Pursuing **Honours** in Computer Science & **Minor** from the Centre for Machine Intelligence and Data Science

Scholastic Achievements

- **Department Rank 5** in a batch of 190+ students, displaying consistent academic proficiency *2023*
- Secured **All India Rank 14** in the **Joint Entrance Exam** (Advanced) amongst $\sim$ **150,000** candidates *2021*
- Secured **100 percentile** in the **Joint Entrance Exam** (Main) amongst $\sim$ **1 million** candidates *2021*
- Awarded IIT Bombay's **Institute Academic Prize for 1st place** among **1400+** first year students *2022*
- Received the **AP grade** for exceptional academic performance (**top 1%**) in 4 courses at IITB *2021-22*
- Granted the prestigious **KVPY Fellowship** by achieving **All India Ranks 2** (SA) and **4** (SX) *2019, 20*
- Awarded the prestigious **Aditya Birla Group Scholarship**, covering a large part of college tuition fee *2022*

Olympiad Experience

- Won a **Gold** Medal for India at the **International Junior Science Olympiad** held in Botswana *2018*
- Selected as part of the 5-member Indian contingent for the 51st **International Physics Olympiad** *2021*
- Selected as part of the 8-member Indian contingent for the 21st **Asian Physics Olympiad**, Taiwan *2021*
- Invited to attend the Orientation Camps in **Physics, Chemistry, Astronomy** held by the **HBCSE** *2021*

Research Experience

Partial Order methods for concurrent program verification **Summer '23**

Prof. Andreas Pavlogiannis, Aarhus University *Research Internship*

- Extended a large, existing Java codebase for the M2 algorithm, which computes the novel *trace-closed partial order* of a set of events in an execution, to detect bugs such as the **Use-After-Free, Double-Free** in multithreaded programs
- Reviewed literature on partial order methods for efficient, sound **consistency checking** of an execution under the Total Store Order (TSO) memory model axioms with applications in the **design of commercial microprocessors** and systems
- Implemented the algorithms utilising a suffix-minima based data structure for storing dynamic, low-width partial orders

Key Projects

Quantum Computing, Quantum Machine Learning **Summer '22**

Web and Coding Club, IITB *Summer Project*

- Designed a QML circuit in PennyLane to implement a **Single Qubit Classifier**, labeling points in a 2D-region with 92.3% accuracy using 5 tunable rotation gates and classical data reuploading based on a paper by *Salinas, Lierta et.al.*
- Implemented Quantum Circuits using IBM's Qiskit SDK to solve a **3 SAT problem with Grover's search algorithm**, and simulated quantum teleportation, superdense coding, **quantum fourier transform**, phase estimation, Shor's algorithm
- Used QML to train a **linear solver** and experimented with the **amount of entanglement** in the circuit, the loss function

Super-Resolution of face images with a k-PCA prior **Spring '23**

Prof. Suyash Awate, IITB *Course Project*

- Extracted higher order, **non-linear correlations** in face images by constructing a prior model using **Kernel PCA**.
- Combined it with a noise model based on known blur-matrices to obtain the **Bayesian posterior probability** model
- Implemented gradient descent to obtain the MAP estimate and super-resolved a set of low-resolution face images

FastChat **Autumn '23**

Prof. Kavi Arya, IITB *Course Project*

- Built a **messenger service from scratch** with file transfer, group messaging, encryption, password authentication
- Implemented a network with multiple inter-communicating servers using the 'socket', 'select' python libraries, and a **PostgreSQL** database on the server side for storing user public keys, encrypted messages, passwords
- Used **bash scripting** to collect throughput and latency data, and optimized those by varying **load balancing** strategies

Robust Optimization for ML & Optimal Learning **June '23-Present**

Prof. Debasish Chatterjee, IITB *Ongoing Research Project*

- Attempting to extend techniques for near-optimal solutions of **convex SIPs** to function recovery from *noisy* data
- Exploring **Hamiltonian Monte Carlo** to employ targeted sampling for faster optimization in higher dimensional spaces

Linear time decodable Graph Codes **Autumn '23**

Prof. Nikhil Karamchandani, IITB *Course Project*

- Studied the properties of **expander graphs**, and the rate, distance metrics of **error correcting codes** derived from them
- Presented the algorithm for $\mathcal{O}(N)$ recovery from upto $\sim D/4$ bit flips for an $[N, K, D]$ code, and its complexity analysis

Other Projects

Microarchitecture-based optimization **Spring '23**

Prof. Biswabandan Panda, IITB *Course Project*

- Implemented and tested a **best-offset learning prefetcher** for the L2 cache in ChampSim based on a DPC2 winning paper
- Simulated combinations of various LLC cache associativities, eviction policies (LRU/LFU/FIFO), cache hierarchies (inclusive/exclusive), and optimized the IPC for **graph algorithms** such as BFS, PageRank, Dijkstra's

Rail Planner **Spring '22**

Prof. Supratik Chakraborty, IITB *Course Project*

- Self-implemented data structures to store, access and modify a database of stations, journeys, and reviews in C++
- Coded efficient algorithms for **substring matching**, sorting and graph searching for the planner functionalities

Group Theory **Summer '22**

Maths and Physics Club, IITB *Reading Project*

- Read **Group Theory** from *Abstract Algebra, Dummit & Foote* and summarised the results in a comprehensive report
- Covered topics including Homomorphisms, Group Actions, Cosets, **Lagrange's Theorem, the Sylow Theorems**

2D Rocket League **January '22**

DevCom, IITB *Game Hackathon **Top 10** submission*

- Designed a game in JavaScript, employing the **Separating Axis Theorem** to detect collisions between arbitrarily aligned rectangles, circles, and handling them by giving appropriate velocity changes to the components

Positions of Responsibility

Mentor: Department Academic Mentorship Programme, CSE IITB *June 2023-Present*

- One of the 30 mentors chosen within the department via an extensive **interview, SoP, and peer review** based selection process to guide the junior batch and smoothen their transition into the sophomore year

Jury Member: European Physics Olympiad 2023 *June 2023*

- Reviewed the official marking scheme, and **graded the papers** of the contingents from 6 countries

Teaching Assistant: MA106 (Linear Algebra), IITB *March-April 2023*

- Conducted **weekly tutorials, and doubt-clearing** sessions for $\sim$ 40 students

Relevant Courses Undertaken

† To be completed in Autumn '24

- Data Analysis and Interpretation
- Medical Image Computing
- Programming Paradigms
- Design and Analysis of Algorithms
- Computer Networks
- Computer Architecture
- Software Systems Lab
- Data Structures and Algorithms
- Probability I
- Linear Algebra
- Differential Equations
- Operating Systems†

Technical Skills

Programming Languages	C++, Python, Java, VHDL, MATLAB, Bash, Sed, AWK, Prolog
QC & Data Science	Qiskit, PennyLane, NumPy, Matplotlib, Scikit-Learn, Pandas
Development	JavaScript, HTML, CSS, Django, Markdown, Doxygen, Sphinx, Git, LaTeX

Extracurricular Activities

Part of the city's runner group since 2018 and ran the **Aarhus Half Marathon**, Denmark in 1:43:21 *2023*

Elected as **Head Boy** in the High School Council, and assisted in organizing events for $\sim$ 1200 students *2018-19*

Constructed a plan to develop **sustainable tourism** at *Unapdev* which was awarded gold at the state level *2018*