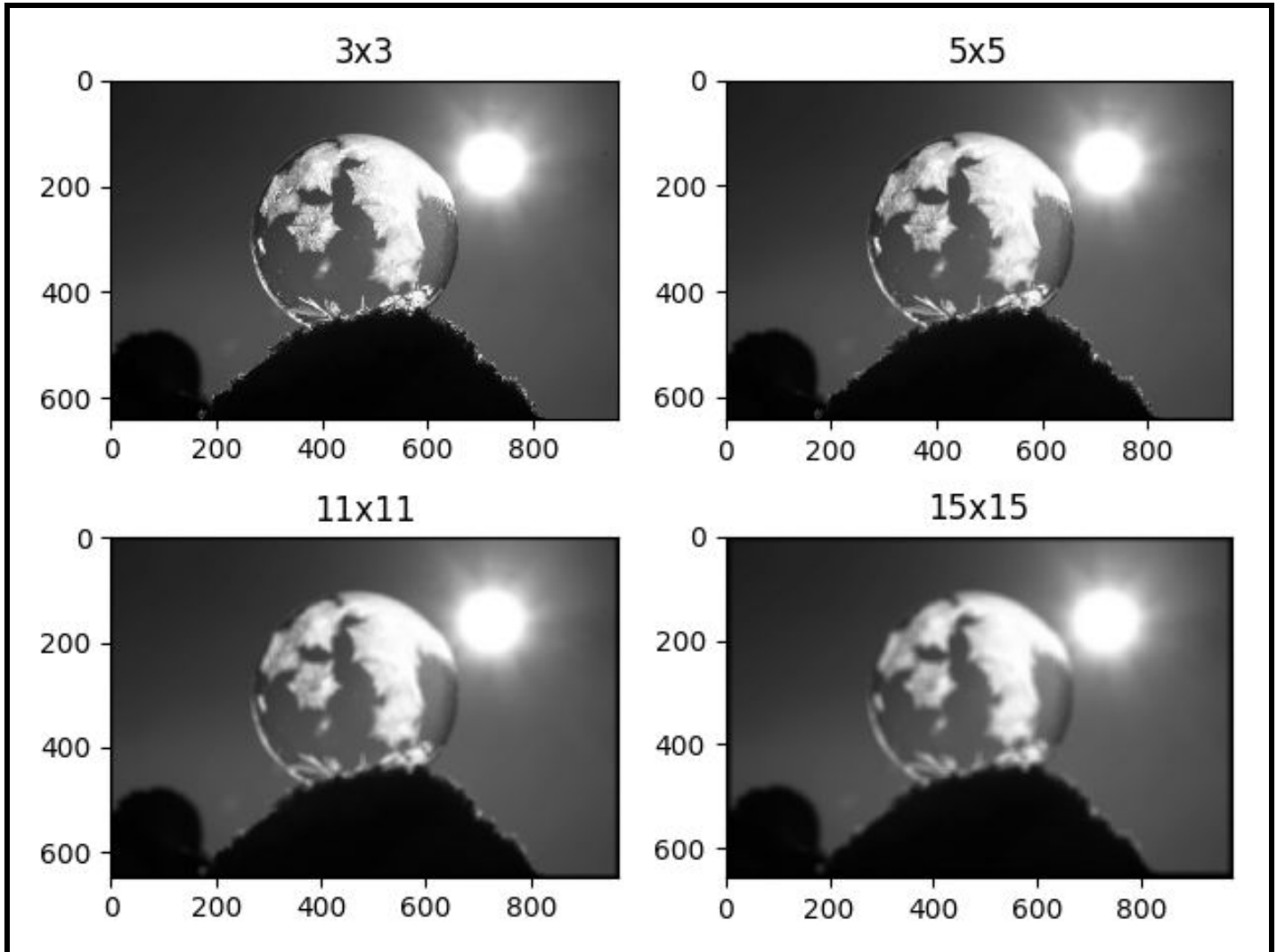


Assignment - 1 Report

Submitted By: Kshitij Srivastava (MT18099)

NOTE: PADDING HAS BEEN DONE FOR ALL IMAGES USING ZEROES.

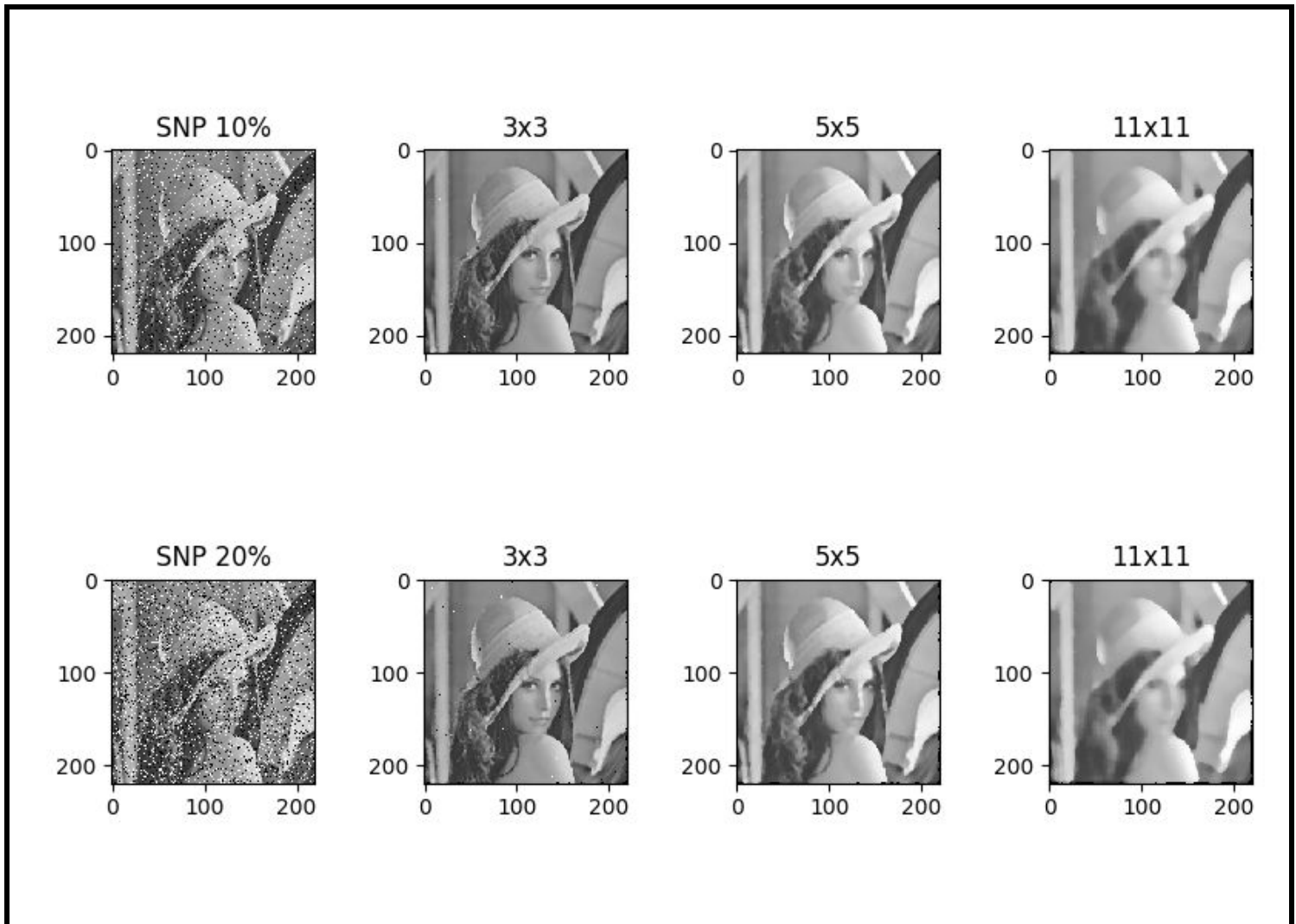
Question 1: Perform average filtering.



Observation: On increasing the size of the filter, the amount of blurriness in the image also increases.

Inference: This happens because with increasing filter size, the neighborhood size of the pixel also increases and so, even farther pixel values have a weight in the average.

Question 2: Add salt and pepper noise and perform median filtering.

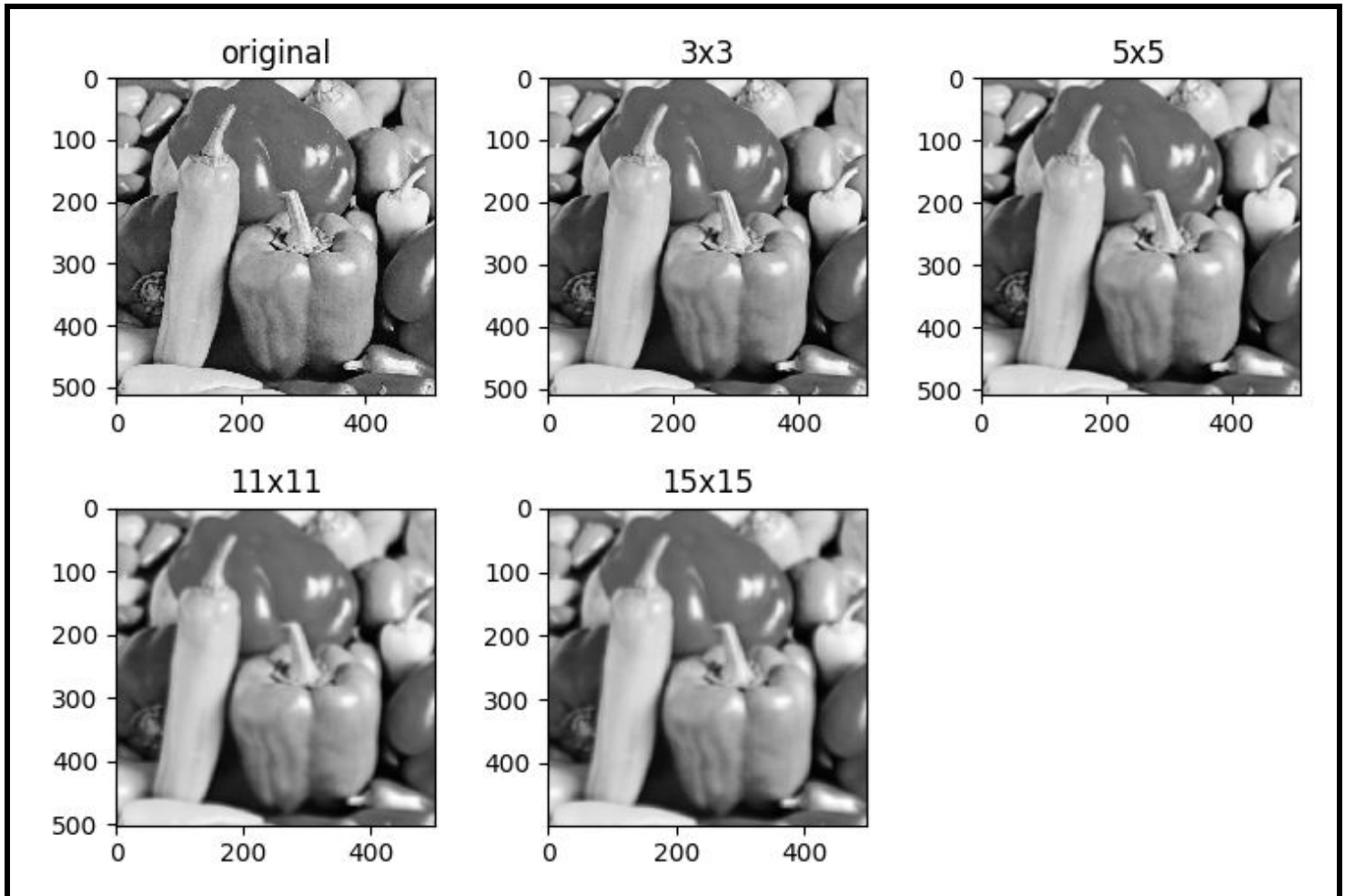


Observation: Upon increasing the kernel size, the blurriness increases. The edges become are not very clear.

Inference: The neighborhood size of the pixel increases and thus, it has a greater effect on the median value.

Question 3: Perform Gaussian filtering and vary sigma for one of the filters.

