(Harris) Junseo Lee – Curriculum Vitae

Quantum Computing Research Scientist @ Norma Inc. harris.junseo@gmail.com
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EDUCATION

Yonsei University Seoul, South Korea
B.S. in Electrical and Electronic Engineering Mar. 2019 – Feb. 2023
Thesis: *Combinatorial Designs for Information Theory* (Supervisor: Prof. Hong-Yeop Song)
Recipient of the *Hyundai Motor Foundation Future Technology Scholarship* including full funding and stipend

Chungnam Science High School Gongju, South Korea
High school diploma, Mathematics, Early graduation for top 20% students Mar. 2017 – Dec. 2018

RESEARCH INTERESTS

Theory of Quantum Computation and Quantum Information: Quantum Shannon Theory, Quantum Learning Theory, Quantum Complexity Theory, Quantum Algorithms, Fault-Tolerant Quantum Computation

POSITIONS

Norma Inc. Seoul, South Korea
Quantum Computing Research Scientist Jan. 2023 – present
Technical Research Personnel – *National service as an alternative for military conscription*
Leave for Basic Military Training at Korea Army Training Center (Dec. 2023 – Jan. 2024)

RESEARCH

Quantum Data Science & AI Lab, Yonsei University Seoul, South Korea
Research Collaboration (with Prof. Daniel Kyungdeock Park) Sep. 2024 – present
· Research on quantum machine learning, focusing on quantum kernel method

Quantum Software Lab, University of Edinburgh Edinburgh, UK
Research Collaboration (with Prof. Chris Heunen) May 2024 – present
· Research on the quantum programming languages and category theory
· Preparing for international cooperation projects in industrial technology (Eureka's Network projects program)

Research Institute of Mathematics, Seoul National University Seoul, South Korea
Research Collaboration (with Dr. Kabgyun Jeong) Jan. 2023 – present
Research Assistant (Supervisor: Dr. Kabgyun Jeong) Mar. 2020 – Jan. 2023
· Research on the mathematical properties of quantum channels and entropy inequalities

High Dimensional Signal Processing Lab, Yonsei University Seoul, South Korea
Research Intern (Supervisor: Prof. Chulhee Lee) Jul. 2022 – Dec. 2022
· Research on the mathematical foundations of deep learning and computer vision

Mathematical Biology Lab, Yonsei University Seoul, South Korea
Lead Research Intern (Supervisor: Prof. Jeehyun Lee) Dec. 2021 – Jun. 2022
· Research on mathematical modeling and numerical analysis of epidemics

PUBLICATIONS

Journal Articles

[J5] M. Shin, **J. Lee**, K. Jeong. Estimating quantum mutual information through a quantum neural network. *Quantum Information Processing*, 23.2 (2024).

[J4] **J. Lee**, K. Jeong. Quantum Rényi entropy functionals for bosonic gaussian systems. *Physics Letters A*, 490 (2023).

[J3] **J. Lee**, H. Yeo, K. Jeong. Weighted p-Rényi entropy power inequality: Information theory to quantum Shannon theory. *International Journal of Theoretical Physics*, 62.11 (2023).

[J2] **J. Lee**, K. Jeong. High-dimensional private quantum channels and regular polytopes. *Communications in Physics*, 31.2 (2021).

[J1] 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 (2018).

Book Chapters

[B1] **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 (1st ed.)*, edited by M. Hammoudeh, A. T. Essa, A. M. Sherbeeni, C. M. Firth, A. S. Essa. CRC Press (2024).

arXiv Preprints

[A3] M. Shin†, **J. Lee**† **(co-first author)**, S. Lee, K. Jeong. Rank is all you need: Estimating the trace of powers of density matrices. arXiv:2408.00314 (2024).

[A2] M. Shin†, S. Lee†, **J. Lee**† **(co-first author)**, M. Lee, D. Ji, H. Yeo, K. Jeong. Disentanglement provides a unified estimation for quantum entropies and distance measures. arXiv:2401.07716 (2024).

[A1] M. Lee, M. Shin, **J. Lee**, K. Jeong. Mutual information maximizing quantum generative adversarial network and its applications in finance. arXiv:2309.01363 (2023).

Patents

[P1] K. Jeong, M. Shin, **J. Lee**. Method for estimating quantum mutual information through a quantum neural network. Korea Patent: App. No. 10-2024-0104765 (2024).

MAJOR HONORS & SCHOLARSHIPS

High Honor Student, Yonsei University	2022
Research Travel Grant for Academic Conference Participation, Hyundai Motor Foundation	2022
Selected Paper Award, DB Group Finance and Economics Contest	2022
Teaching Scholarship for Software Courses, Yonsei University	2021, 2022
Best Tutor Award, Innovation Center for Teaching and Learning, Yonsei University	2021, 2022
Tutoring Scholarship, Innovation Center for Teaching and Learning, Yonsei University	2021, 2022
Student Research Grant, Hyundai Motor Foundation	2021, 2022
Full-Tuition Scholarship, Hyundai Motor Foundation	2021, 2022
Third Prize, Korean Physical Society Undergraduate Research Project Exhibition	2021
Honor Student, Yonsei University	2020, 2021
Bronze Award, The Humantech Paper Award, Samsung Electronics	2018
Excellent Translator Award, NAVER Connect Foundation	2018
Gold Award, Korean Olympiad in Informatics – Regional Qualifiers	2016

CERTIFICATIONS & ACHIEVEMENTS

Advanced Achievement, IBM Quantum Spring Challenge	2023
Advanced Achievement, QHack Coding Challenges, Xanadu Quantum Technologies	2023
Advanced Data Analytics Semi-Professional, Korea Data Agency	2023
IBM Certified Associate Developer – Quantum Computation, IBM Professional Certification	2023

TALKS AND POSTERS

Invited and Contributed Talks

[T17] "TBD" Invited talk at Seoul National University QST Seminar, Dec. 6th, 2024.

[T16] "Efficient estimation of trace of powers of density matrices via rank-based methods" Contributed talk at the Annual Meeting of Korean Mathematical Society, Oct. 25th, 2024.

[T15] "Rank is all you need to estimate the trace of the powers of density matrices" Invited talk at the 4th Korea Institute of Science and Technology Information-Korea University-Seoul National University Joint Workshop, Oct. 15th, 2024.

[T14] "Quantum machine learning models for drug library generation" Invited talk at Yonsei University Quantum Computing and Monte Carlo Workshop, Aug. 30th, 2024.

[T13] "Topics in theoretical quantum computer sciences" Invited lecture at Shinil High School, Aug. 28th, 2024.

[T12] "QMA $\neq$ NP? The remaining journey in quantum complexity theory: The NLTS theorem and the quantum PCP conjecture" Invited talk at Center for Quantum Network's Channel Capacity Summer Workshop, Jul. 25th, 2024.

[T11] "Disentanglement provides a unified estimation for quantum entropies and distances" Contributed talk at the Spring Meeting of the Korean Physical Society, Apr. 25th, 2024.

[T10] "Disentanglement provides a unified estimation for quantum entropies and distance measures" Contributed talk at the Annual Meeting of the Quantum Information Society of Korea, Apr. 23rd, 2024.

[T9] "Mutual information maximizing quantum generative adversarial network and its applications in finance" Invited talk at North Carolina State University Triangle Quantum Computing Seminar, Nov. 3rd, 2023.

[T8] "Estimating quantum mutual information through a quantum neural network" Invited talk at National Institute of Science Education and Research Bhubaneswar, Aug. 18th, 2023.

[T7] "Generalized private quantum channel and randomizing quantum states" Invited talk at the 2nd Korea Institute of Science and Technology Information-Korea University-Seoul National University Joint Workshop, Sep. 22nd, 2023.

