

Sohil Shah | Curriculum Vitae

Ashdown House, #2009B, 235 Albany Street, Cambridge, MA, 02139

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I am a third-year PhD candidate in Operations Research at Massachusetts Institute of Technology. My research primarily focuses on multi-agent reinforcement learning, online matching algorithms, and information design with an emphasis on applications to ride sharing, data markets and advertisement auctions. I have bachelors degrees with comprehensive honors in mathematics, computer science, economics and chemistry from the University of Wisconsin–Madison.

Education

University of Wisconsin

B.S. in Mathematics, Computer Science, Economics and Chemistry, 4.00/4.00
Comprehensive Honors

Madison, WI

09/2013–05/2017

Massachusetts Institute of Technology (MIT)

Ph.D. in Operations Research, 5.00/5.00
Advisor(s): Patrick Jaillet, Saurabh Amin

Cambridge, MA

09/2018–06/2023 (expected)

Research Experience

Laboratory for Information & Decision Systems (MIT)

09/2018–ongoing

Multi-Agent Reinforcement Learning and Dynamic Information Provision

- Studying the ability of platforms to influence strategic agents on mobility platforms with information design
- Studying the ability of platforms to incentivize exploration in multi-agent Markov-decision processes
- Developing algorithms to leverage black-box machine learning algorithms with traditional robust algorithms to improve performance
- Applications: Ride-sharing, Ad Auctions, Two-sided matching

University of Wisconsin–Department of Economics

01/2016–05/2017

Auction Design & Distributional Effects of NCAA APR program

- Researched methods to eliminate multiplicity of equilibria in auctions with highly interdependent valuations
- Researched theory over how agents can design information signals that connect with a result space to improve likelihood other rational agents take a favorable action (Bayesian persuasion)
- Developing framework of equilibrium solution concepts that are behaviorally fault-tolerant
- Conducted independent econometric study analyzing the distributional effects of the NCAA's Academic Progress Rate Program on collegiate athletic teams

REU: Differential Equations and Applications at University of Wisconsin

05/2015–06/2017

Minimal Invariant Regions in Mass-Action Systems

- Studied the notion of permanence in nonlinear, polynomial dynamical systems with a particular emphasis on expanding the theory around reversible mass-action systems
- Developed set of tight bounds on the size of the minimal invariant region necessary for a system to satisfy permanence
- Developed MATLAB scripts to model 2-D dynamical systems and compute minimal permanent regions

University of Wisconsin–Department of Chemistry

06/2011–05/2015

Synthesis of Novel Photocatalytic Molecules and Materials

- Developed novel method to adjoin nanomaterials on the nano-scale to improve their utility in photovoltaics and photocatalysis by modifying accessible band gap
- Worked on synthesizing novel organic molecules with enhanced photocatalytic performance in ruthenium organometallics
- Attempted to improve the durability of plastic materials by homogeneously integrating chemically treated nanodiamonds into polystyrene

Publications

Shah, S., Kulkarni, K. (2021) Crowdsourcing Markov Decision Process Exploration Through Dynamic Information Provision. *Working Paper*.

Shah, S., Amin, S., and Jaillet P. (2021) Impact of Information on Decentralized Spatiotemporal Pricing. *In Submission*.

Hameister, T., **Shah, S.,** Schneider, N., Fricker, E., and Craciun G. (2018) Minimal Attracting Regions for Reversible Mass-Action Systems. *In Submission*.

Shah, S., Benson, M. C., Bishop, L. M., Huhn, A. M., Ruther, R. E., Yeager, J. C., Tan, Y., Louis, K. M., and Hamers, R. J. (2012) Chemically assembled heterojunctions of SnO₂ nanorods with TiO₂ nanoparticles via “click” chemistry. *Journal of Materials Chemistry* 22, 11561–11567.

Work Experience

Amazon CoreAI

06/2020–08/2020

Applied Scientist Intern

- Developed machine learning models to predict click-thru rates for all ASINs on Amazon.com
- Developed discrete choice model to learn heterogeneous consumer preferences and optimize selection of ASINs provided on short-term Amazon stock

Amazon

06/2017–08/2018

Machine Learning Engineer/Software Development Engineer

- Developed machine learning models to predict shipping costs and other shipment metrics in real-time
- Developed workflow to continuously retrain machine learning models and vend predictions at production-scale to various teams at Amazon including the retail website and personalization teams
- Designed and implemented new data-driven strategies to reduce Amazon’s fulfillment costs such as strategically modifying the loads on fulfillment centers using machine learning and optimization
- Built one of the largest data pipelines in the world using various big data technologies to process each individual fulfillment made by Amazon, render them into meaningful observations, generate analyses, and vend all data to teams across Amazon

The Brattle Group

06/2016–08/2016

Research Analyst Intern

- Developed forecasting models to predict electric load patterns of future transportation paradigms involving electric vehicles and autonomous vehicles
- Analyzed fraudulent behavior from energy sellers that attempted to conceal market manipulation during California Energy Crisis

Optiver US LLC

05/2014–08/2014

Trading Intern

- Developed software to assist screen traders in evaluating profitability of prior trades graphically
- Extensively studied option pricing theory
- Performed statistical analysis quantifying trends in least profitable trades for company and identified possible corrective actions

Awards and Honors

National Science Foundation Graduate Research Fellow (2019-2022)

One of 1500 graduate students nationally awarded continuing research funding for 3 years

Barry M. Goldwater Scholar (2015-2017)

One of 260 students selected nationally based on scientific, mathematic, and engineering achievement

Mary Claire Phipps Scholarship in Economics (2015-2017)

One of two students in university to receive \$5000 per annum scholarship for academic achievement in economics

Charles Wurth Scholarship (2013-2017)

One of two students in university awarded \$8000 per annum scholarship for academic achievement

Top 200 finish in Putnam Competition (2015)

Best individual placement in national competition in last ten years at University of Wisconsin

David Durra Scholarship (2015)

Awarded \$3000 scholarship for scientific and mathematic achievement

Draminski Scholarship in Economics (2015-2016)

Awarded \$500 per annum scholarship for scholastic and extracurricular achievement in economics

Hilldale Undergraduate Research Fellowship (2014-2015)

Awarded monetary prize of \$3000 to fund undergraduate research

Phi Beta Kappa (2014)

Inducted as freshman

SPiE Optics and Photonics Scholarship Winner (2013)

Awarded \$2000 scholarship for scientific achievement

Intel Science Talent Search Semifinalist (2013)

Awarded \$1000 scholarship for scholastic achievement and quality of research

Siemens Competition Regional Finalist (2013)

Awarded \$1000 scholarship for scholastic achievement and quality of research

Academic Excellence Scholar (2013)

Earned \$9000 prize for students in the state of Wisconsin with the highest GPA and ACT scores in their graduating high school class

Relevant Coursework

†= Graduate course

University of Wisconsin

Mathematics: Stochastic Processes[†], Real Analysis, Abstract Algebra, Partial Differential Equations[†], Number Theory, Combinatorics, Euclidean Geometry, Probability, Differential Equations, Linear Algebra

Economics: Advanced Microeconomic Theory[†], Game Theory[†], Econometrics, Behavioral Economics, Economics of Legal Systems, Intermediate Microeconomics, Intermediate Macroeconomics

Computer Science: Algorithms, Artificial Intelligence and Machine Learning, Operating Systems, Cryptography, Linear Programming, Machine Organization, Data Structures

Other: Quantum Mechanics, Thermodynamics, Organic Chemistry, Financial Mathematics

Massachusetts Institute of Technology

Computer Science: Mathematical Programming[†], Fundamentals of Probability (with measure theory)[†], Nonlinear Optimization[†], High-dimensional Statistics[†], Machine Learning[†], Networks[†], Algorithms for Inference[†], Inference and Information[†], Mathematical Models in Social Sciences and Social Networks[†]

Leadership Experiences

University of Wisconsin

American Chemical Society - Student Chapter (President)

Organized several career-building, academic and research oriented events for student body
Interfaced with faculty as we organized the direction of the organization

Greater University Tutoring Service (Volunteer)

Taught evening recitations of probability, calculus and other courses for students seeking additional instruction time

Massachusetts Institute of Technology

Machine Learning Across MIT (Committee Chair)

Head of organization that serves and connects all 500+ graduate machine learning researchers at MIT
Organize, select and curate the Machine Learning Tea Seminars across the university
Create events and resources to encourage collaboration and networking across MIT machine learning community

Ashdown Graduate House (Inventory Officer)

Manage community resource inventory for graduate community and organize several events for graduate student residents

Laboratory for Information and Decision Systems (Tea Talk Committee)

Organize, select and curate the Tea Talk Seminars within the lab

Technical Skills

Programming Languages: C, C++, Python, Java, Kotlin, Julia, MATLAB, R, TeX, Assembly, x86, VBA, Stata

Software Skills: TensorFlow, Keras, sklearn, Apache Spark, Apache MXNet, Spring, SQL, Apache Avro, Spring, Docker, git

AWS: S3, DynamoDB, Lambda, Glue, Athena, Redshift, EMR, EC2, Kinesis, SQS, Quicksight, Sagemaker, Step Functions, CloudFormation, CloudWatch, Machine Learning, Batch