

## Final Exam

The total time allowed for the final exam is two days. The final exam starts on Tuesday, 24 March 2020, at 14.00 and is due Thursday, 26 March 2020, at 14.00.

### Part 1: describe the basic principle of digital image processing

1. Figure 1(a) shows an original grayscale image, which of the following gray-level transformation operations could have been applied to obtain an image in Figure 1(b)? Explain your reasons. [6 marks]

- a) Contrast stretching (with A of 0 and B of 80);
- b) Power-law transformation (with a gamma of 2);
- c) Gray-level slicing with the background (by using A of 0 and B of 80);
- d) Bit plane slicing (extraction of only the most significant bit, 7 bit).



Figure 1(a)



Figure 1(b)

2. Figure 2(a) shows the original image, which of the following gray-level transformation operations could have been applied to obtain the image in Figure 2(b)? Explain your reasons. [6 marks].

- a) Contrast stretching (with A of 0 and B of 60);
- b) Power-law transformation (with a gamma of 0.3);
- c) Gray-level slicing with the background (by using A of 0 and B of 60);
- d) Histogram equalization.



Figure 2(a)



Figure 2(b)

3. Figure 3(b) shows the result of applying some processing with an original RGB image in Figure 3(a) that the original image is affected by salt and pepper noise. What is the most likely processing to give this result? Explain your reasons. [6 marks]

- a) The Laplacian filtered, followed by the average filtering;
- b) The Prewitt filtered, followed by the median filtering;
- c) The median filtered, followed by the Prewitt filtering;
- d) The average filtered, followed by the Laplacian filtering.



Figure 3(a)



Figure 3(b)

4. Figure 4(c) shows the result of applying a histogram with the original image in Figure 4(a) [6 marks].

4.1 Which of the following image segmentation operations could have been applied to obtain the image in Figure 4(b) between the single global thresholding and the multiple global thresholding? Explain your reasons.

4.2 Answer one or two threshold values that relate to your selected in question 4.1 (One threshold value for the single global thresholding or two threshold values for the multiple global thresholding).

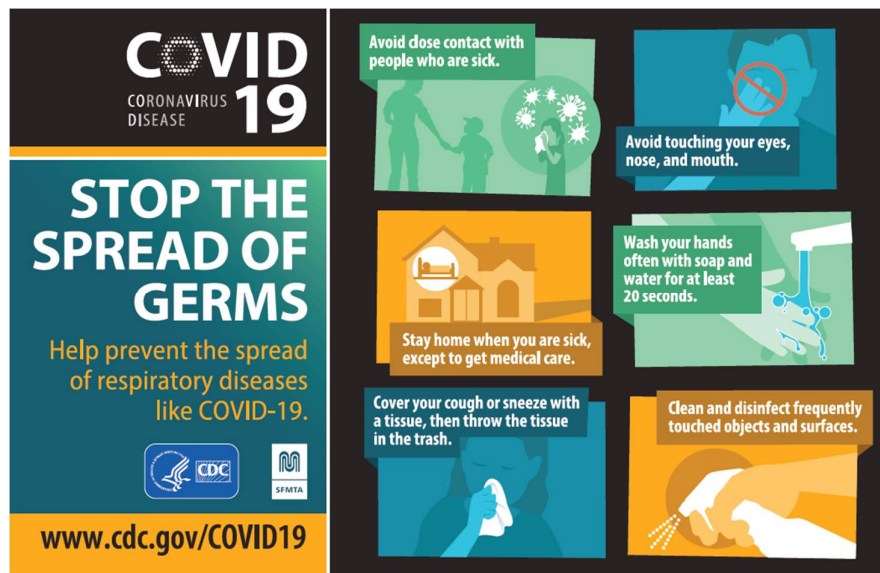


Figure 4(a)

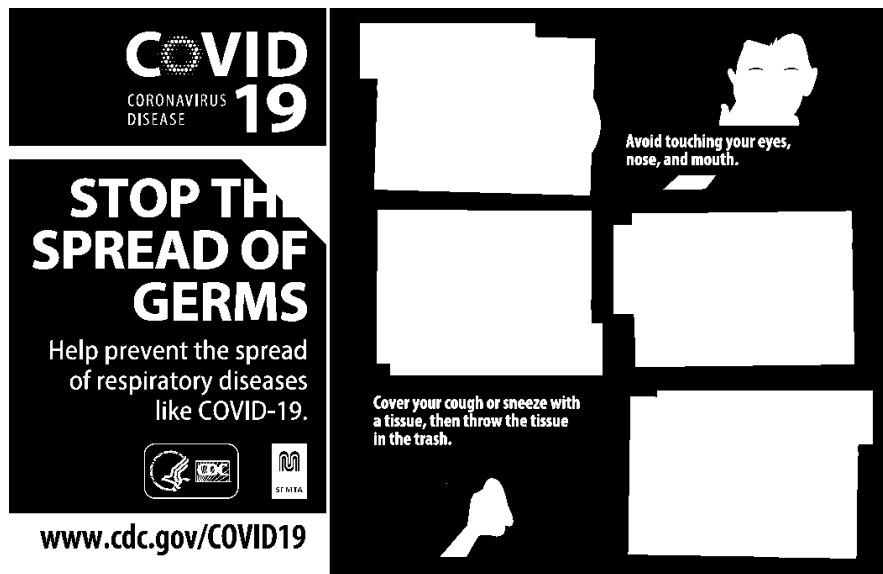


Figure 4(b)

