# Jiwoon Lee

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## Education

**Kwangwoon University** Sep 2024 – Present
*Master of Engineering Student* *On-site – Seoul, Republic of Korea*
*Advisor: Prof. Cheolsoo Park*

- GPA: 4.25 / 4.5 (14 credits, completion of 2 semesters)

**Kwangwoon University** Feb 2019 – Aug 2024
*Bachelor of Science in Computer Engineering* *On-site – Seoul, Republic of Korea*
*Advisor: Prof. Cheolsoo Park*

- GPA: 3.67 / 4.5

## Research Interests

Computational neuroscience, signal processing, brain-computer interface, statistical machine learning

## Journal Articles

- Y. Park†, **J. Lee**†, D. Sim, Y. Cho, C. Park. 2025. "Designing Spiking Neural Network-Based Reinforcement Learning for 3D Robotic Arm Applications." *Electronics* (**SCIE, Co-first author, IF = 2.6, JCR Top 45.2%**) [LINK]
- C. Lee†, Y. Park†, S. Yoon†, **J Lee**†, Y. Cho, C. Park. 2024. "Brain-Inspired Learning Rules for Spiking Neural Network-based Control: A Tutorial." *Biomedical Engineering Letters* (**SCIE, Co-first author, IF = 3.2, JCR Top 45.9%**) [LINK]
- H. Yu†, S. Baek†, **J. Lee**†, I. Sohn, B. Hwang, C. Park. 2024. "Deep Neural Network-based Empirical Mode Decomposition for Motor Imagery EEG Classification." *IEEE Transactions on Neural Systems and Rehabilitation Engineering* (**SCIE, Co-first author: IF = 4.8, JCR Top 2.9%**) [LINK]
- J. Yang, J. Kim, H. Ryu, **J. Lee**, C. Park. 2024. "Predicting Car Rental Prices: A Comparative Analysis of Machine Learning Models." *Electronics* 13, no. 12: 2345 (SCIE, Co-author: IF = 2.6, JCR Top 45.2%) [LINK]
- **J. Lee**†, D. Kim†, Y. Park, J. Park, S. Park, C. Park. "Energy-Efficient Adaptation for Robotic Arm Control on a Neuromorphic Hardware." *Under Review* (**Co-first author**)
- J. Kim, **J. Lee**, C. Park. "Advances in Analog Circuit Design Automation using Reinforcement Learning: A Review." *Under Review* (Co-author)

## Projects

**Neural Network-Based Approach for Circuit Yield Enhancement** Aug 2025 – Present

- Non-Disclosure Agreement

**GPGPU-Based Approach for High-Speed Circuit Simulation** Aug 2025 – Present

- Non-Disclosure Agreement

**EMG-based robotic arm control using neuromorphic processor** Mar 2023 – Present

- Classified of six arm movements and controlled robotic arm using electromyogram (EMG) signals and dynamic vision sensor (DVS)
- Received an Excellence Award at the world embedded software contest 2023
- Developing a quantized spiking neural network (SNN) and reward-modulated spike timing-dependent plasticity (STDP) algorithm for neuromorphic processors
- Developing an algorithm based on a reinforcement learning framework for continuous real-time robot arm control

**Opensource SNN Accelerator for FPGA** Jan 2023 – Present
*GitHub*

- Implemented SNN and STDP-based on-chip learning on a FPGA in Verilog
- Implementing in high level synthesis (HLS) for scalability
- Development Environment: (Current) PYNQ-Z2, Xilinx Vivado, (Previous) Artix 7

**Prediction of Car Rental Prices with Machine Learning approaches** Jan 2023 – Jun 2024
*Publication*

- Developed a vehicle rental price prediction model using time series prediction algorithms such as autoregressive and moving average, recurrent neural network, and foundation model

**Analysis of an SVM-based breast tumor classification model using the LIME method** Jul 2022 – Aug 2022
*Presentation*

- Developed a support vector machine (SVM)-based breast tumor classification model with a classification accuracy of 98.2%
- Analyzed an SVM-based model with local interpretable model-agnostic explanation (LIME) method, which is an algorithm for explainable artificial intelligence
- The experimental results confirmed that the concave, area, perimeter, texture, and radius of the cell affected the classification of benign and malignant

