Homework 2

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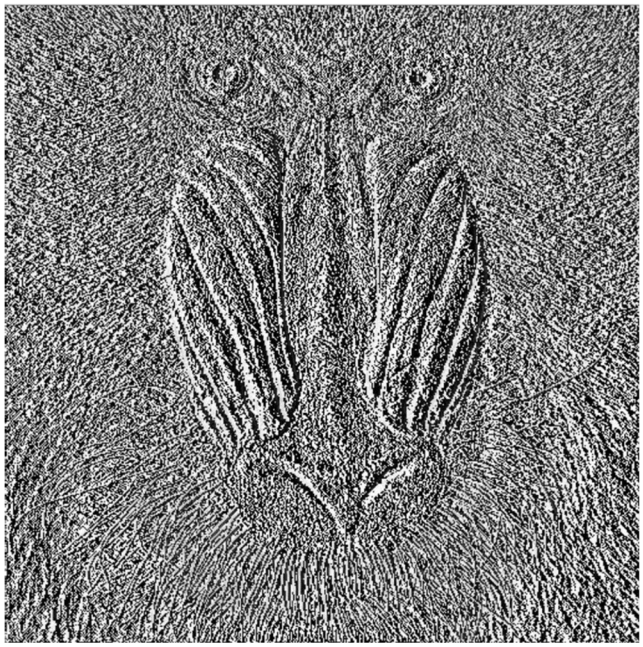
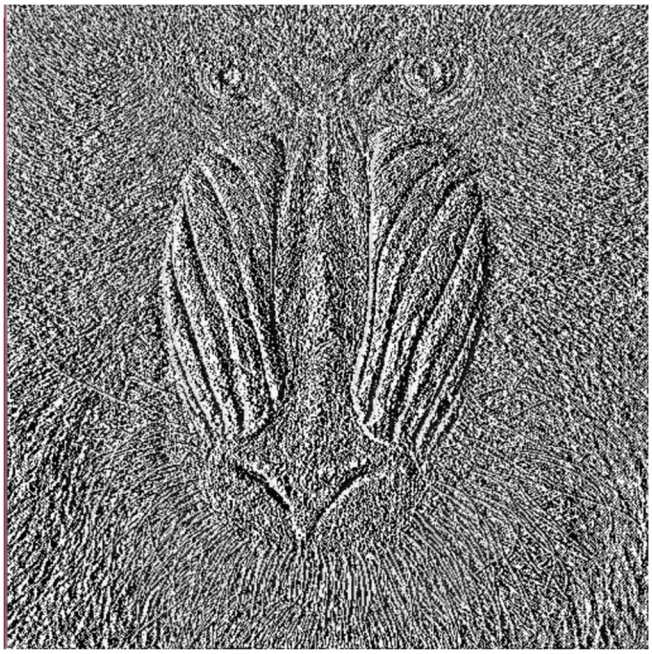
Question 1

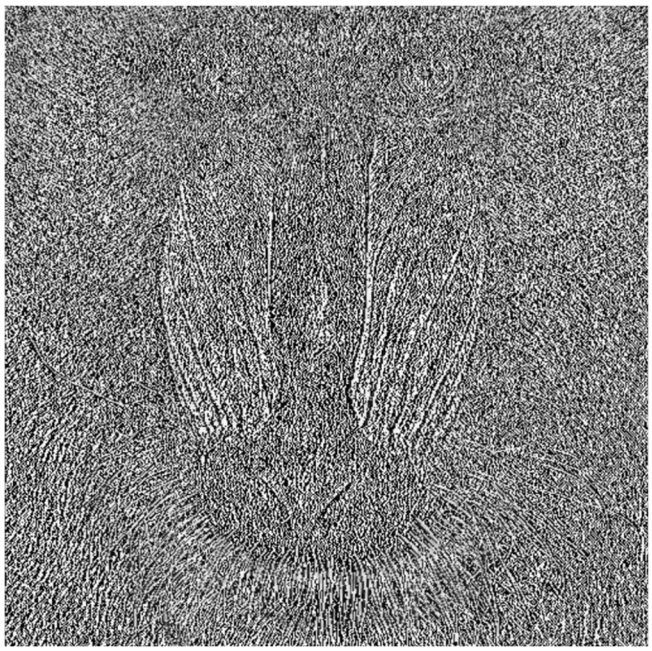
First, I implement the kernel to take the derivative of the images. One for X axis the other for Y axis. The kernel which takes the partial derivative of x gives the x gradient which means we can see the shadows in y axes more clearly. Vice versa for the partial derivative of y.



