# Curriculum Vitae – (Harris) Junseo Lee

## Personal Information


| | |
|---|---|
| Personal e-mail | harris.junseo@gmail.com |
| Website | https://harris-junseo-lee.github.io |
| Nationality | South Korea |


## Research Interests

### Theory of Quantum Computation and Quantum Information

(1) **Fault-Tolerant Quantum Computation**
Quantum error correction, topological codes and anyon computation

(2) **Quantum Algorithms and Machine Learning**
Computational complexity and quantum neural networks

(3) **Quantum Shannon Theory**
Properties of quantum channel capacities and quantum entropy power inequalities

(4) **Quantum Software**
Categorical semantics of quantum program, quantum circuit optimization and QML applications

## Education

Mar 2019 – Feb 2023 **B.S. in Electrical and Electronic Engineering**
Yonsei University, South Korea
** Cumulative GPA:* 3.9/4.0*, Upper Division GPA:* 4.0/4.0
** Received full funding and a stipend through the Future Technology Scholarship by the Hyundai Motor Foundation*

Mar 2017 – Dec 2018 Chungnam Science High School, South Korea
** Early graduation for top 20% students,*

## Employment History

Jan 2023 – present **Quantum Computing Researcher**
Quantum AI Team, Norma Inc., South Korea
** Alternative to the compulsory military service*

## Research Experience

Aug 2024 – Oct 2024 **Quantum Software Lab (Foundations of Computer Science Group)**
Visiting Researcher
School of Informatics, The University of Edinburgh, UK

Mar 2020 – present **Research Institute of Mathematics (Quantum Information Group)**
Research Assistant
Department of Mathematical Sciences, Seoul National University, South Korea

Jul 2022 – Dec 2022 **High Dimensional Signal Processing Lab**
Research Assistant
School of Electrical and Electronic Engineering, Yonsei University, South Korea

## Research Experience (continued)

| | |
|---|---|
| Dec 2021 – Jun 2022 | **Mathematical Biology Lab**<br>Research Assistant<br>School of Mathematics and Computing, Yonsei University, South Korea |
| Apr 2018 – Aug 2018 | **Atomic-Scale Device Simulation Lab**<br>Pre-Undergraduate Research Participation Program (Pre-URP)<br>School of Electrical Engineering, KAIST, South Korea |
| Jul 2017 – Aug 2017 | **Biomaterials Engineering Laboratory**<br>Pre-Undergraduate Research Participation Program (Pre-URP)<br>Department of Bio and Brain Engineering, KAIST, South Korea |

## Research Publications

### Journal Articles

[1] M. Shin, **J. Lee**, and K. Jeong, "Estimating quantum mutual information through a quantum neural network," *Quantum Information Processing*, vol. 23, no. 2, pp. 1–16, 2024.

[2] **J. Lee** and K. Jeong, "Quantum rényi entropy functionals for bosonic gaussian systems," *Physics Letters A*, vol. 490, p. 129 183, 2023.

[3] **J. Lee**, H. Yeo, and K. Jeong, "Weighted p-rényi entropy power inequality: Information theory to quantum shannon theory," *International Journal of Theoretical Physics*, vol. 62, no. 11, p. 253, 2023.

[4] **J. Lee** and K. Jeong, "High-dimensional private quantum channels and regular polytopes," *Communications in Physics*, vol. 31, no. 2, p. 189, 2021.

[5] K. Jeong, **J. Lee**, J. T. Choi, *et al.*, "Single qubit private quantum channels and 3-dimensional regular polyhedra," *New Phys.: Sae Mulli*, vol. 68, pp. 232–240, 2018.

### Book Chapters

[6] **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*, M. Hammoudeh, A. T. Essa, A. M. Sherbeeni, C. M. Firth, and A. S. Essa, Eds., CRC Press, 2024, ch. 11.

