Image Processing HW2

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Assignment:

1. (20%) Use binary morphological operations to 1) fix the image shown below ("text-broken.tif") and 2) find the boundaries of each character.

   Sol :

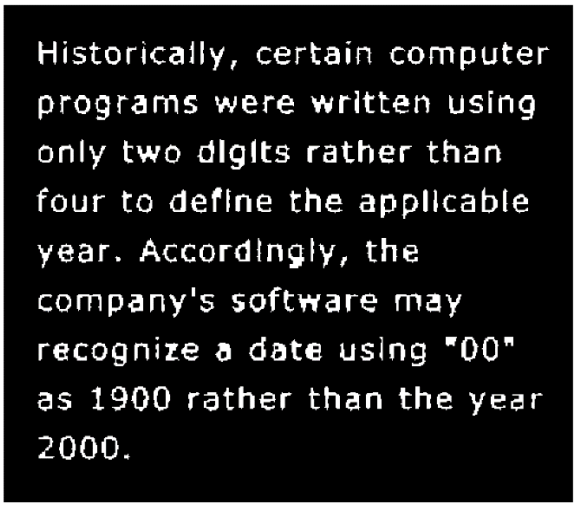
   使用cv2.imread()讀入需要修復的圖片

   1)

   Step1.使用cv2.getStructuringElement()定義及取得元素的結構

   Step2.並透過dilation和erosion來修補圖像(這裡在經過實驗後，驗證出將dilation和erosion各做2次會有最佳的修復效果)

   Step3.使用cv2.imwrite()保存修補後的圖像

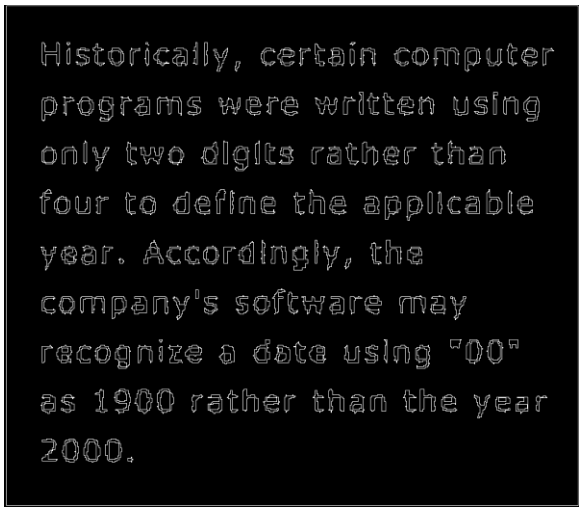


   2)

   Step1.透過erosion來提取圖像文字的內部

   Step2.透過subtract將原圖像與erosion後的圖像相減以取得邊界

   Step3.使用cv2.imwrite()保存取邊界後的圖像



2. (20%) Please use linear stretching to enhance the contrast of the image “aerialview-washedout.tif.”

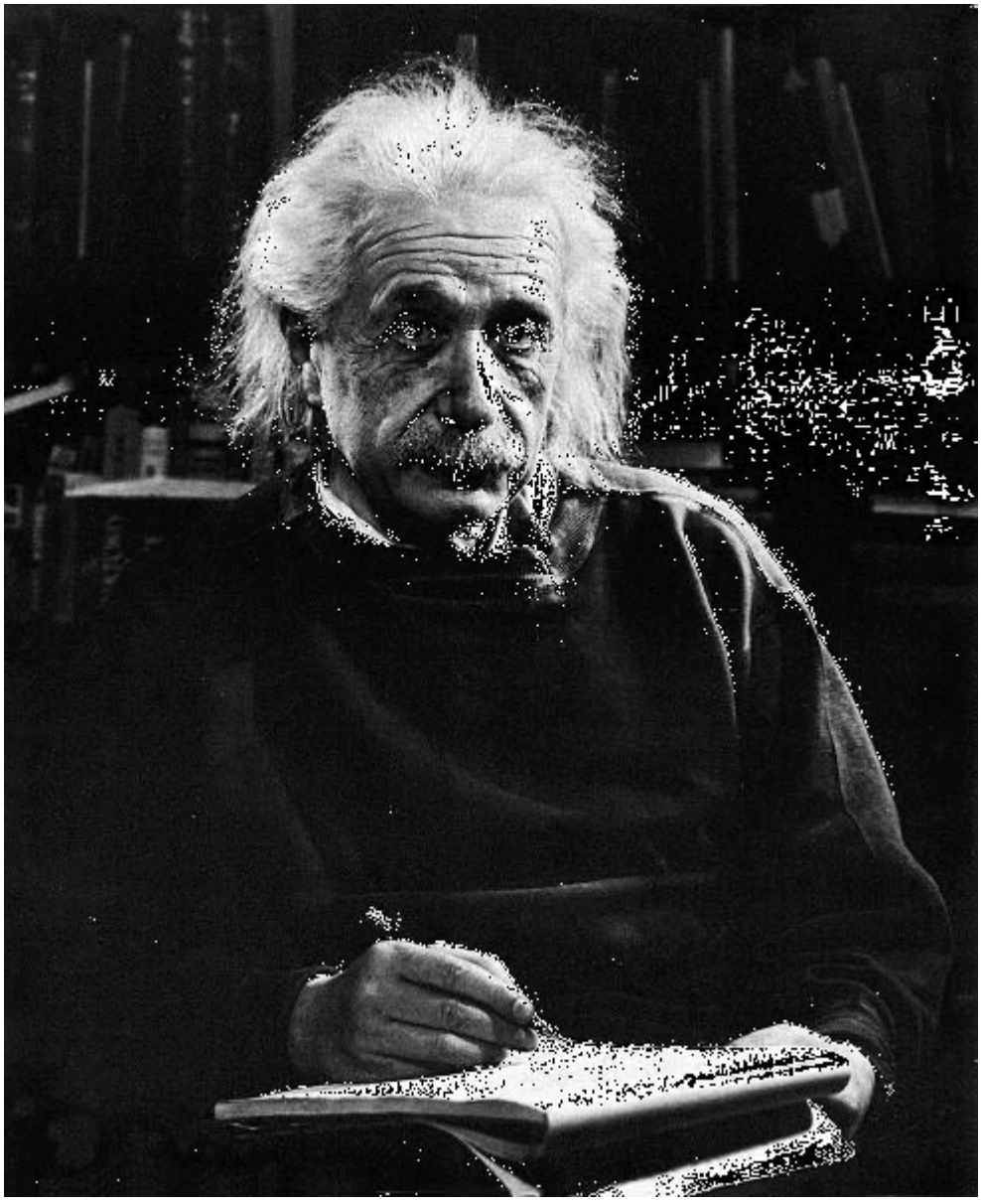
   Sol :

   Step1.使用cv2.imread()讀入需要做linear stretching的圖片，
   並寫入” cv2.IMREAD_GRAYSCALE”參數以灰階格式讀取影像

   Step2.使用np.percentile()來計算影像第1%及99%的像素值來當作linear stretching的max_value及min_value

   Step3.將max_value及min_value代入linear stretching的公式，將影像的像素值範圍映射到0~255之間，並使用.astype(np.uint8)將結果轉換成8位無符號整數類型，否則影像的數值類型不會改變。

   Step4.使用cv2.imwrite()保存拉伸後的圖像



3. (20%) Please apply global HE to “einstein-low-contrast.tif” or “aerialview-washedout.tif.” You should implement it only using “for loop’ and +-*/.
   Sol :
   Step1.使用cv2.imread讀入需要做Histogram equalization的圖片
   Step2.使用np.histogram()計算圖像的直方圖
   Step3.計算直方圖的累積分布函數CDF(Cumulative Distribution Function)
   Step4.將CDF進行normalization以減少誤差
   Step5.計算從輸入強度到輸出強度的映射函數
   Step6.將前一步的映射函數用在圖像的Histogram equalization(直方圖均衡化)
   Step7.使用cv2.imwrite()保存直方圖均衡化後的圖像

4. (20%) Please divide the histogram of “aerialview-washedout.tif” into two sub-histograms using the median μ of the image and apply HE to two sub-histograms separately (one ranging from 0~μ and the other from (μ+1)~255). You should implement it only using “for loop’ and +-*/. Using any built-in APIs, such as numpy.histogram, cumsum, numpy.interp, etc. would result in only 60% of your final score.

   Sol :

   Step1.使用cv2.imread讀入需要做Histogram equalization的圖片

   Step2.使用2個for迴圈(row&column)來計算圖像的直方圖

   Step3.使用for迴圈及if判斷式來計算中位數(median)

   Step4.使用2個array將直方圖存成2個子直方圖(sub-histograms)

   Step5.計算每個子直方圖的像素總數及進行normalization

   Step6.計算每個子直方圖的累積分布函數CDF(Cumulative Distribution Function)

   Step7.對每個子直方圖做Histogram equalization(直方圖均衡化)

   Step8.使用計算直方圖均衡化後的直方圖用在圖像上

   Step9.使用cv2.imwrite()保存直方圖均衡化後的圖像

5. (20%) Following Question 3, please implement the contrast enhancement method proposed in the paper “Two-dimensional histogram equalization and contrast enhancement (T. Celik 2012, as attached),” which was also taught in class as CVCE version 1. The window size could be set to 7x7.

   Sol :

   Step1.使用cv2.imread讀入需要做Histogram equalization and contrast enhancement的圖片

   Step2.定義window size的大小 = 7，並將圖像分成不重疊的block

   Step3.使用2層for迴圈來重複進行以下行為:

   a.提取當前迴圈的block

   b.計算block的直方圖

   c.計算直方圖的累積分布函數CDF(Cumulative Distribution Function)

   d.將CDF做normalization成0~255之間的值

   e.從上述CDF的結果將每個輸入強度映射到相應輸出強度的映射函數

   f.將映射函數應用於block中的每個像素

   g.用equalized block替換當前的block

Step4.使用cv2.imwrite()保存圖像