

Junseo Lee

CONTACT INFORMATION

Seoul National University
Research Institute of Mathematics
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EDUCATION

Yonsei University, Seoul, Korea
B.S. in Electrical and Electronic Engineering, Mar. 2019 – Feb. 2023
Fully funded by the [Hyundai Motor Chung Mong-Koo \(CMK\) Scholarship](#)
High Honors (2022); Honors (2021, 2020)

Chungnam Science High School, Gongju, Korea
Concentration in Mathematics, Early Graduation (Top 20%), Mar. 2017 – Dec. 2018

RESEARCH EXPERIENCE

Research Institute of Mathematics, Seoul National University, Seoul, Korea
Research Affiliate, Quantum Information Theory Group, Jan. 2023 – Present
Undergraduate Research Assistant, Mar. 2021 – Dec. 2022

(Mandatory Military Service) Norma Inc., Seoul, Korea
Technical Research Personnel of the Republic of Korea Army¹
Research Scientist, Quantum AI Team, Jan. 2023 – Present

PUBLICATIONS ([Google Scholar](#))

Note: Authors marked with an asterisk (*) contributed equally; authors marked with a dagger (†) are listed in alphabetical order.

Research Interests: Quantum Information, Learning Theory, Complexity Theory

Preprints

1. J. Lee[†], M. Shin, “Optimal certification of constant-local Hamiltonians,” [arXiv:2512.09778](#).
2. M. Fanizza, V. Iyer, J. Lee[†], A. A. Mele, F. A. Mele, “Efficient learning of bosonic Gaussian unitaries,” [arXiv:2512.09778](#).
► **Contributed talk, QIP 2026.**
3. N. A. Nghiem, J. Lee, T.-C. Wei, “Hybrid quantum-classical framework for Betti number estimation with applications to topological data analysis,” [arXiv:2508.01516](#).
4. K. Anand, K. Jeong, J. Lee[†], “Collapses in quantum-classical probabilistically checkable proofs and the quantum polynomial hierarchy,” [arXiv:2506.19792](#).
5. J. Lee[†], N. A. Nghiem, “New aspects of quantum topological data analysis: Betti number estimation, and testing and tracking of homology and cohomology classes,” [arXiv:2506.01432](#).

Journal Articles

6. D. Ji, J. Lee, M. Shin, I. Sohn, K. Jeong, “Bounding quantum uncommon information with quantum neural estimators,” *Quantum Science and Technology* **11**, 015001 (2026). doi:10.1088/2058-9565/ae18f4.
7. M. Shin*, J. Lee*, S. Lee, K. Jeong, “Resource-efficient algorithm for estimating the trace of quantum state powers,” *Quantum* **9**, 1832 (2025). doi:10.22331/q-2025-08-27-1832.

¹A designation under South Korea’s Military Service Act for qualified scientists completing mandatory service through three years of full-time industry research.

	<ol style="list-style-type: none"> 8. M. Lee, M. Shin, <u>J. Lee</u>, K. Jeong, “Mutual information maximizing quantum generative adversarial networks,” <i>Scientific Reports</i> 15, 32835 (2025). doi:10.1038/s41598-025-18476-y. 9. M. Shin*, S. Lee*, <u>J. Lee*</u>, D. Ji, H. Yeo, K. Jeong, “Disentanglement provides a unified estimation for quantum entropies and distance measures,” <i>Physical Review A</i> 110, 062418 (2024). doi:10.1103/PhysRevA.110.062418. 10. M. Shin, <u>J. Lee</u>, K. Jeong, “Estimating quantum mutual information through a quantum neural network,” <i>Quantum Information Processing</i> 23, 57 (2024). doi:10.1007/s11128-023-04253-1. 11. <u>J. Lee</u>, K. Jeong, “Quantum Rényi entropy functionals for bosonic gaussian systems,” <i>Physics Letters A</i> 490, 129183 (2023). doi:10.1016/j.physleta.2023.129183 ► Special Issue, <i>Foundations and applications of Quantum Optics</i> (2024). 12. <u>J. Lee</u>, H. Yeo, K. Jeong, “Weighted p-Rényi entropy power inequality: Information theory to quantum Shannon theory,” <i>International Journal of Theoretical Physics</i> 62, 253 (2023). doi:10.1007/s10773-023-05512-8 13. <u>J. Lee</u>, K. Jeong, “High-dimensional private quantum channels and regular polytopes,” <i>Communications in Physics</i> 31, 189 (2021). doi:10.15625/0868-3166/15762 ► Third Prize, Undergraduate Research Exhibition, Korean Physical Society (2021). 14. K. Jeong, <u>J. Lee</u>, J. Choi, S. Hong, M. Jung, G. Kim, J. Kim, S. Kim, “Single qubit private quantum channels and 3-dimensional regular polyhedra,” <i>New Physics: Sae Mulli</i> 68, 232 (2018). doi:10.3938/NPSM.68.232 ► Bronze Award, The Humantech Paper Award, Samsung Electronics (2018).
Book Chapters	<ol style="list-style-type: none"> 15. <u>J. Lee</u>, “Assessing Quantum Integer Factorization Performance with Shor’s Algorithm,” In: <i>Quantum Computing: A Journey into the Next Frontier of Information and Communication Security</i>, <i>CRC Press</i> (2024). doi:10.1201/9781003475286
Patents	<ol style="list-style-type: none"> 16. K. Jeong, M. Shin, <u>J. Lee</u>, “Method for estimating quantum mutual information through a quantum neural network,” <i>Korea Patent Application</i> No. 10-2024-0104765 (pending, 2024).
HONORS AND AWARDS	<p>Funding and Fellowships</p> <ul style="list-style-type: none"> • PhD Study Abroad Fellowship, Hyundai Motor CMK Foundation, 2026 (Expected) • Academic Travel Grant (QIP 2022), Hyundai Motor CMK Foundation, 2022 • Hyundai Motor CMK Scholarship in Intelligent Information Technology, full tuition and living stipend, 2021–2022 • Teaching Fellowship for Software Courses, Yonsei University, 2021–2022 <p>Additional Honors and Awards</p> <ul style="list-style-type: none"> • Selected Paper Award, Finance and Economics Contest, DB Group, 2022 • Best Tutor Award, Yonsei University, 2021–2022 • Third Prize, Undergraduate Research Exhibition, Korean Physical Society, 2021 • Bronze Award, The Humantech Paper Award, Samsung Electronics, 2018 • Best Translator Award, NAVER Connect Foundation and Khan Academy, 2018 • National Honorable Mention, Korean Olympiad in Informatics, 2016 • Regional Gold Award, Korean Olympiad in Informatics, 2016
PROFESSIONAL ACTIVITIES	<p>Journal Reviewer: Physical Review Letters, IEEE Transactions on Information Theory, npj Quantum Information, Physical Review Research, Physical Review Applied, Physical Review A, Physics Letters A, Annalen der Physik</p>

Conference Reviewer: Quantum Techniques in Machine Learning (QTML 2025)

Community Service:

- *Creator and Maintainer*, [Quantum Learning Theory Zoo](#), curated repository of quantum learning theory papers, 2025 – Present
- *Selection Committee*, [Quantum Internship Program](#), National Information Society Agency and Korea Quantum Industry Center, 2024 – 2025
- *Co-organizer*, [SNU Quantum Information Theory Seminar](#), 2024 – 2025
- *Co-organizer*, [Quantum AI Hackathon](#), jointly organized by Kakao Enterprise Corp. and Jeonju University, 2025
- *Facilitator (Mentor)*, Mathematics Section, Korea Scholar’s Conference for Youth (KSCY), Yonsei University, 2019

TEACHING

Quantum Information Science Club Association (QISCA)

(Teaching materials are available at: harris-junseo-lee.github.io/teaching/)

- *Invited Lecturer*, [Quantum Learning Theory for Bosonic Systems](#), Winter 2025
- *Invited Lecturer*, [Quantum Complexity Reading Group](#), Fall 2025
- *Invited Lecturer*, [Quantum Learning and Complexity Theory](#), Summer 2025

University–Industry Research Internship

- *Instructor*, AAA558/AAA559: College of Informatics Internship, Korea University (Graduate Course), Fall 2025
- *Instructor*, SW4343: Software Field Placement 1 ([Quantum Internship Program](#)), Korea Aerospace University, Fall 2024

Yonsei University

- *Teaching Assistant*, YCS1009: Change the World through Programming, Fall 2022
- *Teaching Assistant*, YCS1002: Software Programming, Fall 2022
- *Teaching Assistant*, EEE1108: Engineering Information Processing, Fall 2021
- *Course Tutor*, MAT2016: Engineering Math 3, Spring 2022 [Best Tutor Award]
- *Course Tutor*, MAT1012: Engineering Math 2, Fall 2021 [Best Tutor Award]

SELECTED TALKS

Note: Talks marked with an asterisk (*) were delivered online.

