

# Junseo Lee

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## CONTACT INFORMATION

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](#) in Intelligent Information Technology

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

## RESEARCH INTERESTS

**Quantum Information and Theoretical Computer Science**  
Quantum Complexity Theory; Quantum Learning Theory; Quantum Algorithms; Quantum Many-Body Theory

## RESEARCH EXPERIENCE

**Research Institute of Mathematics (RIM), Seoul National University (SNU)** Seoul, Korea  
*Research Affiliate* (Quantum Information Theory Group) Jan. 2023 – Present  
*Undergraduate Research Assistant* (Advisor: Dr. Kabgyun Jeong) Mar. 2021 – Dec. 2022

**Technical Research Personnel, Republic of Korea Army** Seoul, Korea  
*Research Scientist* (Mandatory 3-Year National Military Service) Mar. 2023 – Mar. 2026  
A designation under South Korea's Military Service Act for qualified scientists

**High Dimensional Signal Processing Lab, Yonsei University** Seoul, Korea  
*Undergraduate Research Assistant* (Advisor: Prof. Chulhee Lee) Jul. 2022 – Dec. 2022

**Mathematical Biology Lab, Yonsei University** Seoul, Korea  
*Undergraduate Research Assistant* (Advisor: Prof. Jeehyun Lee) Dec. 2021 – Jun. 2022

## PUBLICATIONS ([Google Scholar Profile](#))

\*Equal contribution. <sup>†</sup>Authors listed alphabetically.

### Preprints

- (16) J. Lee<sup>†</sup>, M. Shin, "Optimal certification of constant-local Hamiltonians," [arXiv:2512.09778 \(2025\)](#).
- (15) M. Fanizza, V. Iyer, J. Lee<sup>†</sup>, A. A. Mele, F. A. Mele, "Efficient learning of bosonic Gaussian unitaries," [arXiv:2510.05531 \(2025\)](#).  
► Contributed talk, **QIP 2026**.
- (14) 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 \(2025\)](#).
- (13) K. Anand, K. Jeong, J. Lee<sup>†</sup>, "Collapses in quantum-classical probabilistically checkable proofs and the quantum polynomial hierarchy," [arXiv:2506.19792 \(2025\)](#).
- (12) J. Lee<sup>†</sup>, 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 \(2025\)](#).

### Journal Articles

- (11) 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.

- (10) 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.
- (9) M. Lee, M. Shin, J. Lee, K. Jeong, "Mutual information maximizing quantum generative adversarial networks," [Scientific Reports](#) **15**, 32835 (2025). doi : 10.1038/s41598-025-18476-y.
- (8) M. Shin\*, S. Lee\*, J. Lee\*, D. Ji, H. Yeo, K. Jeong, "Disentanglement provides a unified estimation for quantum entropies and distance measures," [Physical Review A](#) **110**, 062418 (2024). doi : 10.1103/PhysRevA.110.062418.
- (7) M. Shin, J. Lee, K. Jeong, "Estimating quantum mutual information through a quantum neural network," [Quantum Information Processing](#) **23**, 57 (2024). doi : 10.1007/s11128-023-04253-1.
- (6) J. Lee, K. Jeong, "Quantum Rényi entropy functionals for bosonic gaussian systems," [Physics Letters A](#) **490**, 129183 (2023). doi : 10.1016/j.physleta.2023.129183  
 ► Special Issue, [Foundations and applications of Quantum Optics](#) (2024).
- (5) J. Lee, H. Yeo, K. Jeong, "Weighted  $p$ -Rényi entropy power inequality: Information theory to quantum Shannon theory," [International Journal of Theoretical Physics](#) **62**, 253 (2023). doi : 10.1007/s10773-023-05512-8
- (4) J. Lee, K. Jeong, "High-dimensional private quantum channels and regular polytopes," [Communications in Physics](#) **31**, 189 (2021). doi : 10.15625/0868-3166/15762  
 ► Third Prize, Undergraduate Research Exhibition, Korean Physical Society (2021).
- (3) K. Jeong, J. Lee, J. Choi, S. Hong, M. Jung, G. Kim, J. Kim, S. Kim, "Single qubit private quantum channels and 3-dimensional regular polyhedra," [New Physics: Sae Mulli](#) **68**, 232 (2018). doi : 10.3938/NPSM.68.232  
 ► Bronze Award, The Humantech Paper Award, Samsung Electronics (2018).

