Ruijie Meng

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BIOGRAPHY

Ruijie Meng is currently a Ph.D. candidate at National University of Singapore, advised by Provost's Chair Professor Abhik Roychoudhury. Her research focuses on improving important software systems, in particular, the reliability and security aspects of concurrent and stateful reactive systems (e.g., distributed systems and network protocols). Her research interests span software engineering and security topics: fuzz testing, software model checking, program analysis and LLMs for testing. Her research work has led to several papers published at premier conferences in both the software engineering domain (e.g., ICSE, FSE, and ASE) and the security domain (e.g., CCS and NDSS). She has developed several open-source automated security testing tools that are responsible for many previously-unknown (critical) vulnerabilities discovered in large real-world software systems.

EDUCATION

Ph.D. candidate, National University of Singapore (NUS), *Singapore* Aug 2020 – Present

- Major: Computer Science, School of Computing
- Advisor: Abhik Roychoudhury
- GPA: 4.83/5

M.Eng., University of Chinese Academy of Sciences (UCAS), *Beijing, China* Sep 2017 - Jun 2020

- State Key Laboratory of Computer Science, Institute of Software Chinese Academy of Sciences
- Advisor: Yan Cai
- GPA: 3.81/4 (Rank: 1/102)

B.Eng., Tianjin University (TJU), *Tianjin, China* Sep 2013 - Jun 2017

- Major: Software Engineering, School of Computer Software
- GPA: 3.79/4 (Rank: 3/113)

B.Ec., Nankai University (NKU), *Tianjin, China* Sep 2014 - Jun 2017

- Minor**:** Finance, School of Finance

RESEARCH PROJECTS

My recent research projects have been focused on developing innovative fuzzing algorithms to test **stateful and reactive software systems**. Specifically, my projects are over three main dimensions:

• **Advancing Fuzzing for More Complex Test Oracles:** Existing fuzzing cannot check property violations. We leverage the concept of automat-theoretic model checking to direct fuzzing to search for LTL-property violations.

• **Navigating Fuzzing towards Deep States:** Existing code feedback is not effective in guiding fuzzing towards deep states of reactive systems. We leverage LLMs to reason protocol states in fuzzing network protocols and build the first greybox fuzzer for distributed systems guided by model behaviors.

• **Capturing Effect of Complex Program Environment:** As reactive systems interact with complex execution environments, we propose fuzz testing to capture effect of different environments, avoiding environment modelling.

Beyond these, I also worked on detection of concurrency bugs and vulnerabilities via program analysis.

PUBLICATIONS

- **Program Environment Fuzzing** arXiv'24
  Ruijie Meng, Gregory J. Duck, Abhik Roychoudhury
  arXiv preprint arXiv:2404.13951

- **Large Language Model guided Protocol Fuzzing** NDSS'24
  Ruijie Meng, Martin Mirchev, Marcel Böhme, Abhik Roychoudhury
  Network and Distributed System Security Symposium (NDSS), 2024.

- **Greybox Fuzzing of Distributed Systems** CCS'23
  Ruijie Meng, George Pirlea, Abhik Roychoudhury, Ilya Sergey
  ACM Conference on Computer and Communications Security (CCS), 2023.

- **Linear-time Temporal Logic guided Greybox Fuzzing** ICSE'22
  Ruijie Meng, Zhen Dong, Jialin Li, Ivan Beschastnikh, Abhik Roychoudhury
  IEEE/ACM International Conference on Software Engineering (ICSE), 2022.

- **Low-Overhead Deadlock Prediction** ICSE'20
  Yan Cai, **Ruijie Meng**, Jens Palsberg
  IEEE/ACM International Conference on Software Engineering (ICSE), 2020.

- **ConVul: An Effective Tool for Detecting Concurrency Vulnerabilities** ASE'19
  Ruijie Meng, Biyun Zhu, Hao Yun, Haicheng Li, Yan Cai, Zijiang Yang
  IEEE/ACM International Conference on Automated Software Engineering Tool (ASE), 2019.

