计算机视觉

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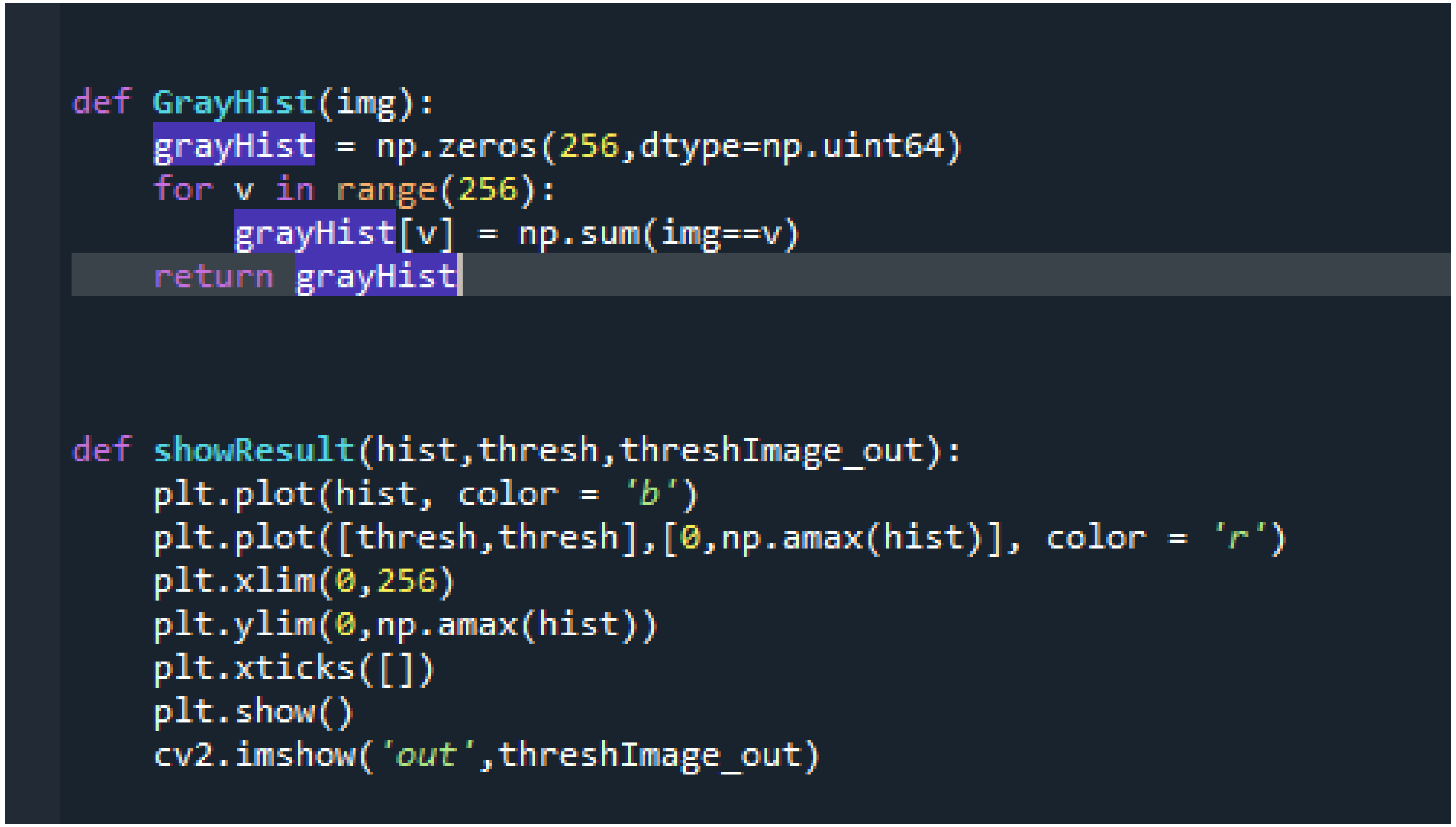
4.1 图像分割

4.1 图像分割

获取直方图、显示结果

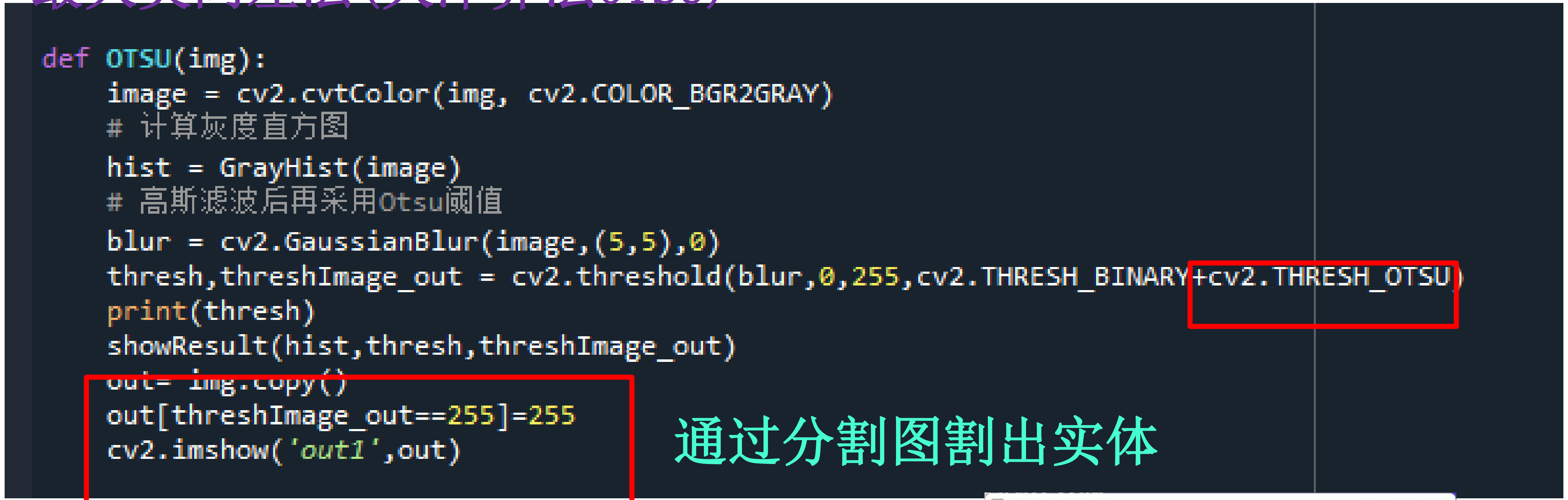


```python
def GrayHist(img):
    grayHist = np.zeros(256,dtype=np.uint64)
    for v in range(256):
        grayHist[v] = np.sum(img==v)
    return grayHist


def showResult(hist,thresh,threshImage_out):
    plt.plot(hist, color = 'b')
    plt.plot([thresh,thresh],[0,np.amax(hist)], color = 'r')
    plt.xlim(0,256)
    plt.ylim(0,np.amax(hist))
    plt.xticks([])
    plt.show()
    cv2.imshow('out',threshImage_out)
```

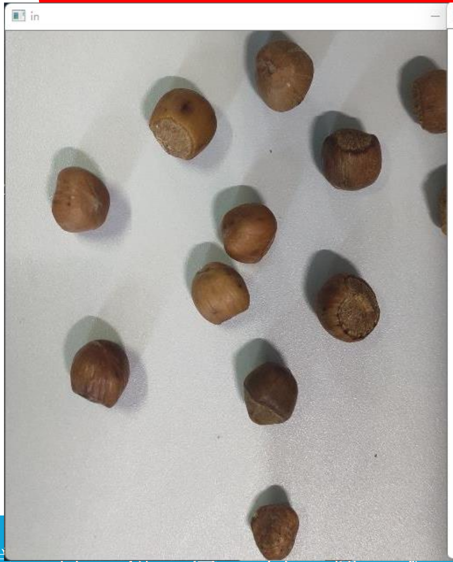
4.1 图像分割

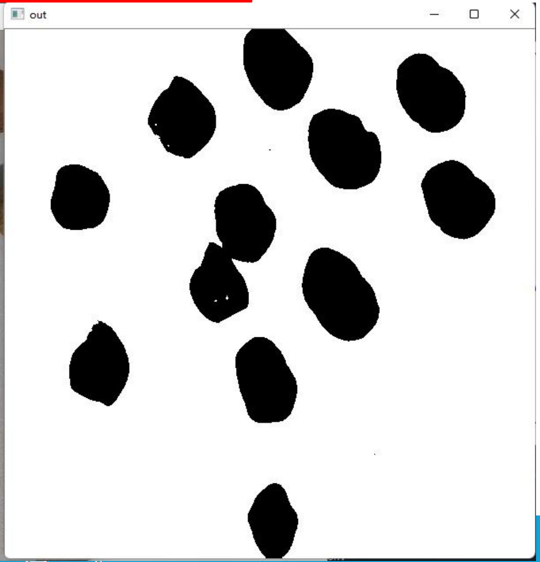
最大类间差法(大津算法OTSU)

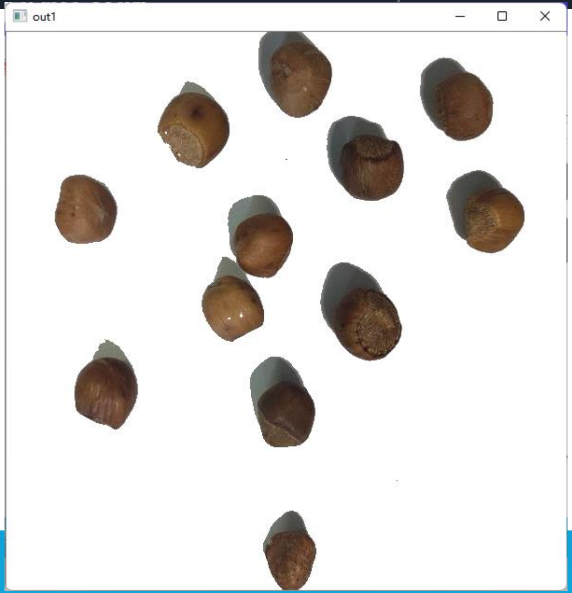


```
def OTSU(img):
    image = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
    # 计算灰度直方图
    hist = GrayHist(image)
    # 高斯滤波后再采用Otsu阈值
    blur = cv2.GaussianBlur(image,(5,5),0)
    thresh,threshImage_out = cv2.threshold(blur,0,255,cv2.THRESH_BINARY+cv2.THRESH_OTSU)
    print(thresh)
    showResult(hist,thresh,threshImage_out)
    out= img.copy()
    out[threshImage_out==255]=255
    cv2.imshow('out1',out)
```

通过分割图割出实体

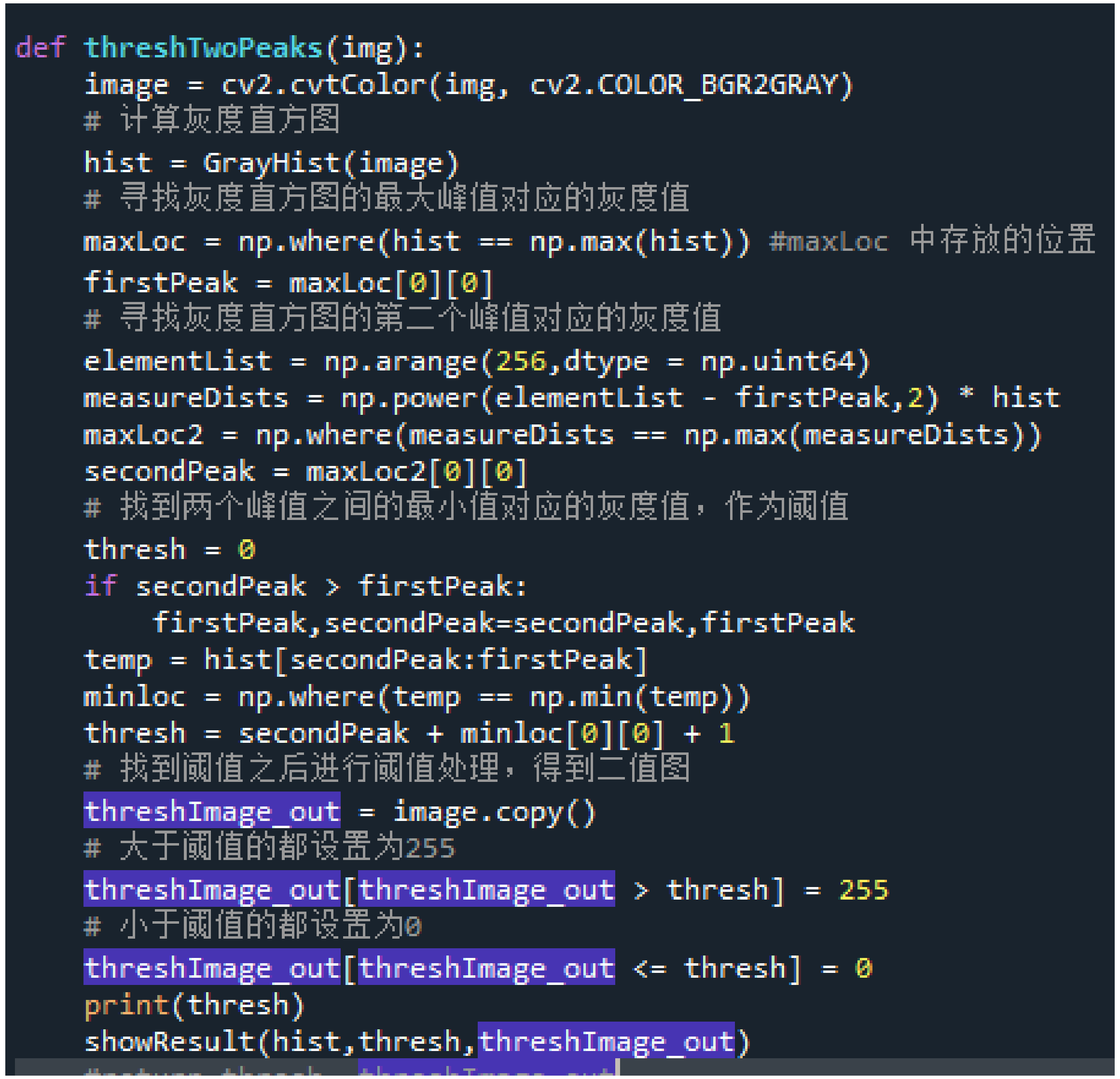






4.1 图像分割

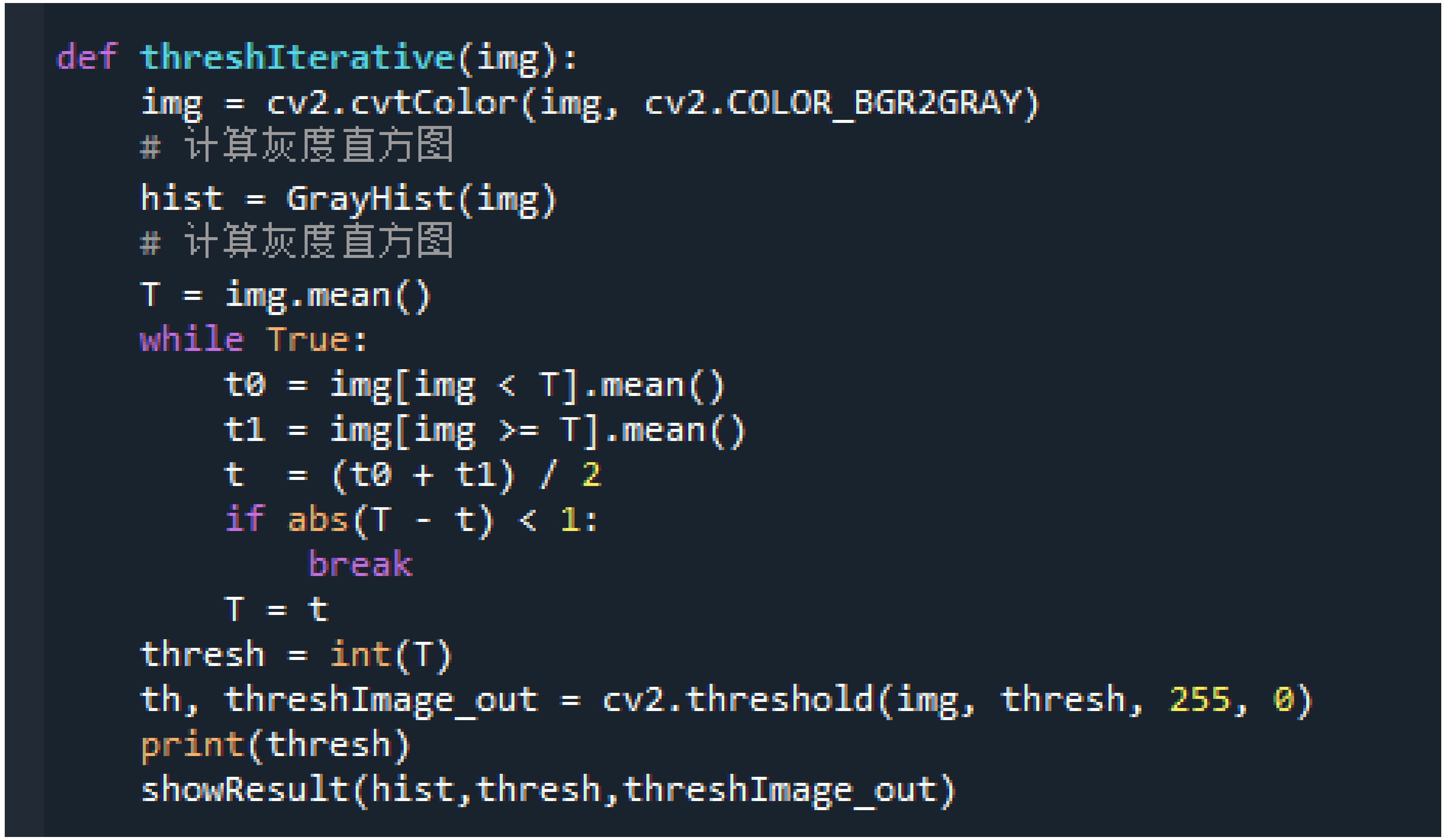
最小误差法(双峰法)



```python
def threshTwoPeaks(img):
    image = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
    # 计算灰度直方图
    hist = GrayHist(image)
    # 寻找灰度直方图的最大峰值对应的灰度值
    maxLoc = np.where(hist == np.max(hist)) #maxLoc 中存放的位置
    firstPeak = maxLoc[0][0]
    # 寻找灰度直方图的第二个峰值对应的灰度值
    elementList = np.arange(256,dtype = np.uint64)
    measureDists = np.power(elementList - firstPeak,2) * hist
    maxLoc2 = np.where(measureDists == np.max(measureDists))
    secondPeak = maxLoc2[0][0]
    # 找到两个峰值之间的最小值对应的灰度值，作为阈值
    thresh = 0
    if secondPeak > firstPeak:
        firstPeak,secondPeak=secondPeak,firstPeak
    temp = hist[secondPeak:firstPeak]
    minloc = np.where(temp == np.min(temp))
    thresh = secondPeak + minloc[0][0] + 1
    # 找到阈值之后进行阈值处理，得到二值图
    threshImage_out = image.copy()
    # 大于阈值的都设置为255
    threshImage_out[threshImage_out > thresh] = 255
    # 小于阈值的都设置为0
    threshImage_out[threshImage_out <= thresh] = 0
    print(thresh)
    showResult(hist,thresh,threshImage_out)
```

4.1 图像分割

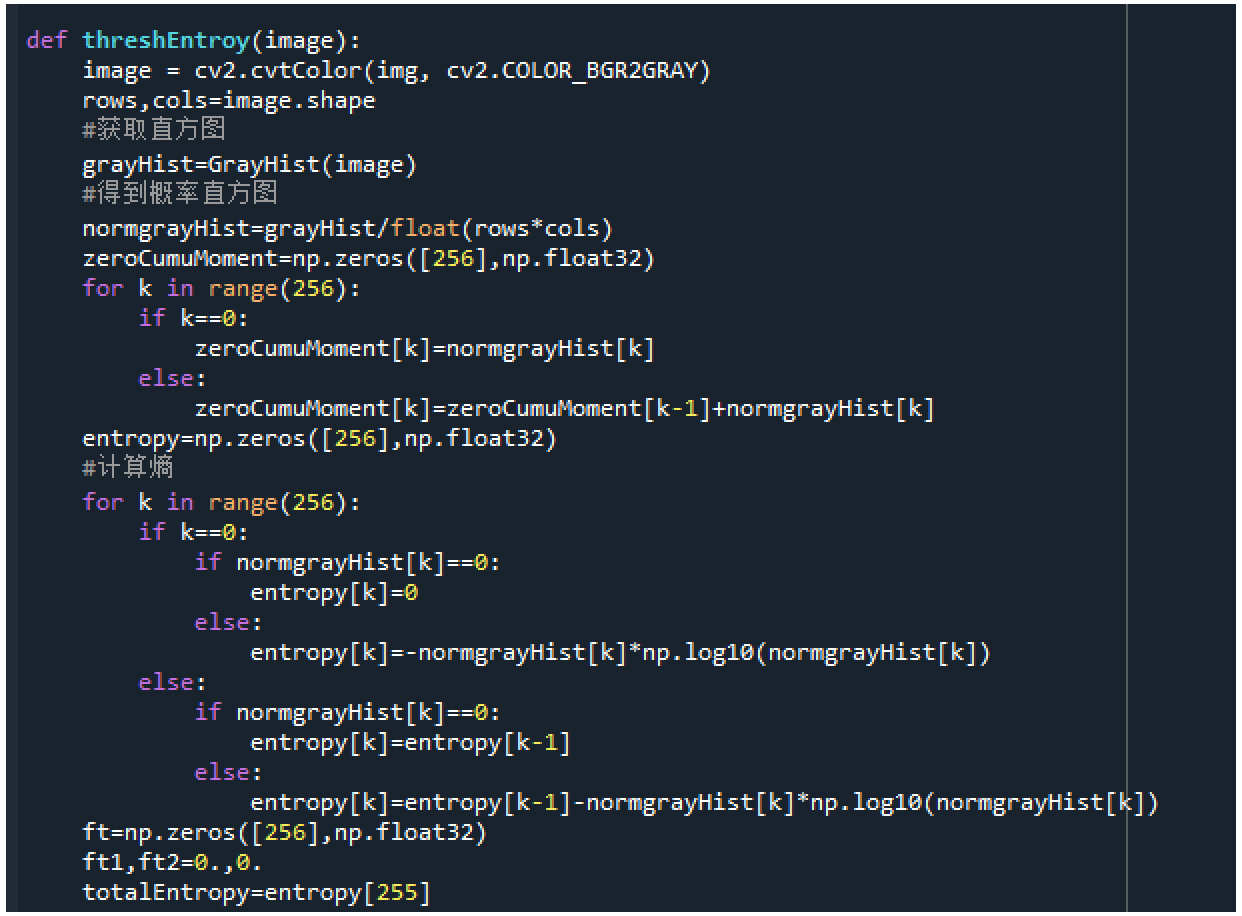
迭代法



```python
def threshIterative(img):
    img = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
    # 计算灰度直方图
    hist = GrayHist(img)
    # 计算灰度直方图
    T = img.mean()
    while True:
        t0 = img[img < T].mean()
        t1 = img[img >= T].mean()
        t  = (t0 + t1) / 2
        if abs(T - t) < 1:
            break
        T = t
    thresh = int(T)
    th, threshImage_out = cv2.threshold(img, thresh, 255, 0)
    print(thresh)
    showResult(hist,thresh,threshImage_out)
```

