LI Jiaying

Ph.D., Microsoft

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Research Interests

Software Verification, Programming Languages, Artificial Intelligence

My primary research focuses on the correctness of software systems, including classic computer programs, smart contracts, and artificial intelligence systems. I also have a broad interest in both the theoretic and practical aspects of software analysis, testing and verification. My vision is to furnish new insights and perspectives to help practitioners build trustworthy and high-quality software systems.

Education

2013.09 — 2018.04 **Ph.D. of Computer Science**, *Information Systems Technology and Design*, Singapore University of Technology and Design, Singapore.
Research Areas: formal verification and program analysis
Thesis: Facilitating Formal Verification with Invariant Learning
Advisor: Professor Sun Jun

2017.11 — 2018.03 **Visiting Scholar**, *Department of Computer Science*, University of California, Davis, USA.
Research Areas: program verification
Advisor: Professor Su Zhendong

2011.09 — 2013.06 **Master** (dropped), *Institute of Computing Technology*, Chinese Academy of Sciences, China.
Research Areas: storage systems, operating systems
Advisors: Professor Xu Lu, Professor Zhan Jianfeng

2007.09 — 2011.06 **Bachelor of Engineering**, *College of Software*, Nankai University, China.
GPA: 3.9/4.0   Rank: 1/134
Thesis: Multi-tasking OS Kernel with a Priority Scheduling Mechanism
Advisor: Professor Li Yaoguo

Employment Experiences

2021.06 — present **Senior SDE**, *Bing Platform*, Microsoft, Beijing, China.
Manager: Li Chao

2019.10 — 2021.06 **Research Scientist**, *School of Computing and Information Systems*, Singapore Management University, Singapore.
Advisor: Professor Sun Jun

2018.05 — 2019.09 **Research Fellow**, *iTrust Lab., Information Systems Technology and Design*, Singapore University of Technology and Design, Singapore.
Advisors: Professor Sun Jun, Professor Paweł Szałachowski

2013.07 — 2013.09 **Research Assistant**, *Information Systems Technology and Design*, Singapore University of Technology and Design, Singapore.
Advisor: Professor Sun Jun

Publications

2024   **ReLU Hull Approximation**, In the 51st ACM SIGPLAN Symposium on Principles of Programming Languages (POPL), 2024.
Zhongkui Ma, Jiaying Li, Guangdong Bai

2023   **Towards an Effective and Interpretable Refinement Approach for DNN Verification**, In the 23rd IEEE International Conference on Software Quality, Reliability, and Security (QRS), 2023.
Jiaying Li, Guangdong Bai, Long H. Pham, Jun Sun

2023   **A Comprehensive Study of Real-World Bugs in Machine Learning Model Optimization**, In the 45th IEEE/ACM International Conference on Software Engineering (ICSE), 2023.
Hao Guan, Ying Xiao, Jiaying Li, Yepang Liu, Guangdong Bai

2021   **Verification Assisted Gas Reduction for Smart Contracts**, In the 28th Asia-Pacific Software Engineering Conference (APSEC), 2021 **Best Paper**.
Bo Gao, Siyuan Shen, Ling Shi, Jiaying Li, Jun Sun, Lei Bu

2021   **sVerify: Verifying Smart Contracts through Lazy Annotation and Learning**, In the 10th International Symposium On Leveraging Applications of Formal Methods, Verification and Validation (ISoLA), 2021.
Bo Gao, Ling Shi, Jiaying Li, Jialiang Chang, Jun Sun, Zijiang Yang

2019   **Deep Clustering by Gaussian Mixture Variational Autoencoders with Graph Embedding**, In the International Conference in Computer Vision (ICCV), 2019.
Linxiao Yang, Ngai-Man Cheung, Jiaying Li, Jun Fang

2017   **Classification-based Parameter Synthesis for Parametric Timed Automata**, In the 19th International Conference on Formal Engineering Methods (ICFEM), 2017.
Jiaying Li, Jun Sun, Bo Gao and Étienne André

2017   **Automatic Loop-invariant Generation and Refinement through Selective Sampling**, In the 32nd IEEE/ACM International Conference on Automated Software Engineering (ASE), 2017.
Jiaying Li, Jun Sun, Li Li, Quang Loc Le, Shang-Wei Lin

