

*"There are two ways to write error-free programs; only the third works." –Alan J. Perlis*

## Research Interest

**Software Engineering**, in particular: Test/Oracle Generation, Automated Bug Localization and Repair, Regression Testing, Mutation Testing, and Program Synthesis.

**Formal Methods and Programming Languages**, in particular: Model Checking, Model Based Testing, First-Order Logic, Program Invariant Inference, Points-to Analysis and Symbolic Execution.

## Academic Experience

2018-PRESENT	<b>Assistant Professor</b> , North Carolina A&T State University	Greensboro, NC
2012-2017	<b>Research Assistant</b> , The University of Texas at Austin	Austin, Texas
2011-2012	<b>Undergraduate Research Assistant</b> , The University of Texas at Dallas	Richardson, Texas

## Education

**The University of Texas at Austin** Austin, Texas  
PH.D. IN SOFTWARE ENGINEERING May 2017

- **Dissertation:** Automated Testing and Sketching of Alloy Models
- **Research Group:** Software Validation, Verification and Testing (SVAT) | **Advisor:** Dr. Sarfraz Khurshid

**The University of Texas at Austin** Austin, Texas  
M.S. IN SOFTWARE ENGINEERING May 2014

- **Thesis:** AUnit - A Testing Framework for Alloy
- **Research Group:** Software Validation, Verification and Testing (SVAT) | **Advisor:** Dr. Sarfraz Khurshid

**The University of Texas at Dallas** Richardson, Texas  
B.S. IN SOFTWARE ENGINEERING May 2012

- **Specialization:** Embedded Systems | **GPA:** 4.0

## Publications

### REFEREED CONFERENCE PAPERS

- [1] Kaiyuan Wang, Allison Sullivan, and Sarfraz Khurshid. ARepair: A repair framework for Alloy. In *International Conference on Software Engineering (ICSE) Demonstration Track*, 2019
- [2] Kaiyuan Wang, Allison Sullivan, and Sarfraz Khurshid. Automated model repair for Alloy. In *International Conference on Automated Software Engineering (ASE)*, 2018
- [3] Kaiyuan Wang, Allison Sullivan, Darko Marinov, and Sarfraz Khurshid. Asketch: a sketching framework for Alloy. In *The ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering (FSE)*, 2018
- [4] Allison Sullivan, Kaiyuan Wang, and Sarfraz Khurshid. AUnit: A test automation tool for Alloy. In *International Conference on Software Testing, Verification and Validation (ICST)*, 2018
- [5] Kaiyuan Wang, Allison Sullivan, Manos Koukoutos, Darko Marinov, and Sarfraz Khurshid. Systematic generation of non-equivalent expressions for relational algebra. In *International ABZ Conference ASM, Alloy, B, TLA, VDM, Z*, 2018
- [6] Kaiyuan Wang, Allison Sullivan, Darko Marinov, and Sarfraz Khurshid. Solver-based sketching of Alloy models using test valuations. In *International Conference on Automated Software Engineering (ASE)*, 2018

- [7] Kaiyuan Wang, Allison Sullivan, and Sarfraz Khurshid. MuAlloy: A mutation testing framework for Alloy. In *International Conference on Software Engineering (ICSE)*, 2018
- [8] Allison Sullivan, Kaiyuan Wang, Razieh Nokhbeh Zaeem, and Sarfraz Khurshid. Automated test generation and mutation testing for Alloy. In *IEEE Conference on Software Testing, Validation and Verification (ICST)*, 2017
- [9] Nima Dini, Allison Sullivan, Milos Gligoric, and Gregg Rothermel. The effect of test suite type on regression test selection. In *International Symposium on Software Reliability Engineering (ISSRE)*, 2016
- [10] Allison Sullivan, Razieh Nokhbeh Zaeem, Sarfraz Khurshid, and Darko Marinov. Towards a test automation framework for Alloy. In *SPIN*, 2014

#### REFEREED WORKSHOP PAPERS

- [11] Allison Sullivan, Kaiyuan Wang, Sarfraz Khurshid, and Darko Marinov. Evaluating state modeling techniques in Alloy. In *Workshop on Software Quality Analysis, Monitoring, Improvement, and Applications (SQAMIA)*, 2017

#### THESIS AND DISSERTATION

- [12] Allison Sullivan. Automated testing and sketching of Alloy models. In *Texas ScholarWorks - UT Electronic Theses and Dissertations*, 2017
- [13] Allison Sullivan. AUnit: A testing framework for Alloy. In *Texas ScholarWorks - UT Electronic Theses and Dissertations*, 2014

## University Service

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#### Faculty Mentor for SAE International and General Motors co-sponsored AutoDrive Challenge

- **Functional Safety Group.** Mentors 3 graduate students, 1 undergraduate student.
- **Mapping Challenge Group.** Mentors 2 graduate students, 1 undergraduate student.

#### Faculty Advisor for 2nd Annual Advancing Minorities' Interest in Engineering (AMIE) Design Challenge

- Advises a team of undergraduate students competing in a "Design Thinking" challenge, which helps students develop skills to focus on user outcomes in problem solving and the development of user centric solutions. The competition will take place at the 2019 Black Engineer of the Year Conference.

#### NC A&T Representative to Facebook T3 Summit on Data Structures and Algorithms

- Fostered my professional development skills by attending this summit to learn more about engineering at Facebook, work with Facebook engineers and other HBCU faculty to design and share course material for Data Structures and Algorithms, and to learn and share expertise for building a challenging and supportive CS culture on campus.

