Faculty of Engineering
Cairo University

Computer Vision

Task I

Team 7

Name	ID
Ahmed Hassan	9202076
Dina Khalid	9202529
Abdelrahman Yasser	9202808
Mohammed Nasser	9203348
Mahmoud Rabea	9203396

-

Table of Contents

<u>**Noise functions**</u>

We add different types of noise to an image according to user.

- Gaussian Noise: we can change its value from mean and standard deviation, as it follows normal distribution.

  These are different gaussian noise with different Sigma.

- Salt and Pepper noise:

  Also known as impulse noise, it white and black dots in our image.

  Ex: we make random points to be white and random points to be black.

- Uniform noise:

  For each pixel in the image we generate a random number that follows uniform distribution.

  Ex:

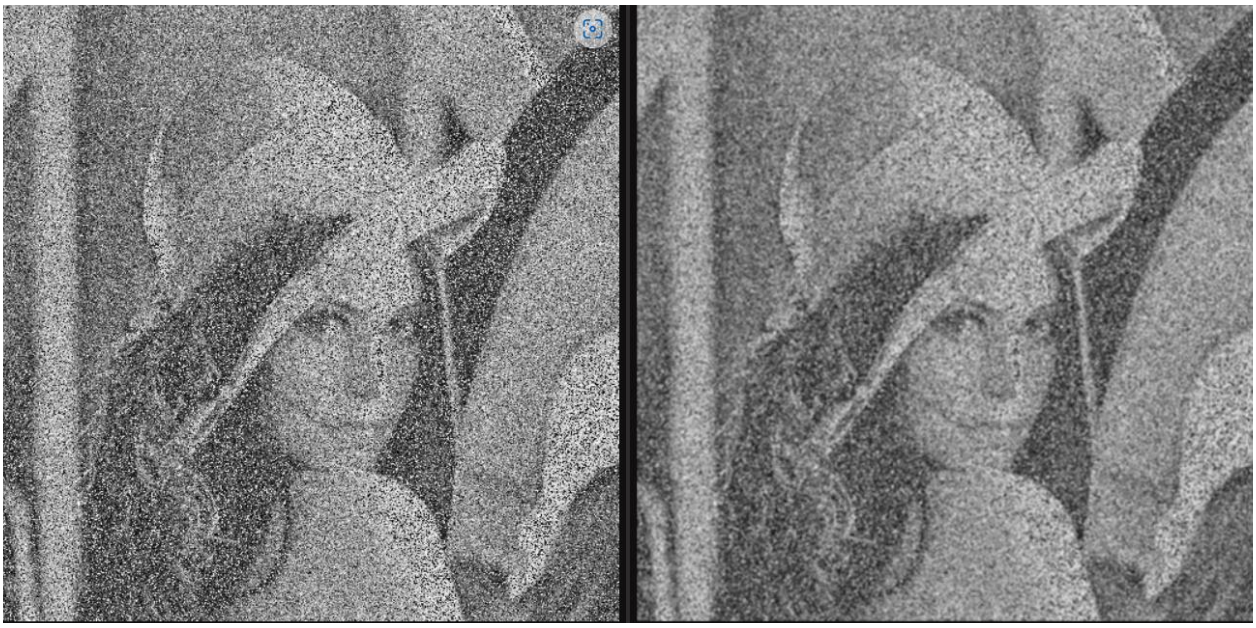
Filters

- Median Filter with salt and pepper noise:

  this filter is best filter to remove effect of salt and pepper noise, this filter moves kernel on image with specific size and take the median of kernel size pixels.

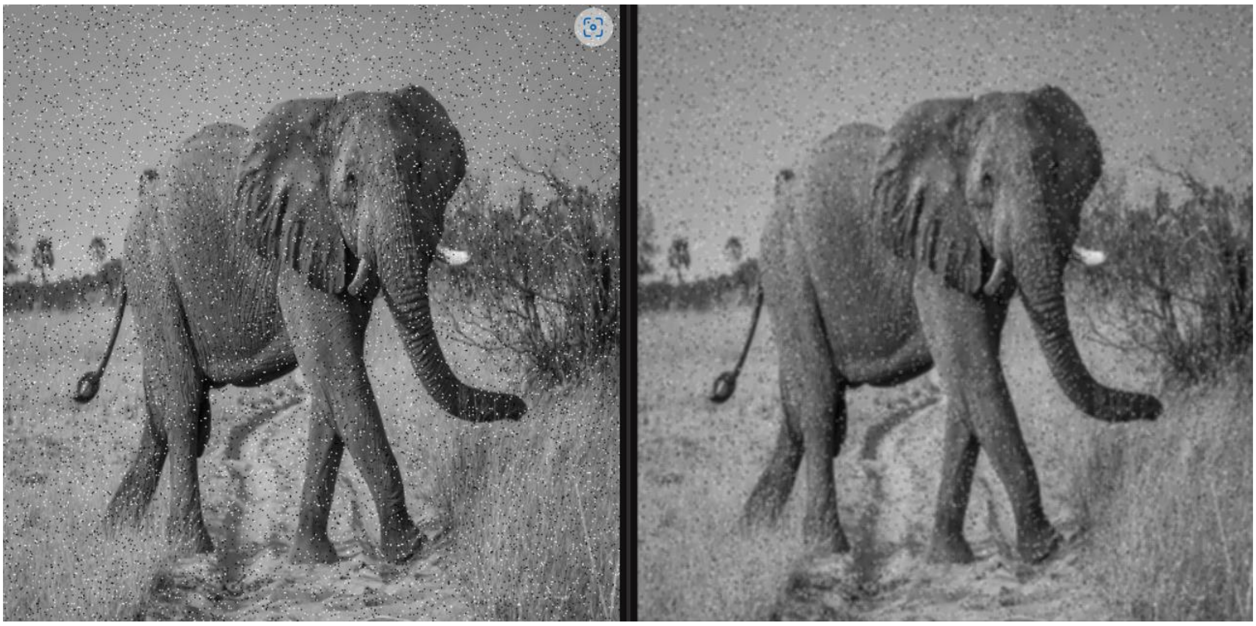
- Gaussian Filter with Gaussian noise

  this filter kernel changes when you change sigma of the filter and then we make convolution for this kernel with image



- Averaging Filter with S&P noise

  averaging filter consist of kernel of ones and make convolution of this kernel with image, this method take the average of pixels.



- High pass Filter

  high pass filter in frequency domain as we make fourier for image to get it’s frequency response then cut from center (dc freq) and keep frequencies far from center that repersent high frequency (high variations only pass)

- Low pass filter

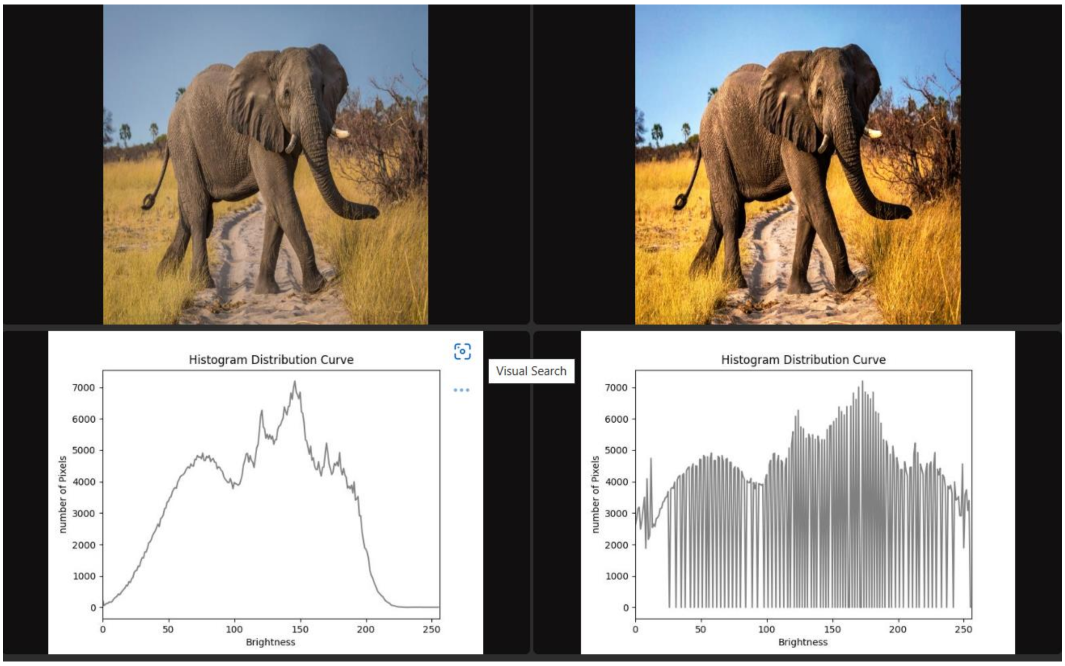
  this filter take most of (low frequencies) from frequency domain of image so it take dc and the small variations and image appear blurred.

Histograms

we Compare The original image with the output image of histogram equalization and their histograms.

We first Calculate the histogram array which iterates over the image to calculate different frequencies of image's intensities then we calculate the cumulative distribution of the pixel values.

Which depends on calculating Probability distribution function (PDF) after calculating PDF we sum each pixel value intensity with its previous values after that we multiply their values with the maximum value of the pixel we then round the values to the nearest integer after that we map the new values to their frequencies.



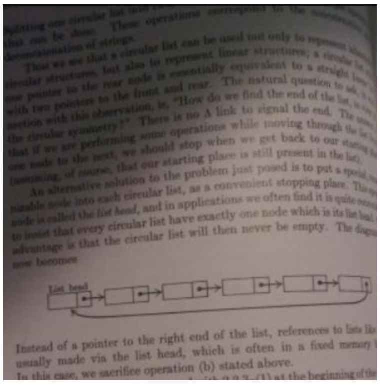
Comparison between the original image and the equalized image and their histograms.

Thresholding

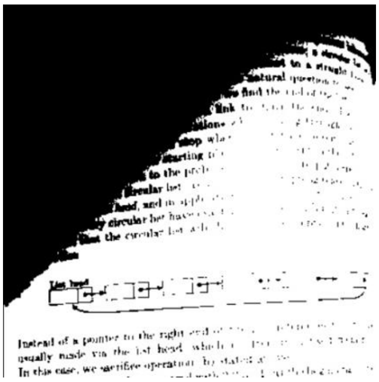
thresholding is the simplest method of [segmenting images](). From a [grayscale]() image, thresholding can be used to create [binary images]().

- Global : we apply fixed threshold to the whole image according to it's intensity histogram, we can find the thresholding value by begin with a start threshold then take average between the values above the threshold and the values below the threshold, then take the average of these two averages and see if the relation between the new threshold and the previous threshold.

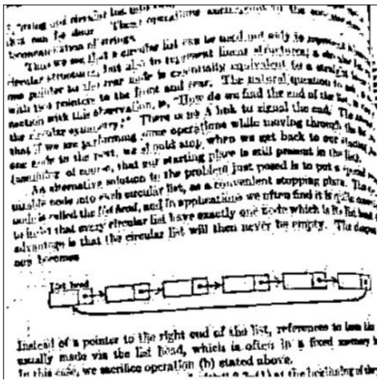
- Local : we apply different threshold values to different parts of the image, based on the local value of the pixels.



Original



Global

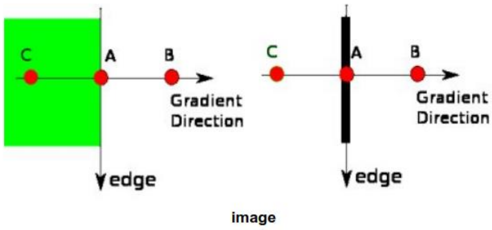


Local

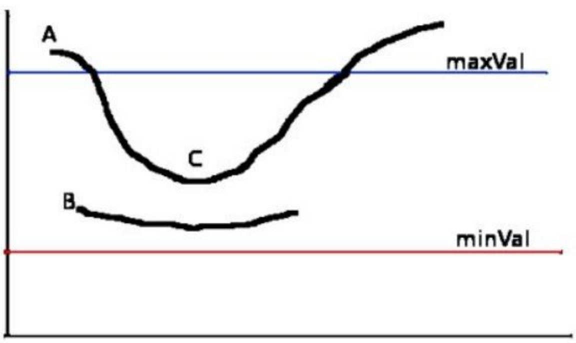
Edge Detection

Canny Edge Detection is developed by John F. Canny

1. **Noise reduction:** Edge detection is susceptible to noise in the image, so we remove the noise in the image with a 3x3 Gaussian filter.
2. **Finding Intensity Gradient of the Image:** Calculating the first derivative in both horizontal and vertical directions by filtering with Sobel kernel.
3. **Non-maximum Suppression:** After getting gradient magnitude and direction, a full scan of image is done to remove any unwanted pixels which may not constitute the edge. For this, at every pixel, pixel is checked if it is a local maximum in its neighborhood in the direction of gradient.