4.1 图像分割

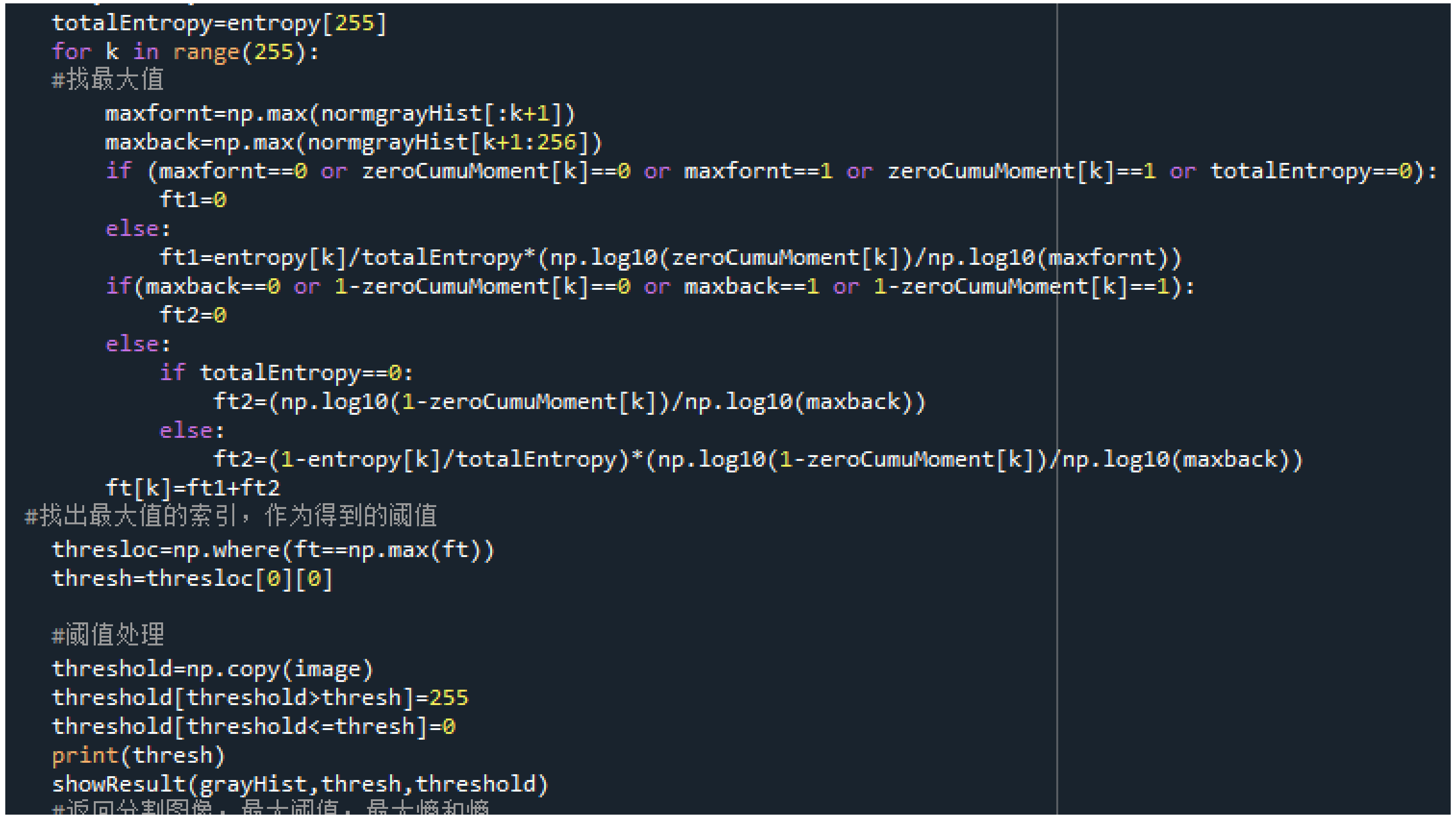
最大熵算法



```python
def threshEntroy(image):
    image = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
    rows,cols=image.shape
    #获取直方图
    grayHist=GrayHist(image)
    #得到概率直方图
    normgrayHist=grayHist/float(rows*cols)
    zeroCumuMoment=np.zeros([256],np.float32)
    for k in range(256):
        if k==0:
            zeroCumuMoment[k]=normgrayHist[k]
        else:
            zeroCumuMoment[k]=zeroCumuMoment[k-1]+normgrayHist[k]
    entropy=np.zeros([256],np.float32)
    #计算熵
    for k in range(256):
        if k==0:
            if normgrayHist[k]==0:
                entropy[k]=0
            else:
                entropy[k]=-normgrayHist[k]*np.log10(normgrayHist[k])
        else:
            if normgrayHist[k]==0:
                entropy[k]=entropy[k-1]
            else:
                entropy[k]=entropy[k-1]-normgrayHist[k]*np.log10(normgrayHist[k])
    ft=np.zeros([256],np.float32)
    ft1,ft2=0.,0.
    totalEntropy=entropy[255]
```

4.1 图像分割

最大熵算法

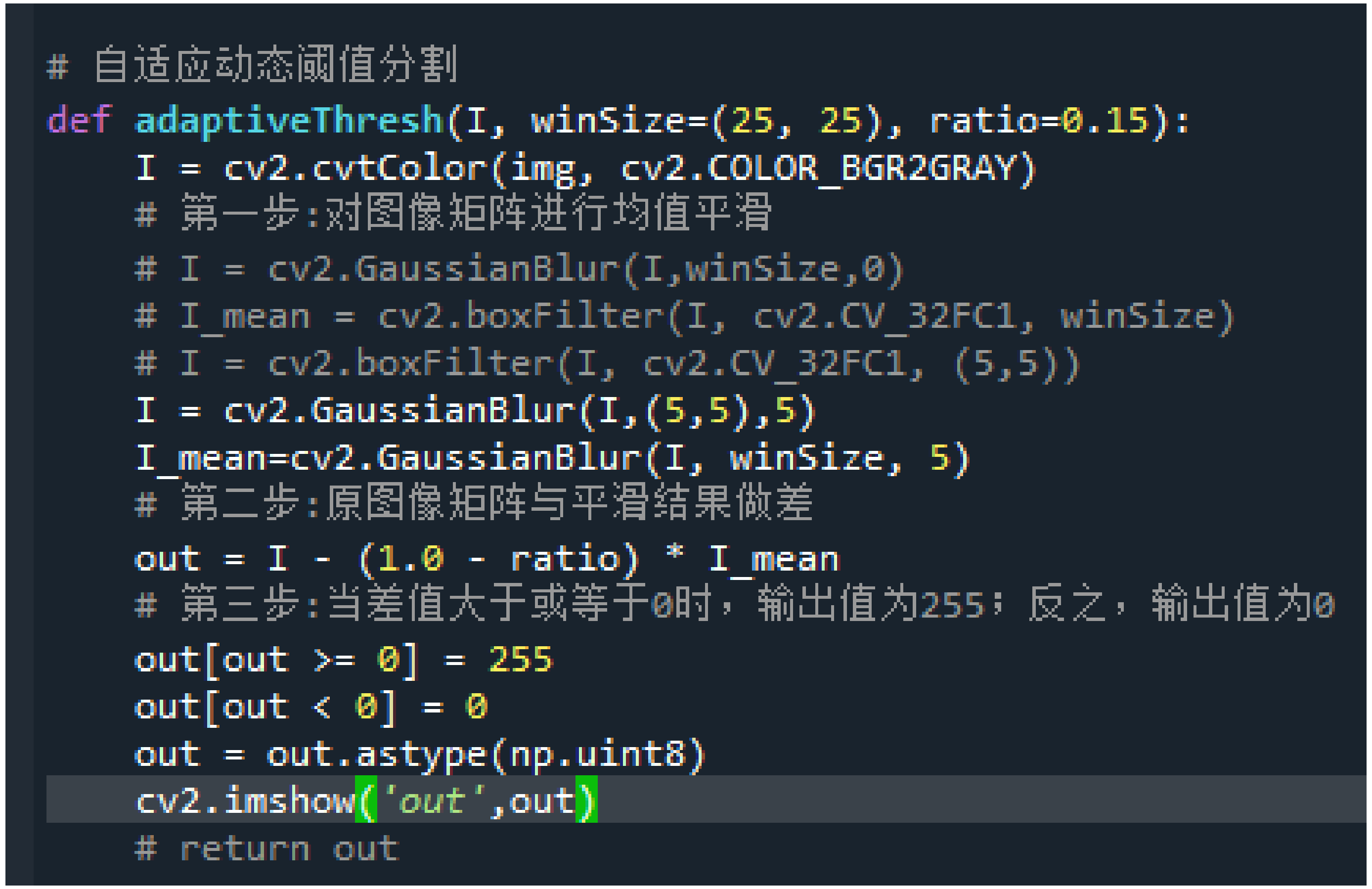


```
    totalEntropy=entropy[255]
    for k in range(255):
    #找最大值
        maxfornt=np.max(normgrayHist[:k+1])
        maxback=np.max(normgrayHist[k+1:256])
        if (maxfornt==0 or zeroCumuMoment[k]==0 or maxfornt==1 or zeroCumuMoment[k]==1 or totalEntropy==0):
            ft1=0
        else:
            ft1=entropy[k]/totalEntropy*(np.log10(zeroCumuMoment[k])/np.log10(maxfornt))
        if(maxback==0 or 1-zeroCumuMoment[k]==0 or maxback==1 or 1-zeroCumuMoment[k]==1):
            ft2=0
        else:
            if totalEntropy==0:
                ft2=(np.log10(1-zeroCumuMoment[k])/np.log10(maxback))
            else:
                ft2=(1-entropy[k]/totalEntropy)*(np.log10(1-zeroCumuMoment[k])/np.log10(maxback))
        ft[k]=ft1+ft2
  #找出最大值的索引，作为得到的阈值
    thresloc=np.where(ft==np.max(ft))
    thresh=thresloc[0][0]

    #阈值处理
    threshold=np.copy(image)
    threshold[threshold>thresh]=255
    threshold[threshold<=thresh]=0
    print(thresh)
    showResult(grayHist,thresh,threshold)
    #返回分割图像，最大阈值，最大熵和熵
```

4.1 图像分割

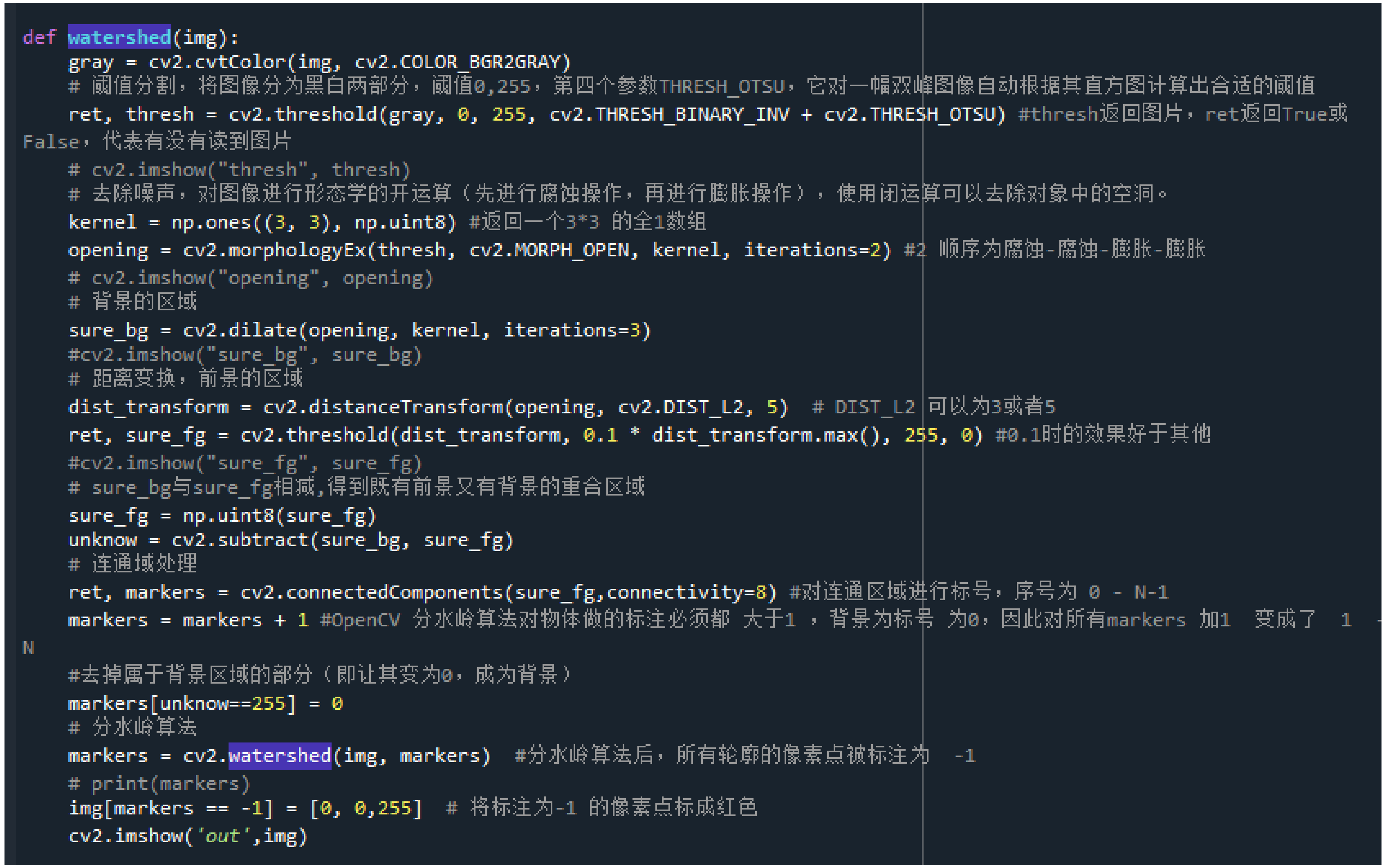
自适应阈值



```
# 自适应动态阈值分割
def adaptiveThresh(I, winSize=(25, 25), ratio=0.15):
    I = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
    # 第一步:对图像矩阵进行均值平滑
    # I = cv2.GaussianBlur(I,winSize,0)
    # I_mean = cv2.boxFilter(I, cv2.CV_32FC1, winSize)
    # I = cv2.boxFilter(I, cv2.CV_32FC1, (5,5))
    I = cv2.GaussianBlur(I,(5,5),5)
    I_mean=cv2.GaussianBlur(I, winSize, 5)
    # 第二步:原图像矩阵与平滑结果做差
    out = I - (1.0 - ratio) * I_mean
    # 第三步:当差值大于或等于0时，输出值为255；反之，输出值为0
    out[out >= 0] = 255
    out[out < 0] = 0
    out = out.astype(np.uint8)
    cv2.imshow('out',out)
    # return out
```

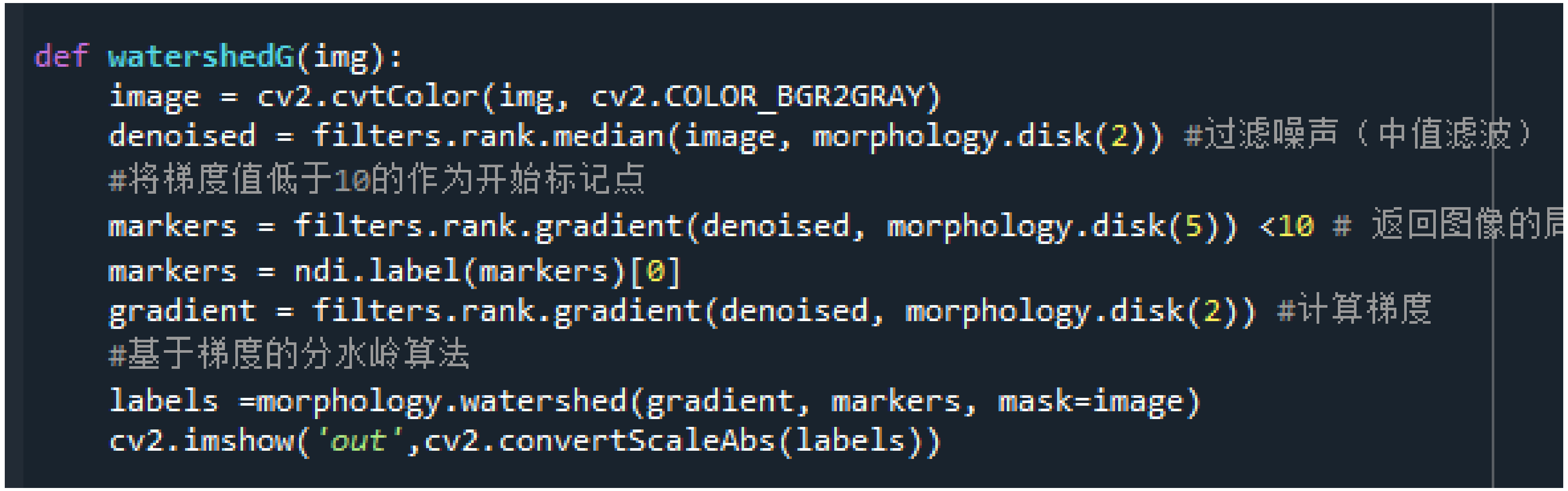
4.1 图像分割

基于距离变换的分水岭算法



```
def watershed(img):
    gray = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
    # 阈值分割，将图像分为黑白两部分，阈值0,255，第四个参数THRESH_OTSU，它对一幅双峰图像自动根据其直方图计算出合适的阈值
    ret, thresh = cv2.threshold(gray, 0, 255, cv2.THRESH_BINARY_INV + cv2.THRESH_OTSU) #thresh返回图片，ret返回True或
False，代表有没有读到图片
    # cv2.imshow("thresh", thresh)
    # 去除噪声，对图像进行形态学的开运算（先进行腐蚀操作，再进行膨胀操作），使用闭运算可以去除对象中的空洞。
    kernel = np.ones((3, 3), np.uint8) #返回一个3*3 的全1数组
    opening = cv2.morphologyEx(thresh, cv2.MORPH_OPEN, kernel, iterations=2) #2 顺序为腐蚀-腐蚀-膨胀-膨胀
    # cv2.imshow("opening", opening)
    # 背景的区域
    sure_bg = cv2.dilate(opening, kernel, iterations=3)
    #cv2.imshow("sure_bg", sure_bg)
    # 距离变换，前景的区域
    dist_transform = cv2.distanceTransform(opening, cv2.DIST_L2, 5)  # DIST_L2 可以为3或者5
    ret, sure_fg = cv2.threshold(dist_transform, 0.1 * dist_transform.max(), 255, 0) #0.1时的效果好于其他
    #cv2.imshow("sure_fg", sure_fg)
    # sure_bg与sure_fg相减,得到既有前景又有背景的重合区域
    sure_fg = np.uint8(sure_fg)
    unknow = cv2.subtract(sure_bg, sure_fg)
    # 连通域处理
    ret, markers = cv2.connectedComponents(sure_fg,connectivity=8) #对连通区域进行标号，序号为 0 - N-1
    markers = markers + 1 #OpenCV 分水岭算法对物体做的标注必须都 大于1 ，背景为标号 为0，因此对所有markers 加1  变成了  1 -
N
    #去掉属于背景区域的部分（即让其变为0，成为背景）
    markers[unknow==255] = 0
    # 分水岭算法
    markers = cv2.watershed(img, markers)  #分水岭算法后，所有轮廓的像素点被标注为  -1
    # print(markers)
    img[markers == -1] = [0, 0,255]  # 将标注为-1 的像素点标成红色
    cv2.imshow('out',img)
```

