Hariprashad Ravikumar

PhD Candidate specializing in High-Performance Computing (HPC) and Deep Learning
Expertise in GPU-accelerated computing with C++/CUDA and Python

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Experience

Graduate Research Assistant, New Mexico State University   *(Aug 2021 - Present)*

PhD Project: Lattice QCD and Machine Learning Approaches to TMD Physics

- Achieved 93%+ model fit accuracy by building an end-to-end ML pipeline processing 30,000+ multidimensional observables from Monte Carlo simulations using symbolic regression (PySR) with physics-constrained loss functions.
- Reduced data processing time 10× by developing GPU-accelerated CUDA C++ (cuFFT) pipelines for multi-terabyte Fourier transforms on HPC clusters.
- Ensured numerical stability and reproducibility across multi-stage fitting and extrapolation workflows by creating production-grade Python and Mathematica packages for jackknife resampling and uncertainty propagation.

Independent Collaborations

1. **Los Alamos National Laboratory** - Computational Physics Collaboration *(May 2024 - Present)*
   - Accelerated multi-terabyte scientific calculations by developing and optimizing parallelized C++ CUDA kernels for GPU-accelerated HPC clusters (NERSC Perlmutter), achieving significant runtime reduction in large-scale Monte Carlo simulations.
   - Managed and executed 75,000+ CPU/GPU compute hours by designing and deploying custom SLURM workflows for large-scale job orchestration, enabling robust, automated parallel analysis.
   - Increased model reliability through rigorous validation methods, applying AIC-based selection, chi-squared minimization with full covariance matrices, and bootstrap/jackknife resampling across 50,000 correlated data points.

2. **North Carolina State University** - Mathematical Physics Collaboration *(Dec 2020 - Present)*
   - Implemented and managed Mathematica symbolic computation workflows on HPC clusters (NERSC Perlmutter) to analyze complex algebraic structures and symmetry constraints.

Technical Projects

1. **AI-DataScience-Lab: Cloud-Hosted Forecasting App**   GitHub | Live App
   - Built a cloud-hosted ML forecasting platform with automated data ingestion, model training, and retrieval pipelines using AWS/Azure, Flask, and React.
   - Integrated GPT API to generate natural-language summaries, bridging structured data with NLP-driven insights.

2. **Neural Network from Scratch with `NumPy`**   GitHub
   - Implemented a two-layer neural network from the ground up in NumPy, building a deep understanding of backpropagation, activation functions (ReLU, softmax), and optimization.
   - Trained the model for the computer vision task of handwritten digit recognition on 5,000 MNIST samples, achieving 80% accuracy within 60 epochs by tuning the learning rate.

3. **$\mathbb{Z}_2$ Lattice Gauge Monte Carlo Simulation**   GitHub
   - Implemented large-scale Monte Carlo simulations on HPC clusters, validating results against analytical benchmarks and optimizing data processing throughput for large datasets.

Technical Skills

Programming	Python, C++, CUDA, Bash, SQL, JavaScript, Lua, HTML/CSS, YAML
ML & APIs	Numba, TensorFlow, PyTorch, Scikit-learn, Pandas, cuFFT, cuDNN, Flask, FastAPI, RAG
Cloud & MLOps	Azure, AWS (Lambda, S3), CI/CD, Docker, Git, SLURM
Methods & HPC	MPI, GPU acceleration, Parallel Computing, Regression, Monte Carlo methods

Education

PhD in Physics, New Mexico State University, USA	*Aug 2021 – July. 2026 (expected)*
MS in Physics, New Mexico State University, USA	*Aug 2021 – May 2024*
MSc in Physics, National Institute of Technology Jalandhar, India	*July 2019 – May 2021*
BSc in Physics, Dr. N.G.P. Arts and Science College, India	*June 2015 – May 2018*

Certifications

- Fundamentals of Accelerated Computing with CUDA Python by NVIDIA

- Advanced Learning Algorithms by DeepLearning.AI

- Getting Started with Accelerated Computing in CUDA C/C++ by NVIDIA

- Supervised Machine Learning: Regression and Classification by DeepLearning.AI

- Google Advanced Data Analytics Professional Certificate

Awards

- **2025 NMC Collaboration Grant**, awarded by the New Mexico Consortium to conduct my independent research project in collaboration with scientists at Los Alamos National Laboratory
- **2023 George and Barbara Goedecke Physics Excellence Fund Scholarship**, awarded by the NMSU Physics Department
- **2021 Graduate Success Scholarship**, awarded by the NMSU Graduate School

Selected Talks

- (Jun 3, 2025) *"First Principles Lattice QCD Calculations of nEDMs"*, T-2 Seminar, Theoretical Division, **Los Alamos National Laboratory**, USA

- (May 16, 2024) *"Lattice QCD Calculations of x Dependence of Sivers TMD"*, T-2 Seminar, Theoretical Division, **Los Alamos National Laboratory**, USA

- (June 15, 2023) *"Lattice QCD calculations of TMDs"*, HUGS Student Seminar, **Thomas Jefferson National Accelerator Facility**, USA

Full list available at: hariprashad-ravikumar.github.io/talks

Volunteering

- **Vice President**, Physics Graduate Student Organization (NMSU)   *Sep 2025 – Present*
  Organized professional development events and served as the primary liaison between 40+ graduate students and faculty.

Relevant Graduate Coursework

- Advanced Computational Physics, Statistical Mechanics, Quantum Computing