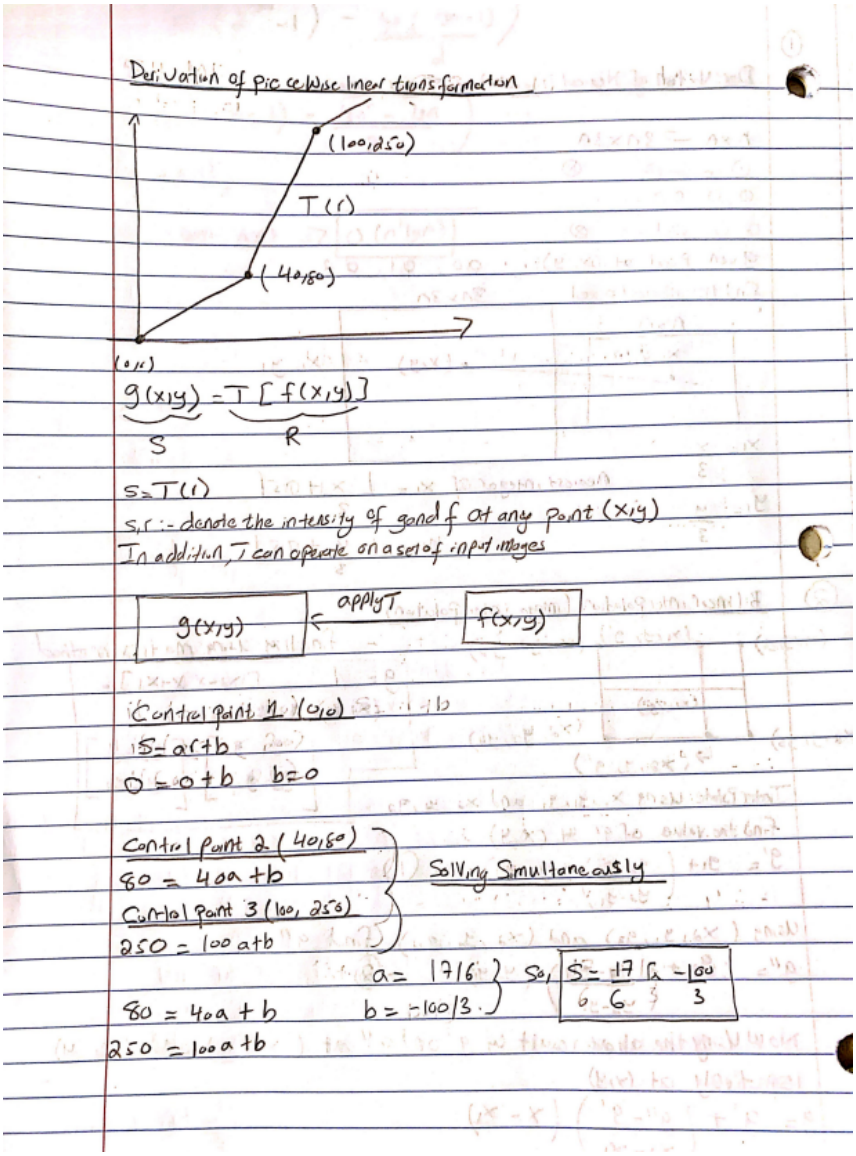
Problem Statement

The goal of this assignment is threefold:

1. Derive piece wise transformation equations s = T(r) for the following piecewise linear transformation between input gray r and output gray s. The control points are given as: (0,0) (40,80) (100,250) using the image provided
2. Write a function that transforms input intensity r to output intensity s using piecewise linear transform as given above. where r is input intensity and s is output s intensity. Assume the dynamic range r is 0-100 and s is 0-250. Apply the above piece-wise linear transformation on washdc512.jpg image and show the results.
3. Apply Gamma-Correction using the following mapping function on the same image and show the results for various values of gamma (Assume c = 1.0 and γ = 1.5, 0.5) s = c r γ

Derive piecewise transformation equations



Code

In [12]:
```
import numpy as np
import matplotlib.pyplot as plt
```

Problem Statement

The first part of this assignment is to write a function that transforms input intensity r to output intensity s using piecewise linear transform as given above where r is input intensity and s is output s intensity.

Assume the dynamic range r is 0-100 and s is 0-250.

