◆ 2015 – 2024

# PORTFOLIO

Yujee Song

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# *Overview*

## PROFILE



NAME    Yujee Song

## EDUCATIONS

2023 - Present
**POSTECH**
MSc. in Artificial Intelligence
- Class President, GSAI

2020 - 2022
**Chung-Ang University**
BSc. in CSE
- Summa Cum Laude
- GPA 4.47 / 4.50

2015 - 2017
**UC Irvine**
BSc. in CSE
- GPA 3.57 / 4.00

## HONORS

2015 - 2017      • Dean's list, 5 times

2019 - 2022      • Dean's list, 2 times

2022            • Summa Cum Laude

2024 - present   • Student body president

2024            • ICLR 2024, 1 paper

## RESEARCH INTERESTS

- Time Series Analysis

- Medical AI

- Explainable AI

- Generative Modeling

- Dynamical System Modeling

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# Education

## 2023 - Present
### POSTECH
MSc. in Artificial Intelligence

- Medical Information Processing (MIP) Lab

- Supervised by Prof. Won Hwa Kim

- Research Interests :

  - Time Series Analysis

  - Explainable AI

  - Generative Model

  - Graph Machine Learning

  - Dynamical System Modeling

## 2015 - 2017
### UC Irvine
BSc. in Computer Science & Engineering

- GPA : 3.57  / 4.0

- Dean's Honors List, 5 out of 6 time

## 2020 - 2022
### Chung-Ang Univ
BSc. in Computer Science & Engineering

- GPA : 4.47 / 4.50

- Academic Achivement Award, 2 out of 3 times

- Summa Cum Laude

# Honors & Expriences

| | |
|---|---|
| 2024 | Paper Accepted at International Conference of Learning Representation **(ICLR)** 2024 |
| 2024 | Paper Accepted at MICCAI PRIME (co-author) |
| 2024 | Intership at VUNO (3 months) |
| 2024 - Present | **Class President**, Graduate School of Artificial Intelligence |
| 2022 | **Summa Cum Laude**, Chung-Ang Univ. |
| 2021 | Excellence Award, Chung-Ang Univ. Engineering Conference |
| 2020 - 2021 | Academic Scholarship / **Dean's List**, 2times |
| 2015 - 2017 | **Dean's Honor List**, 5 times |

# Publication

## Decoupled Marked Temporal Point Process using Neural ODEs (ICLR 2024)

Yujee Song, Donghyun Lee, Rui Meng, Won Hwa Kim

### Problem Definition

Modeling Marked Temporal Point Process (MTPP) has been s successfully handled. However, interpretability of the dependencies among events are difficult to be obtained.

### Method

We propose a novel framework Dec-ODE, which characterizes MTPP using **decoupled hidden state dynamics driven by Neural ODEs.** Also, utilizing the characteristics of ODEs, our framework can be trained and estimate important characteristics **efficiently.**

### Result

Dec-ODE offers interpretable results, while showing comparable or better results in various metrics compared to state-of-the-art methods. This demonstrating that Dec-ODE successfully models the complex dynamics of MTPP with independently propagated influence functions.

### Conclusion

Dec-ODE provides explainability to the modeling of MTPP, which suggests significant potential for MTPP related applications such as out-of-distribution detection and survival analysis.
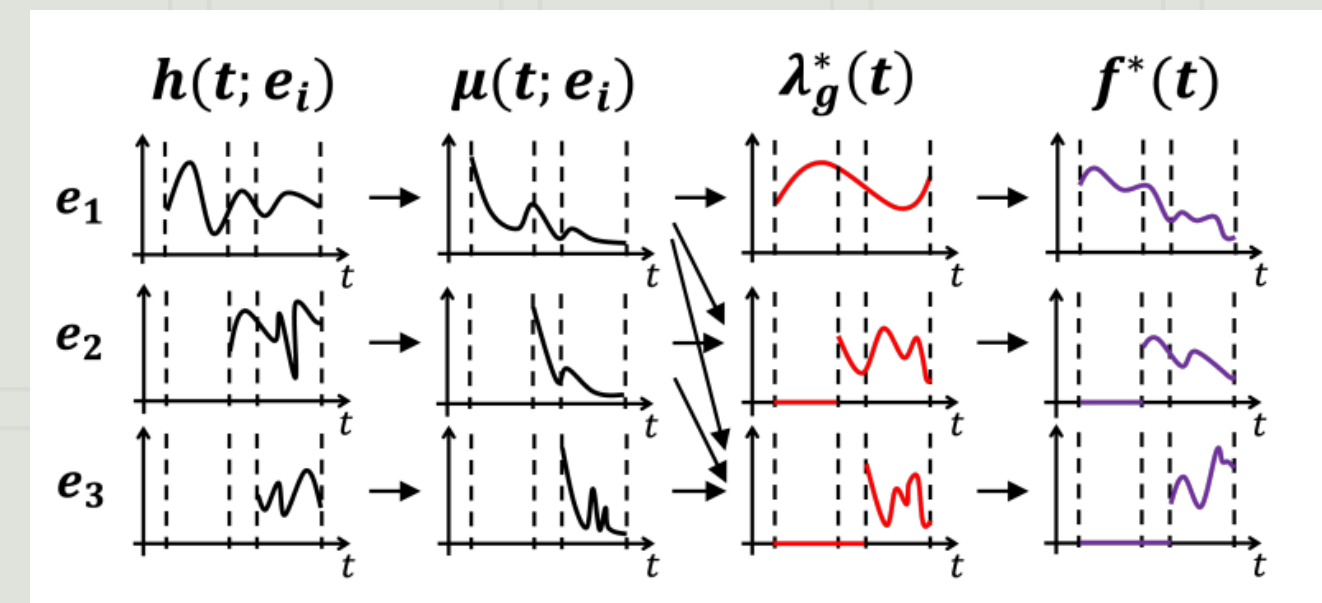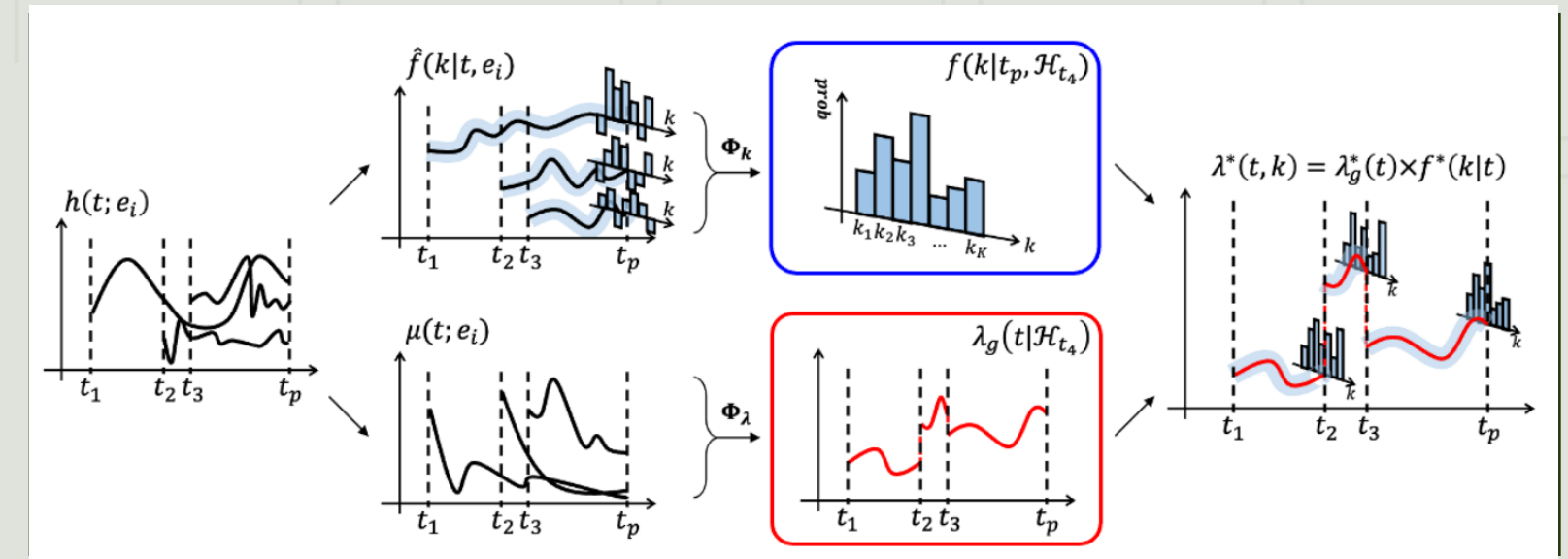
# Publication

## Decoupled Marked Temporal Point Process using Neural ODEs (ICLR 2024)

Yujee Song, Donghyun LEE, Rui Meng, Won Hwa Kim

### Possible Real-Life Applications

**Diagnosing Machine Malfunctions**

Our model can predict machinery malfunctions by analyzing sensor data and maintenance logs, identifying patterns that precede failures. This enables proactive maintenance, reducing downtime and costs.

**Analyzing Stock Market Fluctuations**

In finance, our model analyzes historical trading data and market events to pinpoint triggers of market volatility. This helps analysts understand the impact of specific events on stock prices, aiding in better investment strategies.

**Enhancing Healthcare Monitoring**

Our approach predicts critical health events by analyzing patient data from vital signs to clinical notes. In intensive care units, it can foresee complications, prompting timely medical interventions and improving patient outcomes.

**Improving Customer Behavior Analysis**

Businesses can use our model to analyze customer interactions and purchase history, predicting future behavior. This enables targeted marketing and personalized recommendations, boosting sales and customer satisfaction.
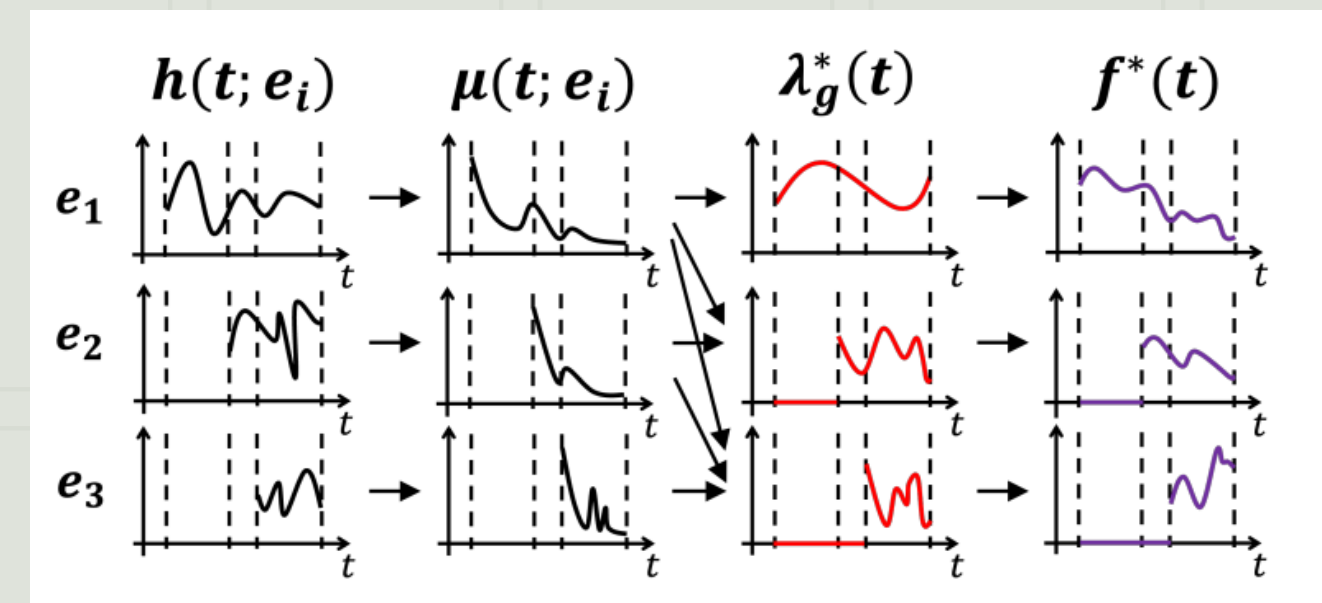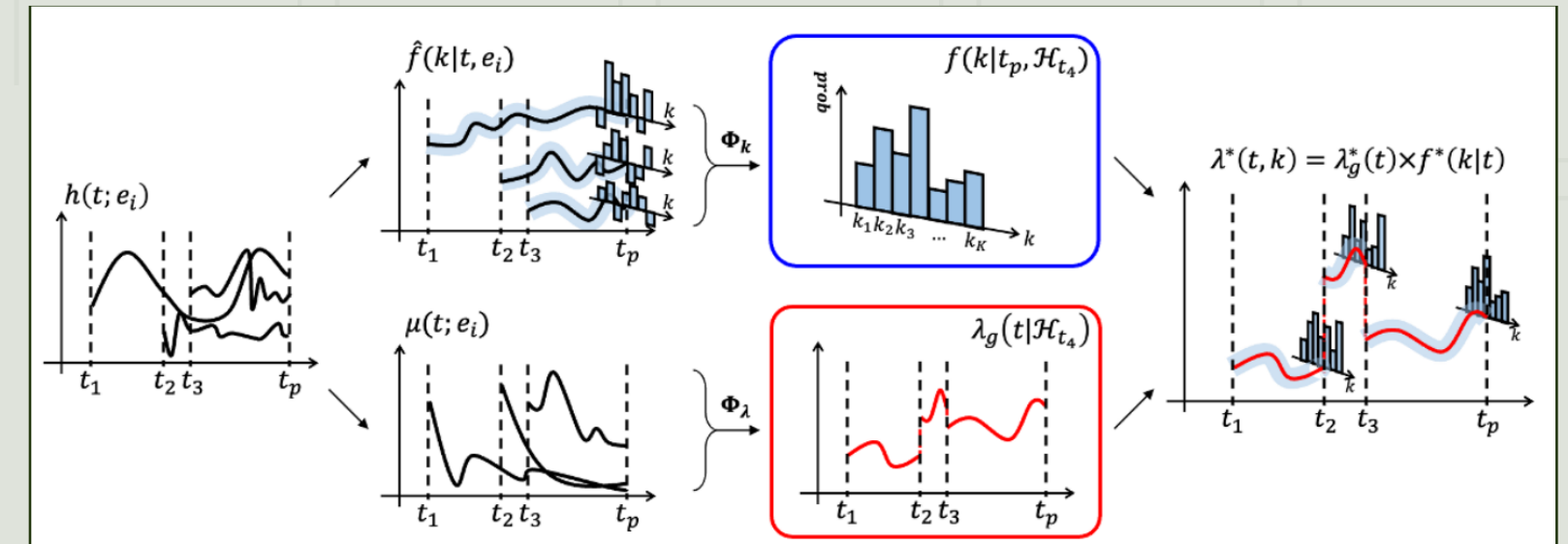
# Publication

## Gene-to-Image: Decoding Brain Images from Genetics via Laten Diffusion Models

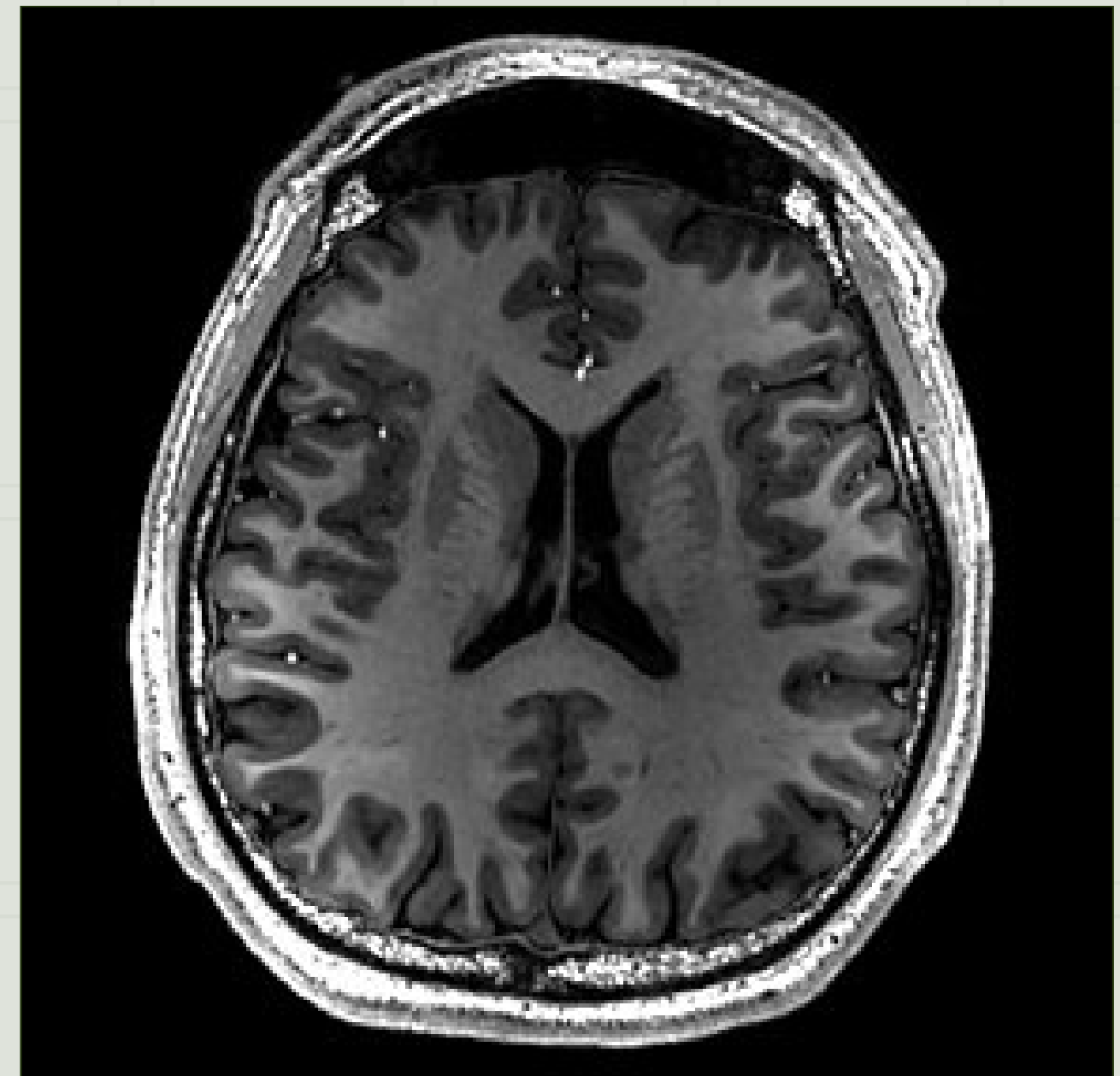Suyeon Jeon, Yujee Song , Won Hwa Kim

### Problem Definition

Utilizing genetic information to generate more realiable brain MRI image.

### Tasks

- Validating possible approaches
- Baseline experiment
- Researching related work
- Implementing comparison metrics

### Result

Our approach was able to generate brain MRI images with comparable or better results under various metrics. It is currently under-review.

# Publication

## Topology-aware Graph Diffusion Model for Graph Generation (under review)

Joonhyuk Park*, Donghyun Lee*, <u>Yujee Song</u>, Won Hwa Kim

### Problem Definition

Generating graphs that resembles the topology (i.e. overall structure) of the population.

### Tasks

- Improving Proposed Methods
- Baseline Experiment
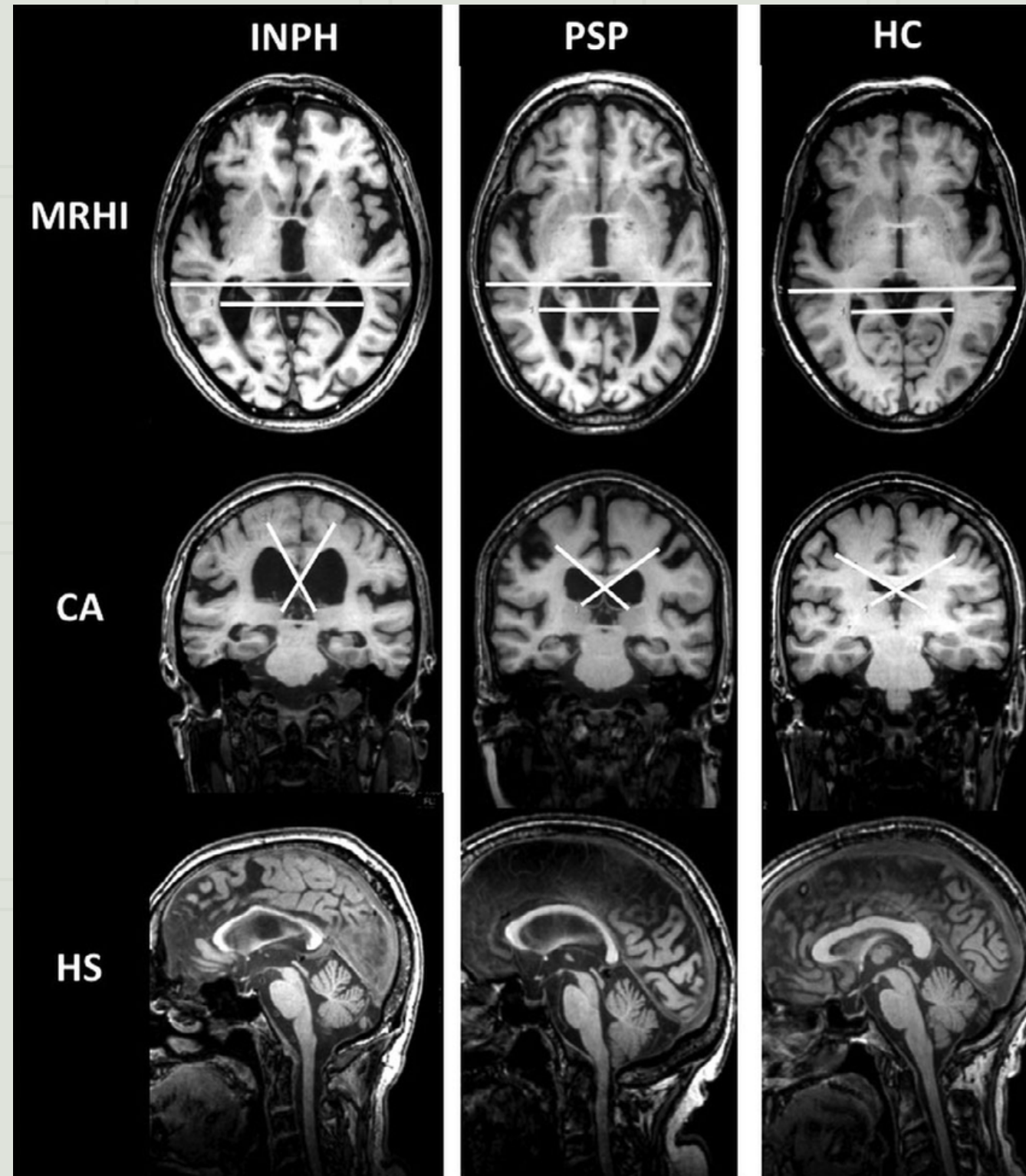- Result Visualization & Analysis

### Result

Our proposed approach was able to show that incorporating topological information to graph generation helps in sampling from distribution that is closer to the observed data.
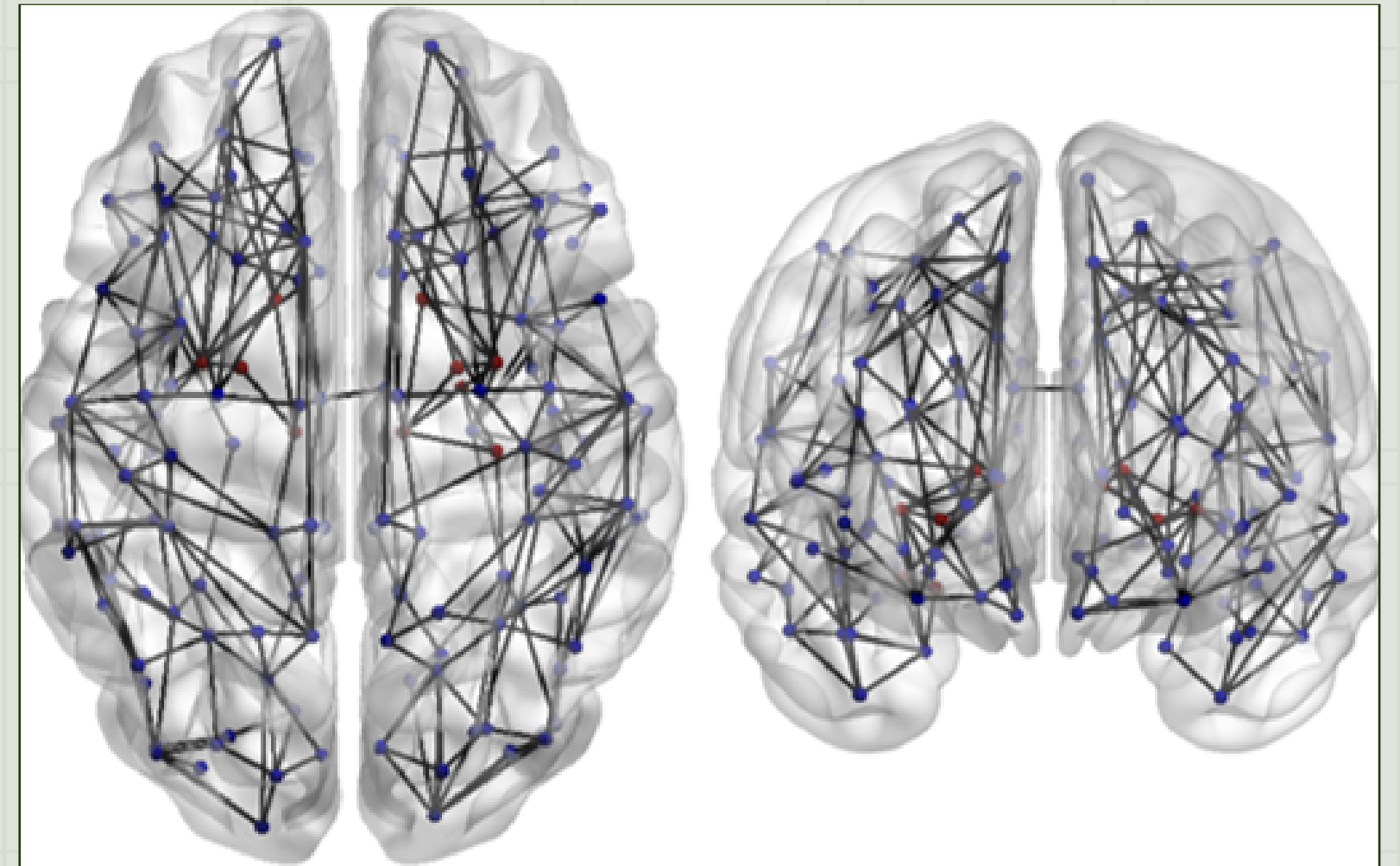
# Differentiating idiopathic Normal Pressure Hydrocephalus (iNPH) and Progressive Supranuclear Palsy (PSP)

Jul 2024 - Present



**Joint Research with VUNO and Asan Medical Center**

## Goals
- Differentiating iNPH and PSP using brain MRI
- Investigating the effectness of deep learning based volumetric measurements

## Tasks
- Designing experiments to verify the effectiveness of different types of features
- Result analysis and comparison with the statistical significance

## Results
- Deep learning based analysis of MRI showed great effectiveness in the differentiation
- Not all statistically significance features gaurantees effectiveness in data driven classification methods
- Identified the volumes of bilateral ventricles and midbrain as the main characteristics
- Using the inference metrics to measure the dialation of ventricles were not as effective as using the direct volumetric analysis

