Harsh Shah | **200050049**
Computer Science & Engineering | **B.Tech.**
Indian Institute of Technology Bombay | **Gender: Male**
DOB: 18/05/2002

Examination	University	Institute	Year	CPI / %
Graduation	IIT Bombay	IIT Bombay	2024	9.48
Intermediate	CBSE	Satyameva Jayate International School	2020	93.40%
Matriculation	CBSE	St. Kabir School	2018	95.40%

Pursuing **Honours** in **Computer Science** and Minor in **Data Science** and **Artificial Intelligence**

Scholastic Achievements

- Secured **All India Rank 11** in Joint Entrance Examination (Advance) among **150K+** aspirants *(2020)*
- Secured **All India Rank 59** in Joint Entrance Examination(Mains) among **1 million+** aspirants *(2020)*
- Recipient of **KVPY fellowship award** by Govt. of India upon securing **AIR 227** among **50K+** candidates *(2019)*
- Among **Nation's top 1%** in National Standard Examination in Physics(NSEP) given by **50K+** candidates *(2019)*
- Among **Nation's top 1%** in National Science Examination in Astronomy(NSEA) given by **17K+** candidates *(2019)*
- Awarded **Advanced Performance(AP)** for BB101, Biology course, in the institute **37/1300+** students *(2021)*
- Secured **AIR 13** in National Mathematics Talent Contest(NMTC) clearing **2 stages** of **nationwide** exam *(2018)*

Professional & Research Experience

NIC Driver Optimization and Development *(May'23-July'23)*

Systems Intern | Quadeye Securities LLP

- Optimized the device drivers of ultra-low latency **Network Interface Cards(NIC)**, for trading applications
- Utilized **vectorized instructions(AVX)** and speculative **cache prefetching** to reduce packet transmission latency
- Analysed the performance of modified **linux kernel modules** of the driver, using tools like **perf** and **sockperf**
- Implemented **asynchronous DNS lookups**, tested using a faulty local DNS server simulating delayed responses

Natural Language to SQL Queries *(May'22-July'22)*

*Research Intern | Guide: Dr. Jian SU | Agency for Science, Technology and Research(A*STAR)*

- Implemented **LSTMs** based classifier over **fine-tuned BERT** for improving schema encoding via **cross-attention**
- Merged **WikiSQL** and **Spider** datasets for extending existing **text-to-SQL** models over larger query set
- Trained models on remote **GPU clusters** using **PyTorch** python library and **CUDA** tools for **accelerated** training

HARMONI-Open Sourced Robot Interaction Package *(Mar'22-July'22)*

Research Intern | Guide: Prof. Hatice Gunes and Dr. Micol Spitale | AFAR lab, University of Cambridge

- Fixed major issues in a robot interaction software, **HARMONI**, working with **multi-threaded ROS** based programs
- Used **Amazon Lex**, **Amazon Polly** and local **speech-to-text** models for defining the behaviour of robot interaction
- Implemented **behaviour trees** and their **unit tests**, making the package **modular** and **streamlined** to use

Domain Generalization in Computer Vision *(June'22-Present)*

Research Collaboration (Virtual) | Guide : Mr. Vibhav Vineet (Senior Researcher at Microsoft Research, Redmond)

- Implemented a novel **regularization technique** on **Vision Transformers(ViT)** using **Mixture Of Experts**, in order to increase **robustness** of classification models in computer vision, against **distribution shifts** during inference
- Submitted a research paper to **NeurIPS'23** conference, reporting an **average increase of over 1.2%** accuracy as compared to that of **vanilla vision transformer** models on **domain generalization** datasets

Nearest Neighbour Search using Group Testing *(Aug'23-Present)*

B.Tech Project | Guide : Prof. Ajit Rajwade, IITB

- Exploited the distribution of **VGG descriptors** of image datasets to improve **recall** and **search time** of queries
- Implemented novel **group testing** approaches to prune the search space, decreasing search time by **6 times** as compared to exhaustive search competing with other **LSH, graph** and **inverted-index based** methods

Illumination Prediction for Mixed Reality *(Jan'23-May'23)*

RnD Project | Guide : Prof. Parag Chaudhuri, IITB

- Worked on predicting the **illumination Spherical Harmonics(SH)** in an environment through a **reflecting sphere**
- Developed a **Unity-based application** to coherently illuminate **AR objects** using the predicted spherical harmonics
- Used **ARcore** and **ARfoundation** libraries for **plane detection** and **object placement** via user input