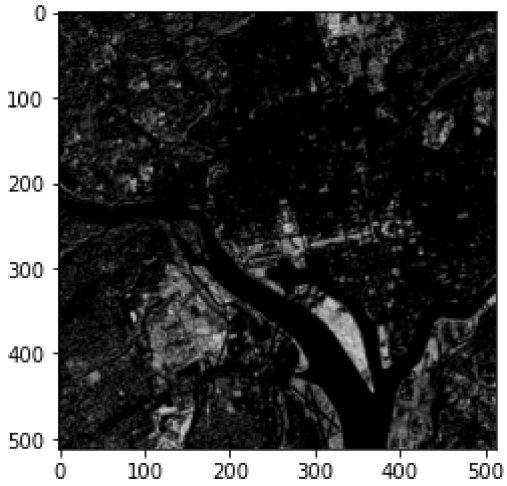
The given control points are (0,0), (40,80) and (100,250)

Apply the above piece-wise linear transformation on washdc512.jpg image and show the results.

Then in the second part Apply Gamma-Correction using the following mapping function on the same image and show the results for various values of gamma (Assume c = 1.0 and γ = 1.5, 0.5) s = c r γ

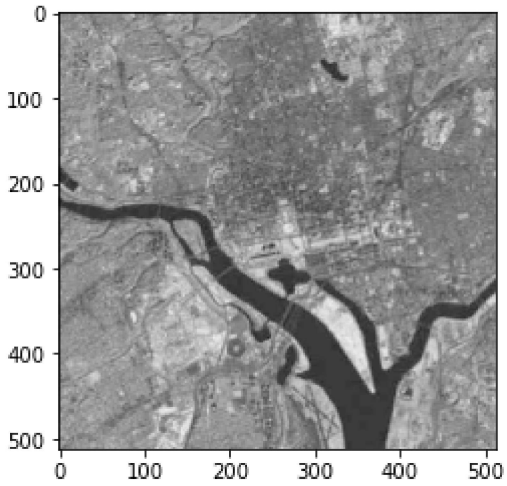
a) Piecewise-Linear Transformation (Contrast Stretching)

In [30]:
```
def pieceWise(pix, r1, s1, r2, s2):
    if(0 <= pix and pix <= r1):
        return (s1/r1)*pix
    elif(r1 < pix and pix <= r2):
        return((s2 - s1)/(r2 - r1)) * (pix - r1) + s1
    else:
        return ((250 - s2)/(250 - r2)) * (pix - r2) + s2

img = plt.imread('washdc512.jpg')

r1 = 40
s1 = 0
r2 = 100
s2 = 250

pixelValvec = np.vectorize(pieceWise)

contrastStretched = pixelValvec(img, r1, s1, r2, s2)

plt.imshow(contrastStretched, cmap = 'gray')
plt.imsave('washdc512pw.jpg', contrastStretched, cmap = 'gray' )
```



b) Implementing Gamma-Correction Factor

In [35]:
```
img = plt.imread('washdc512.jpg')

for gamma in [1.5,0.5]:
    gammaC = np.array(255*(img/255) ** gamma, dtype = 'uint8')
    plt.imshow(gammaC, cmap = 'gray')
    plt.imsave('gammaT'+str(gamma)+'.jpg', gammaC, cmap = 'gray')
```



