

CMPE297 Homework 1

HL

1. Given the image $I(x,y)$ and the kernel shown in Figure 1, perform 2D convolution to find the output image. (Assume padding 0's outside the image)

```
>> A = [ 0 0 100 100 100
         0 0 100 100 100
         0 0 100 100 100
         0 0 100 100 100
         0 0 100 100 100 ]

>> B = [ 1 0 -1
         1 0 -1
         1 0 -1 ]
```

Figure 1.

2. Given Laplace operator and 2D Gaussian function in Figure 2, derive the 2D LoG function given in Figure 3, assuming $\mu_x = \mu_y = 0$.

$$\nabla^2 = \frac{\partial^2}{\partial x^2} + \frac{\partial^2}{\partial y^2} \quad \dots(1)$$

First, 1D Gaussian function

$$G(x) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu)^2}{2\sigma^2}}$$

Then, 2D Gaussian function,

$$G(x,y) = \frac{1}{\sqrt{2\pi}\sigma} e^{-\frac{(x-\mu_x)^2 + (y-\mu_y)^2}{2\sigma^2}} \quad \dots(5)$$

Figure 2.

$$\nabla^2 G(x,y) = \frac{x^2 + y^2 - 2\sigma^2}{\sqrt{2\pi}\sigma^5} e^{-\frac{x^2 + y^2}{2\sigma^2}}$$

Figure 3.

3. Based on the computation result given in 2, compute 3 by 3 LoG kernel, write a python program with numpy to verify your result, and then compute 5-by-5, 7-by-7 kernel.

(End)