J Vijayavallabh

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Summary

Pre-final Year Bachelors in Biological Engineering at IIT Madras with a strong focus on AI, machine learning, and deep learning applications in biological and financial domains. Experienced in research, publications, and hackathons.

Education

2027 B.Tech in Biological Engineering at **Indian Institute of Technology Madras** (CGPA: 8.71/10)
2023 Class XII (CBSE) at **Sri Chaitanya Techno School** (95.4%)
2021 Class X (CBSE) at **Sri Chaitanya Techno School** (99.4%)

Publications and Patents

- **Enhancing Financial RAG with Agentic AI and Multi-HyDE: A novel Approach to Knowledge Retrieval and Hallucination Reduction** (Proceedings of the EMNLP 2025 FinNLP) [Inter-IIT Tech Meet].
- **Sparse Hyperbolic Convolutional Networks with Enhanced Object Localization via GradCAM Analysis** [Proceedings of the International Conference on Computer Vision [**ICCV**] BEW 2025] [SENAI IITM].
- **Patent:** SECure RAG: Semantically Enhanced Contextualization for Unified Reasoning with Explainability in RAG.

Professional Experience

AI Research and Development Intern, Photios April 2025
- Fine-tuned state-of-the-art Automatic Speech Recognition (ASR) models using Deep Learning techniques for transcribing sales interactions in retail environments, by extensive literature review and comparative analysis of ASR architectures.
- Architected automated data cleaning pipeline with FastText model to filter Sanskrit words from Hindi datasets, then fine-tuned custom N-Gram language model integrated with AI4Bharat Conformer, reducing Word Error Rate (WER) and enhancing transcription accuracy in Natural Language Processing (NLP) applications.

Research Experience

Research Intern, Kansas State University May - July 2025
- Worked with Prof. Bala Natarajan and Prof. Babji Srinivasan on single-cell RNA (scRNA) analysis using Inductive Graph Learning, developing transformer-based Graph Neural Networks (GNNs) to model cell-to-cell relationships.
- Integrated GraphSAGE layers with novel spatial, degree, and path encoders from Graphormer into the scGraphformer model's attention mechanism, implemented Trajectory Inference via scTEP methodology, and leveraged inductive learning to enhance performance metrics on golden non-synthetic datasets in Bioinformatics and Machine Learning applications.

Student Researcher, SENAI IITM December 2024 - Present
- Worked with Prof. Raghunathan Rengaswamy on Geometric Representation Learning, architecting Hyperbolic Grad-CAM and integrating activation sparsity methods into Hyperbolic CNNs and hybrid models to enhance interpretability in non-Euclidean spaces, revealing part-whole relationship discovery and hierarchical structure within an image.
- Led technical presentations on Geometric Deep Learning, including Disentanglement Learning via Topology, Topology of Deep Neural Networks, and Principal Component Analysis applications in Machine Learning and Applied Research.

Student Researcher, RBCDSAI September 2024 - Present
- Worked with Prof. Karthik Raman on modeling Gene-Protein Relationships for reaction prediction using Deep Learning techniques, architecting a novel seq-to-seq pipeline with Protein Language Models [ESM] as encoders and BART-based decoder via cross-attention to translate protein representations into chemical SMILES in Bioinformatics applications.
- Optimized generative model capabilities through tokenization and data partitioning experiments to maximize chemically valid SMILES output, and engineered ensemble models (LightGBM, RandomForest) on sparse microbiome datasets, achieving top-tier results in DREAM Challenge 2022 for Preterm Birth Prediction using Machine Learning ensembles.

Personal Projects

Inter IIT Tech Meet 13.0 October - December 2024

– Represented IIT Madras in High Prep AI Contingent for building Agentic Retrieval-Augmented Generation (RAG) framework for financial documents, developing multi-state, adaptive, secure, and explainable systems with novel retrieval techniques, and dynamic workflows tailored to query complexity utilizing Pathway's vector store.

– Engineered Multi-HyDE hybrid retrieval mechanism combining multi-query and hypothetical document embeddings, robust PDF parsing, dynamic data handling with Llama Guard, integrated Explainable AI (XAI) for transparency and source attribution, hosted on Azure via Docker and FastAPI, and benchmarked on GPT-4o and Gemini-1.5 using metrics like Semantic Similarity, Recall, Factual Correctness, Faithfulness, and ROUGE in LLM evaluations.

AI Club Guild Hackathon September - October 2024

– Ranked Top 5 out of 200 in AI Club Guild Selection Hackathon for facial emotion detection, developing custom ensemble of SWIN, BEIT, and CONVNEXT models with neural network-based weighting and data augmentation on small datasets.

– Utilized Optuna for hyperparameter tuning and implemented FP16/FP32 mixed precision training, reducing GPU memory usage by 37% without precision loss, optimizing efficiency in Machine Learning model deployment.

Sheet Music LLM Finetuning June 2025

– Fine-tuned Small Vision Language Models (VLMs) for Sheet Music Theory Understanding and Visual Question Answering (VQA), adapting Llama-3.1-Nemotron-Nano-VL-8B on NOTA dataset with initial music-to-text transcription (image-to-ABC notation) followed by VQA training in Multimodal AI and Deep Learning applications.

– Employed Parameter-Efficient Fine-Tuning (PeFT) techniques like QLoRA via Unsloth framework on Kaggle GPUs to optimize model training efficiency and performance in Machine Learning and Computer Vision tasks.

Scholastic Achievements

– Bagged a rank in the top 0.5% of students in the JEE Mains 2023 and top 1% of students in the JEE Advanced 2023.

– Placed in the Top 5 in the AI Club Guild Selection Hackathon on the Facial Emotion Recognition Problem Statement.

– Placed in the Top 6 in the Inter IIT Tech Meet 13.0 High Prep Problem Statement - Built a Dynamic Agentic RAG for SEC-10K Filings.

– Awarded Merit in the ABRSM Grade 8 Piano Practical Exam (November 2024), a high honour in the final stage of graded music exams.

Skills

Technical Skills	Python, Matlab, PyTorch, Pandas, TensorFlow, LaTeX, RDKit, GitHub, Langchain, DGL, Unsloth, NumPy, Pathway, Matplotlib, Networkx, Docker, FastAPI, Bash Scripting, NLTK, Optuna, Knowledge Graph, Azure
Courses and Certifications	Data Structures and Algorithms for Biology, Signals and Systems, Linear Algebra, Probability and Statistics, Deep Learning Specialisation, Large Language Model Agents MOOC, GeeksforGeeks Machine Learning course