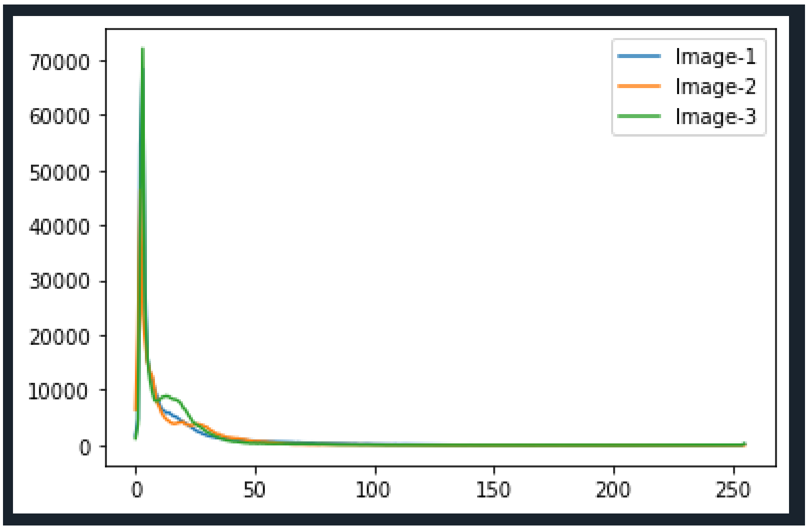
3 Problem # 3: Nighttime Road Contrast Enhancement [40 Points]

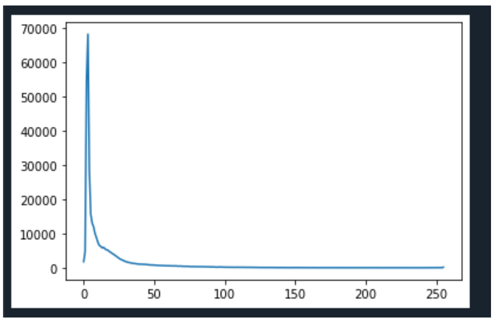
The visibility of lane markings, road signs, and obstacles on the roads is significantly reduced at night-time. To assist drivers in dark conditions, we can perform contrast enhancement on images captured by the car's front-facing camera and display the enhanced images to the driver. You are given three images captured at different times on different roads: `hw1_dark_road_1.jpg`, `hw1_dark_road_2.jpg` and `hw1_dark_road_3.jpg` (Fig. 3). For each image, perform the following operations:

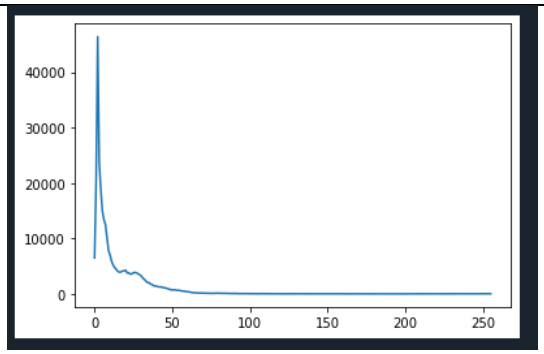
(a) Plot and submit the histogram of the original image's grayscale values (write your own code to compute the histogram; you may <u>not</u> use toolbox/library functions). Briefly comment on the shape of each histogram.

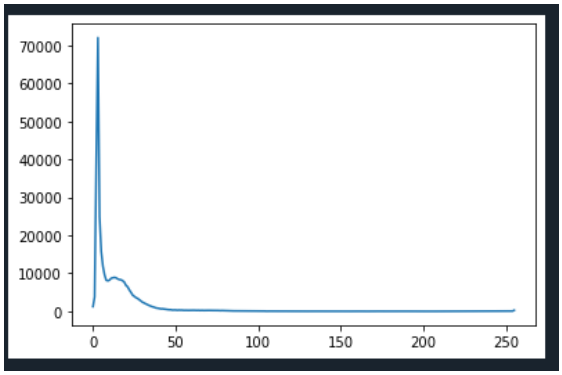


We can see that the histogram is shifted towards the left-hand side which is showing that the images are dark. Further we can see that the images are of high contrast, which means that a large part of range is being wasted.

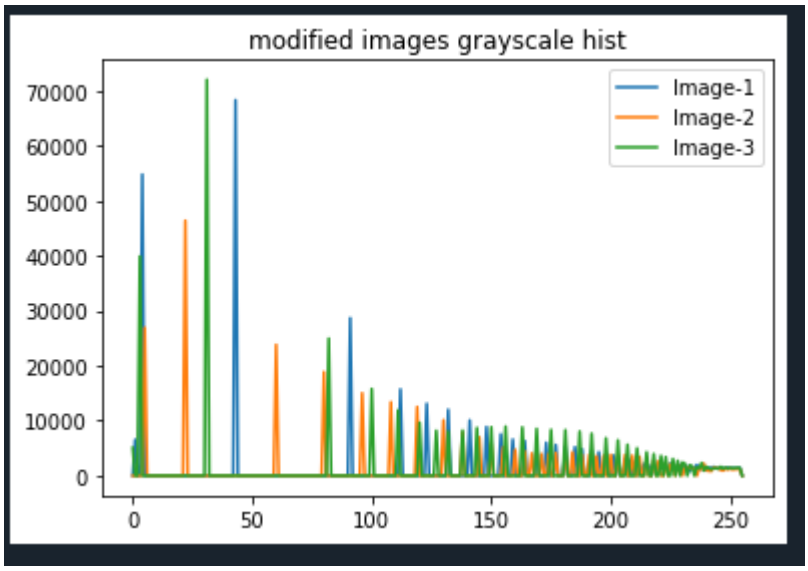
The lower grayscale values are being used and as we go higher,the values are 0.





(b) Apply global histogram equalization to the original image. Display and submit the modified image (implement the algorithm yourself; you may not use toolbox/library functions). Plot and submit the histogram of the modified image's grayscale values. Comment on visually desirable/undesirable regions in the modified image.



In image#1

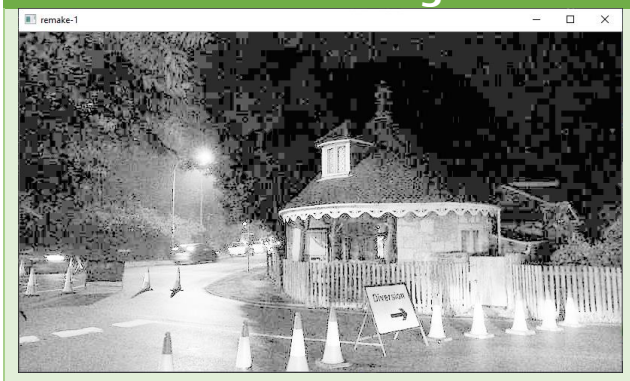
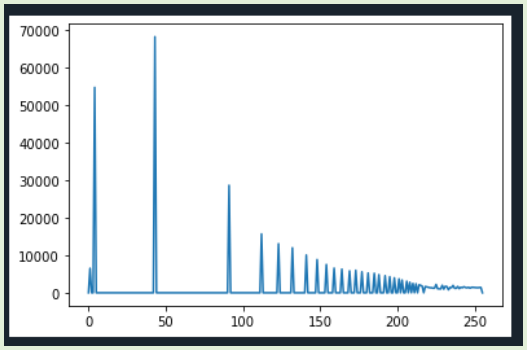
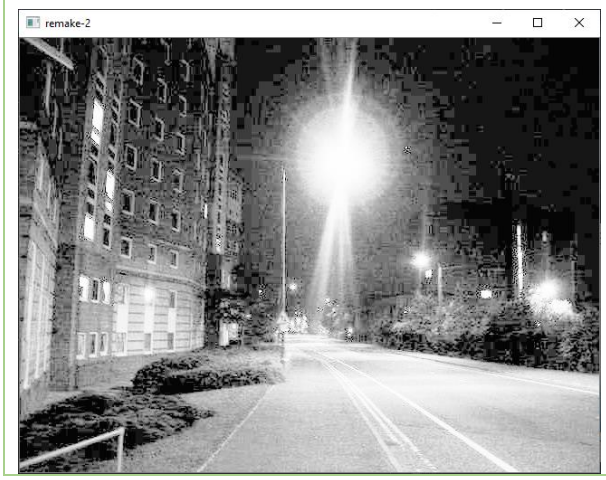
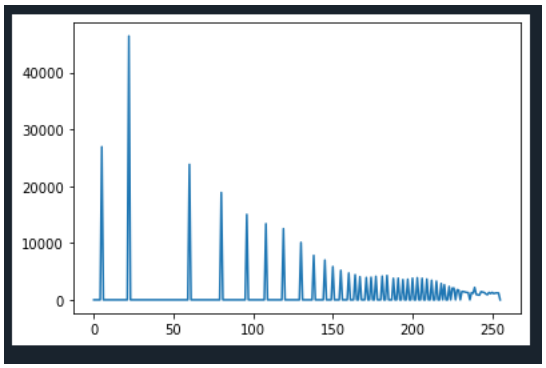
In the modified images we can see that there is some distortion introduced in the image 1 in the darker region i.e. sky, but the image1 is now illuminated and histogram is now distributed over the grayscale range.

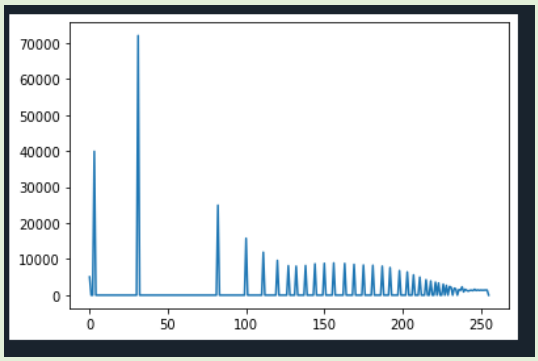
In image#2

In the modified 2nd image the contrast has been enhanced now and we have more details visible but along with that there are some regions which are undesired i.e. sky.

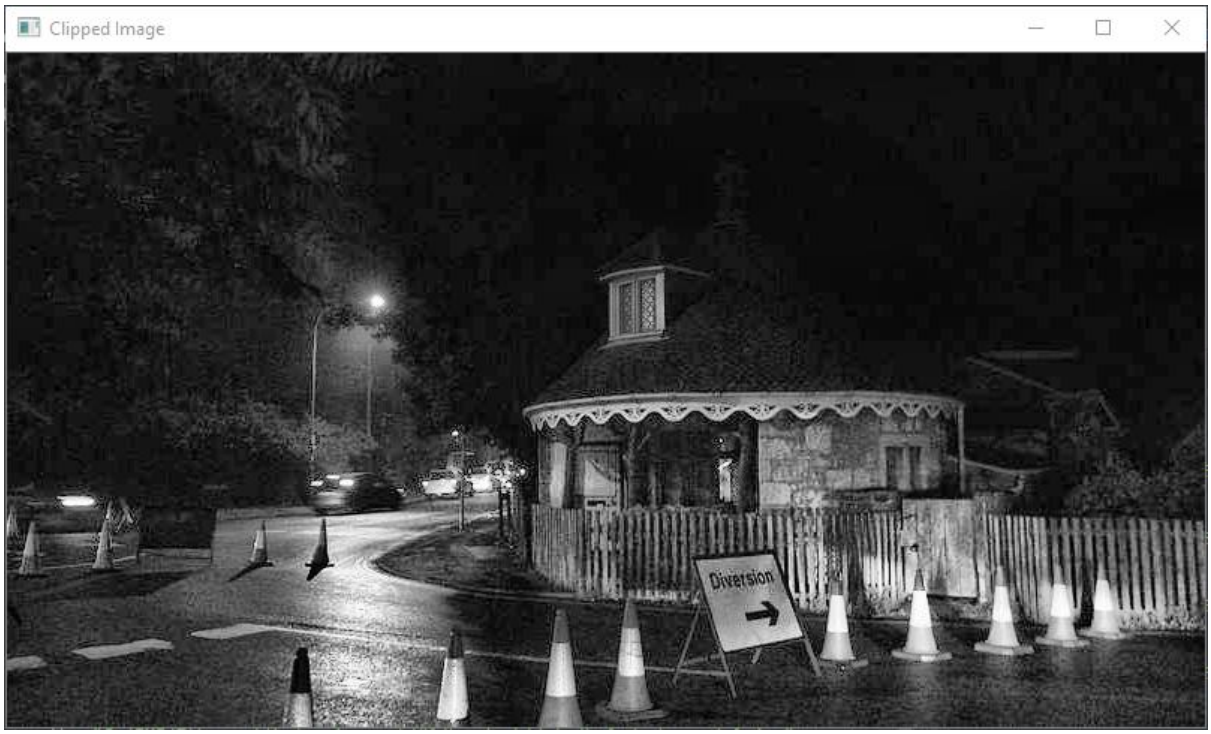
In image#3

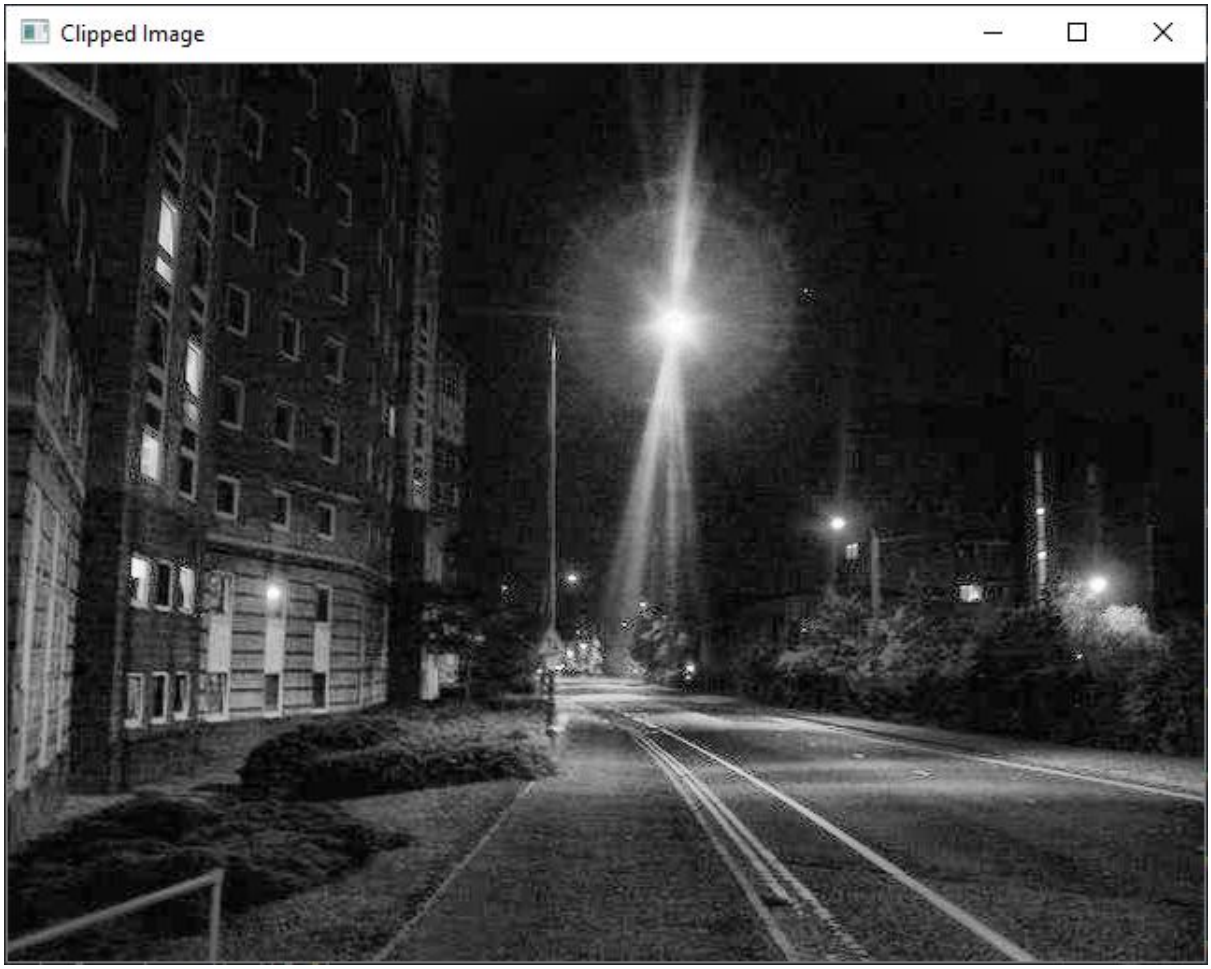
In this modified image we can see more details now, things far off are visible enough to identify but in this case also there is undesired region where there is darker region i.e. sky.

Modified images	Grayscale hist
	
	



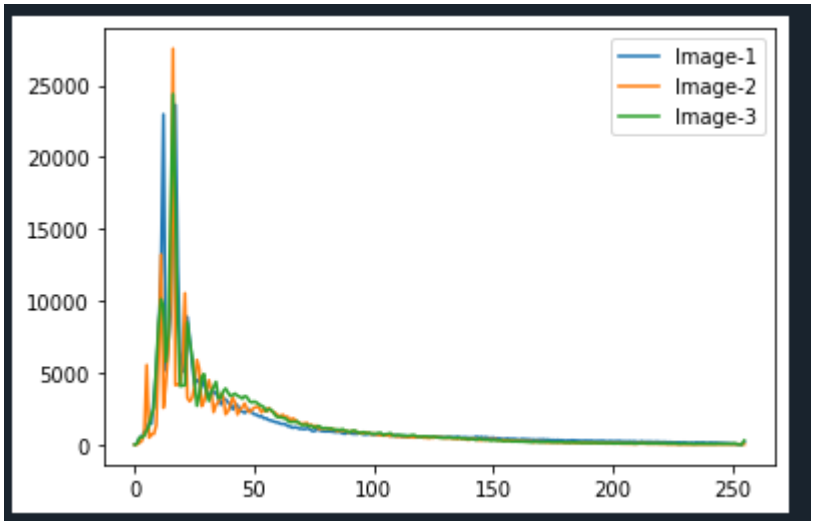
(c) Apply locally adaptive histogram equalization to the original image. This time round, you should use the toolbox/library function — google it up! Display and submit the modified image. Plot and submit the histogram of the modified image's grayscale values. Choose and report the number of tiles and the clipping limit for attaining higher contrast while avoiding the generation of noisy regions and the amplification of nonuniform lighting effects. Comment on the subjective quality of the modified image compared to the result in (b).



