Debangshu Banerjee

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Education

University of Illinois Urbana-Champaign 2022–Current
Ph.D. student in Computer Science.
Research advisor: Dr. Gagandeep Singh.
GPA: 4.0/4.0.

Indian Institute of Technology Guwahati 2016–2020
B.Tech in Computer Science & Engineering With Minor in Mathematics.
Undergrad research advisor: Dr. R. Inkulu.
GPA: 9.69/10 (Rank 2 out of 88).

Research Interests

LLM for verified code, LLM expressivity and reasoning, Formally Verified Foundational Agents.

Publications (reverse chronological order)

1. **DafnyPro: LLM-Assisted Automated Verification for Dafny Programs**
   D. Banerjee, S. Zetzsche, O. Bouissou.
   Preprint

2. **DINGO: Constrained Inference for Diffusion LLMs** [arxiv]
   T. Suresh*, D. Banerjee*, S. Ugare, S. Misailovic, G. Singh.
   Annual Conference on Neural Information Processing Systems (NeurIPS), 2025.
   Workshop on Reliable and Responsible Foundation Models @ICML, 2025.

3. **CRANE: Reasoning with constrained LLM generation** [arxiv]
   D. Banerjee*, T. Suresh*, S. Ugare, S. Misailovic, G. Singh.
   International Conference on Machine Learning (ICML), 2025.
   The VerifAI Workshop @ ICLR, 2025.

4. **Support is All You Need for Certified VAE Training** [openreview]
   C. Xu, D. Banerjee, D. Vasisht, G. Singh.
   International Conference on Learning Representations (ICLR), 2025.

5. **Relational Verification Leaps Forward with RABBit** [openreview] [code]
   T. Suresh*, D. Banerjee*, G. Singh.
   Annual Conference on Neural Information Processing Systems (NeurIPS), 2024.

6. **Relational DNN Verification With Cross Executional Bound Refinement** [paper] [code]
   D. Banerjee, G. Singh.
   International Conference on Machine Learning (ICML), 2024.

7. **Input-Relational Verification of Deep Neural Networks** [paper] [code]
   D. Banerjee, C. Xu, G. Singh.
   Programming Language Design and Implementation (PLDI), 2024.

8. **Interpreting Robustness Proofs of Deep Neural Networks** [openreview] [code] [slides]
   D. Banerjee, A. Singh, G. Singh.
   International Conference on Learning Representations (ICLR), 2024.
   Workshop on Formal Verification of Machine Learning @ ICML, 2023 **(Outstanding paper award)**.

9. **Incremental Randomized Smoothing Certification** [openreview] [code]
   S. Ugare, T. Suresh, D. Banerjee, G. Singh, and S. Misailovic.
   International Conference on Learning Representations (ICLR), 2024.

10. **Incremental Verification of Neural Networks** [paper] [arxiv] [code]
    S. Ugare, D. Banerjee, S. Misailovic, and G. Singh.
    Programming Language Design and Implementation (PLDI), 2023.

11. **Vertex Guarding for Dynamic Orthogonal Art Galleries** [paper][arxiv]
    D. Banerjee, R. Inkulu.
    International Journal of Computational Geometry & Applications(IJCGA) Volume 31, 2021.

* indicates equal contribution

Invited Talks

Interpreting Robustness Proofs of Deep Neural Networks [slides]
Invited talk at 2nd Workshop on Formal Verification of Machine Learning @ ICML, 2023.

Reviewing

Served as a reviewer for multiple top ML/PL conferences - ICML, NeurIPS, ICLR, AISTATS, POPL.

Research Projects

Verified Agent Synthesis with Formal Contracts
Working on a framework that combines automatic agent synthesis with formal verification, ensuring provable safety and compliance with user requirements such as access control and resource bounds, while maintaining high performance.

Expressive Constrained Generation for LLMs
This project improves LLMs' ability to generate syntactically valid and functionally correct outputs in tasks like code generation and symbolic reasoning. It explains why strict grammatical constraints harm reasoning and introduces CRANE, a decoding algorithm that balances syntactic correctness with reasoning capabilities.

Relational Verification of Neural Networks
Worked on developing the first GPU-accelerated scalable relational verification algorithms for hyperproperties such as monotonicity, fairness, etc. defined over multiple executions of Deep Neural Networks. The goal of this project is to enable trustworthy deployment of Neural Networks in financial and scientific applications.

Work Experience

Research Intern, AI Infrastructure, Google Fall 2025
Developing a framework to auto-synthesize agents using a Drafter LLM. The synthesized agents are guaranteed to conform to user-specified safety policies (e.g., access control) while exposing parametric operators that enable task-specific adaptation with provable safety.

Research Intern, Automated Reasoning, Amazon Science Summer 2025
Worked on automated program verification of Dafny programs using annotations (loop invariants, assertions) generated by LLMs. Designed DafnyPro, an inference-time framework that improved SOTA performance by 20 percentage points with Claude 3.7 Sonnet on the largest Dafny program verification benchmark, DafnyBench. Finetuned smaller Qwen3 models (4B, 8B, and 14B) using auto-informalized error messages generated by the Dafny verifier, achieving up to 15% gains over similarly sized models.

Software Engineer III (L4), Google 2022–2022
Worked with the search quality improvement team for google apps to improve the quality and coverage of search suggestions shown in Gmail and Drive. Improved suggestion CTR in Gmail by +1.5% and in Drive by +8%.

Software Engineering Intern, Google Summer 2019

Mentor: *Hrishikesh Amur, Staff Software Engineer*

– Implemented the search flow(document retrieval, scoring and sorting) for Gmail using Google's own distributed system framework named plaque.

Honours & Awards

- Received **Bloomberg Infrastructure & Security Research Ph.D. Fellowship (2025)** for *Verified Agent Synthesis with Formal Contracts*.
- **Outstanding paper award** at Workshop on Formal Verification of Machine Learning at ICML, 2023.
- Obtained **2nd highest GPA** among all 600 B.Tech students of the batch of 2020 (IIT Guwahati).
- **Institute Merit Scholarship** awarded twice(2017, 2018) for securing the highest yearly GPA among all students in the Computer Science department (IIT Guwahati).
- One of 30 students from the state qualified for **Regional Mathematics Olympiad (RMO)** and selected to participate in Indian National Mathematics Olympiad (INMO).