Aniruddha **Sundararajan**

Indian Institute of Technology Madras

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Education

Indian Institute of Technology Madras	*Jul 2018 – Present*
Dual Degree (B.Tech Engineering Physics & M.Tech Data Science)	CGPA: **9.25**/10
Kola Saraswathi Vaishnav Sr. Sec. School	*Apr 2017 – Apr 2018*
Class XII, CBSE	Score: **483**/500
National Public School, Chennai	*Apr 2015 – Apr 2016*
Class X, CBSE	CGPA: **10**/10

Scholastic Achievements

2022	**335/340** in Graduate Record Examination: 170 Quantitative & 165 Verbal
2020	**Recipient of the IITM Young Research Fellowship** for a funded undergraduate research project
2018	**All India Rank 1741** (among top 0.7 percentile) in Joint Entrance Examination Advanced 2018
2017	**5/5** in 3 Advanced Placement Exams: Calculus BC, Physics C: Mechanics, and Physics C: Electricity & Magnetism
2017	**800/800** in 3 SAT Subject Tests: Math 2, Physics, & Chemistry

Experience

Thesis Project — *Aug 2022 – Present*
Research project with Dr. Balaraman Ravindran, IIT Madras — Reinforcement Learning

- **Option-Indexed Hierarchical RL:** We learn an affinity function between options and the items present in the environment. This allows us to effectively reuse a large library of pre-trained options (lifelong learning setting) in zero-shot generalization at test time by restricting goal-directed learning to only those options relevant to the task at hand.
- Ideated and implemented a co-occurrence-based representation for options to match them to tasks efficiently.
- Submitted our work to the Autonomous Agents and Multiagent Systems Conference 2023 under Learning and Adaptation.
- Explored academic literature related to MDP Homomorphisms, Equivariant Neural Networks, and incorporating symmetries into Model-based RL.

Amazon — *Feb 2022 – Jul 2022*
Applied Scientist Intern — Machine Learning for Finance

- Worked in the Accounts Payable team of Amazon, responsible for making timely payments from Amazon to vendors.
- Developed a novel technique for unsupervised multivariate anomaly detection using flexible negative sampling. Co-authored 2 papers on variants of this technique in Amazon's internal Machine Learning conference (AMLC).
- Built a cancellation propensity model based on Gradient Boosted Trees to predict the probability that an invoice might be cancelled and prevent erroneous payments, leading to potential savings ranging from 100k$ to 20M$.
- Received a full time job offer based on my performance in the internship.

Texas Instruments — *May 2021 – Jul 2021*
Digital & Signal Processing Engineer Intern — Automotive Ethernet

- Performed system modelling and signal level simulation of a 10 Mbps automotive ethernet in MATLAB.
- Proposed an architecture spec for PHY layer of the ethernet that met the IEEE 802.3cg standard for 10BaseT1S.
- Received a full time job offer based on my performance in the internship.

IITM Young Research Fellow ☐ — *Sep 2020 – Jul 2021*
Research project with Dr. Avhishek Chatterjee, IIT Madras — Error Control Coding

- **Achieving near capacity performance in queue-channel systems with waiting-time dependent errors** ☐: Designed error control coding schemes that make bits/qubits robust to noise in queue-channel systems with waiting-time dependent errors.
- Used Python and Mathematica to perform simulations of the channel, implement my convolution-based encoder and Maximum a Posteriori decoder from scratch, and validate the performance of the scheme in terms of bit error rates.
- Learned various research skills like reading, writing and presenting academic work through the YRF's research readiness program.

Projects

How does Batch Normalization help optimization? — *Jul 2022 – Nov 2022*
Course project with Dr. Uday Khankhoje, IIT Madras — Optimization

- Reproduced experimental results from the research paper "How Does Batch Normalization Help Optimization?" by Santurkar et al. ☐, which proposed the landscape smoothening effect of the BatchNorm technique as a novel explanation for its effectiveness.

- Developed an academic poster ⬈ and presented it at the Electrical Engineering Department of IIT Madras.

Using summaries to improve review sentiment classification
Jan 2021 – May 2021
Course project with Dr. Avhishek Chatterjee, IIT Madras
Deep Learning

- Developed a novel hierarchical classification-based approach to perform review sentiment classification. The first-stage BiGRU based classifier leveraged short summaries of the review text, which capture the essential sentiment features, to predict if the review is positive (score 1-2) or negative (score 3-5). Subsequent BiGRU models perform finer classification based on the first classifier's prediction using the full review text.
- Tested the architecture on the Sports and Outdoors dataset from Amazon 5 cores repository and achieved performance close to state-of-the-art (**51%** balanced accuracy and **44%** macro F1 score) despite having far fewer trainable parameters.

Estimation of the bilinear form y*f(A)x for Hermitian matrices
Jul 2020 – Nov 2020
Course project with Dr. Andrew Thangaraj, IIT Madras
Linear Algebra

- Reproduced numerical results from the research paper "Estimation of the bilinear form y*f(A)x for Hermitian matrices" by Fika et al. ⬈
- Estimated bilinear forms of f(A) without explicitly calculating f(A) by extrapolating the moments y*f(A)x. Verified the accuracy of the estimations using MATLAB simulations.

Build a modern computer from first principles: From Nand to Tetris
May 2019 – Aug 2019
Coursera course project
Computer Architecture

- **Part I**: Built the hardware part of a fully functioning general-purpose modern computer starting from logic gates.
- **Part II**: Built a modern software hierarchy that can translate and execute object-based, high-level languages on a bare-bone computer hardware platform. Implemented a virtual machine and a compiler for a Java-like programming language (Jack).

Teaching Experience

Physics Lab Teaching Assistant
Aug 2022 – Present

- Currently working as a teaching assistant for the Physics Preparatory Lab course, which is offered to help underprivileged first-year students prepare for their studies at IIT Madras.

Programming Club Coordinator
Mar 2019 – Jun 2020

- Worked as a coordinator in the CΦ Programming Club of IIT Madras.
- Conducted educative sessions for students in the field of data structures and algorithms. Authored questions for the institute-wide programming contests run by the club on online platforms.

Skills

Programming	Python, C++, C
Analysis	MATLAB, Mathematica
Frameworks & Tools	Scikit-learn, TensorFlow, Keras, PyTorch, Pandas, PySpark, AWS EC2, AutoCAD, LTspice, LaTeX
Languages	Tamil, English (108 in TOEFL iBT)

Relevant Coursework

Math	Probability, Statistics & Stochastic Processes, Linear Algebra, Multivariable Calculus
Data Science	Machine Learning, Deep Learning, Data Analytics, Big Data Lab
Computer Science	Programming & Data Structures, Discrete Mathematics for CS, Optimization
Engineering Physics	Quantum Computation & Information, Statistical Physics, Mathematical Physics
Electrical Engineering	Information Theory, Communication systems, Digital Signal Processing, Digital Systems

MOOCs

2022	Introduction to Operations Research ⬈
2022	Design and Analysis of Algorithms ⬈
2020	Deep Learning Specialization (5 courses) ⬈
2020	CS-191x Quantum Mechanics and Quantum Computation ⬈
2020	Digital Signal Processing ⬈
2019	Build a Modern Computer from First Principles: From Nand to Tetris Parts I ⬈ & II ⬈
2019	Programming, Data Structures and Algorithms Using Python ⬈
2018	DAT208x: Introduction to Python for Data Science ⬈