DIP Homework Assignment #4

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**Execution**

To reproduce the result, simply execute README.m under Matlab environment.

**Problem 1: Shape Analysis**

Sample1.raw is a gray-level image that contains some characters. Please design an algorithm to recognize different characters and count the number of occurrence of each character using TrainingSet.raw as the training set. Please provide the flow chart and details of your algorithm, and discuss the result in the report.

For problem 1, the following two functions were implemented:

1. shapeAnalysis.m: The function takes Sample1.raw and TrainingSet.raw, denoted as S1 and TS, respectively, as inputs and performs a series of steps, which will be described in detailed later in Figure 1-3, to deal with the required task. Finally, for each instance that appears in S1, the function outputs the class of shape it belongs to.
2. signSegment.m: The function takes S1 as input and segments S1 into small pieces recursively such that each piece is an independent instance to be classified. The function returns a cell array Ins, where the i-th instance (an image matrix) in S1 can be accessed by Ins{i}. Figure 1-1 depicts the concept of the recursive segmentation performed by signSegment.m.

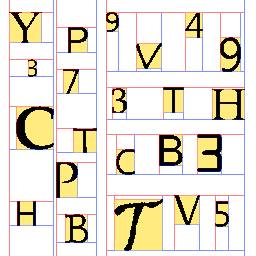


Figure 1-1: Starting from the leftmost column of S1, the function finds the first column that contains at least one black pixel, as suggested by the red vertical line. Then, from that red vertical line, the function searches for the first column that contains all white pixels, as suggested by the blue vertical line. The segment between the red and the blue vertical lines is then taken as an independent input image by another signSegment.m and the same task described previously is performed again, except that for now the function starts from the top row and looks for the first row that contains at least one black pixel and so on.

Figure 1-2 displays some instances segmented by signSegment.m.

rslt_images/Q1_instances/instance1.png rslt_images/Q1_instances/instance2.png rslt_images/Q1_instances/instance11.png rslt_images/Q1_instances/instance20.png

Figure 1-2: From left to right are Ins{1}, Ins{2}, Ins{11}, Ins{20}.

We can see that they can have very different sizes, which will be

one of the difficulties we will encounter during classification.

**Problem 2: Morphological Processing**

Given a binary image Sample2.raw, please try to produce the same images as illustrated in Fig. 4 by adopting appropriate morphological processing. Please describe the designed algorithm in detail for each case.

https://www.csie.ntu.edu.tw/~b01902040/doc/DIP\_hw4\_Q2\_Skeletonize.gif

**Problem 3: Texture Analysis**

Let’s denote Sample.raw as I. Please generate several images by the instructions below.

1. Transfer I to frequency domain by DFT (Discrete Fourier Transform) with centering and output the result as D.
2. Apply an ideal low-pass filter to D with and . Output results as and , respectively.
3. Apply a Gaussian low-pass filter to D with and . Output results as and , respectively.
4. Transfer , , , and back to spatial domain by Inverse DFT. Please compare the results and provide some discussions in the report.