`63070501061 S.RAKNA`

Image Convolution

> Create your own Gaussian Kernel

Part 1

> 10 points. 2 hrs.

- Using Python, compute and print the matrix for *Gaussian kernel with σ = 2.5*
- Using *kernel size of 15 x 15* (we use width = ceiling (6*σ)).
- Print the kernel as output.

In [ ]:
```
import cv2
import matplotlib.pyplot as plt
import numpy as np
```

In [ ]:
```
def g(x, y, center, variance):
    '''
    Returns the value of the Gaussian function at the given point.

    Parameters
    ----------
    x : int
        x-coordinate of the point.
    y : int
        y-coordinate of the point.
    center : int
        Center of the Gaussian function.
    variance : float
        Variance of the Gaussian function.
    '''
    return np.exp(-((np.square(x-center)+np.square(y-center))/(2*variance)))


def gaussian_kernel(sigma, kernel_size):
    """Returns a 2D Gaussian kernel with the given sigma and kernel size."""
    G = np.zeros((kernel_size, kernel_size))
    center = kernel_size//2
    variance = np.square(sigma)
    coefficient = 1/(2*np.pi*variance)
    for x in range(kernel_size):
        for y in range(kernel_size):
            G[x, y] = coefficient*g(x, y, center, variance)
    return G
```

In [ ]:
```
# Call the function to get a 15*15 Gaussian kernel with sigma=2.5
kernel = gaussian_kernel(2.5, 15)
kernel
```

Out[ ]:
```
array([[1.00246998e-05, 2.83620512e-05, 6.83780610e-05, 1.40478159e-04,
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       [1.00246998e-05, 2.83620512e-05, 6.83780610e-05, 1.40478159e-04,
        2.45931251e-04, 3.66886314e-04, 4.66403914e-04, 5.05249329e-04,
        4.66403914e-04, 3.66886314e-04, 2.45931251e-04, 1.40478159e-04,
        6.83780610e-05, 2.83620512e-05, 1.00246998e-05]])
```
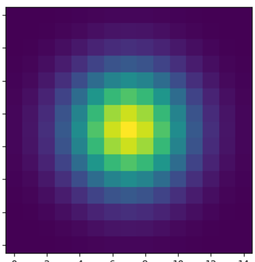

In [ ]:
```
# Export the kernel to a csv file
np.savetxt('kernel.csv', kernel, delimiter=',')
```

In [ ]:
```
plt.imshow(kernel)
```

Out[ ]:
```
<matplotlib.image.AxesImage at 0x11a514af0>
```



Part 2

> 10 points. 0.5 hrs.

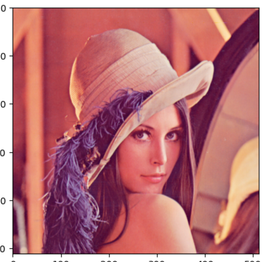
- Modify the *OpenCV* code shown in class to show the result of the convolution

of your **15 x 15 Gaussian kernel** using the Lenna image.

In [ ]:
```
lenna = cv2.imread('./Lenna.png', cv2.IMREAD_COLOR)
if lenna is None:
    print('Failed to load image')
    exit()
```

In [ ]:
```
# show image with original color
plt.imshow(cv2.cvtColor(lenna, cv2.COLOR_BGR2RGB))
```

Out[ ]:
```
<matplotlib.image.AxesImage at 0x12a9e7b50>
```



In [ ]:
```
# convolution with kernel
lenna_conv = cv2.filter2D(lenna, -1, kernel)
plt.imshow(cv2.cvtColor(lenna_conv, cv2.COLOR_BGR2RGB))
```

Out[ ]:
```
<matplotlib.image.AxesImage at 0x12aa63580>
```