Parth Pundalik Pai

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Education

Indian Institute of Technology Bombay, Mumbai, India CGPA: 8.88/10.0
Bachelor of Technology in Mechanical Engineering Nov'22 - May'26 (expected)
Minor in Data Science and Machine Learning Nov'22 - May'26 (expected)

The Learning Centre PU College, Mangalore, India CGPA: 9.53/10.0
Higher Secondary Education in Physics, Chemistry and Mathematics July'20 - Aug'22

Scholastic Achievements

- Received an **AP** grade in the MS101 course, achieved by only **7 individuals** out of **600+** students. *(2023)*
- Achieved a **Branch Change** to **Mechanical Engineering** owing to good academic performance *(2023)*
- Secured **Karnataka State Rank 46** among **216k+** candidates appeared for **KCET** examination *(2022)*
- Procured **99.65** in **Joint Entrance Examination Mains** among **0.94M+** candidates across India *(2022)*
- Among **Top 2.13** percentile out of **0.16M+** candidates in **JEE Advanced** Examination *(2022)*
- Secured a place in top **5 percentile** out of **50k** candidates in **KVPY** SX examination *(2022)*

Key Technical Projects

Guidance Navigation and Control Subsystem |*Student Satellite Program* *(May'23 - Nov'23)*
A 40+ member team with the vision of making IIT Bombay a centre of excellence in space technology
Attitude Determination and Control Subsystem

- Designed and executed the **Model Predictive Control** algorithm in **MATLAB** by using **Prediction horizon, Control horizon** and Tuned the MPC parameters to obtain **Minimum cost**
- Implemented the algorithm using **Receeding horizon** technique yeilding new **Predicted state**
- Developed algorithms for **LU decomposition** with Partial Pivoting, **QR decomposition** using Householder reflections, the **Gram-Schmidt Process**, and **Cholesky decomposition** in **MATLAB**
- Implemented **Singular Value Decomposition** and **Rank Approximation** Algorithm for large matrices

Denoising Diffusion Probabilistic Model | *Self Project* *(May'24 - Jul'24)*

- Implemented **Denoising Diffusion Probabilistc Model** paper from scratch using **PyTorch**
- Designed **ResNet** and **Time-Step embeddings** using **Convolutional Neural Networks**
- Trained the Neural Networks in **Reverse Process** of Diffusion to generate high-quality **MNIST** images

Breakout Genius - AI game master using RL | *Season of Code 2023* *(May'23 - July'23)*
Built a Reinforcement Learning game master to play Atari games *WnCC, IIT Bombay*

- Created **Atari Breakout Game** environment using **OpenAI's gym** package, NumPy and Pytorch
- Built a **DQNAgent** class having **CNN network** to return relevant **q-values** and **sample-actions**
- Recorded **mean rewards** and **Temporal Difference(TD) losses** while training using **Adam** Optimizer
- Tested a pre-trained PyTorch model for **9M** steps and rendered the animation to output the video file

Language Translation model using NLP | *Learner's Space 2023* *(June'23 - July'23)*
English to Italian Translation model using Natural Language Processing *UGAC, IIT Bombay*

- Built Language Translation model from English to Italian using **transformers and tokenizers**
- Preprocessed the data using **sklearn** library and tokenised it with transformer's **AutoTokenizer**
- Evaluated the accuracy of the model using **sacrebleu** score to check word matchings
- Created an interactive app environment using **gradio** and tested the saved pre-trained model

Other Projects

ML Based Movie-Recommendation System | *ME781 Course Project* *(Oct'23 - Nov'23)*
Guide: Prof. Asim Tewari, Department of Mechanical Engineering *IIT Bombay*

- Preprocessed data and created embeddings using **AutoTokenizer** and saved it using **HuggingFace** repo
- Used **bert-based-uncased** model from Huggingface to convert the given prompt into embeddings
- Used **Cosine Similarity** to compare existing and the prompt embeddings to give top 5 recommendations.
- Created an interactive app environment using **gradio** and tested the model to give movie recommendations

ML based Analysis of external flow around Air-Foil | *ME228 Course Project* *(Feb'24 - May'24)*
Guide: Prof. Alankar Alankar, Department of Mechanical Engineering *IIT Bombay*

- Implemented **Neural-Networks** to establish **Pressure coefficient** and **Flow Velocity** relations
- Used **Computer Vision** approach to estimate pressure coefficient using the **Streamline Plots**
- Optimised value of camber, angle of attack etc. to achieve **Minimum Drag** and **Maximum lift**

RL based stock traiding strategy optimization | *Finsearch 2024* *(June'24 - Present)*
Reinforcement Learning based stock price prediction *Finance Club, IIT Bombay*

- Conducted an indepth study of RL algorithms such as **Q Learning** and **Policy Gradient Methods**
- Implemented **DDPM** and **DQN** algorithms gaining hands-on experience in optimizing RL models
- Successfully applied DQN algorithm to the **Inverted Pendulum** system by stabilizing it's base
- Implementig the RL model on the **NIFTY50** dataset and comparing with **ARIMA** as benchmark model

MusGen - Music Generation using RNNs and LSTMs | *Summer of Code 2024* *(May'24 - Present)*
Generating music using RNNs and LSTMs *WnCC, IIT Bombay*

- Preprocessed the **deutsch folk songs** from **ESAC** dataset and encoded into **time-series** representation
- Trained an **LSTM** Neural network using **tensorflow** and decoded the generated melodies into **MIDI** notes
- Implementing the model architecture on **larger dataset** and **larger mapping** file for more variation

Relevant Courses Undertaken

Programming	Python | Arduino | C++ | LaTeX
Softwares	GitHub | Fusion 360 | MATLAB | Linux
Packages	PyTorch | Transformers | Scikit-learn | Numpy | Pandas | Matplotlib | Keras
Math and CS Courses	Linear Algebra, Differential Equations, Differential Calculus, Integral Calculus, Computer Programming and Utilization, Randomized Algorithms*, LaTeX†
ML Courses	Programming in Data Science, Statistical Machine Learning and Data Mining, Introduction to Machine Learning, Applied Data Science and Machine Learning

**currently in Summer of Science 2024, † completed in Learner's Space 2024*

Positions of Responsibility

Class Representative | First Year B.S Mathematics *(Nov'22-June'23)*

- Handled classroom administration and mediated with professors for the smooth running of courses
- Organised Fresher's Party, Traditional Day, and Department Trip conducted by **Math Association**
- Streamlined the doubts by making relevant **discussion groups** on online platforms.

Extracurricular Activities

- Worked as **Coordinator, 53rd Mood Indogo** in the Asia's largest college Cultural festival *('23-24)*
- Won **Gold Medal** in Stageplay at 6th **Inter-IIT Culturals Meet** held at **IIT Kharagpur** *('23-24)*
- Participated in the **Versova Beach Cleaning** programme hosted by **Abhyuday, IIT Bombay** *('24)*
- Mentored a group of 8 students in **Season of Code 2024** conducted by **WnCC club**, IIT Bombay *('24)*
- Completed the **Junior Degree** in Hindustani Classical **Vocals** issued by **KSEEB**, Karnataka *('13-15)*
- Professionally trained in Indian Classical **Flute** after a year-long training under NSO-Culturals *('22-23)*