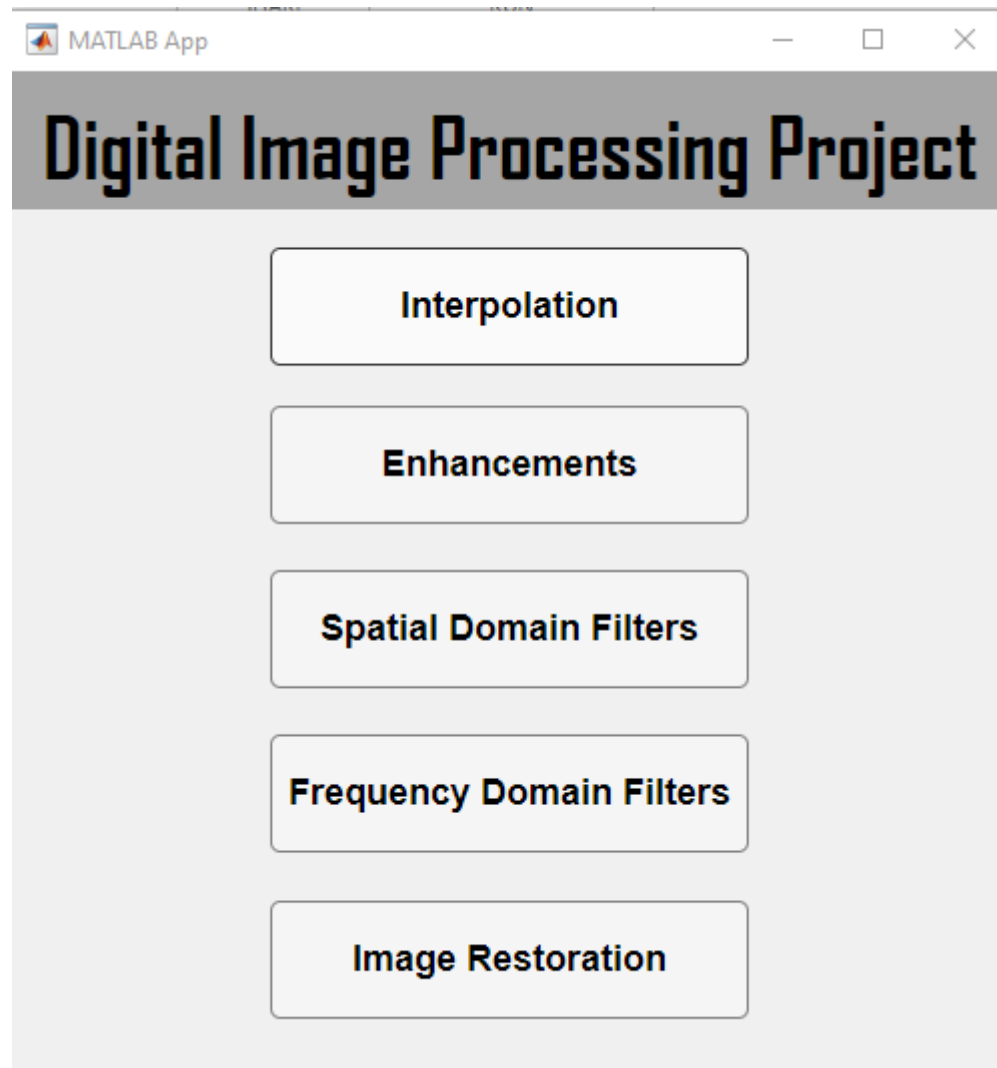# Digital Image Processing (Project)

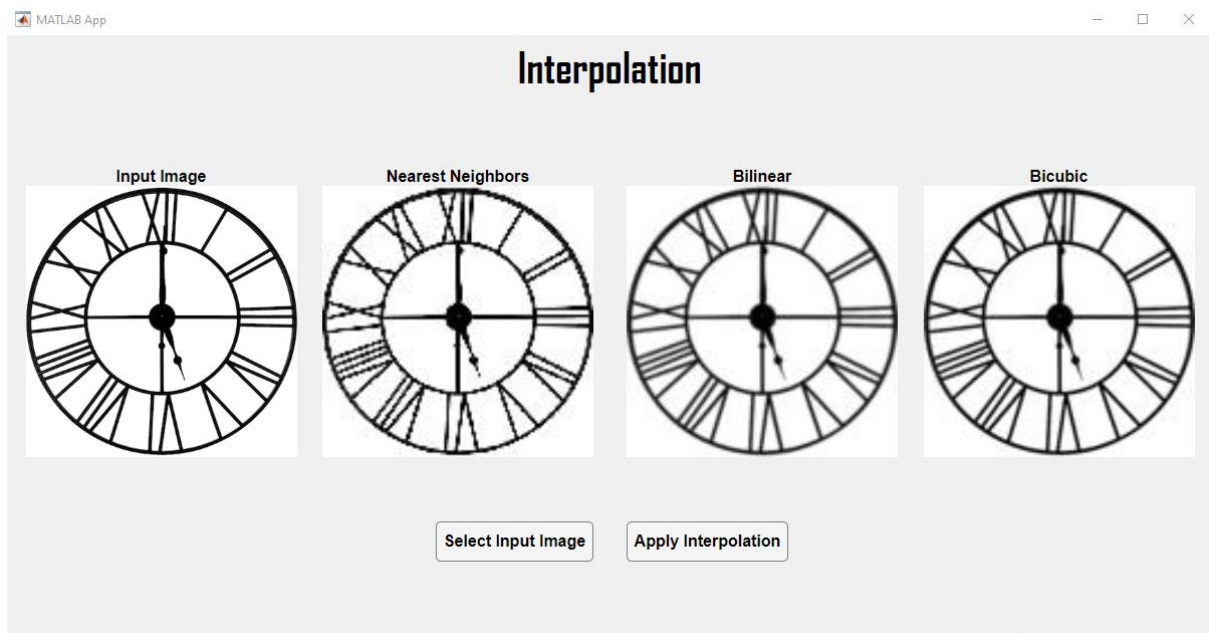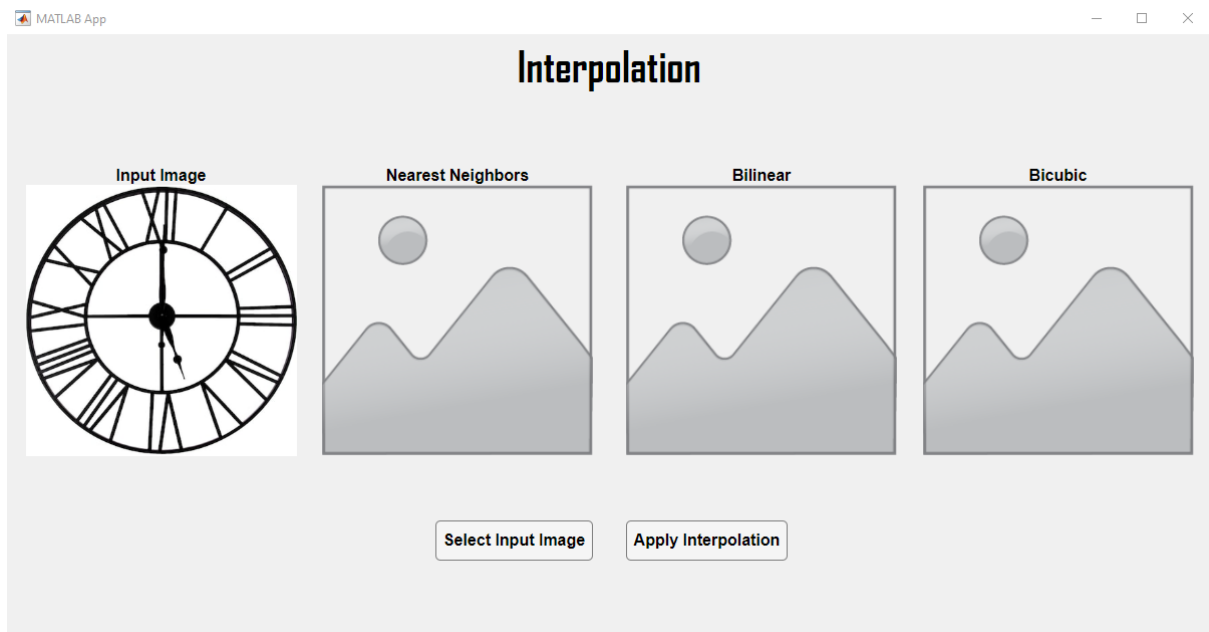## Submitted by:
Sagar (023-19-0042)

