1. Determine the fiber volume fraction, v_f ,for a given SEM image by writing a MATLAB <u>function</u>. Your function should take an image as an input and return (1) <u>the segmented matrix</u> and (2) <u>fiber volume fraction</u> as outputs. You can find the SEM image in the course webpage (assignment → SEM.tif)

a. Import the image into MATLAB using "*imread*" function.
b. Plot the histogram of all elements using "hist" function.
c. Assign a proper threshold value (You should be able to infer a proper value from the histogram).
d. Change the intensity value of matrix pixels to 0 and fiber pixels to one. Your segmented image should be a binary image. (This process is called segmentation/digitization of an image)
e. Determine the fiber volume fraction based on your segmentation (number of fiber pixels divided by total number of pixels)
f. Show your final result beside the original image to confirm the accuracy of your segmentation (use "*imshow*")

You can see the result of my segmentation, yours might not be as accurate but it should be similar.
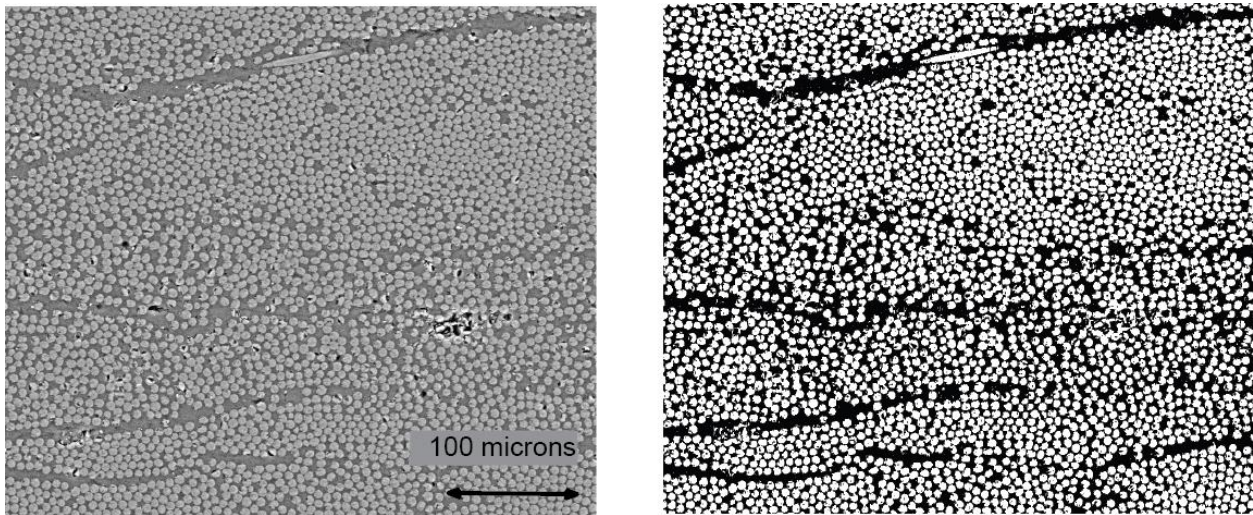
(Left) Actual SEM image. (Right) Segmented image.

Note: For some functions in Matlab, your data needs to be "double" for some other, "uint8", learn the difference and convert your data back and forth depending on which function you are using.

2. Determine the size of the image in micron knowing the pixel size is 487 nm.

3. Select five carbon fibers and determine the average fiber diameter in micron (use "imdistline" to measure the distance in pixel).

4. **Extra credit question**

As there is no clearly defined global threshold value to distinguish all fiber pixels from matrix pixels, the better approach is to assign two different threshold values, one for fiber and one for matrix. Therefore, the pixels in between need to be determined by adjacent pixels. You can consider four or eight neighborhood pixels. In other words, you are judging the pixels that land between the two thresholds by the surrounding pixels, this algorithm helps to clean the matrix from fiber pixels and fibers from matrix pixels.