Aniruddha **Sundararajan**

Indian Institute of Technology Madras

s-aniruddha.github.io | s-aniruddha | Aniruddha-sundararajan

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

- Currently working on developing methods for matching options to tasks in Hierarchical Reinforcement Learning.
- Explored literature related to Homomorphisms in Markov Decision Processes to exploit symmetries in 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 (tabular variant & time-series variant) on the above technique for Amazon's internal Machine Learning conference (AMLC).
- Designed an efficient algorithm to create rolling window features in large datasets in PySpark.
- Built a cancellation propensity model based on Gradient Boosted Trees to predict the probability that an invoice might be cancelled and prevent premature/wrong 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 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

- Project Title: Achieving near capacity performance in queue-channel systems with waiting-time dependent errors.
- Designed error control coding schemes that achieve high data rates and make bits/qubits robust to noise in queue-channel systems with waiting time dependent errors by adapting the convolutional encoder and the BCJR decoder to suit this channel.
- Used Python and Mathematica to perform simulations of the channel, to implement my encoder and decoder from scratch and to 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 - Present
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 new explanation for its effectiveness.
- Currently working on making a research poster to present the experimental and theoretical results of this paper 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

- Built a novel biGRU based neural network architecture to perform hierarchical classification. The first-stage classifier leveraged short summaries of the review text, which capture the important sentiment features, to predict if the review is positive (score 1-2) or negative (score 3-5). Subsequent 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 the 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) by extrapolating the moments y*f(A)x without explicitly calculating f(A) and checked the accuracy of the estimation 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, designed to enable the translation and execution of object-based, high-level languages on a bare-bone computer hardware platform (built in part I). Implemented a virtual machine and a compiler for a simple Java-like programming language (Jack). Learned about basic operating system routines, stack processing, code parsing, code generation, memory management, vector graphics and input-output handling.

Teaching Experience

Physics Lab Teaching Assistant

Aug 2022 - Present

- Currently working as a teaching assistant for the physics preparatory lab course at IIT Madras, a course offered to help prepare underprivileged first year students 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 problems for the institute-wide programming contests conducted 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	English, Tamil

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