Vishal Sivaraman

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Education

Georgia Institute of Technology — Atlanta, GA
M.S. in Operations Research, ***GPA: 4.0/4.0*** — *Aug. 2023 - May. 2025*

Indian Institute of Technology Madras — Chennai, India
B.Tech Hons. in Chemical Engineering, ***GPA: 9.52/10*** — *Jul. 2018 - May. 2022*

Publications

Sivaraman, V., Kurapati, R., & Natarajan, U. (2024). Solvation-free energy of uncharged and charged water-soluble synthetic polymer using adaptive Poisson-Boltzmann solver: poly(acrylic acid). Molecular Simulation, 1–10. doi.org/10.1080/08927022.2024.2439623

Professional Experience

Goldman Sachs — Bengaluru, India

Quantitative Strategist, Credit Risk Strategists Team — *June 2022 - July 2023*

- Responsible for building and optimizing FRTB CVA capital models to accurately capture the trading costs.
- Oversaw model validation, output generation and took end-to-end ownership of BA-CVA Capital models.
- Developed a loss ratings model for equity-backed margin loans.

Quantitative Strategist Summer Internship — *June 2021 - July 2021*

- Reduced the compute usage incurred by a distributed implementation of CVA Capital calculations.
- Proposed and implemented techniques that resulted in reduction of upto **90%** machines used and **51%** reduction in usage time.

AstraZeneca — Chennai, India

Analyst Summer Internship — *May 2020 - July 2020*

- Developed a de Novo design (computational drug design) method using deep-RL framework in the therapeutic area of Oncology.
- Improvised an **Actor-Critic model** developed by Niclas et al.,2019 and enabled it to optimize the drug's potency(pIC50 value).
- Built an **XGBoost** regressor to predict the pIC50 of a drug targeting AKT protein and achieved an R^2 value of 0.7.

Research and Teaching Experience

Spatial Matching of Dynamic Two-Sided Queues — Atlanta, GA

Guide: Prof. Siva Theja Maguluri, Georgia Tech — *January 2024 - Current*

- Designing algorithms that allows system stability and reduce cost of spatial matching in two-sided queueing systems.
- Implemented Monte Carlo simulations of the algorithms using SciPy and NetworkX to study their performance across systems.

Graduate Teaching Assistant - Deterministic Optimization — Atlanta, GA

Georgia Tech — *Jan. 2024 - Current*

- Organized office hours to provide tutoring & assistance for 100+ graduate students. Responsible for answering queries on Piazza.

APBS for Prediction of Solvation Energies of Water-Soluble Synthetic Polymers — Chennai, India

Bachelor's Thesis, Guide: Prof. Upendra Natarajan, Indian Institute of Technology Madras — *May 2021 - May 2022*

- Modeled synthetic polymers using the faster implicit solvent based method: Adaptive Poisson-Boltzmann Solver (APBS).
- Used GROMACS MD Simulation to sample polymer conformers and developed a framework to simulate them in APBS.
- Benchmarked the trends of solvation energy with respect to chain length. See Publications.

Relevant Projects

Markov Chain Monte Carlo Methods, Simulation Course Project — *Apr. 2024*

- Developed a tutorial on Markov Chain Monte Carlo covering Python implementations and theory on Bayesian Statistics.
- Demonstrated the Propp-Wilson algorithm to sample states from the Ising model, a ferromagnetism model.
- Implemented Metropolis-Hastings for distribution fitting to **model climactic fluctuations** over time. [report][code]

Parallelised Solution for Real-Time OPF, Computational Optimization Semester Project — *Feb. 2024 - Apr. 2024*

- Attempted to reproduce Fast Batched Solution for Real Time OPF With Penetration of Renewable Energy by Dinavahi et al.
- Implemented the primal-dual interior point method in C++ utilising CoDiPack for derivative operations, cuBLAS for linear algebra and CUDA for parallelised sparse matrix inversions. [presentations][code]

Deterministic Optimization Course Project — *Oct. 2023 - Nov. 2023*

- Formulated an LP problem for optimising the hourly purchasing decisions of running a plant requiring electricity and hydrogen.
- Performed a cost-analysis of alternate energy sources by varying the formulation using Gurobi in Python to solve the LPs.[report]

Reinforcement Learning Course Project — *Nov. 2021*

- Implemented epsilon-greedy **Q learning** and **REINFORCE** algorithms to train RL agents to play the **openAI environments**: taxi and acrobot. Implemented the TD(0) algorithm to obtain the optimal policy for a game-show environment. [report][code]

Bayesian Online Change Point Detection, Parameter and State Estimation Course Project — *Jan. 2021*

- Implemented the Bayesian Online Change Point Detection algorithm in MATLAB as described in the paper by Adams et al.
- **Extended the algorithm** to find changepoints in the variance of an AR signal's innovations by employing an RLS estimator.
- Improved handling of **overflow/underflow** errors and built appropriate **visualization tools**. [report][code].

