

# Haoze (Andrew) Wu

## PERSONAL INFO

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Blog: <http://blog.haozewu.com>

## EDUCATION

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### Stanford University

Stanford, CA

*PhD Program in Computer Science*

Starting Sept. 2018

### Davidson College

Davidson, NC

*Bachelor of Science in Mathematics and Philosophy*

Aug.2014—May 2018

**GPA:** 3.99/4.0 overall

*Magna Cum Laude*

*Phi Beta Kappa*

*R. Bruce Jackson, Jr., Mathematics Award*

*Computer Science Award*

*Steinway Piano Gallery-Charlotte Award*

*Zachary F. Long Jr. music Scholarship*

## GRANTS and Fellowship

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### Research Grants:

1. Stanford School of Engineering Fellowship (Fall 2018 – Spring 2019)
2. DAAD RISE Scholarship (Summer 2017)
3. Davidson Research Initiative—Weinstein Research Fellowship (Summer 2016)

### Travel Grants:

1. Conference scholarship fund for Programming Languages Mentoring Workshop at POPL 2018
2. NSF travel fund for Cornell, Maryland, Max Planck Pre-Doctoral Research School 2017

## RESEARCH EXPERIENCE

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### 1. Formal methods

Stanford University

Stanford, CA

#### **Parallelizing Neural Network Verification**

Ongoing work

*Supervisor: Dr. Clark Barrett*

- Background: *Marabou* is a tool for verifying Deep Neural Network using ReLU as activation functions.
- Parallelize the algorithm in *Marabou* using a divide-and-conquer style parallelization.

Max-Planck Institute for Software Systems

Kaiserslautern, Germany

#### **Formalizing A Program Logic over the Promising Semantics**

Sept. 2017—Jan. 2018

*Supervisor: Dr. Viktor Vafeiadis*

- Background: The *promising semantics* is a weak memory model that validates standard compiler optimizations while supporting basic invariant-based reasoning. A newly proposed program logic supports reasoning about concurrent programs over the promising semantics.
- Mechanized the soundness proof of the program logic over the promising semantics in *Coq*.

- Side project: Created a Coq tactic for the *Hahn* library (a library about lists and binary relations) to efficiently solve relation algebra queries that falls into the class of the *Kleene Algebra with Test* using a relation algebra library by Damien Pous.

University of Minnesota, Twin Cities

Minneapolis, MN

### Executing LF Specifications with $\lambda$ Prolog

May—June 2017, Oct. 2017

Supervisors: Mary Southern, Dr. Gopalan Nadathur

- Background: The *Edinburgh Logical Framework* (LF) is a rich specification language. LF specifications can be translated into a predicate logic that is executable in the logic programming language  $\lambda$ Prolog.
- Designed an algorithm that optimizes the translation of LF specifications into a predicate logic form by eliminating redundant type-checking information.
- Implemented the algorithm in *OCaml* as part of an implementation of LF based on  $\lambda$ Prolog.

Max-Planck Institute for Software Systems

Kaiserslautern, Germany

### Extending A Program Logic for the C11 Memory Model

June—Aug. 2017

Supervisors: Marko Doko, Dr. Viktor Vafeiadis

- Extended the *Fence Separation Logic* (FSL), a *Hoare logic* for the C11 Memory Model, to support memory deallocations.
- Proved that the extended FSL is sound with respect to C11 and formalized the proof in Coq.
- Proved that if an FSL triple  $\{P\} E \{Q\}$  holds, then the execution E is memory safe and free of data races.

## 2. Satisfiability

Davidson College

Davidson, NC

### Synthesizing Pseudo-industrial SAT Instance

Ongoing work

Supervisor: Dr. Raghuram Ramanujan

- Used *Generative Adversarial Net* (GAN) to learn biased random walks on real-world SAT instances.
- Constructed SAT instances using the generated biased random walks.
- Achieved *state-of-the-art* result in terms of capturing the graph-based properties (i.e., modularity, scale-free structures) of real-world SAT instances.

Stanford University

Stanford, CA

### Improving the Branching Heuristics of CVC4

Sept.—Oct. 2018

Supervisor: Dr. Clark Barrett

- Added *learning-rate based heuristics* and *literal-block-distance* based clause deletion to the SAT engine of CVC4 (a full-fledged SMT solver).
- Improved the relevancy-based heuristics of CVC4.
- Decreased the runtime of CVC4 on 14 out of 28 benchmarks by more than 10%.