### Book Chapters

- (2) J. Lee, "Assessing Quantum Integer Factorization Performance with Shor's Algorithm," In: *Quantum Computing: A Journey into the Next Frontier of Information and Communication Security*, [CRC Press](#) (2024). doi : 10.1201/9781003475286

### Patents

- (1) K. Jeong, M. Shin, J. Lee, "Method for estimating quantum mutual information through a quantum neural network," [Korea Patent Open No. 10-2026-0009068](#) (2024). doi : 10.8080/1020240091151

## PROFESSIONAL ACTIVITIES

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**Journal Reviewer:** Physical Review Letters, IEEE Transactions on Information Theory, npj Quantum Information, Quantum, Physical Review Research, Physical Review Applied, Physical Review A, Physics Letters A, Annalen der Physik

**Conference Reviewer:** QTML 2025, QCTiP 2026, TQC 2026

### Community Service:

- *Poster Session Judge*, National Undergraduate Quantum Conference, Seoul National University, 2026
- *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

## SELECTED HONORS AND AWARDS

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### Funding and Fellowships

- *PhD Study Abroad Fellowship*, Hyundai Motor CMK Foundation, 2026 (Expected)
- *Academic Travel Grant*, 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

### Additional Honors and Awards

- *High Honor Student*, Yonsei University, 2022
- *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
- *Honor Student*, Yonsei University, 2020–2021
- *Bronze Award*, The Humantech Paper Award, Samsung Electronics, 2018
- *Best Translator Award*, NAVER Connect Foundation and Khan Academy, 2018
- *National Honorable Mention and Regional Gold Award*, Korean Olympiad in Informatics, 2016

## TEACHING EXPERIENCE

### Quantum Information Science Club Association (2025–2026)

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

- *Invited Lecturer*, [Quantum Learning Theory for Bosonic Systems](#), Winter 2026
- *Invited Lecturer*, [Quantum Complexity Reading Group](#), Fall 2025
- *Invited Lecturer*, [Quantum Learning and Complexity Theory](#), Summer 2025

### University–Industry Research Internship (2024–2025)

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

### Yonsei University (2021–2022)

- *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 Mathematics 3, Spring 2022 [Best Tutor Award]
- *Course Tutor*, MAT1012: Engineering Mathematics 2, Fall 2021 [Best Tutor Award]

## SELECTED TALKS

\*Online talk.

### Research Talks

“Optimal certification of constant-local Hamiltonians”

- *Invited talk*, Quantum Software Lab Seminar, University of Edinburgh, Mar. 2026\*

“Efficient learning of bosonic Gaussian unitaries”

- *Invited talk*, [Annual Meeting of the Quantum Information Society of Korea](#), Feb. 2026
- *Invited talk*, [N<sup>3</sup>etFraST Workshop](#), Nov. 2025
- *Invited talk*, [Yonsei Quantum Data Science & AI Lab Seminar](#), Nov. 2025
- *Contributed talk*, [QIP 2026](#), Jan. 2026 (Presented under the title “Efficient Learning Algorithms for Structured Bosonic and Fermionic Unitary Operators”, as a merged submission with [arXiv:2504.11318](#).)

“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”

- *Invited talk*, [Triangle Quantum Computing Seminar](#), NC State University Quantum Initiative, Nov. 2023\*

“Estimating quantum mutual information through a quantum neural network”

- *Invited talk*, [CS Katha Barta](#), National Institute of Science Education and Research Bhubaneswar, Aug. 2023\*

“Quantum Rényi entropy functionals for bosonic Gaussian systems”

- *Poster*, QIP 2022, Mar. 2022

“High-dimensional private quantum channels and regular polytopes”

- *Invited talk*, KISTI-KU-SNU Joint Workshop, Sep. 2023\*
- *Invited talk*, SNU Quantum Information Theory Seminar, Aug. 2021\*
- *Contributed talk*, Winter Meeting of the Optical Society of Korea, Feb. 2022
- *Contributed talk*, Fall Meeting of the Korean Physical Society, Oct. 2021\*
- *Poster*, QIP 2022, Mar. 2022

### Tutorials and Public Lectures

“Learning theory in  $\infty$ -dimensional quantum systems”

- *Invited talk*, Team QST Summer Workshop, Seoul National University, Aug. 2025

“Introduction to quantum machine learning”

- *Invited talk*, AWS Korea Healthcare & Research Team Seminar, Mar. 2025

“Topics in theoretical quantum computer science”

- *Invited talk*, Shinil High School, Aug. 2024

“Quantum machine learning models for drug library generation”

- *Invited talk*, Yonsei Quantum Computing and Monte Carlo Workshop, Aug. 2024

“QMA  $\stackrel{?}{=} \text{NP}$ : The NLTS theorem and the quantum PCP conjecture”

- *Invited talk*, SNU Center for Quantum Network’s Channel Capacity Summer Workshop, Jul. 2024

“Minimal data may be sufficient for quantum artificial intelligence”

- *Invited talk*, [SNU Department of Mathematical Sciences Seminar](#), Jun. 2023\*

### SKILLS AND TECHNICAL EXPERIENCE

**Programming Languages:** Proficient in C, C++ (Informatics Olympiad), and Python; experienced with Java.

**Quantum Software:** Proficient in PennyLane and IBM Qiskit (certified); experienced with Q# and PyZX.

- *IBM Certified Associate Developer*, Quantum Computation using Qiskit, 2023
- *Advanced Achievement*, IBM Quantum Spring Challenge, 2023
- *Advanced Achievement*, Xanadu QHack Coding Challenges, 2023