

Homework 03: due 2022/04/20 23:59(100%)

- Tutorial :

1. *scipy.signal.convolve2d*:

<https://docs.scipy.org/doc/scipy/reference/generated/scipy.signal.convolve2d.html>
(<https://docs.scipy.org/doc/scipy/reference/generated/scipy.signal.convolve2d.html>)

2. **OpenCV2 Convolution**: <https://blog.csdn.net/hysterisis/article/details/113097507>
(<https://blog.csdn.net/hysterisis/article/details/113097507>)

3. *cv2.filter2D*:

https://docs.opencv.org/3.4/d4/d86/group__imgproc__filter.html#ga27c049795ce870216ddfb366086b5a04
(https://docs.opencv.org/3.4/d4/d86/group__imgproc__filter.html#ga27c049795ce870216ddfb366086b5a04)

- After you go through the tutorials, you should be able to work on this assignment.

- Please answer the following questions and work directly on this jupyter notebook.

- Make sure the code can be run and show the result and figures properly.

- Please write down your observation with markdown in this notebook briefly.

In [1]:

```
import cv2
import os
from scipy import signal
import numpy as np
import matplotlib.pyplot as plt
```

1. Please use the defined input matrix and the kernel below, and use the *scipy.signal.convolve2d* and *cv2.filter2D* to implement the convolution operation. The result output after convolution is given for your reference. (With half zero padding to make the shape fixed) (50%)

Input	kernel	output
$\begin{bmatrix} 1 & 2 & 3 & 4 & 5 \\ 5 & 4 & 3 & 2 & 1 \\ 1 & 2 & 3 & 4 & 5 \\ 5 & 4 & 3 & 2 & 1 \\ 1 & 2 & 3 & 4 & 5 \end{bmatrix}$	$\begin{bmatrix} 1 & 2 & 3 \\ 1 & 2 & 3 \\ 1 & 2 & 3 \end{bmatrix}$	$\begin{bmatrix} 18 & 36 & 36 & 36 & 30 \\ 22 & 46 & 52 & 58 & 52 \\ 32 & 62 & 56 & 50 & 38 \\ 22 & 46 & 52 & 58 & 52 \\ 18 & 36 & 36 & 36 & 30 \end{bmatrix}$

In [2]:

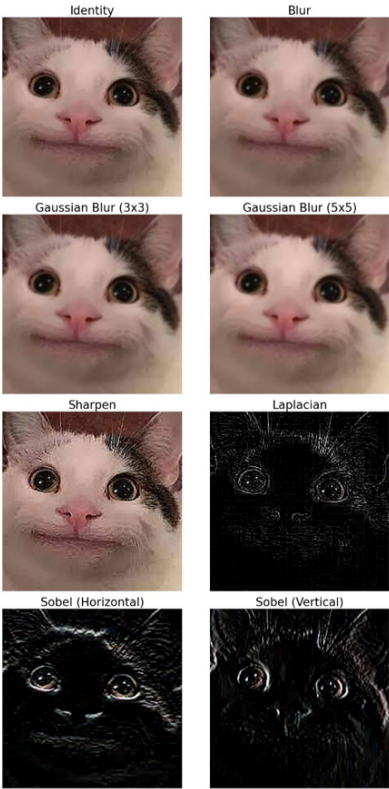
```
# Do not change this block
kernel = np.array([[1,2,3],
                   [1,2,3],
                   [1,2,3]])

input = np.zeros((5, 5))
for i in range(5):
    for j in range(5):
        if i%2 == 0:
            input[i][j] = j+1
        else:
            input[i][j] = 5-j
```

In []:

2. Please do the convolution operation on your own image or on the give test.jpg. Using all the kernels below, and save each filtered image in .png file with the corresponding kernel names. Also, move all the filtered images to a folder. (50%)

Identity	Blur
$\begin{bmatrix} 0 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 0 \end{bmatrix}$	$\frac{1}{9} \begin{bmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{bmatrix}$
Gaussian Blur (3x3)	Gaussian Blur (5x5)
$\frac{1}{16} \begin{bmatrix} 1 & 2 & 1 \\ 2 & 4 & 2 \\ 1 & 2 & 1 \end{bmatrix}$	$\frac{1}{256} \begin{bmatrix} 1 & 4 & 7 & 4 & 1 \\ 4 & 16 & 26 & 16 & 4 \\ 7 & 26 & 41 & 26 & 7 \\ 4 & 16 & 26 & 16 & 4 \\ 1 & 4 & 7 & 4 & 1 \end{bmatrix}$
Sharpen	Laplacian
$\begin{bmatrix} 0 & -1 & 0 \\ -1 & 5 & -1 \\ 0 & -1 & 0 \end{bmatrix}$	$\begin{bmatrix} -1 & -1 & -1 \\ -1 & 8 & -1 \\ -1 & -1 & -1 \end{bmatrix}$
Sobel (Horizontal)	Sobel (Vertical)
$\begin{bmatrix} -1 & -2 & -1 \\ 0 & 0 & 0 \\ 1 & 2 & 1 \end{bmatrix}$	$\begin{bmatrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{bmatrix}$



In []: