

Ziyang Li

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EDUCATION

- **University of Pennsylvania** Philadelphia, PA
Ph.D. Computer and Information Science, Advisor: Mayur Naik; GPA: 4.0/4.0 Jul 2019 – Present
- **University of California – San Diego** La Jolla, CA
B.S. Computer Science (GPA: 3.9/4.0); B.S. Mathematics (GPA: 3.7/4.0) Sep 2015 – Jun 2019

RESEARCH INTEREST

Ziyang’s research spans the fields of programming languages (PL) and machine learning (ML). He is particularly interested in neurosymbolic approaches which integrates traditional symbolic reasoning frameworks with machine learning models, jointly improving natural perception and reasoning capabilities. He designs the programming language, Scallop, which is a neurosymbolic language based on Datalog, that can be integrated with PyTorch framework, supporting differentiable logical reasoning. He applies neurosymbolic methods to various domains such as computer vision (CV), natural language processing (NLP), program analysis, computer security, medical, and bio-informatics, with the premise that a joint system can receive the benefit of both data-driven learning and distilled symbolic knowledge.

PUBLICATIONS

- **Neurosymbolic Programming in Scallop: Principle and Practice**
Ziyang Li, Jiani Huang, Jason Liu, Mayur Naik
Invited Monograph, to appear in Foundations and Trends in Programming Languages
- **Data-Efficient Learning with Neural Programs**
Alaia Solko-Breslin, Seewon Choi, Ziyang Li, Neelay Velinger, Rajeev Alur, Mayur Naik, Eric Wong
Proceeding of NeurIPS 2024, [arXiv]
- **Crowd-sourced machine learning prediction of Long COVID using data from the National COVID Cohort Collaborative**
Timothy Bergquist et al., . . . , Neelay Velinger, Ziyang Li, Yinjun Wu, Jiani Huang, Adam Stein, Emily J. Getzen, Qi Long, Mayur Naik, Ravi B. Parikh, . . .
To appear in eBioMedicine
- **LLM-Assisted Static Analysis for Detecting Security Vulnerabilities**
Ziyang Li, Saikat Dutta, Mayur Naik
[arXiv]
- **TYGR: Type Inference on Stripped Binaries using Graph Neural Networks**
Chang Zhu, Ziyang Li*, Anton Xue, Ati Priya Bajaj, William Gibbs, Yibo Liu, Rajeev Alur, Tiffany Bao, Hanjun Dai, Adam Doupé, Mayur Naik, Yan Shoshitaishvili, Ruoyu Wang, Aravind Machiry*
USENIX Security 2024, [Paper]
- **DISCRET: Synthesizing Faithful Explanations For Treatment Effect Estimation**
Yinjun Wu, Mayank Keoliya, Kan Chen, Neelay Velinger, Ziyang Li, Emily J Getzen, Qi Long, Mayur Naik, Ravi B Parikh, Eric Wong
International Conference on Machine Learning 2024 (ICLR 2024), **Spotlight**, [arXiv]
- **Understanding the Effectiveness of Large Language Models in Detecting Security Vulnerabilities**
Avishree Khare, Saikat Dutta, Ziyang Li, Alaia Solko-Breslin, Rajeev Alur, Mayur Naik
[arXiv]

- **LASER: Neuro-Symbolic Learning of Semantic Video Representations**
Jiani Huang, Ziyang Li, Mayur Naik, David Jacobs, Sernam Lim
[arXiv]
- **Relational Programming with Foundation Models**
Ziyang Li, Jiani Huang, Jason Liu, Felix Zhu, Eric Zhao, William Dodds, Neelay Velingker, Rajeev Alur, Mayur Naik
AAAI Conference on Artificial Intelligence (AAAI 2024), Paper
- **Improved Logical Reasoning of Language Models via Differentiable Symbolic Programming**
Jiani Huang, Hanlin Zhang*, Ziyang Li, Mayur Naik, Eric Xing*
ACL-Findings 2023, [arXiv]
- **Scallop: a Language for Neurosymbolic Programming**
Ziyang Li, Jiani Huang, Mayur Naik
Programming Language Design and Implementation (PLDI 2023). [Code] [arXiv]
- **Scallop: From Probabilistic Deductive Databases to Scalable Differentiable Reasoning**
Jiani Huang, Ziyang Li*, Binghong Chen, Karan Samel, Mayur Naik, Le Song, Xujie Si*
NeurIPS 2021. [Paper] [Code]
- **ARBITRAR: User-Guided API Misuse Detection**
Ziyang Li, Aravind Machiry, Binghong Chen, Mayur Naik, Ke Wang, Le Song
IEEE Security and Privacy (S&P) 2021. [Paper] [Code] [Talk]
- **HOPPITY: Learning Graph Transformations to Detect and Fix Bugs in Programs**
Elizabeth Dinella, Hanjun Dai, Ziyang Li, Mayur Naik, Le Song, Ke Wang
International Conference on Learning Representations (ICLR) 2020, **Spotlight**. [Paper]

Workshop Papers:

- **Scallop: From Probabilistic Deductive Databases to Scalable Differentiable Reasoning**
Jiani Huang, Ziyang Li*, Binghong Chen, Karan Samel, Mayur Naik, Le Song, Xujie Si*
AIPLANS Workshop @ NeurIPS 2021
- **Numerical Reasoning over Legal Contracts via Relational Database**
Jiani Huang, Ziyang Li, Ilias Fountalis, Mayur Naik
DBAI Workshop @ NeurIPS 2021

In Submission:

- **Weighted Contrastive Learning for Scene Graph Generation**
Yinjun Wu, Adam Stein, Ziyang Li, Mayur Naik
In Submission

