Pursuing a **Minor** degree in **Artificial Intelligence** and **Data Science** from **C-MInDS, IIT Bombay**

Scholastic Achievements

- Achieved **99.81 Percentile** in **JEE-Main** out of over 1 million candidates *(2021)*
- Achieved **99.14 Percentile** in **JEE-Advanced** out of over 0.14 million candidates *(2021)*
- Achieved **AP grade** for excellent performance in **PH 108 - Basics of Electricity & Magnetism** *(2022)*
- Secured a **Branch Change** to **Computer Science** department on the basis of academic performance *(2022)*
- Secured **AIR 275** in the prestigious **KVPY SX** and awarded fellowship by **IISc Bangalore** *(2021)*

Work Experience

Applied AI Researcher at Brance Technologies *(Summer 2023)*

- Developed and implemented performant chatbot systems using **vector embeddings** for data retrieval and **Large Language Models** for question-answering, resulting in significantly improved user experience and engagement
- Utilized **Haystack** framework and **FAISS** to efficiently index and store proprietary data, leveraging **vectorDBs** to store the embeddings. Utilized **Hugging Face models** to form the **indexing, retrieval and reranking pipeline**
- Implemented **Locality-Sensitive Hashing (LSH)** to create a highly **performant caching system** to cache user queries that utilizes **semantic search**, optimizing the speed, accuracy, and efficiency of data retrieval for chatbot
- Leveraged **Nginx** and **FastAPI** on an **AWS EC2** instance to ensure seamless communication, and reduced latency for the chatbot system. Utilized **async calls** and FastAPI's scalability for smooth data retrieval and processing

Key Projects

Stable Diffusion from Scratch *(Summer 2023)*

Self Project

- Used **PyTorch** to implement a **Stable Diffusion** model and evaluate the quality of its generations using **FID scores**
- Implemented a **Variational Autoencoder (VAE)** and trained it on the Fashion MNIST dataset using **reconstruction loss** and **KL-Divergence loss**, enabling accurate reconstruction of inputs and latent space interpolation
- Implemented a **Diffusion U-Net** with **timestep embeddings** and **self-attention** and used it to implement both unconditional and conditional **DDPM** (Denoising Diffusion Probabilistic Models) on MNIST and CIFAR-10 datasets
- Implemented **latent diffusion** by utilizing the diffuser's VAE to **encode images** to latent representations, and subsequently trained a **DDPM** on these latents using the LSUN churches datasets to generate high-quality images

Discrete Event Simulator for Bitcoin Network *(Spring 2023)*

Guide: Prof. Vinay J. Ribeiro | Course Project : Introduction to Blockchains and Smart Contracts *IIT Bombay*

- Implemented a discrete event simulator for the Bitcoin Network and **analyzed the forking** and length of the main chain. Additionally, simulated **selfish mining** and **stubborn mining** attacks on the network by an adversary node
- Analyzed the **adversary's relative profitability** under various factors like hashing power and network latency etc.
- Utilized the **Networkx library** to create a connected **P2P network** and generated visual representations of the blockchain. Used the **SimPy library** to maintain a **global clock** and simulate the **mining and transaction events**

Layer 2 DAPP for Lightning Network Simulation *(Spring 2023)*

Guide: Prof. Vinay J. Ribeiro | Course Project : Introduction to Blockchains and Smart Contracts *IIT Bombay*

- Developed a Layer 2 DAPP on the **Ethereum blockchain**, utilizing **Ganache and Truffle** to set up a local Ethereum node. Implemented the smart contract in **Solidity**, enabling the execution of transactions within the Layer 2 DAPP
- Developed a simulation model of **Lightning Networks**, a Layer 2 scaling solution for the Ethereum blockchain

Lunar Lander using Deep Reinforcement Learning *(Autumn 2022)*

Self Project

- Used **OpenAI's Gym** environment to train a lunar lander game using **Deep Q-Learning with Experience Replay**
- Used **Tensorflow** to define the training loop. Used **deque** to store experience buffer and **soft update** of Q-targets to stabilize the training. Used **epsilon greedy policy** to select the action with some amount of **random decisions**
- **Tuned and optimized model hyperparameters** including learning rate, batch size, and number of episodes, epsilon, gamma, number of timesteps to achieve the best results and solved the environment **within 500 episodes**

KYC-Website *(Summer 2023)*

Self Project

- Developed a secure web application utilizing **Node.js, Express.js & MongoDB** for mimicking the KYC requirements
- Learned about **full-stack development** and utilized **Bootstrap, EJS, Passport.js** to create a responsive web application with secure authentication, form validation and user sessions. Used **FastAPI** to make the backend API
- Utilized the **easy-ocr library** for **ID information extraction** and the **face-recognition library** for **real-time face matching** to automate the KYC verification process, ensuring swift verification without human intervention

