Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Computer Science and Technology
300 level 1st Semester Examination – May/July 2017
CST373-3 Digital Image Processing

Uva Wellassa University

Instructions to candidates
Duration: Three (03) hours
Number of questions: Six (06)
Mark allocation: 150
Answer all questions.

1.

a. Write an example for Low, Mid and High-level image processing. (3 mark)

b. Briefly explain an application of image processing in any domain other than computer science. (6 mark)

c. Explain whether the following image subsets (Figure 1), R1 and R2 are 4-adjacent or 8-adjacent for V= {1}. (6 mark)

	R1				R2				
0	0	0	0	0	0	0	1	1	0
1	0	0	1	0	0	1	0	0	1
1	0	0	1	0	1	1	0	0	1
0	0	1	1	1	0	0	0	0	0
0	0	1	1	1	0	0	1	1	1

Figure 1: Image Subsets - R1 and R2

d.

i. Define mixed adjacency (m-adjacency). (4 mark)

ii. Compute the shortest 4, 8 and m paths between P and Q in the following piece of image. If a particular path does not exist between these two points, explain why.
Note: V = {1 , 3} (6 mark)

2	3	2	3(P)
1	6	4	1
4	2	3	2
1(Q)	3	3	1

Figure 2: Image Subset

2.

a. List **two (02)** advantages of Nearest Neighbor (NN) Interpolation. (2 mark)

b. Write **three (03)** reasons, why the quality of an image can be degraded? (3 mark)

c. Briefly describe the effects of an image after performing the addition, subtraction multiplication and division by a constant. (8 mark)

d. Explain in which situation we need to apply the following transformations. (6 mark)

i. Image negative transformation

ii. Histogram equalization

e. Determine the new values of the given piece of image (Figure 4) by using the intensity transformation function (s = *T(r)*) in Figure 3 (L = 16, A=6, B=11). (6 mark)

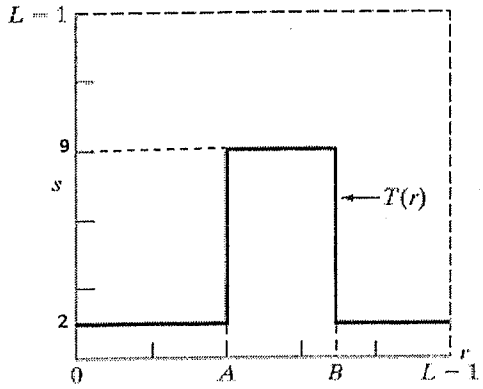

Figure 3: Intensity Transformation Function

2	3	12	9	2	3	4	11	5	6
8	2	11	9	10	11	7	11	12	12
13	11	14	2	5	5	7	15	15	12
1	1	1	8	8	7	6	5	3	3
0	0	15	3	13	4	14	15	11	12
1	0	15	14	12	10	3	2	2	1
4	5	6	9	11	10	13	15	15	1
6	7	5	10	12	12	14	15	2	3

Figure 4: Image Subset 2

3.

a. What is the principal objective of "Laplacian filter"? (2 mark)

b. Briefly explain how "mean filter" works. (6 mark)

c.

i. In spatial filtering, part of the neighborhood will reside outside the image when the origin of the filter is at border of the image. Write **two (02)** methods to solve this problem. (2 mark)

ii. Apply "max filter" to Figure 5 and determine the new image by mentioning the steps that you have followed. (8 mark)

12	14	1	10	11
16	13	4	3	2
15	4	2	7	8
11	12	12	11	10
13	2	3	3	8

Figure 5: Image Subset 3

d. Explain how spatial filtering techniques are useful for image enhancement. (7 mark)

4.

a. What is the basic morphological operation used for hole filling? (2 mark)

b. Compare and contrast "Erosion" and "Dilation". (5 mark)

c. "Erosion" and "Dilation" are dual with respect to set complementation and reflection. Verify the $(A \ominus u)^c = A^c \oplus \hat{u}$ property using suitable diagrams (Hint: A is an image and u is a structuring element). (8 mark)

d. Explain how morphological operations are used to correct the noisy fingerprint given in Figure 6. (10 mark)

Figure 6: A fingerprint image with noises and after processed
Images taken from Gonzalez & Woods, Digital Image Processing (2002)

5.

