

Eshika Pathak

Graduate Student, Electrical and Computer Engineering, Carnegie Mellon University

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Education

Carnegie Mellon University

Pittsburgh, PA

Master of Science in Electrical and Computer Engineering, AI/ML Specialization, CGPA: 4.00/4.00

December 2024

Courses: Optimization, Applied Stochastic Processes, Machine Learning for Signal Processing, Machine Learning for Engineers, Introduction to Deep Learning, Statistical Models of the Brain — Ongoing: Robot Learning, Generative AI, Algorithms for Large-scale Distributed Machine Learning

Indian Institute of Technology (IIT)

Gandhinagar, India

Bachelor of Technology in Electrical Engineering, CGPA: 9.51/10.00 (Rank 1)

July 2023

Internships

Control and Learning Group, Carnegie Mellon University

Pittsburgh, PA

Research Assistant, Autonomous Vehicle Safe Control in the Presence of Self-Seeking Humans

May 2024 - Aug 2024

- Developed and tested a new control method that accounts for shifts in strategic human behaviors, achieving better safety and performance trade-offs compared to traditional deterministic and equilibrium-based strategies.
- Designed and experimentally validated optimal and safe autonomous vehicle policies by accounting for humans' self-seeking behaviors in a game-theoretic setting. *Submitting to PNAS 2025 as first author.*

Bosch Center for Artificial Intelligence

Bangalore, India

Research Intern, Bidirectional Charger Models, V2X Framework & Optimal Decision Making

May 2022 - July 2022

- Only intern selected to work with the Corporate Research department in India over the summer.
- Designed and developed two bidirectional charger models for a specific consumer electric vehicle.
- Implemented an end-to-end simulation framework for vehicle-to-grid and vehicle-to-house (V2X) power transfer capabilities and optimal multi-variable decision-making.
- Analyzed four simulated use-case scenarios to determine the financial gain and battery health insights of V2X operations.

Nano Devices and Circuits Lab, IIT Gandhinagar

Gandhinagar, India

Research Intern, OPC Algorithms in Computational Lithography

August 2021 - May 2022

- Developed a robust multi-iteration lithography simulation system (resist and optical model) with control on various optical proximity correction (OPC) parameters.
- Implemented Hopkin's and Abbe's imaging formulations and rule and model-based algorithms for OPC.
- Formulated an intelligent mask fragmentation algorithm to reduce computation time while improving OPC accuracy.

Learning and Emerging Networked Systems Lab, Texas A&M University

College Station, TX

Research Intern, Reinforcement Learning (RL) Algorithms for Autonomous Navigation

May 2021 - July 2021

- Designed and developed RL algorithms for autonomous navigation of mobile robots in indoor environments.
- Built and evaluated RL and control algorithms to enable efficient waypoint tracking of simulated and physical robots.
- Designed and tested eleven reward functions. Trained an optimal RL model and deployed the algorithm on a TurtleBot for real-world validation (demonstrated perfect waypoint tracking).

Select Projects

Safety Certificate against Latent Variables with Partially Unidentifiable Dynamics

2024

Independent study — Control and Learning Group, CMU

- Designed simulations and experiments to test safe reinforcement learning algorithms in environments with latent confounders, focusing on assessing the algorithms' performance in systems with partially unidentifiable dynamics.

Adaptive Risk-Aware RL Based Multi-Stock Portfolio Optimization

2024

Course project — 18786: Introduction to Deep Learning, CMU

- Implemented deep RL agents with control barrier function-based controllers for adaptive risk management in portfolio optimization, optimizing agent performance across volatile market conditions.

Personalized Federated Learning using Hypernetworks

2024

Course project — 18660: Optimization, CMU

- Reproduced and conducted ablation studies on pFedHN and pFedHN-PC, providing insights into the effects of client learning configurations and hypernetwork architectures on performance in non-IID data scenarios.

Information Coding and Learning in SNNs and PCNs

2024

Course project — 36759: Statistical Models of the Brain, CMU

- Applied SuperSpike and differential equation-based learning for image classification in Spiking Neural Networks (SNN) and Predictive Coding Networks (PCN), focusing on biologically inspired mechanisms and backpropagation alternatives.