2016   **Scaling BDD-based Timed Verification with Simulation Reduction**, In the 19th International Conference on Formal Engineering Methods (ICFEM), 2016.
Truong Khanh Nguyen,Tian Huat Tan, Jun Sun, Jiaying Li, Yang Liu, Manman Chen, Jin Song Dong

2015   **An Invariant Inference Framework using Active Learning and SVMs**, In the 20th International Conference on Engineering of Complex Computer Systems (ICECCS), 2015.
Jiaying Li

Preprints

2022   **Boosting DeepPoly with Abstraction Refinement for Neural Network Verification**.
Long H. Pham, Jiaying Li, Jun Sun

2021   **Verifying Smart Contracts by Learning Contract Invariants**.
Bo Gao, Ling Shi, Jiaying Li, Jun Sun

2021   **SOCRATES: Towards a Unified Platform for Neural Network Analysis**.
Long H. Pham, Jiaying Li, Jun Sun

2018   **Learning Loop-invariants with Program Structure-based State Partitioning**.
Jiaying Li, Jun Sun

Research Experiences

2020 — 2023 **Deep Neural Network Analysis and Verification**.
DNNs were subject to vulnerabilities. This project aims at analyzing and verifying DNNs. We build a unified platform to ease researchers in developing, extending and evaluating different DNN testing and verification techniques. We also develop a automated debugging technique that can refine DNN verification in an interpretable yet effective way. Moreover, we propose a novel method that can approximate multiple neurons together in a precise, efficient and scalable way, greatly advancing the SOTA approaches.

2018 — 2021 **Smart Contract Analysis and Verification**.
Smart contracts are programs running on blockchain infrastructures and they suffer from vulnerabilities that may lead to huge financial loss. This line of research aims to verify the correctness of smart contracts and optimize their gas usage. We first develop an unbounded verifier for smart contract based on symbolic execution and invariant learning. By leveraging the verification result, we further develop an optimization technique that can reduce the gas optimization for smart contract automatically.

2015 — 2018 **Program Analysis and Verification**.
Loop invariant generation is a fundamental problem in computer science. This line of work aims at infering loop invariants automatically. We first propose a learning-based technique to generate loop invariants. It leverages classification algorithms and active learning techniques. Then, we consider invariants in disjunctive forms, which are challenging to generate through existing techniques. To tackle the challenges, we use program control flow information to generate these invariants in a compositional way.

Awards

2021	Best Paper Award, APSEC 2021, Taiwan
2013 - 2018	SUTD President's Graduate Fellowship, Ministry of Education, Singapore
2011	First Prize National Fellowship, Ministry of Education, China
2010	National Scholarship, Ministry of Education, China
2009	National Endeavor Scholarship, Ministry of Education, China
2008	Second Prize National Fellowship, Ministry of Education, China

Services

Program Committee	ICFEM 2023
Reviewer	APSEC2016, ICECCS 2017, SATE 2018, ICFEM2018, ICFEM2019, TASE 2019, FormaliSE 2019, AST 2020, SETTA 2020, IMLSE 2020, Internetware 2020, SiMLA 2022, ICFEM 2023
Teaching Assistant	Machine learning (undergraduate, ISTD, SUTD, Spring, 2014)
	Elements of software construction (undergraduate, ISTD, SUTD, Fall, 2014)

Talks

2023	Towards Better Neural Network Verification, Senior Sharing, Microsoft, Beijing, China
2023	Refining DNN Verification via Debugging, QRS 2023, Chiang Mai, Thailand
2023	Detecting Memory Bugs in C/C++, 1ES Sharing, Microsoft, Beijing, China
2021	Interpretable Refinement for DNN verification, Huawei, Hangzhou, China
2018	Facilitating Formal Verification with Invariant Learning, Thesis Defense, SUTD, Singapore
2017	Learning Parametric Timed Automata, ICFEM 2017, Xi'an, China
2017	Generating Loop Invariants via Learning, ASE 2017, UIUC, Illinois, USA
2016	Better BDD-based Timed Verification, ICFEM 2016, Tokyo, Japan
2015	Learning-based Loop Invariant Generation, ICECCS 2015, Gold Coast, Australia