

Yue Gao

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RESEARCH INTERESTS

Adversarial Machine Learning (adversarial robustness, black-box evasion attacks and defenses)

System Security (machine learning systems, web-based applications and services)

EDUCATION

University of Wisconsin–Madison

Madison, WI

Ph.D. Candidate in Computer Science (advised by Prof. Kassem Fawaz)

Sep 2018 – Jan 2024 (expected)

- Thesis: *Characterizing the Limitations of Defenses in Adversarial Machine Learning*
- Courses: *Introduction to Information Security, Applied Cryptography, Advanced Operating Systems.*

Shanghai University

Shanghai, China

B.S. in Computer Science and Technology (GPA 3.99/4.00, Ranked 1/292)

Sep 2014 – Jul 2018

- Thesis: *A Deep Neural Network based Image Compression Method*
- Courses: *Operating Systems, Computer Network, Assembly Language, Software Engineering.*

WORK EXPERIENCE

Research Assistant @ University of Wisconsin–Madison

Madison, WI

Advised by Prof. Kassem Fawaz

Nov 2018 – Present

- Investigated the weaknesses of evasion attacks and defenses from the perspective of a border ML system.
- Improved the security analysis of ML-based and web-based systems in black-box settings.

Research Intern @ Microsoft Research

Redmond, WA

Mentored by Dr. Jay Stokes and Dr. Emre Kiciman

Jun 2021 – Sep 2021

- Proposed a research project on defenses against imperceptible textual backdoor attacks on language models.
- Discovered blind spots in state-of-the-art attacks and defenses, and published stronger defenses at MILCOM.
- Successfully reduced the attack success rate from 100% to 12%, even at a challenging poisoning rate of 10%.

Research and Development Intern @ TuCodec

Shanghai, China

Mentored by Dr. Chunlei Cai

Jan 2018 – Jul 2018

- Secured 1st place as a primary contributor in the CVPR 2018 Challenge on Learned Image Compression.
- Improved the average runtime efficiency of DNN-based compression from 1 min to 4 secs per 4K-res image.
- Independently developed DNN-based desktop apps on Ubuntu, MacOS, Windows using C++, Python, and Qt.
- Developed secure ML systems and prevented model stealing with both frontend and backend security measures.
- Scaled image compression DNN models with Docker, Kubernetes, and architecture-level optimizations.

PUBLICATIONS

Conference

[1] On the Limitations of Stochastic Pre-processing Defenses

Yue Gao, Ilia Shumailov, Kassem Fawaz, and Nicolas Papernot

Proceedings of the 36th Conference on Neural Information Processing Systems (NeurIPS), 2022

[2] Rethinking Image-Scaling Attacks: The Interplay Between Vulnerabilities in Machine Learning Systems

Yue Gao, Ilia Shumailov, and Kassem Fawaz

Proceedings of the 39th International Conference on Machine Learning (ICML), 2022

Oral Presentation (Top 2%)

[3] Experimental Security Analysis of the App Model in Business Collaboration Platforms

Yunang Chen*, Yue Gao*, Nick Ceccio, Rahul Chatterjee, Kassem Fawaz, and Earlene Fernandes

31st USENIX Security Symposium (USENIX Security), 2022

Bug Bounty (\$1500)

[4] I Know Your Triggers: Defending Against Textual Backdoor Attacks With Benign Backdoor Augmentation

Yue Gao, Jack W. Stokes, Manoj Prasad, Andrew Marshall, Kassem Fawaz, and Emre Kiciman

IEEE Military Communications Conference (MILCOM), 2022

Workshop

[1] Variational Autoencoder for Low Bit-rate Image Compression

Lei Zhou*, Chunlei Cai*, Yue Gao, Sanbao Su, and Junmin Wu

Proceedings of the IEEE Conference on Computer Vision and Pattern Recognition (CVPR) Workshops, 2018

Winner of the first Challenge on Learned Image Compression

Preprints

[1] SEA: Shareable and Explainable Attribution for Query-based Black-box Attacks

Yue Gao, Ilia Shumailov, and Kassem Fawaz

arXiv, 2023

[2] Analyzing Accuracy Loss in Randomized Smoothing Defenses

Yue Gao*, Harrison Rosenberg*, Kassem Fawaz, Somesh Jha, and Justin Hsu

arXiv, 2020

SELECTED PROJECTS

Security of Real-World Machine Learning Systems

Sep 2020 – May 2022

- Investigated the security of a real-world ML pipeline exposed to diverse security threats, e.g., dependencies.
- Revealed threats amplified by 9x and broke state-of-the-art defenses by jointly exploiting multiple vulnerabilities.
- Formally proved the non-robustness of randomization-based defenses beyond demonstrating empirical attacks.

