NANYANG TECHNOLOGICAL UNIVERSITY SINGAPORE

School of Computer Science and Engineering
College of Engineering

Network Analysis on Neuro-Imaging Data

Predicting onset of Alzheimer's Disease from Diffusion Tensor Imaging

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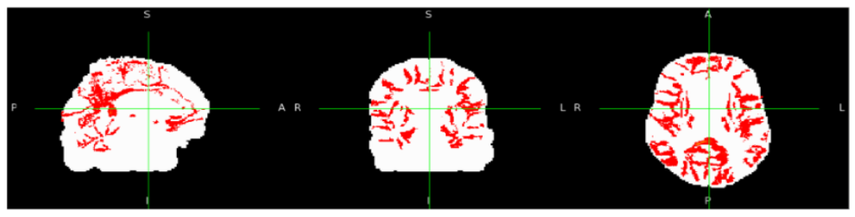
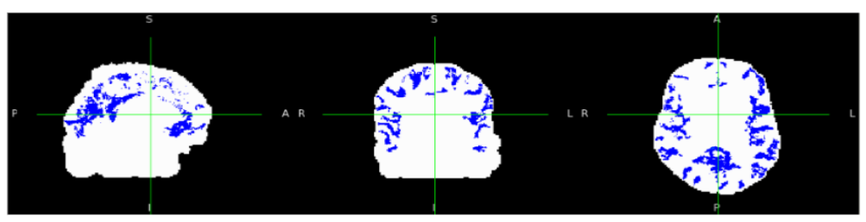
Project Objectives:

(1) Design a complete, explainable, scalable, and expert-validated brain network construction pipeline using Diffusion Tensor Imaging (DTI) that would result in the generation of high-quality structural connectivity matrices;
(2) Review various Graph Convolutional Network (GCN) baselines comprising of different combinations of hierarchical pooling (DiffPool, SAGPool, ASAP) and readout (Global Add/Mean/Max Pool, SoftmaxAggregation, PowerMeanAggregation) modules and examine their impact on graph-level classification.



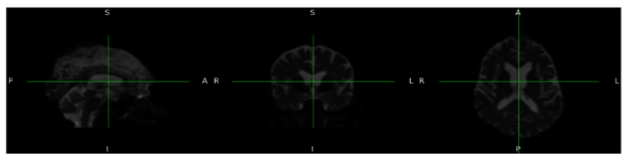
AAL116 Tractography



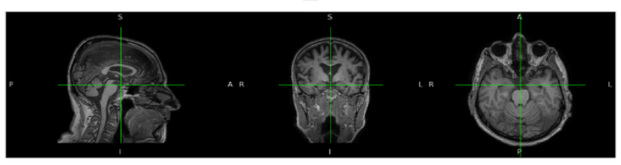
SCHAEFER100 Tractography

DTI Preprocessing Pipeline

FMRIB
Oxford Centre for Functional MRI of the Brain



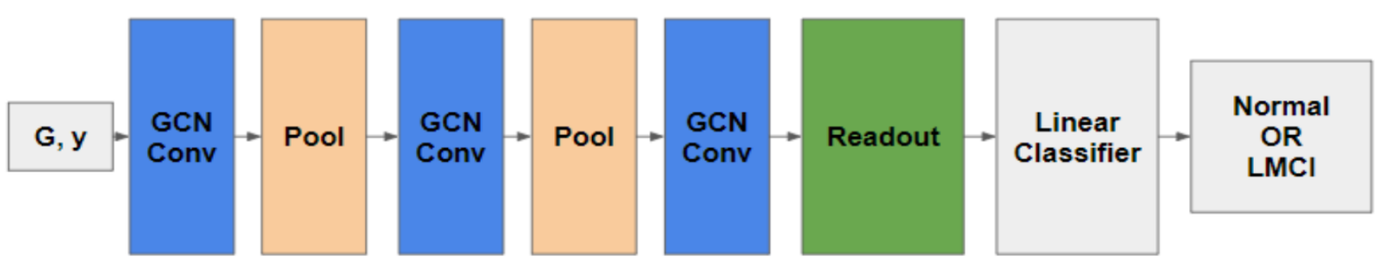
DTI scan (one volume)



T1w scan

Model Pipeline

PyG



Key Findings:

- The developed DTI Preprocessing Pipeline maintained the anatomical soundness of subject brain scans throughout multiple transforms, resulting in **high-quality structural connectivity matrices**
- This positively impacted downstream model analysis, where **relatively simple GCN-based architectures sufficed** for good classification performance; the record was **96.25% test accuracy** using DiffPool and Global Mean Pool for the SCHAEFER100-based parcellation
- **SCHAEFER100** (Schaefer atlas, 7 Networks 100 Parcellations) **outperformed AAL116** (Automated Anatomical Labelling atlas, 116 Parcellations) on the ADNI dataset for 79 subjects (41 normal controls, 38 LMCI)