ECE 415 – Computer Vision I
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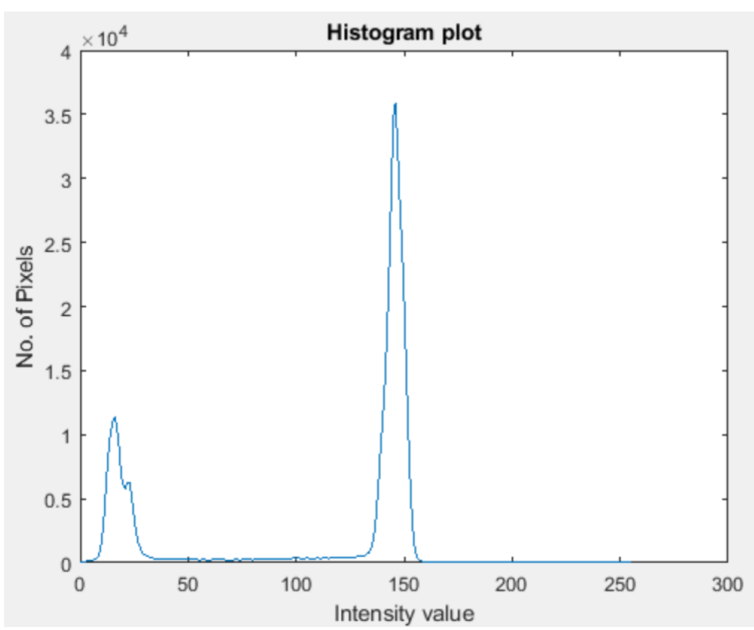
Homework – 5

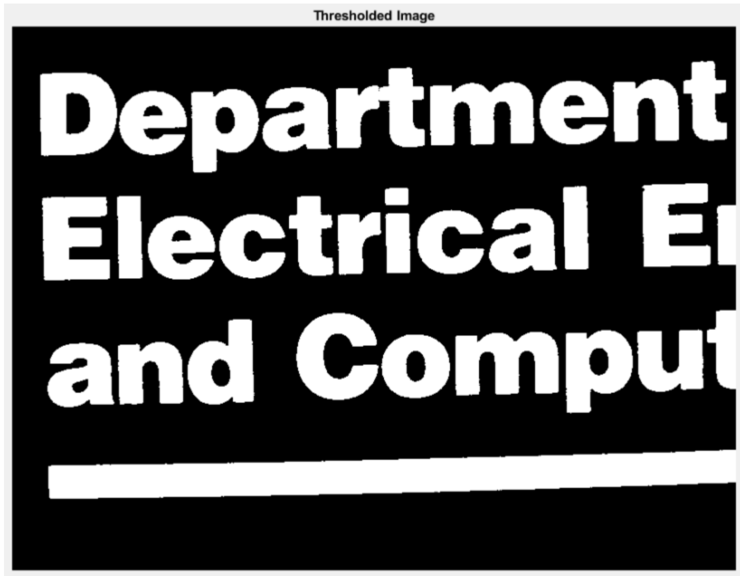
Problem 1)

1). The input image is:

2). The Histogram of pixel image intensities is:

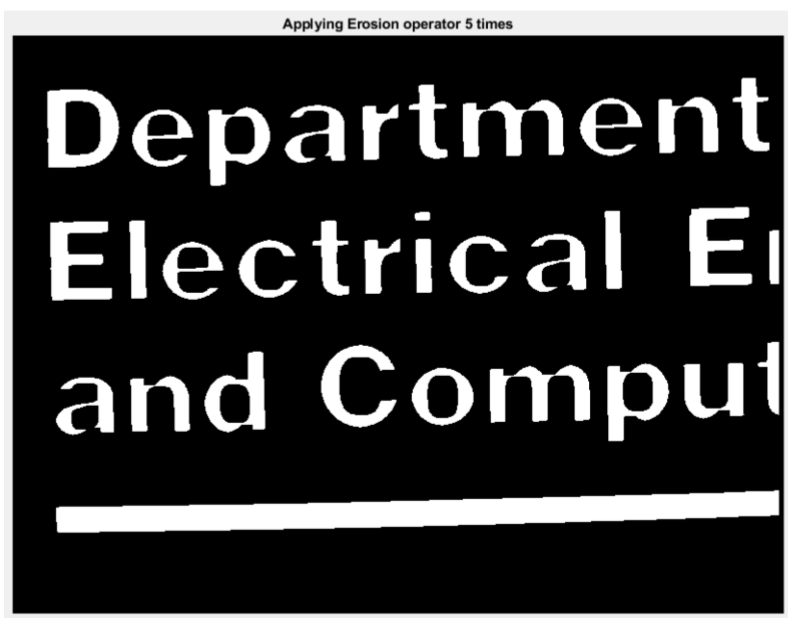


3). The Binary threshold image is:

