# Aniruddha **Sundararajan**

## INDIAN INSTITUTE OF TECHNOLOGY MADRAS

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## Education

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|---|---|
| **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 – May 2018* |
| Class XII, CBSE | Score: **483**/500 |
| **National Public School, Chennai** | *Apr 2015 – May 2016* |
| Class X, CBSE | CGPA: **10**/10 |

## Scholastic Achievements

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| 2022 | **335/340** in Graduate Record Examination: 170 Quantitative & 165 Verbal |
| 2020 | **Recipient of the IIT Madras 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* — Reinforcement Learning
Research project with Prof. Balaraman Ravindran, IIT Madras

- **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 on MDP Homomorphisms, Equivariant Neural Networks, and incorporating symmetries into Model-based RL.

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

- Worked in the Accounts Payable team of Amazon, responsible for making timely payments from Amazon to vendors.
- Developed a novel unsupervised multivariate anomaly detection technique using flexible negative sampling.
- Submitted 2 papers on variants of this technique to 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 canceled and prevent erroneous payments.
- Received a full-time job offer based on my performance in the internship.

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

- Performed system modeling 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* — Error Control Coding
Research project with Prof. Avhishek Chatterjee, IIT Madras

- Received the prestigious IITM Young Research Fellowship (https://yrf.iitm.ac.in/) to work on a year-long funded research project.
- **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 scheme's performance 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* — Optimization
Course project with Prof. Uday Khankhoje, IIT Madras

- 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.
- Designed an academic poster and presented it to the Electrical Engineering Department of IIT Madras.

### Using summaries to improve review sentiment classification
Course project with Prof. Avhishek Chatterjee, IIT Madras

*Jan 2021 – May 2021*
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 3-5) or negative (score 1-2). 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. Achieved performance close to the then 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
Course project with Prof. Andrew Thangaraj, IIT Madras

*Jul 2020 – Nov 2020*
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
Coursera course project

*May 2019 – Aug 2019*
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 in data structures and algorithms for students from all disciplines. Authored questions for the institute-wide programming contests run by the club on online platforms.

## Skills

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| **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

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|---|---|
| **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, Classical Dynamics |
| **Electrical Engineering** | Information Theory, Communication systems, Digital Signal Processing, Digital Systems |

## MOOCs

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| 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 ⎘ |
| 2019 | Build a Modern Computer from First Principles: From Nand to Tetris Part I ⎘ |
| 2019 | Build a Modern Computer from First Principles: From Nand to Tetris Part II ⎘ |
| 2019 | Programming, Data Structures and Algorithms Using Python ⎘ |
| 2018 | DAT208x: Introduction to Python for Data Science ⎘ |