In this lab, you will implement edge detection algorithms based on Sobel, Prewitt, and Laplacian of Gaussian operators.
Important Note: Submit all your codes to SUCourse as a single zip file. Deadline for in-lab code submission to SUCourse is **17:00**.

Things to do:

Your functions must be as generic as possible, i.e., don't make any assumptions about the size, the type and the colors of the images. Your functions must convert the image to grayscale if it is colored and you must employ the row and column numbers of the images as variables.

- **Prewitt Operator:** *Prewitt* filtering is a discrete 2D derivative operation which can be applied with the following kernels

-1	0	1
-1	0	1
-1	0	1

X Filter

-1	-1	-1
0	0	0
1	1	1

Y Filter

To detect edges in a grayscale image, the gradient image obtained by the horizontal and the vertical Prewitt operators is binarized by a threshold. The gradient image is calculated as

$$G(p) = \sqrt{G_x(p)^2 + G_y(p)^2} \tag{1}$$

Now write a function which takes an image and a threshold value as inputs and utilize "**Prewitt filters**" to return a binary image of detected edges. Your function name should be "lab3prewitt.m".

Your results should look as follows:

Original Image

Prewitt X Filtered Image

Prewitt Y Filtered Image

Prewitt Gradient

Prewitt Edges

- **Sobel Operator:** *Sobel* filtering is a discrete 2D derivative operation which can be applied with the following kernels

-1	0	1
-2	0	2
-1	0	1

X Filter

-1	-2	-1
0	0	0
1	2	1

Y Filter

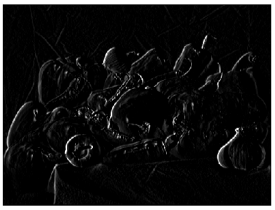
To detect edges in a grayscale image by employing Sobel operators, the same procedure is applied as Prewitt based edge detection except the kernels are changed.

Now write a function which takes an image and a threshold value as inputs and utilize "**Sobel filters**" to return a binary image of detected edges. Your function name should be "lab3sobel.m".

Your results should look as follows:

Original Image

Sobel X Filtered Image



Sobel Y Filtered Image

Sobel Gradient

Sobel Edges

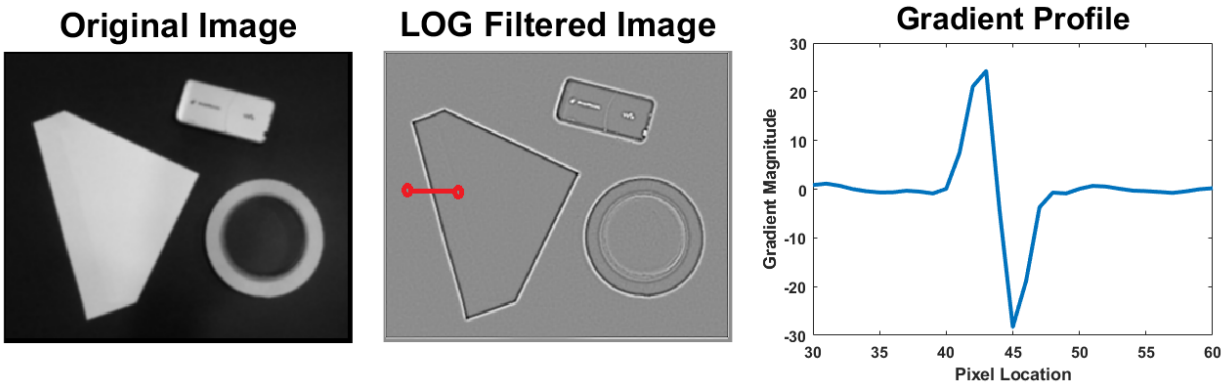
- **Laplacian of Gaussian Smoothed Image:** As Laplace operator may detect edges as well as noise, it is desirable to smooth the image first by a Gaussian filter. Applying the Laplacian for a Gauss-filtered image can be done in one step of convolution with the following kernel

0	1	0
1	-4	1
0	1	0

Different from the Sobel and Prewitt based edge detection algorithms, zero crossing points represent the edge pixels. Extract the gradient profile from a line segment of the LoG filtered image belonging to an edge region and investigate the zero crossing behavior as shown in the results below.

Now write a function which takes an image as input and utilize "**Laplacian of Gaussian**" to return the LoG filtered image. Your function name should be "lab3log.m".

Your results should look as follows:



Post Lab

Post lab reports must include brief explanations of the functions that you implemented in this lab.

- Provide resulting images by utilizing all these functions. Discuss the differences of the edge detectors implemented in this lab in terms of their applicability for different scenarios.
- Write a program that finds zero crossings in the LoG filtered image for edge detection.

Deadline for post lab report submission to SUCourse: **2 November 2021, 23:55**.