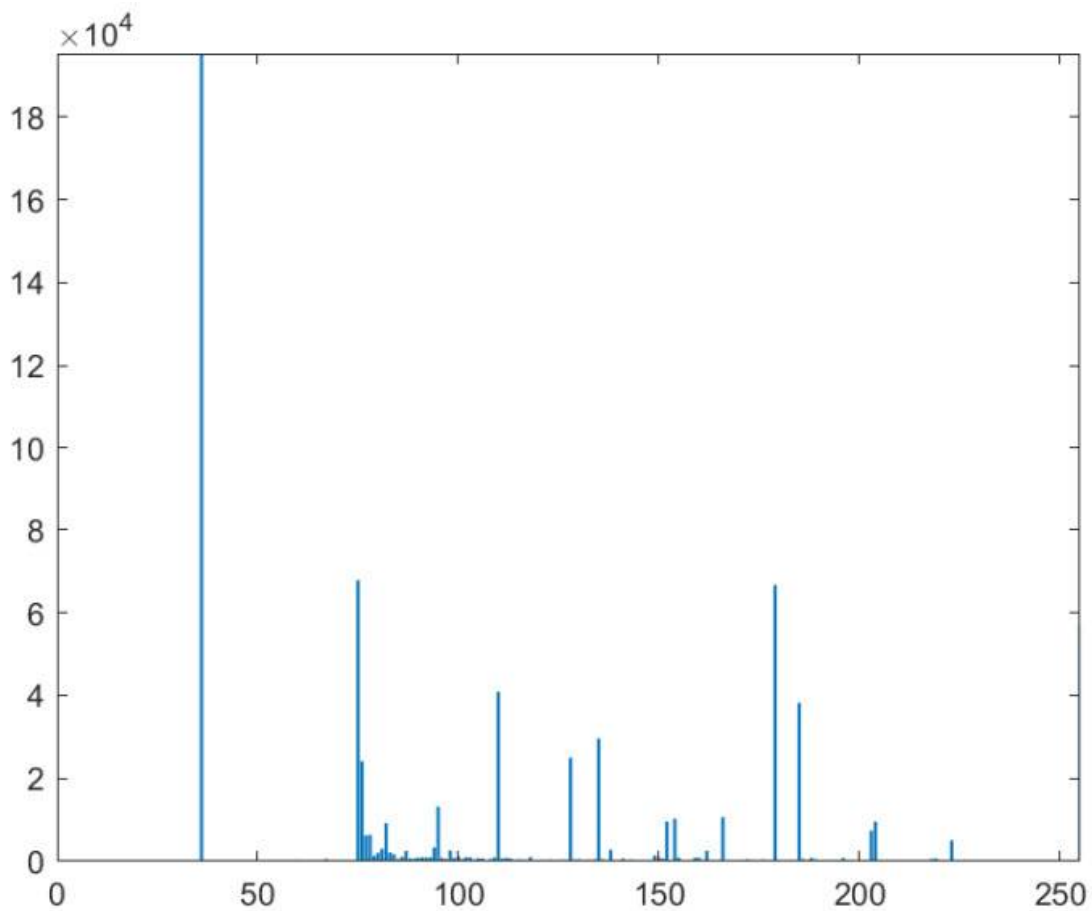


Figure 4(c)

Part 2: design and develop an application of digital image processing

5. Consider the original RGB image in Figure 5. A small plant, which consists of the leaves and branches. However, as you can see, the original image is affected by different illumination conditions in different areas of the image. Answer the possible processing steps that would calculate the total surface area of leaves on the small plant, excluding the branch's surface area. Explain your reasons. [12 marks]



Figure 5

6. Figure 6(a) and Figure 6(b) show some examples of the X-ray images, COVID-19-positive and normal, respectively. [24 marks]

6.1 In order to achieve higher accuracy, answer the possible pre-processing steps and tuning parameters of the training model that would classify COVID-19-positive in the X-ray images. Explain your reasons.

6.2 As you explained in question 6.1, write a program in Python to create the training model for detecting COVID-19-positive in the X-ray images. The starting code and the dataset are provided with the google drive.

