Note: I am Using Scipy v1.1.0. In case of any errors you can install scipy 1.1.0 by the following command: pip install scipy==1.1.0

In [1]:
```
import scipy
scipy.__version__
```

Out[1]:
```
'1.1.0'
```

To download images Click on this url: https://drive.google.com/drive/folders/1pcaTwofZGfoCxZ3Hv2X6vW6xf_1i88eb?usp=sharing (https://drive.google.com/drive/folders/1pcaTwofZGfoCxZ3Hv2X6vW6xf_1i88eb?usp=sharing)

Histogram Equalization of Image in Python

Import Libraries

In [2]:
```
from skimage import data
from scipy.misc import imread, imresize
import numpy as np
from scipy import ndimage
import matplotlib.pyplot as plt
import math
import cv2
```

Original Image

In [3]:
```
original_image =imread('camera.png',False, 'L')     #read image as grey scale image
```

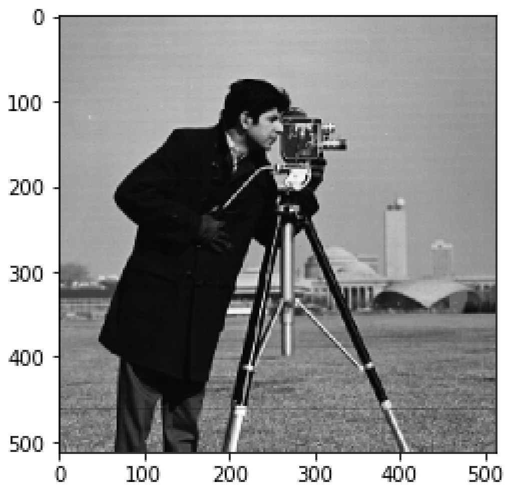
```
C:\ProgramData\Anaconda3\lib\site-packages\ipykernel_launcher.py:1: DeprecationWarning: `imread` is deprecate
d!
`imread` is deprecated in SciPy 1.0.0, and will be removed in 1.2.0.
Use ``imageio.imread`` instead.
  """Entry point for launching an IPython kernel.
```

In [4]:

```
processed_img =original_image.copy()
plt.imshow(processed_img,cmap=plt.cm.gray)
```

Out[4]:

```
<matplotlib.image.AxesImage at 0x1b292040f08>
```



Finding Probabilities

In [5]:

```
# first finding PDF
greylevels_original, counts = np.unique(processed_img, return_counts=True)
prob=counts/sum(counts)
```

In [6]:

```
# finding CDF
x=0
cdf_prob=[]
for i in prob:
    x=x+i
    cdf_prob.append(x)
x_cdf,y_cdf=greylevels_original.copy(),cdf_prob.copy()
```

In [7]:

```
newgreylevels=(np.multiply(cdf_prob,255)) # New Pixel value= CDF*(L-1)
```

In [8]:

```
normalized_img=original_image.copy()
```

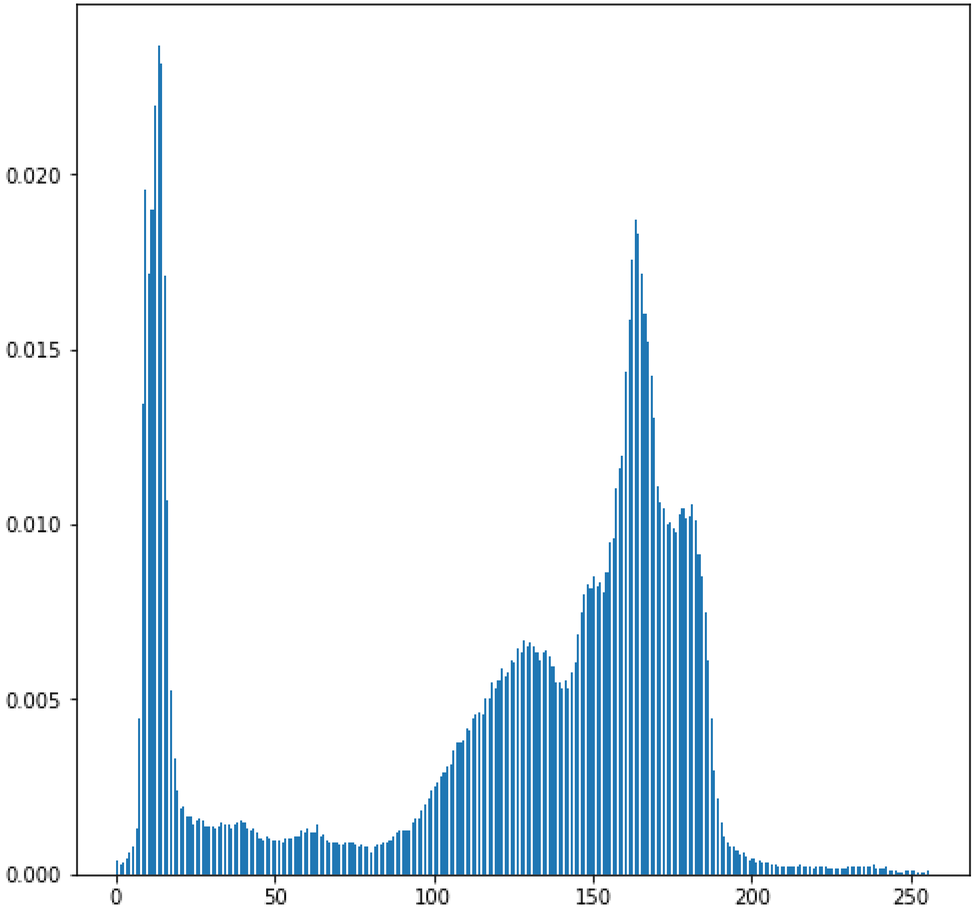
In [9]:

```
# Updating Pixels
mapping=dict(zip(greylevels_original,newgreylevels))
normalized_img=np.vectorize(mapping.get)(normalized_img)
```

PDF Histogram

In [10]:

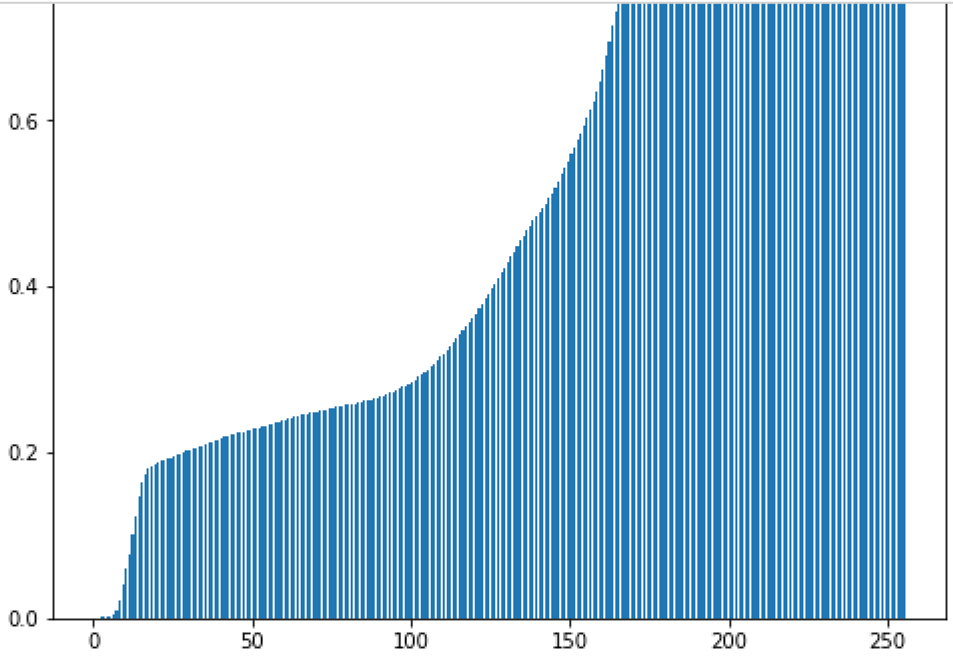
```
prob_pdf=counts/sum(counts)
x_pdf,y_pdf=greylevels_original,prob_pdf
plt.figure(figsize=(8,8))
plt.bar(x_pdf,y_pdf,align='edge',width=0.7)
plt.show()
```



