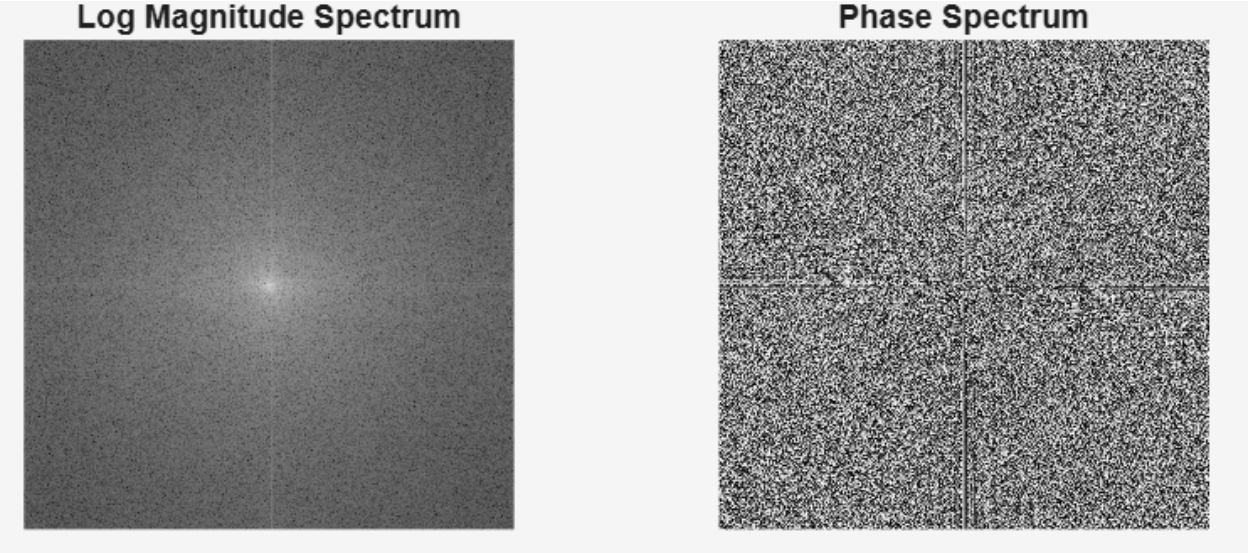
Assignment 2 - Image Processing:

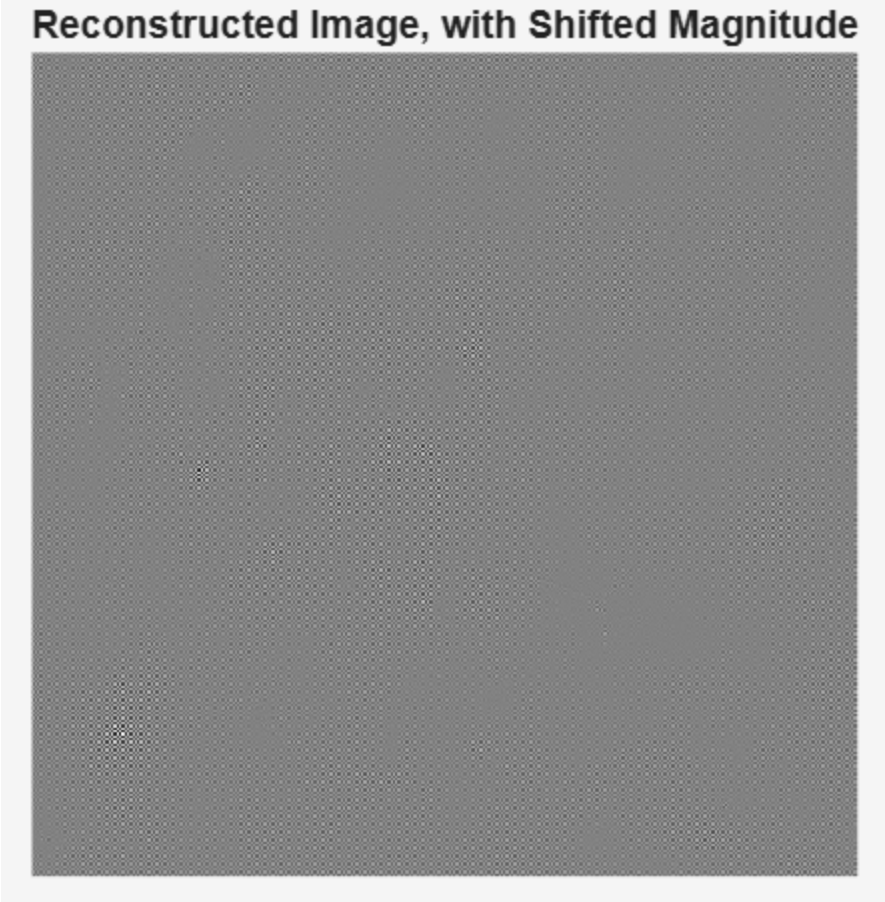
All matlab codes and images from Q2 can be found attached separately.

Question 1)

a)

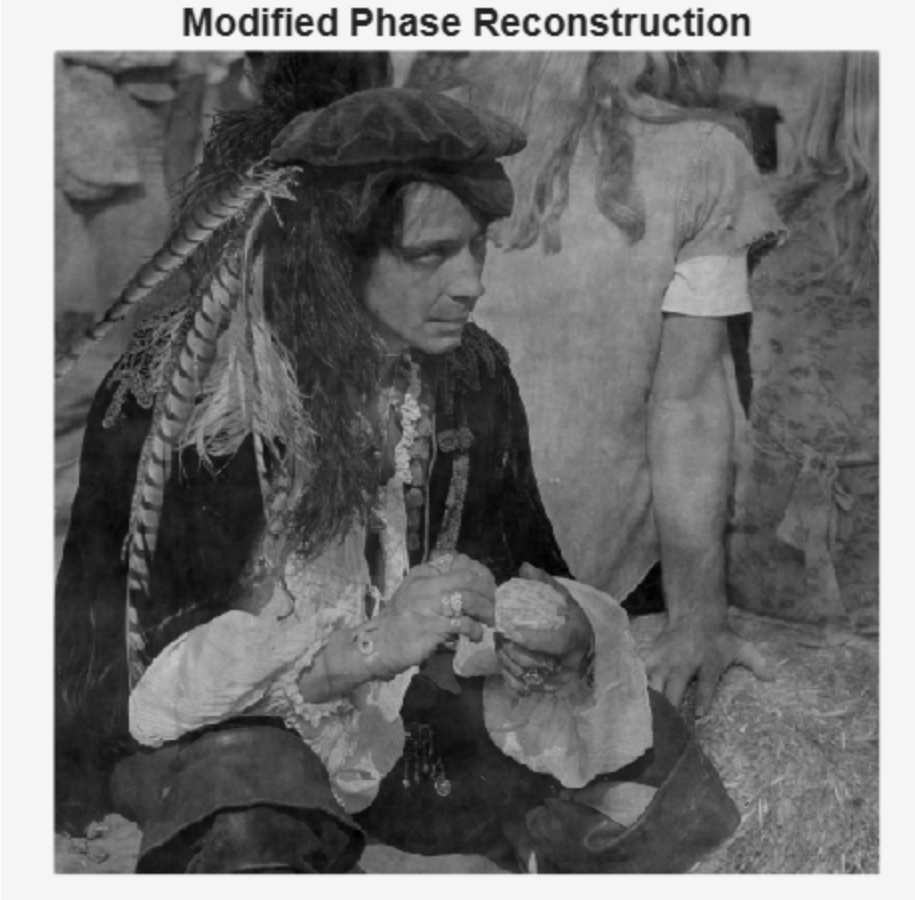


b)



As we can see, shifting the magnitude spectrum by 0.5 along both frequency axes distorts the image. In particular the low frequencies which normally sit in the center, get pushed out to the edges, and the high frequencies from the edges are moved into the center. Since the phase stays the same, this mismatch causes the image to look very scrambled.

c)



As we can see, changing the phase values messed with the structure of the image. In the original image, the pirate's face was less grainy and brighter, but after phase reconstruction, the image is significantly blurred and distorted in certain areas.

