Uva Wellassa University, Sri Lanka
End Semester Examination – June 2009
CST310-3 Digital Image Processing
Time: Three (03) hours

Total 07 Questions
Answer five (05) questions only
Please returned the question paper with the answer script

01)

I. Describe the phenomenon brightness adaptation in the human eye. (3 marks)

II. Describe two methods used for zooming a digital image, and discuss their relative performance (4 marks)

III. *F (m,n)* is an image matrix and *P (1,2)* is a matrix that contains the pixel positions (x,y) of a one pixel-thick 8-path between two pixel positions in this image, given in the connected order. *1* is the length of the path *V* is the set of gray level values used to define the adjacency.

a. Write a pseudo code of an algorithms to convert the 8 path to a 4-path (8 marks)

b. Discuss the additional complications one confronts in developing an algorithms to convert a one-pixel thick m-paths to a 4-path (5 marks)

02)

I. Describe the techniques that you may use to carry out the following operations with respect to a digital image

a. Improve an image acquired under poor lighting conditions
b. Obtain the negative of an image
c. Covert an image to have only black and white regions (6 marks)

II. Comment on the final visual effect you expect after performing the two gray level transformations given in figure 2(b), one after the other on a grayscale image (2 marks)

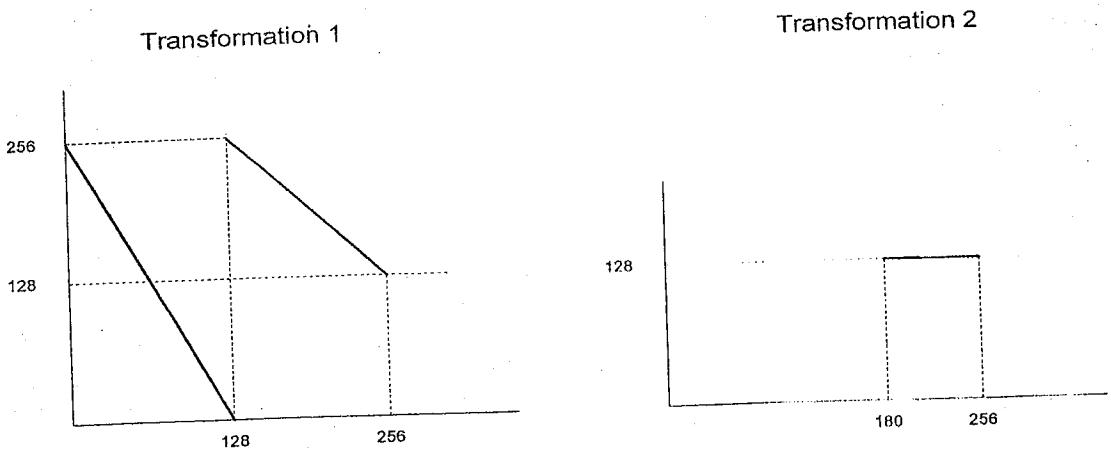


figure 2(b)

III. Briefly describe the following

a. Coding redundancy

b. Pseudo coloring

(4 marks)

IV.

a. Explain in detail about patterns and pattern classes with examples. Also, explain how the pattern classes are useful for recognition.
(4 marks)

b. With a neat block diagram, explain a pattern recognition system in detail.
(4 marks)

03)

I. Explain the basic steps involved in filtering an image in the frequency domain. Discuss the advantages of frequency domain processing when compared with special domain processing.
(5 marks)

II. Describe two approaches for the representation of color images. How does the choice affect the ability to represent color information? What are the strengths and weaknesses of each approach?
(6 marks)

III. Given an index color image

a. Give the algorithm steps to construct a true-color image.

b. Give the algorithm steps to construct the intensity (gray scale) image.

c. How does the gray scale image differ from the array values?

(10 marks)

04)

I. Describe the RGB and HSI color models. (4 marks)

II. Most liquid crystal displays divide a pixel into three sub-pixels colored red, green, and blue. Explain why this is so. (4 marks)

III. Gray levels of an image region are shown below

20	18	16	25	26
22	25	27	26	26
20	**32**	**29**	**25**	17
18	26	24	23	19
26	27	20	21	23

a. Compute the resulting gray levels for the three pixels (shown in BOLD) after applying the following mask (4 marks)

-2	-1	-2
-1	12	-1
-2	-1	-2

b. Briefly describe the effects of the above mask (2 marks)

IV. The shape and aspect ratio correction feature of a digital multimedia projector requires that a 2040x2040 digital image be projected onto the shape given in figure 4(d) when projecting with a certain upwards inclination

