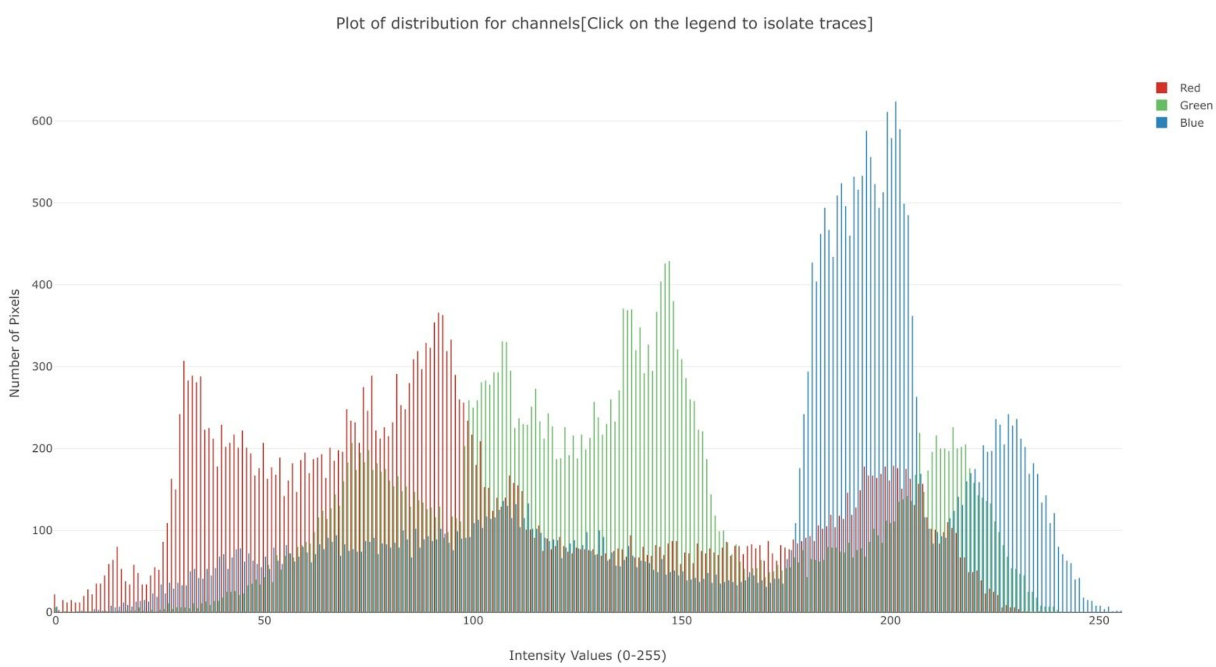
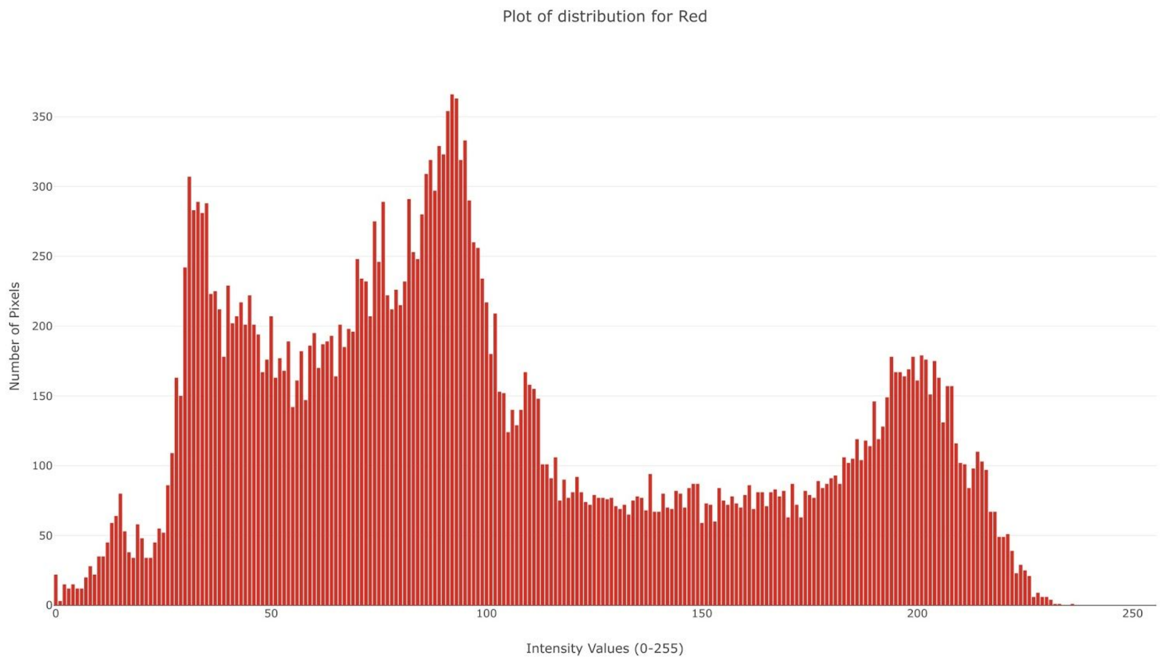
Computer Vision Homework 1 Practical Report

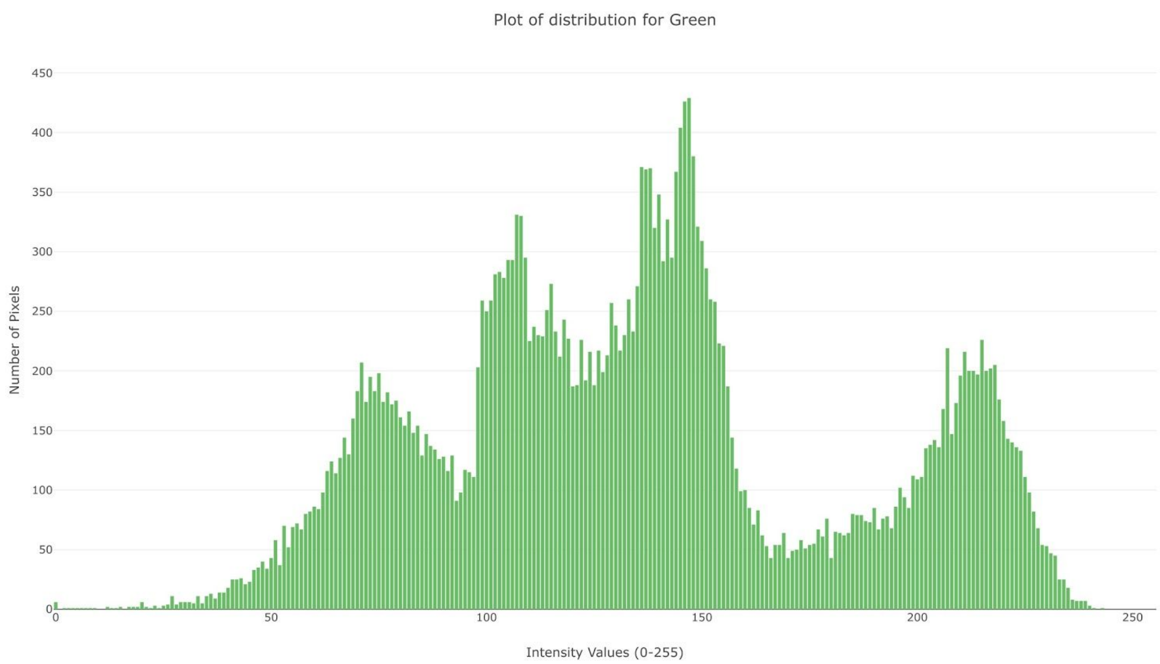
Name: Hitesh Paul
NetId: hp1293
Email: hp1293@nyu.edu

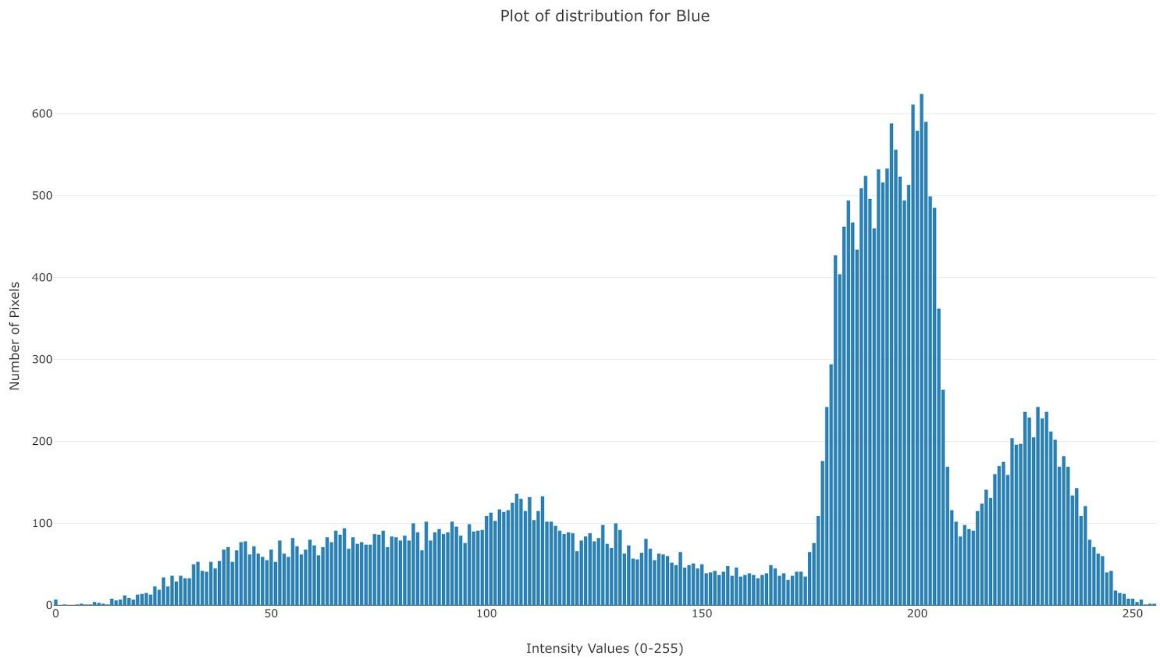
B1 Histogram and CDF

The above image was provided for this question. Histogram is a plot of pixel values per intensity level. Below is the generated graphs for the same.



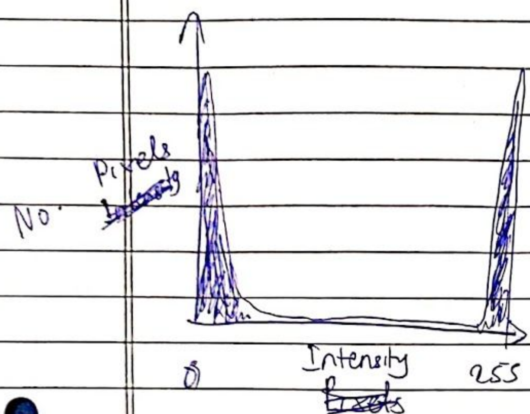

Plot of distribution for Red
Number of Pixels
Intensity Values (0-255)
0
50
100
150
200
250
300
350


Plot of distribution for Green
Number of Pixels
Intensity Values (0-255)
0
50
100
150
200
250
300
350
400
450

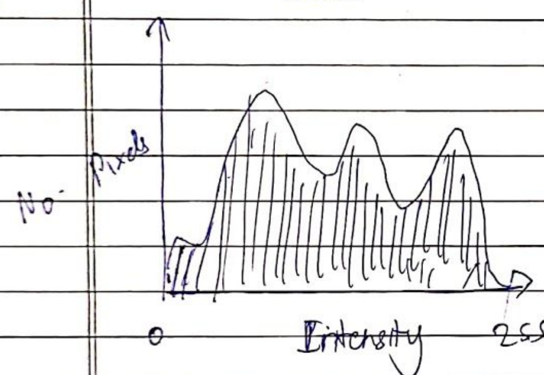


Each of the above histogram reflects some of the visible properties of the image. For instance, if we look at the combined graphs for R,G and B space, we can conclude that the image has very few too bright or too dark pixels since the distribution around start and end of the graph is low. The image has good exposure since majority of the pixels are in the center levels. Although we cannot deduce any particular information regarding the shape of the objects in the image, we can tell by looking at the graphs whether the image is good, overexposed, saturated, etc. These low level details will help guide us towards further processing of the image and answer questions such as should the histogram be more spread to obtain a good dynamic range?, Are there too many dark or bright pixels?, Etc. The distribution decides how difficult would it be to extract object details from the image, i.e, if there are too many bright or dark pixels, object separation will be difficult. Also, if there are too many pixels of same intensity and the graph dies out at other levels it will be hard to further process and extract object information.

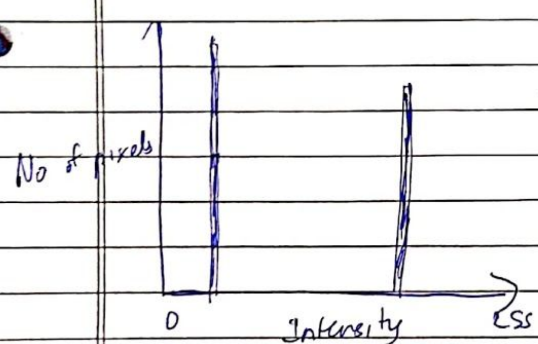
Explanation is given below:



