HW3

- **A discription of your homework**

  Programming language used: Python 2.7

  Library used: Numpy, PIL, Scipy.misc

  Plotting tool: Excel 2013

- **Your parameters**

  i: row

  j: column

  tem: 用於儲存每個像素的灰階數值 0~255

  num: 用於儲存各灰階數值的像素數

  n_j: $S_k = 255 \sum_{j=0}^{k} \frac{n_j}{n}$ 公式中的 n_j

  sigma_k: $S_k = 255 \sum_{j=0}^{k} \frac{n_j}{n}$ 公式中的 $\sum_{j=0}^{k} n_j$

  s_k: $S_k = 255 \sum_{j=0}^{k} \frac{n_j}{n}$ 公式中的 S_k

- **The algorithm you used**

1. 將整張照片變暗

   將所有灰階數值改為原本的 1/3

2. 提高對比度

   Histogram linearization: $S_k = 255 \sum_{j=0}^{k} \frac{n_j}{n}$

   k: 0~255

   n_j: number of pixels with intensity j

   n: total number of pixels = 512*512

   (1) 計算各灰階數值的像素數:

   k：灰階值，n_j[k]：灰階值為 k 的像素數

   使用迴圈跑過該圖片所有像素，該像素為 k 者，則在 n_j[k]加一

   註：讀入照片時，將灰階數值小數位無條件捨去

   (2) 計算公式中的$\sum_{j=0}^{k} n_j$和S_k

   (3) *(非作業中要求的項目)輸出高對比的 lena 圖片

3. 畫長條圖

   (1) 計算各灰階數值的像素數:

   k：灰階值，num[k]：灰階值為 k 的像素數

   使用迴圈跑過該圖片所有像素，該像素為 k 者，則在 num[k]加一

   註：統計時，將灰階數值小數位無條件捨去

   (2) 輸出成.txt 檔

   (3) 將資料放入 excel 畫長條圖

- **Principal code fragment**

```python
def low(x):
    tem = np.zeros(x.shape)
    for i in range(x.shape[0]):
        for j in range(x.shape[1]):
            tem[i][j] = x[i][j]/3.0
    return tem

def high(x):
    tem = np.zeros(x.shape)
    s_k=[]
    n_k=np.zeros([255+1])
    for i in range(x.shape[0]):
        for j in range(x.shape[1]):
            n_k[int(x[i][j])]=n_k[int(x[i][j])]+1

    for k in range(255+1):
        sigma_k=0
        for m in range(k+1):
            sigma_k = sigma_k+n_k[m]
        s_k.append(255.0/(512.0*512.0)*sigma_k)

    for i in range(x.shape[0]):
        for j in range(x.shape[1]):
            tem[i][j]=s_k[int(x[i][j])]
    return tem

def his(x):
    num = np.zeros([256])
    for i in range(x.shape[0]):
        for j in range(x.shape[1]):
            num[int(x[i][j])] = num[int(x[i][j])]+1
    f = open('his_high.txt','w')
    for k in range(len(num)):
        f.write(str(k)+' '+str(num[k])+'\n')
    f.close()
```

- **Resulting images**

1. a histogram