Vidhata Jayaraman

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Education

University of Illinois Urbana-Champaign (UIUC) Anticipated Graduation: May 2026
B.S. in Computer Engineering | B.S. in Mathematics Distinction: Highest Honors
GPA: *3.97/4.0 | 4.0/4.0* Dean's List (Top 20% of Student Body)
Thesis: "Information-theoretic limits of Knowledge Distillation"

Research Interests

Machine Learning, Probability Theory & Statistics, Information Theory, Optimization, Control Theory, Quantum Information, Uncertainty Quantification

Relevant Coursework

Pure Math: Real Analysis, Linear Algebra, Abstract Algebra, Ordinary & Partial Differential Equations, Complex Analysis, Graph Theory, Probability & Measure, Algebraic Topology

Applied Math/CS: Machine Learning, Optimization, Deep Generative Models, Random Processes, Information Theory, Analog Signal Processing, Digital Signal Processing, Algorithms & Models of Computation, Quantum Information Theory

Research Experience

Senior Thesis (Co-advised by Prof. Rayadurgam Srikant and Prof. Lav Varshney) September 2025 – Present

- *Information-theoretic limits of Knowledge Distillation* (Primary researcher). Developing an information-theoretic framework for knowledge distillation, deriving fundamental limits on student performance with emphasis on LLMs.

Research with Professor Lav Varshney February 2024 – Present

Current Projects

- *2-stage retrieval in Transformers*: Analyzing an Associative Memory model to explain 2-stage retrieval in Transformers.
- *Visual redundancies in VLMs*: Found redundancy in visual token representations in VLMs and justified their existence rigorously (Publications: 1, 2).
- (Jan. 2026) *Multimodal Federated Learning*: Will be working with Argonne National Laboratory to improve learning with multimodal data in a federated learning paradigm (i.e., learning from decentralized private data)

Past Projects

- *Extending Community Detection/Graph Clustering to Quantum Networks* (Primary researcher). Extending "No Free Lunch" theorems and community detection algorithms from classical graphs to quantum network structures.
- *Emergent Capabilities in Transformers*: Investigated Modern Hopfield Networks and neural associative memories to analyze emergent capabilities as model scale increases and their connection to Transformer architectures.
- *Mitigating Catastrophic Forgetting in LLMs*: Identified layer-level clustering patterns in LLMs post-continual learning and designed a switch network to mitigate catastrophic forgetting (Publication 4).

Research with Professor Xu Chen March 2023 – February 2024

- Developed a Physics-Informed Neural Network (PINN) using the Deep Galerkin Method (DGM) to model voltage and electric field from a charged circle/sphere inside a grounded box (code available upon request).
- Work was adapted by Samsung engineers for use in internal modeling applications.
- Built an operator estimator for RLC (Resistor–Inductor–Capacitor) circuits to generalize across arbitrary parameters.

Publications & Presentations

(Citations in reverse chronological order)

1. Hartman, M.†, **Jayaraman V.A.**†, Choraria, M., Bhimaraju, A., & Varshney, L.R. (2025). Skip-It? Theoretical Conditions for Layer Skipping in Vision-Language Models. Preprint arXiv:2509.25584 *(Under review for ICLR 2026)*
2. Hartman, M.†, **Jayaraman, V.A.**†, Choraria, M., Bhimaraju, A., & Varshney, L. R. (2025). Unmasking the functionality of early layers in VLMs *(Presented: eXCV Workshop @ ICCV 2025)*
3. **Jayaraman, V.A.**, Dagommer, M. (2025). pADME Explainability and Uncertainty Quantification, Poster available upon request.

4. Wu, X., Hartman, M.*, **Jayaraman, V.A.***, & Varshney, L. R. (2024). SwitchCIT: Switching for Continual Instruction Tuning of Large Language Models. Preprint arXiv:2407.11780. *(Undergoing revision for JSTSP 2025)*
5. Bernstein, H.C., Bindel, S.R., McKibben, M.A., & **Jayaraman, V.A.** (2024). Planning Model based on Projection Methodology Bayesian Discrete Extended (PM2-BDE) *(Under internal review)*, Manuscript available upon request

† denotes joint-first author and * denotes equal contribution.

Industry Experience

Argonne National Laboratory | *(Incoming) Research Intern* January 2026 – August 2026
- Designing multimodal deep learning architectures to fuse high-dimensional molecular, imaging, and clinical data, enabling robust cancer biomarker discovery and optimized target population selection for precision medicine.
- Implementing Privacy-Preserving Federated Learning (PPFL) protocols to orchestrate distributed training across disparate healthcare facilities without compromising data security.

AbbVie | *Machine Learning Research Intern* May 2025 – August 2025
- Extended the SubgraphX Graph Neural Network (GNN) explainability framework to support multi-target regression and incorporate learned 3D molecular structure, overcoming limitations of the original classification-only method.
- Validated results by extracting key molecular substructures correlated with metabolic stability, directly enhancing internal site-of-metabolism analysis tools.
- Investigated Uncertainty Quantification methods, developing a novel approach utilizing metric learning (See Poster 3).

Johns Hopkins University Applied Physics Laboratory | *Data Science Intern* June 2024 – August 2024
- Implemented a Bayesian framework for Reliability Growth Planning (RGP) to model system failure intensities, enabling posterior estimation of reliability metrics during developmental testing.
- Engineered a Retrieval-Augmented Generation (RAG) pipeline to query technical documentation
- Authored a manuscript detailing the proposed Bayesian reliability methodology (Publication 5).

National Institute of Standards and Technology (NIST) | *Research Intern* June 2023 – August 2023
- Engineered a text anomaly detection pipeline utilizing Cloze probabilities from a fine-tuned GPT-2 language model.
- Validated against outlier analysis done in dimensionally-reduced embedding spaces (e.g., via PCA/t-SNE).

Brunswick i-JET Research Lab | *Autonomous Simulation Intern* January 2023 – May 2023
- Implemented Simultaneous Localization and Mapping (SLAM) within the Robot Operating System (ROS) to generate maps for autonomous navigation.
- Developed a simulation environment for an autonomous wake generator for real-time visualization and data analysis.

Teaching and Mentorship

Algorithms & Models of Computation Classroom Assistant
August 2025 – Present
- Assist weekly in quiz and exam grading, and hold 2-hour-long office hours weekly.
- Writing lecture notes on the connection between the WL graph isomorphism test and the expressivity of GNNs.

Analog Signal Processing (ECE 210) Tutor (IEEE-HKN)
August 2023 – May 2024
- Provided 1-on-1 tutoring, created review slideshows/worksheets, and gave review lectures before midterms.

Skills & Expertise

Deep Learning: PyTorch, TensorFlow
Natural Language: NLTK, spaCy, LangChain
Software: Python, C/C++, Java
Web/API: Flask, Django, HTML/CSS, Javascript
DevOps: Git, Docker
Low-Level: x86 assembly, SystemVerilog
Robotics: ROS, OpenCV
Research/Math: LaTeX

Grants & Awards

- Awarded grant for undergraduate research from the Office of Undergraduate Research (OUR) 2025
- Accepted to AI Startup School by YCombinator for gifted researchers. 2025
- Awarded James Scholar at University of Illinois Urbana-Champaign 2023 - 2025
- Inducted into Eta Kappa Nu (IEEE-HKN), an ECE Honors Society 2023
- Inducted into Tau Beta Pi, the Engineering Honor Society 2023