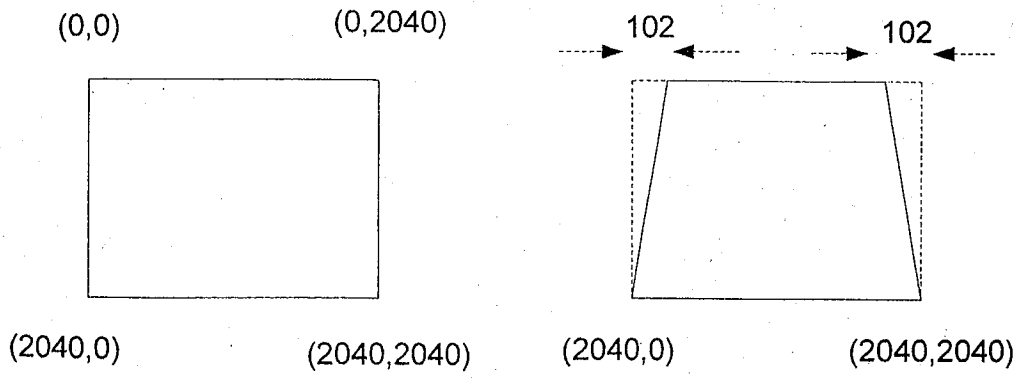


figure 4(d)

Obtain the transfer functions you would use to map the gray levels to effect this shape correction (6 marks)

05)

I. What is image compression? (2 marks)

II. Give names of two loss-less image compression schemes, and briefly describe one of them (4 marks)

III. A portion of a digital image is given below.

100	210	150	250	150	200	200	200
150	220	70	80	20	120	120	240
255	125	122	25	55	202	222	12
10	110	190	170	70	65	104	100
100	100	255	255	255	10	10	10
18	18	190	200	200	20	20	20
50	50	50	50	50	75	75	75
10	10	10	0	0	0	0	0

a. Perform the gray level transformation given in figure 5(c) and obtain the resulting image.

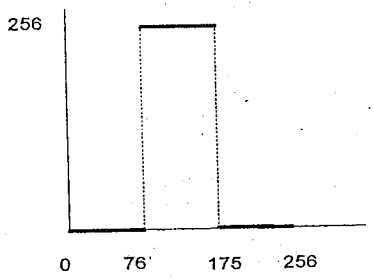


figure 5(c)

(4 marks)

b. Perform run length encoding of the binary image obtained in (i) add a digit to indicate the line number starting from 1 (4 marks)

c. Compute the compression ratio as well as digits in the encoded file (4 marks)

d. Comment on the images that are suitable for run length encoding (2 marks)

06)

I. Segment the image shown in figure 6(a) into sub regions using the region growing techniques use the properly |gray level (Sx ,Sy) ~ gray level (x , y)| #2 and the two seeds point shown in bold gray level (Sx ,Sy) is the gray level of the given seed point of the region. Use 4-neighbors in all comparisons. Mark the different labels using different letter symbols/ colors

(6 marks)

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

figure 6(a)

II. Give four shape features you could extract from digital images of objects and briefly describe the sequence of application of image processing routines to extract one of them.

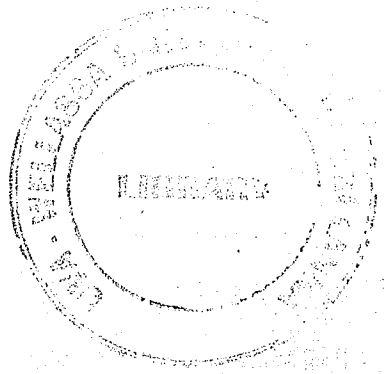
(4 marks)

III. Obtain the histogram of the image region given below.

0	1	2	2	1	3
0	0	1	2	2	2
1	0	1	0	2	3
2	1	1	2	3	3
2	1	0	2	4	4
1	2	2	4	4	4

(4 marks)

IV. 1.3 Obtain a transfer function to modify the histogram so that gray level 4 is transformed to gray level 7 and 0 is transformed to 1, while linearly stretching all the intermediate gray levels to the range from 1 to 7
(6 marks)



07) Gray levels of an image region re shown below

0.	1	2	3	4	5
0	0	1	2	3	4
0	0	0	1	1	2
0	0	0	0	1	1
4	3	2	1	0	0
5	4	3	2	1	0

I. Calculate the number of bits required and the average length of a code word if a uniform length code of minimum width is used to store this image n (2 marks)

II. If the same image is run-length-encoded, what would be the total number of bits required? (4 marks)

III. What would be the compression ratio after run –length encoding, compared to the uniform length code in part) above? Comment on your answer (4 marks)

IV. Perform Huffman coding to the same image calculate the average number of bits per word, and hence the compression ratio compared to the uniform coding as in a) above comment on your answer (6 marks)

V. Describe the following morphological operations for binary images and give example of their use in image processing:

a. Dilation

b. Erosion (4 marks)