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)*
- Secured **All India Rank 1207** in **JEE-Advanced** out of over 0.14 million candidates *(2021)*
- Secured **AP grade** for excellent performance in **PH 108**, awarded to 27 out of over 1300 students *(2022)*
- One of the **17 out of 1400+** students to secure a **Branch Change** to the department of **CSE** *(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 entire **indexing and retrieval pipeline**
- Included **document reranking** resulting in improved relevance and accuracy of the retrieved information for chatbot
- 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 independently develop and implement **each component** of a Stable Diffusion model on smaller datasets before using the Hugging Face's **diffuser library** to implement the final diffusion model on a larger dataset
- 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
- Used various scheduling techniques like **DDIM**, **LMSDiscrete** and **PNDM** etc. to improve speed of the generations
- 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
- Used various metrics like **FID** (Fréchet Inception Distance) scores to evaluate the quality of the generated 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
- Ran the simulation using an external Python script to perform various transaction scenarios and analyze their outcomes

KYC-Website
Self Project   *(Summer 2023)*

- Developed and implemented KYC-Website, a secure web application utilizing **Node.js, Express.js, and MongoDB Atlas** for KYC verification, mimicking the KYC requirements for banking and financial institutions
- 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
- Learned about **full-stack development** by utilizing technologies such as **Bootstrap, EJS, Passport.js** to create a user-friendly and responsive web application with secure authentication, form validation and user sessions
- Utilized **FastAPI** to wrap and integrate the **machine learning components** of the project, ensuring seamless communication and efficient handling of requests between the web application and the ML API servers

FastChat
Guide: Prof. Kavi Arya | Course Project : Software Systems Lab   *(Autumn 2022)*
                                                                                              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** and **PostgreSQL** database
- Implementing a **load balancer** with **least connect strategy** using bash to distribute load among multiple servers, and focusing on obtaining **high throughput** while using only limited resources dedicated for the servers
- Used **bash** scripts to simulate common messaging patterns and calculate **throughput** and **latency** of the system

OTHER PROJECTS

Deep Learning
Self Project   *(Summer 2023)*

- 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 domains
- Trained an agent to play **lunar lander** game using **Deep Q-Network (DQN)**, a reinforcement learning algorithm
- 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

Z3 SAT Solver
Guide: Prof. Ashutosh Gupta | Course Project : Logic for Computer Science   *(Spring 2023)*
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- 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
Guide: Prof. Biswabandan Panda | Course Project : Digital Logic Design and Computer Architecture   *(Spring 2023)*
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- 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
Guide: Prof. Bhaskaran Raman | Course Project : Computer Networks Lab   *(Spring 2023)*
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- 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
Guide: Prof. Supratik Chakraborty | Course Project : Data Structures and Algorithms Lab   *(Autumn 2022)*
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- 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 NodeJS, ExpressJS, 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 the 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)*