Question 2)

For some reason the walkbridge.tif image wasn’t working so I did it with the pirate.tif image instead

The images are attached separately, in the following naming conventions:

1. butter_high_do_[value1]_n_[value2]
    - The low pass butterworth filters start with butter_low instead

2. gaussian_high_[value1]
   gaussian_low_[value1]
   - Value1 represents D0 for the gaussian
3. ideal_high_[value1]
   ideal_low_[value1]
   - Value1 represents D0 for the ideal filters

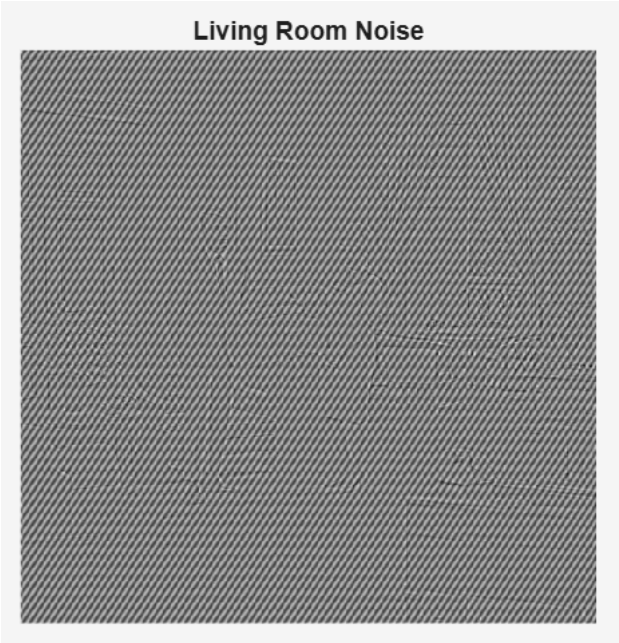
Question 3)

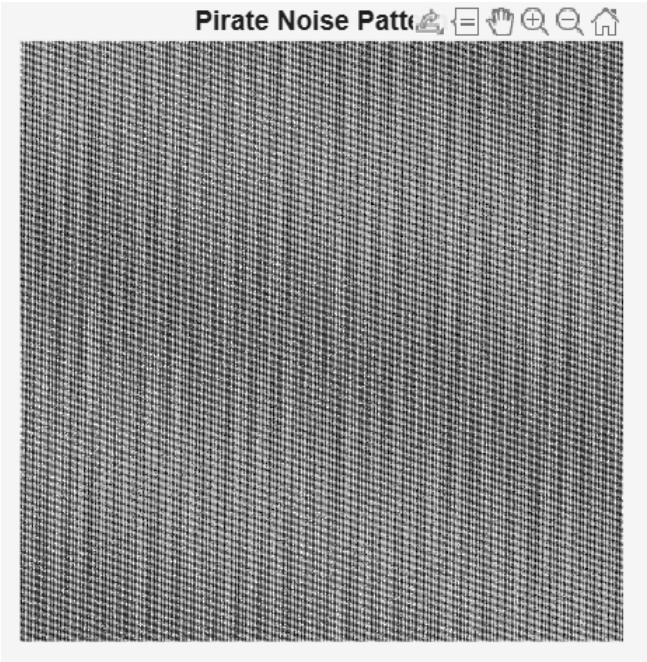
a)

I used a low pass Gaussian filter to blur, and smooth the images. While the images are not fully denoised, both images are much more visible.

b)

