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

Q1)

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. *I* 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)

Q2)

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)

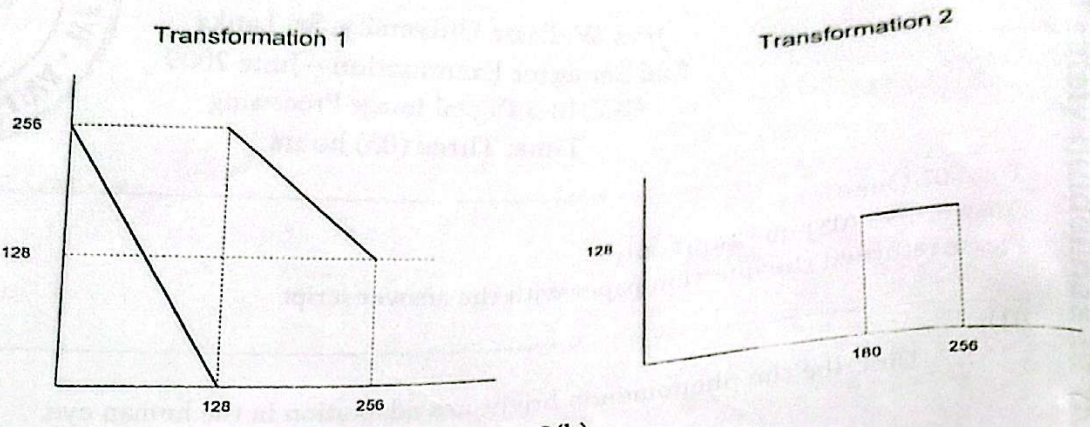


figure 2(b)

III. Briefly describe the following (4 mark
   a. Coding redundancy
   b. Pseudo coloring

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 mark

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

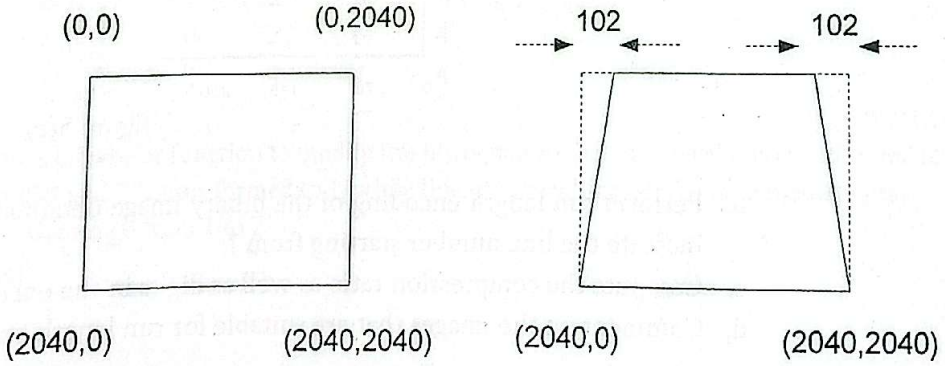


figure 4(d)

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.

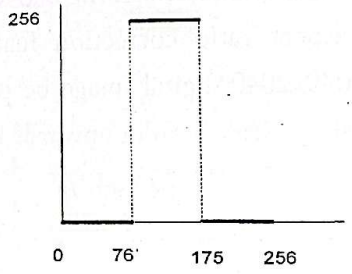


figure 5(c)

(4 marks)

b. Perform run length encoding of the binary image obtained in (i) add a digit t 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)

30

Uva Wellassa University, Sri Lanka
End Semester Examination – June/July 2010
CST 304-3 DIGITAL IMAGE PROCESSING
Time: Three (03) hours

Total 05 Questions
Answer all five (05) questions

Q1

I. Describe the phenomenon brightness adaptation in the human eye. (4 marks)

II. Describe two methods used for zooming a digital image, and discuss their relative performance. (6 marks)

III. The intensity distribution in an image is uniform over a range from 0 to 1. The image is passed through a power low intensity transformation with $\gamma = 0.5$. What is the distribution (density) of the output image? The cumulative distributions is

$$F_X(x) = \begin{cases} 0 & x < 0 \\ x & 0 < x < 1 \\ 1 & 1 < x \end{cases}$$

(10 marks)

Q2

I. Describe the techniques that you may use to improve:

a. A poorly focused image.

b. An image superimposed with pure black and pure white noise pixels.