**Restoration and interpolation of ECG using generative model** Jun 2022 – Oct 2022
*Proceedings*

- Developed conditional denoising diffusion probabilistic model (DDPM) for ECG interpolation and restoration
- Experimental results show that up to 50% of random missing data can be restored, and interpolation after undersampling, successfully achieves up to 70% despite the Nyquist sampling theory
- Received a Best Paper Award (Bronze) at 2022 IEEE ICCE-Asia

**Generalization of multivariate EMD using Neural Networks for Motor Imagery EEG** Oct 2021 – Oct 2023
*Publication*

- Generalized the model-free algorithm multivariate EMD using deep neural networks
- Effectively solved the mode mixing problem, which is a problem of existing EMD-based algorithms
- Our proposed method showed better motor imagery classification results than other EMD-based algorithms

**Real-Time matchmaking system with Queue and the Nearest Neighbor algorithm** Jun 2021 – Apr 2022

- Designed real-time matchmaking system with Queue and the Nearest Neighbor algorithm for study stream service
- Received an Excellence Award at Ministry of National Defence Start-Up Challenge
- Qualified for the finals at K-Startup Grand Challenge 2021
- Received KRW 70 million (approximately USD 50,000) in support from the Pre-Startup Package of the Korea Institute of Startup & Entrepreneurship Development

**Arrhythmia classification by using Signal to Image method** Nov 2019 – Dec 2019
*GitHub*

- Converted ECG signals into images to classify arrhythmias
- The experimental results showed good classification performance with small data compared to other algorithms

**Unsupervised learning based measurement of video liveness** Aug 2019 – Sep 2019
*GitHub 1, 2*

- Analyzed the dynamics of the video using metrics such as pixel error and structural similarity for each frame
- Developed a program that edits videos in high-dynamic sections by dividing the dynamics into three stages

**Text-To-Speech using a GAN** Jul 2019 – Sep 2019

- Developed a GAN that takes text as input and generates a mel spectrogram for voices
- Received a Grand Prize at 2019 Chambit Design Semester Performance Presentation in Kwangwoon University

**Wi-Fi and Beacon based Augmented Reality Navigation System** Jan 2016 – Jun 2016
*Patent (application)*

- Developed an augmented reality navigation system based on Wi-Fi and Beacon
- Developed an indoor positioning system using the triangulation method between the device and sensor

## Work Experience

**Research Assistant** Jan 2022 – Present
*Bio Computing and Machine Learning (BCML) Lab, Kwangwoon University* *On-site – Seoul, Republic of Korea*
*Advisor: Prof. Cheolsoo Park*

- Opensource SNN accelerator for FPGA
- Neuromorphic hardware-friendly reward-modulated STDP
- Robot arm control using EMG and SNN
- Reconstruction method for missing electrocardiogram (ECG) using DDPM
- Motor imagery classification via multivariate EMD
- Classification of arrhythmias via 1D-2D transformation
- Detection of abnormal walking based on sensor data

**Research Intern** Jul 2022 – Aug 2022
*Qualcomm Institute, University of California, San Diego* *On-site – San Diego, California, United States*
*Advisor: Dr. Seokheon Cho*

- Analysis of disease classification model using the LIME method
- Classification of breast tumors using an SVM

**Fire Direction Specialist, Squad Leader, Sergeant** Jun 2020 – Dec 2021
*Capital Defense Command, Republic of Korea Army* *On-site – Seoul, Republic of Korea*

- Mathematical computations to determine artillery firing angles
- Training new recruits in these mathematical calculations
- Squad management tasks

## Teaching Experience

**Teaching Assistant** Mar 2024 – Present
*Kwangwoon University* *On-site – Seoul, Republic of Korea*

- Mentoring 50 students in Digital Logic Circuits 1 (Spring 2025)
- Mentoring 18 students in Computer Engineering Basic Experiment 1 (Spring 2025)
- Mentored 73 students in Assembly Language Programming (Fall 2024)
- Mentored 102 students in Computer Architecture (Spring 2024)

**Student Mentor** Jan 2022 – Present
*BCML Lab, Kwangwoon University* *Hybrid – Seoul, Republic of Korea*

- Mentored around 50 undergraduate students in BCML lab, in machine learning [LINK]

## Honors and Awards

- Excellent Exhibition Center Award, "Human Brain Neuro-computing Platform Research Center", 2025 World IT Show, Ministry of Science and ICT, 2025
- Excellent Exhibition Center Award, "Human Brain Neuro-computing Platform Research Center", 2024 World IT Show, Ministry of Science and ICT, 2024
- Excellence Award, "SNN-based arm motion imitation robot arm control algorithm using EMG and DVS", The World Embedded Software Contest 2023, Korea Electronics Technology Institute, 2023
- Software Competence Excellence Scholarship, Kwangwoon University, {2019, 2022, 2023}
- **Best Paper Award (Bronze)**, 2022 IEEE ICCE-Asia 2022, IEEE, 2022 [**LINK**]
- Excellence Award, “SWIM: Study WIth Me, a study stream service”, Ministry of National Defense Start-Up Challange, Ministry of National Defense Republic of Korea, 2021
- Academic Excellence Scholarship, Kwangwoon University, 2019

- Grand Prize, “Text-To-Speech based on Generative Adversarial Network”, 2019 Chambit Design Semester Performance Presentation, Kwangwoon University, 2019
- Microsoft Azure Prize, "Mixed Reality Game", The 1st Welcome to the maker world, Microsoft Korea, 2017

## Certifications

- Introduction to Statistical Methods with MATLAB, MATLAB, Feb 2023
- Qualcomm Institute Artificial Intelligence (AI) Development Project, Qualcomm Institute, Aug 2022
- AI Framework Certificate(KNIME Certification: L1 Examination, KNIME, Aug 2022
- Principles of Supercomputer and Supercomputing, Korea Institute of Science and Technology Information, Nov 2016

## Professional Memberships and Services

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|---|---|
| Organizer, Google Developer Student Clubs Kwangwoon University | Sep 2023 – Aug 2024 |
| Student member, IEEE, Seoul Section | Sep 2022 – Feb 2024 |
| Member, IEEE Consumer Technology Society | Sep 2022 – Feb 2024 |

## Conference Papers

- **J. Lee**, Y. Park, H. Lee, J. Park, C. Park, “Neuromorphic Spike-based Reinforcement Learning for 2-DoF Robotic Arm Control", In *34th Korean Signal Processing Conference*, Oct 2024, Seoul, Korea
- J. Yang, J. Kim, **J. Lee**, H. Ryu, S. Yeo, P. Kim, Y. Kim, J. Lim, H. Yoon, C. Park, “Metaverse: Research Based Prediction Model of the Car Price in view of the Machine-learning Method", In *2023 IEEE International Conference on Metaverse Computing* (IEEE MetaCom 2023), Jun 2023, Kyoto, Japan [LINK]
- Y. Kang, **J. Lee**, C. Park, “Probabilistic Modeling for Multivariate Signal Restoration in PPG and ECG Using Denoising Diffusion", In *The Korean Society of Medical & Biological Engineering Spring Conference 2023*, May 2023, Daegu, South Korea
- **J. Lee**, C. Park, “Denoising Diffusion Probabilistic Model based Time-Series ECG data Interpolation”, In *2022 Korean Society of Medical & Biological Engineering Autumn Conference*, Nov 2022, Incheon, South Korea
- **J. Lee**, C. Park, “Restoration of Time-Series Medical Data with Diffusion Model”, In *2022 IEEE International Conference on Consumer Electronics-Asia* (ICCE-Asia), Oct 2022, Yeosu, South Korea [LINK]
- S. Baek, H. Yu, **J. Lee**, C. Park, “Design of Explainable AI Model with LIME for Single Channel Electroencephalogram”, In *2022 Summer Annual Conference of IEIE*, Jun 2022, Jeju, South Korea [LINK]
- S. Baek, S. Han, **J. Lee**, C. Park, “Arrhythmia Classification Using 1D-2D Conversion”, In *u-Healthcare 2019*, Dec 2019, Seoul, South Korea

## Volunteering

**Colorful Happy Classroom After-School Program** Apr 2019 – Jul 2019

*Korea Foundation for the Advancement of Science and Creativity (KOFAC)*

- Programming class for elementary school students
- Scratch programming

**2014 Korea Education Fair for Happiness** Sep 2014 – Sep 2014

*Korea Foundation for the Advancement of Science and Creativity (KOFAC)*

- Programming class
- Web programming, C programming