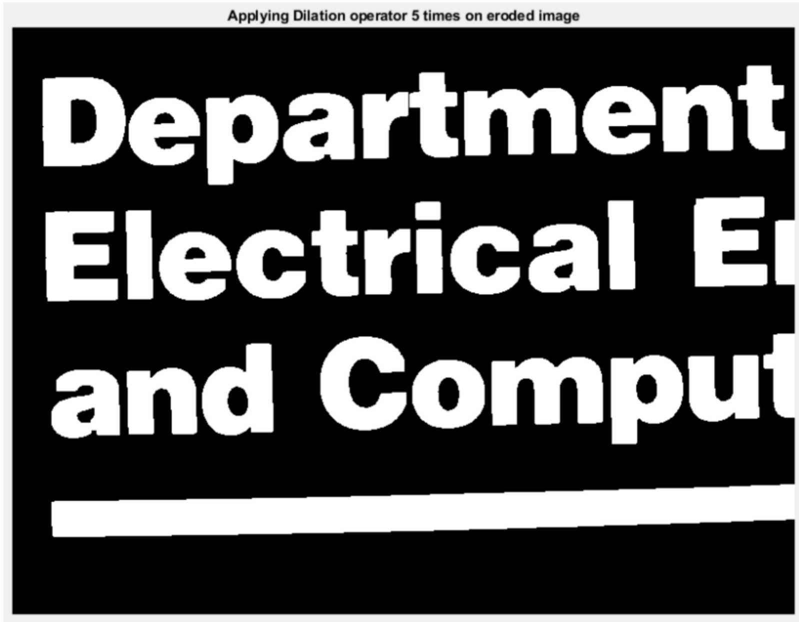


The thresholding method used is "Adaptive Thresholding by Averaging." The threshold value is calculated by taking the average value of pixels. A pixel value below the threshold value is taken as 1 and the pixel value above the threshold value is taken as 0. Thus, we obtain a binary threshold image.

4). Applying erosion 5 times and using a kernel size of 3x3 for the structuring element, we get:



5). Using a structural element of 3x3 kernel size for dilation, we get:

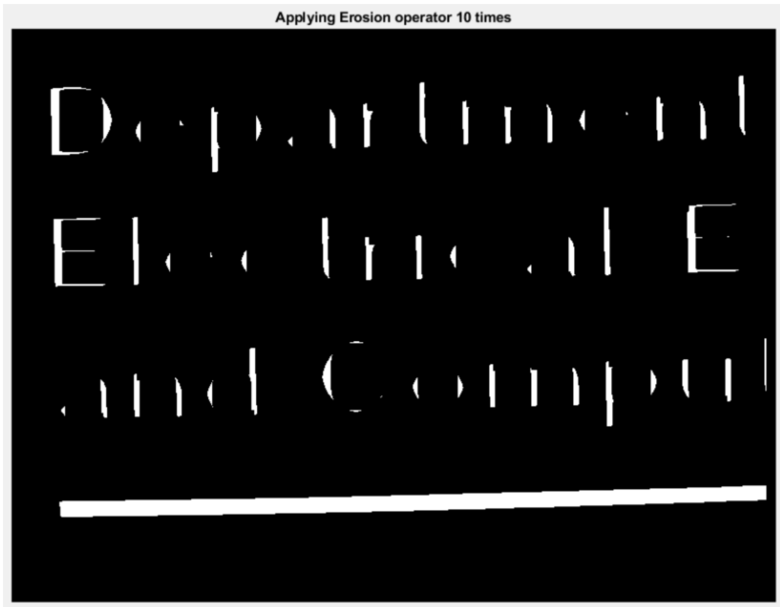


6). The images in (5) and (3) look similar, but there is a small degradation of letters in (5). It can be seen that a few bordering regions of the letters are cut off, thus the letters in image (5) are not exactly the same in image (3).

