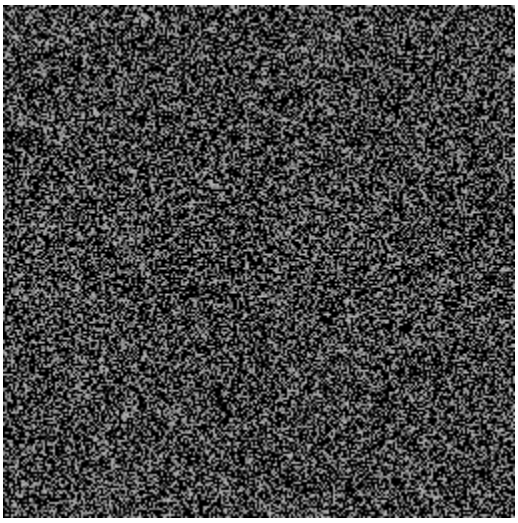
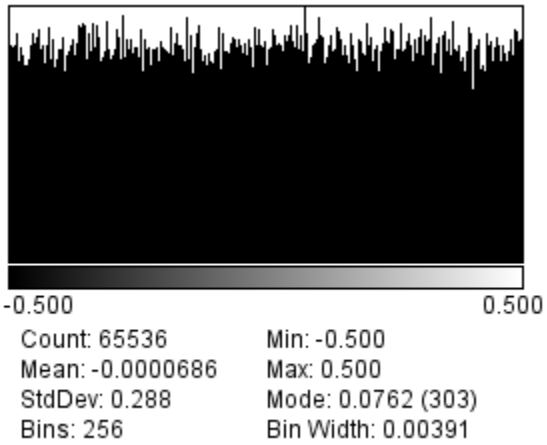
IVT Akande Mayowa Session2

Session 2

4. Uniform and Gaussian random white noise

1. Generate a 256 * 256 pixels image with uniform-distributed random numbers in (-1/2, 1/2).
The code to generate the uniform-distributed image was written to get the image below



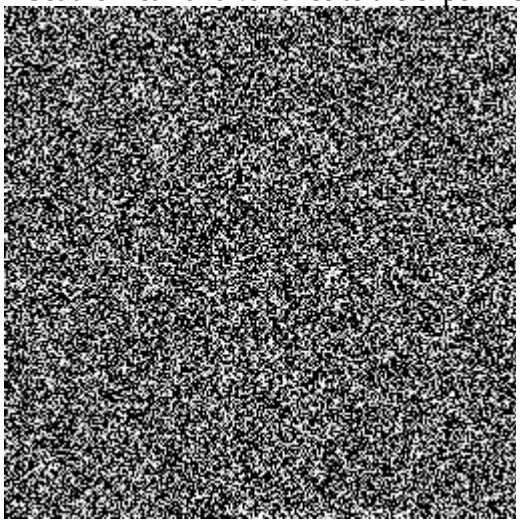


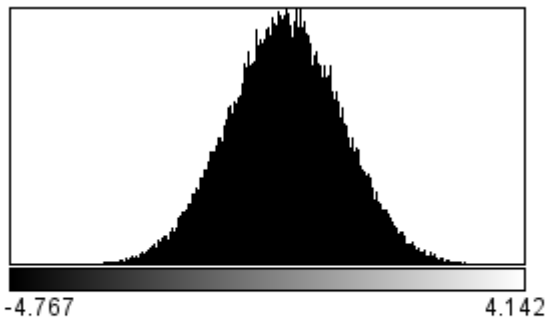
Experimental Values

Theoretical:
Mean = 0.5(a+b) = 0
stdDev = square root of (variance)
Variance = 1/12((b-a) *(b-a)) = 0.0833
stdDev = 0.2886

2. Generate a 256 * 256 pixels image with Gaussian-distributed random numbers.
The code to generate the Gaussian-distributed random numbers was written to get the image below

Set the mean and variance to the experimental values of your uniform-distributed numbers