Research Talks

“Efficient learning of bosonic Gaussian unitaries”

- *Invited talk*, [Annual Meeting of the Quantum Information Society of Korea](#), Feb. 2026
- *Invited talk*, [N³etFraST Workshop](#), Nov. 2025
- *Invited talk*, [Yonsei Quantum Data Science & AI Lab Seminar](#), Nov. 2025
- *Contributed talk*², [QIP 2026](#), Jan. 2026

“New aspects of quantum topological data analysis”

- *Invited talk*, KISTI-SNU Joint Workshop, Jun. 2025

“Resource-efficient algorithm for estimating the trace of quantum state powers”

- *Invited talk*, Electronics & Telecommunications Research Institute, Dec. 2024
- *Invited talk*, SNU Quantum Information Theory Seminar, Dec. 2024*
- *Invited talk*, [IBM-Yonsei Qiskit Fall Fest](#), Nov. 2024*
- *Contributed talk*, Annual Meeting of Korean Mathematical Society, Oct. 2024
- *Poster*, QIP 2025, Feb. 2025

“Mutual information maximizing quantum generative adversarial network”

²Presented under the title “Efficient Learning Algorithms for Structured Bosonic and Fermionic Unitary Operators”, as a merged submission with [arXiv:2504.11318](https://arxiv.org/abs/2504.11318).

	<ul style="list-style-type: none"> • <i>Invited talk</i>, Triangle Quantum Computing Seminar, NC State University Quantum Initiative, Nov. 2023* <p>“Estimating quantum mutual information through a quantum neural network”</p> <ul style="list-style-type: none"> • <i>Invited talk</i>, CS Katha Barta, National Institute of Science Education and Research Bhubaneswar, Aug. 2023* <p>“Quantum Rényi entropy functionals for bosonic Gaussian systems”</p> <ul style="list-style-type: none"> • <i>Poster</i>, QIP 2022, Mar. 2022 <p>“High-dimensional private quantum channels and regular polytopes”</p> <ul style="list-style-type: none"> • <i>Invited talk</i>, KISTI-KU-SNU Joint Workshop, Sep. 2023* • <i>Invited talk</i>, SNU Quantum Information Theory Seminar, Aug. 2021* • <i>Contributed talk</i>, Winter Meeting of the Optical Society of Korea, Feb. 2022 • <i>Contributed talk</i>, Fall Meeting of the Korean Physical Society, Oct. 2021* • <i>Poster</i>, QIP 2022, Mar. 2022
Tutorials and Public Lectures	<p>“Learning theory in ∞-dimensional quantum systems”</p> <ul style="list-style-type: none"> • <i>Invited talk</i>, Team QST Summer Workshop, Seoul National University, Aug. 2025 <p>“Introduction to quantum machine learning”</p> <ul style="list-style-type: none"> • <i>Invited talk</i>, AWS Korea Healthcare & Research Team Seminar, Mar. 2025 <p>“Topics in theoretical quantum computer science”</p> <ul style="list-style-type: none"> • <i>Invited talk</i>, Shinil High School, Aug. 2024 <p>“Quantum machine learning models for drug library generation”</p> <ul style="list-style-type: none"> • <i>Invited talk</i>, Yonsei Quantum Computing and Monte Carlo Workshop, Aug. 2024 <p>“QMA $\stackrel{?}{=} \text{NP}$: The NLTS theorem and the quantum PCP conjecture”</p> <ul style="list-style-type: none"> • <i>Invited talk</i>, SNU Center for Quantum Network’s Channel Capacity Summer Workshop, Jul. 2024 <p>“Minimal data may be sufficient for quantum artificial intelligence”</p> <ul style="list-style-type: none"> • <i>Invited talk</i>, SNU Department of Mathematical Sciences Seminar, Jun. 2023*
SKILLS AND TECHNICAL EXPERIENCE	<p>Programming Languages: Proficient in C, C++ (Informatics Olympiad), and Python; experienced with Java.</p> <p>Quantum Software: Proficient in PennyLane and IBM Qiskit (certified); experienced with Q# and PyZX (ZX-calculus).</p> <ul style="list-style-type: none"> • <i>IBM Certified Associate Developer</i>, Quantum Computation using Qiskit, 2023 • <i>Advanced Achievement</i>, IBM Quantum Spring Challenge, 2023 • <i>Advanced Achievement</i>, Xanadu QHack Coding Challenges, 2023
REFERENCES	Available upon request.

(Last updated on December 22, 2025)