Pratik M. Kamble

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Research

Research Interests

Systems security, compiler and runtime analysis, WebAssembly security, and software debloating. Doctoral research with Prof. Aravind Prakash examines the validity of forced-execution observations and compiler-guided operand repair, alongside ongoing fault-injection research.

Education

Binghamton University (SUNY), Binghamton, NY
Ph.D. in Computer Science — Aug 2025 – Expected May 2030
GPA: 4.00/4.00. Advisor: Prof. Aravind Prakash. Passed the Research Proficiency Exam, Nov 2026.

University of Florida, Gainesville, FL
M.S. in Computer Science — Aug 2021 – May 2023
GPA: 3.80/4.00.

University of Pune, Pune, India
B.E. in Computer Engineering — Aug 2015 – May 2019
GPA: 8.37/10.00.

Research Experience

Binghamton University (SUNY) — Binghamton, NY
Research Assistant, Research Foundation for SUNY — Aug 2025 – Present

Compiler-guided consistency in forced execution

Associated manuscript submitted; review pending.

- Investigated whether forced execution preserves the selected branch's condition: redirect-only forcing left it false on 63.7% of 4,691 paired directed edges, undermining value-dependent observations from those executions.
- Built a compiler-to-runtime prototype that binds each supported edge to an operand-repair action in the final executable, validates the request, repairs the operand, and rechecks the branch condition. Implemented LLVM instrumentation, post-link metadata packaging, and a Spike runtime extension on RV64 analysis builds.
- Raised edge-condition consistency from **36.3% to 83.9%**, with gains across all 30 subjects: 11 C applications and libraries and 19 Embench-IoT kernels. A separate 23,636-edge census, including unsupported and failed requests, yielded a true condition on 18.4% of edges versus 7.3% for redirect-only forcing.
- Measured changed outputs or called-function sets on **31.1% of 412 matched edges**; examined nine real-program cases to establish the limits of one-operand repair. The prototype uses dedicated `-O0` builds; a true local condition does not establish whole-path feasibility.

Research Experience (continued)

WebAssembly code bloat and security implications

Published at DIMVA 2026.

- Analyzed 8,461 WasmBench binaries using staged static reachability analysis. Measured dynamic coverage separately on 27 Wasm-R3 benchmarks, application libraries, microbenchmarks, and Linux-on-Wasm under controlled workloads.
- Used independent Wizard and Walrus instrumentation pipelines to measure function, basic-block, and instruction coverage. Found 70–85% of functions unexecuted in evaluated workloads despite near-zero provably dead code under conservative static analysis.
- Simulated debloating on optimized library binaries, measuring 4.9–11.6× smaller average control-flow integrity (CFI) equivalence classes, up to 40.7% fewer sensitive WASI imports, and potential removal of up to 81% of memory-store and 84% of indirect-call operations.

What humans still have to do when a coding agent writes secure firmware

First author; submitted to IEEE Software, special issue on Building Trustworthy Software in the Time of AI; under review.

- Followed a MITRE eCTF 2026 firmware built by a coding agent from prompts to attack, using saved records. It passed the functional tests, kept every flag for 99% of the attack phase, and lost flags only to voltage-glitch attacks.
- Identified the work that remained for humans: finding unstated rules, checking defenses, keeping code testable, and verifying agent reports.

Ongoing research

Early-stage investigation of fault-injection attacks.

University of Florida Gainesville, FL

Research Assistant, Embodied Learning & Experience Lab Jan 2023 – May 2023

- Developed backend APIs and a recommendation engine for an AI-powered platform supporting student mental health through nature-based mindfulness interventions.
- Built Android features for an augmented-reality mobile assistant for everyday STEM learning.
- Contributed to publications in the *Journal of Hospitality & Tourism Education* and *IEEE VRW* in 2024.

