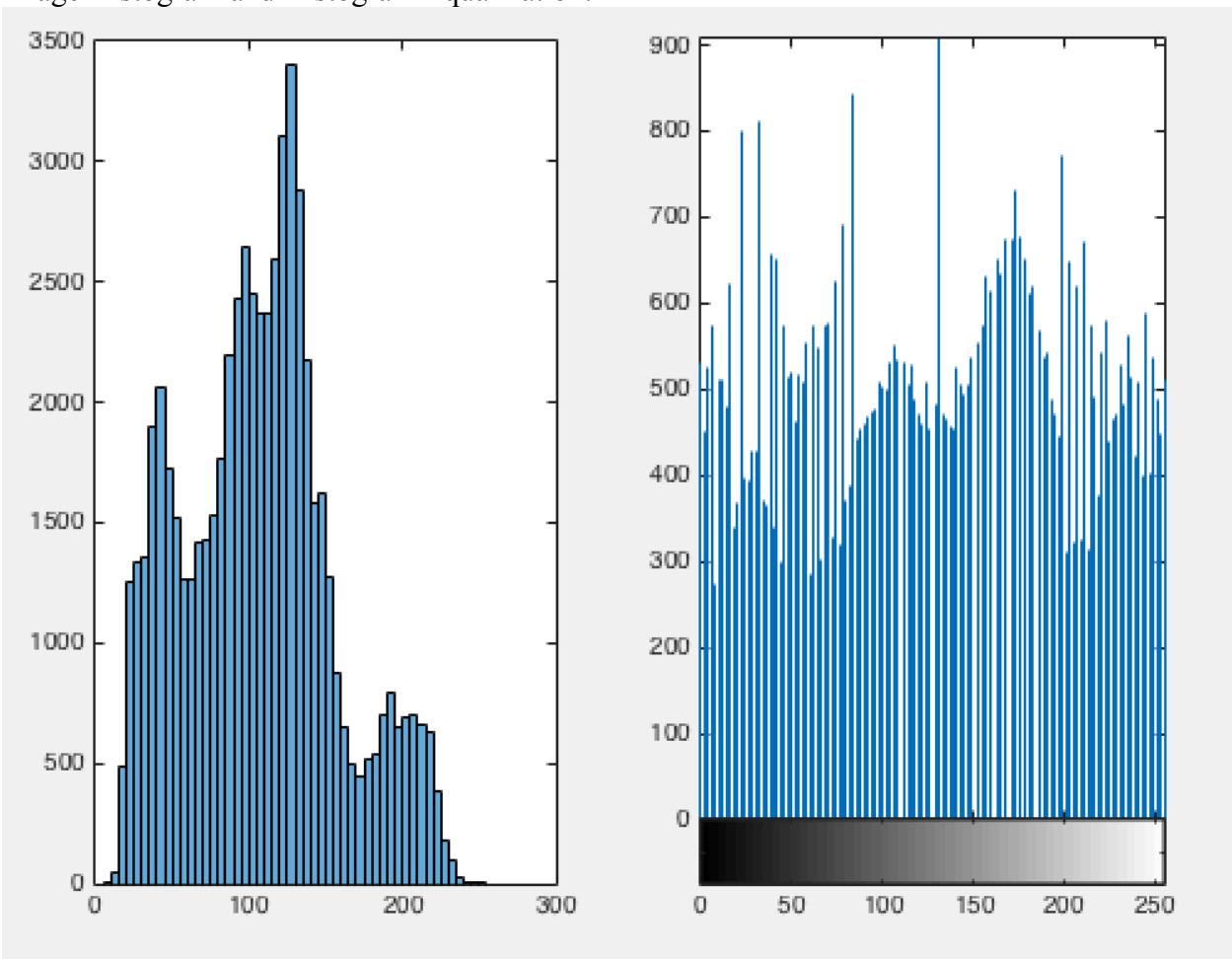
Abu Butt-3097
CSc-47100

October 15, 2017
Prof. Zhigang Zhu

1)
The image I used was of Professor Zhigang Zhu.

Image Histogram and Histogram Equalization:



Intensity Histogram:

