Eeshaan Jain

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Education

Indian Institute of Technology Bombay — *CPI: 9.57/10*

Dual Degree (B.Tech + M.Tech) in Electrical Engineering with Minor in AI and Data Science — *Jul 2019 - Ongoing*

Aditya Horizon Junior College — *Percentage: 93.2%*

Intermediate (HSC - Higher Secondary Certificate) — *Jul 2017 - Apr 2019*

Wisdom World School — *Percentage: 98.2%*

Matriculation (ICSE - Indian Certificate of Secondary Education) — *Jun 2012 - May 2017*

Interests

Machine Learning Graph Neural Networks, Generative and Adversarial Networks, Privacy on Social Networks

Quantum Quantum Computing, Quantum Machine Learning

Experience

AGRIVATOR — *A Startup at IIT Bombay*

Machine Learning Subsystem — *Jun 2021 - Oct 2021*

- Surveyed recent literature on **SOTA** approaches to image segmentation on **crop-weed detection** and **soil-nutrient monitoring**
- Benchmarked real-time performance of **Fast-RCNN**, **Faster-RCNN** and **YOLO-v4** on soyabean crop weed detection
- Integrated the model with an **autonomous bot** to continuously monitor crop state and synchronously provide improvements

Key Projects

ESTIMATION OF EPIDEMIC STATE USING GRAPH NEURAL NETWORKS

Guide: Prof. Abir De — *Sep 2021 - Nov 2021*

- The goal of the project was to approximately determine the **state of epidemic spread** in a small-world network using **GCNs**
- Generated **random networks** using the Erdős–Rényi-Gilbert, Watts-Strogatz and Barabási–Albert models for our dataset
- Implemented the **SIR** contagion model , treating the epidemic as a CTMC, on our graphs to get a **spatio-temporal** dataset.
- Performed **node classification** (S/I/R) using **Graph Neural Networks** by monitoring only a **small subset** of nodes (15% - 25%)

BENCHMARKING IMAGE NETWORKS ON CANINE VISION SPECTRUM

Guide: Prof. Amit Sethi — *Oct 2021 - Nov 2021*

- The goal of the project was to **benchmark** popular CNN models on an image dataset transformed into the **canine** vision spectrum
- Applied **non-linear transformations** and **clipping** to the cats v/s dog dataset by Microsoft Research to get images in the CVS
- Surveyed literature based around effect of color space and vision spectrums on the performance of CNNs in the classification setting
- Benchmarked the performance of our dataset on DenseNet-121, ResNet-50 and EfficientNet-B1 in two parameter settings

IMPROME - IMAGE PROCESSING MADE EASY

Guide: Prof. Amit Sethi — *Aug 2021*

- Developed a **graphical user interface** using the **PyQt** framework in Python to perform image processing operations
- Reviewed literature on **color spaces**, **histogram specifications**, **intensity transformations** and **frequency transformations**
- Implemented image processing algorithms such as vectorized **convolutions**, **transformations** and **equalizations** from scratch

NEURAL MACHINE TRANSLITERATION

Guide: Prof. Biplab Banerjee — *Mar 2021 - May 2021*

- The goal of the project was to create an interface to facilitate **transliteration of text** in images from one language to another
- Explored and implemented various **sequence to sequence** machine transliteration models to convert a piece of Hindi text into English
- Pipelined the transliteration model with **optical character recognition** techniques using EasyOCR to extract Hindi text from an image
- Surveyed literature on **attention-based transliteration models** such as **DeepTrans**, which is implemented in the TensorFlow library

STOCK MARKET ANALYSIS AND PRICE PREDICTION

Guide: Prof. Amit Sethi, Prof. Sunita Sarawagi — *Mar 2021 - May 2021*

- Studied the performance of seven sectors of the **Indian stock market** during the first wave of **COVID-19** from Feb 2020 to Jun 2020
- Performed **exploratory data analysis** on the NIFTY sectoral indices and compared them using **technical indicators** such as RSI
- Compared performance of **sequential neural network architectures** such as LSTMs and 1D CNNs to **predict stock market prices**
- Received a **special mention** and credited as the **most outstanding project** amongst 40+ projects in the field of Data Science

NON-SMALL CELL LUNG CANCER DETECTION AND MUTATION PREDICTION

Guide: Prof. Amit Sethi *Jan 2021 - Apr 2021*

- Trained **Inception v3** on whole-slide images obtained from TCGA to **classify** the tissue cancer into LUAD, LUSC or non-cancerous
- Obtained an **AUC score** of 0.97 on cancer classification comparable to the predictions obtained by visual inspection from **pathologists**
- Further trained the network to predict 6 of the most common **mutated genes** in **LUAD** obtaining a **maximum AUC score** of 0.84