基于梯度的分水岭算法



```
def watershedG(img):
    image = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
    denoised = filters.rank.median(image, morphology.disk(2)) #过滤噪声（中值滤波）
    #将梯度值低于10的作为开始标记点
    markers = filters.rank.gradient(denoised, morphology.disk(5)) <10 # 返回图像的
    markers = ndi.label(markers)[0]
    gradient = filters.rank.gradient(denoised, morphology.disk(2)) #计算梯度
    #基于梯度的分水岭算法
    labels =morphology.watershed(gradient, markers, mask=image)
    cv2.imshow('out',cv2.convertScaleAbs(labels))
```

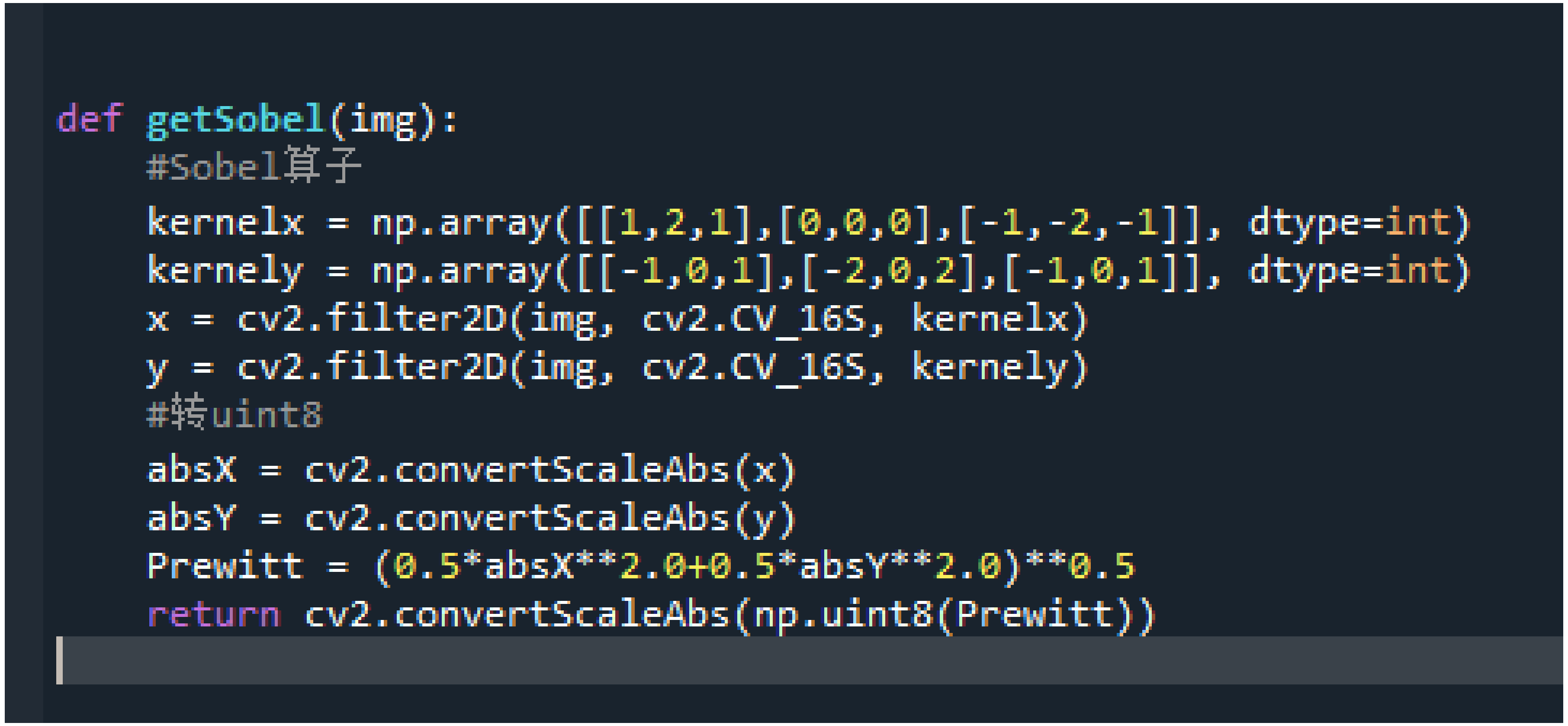
4.1 图像分割

按边缘分割举例

- 前处理：形态学+滤波
- 边缘检测：边缘检测
- 后处理：二值化+填充+形态学

4.1 图像分割

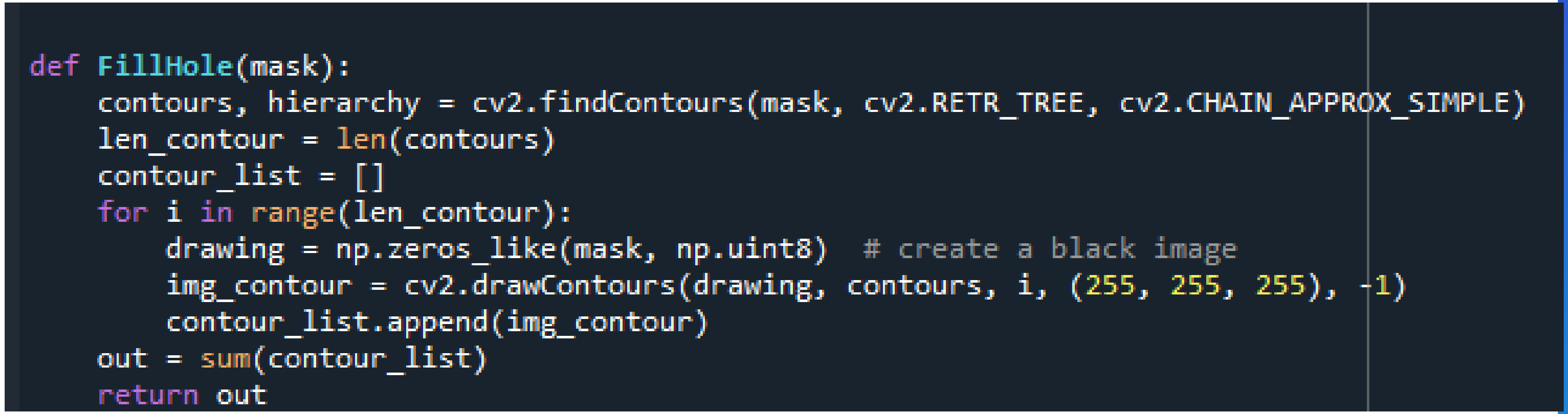
边缘检测举例



```
def getSobel(img):
    #Sobel算子
    kernelx = np.array([[1,2,1],[0,0,0],[-1,-2,-1]], dtype=int)
    kernely = np.array([[-1,0,1],[-2,0,2],[-1,0,1]], dtype=int)
    x = cv2.filter2D(img, cv2.CV_16S, kernelx)
    y = cv2.filter2D(img, cv2.CV_16S, kernely)
    #转uint8
    absX = cv2.convertScaleAbs(x)
    absY = cv2.convertScaleAbs(y)
    Prewitt = (0.5*absX**2.0+0.5*absY**2.0)**0.5
    return cv2.convertScaleAbs(np.uint8(Prewitt))
```