→ Less information.
Too may bright or dark pixels

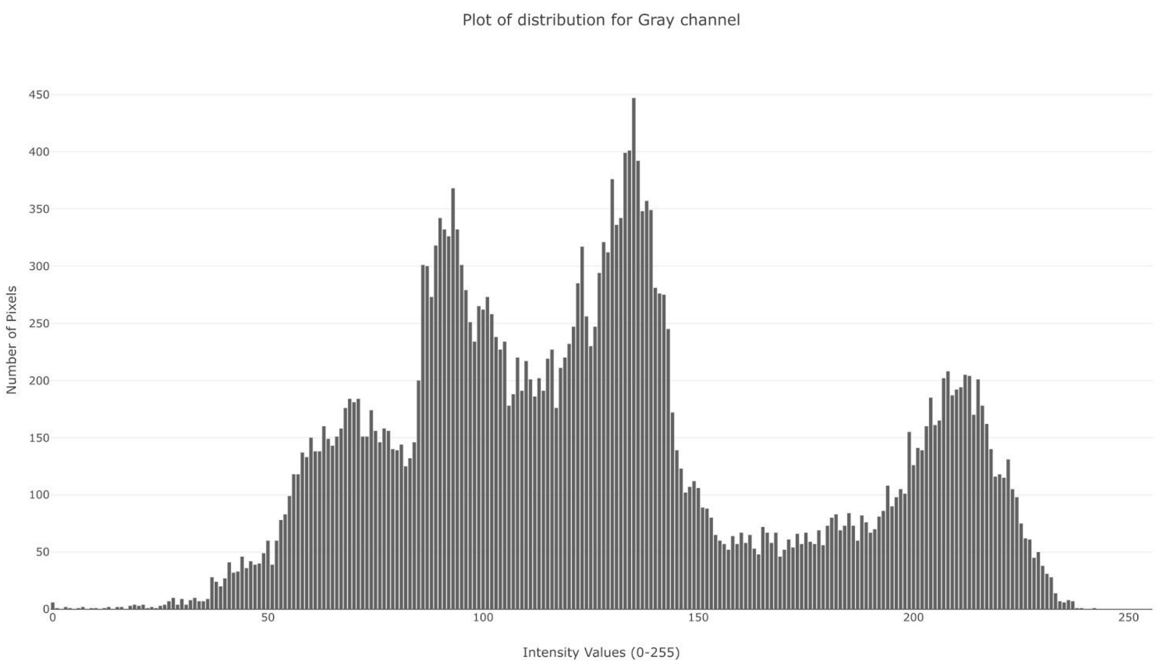


→ Good Information



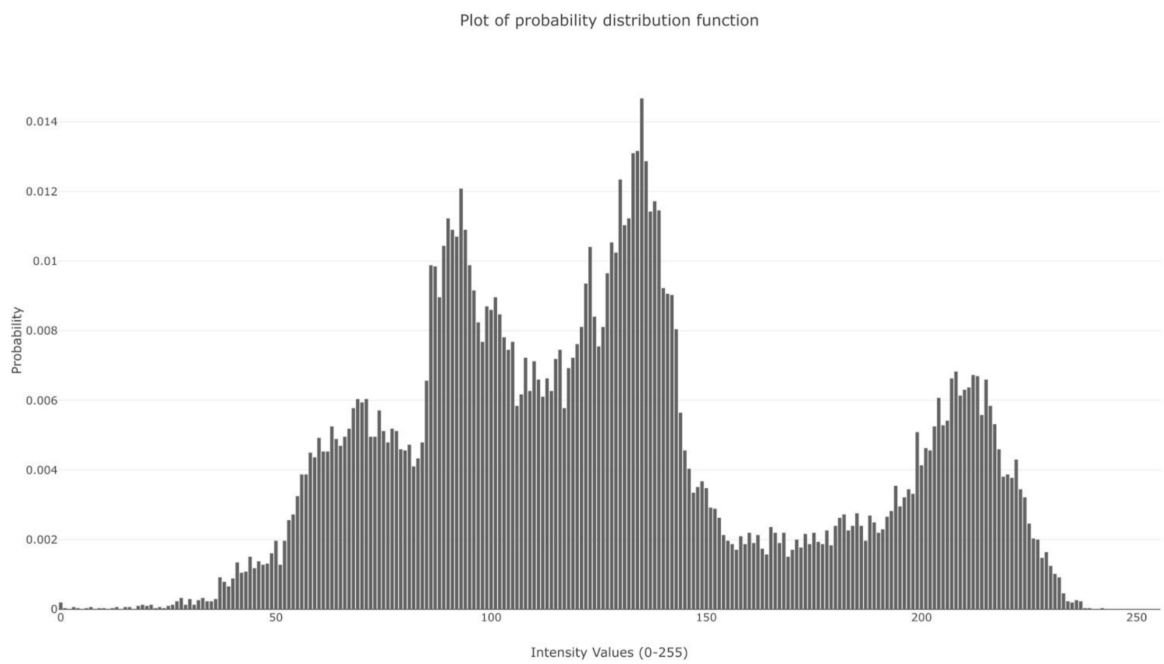
→ Graph dies out at other parts whereas few levels have too many pixels. Again, difficult to derive information depending on context.

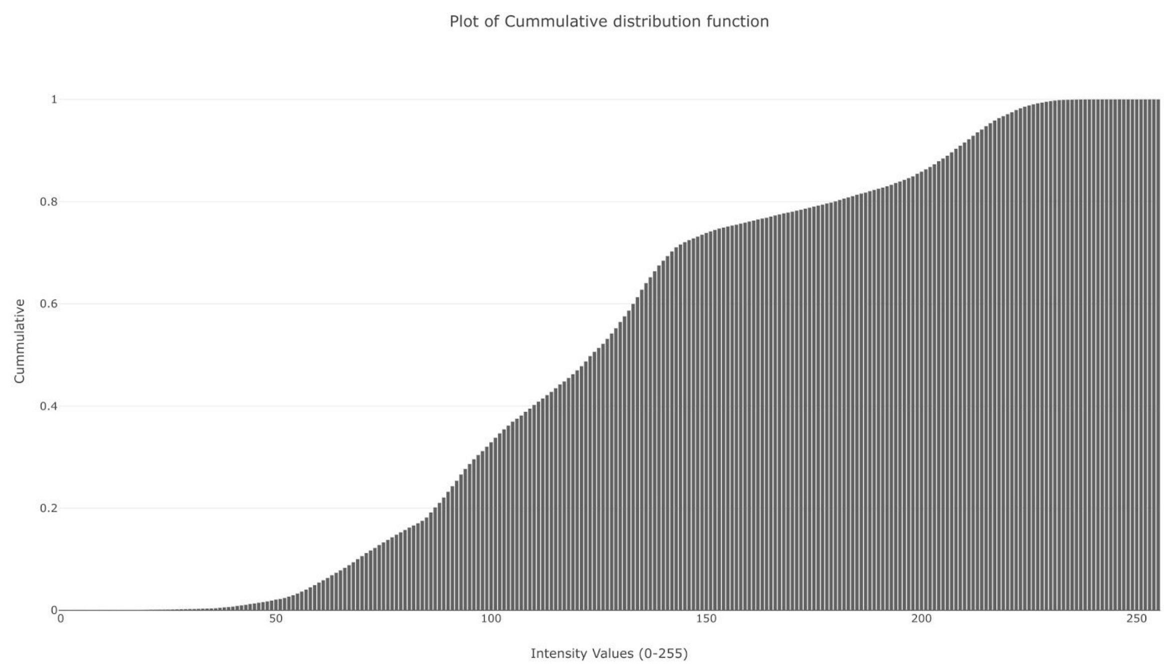
Next, we convert the image to grayscale and generate the corresponding graph which is shown below:



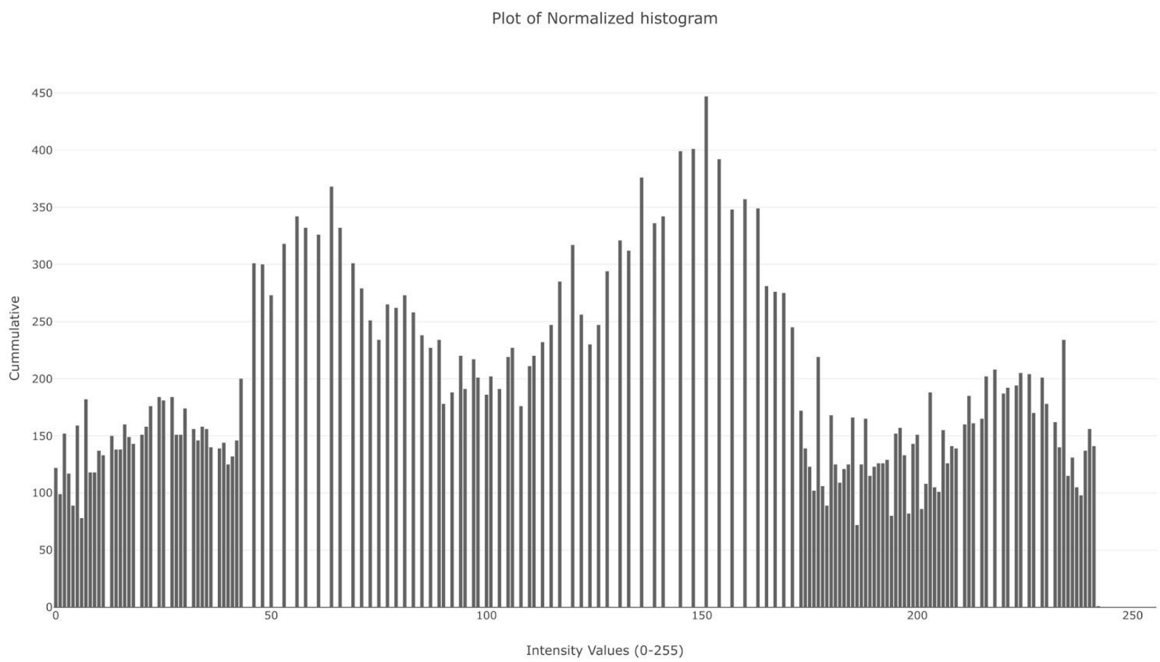
While converting to Grayscale image, since we multiply the Green channel with the highest factor(0.59), it is the top contributor to the image and the graph is dominated by it. If you observe closely, the gray scale graph is very similar in shape w.r.t the Green channel graph shown previously. Although red channel has good number of pixels in the intensity range of 0 to 60, its effect on the Grayscale is not that huge since the values are suppressed 70%(multiplying by a factor of 0.3). Blue channels contribution is lowest(11 percent). The image appears to be balanced since we suppress the effect of red which has a very high wavelength.

The Probability Distribution Function and Cumulative Distribution Function if shown below respectively:


Plot of probability distribution function
Probability
0.014
0.012
0.01
0.008
0.006
0.004
0.002
0
0
50
100
150
200
250
Intensity Values (0-255)

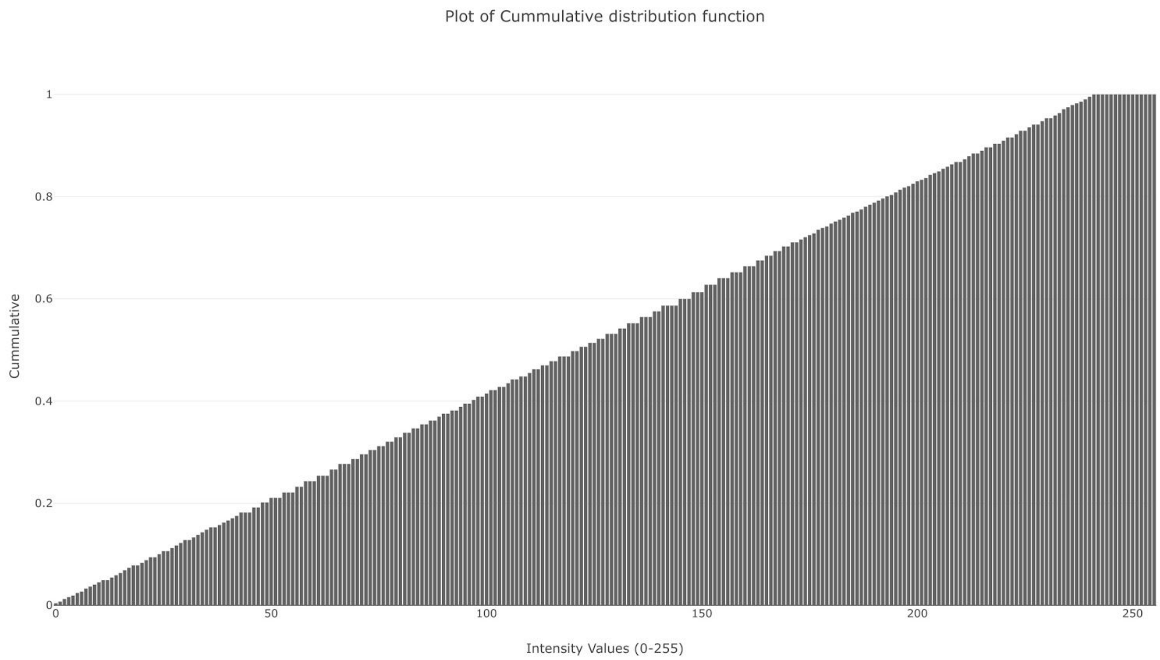

Plot of Cummulative distribution function
Cummulative
1
0.8
0.6
0.4
0.2
0
0
50
100
150
200
250
Intensity Values (0-255)

Applying histogram equalization results in the following image and histogram:



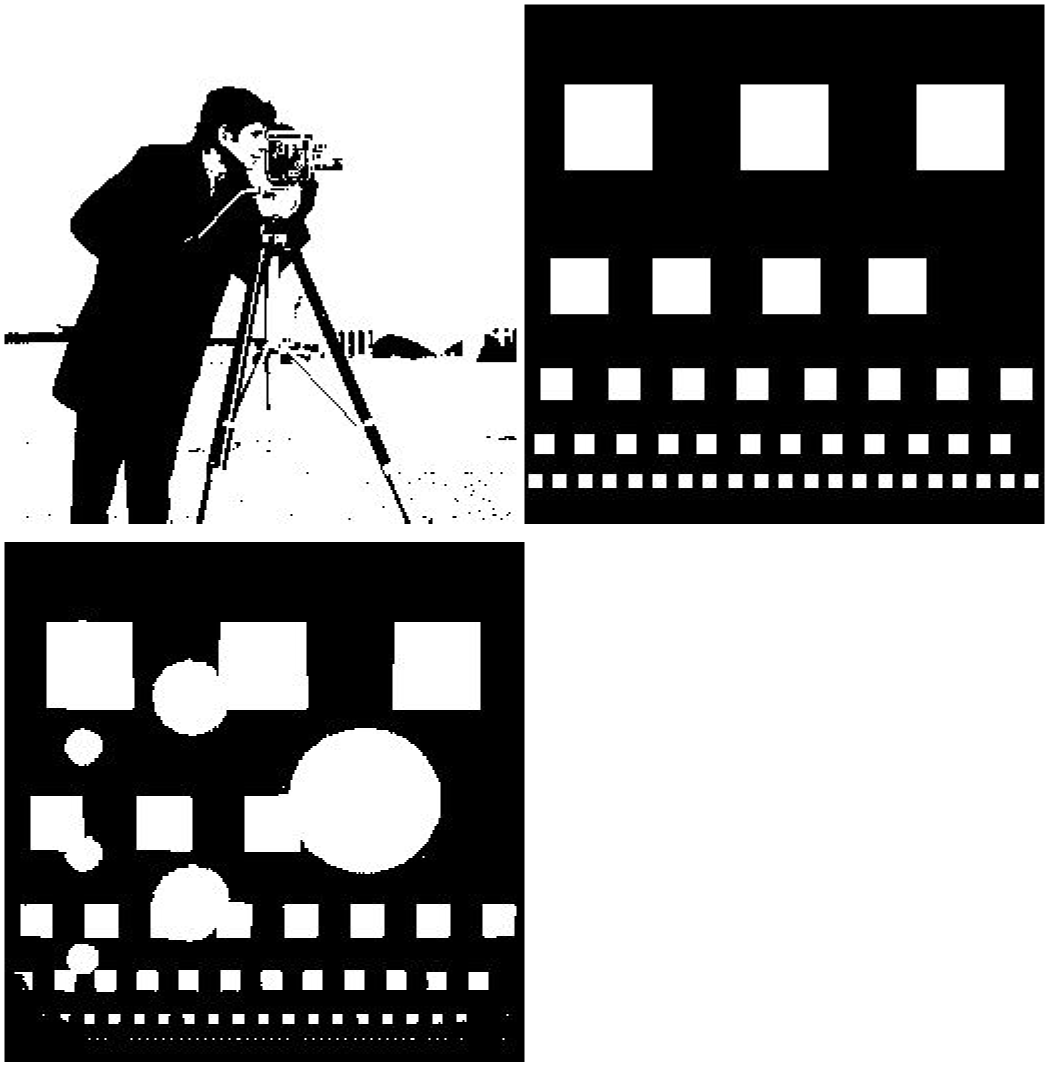
As seen above after applying histogram equalization to the grayscale image, the resulting image is much sharper. The white portion of the images have turned more white, whereas the darker portion of the image has turned more dark. In between gradients are more highlighted.

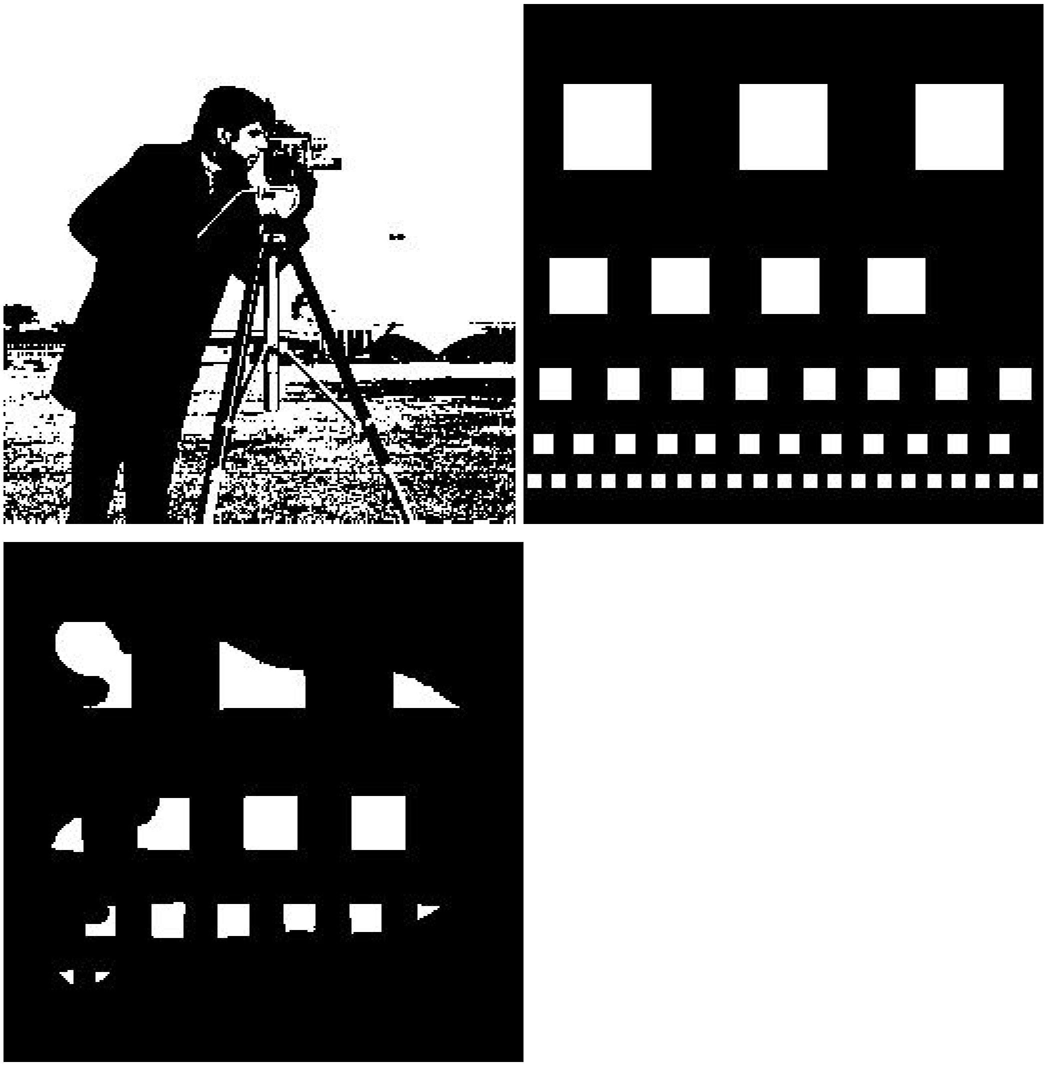
The histogram for the resulting image is flatter and stretched compared to the original one, but not flat completely. This can be observed by the difference between the global maxima and minima of the resulting plots. The gaps in the histogram is the result of approximation since we have discrete intensity levels and finite number of pixels. This histogram is not completely flat, due to approximation and the discrete nature. In fact, since we have finite numbers, we are not “redistributing” the values across the intensity range, only spreading the graph in the process. The resulting cdf is shown below:

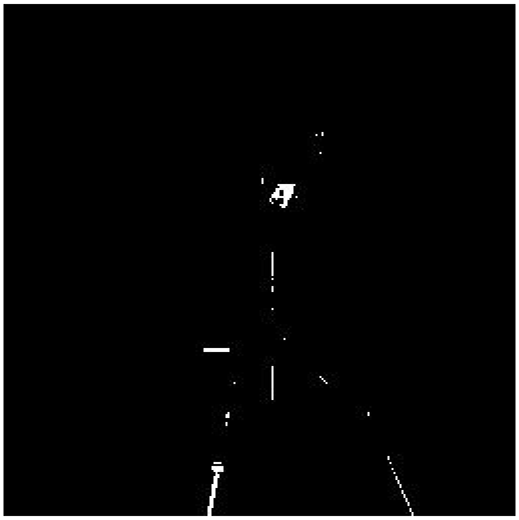
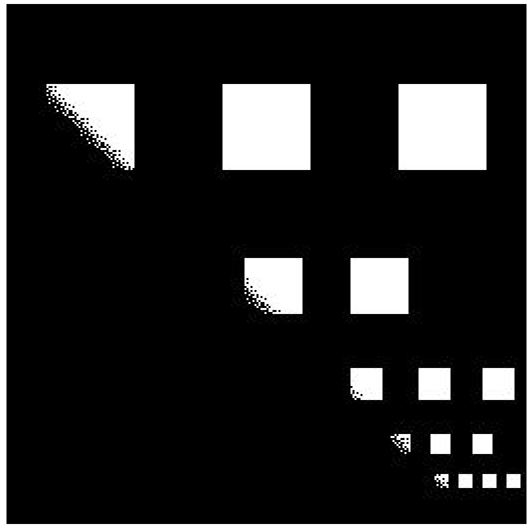


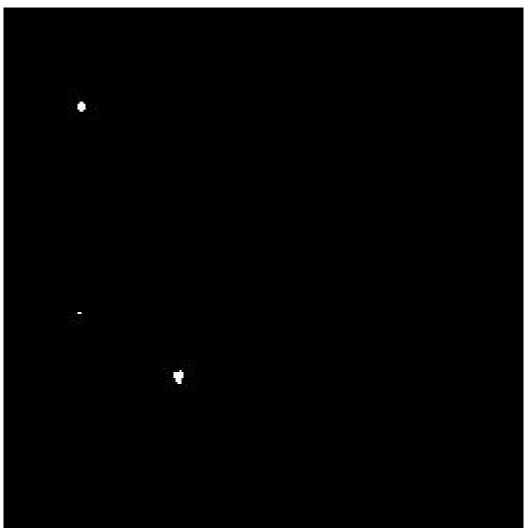
B2) Image thresholding

Below are the results of image thresholding for values **80, 125, 230** respectively:



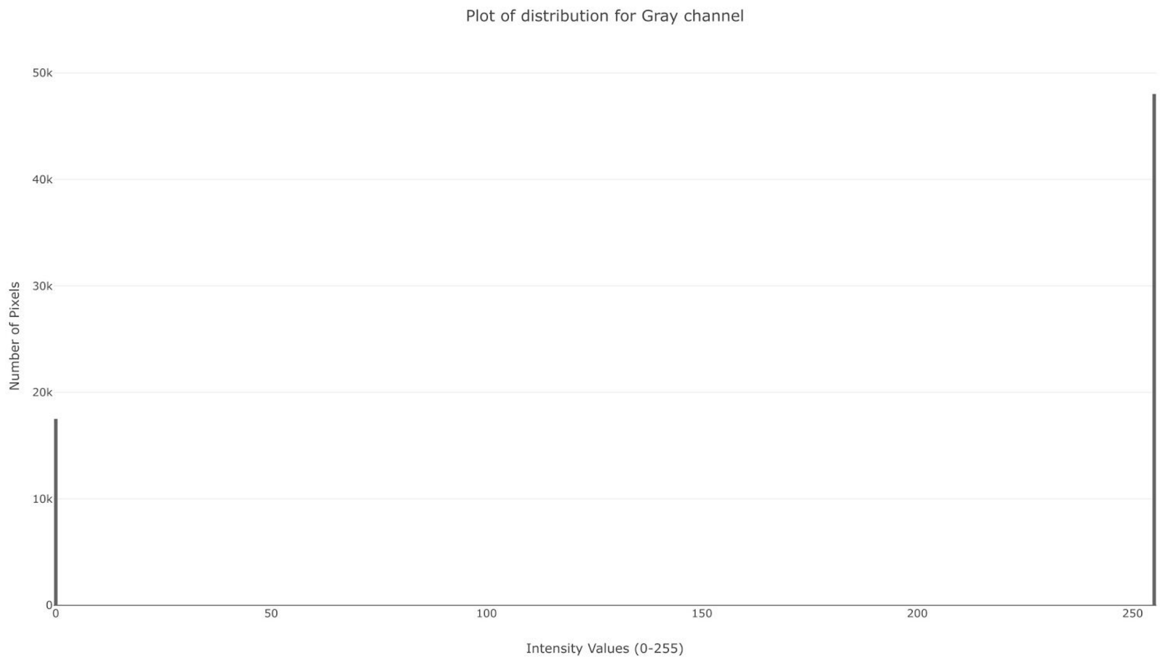


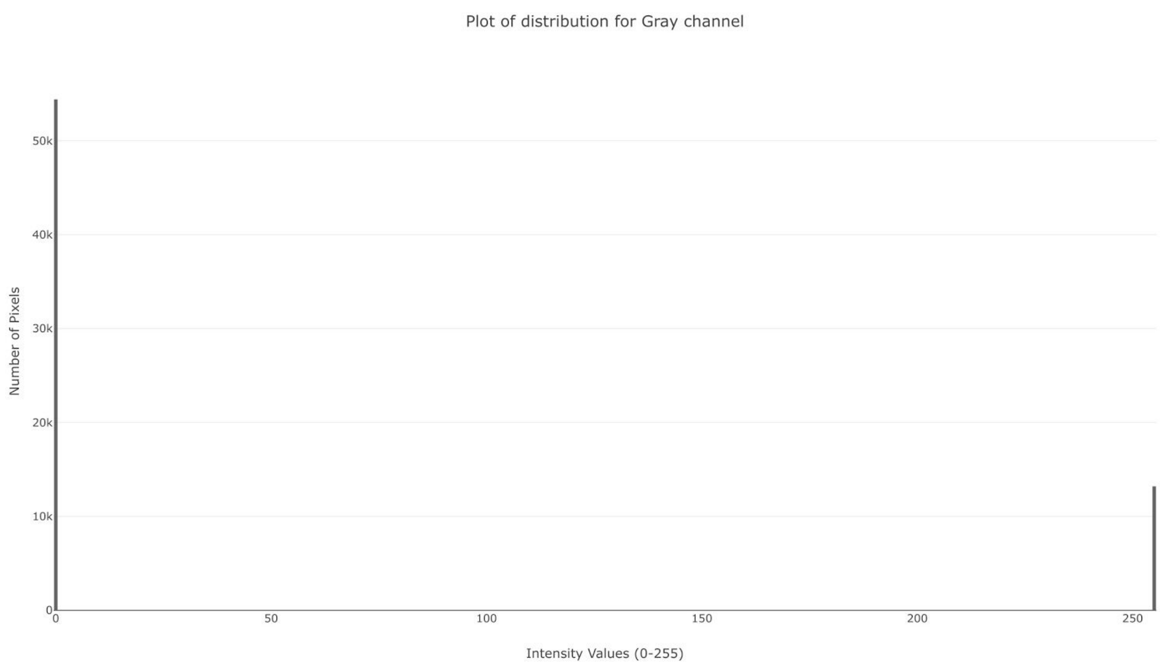
 

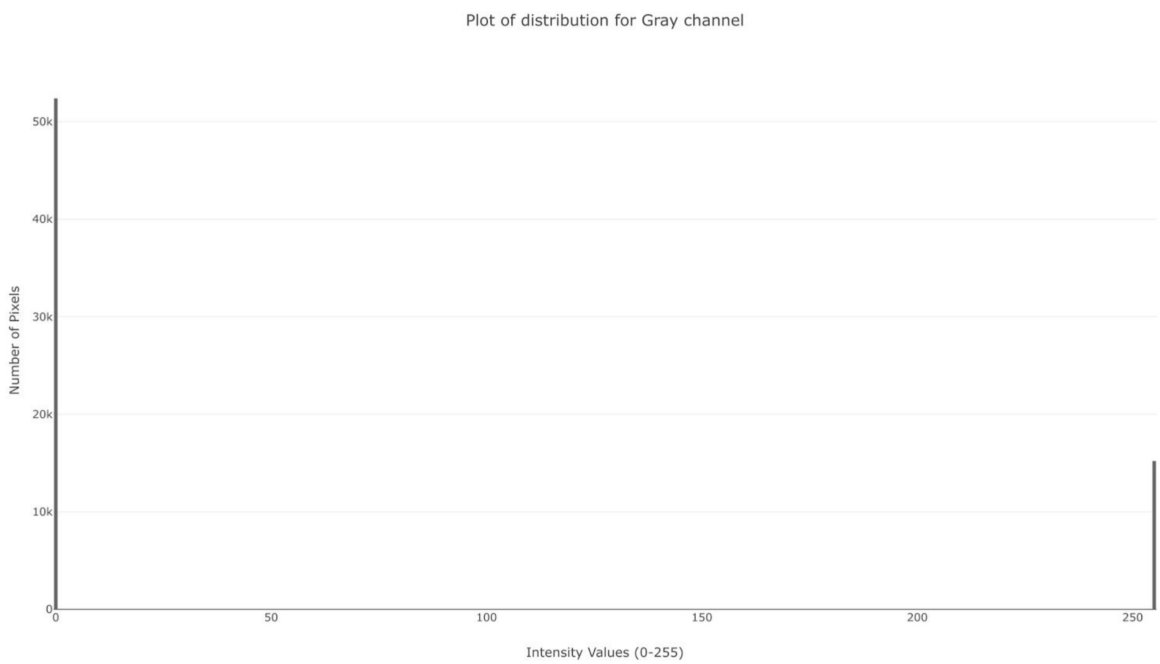


Otsu’s Threshold:

Below is the histogram for the three images b2_a.png, b2_b.png and b2_c.png according to Otsu’s method respectively:

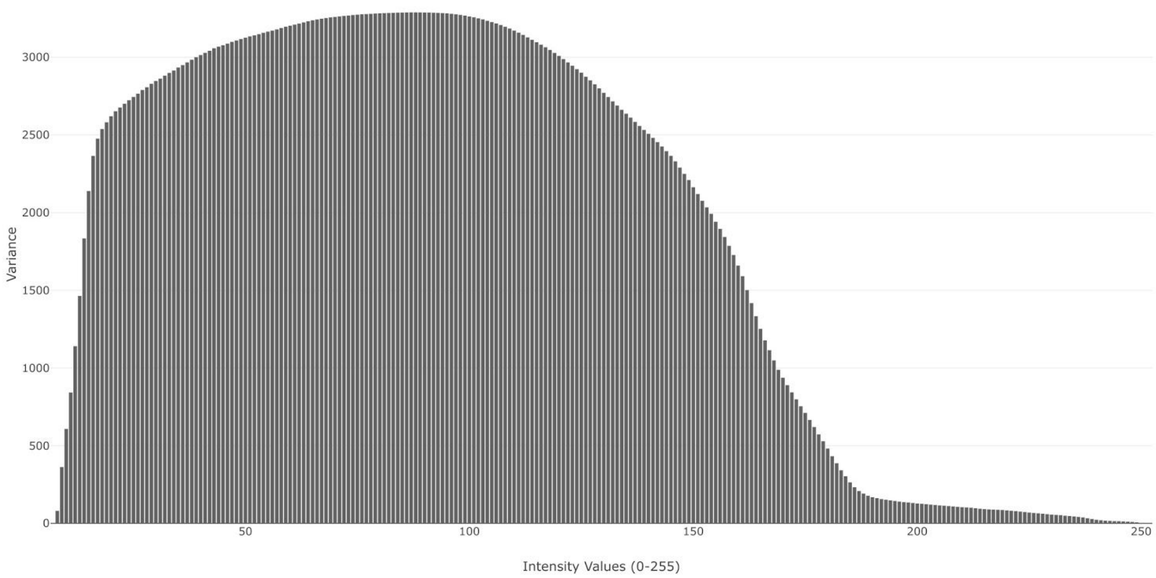

Plot of distribution for Gray channel
50k
40k
30k
20k
10k
0
Number of Pixels
0
50
100
150
200
250
Intensity Values (0-255)


Plot of distribution for Gray channel
50k
40k
30k
20k
10k
0
Number of Pixels
0
50
100
150
200
250
Intensity Values (0-255)

