

# NIKHIL P. S. BISHT

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[astrodnerd.github.io](https://astrodnerd.github.io) [github.com/AstroDnerd](https://github.com/AstroDnerd)

## 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

- 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.
- 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).
- 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.

- Designed **Bayesian Neural Networks (BNN)** for multi-target probabilistic regression, successfully modeling high-dimensional non-linear relationships with quantified uncertainty intervals.
- 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.

- 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.
- 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

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<b>ENZO Codebase Contribution (High-Performance Computing)</b> <i>C++, MPI, HDF5, Git</i>    <a href="#">(The ENZO Project)</a>	Nov'22 - Mar'24
<ul style="list-style-type: none"><li>○ <b>Context:</b> Contributed to the <b>development of ENZO</b>, an open-source adaptive mesh refinement (AMR) code used for petascale fluid dynamics simulations.</li><li>○ <b>Action:</b> Diagnosed and patched <b>critical memory leaks</b> and race conditions by utilizing GDB and Valgrind to trace segfaults in multi-node distributed environments. Implemented <b>dynamic load-balancing algorithms</b> (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%.</li><li>○ <b>Result:</b> Successfully <b>debugged concurrency errors</b> in multi-node execution, enabling the simulation of previously unstable high-density collapse scenarios.</li></ul>	

<b>High-Performance N-Body Simulation Engine (Barnes-Hut)</b> <i>C++, Python, Spatial Data Structures</i>    <a href="#">(GitHub Repo)</a>	Aug'17 - Apr'18
<ul style="list-style-type: none"><li>○ <b>Context:</b> Developed a <b>physics engine</b> to simulate gravitational interactions between thousands of bodies, addressing the computational bottleneck of direct summation.</li><li>○ <b>Action:</b> Implemented the Barnes-Hut algorithm using Recursive Octrees (spatial partitioning trees) to approximate long-range forces, successfully <b>reducing algorithmic time complexity</b> from <math>O(N^2)</math> to <math>O(N \log N)</math>.</li><li>○ <b>Result:</b> Achieved a <b>100x</b> speedup for large particle counts (<math>N &gt; 10^5</math>) compared to brute-force methods, enabling real-time visualization of complex dynamical systems.</li></ul>	

<b>Non-Linear Regression &amp; Dark Matter Inference Modeling</b> <i>Python, Scipy, Statistical Analysis</i>    <a href="#">(Report)</a>	Jun'18 - Dec'18
<ul style="list-style-type: none"><li>— Prof. Tarun Kumar Jha, BITS Goa.</li><li>○ <b>Context:</b> Modeled the rotational velocities of galaxies to infer the distribution of non-visible mass (Dark Matter).</li><li>○ <b>Action:</b> Processed noisy spectroscopic data to extract rotation curves. Applied <b>Non-Linear Least Squares regression</b> to fit multi-component mass models (Bulge, Disk, Halo) to the observed data.</li><li>○ <b>Result:</b> Optimized model parameters to minimize <math>\chi^2</math> <b>error</b>, statistically confirming the necessity of Dark Matter halos to explain velocity dispersions in local cluster galaxies.</li></ul>	

## ACHIEVEMENTS AND SCHOLARSHIPS

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<b>First Place, 3 Minute Thesis Competition (3MT), Florida State University</b> ( <a href="#">Certificate</a> )	Mar'25
<b>State Topper (Goa), National Graduate Physics Examination (NGPE)</b> ( <a href="#">Certificate</a> )	Jan'19
<b>Silver Medal, University Physics Competition (UPC)</b> ( <a href="#">Certificate</a> )	Nov'18
<b>Optimal Compost Pile Sizes using Fractal Modelling of pores</b>	
<b>Olympiads:</b> Gold Medals in NSO (National Science Olympiad) (2013 & 2014), NCO (National Cyber Olympiad) (2014) & IMO (International Mathematics Olympiad)(2014) by <a href="#">SOF</a>	2013-2014

## EDUCATION

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<b>Florida State University (FSU)</b> , Tallahassee, FL PhD Physics, Doctoral Candidate under Prof. David Collins	2022–Present
Overall GPA: <b>3.54/4</b> over 75 credits	
Thesis: <i>Forecasting Molecular Cloud Collapse with ENZO using Deep Learning</i>	
<b>Birla Institute of Technology and Science (BITS)</b> , Pilani, India MSc. (Hons.) Physics + B.E. (Hons.) Computer Science ( <a href="#">Transcript</a> )	2017–2022
Overall GPA: <b>9.08/10</b> over 204 credits ( <i>1st Rank, Dept. of Physics</i> )	