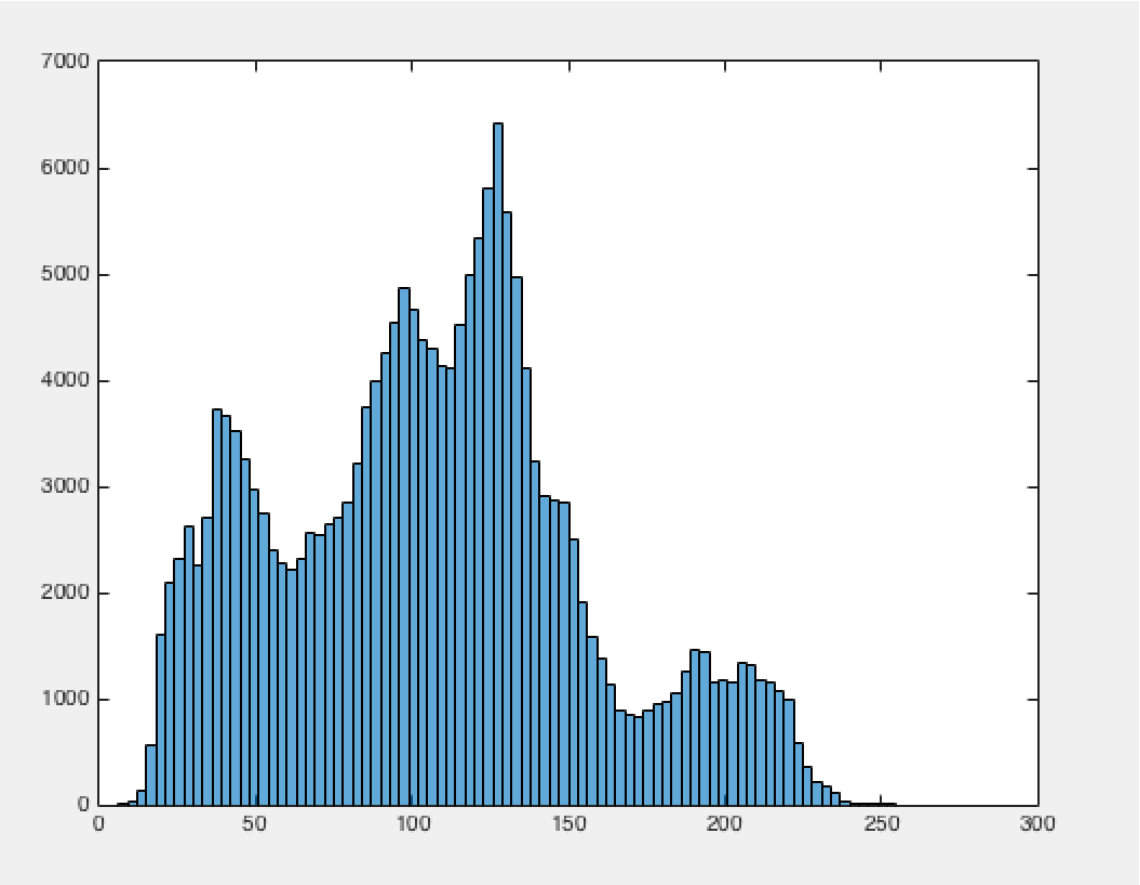


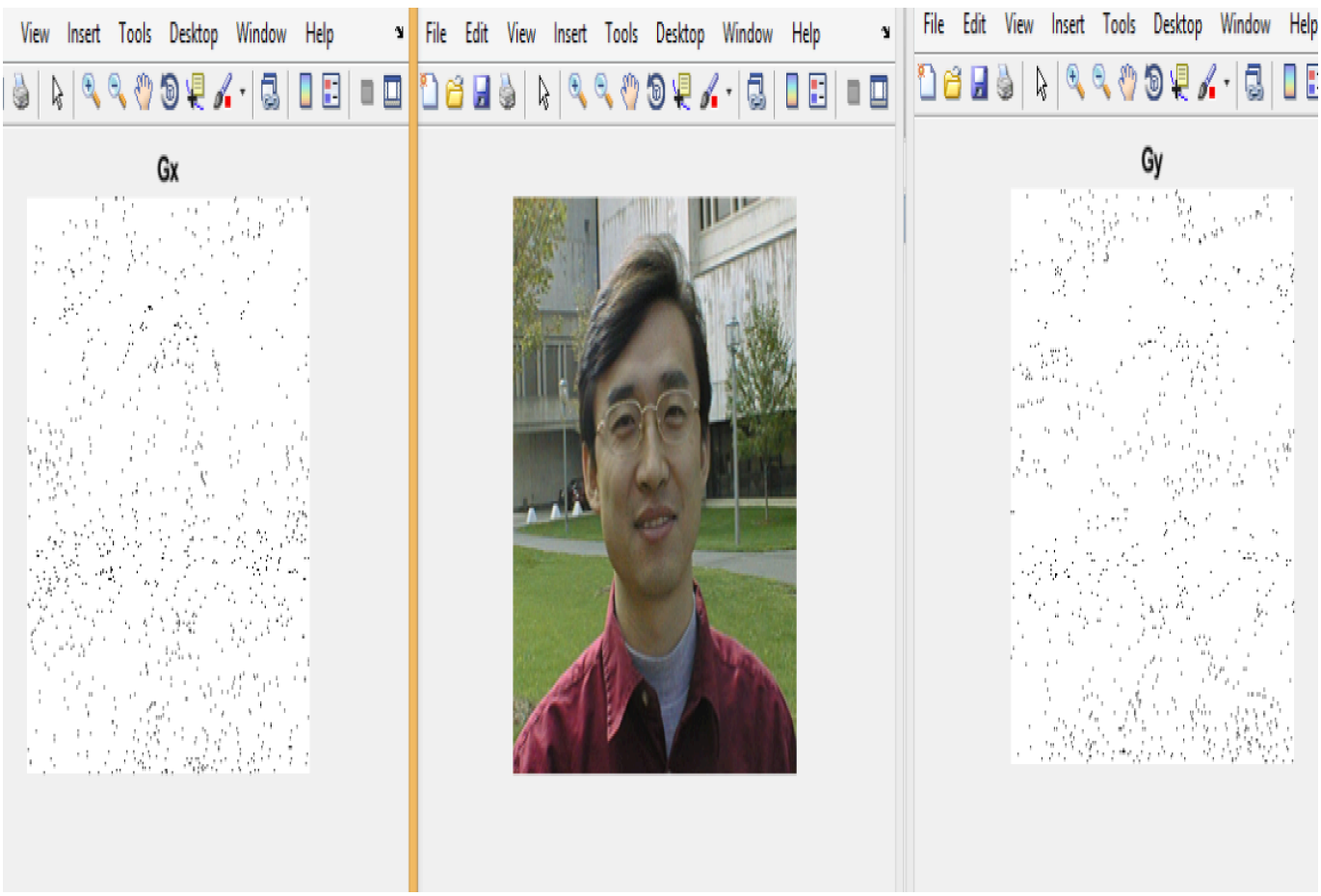
Image Contrast Enhancement:

Image Thresholding:

Explanation:

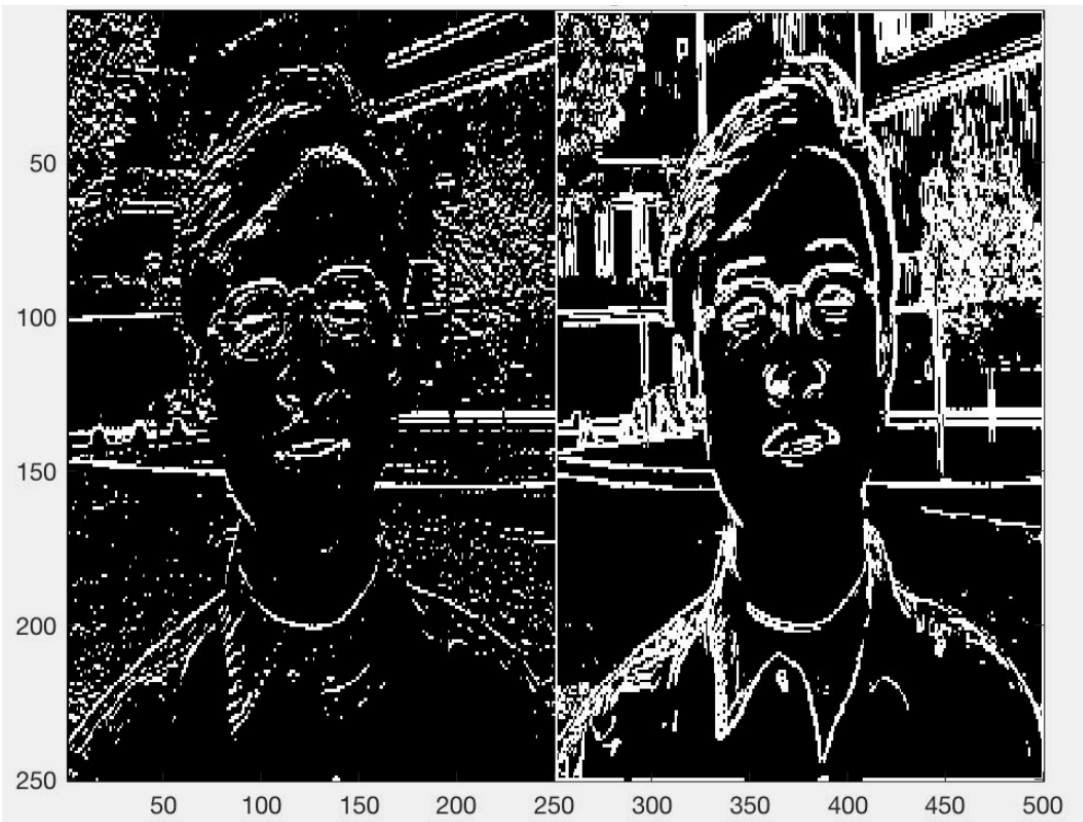
As you can the images of histograms and some related images operations. The purpose of histogram is to remove the spatial information and show the relative frequency of occurrence of gray values. Also, the histogram, plots the absolute pixel count as a function of gray value.
As you can see, in the first image contains the histogram of Prof. Zhu's image. The x-axis is the gray values and y-axis are the pixel count. Most of the gray values are in the range of [70-120]. The histogram also show that there is enough percentage of pixel counts that are gray values. The histogram also consists of peak at the gray values of 110 to 120. The other image is the histogram equalization, which is used for images contrast adjustments. The next image is just to show the histogram of the image intensity colors. This was to show just the spread of the intensity color on the histogram. The last images are for Image Contrast Enhancement and Thresholding. I set the contrast values from .3 to .5 and from .0 to .5. Image contrast enhancement are used to darken or lighten the image colors. If I increase the contrast value for my image, it will make the image darken. The next image is with the thresholding with the value of K being 255. Thresholding is used for image segmentation. It is a way of splitting the image in foreground and background. It is also used for converting grayscale images into the binary images.

