Gaussian Blur

1. Take a sample image.

Figure 1: Sample Image

2. Need to apply a Gaussian blur filter.

Def gen_gaussian_kernel(k_siZe, sig):

c = k_siZe // 2

x, y = mgrid[0 - c : k_siZe - c, 0 - c : k_siZe - c]

*g = 1 / (2 * pi * sig) * exp(-(square(x) + square(y)) / (2 * square(sig)))*

return g

$$G(x,y) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2+y^2}{2\sigma^2}}$$

Figure 2: Gaussian Filter Equation

Example of a 2-D Gaussian filters function:

Table 1: Example of 2-D Gaussian Filter

0.00	0.00	0.00	0.00	0.00	0.00	0.00
0.00	0.00	0.01	0.01	0.01	0.00	0.00
0.00	0.01	0.05	0.11	0.05	0.01	0.00
0.00	0.01	0.11	0.25	0.11	0.01	0.00
0.00	0.01	0.05	0.11	0.05	0.01	0.00
0.00	0.00	0.01	0.01	0.01	0.00	0.00
0.00	0.00	0.00	0.00	0.00	0.00	0.00

Suppose, we have a 7x7 blue colour values of an image.

Table 2:7x7 blue colour values of an image

65	81	70	50	90	95	54
87	65	72	80	85	89	70
45	45	79	84	88	90	95
52	54	77	87	84	90	90

100	90	80	84	98	115	101
85	85	84	70	65	10	20
10	110	65	55	25	35	45

After applying the Gaussian filter,

Table 3: Gaussian Filter Application Process

65 x 0.00	81 x 0.00	70 x 0.00	50 x 0.00	90 x 0.00	95 x 0.00	54 x 0.00
87 x 0.00	65 x 0.00	72 x 0.01	80 x 0.01	85 x 0.01	89 x 0.00	70 x 0.00
45 x 0.00	45 x 0.01	79 x 0.05	84 X 0.11	88 x 0.05	90 x 0.01	95 x 0.00
52 x 0.00	54 x 0.01	77 X 0.11	87 X 0.25	84 X 0.11	90 x 0.01	90 x 0.00
100 x 0.00	90 x 0.01	80 x 0.05	84 X 0.11	98 x 0.05	115 x 0.01	101 x 0.00
85 x 0.00	85 x 0.00	84 x 0.01	70 x 0.01	65 x 0.01	10 x 0.00	20 x 0.00
10 x 0.00	110 x 0.00	65 x 0.00	55 x 0.00	25 x 0.00	35 x 0.00	45 x 0.00

When we apply the filter, it will determine the new value of the blue colour pixel value for the centre pixel. This weighted average, the sum of the multiplications, becomes the new value for the centre pixel (3, 3).

Similarly, for different values of *sigma (σ) =1, 2, 3, 4, 5,* the sample image in grayscale will be:
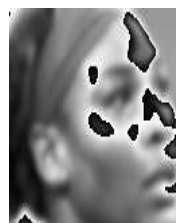
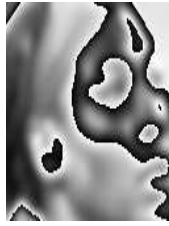

Figure 3: Sigma= 1

Figure 4: Sigma= 2

Figure 5: Sigma= 3

Figure 6: Sigma= 4

Figure 7: Sigma= 5

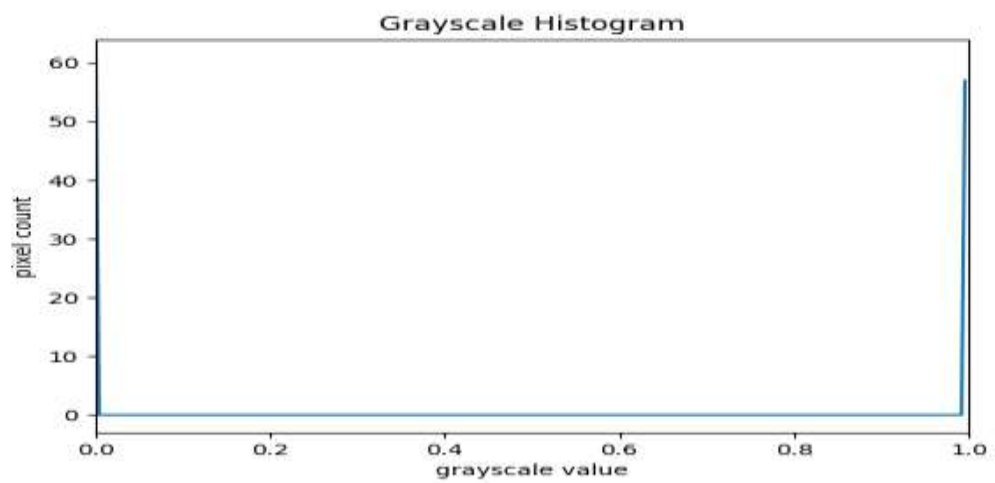3. Now, the histograms of these 5 images are:

