

Mayank Gupta

Final Year Undergraduate **B.**Tech in Electrical Engineering Indian Institute of Technology Bombay

Pursuing Dual Minor in Computer Science, Artificial Intelligence and Data Science

Research Interests

Artificial Intelligence, Computer Vision, Reinforcement Learning, Speech processing, Natural Language Processing, Generative AI, Cybersecurity, Optimization, Algorithms, Systems

EDUCATION

Indian Institute of Technology, Bombay

Bachelor of Technology with Honors in Electrical Engineering — CGPA : 8.89/10 Minor in Artificial Intelligence and Data Science Minor in Computer Science

RESEARCH PROJECTS

Modular correlation searcher using Markov Chains

Guide: Prof. Dr. Carsten Schilde and Ahmed Eisa | Institute of Particle Technology, T.U. Braunschweig, Germany 2024

- Developed Optimization methodologies to find an easy to understand equation from a data of multiple dependent and independent parameters
- Designed a framework to use Markov Chains(MC) with Simulated Annealing for efficient Symbolic Regression
- Designed states to find the best guess for the next function, constant or variable using probabilities for MC, found from the state energies and temperature from simulated annealing, resulting in a 38% faster strategy

Intelligent communication between IoT agents

Guide: Prof. Dr. Israel Leyva Mayorga | Dept. of Electronic Systems, Aalborg University, Denmark

- Simulated communication between base station and intelligent Internet of Thing(IoT) agents using Reinforcement Learning by controlling physical parameters and observing factors like Latency, Transmissions and Energy
- Added an intelligent agent and dumb agents along with a Q-learning based approach to train the intelligent agent
- Designed a custom reward-penalty space and achieved a 80% improvement in the Latency, 40% reduction in the number of failures for a 71% lesser throughput and 80% better energy efficiency for Q-learning

Hindi Song Generation

Guide: Prof. Dr. Preeti Rao | Dept. of Electrical Engineering, IIT Bombay

- Developed a Diffusion model to generate natural sounding Hindi songs using a highly limited labeled dataset
- Implemented novel fine-tuning methods on a pre-trained Chinese model, fine-tuning it on Hindi songs to train it on differences in phoneme utterances and pitch across languages
- Designed **fine-tuning** approaches for the **vocoder** which was trained on English speech data, which converts the mel-spectrogram to audio to ensure it gives high quality audio for Hindi songs

Automatic particle size distribution of nanoparticles

Mentor: Prof. Dr. Tobias Voss | Institute of Semiconductor Technology, T.U. Braunschweig, Germany

- Developed segmentation algorithms to detect nanoparticles and evaluate their dimensions from Scanning Electron Microscope(SEM) images using a Mask RCNN, do determine different characteristic properties of the particles
- Automatically detected scale bars and calculated the pixel-length ratios using scale length and OCR techniques
- Created a user-friendly Graphical User Interface (GUI) using PyQT5 to streamline and automate the evaluation process of SEM images and generate informative graphs for different kinds of nanoparticles

SCHOLASTIC ACHIEVEMENTS

- Awarded Branch Change to Electrical Engineering (B.Tech) for Exemplary Academic Performance [2022]
- Conferred Advance performer grade in Programming for Data Science and Engineering Mechanics awarded to the top 2% of the class [2022] [2021]
- Secured All India Rank 888 in Joint Entrance Examination Advanced 2021 out of 250,000+ aspirants
- Secured All India Rank 1393 in Joint Entrance Examination Mains 2021 out of 1M+ aspirants
- Placed among the top 0.02 percentile in the BITSAT examination, the entrance examination for the prestigious BITS Pilani University [2021]

2024

2021-25

2023

[2021]

2024

OTHER PROJECTS

Cross-lingual Sentiment Analysis in Tweets

Course Project in Speech and Natural Language Processing | Instructor: Prof. Pushpak Bhattacharyya

- Developed a robust pipeline for sentiment classification of cross-lingual tweets using advanced embedding methods like VecMap, GloVe, and multilingual BERT models, achieving improved accuracy over baseline techniques
- Implemented an LSTM-based classifier with Adam optimizer with weight decay, leading to faster convergence and improved classification compared to traditional approaches, achieving a 62% accuracy
- Applied comprehensive data preprocessing techniques, including handling emojis, special characters, and noise, to adapt models for code-mixed social media text, enhancing the model's performance for cross-lingual tweets

Disease Detection in Plants

Course Project in Intro to Machine Learning | Instructor: Prof. Amit Sethi

- Developed a ML model achieving 95.7% accuracy in plant disease detection using images of leaves
- Evaluated and compared the performance of various ML algorithms, including CNN, KNN, and Random Forest
- Performed image pre-processing and used the images' Hu-moments and Haralick textures as input features

Analyse and predict the prices of used cars

Course Project in Programming for Data Science | Instructor: Prof. Amit Sethi

- Performed exploratory data analysis and visualisation on data of used cars using different kinds of plots from Seaborn
- Predicted the price of used cars using linear regression with gradient descent, Random Forest Algorithm, K nearest Neighbours (KNN) and Multiple Linear Regression, comparing the results from each model
- Used NN with PyTorch to suggest the best car to be purchased based on multiple factors like prices, popularity, mileage using algorithms like Bayesian Linear regression and ARD regression to provide different opinions