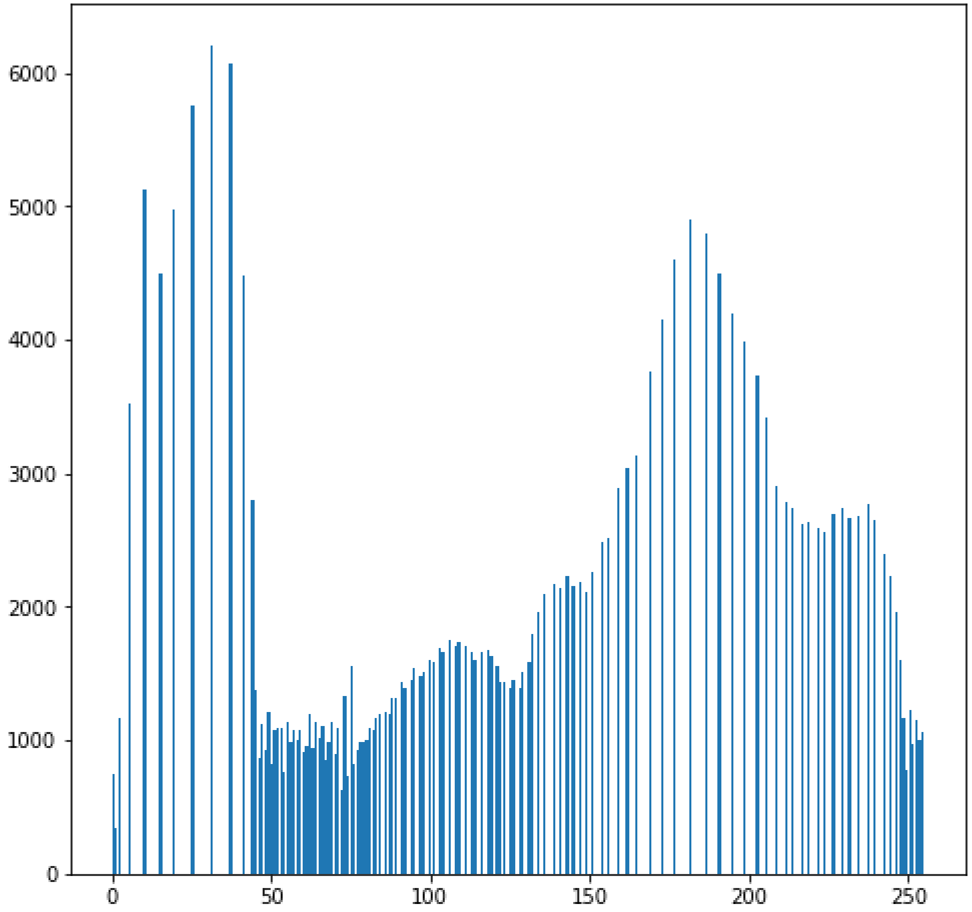
CDF Histogram

In [11]:

```
plt.figure(figsize=(8,8))
plt.bar(x_cdf,y_cdf,align='edge',width=0.7)
plt.show()
```



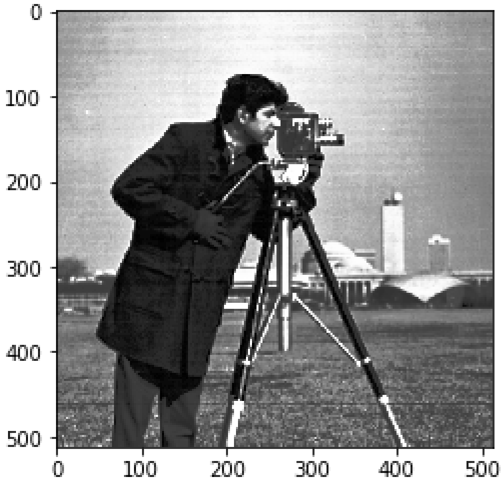
```
In [12]: #after histogram equalization Image Histograms Looks Like this
         plt.figure(figsize=(8,8))
         plt.hist(normalized_img.flatten(),bins=256,range=[0,255],width=0.8)
         plt.show()
```



