CURRICULUM VITAE

PERSONAL INFORMATION

Name: Wenxi Wang ***Gender:*** Female ***Personal website***: https://wenxiwang.github.io/

EDUCATION

Degree: Doctor of Philosophy, The University of Texas at Austin ***Aug. 2018- present***
Research Areas: Constraint Solving, Model Counting, Machine Learning, Software Engineering
Supervisor: Sarfraz Khurshid
Applicable Coursework:
Reinforcement Learning, Deep Learning, Neural Network, Program Synthesis, Convex Optimization, Automated Logical Reasoning, Verification & Validation of Software, Software Evolution, Software Testing, Software Testing in the era of Nondeterminism

Degree: Master of Philosophy, The University of Melbourne ***Aug. 2014- Mar. 2017***
Research Areas: Constraint Solving, Discrete Optimization, Machine Learning
Thesis: A Bit-Vector Solver with Word-Level Propagation (pdf)
Supervisors: Harald Sondergaard (principle supervisor), Peter J. Stuckey (co-supervisor)

Degree: Bachelor of Engineering, Dalian University of Technology ***Sep. 2009- Jun. 2014***
Major: Computer Science and Technology (Intensive Japanese)
Applicable Coursework:
Operating Systems, Computer Networks, Computer Architecture, Algorithms and Data Structures, Linear Algebra, Probability theory, C/C++ Programming Language, Java Programming Language

EMPLOYMENT

Research Intern, Automated Reasoning Group, Amazon Web Service, USA ***May. 2022- Aug. 2022***
Research Intern, Software Quality & Security Laboratory, Fujitsu, USA ***May. 2019- Aug. 2019***
Research Intern, Dept. of Computing, Hong Kong Polytechnic University, HK ***Sep. 2017 - Aug. 2018***

PUBLICATIONS

1. **Wenxi Wang**, Yang Hu, Mohit Tiwari, Sarfraz Khurshid, Kenneth McMillan, Risto Miikkulainen
NeuroComb: Improving SAT Solving with Graph Neural Networks
(arXiv Report submitted on October 2021; under conference submission). Paper Link

2. **Wenxi Wang**, Yang Hu, Kenneth McMillan, Sarfraz Khurshid
SymMC: Model Enumeration and Counting Using Symmetry Information for Alloy Specifications
21st ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering
(ESEC/FSE 2022). (to appear)

3. Chengpeng Li, Chenguang Zhu, **Wenxi Wang**, August Shi
Repairing Order-Dependent Flaky Tests via Test Generation
44th International Conference on Software Engineering
(ICSE 2022). (to appear)

4. **Wenxi Wang**, Pu Yi, Sarfraz Khurshid, Darko Marinov
Initial Results on Counting Test Orders for Order-Dependent Flaky Tests using Alloy
33rd IFIP International Conference on Testing Software and Systems
(ICTSS 2021). Paper Link

5. Yang Hu, **Wenxi Wang**, Casen Hunger, Naveena Sankaranarayanan, Riley Wood, Sarfraz Khurshid, Mohit Tiwari
ACFuzz: Discovering Kernel Access Control Vulnerabilities via Differential Fuzzing
The ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering
(ESEC/FSE 2021). Paper Link

6. Jiayi Yang, **Wenxi Wang**, Darko Marinov, Sarfraz, Khurshid
AlloyMC: Alloy Meets Model Counting
The ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering, Tool Demos
(ESEC/FSE Demo 2020). Paper Link

7. Muhammad Usman, **Wenxi Wang**, Sarfraz Khurshid
TestMC: A Framework for Testing Model Counters
IEEE/ACM International Conference on Automated Software Engineering
(ASE 2020). Paper Link

8. **Wenxi Wang**, Muhammad Usman, Alyas Almaawi, Kaiyuan Wang, Kuldeep S. Meel and Sarfraz Khurshid
A Study of Symmetry Breaking Predicates and Model Counting
International Conference on Tools and Algorithms for the Construction and Analysis of Systems
(TACAS 2020). Paper Link

9. Muhammad Usman, **Wenxi Wang**, Kaiyuan Wang, Marko Vasic, Haris Vikalo, Sarfraz Khurshid
A Study of the Learnability of Relational Properties (Model Counting Meets Machine Learning)
ACM SIGPLAN Conference on Programming Language Design and Implementation
(PLDI 2020). Paper Link

10. Muhammad Usman, **Wenxi Wang**, Kaiyuan Wang, Cagdas Yelen, Nima Dini and Sarfraz Khurshid
Study of Learning Data Structure Invariants Using Off-the-shelf Tools
International SPIN Symposium on Model Checking of Software
(SPIN 2019). Paper Link

11. **Wenxi Wang**, Kaiyuan Wang, Milos Gligoric, Sarfraz Khurshid
Incremental Analysis of Evolving Alloy Models
International Conference on Tools and Algorithms for the Construction and Analysis of Systems
(TACAS 2019). Paper Link

12. **Wenxi Wang**, Kaiyuan Wang, Mengshi Zhang, Sarfraz Khurshid
Learning to Optimize the Alloy Analyzer
IEEE International Conference on Software Testing, Verification and Validation
(ICST 2019). Paper Link

13. **Wenxi Wang**, Harald Sondergaard, Peter J. Stuckey
Wombit: A Portfolio Bit-Vector Solver using Word-Level Propagation
Journal of Automated Reasoning
(JAR 2018). Paper Link

14. **Wenxi Wang**, Harald Sondergaard, Peter J. Stuckey
A Bit-Vector Solver with Word-Level Propagation
Integration of AI and OR Techniques in Constraint Programming
(CPAIOR 2016). Paper Link

RESEARCH PROJECTS

• ***Improving SAT solving with Deep Neural Networks*** ***Feb. 2020 - present***

Role: Research Student in Dept. of Electrical and Computer Engineering, The University of Texas at Austin

Introduction:

Propositional satisfiability (SAT) is an NP-complete problem that impacts many research fields, such as planning, verification, and security. Existing approaches so far either have not made solving more effective, or have required frequent online accesses to substantial GPU resources. Our long-term goal is to make real and practical improvement towards SAT solving with deep learning (e,g., supervised learning and reinforcement learning).

