Shirsh Mall

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Education

Indian Institute of Technology Delhi — New Delhi

Master of Science (MSc.) in Physics · IIT-JAM Rank: 97 · CGPA: 7.4 — *Aug 2021 – May 2023*

- Relevant Coursework: **Deep Learning for Mechanics, Probability and Statistics**

Dyal Singh College, University of Delhi — New Delhi

Bachelor Of Science (BSc.) in Physics Honours · CGPA: 8.5 — *Aug 2018 – July 2021*

- Relevant Coursework: Linear Algebra, Calculus

Projects

GitHub Portfolio Page

Image Captioning and Image Retrieval System — Tools: Selenium, TensorFlow, PyTorch, Hugging Face, FAISS, FastAPI, Docker

- Collected diverse datasets: **1000 captions** from ChatGPT and **web scraped** Google images, and 150K GCC **image-caption pairs**, after thorough **preprocessing**.
- Utilized **ViT-BERT** pre-trained model and fine-tuned to **generate image captions** and evaluated using **Rouge** score.
- **Implemented CLIP model** for **image retrieval** using PyTorch. Enhanced the retrieval capabilities by **fine-tuning** OpenAI's pre-trained CLIP model for improved performance.
- Created **web app** with user-friendly tabs for image captioning and retrieval using **FastAPI, HTML**, and **CSS**, incorporating **FAISS indexing** to boost retrieval **speed by 10x**, followed by **containerization** using **Docker**.

Semantic Search-based Recommendation and QnA System — Tools: BeautifulSoup, Selenium, NLTK, Hugging Face, FAISS, Gradio

- **Web-Scraped** 1000 Reuters news articles with their summaries and added CNN news data for more depth.
- Fine-tuned BART models for news **summarisation**, generated news article **embeddings**, enabling **10x faster semantic search** with **FAISS indexing**.
- Implemented **context-based question-answering** using pre-trained models with Wikipedia-search dynamic content extraction.
- Created user-friendly **web applications** and **deployed** using **Gradio**
- The project facilitates content discovery and user engagement for news platforms through semantic search and real-time Q&A.

English to Hindi Machine Translator — Tools: TensorFlow, Keras, PyTorch, Hugging Face, NLTK, Regex

- **Implemented from scratch** an **Encoder-Decoder** architecture with **Bidirectional GRU** and **Multi-head Attention** Layers, along with **Greedy Search** and **Minimum Bayes Risk Decode** inference methods using TensorFlow.
- Improved translation performance by **fine-tuning** a pre-trained model, making it more adaptable to Hindi sentences.
- The developed translation models enable broader market reach and accessibility for non-English-speaking customers.

Fine Tune LLM for Instruct Question-Answering — Tools: PyTorch, Hugging Face

- **Fine-tuned** the **Flan T5 Large** model for **answering questions** with **task-specific instructions** on a subset of **75k** instances of the Open-Orca dataset.
- Implemented Parameter-efficient fine-tuning (**PEFT**) and employed Quantization and Low-rank approximation (**QLoRA** Layers), which **reduced** training time and memory usage by **90%**.
- Education sector benefits from this project, utilising LLM capabilities to improve online learning with accurate responses.

Technical Skills

Programming Language: Python | **Database**: SQL | **Data Science**: Machine Learning · Natural Language Processing · Computer Vision
Frameworks: Scikit-Learn · TensorFlow · PyTorch · Hugging Face | **Model Deployment:** Streamlit · Flask · FastAPI · Gradio · Docker
Additional Skills: Explainable AI (Shap) · Web Scraping · Elementary Tableau

Research Experience and Academic Coursework

Masters Thesis: Particle Physics Data Analysis using Deep Learning

- Achieved accurate **signal-background events classification** and constructed **predictive ANN models** for key physical variables.
- **Transformed data into image** for deeper analysis and implemented **CNN models** for **Jet-Images classification**, after jet clustering
- Employed **data analysis**, utilised **data simulation** tools for event generation using theoretical learning.
- This project facilitates identifying signal events, **reducing repetitive initial theoretical calculations**, aiding physicists in research.

Assignments - Implementation from Scratch

- Multivariate non-linear regression, Binary classification, One-vs-all and Softmax multi-class classification algorithms.
- ANN and CNN multi-class classification using MNIST dataset, RNN for time series dataset and Physics Informed-Neural Network.