Peer-reviewed Publications

- S. Deshpande, **P. Kamble**, A. Carchi, and A. Prakash. "Learning Through Competition: A Retrospective on the 2026 MITRE eCTF at Binghamton University." *30th Colloquium for Information Systems Security Education (CISSE)*. Accepted; publication pending.
- **P. M. Kamble** and A. Prakash. "Dead Weight: Analyzing Code Bloat and Its Security Implications in WebAssembly Binaries." *DIMVA*, 2026.
- Y.-C. Wang, Y. Lu, S. Grunwald, S. L. Chu, **P. Kamble**, and J. Kumar. "An AI Approach to Support Student Mental Health: Case of Developing an AI-Powered Web-Platform with Nature-Based Mindfulness." *Journal of Hospitality & Tourism Education*, 36(3), 267–280, 2024.
- A. Kulkarni, C. Albright, **P. Kamble**, and S. L. Chu. "Investigating Situated Learning Theory Through an Augmented Reality Mobile Assistant for Everyday STEM Learning." *IEEE VRW*, 955–956, 2024.
- **P. M. Kamble**. "Life Logging: A Practicable Approach." *ICCUBEA*, 1–4, 2018.

Honors & Awards

Distinguished Reviewer Award, USENIX Security 2026 Artifact Evaluation. Recognized for thorough, constructive artifact reviews supporting reproducibility and open science.

Binghamton University nominee, Google PhD Fellowship 2026 (one of four nominees selected by the university).

Patent

A System and a Method for Performing a User Activity Using an Electroencephalogram (EEG).

Co-inventor; Indian Patent No. **540976**, granted Jun 6, 2024. Application No. 201921011129. Interprets EEG signals as device-control commands; developed during undergraduate research.

Professional Experience

Vibrent Health Fairfax, VA

Software Engineer Jun 2023 – May 2024

- Built a Kafka bulk-messaging interface, improving delivery speed and reducing server load for a platform serving NIH's All of Us Research Program and Children's National Hospital.
- Identified and resolved an architecture defect causing duplicate records, improving platform stability.

Vibrent Health Fairfax, VA

Software Engineering Intern Jun 2022 – Aug 2022

- Designed a GitHub API-based security-vulnerability detection tool and built services using Spring Boot, REST APIs, and JPA/Hibernate.
- Supported Docker, Kubernetes, and CI/CD deployments for NIH's All of Us Research Program.

Vignet Inc. Pune, India

Software Engineer Jul 2019 – Jul 2021

- Built Java/Spring/Hibernate applications for a precision-medicine research platform.
- Designed Spring Boot and Kafka microservices for Fitbit integration and contributed SQL-based user migration workflows and third-party data integration.

Academic Service & Leadership

CISSE 2026 Program Committee Member

Reviewed cybersecurity education papers.

USENIX Security 2026 Artifact Evaluation Committee Member

Evaluated research artifacts for availability, functionality, and reproducibility.

Capture the Flag Club, Binghamton University Binghamton, NY

Team Co-Captain Jan 2026 – Present

- Co-captained the team to 13th place among 100+ teams in MITRE eCTF 2026, directing defensive firmware and offensive exploit work on embedded systems and host-device communication protocols.
- Mentor students in embedded security and organize collaborative competition training.

Gator Hatchery Gainesville, FL

Consultant Aug 2022 – May 2023

Advised student entrepreneurs on planning and organizing the technical aspects of early-stage ventures.

UF Off Campus Life Gainesville, FL

Ambassador Aug 2022 – May 2023

Supported student community building through outreach and programming initiatives.

Technical Skills

Programming: C, C++, Python, Java, SQL.

Systems: Linux, RISC-V, WebAssembly.

Security research: Static analysis, compiler instrumentation, dynamic coverage analysis, forced execution, debloating analysis, AFL++ experimentation.

Research tools: LLVM, Spike, WABT, Binaryen, Wizard, Walrus, Emscripten.

Software engineering: Git, Docker, Spring Boot, REST APIs, Apache Kafka.