### Preprints

[7] M. Shin, S. Lee, M. Lee, *et al.*, *Layerwise quantum convolutional neural networks provide a unified way for estimating fundamental properties of quantum information theory*, 2024. arXiv: `2401.07716 [quant-ph]`.

[8] M. Lee, M. Shin, **J. Lee**, and K. Jeong, *Mutual information maximizing quantum generative adversarial network and its applications in finance*, 2023. arXiv: `2309.01363 [quant-ph]`.

## Presentations

### Invited talks

2023 Mutual Information Maximizing Quantum GAN and Its Applications in Finance
*Triangle Quantum Computing Seminar Series @ North Carolina State University, USA*

Estimating Quantum Mutual Information Through a Quantum Neural Network
*CS Katha Barta @ National Institute of Science Education and Research, India*

Minimal Data May Be Sufficient for Quantum AI
*QST Seminar @ Seoul National University, South Korea*

## Presentations (continued)

2022 Classical and Quantum Classification Methods
*Quantum Project Seminar @ Namsung High School, South Korea*

Quantum Speedup and Machine Learning Problems
*Quantum Project Seminar @ Namsung High School, South Korea*

2021 Structure of Private Quantum Channels: to Higher Dimensional Regular Polytopes
*QST Seminar @ Seoul National University, South Korea*

On High-dimensional Private Quantum Channels and Regular Polytopes
*Quantum Project Seminar @ Namsung High School, South Korea*

### Contributed talks

2024 Disentanglement Provides a Unified Estimation for Quantum Entropies and Distances
*Korean Physical Society – Spring Meeting @ Daejeon Convention Center, South Korea*

Disentanglement Provides a Unified Estimation for Quantum Entropies and Distances
*Quantum Information Society of Korea – Annual Meeting @ Busan Port International Exhibition & Convention Center, South Korea*

2023 Generalized Private Quantum Channel and Randomizing Quantum States
*KISTI-KU-SNU Joint Workshop @ Korea University, South Korea*

Performance Evaluation of Quantum Simulators for Factorization and Quantum Security
*Quantum.Tech APAC @ Equarius Hotel, Singapore*

Isotropic measure and $\varepsilon$-randomizing maps on the high-dimensional quantum system
*Center for Quantum Network's Channel Capacity Winter Kick-off Workshop @ Kyungpook National University, South Korea*

2022 Geometric Representation of Quantum Randomizing Maps on High-dimensional Quantum Systems
*Optical Society of Korea – Winter Meeting @ Daejeon Convention Center, South Korea*

2021 Quantum Rényi Entropy Power Inequality for Bosonic Gaussian Systems
*Korean Society for Industrial and Applied Mathematics – 2021 Annual Meeting @ Busan Exhibition & Convention Center, South Korea*

Geometric Approach to Private Quantum Channels: High-dimensional cases and Regular Polytopes
*Korean Physical Society – 2021 Fall Meeting @ Virtual Conference*

### Posters (International Conferences)

2023 Quantum Neural Networks for Quantum Mutual Information Estimation
*The 23rd Asian Quantum Information Science Conference (AQIS) @ Korea Institute For Advanced Study, South Korea*

Optimizing Quantum Integer Factorization Performance: A Scalable Evaluation Approach with Parameter Pre-Selection Method
*The 23rd Asian Quantum Information Science Conference (AQIS) @ Korea Institute For Advanced Study, South Korea*

Quantum Rényi Entropy Functionals for Bosonic Gaussian Systems
*The 27th edition of the Central European Workshop on Quantum Optics (CEWQO) @ University of Milan, Italy*

Quantum Neural Network Approach to Measuring Von Neumann Entropy
*The 18th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC) @ University of Aveiro, Portugal*

2022 Quantum Rényi Entropy Functionals for Bosonic Gaussian Systems,
*The 17th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC) @ The University of Illinois at Urbana-Champaign, USA*

## Presentations (continued)

Quantum Rényi Entropy Functionals for Bosonic Gaussian Systems
*The 25th Annual Conference on Quantum Information Processing (QIP) @ California Institute of Technology, USA*