2)
In this question, we should apply sober operator to our image. I again used Prof.Zhu's image. The purpose of using sobel-operator is to create an image emphasising edges.



For this question, what I did was, I defined the sobels for x and y matrices. Then I changed the image to gray scale, and then used 2D convolution on the image. The convolution functions that I used returns the central part of the convolution, which is the same size as A. Also, I used the absolute values for the horizontal and vertical gradient image. The difference between 1x2 and sober operator is that sober operator make the corresponding image more visual and visible to analyze and see.

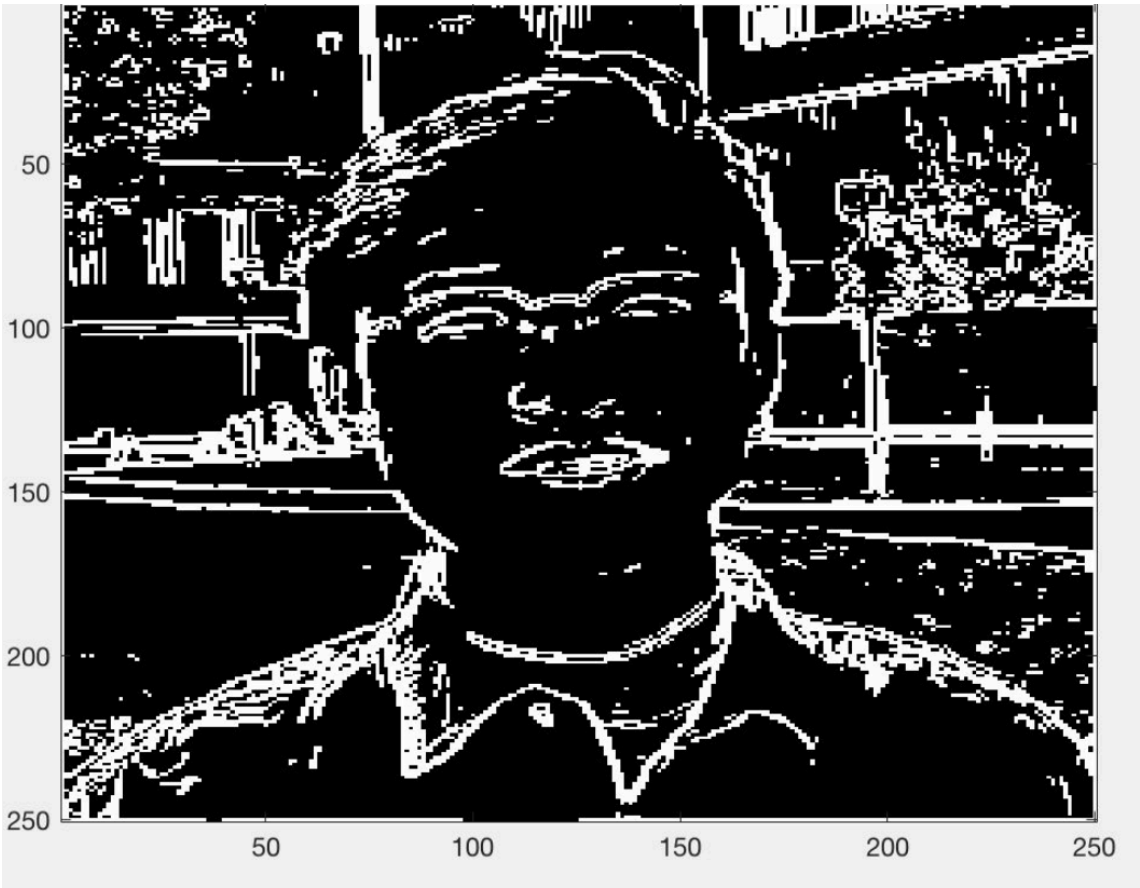
3)



Two Generate Edge Map.

