

Donghyuk Lee

Undergraduate Student

Major, School of Electrical Engineering

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Executive Summary

I am an undergraduate student in the School of Electrical Engineering at KAIST. I am studying with an interest in research on biomedical devices based on computational methodologies such as machine learning and in the field of wave optics.

During my time at science high school, I conducted various research activities combining graph theory and genetics. Specifically, I developed a screening model that rapidly predicts diabetes based on the 5hMC methylation pattern of circulating cell-free DNA (cfDNA). Additionally, under the guidance of Professor Jin-Soo Seo (Yonsei university, Seo Lab), I conducted research using graph perturbation theory to elucidate the correlation between the ApoE4 genotype (a causative gene for Alzheimer's disease) and lipid rafts from a metabolic perspective. Beyond this, I have made diverse attempts to integrate various machine learning techniques, such as GANs and LLMs, into biotechnology research.

I also possess wet lab research experience. During my sophomore year of high school, I conducted research in Professor Yoon's lab at KAIST (Yoon Lab) on elucidating cell-specific transcriptomic dynamics during human brain organoid development. During this research, I had the opportunity to use confocal imaging, which sparked my interest in imaging and processing techniques. Consequently, I am currently pursuing personal studies related to optics.

Research Interest

- Optical Imaging
- Machine Learning

Education

B.S. in Electrical Engineering

Expected in 2029

Korea Advanced Institute of Science and Technology (KAIST)

Gyeonggi Buk Science High School

January 2025

Awards & Certificates

2021

- Korea Middle School Physics Competition (KMPHC) **Silver Medal**
- Korea Middle School Chemistry Competition(KMChC) **Silver Medal**
- Korean Mathematical Olympiad (KMO) **Encouragement Award**

2022

- Korea Brain Camp **Certificate (with Honors)**

2023

- Nationwide Science High School/Gifted School Creative Foundation Outstanding Research Presentation Contest **Bronze Medal (3rd place)**
- Nationwide Science Exhibition **Excellence Award (4th place)**
- KAIST pre-URP (Yoon Lab) **Certificate**

Research History

- [1] 2022 Creative Individual Research: Production of 1202T mutant mCherry–pBHA transformed *E. coli* via SDM and evaluation of its pH responsiveness as a bio–compatible micro pH–meter
- [2] 2023 Spring Semester Creative Individual Research: Epigenetic prediction of Alzheimer's disease induction mechanisms through genetic network learning
- [3] 2023 Fall Semester Creative Individual Research: Development of a Non–invasive Comprehensive Diabetes Complication Diagnosis Model Using Liquid Biopsy and Explainable AI
- [4] 2024 Spring Semester Creative Individual Research: Study on the Correlation between Gene Expression Data Transformation and Prediction via Adversarial Generative Neural Networks and Enhanced Epigenetic Aging Profiling Performance
- [5] 2022–2023 (First Half) RnE: Study on Cancer Cell–Specific Chemotaxis of *Pseudomonas fluorescens*–Powered Bio–Microbots
- [6] 2023 Second Half RnE: Study on the Correlation between Biofilm Formation and *R. palustris* Cell Efficiency Based on 3D Electrode Pretreatment Processes
- [7] 2023 KAIST Collaborative Research: Elucidation of Cell–Specific Transcriptome Dynamics During Human Cerebral Organoid Development
- [8] 2023–2024 DGIST Joint Research (Individual Research Activity): Computational Elucidation of Alzheimer's Disease Onset Mechanisms According to ApoE Isoforms and Epigenetic Normalization of ApoE4 Genotype Effects

Studies & Seminars

- [1] AD Biology Abstract & System Biology seminar
- [2] Build GNN models with PyG3
- [3] AI–driven drug discovery "Attention architecture"
- [4] KAIST lab meeting – Changes in Cholesterol Due to Lysosomal Alkalization in ApoE4 Astrocytes
- [5] Paper review seminar – Network Inference Analysis Identifies SETDB1 as a Key Regulator Colorectal Cells into DifferentiatedNormal–Like Cells
- [6] Verification methods seminar – Shapiro Wilk Test & Levene's Test
- [7] The Nitroplast: A Nitrogen–fixing Organelle
- [8] PSI Blast, protein 3D folding structure simulation seminar

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