Instructor:
Dr. Ghulam Murtaza Memon

Main Window:

MATLAB App

Digital Image Processing Project

Interpolation

Enhancements

Spatial Domain Filters

Frequency Domain Filters

Image Restoration

MATLAB App

Interpolation Window:

- Image interpolation works in two directions, and tries to achieve a best approximation of a pixel's color and intensity based on the values at surrounding pixels. Shrinking image using nearest neighbors, bilinear, and bicubic methods result in different outputs. We can see the distortion in nearest neighbors method compared to others since it is the most basic interpolation method.

Enhancements Window:
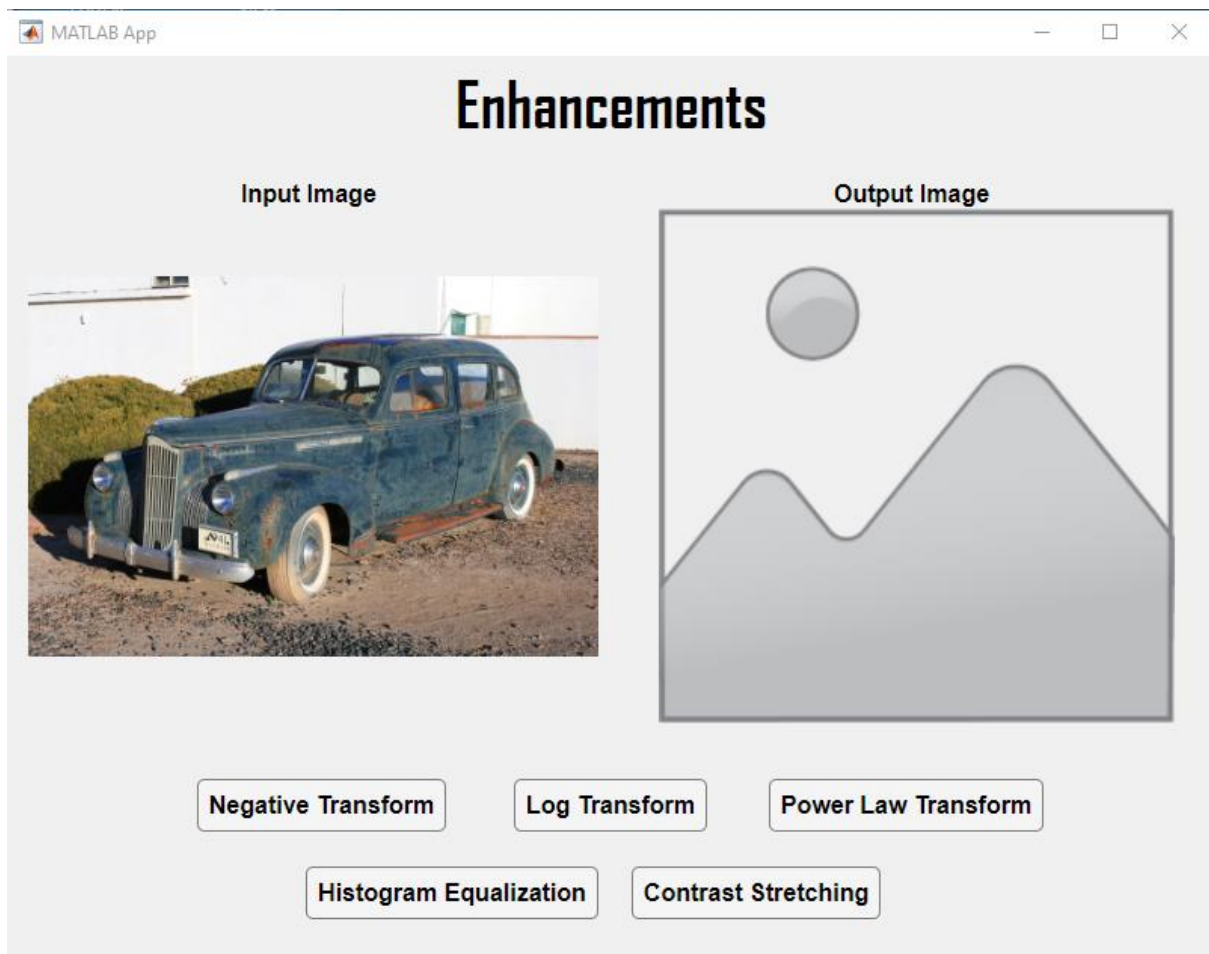
Negative Transform: Image Negative is a typical grey scale transformations that does not depend on the position of the pixel in the image. It reverses the gray level order.
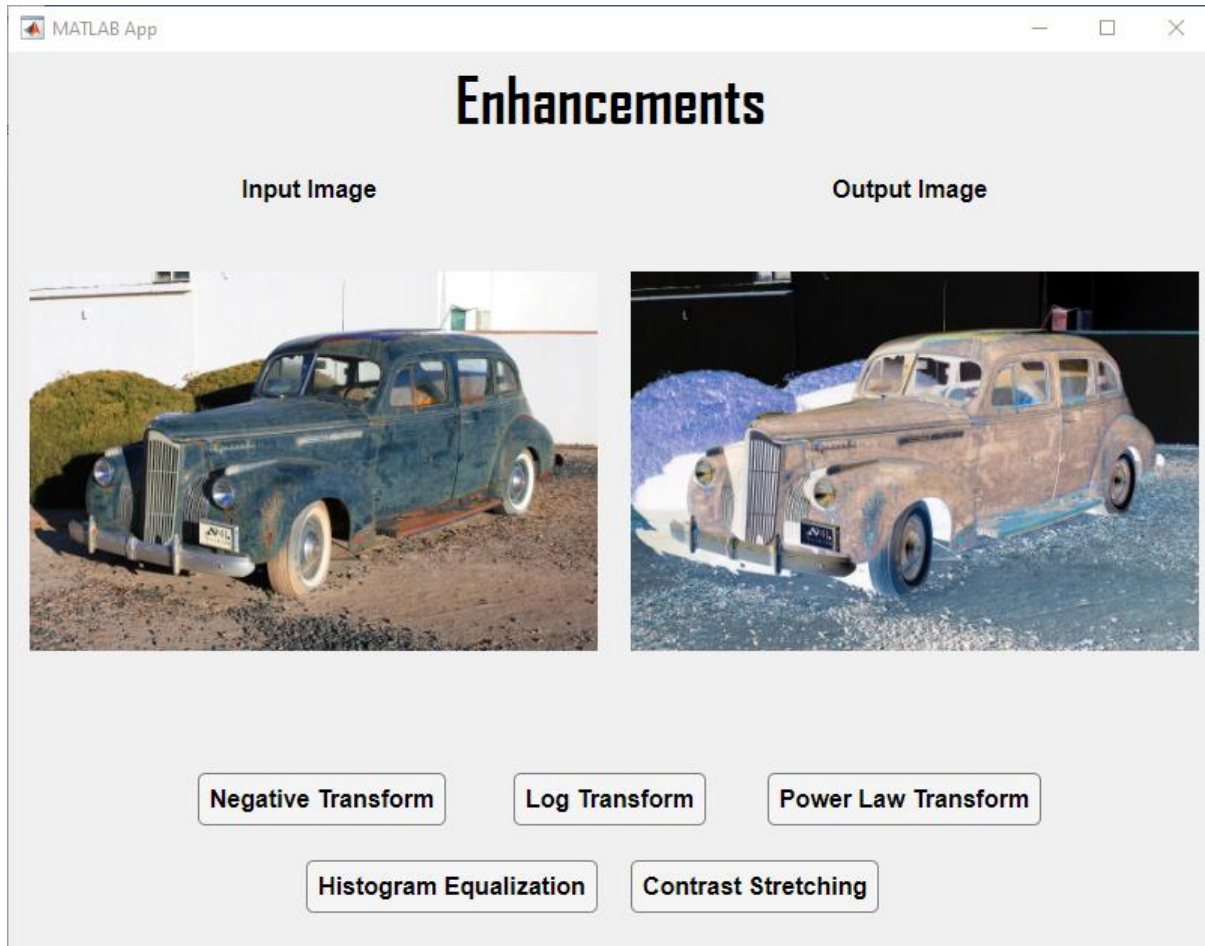
Log Transform: Log Transformation is particularly useful when the input gray level values may have an extremely large range of values.

- For lower amplitudes of input image the range of gray levels is expanded.
- For higher amplitudes of input image the range of gray levels is compressed.
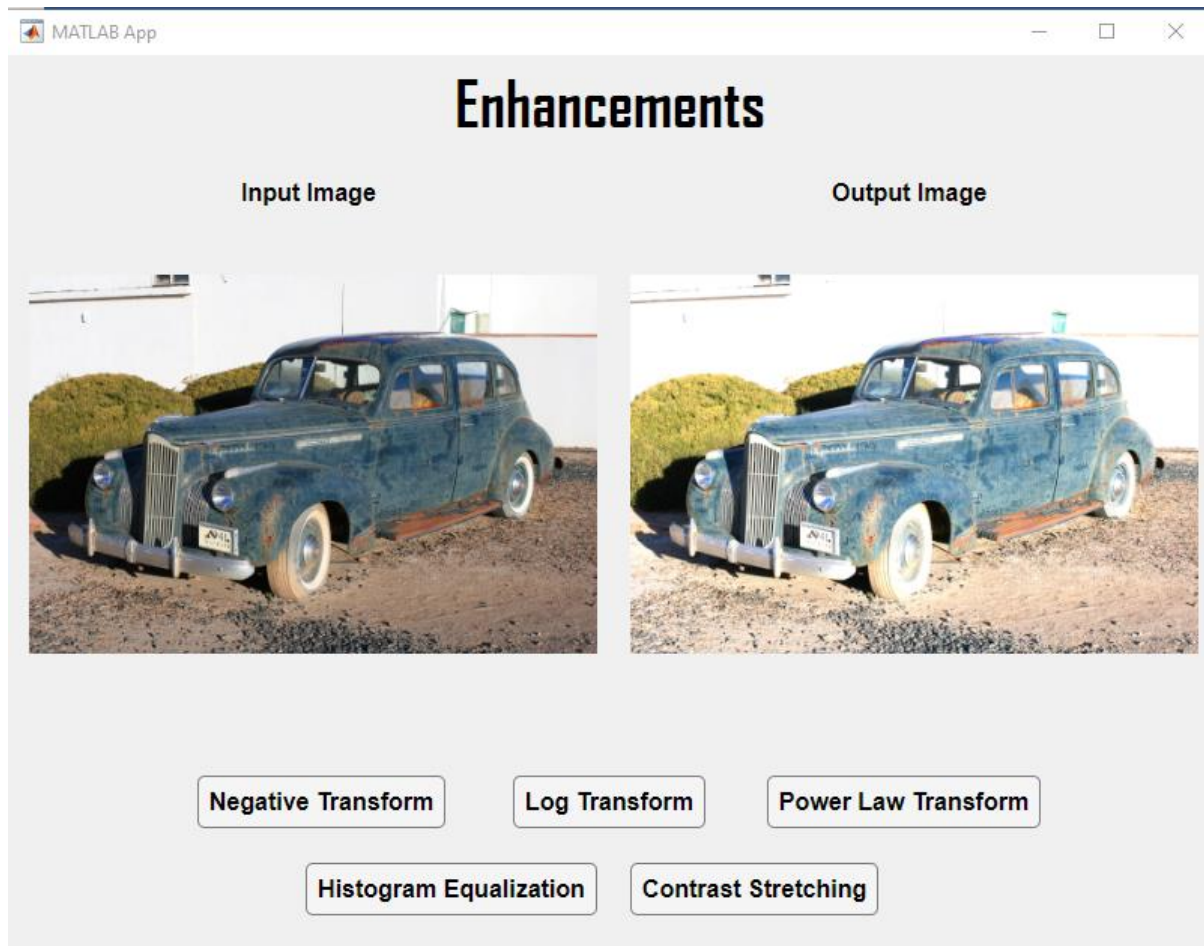
Power Law Transform: It map a narrow range of dark input values into a wider range of output values and vice versa.
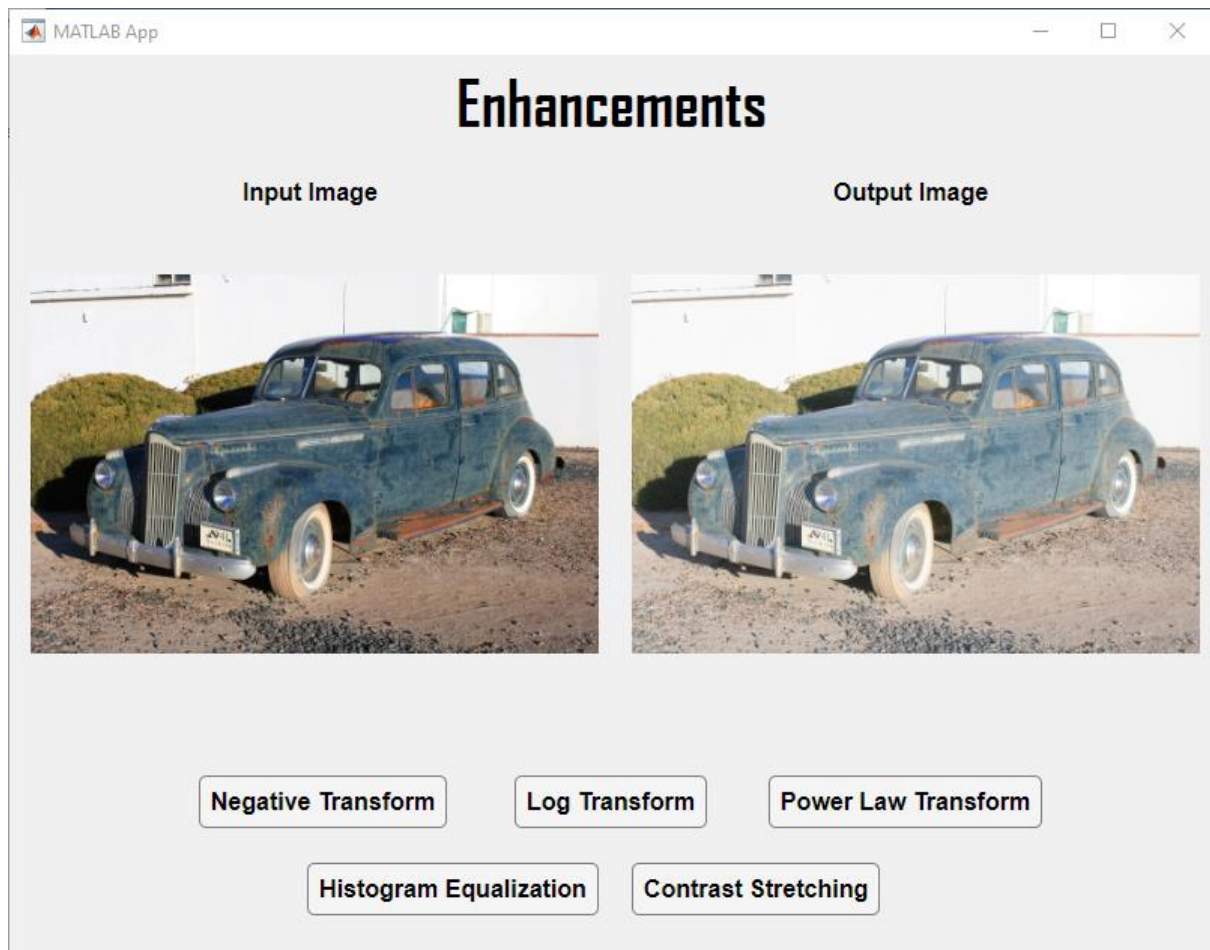
Histogram Equalization: Histogram Equalization is a computer image processing technique used to improve contrast in images. It accomplishes this by effectively spreading out the most frequent intensity values, i.e. stretching out the intensity range of the image.
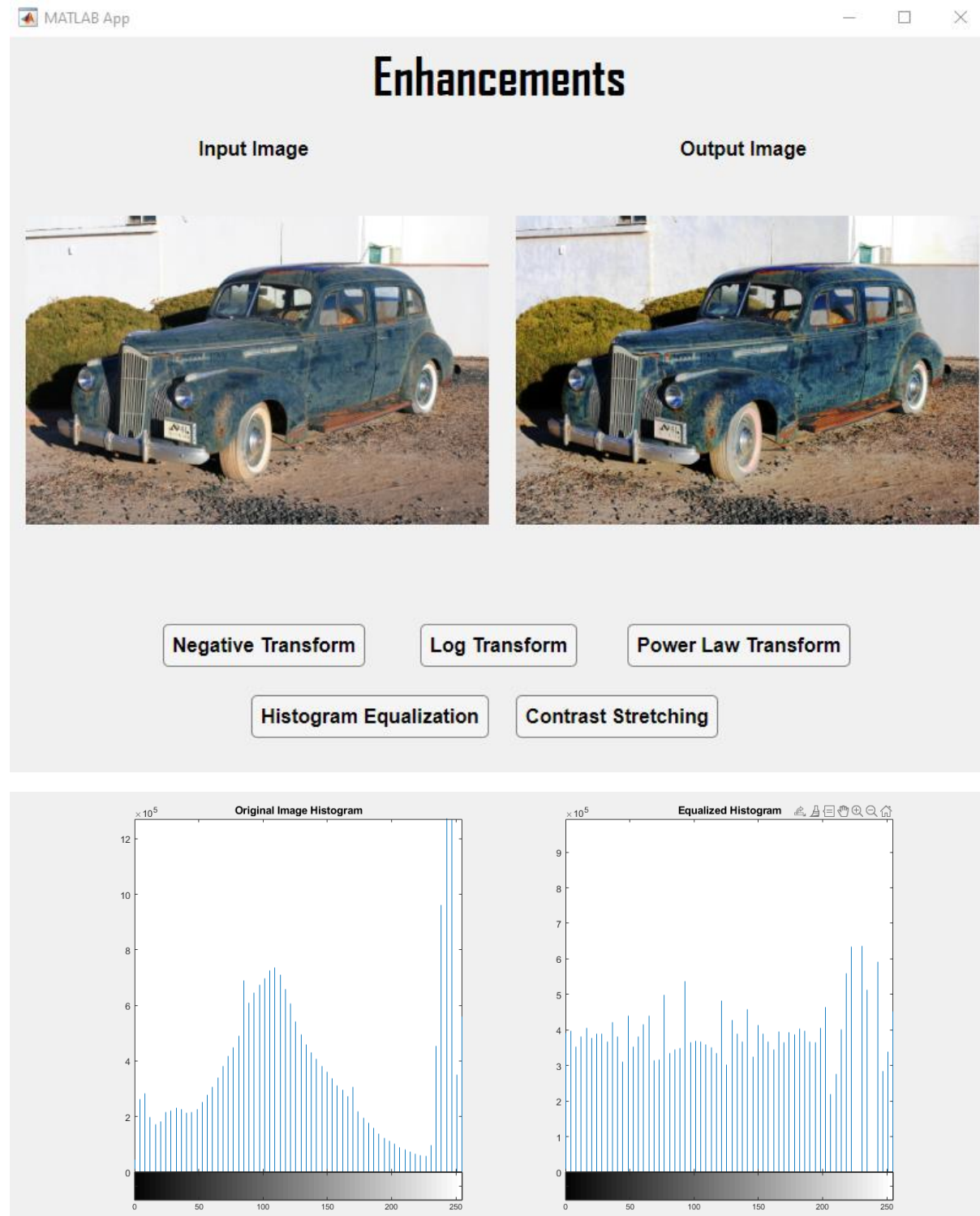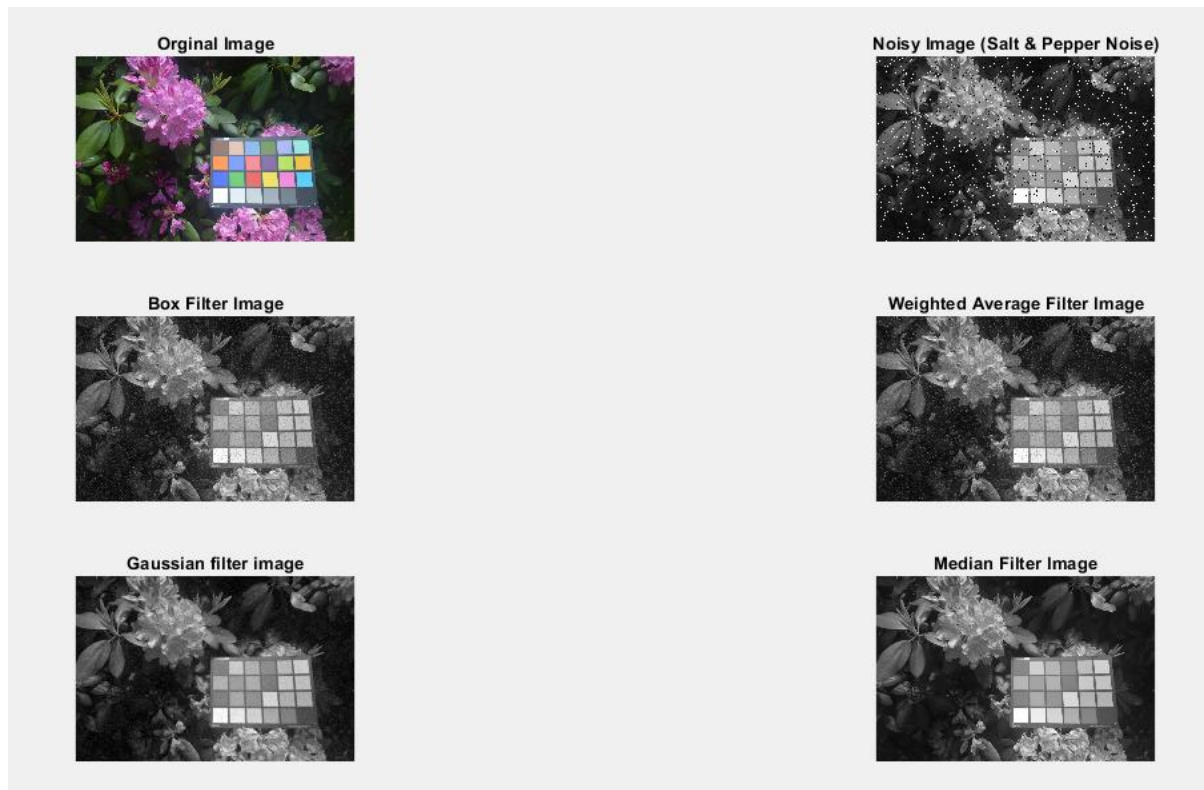
Contrast Stretching: Contrast stretching (often called normalization) is a simple image enhancement technique that attempts to improve the contrast in an image by `stretching' the range of intensity values it contains to span a desired range of values, e.g. the full range of pixel values that the image type concerned allows.