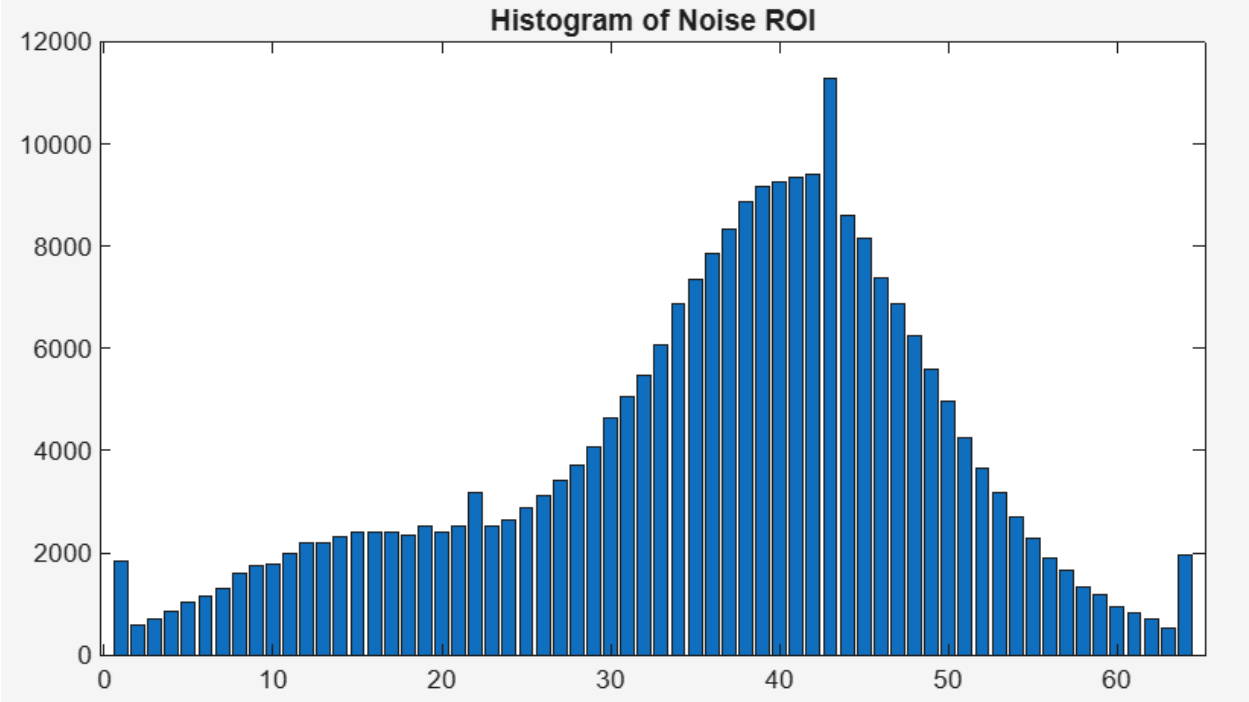
The noise patterns of both images can be found below, the top one being the living room noise pattern and the bottom one being of the pirate.





Question 4)

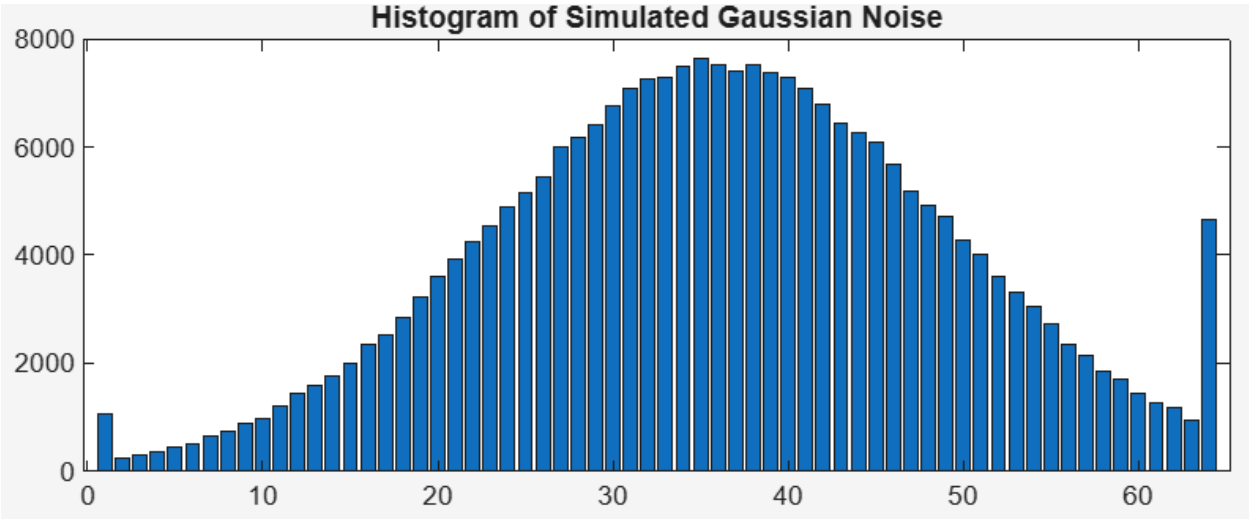
a)
This is the original image, I used a ROI of the full image for noise analysis.



