Assignment05

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- Description: Convolution to image
- github: https://github.com/mydream757/Computer_Vision

1. Import liabraries

- import needed libraries.

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

2. Define methods

- normalize data by this expression. $data_{normalized} = \frac{data - data_{min}}{data_{MAX} - data_{min}}$

```
In [2]: # normalize the values of the input data to be [0, 1].
        def normalize(data):
            data_normalized = (data - min(data)) / (max(data) - min(data))
            return(data_normalized)
```

- compute magnitude by this expression. $Mag = \sqrt{dx^2 + dy^2}$

```
In [3]: #compute magnitude of vectors.
        def compute_magnitude(dx,dy):
            #dx,dy are numpy arrays
            return (dx**2+dy**2)**0.5
```

- draw arrows. the arrows are used for visualizing the gradients at each square.

I will separate origin arrays into arrays by 50x50. so the 'sampling_size' parameter is needed.

```
In [4]: def draw_arrows(x,y,mean_x,mean_y,sampling_size):
            #mean_mag is used for making arrows-length longer or shorter on same ratio.
            mean_mag = compute_magnitude(mean_x,mean_y)
            #find max magnitude. It is max length of arrow
```

```
    mag_max = mean_mag.max()
    for j in range(mean_mag.size):
        #multiply same ratio to all arrow length
        dx = mean_x[j]*((sampling_size/2)/mag_max)
        dy = mean_y[j]*((sampling_size/2)/mag_max)
        #Thesetting can be changed by sampling size.
        plt.arrow(x[j],y[j],dx,dy,color='b'
                ,width=sampling_size/50, head_width=sampling_size/10,
                head_length=sampling_size/10,length_includes_head = False)
```

3. Main function

- the used image is 'cau.jpg'

```
In [5]: #get the image name

        file_image = 'cau.jpg'
        im_color = io.imread(file_image)
        im_gray = color.rgb2gray(im_color)

        #color image plot
        p1 = plt.figure()
        plt.title('color image')
        plt.imshow(im_color)
        plt.axis('off')

        #gray image plot
        p2 = plt.figure()
        plt.title('gray image')
        plt.imshow(im_gray, cmap='gray')
        plt.axis('off')
        plt.show()
```

color image

gray image

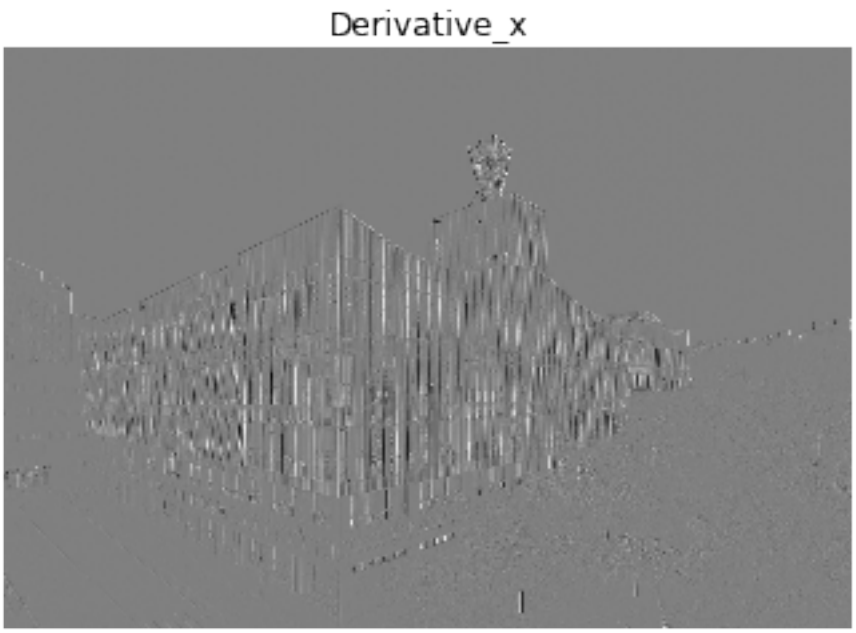
- kernels for computing derivatives.

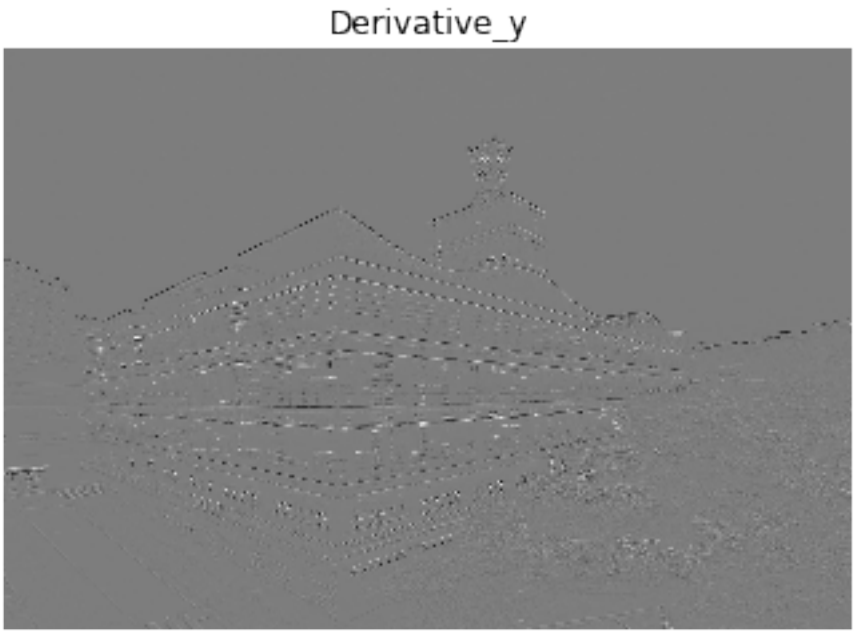
In [6]:
```
#kernels for computing x,y derivatives
kerY = np.array([[1,2,1],[0,0,0],[-1,-2,-1]]) #for y-derivative
kerX = np.array([[1,0,-1],[2,0,-2],[1,0,-1]]) #for x-derivative
#convolved arrays
im_kerX = signal.convolve2d(im_gray, kerX, boundary='symm', mode='same')
im_kerY = signal.convolve2d(im_gray, kerY, boundary='symm', mode='same')
```