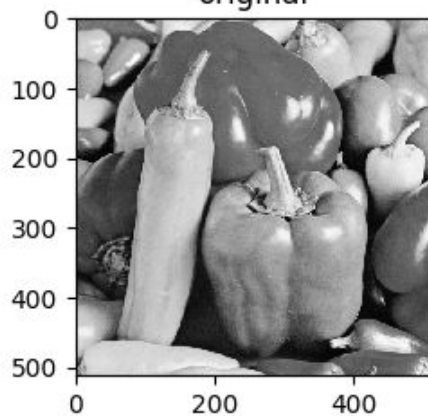
NOTE: For the first part, **sigma = 5.0** and for the second part the kernel size is **11x11**.



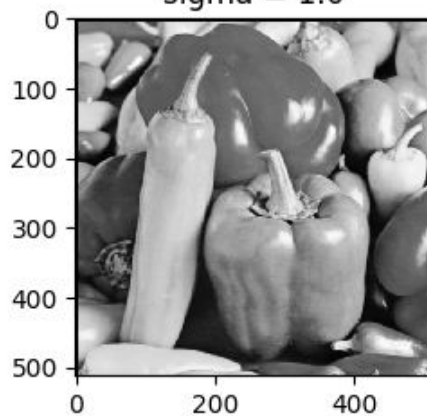
Effect of increasing the kernel size:

The blurriness of the image increases. Upon further experimentation, it was observed that the blurriness also increases by increasing the sigma value (as seen below).

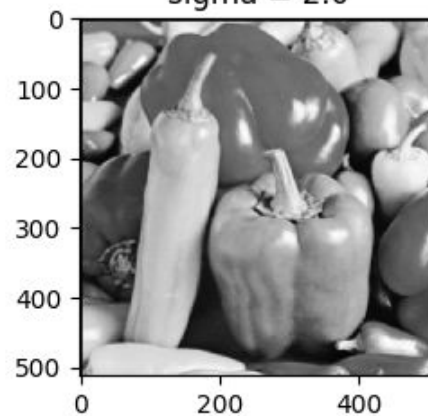
original



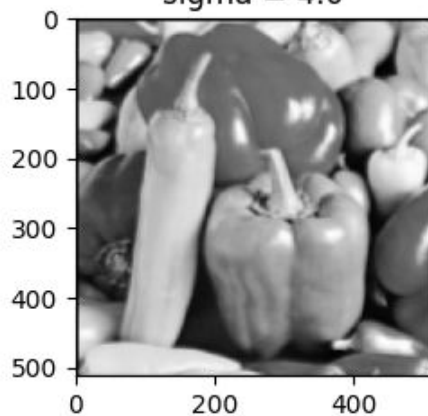
$\sigma = 1.0$



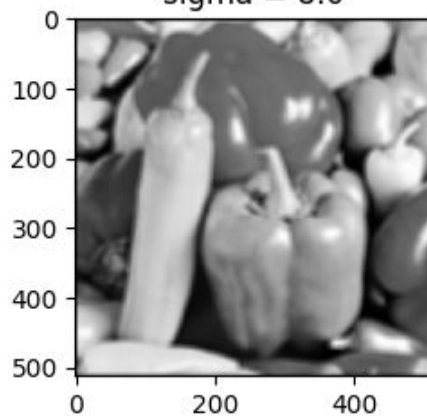
$\sigma = 2.0$



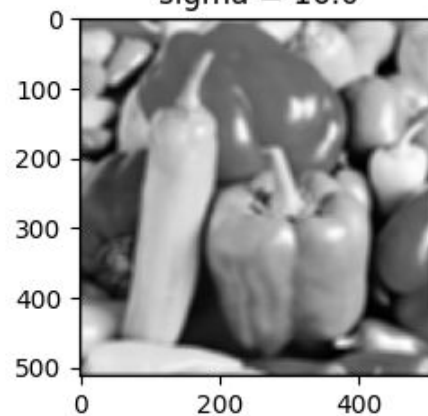
$\sigma = 4.0$



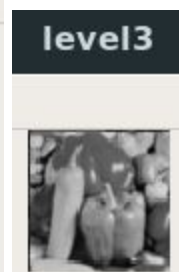
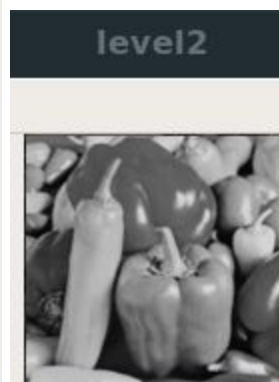
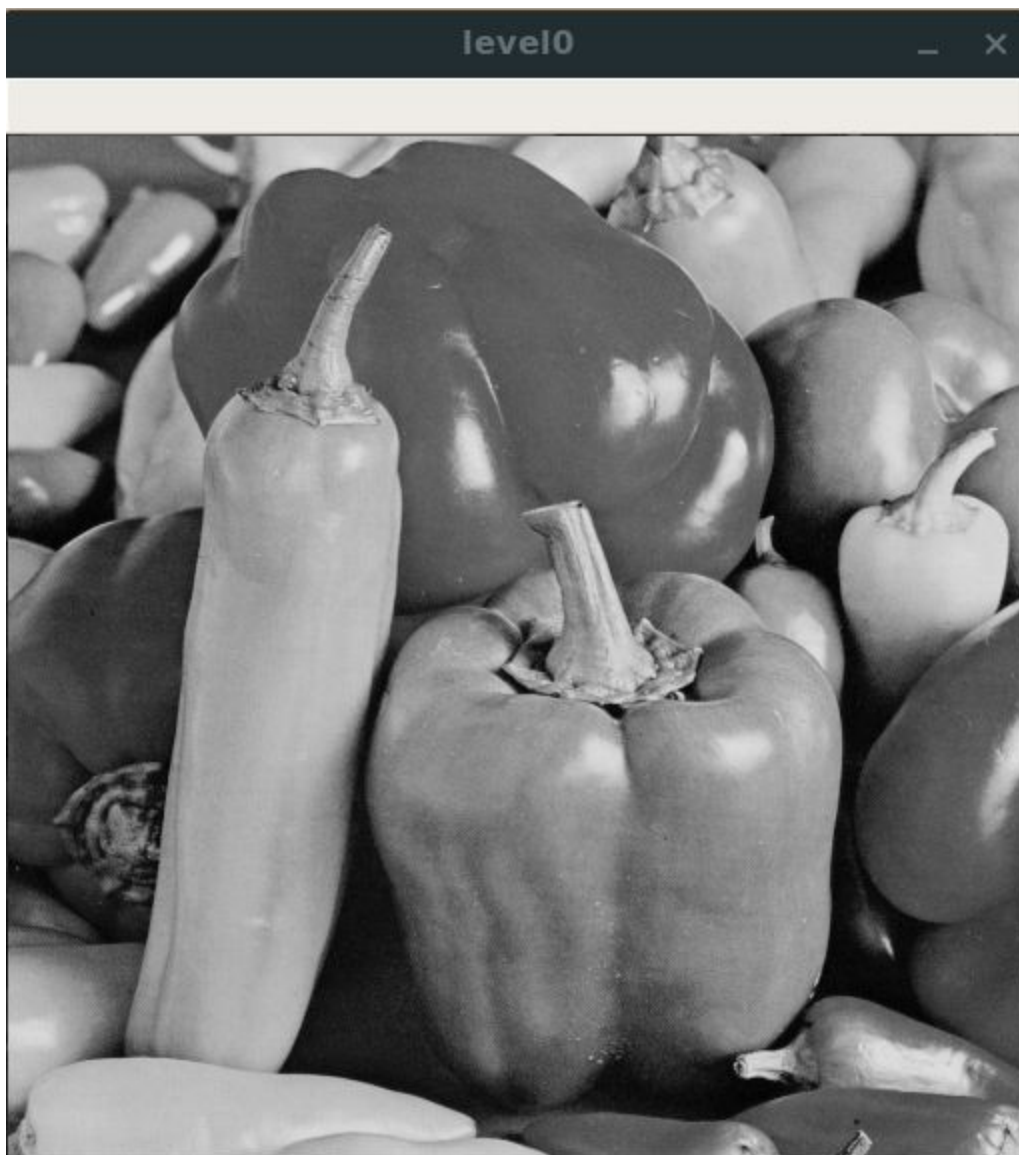
$\sigma = 8.0$



$\sigma = 16.0$

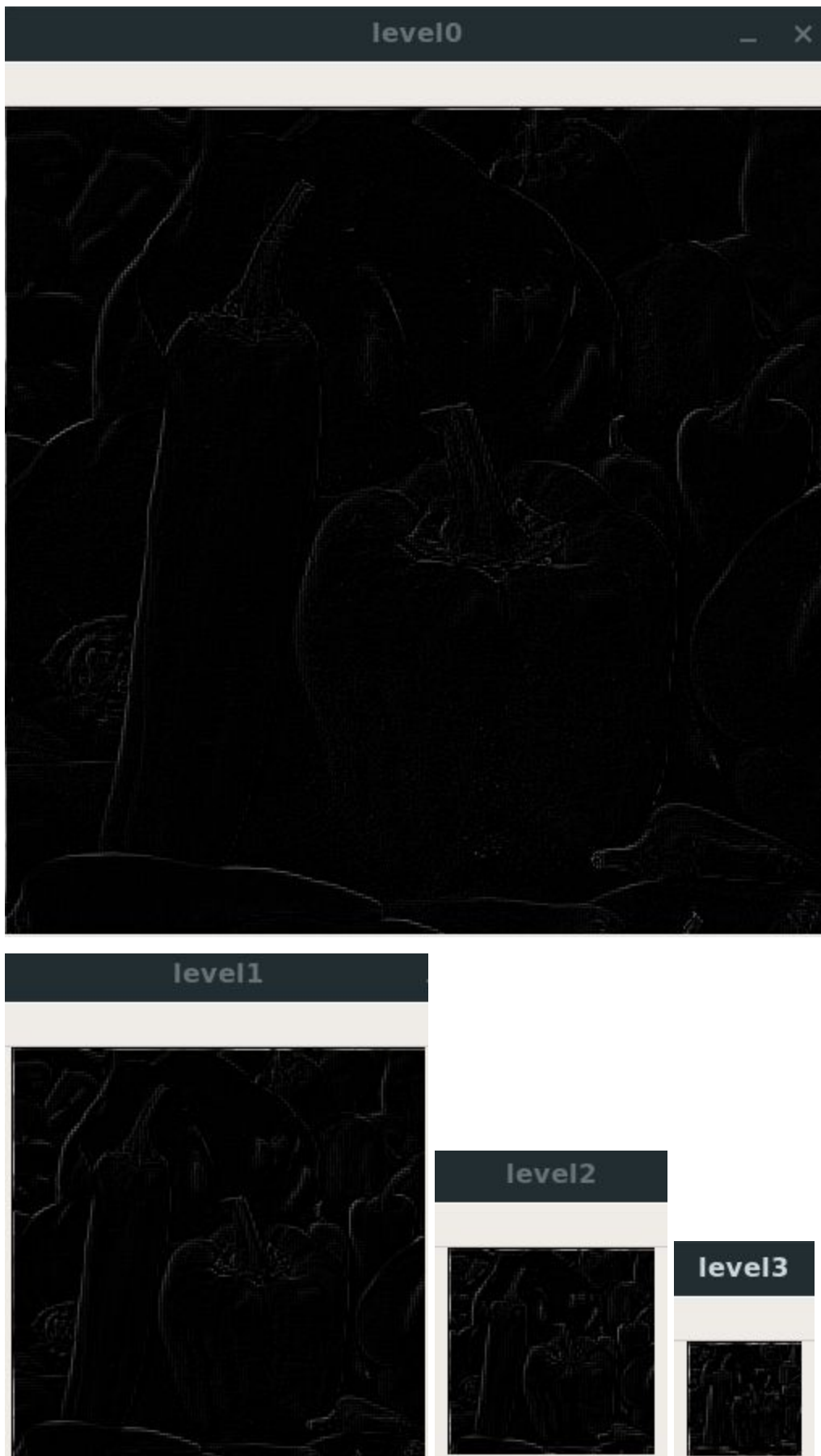


Question 4: (a) Gaussian Pyramid



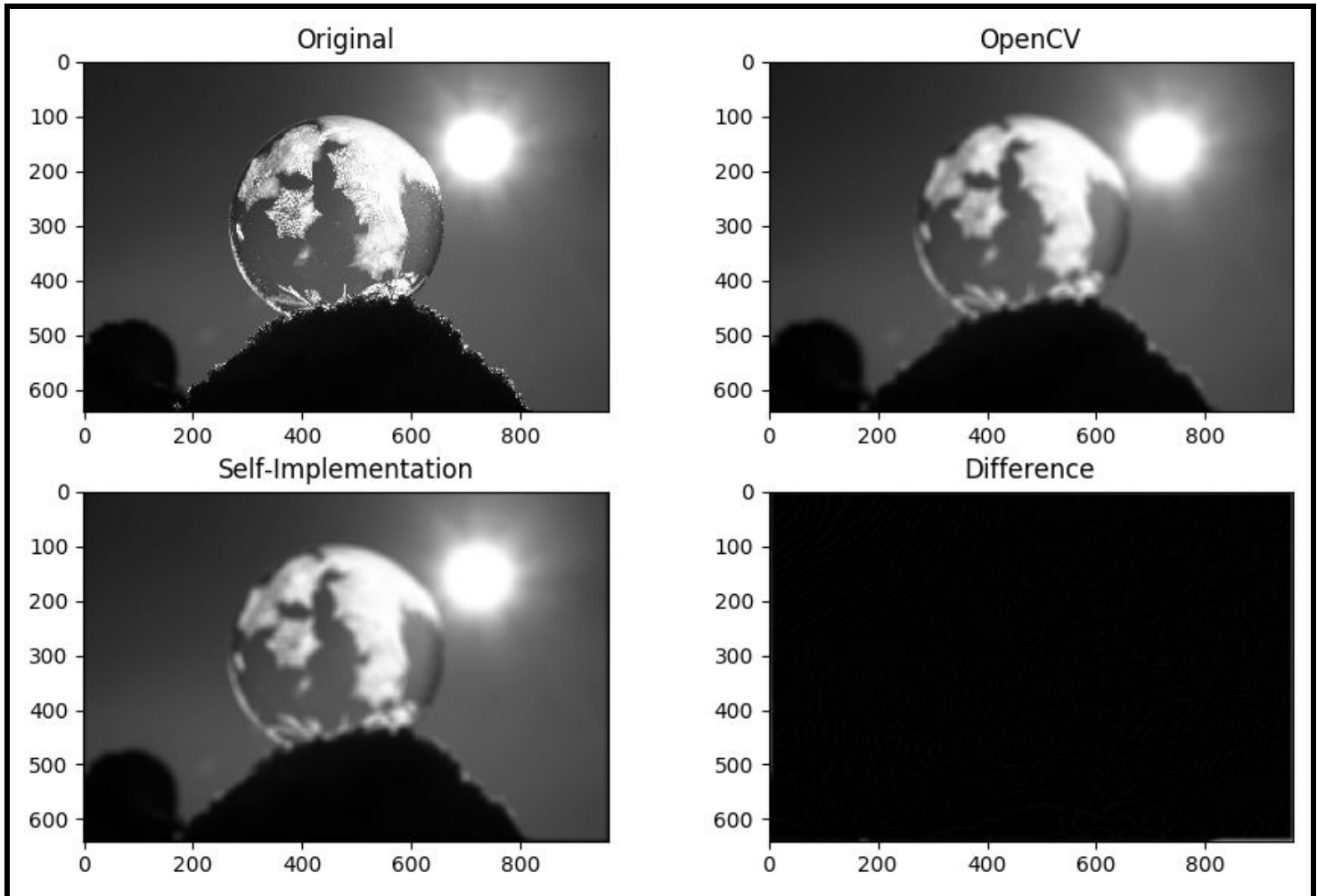
Kernel=3x3; Sigma=8.0

(b) Laplacian Pyramid



Question 5: Compare results with inbuilt functions.

