Hyeongmin Choe

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OVERVIEW

I am an Integrated PhD student 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 homomorphic encryption (HE) and lattice-based post-quantum cryptography (PQC). I am a member of *Team SMAUG* and *Team HAETAE,* PQC standard candidates 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.

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.

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.

CONFERENCES

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

SPECIFICATIONS

S03 Jung Hee Cheon, Hyeongmin Choe, Julien Devevey, Tim Güneysu, Dongyeon Hong, Markus Krausz, Georg Land, Damien Stehlé and MinJune Yi, "HAETAE: Algorithm Specifications and Supporting Documentation," *NIST Additional Digital Signature Schemes Round 1*, May 2023.

S02 Jung Hee Cheon, Hyeongmin Choe, Julien Devevey, Tim Güneysu, Dongyeon Hong, Markus Krausz, Georg Land, Damien Stehlé and MinJune Yi, "HAETAE: Hyperball bimodAl modulE rejecTion signAture schemE," *KpqC Competition Round 1*, Dec 2022.

S01 Jung Hee Cheon, Hyeongmin Choe, Dongyeon Hong and MinJune Yi, "SMAUG: the Key Exchange Algorithm based on Module-LWE and Module-LWR," *KpqC Competition Round 1*, Dec 2022.

MANUSCRIPTS

M02 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," *Cryptology ePrint Archive, Paper 2023/624*, May 2023.

M01 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.
Encouragement Prize, National Cryptography Contest 2022

AWARDS & HONORS	**AWARDS**

- Excellence in Teaching   Aug 2023
  Seoul National University, Department of Mathematical Sciences
  For teaching Honor Calculus Practice 1

- Encouragement Prize (4th, Top 15)   Oct 2022
  (Korean) National Cryptography Contest, National Security Research Institute (NSRI)
  For the paper "Arithmetic PCA for Encrypted Data"

- First Place Prize, iDASH Secure Genome Analysis Competition   Dec 2020
  iDASH Genomic Data Privacy and Security Protection Competition, National Institutes of Health (NIH)
  In Track I: Secure multi-label Tumor classification using Homomorphic Encryption

HONORS

- BK 21+ Scholarship   Sep 2019 – Aug 2022, Feb 2023 – Present
  Ministry of Education of Korea

- Presidential Science Scholarship   Mar 2013 – Dec 2018
  Korea Student Aid Foundation

TALKS

- 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: 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

- Introduction to SMAUG KEM and HAETAE signature schemes   Jan 2023
  Winter Crypto Camp 2023, Konjiam Resort, South Korea

- Efficient, Round-optimal Blind Signatures from Standard Assumptions   Apr 2022
  2022 KMS Spring Meeting, virtual

- Blind Signatures from HE   Jan 2022
  Winter Crypto Camp 2022, Konjiam Resort, South Korea

- Security Analysis on NIST PQC Lattice-based Finalists   Nov 2021
  3rd KpqC Workshop, PyeongChang, 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 – Present
- 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 – Present
- Development and Library Implementation of Fully Homomorphic ML Algorithms supporting Neural Network Learning over Encrypted Data (IITP)   2020 – Present

EXPERIENCES

TEACHING

- Seoul National University, Math Courses TA
  - Computational Number Theory, Honor Calculus Practice 1*, 2   2023
    *Awarded for excellence in teaching
  - 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   Jan 2013 – Aug 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++, HEaaN, HElib, 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.

Last Updated: Aug 2023