Seewoo Lee

Ph. D. student in Mathematics
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Education

University of California Berkeley — Berkeley
Ph.D in Mathematics — 2018 – 2026 (expected)

- 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

- 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. G. Bates, R. Jesubalan, **S. Lee**, J. Lu, H. Shim, *Powerful Fibonacci polynomials over finite fields*, arXiv:2601.02664, submitted
2. 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, submitted
3. K. Lee, **S. Lee**, *Machines Learn Number Fields, But How? The Case of Galois Groups*, arXiv:2508.06670, submitted
4. J. Baek, **S. Lee**, *Formalizing Mason–Stothers Theorem and its Corollaries in Lean 4*. arXiv:2408.15180
5. **S. Lee**, *Algebraic proof of modular form inequalities for optimal sphere packings*. arXiv:2406.14659, submitted
6. **S. Lee**, Y. Choi, J. Park, B. Kim, J. Shin, *Consistency and Monotonicity Regularization for Neural Knowledge Tracing*, arXiv:2105.00607
7. Y. Choi, Y. Lee, J. Cho, J. Baek, D. Shin, H. Yu, Y. Shim, **S. Lee**, J. Shin, C. Bae, B. Kim, J. Heo, *Assessment Modeling: Fundamental Pre-training Tasks for Interactive Educational Systems*, arXiv:2022.05505

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 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. Pohang
POSTECH 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 Pohang
POSTECH 2014 – 2015

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

Outreach

KIAS Winter School on Mathematics and AI Jeongseon
Team Leader 2025 Winter

– 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
Mentor 2025 Summer

– 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
Mentor 2023-present

– (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
Mentor 2015 Winter

– 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++, 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)

(Last updated: January 7, 2026)