a. Write an example for discontinuity segmentation and similarity segmentation. (2 mark)

b. Briefly explain the masks which are detecting lines in specified direction. (7 mark)

c. Write **two (02)** methods that can be followed to neglect the negative values in Laplacian image when detecting lines. (5 mark)

d.

i. Write a simple algorithm to find the global threshold. (9 mark)

ii. Name a problem in segmentation by thresholding. (2 mark)

6.

a. What is meant by feature extraction in image processing? (2 mark)

b. Describe the region growing in image segmentation with the aid of a diagram. (8 mark)

c. Assume the chain code of a sample image is **0 0 0 3 0 0 3 3 3 3 3 2 2 2 2 2 1 1 1 1 1 1**.

i. Draw the boundary of the sample image. (3 mark)

ii. Determine the first difference and the shape number. (4 mark)

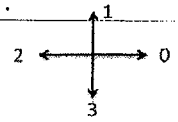

Figure 7: Directional Numbers

d. Explain the steps to identify the largest round object in Figure 8 using image processing techniques. (8 mark)

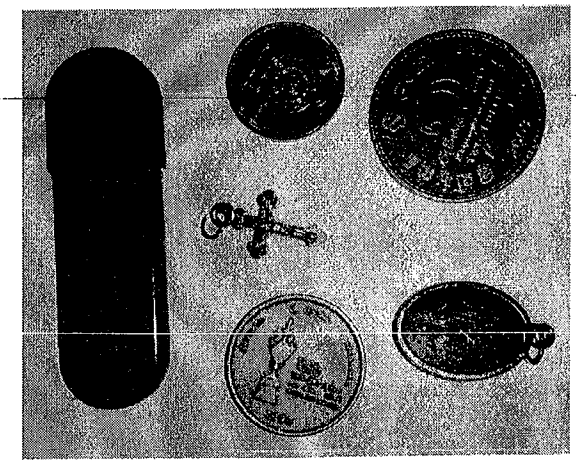

Figure 8: Objects

Appendix

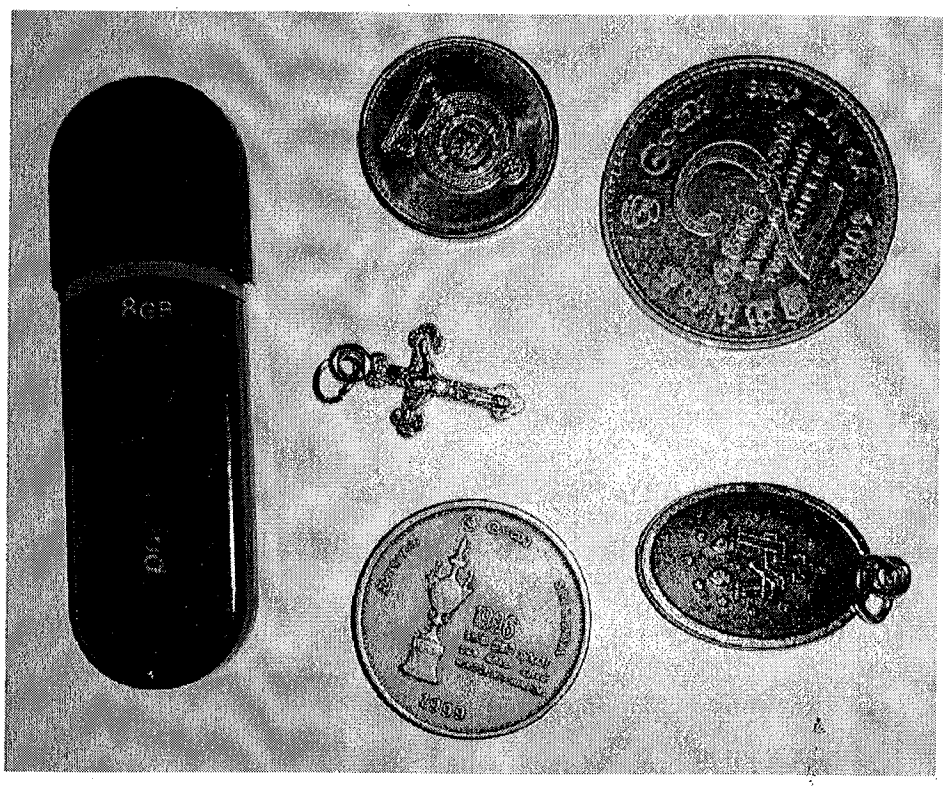

Figure 8: Objects