

Sheel Shah

Curriculum Vitae

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EDUCATION

Indian Institute of Technology Bombay

2019 - Present

Electrical Engineering, Bachelor of Technology with Honours

Department rank 7 of 76 (CPI – 9.6/10)

Pursuing a Minor in Artificial Intelligence and Data Science (CPI – 9.5/10)

SCHOLASTIC ACHIEVEMENTS

- Awarded AP grade in **Probability and Random Processes** (top **3** of **314** students) *Dec'20*
- Awarded **change of branch** to Electrical Engineering for academic excellence (top **1%**) *Aug'20*
- Awarded an AP grade in **Calculus**, which was awarded to top **35** out of **1137** students *Dec'19*
- Secured **All India Rank 410** in *JEE Advanced* amongst over 225 thousand candidates *Jun'19*
- **World Math Topper** in IGCSE Board Exams of the year 2017 *Mar'17*

INTERNSHIPS AND RESEARCH PROJECTS

Quantitative Strategist

May'22 - Jul'22

Quadeye – India's Leading Proprietary Trading Firm

- Designed a statistical arbitrage-based **pair trading** strategy on best pairs found using extensively cleaned market data and **adapted numerous indicators** to filter out false trading signals
- Received a **pre-placement offer** from the company based on the quality of work in the internship

Software Development

Dec'21 - Apr'22

Fraazo - a D2C start-up for farm fresh produce

- Developed the **entire home-delivery receipt system** with physical testing and deployment to production
- Optimized back-end jobs by **re-structuring database queries**, speeding jobs up by over 20x
- Designed and **built an admin authorization module** to streamline the permission control of internal admins

Research in Reinforcement Learning

May'21 - Jul'21

Global Talent Attraction Program - Prof. Qin Zhang, Indiana University

- Implemented the algorithm proposed in the paper 'Collaborative Learning with Limited Interaction', which was presented at the **IEEE Symposium on Foundations of Computer Science 2019**
- **Contributed a framework** to test multi-agent algorithms in the bandit algorithms Python library *banditpylib*
- Modified the algorithms **LinUCB** and **Lil'UCB** for the collaborative learning setting and implemented them
- Studied and simulated several **reinforcement-learning bandit** algorithms in various settings

KEY PROJECTS

2D reconstruction from 1D projections

Aug'22 - Present

B. Tech. Project, Prof. Ajit Rajwade

Computer Science Dept, IIT Bombay

- Surveyed literature to understand **tomography** and **Fourier sampling under unknown angles**
- Researching techniques to **prove error bounds** on reconstruction for **electron microscopy** in 2D

Optimal File Caching Mechanisms

Aug'22 - Present

Research and Development Project, Prof. Nikhil Karamchandani

Electrical Engineering Dept, IIT Bombay

- Understood modern caching algorithms using tools from **information theory** and **multi-armed bandits**
- Proving **upper and lower bounds** on regret of **coded caching** strategies under arbitrary file distributions

Reinforcement Learning for ConnectX

Jan'22 - May'22

Advanced Reinforcement Learning Project, Prof. S. Kalayanakrishnan Computer Science Dept, IIT Bombay

ConnectX is a generalization of Connect 4, and is an ongoing competition on Kaggle

- Ranked **9th** out of 225 participating teams in the Kaggle competition for ConnectX
- Conducted **extensive literature survey** to understand the state-of-the-art algorithms for Connect 4 and explored ideas of generalizing them to ConnectX
- Designed a **novel MCTS-MiniMax hybrid algorithm** and implemented **Monte Carlo Tree Search**, the MiniMax algorithm with **bitboards**, **alpha-beta pruning** and **transposition tables**, and **AlphaZero** 📄

Compressive Image Classification

Jan'22 - May'22

Advanced Image Processing Project, Prof. Ajit Rajwade

Computer Science Dept, IIT Bombay

- Explored the idea of deterministic sensing matrices for **Compressed Sensing**, using Delsarte-Goethals frames
- Delineated **error bound proofs** for the performance of Support Vector Machines on compressively sensed data
- Implemented the proposed idea on a texture database to achieve **83% classification accuracy** of images 📄

Deep Reinforcement Learning

Mar'21 - May'21

Machine Learning Course Project, Prof. Abir De

Computer Science Dept, IIT Bombay

- **Mastered** the popular Atari game, Pong, achieving a perfect score of 21 using **Deep Q-Learning**
- Implemented a **Double Deep Q-Network** and a **Duelling Deep Q-Network** in PyTorch 📄

Sentiment Analysis

Jun'20 - Jul'20

Student Coder Challenge, Hexaware

- Performed **Review Data Analysis** on Amazon reviews and derived business insights from them
- Integrated a web scraping pipeline to a deep neural network for **categorization** and **logistic regression**, and produced a consumable final analysis summary in **Microsoft Power BI** to show insights on a dashboard
- Achieved the **2nd place** in the **sentiment analysis** category of the Student Coder Challenge, 2020