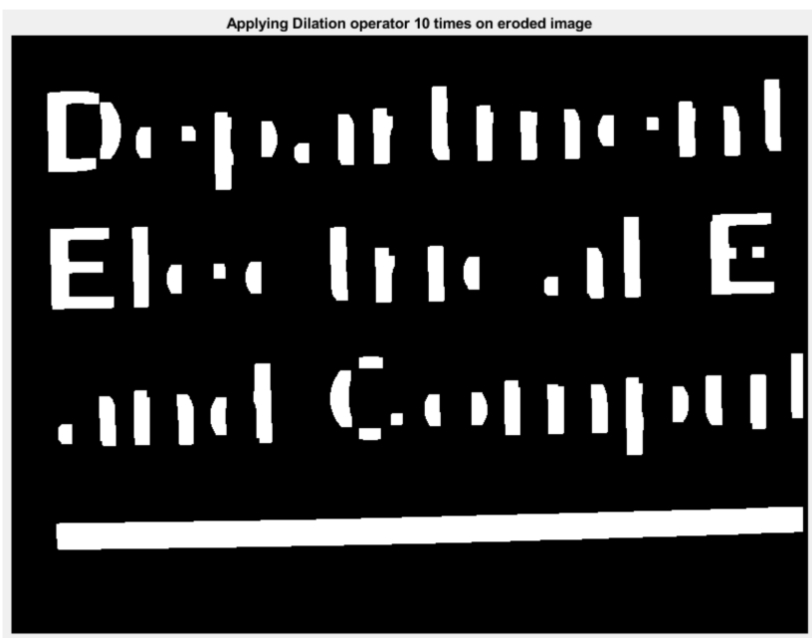
7). The absolute difference of image created in image (3) and image (5) and mapped to full dynamic range of 8 bits is as follows:

The white spots in the image are the regions which are not present in (5). Therefore, (5) has been degraded in these pixels. Thus, applying erosion and dilation we do not get perfect reconstruction of the original image.

8). The image after applying erosion 10 times on (3) is:



9). Applying Dilation operator 10 times on the above image, we get:

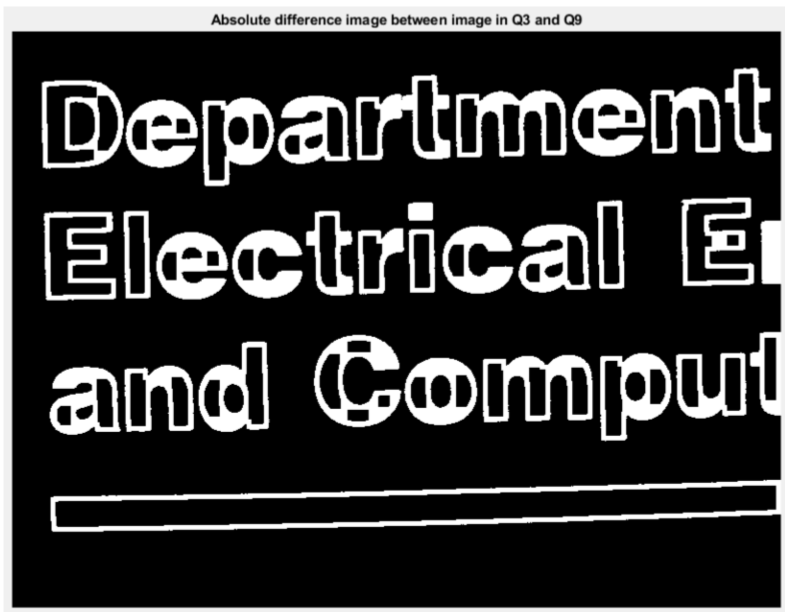


10). The images obtained in (9) and image (3) are clearly not identical as there is a difference between the two images. The image obtained in (9) is missing a significant amount of white pixels in comparison to image in (3).

The images obtained in (5) and (9) are not identical, as (9) is missing values in comparison to (5), which also has a few missing white pixels compared to image in (3).

Hence, it can be observed that the greater number of times erosion and dilation are performed, the more the reconstructed image will deviate from the input image.

