Assignment05

Name : Dohyun Kwon

Student ID : 2018120191

Github repository : https://github.com/hilariouss/assignment05.git (https://github.com/hilariouss/assignment05.git)

1. Import libraries

In [1]:
```
import matplotlib.pyplot as plt
import numpy as np
from scipy import signal
from scipy import ndimage
from skimage import io, color
from skimage import exposure
from math import atan
from PIL import Image
```

1. Load image

In [2]:
```
file_image = 'cau.jpg'
im = Image.open('cau.jpg')
im_color = io.imread(file_image)
im_gray = color.rgb2gray(im_color)
width,height=im.size
```

1. Kernels definition

In [4]:
```
Derivative_mask_x       = np.array([[-1, 0, 1],[-1, 0, 1],[-1, 0, 1]])
Derivative_mask_y       = np.array([[1, 1, 1],[0, 0, 0],[-1, -1, -1]])
Sobel_Gx_kernel =  np.array([[-1,0,1],[-2,0,2],[-1,0,1]])
Sobel_Gy_kernel = np.array([[1,2,1],[0,0,0],[-1,-2,-1]])
Smooth_kernel           = np.array([[.11, .11, .11],[.11, .11, .11],[.11, .11, .11]])
MySharpening_kernel     = np.array([[0,-1,0],[-1,5,-1],[0,-1,0]])
```

1. Results images

In [7]:
```
im_conv_Sobel_Gx_kernel = signal.convolve2d(im_gray, Sobel_Gx_kernel, boundary='symm', mode='same')
im_conv_Sobel_Gy_kernel = signal.convolve2d(im_gray, Sobel_Gy_kernel, boundary='symm', mode='same')
im_conv_Sharpen        = signal.convolve2d(im_gray, MySharpening_kernel, boundary='symm', mode='same')
im_conv_Smooth        = signal.convolve2d(im_gray, Smooth_kernel, boundary='symm', mode='same')
```

1. x and y-gradient of Sobel kernel

In [8]:
```
sx = ndimage.convolve(im_gray, Sobel_Gx_kernel)
sy = ndimage.convolve(im_gray, Sobel_Gy_kernel)
```

1. Absolute value of gradient

In [9]:
```
AbsGrad = np.hypot(sx, sy)
```

1. Direction of gradient

In [10]:
```
flatten_sx = sx.flatten() # 2D to 1D
flatten_sy = sy.flatten()
Div_Result = np.zeros(width*height)
for i in range(width*height):
    Div = flatten_sy[i]/flatten_sx[i]
    Div_Result[i] = atan(Div)
Dir = np.reshape(Div_Result, (-1, width))# chg to 2D
```

```
C:WUsersWFamilyWAppDataWLocalWContinuumWanaconda3WlibWsite-packagesWipykernel_launcher.py:5: RuntimeWarning: in
valid value encountered in double_scalars
  """
C:WUsersWFamilyWAppDataWLocalWContinuumWanaconda3WlibWsite-packagesWipykernel_launcher.py:5: RuntimeWarning: di
vide by zero encountered in double_scalars
  """
```

8-1. Plot color image

In [20]:
```
p1 = plt.subplot(1,2,1)
p1.set_title('color image')
plt.imshow(im_color)
plt.axis('off')
```

Out[20]: (-0.5, 1967.5, 1346.5, -0.5)

8-2. Plot gray image

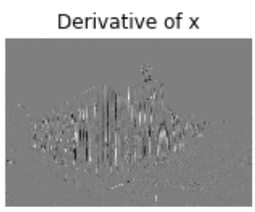
In [21]:
```
p2 = plt.subplot(1,2,2)
p2.set_title('gray image')
plt.imshow(im_gray, cmap='gray')
plt.axis('off')
```

Out[21]: (-0.5, 1967.5, 1346.5, -0.5)