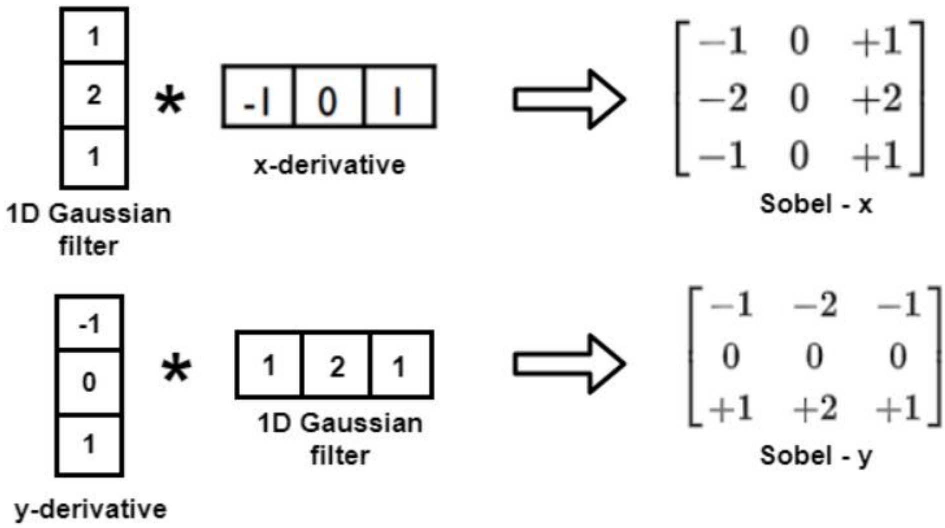


4. **Hysteresis Thresholding:** This stage decides which are all edges are really edges and which are not. The edge A is above the maxVal, so considered as "sure-edge". Although edge C is below maxVal, it is connected to edge A, so that also considered as valid edge and we get that full curve. But edge B, although it is above minVal and is in same region as that of edge C, it is not connected to any "sure-edge".



Sobel Edge detection is simply a first order derivative for edge detection

This is obtained by multiplying the x, and y-derivative filters with some smoothing filter(1D) in the other



direction. For example, a 3×3 Sobel-x and Sobel-y filter can be obtained as

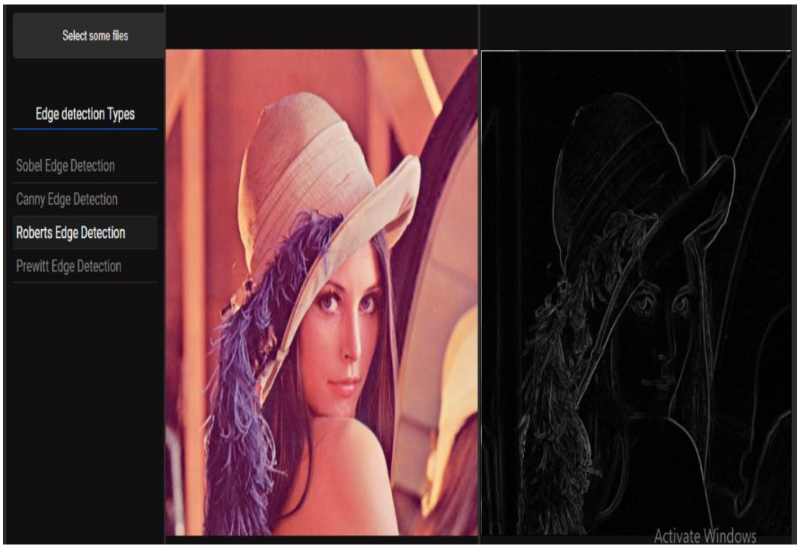
When we convolve these Sobel operators with the image, they estimate the gradients in the x, and y-directions(say G_x and G_y). For each point, we can calculate the gradient magnitude.

Roberts Edge Detection

The operator is made up of a pair of 2×2 convolution masks. The masks can be applied to the input image independently to produce separate gradient component measurements in each orientation.

0	1
-1	0

1	0
0	-1



Prewitt Edge Detection

Prewitt mask is a first-order derivative mask. In the graph representation of Prewitt-mask's result, the edge is represented by the local maxima or local minima.

$$G_x = \begin{bmatrix} 1 & 0 & -1 \\ 1 & 0 & -1 \\ 1 & 0 & -1 \end{bmatrix} \qquad G_y = \begin{bmatrix} 1 & 1 & 1 \\ 0 & 0 & 0 \\ -1 & -1 & -1 \end{bmatrix}$$

Hybrid Images

A hybrid image is the sum of a low-pass filtered version of the one image and a high-pass filtered version of a second image. There is a free parameter, which can be tuned for each image pair, which controls *how much* high frequency to remove from the first image and how much low frequency to leave in the second image. This is called the "cutoff-frequency"