Seewoo Lee

Ph. D. student in Mathematics
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Education

University of California Berkeley — Berkeley
Ph.D in Mathematics — 2018 – Present

- On leave for military service (2019 Fall - 2022 Summer)
- Advisor: Sug Woo Shin

Pohang University of Science and Technology (POSTECH) — Pohang
M.S in Mathematics — 2017 – 2018

- Thesis: *Maass wave forms, quantum modular forms and Hecke operators*
- Advisor: YoungJu Choie

Pohang University of Science and Technology (POSTECH) — Pohang
B.S. in Mathematics — 2013 – 2017

- *Summa Cum Laude* with top honours in mathematics
- Honor's thesis: *Quantum modular forms and Hecke operators*

Experiences

CryptoLab — Seoul
Research Engineer — 2021.05 – 2022.07

- Research on Homomorphic Encryption and application in Machine Learning

Riiid! — Seoul
Research Scientist — 2019.07 – 2021.05

- Research on Knowlege Tracing, Score Prediction, Student Dropout Prediction, Item Recommendation

Research Interests

- Number theory, Automorphic Forms and Representations, Analytic Number Theory, Algebraic Number Theory, Relative Langlands Program
- Deep learning, Natural Language Processing, Homomorphic Encryption, Formalization of mathematics

Publications

- Math

1. J. Baek, **S. Lee**, *An equilateral triangle of side $> n$ cannot be covered by $n^2 + 1$ unit equilateral triangles homothetic to it*, American Mathematical Monthly, 1-9 (2024)
2. D. Choi, **S. Lee**, *Non-archimedean Sendov's conjecture*, p-adic numbers, Ultrametric Analysis and Applications 14, 77-80 (2022)
3. **S. Lee**, *Maass wave forms, Quantum Modular Forms and Hecke Operators*, Res. Mathematical Science 6, 7 (2018), Modular Forms are Everywhere: Celebration of Don Zagier's 65th Birthday
4. **S. Lee**, *Quantum Modular Forms and Hecke Operators*, Res. Number Theory 4, 18 (2018)
5. Y. Chen, R. Chernov, M. Flores, M. F. Bourque, **S. Lee**, B. Yang, *Toy Teichmüller spaces of real dimension 2: the pentagon and the punctured triangle*, Geom. Dedicata 197 (2018), 193-227

- Others

1. **S. Lee**, G. Lee, J. Kim, J. Shin, M. Lee, *HETAL: Efficient Privacy-preserving Transfer Learning with Homomorphic Encryption*, International Conference on Machine Learning. 2023 (Oral, 155/6538)
2. **S. Lee**, J. Kim, *Revisiting the Convergence Theorem for Competitive Bidding in Common Value Actions*, Economic Theory Bulletin 10, 293-302 (2022)
3. **S. Lee**, K. Kim, J. Shin, J. Park, *Tracing Knowledge for Tracing Dropouts: Multi-Task Training for Study Session Dropout Prediction*, Educational Data Mining. 2021
4. M. Kim, Y. Shim, **S. Lee**, H. Loh, J. Park, *Behavioral Testing of Deep Knowledge Tracing Models*, Educational Data Mining 2021
5. H. Loh, D. Shin, **S. Lee**, J. Baek, C. Hwang, Y. Lee, Y. Cha, S. Kwon, J. Park and Y. Choi, *Recommendation for Effective Standardized Exam Preparation*, LAK21: 11th International Learning Analytics and Knowledge Conference. 2021
6. D. Shin, Y. Shim, H. Yu, **S. Lee**, B. Kim, Y. Choi, *SAINT+: Integrating Temporal Features for EdNet Correctness Prediction*, LAK21: 11th International Learning Analytics and Knowledge Conference. 2021
7. Y. Choi, Y. Lee, D. Shin, J. Cho, S. Park, **S. Lee**, J. Baek, B. Kim, Y. Jang, *EdNet: A Large-Scale Hierarchical Dataset in Education*, International Conference on Artificial Intelligence in Education (2021), 69-73
8. J. Kim, **S. Lee**, *Joint Liability and Stochastic Shapley Value*, International Review of Law & Economics 60 (2019), 1-8

Preprints

1. **S. Lee**, *Algebraic proof of modular form inequalities for optimal sphere packings*. arXiv:2406.14659
2. J. Baek, **S. Lee**, *Formalizing Mason–Stothers Theorem and its Corollaries in Lean 4*. arXiv:2408.15180

Awards, Grants & Honours

Department of Mathematics Summer Grant, UC Berkeley . . . . . 2024 Summer
Outstanding Graduate Student Instructor Award, UC Berkeley . . . . . 2024 Spring
Graduate Student Researcher, UC Berkeley . . . . . 2023 Spring, Summer
Kwanjeong Educational Foundation Scholarship, KEF 2017–2018
Excellency Award (Top Honours), Dept. of Mathematics, POSTECH 2017
POSTECH Outstanding Talent Development Scholarship, POSTECH 2013–2016
National Science and Technology Scholarship, KOSAF 2013–2016
Silver medals, Undergraduate Mathematical Competition, KMS 2013, 2015, 2016
31st place, ACM-ICPC Daejeon Regional, ACM 2015
Grand prize, POSTECH Programming Contest, Dept. of Computer Science, POSTECH 2015
Honorable mention, Korean Olympiad of Informatics, NIA 2012