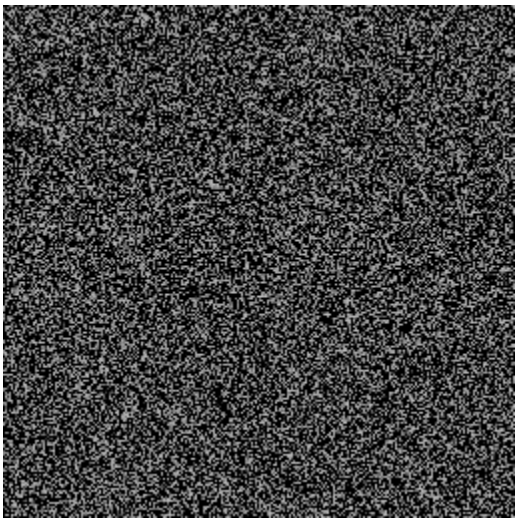
3. Compare the two uniform and Gaussian-distributed noise images, side-by-side

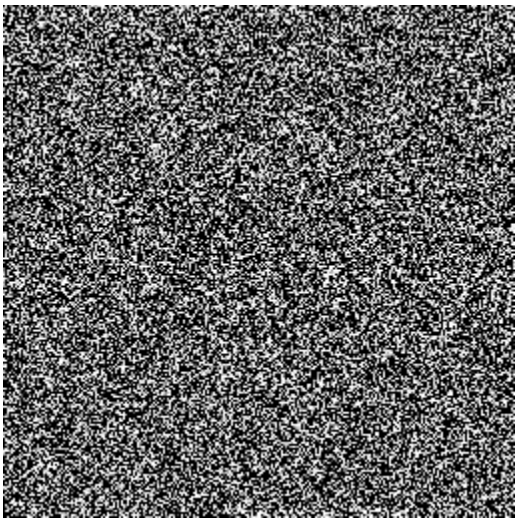
   The two uniform and Gaussian-distributed noise images were compared side-by-side as seen below showing the mean, variance, minimum and maximum values for the two cases.

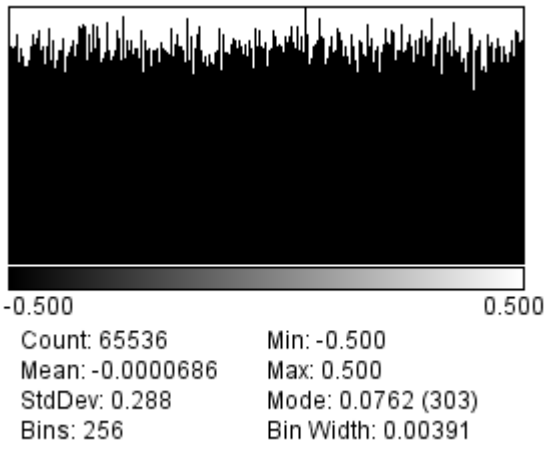
   Standard deviation was calculated as the square root of variance

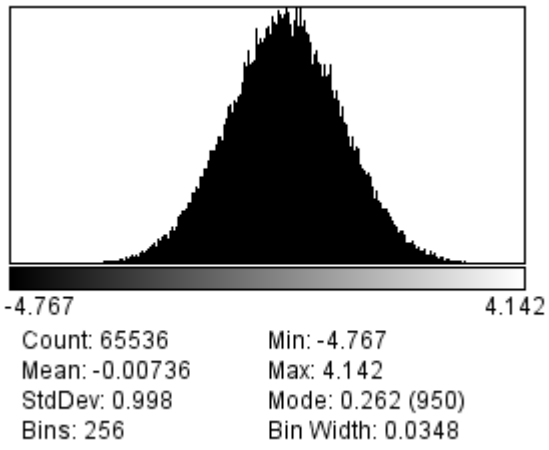
   The image for Gaussian Distribution looks brighter as it has a higher mode at 0.262 while the mode for Uniform Distributed image is at 0.0762 (lower intensity level).

   The image for Gaussian Distribution has a higher mean value.









Uniform Distribution

Gaussian Distribution

5 Blur and additive white noise using ImageJ

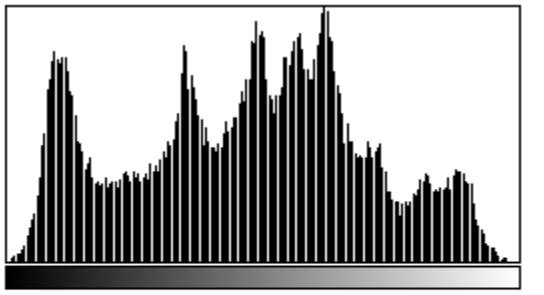
1. Blur the “Lena" image in ImageJ with “Gaussian Blur..." in the “Process > Filters" menu
Use a standard deviation (sigma) equal to 1
Explain where you perceive visual differences?

