ECE 435 Medical Image Processing
Assignment 4

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Question 2: Test the algorithm on the image "angiogram.tif". You will provide the following results:

1. The binarized image with the value of the threshold at convergence
2. The histogram of angiogram.tif image with the value of the threshold specified on it.
3. A table containing the value of the threshold at every iteration before reaching convergence.

Answer: The following results are obtained when tolerance is set to $\mathbf{10^{-8}}$. The initial estimate of the threshold is randomly selected from the element of the image.

The binarized image with threshold at convergence of **103.9122** and the histogram of "angiogram.tif" image with the threshold at convergence of **103.9122** shows in Figure 1. Table 1 shows the value of the threshold at every iteration before reaching convergence.

Table 1

Iteration	Threshold Value
1	43
2	71.4590
3	82.2945
4	88.1546
5	92.6288
6	95.8906
7	97.8611
8	97.8611
9	99.3100
10	100.7898
11	101.6115
12	102.3741
13	103.1515
14	103.9122

Moreover, after invoking the function a few times, we obtain a different segmentation result since the initial estimate of the thresholds are different.

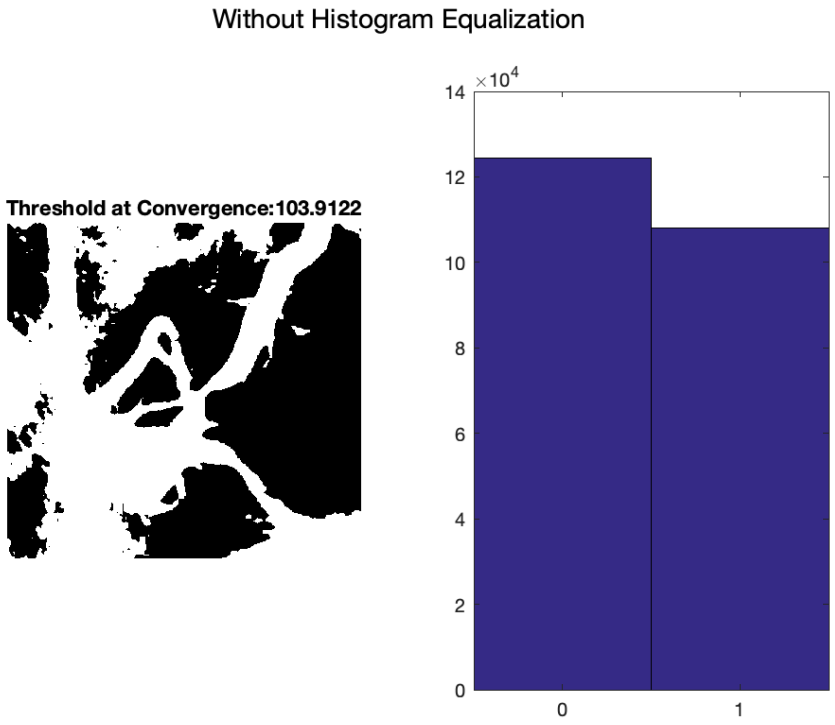

Figure 1: Binarized Image and Its Histogram when Threshold at Convergence of 103.9122

The binarized image with threshold at convergence of **137.5802** and the histogram of "angiogram.tif" image with the threshold at convergence of **137.5802** shows in Figure 2. Table 2 shows the value of the threshold at every iteration before reaching convergence.

Table 2

Iteration	Threshold Value
1	168
2	137.5802

Question 3: Apply histogram equalization to angiogram.tif. You may choose to work with the Matlab **histeq** function. Next, apply the same thresholding algorithm to the equalized image. Compute the new threshold, and the new binarized images

The binarized image with threshold at convergence of **105.6698** and the histogram of "angiogram.tif" image with the threshold at convergence of **105.6698** shows in Figure 3. Table 3 shows the value of the threshold at every iteration before reaching convergence.

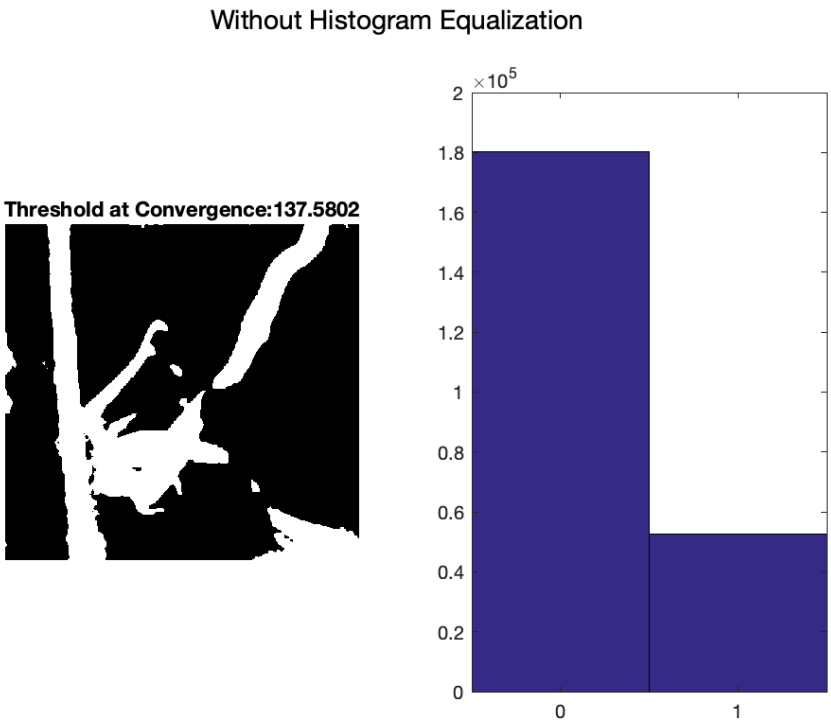

Figure 2: Binarized Image and Its Histogram when Threshold at Convergence of 137.5802

