

Matthew J. Davis

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Education

- **Georgia Institute of Technology** 2022 - Present
Ph.D Computer Science
Advisors: Dr. Vivek Sarkar, Dr. Vijay Ganesh
 - President's Fellow
 - **Texas A&M University – College Station** 2022
B.S. of Computer Science & Engineering
 - Engineering Honors
 - Summa Cum Laude
 - Undergraduate Research Scholar
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Technical Skills

Languages: Java, C++, Python, Cuda, C, Bash, SQL, JavaScript
Tools & Frameworks: MPI, OpenMP, Thread Sanitizer, LLVM

Experience

- **Oak Ridge National Lab** 2025
Research Student Intern *Supervisor: Dr. Keita Teranishi*
 - Developed a novel legacy code-translation infrastructure
 - Work under review for publication
 - **Helios Solutions** 2022
Software Engineering Intern *Supervisor: Mr. Joel Busa*
 - Developed software and developer infrastructure tools used by customer Intuitive Machines on their lunar landers: IM-1, IM-2, & IM-3.
 - Created graphic user interface tools for customer TTEch's switch and cable modeling.
 - **Argonne National Lab** 2021
Research Aide *Supervisor: Dr. Yanfei Guo*
 - Assisted the pmodel's MPICH team by integrating automated concurrency bug detection passes into their CI systems.
 - Adapted symbolic execution tool KLEE to automatically generate values for unit testing of MPI library functions.
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Research

- **Verified LLM-Based Code Translation** 2024 – Present
Advisor: Dr. Vijay Ganesh *Collaborators:*
 - Translating legacy & non-portable HPC code to modern languages and programming models
 - Translating Online Encyclopedia of Integer Sequences (OEIS) entries to Lean and C/C++
 - Translating loops to loop-invariant annotated loops for program verification
 - Large Language Models in a translation loop with validators providing feedback to guide repair

- Configuration Generation for NN Verification**
Advisor: Dr. Vijay Ganesh

2024 – Present
Collaborators: Salil Kamath

 - Created a reinforcement learning model trained using fuzzed NN instances to generate per-instance hyperparameter configurations for NN verifiers
 - Optimized solve time, keeping up with expert-tuned configurations.
- Hybrid OpenMP Data Mapping Violation Detection & Repair**
Advisor: Dr. Vivek Sarkar

2022 – Present
Collaborators: Dr. Lechen Yu

 - Reducing Arbalest Instrumentation using compiler analysis
 - Further optimizing by selecting a subset of target regions using OMPSanitizer’s static analysis results
 - Optimizing and repairing mapping data movement via OMPMemOpt & Arbalest results
- HPCTest - Detecting Heterogeneous Bugs in Scientific Computing Software**
Advisor: Dr. Vivek Sarkar

2022 – 2024
Collaborators: Manish Motwani

 - Combined LLM input generation, static analysis, guided fuzzing, & differential testing to create a fuzzing-based bug detection system which is scalable to large HPC & Scientific Computing systems.
 - Developed tools to guide the fuzzer using feedback based off analysis of runtime values and execution patterns.
- Extending OpenRace for CUDA Race Detection**
Advisor: Dr. Jeff Huang

2020 – 2021
Collaborators: Brad Swain, Coderrect Inc.

 - Extended static data race detection tool OpenRace to model and detect races in CUDA 8 and before (no cooperative groups) and fixed flaws in the OpenMP Device offload modeling which improved results on the DataRaceBench benchmark.
 - This work was merged into the OpenRace repository.
- Dynamatic OpenMP Race Detector**
Advisor: Dr. Jeff Huang

2019 – 2020
Collaborators: Dylan Theriot, Fatma Elsheimy

 - Developed a hybrid (static & dynamic) program analysis tool. This tool finds data race bugs in OpenMP programs by combining results from the HPCRace static analysis tool & Google Thread Sanitizer reports.
 - Improved the performance on benchmark DataRaceBench, keeping all true positives of HPCRace and disproving all false positives.
 - This work is published at: [Dynamatic: An OpenMP Race Detection Tool Combining Static and Dynamic Analysis](#)
- NEO-UFO**
Advisor: Dr. Jeff Huang

2019
Collaborators: Yahui Sun, Matthew Chen, Andrew Chin, Andreas Tsouloupas

 - Wrote a static analysis pass to identify regions in the Chromium browser base which were unlikely to have Use-After-Free (UAF) bugs. Converted these regions into Thread Sanitizer blacklist files to toggle off the expensive tracing and analysis for dynamic analysis tool UFO, greatly reducing the overhead.

Honors & Awards

- Eagle Scout
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Publications

- 2025** - Salil Kamath, **Davis, Matthew James**, Jonathan Andreasen, Yatis Dodia, and Vijay Ganesh. Automated VNN solver configuration selection via deep reinforcement learning. In *International Symposium on AI Verification*. [Link](#)
- 2022** - **Davis, Matthew James**; Theriot, Dylan (2022). Dynamatic: An OpenMP Race Detection Tool Combining Static and Dynamic Analysis. Bachelor’s Thesis. [Link](#)