Eshwar Ram Arunachaleswaran

DOCTORAL STUDENT IN COMPUTER SCIENCE

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Education

PhD in Computer Science | University of Pennsylvania | GPA: 4.0 / 4.0 | Philadelphia, PA, US   Aug 2019 - (Current)
Advisors: Sampath Kannan, Anindya De

B.E. (Hons) Computer Science | Birla Institute of Technology and Science (BITS) Pilani | GPA: 8.78 / 10 | Pilani, India   Aug 2014 - Jan 2018

Experience

Simons Institute for the Theory of Computing at UC Berkeley | Visiting Researcher | Berkeley, CA   Sep 2024 - present
· Attending the program – Theory of Large Language Models and studying multi-agent learning problems

University of Pennsylvania | Graduate Research Assistant | Philadelphia, US   Aug 2019 - present
· Identified and characterized optimal machine learning algorithms for strategic settings; analyzed properties of Follow-the-Regularized-Leader Algorithms
· Optimized Time-dynamic responses to algorithms (including gradient descent, multiplicative weights) used in repeated games - came up with a closed form solution to an open problem from control that previously only had a computationally infeasible Dynamic Programming solution/ an unstructured Reinforcement Learning solution; with applications to dynamic pricing, autobidding, market algorithms, etc.
· Developed Novel Machine Learning Algorithms using tools from Game Theory and Convex Optimization; including the first efficient algorithm for groupwise optimal regret minimization against linear regressors
· Developed hierarchical clustering algorithms and corresponding lower bounds for learning ultrametric trees using noisy experiments, with applications to phylogeny reconstruction
· Organizer - UPenn CS Theory Seminar   Aug 2022 - Aug 2024

Indian Institute of Science (IISc) | Research Assistant | Bengaluru, India   Jan 2018 - Jul 2019
· Worked on problems from computational fair division with Siddharth Barman, Developed state of the art algorithms for envy-free cake cutting, envy-free rent division, and improved algorithms for allocations of indivisible goods under various criteria

Conduent Research | Summer Research Intern | Bengaluru, India   May 2017 - Jul 2017
· Worked on Resource Allocation problems, and wrote modules implementing algorithms for these problems.

University of Pennsylvania | Teaching Assistant | Philadelphia , US
· Teaching Assistant for Graduate Algorithms (Fall 20) ; TA for Randomized Algorithms (Fall 21); TA for Graduate Theory of Computation (Fall 22, 24)

Research Interests and Skills

Research Interests   Algorithmic Game Theory, Machine Learning Theory, Theory of Multi-Agent Learning, Reinforcement Learning

Technical Skills   Convex Optimization, Discrete Probability, Measure Theory, Real Analysis, Monte Carlo Methods, Regression, Calibrated Forecasting, Multi-Arm Bandits, No-Regret Algorithms, Boosting, Time series analysis, reinforcement learning

Languages   Python (scikit-learn, pandas, NumPy, SciPy), C, C++
Relevant Graduate Coursework   Randomized Algorithms, Machine Learning, Game Theory in Machine Learning, Elements of Probability Theory, Algorithms for Big Data, Computational Learning Theory, Analysis of Boolean Functions, Advanced Complexity Theory, Advanced Analysis, Combinatorial Optimization

Publications

· Algorithmic Collusion Without Threats; with N. Collina, S. Kannan, A. Roth, J. Ziani : in *Innovations in Theoretical Computer Science (ITCS) 2025*
· An Elementary Predictor Obtaining $2\sqrt{T}$ Distance to Calibration; With N. Collina, A. Roth, M. Shi : in *ACM-SIAM SODA*, 2025 .
· Pareto-Optimal Algorithms for Learning in Games ; With N. Collina, J. Schneider: in *Economics and Computation (EC)*, 2024 ; Accepted at ESIF Economics and AI+ML Meeting, 2024 ; Talk Slides .
Oracle Efficient Algorithms for Groupwise Regret; With K. Acharya, S. Kannan, A. Roth, J. Ziani; in *ICLR* 2024.
· Efficient Stackelberg Strategies for Finitely Repeated Games ; With N. Collina, M. Kearns; in *AAMAS (Full Paper)* , 2023.
· Reconstructing Ultrametric Trees from Noisy Experiments; With A. De, S. Kannan; in *Algorithmic Learning Theory* (ALT), 2023.
· Wealth Dynamics Over Generations: Analysis and Interventions; with K. Acharya, S. Kannan, A. Roth, J. Ziani; in *IEEE Conference on Secure and Trustworthy Machine Learning* (SaTML), 2023.
· Pipeline Interventions; with S. Kannan, A. Roth, J. Ziani; in **Mathematics of Operations Research** (Originally appeared in *Innovations in Theoretical Computer Science* (ITCS), 2021).
· Fully Polynomial Time Approximation Schemes for Fair Rent Division; with S. Barman and N. Rathi; in **Mathematics of Operations Research** (Originally appeared in ACM-SIAM Symposium on Discrete Algorithms (SODA) 19) .
· Fair and Efficient Cake Cutting with Connected Pieces; with S. Barman, R. Kumar and N. Rathi; in *Web and Internet Economics* (WINE), 2019.
· Fair Division with a Secretive Agent; with S. Barman and N. Rathi; in *AAAI*, 2019.
· Learning to Play Against Unknown Opponents; *Working Paper 2025* with N. Collina, J. Schneider .
· Swap Regret and Correlated Equilibria Beyond Normal-Form Games; *Working Paper 2025* with N. Collina, Y. Mansour, M. Mohri, J. Schneider, B. Sivan.

Professional Activities and Service

Member - EC 2025 Program Committee; Reviewer - ICLR 24; Subreviewer - STOC 25, AAMAS 19, WINE 18.

Funding Awards

· AWS AI for research in Trustworthy AI Funding Award - 2023