The Image shows the Original Lena vs blurred “Lena”

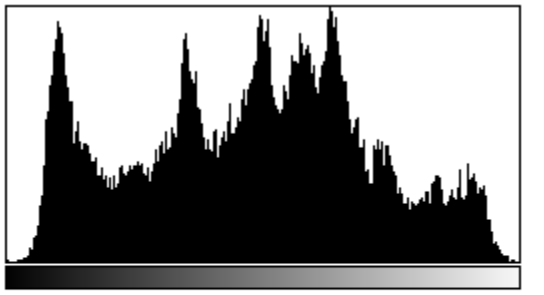
Original

Blurred

I can perceive clearly visual differences on the face of the blurred image as this appears smooth, the original image (left) has some texture. I can also notice some texture differences in the black region of the hat. The original image has sharper edges when compared to the blurred image.



Original



Blurred

The original and blurred Lena has the same mean values but different min, max, mode and standard deviation values.

The image after blurred is compact. The blurred image appears dimmer. Blur smoothens variation

Blur is a filter; some values were filtered out.

I added blur to the original image with a standard deviation of 1. I took the difference in the original Lena Image and the blurred image, and I squared the difference to compute the MSE as 18.337.

2. Alter further the blurry image by adding Gaussian-distributed random noise
Which value for the noise variance provides the best visual result to your opinion?
Do you agree with the statement “Noise is a medication for blur”? Why?

Comparing the original blurred Image Vs blurred image with different noise standard deviations (0, 1, 2, 4, 8)

Original Lena + Blur sigma 1

Original Lena + Blur sigma 1 + Noise sigma 1

Original Lena + Blur sigma 1 + Noise sigma 2

Original Lena + Blur sigma 1 + Noise sigma 4

Original Lena + Blur sigma 1 + Noise sigma 8

In my opinion, a noise variance of 4 provides the best visual result as it adds moderate texture suitable, pleasing and appealing to the human visual system.

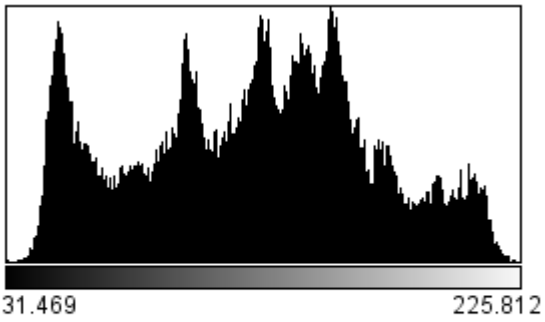
Yes, I agree with the statement “Noise is a medication for blur" because comparing the images, the image with noise has more texture which makes it look more appealing to the human visual system.

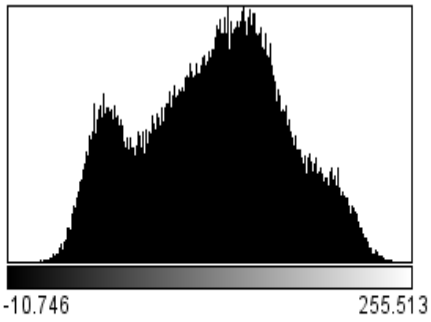
When an Image is blurred, the resulting image depends on the content of the original image while adding Noise to an image is independent on the content of the original image.
By calculating the MSE of “Original Lena - (Original Lena +Blur+ Noise) = 18.299

Noise addition help to minimize error. 18.299 < 18.337

6. Additive White Noise and Blur using Image J

1. Add a Gaussian-distributed random noise realization to the original “Lena" image. Which variance value matches the MSE of the blurred image?





Blurred image sigma 1 Lena + GD (SD 11.137)

Noise variance of 124.052 matches the MSE of the blurred image.

2. Restore the noisy image by applying a Gaussian blur filter
   Which standard deviation provides the best restoration in terms of MSE?
   Do you agree with the statement “Blur is a medication for noise”? Why?


Blur 0.1


Blur 0.5


Blur 1


Blur 2

Comparing the noisy image vs Blurred Noisy image of standard deviation (0.1, 0.5, 1 and 2). The standard deviation of 0.1 provides the best restoration.

I do not agree with the statement that blur is a medication for Noise. Adding blur to my image makes my image smooth and I do not have texture anymore making it unpleasant to the human visual system.