Arhaan Ahmad | **210050016**
Computer Science & Engineering | **B.Tech.**
Indian Institute of Technology Bombay | **Gender: Male**
DOB: 30/08/2003

Examination	University	Institute	Year	CPI / %
Graduation	IIT Bombay	IIT Bombay	2025	
Intermediate	CBSE	Krishna Public School	2021	95.20%
Matriculation	ICSE	St. Mary's Academy	2019	97.60%

Pursuing a **Minor** Degree in **Machine Intelligence and Data Science**

Scholastic Achievements

- Awarded 2 **AP** (Advanced Performer) grades given to the **Top 1%** out of 1400+ freshmen for outstanding academic performance in the courses on Physical Chemistry (CH 107) and Quantum Mechanics (PH 107) (*'22*)
- Secured **All India Rank 62** in Joint Entrance Examination (Advanced) among 1,50,000+ students (*'21*)
- Acquired **All India Rank 383** in Joint Entrance Examination (Main) among roughly 1 million students (*'21*)
- Awarded the prestigious **KVPY** fellowship by **IISc Bangalore** for securing **All India Rank 14** (*'20*)
- Recipient of the **National Talent Search Examination** (NTSE) scholarship by NCERT, Govt. of India (*'19*)

Olympiad Experience

- Won a **Gold Medal** for India at the 14^{th} **International Olympiad on Astronomy and Astrophysics** (*'21*)
- Part of the **Grading Team** of the International Physics Olympiad (**IPhO**) 2022, organised by Switzerland (*'22*)
- Among the **65 students** selected for camp after qualifying the Indian Olympiad Qualifier in Physics (**IOQP**) and Indian Olympiad Qualifier in Chemistry (**IOQC**), organised for selecting India's team for IPhO and IChO (*'21*)
- Qualified for the **Indian National Mathematics Olympiad** for 3 consecutive years (*'19, '20, '21*)

Internships & Research Projects

Detecting Dataraces in Concurrent Programs (*May '23 - Present*)
Guide: Prof. Umang Mathur | Research Internship — *National University of Singapore*

- Conducted extensive literary review of the existing theory and algorithms for detecting data races in **concurrent programs** using a single trace and studied the computational **complexity class** of the problems involved
- Implemented these algorithms, including an **SMT solver-based** approach and tested it on existing benchmarks
- Working on the theoretical foundations and practical implementations of extending the work to use multiple traces

Hunting For GRBs (*January '23 - Present*)
Guide: Prof. Varun Bhalerao | Research Project — *Department Of Physics, IIT Bombay*

- **Streamlining** the existing pipeline for analysing the data received from the CZTI detector aboard Astrosat
- Working on reducing the number of **false triggers** to minimise the time taken in manually scanning the events triggered by the pipeline, and **automating** various parts of the pipeline that were being executed manually before
- Working on **preparing our systems** for the run of the LIGO gravitational waves observatories, in the international efforts to **observe electromagnetic counterparts** of gravitational wave sources being detected

Projects

Game Theory | Learning Project (*Summer '22*)
Summer of Science — *Maths and Physics Club, IIT Bombay*

- Studied Game Theory with an emphasis on **social choice** and summarised the findings in a comprehensive report
- Explored **normal** and **extensive** form games, dominant strategies, equilibrium concepts, pure and mixed strategy **Nash equilibrium** & Best Response, its applications in **strategic** form games, Pareto dominance & optimality
- Studied coalition games, **Shapley value** for dividing payoff and the theory of **social choice** including **Sen's Theorem** and **Arrow's Theorem**; made a 10-minute presentation on Arrow's Theorem and its proof
- Reviewed recent papers including an analysis of the effect of a knowledgeable principal persuading the agent in sequential **decision making** and another studying the single-agent dynamics in a **coalition** forming setting

Microarchitecture Optimisations (*Spring '23*)
Prof. Biswanandan Panda — *Course Project (Computer Architecture)*

- Implemented the DPC2 winning **best-offset learning prefetcher** for the L2 cache in ChampSim simulator
- Implemented the state-of-the-art 256-bit **L-TAGE** branch predictor and compared its performance on Cadical and Kissat based SAT solvers against commonly used branch predictors like hashed perceptron and gshare

FastChat (*Autumn '22*)
Prof. Kavi Arya — *Course Project (Software Systems Lab)*

- Constructed an **interactive messaging network** amongst numerous clients, with servers regulating the process.
- Utilised **Python's socket** library to obtain **high throughput** with tightly constrained server resources
- Added **End-to-End Encryption** between clients while ensuring **Low Latency** of individual message delivery
- Analysed the **robustness** of the system, by noting metrics such as **latency** and **throughput**, while varying the number of clients, messages, servers and changing load balancing strategies by simulating clients with python scripts.