Davidson College

Davidson, NC

### Improving CDCL-styled SAT-solving

June—Aug. 2016

Supervisor: Dr. Raghuram Ramanujan

- Background: *Conflict-Driven Clause Learning* (CDCL) algorithm is a state-of-the-art complete algorithm for solving instances of the *propositional Boolean Satisfiability Problem* (SAT). CDCL is an extension of the *DPLL* algorithm. The *branching heuristic* of CDCL has a large impact on its runtime.
- Used the Monte-Carlo method and machine learning techniques to design better branching heuristics for CDCL-styled SAT solvers.
- Outperformed the baseline SAT-solver (*Minisat* with default setting) 55% of the time on hard satisfiable benchmarks as measured by the number of backtracks.

Davidson College Davidson, NC

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**Designing Alternative Max-SAT solving algorithm**

Nov. 2016

*Supervisor: Dr. Raghuram Ramanujan*

- Analyzed the error bound of an incomplete Max-SAT solving algorithm given an imperfect SAT oracle with a fixed accuracy  $(1 - \epsilon)$ .

**3. Others**

Davidson College Davidson, NC

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**Predicting Gene Ontology with Machine Learning**

Apr. 2016

*Partner: Yangyu Zhou*

- Used machine learning techniques to predict whether a *C. elegans* gene is involved in *axon regeneration*, as the final project in the *Machine Learning* course.
- Scraped online databases and extracted/computed 31 features for each training example.
- Trained and compared five different machine learning models (*Logistic Regression, K-Nearest Neighbors, Random Forest, SVM, Feed-forward Neural Network*) using the *Python scikit-learn* library.

PRESENTATIONS & PUBLICATIONS

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**Papers:**

1. Haoze Wu, *Improving SAT-solving with Machine Learning*. ACM Student Research Competition at 2017 Special Interest Group on Computer Science Education (SIGCSE'17). ([arXiv](#))

**Presentations:**

1. Improving SAT-solving with Machine Learning. Joint Science Symposium for Student Research, Davidson College, Davidson, NC. Sept. 2016.

**Unpublished work:**

1. Haoze Wu, Yangyu Zhou, *Gene Ontology(GO) Prediction Using Machine Learning Methods*. Submitted to Journal of Bioinformatics and Computational Biology in Feb. 2017. ([arXiv](#))

OTHER RESEARCH-RELATED EXPERIENCE

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**Programming Languages Mentoring Workshop @ POPL 2018** Los Angeles, CA  
*Participant* Jan. 2018

**Cornell, Maryland, Max Planck Pre-Doctoral Research School** Saarbrücken, Germany  
*Participant* Aug. 2017

- Attended lectures with faculty and researchers from participating institutions in the areas of security and privacy, social systems, distributed systems, machine learning, programming languages, and verification.

**The Mathematical Contest in Modeling held by COMAP** Davidson, NC  
*Contestant, Meritorious winner* Jan. 2016

COLLEGE AND DEPARTMENTAL SERVICE

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**Davidson College Human Subjects Institutional Review Board** Davidson, NC  
*Committee member* Fall 2016—Spring 2018

- Review research protocols submitted by researchers (students and/or faculty).

**Davidson College Center for Teaching and Learning**

Davidson, NC

*Mathematics and Computer Science Tutor*

Fall 2015—Spring 2017

- Tutored students in Computer Science and Mathematics courses including Data Structures, Discrete Structures, Calculus III, Linear Algebra, and Differential Equations.

**Davidson College Mathematics and Computer Science Department**

Davidson, NC

*Assistant Teacher for CSC 221 Data Structures*

Fall 2015—Spring 2017

- Led two 1.5-hour recitation sessions every week.

**Sustainability Digital Environment Project—iOS App “Foodscape”**

Davidson, NC

*iOS Developer (funded by Duke Energy)*

Summer 2015

- Developed an iOS Application—*Foodscape*—that provides food and sustainability information about dining services in Davidson and allows users to build personalized menus.

**EXTRA-CURRICULAR ACTIVITIES & CUMMUNITY SERVICE**

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**Music-related:**

1. Choir: Davidson Singer (Fall 2015—Spring 2018)
2. Davidson College Symphony Orchestra (Fall 2016—Spring 2017)
3. Piano solo recitals (list of past performances: <http://haozewu.com/#music>)
4. Piano accompanist for Sunday Mass at Lingle Chapel, Davidson (Fall 2015—Spring 2018)

**Others:**

1. Intramural basketball (Spring 2015—Fall 2016)
2. First year sustainability representative (Fall 2014—Spring 2015)