From this, we can see there is a bell shaped curve of noise, which means our parameters are:

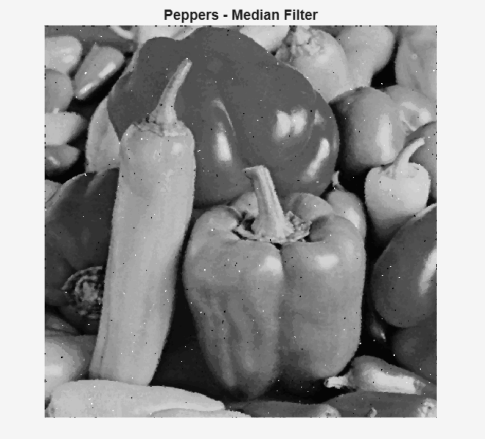
```
Estimated mean: 0.55853
Estimated std dev: 0.20852
```

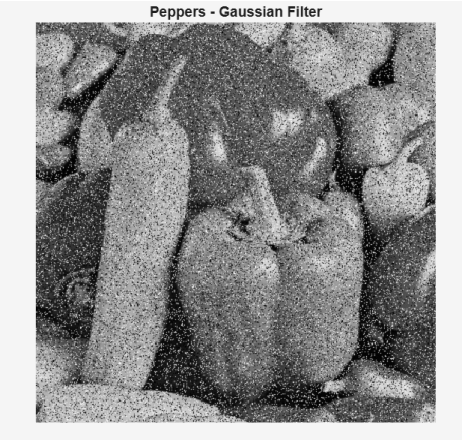
c)

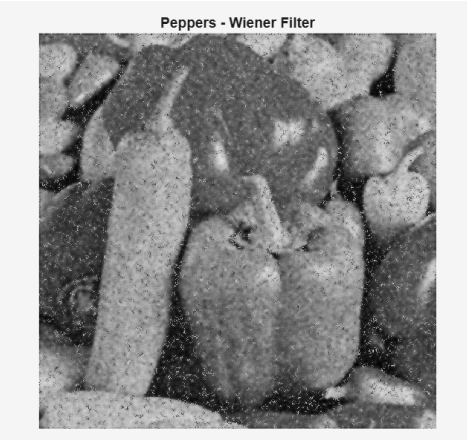


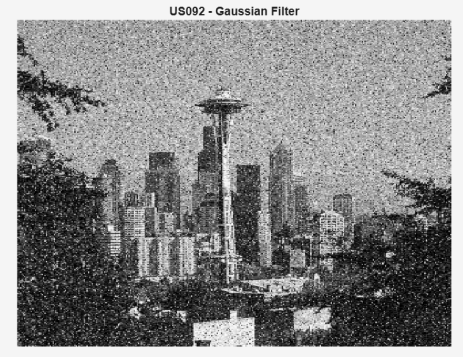
As we can see, both of our histograms are very similarly smooth bell-shaped curves, although they are not identical, this confirms that our simulated Gaussian noise closely matches the original noise pattern in the image.

Question 6:









As we can see, the median filter is the best. It looks the most smooth, as it has very little noise compared to the other two filters in both the pepper and city images. The wiener filter is second and the Gaussian filter is last.