BONESHWAR V K

Gmail | GitHub | Website

Summary

My primary research interests are applications of deep learning particularly developing architectures like graph neural networks, large language models, large reasoning models or large knowledge models, and generative pipelines involving GANs and diffusion models with a focus on applied research, especially in healthcare. In the long term, I aspire to contribute to the open source research community by developing foundational models that are robust and can generalize across multiple domains and modalities, progressing towards AGI.

Education

- **Indian Institute of Technology Madras** *2025*
  B.S in Biological Sciences and M.S in Biological Sciences (Specialization in Computational Biology) CGPA: 8.12/10
- **Velammal Vidyalaya, Chennai** *2020*
  Higher Secondary Education, Central Board of Secondary Education Percentage: 95.0

Skills

Programming Languages: Python, C++, C#
Tools and Software: Gromacs, AutoDock, Weka, Pymol, VMD, Blender
Libraries and Packages: PyTorch, NetworkX, PyG, DGL, Gensim, Rpy2, Scikit-learn, Pandas, TensorFlow

Relevant Coursework

Fundamentals of Deep Learning	Natural Language Processing	Algorithms in Computational Biology
DSA[13] in Biology	Bioinformatics	Data Analytics Laboratory

Publications

- **Inductive graph neural network framework for imputation of single-cell RNA sequencing data** *2025*
  Computers and Chemical Engineering
  – Developed inductive GNN[1]-based framework for scRNA imputation and cell clustering achieving an improvement of upto 60% in Silhouette score, 14.9% in ARI[2], 48% in runtime, and 4.5% in L_1 Median error over baseline models
- **PAITS: Position Aware Inductive Transformer for Single cell RNA seqeuencing data** *2025**
  Computers in Biology and Medicine
  – Developed position-aware framework for incorporating graph's structure using encodings and learned better representation for individual cells. Outperforms baseline state-of-the-art models for both gold standard datasets and **glioma cancer datasets** in terms of test accuracies

Research Experiences

- **Project Member** *April 2025 - Present*
  CRIS Lab, Columbia University *Guide: Prof. Venkat Venakatasubramanian*
  – Implementing a novel framework that heuristically incorporates biological knowledge and hierarchical knowledge graphs leveraging parse trees instead of embedding based graphs
  – Investigating on concept spaces via topological analysis of data (TDA) and LLM's learned representations analogous to golden gate
- **Undergraduate Researcher** *Dec 2023 - May 2025*
  HILCPS Lab, Indian Institute of Technology Madras *Guides: Prof. Babji Srinivasan, Prof. Rajagopalan Srinivasan*
  – Developed a novel deep learning based pipeline model leveraging a U-Net and a masked bi-directional transformer for 3D aware image generation task constrained on **3D geometry, stability** for 3D objects and **3D background.**
  – Introduced fully differentiable novel loss function assuring **connectivity** & **stability** using Betti numbers & PHA[3] for improved synthetic image generation with real world constraints- photorealism, geometry, gravity and stability
- **Research Intern** *May 2024 - July 2024*
  CPSWin Lab, Kansas State University *Guides: Prof. Bala Natarajan, Prof. Babji Srinivasan*
  – Developed an end-to-end novel framework for Gliblastoma Multiforme specific gene imputation, cell clustering and pseudotime calculation, leveraging variational graph auto-encoders and LTMG[5] pre-processing ***(M.S Thesis)***
  – Outperforms the SOTA[4] pipelines in terms of analyzing the heterogeneity of scRNA-sequence datasets using the MST[6] algorithm from ensemble of embeddings from the GNN based framework by 21% in accuracy on test data
- **AI Researcher** *Nov 2023 - Jan 2024*
  Sarvam AI *Guides: Vivek Raghavan, Pratyush Kumar*
  – Developed an end-to-end question answering pipeline leveraging **CSV agent** and evaluated it over OpenAI and open source LLMs- GPT-3.5, GPT-4, Llama and Mistral 7B, achieving SOTA results on large scale CSV Files
  – Benchmarked OCR[7] techniques-PyMuPDF, pypdf2, Unstructured and developed pipeline for information retrieval on multilingual PDFs **(non UTF-8 encoded)** of **Indic languages**- Hindi, Tamil, Telugu, Malayalam & Kannada
  – Leveraged RAGs[8] to store the retrieved information from PDFs and other scanned documents and stored them in vector databases such as FAISS and Pinecone and evaluated retrieval performances of the RAGs using **RAGAS**

Professional Experiences

- **Associate Data Scientist** *May 2025 - Present*

  Convozen AI, NoBroker.com
  - Integrated **deep filter net v3** for filtering background noise and enhancing human voice. Improved VAD's performance, reducing the false positives by 13%
  - Working actively on speech-to-speech realtime models including GPT-4o realtime, Gemini native 2.5 and exploring **Text-to-speech models- XTTS V2 & Fastspeech**
- **Autonomous Systems Engineer** *May 2023 - July 2023*

