Final Project

In your final project, you will be working with data derivatives from MRI images from real research studies. In particular, you will be looking at volumes of structures (curated by Hubert Liu) in a particular brain region and how they vary with age, sex, and disease/disorder.

Your final project will take the form of a **8 minute powerpoint presentation**. Powerpoints are **due on 10/14** and you should be ready to present on either 10/14 or 10/16. The presentation should be rich in figures/images and include the following components:

- Describe the function and shape of the brain region
    - Where is it located in the brain?
    - What does it look like?
- How might it be involved in the disease/disorder? Is there existing literature behind its involvement?
- Within each structure, compute the volume means and standard deviations for the control/healthy subjects. Then, for each subject (healthy and diseased), compute the z-score relative to this mean/standard deviation. These z-scores will give each patient a "bar code." Plot these bar codes as a heat map where black is 0, red is positive and blue is negative. Show some of these bar codes.
- Choose a statistical test to compare the structure volumes between the "control" and "disease/disorder" groups. Describe it and present its results on the volume data.
- Segment the MNI atlas (curated by Can Ceritoglu) MRI image on MRICloud (https://mricloud.org/)
    - Create an account
    - Go to Segmentation -> T1-Multiatlas
    - Upload the hdr file as the Header, and the img file as the Image
        - Note: the MNI atlas image was created by combining scans from several healthy, young adults
    - Use the default atlas, and the "Axial" Slice type
    - This tutorial may be useful - https://www.jove.com/video/57256/whole-brain-segmentation-change-point-analysis-anatomical-brain
- Make a barcode for this patient, where do they fall compared to your dataset?

Diseases/Disorders:

- ADNI (http://adni.loni.usc.edu/) – Alzheimer's disease
- BIOCARD (http://www.alzresearch.org/biocard.cfm) – Alzheimer's and General Cognitive Decline
- ADHD – ADHD 2000 (http://fcon_1000.projects.nitrc.org/indi/adhd200/) - ADHD
- TRACK-HD (http://hdresearch.ucl.ac.uk/our-results/track-hd/) and PREDCT-HD (https://predict-hd.lab.uiowa.edu/) – Huntington's disease

Brain regions and associated structure – Name (Code)

- Limbic system
    - Amygdala (Amyg)
    - Fimbria (Fimbria)
    - Hippocampus (Hippo)
    - Mammillary bodies (Mammillary)
- Basal Ganglia
    - Caudate (Caud)
    - Putamen (Put)
    - Globus pallidus (GP)
    - Nucleus accumbens (NucAccumbens)
- Diencephalon/Mesencephalon
    - Thalamus (Thalamus)
    - Hypothalamus (Hypothalamus)
    - Midbrain (Midbrain)
    - Red nucleus (RedNc)
    - Substantia nigra (Snigra)
- Frontal Lobe
    - Superior frontal gyrus (SFG)
    - Middle frontal gyrus (MFG)
    - Lateral fronto-orbital gyrus (LFOG)
    - Middle fronto-orbital gyrus (MFOG)
    - Inferior frontal gyrus (IFG_opercularis/orbitalis/triangularis)
    - Precentral gyrus (PrCG)
- Cingulate Lobe
    - Dorsal anterior cingulate gyrus (dorsal_ACC)
    - Rostral anterior cingulate gyrus (rostral_ACC)
    - Subcallosal anterior cingulate gyrus (subcallosal_ACC)
    - Subgenual anterior cingulate gyrus (subgenual_ACC)
    - Posterior cingulate gyrus (PCC)
- Parietal lobe
    - Angular gyrus (AG)
    - Insula (Insula)
    - Postcentral gyrus (PoCG)
    - Precuneus (PrCu)
    - Supramarginal gyrus (SMG)
    - Superior parietal gyrus (SPG)
- Occipital lobe
    - Cuneus (Cu)
    - Inferior occipital gyrus (IOG)
    - Lingual gyrus (LG)
    - Middle occipital gyrus (MOG)
    - Superior occipital gyrus (SOG)
- Temporal lobe
    - Inferior temporal gyrus (ITG)

    - Entorhinal area (ENT)
    - Fusiform gyrus (FuG)
    - Middle temporal gyrus (MTG)
    - Parahippocampal gyrus (PHG)
    - Superior temporal gyrus (STG)
- Ventricles
    - All components of the lateral ventricles (LV)