Adversarially Robust Multimodal Object Detection (Collaborative)

Jun 2019 – Present

- Led a 9-member cross-university team to 1st and 2nd place in grant competitions from DARPA.
- Performed red teaming and broke over 10 internal defenses proposed by team members prior to submission.
- Proposed self-supervised and diffusion-based methods to enforce robust modality across RGB and Depth.
- Successfully reduced the disappearance rate from 62% to 9% even under the red-team evaluation from MITRE.
- Developed initial code bases and eval pipelines for team members from varying technical backgrounds.
- Contributed plug-and-play modules to the official upstream evaluation team and received acknowledgment.

Shareable and Explainable Attribution for Black-box Attacks on ML systems

Jan 2023 – Aug 2023

- Characterized the attack's progression for forensic purposes and human-explainable intelligence sharing.
- Fingerprinted and attributed zero-day attacks on their first and second occurrence, respectively.
- Discovered specific minor implementation bugs in popular ML attack toolkits like ART.

Security Analysis of Business Collaboration Platforms

Mar 2021 – Dec 2021

- Analyzed the permission model of third-party apps in Slack and Microsoft Teams with only closed-source access.
- Exploited OAuth designs to bypass access control and user privacy, and received bug bounty for medium severity.
- Demonstrated POC attacks of eavesdropping on private chats, spoofing video calls, and unauthorized code merging.

SELECTED HONORS & AWARDS

Slack Bug Bounty: Medium Severity, \$1500	2022
Top 10% Reviewers Award: NeurIPS	2022
CVPR Competition Winner: Challenge on Learned Image Compression	2018
National Scholarship: China	2017
Top 100 Elite Collegiate Award: China Computer Federation	2017
Scholarship for Exceptional Leadership: Shanghai University	2017
City Scholarship: Shanghai	2016
Outstanding Student Award: Shanghai University	2016
Outstanding Volunteer Award: ACM ICPC Asia Regional Contest	2016
Scholarship for Exceptional Innovation: Shanghai University	2016
Scholarship for Exceptional Academic Achievements: Shanghai University	2015 – 2018
Bronze Prize for Programming Contest: ACM ICPC Asia East-Continent Final Contest	2015
Bronze Prize for Programming Contest: ACM ICPC Asia Shanghai Regional Contest	2015

PROFESSIONAL ACTIVITIES

Reviewer: NeurIPS and ICML	2022 – 2024
External Reviewer: USENIX Security Symposium	2021 – 2022
External Reviewer: IEEE Symposium on Security and Privacy	2021 – 2022
External Reviewer: ACM Conference on Computer and Communications Security	2019
Team Leader: Collegiate ICPC Team at Shanghai University	2016 – 2017

TALKS

1. The Vulnerabilities of Preprocessing in Adversarial Machine Learning <i>ML Red Team, Google</i>	Oct 2023
2. The Vulnerabilities of Preprocessing in Adversarial Machine Learning <i>TrustML Young Scientist Seminar, RIKEN AIP</i>	Apr 2023
3. On the Limitations of Stochastic Pre-processing Defenses <i>University of Southern California (virtual)</i>	Oct 2022
4. The Interplay Between Vulnerabilities in Machine Learning Systems <i>University of Michigan</i>	Sep 2022
5. Experimental Security Analysis of the App Model in Business Collaboration Platforms <i>USENIX Security 2022</i>	Aug 2022
6. The Interplay Between Vulnerabilities in Machine Learning Systems <i>ICML 2022</i>	Jun 2022

TEACHING AND MENTORING

Teaching Assistant: CS 368 (C++ for Java Programmers), University of Wisconsin–Madison	Fall 2018
Guest Lecturer: Advanced Algorithms & Data Structures, Shanghai University	2015 – 2017
Problem Designer: Undergraduate Programming Contests, Shanghai University	2015 – 2017
Student Mentor: Undergraduate Computer Science Coursework, Shanghai University	2015 – 2017

TECHNICAL SKILLS

Python	Research (2018 – present), System Optimization (2018), Backend Development (2016 – 2017).
PyTorch	Research (2019 – present), Distributed Training (2020 – 2022).
Docker	Research (2018 – present), Computing Cluster (2017 – 2018), Model Deployment (2017 – 2018).
C / C++	Linux Kernel (2019), Encryption (2019), Software Development (2017 - 2018), ICPC (2014 – 2018).
Security	CTF (2015 – 2017, with IDA Pro, Burp Suite, and nmap).
TensorFlow	Research (2017 – 2020), Service Deployment (2018).
Java EE	Backend Development (2016).

ARTICLES AND MEDIA COVERAGE

CleverHans. Can stochastic pre-processing defenses protect your models?	2022
USENIX login. Experimental Security Analysis of the App Model in Business Collaboration Platforms	2022
Wired. Slack's and Teams' Lax App Security Raises Alarms	2022