

NIKHIL P. S. BISHT

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PROFESSIONAL SUMMARY

Machine Learning Researcher & Data Scientist PhD Candidate specializing in Deep Learning and HPC with 4+ years of experience architecting end-to-end ML pipelines for terabyte-scale 3D datasets. Expert in Computer Vision (UNets, Transformers), Probabilistic Modeling, and Distributed Computing. Proven ability to translate complex stochastic problems into scalable, production-ready models using PyTorch and Cloud infrastructure.

PROFESSIONAL EXPERIENCE

Data Scientist (Graduate Research Fellow), Computational Astrophysics Nov'22 - Present
— [Prof. David Collins](#), Florida State University, FL

- o Architected a **3D spatiotemporal forecasting model** using Attention-based U-Nets and ConvGRUs to predict volumetric structural evolution, achieving state-of-the-art accuracy on multi-terabyte simulation datasets.
- o Engineered a distributed ETL pipeline for 3D volumetric data (HDF5/Parquet), optimizing I/O throughput by **67%** and reducing training time from weeks to days via **Multi-GPU distributed training** (DDP, MPI).
- o Developed custom domain-aware loss functions and uncertainty quantification metrics to validate model performance against physical constraints, reducing inference error rates by **28%**.

Undergraduate Applied Physics & Machine Learning Engineer (Report) Jul'20 - Aug'22
— [Prof. Kinjal Banerjee](#), BITS Goa.

- o Designed **Bayesian Neural Networks (BNN)** for multi-target probabilistic regression, successfully modeling high-dimensional non-linear relationships with quantified uncertainty intervals.
- o Implemented Monte Carlo dropout and ensemble methods to map complex feature spaces, enabling robust parameter estimation in **noisy environments with unstructured datasets**.

Lead Engineer (Computer Science Vertical), Project Radio Telescope (Blog) Mar'18 - Jul'22
— [Prof. Prasanta Kumar Das](#), BITS Goa.

- o Founded and led a cross-functional engineering team of 10+ to build a **full-stack** instrumentation facility. Developed Python-based automated signal processing pipelines for real-time spectral analysis and noise reduction.
- o Established **collaborations** with the National Centre for Radio Astrophysics (NCRA) and Square Kilometre Array (SKA) partners to validate instrumentation and **roadmap advanced science goals**, creating the campus's first operational radio-astronomy facility in Goa.

Coordinator, Physics Association (Blog, Certificate) 2019-2021

Secretary, Students for Exploration & Development of Space, Celestia (Blog, Certificate) 2018-2019

SKILLS AND EXPERTISE

Languages: Python (*Expert*), C++ (*Intermediate - STL, Pointers, Memory Management*), SQL, Bash.
Machine Learning: PyTorch, TensorFlow, NumPy, Pandas, Keras, Scikit-Learn, XGBoost, Computer Vision (*3D UNet, CNNs, Transformers*), Bayesian Inference, Time-Series Analysis.
Big Data & HPC: Distributed Computing (*MPI, CUDA*), Dask, SLURM, HDF5, Parquet, ETL Pipelines.
DevOps & Tools: Docker, Git/GitHub, Linux, CI/CD, Jupyter, MLOps practices.
Computer Science: Algorithmic Optimization, Spatial Hashing (*Octrees/KD-Trees*), GDB, Valgrind, Linux/Unix Administration, Monte Carlo Methods, Numerical Integration (*Runge-Kutta*), Computational Fluid Dynamics (CFD)

SELECTED PROJECTS

ENZO Codebase Contribution (High-Performance Computing)

Nov'22 - Mar'24

C++, MPI, HDF5, Git || ([The ENZO Project](#))

- **Context:** Contributed to the **development of ENZO**, an open-source adaptive mesh refinement (AMR) code used for petascale fluid dynamics simulations.
- **Action:** Diagnosed and patched **critical memory leaks** and race conditions by utilizing GDB and Valgrind to trace segfaults in multi-node distributed environments. Implemented **dynamic load-balancing algorithms** (Jeans Criterion) to optimize grid refinement. Engineered custom linked-list data structures to manage tracer particles in a distributed memory space, reducing overhead by 15%.
- **Result:** Successfully **debugged concurrency errors** in multi-node execution, enabling the simulation of previously unstable high-density collapse scenarios.

High-Performance N-Body Simulation Engine (Barnes-Hut)

Aug'17 - Apr'18

C++, Python, Spatial Data Structures || ([GitHub Repo](#))

- **Context:** Developed a **physics engine** to simulate gravitational interactions between thousands of bodies, addressing the computational bottleneck of direct summation.
- **Action:** Implemented the Barnes-Hut algorithm using Recursive Octrees (spatial partitioning trees) to approximate long-range forces, successfully **reducing algorithmic time complexity** from $O(N^2)$ to $O(N \log N)$.
- **Result:** Achieved a **100x** speedup for large particle counts ($N > 10^5$) compared to brute-force methods, enabling real-time visualization of complex dynamical systems.

Non-Linear Regression & Dark Matter Inference Modeling

Jun'18 - Dec'18

Python, Scipy, Statistical Analysis || ([Report](#))

— [Prof. Tarun Kumar Jha](#), BITS Goa.

- **Context:** Modeled the rotational velocities of galaxies to infer the distribution of non-visible mass (Dark Matter).
- **Action:** Processed noisy spectroscopic data to extract rotation curves. Applied **Non-Linear Least Squares regression** to fit multi-component mass models (Bulge, Disk, Halo) to the observed data.
- **Result:** Optimized model parameters to minimize χ^2 **error**, statistically confirming the necessity of Dark Matter halos to explain velocity dispersions in local cluster galaxies.

ACHIEVEMENTS AND SCHOLARSHIPS

First Place, 3 Minute Thesis Competition (3MT), Florida State University ([Certificate](#)) Mar'25

State Topper (Goa), National Graduate Physics Examination (NGPE) ([Certificate](#)) Jan'19

Silver Medal, University Physics Competition (UPC) ([Certificate](#)) Nov'18

[Optimal Compost Pile Sizes using Fractal Modelling of pores](#)

Olympiads: Gold Medals in NSO (National Science Olympiad) (2013 & 2014), NCO (National Cyber Olympiad) (2014) & IMO (International Mathematics Olympiad)(2014) by [SOF](#) 2013-2014

EDUCATION

[Florida State University \(FSU\)](#), Tallahassee, FL

2022–Present

PhD Physics, Doctoral Candidate under [Prof. David Collins](#)

Overall GPA: **3.54/4** over 75 credits

Thesis: *Forecasting Molecular Cloud Collapse with ENZO using Deep Learning*

[Birla Institute of Technology and Science \(BITS\)](#), Pilani, India

2017–2022

MSc. (Hons.) Physics + B.E. (Hons.) Computer Science ([Transcript](#))

Overall GPA: **9.08/10** over 204 credits (*1st Rank, Dept. of Physics*)