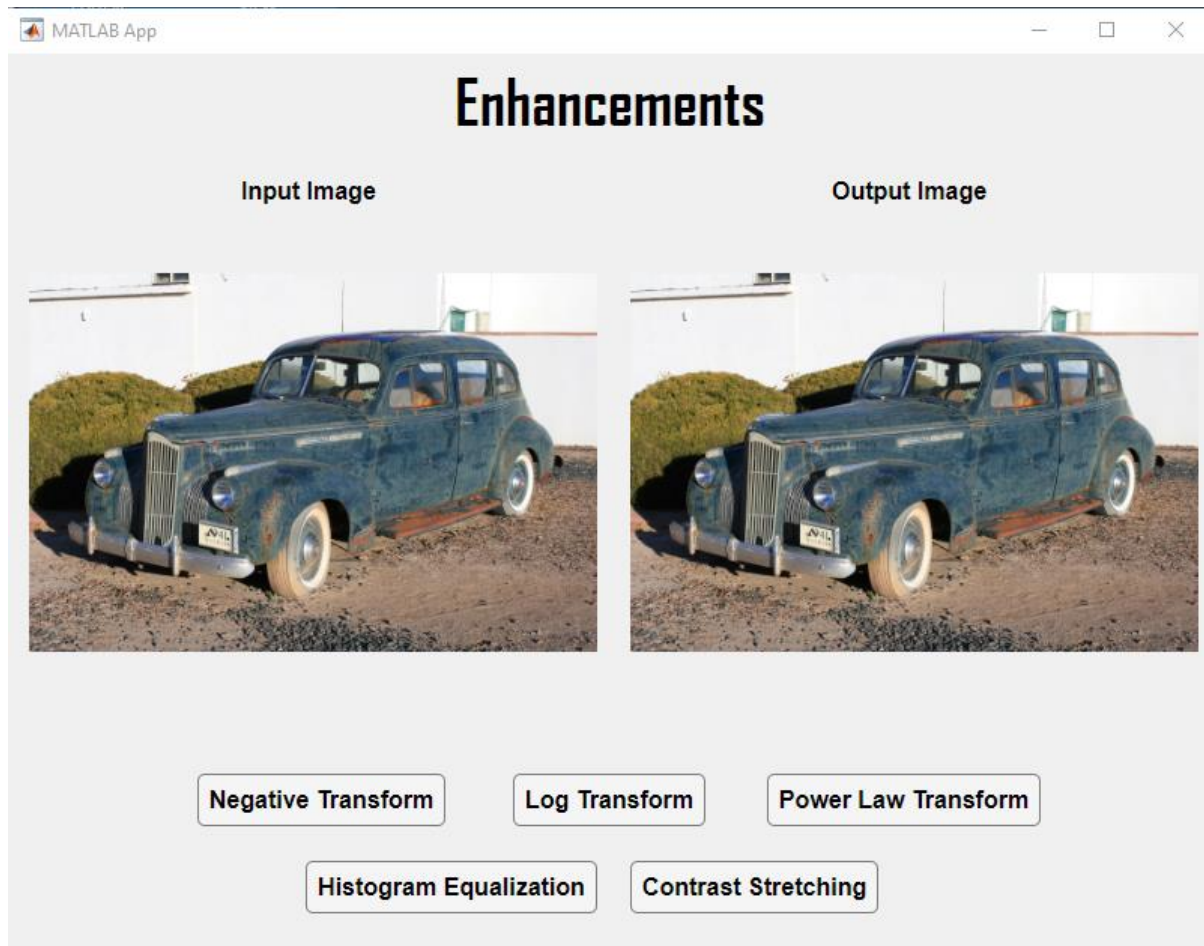
Spatial Domain Filters Window:
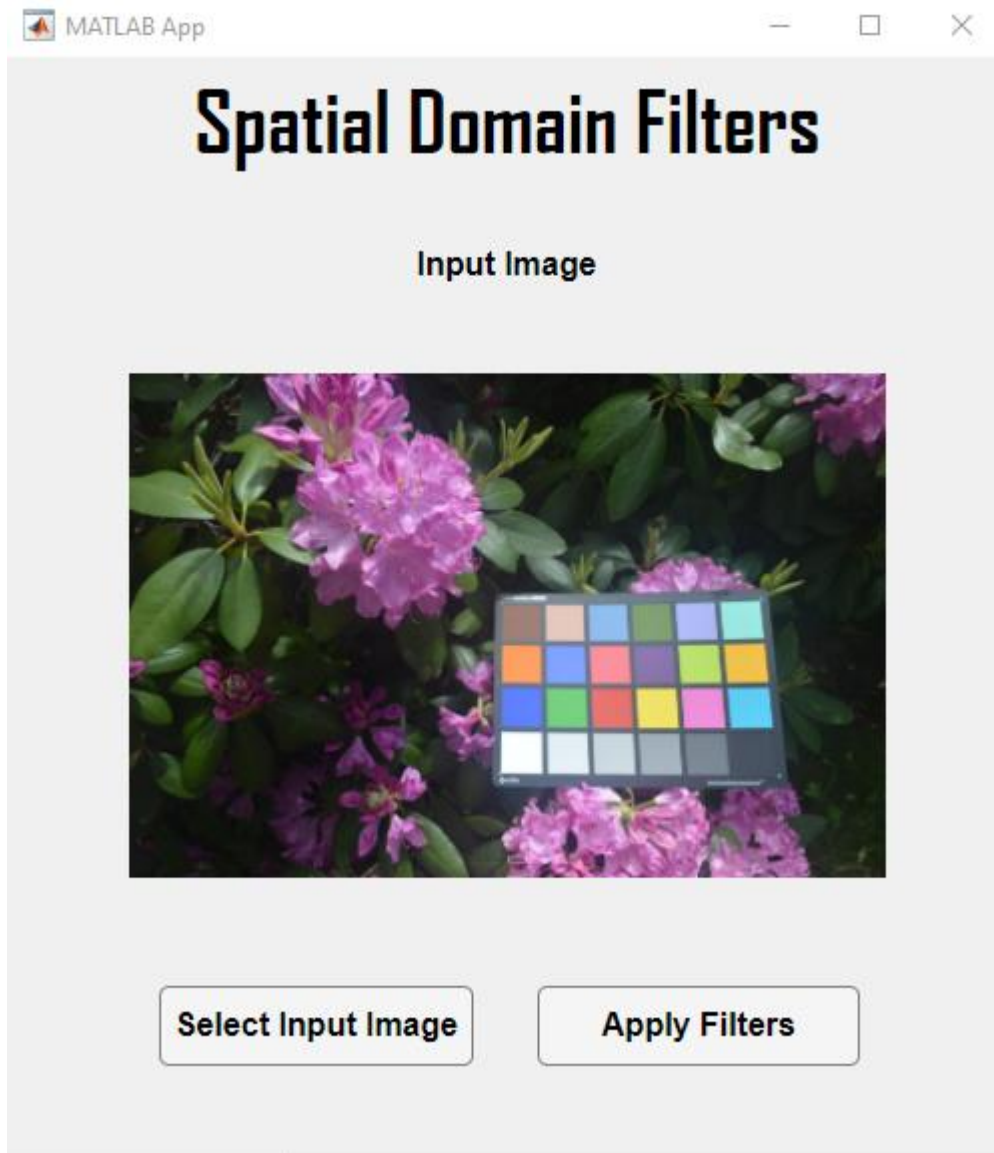
- **Box Filter** is a low-pass filter that smooths the image by making each output pixel the average of the surrounding ones, removing details, noise and edges from images.
- In **weighted average filter**, we give more weight to the center value, due to which the contribution of center becomes more than the rest of the values. Due to weighted average filtering, we can control the blurring of image.
- A **Gaussian Filter** is a low pass filter used for reducing noise (high frequency components) and blurring regions of an image.
- **Median filter** is a nonlinear filter used to remove noise from images. It is widely used as it is very effective at removing noise while preserving edges. It is particularly effective at removing 'salt and pepper' type noise pixel, over the entire image.

