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 code, LLM expressivity and reasoning, Formally Verified Machine Learning.

Publications (reverse chronological order)

1. **CRANE: Expressive Grammar-Constrained LLM Generation** [paper]
   D. Banerjee*, T. Suresh*, S. Ugare, S. Misailovic, G. Singh.
   Preprint.

2. **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.

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

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

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

6. **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)**.

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

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

9. **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 conferences - ICML, NeurIPS, ICLR, AISTATS.

Research Projects

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

Software Engineer III (L4), Google 2022–2022
Leading the efforts to improve the ranking and quality of the search suggestions shown in Gmail and Drive. This is part of the combined effort to reduce the user effort to search emails and documents in Gmail & Drive.

Software Engineer II (L3), Google 2020–2022
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.

Research Intern, Indian Statistical Institute Summer 2018
Mentor: *Prof. Pradipta Maji*
- Worked on estimating the reliability of dictionary learning-based image classifiers for noisy data.
- Based on mutual coherence of the dictionary derived necessary and improved sufficient conditions for support recovery of sparse signals and reliable classification with linear classifier for noisy data.

Honours & Awards

- **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).