Hyeongmin Choe

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OVERVIEW

I am a Ph.D. candidate at the Department of Mathematical Sciences, Seoul National University (SNU), Republic of Korea. My advisor is Prof. Jung Hee Cheon. I work on cryptography, currently focusing on, but not limited to, Homomorphic Encryption (HE) and Lattice-based Post-Quantum Cryptography (PQC). I am a member of *Team SMAUG(-T)* and *Team HAETAE*, participating in PQC standard efforts in KpqC competition and NIST Additional Signatures.

EDUCATION

Seoul National University, Seoul, Republic of Korea

- Integrated Ph.D. in Mathematical Sciences — Sep 2019 – Present
  - Consists of a two-year M.S. course and a three-year Ph.D. course
  - Adviser: Jung Hee Cheon
  - Focus: Cryptography (Homomorphic Encryption, Lattice-based Post-Quantum Cryptography)
- B.S. in Mathematical Sciences — Mar 2013 – Aug 2019

PUBLICATIONS

Authors are listed in alphabetical order by last name, unless an asterisk(*) is indicated.

CONFERENCES

C04 Hyeongmin Choe, "Toward Practical Threshold FHE: Low Communication, Computation and Interaction," *ACM CCS 2024 Doctoral Symposium (Extended Abstract)*.

C03 Jung Hee Cheon, Hyeongmin Choe, Alain Passelègue, Damien Stehlé, and Elias Suvanto, "Attacks Against the IND-CPA^D Security of Exact FHE Schemes," *The ACM Conference on Computer and Communications Security (CCS) 2024*.

C02 Jung Hee Cheon, Hyeongmin Choe, Julien Devevey, Tim Güneysu, Dongyeon Hong, Markus Krausz, Georg Land, Marc Möller, Damien Stehlé, and MinJune Yi, "HAETAE: Shorter Lattice-Based Fiat-Shamir Signatures," *The annual Conference on Cryptographic Hardware and Embedded Systems (CHES) 2024*.

C01 Jung Hee Cheon, Hyeongmin Choe, Dongyeon Hong, and MinJune Yi, "SMAUG: Pushing Lattice-based Key Encapsulation Mechanisms to the Limits," *Selected Areas in Cryptography (SAC) 2023*.

JOURNALS

J04 *Seungwan Hong, Jai Hyun Park, Wonhee Cho, Hyeongmin Choe and Jung Hee Cheon, "Secure tumor classification by shallow neural network using homomorphic encryption," *BMC Genomics*, vol. 23, no. 284, Apr 2022.

J03 Jung Hee Cheon, Hyeongmin Choe, Donghwan Lee and Yongha Son, "Faster Linear Transformations in HElib, revisited," *IEEE Access*, vol. 7, pp. 50595–50604, Apr 2019.

J02 *Siyul Lee and Hyeongmin Choe, "On Fourth-order Iterative Methods for Multiple Roots of Nonlinear Equations with High Efficiency," *Journal of Computational Analysis and Applications*, vol. 18(1), pp. 109–120, Jan 2015. (High school R&E)

J01 *Siyul Lee and Hyeongmin Choe, "Multiplicational Combinations and A General Scheme of Single-step Iterative Methods for Multiple Roots," *Journal of Computational Analysis and Applications*, vol. 15(6), pp. 1138–1149, Oct 2013. (High school R&E)

MANUSCRIPTS

M05 Jung Hee Cheon, Hyeongmin Choe, Jungjoo Seo, Hyoeun Seong, "SMAUG(-T), Revisited: Timing-secure, More Compact, Less Failure," Nov 2024. *In submission.*

M04 Jung Hee Cheon, Hyeongmin Choe, Yongdong Yeo, "Reusable Dynamic Multi-Party Homomorphic Encryption," Jun 2024.

M03 Jung Hee Cheon, Hyeongmin Choe, Minsik Kang, Jaehyung Kim, "Grafting: Complementing RNS in CKKS," *Cryptology ePrint Archive, Paper 2024/1014*, Jun 2024. *In Submission.*

M02 Jung Hee Cheon, Hyeongmin Choe, and Jai Hyun Park, "Tree-based Lookup Table on Batched Encrypted Queries using Homomorphic Encryption," *Cryptology ePrint Archive, Paper 2024/087*, Jan 2024. *In Submission.*

M01 Jung Hee Cheon, Hyeongmin Choe, Saebyul Jung, Duhyeong Kim, Dah Hoon Lee, and Jai Hyun Park, "Arithmetic PCA for Encrypted Data," *Cryptology ePrint Archive, Paper 2023/1544*, Oct 2023.

SPECIFICATIONS

Specifications submitted to standardization processes.

- HAETAE (based on C02), submitted to *KpqC Competition Round 2* (Feb 2024), *NIST Additional Digital Signature Schemes Round 1* (May 2023), and *KpqC Competition Round 1* (Dec 2022).
- SMAUG(-T) (based on C01), submitted to *KpqC Competition Round 2* (Feb 2024) and *KpqC Competition Round 1* (Dec 2022).

AWARDS & HONORS

AWARDS

- Korean National Cryptography Contest, National Security Research Institute (NSRI)
  An annual contest encouraging Korean students to work on cryptography research papers. Grand, Best, Excellence, Encouragement, and Special prizes.
  - Grand Prize for C03 — Oct 2024
  - Encouragement Prize for M04 — Oct 2024
  - Special Prize for M05 (with a different working title) — Oct 2024
  - Encouragement Prize for M01 — Oct 2022
- TA Awards, Seoul National University — Aug 2023
  - Excellence in Teaching, for teaching "Honor Calculus Practice 1 (2023 Spring)"
- iDASH Genomic Data Privacy and Security Protection Competition, American NIH — Dec 2020
  - First Place Prize in Track I: "Secure Multi-label Tumor Classification using Homomorphic Encryption"

HONORS

- *BK 21+ Scholarship* — *Sep 2019 – Present*
  Ministry of Education of Korea
- *Presidential Science Scholarship (Undergraduate)* — *Mar 2013 – Dec 2018*
  Korea Student Aid Foundation

TALKS

Lists of selective talks.

2024

- *Toward Practical Threshold FHE: Low Communication, Computation and Interaction* — *Oct 2024*
  ACM CCS 2024 Doctoral Symposium (affiliated with ACM CCS 2024), Salt Lake City, U.S.A.
- *HAETAE v3.0* — *Aug 2024*
  Invited Talk, KpqC Contest 2nd Round Colloquium, Hansung University, South Korea
- *HAETAE: Shorter Lattice-based Fiat-Shamir Signatures* — *May 2024*
  Invited Talk, Sungshin Women's University, South Korea
- *Bridging Algebraic Number Theory to Post-Quantum Digital Signatures* — *Feb 2024*
  2024 Algebra Camp, Bloomvista, South Korea

2023

- *Mathematical Foundation of Lattice Crypto (jointly with Jung Hee Cheon)* — *Sep 2023*
  Pre-study of Damien Stehlé's talk, "CRYSTALS-KYBER, CRYSTALS-DILITHIUM and Beyond"
  Distinguished Lecture on NIST PQC Standards, Seoul National University, South Korea
- *SMAUG: Pushing Lattice-based Key Encapsulation Mechanisms to the Limits* — *Aug 2023*
  SAC 2023, University of New Brunswick, Canada
- *HAETAE, a Post-Quantum Signature Scheme* — *Jul 2023*
  Invited Talk, Korea University, South Korea
- *HAETAE: Rejecting on Hyperballs* — *May 2023*
  KIAS-JBNU KpqC Workshop, Jeonbuk National University, South Korea
- *Introduction to HAETAE* — *Feb 2023*
  2023 KpqC Winter Camp, Chung-Ang University, South Korea

2022 & BEFORE

- *Efficient, Round-optimal Blind Signatures from Standard Assumptions* — *Apr 2022*
  2022 KMS Spring Meeting, virtual
- *Security Analysis on NIST PQC Lattice-based Finalists* — *Nov 2021*
  3rd KpqC Workshop, Alpensia Resort, South Korea
- *Conversion between Two RLWE-based FHE Schemes and its Application* — *Oct 2020*
  2020 KMS Fall Meeting, virtual

PROJECTS *List of selective projects.*

- *DARPA Data Protection in Virtual Environments (DPRIVE)* — *2022 – 2023*
- *HE Technology for 6G Security (LG Elec.)* — *2022 – 2023*
- *Security Analysis on NIST PQC Finalists (NSR)* — *2021*
- *Sensitive Data Protection using HE and its Acceleration (Samsung Elec.)* — *2020 – 2024*
- *Development and Library Implementation of Fully Homomorphic ML Algorithms supporting Neural Network Learning over Encrypted Data (IITP)* — *2020 – 2023*

EXPERIENCES

TEACHING

- *Invited Lecturer for PQC Training Course, conducted by CryptoLab Inc.* — *2024*
  Concrete Security of Lattice-based PQC Schemes–Lectures and Tutorials (7h)
- *Seoul National University, Math Courses TA*
  - *Calculus TA Seminar* — *2024*
  - *Computational Number Theory, Honor Calculus Practice 1, 2* — *2023*
  - *Differential & Integral Calculus Practice 1* — *2022*
  - *Number Theory, Differential & Integral Calculus Practice 1, Honor Calculus Practice 2* — *2021*
  - *Calculus TA Seminar, Calculus Practice 1, Honor Calculus Practice 2* — *2020*
- *Korean Mathematical Olympiad (KMO) Winter/Summer School TA* — *2013 – 2014*
  2013 & 2014 Winter/Summer Schools

MILITARY

- *Republic of Korea Air Force (ROKAF)* — *Jul 2015 – Jul 2017*
  Intelligence System Management Group, Gyeryong, discharged as a Sergeant

INTERNSHIPS

- *Undergraduate Research Internships*
  - *Stochastic Representations of the Hyperbolic PDEs* — *2019*
    Seoul National University, advised by Prof. Seung Yeal Ha
  - *Homomorphic Signature Schemes and Threshold Cryptosystems* — *2018 – 2019*
    Sejong University, advised by Prof. Ji Sun Shin
  - *Lattice Reductions and Homomorphic Encryption with C++* — *2018 – 2019*
    Seoul National University, advised by Prof. Jung Hee Cheon
  - *Machine Learning (Image Processing) with Python, Matlab* — *2017*
    Seoul National University, advised by Prof. Myungjoo Kang

SKILLS

- *LaTeX, Matlab, Python: Proficient*
- *C/C++, Mathematica, SageMath, HTML: Working Knowledge*
- *R, PyTorch, TensorFlow: Basic*

SERVICES

REVIEWER (JOURNALS)

- *Design, Codes and Cryptography (DCC), Journal of Cryptology (JoC).*

REVIEWER (CONFERENCES)

- *ANTS 2020, MathCrypt 2021, PQCrypto 2021, Asiacrypt 2021, 2022, ACM CCS 2022, FHE.org 2022, PQCrypto 2023, PKC 2024, Eurocrypt 2024, PQCrypto 2024.*

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