11). The absolute difference of image created in image (3) and image (9) and mapped to full dynamic range of 8 bits is as follows:

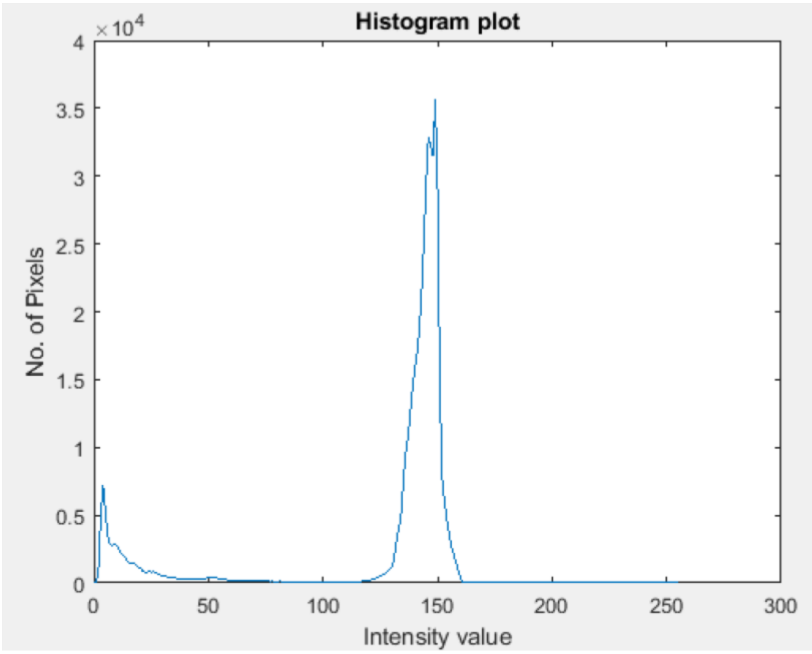


This shows the number of white pixels that have been lost in (9) in comparison with (3).

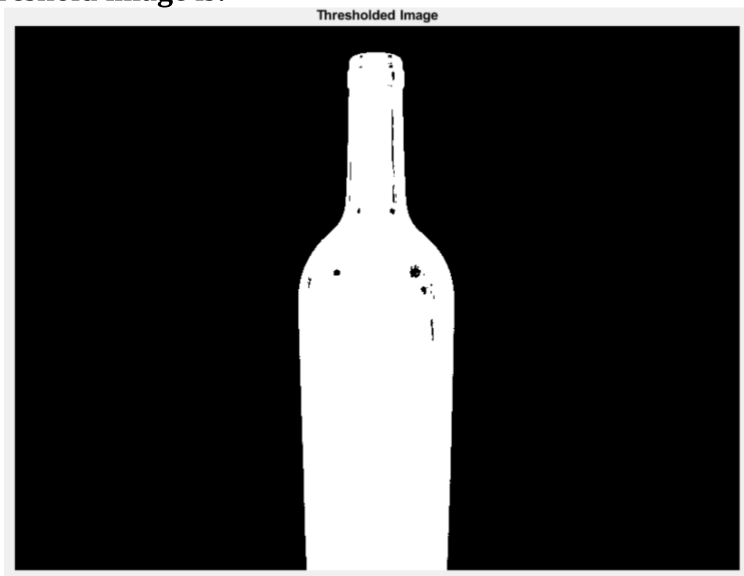
Problem 2)

1). The input image is:

2). The histogram of the image pixel intensities is:



3). The Binary Threshold image is:



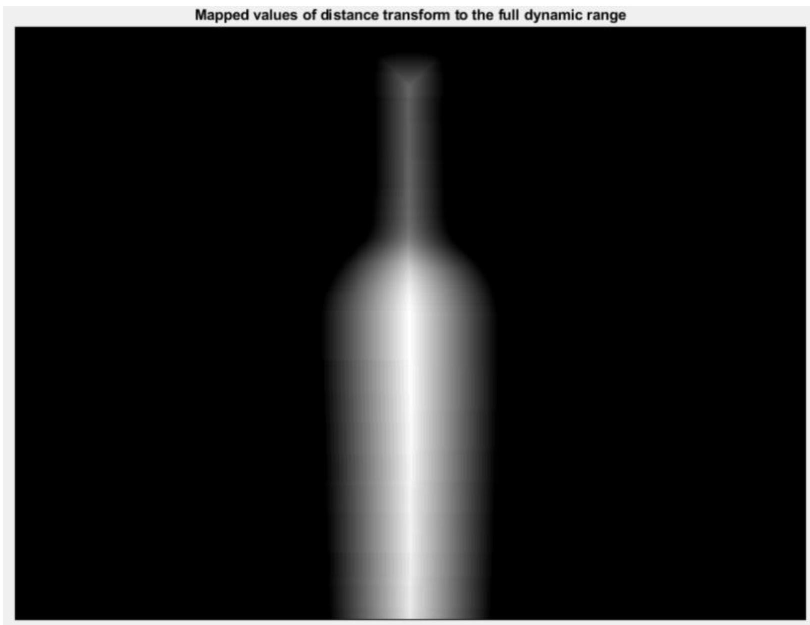
The thresholding method used is "Global Thresholding." The threshold value is calculated using the values of start and end of the largest peak. Any pixel value inside the range of the two thresholds is taken as 1 and outside the two thresholds is taken as 0. Thus, we obtain a binary threshold image.

