Haricharan Balasundaram

Email ◇ Website ◇ GitHub

EDUCATION

Indian Institute of Technology, Madras **CGPA: 9.51/10.00, Department Rank 1**

B.Tech (Hons.) in Engineering Physics + M. Tech. in Electrical Engineering *Nov 2021 - Present*
Minor in Computer Science

AWARDS AND ACHIEVEMENTS

- Recipient of *Ms. Latha and Sampath Srinath* prize for **highest CGPA** in semesters 3 and 4 in the Engineering Physics department
- Secured an **JEE Advanced** All India Rank of **1153** and **JEE Mains** All India Rank of **2565** among 1 million+ candidates
- Secured **Bronze medal** in **Inter-IIT** Tech Meet Quant Competition held in December 2023 by producing alphas using market data
- **Candidate Master** in Codeforces Competitive Programming, **Global Rank #59** in **Round #886** among 25000 participants

RELEVANT COURSEWORK

Electrical Engineering: Advanced Topics in Communication (5G), Information Theory, Convex Optimization, Multirate DSP, Communication Networks, Linear Algebra for Engineers, Probability and Statistics, Mathematical Physics, Quantum Computing

Minor in CS: Approximation Algorithms, Parameterized Algorithms, Advanced Graph Algorithms, Linear Programming

RESEARCH EXPERIENCE

Multi-Armed Bandits on Budgeted Erasure Channels

Guide: Prof. Krishna Jagannathan, Department of Electrical Engineering, IIT Madras *Dec 2023 - Present*

- Working on Multi-armed Bandits (MAB) formulation for **maximizing information** sent in wireless erasure channels
- Tested analogies of MAB strategies such as **ϵ-first** and **Successive Arm Elimination (SAE)** to measure asymptotic performance
- Attended **National Communications Conference (NCC '24)** organized by the Department of EE, IIT Madras

Approximation Algorithms for Hospital-Resident Matchings

Prof. Meghana Nasre, Department of Computer Science, IIT Madras *Oct 2023 - Jul 2024*

- Worked on **approximation algorithms** for generalizations of augmentation problems in hospitals-residents setting
- Formulated ***Integer Linear Program (ILP)*** for perfect matchings in many-to-many assignments in bipartite graphs
- Proved hardness of approximation of the augmentation problem in a restricted setting

Many-to-oneness of Lattice Filters

Prof. C. S. Ramalingam, Department of Electrical Engineering, IIT Madras *Aug 2023 - Nov 2023*

- Used MATLAB for **brute-force calculations** to determine the oddness or evenness of lattice coefficients
- Explored conditions on lattice coefficients which lead to **many-one lattice filters** and discovered lattice filters without pre-images

Control Systems for Rehabilitation [Repo]

Prof. Sourav Rakshit, Gait and Motion Analysis (GAMA) Lab, Machine Design Section, IIT Madras *Nov 2022 - Jan 2023*

- Worked on **trajectory tracking** using advanced control systems including Linear-Quadratic Regulator (LQR), iterative LQR (iLQR), and Soft Actor-Critic (SAC) for **gait training of paralyzed patients**, with 75% accuracy
- Contributed to **Open Source Repository** in implementing LQR to achieve multiple-motor position control

TEACHING EXPERIENCE

- **Head Teaching Assistant** for Signals and Systems (EE1101), oversaw 400+ students and coordinating with 6 faculty members
- **Teaching assistant** for Multirate Digital Signal Processing (EE6133), formulated assignments and conducted tutorial sessions
- **Shaastra 2023:** conducted workshop on Cryptography and **Shaastra 2024:** conducted workshop on Quantitative Finance
- Conducted information session on **Fundamentals of Mathematics and Programming** to incoming freshers in 2023

PROFESSIONAL EXPERIENCE

Software Developer Intern at D. E. Shaw India
Using LLMs to Automate Processing Vendor Emails *May 2024 - Jul 2024*

- Designed **Python pipelines** to assist operations teams in processing critical financial data for business systems
- Leveraged LLMs to **automate the classification** of vendor **emails**, streamlining communication and data extraction

COURSE PROJECTS

EE5143: Information Theory [Slides]
Prof. Andrew Thangaraj, EE Department, IITM *Feb 2024*

- Presented **Lempel-Ziv compression algorithms (LZ77 and LZ78)**, focusing on information-theoretic analysis and optimality
- Compared **advantages** of LZ compression over Huffman-coding, explained practical applications such as **'gzip'** and **'GIF'** formats

CS6130: Advanced Graph Algorithms [Slides]
Prof. Meghana Nasre, CS Department, IIT Madras *Apr 2024*

- Presented the paper '*Vital Edges for (s,t)–min-cut: Efficient Algorithms, Compact Structures, and Optimal Sensitivity Oracle*'
- Presented **classification of vital edges** into tight and loose vital edges and a generalization of the **Maxflow-Mincut theorem**
- Explained utilization of **data structure** (*ancestor tree*) to compute all tight edges and **bounded** the number of **loose edges**

EE5121: Convex Optimization [Poster]
Prof. Uday Khankhoje, EE Department, IIT Madras *Nov 2023*

- Poster presentation on the paper '*Subsampled Hessian Newton methods for solving supervised learning problems*'
- **Improved descent direction** by integrating approximate Hessian direction with gradient, leading to better optimization outcomes
- Achieved a **12% improvement** in optimizing **overqualified constraint datasets** using the improved descent technique

CS6841: Approximation Algorithms [Slides]
Prof. Meghana Nasre, CS department, IIT Madras *Nov 2023*

- Presented an **approximation algorithm** for the '*Connected Dominating Set problem using only local information*' in graphs
- Proved that the algorithm achieved a H_n–approximation factor, **matching the theoretical lower bound** on approximation
- Improved bounds on the proof of the approximation guarantee to get a **smaller constant factor** in restricted cases

EE6133: Multirate Digital Signal Processing
Prof. Aravind, EE Department, IIT Madras *Oct 2023*

- Implemented a 2-channel **Cosine Modulated Filter Bank** (CMFB) for reconstructing music and speech signals without aliasing
- Reviewed **compression techniques** in the MP3 standard and **implemented** parts of the MP3 standard involving Multirate DSP

POSITIONS OF RESPONSIBILITY

Head and Founder
Mathematics Club, Centre for Innovation, IITM *Nov 2022 - Mar 2024*

- **Co-founder** and **Head of Mathematics Club**, Centre for Innovation, IITM with a reach of 1000+ students
- **Led sessions and workshops** on number theory, quintic unsolvability, game theory, probability, and linear algebra
- **Directed and managed projects** on Probability and Stochastics, Nonlinear dynamics and Group Theory for **CFI Open House**
- Supervised a cohort of 4 project leads, 15 coordinators, and 57 deputy coordinators in the 2023-2024 academic year

Core Team Member
Programming Club, Centre for Innovation, IITM *Apr 2023 - Mar 2024*

- Conducted sessions on **Competitive Programming**, covering topics like Graphs and Dynamic Programming for students
- Created popular **video editorials** for Codeforces rounds and curated contests using Polygon platform

EXTRA-CURRICULAR ACTIVITIES

- Presented achievements of Mathematics club at **G20 Global Summit** held at IIT Madras to international delegates
- **Press Correspondent** for The Fifth Estate, IITM: the institute's *independent student media body*