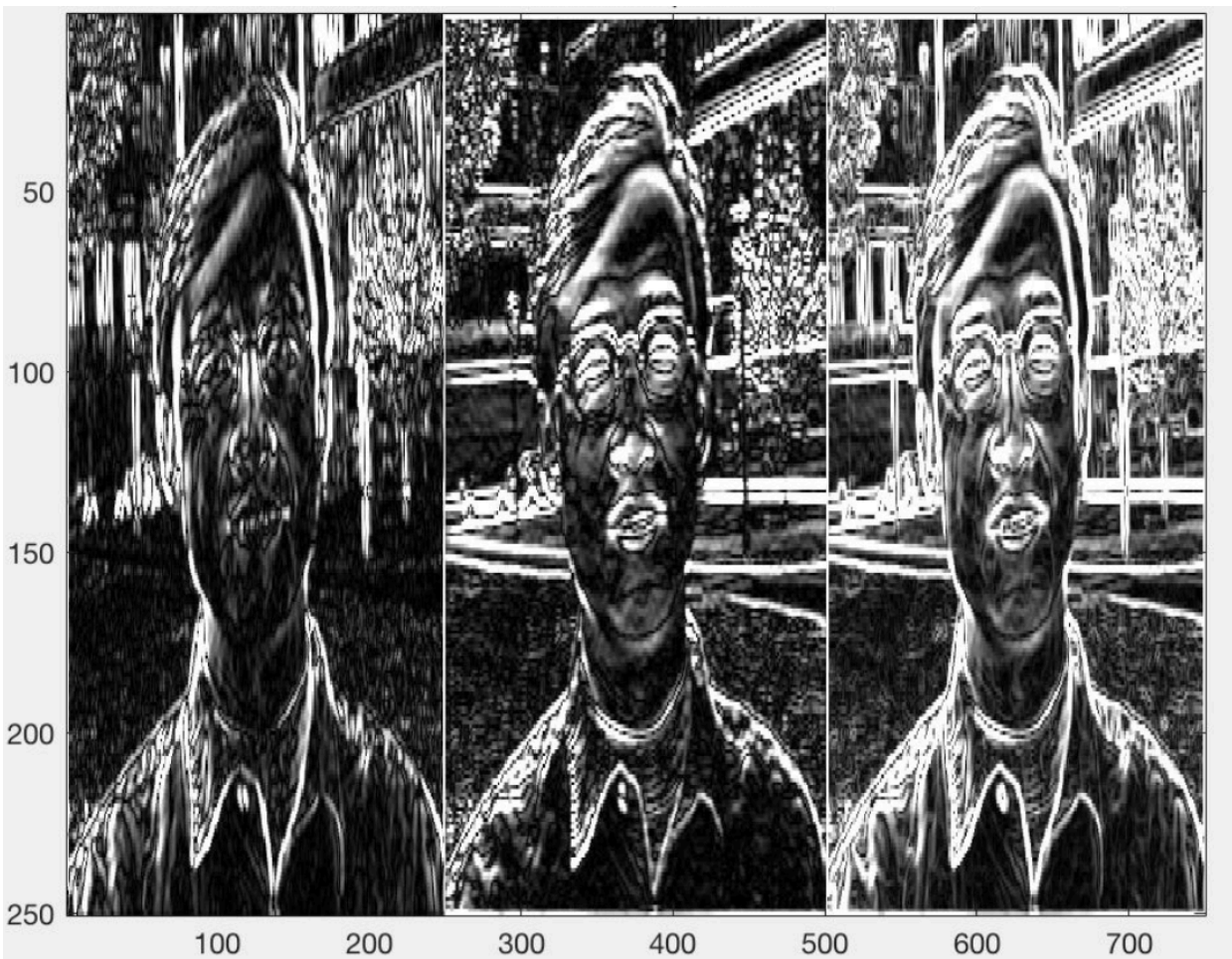
I used this function to find out the threshold : histo(image(i,j)+1)= histo(image(i,j)+1) + 1

5% will be a good value of the pixels with the highest gradient values as edge pixels. Because it provides with an average pixels of gradient values.



4 pieces and thresholding.

4)
1.



This is the image after applying 5x5 sobel operation to an image. The operator that I used are

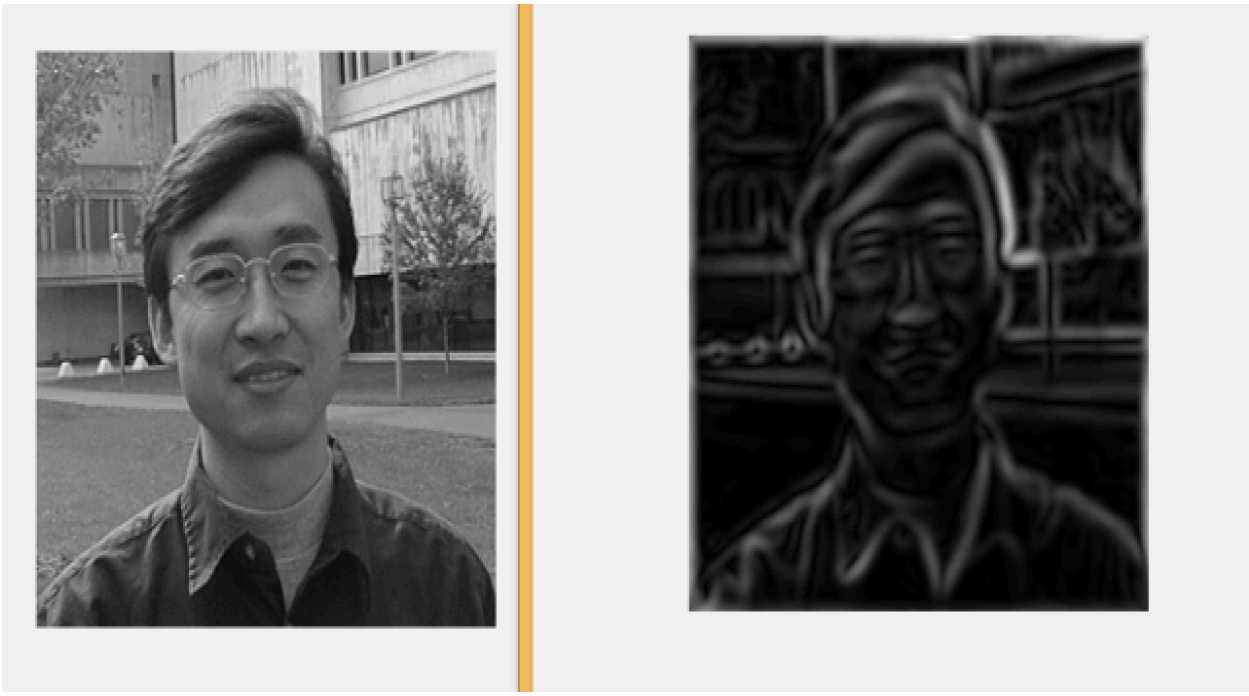
Gx_5=[2,2,0,-2,-1;4,8,0,-8,-4;6,12,0,-12,-6;4,8,0,-8,-4;1,2,0,-2,-2]; Gy_5=[-2,-4,-6,-4,-1;-2,-8,-12,-8,-2;0,0,0,0,0;2,8,12,8,2;1,4,6,4,2];