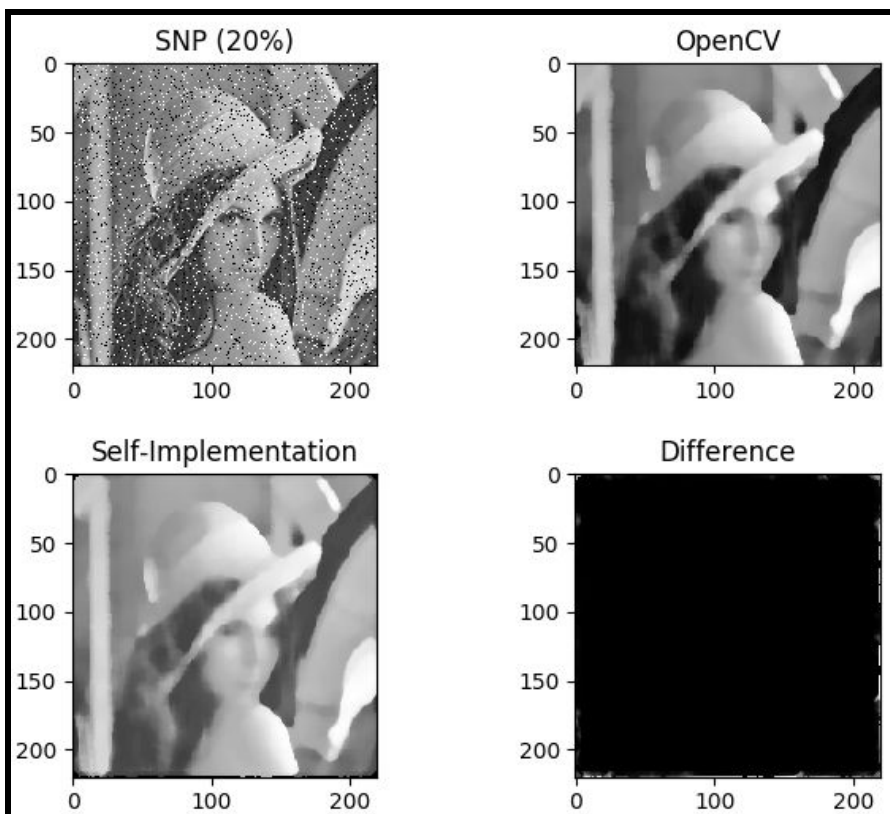
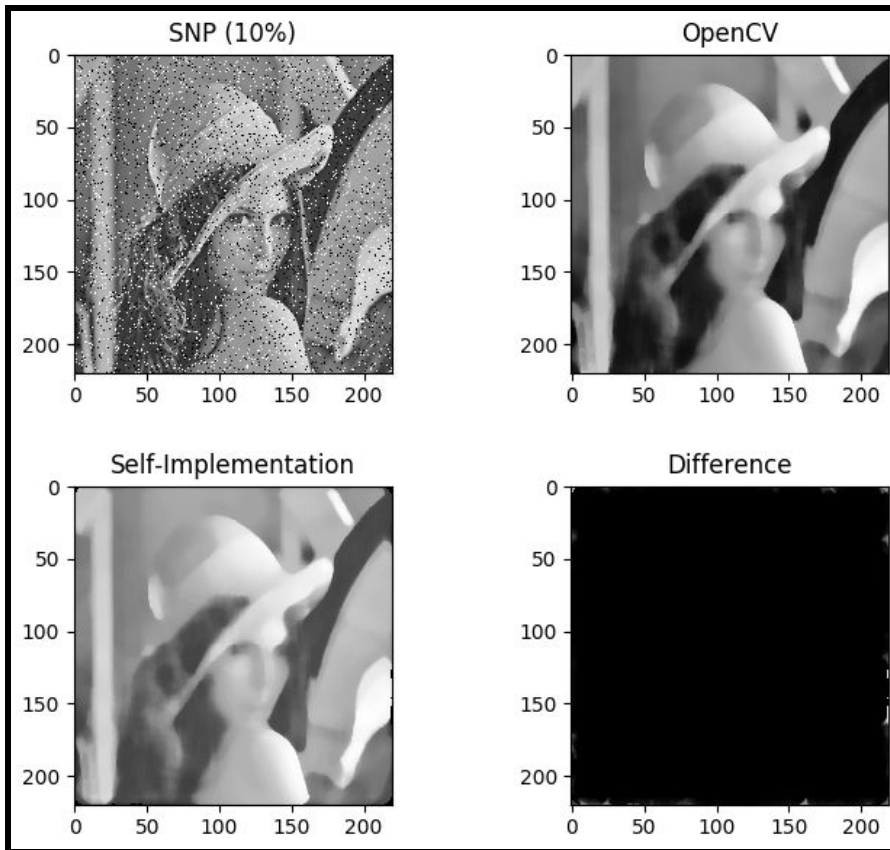
Average filter comparison



Difference:

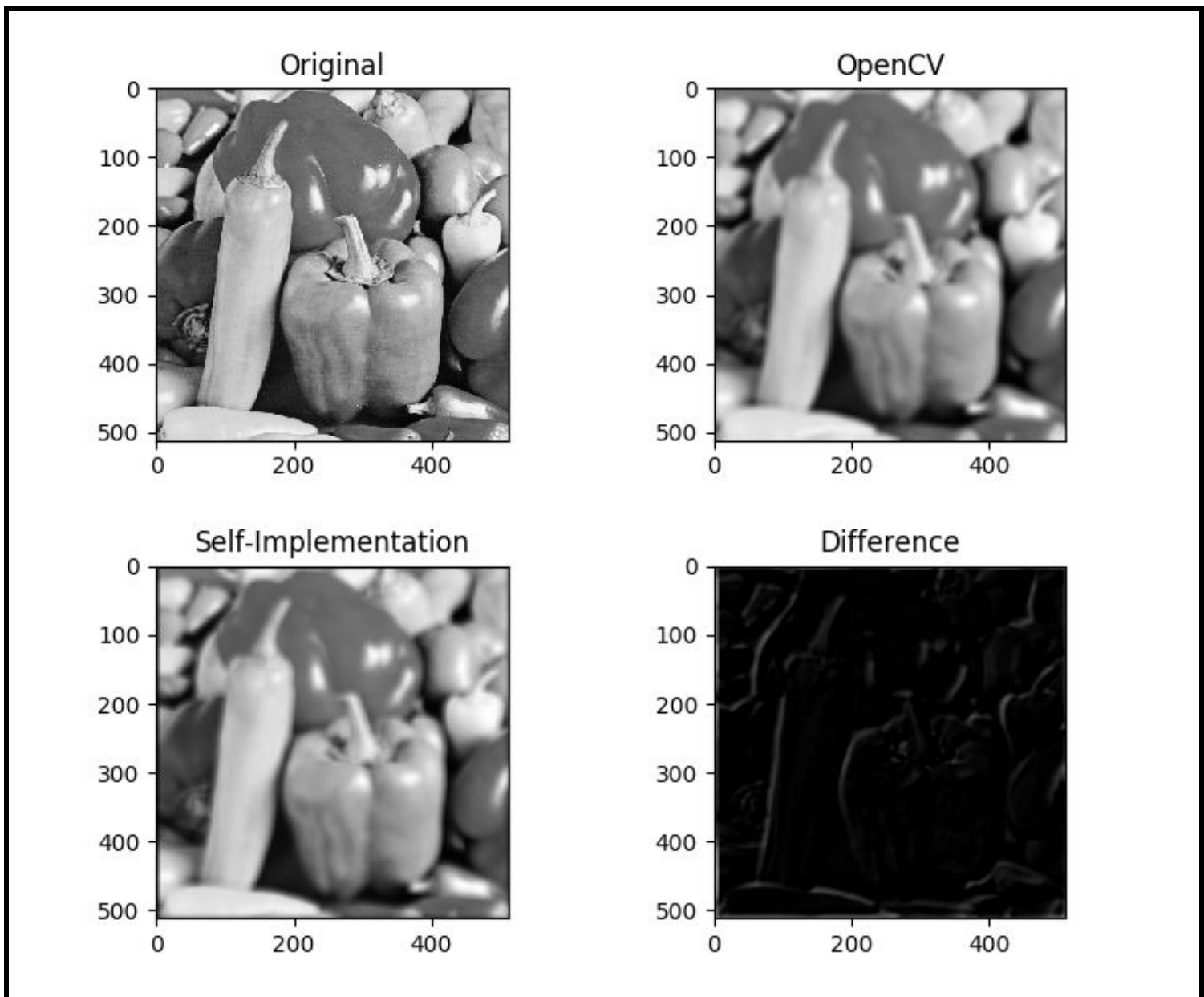
In the lower right image, there is some visible difference (lower right corner). It might be because of the type of padding used in both images. But mostly, the processing looks correct.

