CV Assignment1

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1 Question 1

With increase in size of the kernel, effect of neighbours increases on the pixel value. This is because with increase in kernel value, more neighbour values participate in the average function. This also effects the blur of the image, greater the kernel value more is the blurriness.

For kernel size 3x3, 0 padding of size 1 is done along the borders of image.

For kernel size 5x5, 0 padding of size 2 is done along the borders of image.

For kernel size 11x11, 0 padding of size 5 is done along the borders of image.

For kernel size 15x15, 0 padding of size 7 is done along the borders of image.

2 Question 2

2.1 Part 1

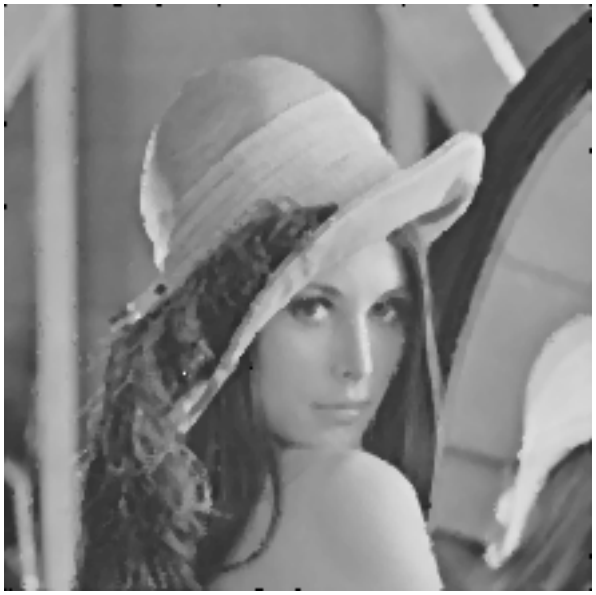
Noise is adding by assigning 255 or 0 values to random pixels of the image.
After adding 10% noise

After adding 20% noise

2.2 Part 2

In median filtering we took the median value from the kernel matrix. This method is useful for removing salt and pepper noise because salt(255) and pepper(0) values are very unlikely to get in the median of the values of kernel matrix.
With increase in kernel size the probability of the correcting the noise increases, this is because greater kernel matrix consider more number of neighbours and the proportion of the noise decreases.

For kernel size 3x3, 0 padding of size 1 is done along the borders of image. After adding 10% noise and then median filtering



For kernel size 5x5, 0 padding of size 2 is done along the borders of image. After adding 10% noise and then median filtering

For kernel size 11x11, 0 padding of size 5 is done along the borders of image. After adding 10% noise and then median filtering

With increase in kernel size also results in increased randomness in picture. In median filtering there is very less chance that the pixel retains it original value and by increasing the kernel size we further decrease this chance, hence picture loses its detail and results in blur image.

3 Question 3

Gaussian filtering is similar to the average filtering, it accounts for the values of the neighbours. Gaussian filter assigns weighted average of values within the kernel matrix. It assigns weight values to pixels (within kernel matrix) by using Gaussian distribution as follows :

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

Where (0,0) is the pixel coordinate to which the filter is applied.

For kernel size 3x3, 0 padding of size 1 is done along the borders of image.

For kernel size 5x5, 0 padding of size 2 is done along the borders of image.

For kernel size 11x11, 0 padding of size 5 is done along the borders of image.

For kernel size 15x15, 0 padding of size 7 is done along the borders of image.

Similar to average filter with increase in kernel size the blurriness of image increases, because more neighbour pixel values participate to estimate the value of original pixel value. In Gaussian filter we took weighted average so more weight is given to the original pixel value, hence it has less blurriness when compared to average filer of same kernel size.
Increasing standard deviation of the Gaussian filter reduces the filter value corresponding to the original value of matrix, increases the value of it's neighbours. This is because of more flattened with low peak Gaussian curve., this leads to increased blurriness in picture.

Following are the pictures by applying Gaussian filter with kernel size 5x5 and with varying standard deviation values.
With $\sigma = 1$:

With $\sigma = 3$:

With $\sigma = 5$:

With $\sigma = 7$:

With $\sigma = 10$:

4 Question 4

Gaussain Pyramid is constructed as follow :
For level 1 original image is considered.

For level 2, First the Gaussian filter is applied to level 1 of Gaussian pyramid and then is down-sampled to half of the original size.

For level 3, First the Gaussian filter is applied to level 2 of Gaussian pyramid and then is down-sampled to half of the original size.

Laplacian pyramid is constructed as follows :
For level 1, the G2 (Gaussian level 2) is up sampled and then subtracted from G1.