Achievements

- **Economic Times Campus Stars 2022**: Selected for the final round (Phase-4) of the national level competition.
- Recipient of the Dr. Anita Mehta-Damani Prize for the **best academic record in sophomore year** of ChemE.
- **Finalist, Aditya Birla Scholarship**: Selected among a cohort of 35 students selected from top Indian engineering institutes.
- Ranked **709** among **≈1.5M students** (top 0.0005%) in JEE-Main 2018, a highly competitive engineering entrance examination.
- Grade XII CBSE: top **0.1%ile** in the country in Physics, Chemistry and Mathematics in AISSCE-18.
- Recipient of KVPY SX Fellowship, (2017) awarded by IISc, Bangalore. Ranked 1063 among over **150k applicants**.

Other Projects

IPCA and MLPCA, Multivariate Data Analysis Course *Apr. 2022*

- Deployed the Iterative Principal Component Analysis in MATLAB developed in Narasimhan, 2004 to estimate error variances.
- Combined weighted PCR with the IPCA algorithm to develop a linear calibration model with an RMSE of $0.69*10^{-5}$.
- Implemented the MLPCR algorithm from scratch prescribed in Wentzell, 1997 for the calibration model. [report][code]

Process Control Simulation, Process Control Lab group project *Oct. 2021 - Nov. 2021*

- Modelled a MIMO Distillation Column using input-output system data on MATLAB/SIMULINK.
- Estimated Transfer Functions for a Fluid Catalytic Cracking system and analysed its stability using Bode and Nyquist plots.
- Designed PID controllers to achieve the desired setpoint tracking in the presence of disturbances for the column. [report][code]

Income Inequality and Climate Change, Climate Economics Course Project *Sep. 2021 - Oct. 2021*

- Part of a team that investigated the relationships between **income inequality and climate change** in the context of India.
- Identified and relaxed assumptions in the literature on stationarity of the data. Presented impacts of CO_2 emissions and water pollution on Income Inequality by building ARIMA and Feasible Generalized Least Squared models in MATLAB. [paper][code]

Critical Review of Research Work in Renewable Energy, Course Presentations *Dec. 2020 - Apr. 2021*

- Rigorously analyzed this review (Okonkwo, 2021) on Platinum degradation mechanisms in PEM fuel cell systems.
- Critically compared 2 papers each on metal-free photocatalysts for hydrogen evolution and dye sensitized solar cells.
- Identified the core transformational idea, pointed out experiments and measurements to further support the results. [ppts]

Skills

Programming Languages: Python (tools: pandas, sci-kit learn, keras, scipy, CVXPy, NetworkX, gurobi), C++, MATLAB
Misc: git, LaTeX, SIMULINK, ARENA, ASPEN, GROMACS, Avogadro, APBS

Coursework

Systems Engineering: Process Control, Modern Control Theory, Nonlinear Systems Analysis, Game Theory, Reinforcement Learning, Parameter and State Estimation, Mathematical Foundations of Data Science, Process Optimization
CS and Math: Deterministic Optimization, Computational Optimization, Stochastic Optimization, Stochastic Processes, Probabilistic Models, Theoretical Statistics, Multivariate Data Analysis, Statistical Learning, Numerical Methods, Simulation
Energy and Environment: Fuel Cells, Solar Photoelectrochemistry, Climate Economics

Leadership and Extracurricular Activities

Events & Workshops Core, Shaastra-2022 (Institute Technical Festival) *May 2021- Jan. 2022*

- Led a 3 tier team of about **120 students** to conduct **42 events and 24 workshops** with a budget of **Rs. 1.85 million**.
- Ideated and organised a nationwide **Data Science Research Symposium** to enable students to showcase their research work.

The Fifth Estate, official student run news body of IIT-M *Jul. 2019 - May 2021*

- **Editor:** Was a part of a 6 member editorial team in my junior year, leading **20** correspondents. Ideated and published articles on a plethora of topics from startups to research and reporting. And was responsible for managing the social media pages.
- **Correspondent:** As a correspondent in my sophomore year, I interviewed multiple student representatives and published articles on a variety of themes ranging from day to day affairs to documenting the history of student communities. [articles]

Volunteering *Jul. 2019 - Sep. 2024*

- Participated in the Climate Change AI summer school 2024, where I explored the current research landscape regarding the application of AI across various aspects of climate change, including energy and infrastructure.
- **Student Mentor:** Mentored 8 freshmen as a student mentor and helped them get involved in co-curricular activities.
- **Sustainability Network, IITM:** Organized awareness drives and talks to promote sustainability including a beach cleanup.
- **Lets Play to Learn:** Ideated on and oversaw the development of a hyper-casual game to inculcate numerical methods concepts.