PhysicC | Physics Engine for Gaming (*Summer '22*)
Seasons Of Code *Web and Coding Club, IIT Bombay*

- Developed a 2-dimensional **physics engine** that can be integrated with a game engine to handle all object dynamics
- Studied optimisations for **efficient collision detection** of multiple objects, fast enough to prevent lag in games
- Implemented **broadphase** collision detection to quickly prune away pairs of distant objects that cannot collide

Anonymous Communication Tools | Reading Project (*Spring '23*)
Prof. Manoj Prabhakaran *Course Project (Cryptography)*

- Investigated the **internal workings** of various Anonymous Communication tools, primarily the **Tor Project**
- Created a report detailing the working of **onion routing** and Tor specific features like Tor **Hidden Services**

Simple File Transfer Protocol (*Spring '23*)
Prof. Bhaskaran Raman *Course Project (Computer Networks)*

- Implemented a server-client **file sharing** network in C by establishing **TCP** connections between the two machines
- Ensured that the system did not break when sending large files and that all files are delivered without corruption
- Used the **poll system call** at each node to allow multiple peers to download concurrently and prevent blocking

Image Compression, Reconstruction and Generation using PCA (*Autumn '22*)
Prof. Suyash P. Awate *Course Project (Data Analysis and Interpretation)*

- Visualized the **principal modes** of dispersion of images from the MNIST database using PCA in MATLAB
- Projected the 28×28 dimension images onto an 84 dimension plane that maximised dispersion to reduce the size
- Used PCA to **generate** new images that are distinct from, but representative of, a given sample of fruit images

Railway Planner (*Autumn '22*)
Prof. Supratik Chakraborty *Course Project (Data Structures and Algorithms Lab)*

- Implemented various core data structures like **Dictionary**, Priority Queues, Binary Search Trees, and **AVL** Trees along with various algorithms to build different aspects of a **railway planner** system in **C++**
- Used **Tries** for autocompletion of names, and the **Knuth-Morris-Pratt** algorithm for efficient search of reviews
- Learnt how to utilise the power of **debuggers** like **GDB** to debug our 1500+ line codebase

Year Of Security | Basics for Cybersecurity (*Spring '22*)
Cybersecurity Community, IIT Bombay

- Solved various Capture the Flag (CTF) challenges using **Bash Scripting**, Python, C and **Assembly** language
- Implemented the **minimax** algorithm to create a tic-tac-toe agent and used **pwntools** for bruteforcing other games

Positions of Responsibility

Manager | Krittika, The Astronomy Club, IIT Bombay (*May '23 - Present*)
Institute Technical Council, IIT Bombay

- Leading a team of **8 conveners** towards fostering the enthusiasm of the students of IIT Bombay in Astronomy
- Responsible for organizing several institute-wide competitions, documentary screenings, educational trips and talks

Student Mentor | Astronomy Olympiad (*August '22 - Present*)
Homi Bhabha Centre for Science Education (HBCSE), Mumbai

- **Mentored** the Indian team for IOAA 2022, Georgia, which went on to win **3 gold and 2 silver medals**
- Helped in the selection process for the Indian team to IOAA 2023, Poland, from over 40 candidates at the selection camp by contributing to the exam problems, grading the papers, solving doubts and mentoring the students

Teaching Assistant (*November '22 - April '23*)
Department of Mathematics, IIT Bombay

- Responsible for **conducting tutorials** for a class of **40 students**, and mentoring them with their coursework for three freshmen mathematics courses, MA109 (Calculus I), MA111 (Calculus II) and MA106 (Linear Algebra)
- Conducted a Tutorial Service Centre Session for **1400**+ freshmen for quick recap and doubt clearing before exams

Technical Skills

Languages	Python, C++, LaTeX, Java, Javascript, Prolog, Sed, Awk, Bash, SQL, MATLAB, Solidity
Web Development	HTML, CSS, Javascript, Bootstrap, Django, React.js, Next.js
Data Science	PyTorch, NumPy, SciPy, Matplotlib, Seaborn, Pandas, Jupyter Notebook, Astropy
Other Tools	Git, Github, Github Actions, GDB, CMake, Doxygen, Sphinx, AutoCAD, Docker

Key Courses Taken

Computer Science	Data Structures & Algorithms, Discrete Structures, Software Systems Lab, Data Analysis & Interpretation, Abstractions & Paradigms in Programming, Computer Networks, Logic For CS, Digital Logic Design & Computer Architecture, Cryptography & Network Security, Automata Theory**, Operating Systems**, Artificial Intelligence & Machine Learning**
Mathematics	Differential Calculus, Integral Calculus, Ordinary Differential Equations, Linear Algebra

*** to be completed by November '23*

Extra-Curricular Activities

- Placed **3rd** worldwide out of ∼750 teams in the open category of **Online Physics Brawl**, by FYKOS ('*21*)
- Ranked **12th** out of 600+ teams in the Online Physics Olympiad (OPhO) 2021 and won a silver medal ('*21*)
- Designed & built a **Wi-Fi controlled car** in XLR8 conducted by Electronics & Robotics Club, IIT Bombay ('*22*)
- Reached the semifinals in **CodeWars**, a strategy based game programming contest by WnCC, IIT Bombay ('*22*)
- Pitched a **Business Model** for promoting agrotourism in India for **EnB Buzz** by E-Cell, IIT Bombay ('*22*)