METHODS IN NATURAL LANGUAGE PROCESSING

HSE Russia, Coursera *May 2020 - Jun 2020*

- Performed **semantic analysis** using linear models (multi-label classifiers) on StackOverflow for predicting tags given questions
- Studied about **language models**, **probabilistic Markov models** and performed named-entity recognition on Twitter using LSTMs
- Worked with character, word and sentence **embeddings** and used them to identify duplicate questions on StackOverflow
- Reviewed statistical machine translation, encoder-decoder models and summarization using **pointer-generator networks**

Other Projects

PYFRAC - FRACTIONS IN PYTHON

Self Project *May 2021*

- Developed the pyfrac module in Python to perform operations on **rational numbers** which can be sub-classed for complex data types
- **Extended** the usage of fractions module in python by addition of **mutability** and **optimizations** to convert decimals to fractions

DIGITAL CIRCUIT DESIGN IN QUARTUS

Guide: Prof. Maryam Shojaei Baghini *Jan 2021 - Apr 2021*

- Implemented a 16 bit **Kogge Stone** adder/ subtractor, arithmetic right **shift** and a **clock divider** on the Krypton CPLD-based board
- Designed a tone synthesizer circuit to **automate** the sequence of 8 musical notes to generate music using a **finite state machine**
- Emulated the **blinking taillights** of the Ford Thunderbird by modeling the blinking sequence with a **finite state machine**

WORKING WITH CISC AND RISC MICROPROCESSORS

Guide: Prof. Dinesh Sharma & Prof. V Raj Babu *Jan 2021 - Apr 2021*

- Implemented **software keyboard scanning** on the Intel 8051 and Mini-MIPS processor using FSM with a keystroke interval of 50ms
- Programmed the 8051 for communication via **Continental Morse Code** using UART and perceived it by synthesizing tones at 500Hz
- Analyzed the **stack structure** and operations in the 8086 and utilized **string instructions** for efficient movement of data

HYPERLOOP POD SUBSCALE PROTOTYPE DESIGN

Team Hyperloop IITB *Jan 2020 - Dec 2020*

- Amongst 50 tech-enthusiasts aiming to build a **subscale prototype** of the Hyperloop Pod which could travel at hypersonic speeds
- Applied knowledge acquired on **I2C** and **CAN** communication protocols to the Hyperloop communication systems
- Studied about various control and communication systems and various **error correction** and **detection** algorithms
- Qualified in the **top 5** university teams internationally for the finals of the **European Hyperloop Week** (EHW 2021)

IMAGE TO IMAGE TRANSLATION - SKETCH TO COLOR

Seasons of Code - Winter *Apr 2020 - Aug 2020*

- Surveyed literature on **generative adversarial networks** and image-to-image translation using **conditional** adversarial networks
- Implemented a **conditional-GAN** which accepts **sketched** image and predicts its **colored version** without knowing the ground truth

AUTONOMOUS GARBAGE COLLECTING BOT

Institute Technical Summer Project *Apr 2020 - Aug 2020*

- Designed an **autonomous** garbage collecting bot which can **classify**, **detect** and **collect** plastic, cardboard, metal and wrappers
- Constructed a full-scale model of the bot on **Blender**, designed the electric circuit on **Fritzing** using **Raspberry Pi 4** and **Arduino**
- Used **YOLO** for object detection, **ROS** for simulation, and designed a custom gripper for **palming action** to pick the garbage
- Declared as one of the **top 3** projects overall out of more than 60 projects that were submitted in ITSP 2020

VIRTUAL REALITY GAME DEVELOPMENT

Tinkerer's Lab, IIT Bombay *Apr 2020 - Aug 2020*

- Headed the **animation team** and developed a first person virtual reality game in **Unity** Game Engine and **Blender** 3D software
- Applied knowledge acquired in the field of 3D animation and modelling to **create assets** and **characters** to be used in the game
- Read about construction of **virtual reality gloves** linked with **headset** to control movement and actions in the game

Skills

Languages	Python, C++, Julia, HTML, CSS, Javascript
Machine Learning	PyTorch, PyTorch-Geometric, TensorFlow, Keras, NLTK, Scikit-Learn, OpenCV, Flux.jl
Softwares	Scilab, MATLAB, Quartus, Keil, Blender, Git, AutoCAD, SolidWorks, GNU Radio, Spice
Python Libraries	NumPy, Pandas, Matplotlib, Seaborn, SciPy, Qiskit, SymPy, PyQt5, JAX, NetworkX