Blind Source Separation in High-Density EMG Data

2023

Course project — 18797: Machine Learning for Signal Processing, CMU

- Developed a multi-stage framework for high-density EMG analysis, using noise filtering, wavelet extraction, PCA, NMF, and K-means clustering, with hyperparameter tuning for accurate motor unit signal decomposition and classification.

Automating Microbial Growth Detection and Monitoring Using TDLAS

2023

Independent study — Photonic Sensors Lab, IIT Gandhinagar

- Designed and conducted experiments using quantum cascade lasers and TDLAS for *E.coli* growth detection, developed an automated data acquisition system, and proposed research on facultative bacterial adaptation.

Wearable Foot Plantar Pressure Monitoring and Analysis System

2022

Independent study — Intelligent Rehabilitation and Affective Computing Systems Lab, IIT Gandhinagar

- Developed and optimized a real-time system to visualize and monitor plantar pressure and gait using piezoelectric sensors in shoe insoles, reducing data latency from one minute to a second.

ICE Snoop Resistant Secure Communication and Alert System

2022

Course project — EE411: Digital Signal Processing, IIT Gandhinagar

- Designed and implemented a secure in-case-of-emergency (ICE) alert system, two frequency scrambling and unscrambling algorithms, and a communication module for two mobile devices.

Mathematical Modeling and Analysis of COVID-19 Pandemic using SEIR

2021

Course project — MA203: Numerical Methods and Statistics, IIT Gandhinagar

- Innovated an extended Susceptible-Exposed-Infectious-Removed (SEIR) numerical model to account for vaccination, deaths, and limited beds and predict the future of the COVID-19 pandemic. Analyzed Indian government data using the model.

Skills

- Languages:** Python, MATLAB
- Libraries and Frameworks:** NumPy, Pandas, Matplotlib, SciPy, CVXPY, TensorFlow (Keras), PyTorch, OpenCV, OpenAI Gym, Stablebaselines3, Quantipi, FinRL
- Tools:** Simulink, MATLAB App Designer, QtDesigner, STM32, Xilinx Vivado, DipTrace, LTSpice, Arduino, Autodesk Inventor, OpenChoice Desktop, LabView

Awards

- Institute Gold Medal, IIT Gandhinagar:** For the highest academic performance among batchmates over four years.
- O.P. Jindal Engineering and Management Award:** Amongst the top eighty engineering students in India.
- Award for Academic Excellence, IIT Gandhinagar:** For securing the highest CGPA (three consecutive years).
- Dean's List Semester I, III, IV, V, VI, IIT Gandhinagar:** For outstanding academic performance.
- National Talent Search Examination (NTSE) State Scholar:** Amongst the top 0.001% of high school students of Karnataka. Awarded a two-year scholarship from the Karnataka state government for excellence in the olympiad.
- National Mathematics Talent Contests (NMTC) State Scholar:** Amongst the top 1% of high school students from Karnataka, India for 2 consecutive years in the mathematics olympiad.

Teaching Experience

- CMU — Teaching Assistant, 18662: Principles and Engineering Applications of AI (2024):** Assisted in delivering, recitations, preparing course materials, grading assignments, and guiding graduate students through complex machine-learning concepts via real-world examples.
- IIT — Peer Assisted Learning Mentor (2021-22):** Mentored two freshmen each semester, assisting them with coursework, improving their English communication skills, and helping them adapt to the competitive college environment.
- IIT — Teaching Assistant, MS 403: Engineering Entrepreneurship (2021):** First undergraduate to work as a teaching assistant for the graduate-level course. Assisted Prof. Rajen Jaswa in the course's planning, instructing, teaching, mentoring, and logistics.

Leadership and Extracurriculars

- Coordinator, Entrepreneurship Initiative (2022):** Led a team of 12 to organize talks, events, and workshops. Formulated a plan for the institute's first-ever entrepreneurship summit.
- Student Executive, IIT Gandhinagar's Innovation Council (2022):** Amongst the 6 students selected by IIT Gandhinagar to be part of India's Ministry of Education Initiative to promote entrepreneurship among students.
- Core Committee, Blithchron: IIT Gandhinagar's Annual Cultural Fest (2021):** Co-led a team of 107 to organize 12+ cultural events for over 1500 participants and led design projects for the fest.
- Point guard, IIT Gandhinagar women's basketball team:** Placed fourth in the national Inter-IIT sports meet (2019 and 2022) and won statewide competitions, including Concours 2022 and Shaurya Cup 2022.