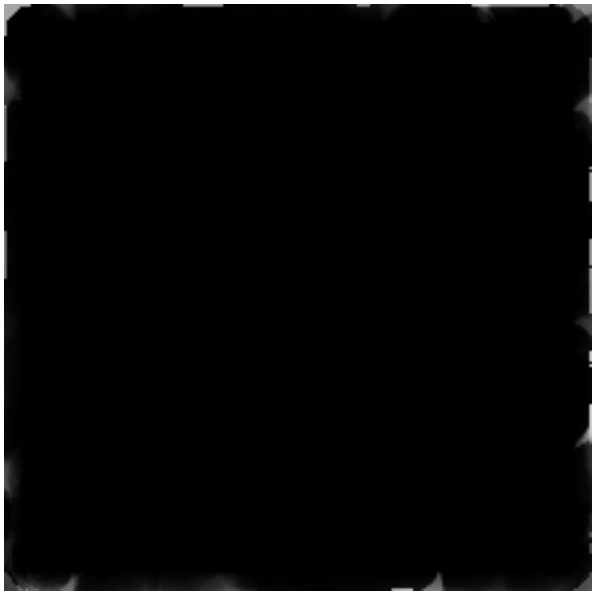
For level 2, the G3 (Gaussian level 3) is up sampled and then subtracted from G2.

For level 3, the G4 (Gaussian level 4) is up sampled and then subtracted from G3.

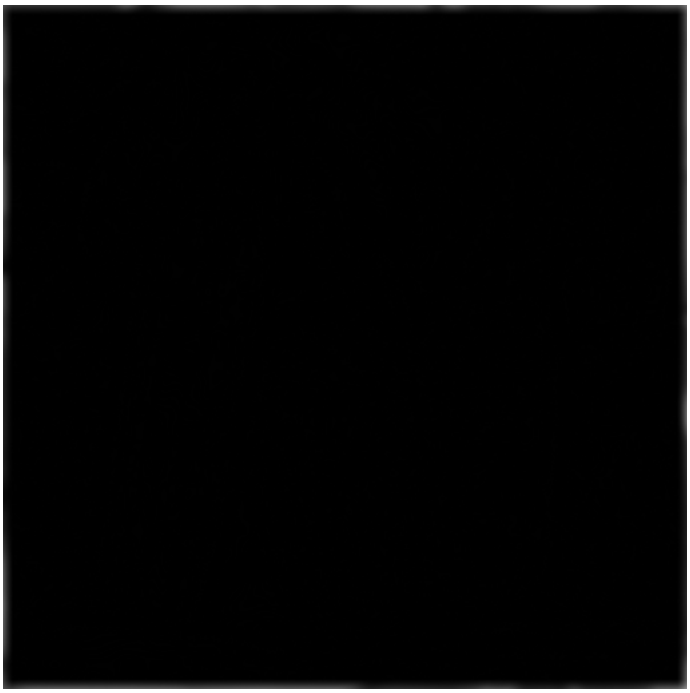
5 Question 5

Results by subtracting(Absolute difference) library output to our output image we get the following result using average filter :
Average filter with kernel size 15.

Median filter with kernel size 15, there is some difference along the edges which is because I considered zero padding along the edges.



Gaussian filter with kernel size 15, there is some difference along the edges which is because I considered zero padding along the edges.



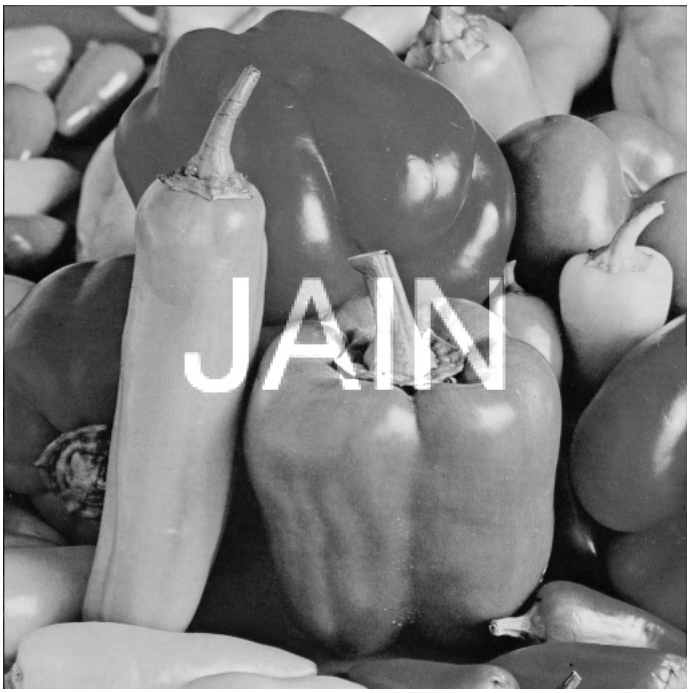
There exist minute differences between the inbuilt and self made filters, but they are so small that they all appears to be white. To enhance the differences we can multiply this image with some constant so as to notice the some differences.

6 Question 6

First the image is constructed by adding the noise image and the image's laplacian output image. Then discrete wavelet transformation is done so as to separate the high frequency information of the image. since the noise is the high frequency information so we set the HL,LH and HH band to 0, and then took the inverse wavelet transformation and the output is as follows :

7 Question 7

Watermarking is done by adding the watermark image to LL band then taking the inverse wavelet transformation. Watermarking is done only on the low level (LL) band to retrieve the high frequency information (edges) of the original image (Watermark is supposed to be behind the image).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