Yueun Lee

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Education

Seoul National University (SNU), Korea **Mar. 2021 – Jun. 2025 (Expected)**

B.S. in Statistics, Mathematics, and Computer Science & Engineering (**Triple Major**)

- Major GPA: Overall 4.07, Stats 4.04, Math 4.3, CS&E 3.99 (out of 4.3)

Seoul Science High School, Korea **Mar. 2018 – Feb. 2021**

School for gifted students in science and mathematics

Research interests

Machine Learning (ML): Deep Learning Theory, Optimal Transport, Reinforcement Learning, Statistical ML
Numerical Analysis: Numerical Linear Algebra, Numerical Optimization

Publications

Published:

[1] G. Hwang, Y. Park, **Y. Lee**, and M. Kang. "Analysis of efficient preconditioner for solving Poisson equation with Dirichlet boundary condition in irregular three-dimensional domains". In: *Journal of Computational Physics* 519 (2024), p. 113418. DOI: https://doi.org/10.1016/j.jcp.2024.113418

Submitted:

[2] H. Lee, **Y. Lee**, M. Imaizumi, and J. Won. *Wasserstein Autoencoders using Exact Penalties*. Submitted. 2024

[3] G. Hwang, Y. Park, **Y. Lee**, J. Hahn, and M. Kang. *Localized Estimation of Condition Numbers for MILU Preconditioners on a Graph*. Submitted to *SIAM Journal on Numerical Analysis*. 2024. URL: https://arxiv.org/abs/2501.00245

Honors and Awards

The National Presidential Science Scholarship in Mathematics **2021 – 2024**
Korea Student Aid Foundation

- Full tuition and a $5,000 annual stipend for distinguished undergraduates from the Korean government

Undergraduate Mathematics Competition: 1st Award **Dec. 2023**
Korean Mathematics Society

- Achieved the highest score among all participants, receiving a monetary prize of $800

Korea Mathematics Olympiad - Final round: Excellence Award **Jul. 2020**
Korean Mathematics Society

- Top 27 participants in a competitive qualifier for the national IMO team selection

Korea Mathematics Olympiad: Gold Award **Dec. 2018, Dec. 2019**
Korean Mathematics Society

- Top 28, 26 participants in a prestigious mathematics competition for high school students

International Mathematics Tournament of Towns: Gold Award (Top Gold Winner) **Dec. 2018**
Korean Organizing Committee

- 1st place nationally in the Senior A-level (Advanced) with challenges similar to IMO

Iranian Geometry Olympiad: Gold Award (Top Gold Winner) **Oct. 2018**
Iranian Mathematical Society

- 1st place among international participants in a prestigious geometry competition

Research experience

Numerical Computing & Image Analysis Research Group **Mar. 2024 – Present**

Advisor: Myungjoo Kang (Department of Mathematics, SNU)

- Topic: Analyzing Modified Incomplete LU (MILU) preconditioners on a graph [3] Jul. 2024 – Present
  - Introduced a generalized MILU for a graph structure
  - Proposed the Localized Estimator of Condition Number (LECN), which provides an upper bound for the condition number of the preconditioned system
  - Demonstrated the versatility of LECN through case studies on uniform grids, high-order schemes, and hierarchical grid structures(e.g., Quadtree/Octree meshes)

- Topic: MILU-type preconditioner analysis for Poisson equation on irregular domains [1] Mar. 2024 – Jun. 2024
  - Confirmed the second-order accuracy of the Gibou method and MILU's condition number reduction from $O(h^{-2})$ to $O(h^{-1})$, both proven in two dimensions, also holds in three dimensions
  - Suggested that increasing order path lengths impact MILU performance, leading to the introduction of Sectored-MILU, which supports parallel computing
  - Demonstrated that Sectored-MILU achieves an $O(h^{-1})$ reduction in condition number and consistently outperforms MILU in various domains

Statistical Computing Lab **Dec. 2023 – Present**

Advisor: Joong-Ho Won (Department of Statistics, SNU)

- Topic: A simulation study of the penalty method for Wasserstein Autoencoders [2] Mar. 2024 – Present
  - Demonstrated that a specific nonlinear transformation of f-divergences serve as an exact penalty
  - Conducted one-dimensional simulations that showcase the superior performance of the exact penalties compared to other f-divergences
  - Analyzed the effectiveness of the exact penalties in multidimensional simulations

- Topic: Study of Stochastic Optimization Dec. 2023 – Feb. 2024
  - Studied Stochastic Optimization through Taiji Suzuki's book "確率的最適化（機械学習プロフェッショナルシリーズ）" and presented on specific topics within Batch Stochastic Optimization, particularly focusing on SDCA, SVRG, and SAG methods
  - Composed a section rigorously proving the KKT conditions and Lagrange duality
  - Winter 2023 Undergraduate's Research Internship (Research Fund of $500) by SNU

Oh Reinforcement Learning Group **Jun. 2024 – Sep. 2024**

Advisor: Min-hwan Oh (Graduate School of Data Science, SNU)

- Topic: Study of Bandit Algorithms Jun. 2024 – Sep. 2024
  - Reviewed the comprehensive content of the book "Bandit Algorithms" by Tor Lattimore and Csaba Szepesvári
  - Examined the concepts of reinforcement learning, focusing on regret analysis
  - Analyzed the theories of stochastic/adversarial bandits and linear bandits, along with their upper and lower bounds on regret

Intelligent Data Exploration and Analysis (IDEA) Lab **Jun. 2023 – Aug. 2023**

Advisor: Yongdai Kim (Department of Statistics, SNU)

- Topic: Study of Optimal Transport Jun. 2023 – Aug. 2023
  - Reviewed recent optimal transport papers, focusing on fast large-scale algorithms and applications in generative modeling
  - Explored various gradient descent algorithms, focusing on their motivations and intuitions
  - Summer 2023 Undergraduate's Research Internship (Research Fund of $500) by SNU

Skills

C/C++, Python (advanced), **Java, R, Julia** (intermediate)

Languages

English (fluent), **Korean** (native)