Teaching Experience

Graduate Student Instructor (T.A.) Berkeley
UC Berkeley 2019 – Present

- (2025 Spring) Cryptography, Introduction to Mathematical Logic
- (2024 Fall) Abstract Linear Algebra
- (2024 Spring) Methods of Mathematics: Calculus, Statistics, and Combinatorics
- (2023 Fall) Methods of Mathematics: Calculus, Statistics, and Combinatorics
- (2022 Fall) Multivariable Calculus
- (2019 Spring) Methods of Mathematics: Calculus, Statistics, and Combinatorics

Directed Reading Program Berkeley
UC Berkeley 2023

- (2025 Spring) Modular forms (Dongho Kim)
- (2023 Fall) Elliptic curves (Jacob Martin)
- (2023 Spring) p-adic numbers (Lucas Xie)

Grader & T.A. Pohang
POSTECH 2015 – 2018

- (2018 Spring) Differential Manifolds and Lie groups (Graduate course)
- (2017 Fall) Modern Algebra II
- (2017 Spring) Calculus
- (2016 Fall) Applied Linear Algebra (Undergraduate T.A.)
- (2015 Winter) POSTECH Potential Development Camp for High School Students

Tutoring Pohang
POSTECH 2014 – 2015

- (2015 Spring) Calculus
- (2015 Spring) Modern Algebra I
- (2014 Fall) Analysis II
- (2014 Spring) Analysis I

Talks

- Research Talks
  - RTG seminar, Berkeley, February 2025
    Algebraic proof of modular form inequalities for optimal sphere packings
  - Algebra Discrete Math seminar, Davis, January 2025
    Algebraic proof of modular form inequalities for optimal sphere packings
  - 6th EU/US Workshop on Automorphic Forms and Related Topics, Luminy, September 2024
    Algebraic proof of modular form inequalities for optimal sphere packings
  - POSTECH Number Theory Seminar, Pohang, May 2024
    Algebraic proof of modular form inequalities for optimal sphere packings
  - Student Number Theory Seminar, Berkeley, April 2024
    Algebraic proof of Viazovska's inequalities
  - School of Mathematics, KIAS, Seoul, December 2023
    A new proof of Viazovska's modular form inequality and beyond
  - International Conference on Machine Learning, Hawaii, US, July 2023
    HETAL: Efficient Privacy-preserving Transfer Learning with Homomorphic Encryption
  - Center for Artificial Intelligence and Natural Sciences, KIAS, Seoul, June 2023
    HETAL: Efficient Privacy-preserving Transfer Learning with Homomorphic Encryption
  - School of Computing, KAIST, Daejeon, June 2023
    HETAL: Efficient Privacy-preserving Transfer Learning with Homomorphic Encryption
  - 1st FHE.org workshop, Trondheim, May 2022
    Encrypted Multinomial Logistic Regression Training with Softmax Approximation
  - Workshop for Young Mathematicians in Korea, Online, January 2022
    Hitchhiker's guide to non-archimedean world
  - Graduate student seminar, Sogang University, Seoul, July 2018
    Maass wave forms, quantum modular forms and Hecke operators
  - Sungkyunkwan University, Seoul, June 2018
    Maass wave forms, quantum modular forms and Hecke operators
  - NCTS-POSTECH Number Theory Workshop, NTU, Taiwan, December 2017
    Quantum modular forms and Hecke operators
- Expository Talks
  - Bruhat-Tits building seminar, Berkeley, February 2025
    Bruhat-Tits buildings for split groups
  - Berkeley–Stanford Number Theory Learning Seminar, Berkeley, December 2024.
    Proof of irrationality of $L(2, \chi_{-3})$ and product of log values
  - Student Number Theory Seminar, Berkeley, October 2024
    Modular forms on G_2
  - Geometric class field theory learning seminar, Berkeley, Sep 2024
    Singular algebraic curves and de-normalization
  - Student Number Theory Seminar, Berkeley, March 2024
    Linear Programming Beyond Sphere Packing

- Orbit methods and automorphic forms learning seminar, Berkeley, Oct 2023
  Gan–Gross–Prasad conjectures
- Student Number Theory Seminar, Berkeley, Nov 2022
  Shimura correspondence and Waldspurger's formula
- Instructional Workshop on Class Field Theory, KIAS, Seoul, January 2018
  Proof of the main theorem of local class field theory

Languages

- Korean (native), English (fluent)
- Python (PyTorch, Numpy, Pandas), C/C++, LaTeX, SAGE Math, Lean, MATLAB, Haskell

Miscelleneous (click the icons)

- Working as a reviewer for Mathematical Reviews (2022∼)
- GitHub blog on various topics
- Math Stackexchange & Math Overflow
- Speedcuber
- DJ (Techno, Trance, House)