

HOMWORK ASSIGNMENT 3

Morphological Processing and Texture Analysis

Due Date: 11:59 p.m. on Apr. 16, 2024

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. For each problem, please specify the parameters that you used. (Note that the white pixels represent foreground objects and the black pixels are background.)

- (a) (15 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) (15 pt) Design an algorithm to remove background noise of **sample1.png** and output the result as **result3.png**. Describe the steps in detail and specify the corresponding parameters. Please also perform noise removal on **sample1.png** as you did in HW1. Compare these two resultant images and provide discussions for these two approaches.
- (d) (10 pt) Design an algorithm to count the number of objects in **sample1.png**. Describe the steps in detail and specify the corresponding parameters.



(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) (20 pt) Please apply Law's method to **sample2.png** to extract the feature vectors. Describe your approach for extracting the feature vectors. You may include the feature images (normalize to 255) in your report for explanation, but it is optional.
- (b) (20 pt) Apply the k-means algorithm to classify each pixel using the feature vectors obtained in (a). Assign the same color to pixels with the same texture and save the result as **result4.png**. Describe in detail how you use the features in the k-means algorithm and all the chosen parameters.
- (c) (10 pt) Based on **result4.png**, add different texture patterns to each region and save it as **result5.png**. Describe the implementation details and discuss on the result.
- (d) (Bonus) TA is an avid chocolate enthusiast, and **sample3.png** features a variety of chocolates. Your task is to use **image quilting** on **sample3.png** to at least double the amount of chocolates, and save the result as **result6.png**. You will be rewarded with bonus points if the increased amount of chocolates brings great joy to TA. Don't forget to discuss your approach and result.



(a) sample2.png



(b) sample3.png

Figure 2: Images for texture analysis.

Appendix

Problem 1: MORPHOLOGICAL PROCESSING

sample1.png:	600×650	gray-scale
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Problem 2: TEXTURE ANALYSIS

sample2.png:	400×600	gray-scale
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sample3.png:	1000×1500	gray-scale
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