# Rishabh Ravi

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Rishabh Ravi
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## Education

2020 – 25 **Indian Institute of Technology Bombay, India** 9.41/10 GPA
Bachelors and Masters of Technology in Electrical Engineering
Specializing in Electronic Systems (ES)
with Minor in Computer Science and Engineering

## Publications and Preprints

SCAM: Secure Shared Cache Partitioning Scheme
Varun Venkitraman, **Rishabh Ravi**, Tejeshwar Torwade, Nirmal Boran, Virendra Singh
*Accepted in International Conference on Security and Cryptography (SECRYPT) 2025*

Hardware vs. Software Implementation of Warp-Level Features in Vortex RISC-V GPU
Huanzhi Pu, **Rishabh Ravi**, Shinnung Jeong, Udit Subramanya, Euijun Chung, Jisheng Zhao, Chihyo Ahn, Hyesoon Kim
*Accepted in Open Source Solutions for Massively Parallel Integrated Circuits at DATE 2025*

Subsampling of Correlated Graph Signals [arXiv]
**Rishabh Ravi**, Kaushani Majumder, Kalp Vyas, Satish Mulleti

## Research Experience

2024 **HW/SW Codesign for Accelerating CFD Applications** *Guide: Prof. Virendra Singh | IITB*
*The presentation can be found here*
- Profiled and identified bottlenecks in Computational Fluid Dynamics (CFD) applications to be large data movement, whose throughput was sped up by **1.7x** using hardware and software prefetching
- Exploring the benefits of selectively offloading dense matrix computations to **process in memory**

2024 **Extending Vortex support for CUDA** *Guide: Prof. Hyesoon Kim | GaTech*
- Added support for CUDA's **PTX ISA** instructions **VOTE** and **SHFL** to the **RISC-V GPU** Vortex
- Modified the hardware to facilitate **variable warp size** architecture to support CUDA's cooperative thread groups by matching the warp and group size, allowing groups to execute independently

2024 **SCAM: Secure Shared Cache Partitioning Scheme** *Guide: Prof. Virendra Singh | IITB*
- Developed a secure, dynamic cache partitioning algorithm that outperformed PASS-P by **2%**
- Improved the performance by capping the partition to ensure complete L2 utilization and selectively transferring clean, exclusive and dead lines to minimize writeback, and back invalidation latencies

2023 **Subsampling of Correlated Graph Signals** *Guide: Prof. Satish Mulleti | IITB*
- Devised an algorithm to approximate correlated graph signals into a lower-dimensional space using low-rank approximations that allowed for spatial signal subsampling and reconstruction
- Proved that the reconstruction error for deleting two or more nodes was dependent on the nature of the graph and had **perfect reconstruction** for the deletion of just one node

## Research Experience (continued)

2023 **A Review of Commercial Accelerator Architectures** *Guide: Mr. Sunil Shenoy*
*The presentation can be found here* *Sr. Vice President Emeritus, Intel*
- Explored literature by NVIDIA, Google, Intel, and Groq on **hardware accelerators** for applications in data center chips and cards and performed a comparative study on peak performance
- Inferred that developing application-specific hardware, implementing memory slicing, and having larger caches and faster interconnects were key for high-performance

## Academic Achievements

Present **Ranked 1** in the ES specialization of Electrical Engineering based on academic performance

2024 Received the **Undergraduate Research Award** (URA 01) for the work on graph subsampling

Present **Ranked 3** in the department of Electrical Engineering out of 99 students based on academic performance

2023 Designed a 2D Mapping System that ranked among the **top 3** projects out of 70+ projects.

2021 Among the **top 30** students across all departments to be awarded the Change of Branch to Electrical Engineering based 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.

## Professional Internships

2023 **Modem Firmware Engineer** *Guide: Mr. Dileep Lingamallu | Qualcomm*
- Revived a **GPRS-specific** modem firmware and virtual platform for applications in **smartwatches**
- Created test case scenarios, emulating L1 commands, to assess and validate functionality by maintaining signal-to-noise ratio within defined **21 dB** thresholds, affirming the accuracy of decoded data

2022 **Parallel Computing & Profiling** *Guide: Mrs. Tanmaya Karmakar | Nvidia*
- Worked in a team to parallelize **ANUGA**, an open-source hydrodynamic modeling software, by profiling and running time analysis of the program on **Nvidia Nsight Systems**
- Identified hot spots of the program that required parallelization to increase performance