This is the image after applying 7x7 sobel operation to an image. The sobel operator are following

Gx7 = [4,2,1,0,-1,-2,-3;4,3,2,0,-1,-3,-2;5,4,3,1,-3,-4,-5;6,5,5,0,-4,-5,-6;5,4,3,0,-3,-4,-5;4,3,2,0,-2,-3,-5;3, 1,1,0,-1,-2,-2]; Gy7 = [-4,-4,-5,-6,-6,-4,-4;-1,-3,-4,-5,-4,-3,-2;-1,-2,-1,-3,-2,-3,-1;0,0,0,0,0,0,0;1,2,4,5,3,2,1;2,3,4,5,3,3,1; ,3,4,5,6,5,4,4];

The brightness and sharpness of the corresponding image increases as the kernel size increases. As the kernel size increases, you can clearly see the shape of an object. The running time for the kernel is $O(n^2)$.

As the edge detection kernel size increase, this means there are more pixels that are a part of convolution process. This means that the edges might be blurry at a point where the output image edges might look like have a plastic cover. As you can see in the below images, which has the real and blurry image. The second image looks like, it has been wrapped in plastic, where only the important edges are showing. Since the bigger the kernel size, the higher the computational cost (in terms of numbers of operations and the real machine running times). Also if the image size is bigger, means if it has more pixels, it will require bigger kernel size based on the image size, also will require higher the computational cost.



5)
The sobel operator is like the Prewitt Operator (when use to detect edges). It is also a derivative mask and used for edge detection. Sobel operator is also used to detect 2 kinds of edges: Vertical Direction and Horizontal direction. The difference between is that in sobel operator the coefficients are not fixed and coefficients can be adjusted per the requirement:

1	0	1
-2	0	2
-1	0	1

This mask works same as the prewitt operator vertical mask. The only difference is that is “2” and “-2” values in the center of first and third column. If applied on an image, this mask will highlight the vertical image.

How it works

When we apply mask on the image it prominent the vertical edges. It simply works like as first order derivative and calculates the difference of pixel intensities in an edge region. As the center column is of zero so it does not include the original values of an image but rather it calculates the difference of left and right pixel values around that edge. The center values of both the first and third column is 2 and -2 respectively. This give more weightage to the pixel values around the

edge region. This increase the edge intensity and it becomes enhanced comparatively to the original image.

Following is the horizontal Mask of Sobel Operator

-1	-2	-1
0	0	0
1	2	1

Above mask will find edges in horizontal direction and it is because that zeros column is in horizontal direction. When you will convolve this mask onto an image it would prominent horizontal edges in the image. The only difference between it is that it has 2 and -2 as a center element of first and third row.

