Problem 2

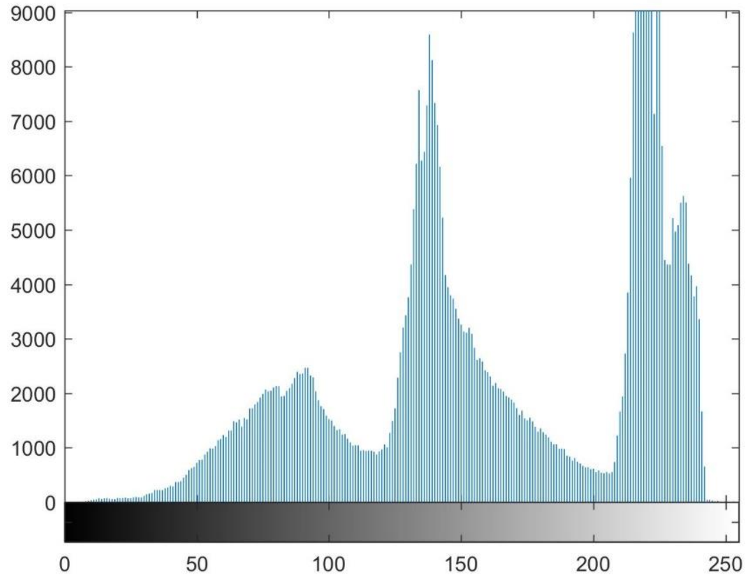
a) Read and show the image.

b) What is the size of the original image? Resize the original image to a third of its size. What is the size of the new image?

The original image is 1000 pixels wide and 563 pixels tall. The resized image is 334 pixels wide and 188 pixels tall.

c) Convert the original image to a gray image and to a black and white image (using a level of 0.5).

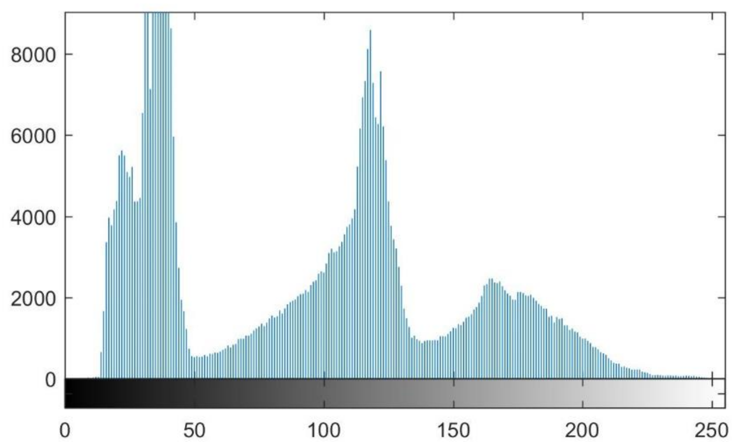
d) Show the histogram of the gray image. What observations can be made from this histogram?



The histogram of the gray image shows that there are three different distributions of gray. One is close to black, one is gray, and one is close to white.

e) For the gray image, apply the following transformations. Report the images obtained and the corresponding histograms. Also, explain the purpose of each of these transformations.

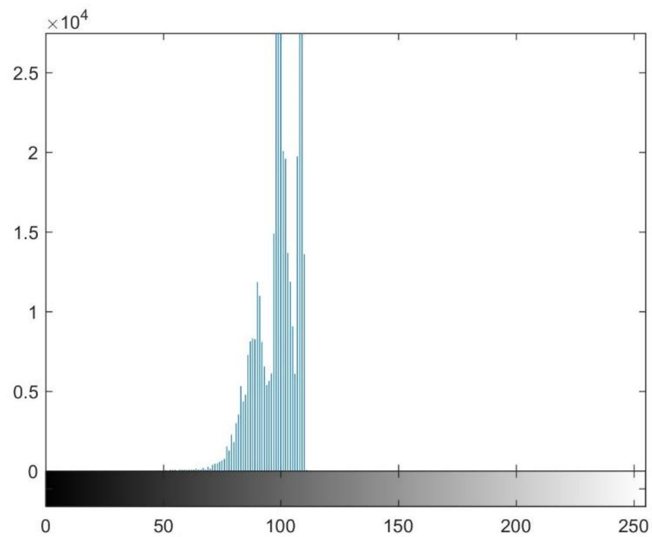
1) Linear transformation



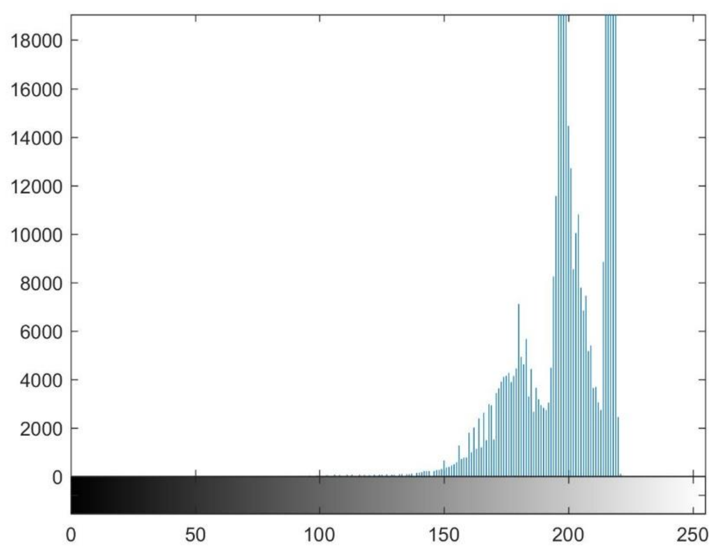
The linear transformation gives the negative of the image.

2) Log-transformation: use c = 20 and c = 40.

C = 20



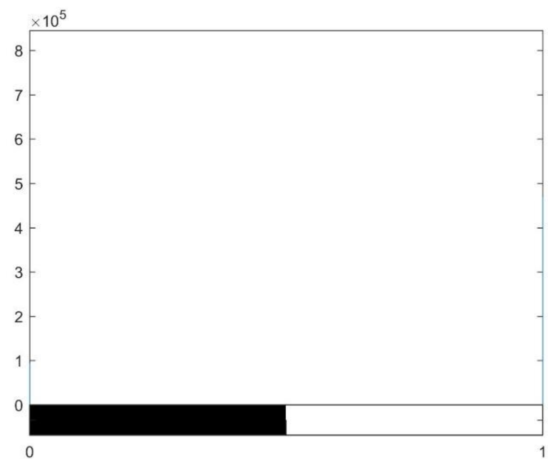
C = 40



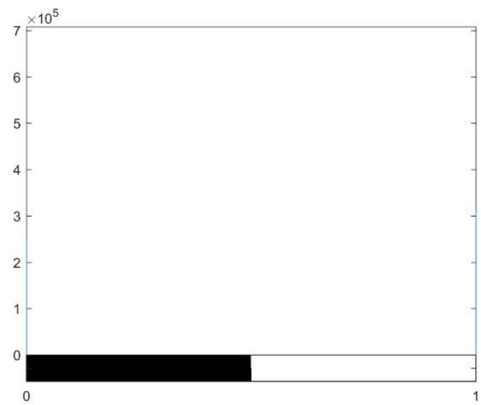
The log transformation is used to increase the brightness of the image. As seen here, the higher the value of C, the brighter the image becomes.

3) Thresholding: use thresholds of 100 and 150.

T = 100

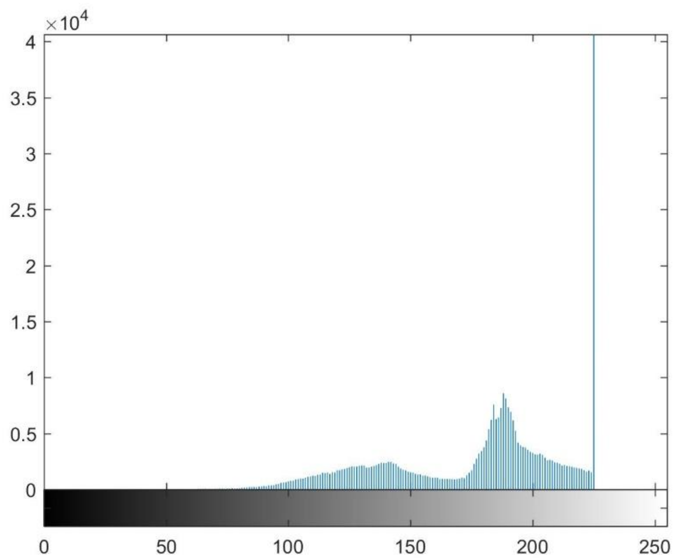


T = 150



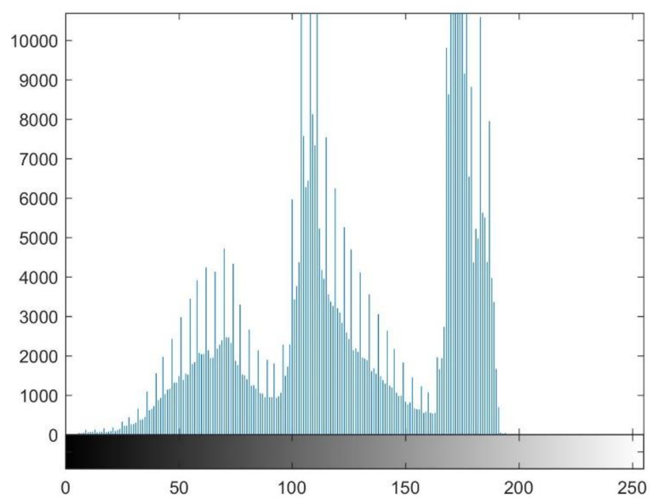
Thresholding converts the image to black and white. The higher the threshold, the more pixels are converted to black.

4) Histogram shift: use a lower bound of 25, an upper bound of 225 and a shift of 50.



A histogram shift also changes the brightness of the image. Here we brighten the image by shifting the histogram 50 units and setting the lower bound to 25.

5) Histogram stretch: use a lambda value of 200. What's the contrast of the original gray image and transformed image?



Stretching the histogram changes the contrast of the image. Here we reduced the image contrast using a lambda of 200. The original image had a contrast of 253 while the transformed image has a contrast of 200.

f) Create a noisy image, by adding random noise with mean zero and variance of 100 to the gray image. Use the following convolution mask to denoise the image. Show noisy vs. denoised image.

Noisy

Denoised

g) For the original colour image, use the following convolution mask to sharpen the image:

h) For the gray image, use Otsu's method to segment the image into 2, 3, 4, and 5 levels. Report the threshold values you obtained for each instance.

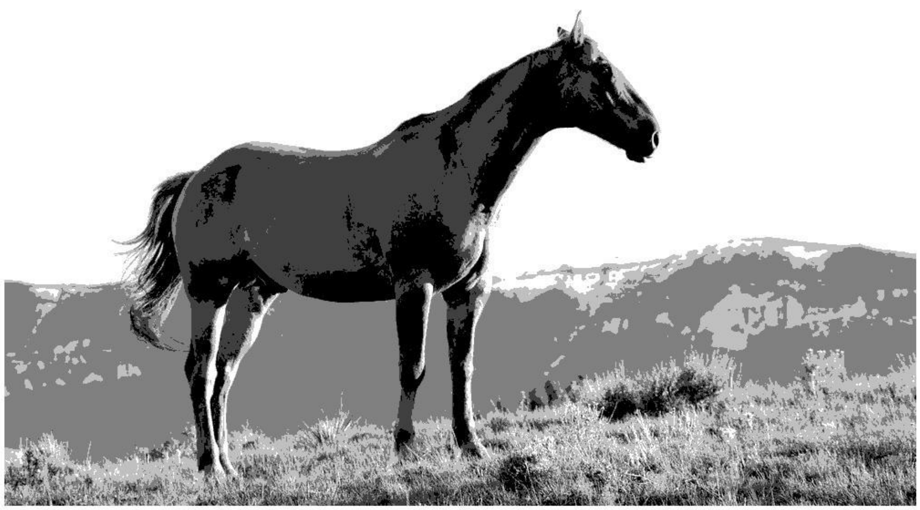
Levels	Threshold Value(s)
2	168
3	112, 183
4	73, 117, 184
5	76, 115, 154, 196

