**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 graduate student 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 an **8 minutes long pre-recorded presentation with 2 minutes for questions (live Q+A)**. Presentations and videos are **due on 10/20 at 10am**. Upload your slides as **both** .pptx and .pdf files along with any code you used. For the recorded videos, **upload them to One Drive and create a shareable link** that you submit to blackboard along with the other files. Pre-recorded presentations will air **in class** on October 20 (Zoom ID: 92910578519) and October 22 (Zoom ID: 98766394621) at 12-1:15pm with live Q+A (2 mins per group).

**As an exercise in universal design for accessibility, each presentation should include autocaptions which can be generated in Google Slides or Microsoft Translator 365 (via myJHU not your own Office software). The use of autocaptions calls for clear speech which will help everyone.**

Bonus points will be given for attendance at each live session. A total of 2 points may awarded: 1 point will be given for 100% class attendance (all 65 students) on Wednesday 10/20, and 1 point will be given for 100% class attendance (all 65 students) on Friday 10/22.

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 Dr. 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. Therefore, we will be segmenting this atlas using MRI Cloud.
  + 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?
* Include any other analysis that you think will make for a meaningful look into the 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)

**Grading breakdown: (105 points possible + 2 for class attendance)**

1. Discuss the location (5 pts), shape (5 pts), function (5 pts) of your ROIs
2. Discuss possible involvement in disease (5 pts) and motivate with relevance of past work (5 pts)
3. Create and explain the “barcode” results (10 pts)
4. Conduct appropriate statistical analysis (10 pts), stating assumptions made about those tests and the analysis (10 pts), discussing the results (10 pts), and comparing these results to the literature (5 pts)
5. Create a barcode for the patient (5 pts) and discuss where they fall in relation to your populations (5 pts)
6. Include any additional analysis you believe there is room for (5 pts), and contextualize and discuss all pertinent results in conclusion (10 pts)
7. Presentation quality (10 pts)