Gradient X



Gradient Y



Magnitude

The magnitude is if we take the square of partial derivative of both x and y axes and square root them. When we obtain the magnitude, we can see the edges clearly. The edges are the pixels where we can observe a dramatic change. When we take the derivative of the picture there will be a fluctuation where the edges are. So, we can use the gradient magnitude to find the edges in the pictures.

Question 2

We mentioned the edges are where the dramatic color changes happen. But sometimes the images can be noisy and the change can be spread so we cannot always observe it clearly. To avoid this we should blur the image with gaussian filter then take the derivate of the image. Instead of doing this step by step we can apply the derivative of the gaussian filter which is called sobel filter. We expect sobel to work better than just doing the derivative. Also the magnitude of sobel is calculated same as the gradient.

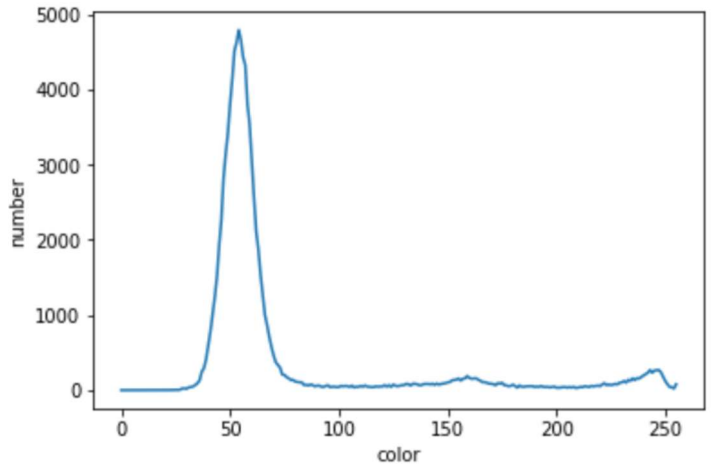
Sobel X

Sobel Y

Magnitude

Question 3

To plot the histogram, I created an array that starts from 0 and ends at 255, one block for each color of gray. Then I traverse the whole image and separate which pixel belongs to which block in array. Then by using that array I created the histogram. The X axis shows the color levels and the y axis shows the how many pixels are that color.



Histogram

To find the threshold I used the Otsu Thresholding. First, I separate the array that I used to create the histogram as black and white and sum all the values cumulative. Then to find the mean value of black and white part of the image I again sum array cumulative and multiply each value with a bin center and divide all values with the weight of each separate color. Then I found the variance of these colors and picked the biggest variance as threshold.

To apply the threshold I traverse the image, if the color is smaller than the threshold, I make the value in the new image black (255). If color is equal or bigger than threshold than I make the value of new image white (0).

Question 4

To create a ROC curve, I had to create multiple Thresholds, true positive, false positive numbers. To calculate true positive and true negative I traverse both ground truth and thresholded image to check the differences. If the ground truth and image values are same and the color is white this value is true positive. If the ground truth and image is not same and the color is white this value is false positive. After calculating positive and negative values I divided true positive with positive values to find the ratio of true marked positive pixels. I also divided the false positive with negative numbers to find the ratio of false marked negative values.

In ROC curve while we increase the threshold some of the unwanted background values may also pass the threshold. To find the best ratio we visualize the thresholds with a ROC curve.

As the curve gets closer to the edge the better our threshold is.