Computer Vision HW5

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- Write programs which do gray-scale morphological dilation, erosion, opening, and closing on a gray-scale image

```python
def dilation(im , kernel) :
    pixels = im.load()
    im_dil = Image.new('L', im.size, 'black')

    for i in range(im.size[0]) :
        for j in range(im.size[1]) :
            if (pixels[i,j]) != 0 :
                Max = 0
                for k in range(len(kernel)):
                    if (i+kernel[k][0] >= 0 and j+kernel[k][1] >= 0 and i+kernel[k][0] < im.size[0] and j+kernel[k][1] < im.size[1]) :
                        Max = pixels[i+kernel[k][0] , j+kernel[k][1]] if pixels[i+kernel[k][0] , j+kernel[k][1]] > Max else Max
                for k in range(len(kernel)):
                    if (i+kernel[k][0] >= 0 and j+kernel[k][1] >= 0 and i+kernel[k][0] < im.size[0] and j+kernel[k][1] < im.size[1]) :
                        im_dil.putpixel((i+kernel[k][0] , j+kernel[k][1]) , Max)

    return im_dil
```

Do Gray-scale Dilation

選取 kernel 覆蓋中 pixel value 最高的值當作整個 kernel 覆蓋的值

```python
def erosion(im , kernel) :
    pixels = im.load()
    im_ero = Image.new('L', im.size, 'black')

    for i in range(im.size[0]) :
        for j in range(im.size[1]) :
            Min = 255
            erosion = 1
            for k in range(len(kernel)):
                if (i+kernel[k][0] < 0 or j+kernel[k][1] < 0 or i+kernel[k][0] >= im.size[0] or j+kernel[k][1] >= im.size[1] or pixe
                    erosion = 0

            if erosion == 1 :
                for k in range(len(kernel)):
                    Min = pixels[i+kernel[k][0] , j+kernel[k][1]] if pixels[i+kernel[k][0] , j+kernel[k][1]] < Min else Min

                im_ero.putpixel((i, j) , Min)

    return im_ero
```

Do Gray-scale Dilation

先判斷有沒有 kernel 可以覆蓋的部分，選取 kernel 覆蓋中 pixel value 最低的值當作該點的值

```python

def opening(im , kernel) :
    return dilation(erosion(im , kernel) , kernel)

def closing(im , kernel) :
    return erosion(dilation(im , kernel) , kernel)

```

Use Gray-scale Dilation/Erosion to combine Gray-scale Opening and Closing

Result :

Gray-scale Dilation	Gray-scale Erosion
	
Gray-scale Opening	Gray-scale Closing
	

Environment :

Anaconda3

Python 3.6.1

Using Library :

PIL

Benchmark :

Lena.bmp