Original Image — Laplacian filter -4 — Org image + Laplacian -4 — Org image + Laplacian -8
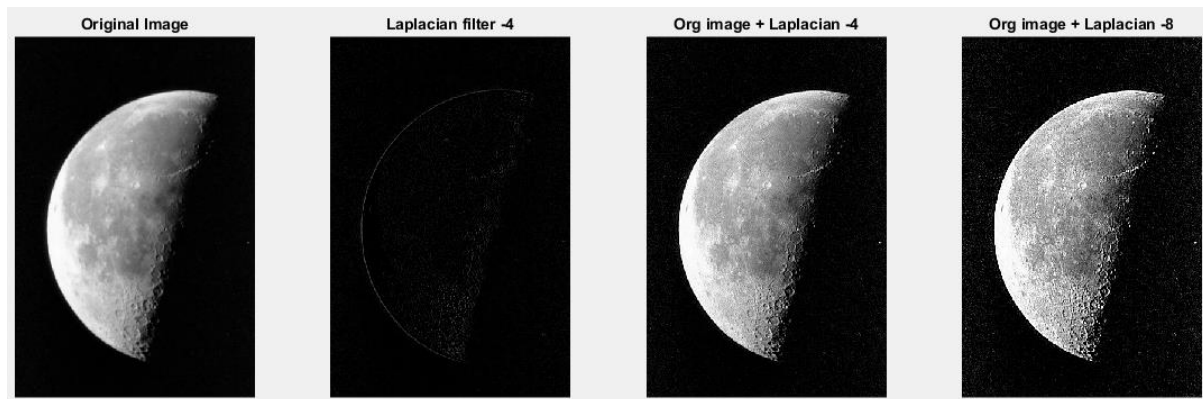
- A **Laplacian filter** is an edge detector used to compute the second derivatives of an image, measuring the rate at which the first derivatives change. This determines if a change in adjacent pixel values is from an edge or continuous progression.