Reconstruction of Undersampled Images

Course project in Advanced Image Processing | Instructor: Prof. Ajit Rajwade

- Reconstructed dynamic CT images from an undersampled projection dataset and eliminated streaking artifacts
- Used discrete gradient transform and wavelet transform to obtain sparse representations
- Utilized algebraic reconstruction technique along with steepest gradient descent iteratively to obtain the images

Image Quilting for Texture Synthesis and Transfer

Course Project in Digital Image Processing | Instructor: Prof. Ajit Rajwade

- Quilted a source texture by iterating over blocks of fixed length, to form a single large image
- Transferred a source texture on an image of an object by mapping the luminescence values
- Explore novel possibilities of the mapping between the image and the texture like intensity, hue, saturation and intensity density

Reinforcement Learning reading project

Winter in Data Science Project, Analytics Club IITB

- Performed literature evaluation of the mathematical formulation of Markov Decision Processes
- Explored multi-armed bandits and methods of dynamic programming like value and policy iteration
- Profoundly analyzed and implemented action value methods like the ϵ -greedy algorithm, UCB algorithm and Thompson Sampling algorithm for maximization of reward in an n-armed bandit

Road Accident Prevention

Seasons of Code Project, Web and Coding Club, IIT Bombay

- Performed literature research on Deep Learning and Neural Networks to improve a pre-existing skeleton CNN and trained it on a public dataset to classify if eyes are opened or closed
- Studied haar cascade classifier in OpenCV and used them to capture a face and detect region where eyes are present

Face, Hand and Pose gesture detector

- Trained a model using TensorFlow's Keras on images of different people's faces then recognised a person from a real time image which is captured and processed using OpenCV
- Developed a mouse controller and volume controller by detecting different points on hands
- Developed a gym trainer by detecting location of each critical point on the body using Mediapipe and formulated an algorithm to calculate the angles between multiple points on the body

[Report link] [Github link] 2024

[Report link] [Github link] 2022

[Report link] [Github link] 2023

[Report link][Github link] 2022

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[Github link] 2024

[Report link] [Github link] 2024

Transparent SSL Proxy Server

Course project in Principles of Data and System Security | Instructor: Prof. Virendra Singh

• Implemented XSS mitigation technique on a webserver and added self-signed digital certificates to encrypt data

Miniature DC Current Controller

Project in Electronic Design lab | Instructor: Prof. Siddharth Tallur

- Implemented a high-current source with 0.1% precision in current measurements, ensuring spike protection
- Awarded the Best Project Award for easy user accessibility and designing a consumer deliverable product

Fully Homomorphic Encryption

Course project in Topics in Cryptology | Instructor: Prof. Virendra Singh

- Implemented Fully Homomorphic Encryption in Python, showing robustness over addition and multiplication
- Trained a Logistic Regression model on plaintext and encrypted data with accuracy of 98% and 96%

RISC superscalar microprocessor design

Course project in Processor Design | Instructor: Prof. Virendra Singh

- Designed a 16-bit microprocessor using VHDL, implementing a superscalar structure which can solve 22 different instructions using different hardware components
- Designed a Branch Target Buffer to store output of mispredicted branch instructions

Bubble Trouble

Course project in Computer Programming | Instructor: Prof. Parag Chaudhuri

- Designed a single player bubble trouble game using Object Oriented programming, implementing collisions between different components, timer, lives, play again choice and calculated scores
- Created new classes and structures involving member functions to record the gameplay

MENTORSHIP _

Mentor for Codewars, organised by Web and Coding Club, IITB

- Mentored 15+ students in Python and C++ for Codewars, an Institute wide Game Development Hackathon
- Guided the students in OOP concepts in Python and C++ which were essential in designing the game
- Taught them multiple efficient algorithms to decrease latency and at the same time win against an opponent

TECHNICAL SKILLS

| Programming | Python, C/C++, SQL, MATLAB, Assembly, Bash, Embedded C, VHDL |
|-------------|--|
| Libraries | PyTorch, Tensorflow, NumPy, Pandas, Matplotlib, Seaborn, Detectron2, OpenCV, Mediapipe |
| Softwares | LATEX, Git, Conda, Quartus, Arduino, Atmel Studio |

COURSES UNDERTAKEN

| Computer Science | Computer Programming, Programming for Data Science, Data Structures and Algorithms, Design and Analysis of Algorithms, Introduction to Machine Learning, Discrete Structures, Digital Image Processing, Data and System Security, Advanced Image Processing, Database and Information Systems [*] , Speech and Natural Language Processing and the web [*] |
|------------------|---|
| Mathematics | Probability, Optimization, Distributed Optimization and Machine Learning, Cryptology, Markov Chains and Queuing Systems, Calculus, Linear Algebra, Complex Analysis, Differential Equa- |
| Electrical | tions, Large Sparse Matrix Computations* Signal Processing, Control Systems + Lab, Communication Systems + Lab, Analog Circuits + Lab, Digital Circuits + Lab, Electronic Design Lab |

* to be completed by December 2024

EXTRACURRICULARS.

- Completed 1 year of Chess training under National Sports Organization, IIT Bombay
- Secured ranks 4879, 4239 and 4479 in Kickstart conducted by Google among 10,000+ participants
- Secured 2nd position in Main dramatics general championship conducted by Cultural Council

2024

[Github link] 2022

[Github link] 2023

[Github link] 2022

2023