5. Go through all the filters which are available and get a thorough understanding why and how these filters are used, if possible, make a note of them.

Answer:

The filter and their details are given below:

Gaussian filter: It is a filter which is used in image processing for smoothing the image and reducing the noise. Gaussian filters are very good at removing random, subtle image noise patterns. The smoothing of edges causes the blurring of the image, when we increase the value of "σ" I.e. standard deviation the smoothing of edges increases while blurring also increase which cause the loss of useful information.

Bilateral filter: The bilateral filter is used in image processing is a non-linear filter to remove the noise while preserving the edges of the images. Unlike the normal gaussian filter it use two gaussian filter- "spatial gaussian and brightness gaussian". The pixel that are not of similar intensity with the middle pixel lower weight and thus it helps to maintain the edges and remove the noise better.

Mean filtering: mean filtering involves the replacement of each pixel's value with the average value of its neighbouring pixel. In case of mean filtering, it is used for the smoothing and noise removal while preserving its essential features. It is a non-linear filter. When we increase the size of the kernel the noise removal and smoothing degree increase but essential feature and details lost

Sobal filter: Its is use to detect edges within images, which is further used in various edge detection algorithms. Sobel filter is a compact integer based filter which is applied both in horizontal and vertical direction of an image. The sobel filter calculates the gradient descent at each point of the image and apply two convolution horizontall and vertical. Horizontal convolution help to detect vertical edges and vertical convolution helps to identify horizontal edges.

Laplacian filter: Laplacian filter is one of the filter which is used for edge detection. They highlight regions of rapid intensity change and can enhance edges. It is better in case where precise location of edges are required. Sobel filters are single derivative filters, that means that they can only find edges in a single dimension. But with Laplacian filter, we can get edges in both dimensions, thus we take double derivative of the intensity. Laplacian filter is a very sensitive to the noise so first we use gaussian to smooth and remove noise in the picture and then we try to use the Laplacian filter.

Figure 1: before processing

So in the second part of the question, I treid to use this filter on this picture and here are some snapshots of the processed picture after applying three filters. The collab of this I have uploaded on the github link.

After applying mean filter:

After applying gaussian filter:

After applying sobel filter: