COMPUTER VISION
PROF. GUIDO GERIG
SPRING 2018

SUBMITTED BY:

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Net ID: at3617

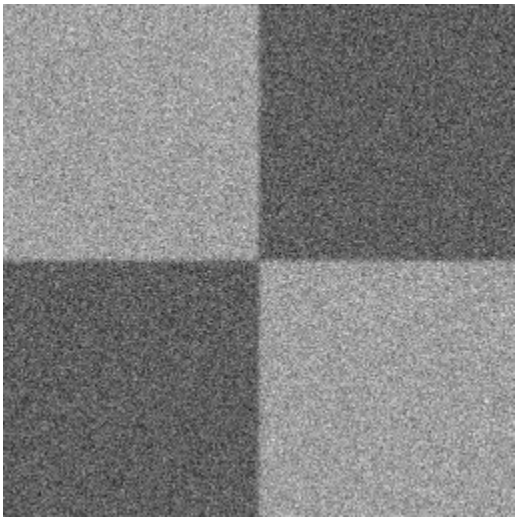
ASSIGNMENT 1

B) PRACTICAL PROGRAMMING ASSIGNMENTS

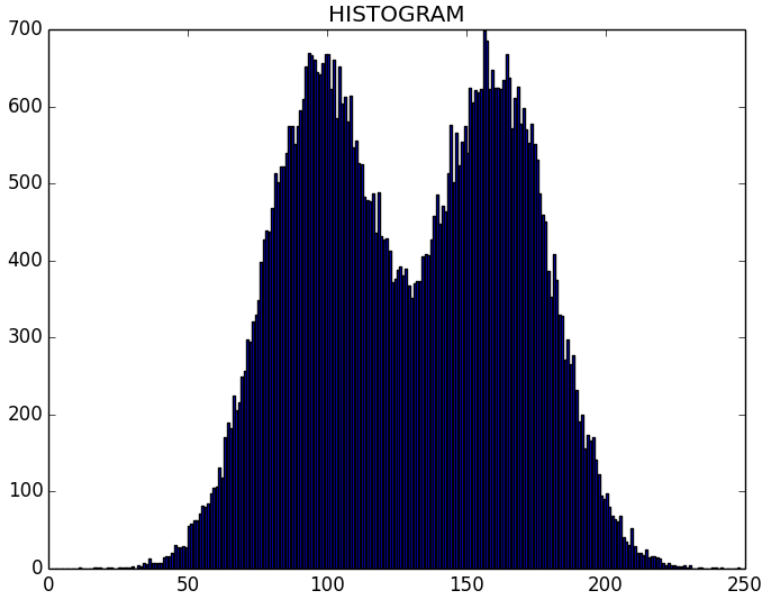
B1) Compute a Histogram and CDF

IMAGE 1:

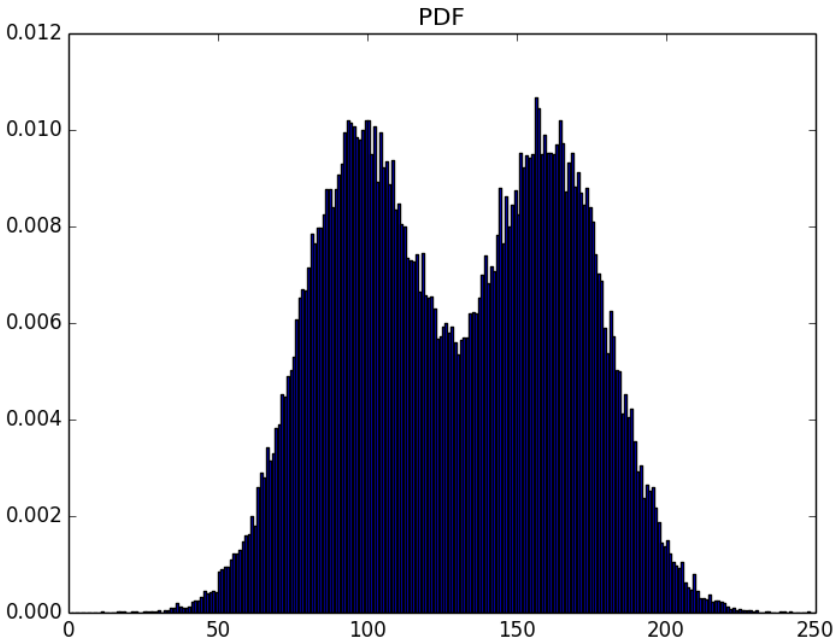
ORIGINAL IMAGE:



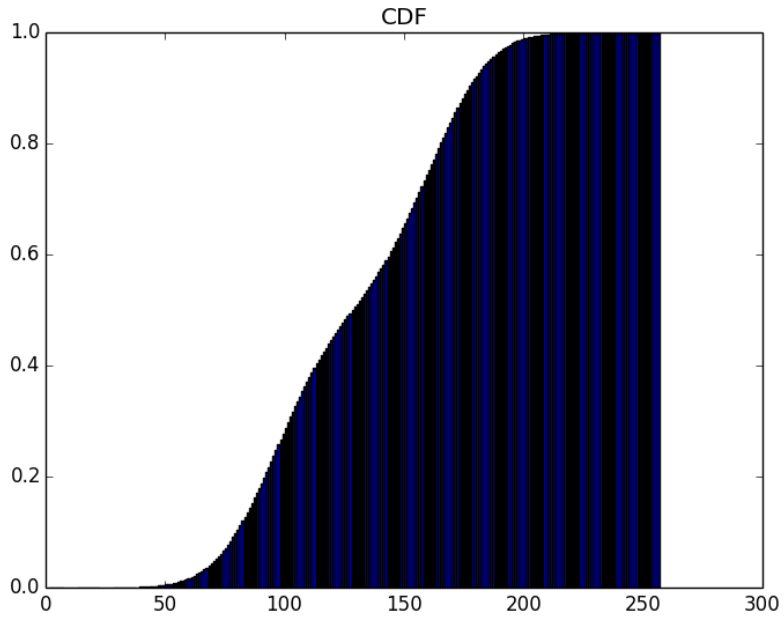
HISTOGRAM:



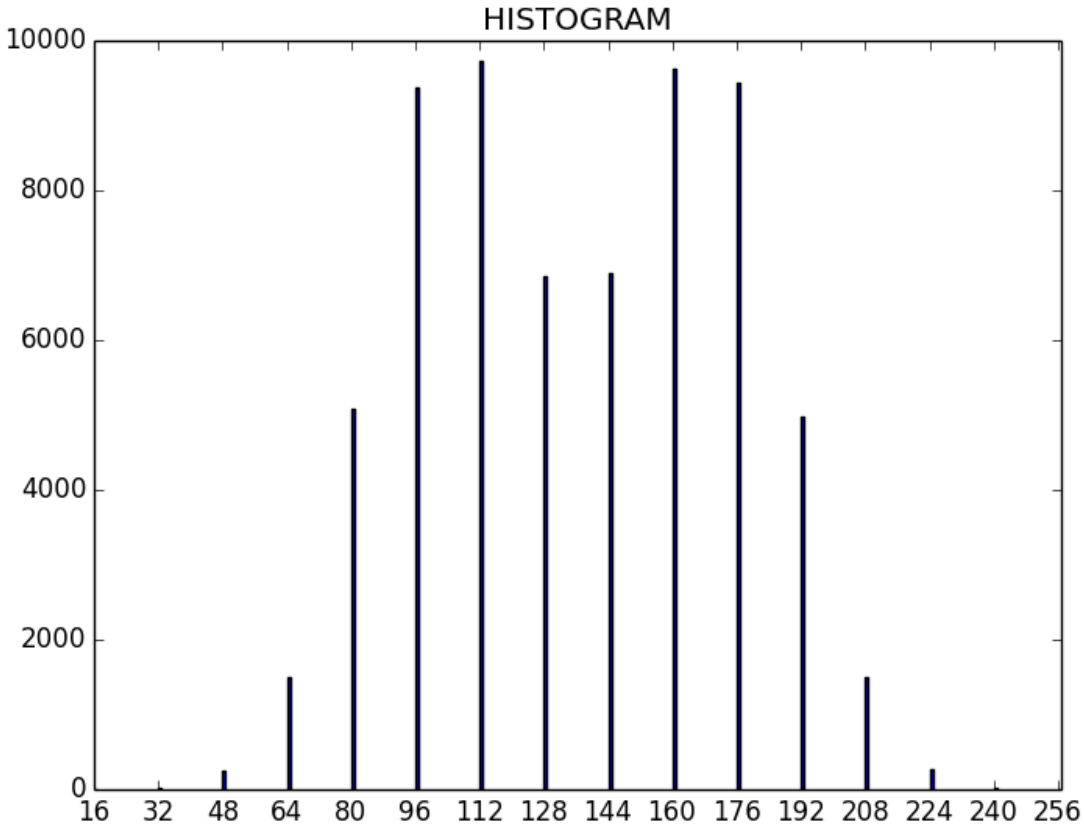
PDF:



CDF:



Histogram with 16 bins:



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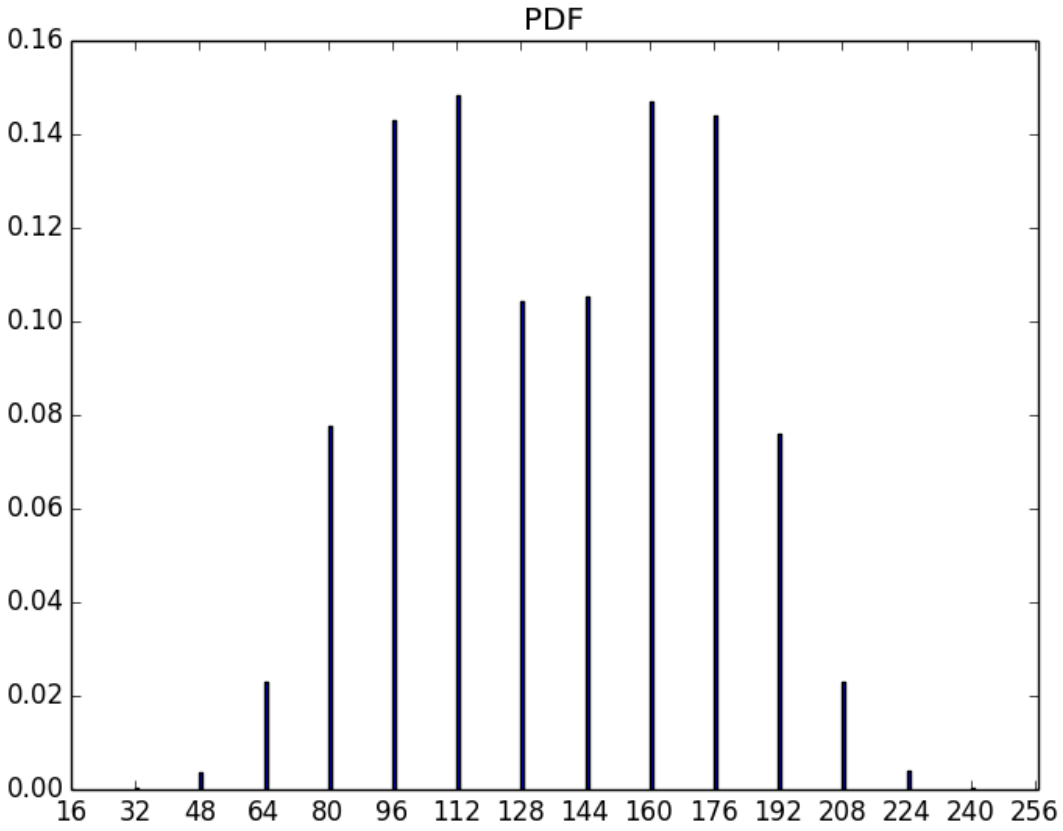

PDF
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
16
32
48
64
80
96
112
128
144
160
176
192
208
224
240
256

CDF:

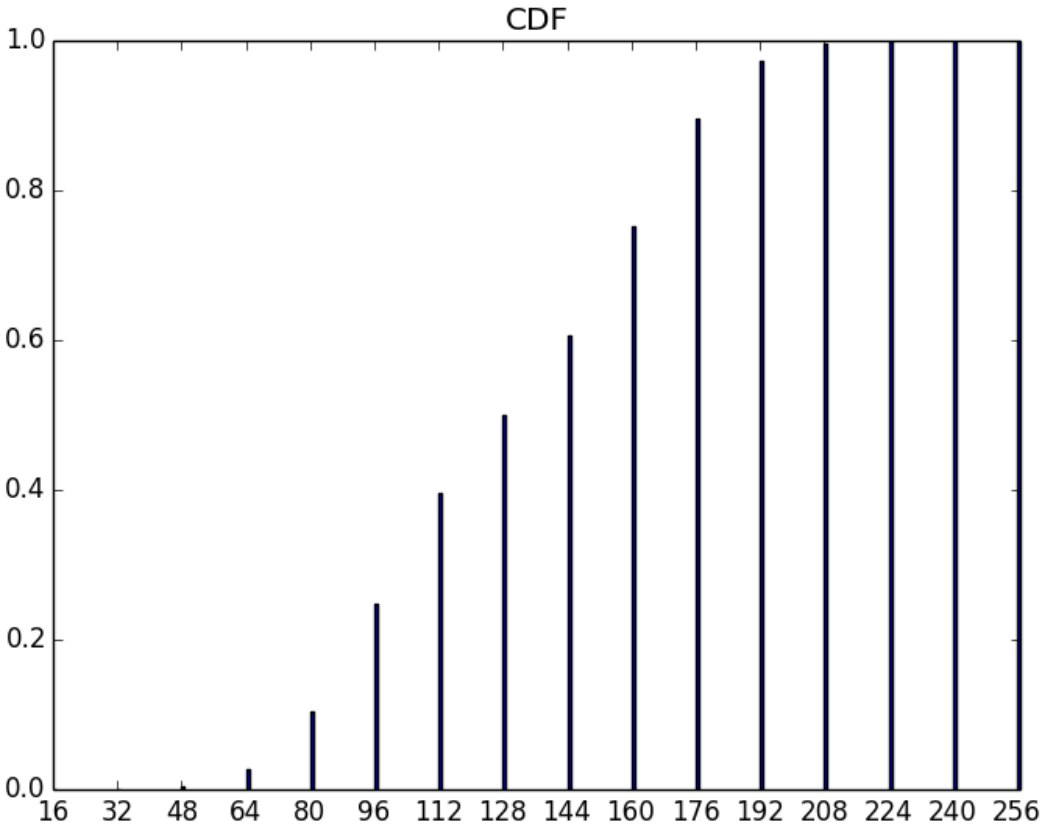
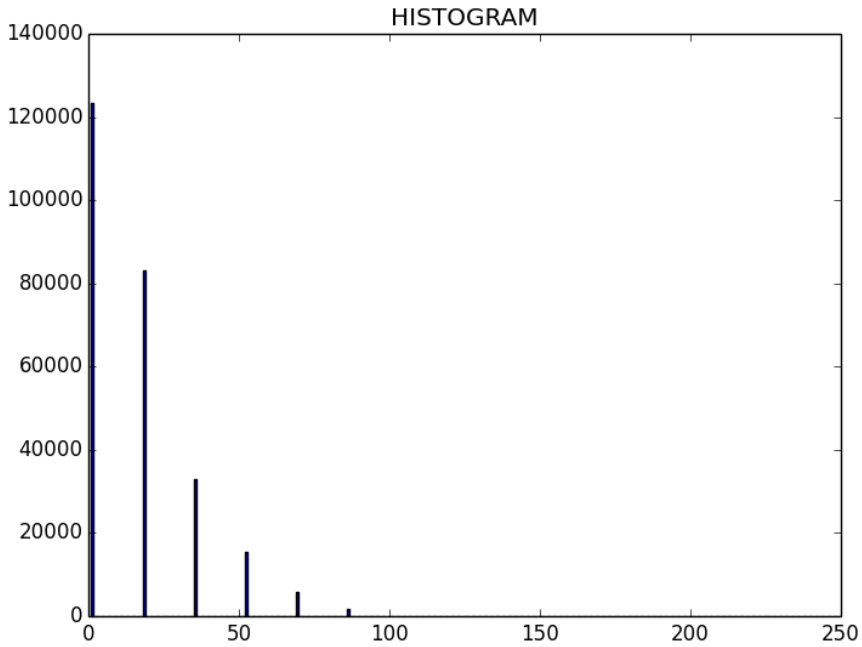

CDF
1.0
0.8
0.6
0.4
0.2
0.0
16
32
48
64
80
96
112
128
144
160
176
192
208
224
240
256

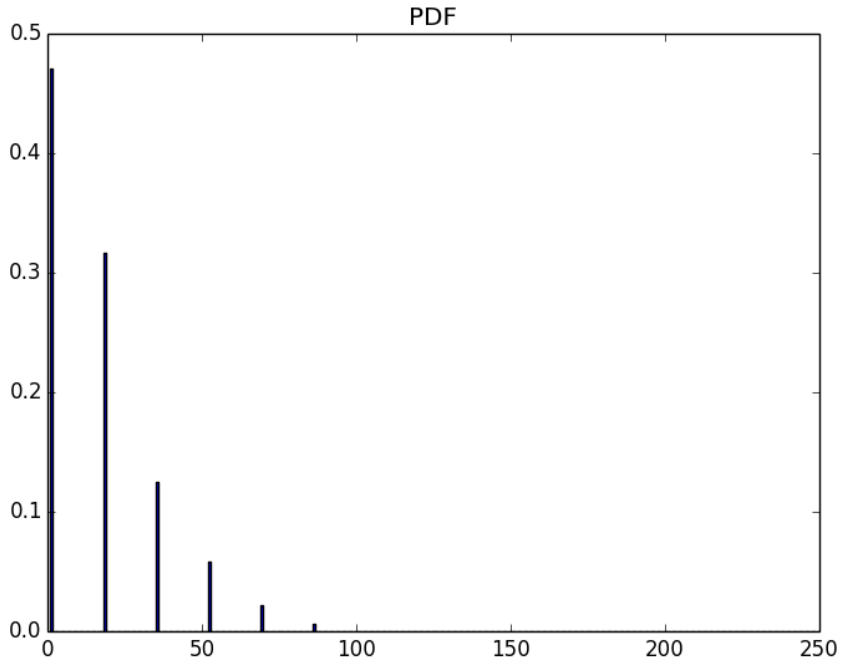
IMAGE 2:

ORIGINAL IMAGE:

HISTOGRAM:



PDF:


PDF
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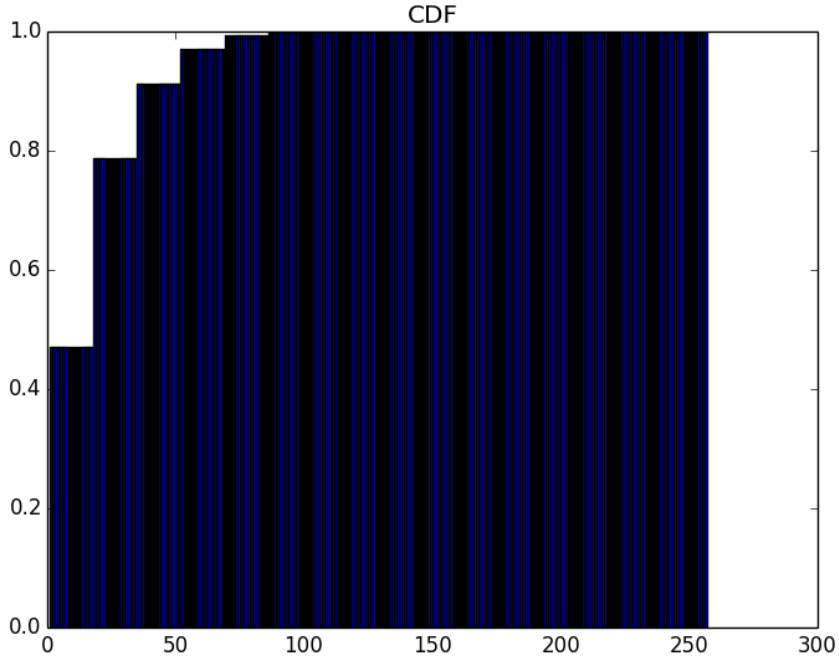
0.4
0.3
0.2
0.1
0.0
0
50
100
150
200
250

CDF:


CDF
1.0
0.8
0.6
0.4
0.2
0.0
0
50
100
150
200
250
300

The histogram of an image provides the frequency of the brightness value in the image. The x-axis represents the L gray levels and y-axis represents the frequency of each gray level. The original image has two prominent gray levels and we see that in the two peaks in the histogram. The low value of the frequency (y-axis) at some points indicate that the frequency of the that gray level in the image is less and we can verify it from the image too. The gray level 0 indicates pure black and 255 indicates pure white. The 0 value for any intensity level indicates that no pixel with that intensity is present in the image.

I have calculated the histogram with bin size of 256 for both the images. My code dynamically accepts the size of the bin as an input too.
For the image 1 which has the gray scale scattered, the components of the histogram cover a broad range of the gray scale.

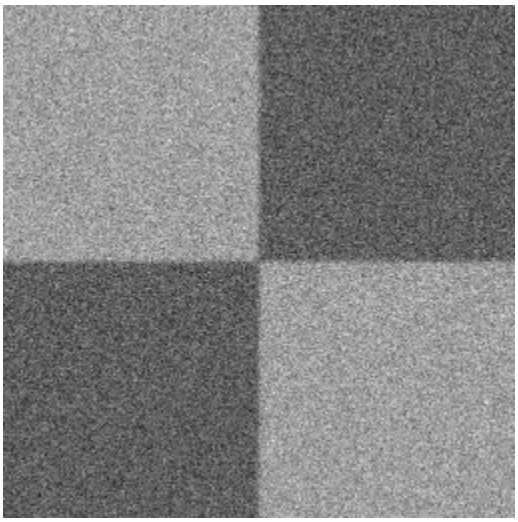
For the image 2 which is very dark, the components of the histogram are biased towards the low side of the gray scale.

From both histograms, we can conclude that the histogram just represents the intensities of the pixel in the image. We won't be able to deduce any information about the structure of the images.

B2) HISTOGRAM EQUALISATION

IMAGE 1:

ORIGINAL IMAGE:



HISTOGRAM:

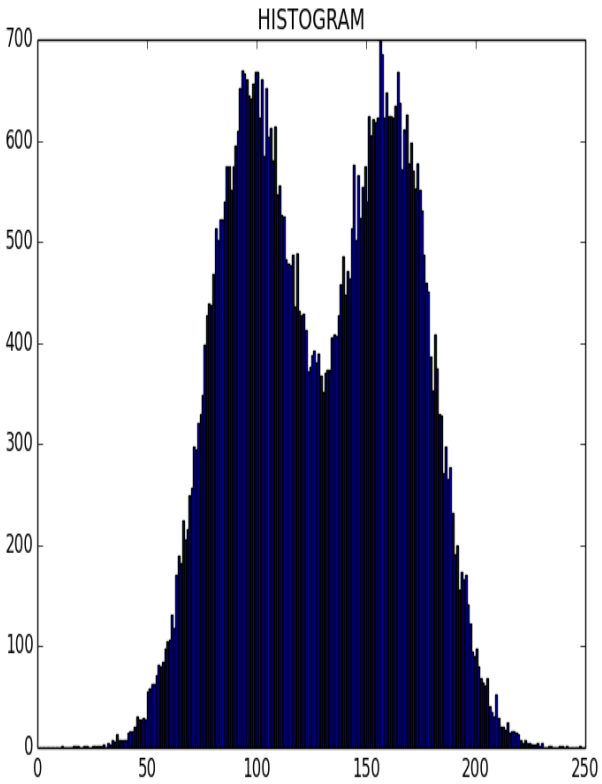
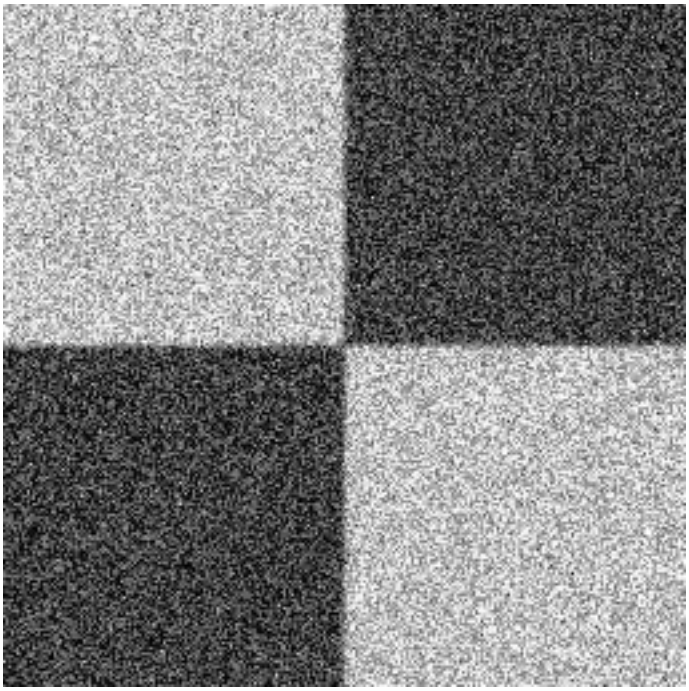
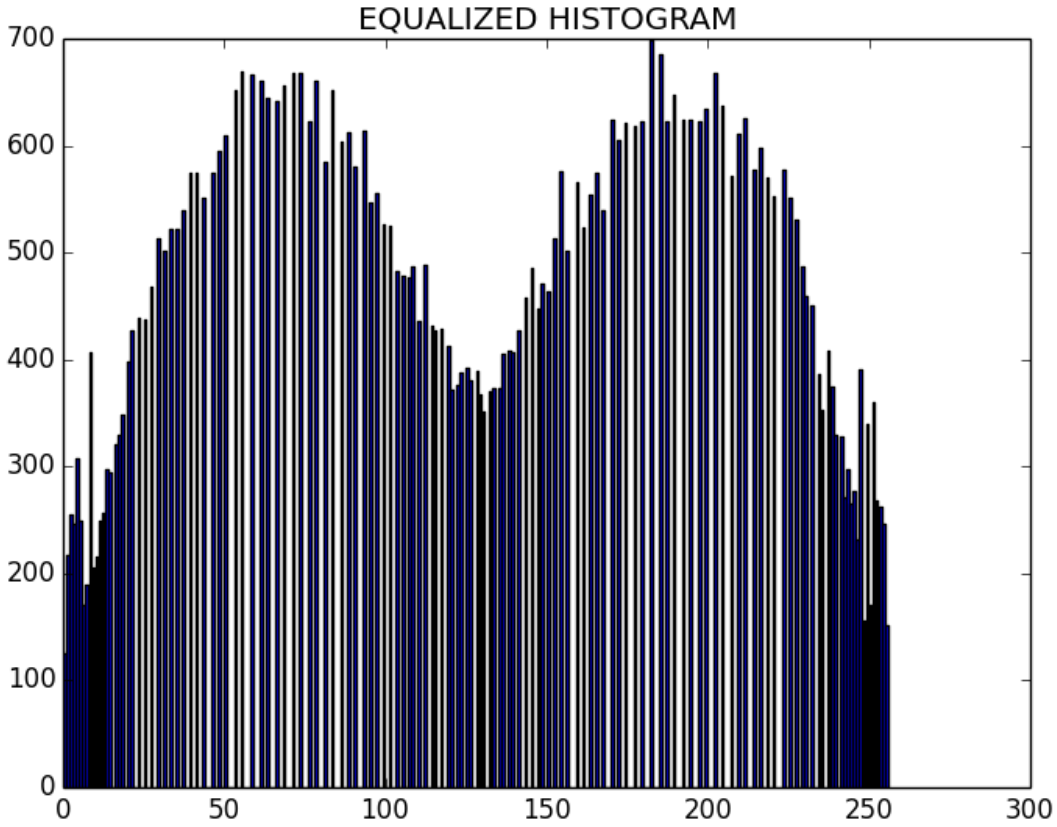


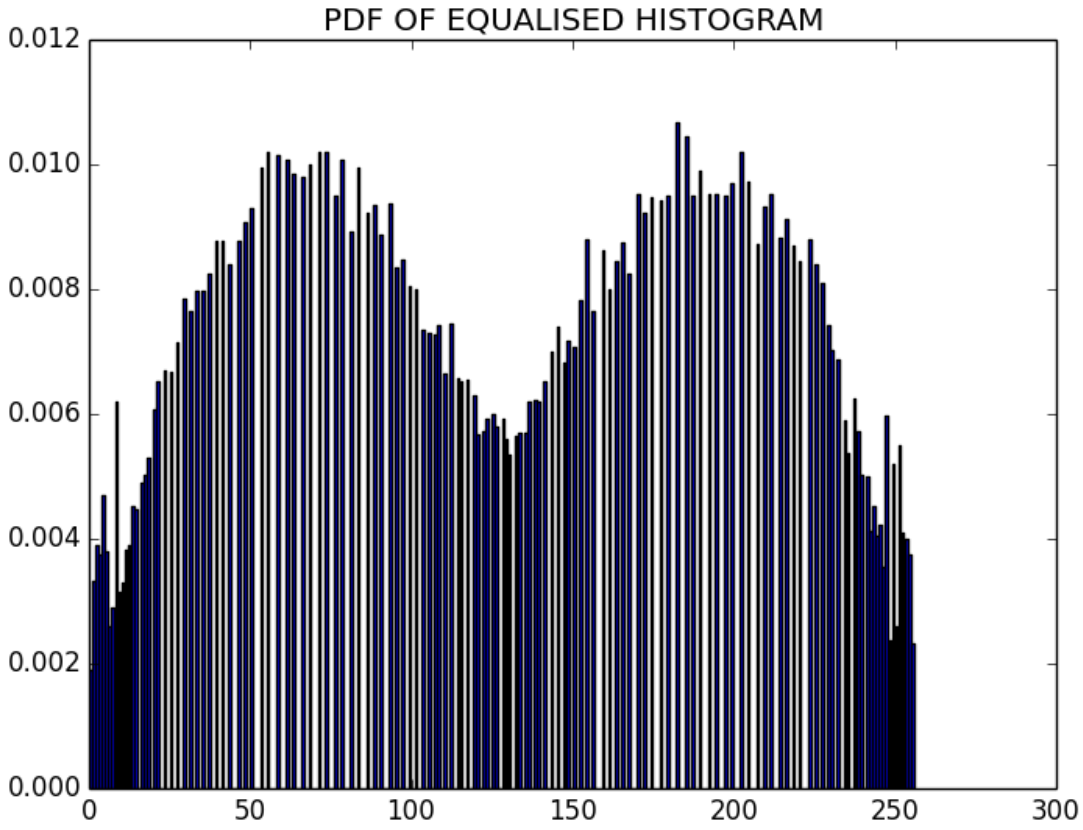
IMAGE AFTER HISTOGRAM EQUALISATION:



EQUALISED HISTOGRAM:



PDF AFTER HISTOGRAM EQUALISATION:



CDF AFTER HISTOGRAM EQUALISATION:

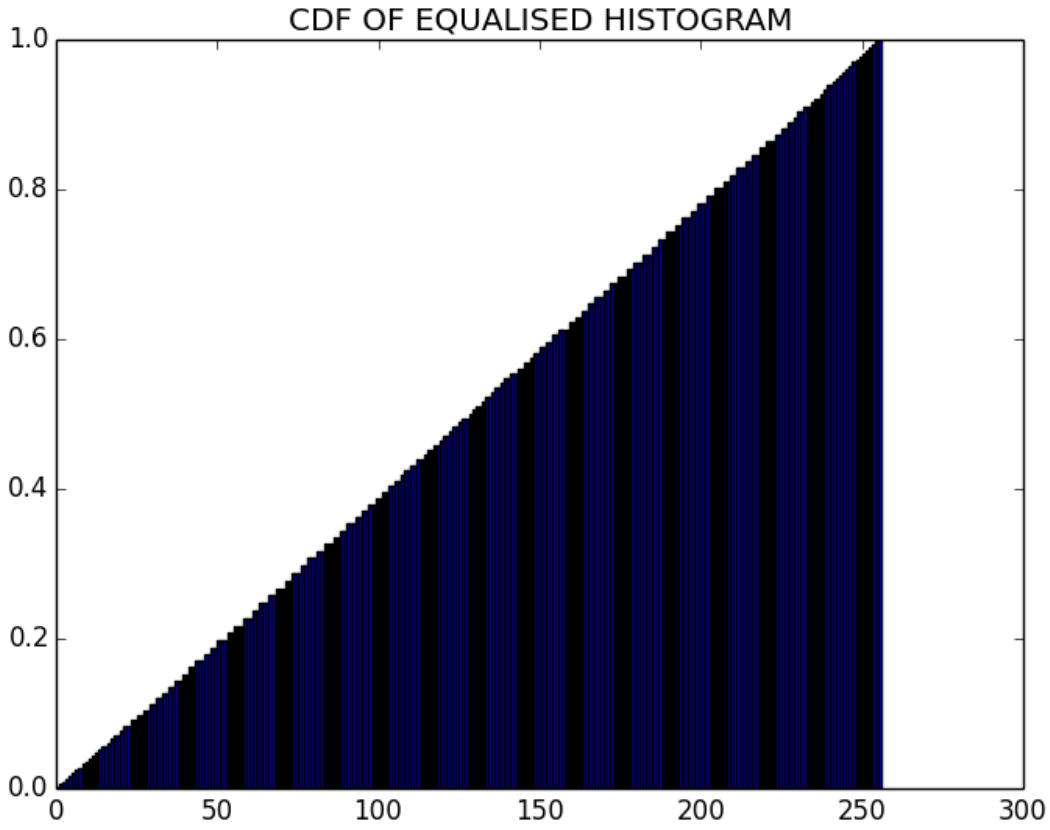


IMAGE 2:

ORIGINAL IMAGE:

HISTOGRAM:

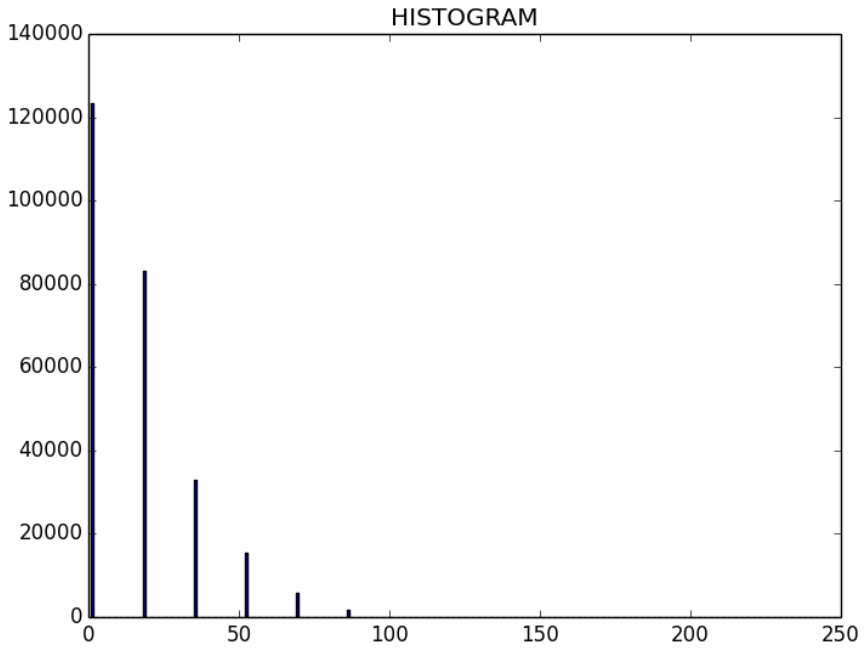
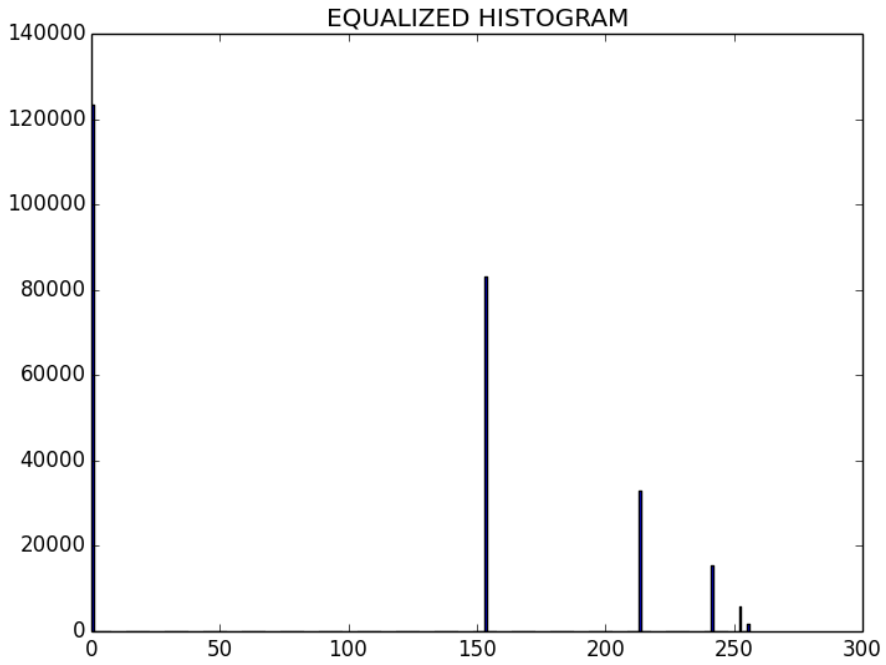
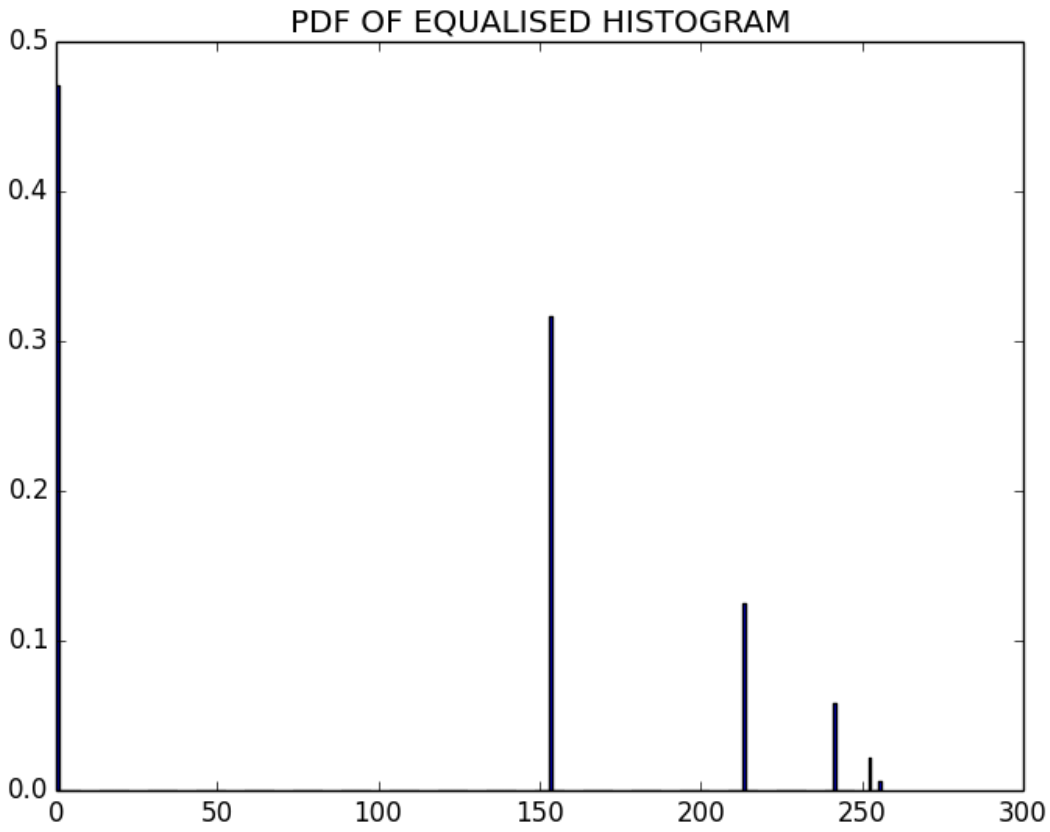


IMAGE AFTER HISTOGRAM EQUALISATION:

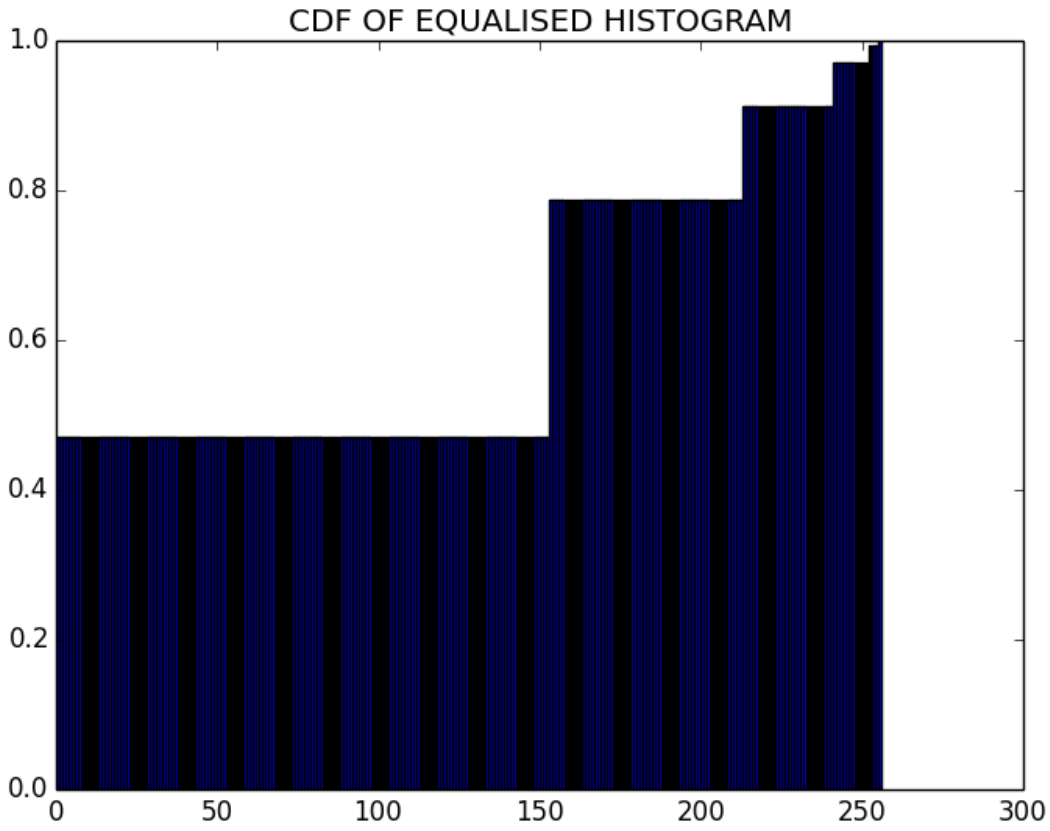
EQUALIZED HISTOGRAM:



PDF AFTER HISTOGRAM EQUALISATION:



CDF AFTER HISTOGRAM EQUALISATION:



Histogram equalization is a transformation for contrast enhancements. It creates an image with equally distributed brightness levels over the whole brightness scale. We find a monotonic pixel brightness transformation such that the desired output histogram is uniform over the whole output brightness scale.

I have calculated the histogram with bin size of 256 for both the images.

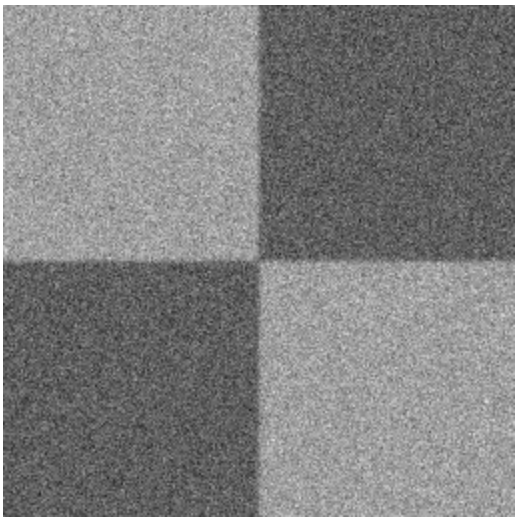
For the image 1, we see that after the equalization, the histogram component which earlier had low frequency has now the frequency increased for the same intensity level. The resultant image after histogram equalization shows much better contrast. The PDF plot also proves the same, that is now the probability of each intensity level is almost uniform. Ideally, the histogram should be uniform, but since we are calculating cumulative histogram, which is approximated by a sum in digital image, so the resulting histogram is not equalized ideally.

For the image 2, we see similar results and the image after histogram equalization looks much better and the objects are recognizable.

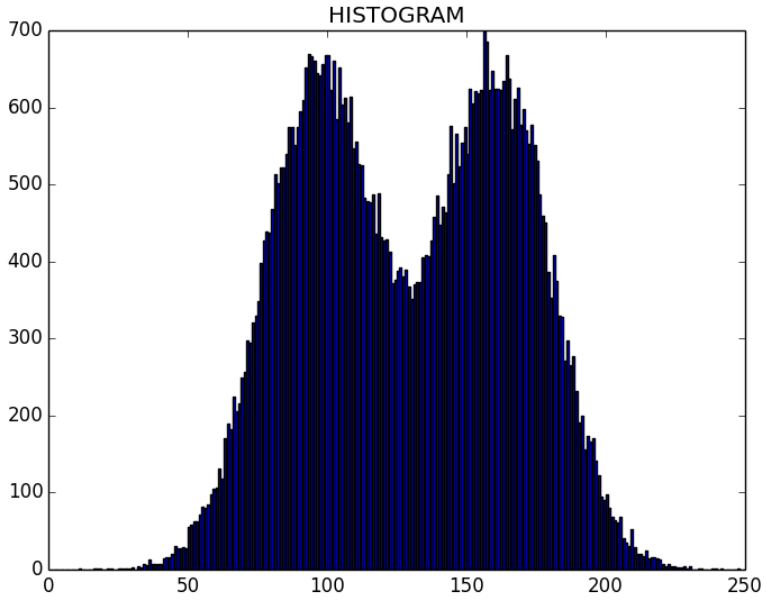
B3) HISTOGRAM MATCHING

IMAGE 1:

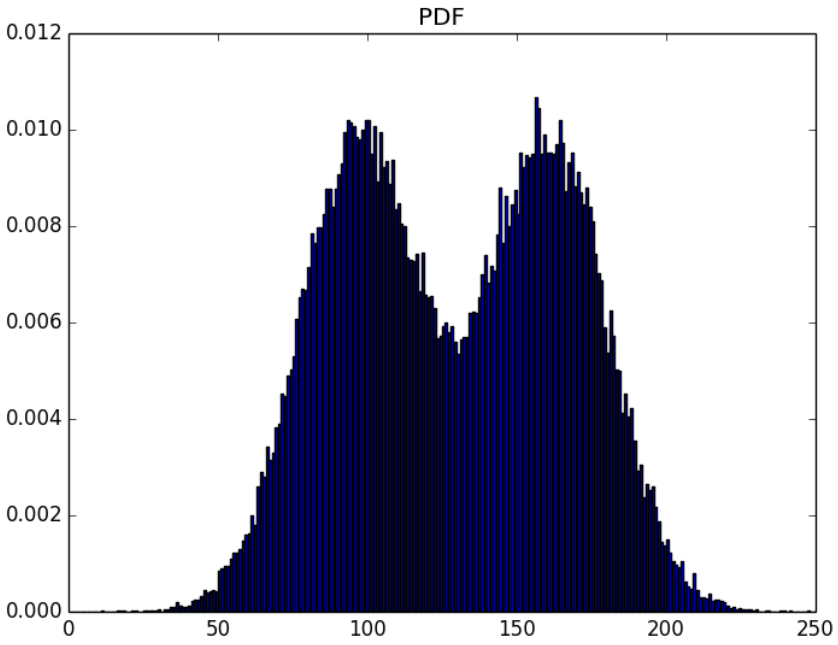
REFERENCE IMAGE: (IMAGE WITH A GOOD CONTRAST)



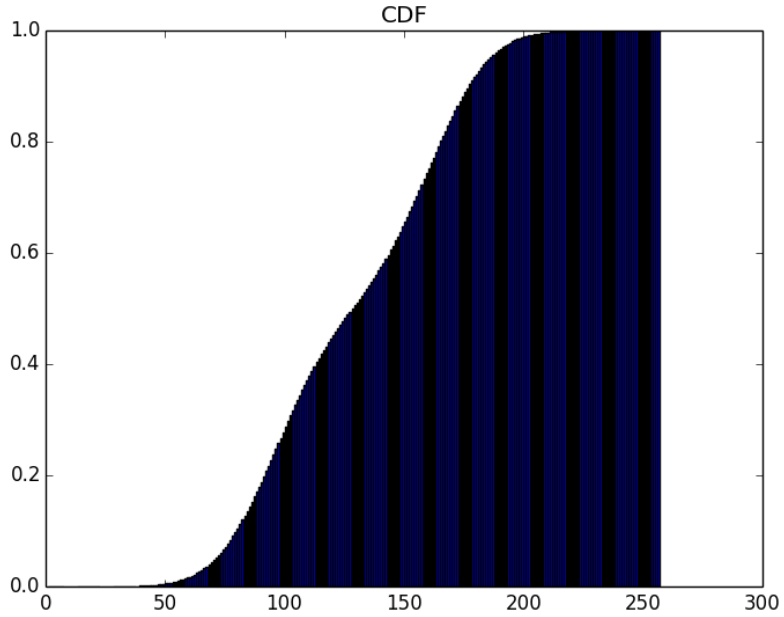
HISTOGRAM:



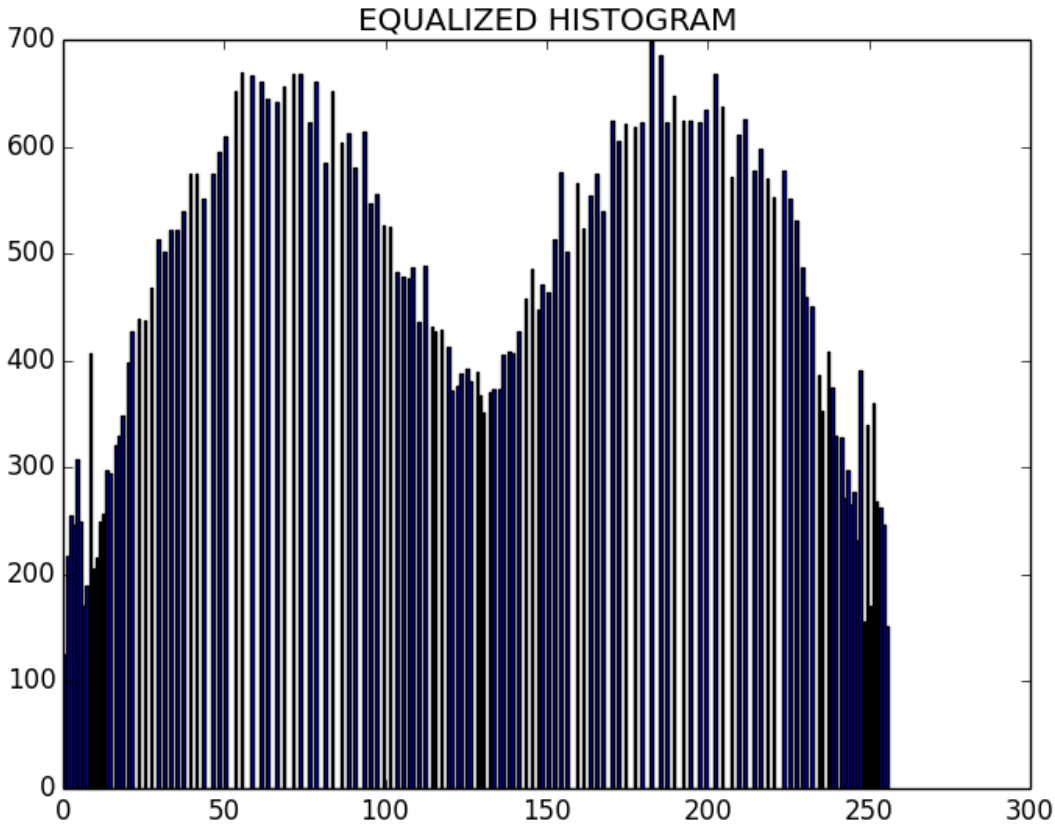
PDF:



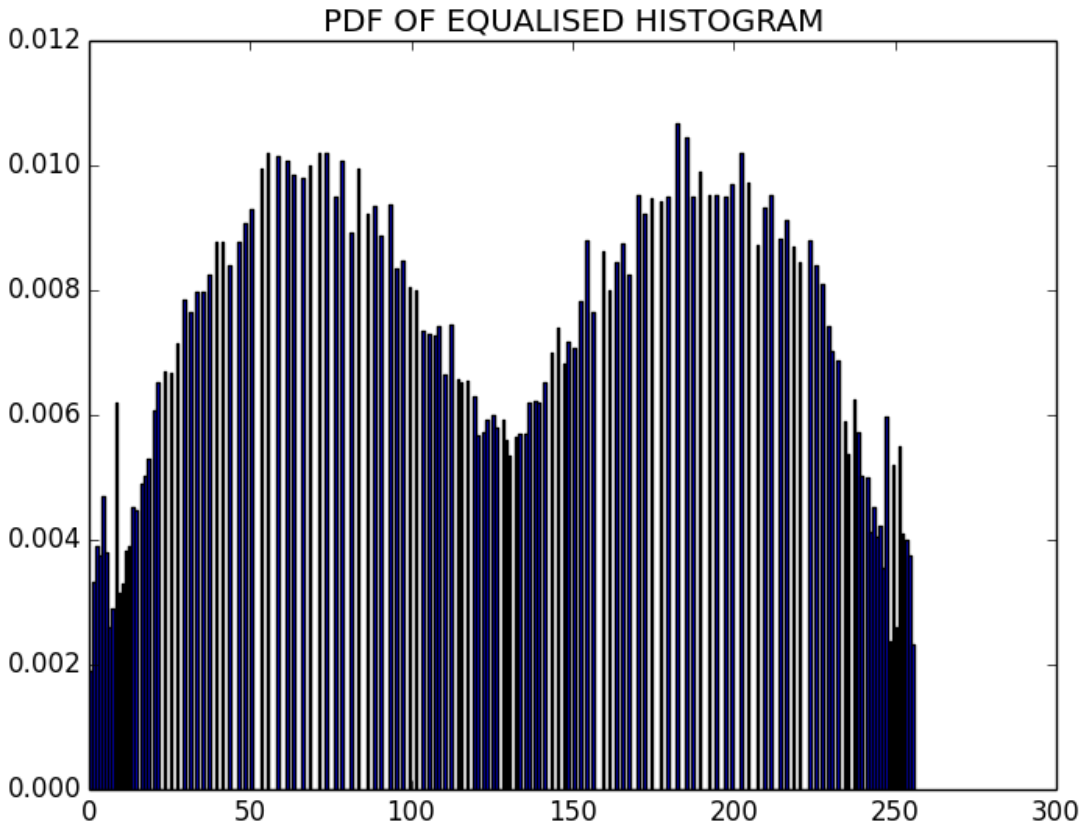
CDF:



EQUALISED HISTOGRAM:



PDF AFTER HISTOGRAM EQUALISATION:



CDF AFTER HISTOGRAM EQUALISATION:

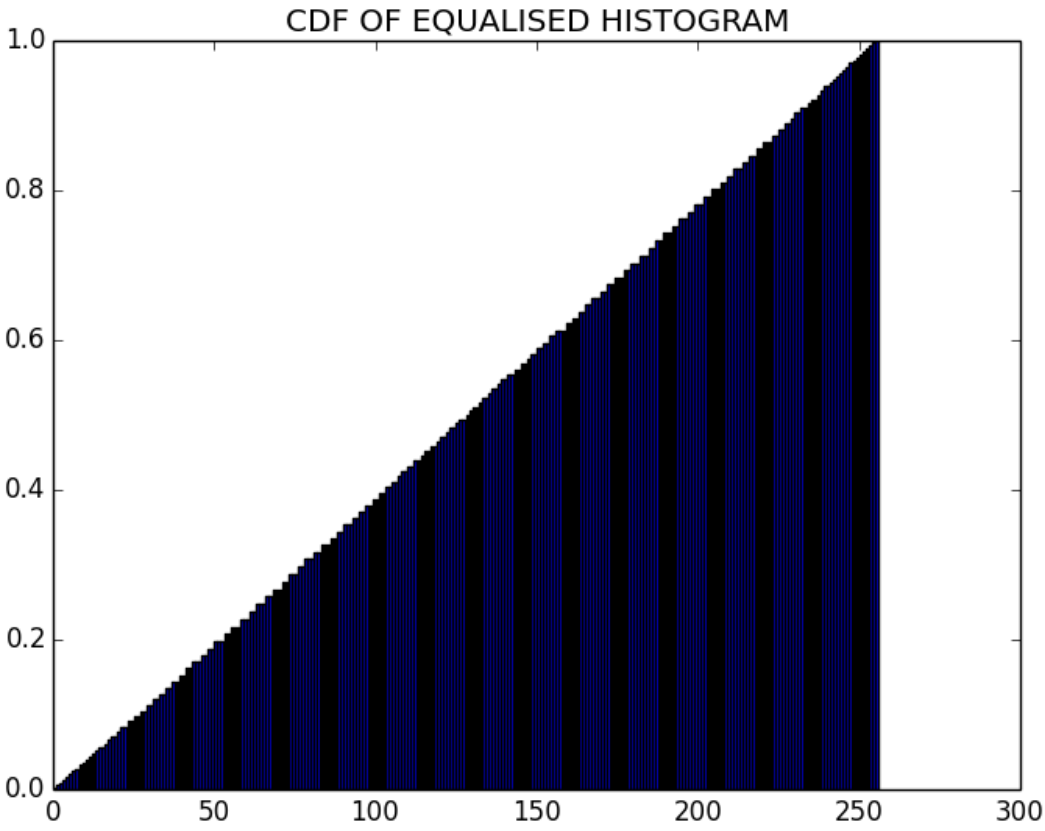
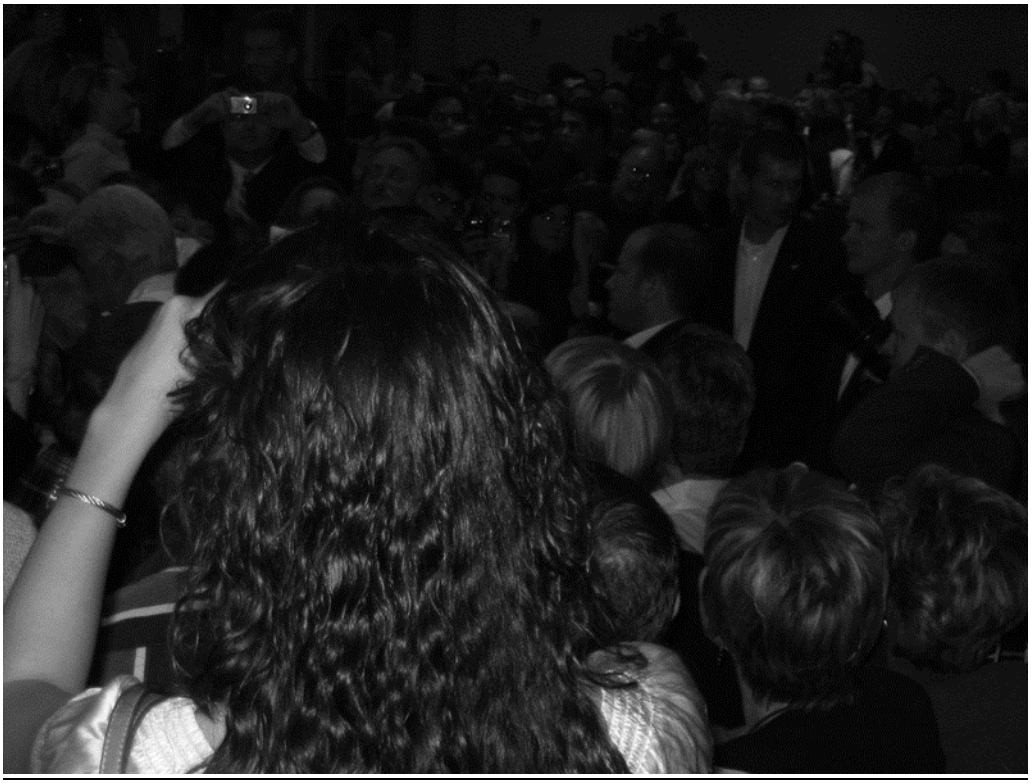
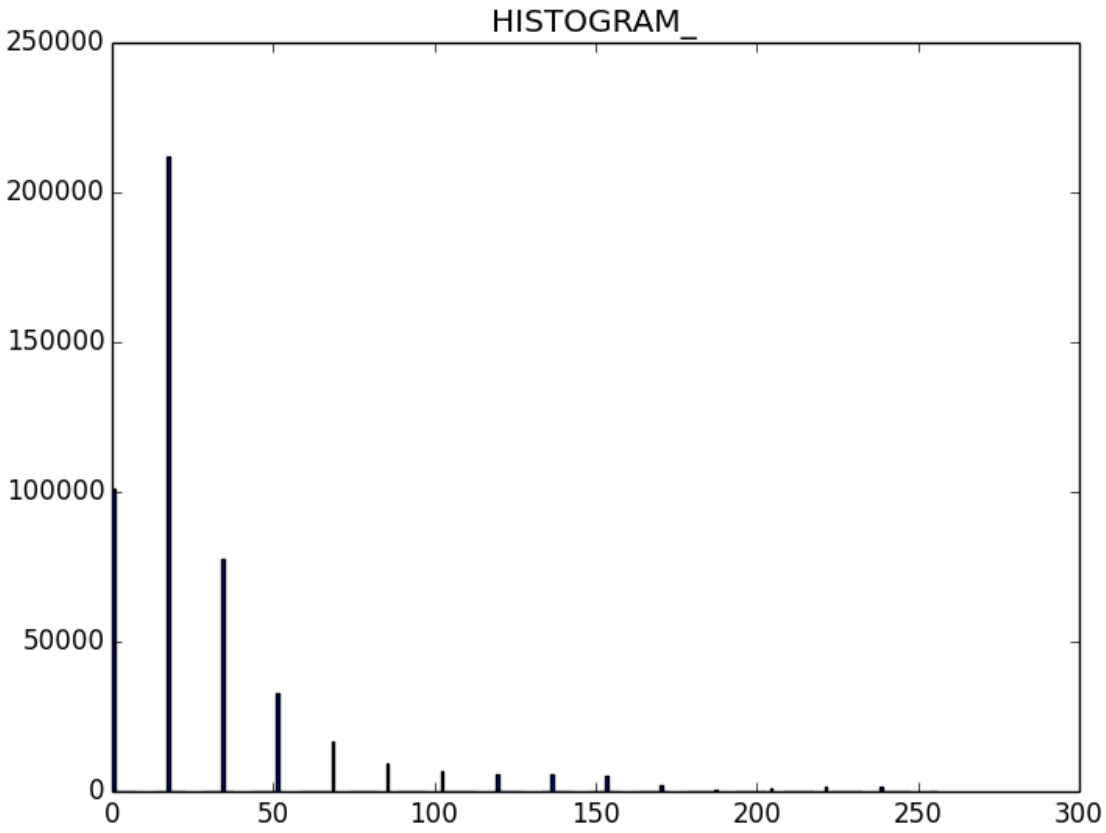


IMAGE 2 (POOR CONTRAST IMAGE):



HISTOGRAM: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50000
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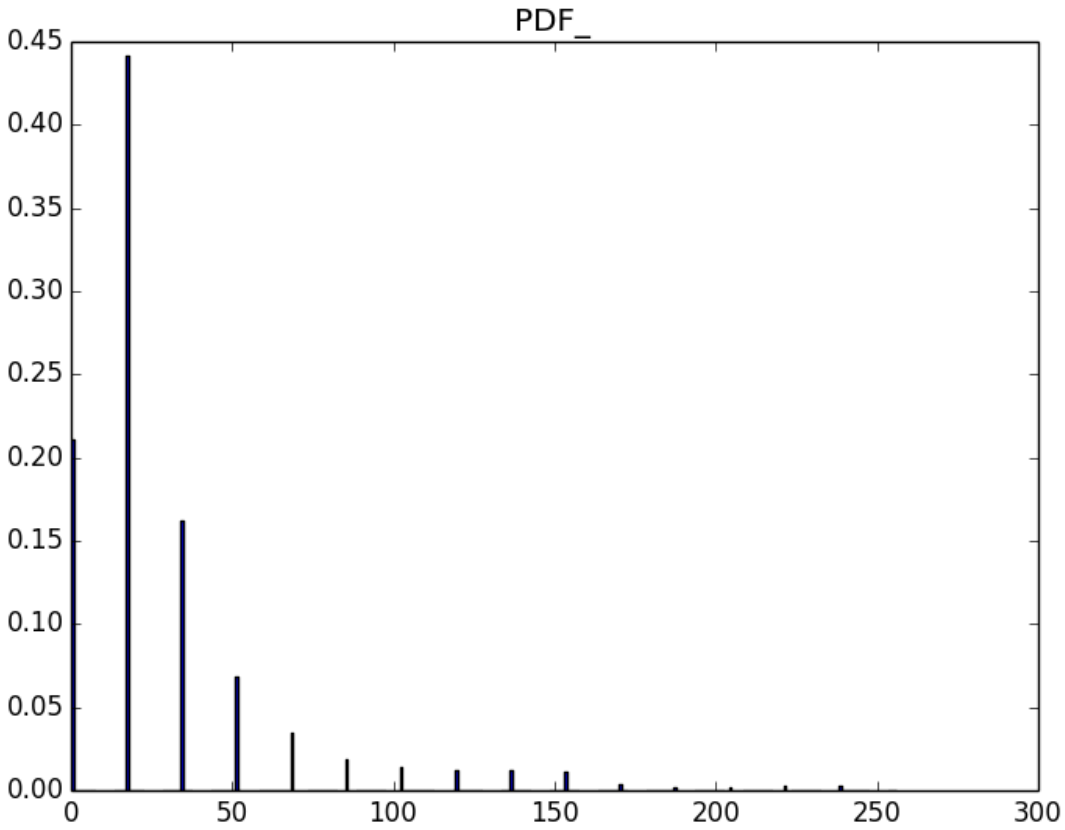
100
150
200
250
300

PDF:


PDF_
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0.35
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0.25
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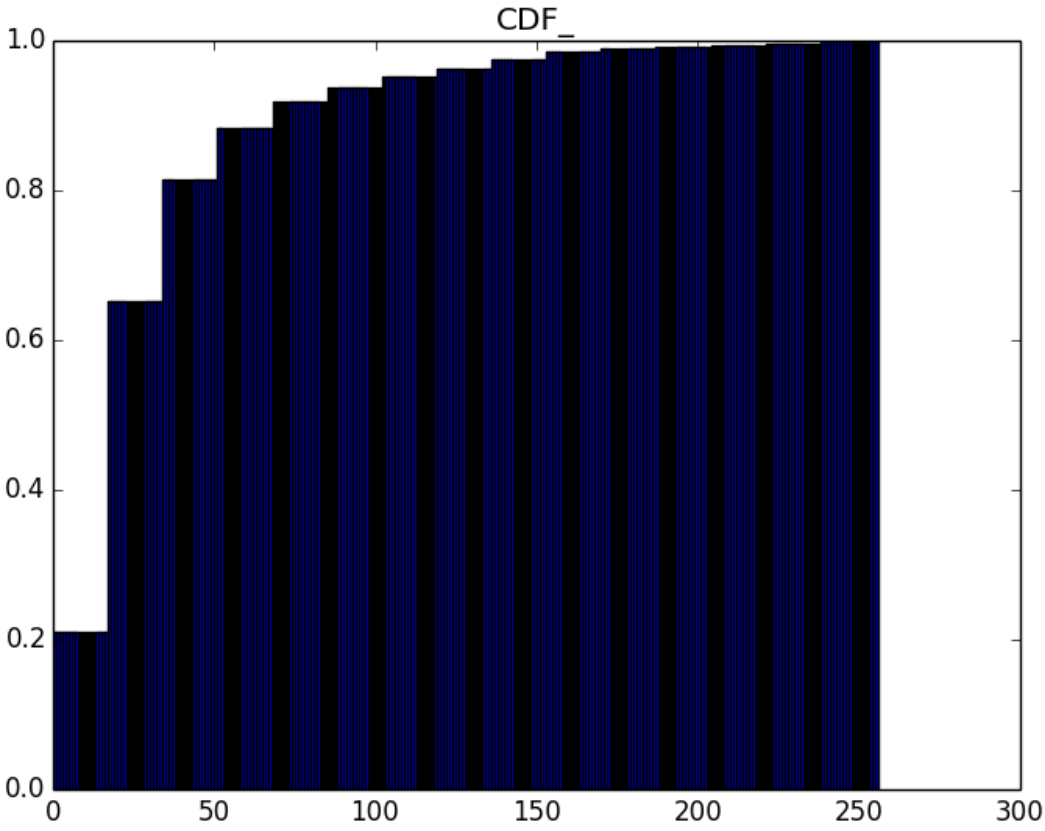
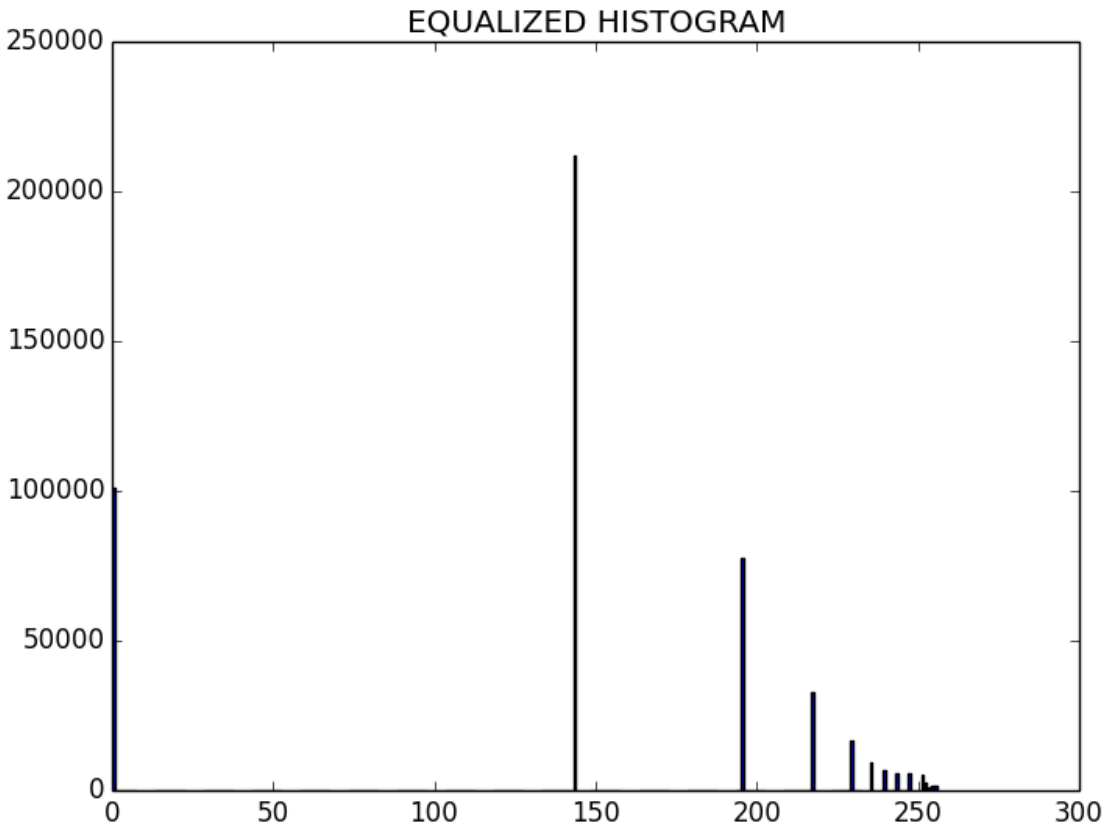
0.05
0.00
0
50
100
150
200
250
300

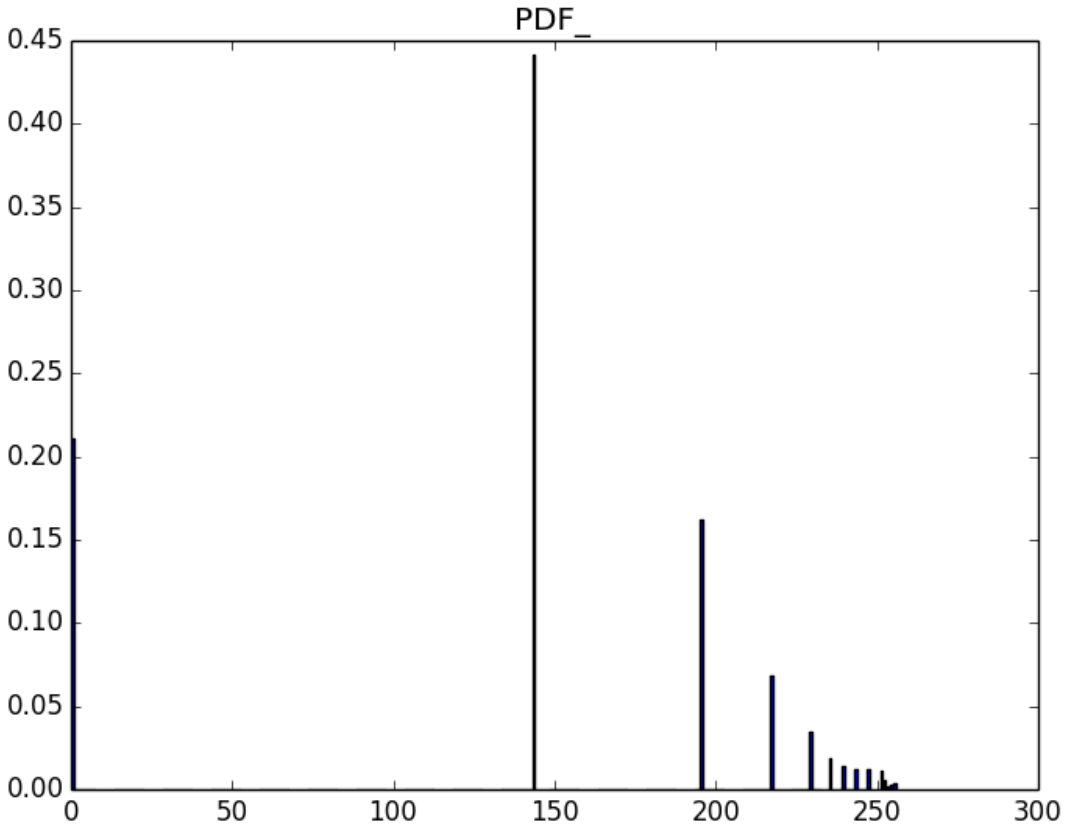
CDF:



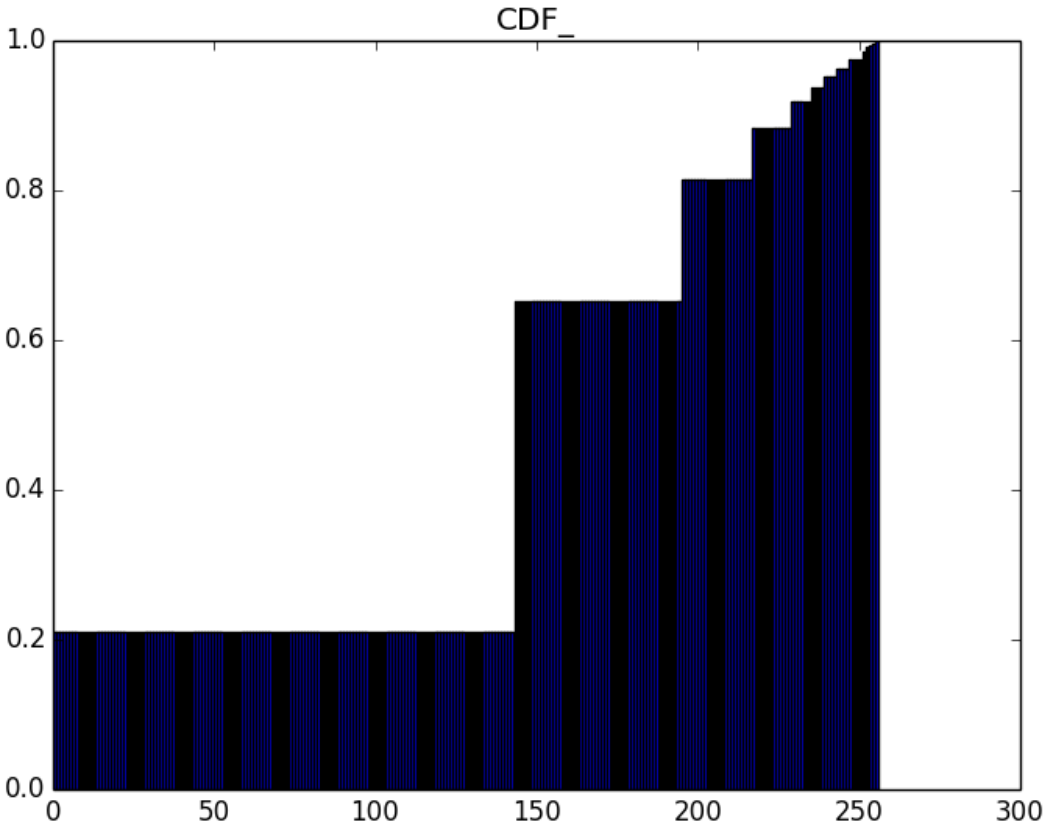
EQUALISED HISTOGRAM:



PDF AFTER HISTOGRAM EQUALISATION:

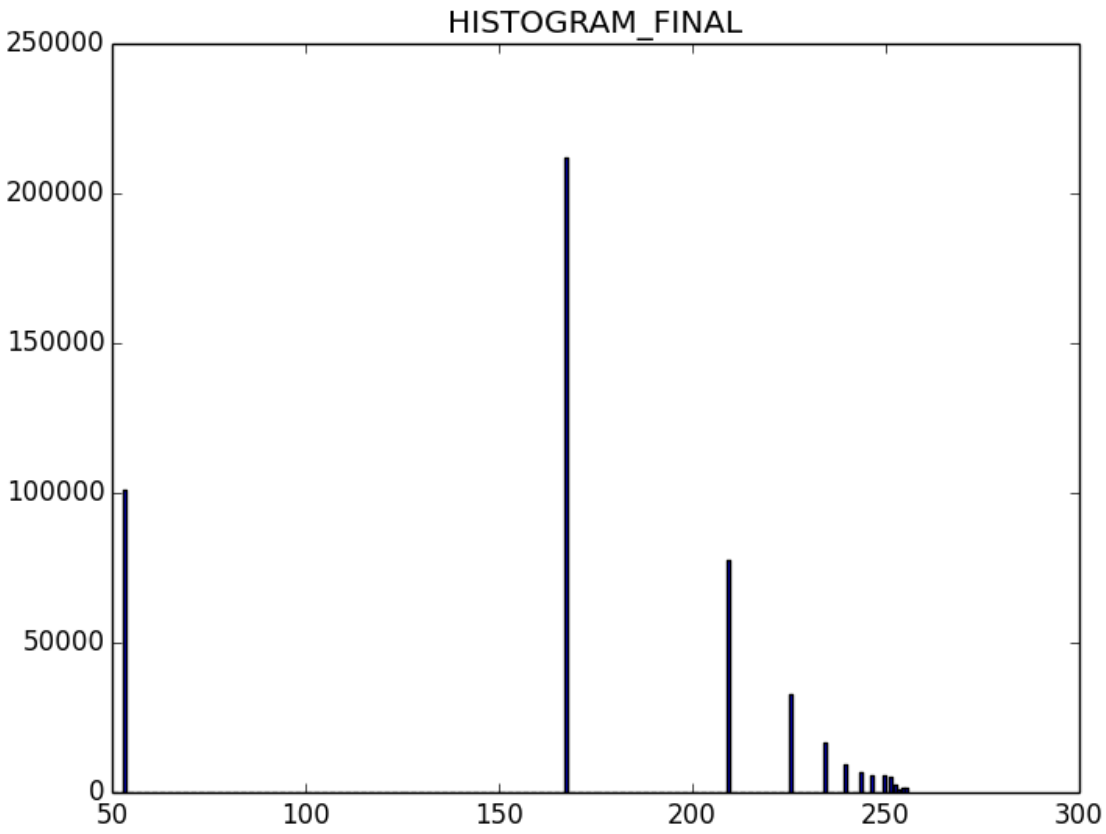


CDF AFTER HISTOGRAM EQUALISATION:



ADJUSTED IMAGE:

HISTOGRAM: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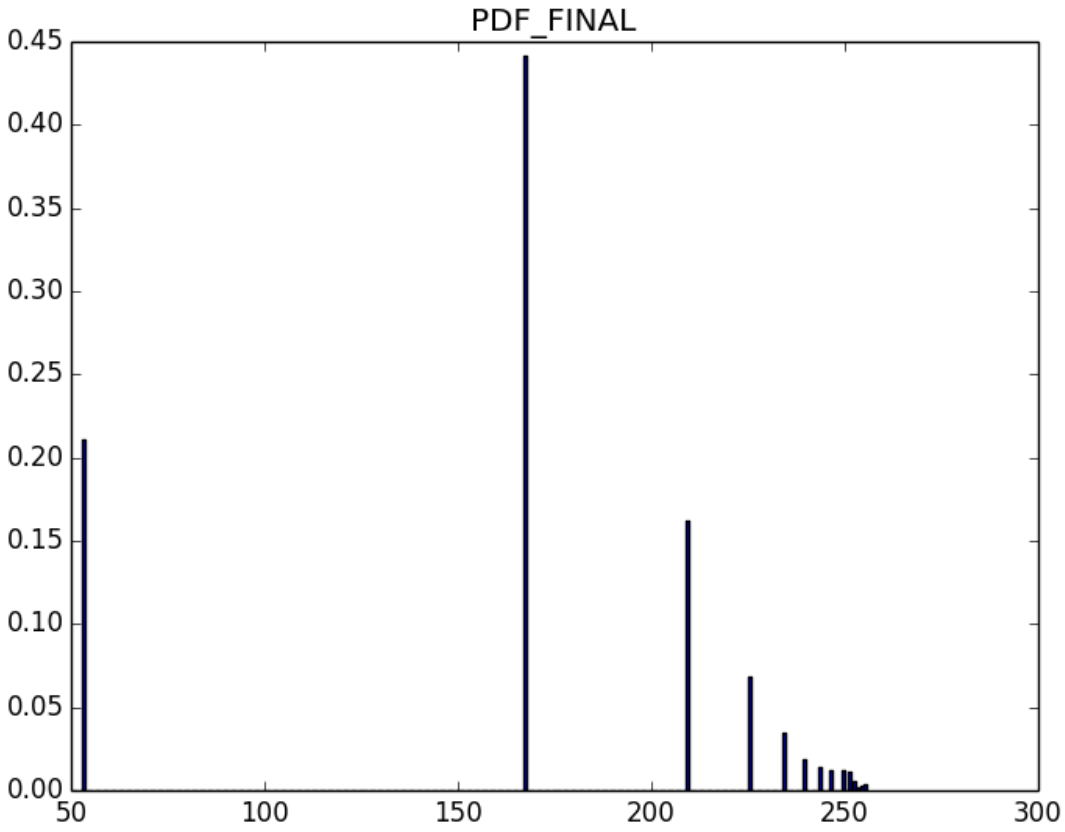
100000
50000
0
50
100
150
200
250
300

PDF:


PDF_FINAL
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0.35
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0.05
0.00
50
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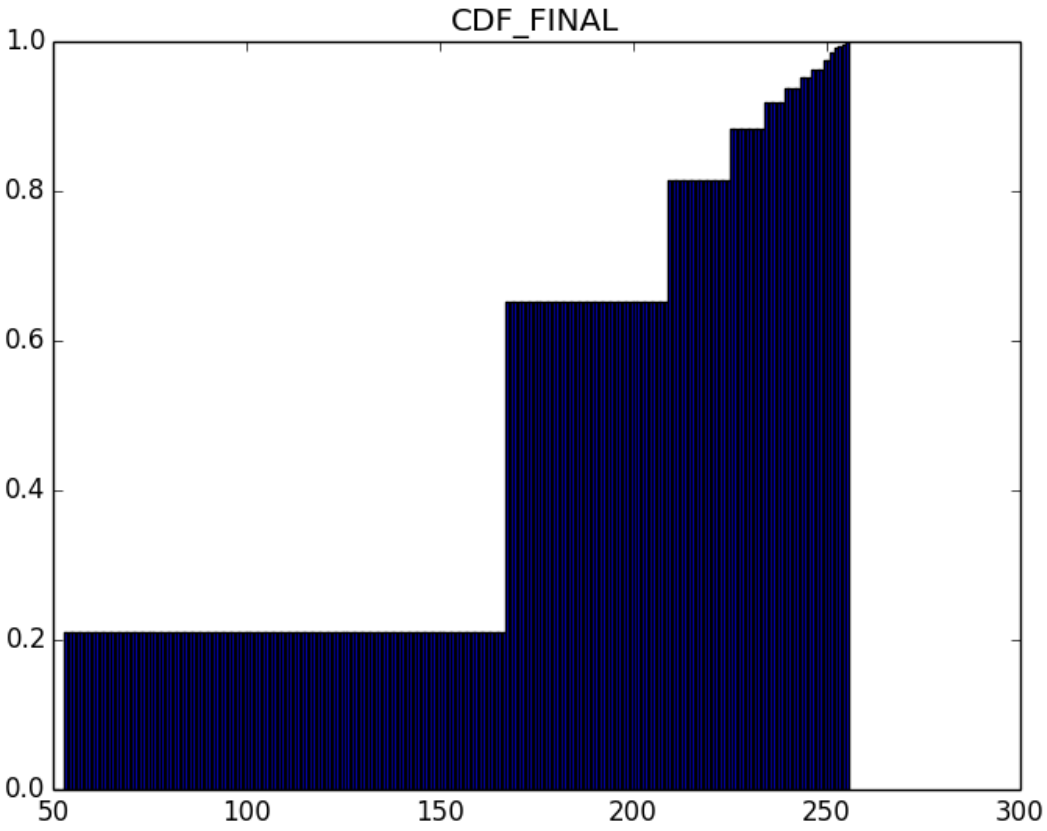
250
300

CDF:



I took an image with a good contrast (image 1) and an image with a poor contrast (image 2). Image 1 histogram shows that the intensity is distributed over the almost complete histogram, while image 2 has its histogram concentrated towards the low value of the intensity since it has very less white pixels.

We try to match the histogram of the image 1 to the image 2 to get a good contrast of the image 2. We calculate the histogram equalization of both the histogram, calculate respective PDF's and CDF's and then relate the two of them. After applying histogram matching we see that the procedure resulted in the anticipated result i.e., the poor contrast image has improved drastically, and its histogram shows that the intensities frequency matches somewhat with that of our reference image i.e., image 1.