Rishabh Ravi

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https://borlaugg.github.io/
Indian Institute of Technology Bombay

Education

2020 – present **Indian Institute of Technology Bombay, India** 9.09/10 GPA
B.Tech. in Electrical Engineering

2018 – 2020 **PSBB Learning Leadership Academy** 94.8%
Higher Secondary

Internships

2023 **Modem Firmware Engineer** *Qualcomm*
Contributed to the development of GPRS-specific modem firmware for practical purposes. Developed GPRS-specific test case scenarios mimicking L1 commands for testing and validation. Improved functionality by shifting and testing the firmware operations from 24 bits to 32 bits.

2022 **Parallel Computing & Profiling** *Nvidia*
Contributed to parallelizing ANUGA, an open-source hydrodynamic modeling project on CPU. Performed running time analysis of the program by profiling it using Nvidia Nsight Systems. Identified hot spots of the program that required hardware optimization to increase performance. Also mentored a batch of students for two online certification courses on CUDA C and python.

Research

2023 **A Comprehensive Study on Cache Partitioning** *Guide: Prof. Virendra Singh | IIT Bombay*
Explored the two cache partitioning algorithms - static and dynamic for multi core processors. Implemented and analyzed the results on the SNIPER simulator using SPEC 2005 benchmarks. Performed a comparative study on the impact on MPKI, miss rates of L2 and LLC, and overall performance by changing the replacement algorithm.

2021 **Cache Security from Side Channel Attacks** *Guide: Prof. Virendra Singh | IIT Bombay*
Studied the vulnerabilities of shared cache and attacks like Flush+Reload, and Prime+Probe. Replicated the work of PASS-P, an algorithm that mitigates the threat of such hardware attacks. Implemented a modified PASS-P algorithm by introducing a more effective and dynamic insertion policy -DAAIP.

2022 **Exploring Replacement Policies** *Guide: Prof. Virendra Singh | IIT Bombay*
Studied the Cache hierarchy, access patterns, and eviction polices of caches in computer architecture. Also explored multiple cache replacement policies that included simple LRU, and MRU policies to more complex policies such as Re-Reference Interval Prediction (RRIP), Hawkeye, and Mockingjay.

Major Projects

2020 – 2021 **Electrical Designer** *Guide: Prof. Leena Vachhani | AUV -IITB | Electrical Subsystem*

Deployed a fully autonomous underwater submarine Matsya, capable of self-navigation and performing multiple tasks as described by the annual International RoboSub competition. Designed space-optimized PCBs on EAGLE software with the facility for compact wire routings. Facilitated wireless communication using ESP32 and ESP8266 following TCP (HTTP) protocol.

Migrated the logic of the electrical stack to work on STM32G4 from the ATmega328P, enabling higher operation speeds and functionality provided by the increased number of I/O ports.

Implemented 2-Dimensional SLAM (Simultaneous Localization and Mapping) in python and estimated position and localized object in a 2-Dimensional map using sensor and motion readings. Predicted positions using Extended Kalman filter algorithm given inertial and odometric data.

2022 – 2023 **Prcoessor Design** *Guide: Prof. Virendra Singh | Course Project | IIT Bombay*

Developed a 16-bit RISC multi-staged processor that handled a total of 17 instructions in VHDL. Incorporated an Arithmetic and Logical Unit to handle arithmetic and logical operations. Implemented a Finite State Machine to efficiently handle state transitions in the processor.

Developed a 16-bit MIPS pipelined processor that outpaced the multistage processor in performance. Pipelined the processor into 6 different stages to get a performance close to 1.94 cycle/instruction. Designed a hazard unit, branch predictor and a forwarding unit to tackle pipelining hazards.

Designed a 16-bit RISC 2-way fetch superscalar processor handling out-of-order execution. Implemented a Re-Order Buffer, and a PRF to handle hazards of instruction level parallelism

The repositories containing the code can be found here.

Teaching

2021-2023 Teaching assistant at IIT Bombay for the following courses.

Year	Course
2023	MA 106, Linear Algebra
2023	MA 111, Calculus II
2022	MA 205, Complex Analysis
2022	MA 207, Partial Differential Equations

Mentorship

2023 – Mentoring a batch of sophomores from the Electrical Engineering department as a part of the Department Academic Mentorship Programme. This involves providing the students with guidance including and not limited to academics.

2022 Mentored a batch of new recruits to AUV-IITB, and helped in training them. This involved providing resources, solving doubts, and demonstrating the functionality of the AUV.

Academic Achievements

2021 – Ranked in top 3 out of 100 students (Dual Degree) in Electrical Engineering Department

2023 Ranked among top three projects in the Electrical Design Lab out 70+ projects.

Academic Achievements (continued)

2021 Among top 30 students to be awarded Change of Branch to Electrical Engineering on excellent academic performance

2020 Achieved All India Rank **878** in **JEE Advanced 2020** out of 150,000 candidates.

2020 Secured **99.82 percentile** in **JEE Mains 2020** out of 1,100,000 candidates.

Technical Skills

Languages LaTeX, C/C++, Python, FORTRAN, VHDL, 8085 Assembly, 8081 Assembly, CUDA, MATLAB, GNU Octave, Bash, Heptagon, Perl

Extracurricular

Football

- Participated and won numerous football tournaments at both school and college level.
- Represented the college football team at a third division football league.