Orginal image — Sobel Gradiant — x-direction Sobel — y-direction Sobel
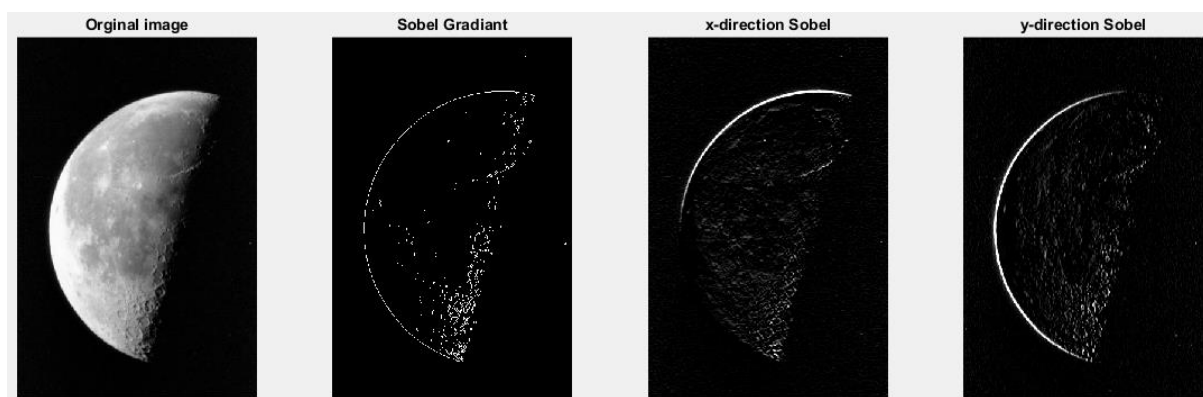
- The **Sobel filter** is used for edge detection. It works by calculating the gradient of image intensity at each pixel within the image. It finds the direction of the largest increase from light to dark and the rate of change in that direction.

Frequency Domain Filters Window:

Original Image   IDEAL Lowpass filter   BUTTERWORTH Lowpass filter
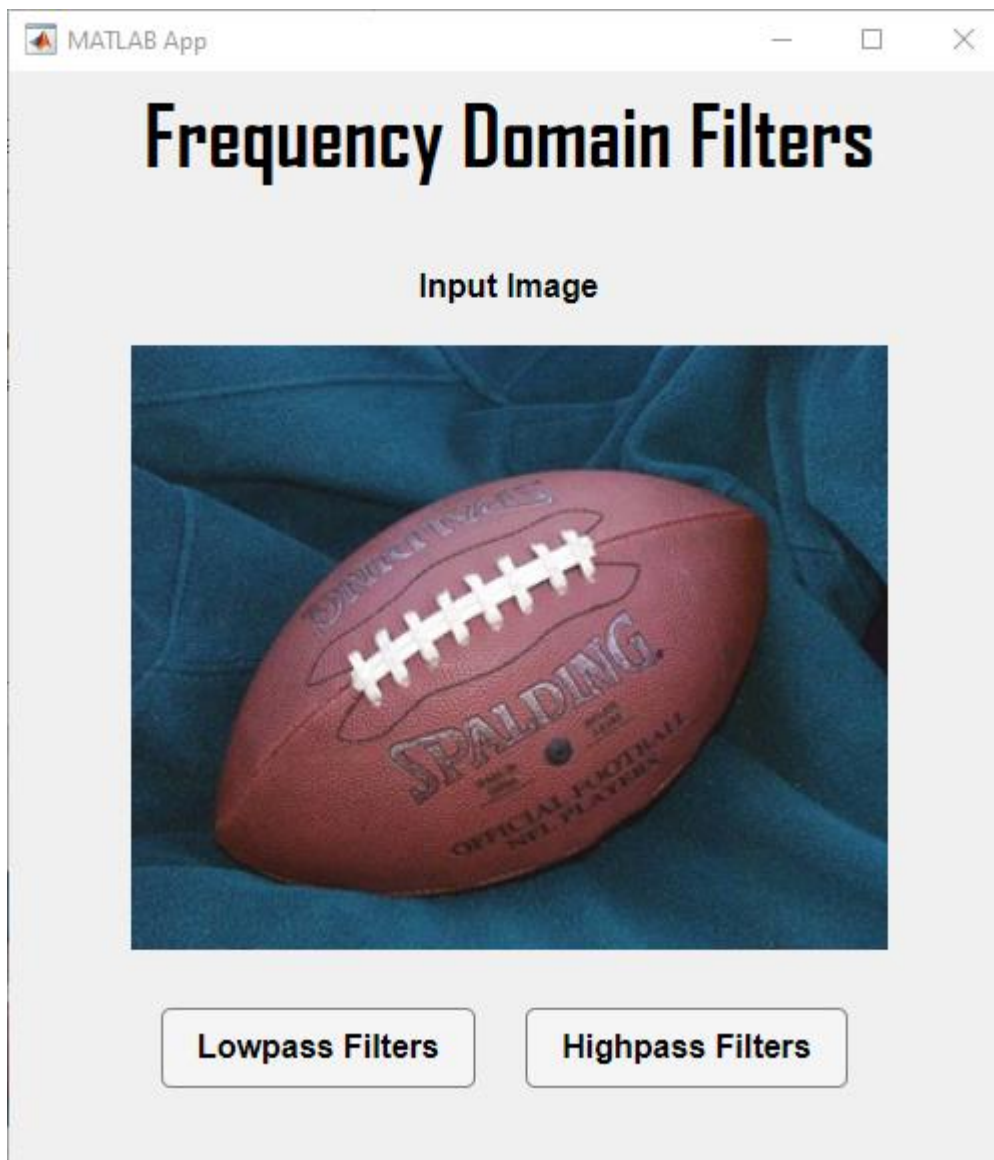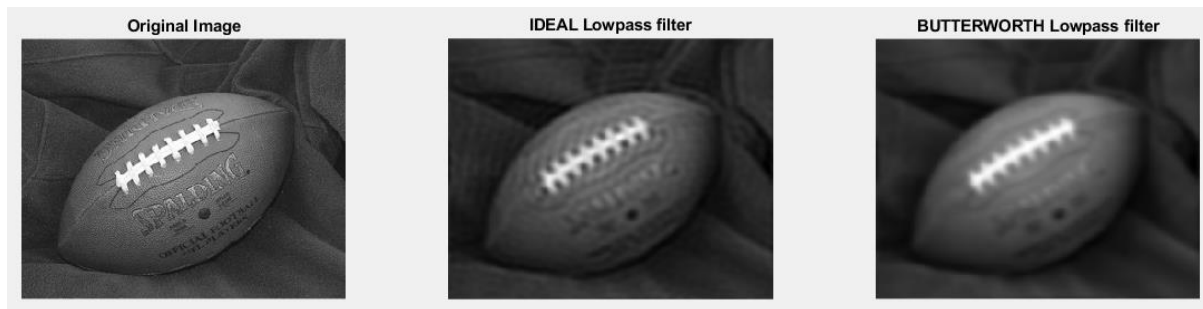
- **Ideal Lowpass Filter (ILPF)** and **Butterworth Lowpass Filter (BLPF)** are used for image smoothing in the frequency domain. It removes high-frequency noise from a digital image and preserves low-frequency components from the origin without attenuation and cuts off all the frequencies outside the circle.