4). To remove the holes in the image (black spots within the white foreground), we need to apply dilation. By applying dilation, we are increasing the number of white pixels and by performing dilation for a few iterations we can remove the holes. The image after removal of holes is:

5). The distance transform is found by using the two pass algorithm. First we find the forward pass matrix of the input image by taking the min([(input(x,y-1)+1) (input(x-1,y)+1)]) and putting that in input(x,y). Next we apply backward pass on the resultant matrix of forward pass. This is done by taking min([FP(x,y) (FP(x+1,y)+1) (FP(x,y+1)+1)]). This will give us the distance of a particular pixel from the background.

The maximum distance from the background is **170** and **23** pixels have this value.

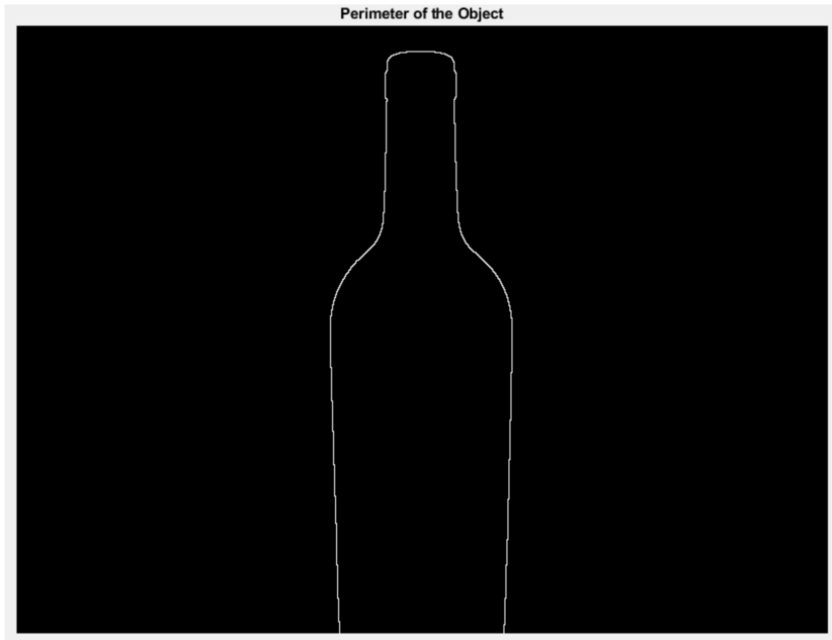
6). Mapping the values of distance transform to the full dynamic range of 8, we get:



Thus, we see that as we move from the background to within the foreground, the grayscale value of the pixel increases, i.e., it goes from black to grey to white.

7). The output image of (4) is a binary image. Thus, it consists of only 0's and 1's. With 0 corresponding to black(background) and 1 corresponding to white(foreground). Thus, to calculate the area we determine the number of pixels with a value of 1 and this gives us the area of the image. The calculated area is **Area = 76950**.

The perimeter can be calculated by dilating the image once, and then taking the difference between (4) and dilated version of (4), which will give us the edge/border of the object. By calculating the number of pixels in the edge, we can determine the perimeter of the object. Thus, the obtained result is **Perimeter is 1353.**



The centroid can be calculated by finding all the coordinates where the image is not zero, and taking the average of the respective coordinates, which will give us the centroid of the object. The obtained result for centroid is **X-Centroid = 362.5519 & Y_Centroid = 399.6322.**