#### Senior Design Advisor

- **Fall 2018, The Bowling App:** Mentored three senior undergraduate students working on a semester-long capstone project.

#### Faculty Supervisor

##### CURRENT STUDENTS

- **Fikirté Ayalke** – **Level:** Doctoral | **Focus:** Formal Methods and Cyber Security | **Projected graduation date:** Spring 2022
- **George Thompson** – **Level:** Masters | **Focus:** Prolog Fault Localization and Repair | **Projected graduation date:** Spring 2020
- **Angel Patterson** – **Level:** Masters | **Focus:** Autonomous Vehicle Formal Verification | **Projected graduation date:** Spring 2020
- **Jasmine Mabrey** – **Level:** Masters | **Focus:** Program and Data structure Repair | **Projected graduation date:** Spring 2020

##### GRADUATED STUDENTS

- **Regina Bunch** – **Level:** Masters | **Project:** AMail: Email for Austim | **Graduation date:** Fall 2018

## Industry Experience

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#### Naval Research Laboratory (NRL)

Washington, D.C.

##### RESEARCH INTERN IN THE CENTER FOR HIGH ASSURANCE COMPUTER SYSTEMS RESEARCH GROUP

Jun. 2015 - Jan. 2016

- **Model Based Testing.** Worked as a research intern to improve NRL's model based testing (MBT) infrastructure. I addressed the need for their process to handle the full expressive power of the SCR language, by using temporal logic to incorporate SCR assumptions into the MBT toolset. I also worked to develop an iterative test generation step for NRL's MBT framework. To generate a test over models with float variables, the model checkers have to capture each increment to the variable as an individual step in a test. To reduce this effort, we used constraint slicing to maximize re-use and selectively generate tests related only to the changed portions of the model.

- **Test Automation Toolset.** Test automation scripts are often written by separate people, even for the same project. This leads to numerous, distinct configurations required to run the tests, as well as numerous, distinct output formats. Using RQM's REST API, I built a toolset to ensure these automation suites automatically work with IBM's project management tool. This toolset bridges existing automation scripts with the new RQM tool and is in place at IBM today.
- **Big Data Testing.** As IBM began adapting support for big data, IBM needed to be able to test in a big data setting. To ease the transition for developers, we created a wrapper API around Hadoop's REST API. Then, I worked with a team to develop a template for a testing framework where the focus is database transactions over big data sets.

## Teaching Experience

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Spring 2019	<b>Instructor</b> , COMP 496: Senior Design, North Carolina A&T State University.
Spring 2019	<b>Instructor</b> , COMP 681: Formal Methods, North Carolina A&T State University.
Fall 2018	<b>Instructor</b> , COMP 285: Analysis of Algorithms, North Carolina A&T State University.
Spring 2016	<b>Teaching Assistant</b> , EE 382C-03: Verification and Validation, The University of Texas at Austin.
Spring 2014	<b>Teaching Assistant</b> , EE 382C-11: Requirements Engineering, The University of Texas at Austin.
Fall 2011	<b>Teaching Assistant</b> , CS 3345: Data Structures and Algorithms, The University of Texas at Dallas.

## Skills

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<b>Systems</b>	Windows, Linux
<b>Languages</b>	Java, C++, Alloy, SCR, Promela, SMT, Prolog, JavaScript, SQL, HTML
<b>Tools</b>	Eclipse, Visual Studio, JUnit, Alloy Analyzer, SPIN, NuSMV, Java Pathfinder, Z3 SMT Solver, Rosette, Selenium, MySQL, IBM DB2, jQuery, Hadoop, Subversion, Git,

## Open Source Contributions

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### AUnit: Unit Testing Tools for Alloy

- **AUnit Analyzer.** Extension to the Alloy Analyzer that provides support for AUnit to the main Alloy IDE, namely: test creation and execution, coverage reporting, and automated test generation based on coverage requirements (<https://sites.google.com/view/aunitanalyzer>).
- **MuAlloy.** A command line tool built on top of Alloy4.2. The tool provides basic features to mutate an Alloy model at its AST level and generate non-equivalent mutant models. For each non-equivalent mutant model, MuAlloy is able to generate an Alloy instance that kills it. (<https://github.com/kaiyuanw/MuAlloy>).

### Alloy Repair and Sketching Tools

- **ARepair: A Repair Framework for Alloy.** A command line tool built on top of Alloy4.2. Given a faulty Alloy model (potentially with multiple faults) and a set of AUnit tests that capture the desired model properties, ARepair is able to repair the model so that all AUnit tests pass (<https://github.com/kaiyuanw/ARepair>).
- **ASketch: A Sketching Framework for Alloy.** A command line tool built on top of Alloy5.0. Given a partial Alloy model, a candidate fragment generator, and a set of AUnit tests that capture the desired model properties, ASketch is able to fill holes with the corresponding candidate fragments and makes the completed model satisfy all AUnit tests (<https://github.com/kaiyuanw/ASketch>).

## Honors & Awards

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2012 - 2016	<b>Virginia and Ernest Cockrell Jr. Fellowship in Engineering Recipient</b> , from The University of Texas at Austin.
Spring 2012	<b>ECS Departmental Honors</b> , from The University of Texas at Dallas.
2008 - 2012	<b>Academic Excellence Scholarship Recipient</b> , from The University of Texas at Dallas.