

## BMEG 400Q-591Q: Lab A

### **Pre-requisites:**

- Understanding Python basics
- A [Google Colab](#) account (no Colab environment setup or subscription required)
- Familiarity with reading 3D NIfTI files and understanding their headers (using [Nibabel](#))
- Familiarity with reading and visualizing 4D fMRI data (using [Nilearn](#))
- Theoretical understanding of the covered topics

### **Learning Objectives:**

By the end of this lab, students will be able to:

#### **1. Explore Medical Imaging Modalities**

- a. Read and visualize 2D X-ray images, 3D CT volumes, MRI, and fMRI data.

#### **2. Apply Image Processing Techniques**

- a. Perform threshold-based segmentation on 2D and 3D medical imaging data.
- b. Use Hounsfield windowing for soft tissue visualization in CT images.

#### **3. Understand Advanced Visualization**

- a. Visualize medical data in 3D and interpret patient volumes.
- b. Explore K-space data and apply masking techniques for MRI image reconstruction.
- c. Use brain atlases to analyze functional brain connectivity.

#### **4. Evaluate Medical Image Analysis**

- a. Perform qualitative and quantitative segmentation evaluations.
- b. Analyze soft tissue details in CT and connectivity patterns in fMRI.

## **Topics to Be Covered:**

### **Part a**

- Reading 2D X-ray images
- Performing 2D threshold segmentation on X-ray images
- Reading 3D CT volumes and their header information
- Visualizing patient volumes in 3D
- Applying Hounsfield windowing for CT images
- Threshold-based segmentation for CT data
- Visualizing segmentation results
- Qualitative and quantitative evaluation of segmentations
- Soft tissue visualization in CT images

### **Part b**

- Reading 3D MRI data
- Visualizing multi-coil MRI data
- Exploring K-space
- Reconstructing images from K-space
- Applying K-space masking
- Reading fMRI data
- Visualizing fMRI data
- Visualizing a brain atlas
- Analyzing brain connectivity