

## RO4101 – DIAGNOSTIC TECHNOLOGIES

### Lab Session #5

#### Learning Outcomes:

This lab exercise aims to introduce and familiarize you with different image-processing techniques including image thresholding, edge detection, image enhancement, and noise removal that are crucial for extracting meaningful features from CT and CTA images.

By the end of this exercise, you will have the knowledge and tools to perform the following tasks in PYTHON:

- ❖ Learn techniques to eliminate or minimize background noise with the help of thresholding and edge detection.
- ❖ Apply image enhancement techniques including scaling and histogram equalization on CT and CTA images to enhance the imaging features.

**Marks Allocated:** 2.0% (20 points)

#### Computing Tools Required:

- ❖ **Python 3.x**
- ❖ **Libraries:** pydicom, numpy, nibabel, matplotlib, scipy, opencv-python (for image processing)

You can install the necessary libraries using pip by running the following command in the terminal:

```
D:\>pip install pydicom numpy nibabel matplotlib scipy
```

#### Instructions:

##### Download the data:

<https://drive.google.com/file/d/1hG6-L5Nw3e3GSwdvZgzXKINokSUElJdE/view?usp=sharing>

You are expected to submit your work as a *Python script file* with the following filename after you have been marked in the lab (*marking in-lab components for these DT labs will be in the last 30mins of any lab session*):

DT-4104-Yourname-lab5.ipynb

#### TASK-1: Load the CT and CTA images and adjust the respective HU levels (5 points)

##### Complete the following tasks:

- 1.1: Load and store the DICOM image (319.dcm) from CT and CTA folders. (1)
- 1.2: Plot the output CT and CTA images in a 2\*2 grid. (1)
- 1.3: Adjust the CT numbers or HU levels according to the requirement or as directed in metadata by applying Windowing. (2)
- 1.4: Plot the output CT and CTA images in a 2\*2 grid. (1)

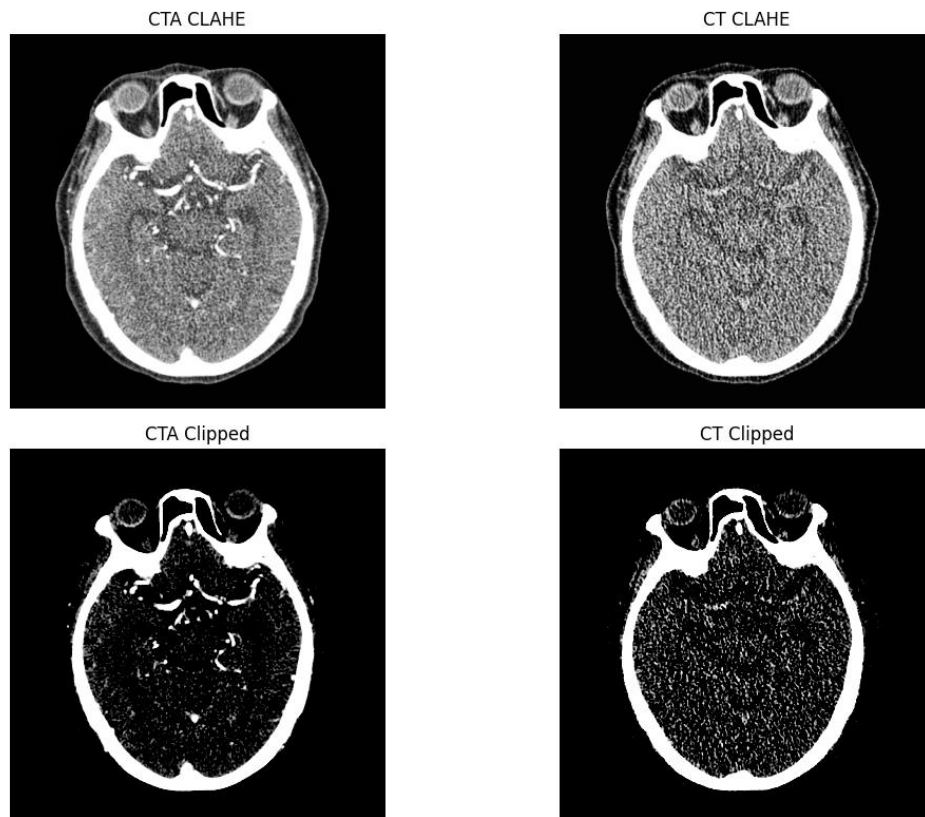
### TASK-2: Image normalizing and feature enhancement (5 points)

**Complete the following tasks:**

- 2.1: Normalize the output image in the range 0-255. (1)
- 2.2: Apply masking to eliminate the background noise. (1)
- 2.3: Apply the CLAHE enhancement technique and plot the results. (1)
- 2.4: Clip the intensity range of the processed image to a desired range to enhance the features. (1)

```
# Clip the values to the specified range
clipped_image = np.clip(clahe_CTA, min_intensity, max_intensity)
# Normalize the clipped image
normalized_image = (clipped_image - min_intensity) / (max_intensity - min_intensity)
```

- 2.5: Plot a 2\*2 grid of the results (CT image, CTA Image, CT clipped, CTA clipped) (1)



### Home Assignment: Apply image enhancement techniques on CT images and visualize the results with required histograms (10 points).

**Complete the following tasks:**

- 1: Load another image from the CT and CTA folder and preprocess the image from the pipeline mentioned above (5)
- 2: Apply the histogram image enhancement and histogram matching technique to the processed image. Compare the respective histograms and CDFs and plot them (5)