

Avaljot Singh

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RESEARCH INTEREST

I am interested in working on Formal Methods and Programming Language. My current research is focused on designing ConstraintFlow, a DSL for Neural Network Certifiers. The high-level declarative specification in ConstraintFlow can be automatically verified for soundness and compiled into optimized executables.

EDUCATION

University of Illinois Urbana-Champaign

PhD in Computer Science; GPA: 4.0/4.0

Aug 2022 - Present

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

Avaljot Singh

SRC @ PLDI'24

Bronze Medal

Interpreting Robustness Proofs of Deep Neural Networks

Debangshu Banerjee, Avaljot Singh, Gagandeep Singh

WFVML @ ICML'23

Outstanding Paper

PUBLICATIONS

Automated Verification of Soundness of DNN Certifiers

Avaljot Singh, Yasmin Sarita, Charith Mendis, Gagandeep Singh

[In Submission]

Synergistic Synthesis of Ranking Function and Invariants for Termination Analysis

Yasmin Sarita, Avaljot Singh, Shaurya Gomber, Gagandeep Singh, Mahesh Viswanathan

[In Submission]

Arxiv

ConstraintFlow: A DSL for Specification and Verification of Neural Network Analyses

Avaljot Singh, Yasmin Sarita, Charith Mendis, Gagandeep Singh

SAS'24

Arxiv

Interpreting Robustness Proofs of Deep Neural Networks

Debangshu Banerjee, Avaljot Singh, Gagandeep Singh

ICLR'24

Paper

WORK EXPERIENCE

Graviton Research Capital LLP

Quantitative Researcher

Gurugram, India

June 2021 - July 2022

- Developed NSE options' arb-strategy
- Worked on parameter fittings for quantitative strategies using different algorithms

Uber

Intern

[Remote] Hyderabad, India

May 2020 - July 2019

- Information extraction from documents using **text detection, recognition, and classification**
- Used state-of-the-art deep learning techniques for text detection and recognition using **CRAFT model**
- Novel way of text classification using **graph isomorphisms** by detecting textual features

RESEARCH EXPERIENCE

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.

Algebraic techniques for network routing [Masters Thesis] January 2020 - December 2020

Prof. Sanjiva Prasad, IIT Delhi *Delhi, India*

- Conservatively extended NetKAT to **Cost-InterNetKAT** involving three distinct innovations
- Introduced inter-layer routing and cost algebra, thus allowing composition of cost-dependent NetKAT policies
- Designed Cost-InterNetKAT **homomorphisms, refinements, abstractions and translations**

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

Teaching Assistant, CS477 Formal Software Development Methods, UIUC Spring'24

Teaching Assistant, Analysis and Design of Algorithms, IIT Delhi Spring'21

Teaching Assistant, Introduction to Functional Programming, IIT Delhi Fall'20

Teaching Assistant, Programming Languages, IIT Delhi Spring'20

Teaching Assistant, Introduction to Computer Science, IIT Delhi Fall'19

ACADEMIC SERVICE

- **Reviewer:** Formal Methods in System Design, 2024

SCHOLASTIC ACHIEVEMENTS

- **2021:** IIT Delhi Semester Merit Award for department **Top 7%** for 7 semesters
- **2020:** Attended 25th Estonian Winter School in Computer Science
- **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