

## Seewoo Lee

Ph. D. student in Mathematics

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### Education

#### University of California Berkeley

Ph.D in Mathematics

Berkeley

2018 – 2026 (expected)

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

#### Pohang University of Science and Technology (POSTECH)

M.S in Mathematics

Pohang

2017 – 2018

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

#### Pohang University of Science and Technology (POSTECH)

B.S. in Mathematics

Pohang

2013 – 2017

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

### Experiences

#### CryptoLab

Research Engineer

Seoul

2021.05 – 2022.07

- Research on Homomorphic Encryption and application in Machine Learning

#### Riidx

Research Scientist

Seoul

2019.07 – 2021.05

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

### Research Interests

- Automorphic Forms and Representations, Computational Number Theory, Relative Langlands Program
- Machine Learning and Deep Learning, Formalization of Mathematics, Homomorphic Encryption

## Publications

- Math

1. **S. Lee**, *Shanks bias in function fields*, To appear in Journal de Théorie des Nombres de Bordeaux, arXiv:2509.16142
2. 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)
3. D. Choi, **S. Lee**, *Non-archimedean Sendov's conjecture*, *p*-adic numbers, Ultrametric Analysis and Applications 14, 77-80 (2022)
4. **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
5. **S. Lee**, *Quantum Modular Forms and Hecke Operators*, Res. Number Theory 4, 18 (2018)
6. 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. F. Lin, K. Nagel, **S. Lee**, J. Jiang, G. Yang, P. Chang, S. Li, N. Sheu, *An Analysis of Silk Density in Spider Webs*, Royal Society Open Science 12: 250455 (2025)
2. **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)
3. **S. Lee**, J. Kim, *Revisiting the Convergence Theorem for Competitive Bidding in Common Value Actions*, Economic Theory Bulletin 10, 293-302 (2022)
4. **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
5. M. Kim, Y. Shim, **S. Lee**, H. Loh, J. Park, *Behavioral Testing of Deep Knowledge Tracing Models*, Educational Data Mining 2021
6. 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
7. 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
8. Y. Choi, Y. Lee, D. Shin, J. Cho, S. Park, **S. Lee**, J. Baek, C. Bae, B. Kim, J. Heo, *EdNet: A Large-Scale Hierarchical Dataset in Education*, International Conference on Artificial Intelligence in Education (2021), 69-73
9. J. Kim, **S. Lee**, *Joint Liability and Stochastic Shapley Value*, International Review of Law & Economics 60 (2019), 1-8

## Preprints

1. J. Getz, A. G. Terradillos, F. HosseiniJafari, B. Hu, **S. Lee**, A. Slipper, M.-H. Tomé, H. Yao, A. Zhao, *Modulation groups*, arXiv:2510.23932
2. K. Lee, **S. Lee**, *Machines Learn Number Fields, But How? The Case of Galois Groups*, arXiv:2508.06670
3. **S. Lee**, *Algebraic proof of modular form inequalities for optimal sphere packings*. arXiv:2406.14659
4. J. Baek, **S. Lee**, *Formalizing Mason–Stothers Theorem and its Corollaries in Lean 4*. arXiv:2408.15180

## Awards, Grants & Honours

Berkeley Math REU, UC Berkeley	2025 Summer
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.)

UC Berkeley

Berkeley  
2019 – Present

- (2025 Fall) Introduction to Abstract Algebra
- (2025 Spring) Cryptography
- (2025 Spring) 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

### Grader & T.A.

POSTECH

Pohang  
2016 – 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.)

**Tutoring**  
POSTECH

Pohang  
2014 – 2015

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

## Outreach

**IAS Winter School on Mathematics and AI**

Jeongseon  
2025 Winter

Team Leader

- Use machine learning to study Artin representations and abelian varieties over finite fields
- Team members: Dohoon Choi, Keunyoung Jeong, Jaehak Yi, Minseo Shin, Euntaek Lee, Taeyoung Kim

**Berkeley Math REU**

Berkeley  
2025 Summer

Mentor

- Diophantine equations on Fibonacci polynomials and ties in Chebyshev bias over finite fields
- Mentees: Graeme Bates, Ryan Jesubalan, Jane Lu, Hyewon Shim

**Directed Reading Program**

Berkeley  
2023-present

Mentor

- (2025 Fall) Group cohomology (Graeme Bates, Jane Lu)
- (2025 Spring, 2025 Fall) Modular forms (Dongho Kim)
- (2023 Fall) Elliptic curves (Jacob Martin)
- (2023 Spring)  $p$ -adic numbers (Lucas Xie)

**POSTECH Potential Development Camp for High School Students**

POSTECH  
2015 Winter

Mentor

- Mentoring high school students for college-level mathematics

## Talks

• Research Talks

- Number Theory Seminar, University of Wisconsin-Madison, Wisconsin, December 2025  
How Machines Learn Galois Groups
- EPFL, Lausanne, November 2025  
Sphere Packing, Sign Uncertainty Principle, Universal Optimality, and Positive Quasimodular forms
- Aarhus University, Aarhus, November 2025  
Sphere Packing, Sign Uncertainty Principle, Universal Optimality, and Positive Quasimodular forms
- Special Seminar, Carnegie Mellon University, Pittsburgh, November 2025  
How Machines Learn Galois Groups
- International Seminar on Automorphic Forms, Online, April 2025  
Algebraic proof of modular form inequalities for optimal sphere packings
- RTG seminar, UC Berkeley, Berkeley, February 2025  
Algebraic proof of modular form inequalities for optimal sphere packings








- Algebra Discrete Math seminar, UC Davis, 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, POSTECH, Pohang, May 2024  
Algebraic proof of modular form inequalities for optimal sphere packings
  - Student Number Theory Seminar, UC Berkeley, 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
    - Student Number Theory Seminar, Berkeley, August 2025  
How Do Automorphic Forms and Elliptic Curves Fly? (Survey on Murmuration)
    - Bruhat-Tits building seminar, Berkeley, February 2025  
Bruhat-Tits buildings for split groups / Moy-Prasad filtration and Local Langlands correspondence
    - 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++,  $\text{\LaTeX}$ , SAGE Math, Lean, MATLAB, Haskell

## Miscellaneous (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)  

(Last updated: December 19, 2025)