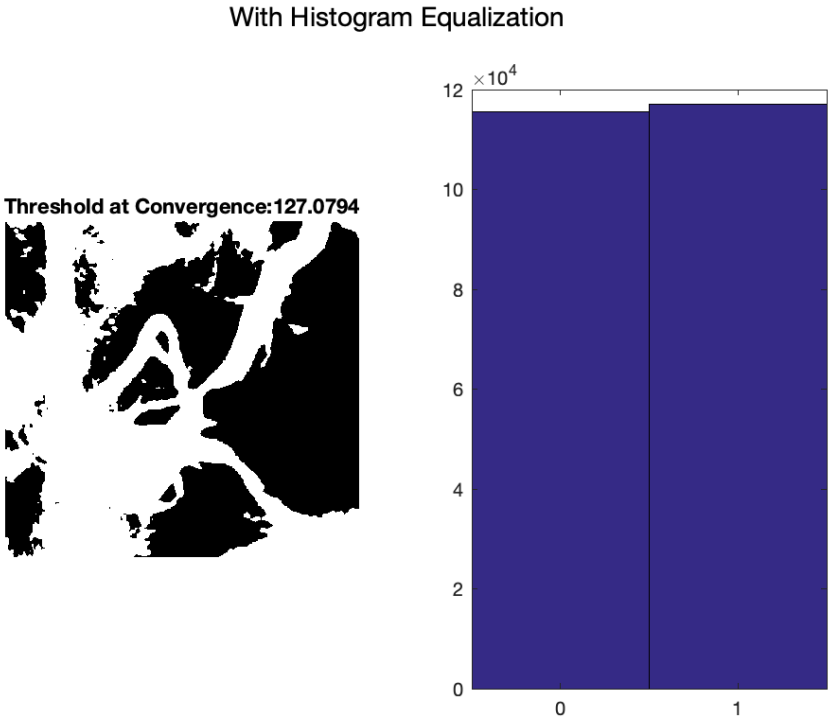

Figure 3: Binarized Image and Its Histogram when Threshold at Convergence of 105.6698

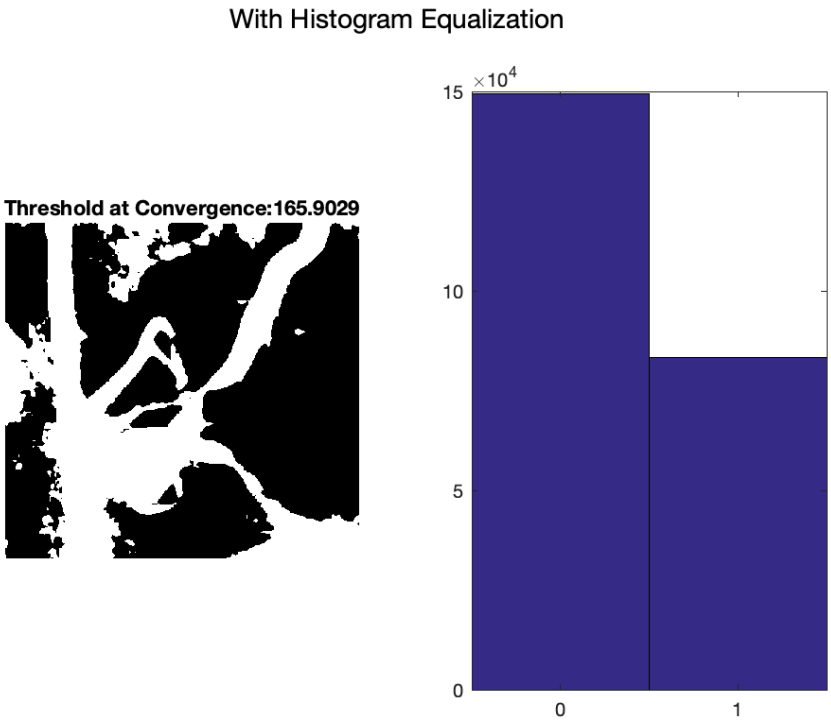

Figure 4: Binarized Image and Its Histogram when Threshold at Convergence of 172.2672

Table 3	
Iteration	Threshold Value
1	28
2	78.6122
3	102.8717
4	115.3512
5	121.2035
6	125.9473
7	127.0794

Moreover, after invoking the function a few times, we obtain a different segmentation result since the initial estimate of the thresholds are different.

The binarized image with threshold at convergence of **172.2672** and the histogram of "angiogram.tif" image with the threshold at convergence of **172.2672** shows in Figure 4. Table 4 shows the value of the threshold at every iteration before reaching convergence.

Table 4	
Iteration	Threshold Value
1	202
2	172.2672

Question 4: Compare and discuss the results obtained by optimal thresholding on the original image, and on the image pre-processed with histogram equalization.