Orginal Image   IDEAL Highpass filter   BUTTERWORTH Highpass filter

- **Ideal Highpass Filter (IHPF)** and **Butterworth Highpass Filter (BHPF)** are used for image sharpening in the frequency domain. Image Sharpening is a technique to enhance the fine details and highlight the edges in a digital image. It removes low-frequency components from an image and preserves high-frequency components.
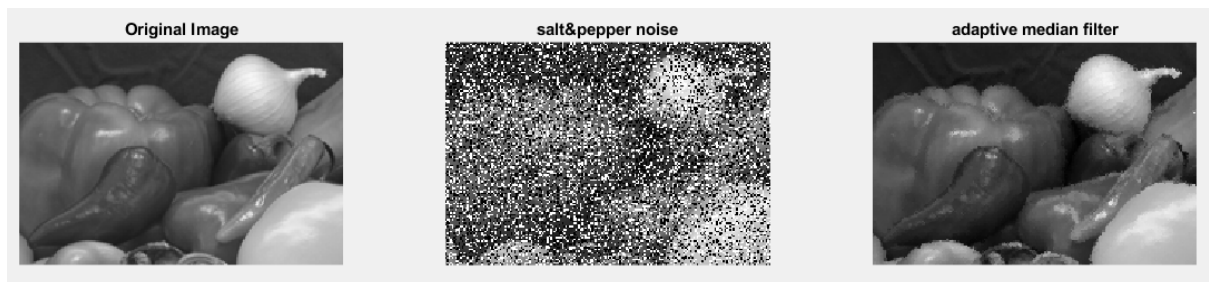
Image Restoration Window:

Geometric Mean Filter: The geometric mean filter is an image filtering process meant to smooth and reduce noise of an image. It is based on the mathematic geometric mean.
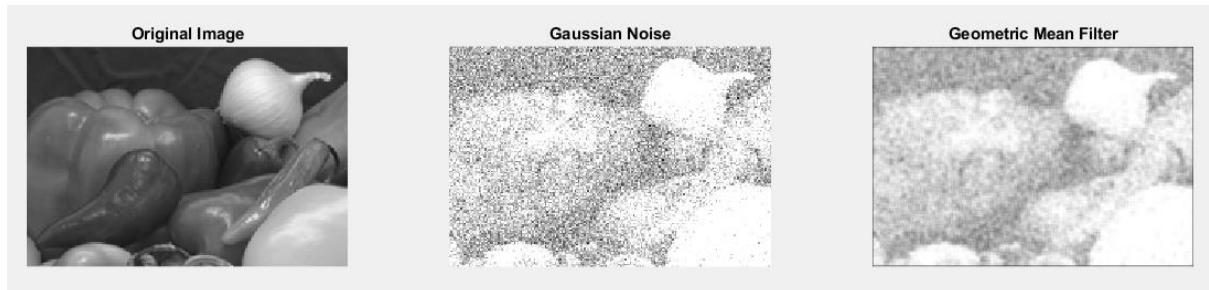
Adaptive Median Filter: An adaptive median filter is used for the restoration of gray scale images that are highly corrupted by salt and pepper noise.

Median Filter: Median filtering is a nonlinear method used to remove noise from images. It is widely used as it is very effective at removing noise while preserving edges.

Original Image

salt&pepper noise

median filter for one time

median filter for two times

median filter for three times