

HOMEWORK ASSIGNMENT 3

Morphological Processing, Texture Analysis

Due Date: 11:59 pm on Apr. 18, 2023

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 to meet the following requirements and provide discussions on each of the results. (Note that the white pixels represent foreground objects and the black pixels are background.) For each subproblem, please specify the parameters that you used.

- (a) (10 pt) Design a morphological processing to extract the objects' boundaries in **sample1.png** and output the result as **result1.png**.
- (b) (10 pt) Perform hole filling on **sample1.png** and output the result as **result2.png**.
- (c) (10 pt) Design an algorithm to count the number of objects in **sample1.png**. Describe the steps in detail and specify the corresponding parameters.
- (d) (20 pt) Apply open operator and close operator to **sample1.png** and output the results as **result3.png** and **result4.png**, respectively. How will it affect the result images if you change the shape of the structuring element?



(a) sample1.png

Figure 1: The input image for morphological processing.

Problem 2: TEXTURE ANALYSIS

In this problem, an image **sample2.png** of a natural scene is given in Figure. 2(a).

- (a) (10 pt) Perform Law's method on **sample2.png** to obtain the feature vectors. Please describe how you obtain the feature vectors and provide the reason why you choose it in this way.
- (b) (20 pt) Use k-means algorithm to classify each pixel with the feature vectors you obtained from (a). Label the pixels of the same texture with the same color and output it as **result5.png**. Please describe how you use the features in k-means algorithm and all the chosen parameters in detail.
- (c) (20 pt) Based on **result5.png**, design a method to improve the classification result and output the updated result as **result6.png**. Describe the modifications in detail and explain the reason why.
- (d) (Bonus) TA can't swim. Try to perform **image quilting**, replacing the sea in **sample2.png** with **sample3.png** or other texture you prefer by using the result from (c), and output it as **result7.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.



(a) sample2.png



(b) sample3.png

Figure 2: Images for texture analysis.

Appendix

Problem 1: MORPHOLOGICAL PROCESSING

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|--------------|------------------|------------|
| sample1.png: | 445×640 | gray-scale |
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Problem 2: TEXTURE ANALYSIS

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| sample2.png: | 600×900 | gray-scale |
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| sample3.png: | 200×200 | gray-scale |
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