How it works

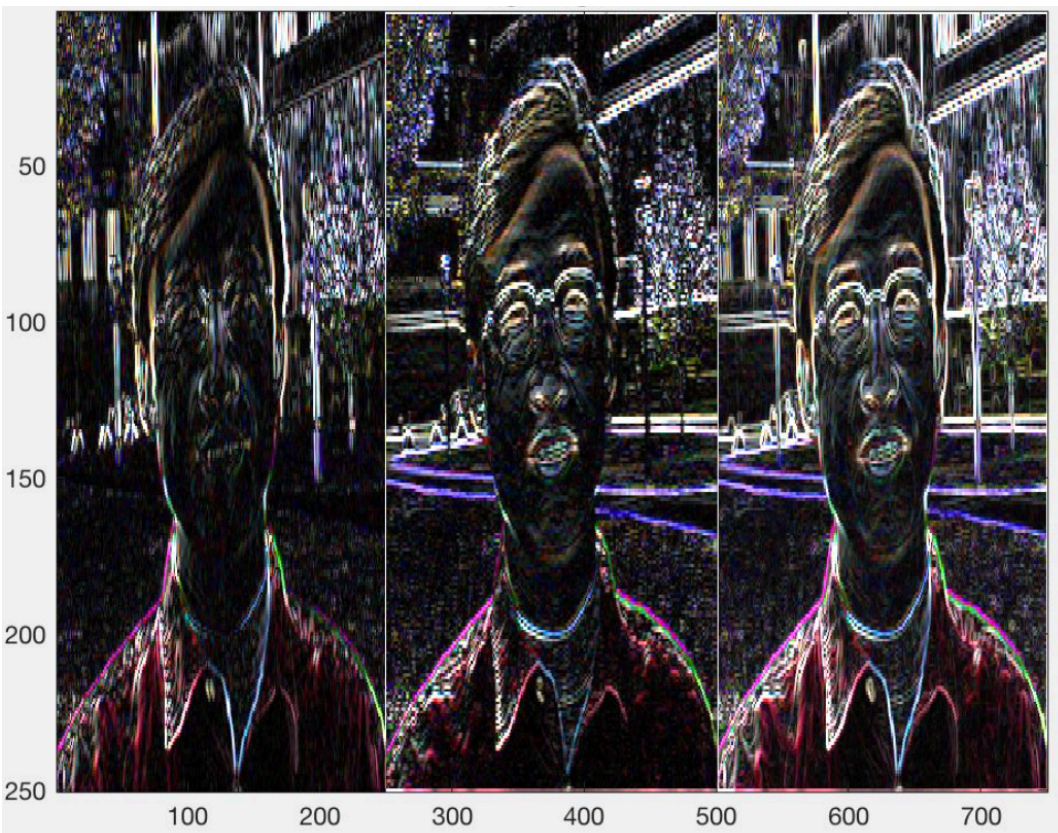
This mask will prominent the horizontal edges in an image. It also works on the principle of above mask and calculates difference among the pixel intensities of an particular edge. As the center row of mask is consist of zeros so it does not include the original values of edge in the image but rather it calculates the difference of above and below pixel intensities of an particular edge. Thus, increasing the sudden change of intensities and making the edge more visible. Now it's time to see these masks in action: After applying Vertical Mask After applying vertical mask on the above sample image, following image will be obtained. After applying Horizontal Mask After applying horizontal mask on the above sample image, following image will be obtained Comparison As you can see that in the first picture on which we apply vertical mask, all the vertical edges are more visible than the original image. Similarly, in the second picture we have applied the horizontal mask and in result all the horizontal edges are visible. With this method, you can see that we are able detect both horizontal and vertical edges from an image. Also, if you compare the result of sobel operator with Prewitt operator, you will find that sobel operator finds more edges or make edges more visible as compared to Prewitt Operator. This is because in sobel operator we have allotted more weight to the pixel intensities around the edges.

Applying more weight to mask

Now we can also see that if we apply more weight to the mask, the more edges it will get for us. There are no fixed coefficients in sobel operator, so here is another weighted operator:

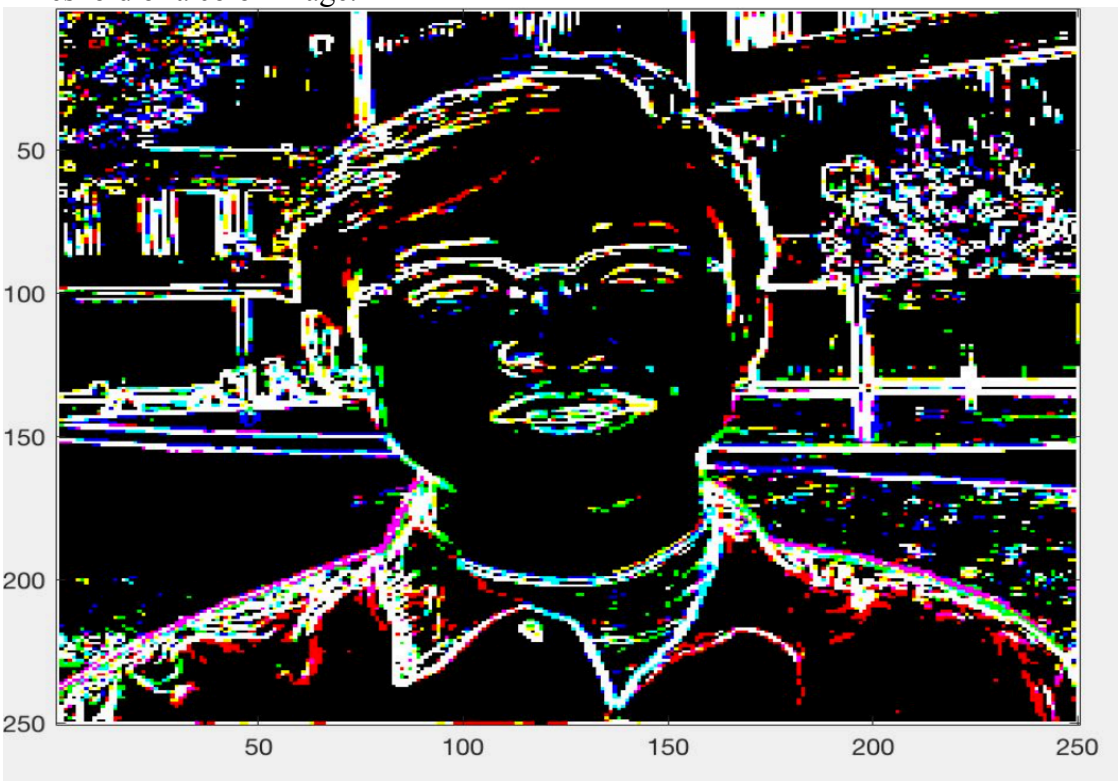
-1	0	1
-5	0	5
-1	0	1

If you can compare the result of this mask with of the Prewitt vertical mask, this mask will give out more edges as compared to Prewitt one just because we have allotted more weight in the mask.