  1oX, IITM Research Park
  - Designed a wheelchair with mapping and navigation system using IMU, encoder, LiDAR with ROS algorithms- **(Hector SLAM, Cartographer SLAM)** and a **multilingual chatbot** supporting 5 Indic languages using RASA
  - Demonstrated the working our product to **Google India's CEO and Chief Justice of India** featuring on Times of India for our innovative realtime autonomous navigation system in a wheelchair
- **Computer Vision Intern** *Nov 2022 - Jan 2023*

  Homeground App *Founder: Santhosh Vuppala*
  - Developed a lightweight deep learning based pipeline to identify keypoints in video frames for detecting human joints and cricket bats leveraging **MobileNet-V2** with an accuracy of **81% accuracy** and **0.73 F1 score**
  - Designed Python framework to visualize & perform shot classification, ball tracking, player positioning & cognitive analytics using physics-based, Kalman filter integrated algorithm

Projects

- **MaskedAlign: Multiple Sequence Alignment for Genomes using transformer model** *Jan 2024 - May 2024*

  Course Project *Guide: Prof. Manikanda*
  - Developed **MaskedAlign**, a novel seq-to-seq masked transformer inspired by **Masked Trajectory Transformer** and **BetaAlign**, to enhance MSA[10] increasing generalization for large scale unseen gene sequences
  - Implemented the model using PyTorch achieving superior alignment accuracy and computational efficiency compared to SOTA methodologies like BetaAlign, ClustalW and MAFFT with reduction in runtime upto **13%**
- **Synthetic Medical and IR Image Generation** *Nov 2023 - Mar 2024*

  Industrial Project: CVRDE, DRDO, India *Guides: Prof. Rajagopalan Srinivasan, Prof. Babji Srinivasan*
  - Enhanced image generation using **MixNMatch**, with custom dataset according to the industrial needs with enhanced control over latent space for encoding the texture, pose and shape, enabling diffusion process to achieve increased separability between foreground and background, improving overall image quality
  - Enhanced accuracy by 6% (custom dataset) integrating RGB to Thermal Infrared image translation module leveraging GANs[11] that are edge guided image translation by restoring edges and key highlights from the original image
- **Traffic Bot** *June 2022 - Feb 2023*

  Computer Vision and Artificial Intelligence Club, CFI, IIT Madras
  - Implemented end-to-end Python pipeline for detecting traffic violations such as helmet, triple riding violation & over-speeding, achieving **F1 score 0.79** leveraging **Yolov5** and was incubated **Nirmaan Incubation Cell, IIT Madras**
  - Deployed our model using existing CCTV infrastructure, leveraging **Jetson Nano** for deployment, and achieved an accuracy of **89%**, improving monitoring efficiency integrated with real-time accurate vehicle tracking

Achievements and Extra-Curricular Activities

- Secured **All India Rank 9 (AIR 9)** in the JEE MAINS B.Arch conducted in 2020
- Qualified for national level exams-**NTSE, JEE MAINS & ADVANCED 2020** among more than 1,30,000 candidates
- Captained state team-**Tamil Nadu** team in the U-14 juniors **National cricket league** held at Punjab, India

Positions of Responsibility

- **Social Impact & NGOs** *2022 - 2023*
  - **Omdena AI Singapore:** Implemented ML based pipeline for analysing workouts (pushups, situps, pullups)
  - **Suvidha Foundation (NGO):** Designed framework for teaching ML to support weaker economic sections
- **Member, Students Election Commission IIT Madras** *2021 - 2022*
  - Responsible for conduction of Student General Elections 2022, managing an electoral base of over 10,000
  - Hosted soapbox & maintained election integrity for the post of academic affairs secretary, IIT Madras
- **Captain, Cricket** *2013 - 2023*
  - Lead Narmada hostel team, IIT Madras in Schroeter 2024, qualifying for the semifinals
  - Lead the high school cricket team in Inter-District school tournament 2018, Tamil Nadu, secured 3^{rd} place in the tournament and being the highest run scorer among the team

**- ongoing/submitted, 1- Graph Neural Networks, 2- Adjusted Rand Index, 3- Persistent Homology Analysis, 4- State-of-the-art, 5- Left Truncated Gaussian Mixture, 6-Minimum Spanning Tree, 7- Optical Character Recognition, 8- Retrieval Augmented Generation, 9- Speech-to-Speech, 10- Multiple Sequence Alignment, 11- Generative Adversarial Networks, 12- Weights and Biases, 13- Data Structures and Algorithms*