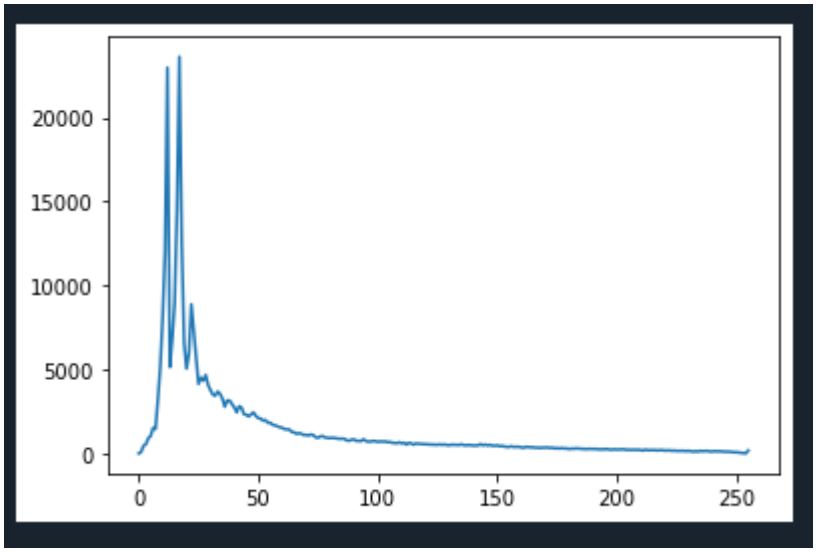


Clip Limit	Tile grid size
4.5	(10,20)

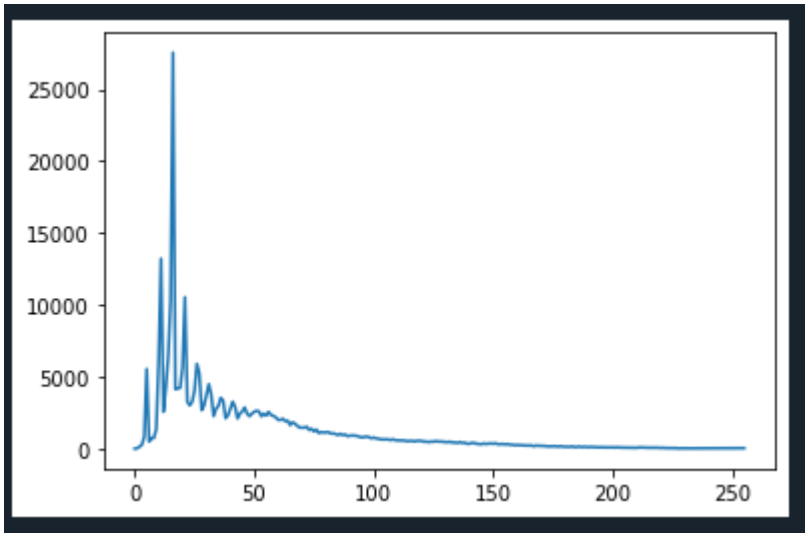
Combine histogram of the modified images



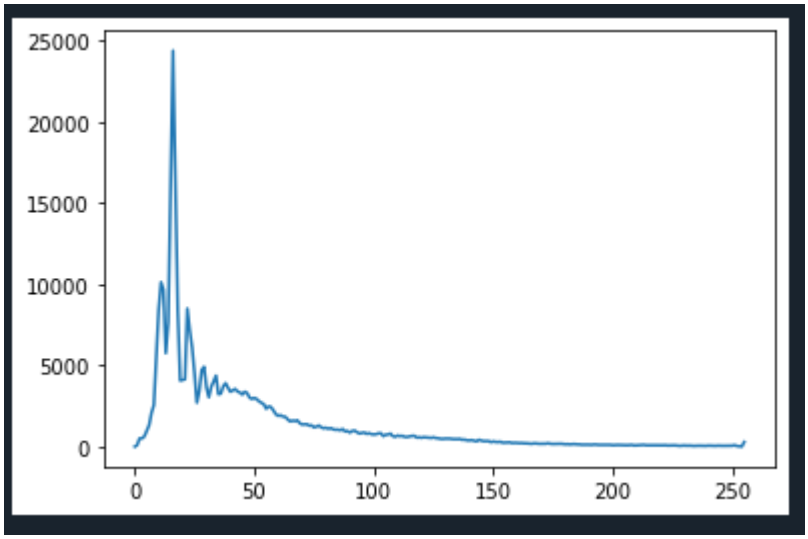
Img#1 hist



Img#2 hist



Img#3 hist



Comment:

The image quality in local histogram equalization case is much better than with global histogram localization as in this case we have control over the noise introduced in the modified image and we can observe images with very less noise using the *clip limit* and *no of tiles* parameters.