4.1 图像分割

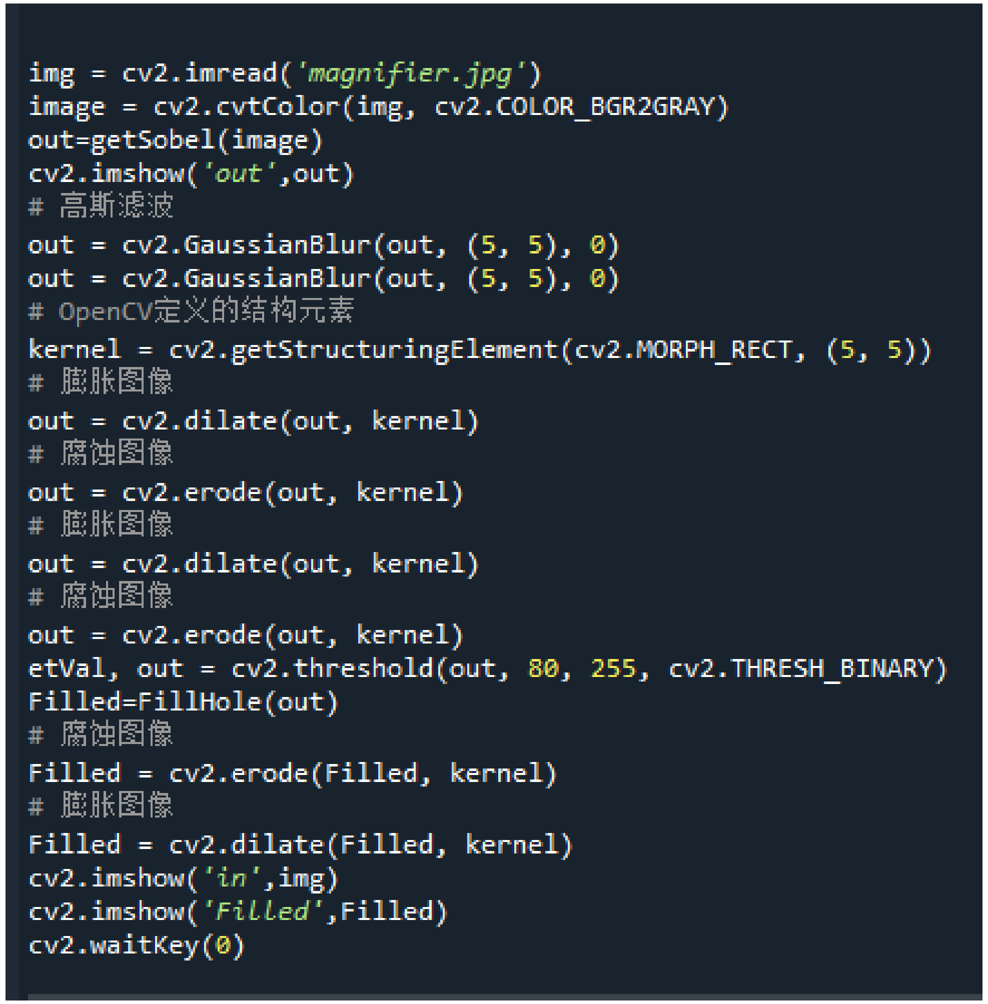
按边缘分割举例



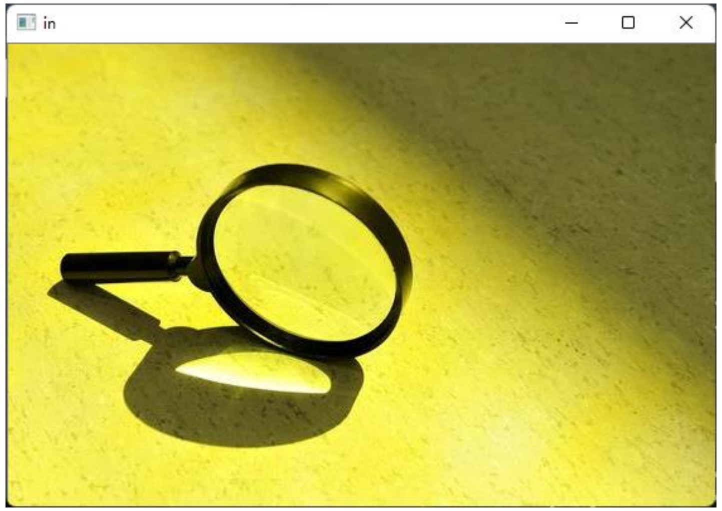
```python
def FillHole(mask):
    contours, hierarchy = cv2.findContours(mask, cv2.RETR_TREE, cv2.CHAIN_APPROX_SIMPLE)
    len_contour = len(contours)
    contour_list = []
    for i in range(len_contour):
        drawing = np.zeros_like(mask, np.uint8)  # create a black image
        img_contour = cv2.drawContours(drawing, contours, i, (255, 255, 255), -1)
        contour_list.append(img_contour)
    out = sum(contour_list)
    return out
```

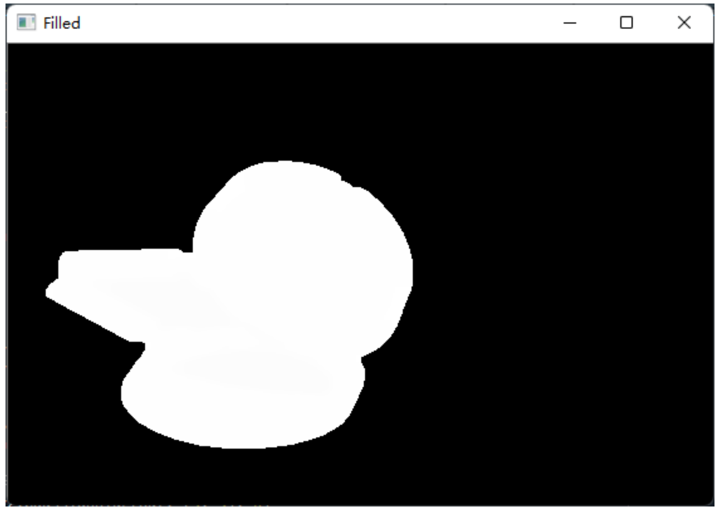
4.1 图像分割

按边缘分割举例



```
img = cv2.imread('magnifier.jpg')
image = cv2.cvtColor(img, cv2.COLOR_BGR2GRAY)
out=getSobel(image)
cv2.imshow('out',out)
# 高斯滤波
out = cv2.GaussianBlur(out, (5, 5), 0)
out = cv2.GaussianBlur(out, (5, 5), 0)
# OpenCV定义的结构元素
kernel = cv2.getStructuringElement(cv2.MORPH_RECT, (5, 5))
# 膨胀图像
out = cv2.dilate(out, kernel)
# 腐蚀图像
out = cv2.erode(out, kernel)
# 膨胀图像
out = cv2.dilate(out, kernel)
# 腐蚀图像
out = cv2.erode(out, kernel)
etVal, out = cv2.threshold(out, 80, 255, cv2.THRESH_BINARY)
Filled=FillHole(out)
# 腐蚀图像
Filled = cv2.erode(Filled, kernel)
# 膨胀图像
Filled = cv2.dilate(Filled, kernel)
cv2.imshow('in',img)
cv2.imshow('Filled',Filled)
cv2.waitKey(0)
```