8-3. Plot Derivative of x

In [22]:
```
p3 = plt.subplot(1,2,1)
p3.set_title('Derivative of x')
plt.imshow(im_conv_Sobel_Gx_kernel, cmap='gray')
plt.axis('off')
```

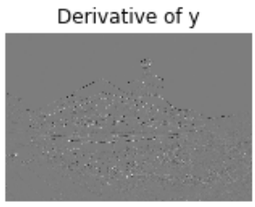
Out[22]: (-0.5, 1967.5, 1346.5, -0.5)



8-4. Plot derivative of y

In [23]:
```
p4 = plt.subplot(1,2,2)
p4.set_title('Derivative of y')
plt.imshow(im_conv_Sobel_Gy_kernel, cmap='gray')
plt.axis('off')
```

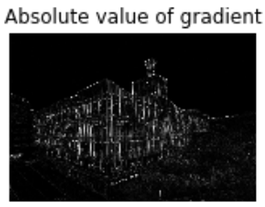
Out[23]: (-0.5, 1967.5, 1346.5, -0.5)



8-5. Plot absolute value of gradient

In [24]:
```
p5 = plt.subplot(1,2,1)
p5.set_title('Absolute value of gradient')
plt.imshow(AbsGrad, cmap='gray')
plt.axis('off')
```

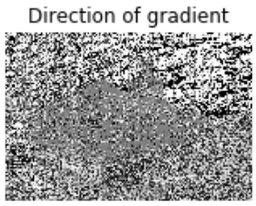
Out[24]: (-0.5, 1967.5, 1346.5, -0.5)



8-6. Plot direction of gradient

In [25]:
```
p6 = plt.subplot(1,2,2)
p6.set_title('Direction of gradient')
plt.imshow(Dir, cmap='gray')
plt.axis('off')
```

Out[25]: (-0.5, 1967.5, 1346.5, -0.5)



8-7. Plot image which is processed with smoothing kernel

In [26]:
```
p7 = plt.subplot(1,2,1)
p7.set_title('Smoothing kernel')
plt.imshow(im_conv_Smooth, cmap='gray')
plt.axis('off')
```

Out[26]: (-0.5, 1967.5, 1346.5, -0.5)

8-8. Plot image which is processed with my own sharpening kernel

In [27]:
```
p8 = plt.subplot(1,2,2)
p8.set_title('Own kernel (sharpening)')
plt.imshow(im_conv_Sharpen, cmap='gray')
plt.axis('off')
```

Out[27]: (-0.5, 1967.5, 1346.5, -0.5)

1. Plot entire results

In [28]:
```
p1 = plt.subplot(1,2,1)
p1.set_title('color image')
plt.imshow(im_color)
plt.axis('off')

p2 = plt.subplot(1,2,2)
p2.set_title('gray image')
plt.imshow(im_gray, cmap='gray')
plt.axis('off')

plt.show()

p3 = plt.subplot(1,2,1)
p3.set_title('Derivative of x')
plt.imshow(im_conv_Sobel_Gx_kernel, cmap='gray')
plt.axis('off')

p4 = plt.subplot(1,2,2)
p4.set_title('Derivative of y')
plt.imshow(im_conv_Sobel_Gy_kernel, cmap='gray')
plt.axis('off')

plt.show()

p5 = plt.subplot(1,2,1)
p5.set_title('Absolute value of gradient')
plt.imshow(AbsGrad, cmap='gray')
plt.axis('off')

p6 = plt.subplot(1,2,2)
p6.set_title('Direction of gradient')
plt.imshow(Dir, cmap='gray')
plt.axis('off')

plt.show()

p7 = plt.subplot(1,2,1)
p7.set_title('Smoothing kernel')
plt.imshow(im_conv_Smooth, cmap='gray')
plt.axis('off')

p8 = plt.subplot(1,2,2)
p8.set_title('Own kernel (sharpening)')
plt.imshow(im_conv_Sharpen, cmap='gray')
plt.axis('off')

plt.show()
```