Farzana Yasmin Ahmad

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Education

2021 – Present **Ph.D., Computer Science**
Biocomplexity Institute, Department of Computer Science, University of Virginia
Advisor: Geoffrey C. Fox
CGPA: 3.90 out of 4.00

2015 – 2019 **BSc in Computer Science and Engineering**
Bangladesh University of Engineering and Technology
CGPA: 3.69 out of 4.00

Research Area

- **Scientific ML** for complex systems
- **Generative AI** (diffusion/flow matching) and fine-tuning/adaptation
- Rigorous evaluation of generative models for fidelity and reliability

Skills

- **Programming: Python (primary)**, C, C++, Java, R
- **Generative Modeling:** Diffusion, Flow Matching, VAE, Fine-tuning
- **Machine Learning:** PyTorch, TensorFlow; Hugging Face (Transformers/Diffusers)
- **Data & Python Ecosystem:** NumPy, pandas, scikit-learn; Matplotlib; HDF5/Zarr; Streamlit
- **LLM Systems (Applied):** prompt design & evaluation (few-shot, instruction-style); RAG pipelines; retrieval metrics
- **HPC & Distributed:** Slurm job scripts/job arrays; multi-GPU training (PyTorch DDP/NCCL); mixed precision (AMP/BF16)
- **Version Control:** Git, GitHub (branching, pull requests, code reviews)

Research Publications

Conference Proceedings

1. **Ahmad, Farzana Yasmin**, V. Venkataswamy, and G. Fox, "Calobench: A benchmark study of generative models for calorimeter showers," in *International Symposium on Benchmarking, Measuring and Optimization(Accepted - to appear)*, Springer, 2024.
2. J. A. Meem, **Ahmad, Farzana Yasmin**, and M. A. Adnan, "Distributed principal component analysis for real-time big data processing," in *Proceedings of the 7th International Conference on Networking, Systems and Security*, 2020, pp. 89–99.

Work Experience

2022 – Present **Graduate Research Assistant** Biocomplexity Institute, University of Virginia
Research Focus: Machine Learning for Scientific problems

Fall 2024 **Graduate Teaching Assistant** Dept of Computer Science, University of Virginia
Course: Economics of Distributed Systems, Instructor: Prof Matheus Venturyne Xavier Ferreira

Fall 2023 **Graduate Teaching Assistant** Dept of Computer Science, University of Virginia
Course: Artificial Intelligence, Instructor: Prof Lu Feng

Spring 2023 **Graduate Teaching Assistant** Dept of Computer Science, University of Virginia
Course: Computer Systems and Organization 2, Instructor: Prof Charles Reiss

Fall 2022 **Graduate Teaching Assistant** Dept of Computer Science, University of Virginia
Course: Mobile Application Development, Instructor: Prof Mark Sherriff

2019–2020 **Lecturer** Dept of Computer Science, United International University

Project Works

Professional Projects

2025 – Present **LANTERN: Physics-Guided Diffusion for Calorimeter Showers**
Base diffusion objective augmented with a *physics-guided auxiliary training objective* (e.g., correlation-aware CFD, MVN likelihood, energy consistency) and timestep weighting/warm-up. (Github)

LANTERN → LEMURS Adaptation
Porting LANTERN to *LEMURS* with additional conditioning signals (incident energy, θ/ϕ angles) and conducting diffusion fine-tuning for transfer across heterogeneous detector geometries (LEMURS_analysis | fine_tuning_on_Diffusion).

2024 – Present **CaloBench: Systematic Benchmark of Generative Models for Calorimeter Data**
Conducted a multi-detector evaluation on calorimeter showers using existing datasets, covering diffusion/score-based and flow-matching models; released reproducible configurations.
Introduced the *Correlation Frobenius Distance (CFD)* metric to quantify preservation of second-order structure (off-diagonal correlations); analyzed energy-stratified behavior and normalization effects. (Github)

2022-2023 **Application of Reinforcement Learning for the Optimization of Dynamic Task Scheduling:** Efficient dynamic task scheduling in heterogeneous environment using Reinforcement Learning.

Academic Projects

Fall 2023 **Mixture-of-Experts:** A Mixture-of-Experts Deep Learning Model for Fake News Detection. We aim to investigate how accurately the MoE model detects fake news compared to other models (e.g., SVM, BERT) that have been widely used for fake news detection. A major challenge for this project is to train and fine-tune an MoE model for the domain of fake news detection, which has not yet been explored much in existing literature.(Github)

Project Works (continued)

Spring 2022 — **PCV- A point cloud-based network verifier:** A point cloud-based network verifier that successfully deals with the state of the art.
$3D$ classifier PointNet and verifies the robustness by generating adversarial inputs. (Github)

Spring 2021 — **Remote DNS Cache Poisoning Atttack:** A remote DNS cache poisoning technique, the Kaminsky Attack, was implemented.

Fall 2021 — **Catch Me if I'm Angry:** A Human-Computer Interaction project that is based around the user's emotion. Detection of the anger level of individuals in an email context and suggests against the user's tendency to send an email to the receiver with an angry tone.

Personal Projects

2025 — **PhinD-me-if-You-Can (Claude for Good 2025 – Student Track)**
Built within a 7.5-hour hackathon at UVA: an AI tool that helps match students with potential PhD advisors.
Used an LLM API to compare student interests with faculty research areas, producing a quantitative match score and a short qualitative explanation.
Contributed to developing the working prototype using Streamlit (learned on the spot), connecting the backend with the frontend, and maintaining the GitHub repo (README, updates, and major code contributions). (Github)

Calo-RAG: Literature retrieval for calorimeter modeling
Built a small RAG pipeline to practice LLM+IR: prompt templates, citation-aware retrieval, and basic reranking. Evaluated coverage on a curated query set using precision/recall(Github)

LLM Time-Series Forecasting for Conflict-Induced Migration *(learning)*
Prompt-based daily forecasts with exogenous conflict/fatality inputs; *RMSE* on rolling windows.
Planned: head-to-head evaluation vs. an *agent-based migration model* (*Ukraine case study*).

Graduate Courses Taken

Design & Analysis of Algorithms, Natural Language Processing, Hardware Accelerator, Reinforcement Learning, Neural Network Verification, Human Computer Interaction, AI for Social Good, Machine Learning for Engineers, Network Security, Formal Methods.

Awards & Other Activities

2025 — **Lightning Talk**, UVA CS Research Symposium, *Benchmarking and Advancing Generative Models for Calorimeter Shower Simulation*

Poster Presentation-Finalist, UVA Engineering Research Symposium (UVERS),*Physics Guided Autoregressive Diffusion Model for Fast Calorimeter Shower Simulation*

Mentorship Chair, Computer Science Engineering Graduate Student Group, University of Virginia

2023-2024 — **Vice President**, Graduate Society of Women in Engineering, University of Virginia

2022-2023 — **President**, Association of Bangladeshi Students at University of Virginia

2022-2023 — International Citizen Leader Fellow at University of Virginia

Awards & Other Activities (continued)

2023	Got invitation to attend the 2023 CRA-WP Graduate Cohort Workshop for Women
2019	Dean's List Scholarship, Bangladesh University of Engineering and Technology.
2017, 2018	University Merit List Scholarship, Bangladesh University of Engineering and Technology.
2018	Batch Representative, Bangladeshi Women in CSE at BUET

References

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