Contributions:

• In a commodity machine with no substantial GPU resources, we have been using supervised learning with graph neural networks to make MiniSAT solver solve 18.5% more problems on the recent SATCOMP-2020 competition problem set. This work is now under submission.

• ***Applying and Improving Model Counting*** ***Apr. 2019 - present***

Role: Research Student in Dept. of Electrical and Computer Engineering, The University of Texas at Austin

Introduction:

We are applying and improving Model Counting which is a classical problem of computing the number of solutions for a given SAT formula. For application, we integrate state-of-the-art model counters into Alloy as another back-end engine. We also applied model counters to quantify of the performance of and semantic differences among trained machine learning models. For improvement, we are trying to utilize symmetry breaking which is a widely used approach in facilitating SAT solving, but has never been considered in model counting. Besides, we also did testing for model counters and found bugs which has been confirmed by the authors.

Contributions:

• Integrated model counters into Alloy Analyzer to provide users a platform of conducting model counting for their models. This work was published at **ESEC/FSE Demo 2020**.

• Applied model counters to help evaluate ML model performance in learning relational properties of complex graph structures. This work was published at **SPIN 2019**, **PLDI 2020**.

• Studied the impact of symmetry breaking on model counting. This work was published at **TACAS 2020**.

• Improved two state-of-the-art model counters by automatically evaluating the impact of symmetry breaking predicates in solution space reduction. This work is under review.

• Tested four state-of-the-art model counters using metamorphic testing and differential testing. This work was published at **ASE 2020**.

• ***Improving Alloy Analyzer*** ***Sep. 2018 - present***

Role: Research Student in Dept. of Electrical and Computer Engineering, The University of Texas at Austin

Introduction:

We are enhancing the Alloy Analyzer, a well-known software modeling tool, based on first-order logic and SAT solving. For first-order logic level, regression command selection and solution reuse ideas can be applied in evolving Alloy models to reduce the number of SAT solver calls. For SAT level, one direction is to propose advanced searching and learning strategy using the knowledge in first-order logic level. Another possibility is to intelligently select a fast SAT solver (from candidate solvers) for different given Alloy models.

Contributions:

• Proposed an approach that can efficiently conduct incremental analysis for evolving Alloy models. This work was published at **TACAS 2019**.

• Proposed an approach that uses machine learning techniques to automatically select a SAT solver for Alloy, based on the features extracted from the given model. This work was published at **ICST 2019**.

• ***A Bit-Vector Solver with Word-Level Propagation using Machine Learning*** ***Aug. 2014- Sep.2017***

Role: Research Student in University of Melbourne, Optimization Research Group

Project Introduction:

Solving bit-vector constraint problems is an NP-hard problem involved in many areas such as software verification, cryptography, scheduling and planning. Bit-vector Satisfiability Modulo Theory (SMT) solver is designed to solve huge amounts of complicated bit-vector constraints. The common method called *bit-blasting* is to break the bit-vector constraints down to the propositional formulas and solve them with SAT solver. However, during the 'break' process, lots of useful information get lost which is the bottleneck of this method. We aim to solve bit-vector constraints directly in *bit-vector/word* level using advanced constraint solving method.

Contributions:

• Designed a novel learning and back-tracking architecture based on SAT solver called MiniSAT particularly for the word-level bit-vector SMT solver, and proposed special algorithms and policies for improving the word-level solving efficiency. This work was published at **CPAIOR 2016.**

• Proposed a portfolio bit-vector solver called Wombit which outperformed state-of-the-art solver STP significantly both in time and memory usage. This work was published at **JAR 2018**.

TEACHING

Teaching Assistant, University of Texas at Austin, Austin, USA ***Spring, 2020***

Teaching Subjects: Software Testing.

Teaching Assistant, University of Texas at Austin, Austin, USA ***Fall, 2019***

Teaching Subjects: Software Design & Implementation II.

Teaching Assistant, University of Texas at Austin, Austin, USA ***Spring, 2019***

Teaching Subjects: Algorithmic Foundations for Software Systems.

Teaching Assistant, University of Melbourne, Melbourne, Australia ***Semester 2, 2016***
Teaching Subjects: Data Structure and Algorithms, and Engineering Computation.

PROFESSIONAL SERVICE

- NeurIPS 2022 Reviewer.
- PLDI 2022 Artifact Evaluation Committee Member.
- ISSTA 2022 Artifact Evaluation Committee Member.
- PLDI 2021 Artifact Evaluation Committee Member.
- External Reviewer: TACAS 2022, FSE 2021, ICST 2020, ASE 2020, ISSRE 2020, and ICSE 2019.

AWARDS & HONORS

Scholarships

Melbourne International Research Scholarship, UoM (very competitive)	2014-2016
Melbourne International Fee Remission Scholarship, UoM (very competitive)	2014-2016
China National Scholarship, Ministry of Education of China (1%)	2012-2013

Honors

Province Excellent Graduates Award, Liaoning Province, China (1%)	2014

Notes：*The number in brackets indicates the ratio of students who have won honors and awards; UoM is short for University of Melbourne.*