# Projects

# Cerebral Microbleeding Lesion Detection from MRI

Aug 2024 - Present



**Joint Research with VUNO and Asan Medical Center**

Detection of microbleed (MB) is critical in the treatment planning of patients with Alzheimer's disease (AD). Especially, as the development of the medicine for AD accelerates, it is critical to monitor MB since it is one of the key characteristics related to the criticalness of the medication.
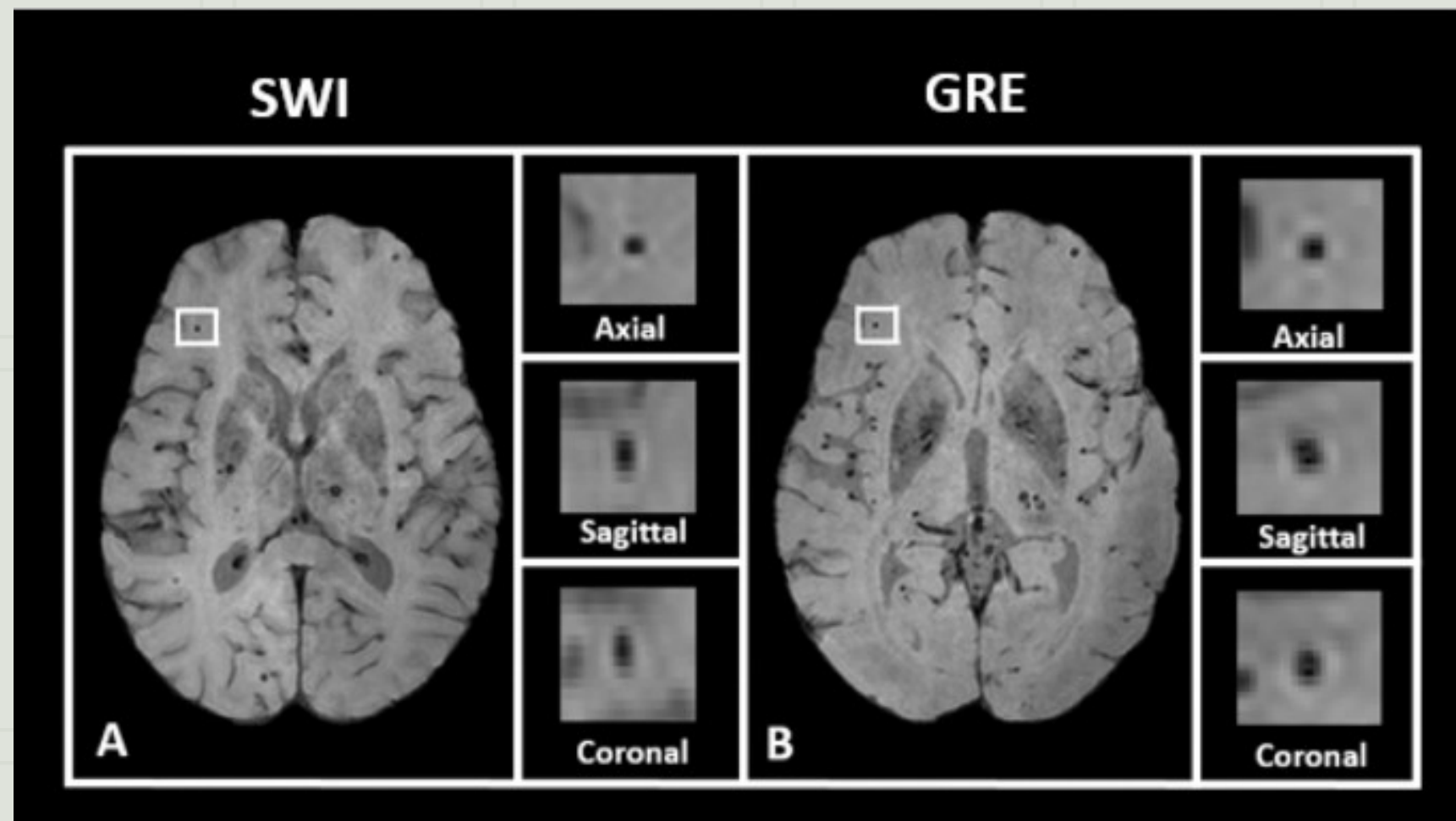
## Goals
- Automatic detection of cerebral MB from SWI image