[T6] "Minimal data may be sufficient for quantum artificial intelligence" Invited talk at Seoul National University QST Seminar, Jun. 30th, 2023.

[T5] "Isotropic measure and ε-randomizing maps on the high-dimensional quantum system" Contributed talk at Center for Quantum Network's Channel Capacity Winter Kick-off Workshop, Jan. 15th, 2023.

[T4] "Geometric representation of quantum randomizing maps on high-dimensional quantum systems" Contributed talk at the Winter Meeting of the Optical Society of Korea, Feb. 17th, 2022.

[T3] "Structure of private quantum channels: to higher dimensional regular polytopes" Invited talk at Seoul National University QST Seminar, Aug. 27th, 2021.

[T2] "Quantum Rényi entropy power inequality for bosonic gaussian systems" Contributed talk at the Annual Meeting of the Korean Society for Industrial and Applied Mathematics, Dec. 3rd, 2021.

[T1] "Geometric approach to private quantum channels: High-dimensional cases and regular polytopes" Contributed talk at the Fall Meeting of the Korean Physical Society, Oct. 21st, 2021.

Posters

[12] "Disentanglement provide a unified estimation for quantum entropies and distance measures" 24th Asian Quantum Information Science Conference (AQIS 2024), Aug. 2024.

[11] "Disentangling to a reduction for estimating quantum information fundamental properties" 2nd Annual Conference on Quantum Simulation (QSim 2024), Aug. 2024.

[10] "Disentanglement provide a unified estimation for quantum entropies and distance measures" 28th International Conference on Atomic Physics (ICAP 2024), Jul. 2024.

[9] "Mutual information maximizing quantum generative adversarial network and its applications" 27th Annual Conference on Quantum Information Processing (QIP 2024), Jan. 2024.

[8] "Estimation of quantum entropies using quantum convolutional neural networks" 27th Annual Conference on Quantum Information Processing (QIP 2024), Jan. 2024.

[7] "Quantum neural networks for quantum mutual information estimation" 23rd Asian Quantum Information Science Conference (AQIS 2023), Aug. 2023.

[6] "Optimizing quantum integer factorization performance: A scalable evaluation approach with parameter pre-selection Method" 23rd Asian Quantum Information Science Conference (AQIS 2023), Aug. 2023.

[5] "Quantum Rényi entropy functionals for bosonic gaussian systems" 27th edition of the Central European Workshop on Quantum Optics (CEWQO 2023), Jul. 2023.

[4] "Quantum neural network approach to measuring von Neumann entropy" 18th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2023), Jul. 2023.

[3] "Quantum Rényi entropy functionals for bosonic gaussian systems" 17th Conference on the Theory of Quantum Computation, Communication and Cryptography (TQC 2022), Jul. 2022.

[2] "Quantum Rényi entropy functionals for bosonic gaussian systems" 25th Annual Conference on Quantum Information Processing (QIP 2022), Jan. 2022.

[1] "Geometry of random unitary channels in high-dimensional quantum states" 25th Annual Conference on Quantum Information Processing (QIP 2022), Jan. 2022.

TEACHING EXPERIENCES

Research Internship Supervisor

SW4343: Software Field Placement 1 (credit-linked internship program, Korea Aerospace University) Fall 2024

Teaching Assistant at Yonsei University

YCS1009: Change the World through Programming Fall 2022
YCS1002: Software Programming Fall 2022
EEE1108: Engineering Information Processing Fall 2021

Course Tutor at Yonsei University

MAT2016: Engineering Mathematics 3 (linear algebra and differential equations) Spring 2022
MAT1012: Engineering Mathematics 2 (multivariable and vector calculus) Fall 2021

PROFESSIONAL ACTIVITIES

Internship Application Reviewer and Interviewer: 3rd Quantum Internship Program – Korea Quantum Industry Center and National Information Society Agency

LANGUAGE PROFICIENCY

Korean (Native or bilingual proficiency) and English (Professional working proficiency)

REFERENCES

References available upon request

Updated October 2024