FastChat *(Autumn 2022)*

Guide: Prof. Kavi Arya | Course Project : Software Systems Lab *IIT Bombay*

- Developing a messaging software with **end-to-end encryption** by using **RSA+AES** to encode the messages and both group chat and individual chat support using **python socket library, threading** and **PostgreSQL** database
- Implementing a **load balancer** with **least connect strategy** using **bash** to distribute load among multiple servers and also used scripts to simulate common messaging patterns and calculate **throughput** and **latency** of the system

Other Projects

Deep Learning *(Summer 2023)*

Self Project

- Implemented and trained **Google's Deeppose**, a deep learning model for **human pose estimation** on LSP dataset
- Implemented a **Cycle-GAN** architecture for image-to-image translation, enabling conversion between two classes
- Implemented **neural style art transfer** using **VGG19** to combine the content of one image with the style of another
- Implemented the **U-Net** architecture and applied it to CARLA, a self-driving car dataset for **semantic segmentation**
- Implemented **ResNets** from scratch and utilized **transfer learning** for image classification and recognition tasks

Generating Representative Images from a Sample *(Autumn 2022)*

Guide: Prof. Suyash Awate | Course Project : Data Analysis and Interpretation *IIT Bombay*

- Used **MATLAB** with a dataset of images of fruits and generated new representative fruit images using **Principal Component Analysis (PCA)** and also optimally **reduced the dimensionality** and **reconstructed** the images

Z3 SAT Solver *(Spring 2023)*

Guide: Prof. Ashutosh Gupta | Course Project : Logic for Computer Science *IIT Bombay*

- Implemented and utilized **SAT solving techniques**, specifically leveraging the **Z3 theorem prover** in Python, to formulate an effective strategy for the game Sliding-Solver and also handle the case of **unsatisfiability** for the game

L-TAGE Branch Predictor *(Spring 2023)*

Guide: Prof. Biswabandan Panda | Course Project : Digital Logic Design and Computer Architecture *IIT Bombay*

- Implemented the L-TAGE branch predictor using **champsim**, a state-of-the-art simulator in **C++** and analyzed the performance of the predictor on various **benchmarking traces** like gcc, leslie3d, milc, perlbench and zeusmp

SwarComm *(Spring 2023)*

Guide: Prof. Bhaskaran Raman | Course Project : Computer Networks Lab *IIT Bombay*

- Implemented the **physical layer** and **link layer** of the **OSI stack** by utilizing eight distinct frequencies of sound to represent octal bits for efficient data transmission. Used **Hamming codes** for error correction and reliable transfer

Railway Planner *(Autumn 2022)*

Guide: Prof. Supratik Chakraborty | Course Project : Data Structures and Algorithms Lab *IIT Bombay*

- Designed a simplified version of a railway planner using various data structures such as **Heaps, Hash Tables, Tries and BSTs** and analyzed the space & time complexity to study the properties of various data structures in **C++**

Technical Skills

Programming	C, C++, Python, Bash, Solidity, Java, JavaScript, VHDL, Sed, Awk
Data Science	Tensorflow, Pytorch, Keras, Trax, Scikit-learn, OpenCV, NumPy, Pandas, Matplotlib
Software & Tools	MATLAB, Git, LaTeX, Docker, Wireshark, Z3, Doxygen, Sphinx, Ngingx, FastAPI
Web Development	HTML5, CSS, JavaScript, BootStrap, jQuery, Node.js, Express.js, SQL, MongoDB

Key Courses Undertaken

Mathematics	Calculus, Linear Algebra, Discrete Structures, Differential Equations, Optimization Models, Logic for Computer Science, Game Theory and Decision Analysis
Computer Science	Data Structures and Algorithms#, Data Analysis and Interpretation, Software Systems Lab, Computer Networks#, Computer Architecture#, Design and Analysis of Algorithms, Introduction to Blockchains Cryptocurrencies and Smart Contracts, Computer Vision

Extracurricular

- Mentored two groups of students during the **SoC (Summer of Code)** program conducted by **WNCC, IITB** guiding them through **deep learning projects** and assisting in implementation of cutting-edge research papers *(2023)*
- Successfully completed one year under **National Sports Organization(NSO)** in **Chess** at IIT Bombay *(2022)*
- Pitched a **Business Model Canvas** for a startup in the health sector which entailed making online ambulance bookings, for the EnB Buzz competition conducted by the **Entrepreneurship cell of IIT Bombay** *(2021)*
- Worked in a team of 4 to make an ESP32 **WiFi-controlled** bot for **XLR8** conducted by **ERC, IITB** *(2022)*