OTHER PROJECTS

Spiking Neural Networks | Computational Neuroscience Project

- Developed models for **simulating neurons and synapses** and used them to build a neural network
- Implemented **STDP**, a **hardware-friendly, biologically inspired learning algorithm** for the network

Scotland Yard | A full-fledged Multiplayer Web Game

- Designed, developed and deployed a **real time, multiplayer** implementation of the popular board game from scratch, including the **back-end, front-end, socket communication** and **graphics**
- Used **Django Channels** for an ASGI backend, along with vanilla **JavaScript** for the front-end

Applications of RL | Reinforcement Learning Project

- Modified the **SARSA** algorithm to use RBF features for continuous control in the Mountain Car environment
- Implemented a **general MDP Planner** and used it to solve Anti-Tic Tac Toe

Ultimate Tic Tac Toe | Optimized Python Programming

- Implemented an **AI agent** that plays the complex game of ultimate tic-tac-toe using the **progressive alpha-beta pruned minimax algorithm**. The agent has beaten several other popular online agents
- A **GUI** to allow playing against the algorithm was implemented using the **PyGame** library

YouTube Trending Data Analysis | Data Science Project

- Performed exploratory data analysis on the YouTube trending dataset using techniques like **K-Means Clustering** for 3d data, **Word Clouds**, **QQ Plots**, **Correlation Plots** and **Histograms**
- Developed a deep model using **Convolution Layers** on images, **TF-IDF Encoding** for text, **PCA**, and dense layers with **dropout** to predict the category of a video with over **75% accuracy**

ML Gym | Seasons of Code, IIT Bombay

- Worked with a **team of 12** members to implement **ML algorithms** that can be trained on the web
- Created the **entire website** from scratch using the **Django Framework** to allow online training and prediction

16 Bit ALU | Digital Systems Project

- Implemented Fast Addition, XOR and NOR in structural **VHDL**

POSITIONS OF RESPONSIBILITY

Department Placement Coordinator

Jul'22 - Present

Institute Placement Team

IIT Bombay

Elected by the batch of B.Tech. Electrical Engineering to represent their interests for placements

- Conducted several preparatory activities to assist the preparation of **over 250 students**
- Contributed to the placement of **1900+** students by collaborating with the Institute Placement Cell

Teaching Assistant

Jul'22 - Present

Foundations of Intelligent and Learning Agents

Computer Science Dept, IIT Bombay

- Designed and evaluated a multi-armed bandit **programming assignment** for a class of **200+** students
- Resolved students' doubts and graded their answer scripts for the mid-semester and end-semester examinations

Web Secretary

Aug'20 - May'21

Electrical Engineering Students' Association

IIT Bombay

- Structured, designed and coded a **new website** for EESA from scratch, using **JQuery** and **Bootstrap**
- The website was visited more than **1900 times** by over a **1000 users** in a span of just **7 months**
- Worked in a team of **17 people** to conduct and organize cultural/social activities for over **1600 students** and **70 faculty members** of the Electrical Engineering department

Teaching Assistant

Dec'20 - Mar'21

Computer Programming and Utilization

Computer Science Dept, IIT Bombay

- Tutored and guided **11 students** to learn the basics of **object-oriented** programming through C++
- Conducted weekly **doubt sessions** and **labs** to aid understanding of concepts taught in class

TECHNICAL SKILLS AND RELEVANT COURSES

Reinforcement/Machine Learning

Advances in Intelligent and Learning Agents, Foundations of Intelligent and Learning Agents, Neuromorphic Engineering, Stochastic Control, Machine Learning, Data Science

Applied Mathematics

Optimization, Advanced Stochastic Processes, Information Theory and Coding, Markov Chains and Queuing Systems, Advanced Image Processing, Probability and Random Processes, Speech Processing, Linear Algebra, Calculus

Web Development

HTML, CSS, JavaScript, Django, Django Channels, RubyOnRails

Programming

C++, Python, R, MATLAB

EXTRACURRICULAR ACTIVITIES

- **Taught** an introductory **drumming** course to a batch of **18 students** in the Institute Music Learning Program
- Played the drums in the closing act of IIT Bombay Surbahaar for an **audience of over 500**
- Participated and **successfully completed** the **Hacktoberfest Challenge** of 2020
- **Finished third** in the **Inter Institute Scrabble League 2020**, representing IIT Bombay as a team
- Completed **1 year** of **Badminton Training** under National Sports Organization, being one of the **top 40** badminton players of the 2019 batch and also represented my hostel in the **Badminton General Championship**
- Participated in the **Hult Prize Competition** with a startup idea revolving around mixed farming