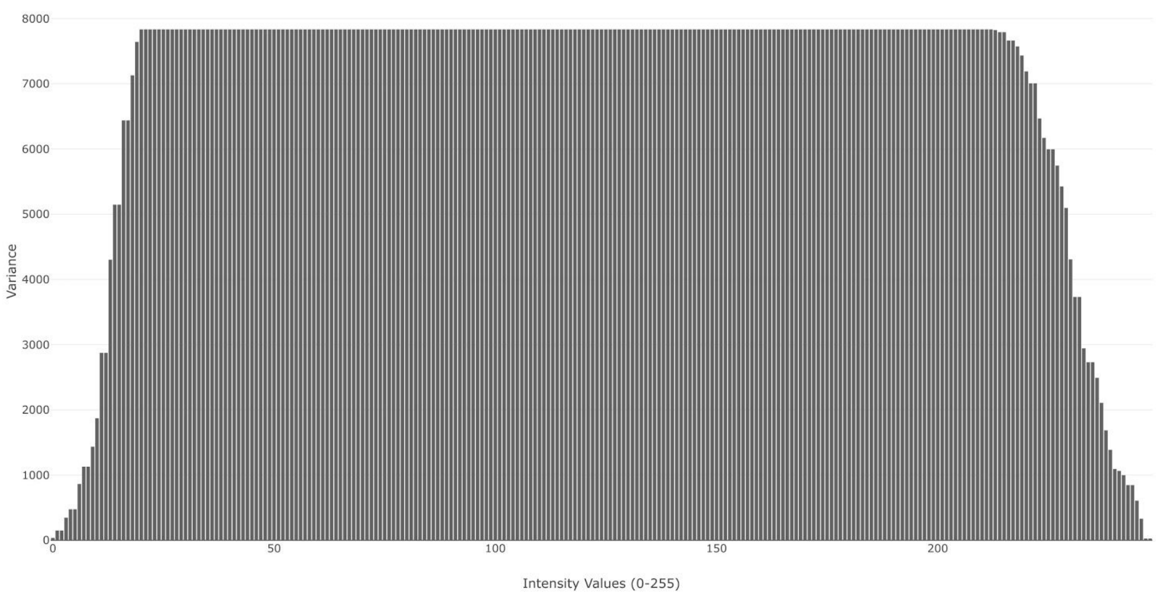


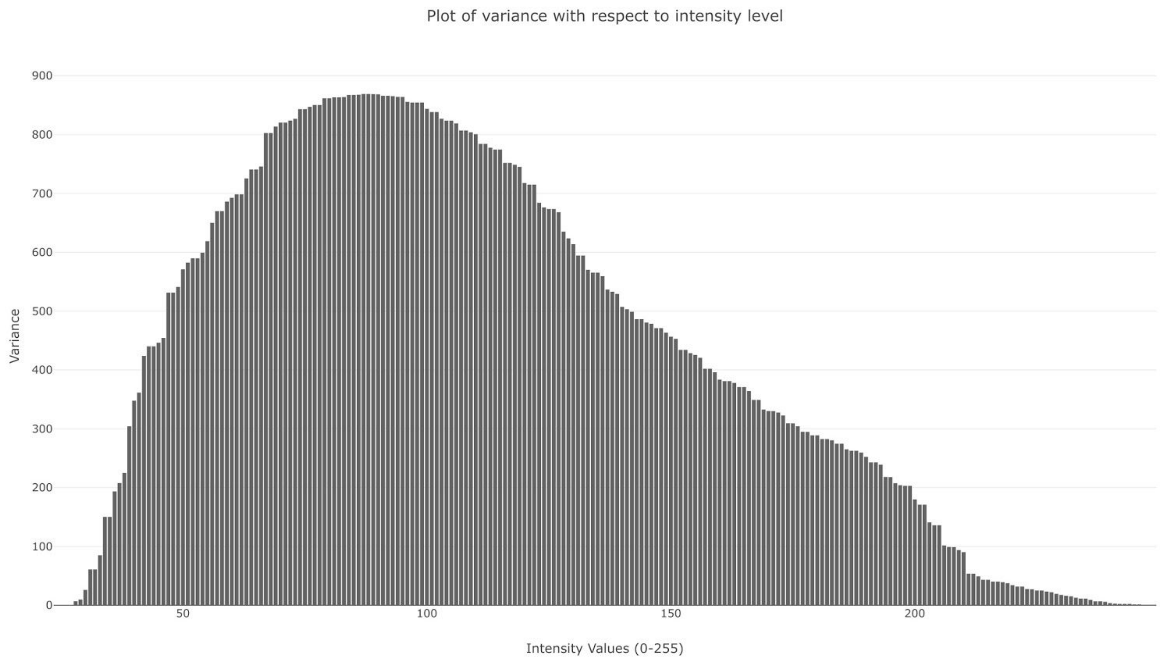
The plot for interclass variations for the three images are shown below respectively:

Plot of variance with respect to intensity level



Plot of variance with respect to intensity level

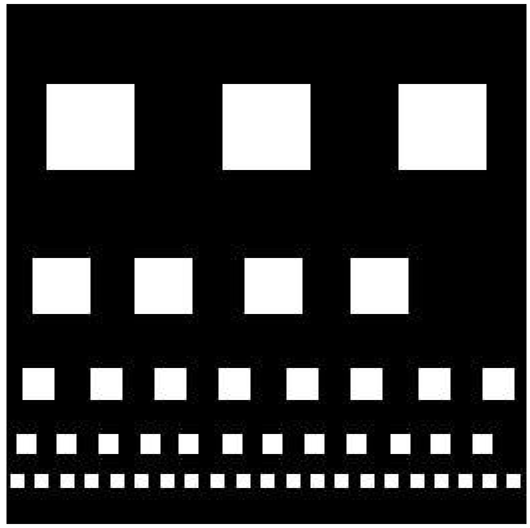
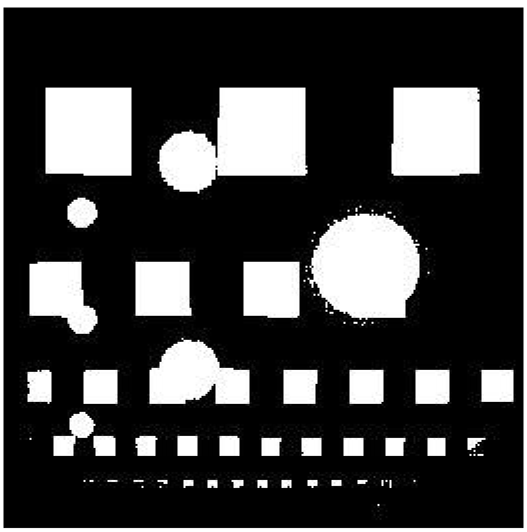




The interclass variance and the threshold chosen after completing the algorithm is stated below:

- B2_a.png: Variance: 3289.115; Threshold: 88
- B2_b.png: Variance: 7833.90; Threshold: 20
- B2_c.png: Variance: 869.088; Threshold: 88

The resulting binary images produced by the algorithm is:

The automatic thresholding produced decent result for b2_b.png, but not so good for the rest of the images. For instance, lot of background details are lost using the generated threshold. Also, gradient patches in b2_c are binarized strongly. Meaning, it could have been better if we could preprocess the image and extract their distributions(the gradients in these images seem to follow gaussian distribution. This can be linked to diffusion of light source). We can then remove/reduce the effect of such distributions and generate a better image.