## Tasks
- EDA on SWI image and patient demographics
- Reviews on previous works done in MB detection and ML methods in natural images that can be applied to this certain problem
- Propose and develop a method to solve this problem
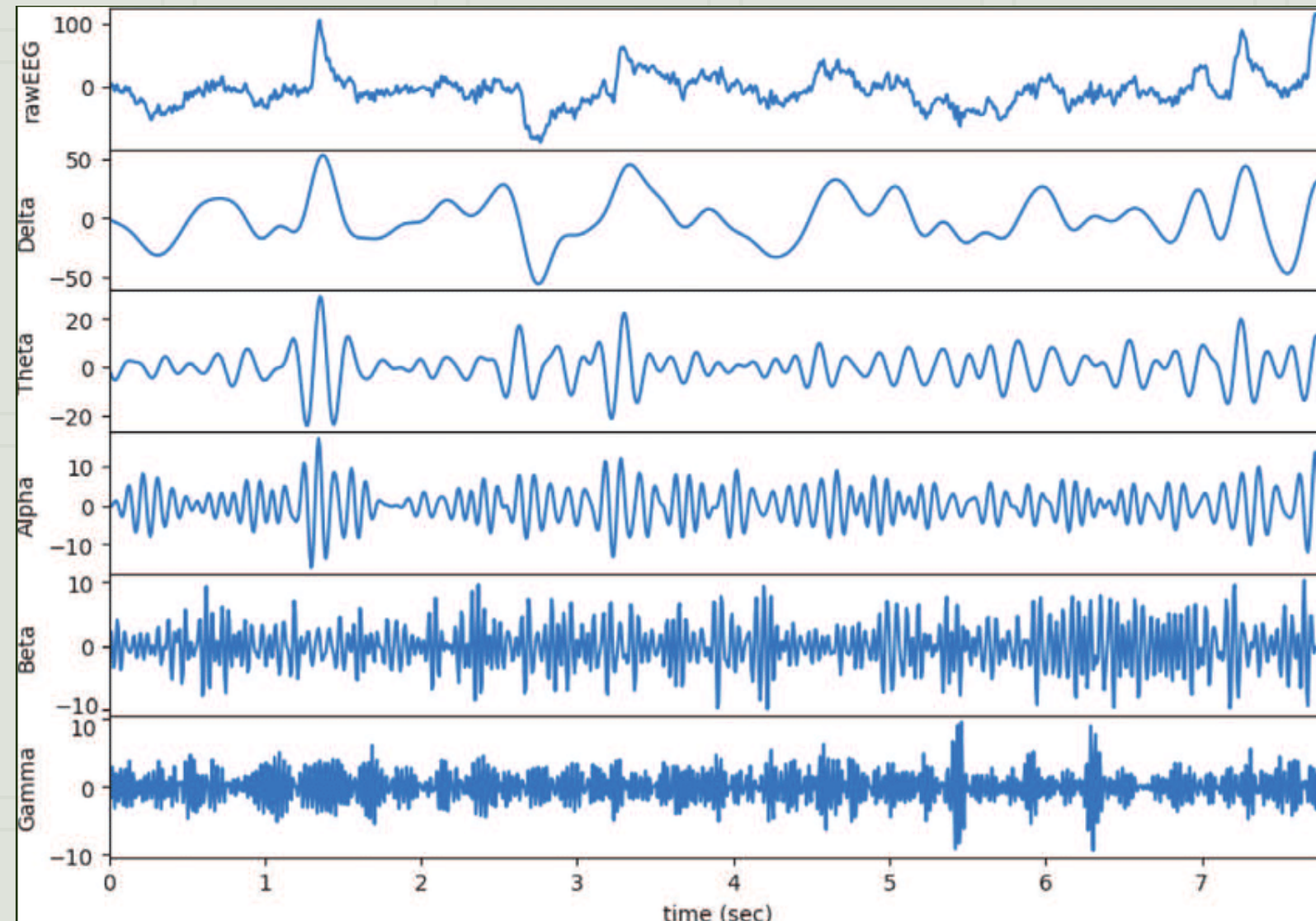
## Result
- Implemented preprocessing step to reduce noise for the training
- Generated 3D segmentation mask from localized point
- In charge of communication with the researchers from Asan medical center
- Proposed and developed methods for MB detection/localization

# Alzheimer's Disease (AD) Diagnosis using Brain Signal

Jul 2023 - Nov 2023



**Joint Research with Korea Institute of Oriental Medicine (KIOM)**

**Goals**
- Diagnosing AD from two-channle resting EEG, and ERP signals.
- 4-way classification: Normal (CN), Early Mild cognitive impairment (EMCI), Late Mild cognitive impairment (LMCI), and Alzheimer's Disease (AD)

**Tasks**
- Propose methodologies and their development.
- Data processing.

**Tools**
- Python
- Pytorch
- Scikit-learn

**Results**
- Comparable results (ACC, AUC) to the currently used diagnostic methods.
- We have concluded that the number of samples were not enough to make a fair comparison.
- Only using 2 channels of EEG signals were not enough to collect suitable information to classify EMCI from CN since the symptoms of development of AD occurs at different regions.

# Thank you for your time

ML Research Portfolio
by  Yujee Song

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