(<https://drive.google.com/drive/folders/1OyHemYogA8a7JLAHmji2JW4HwHZOxqo2?usp=sharing>)



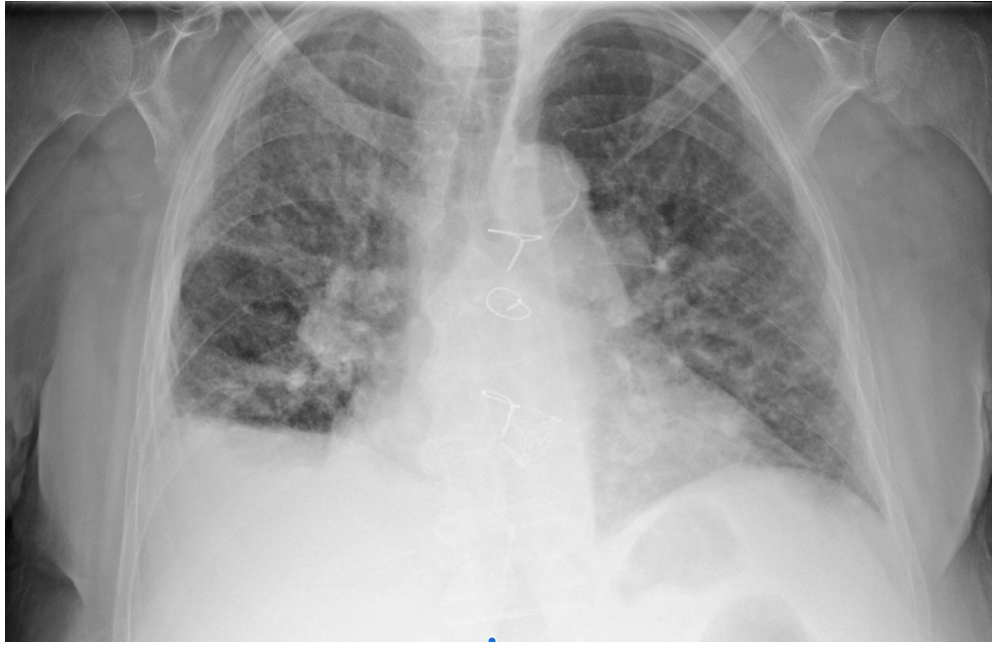


Figure 6(a)

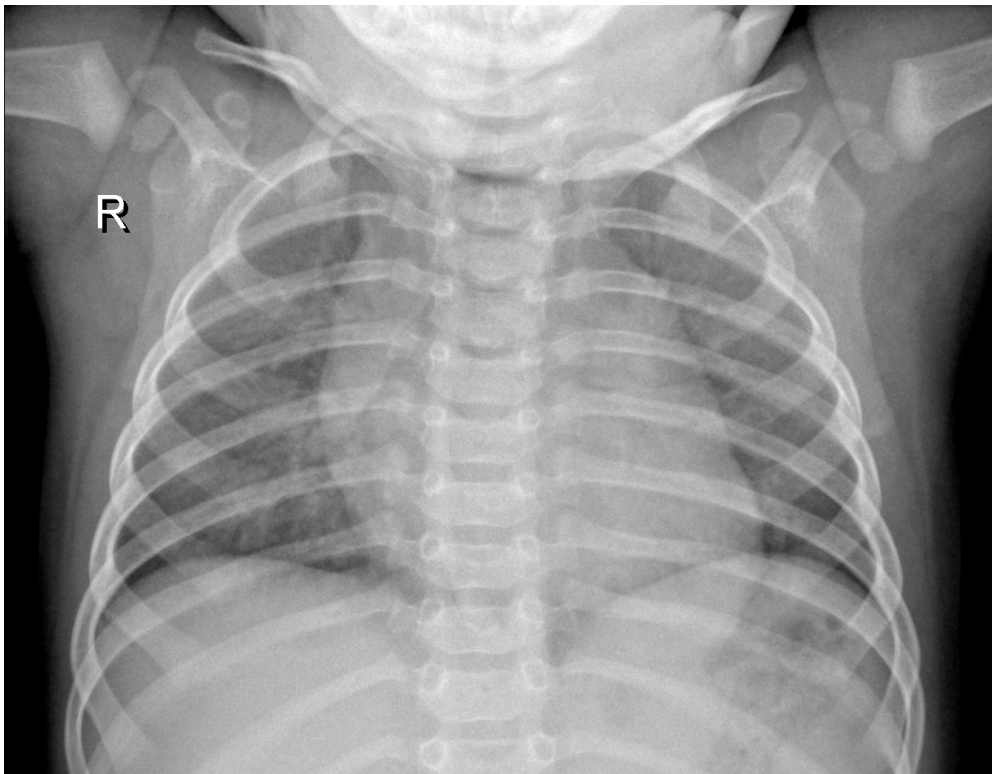


Figure 6(b)