Key Projects

Video Denoising using Low-rank Matrix Completion | Image Statistics
Course Project | Guide: Prof. Ajit Rajwade, IITB *(Mar'22-Apr'22)*

- Implemented **denoising algorithm** using **Matlab** for videos corrupted with Gaussian, Poisson and spike noise
- Formulated the problem as **nuclear norm minimization** using **singular value thresholding** for matrix completion
- Extended the study to **image inpainting** and **recommendation system** using the above techniques

Peer-to-Peer File Transfer System | Socket Programming
Course Project | Guide: Prof. Kameshwari Chebrolu, IITB *(Mar'22-April'22)*

- Built a local **peer-to-peer** file transfer system over a **known network topology** to search and download files
- Employed **BFS** algorithm to search for files till depth 2 and verified file transfer using **MD5 hashing**
- Used socket programming and **multi-threading** in C++ to establish **TCP** connections and build client-server model

Reverse Image Search using Locality Sensitive Hashing | Deep Learning
Course Project | Guide: Prof. Abir De, IITB *(Sept'22-Nov'22)*

- Built a custom **NeuralHash** generator using penultimate activations of **ResNet34** model trained on CalTech dataset
- Successfully employed an **adversarial attack** on the model via Fast Gradient Method to generate misclassified images
- Implemented **Locality Sensitive Hashing(LSH)** for **optimizing** search of images similar to an input query image

Coupled Tomographic Reconstruction of Brain Slices | Image Reconstruction
Course Project | Guide: Prof. Ajit Rajwade, IITB *(March'22)*

- Implemented **tomographic reconstruction** algorithm from **radon** transform of two consecutive brain image slices using **compressed sensing** principles by solving the task as **l1-regularized least squares** optimization problem
- Programmed the algorithm on **Matlab** using **l1_ls package** for solving the optimization problem for reconstruction

Position of Responsibility

Team Leader | *Mars Rover Team, IITB* *(Aug'23-Present)*
Spearheading a team with over 40+ members working in various domains like software, mechanical and biosciences, to build autonomous rover prototypes for competing in international competitions like URC (held in USA).
The team received Best Navigation Award twice in international competitions, ERC'2022 and IRC'2023

- Managing technical funds over **1.5 million INR** for improving the **structure** and **autonomy** of the rover
- Improved the **localization** of the rover by fusing data from **depth sensors, GNSS** and **wheel odometry**
- Integrated **YOLOv5 algorithm** for **cone detection** and localization for navigating the rover to guided location

Teaching Assistant | *Software Systems Lab | Prof. Kameshwari Chebrolu* *(Jan'23-April'23)*

- Created challenging autograded assignments on **sed, awk and LaTeX** for freshers in CS department, IITB

Teaching Assistant | *Foundation of Learning Agents | Prof. Shivaram Kalyanakrishnan* *(Aug'23-Present)*

- Designing autograded assignments to test and apply **reinforcement learning algorithms**, for **200**+ students

Technical Skills

Programming Languages	C, C++, Python, Prolog, VHDL, Assembly Language(ARM), Java, Javascript
Softwares and Tools	Matlab, Git, ROS, Docker, Scilab, Flutter, Unity Game Engine, Android studio
Libraries and Packages	PyTorch, TensorFlow, Flax, FLTK, SFML, Django, OpenCV, Scikit-Learn, Pandas

Key Courses Undertaken

Computer Systems	Computer Networks, Data structures and algorithms, Advanced Computer Architecture*, Design and Analysis of Algorithms, Number Theory and Cryptography*
Data Science	Data Analysis and Interpretation, Foundations of Intelligent and Learning Agents, Mathematical Optimization Techniques, Advanced Image Processing, Learning With Graphs*
Others	Discrete Structures, Linear Algebra, Differential Equations

**To be completed by Dec' 2023*

Extracurricular Activities

- Secured **National rank 4** in **Mimamsa science quiz** by **IISER Pune** with participation of **650+** teams
- Participated in **AI/ML Halliburton** challenge of solving petroleum industrial problems using **machine learning**
- Volunteered in IITB's **Electronics and Robotics Club (ERC)** for organising institute-wide tech-based events
- Completed **one year** of training in **General fitness** under National Sports Organisation **(NSO)**