- **Detecting Concurrency Memory Corruption Vulnerabilities** ESEC/FSE'19
  Yan Cai, Biyun Zhu, **Ruijie Meng**, Hao Yun, Liang He, Purui Su, Bin Liang
  ACM European Software Engineering Conference/Symposium on the Foundations of Software Engineering (ESEC/FSE), 2019.

- **ConRS: A Requests Scheduling Framework for Increasing Concurrency Degree of Server Programs** COMPSAC'19
  Biyun Zhu, **Ruijie Meng**, Zhenyu Zhang, W.K.Chan
  IEEE International Computer Software and Applications Conference (COMPSAC), 2019.

SECURITY FINDINGS

Our tools have uncovered several zero-day security-critical vulnerabilities and granted with CVEs. In CVSS severity level, **7 CVEs** are classified as **CRITICAL**, and **13 CVEs** are categorized as **HIGH**:

• CVE-2023-37117	• CVE-2023-51713	• CVE-2023-31654	• CVE-2023-31655	• CVE-2023-3138
• CVE-2023-30635	• CVE-2023-30636	• CVE-2023-30637	• CVE-2021-38386	• CVE-2021-38387
• CVE-2021-42141	• CVE-2021-42142	• CVE-2021-42143	• CVE-2021-42144	• CVE-2021-42145
• CVE-2021-42146	• CVE-2021-42147	• CVE-2021-38311	• CVE-2021-40523	• CVE-2021-40524

ACADEMIC SERVICES

- Program Committee for ASE 2024 Tool Demonstration Track, 2024
- Reviewer for the Journal of Systems & Software (JSS), 2024
- Program Committee for ISSTA 2024 Artifact Evaluation, 2024
- Reviewer for IEEE Transactions on Computer-Aided Design of Integrated Circuits and Systems (TCAD), 2023
- Reviewer for ACM Transactions on Software Engineering and Methodology (TOSEM), 2023
- Program Committee for ISSTA 2023 Artifact Evaluation, 2023
- Program Committee for FUZZING 2022 Workshop@NDSS Artifact Evaluation, 2022
- Program Committee for ISSTA 2022 Artifact Evaluation, 2022
- Program Committee for ICSE 2022 Artifact Evaluation, 2022
- Student Volunteer for ESEC/FSE 2022, 2022

TEACHING EXPERIENCE

- Fuzzing Summer School — National University of Singapore
  Lecturer — May 2024
- CS5219 Automated Software Validation — National University of Singapore
  Teaching assistant — Aug 2023 – Dec 2023
- CS2040 Data Structures and Algorithms — National University of Singapore
  Teaching assistant — Jan 2023 – Apr 2023
- CS5219 Automated Software Validation — National University of Singapore
  Teaching assistant — Aug 2022 – Dec 2022
- CS2040 Data Structures and Algorithms — National University of Singapore
  Teaching assistant — Jan 2022 – Apr 2022
- CS2040S Data Structures and Algorithms — National University of Singapore
  Teaching assistant — Aug 2021 – Dec 2021

SELECTED AWARDS

- NUS Dean's Graduate Research Excellence Award — 2023
- NUSGS Research Incentive Award — 2023 - 2024
- NUS SoC Research Achievement Award — 2023
- Singapore President’s Graduate Fellowship — 2020 - 2024
- Outstanding Graduate of Beijing (*Top 2%*) — 2020
- Outstanding Graduate of University of Chinese Academy of Sciences (*Top 2%*) — 2020
- President’s Fellowship of University of Chinese Academy of Sciences (*Top 2%*) — 2020
- China National Scholarship (*Top 2%*) — 2019

- ACM SIGAI Scholarship 2019
- ACM SIGSOFT CAPS fund 2019
- First Prize Scholarship of University of Chinese Academy of Sciences (*Top 10%*) 2018, 2019
- Outstanding Bachelor Thesis of Tianjin University (Top *10%*) 2017
- Outstanding Graduate of Tianjin University (*Top 10%*) 2017