2 Levels

3 Levels

4 Levels

5 Levels

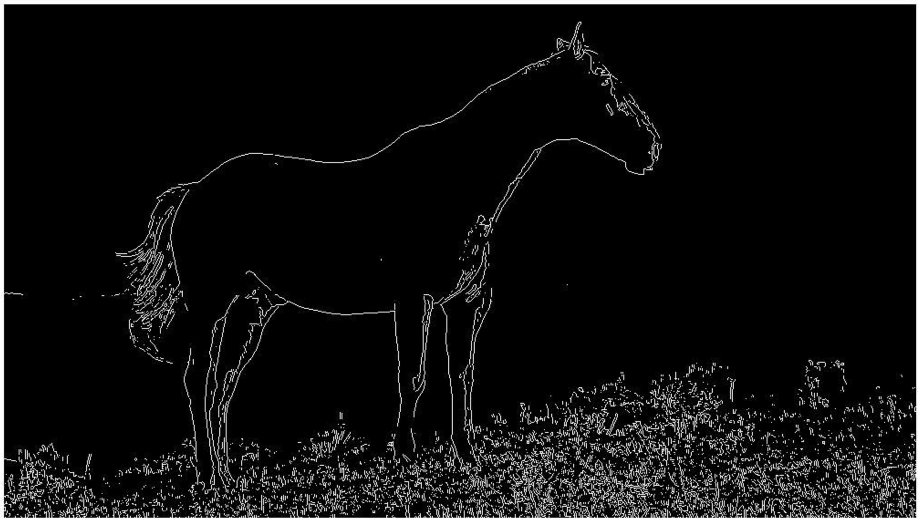


i) For the original colour image, use K-means clustering algorithm to segment the image into 2,3,4 and 5 clusters.

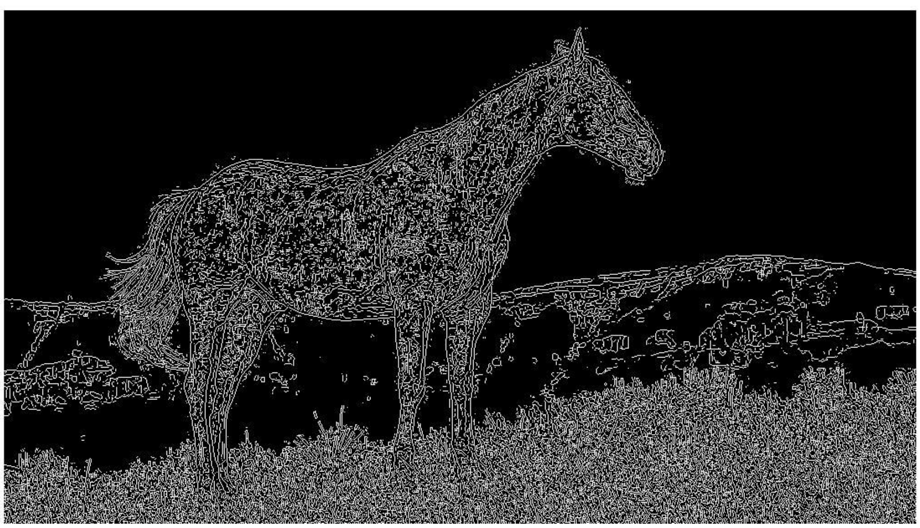
Top left = 2 clusters, top right = 3 clusters, bottom left = 4 clusters, bottom right = 5 clusters

j) Use the Prewitt and Sobel methods to detect the edges in the gray image. Use different threshold values. What happens when the threshold increases?

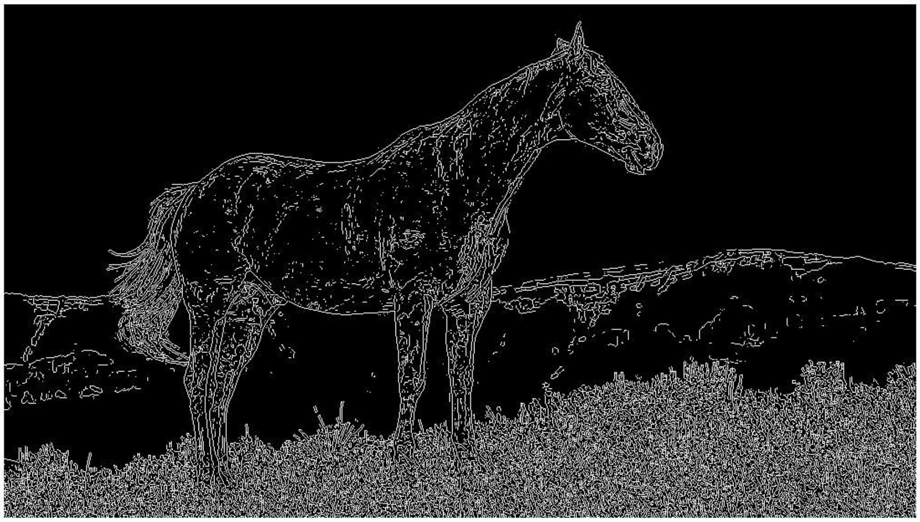
Prewitt Method:



Sobel Method (C = 2):



Sobel Method (C = 4):



Sobel Method (C = 8):

Sobel Method (C = 10):

As the threshold value increases, the edges become clearer, but some less noticeable edges might be lost/undetected.