Output Image (Equalized_Image)

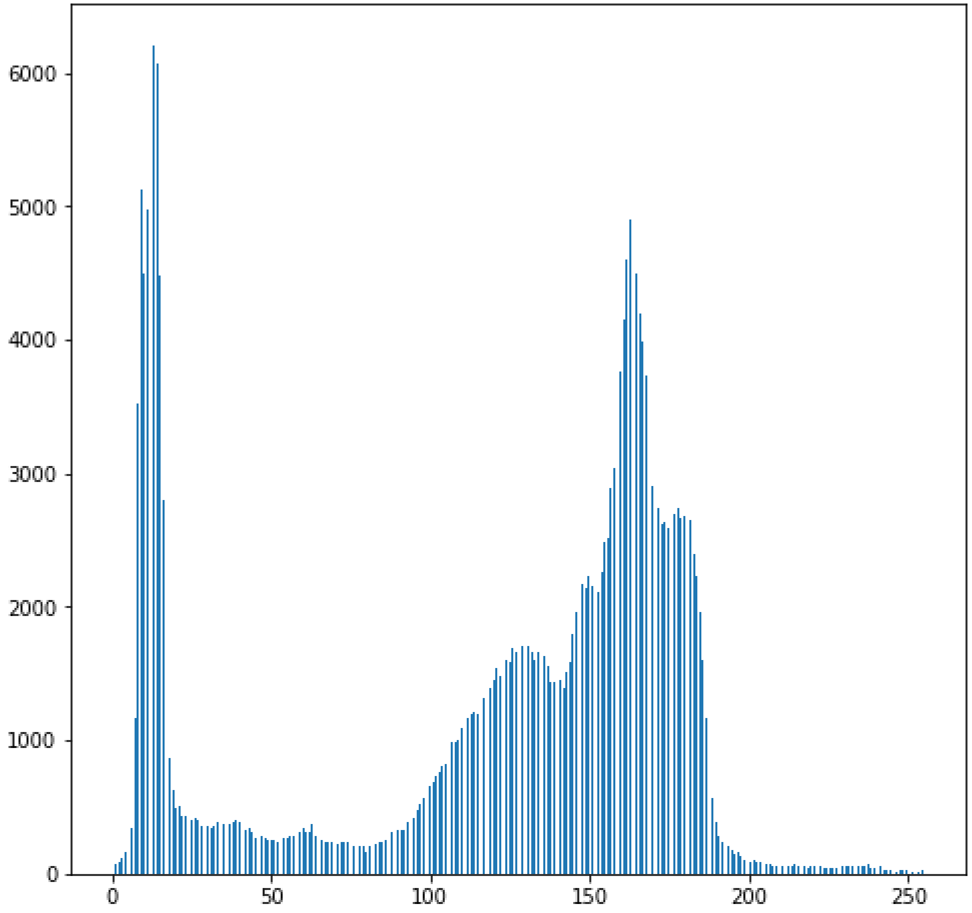
```
In [13]: plt.imshow(normalized_img,cmap=plt.cm.gray)
```

```
Out[13]: <matplotlib.image.AxesImage at 0x1b2928d9608>
```



Simple Histogram of Original Image

In [14]:
```
plt.figure(figsize=(8,8))
plt.hist(original_image.flatten(),bins=256,range=[0,255],width=0.5)
plt.show()
```



Equalization with Help of Builtin Function

In [15]:

```
# install cv2 first by following command: pip install opencv-python
equ = cv2.equalizeHist(original_image)
res = np.hstack((original_image,equ)) #stacking images side-by-side
plt.imshow(res,cmap=plt.cm.gray)
plt.show()
```