Tak Hur

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Profile

First year Ph.D. student at Yonsei University. My research interests focus on Quantum Machine Learning, Quantum Learning Theory, and Quantum Simulation.

Education

Yonsei University — Korea
PhD in Statistics and Data Science — *March, 2023 –*

Imperial College London — United Kingdom
Msci Physics with Theoretical Physics — *Sept, 2021 – August, 2022*

Imperial College London — United Kingdom
Bsc Physics with Theoretical Physics — *Sept, 2017 – August, 2021*

Publications

[1] **Hur, T.** Kim, L. Park, D. (2022). "Quantum convolutional neural network for classical data classification". *Quantum Machine Intelligence 4, 3.*

[2] **Hur, T.** Araujo, I. Park, D. (2023). "Neural Quantum Embedding: Pushing the Limits of Quantum Supervised Learning". (*Publication in progress*)

Presentations

[1] "Neural Quantum Embedding" Plenary talk at *Quantum Techniques in Machine Learning* (QTML). Nov, 2023

[2] "Neural Quantum Embedding" Poster presentation at *Asian Quantum Information Science Conference* (AQIS). Aug, 2023

[3] "Neural Quantum Embedding" Poster presentation at *Joint Symposium on Quantum Computing* (JSQC). Aug, 2023

[4] "Quantum Kernel Optimization via Deep Learning." *Electronics and Telecommunications Research Institute* (ETRI). Jan, 2023

Research Experiences

Neural Quantum Embedding
with Dr. Israel Araujo, Prof. Daniel Park — Jan. 2023 – Sept. 2023

- Presented a novel and effective quantum embedding scheme for quantum machine learning by leveraging the power of classical neural network
- Demonstrated the effectiveness of the method with numerical simulations and IBM quantum hardwares
- Verified the effect of the method on trainability and generalization performances by analyzing local effective dimension and geometric difference

Quantum Convolutional Neural Network

with Leeseok Kim, Supervisor: Prof. Daniel Park March 2021 – Aug. 2021

- Investigated the performance of various Quantum Convolutional Neural Network (QCNN) designs for classical pattern recognition task
- Demonstrated the advantage of quantum machine learning models by comparing QCNN to its classical counterparts
- Paper accepted in *Quantum Machine Intelligence*

Simulating Non-Abelian Braiding Statistics

Supervisor: Dr. Derek Lee Oct. 2021 – June 2022

- Studied braiding statistics of Non-Abelian Anyons for topological quantum computation
- Demonstrated the braiding simulation in a tri-junction using a pulse level control of a quantum circuit (*Qiskit Pulse*)

Other Experiences

IBM Quantum Leadership Training Program July - August 2023

IBM *IBM T.J. Watson Research Center, NY*

- Selected as one of only 15 participants nationwide for the prestigious Quantum Leadership Training Program at IBM's T.J. Watson Research Center
- Acquired expertise in advanced Qiskit functionalities, including Qiskit Runtime, Dynamical Decoupling, and Probabilistic Error Cancellation, through direct mentorship from leading IBM researchers.

NTU-IBM Qiskit Hackathon Aug 2023

IBM / National Taiwan University *NTU, Taiwan*

- Implemented quantum kernel optimization scheme by utilizing classical neural networks
- Led and strategically organized a multidisciplinary team to achieve a third-place

Quantum Open Source Foundation (QOSF) Mentorship March - June 2021

QOSF

- Benchmarked the performances of quantum machine learning models for image classification
- Contributed to the open-source community by publishing the code and authoring an introductory tutorial

2022 / 2021 QHACK Feb 2022 / Feb 2021

Xanadu

- Solved interesting QML problems such as weighted Max-Cut problem with QAOA and solving excited states of the Hamiltonian by utilizing Variational Multiclass Eigensolver
- QHACK 2022 - Top 4 / 300
- QHACK 2021 - Top 30 / 300

2021 / 2020 Qiskit Global Summer School July 2021 / July 2020

IBM

- Studied expressibility of parameterized quantum models and their trainability issues with Barren Plateaus
- Implemented advanced quantum learning models including Quantum Boltzmann Machine and Quantum Generative Adversarial Networks

NYU Deep Learning July – Sept 2021

NYU Center for Data Science

- Learned inference framework of probabilistic learning models and energy based models
- Implemented variational autoencoders and Generative Adversarial Networks with PyTorch

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References

[1] Prof. Kyungdeock Park, dkd.park@yonsei.ac.kr

- *Assistant Professor* at Department of Applied Statistics, Department of Statistics and Data Science, Yonsei University