Karthik Prabhu Palimar

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OBJECTIVE STATEMENT

Computational Physicist with expertise in **mathematical modeling, generative AI**, and **high-dimensional data analysis**. Experienced in developing scalable computational pipelines, applying advanced machine learning techniques, and presenting research findings to interdisciplinary audiences. Seeking full-time roles in **data science** and **machine learning** to drive innovation in data-driven decision-making.

SKILLS

- **Machine Learning:** Generative AI (VAEs, DDPMs) | Retrieval-Augmented Generation (RAG) | CNNs | Transformers
- **Data Science:** Bayesian Inference | Monte Carlo Methods | Forecasting | Image processing
- **Programming:** Python | SQL | Julia | C | C++ | MATLAB
- **Frameworks & Tools:** PyTorch | TensorFlow | AWS | CUDA | PyLance | Polars
- **Soft Skills:** Technical Writing | Cross-Functional Collaboration | Leadership | Mentorship | Peer-review

PROFESSIONAL EXPERIENCE

Doctoral Researcher, University of California, Davis Sep 2018 – Present

- Led end-to-end development of generative models using **Denoising Diffusion Probabilistic Models (DDPMs)** to simulate complex distributions, leading to improved foreground modelling for various down-streams tasks.
- Built **scalable computational pipelines** leveraging **GPU acceleration** (**CUDA**) and auto-differentiation, optimizing performance for high-dimensional data processing.
- Led **forecasting** efforts to determine the precision of the SPT-3G telescope in constraining cosmological parameters for the different survey configurations and dataset combinations using state-of-the-art fully-Bayesian inference technique for the first time.
- Presented research findings at international conferences, and peer-reviewed journals, effectively communicating technical concepts to interdisciplinary audiences.

PROJECTS

Generative Modeling of Foregrounds:

- Leveraged **Denoising Diffusion Probabilistic Models (DDPMs)** and **Variational Autoencoders (VAEs)** in **PyTorch** to develop a generative model for interstellar foreground maps, along with generating thousands of training images for the same.
- Achieved **high-fidelity reconstructions** of foreground maps, accurately recovering large-scale features and pixel value distributions, with residuals showing **no systematic biases** across the test set.
- Enabled the simulation of realistic foreground maps with statistical properties matching observational data, supporting foreground cleaning and cosmological parameter estimation for CMB experiments targeting gravitational lensing signals, and small-scale temperature anisotropies (e.g., SPT-3G, CMB-S4).

Pawsitive Retrieval (Erdös Institute Deep Learning Bootcamp):

- Processed and cleaned a dataset of **5.5 million Reddit posts**, incorporating metadata (e.g., timestamps, subreddit categories) to enhance embedding relevance and improve retrieval accuracy.
- Fine-tuned an embedding model for query processing, achieving a **10-15% improvement in retrieval performance** over baseline models, as measured by precision and recall metrics.
- Designed and implemented a scalable **Retrieval-Augmented Generation (RAG)** pipeline, validated using industry-standard metrics such as Mean Reciprocal Rank (MRR) and Normalized Discounted Cumulative Gain (NDCG), leading to **1st place** in the competition.

EDUCATION

University of California Davis: *Ph.D. (Physics),* ***GPA:3.91/4.0*** Expected graduation: Aug 2025
Indian Institute of Science Education and Research, Pune: *MS (Physics)*, ***GPA:9.0/10.0*** 2013- 2018

SELECTED PUBLICATIONS (Google Scholar)

- **Testing the ΛCDM Cosmological Model with Forthcoming Measurements of the Cosmic Microwave Background with SPT-3G**
- **Learning Correlated Astrophysical Foregrounds with Denoising Diffusion Probabilistic Models**