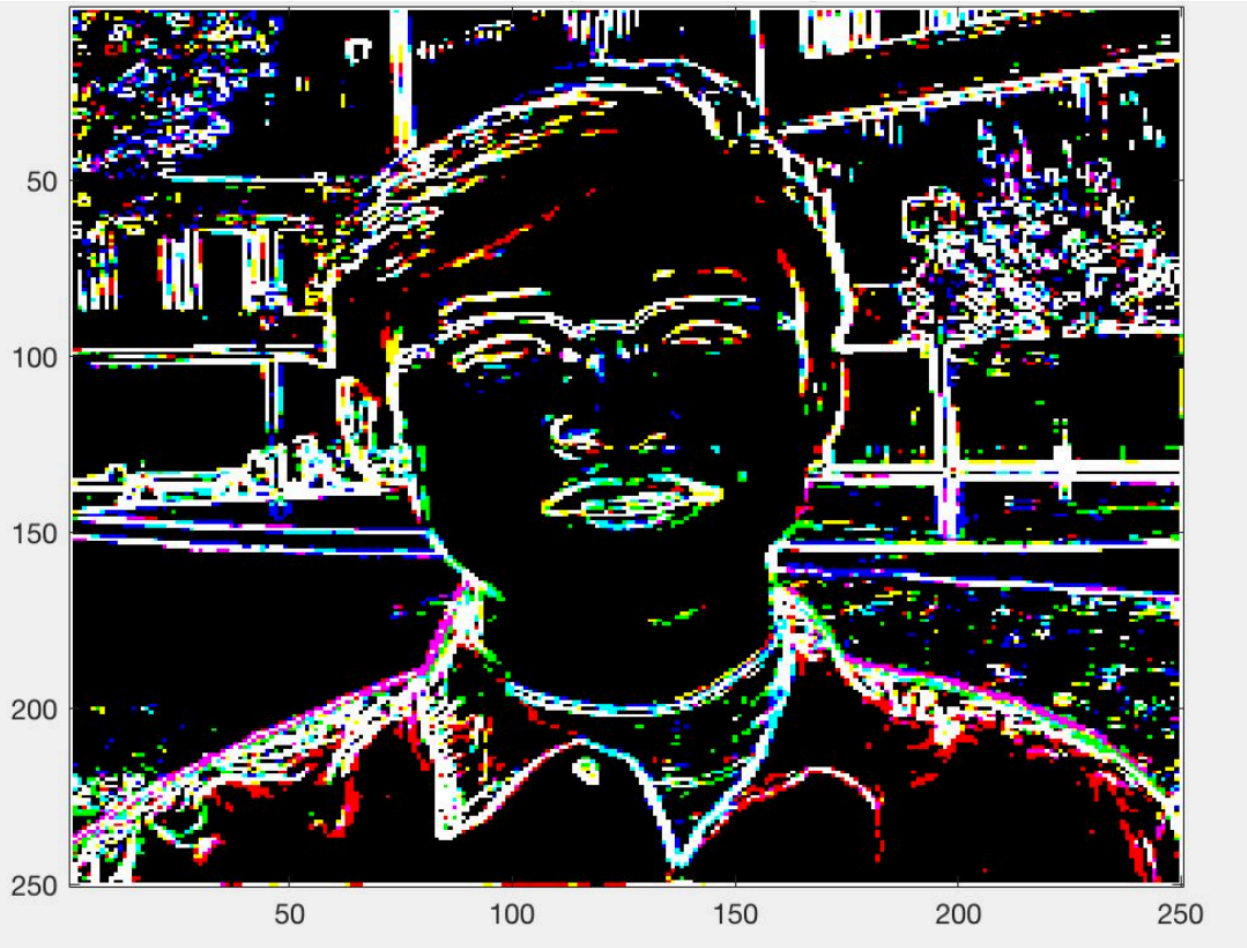


This image is color image edge detector.

Threshold of a color image.



Color Image Threshold.



Local Adaptive thresholds. The local adaptive thresholding shows some RGB colors in the image. It is like color image edge detector and thresholding of color image.

When you combine the RGB color bands of a color image, the combined image may show edges in one channel that did not show up in the other channels. For example, an edge that shows up in the yellow channel may not show up in the orange channel, so the orange channel appears to have less edge pixels. But when you combine the channels, any channel that has an edge at a location will show up, even it has only one channel, so at the end the combined image will consists of more edges in it.