Geometry of Random Unitary Channels in High-dimensional Quantum States
*The 25th Annual Conference on Quantum Information Processing (QIP) @ California Institute of Technology, USA*

## Teaching

### Teaching Assistant @ Yonsei University

| | | |
|---|---|---|
| Fall 2022 | (YCS1002) SW Programming | |
| | (YCS1009) Change the world through programming | |
| Fall 2021 | (EEE1108) Engineering Information Processing | |

### Course Tutor @ Yonsei University

| | | |
|---|---|---|
| Spring 2022 | (MAT2016) Engineering Mathematics III | ** Best Tutor Award* |
| Fall 2021 | (MAT1012) Engineering Mathematics II | ** Best Tutor Award* |

## Miscellaneous Experience

### Awards and Achievements

| | |
|---|---|
| 2023 | **Achievement (Advanced)**, IBM Quantum Challenge |
| | **Achievement (Advanced)**, QHack Coding Challenges, Xanadu |
| 2022 | **High Honor Student**, Yonsei University |
| | **Selected Paper Award**, Finance and Economics Contest, DB Group |
| | **Best Tutor Award**, Innovation Center for Teaching and Learning, Yonsei University |
| | **Future Technology Scholarship**, Hyundai Motor Foundation |
| 2021 | **Honor Student**, Yonsei University |
| | **Best Tutor Award**, Innovation Center for Teaching and Learning, Yonsei University |
| | **Future Technology Scholarship**, Hyundai Motor Foundation |
| 2020 | **Honor Student**, Yonsei University |
| 2018 | **Bronze Award**, The Humantech Paper Award, Samsung Electronics |
| | **Excellent Translator Award**, NAVER Connect Foundation |
| 2016 | **Gold Award**, Korean Olympiad in Informatics – Regional Qualifiers |

### Certification

| | |
|---|---|
| 2023 | **Advanced Data Analytics Semi-Professional**, Korea Data Agency |
| | **IBM Certified Associate Developer – Quantum Computation using Qiskit**, IBM |

## Research Projects

| | |
|---|---|
| Apr 2024 – present | Realizing Quantum Advantage in the Generation of Drug Library by Quantum Machine Learning<br>*Researcher (Norma Inc.) / Government Funded Project* |

## Research Projects (continued)

| | |
|---|---|
| Feb 2023 – Apr 2024 | Development of anomaly detection and blocking technology through threat hunting-based IoT/network vulnerability analysis<br>*Researcher (Norma Inc.) / Government Funded Project* |
| Dec 2022 – Jan 2023 | International cooperation toward channel capacity of quantum network<br>*Researcher (Research Institute of Mathematics, Seoul National University) / Government Funded Project* |
| Sep 2022 – Jan 2023 | Quantum-computing based analysis on vertical dynamics of the quarter car model<br>*Researcher (Research Institute of Mathematics, Seoul National University) / Industry Funded Project - Hyundai NGV* |
| Jul 2022 – Dec 2022 | Coverage optimization of training data using search engines for training data enhancement of ill-peforming classes<br>*Researcher (High Dimensional Signal Processing Lab, Yonsei University) / Government Funded Project* |
| Jul 2022 – Aug 2022 | Development of an algorithm to measure the degree of oldness and contamination of banknotes<br>*Researcher (High Dimensional Signal Processing Lab, Yonsei University) / Industry Funded Project - Hyosung TNS* |
| Jan 2022 – Jun 2022 | Mathematical modeling for superbacteria infection control<br>*Researcher (Mathematical Biology Lab, Yonsei University) / Government Funded Project* |
| Mar 2021 – Jan 2023 | Determination of qualitative bounds for quantum channel capacities and quantum algorithms<br>*Researcher (Research Institute of Mathematics, Seoul National University) / Government Funded Project* |

## Language Proficiency

Native in **Korean** and fluent in **English**.

## References

References available upon request.

*Last updated: May 27, 2024.*