In [7]:
```
#Derivatives plot
p3 = plt.figure()
plt.title('Derivative_x')
plt.imshow(im_kerX, cmap='gray')
plt.axis('off')

p4 = plt.figure()
plt.title('Derivative_y')
plt.imshow(im_kerY, cmap='gray')
plt.axis('off')

plt.show()
```





- sampling size is very important of this program. this choose slicing size and size of overall arrows.

```
In [8]: #this is the size of rows and column for sampling gradient.
        #If sampling size is 50, sampling square(50x50).
        sampling_size = 75
```

- this lists are used for saving x,y,dx,dy. It will change type into numpy array.

```
In [9]: list_mean_x = []
        list_mean_y = []
        list_x = []
        list_y = []
```

- get the convolution result of derivative kernels.

```
In [10]: deri_x = signal.convolve2d(im_gray, kerX, boundary='symm', mode='same')
         deri_y = signal.convolve2d(im_gray, kerY, boundary='symm', mode='same')
         #for gradient
         kerG = kerX + kerY
         im_conv = signal.convolve2d(im_gray, kerG, boundary='symm', mode='same')
```

- slice the origin arrays into several squares formed by 50x50.

```
In [11]: #sampling squares and compute each mean in sliced arrays.
         for i in range(np.size(deri_y,0)//sampling_size):
```

```
            for k in range(np.size(deri_x,1)//sampling_size):
                x = k*sampling_size
                y = i*sampling_size
                next_x = (k+1)*sampling_size
                next_y = (i+1)*sampling_size
                x_mean = np.mean(deri_x[y:next_y,x:next_x])
                y_mean = np.mean(deri_y[y:next_y,x:next_x])
                list_mean_x.append(x_mean)
                list_mean_y.append(y_mean)
                list_x.append((x+next_x)/2)
                list_y.append((y+next_y)/2)
```

- convert the results into numpy arrays.

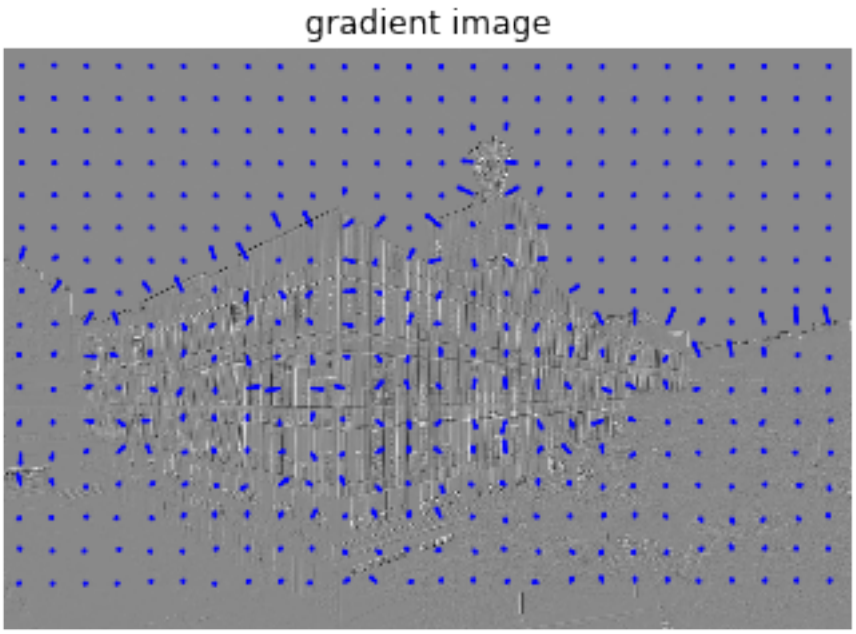
```
In [12]: #get numpy arrays of the results.
         mean_x = np.array(list_mean_x)
         mean_y = np.array(list_mean_y)
         x = np.array(list_x)
         y = np.array(list_y)
```

- plot the gradient image. it includes arrows.

Arrows have some information. the length represents the mean-magnitude of sample space(50x50). the direction of arrow represents the mean-direction of sample space.

```
In [13]: p5 = plt.figure()
         plt.title('gradient image')
         plt.imshow(im_conv, cmap='gray')
         #draw arrows.
         draw_arrows(x,y,mean_x,mean_y,sampling_size)

         plt.axis('off')
         plt.show()
```



- smoothing kernel and my own kernel are exhibited below this.

```
In [14]: #for smoothing image
         blur        = np.array([[0.5,1,0.5],[1,4,1],[0.5,1,0.5]])/8
         result_blur =  signal.convolve2d(im_gray, blur, boundary='symm', mode='same')

         own_kernel = np.array([[0,-1,-2],[1,1,-1],[0,1,2]])
         im_own = signal.convolve2d(im_gray, own_kernel, boundary='symm', mode='same')

         p6 = plt.figure()
         plt.title('smoothe image')
         plt.imshow(result_blur, cmap='gray')
         plt.axis('off')

         p7 = plt.figure()
         plt.title('own kernel convolution')
         plt.imshow(im_own, cmap='gray')
         plt.axis('off')

         plt.show()
```

smoothe image

own kernel convolution

- I think that my kernel makes the image more milky. It feels soft.