

# Aniruddha Sundararajan

INDIAN INSTITUTE OF TECHNOLOGY MADRAS

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## Education

Indian Institute of Technology Madras

Dual Degree (B.Tech Engineering Physics & M.Tech Data Science)

Jul 2018 - Present

CGPA: 9.25/10

Kola Saraswathi Vaishnav Sr. Sec. School

Class XII, CBSE

Apr 2017 - May 2018

Score: 483/500

National Public School, Chennai

Class X, CBSE

Apr 2015 - May 2016

CGPA: 10/10

## Scholastic Achievements

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

Research project with Prof. Balaraman Ravindran, IIT Madras

Aug 2022 - Present

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

### Amazon

Applied Scientist Intern

Feb 2022 - Jul 2022

Machine Learning for Finance

- 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

Digital & Signal Processing Engineer Intern

May 2021 - Jul 2021

Automotive Ethernet

- 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

Research project with Prof. Avhishek Chatterjee, IIT Madras

Sep 2020 - Jul 2021

Error Control Coding

- 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?

Course project with Prof. Uday Khankhoje, IIT Madras

Jul 2022 - Nov 2022

Optimization

- Reproduced experimental results from the research paper "How Does Batch Normalization Help Optimization?" by Santurkar et al., which proposed the landscape smoothing 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

Jan 2021 - May 2021

Course project with Prof. 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 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

Jul 2020 - Nov 2020

Course project with Prof. 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 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

<b>Programming</b>	Python, C++, C
<b>Analysis</b>	MATLAB, Mathematica
<b>Frameworks &amp; Tools</b>	Scikit-learn, TensorFlow, Keras, PyTorch, Pandas, PySpark, AWS EC2, AutoCAD, LTspice, L <sup>A</sup> T <sub>E</sub> X
<b>Languages</b>	Tamil, English (108 in TOEFL iBT)

## Relevant Coursework

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

## MOOCs

2022	Introduction to Operations Research <a href="#">↗</a>
2022	Design and Analysis of Algorithms <a href="#">↗</a>
2020	Deep Learning Specialization (5 courses) <a href="#">↗</a>
2020	CS-191x Quantum Mechanics and Quantum Computation <a href="#">↗</a>
2019	Build a Modern Computer from First Principles: From Nand to Tetris Part I <a href="#">↗</a>
2019	Build a Modern Computer from First Principles: From Nand to Tetris Part II <a href="#">↗</a>
2019	Programming, Data Structures and Algorithms Using Python <a href="#">↗</a>
2018	DAT208x: Introduction to Python for Data Science <a href="#">↗</a>