**P8124 Final Project Proposal**

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1. Analysis objective: what do you want to learn/estimate from this data? What scientific or inferential question do you want to address?
2. Methods: related to course material, ML methods in conjunction with graphical methods
3. Structure: introduction, data, methods, results, discussion

**Objectives**

Nowadays, neuroimaging has become a powerful tool to study the structure and function of human brain in a non-invasive way. The investigator can then interpret findings and eventually understand the relevant neural activities or brain structural changes. One type of brain imaging techniques is the functional magnetic resonance imaging (fMRI), which is a measurement to detect regional and time-varying changes in brain metabolism especially related to human cognition. A common way for fMRI analysis is to restrict the analysis to specific regions of interest (ROIs), “Dosenbach’s 160 functional ROIs” in this case. From each ROI, the time-series of the blood oxygen level dependent (BOLD) signals is extracted to represent the neuronal activity within the ROI.

Autism spectrum disorder (ASD) is a serious neurological disorder that affects one’s daily interactions with other people. The occurrence of ASD in an early age may have negative influence throughout one’s life. The Autism Brain Data Exchange (ABIDE) aims to aggregate both functional and structural brain imaging data from various sites to better understand the mechanism behind ASD. In this project, we use those fMRI data collected from Carnegie Mellon University to investigate the connections between different regions of the brain for people who suffer from ASD and those typical controls (TC).

**Data**

The fMRI data was from the Autism Brain Data Exchange I, which involved 17 international sites. The data used here was collected specifically from Carnegie Mellon University. There are 27 participants in total with 14 people having Autism Spectrum Disorders (ASD) and 13 are the typical controls.

A significant question is how these brain areas are associated, which is termed brain connectivity. The purpose is to find the connections between different regions of the brain.

Blood oxygen level-dependent (BOLD) time courses were generated for 160 regions of interest (ROIs) derived from a series of meta-analyses of task-related fMRI studies that cover much of the brain. Partition the 160 ROIs into six networks: cingulo-opercular, frontoparietal, default mode, sensorimotor, occipital, and cerebellar. The cigulo-opercular control network had the greatest sum total of feature weights, meaning that is was relatively best predictor for functional maturity.

**Methods:**

1. Using the graphical lasso procedure, we create undirected graphs that display the connections between the different regions of interest (ROI) in the brain. By controlling the regularization parameter in this lasso procedure, we identify which ROIs are more strongly connected than the others. Compare these undirected graphs across these two different populations (ASD vs. TC).