Zhenrong (Daniel) Gu

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RESEARCH INTERESTS

Formal methods and automated reasoning, paticularly **decision diagrams** (BDDs / NDDs / ADDs / CFLOBDDs) and **SMT solvers**, with application to programming languages, network verification, and networked systems.

EDUCATION

Xi'an Jiaotong University

Master Student in NetVerify, Advanced Networked System Group — Sep. 2024 – Present
- Advisor: Prof. Peng Zhang

B.Eng. in Computer Science and Technology (Honors Science Program) — Sep. 2020 – Jun. 2024
- GPA: 3.95/4.3, Average Score: 91.64, Major Rank: 4/37
- Thesis: Design and Implementation of Scalable Network Emulation System
- Core Courses: Core Courses: Programming Fundamentals (100), The Design and Analysis of Algorithms (98), Software-Defined Networks (99)

Honors Youth Program, Pre-University Program — Sep. 2019 – Jun. 2020

University of Wisconsin - Madison

Visiting International Student Program (Computer Sciences Thematic Track) — Sep. 2022 – Dec. 2022
- Grades: 4 courses, all A
- Core Courses: Operating Systems (A), Intro to Computer Architecture (A)

RESEARCH EXPERIENCE

Remote Research Collaborator, madPL Group, University of Wisconsin - Madison — **Apr. 2026 – Present**
Collaborator: Prof. Thomas Reps
- Co-developed the generalized CFLOBDD data structure with Meghana A. Sistla, with more generalized application in quantum computing and network verification;
- Designed enhanced data structures and algorithms for CFLOBDDs, reducing the overhead by 3.5-20× and eliminating 2-8× redundant intermediate products;
- Delivered a talk on network verification and generalized CFLOBDDs in person at UW-Madison in Aug. 2026.

Student Researcher, Advanced Networked System Group, Xi'an Jiaotong University — **Jul. 2023 – Present**
Advisor: Prof. Peng Zhang

Automatic Network Configuration Repair — Jul. 2025 – Present
- Proposed a syntax-driven approach to automatic network configuration repair (ACR), addressing the scalability limitations of existing semantic-driven, SMT-constraint-based ACR tools by adapting ideas from automatic program repair (APR);
- Achieved a 97.5% repair rate on a real production network, the system can be scaled up to and tested on 10,000-node-network real incidents.

Access Control Policy Verification — Jul. 2024 – Jun. 2025
- Contribute to the design and refinement of Relia, a general method to accelerate SMT solving with regular constraints by introducing equivalence classes, making cloud access control policy verification 8.21× faster;
- Designed the mechanism to deal with string-based and automata-based concatenation constraint splitting;
- Port the Relia-based regular constraint solving into access control policy intent mining project AccessRefinary, contributing to the idea of multi-round constraint preprocessor (MCP).

Scalable Network Emulation System — Jul. 2023 – Jun. 2024
- Independently designed and developed scalable network emulation system for heterogeneous network devices by fusing routing software images into a single process;
- Developed a custom dynamic loader for routing software images, and a custom user-space data path for intra-process networking;
- Achieved 300-2200× speedup in system boot time, and 3-5× reduction in connection establishment / round-trip time (RTT) latency.

Research Competition Partitipant, NUS Summer Workshop (Visual Computing) **May 2022 – Jul. 2022**
Advisor: Prof. Terence Sim

- Independently created a new method based on primary component analysis (PCA) for face detection and reconstruction;
- Be awarded the champion among all 12 groups, got a grade of A+.

Course and Extracurricular Projects **Sep 2021 – Present**

- Developed an operating system for RISC-V machines with virtual memory with page tables, multiprocessing, custom filesystems, and drivers for VirtIO blocks and displays. Repository: github.com/endaytrer/endros
- Developed a domain-specific language (DSL) and platform for containerized dataplane manipulation, based on eBPF.
- Developed a path tracing demo with JavaScript and WebGL.

WORK EXPERIENCE

ByteDance **Jul. 2025 – May 2026**
Network developer intern, Infrastructure – Network Team

PUBLICATIONS

[1] **Zhenrong Gu**, Peng Zhang, Xing Feng, and Xu Liu. 2026. Astragalus: Automatic Configuration Repair for Production Networks. *Accepted by 2026 ACM SIGOPS Annual Technical Conference* (2026). Retrieved from https://arxiv.org/abs/2605.22092

[2] Ning Kang, Peng Zhang, Jianyuan Zhang, Hao Li, Dan Wang, **Zhenrong Gu**, Weibo Lin, Shibiao Jiang, Zhu He, Xu Du, Longfei Chen, Jun Li, and Xiaohong Guan. 2026. AccessRefinery: Fast Mining Concise Access Control Intents on Public Cloud. *Proceedings of the ACM on Software Engineering* 3, FSE (2026), 1312–1334.

[3] Dan Wang, Peng Zhang, **Zhenrong Gu**, Weibo Lin, Shibiao Jiang, Zhu He, Xu Du, Longfei Chen, Jun Li, and Xiaohong Guan. 2025. Relia: Accelerating the Analysis of Cloud Access Control Policies. In *2025 40th IEEE/ACM International Conference on Automated Software Engineering (ASE)*, 2025. 228–240.

COMPUTER & LANGUAGE SKILLS

Computer Science
Proficiency in C, advanced Rust and C++, TypeScript, JavaScript, Java, Python and Go; Z3 / cvc5 for SMT solving, BDD/decision-diagram libraries, LEAN and formal proof assistants, system programming, proficient GNU/Linux skills (GCC / GDB / Shell), Linux kernel hacking and eBPF, embedded systems, fullstack web development.

Language (English)
TOEFL iBT 110 (R 30, L 30, S 25, W 25); CET-6 584, DET (Duolingo English Test) 130

AWARDS

Outstanding Graduate Leader, Xi'an Jiaotong University **Jun. 2024**

Bronze Award, 2021 International Collegial Programming Contest (ICPC) **Oct. 2021**
Asia Jinan regional contest (Ranked 108th / 726)

First Prize, Shuiyou Scholarship, China **Oct. 2021**

First Prize, 12th "Lanqiao" Cup National Software and IT Contest, China **May 2021**
Track of Java software development (ranked 6th in national final)

PERSONAL INTERESTS

Tennis, photography, video editing, sketching, graphics designing, full-stack web development, contributing to open-source communities.