Scholastic Achievements

2021	**Institute Academic Prize**, Awarded for outstanding academic achievement	*IIT Bombay*
2021	**Department Rank 2**, Out of 79 students in the Dual Degree Programme, Electrical Engineering	*IIT Bombay*
2020	**AP Grade**, Awarded for outstanding performance in Differential Equations-II and Physical Chemistry	*IIT Bombay*
2019	**All India Rank 120**, JEE Main 2019 out of 1.2 million candidates	*JEE*
2019	**All India Rank 355**, JEE Advanced 2019 out of 245,000 qualified candidates	*JEE*
2019	**Top 300**, Indian National Chemistry and Astronomy Olympiads	*INO*
2018	**All India Rank 100**, Kishore Vaigyanik Protsahan Yojana and received their undergraduate fellowship	*KVPY*
2018	**Nation Top 1%**, National Standard Examinations in Physics and Chemistry	*IAPT*
2018	**State Top 1%**, National Standard Examinations in Astronomy	*IAPT*

Key Courses Undertaken

Machine Learning	Programming for Data Science, Introduction to Machine Learning, Learning with Graphs, Foundations of Intelligent Learning Agents, Image Processing, Advanced Machine Learning*
Mathematics & Physics	Calculus, Linear Algebra, Differential Equations-II, Complex Analysis, Quantum Physics, Electricity and Magnetism
Electrical Engineering	Probability and Random Processes, Signal Processing, Microprocessors, Digital Systems, Communication Systems, Digital Signal Processing, Markov Chains and Queuing Systems*
Online Courses	Deep Learning Specialization, Natural Language Processing, Algorithmic ToolBox, Data Structures, Managing the Company of the Future, MATLAB Onramps, Machine Learning with Graphs†, Differential Privacy†

† *non-certified* * *to be completed by Apr 2022*

Positions of Responsibility

CLASS REPRESENTATIVE

Electrical Engineering Department *Sep 2019 - Ongoing*

- Responsible for **establishing communication** between professors, functionaries, other academic staff, and the class
- Suggested measures that could be adopted by instructors to facilitate **better learning experience** in the mode of **online teaching**
- **Facilitated discussion** among students of the class to understand general consensus on various academic issues

UNDERGRADUATE TEACHING ASSISTANT

MA108: Differential Equations, MA207: Partial Differential Equations & CH107: Physical Chemistry *Mar 2021 - Nov 2021*

- Selected on the basis of **in-depth knowledge** of the subject, in addition to good **presentation** and **communication** skills
- Conducted **weekly tutorial sessions** for a batch of 50 freshmen and helped them in the course through **personal interaction**
- **Assisted** the instructor in **course logistics** by proctoring exams and evaluating examinations and periodic assessments

STUDENT PROJECT MENTOR

Institute Technical Summer Project & Summer Of Science *Apr 2021 - Jul 2021*

- **Mentored** a group of 4 students in their Institute Technical Summer Project on the topic of **Dialogue Management**
- **Mentored** a student in their Summer of Science learning project on the topic **Deep Learning and Neural Networks**
- Provided mentees with **regular assistance** and **insights** on various topics to be explored in the respective fields of interest

PYTHON COURSE INSTRUCTOR

PyCK: Python is Cool, Kids! *May 2021 - Jul 2021*

- Introduced **Python** to **1000+ students** at IIT Bombay in the course PyCK hosted under Web and Coding Club, IIT Bombay
- Delivered **biweekly lectures** covering topics such as classes, libraries amongst others in Python and held frequent **doubt sessions**
- Assisted 50+ students in their project by **documenting** their **project** reports and **scrutinizing** their progress periodically

CONVENER

Chemistry Club *May 2020 - Jun 2021*

- Contributed to the **ideation** for setting up the **foundations** of the club and further for the organization of future events
- Organized and conducted **Rascionix**, a national chemistry competition with **200+ participants** from all around India
- Engaged in the creative direction of a regulated stream of **content creation** based around chemistry on various social media platforms

Extracurricular Activity

Chemenigma	Stood 2nd overall and 1st in the prelim round of Chemenigma, a chemistry tournament by IISc Bangalore	2021
Chess	Completed a year long professional course in Chess under National Sports Organization (NSO)	2019-2020
Quantum Computing	Completed the workshop held by MnP Club, IIT Bombay using Qiskit on IBM Quantum Experience	2020
LIMIT	Qualified the LIMIT examination and attended a camp in ISI Bangalore about abstract mathematics	2019
Rubik's Cube	Awarded the fastest cuber in Cubing Fever 2k16 - a district level speedcubing competition	2016
Debate	Represented the school in various inter-school debates and wont the best speaker award twice	2016
Vedic Maths	Completed all 6 levels of Speed Arithmetic under IPA and stood 2nd in their state-level competition	2015