EMILY FIRST

Postdoctoral Researcher at UCSD

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I am interested in leveraging ***AI for theorem proving*** as a playground for exploring how AI can reason better, and in turn, how humans can use AI to reason better themselves in a variety of domains. I am an interdisciplinary researcher, working at the intersection of machine learning, software engineering, and programming languages.

EDUCATION

University of Massachusetts, Amherst, MA — September 2017-May 2023
PhD (May 2023), *MS* (May 2020), *Computer Science*
Advisor: Prof. Yuriy Brun

- GPA 3.97

Harvey Mudd College, Claremont, CA — September 2013-May 2017
B.S., Joint Major in Computer Science and Mathematics
Humanities Concentration in Economics

- GPA 3.5
- Graduated with Distinction

HONORS & AWARDS

- ACM SIGSOFT Distinguished Paper Award at ESEC/FSE 2023
- ACM SIGSOFT Distinguished Paper Award at ICSE 2022
- Jim Gray Computer Science Fellowship (2017)
- Wing and Ellen Tam Software Development Award (2016)

WORK EXPERIENCE

Postdoctoral Researcher, UC San Diego CSE, San Diego, CA — July 2023 - Present
My postdoc advisor is Prof. Sorin Lerner. My research is focused on automated theorem proving using LLMs through fine-tuning, prompt engineering, and neuro-symbolic techniques.

Research Assistant, UMass CICS, Amherst, MA — September 2017- May 2023
My research was focused on automatic synthesis of Coq and Isabelle proof scripts and tool creation for developers using language models.

Student Researcher, Google, Mountain View, CA — May 2022-October 2022
I worked with the N2Formal team on proof synthesis and repair in Isabelle using LLMs.

Teaching Assistant, UMass CICS, Amherst, MA — Fall 2021
I was a TA for COMPSCI 220 Programming Methodologies, a sophomore-level course

in JavaScript.

Research Intern, Raytheon, Woburn, MA May 2019-March 2020
I worked on multiple NLP projects. The main project was predicting the quality of radar runs using error logs. I also worked on using NLP to predict fixes for bug reports.

Consultant Intern, West Monroe Partners, Chicago, IL Summer 2016
I developed features for two iOS apps, debugged legacy code, and performed QA.

Undergraduate Research Assistant, Harvard University, Cambridge, MA Summer 2015
I worked on research on creating a multithreaded translation layer for SMR Drives, which are different from regular hard drives in that they have overlapping tracks, allowing for more data storage but slower write speeds.

PEER-REVIEWED FULL-LENGTH RESEARCH PUBLICATIONS

Robert Thompson, Nuno Saavedra, Pedro Carrott, Kevin Fisher, Alex Sanchez-Stern, Yuriy Brun, João F. Ferreira, Sorin Lerner, **Emily First**
Rango: Adaptive Retrieval-Augmented Proving for Automated Software Verification
In *Proceedings of the 47th International Conference on Software Engineering*
ICSE 2025

Chenyang An, Zhibo Chen, Qihao Ye, **Emily First**, Letian Peng, Jiayun Zhang, Zihan Wang, Sorin Lerner, Jingbo Shang
Learn from Failure: Fine-Tuning LLMs with Trial-and-Error Data for Intuitionistic Propositional Logic Proving
In *Proceedings of the 62nd Annual Meeting of the Association for Computational Linguistics*
ACL Main 2024

Emily First, Markus N. Rabe, Talia Ringer, Yuriy Brun.
Baldur: Whole-Proof Generation and Repair with Large Language Models
In *Proceedings of the 30th ACM Joint European Software Engineering Conference and Symposium on the Foundations of Software Engineering*
ESEC/FSE 2023
ACM SIGSOFT Distinguished Paper Award 🏆

Alex Sanchez-Stern*, **Emily First***, Timothy Zhou, Zhanna Kaufman, Yuriy Brun, Talia Ringer.
Passport: Improving Automated Formal Verification Using Identifiers (*Co-first authors)
In *ACM Transactions on Programming Languages and Systems*
TOPLAS 2023
(Presented as a journal-first paper at PLDI 2023)

Emily First, Yuriy Brun.
Diversity-Driven Automated Formal Verification
In *Proceedings of the 44th International Conference on Software Engineering*
ICSE 2022
ACM SIGSOFT Distinguished Paper Award 🏆

Emily First, Yuriy Brun, Arjun Guha.
TacTok: Semantics-Aware Proof Synthesis
In *Proceedings of the ACM on Programming Languages (PACMPL) Object-Oriented Programming, Systems, Languages, and Applications*
OOPSLA 2020

PREPRINTS

Saketh Ram Kasibatla, Arpan Agarwal, Yuriy Brun, Sorin Lerner, Talia Ringer, **Emily First**
Cobblestone: Iterative Automation for Formal Verification
arXiv 2024
Under Submission

PEER-REVIEWED DEMO-TRACK PUBLICATIONS

Pedro Carrott, Nuno Saavedra, Kyle Thompson, Sorin Lerner, João F. Ferreira, **Emily First**
CoqPyt: Proof Navigation in Python in the Era of LLMs
In *Proceedings of Demonstrations Track at the 32nd ACM International Conference on the Foundations of Software Engineering*
FSE 2024

Arpan Agrawal, **Emily First**, Zhanna Kaufman, Tom Reichel, Shizhuo Zhang, Timothy Zhou, Alex Sanchez-Stern, Talia Ringer, Yuriy Brun.
Proofster: Automated Formal Verification
In *Proceedings of the Demonstrations Track at the 45th International Conference on Software Engineering*
ICSE 2023

PEER-REVIEWED WORKSHOP PUBLICATIONS

Sólrún Einarsdóttir, Yousef Alhessi, **Emily First**, Moa Johansson
On Lemma Conjecturing using Neural, Symbolic and Neuro-symbolic approaches
In *9th Conference on Artificial Intelligence and Theorem Proving*
AITP 2024

Shizhuo Dylan Zhang, **Emily First**, Talia Ringer
Getting More out of Large Language Models for Proofs
In *8th Conference on Artificial Intelligence and Theorem Proving*
AITP 2023

COMMITTEE SERVICE

- OOPSLA 2025 Review Committee Member
- ICSE 2025 Program Committee Member
- Coq Workshop 2022 Program Committee Member

ORGANIZING

- Student Mentoring Workshop @ ICSE 2024
- Tutorial on Machine Learning for Theorem Proving @ NeurIPS 2023

INVITED TALKS

- Mediterranean Machine Learning (M2L) Summer School 2024
    - Talk title: Machine Learning for Theorem Proving
- Large Language Models for Mathematics and Programming Workshop @ Chalmers University of Technology (August 2024)
    - Talk title: Machine Learning for Theorem Proving Using Trial-and-Error
- Lecture for Discrete Mathematics course @ Fordham University (April 2024)
    - Talk title: Machine Learning for Formal Software Verification
- Computational Cybersecurity in Compromised Environments (C3E) 2023
    - Talk title: LLMs for Formal Proofs