Avaljot Singh

avaljotsingh.github.io | avaljot2@illinois.edu | linkedin.com/in/avaljot-singh | github.com/avaljotsingh

Research Interest

I develop principled methods at the intersection of Formal Methods and Artificial Intelligence - enabling trustworthy AI systems and making verification techniques more automatic, scalable, and reliable.

Education

University of Illinois Urbana-Champaign
PhD in Computer Science; GPA: 4.0/4.0 — *Aug 2022 - (Expected) May, 2027*
Advisors: Prof. Gagandeep Singh, Prof. Charith Mendis
Research Areas: Programming Languages and Formal Methods

Indian Institute of Technology, Delhi
Bachelors & Masters in Computer Science; GPA: 9.5/10 — *July 2016 - May 2021*
Advisor: Prof. Sanjiva Prasad
Thesis: Algebraic techniques for network routing

Awards

ConstraintFlow: A Declarative DSL for Certified Artificial Intelligence — **SRC @ PLDI'24**
Avaljot Singh — *Bronze Medal*

Interpreting Robustness Proofs of Deep Neural Networks — **WFVML @ ICML'23**
Debangshu Banerjee, ***Avaljot Singh****, Gagandeep Singh* — *Outstanding Paper*

Publications

RuleFlow: Generating Reusable Program Optimizations with LLMs — [In Submission]
Avaljot Singh*, Dushyant Bharadwaj*, Stefanos Baziotis, Kaushik Varadharajan, Charith Mendis* — *Arxiv*

Unified Operational Formalism for LLM-based Theorem-proving Systems — [In Submission]
Avaljot Singh*, Shaurya Gomber*, Yasmin Sarita, Jose Meseguer, Gagandeep Singh*

AgentRx: Diagnosing AI Agent Failures from Execution Trajectories — [In Submission]
Shraddha Barke, Arnav Goyal, Alind Khare, and ***Avaljot Singh****, Suman Nath, Chetan Bansal* — *Arxiv*

Cost-Driven Synthesis of Sound Abstract Interpreters — [In Submission]
Qiuhan Gu, ***Avaljot Singh****, Gagandeep Singh* — *Arxiv*

Lumos: Let there be Language Model System Certification — [In Submission]
Isha Chaudhary, Vedaant Jain, ***Avaljot Singh****, Kavya Sachdeva, Sayan Ranu, Gagandeep Singh* — *Arxiv*

A Tensor-Based Compiler and a Runtime for Neuron-Level DNN Certifier Specifications — [In Submission]
Avaljot Singh*, Yasmin Sarita, Aditya Mishra, Ishaan Goyal, Gagandeep Singh, Charith Mendis* — *Arxiv*

Synergistic Synthesis of Ranking Function and Invariants for Termination Analysis — [In Submission]
Yasmin Sarita, ***Avaljot Singh****, Shaurya Gomber, Gagandeep Singh, Mahesh Viswanathan* — *Arxiv*

Safety and Trust in Artificial Intelligence with Abstract Interpretation
Foundations and Trends in Programming Languages, 2025
Gagandeep Singh, Jacob Laurel, Sasa Misailovic, Debangshu Banerjee,
Avaljot Singh*, Changming Xu, Shubham Ugare, Huan Zhang* — *Journal*

Automated Verification of Soundness of DNN Certifiers — **OOPSLA'25**
Avaljot Singh*, Yasmin Sarita, Charith Mendis, Gagandeep Singh* — *Paper*

ConstraintFlow: A DSL for Specification and Verification of Neural Network Analyses **SAS'24**
Avaljot Singh, *Yasmin Sarita, Charith Mendis, Gagandeep Singh* *Paper*

Interpreting Robustness Proofs of Deep Neural Networks **ICLR'24**
Debangshu Banerjee, ***Avaljot Singh***, *Gagandeep Singh* *Paper*

Work Experience

Graviton Research Capital LLP Gurugram, India
Quantitative Researcher *June 2021 – July 2022*

Uber Hyderabad, India
Software Development Intern *May 2020 – July 2020*

Research Internships

Symbolic Information Guided Reliability of LLM Agents May 2025 - August 2025
Shraddha Barke, Suman Nath, Microsoft Research *Redmond, USA*
- Studied the failure analysis for LLM agents
- Designed symbolic ways to improve their reliability

M4L: Mixed-mode MPC for Machine Learning March, 2021 - June, 2021
Rahul Sharma, Microsoft Research *Bangaluru, India*
- Designed DSL and a type system for **Mixed-mode MPC**
- Proved the **formal guarantees** of correctness and cryptographic security for well-typed programs

Synthesis and Unified Management of Hybrid Networks May, 2019 - July, 2019
Prof. Nate Foster, Cornell University *Ithaca, USA*
- Defined the syntax and semantics of **Edge-NetKAT**
- Pushing the functionality of NetKAT programs to configurable edge devices.

Object Detection for Local Spotting using 2DOF Actuator June, 2018 - July, 2018
Prof. Idaku Ishii, Hiroshima University *Hiroshima, Japan*
- Implemented a facial recognition system mounted on **mechanical tracking system** for security cameras
- Used **High speed Camera Interfacing** for real-time image synthesis and real-time tracking system

Teaching Experience

CS477 Formal Software Development Methods, UIUC	Spring'24
Analysis and Design of Algorithms, IIT Delhi	Spring'21
Introduction to Functional Programming, IIT Delhi	Fall'20
Programming Languages, IIT Delhi	Spring'20
Introduction to Computer Science, IIT Delhi	Fall'19

Academic Service

- **Reviewer:** Formal Methods in System Design 2024
- **Artifact Evaluation:** ECOOP 2025, CAV 2025

Scholastic Achievements

- **2021:** IIT Delhi Semester Merit Award for department **Top 7%** for 7 semesters
- **2016:** **All India Rank 141** in IIT Joint Entrance Examination (Advanced)
- **2016:** Stood among National **Top 1%** in National Standard Examination in Chemistry (NSEC)
- **2016:** Stood among National **Top 1%** in National Standard Examination in Astronomy (NSEA)
- **2015:** Selected as Kishore Vaigyanik Protsahan Yojana (**KVPY**) Fellow by IISc Bangalore
- **2013:** Selected as National Talent Search Examination (**NTSE**) Scholar by CBSE Delhi