## Technical Projects

2024 **Accelerating Ray Tracing** *Guide: Prof. S Gopalakrishnan*
*The report can be found here* *Course Project*
- Parallelized a RayTracing algorithm using OpenMP and CUDA, achieving a speedup of **7x**
- Performed a comparative study on OpenMP and CUDA and quantized their overheads

2024 **tinyVTA: FPGA-based Accelerator for Neural Networks** *Guide: Prof. Sachin Patkar*
*The detailed report can be found here* *Course Project*
- Implemented an accelerator for floating point operations such as block **matrix-multiply-accumulate** and **activation function** of DNN inference to an **FPGA**
- Verified the correctness by testing against the **MNIST dataset** using a large, fully connected model on the **Xilinx ZCU104 FPGA** and observing consistent results across all 128 test examples

2022-23 **RISC Processor Design** *Guide: Prof. Virendra Singh*
*The code can be found here* *Course Project*
- Developed a six-stage pipelined processor that achieved a peak performance of **1.94 cycle/instruction**, which included a forwarding and hazard unit to tackle pipelining hazards
- Expanded this to a 2-way fetch superscalar processor handling out-of-order execution

2023 **Hand Held 2D Mapping System** *Guide: Prof. Siddharth Tallur*
*The report can be found here* *Course Project*
- Created a robot that remotely yet accurately mapped its trajectory in a **2-dimensional plane**
- Utilized an **IMU** and a **rotary encoder** to obtain position readings, and a **Bluetooth module** for real-time transmission to a computer to plot the path traced against light intensity

## Technical Projects (continued)

2023 **Model based Embedded System Design** *Guide: Prof. Paritosh K Pandya*
*The video can be found here* *Course Project*
- Developed an embedded system using model-based design for **autonomous valet-parking**
- Designed an algorithm for line following, track color inversion, and parking-space identification

2020-22 **Matsya, Autonomous Underwater Vehicle (AUV)** *Guide: Prof. Leena Vachhani*
*AUV-IITB is a team of 40+ students working on the design and development of an AUV*
- Deployed the sixth iteration of **Matsya**, an Autonomous Underwater Vehicle (AUV), capable of **self-navigation** and performing tasks as described by the International RoboSub competition
- Migrated the logic of the electrical stack to work on **STM32G4** from the ATmega328P, enabling higher **operation speeds** provided by the increased I/O ports and better-suited **ISA**

## Mentorship

2023 - 24 **DAMP Mentor** *Student Mentorship Programme*
- Appointed as a mentor from a pool of 80+ applicants based on interviews and peer reviews. Mentored six sophomores on a one-to-one basis in their academic and co-curricular pursuits.

2023 **English Language Improvement Training TA** *Student Mentorship Programme*
- Assigned as an English Language Improvement Training one-on-one TA. Provided resources and held sessions that helped the students become more confident while speaking in public.

2022 **RnD Head** *AUV - IITB*
- Mentored a batch of recruits to AUV-IITB as the RnD head and helped train them. Provided resources and transferred knowledge regarding the functionality of the AUV.

## Teaching

Teaching assistant at IIT Bombay for the following courses.

| Year | Course | Instructor |
|---|---|---|
| 2025 | EE 309 Microprocessors | Prof. Rajababu V |
| 2024 | EE 709 Testing and Verification of VLSI Circuits (Head TA) | Prof. Madhav Desai |
| | EE 779 Advanced Topics in Signal Processing | Prof. Satish Mulleti |
| 2023 | MA 106 Linear Algebra (Head TA) | Prof. Jugal Verma |
| | MA 111 Integral Calculus | Prof. Preeti Raman |
| 2022 | MA 205 Complex Analysis | Prof. Saikat Mazumdar |
| | MA 207 Partial Differential Equations | Prof. Harsha Hutridurga |

## Technical Skills

Languages C/C++, Python, Verilog, System Verilog, VHDL, Assembly, Bash, Perl, MATLAB, GNU Octave, LaTeX

Software Vivado, VTune, Quartus, GEM5, SNIPER simulator, Perf, Valgrind, Arduino, Keil, CubeMX, EAGLE PCB Design, NGSPICE, GNU Radio

## Extracurricular

**Football**
- Participated in and won numerous football tournaments at both school and college levels.
- Represented the college football team at a third-division football league.

**National Service Scheme**
- Engaged in public speaking and outreach activities focusing on environmental education
- Empowered attendees with the significance of individual actions in preserving resources