SIAM Journal on Control and Optimization*, *SIAM Journal on Discrete Mathematics*, *Social Choice and Welfare*, *Theoretical Economics*, and various conferences.

Teaching

- DROM B9135: Engineering Online Marketplaces, co-teaching with Yash Kanoria (GSB), Spring 2017.
- IEOR 8100: Computational Mechanism Design, Spring 2009, Fall 2014.
- IEOR 6400 Scheduling: Deterministic Models, Fall 1999, Spring 2004, Fall 2011.
- IEOR 6614: Optimization II, Spring 2013.
- IEOR 6610 Approximation Algorithms, Fall 2000.
- IEOR 4700 Introduction to Financial Engineering, Fall 2008.
- IEOR 3402 Production-Inventory Planning and Control, Spring 2000-2004, Spring 2008.
- IEOR 3608 Foundations of Optimization, Fall 2017
- IEOR 3608 Introduction to Mathematical Programming, Fall 2014-2016.
- IEOR 4003 Industrial Economics, Fall 2000
- IEOR 4004 Introduction to Operations Research: Deterministic Models, Fall 2001-2006, Spring 2004, Spring 2008, Fall 2010, Spring 2011, Fall 2012
- IEOR 6401 Scheduling: Stochastic Models, Spring 2002
- IEOR 6609 Dynamic Programming, Spring 2003
- IEOR 4405 Production Scheduling, Spring 2006-2007, Spring 2012, Spring 2015.
- IEOR 4505 O.R. in Public Policy, Spring 2006, Fall 2007, Spring 2012-2014, Spring 2016, Spring 2017.
- IEOR 4407 Game Theoretic Models of Operations, Fall 2006, Fall 2008-2010, Fall 2013, Fall 2015, Fall 2016.

Doctoral Students

- Anton Riabov (2004): *Efficient information dissemination systems*, jointly supervised with Daniel Bienstock; currently at IBM T. J. Watson Research Center.
- Akshay-Kumar Katta (2005): *Efficiency, fairness, and incentives in resource allocation*, currently at Amazon.
- Fei Li (2008): *Online algorithms for packet scheduling*, jointly supervised with Cliff Stein; currently at George Mason University.
- Stergios Athanassoglou (2008): *Essays on Fair, Efficient, and Incentive-Compatible Resource and Cost Allocation*, currently at Econometrics and Statistics Unit, European Commission Joint Research Center.
- Thiam Lee (2011): *Essays on Inventory Management and Object Allocation*, jointly supervised with Tim Huh.
- Shyam Chandramouli (2014): *Fair Allocation in Economic Networks.*
- Tulia Humphries (2014): *Essays on Kidney Exchange and online scheduling.*
- Daniela Saban (2015): *Design and Analysis of Matching and Auction Markets*, co-advised with Gabriel Weintraub.
- Itai Feigenbaum (2016): *Optimization in Strategic Environments.*
- Chun Ye (2016): *On the Trade-os between Modeling Power and Algorithmic Complexity.*
- Irene Lo (current)
- Xingyu Zhang (current)