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Research Projects

Visual Haystack and Retrieval Research | Current Research *(Jan'25-current)*
Work Guide : Prof. Ganesh Ramakrishnan, Computer Science Department, IIT Bombay

- Conducting research in Visual Haystack and Retrieval domain with focus on multi-image question answering.
- Developing retrieval algorithms to **efficiently locate relevant images** within large collections of visual data.
- Implementing **advanced indexing and similarity search techniques** for improved visual content retrieval.
- Building **cross-image reasoning capabilities** to enhance retrieval accuracy and processing performance.

Image resolution enhancement | Research and Development Project *(Aug'23-Nov'23)*
Work Guide : Prof. Amit Sethi, Electrical Engineering Department, MEDAL lab, IIT Bombay

- Developed and implemented **deep learning models on Div2K** dataset to enhance the resolution of images
- Utilized state-of-the-art architectures like **Vision Transformer, Swin IR, SRGAN, Real-ESRGAN, SinGAN**
- **Optimized efficiency** while developing transformative solutions for medical imaging, enhancing resolution

Key Projects

ML Metrics Tracker | Self-Project
A SaaS that tracks AI model training metrics and inference

- Built a SaaS platform for tracking ML experiments, logging training/validation metrics, and storing inference results, using **WebSocket architecture** for real-time updates and GitHub OAuth for secure authentication.
- Deployed the platform on **AWS EC2, leveraging AWS services like S3 bucket, DynamoDB, ElastiCache, Route 53, CodeDeploy, and Lambda** to ensure scalability, high availability, and efficient data handling.
- Implemented concurrency techniques using Golang with the Gin framework for seamless request handling, efficient compute, and responsive user interactions, ensuring the platform's high performance and scalability.

Language Translation deep learning model | Self-Project
Transformer based Language Model

- Developed a **sequence to sequence** translation model from scratch on the original **transformer architecture**
- Coded **self-attention, position encoding** from scratch, deepening my understanding of core architecture
- Skillfully handled datasets with tokenization,**embedding and auto regressive** techniques to optimize training

Vector database, RayDB | Self-Project
Redis like Vector database optimized for search

- Architected and developed vector database optimized for search, using **Golang with the Gin framework**
- Developed a deep learning model that **produces multidimensional key vectors** for image and text search
- Designed to mimic **Redis-like capabilities** for storing large-scale vector data, ensuring fast retrieval and scale
- Engineered the database to support **natural language queries**, significantly improving user search experience by utilizing **vector similarity and dot product calculations** to fetch the most relevant content

Speech Recognition system| Self-Project
CNN - Transformer based hybrid audio to text model

- Developed a speech recognition model to convert English audio to text, utilizing a **custom-built transformer**.
- Leveraged a subset of the **LibriSpeech dataset** for training the model, employing efficient data preprocessing
- Implemented a **hybrid CNN-Transformer sequential architecture** for speech recognition, enhancing feature extraction and contextual analysis capabilities, **significantly improving accuracy and processing speed**

Technical Skills

Languages: Go, C++, Python, JavaScript, Java | **Libraries:** PyTorch, Gin, Pandas, Matplotlib