Karthik Srinivasan

New Haven, CT
Email: karthik.srinivasan@yale.edu
LinkedIn: https://www.linkedin.com/in/karthikvasan99/

OBJECTIVE

PhD candidate in Biomedical Engineering with expertise in machine learning, computational biology, and statistical modeling. Passionate about applying ML techniques to biological problems, including applications in bioinformatics. I enjoy tackling challenging problems with real-world impact and have a strong ability to quickly learn new skills. This has allowed me to contribute to diverse fields, including quantum computation, cosmology, and bioinformatics, leading to multiple publications.

EDUCATION

YALE UNIVERSITY — New Haven, CT
Ph.D. in Biomedical Engineering — August 2023 - Present
Focus: Analyzing microbiomes using a statistical physics based machine learning model
Relevant Coursework: Deep Learning Theory and Applications (RNNs, CNNs, LLMs, VAEs, GANs, Diffusion models)

UNIVERSITY OF FLORIDA — Gainesville, FL
Master of Science in Physics — January 2021- August 2023
Focus: Effect of Chern-Simons coupling during inflation
CGPA: 3.91/4

INDIAN INSTITUTE OF TECHNOLOGY MADRAS — Chennai, Tamil Nadu
Bachelor of Technology in Engineering Physics — July 2016 - May 2020
Focus: Quantum algorithms, Schwinger effect in bouncing universes, Gravitational wave astronomy
CGPA: 8.38/10

WORK EXPERIENCE

HUMAN FRONTIER COLLECTIVE SPECIALIST - GEN AI, SCALE AI — June 2025 - August 2025

- Designed and evaluated complex, domain-specific challenge sets to rigorously test generative AI models and refine their performance.
- Collaborated with Scale researchers in interdisciplinary sessions to identify model limitations, analyze behaviors, and inform future research directions.

RESEARCH EXPERIENCE

GRADUATE RESEARCH ASSISTANT, YALE UNIVERSITY — August 2023 - Present

Identifying environmental dimensionality of microbiomes using Machine Learning

- Analyzed large microbiome datasets from Microbiomap using a machine learning model
- Devised a metric based on model performance to quantify the environmental dimensionality of microbiomes
- Implemented the Consumer Resource Model to simulate in-silico microbiomes and applied Markov Chain Monte Carlo to explore the parameter space
- Developed a public repository for the project https://github.com/karthik-yale/niche-dimensionality

Designing host-associated microbiomes using the consumer-resource model

- Developed a **generative mechanistic machine learning** model for analyzing biological sequence data
- Performed **sample specific statistical analysis** via bootstrapping of generative model
- Biased sampling of the latent space via **Monte Carlo methods** to explore unobserved phenotypic regions
- Developed a public repository for the project: https://github.com/karthik-yale/host_microbe
- DOI: https://doi.org/10.1128/msystems.01068-24, No. of citations: **2**

GRADUATE RESEARCH ASSISTANT, UNIVERSITY OF FLORIDA January 2021 - July 2023

Gravitational wave probes of massive gauge bosons at the cosmological collider

- We considered Chern-Simons interaction between the inflaton and light like particles
- Using the in-in formalism in Quantum Field Theory in Curved Spacetime, we computed the two-point and three-point correlation functions for both scalar and tensor perturbations
- Using Numerical Integration with High-performance Cluster-computers and analytical approximations using special functions we predicted the gravitational wave spectrum that could be observed by gravitational wave interferometers
- DOI: https://doi.org/10.1088/1475-7516/2023/02/013, No. of citations: **32**

Parity-odd and even trispectrum from axion inflation

- We extended the in-in formalism to compute the four-point function to study parity-violation in early universe
- Chern-Simons interaction could explain baryon asymmetry which is captured in the parity odd four-point function
- Using Numerical Integration with High-performance Cluster-computers we found parity-odd signal is non-vanishing
- DOI: https://doi.org/10.1088/1475-7516/2023/05/018, No. of citations: **42**

UNDERGRADUATE RESEARCH INTERN, IISER KOLKATA Summer/Winter 2018

Efficient quantum algorithm for solving traveling salesman problem: An IBM quantum experience

- Developed a quantum algorithm to solve the traveling salesman problem on a quantum computer
- Implemented the algorithm on a quantum computer via IBM quantum experience (currently IBM quantum platform)
- The algorithm theoretically achieves a quadratic speedup in compute time over the best classical algorithms
- DOI: https://doi.org/10.48550/arXiv.1805.10928, No. of citations: **126**

Nondestructive discrimination of a new family of highly entangled quantum states

- Proposed a new set of highly entangled states which can be used as an orthonormal bases of error correction and measurement based quantum computing
- We designed circuits using IBM quantum experience to produce and distinguish these states non-destructively
- Using Quantum State Tomography we showed that the states were preserved
- DOI: https://doi.org/10.1007/s11128-018-1976-9, No. of citations: **61**

PERSONAL PROJECTS

Protease-Resistant Insulin Design | RFdiffusion, Pepsickle Spring 2025

- **Mapped** protease-cleavage hotspots on human insulin using Pepsickle and structural PDB references.
- **Generated** carrier-protein designs with RFdiffusion that sterically shield labile residues, yielding lower cleavage scores.
- **Visualized & validated** 3-D models (Jupyter/PyMOL) and shared the full computational pipeline in a public repository: https://github.com/karthik-yale/ProteaseResistantInsulin

Thermodynamic Manifold Inference Fall 2022

- **Re-implemented** the Thermodynamic Manifold Inference (TMI) algorithm from the original Phys. Rev. Research paper, including gradient-based training, out-of-sample embedding, and performance logging.
- **Applied** the model to the full MNIST dataset (70 k images), compressing 784-dimensional inputs to a 2-D manifold while retaining high reconstruction fidelity.
- **Released** a open-source codebase and tutorial notebook: https://github.com/karthikvasan99/TMI_MNIST

Higgs Boson Classification Challenge | Scikit-learn Fall 2022

- **Engineered** feature pipelines (polynomial basis expansion, PCA) for CERN's Higgs Boson Machine-Learning dataset.
- **Benchmarked** Support Vector, Random Forest, and Gradient Boosting classifiers; tuned hyper-parameters via exhaustive grid search to maximize ROC-AUC.
- **Published** reproducible code and results: https://github.com/karthikvasan99/higgs-boson-classification

ADDITIONAL

Coding: Proficient with **Python** Tensorflow, PyTorch, Scikit-learn, Pandas, Numpy, Torch, Scipy, Matplotlib, Seaborn, BioPython and **Mathematica**, Experienced in **R** , **C++**, **C**, **Git**, **MATLAB** and **HPC** environments

SUMMER SCHOOLS

ICTS gws2019, Summer school on gravitational wave astronomy — Summer 2019

- Four courses were taught over a period of two weeks by leading researchers in the field of gravitational wave astronomy
- Advanced General Relativity was taught by Sudipta Sarkar from IIT Gandhinagar
- Primordial Black Holes was taught by Teruaki Suyama from Tokyo Institute of Technology
- Post Newtonian sources of Gravitational Waves was taught by Luc Blanchet from Institute of Astrophysics, Paris
- Self force and Radiation Reaction in General Relativity was taught by Adam Pound from University of Southampton

NIUS, Summer school on gravitational wave astronomy — Summer 2017

- The camp was conducted by Tata Institute of Fundamental Research and Homi Bhabha Centre for Science Education
- It consisted of 40 lectures on topics such as Quantum Mechanics, Quantum computing, advanced topics in Astronomy, Thermodynamics, etc.
- Completed a 30 hour long lab course that covered mechanics, electricity, magnetism and optics