Median Filter comparison



Difference: There is some visible difference in along the border in both the cases. Probably because of the padding scheme used.

Gaussian Filter comparison

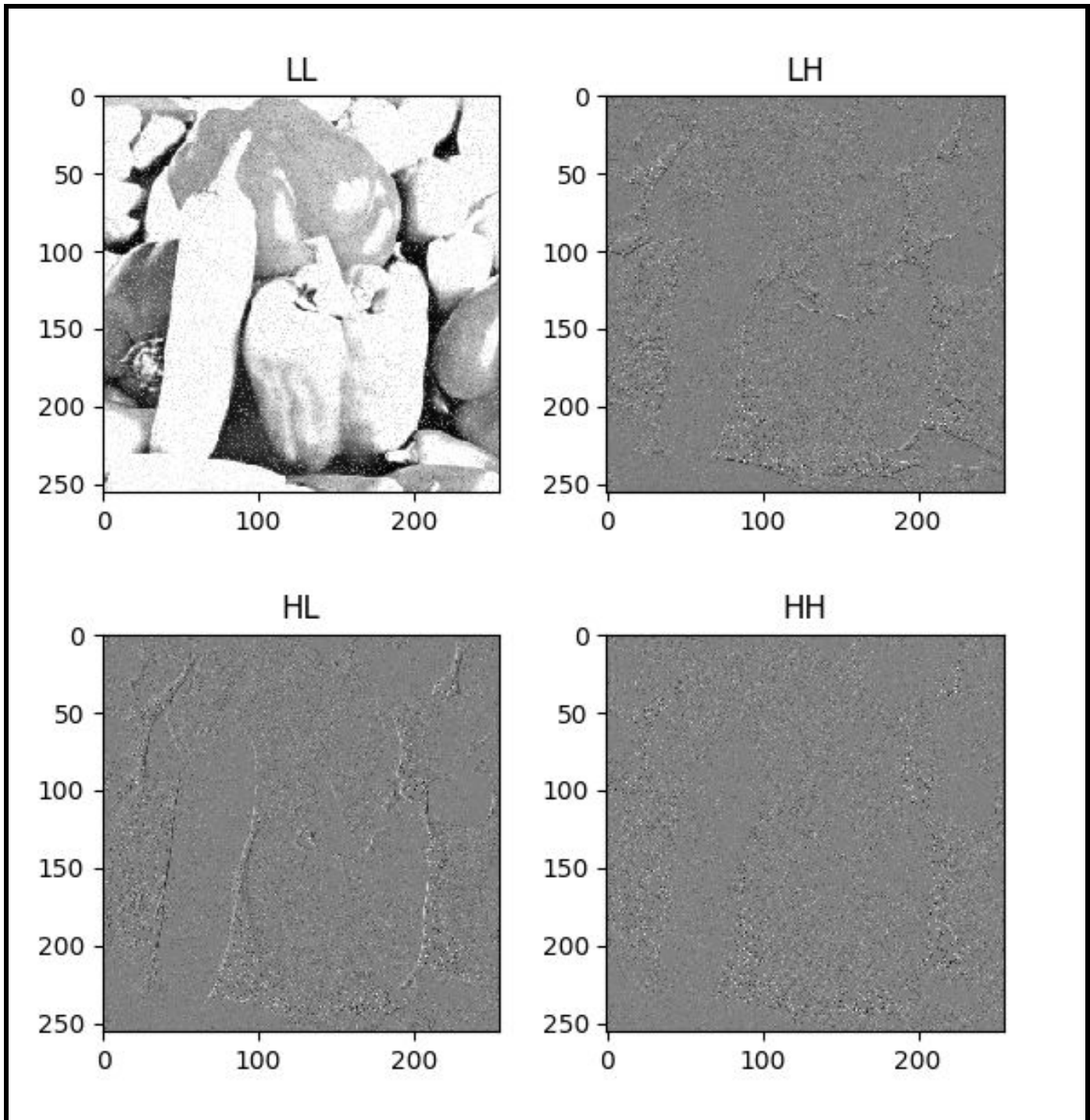


Difference:

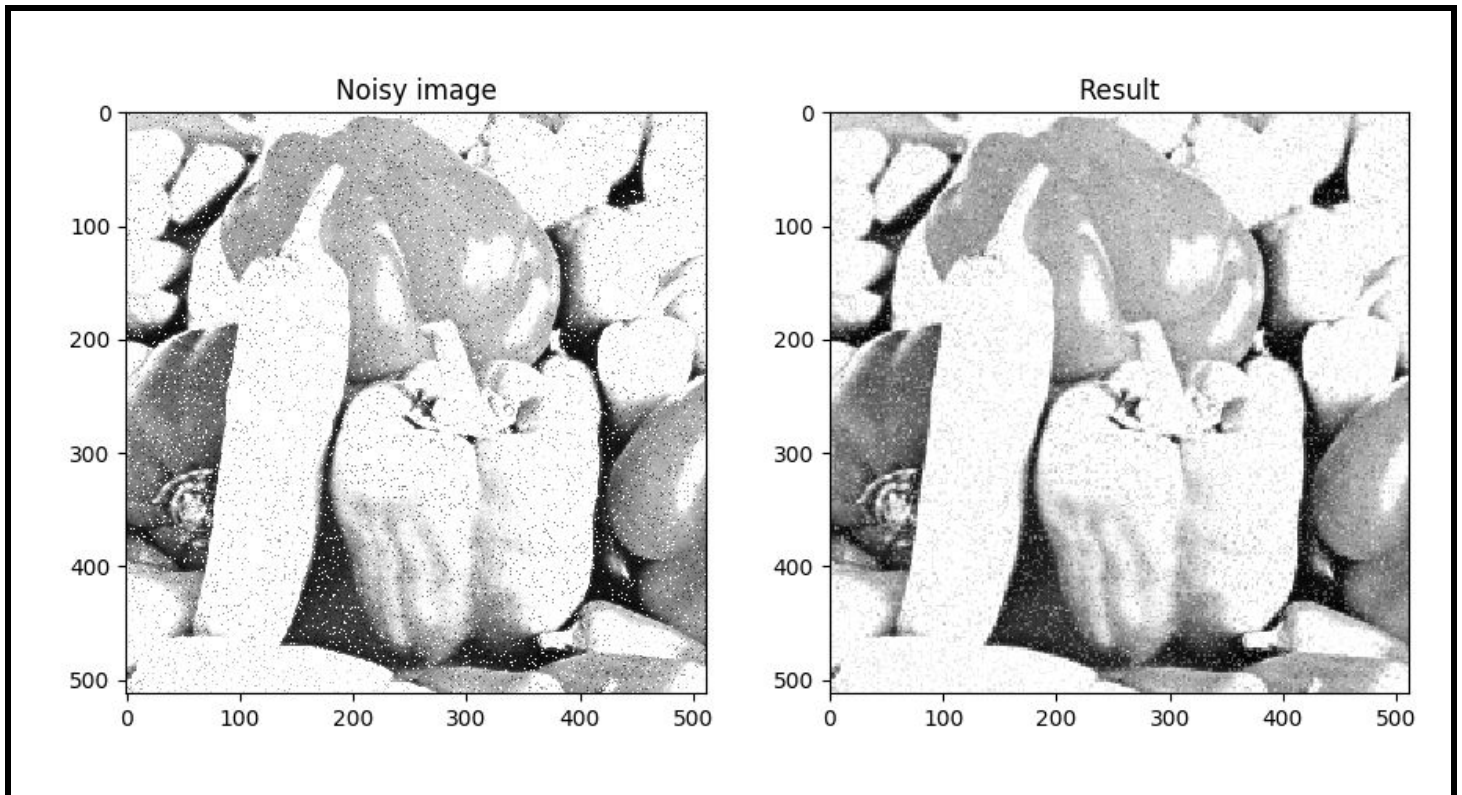
The difference image shows the soft edges on the left side. It is because of the different gaussian kernels used here.

Question 6: Perform wavelet decomposition and remove high-frequency components.

Wavelet Decomposition (Haar wavelet has been used):



After removing high-frequency components:

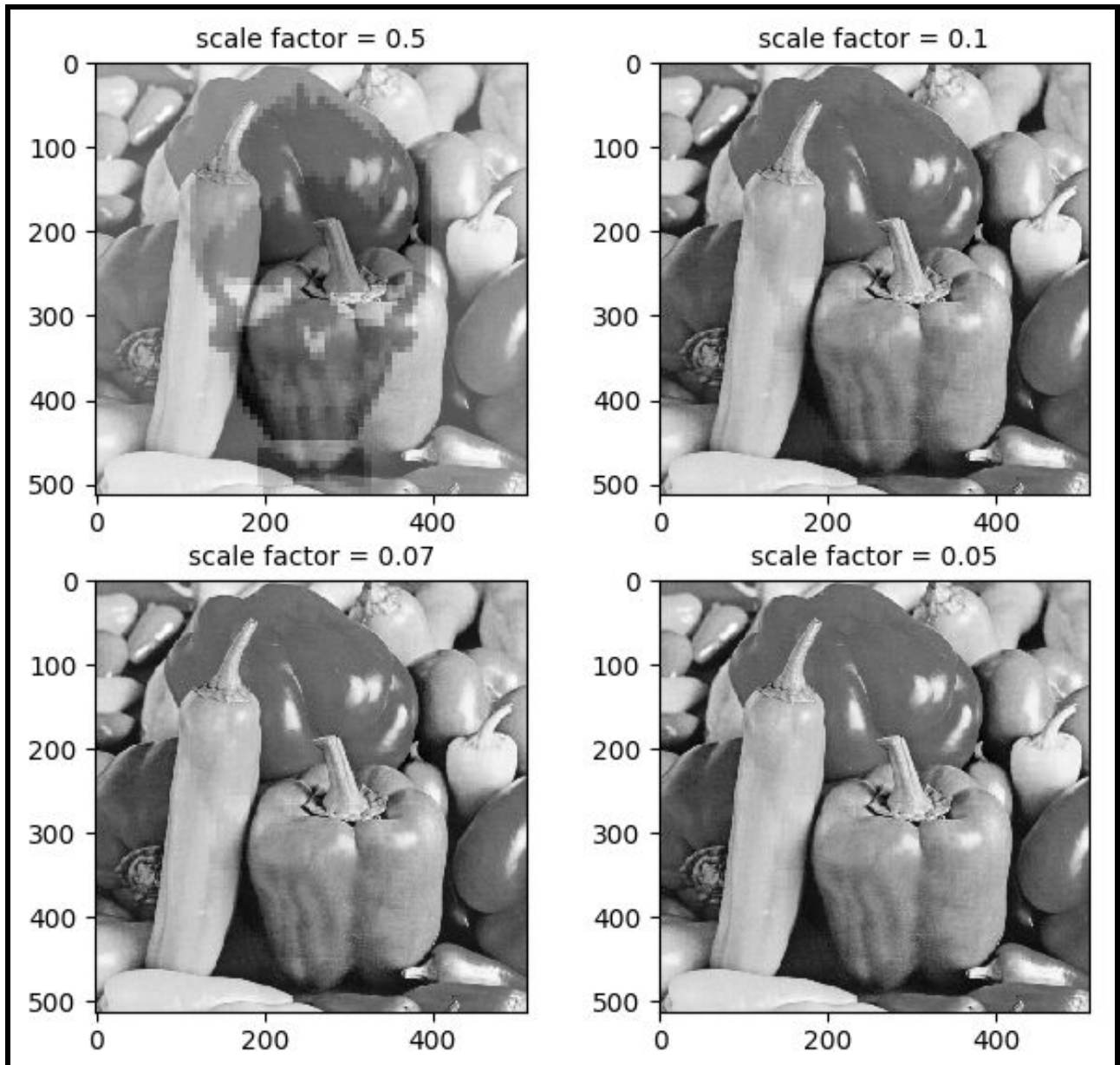


I have used soft thresholding with substitution to remove high-frequency components from the image.

Threshold: $3 \times \text{standard_deviation}(\text{LL subband})$

Substitution value: mean of the respective subband.

Question 7: Perform watermarking using DWT.



Watermark used:

