Chenkai Weng

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Research Interests

Applied cryptography with a focus on secure multi-party computation and zero-knowledge proofs. The design, analysis, and implementation of MPC (e.g., garbled circuits, oblivious transfer, homomorphic encryption, and secret sharing-based protocols) and ZKP protocols (VOLE-based ZK and non-interactive ZK). The building of secure systems by applying cryptography-based privacy-enhancing techniques to various fields, including the database, networking, formal verification, machine learning, health care, and decentralized systems.

Education

Northwestern University — Evanston, IL
PhD in Computer Science; Advisor: Xiao Wang — *Sept. 2019 – Present*

Xidian University — Xi'an, China
BSc in Information Security — *Sept. 2015 – June 2019*

Experience

AI Research Summer Associate — New York, NY
JPMorgan Chase (mentor: Antigoni Polychroniadou) — *Jun. 2023 – Sept. 2023*

Research Intern — Remote
Chainlink Lab (mentor: Dahlia Malkhi) — *Oct. 2022 – May. 2023*

AI Research Summer Associate — New York, NY
JPMorgan Chase (mentor: Antigoni Polychroniadou) — *Jun. 2022 – Sept. 2022*

Research Intern — Remote
Microsoft Research (mentor: Melissa Chase) — *May. 2021 – Jul. 2021*

Security Engineering Intern — Beijing, China
Alibaba Group (Mentor: Cheng Hong) — *July 2018 – Jan. 2019*

Grants & Awards & Fellowships

1. Co-lead the development of an NSF grant (CNS Core: Medium: Privacy-Preserving and Censorship-Resistant Domain Name System)
2. JPMorgan PhD Fellowship 2023.
3. Northwestern Terminal Year Fellowship 2023-24.
4. Runner-up for Best Paper Awards, ACM Conference on Computer and Communications Security (CCS) 2021.
5. NUCS PhD Student Research Award, 2020-21.

Publications

$*$ indicates alphabetical order

1. **ZKSQL: Verifiable and Efficient Query Evaluation with Zero-Knowledge Proofs**
   Xiling Li, Chenkai Weng, Yongxin Xu, Xiao Wang, Jennie Rogers
   Very Large Data Bases (VLDB), 2023

2. $*$**SUPERPACK: Dishonest Majority MPC with Constant Online Communication**
   Daniel Escudero, Vipul Goyal, Antigoni Polychroniadou, Yifan Song, Chenkai Weng
   Annual International Conference on the Theory and Applications of Cryptology and Information Security (Eurocrypt), 2023

3. **AntMan: Interactive Zero-Knowledge Proofs with Sublinear Communication**
   Chenkai Weng, Kang Yang, Zhaomin Yang, Xiang Xie, and Xiao Wang
   ACM Conference on Computer and Communications Security (CCS), 2022

4. **More Efficient Secure Matrix Multiplication for Unbalanced Recommender Systems**
   Zhicong Huang, Cheng Hong, Wen-jie Lu, Chenkai Weng, Hunter Qu
   IEEE Transactions on Dependable and Secure Computing (TDSC)

5. ∗**Constant-Overhead Zero-Knowledge for RAM Programs**
   Nicholas Franzese, Jonathan Katz, Steve Lu, Rafail Ostrovsky, Xiao Wang, Chenkai Weng
   ACM Conference on Computer and Communications Security (CCS), 2021

6. **Mystique: Efficient Conversions for Zero-Knowledge Proofs with Applications to Machine Learning**
   Chenkai Weng, Kang Yang, Xiang Xie, Jonathan Katz, Xiao Wang
   USENIX Security Symposium, 2021

7. **Quicksilver: Efficient and Affordable Zero-Knowledge Proofs for Circuits and Polynomials over Any Field**
   Kang Yang, Pratik Sarkar, Chenkai Weng, Xiao Wang
   ACM Conference on Computer and Communications Security (CCS), 2021
   Best Paper Award runner-up

8. **Wolverine: Fast, Scalable, and Communication-Efficient Zero-Knowledge Proofs for Boolean and Arithmetic Circuits**
   Chenkai Weng, Kang Yang, Jonathan Katz, Xiao Wang
   IEEE Symposium on Security and Privacy (Oakland), 2021

9. **Developing High Performance Secure Multi-Party Computation Protocols in Healthcare: A Case Study of Patient Risk Stratification**
   Xiao Dong, David Randolph, Chenkai Weng, Abel Kho, Jennie Rogers, Xiao Wang
   AMIA Informatics Summit, 2021

10. **Ferret: Fast Extension for coRRElated oT with small communication**
    Kang Yang, Chenkai Weng, Xiao Lan, Jiang Zhang, Xiao Wang
    ACM Conference on Computer and Communications Security (CCS), 2020

11. ∗**Better Concrete Security for Half-Gates Garbling (in the Multi-Instance Setting)**
    Chun Guo, Jonathan Katz, Xiao Wang, Chenkai Weng, Yu Yu
    International Cryptology Conference (CRYPTO), 2020

Preprints

1. **Precio: Private Aggregate Measurement via Oblivious Shuffling**
   F. Betül Durak, Chenkai Weng, Erik Anderson, Kim Laine, Melissa Chase

2. **Privacy-Preserving Regular Expression Matching using Nondeterministic Finite Automata**
   Ning Luo, Chenkai Weng, Jaspal Singh, Gefei Tan, Ruzica Piskac, Mariana Raykova

3. **PDNS: A Fully Privacy-Preserving DNS**
   Yunming Xiao, Chenkai Weng, Ruijie Yu, Peizhi Liu, Matteo Varvello, Aleksandar Kuzmanovic

4. **An Efficient ZK Compiler from SIMD Circuits to General Circuits**
   Dung Bui, Haotian Chu, Geoffroy Couteau, Xiao Wang, Chenkai Weng, Kang Yang, Yu Yu

Teaching

Co-lecturer — Evanston, IL
Northwestern University — *Jan. 2023 – Mar. 2023*
- Advanced topics in cryptography: OT-extension, BGW, MPC-in-the-head, PSI protocols.

Teaching Assistant — Evanston, IL
Northwestern University — *Sept. 2020 – Dec. 2020*
- Introduction to Cryptography

Invited Talks

1. May. and Oct. 2023 - "SUPERPACK: Dishonest Majority MPC with Constant Online Communication", at NYU Crypto reading group, UPenn Security Seminar and CMU Cylab Crypto Seminar.
2. Apr. 2023 - "Efficient and Scalable Zero-Knowledge Proofs based on Vector Oblivious Linear Evaluation", at JPMorgan AlgoCRYPT Seminar.
3. Sept. 2022 - "Efficient Interactive Zero Knowledge Proof Based on VOLE", at Yale University CS talk.
4. Mar. 2021 - "Fast, Scalable, and Communication-Efficient Zero-Knowledge Proofs", Security and privacy seminar at Duke Univeristy.

Service

Program committee member: AsiaCCS 2024.

External reviewer: CRYPTO 2021-23, ITC 2022, Asiacrypt 2022-23, IEEE S&P (Oakland) 2023, PKC 2023.

Journal reviewer: IEEE TDSC, IEEE TIFS, IEEE TCBB, ACM TOPS, IACR JoC.

Software

EMP library: EMP-TOOL (Circuits for floating-point arithmetic, various fundamental cryptographic primitives), EMP-OT (Oblivious transfer based on VOLE), EMP-ZK (Interactive zero-knowledge proofs based on VOLE, including the circuit, polynomial and RAM models).

SUPERPACK: An actively-secure dishonest-majority MPC protocol based on packed Shamir secret sharing.