

All lab assignments must be done individually. You should submit your codes to SUCourse during the lab hours (In-Lab Code Submission) and you should submit your lab-reports within one week after the lab (Post-Lab Report).

Grading : In-lab Codes has a weight of 20% and Post-lab Reports has a weight of 80%. Your programs should be modular, bug-free, commented in MATLAB, self-explanatory. Also, your report should include necessary comments and discussions. Please note that if you miss the lab, you will get automatically zero (even if you submit post-lab report)

In this lab, you will implement smoothing, sharpening and first derivative filters to grayscale images.

Important Note: You should complete the lab until the end of the lab hours and submit all your codes to SUCourse as a single zip file. Deadline for submission to SUCourse is **until the end of the lab, which is 18:30**.

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.

- **Linear Filtering:** Gaussian filtering is a linear operation that involves local convolution with a filter kernel of samples of the 2D Gauss function. Gaussian filtering is used for smoothing the pictures by eliminating “outliers” in image values which are considered to be noise in a given context. In order to apply Gaussian smoothing you can use the kernel below to convolve it with the given image.

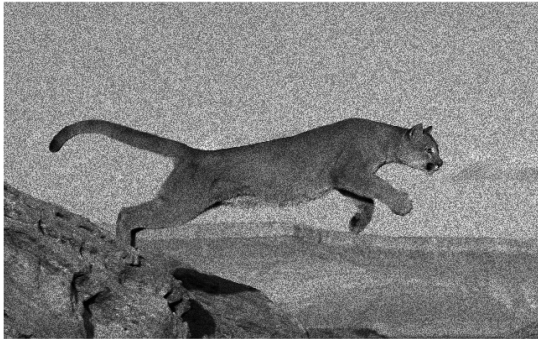
1	4	7	4	1
4	16	26	16	4
7	26	41	26	7
4	16	26	16	4
1	4	7	4	1

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Now write a function which takes an image as input and returns the “**Gaussian smoothed**” version of the image. You will use 5×5 approximated Gaussian filter kernel given above. Your function name should be “lab2gaussfilt.m”.

Your results should look as follows:

Original Image



Gaussian Filtered Image

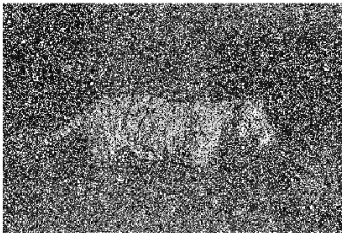


- **Nonlinear Filtering:** Median filtering is a nonlinear operation since it involves sorting and picking the median element. Due to the nonlinearity, median filter can not be implemented as a convolution.

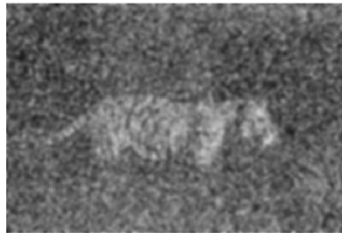
Now write a function which takes an image and a constant k as inputs and returns the “**median filtered**” version of the image. Your function name should be “lab2medfilt.m”.

Your results should look as follows:

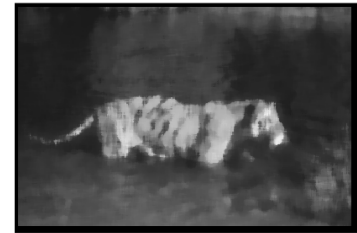
Original Image



Gaussian Filtered Image



Median Filtered Image



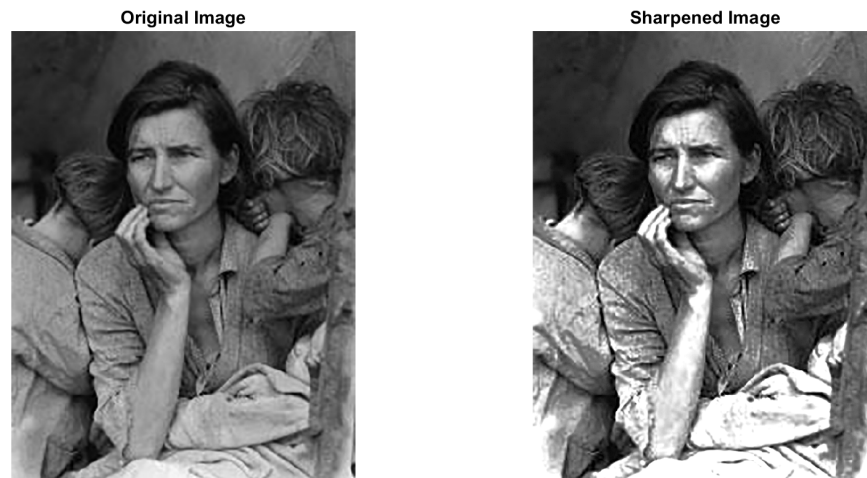
- **Sharpening:** Goal of the sharpening is to produce an enhanced image J by increasing the contrast of the given image I along edges, without adding too much noise within homogeneous regions in the image. Sharpening can be implemented as follows

$$J(p) = I(p) + \lambda [I(p) - S(p)] \quad (1)$$

where S is the smoothed version of the given image I and $\lambda > 0$ is a scaling factor which controls the influence of the correction signal.

Now write a function which takes an image as input, a constant λ and an integer M as inputs and returns the “**sharpened**” version of the image. Use the integer M to select the method of smoothing such as “box filter”, “Gaussian filter” and “median filter”. Your function name should be “lab2sharpen.m”.

Your results should look as follows:



- **First Derivative:** *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

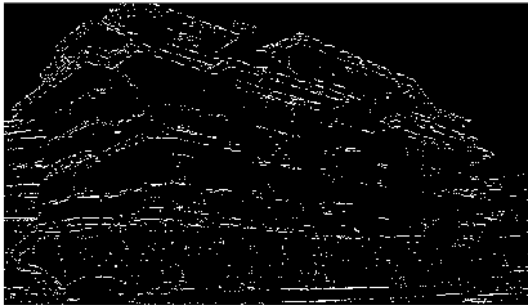
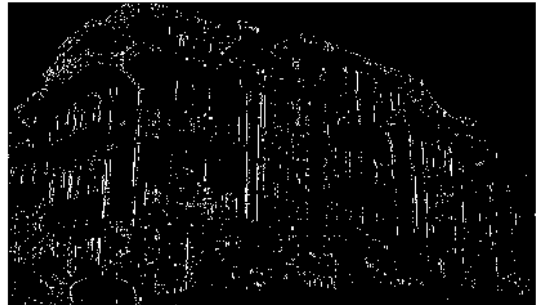
X Filter

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

Y Filter

Now write a function which takes an image as input and utilize “**Sobel filter**” to return two images which are the first derivatives of the image along x and y directions. Your function name should be “lab2sobelfilt.m”.

Your results should look as follows:

Original Image**Sobel Horizontal Filtered Image****Sobel Vertical Filtered Image**

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. Comment on your results. Discuss the differences of the filters implemented in this lab in terms of their applicability for different scenarios.

Deadline for post lab report submission to SUCourse: **12 November 2020, 23:55.**