Conclusion

a) Piecewise linear transformation

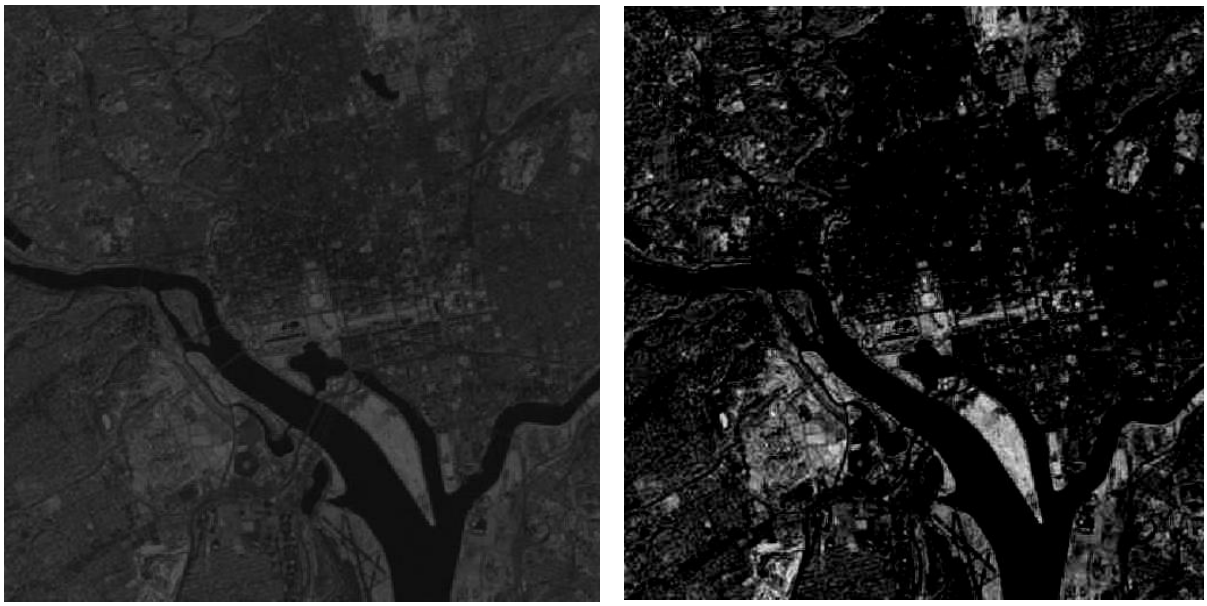


Figure 1: The image on the left shows the original image without piecewise linear transformation function implemented and the image on the right is after implementing the piecewise linear transformation with r1 and r2 values 40 and 100 and s1 and s2 values of 0 and 250 respectively.

If we compare the transformed image from the original image, we notice that the function stretches the intensity levels by essentially decreasing the intensity of the dark pixels and increasing the intensity of the light pixels. We also notice that the function is monotonically increasing so that the order of intensity levels between the pixels is preserved.

b) Power-Law (Gamma) Transformation

Gamma = 0.5

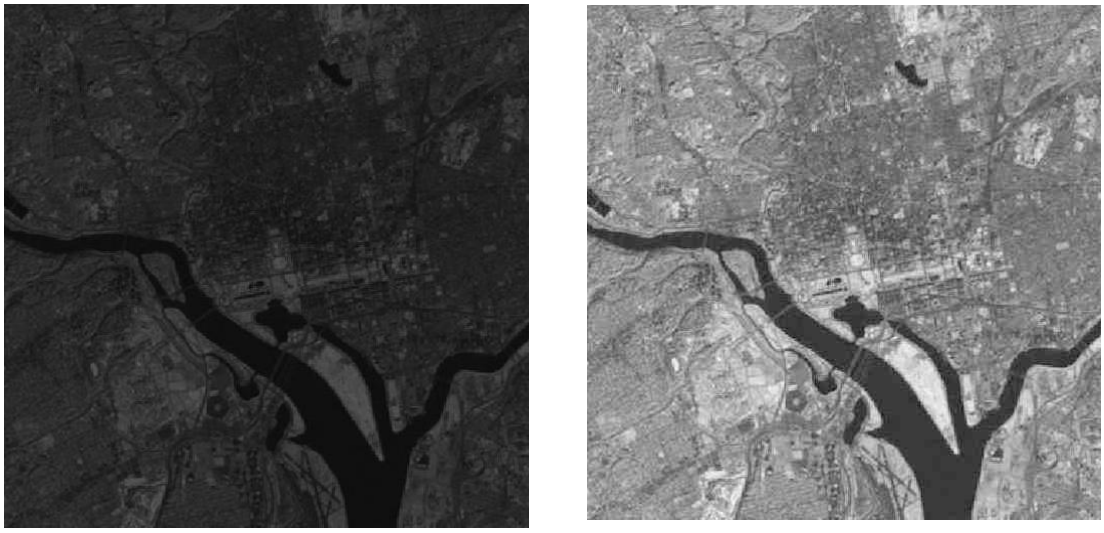


Figure 2: The image on the left shows the original image without gamma transformation function implemented and the image on the right is after implementing the gamma transformation with gamma = 0.5

If we compare the images, we notice that with a gamma value < 1 (0.5) we notice that the image on the right has a higher pixel intensity i.e., the image becomes lighter.

Gamma = 1.5

Figure 2: The image on the left shows the original image without gamma transformation function implemented and the image on the right is after implementing the gamma transformation with gamma = 1.5

If we compare the images, we notice that with a gamma value > 1 (1.5) we notice that the image on the right has a higher pixel intensity i.e., the image becomes lighter, however, if we compare it with the image on the previous page with a gamma value of 0.5, we notice that the image is darker.