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

2. OpenCV2 Covolution: [https://blog.csdn.net/hysterisis/article/details/113097507 (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)](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]:

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

1. Please use the define input matrix and kernel below, and use the *scipy.signal.convolve2d* and *cv2.filter2D* to implement the convolution operation. (With half zero padding to make the shape fixed) (50%)

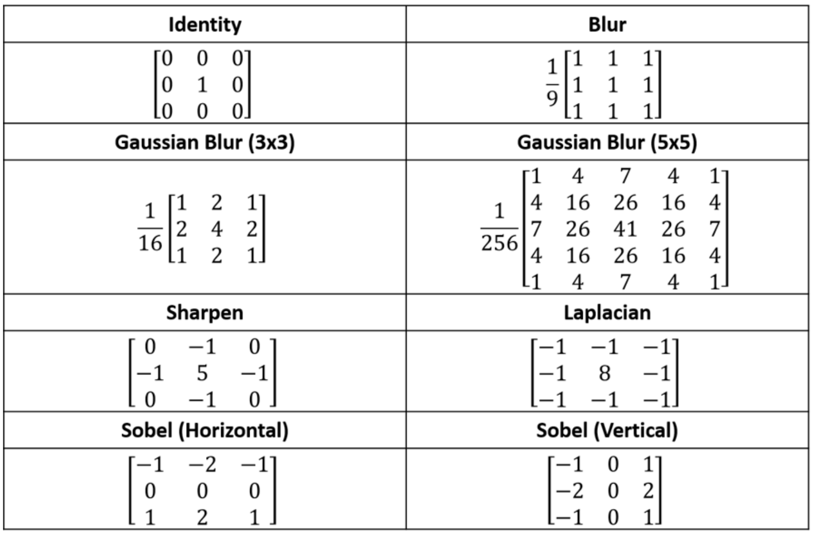
$$\underset{\text{Input}}{\begin{bmatrix} 1 & 2 & 3 & 4 & 5 \\ 5 & 4 & 3 & 2 & 1 \\ 1 & 2 & 3 & 4 & 5 \\ 5 & 4 & 3 & 2 & 1 \\ 1 & 2 & 3 & 4 & 5 \end{bmatrix}} \quad \underset{\text{kernel}}{\begin{bmatrix} 1 & 2 & 3 \\ 1 & 2 & 3 \\ 1 & 2 & 3 \end{bmatrix}} \quad \underset{\text{output}}{\begin{bmatrix}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

In [2]:

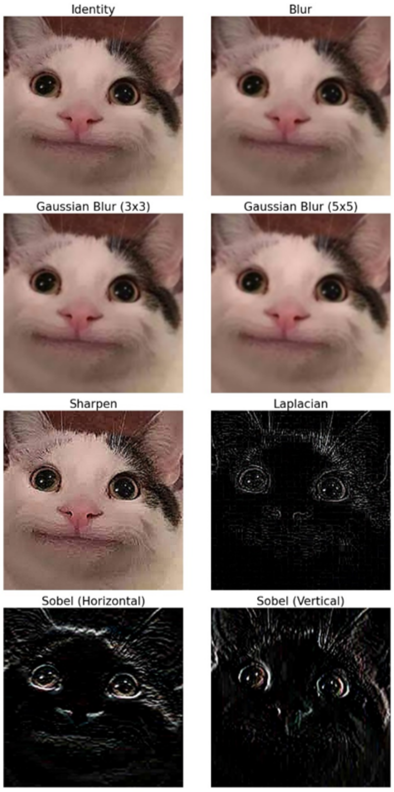
```
# Do not change this block
kernel = np.array([[1,2,3],
                   [1,2,3],
                   [1,2,3]])

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 covolution operation on your own image or on the test.jpg with the kernels below, and save the images in *png* file with their 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 [ ]: