## HOMEWORK ASSIGNMENT 3

### Morphological Processing, Texture Analysis

#### Due Date: 11:59 pm on Apr. 21, 2021

Please read the **submission guideline** carefully before getting started. All images in this homework are in PNG format and can be downloaded from our NTU COOL website. Details of all files offered are listed in the appendix. You are **NOT** allowed to use other functions except I/O, plotting and basic functions.

#### Problem 1: MORPHOLOGICAL PROCESSING

A binary image, **sample1.png**, is given in Figure 1. Please implement several morphological operations and provide discussions about the results. (Note that the white pixels represent foreground objects and the black pixels are background.)

- (a) (15 pt) Perform boundary extraction on sample1.png to extract the objects' boundaries and output the result as result1.png.
- (b) (15 pt) Perform hole filling on sample1.png and output the result as result2.png.
- (c) (30 pt) Please design an algorithm to count the number of objects in Figure 1. Describe the steps in detail and specify the corresponding parameters.



(a) sample1.png

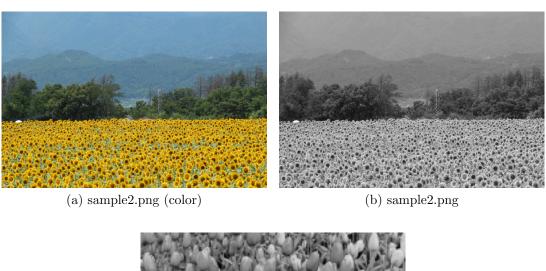
Figure 1: The test image for morphological processing.

### Problem 2: TEXTURE ANALYSIS

In this problem, there is an image **sample2.png** composed of several different textures.

- R (a) (10 pt) Perform Law's method on sample2.png to obtain the feature vector of each pixel and discuss the feature vectors in your report.
  - (b) (10 pt) Use k-means algorithm to classify each pixel with the feature vectors you obtained from
    (a). Label same kind of texture with the same color and output it as result3.png.
  - (c) (20 pt) Based on **result3.png**, design a method to improve the classification result and output the updated result as **result4.png**. Describe the modifications in detail and explain the reason why.
  - (d) (Bonus) Try to replace the flowers in color or gray-scale **sample2.png** with **sample3.png** or other texture you prefer by using the result from (c), and output it as **result5.png**.

    It's allowed to utilize external libraries to help you accomplish it, but you should specify the implementation detail and functions you used in the report.



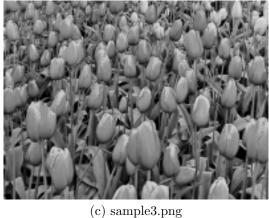


Figure 2: Images for texture analysis.

# Appendix

### Problem 1: MORPHOLOGICAL PROCESSING

sample 1.png:  $400 \times 400$  gray-scale

### Problem 2: TEXTURE ANALYSIS

sample 2.png:  $400 \times 600$  gray-scale

 $sample 2\_color.png: \qquad 400 \times 600 \qquad \qquad color$ 

sample 3.png:  $150\times200$  gray-scale