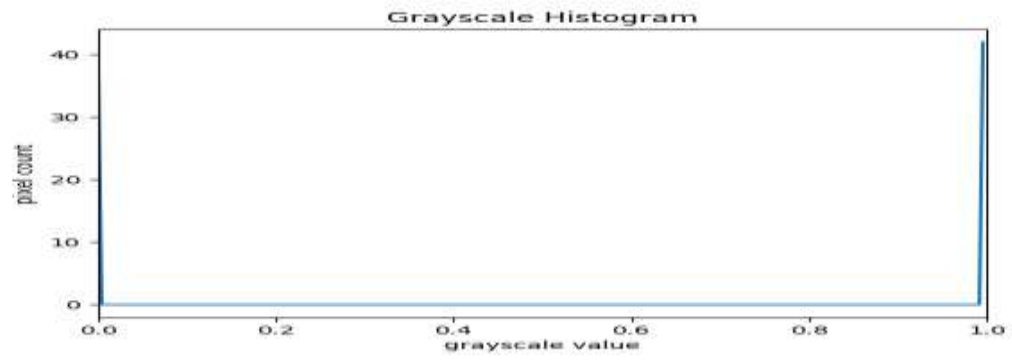**Figure 8: Histogram at Sigma=1**
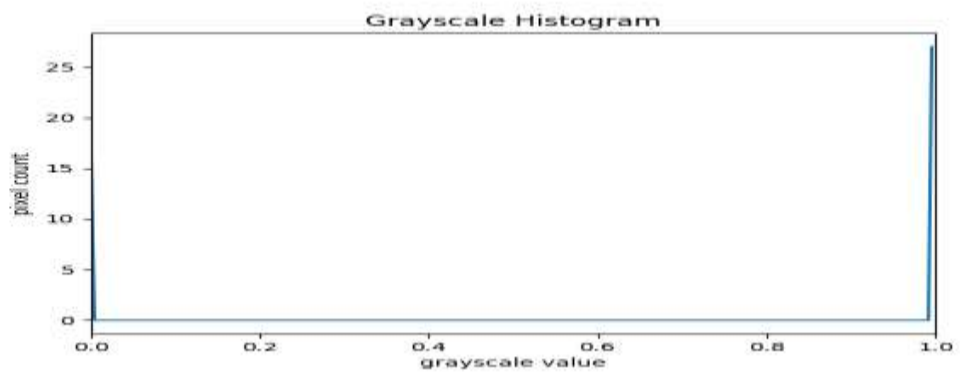
Figure 9: Histogram at Sigma=2

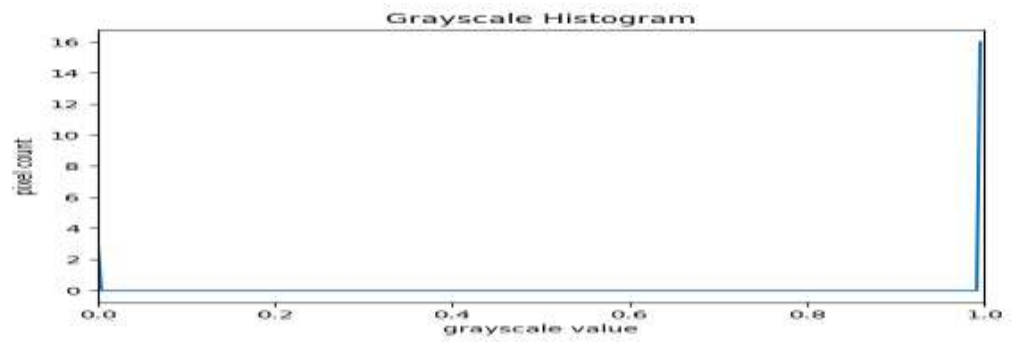**Figure 10:Histogram at Sigma=3**
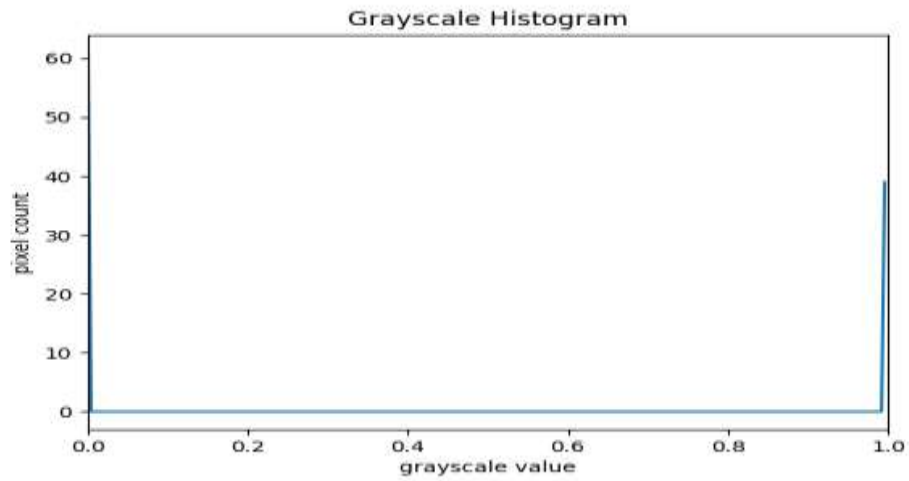

Figure 11: Histogram at Sigma=4

Figure 12: Histogram at Sigma=5

4. Correlation values for images at different sigma level:

Table 4: Correlation Values at Different Sigma Levels

Image at Different Sigma Level	Sigma=1	Sigma=2	Sigma=3	Sigma=4	Sigma=5
Sigma=1		Positive	Positive	Negative	Negative
Sigma=2			Negative	Positive	Negative
Sigma=3				Positive	Positive
Sigma=4					Positive