RESEARCH EXPERIENCES

- **Research Assistant, UPenn PEARL** University of Pennsylvania
Advisor: Mayur Naik July 2019 – Present
- **Undergraduate Research Assistant, UCSD PL** University of California – San Diego
Advisor: Sorin Lerner Sep 2018 – Jun 2019
- **Undergraduate Research Assistant, UCSD VISCOMP** University of California – San Diego
Advisor: Ravi Ramamoorthi Mar 2018 – Jun 2019
- **Undergraduate Research Intern, UCSD Design Lab** University of California – San Diego
Advisor: Scott Klemmer Jun 2017 – Jun 2018

INVITED TALKS AND TUTORIALS

- **Scallop Tutorial** *Summer School of Neurosymbolic Programming* Salem, MA, Jun 2024
- **Neurosymbolic AI** *Guest lecture in Trustworthy AI, UPenn CIS* Philadelphia, PA, Apr 17, 2024
- **Invited Talk on Scallop** *Peking University PL Seminar* Peking, China, Dec 10, 2023
- **Invited Talk on Scallop** *Purdue University PL Seminar* West Lafayette, IN, Nov 9, 2023
- **Invited Talk on Scallop** *KDD'2023* Los Angeles, CA, Aug 7, 2023
- **Tutorial on Scallop** *PLDI'2023* Orlando, FL, Jun 17, 2023
- **Tutorial on Scallop** *Summer School of Formal Techniques* Mountain View, CA, Jun 1, 2022

WORKING EXPERIENCES

- **Relational AI** *Research Intern* Virtual, May 2021 – August 2021
- **Visa, Inc.** *Research Intern, Mentor: Ke Wang* Virtual, May 2020 – July 2020
- **Coursera, Inc.** *Front-end Engineer Intern* Mountain View, CA, Jun 2018 - Sep 2018
- **Deep Media, Ltd.** *Full-stack Engineer Intern* Shenzhen, China, Sep 2016 – Jan 2017
- **Yobs Technology** *Full-stack Engineer Intern* Los Angeles, CA, Jan 2016 – Sep 2016
- **Easyhin** *Front-end Engineer Intern* Shenzhen, China, Aug 2015 – Sep 2015

FELLOWSHIPS

- **Amazon Web Service Fellowship** *For work on Trustworthy AI* Amazon, May 2023
- **KPCB Fellows 2018** *Engineering Fellows (<2%)* San Francisco, June 2018

TEACHING EXPERIENCES

- **Teaching Assistant** *CIS 547, Software Analysis* University of Pennsylvania, Fall 2020, Fall 2021
- **Tutor** *CSE 190, Virtual Reality Technology* University of California – San Diego, Spring 2019
- **Tutor** *CSE 165, 3D User Interaction* University of California – San Diego, Winter 2019
- **Tutor** *CSE 130, Programming Language* University of California – San Diego, Fall 2018
- **Tutor** *CSE 163, Advanced Computer Graphics* University of California – San Diego, Spring 2018
- **Tutor** *CSE 167, Intro to Computer Graphics* University of California – San Diego, Winter 2018
- **Tutor** *CSE 12, Data Structure* University of California – San Diego, Winter 2017

SELECTED SIDE-PROJECTS

Rendering, Animation, and Simulations:

- **Fourier Depth of Field:** Fourier transform based depth of field analysis for RayTracer. [Github]
- **Rotamina:** Character animator and simulator with GUI. Written in C++. [Github]
- **MPM-RS:** Material point method for simulating fluid and soft-body dynamics. Written in Rust. [Github]
- **AoSoA Storage:** Array-of-struct-of-array storage system for high performance parallel computing with Kokkos and Cabana. Designed for physics simulation applications. Used by UPenn CG Group. [Github]

Video Games and VR Applications:

- **VR Piano:** VR Application for recording virtual characters playing the Piano, connecting MIDI keyboards and body tracking systems. Written in Unity.
- **Naruhodo:** An 3D story puzzle game engine made in Unity for easy level design. [Github]
- **Neon Ping Pong:** VR Ping Pong Game written in C++. [Website] [Video]
- **Space Escape:** VR Room Escape Puzzle Game settled in Space Station. Developed in Unity. [Website] [Video]

Web Applications:

- **inso.link**: A mirror download site for OSU! beatmaps for Chinese players. Hosted and maintained since 2016 and has 30K users while supporting >2M downloads. [Website] [Status Site]
- **saemanga.com**: A minimalistic online manga reader. Had >1K users. (2016-2020, currently out-of-service)

Programming Languages and Program Analysis Tools

- **Probabilistic DataLog Engine**: A probabilistic datalog engine with high performance optimizations oriented towards machine learning applications. Written in Rust.
- **Under-constrained Symbolic Execution Engine**: High performance under-constrained symbolic execution engine for LLVM IR written in Rust. Used in Arbitrar.
- **LLVM IR Binding for Rust**: Safe LLVM Binding for Rust. Used in Arbitrar. [Github]
- **Geometry Sketchpad**: Geometry sketching GUI application written in Rust. [Github]
- **Menhera**: A TypeScript-like functional programming language compiler written in OCaml. [Github]

SKILLS

- **Languages**: Rust, C++/C, Python, C#, TypeScript/JavaScript, OCaml, Java, Haskell, Coq
- **Libraries/Engines/Tools**: PyTorch, Unity, Unreal Engine 4/5, React, ExpressJs, Asp.net
- **Design**: Adobe Photoshop, Final Cut Pro, Premiere, After Effects, Illustrator, Blender, Cinema 4D
- **Audio/Music**: Logic Pro, Ableton

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