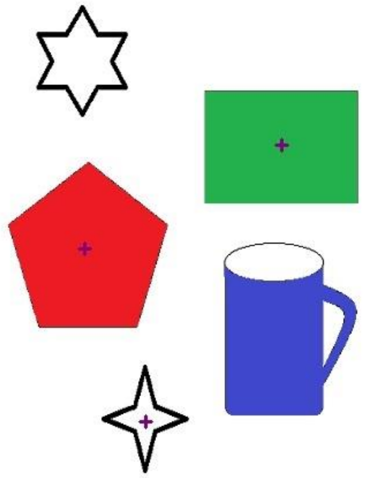


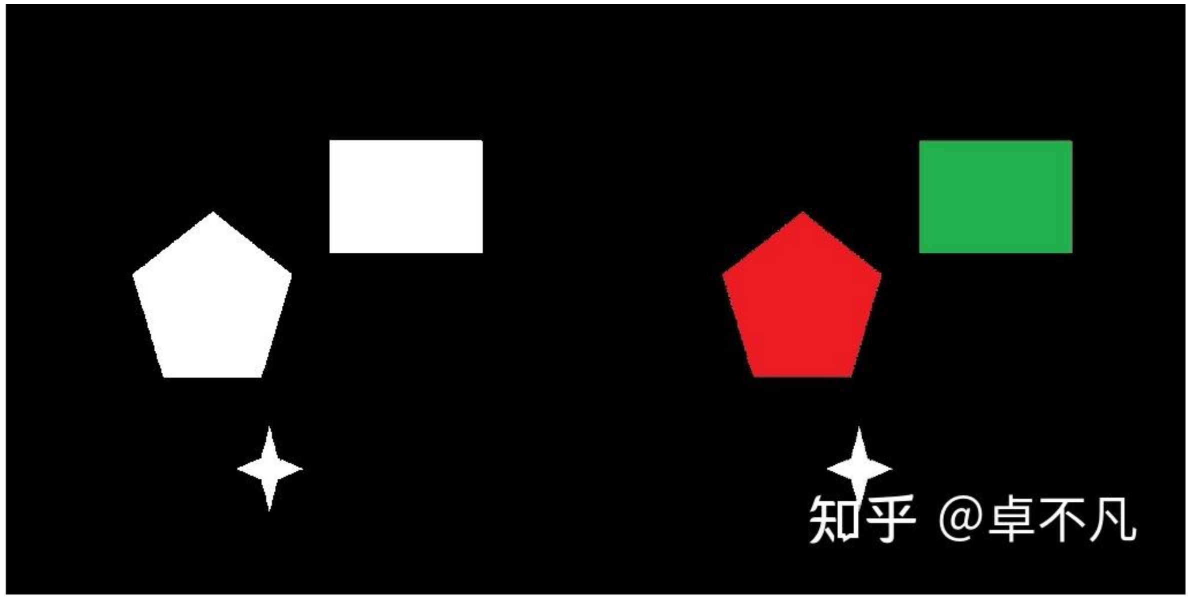


4.1 图像分割

区域增长法

https://zhuanlan.zhihu.com/p/399585256

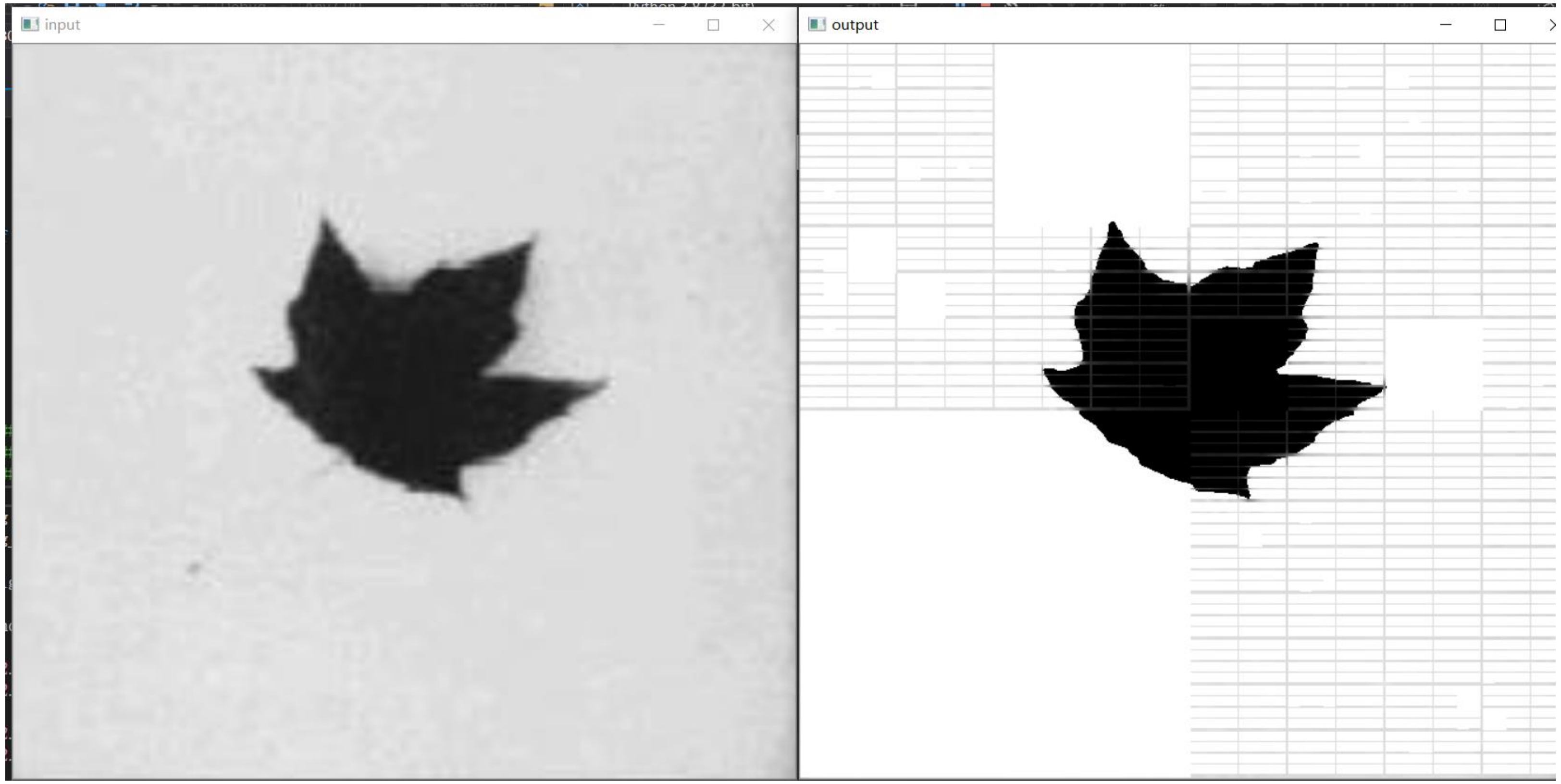




4.1 图像分割

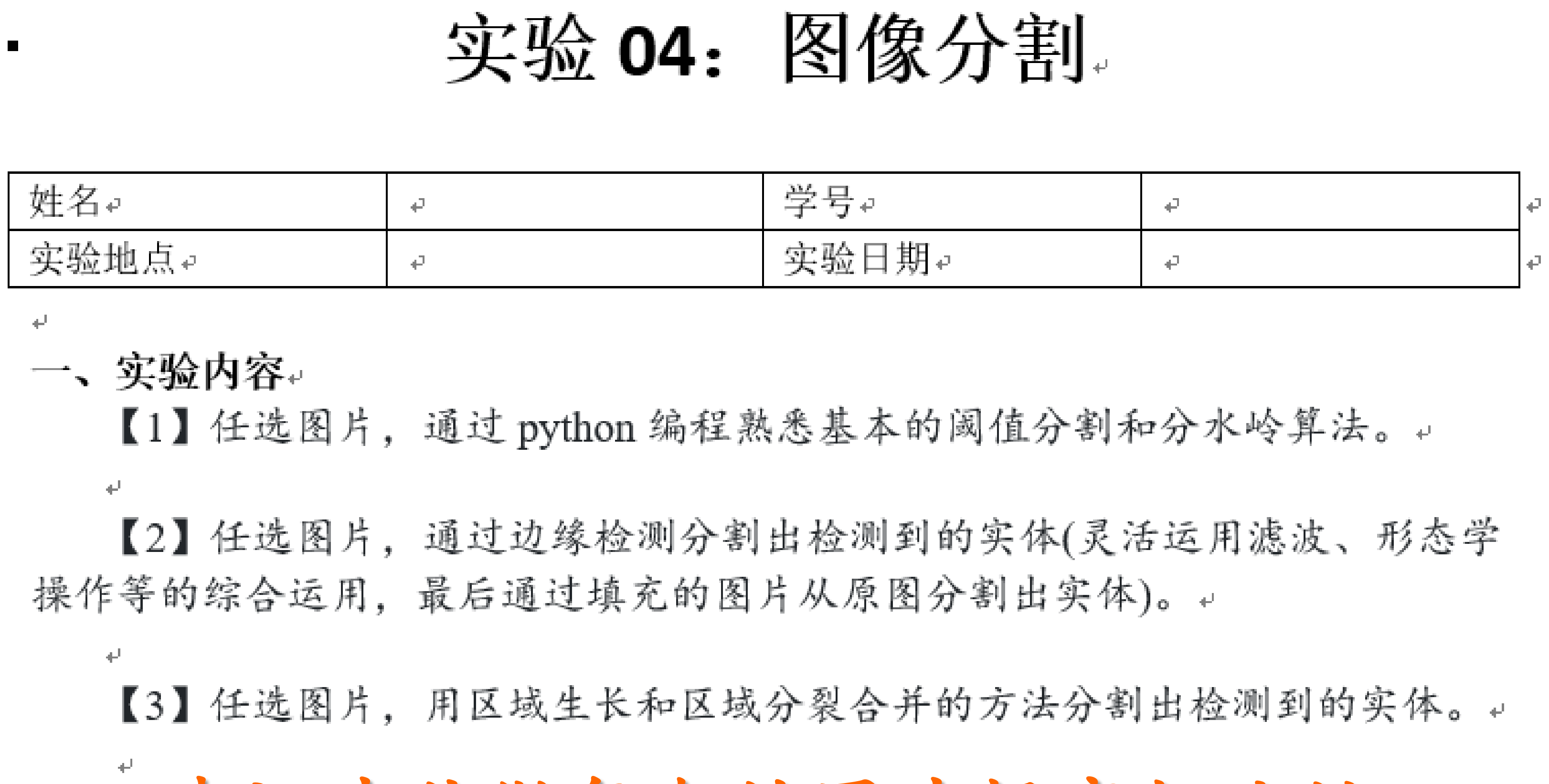
区域分裂合并法

https://blog.csdn.net/qq_30154571/article/details/109557559



4.1 图像分割

◆ **接下来的时间：上机实验并完成实验报告**



实验 04：图像分割

姓名		学号	
实验地点		实验日期	

一、实验内容

【1】任选图片，通过 python 编程熟悉基本的阈值分割和分水岭算法。

【2】任选图片，通过边缘检测分割出检测到的实体(灵活运用滤波、形态学操作等的综合运用，最后通过填充的图片从原图分割出实体)。

【3】任选图片，用区域生长和区域分裂合并的方法分割出检测到的实体。

- **建议选稍微复杂的图片提高挑战性**