

HARSH SHAH

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RESEARCH INTERESTS

Statistical Machine Learning, Optimization, Applied Probability

EDUCATION

Columbia University

PhD in Industrial Engineering and Operations Research

New York, USA

2025 – Present

Indian Institute of Technology Bombay

Bachelor of Technology (with Honours) in Electrical Engineering

Minor in Machine Learning and Data Science

CGPA: 8.93/10.00

Mumbai, India

2021 – 2025

PUBLICATIONS

H. Shah, P. Chandrasekhar, R. Vaze, “*Online Convex Optimization with Switching Cost with Only One Single Gradient Evaluation*,” (2025).

H. Shah, J. Nair, D. Manjunath, N. Mandayam, “*Blotto on the Ballot: A Ballot Stuffing Blotto Game*,” IEEE Conference on Decision and Control (CDC 2025).

RESEARCH PROJECTS

Game Theoretic Analysis of “Blotto on the Ballot: A Ballot Stuffing Blotto Game”

2023–2024

Mentors: Prof. Jayakrishnan Nair and Prof. D. Manjunath

IIT Bombay

- Developed a variant of Colonel Blotto game modeling electoral malpractices, where one agent allocates resources across multiple stations while another strategically removes resources from selected stations
- Obtained the set of Nash equilibria by solving a convex combinatorial optimization problem, where equilibrium strategies are determined by the optimal solution and the values of Lagrange multipliers
- Identified unique structural properties of the optimal solution through extensive simulations and rigorously proved them using Lagrangian Dual and Karush-Kuhn-Tucker (KKT) conditions

Online Convex Optimization with Switching Cost (OCO-S) in Limited Information

2024–2025

Mentor: Prof. Rahul Vaze

TIFR

- Designed a gradient descent-type algorithm for M -smooth convex objective functions, which moves along the gradient line until the hitting cost balances the movement cost, achieving a CR upper bound of $\Omega(M)$
- Constructed objective functions that are indistinguishable by any algorithm by exploiting limited gradient information and used them adversarially to establish a CR lower bound also of order M
- Extended the analysis to the cases involving noisy gradient and delayed gradient information settings

Learning in Resource Pooling

2024–2025

Mentors: Prof. Vivek Borkar and Prof. Jayakrishnan Nair

IIT Bombay

- Developed an iterative algorithm to adjust pooling whose ODE approximation mimics replicator dynamics
- Proved algorithmic convergence using stochastic approximation techniques and cooperativeness of ODE
- Simulated the algorithm in a multi-agent resource pooling environment to validate system performance

SCHOLASTIC ACHIEVEMENTS

- Recipient of the Ruihua Fellowship for the Fall semester 2025
- Recipient of the Kishore Vaigyanik Prostahan Yojana (KVPY) Fellowship from IISc Bangalore 2021
- Ranked in the top 1 % nationally in the Indian Olympiad Qualifier in Physics 2021
- Among top 150 nationally to secure the Merit Award in the Indian National Maths Olympiad (INMO) 2018
- Among top 30 in Maharashtra, India to qualify Regional Maths Olympiad (RMO) 2018