

Aayush Rajesh

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Research Interests

Information and Coding Theory, Communication Systems, Signal Processing, Probability Theory

Education

Indian Institute of Technology Bombay

Bachelor of Technology in Electrical Engineering

CPI: 9.81/10 (4th out of 202 students)

Minor in Computer Science and Engineering

Mumbai, India

2020 - present

Scholastic Achievements

- Recipient of **Institute Academic Prize** (top 20 out of 1356 students) for academic excellence (2021)
- Secured **All India Rank 78** in **JEE Advanced** out of 150 thousand candidates (2020)
- Achieved **All India Rank 115** in **JEE Main** out of 1 million candidates (2020)
- Awarded the **KVPY Fellowship** with an **All India Rank 677** by Govt. of India (2020)
- Awarded **Certificate of Merit** by Central Board of Secondary Education, Government of India for being among top 0.1 percent of candidates in **Computer Science** and **Chemistry** (2020)
- Among the top 331 students selected for **Indian National Astronomy Olympiad** (2019)

Research Experience

Information-Theoretic Cryptography

Guide: Prof. Vinod Prabhakaran

May 2022 - Present

Tata Institute of Fundamental Research, Mumbai

- Working on information-theoretic cryptography, specifically the analysis of 3-party **multi-secret sharing** schemes over binary functions
- Computed the optimal lower bound on **randomness complexity** of secret sharing for candidate functions
- Searched for secret sharing schemes, under the constraints of **privacy** and **correctness**, with upper bounds on randomness complexity, matching the calculated lower bounds
- Analysing the complexities under modified settings of the original problem

Technical Projects

CISC and RISC Processor Design

Guide: Prof. Virendra Singh

January 2022 - May 2022

EE309: Microprocessors

- Developed an on-paper design of a microcoded **CISC Processor** using Hardware Flowchart Method
- Designed and implemented a 16-bit multicycle **RISC Processor** in **VHDL** with a Turing-complete instruction set architecture of 17 instructions
- Extended the design to a 6-stage **pipelined** architecture and tested both on an **Altera MAX V CPLD**
- Optimized performance of pipeline by introducing **hazard mitigation** techniques such as **data forwarding**

Microprocessor Implementations

Guide: Prof. Saravanan Vijayakumaran

January 2022 - May 2022

EE337: Microprocessors Lab

- Implemented a **reaction timer** capable of displaying the time it takes for the user to respond to a stimulus

- Interfaced LM35 sensor with the microcontroller using an ADC, through **serial peripheral interfacing** to monitor and display real-time ambient temperature
- Developed a subroutine capable of generating voltage waveforms corresponding to **music note frequencies**, which can play music when connected to an **audio driver circuit**
- Simulated a **two-party ATM** capable of taking action inputs from a keyboard using **UART**

Digital Circuit Design

Guide: Prof. Maryam Shojaei Baghini

July 2021 - November 2021

EE214: Digital Circuits Lab

- Simulated basic combinational circuits using both structural and behavioral descriptions, such as **Multiplier**, **Adder-Subtractor**, and an **Arithmetic Logic Unit** on Quartus software using VHDL
- Created a logical representation of an **ATM Machine**, capable of specifying number of smaller denomination currencies in order to comprise an amount given as input through a CPLD Board
- Built upon the concept of **finite state machines** to design a sequential **String Detector** capable of recognizing and displaying a specific string on an LCD

Other Projects

Lasso Game

Guide: Prof. Bhaskaran Raman

January 2021 - March 2021

CS101: Computer Programming and Utilization

- Used **C++** to program a Lasso game, involving catching projected objects using a lasso controlled by the computer keys, complete with a scoring system, life count, and three different **levels**, last level being **timed**
- Implemented randomly projected objects using **classes**, each with different game properties and effects, such as affecting the total score, life count, or altering the speed of the thrown lasso

T.O.H.F.A.

Self Project

May 2019 - September 2019

- Developed an easy-to-use Python-based assistant, capable of **speech recognition**, with the purpose of helping teachers in attendance and grading duties
- Allowed for multiple users to securely access and store data, making use of **Python-SQL interfacing**

Key Positions Held

Teaching Assistant

Served as an undergraduate teaching assistant for a batch of **40+** students, with the responsibility of conducting weekly problem solving sessions, and academically mentoring students of the duration of the following courses:

- MA109: Calculus-I
- MA106: Linear Algebra

Autumn 2021

Spring 2022

Department Academic Mentor

Department of Electrical Engineering, IIT Bombay

June 2022 - Present

- Selected from among **100+ applicants** on the basis of interviews and extensive peer reviews
- Mentoring **8** sophomores in the department in managing their academics and extracurriculars

Technical Skills

Languages

C++, Python, VHDL, Assembly, MySQL

Software

GNU Radio, Quartus, Keil μ Vision, MATLAB, Ngspice, \LaTeX

Courses Undertaken

Electrical Engineering	Error Correcting Codes*, Communication Systems*, EM Waves*, Markov Chains and Queuing Systems, Electronic Devices and Circuits, Control Systems, Power Engineering, Microprocessors, Probability and Random Processes, Digital Systems, Signal Processing, Analog Circuits
Computer Science	Foundations of Intelligent and Learning Agents*, Design and Analysis of Algorithms*, Data Structures and Algorithms, Logic for Computer Science, Computer Programming and Utilization
Mathematics	Calculus, Linear Algebra, Differential Equations, Complex Analysis
Miscellaneous	Quantum Physics and Application, Basics of Electricity and Magnetism, Biology

* To be completed by November, 2022

Extracurriculars

- Completed one year of **Chess** training under **National Sports Organisation, IIT Bombay** (2020-21)
- Stood **first** in **Bazinga Physics** organized by Math and Physics Club, IIT Bombay (2021)
- Achieved **second place** in **Astromania** organized by Krittika - The Astronomy Club, IIT Bombay (2021)