(4 marks)

II. What sequence of application of the above techniques would you follow to restore an image with both of the above defects? Give reasons for the selection of techniques and the sequence you suggest. (2 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

7

a. Compute the resulting gray levels for the three pixels (shown in **BOLD**) after applying the following mask. (6 marks)

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

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

c.

1	2	1
2	4	2
1	2	1

We are given a 3x3 mask for low-pass filtering, shown above. Describe an efficient method for convolving an image with this filter. Estimate the number of operations (additions and multiplications) required to convolve an nxn image using your method. (6 marks)

Q3

I. We wish to convolve a 1024 x 1024 image with a filter that has a support set 100x100 points. Describe how to do this with the FFT. Your method should avoid wraparound artifacts. (10 marks)

II. What is meant by histogram equalization? (2 marks)

III. What is meant by bit plane slicing? (2 marks)

IV. Differentiate linear spatial filter and non-linear spatial filter. (6 marks)

Q4

I. Briefly describe the followings.

a. Image enhancement.

b. Image segmentation. (4 Marks)

II. Describe the effects of using median filter and local averaging for noise removal giving advantages and disadvantages of each method. (4 Mark

III. Gray levels of a image region are shown below

21	18	16	15	12	10
22	**05A**	17	13	16	20
22	23	16	15	12	30
18	26	14	**73B**	14	40
26	27	12	11	11	50
11	12	09	09	80	60
10	20	30	40	50	60

Compute the resulting gray levels for the pixels A and B (shown in bold) after performing

a. Local averaging with a 3*3 mask. (2 Marks)

b. Median filtering with a 3*3 mask. (2 Marks)

c. Midpoint filtering with a 3*3 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

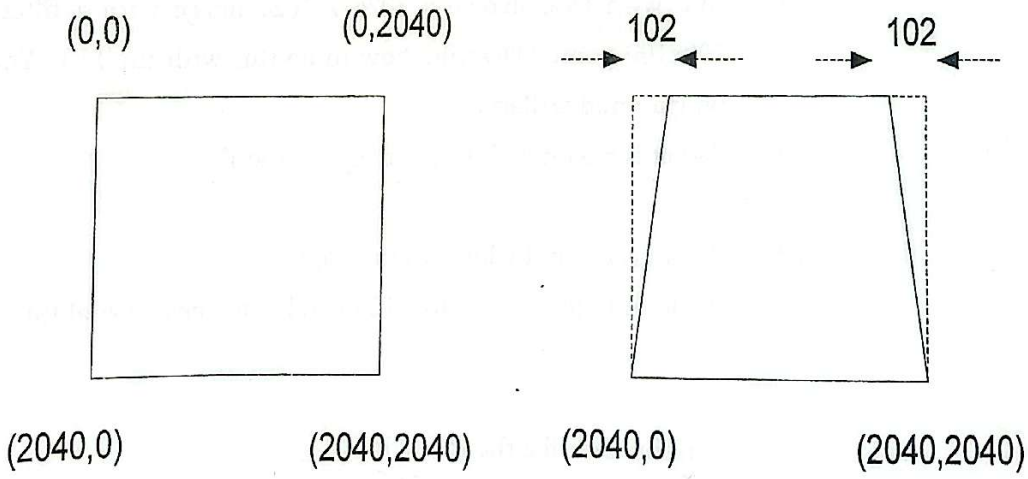


figure 4(d)

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

7

a. Compute the resulting gray levels for the three pixels (shown in **BOLD**) after applying the following mask. (6 marks)

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

b. Briefly describe the effects of the above mask. (2 mark

c.

1	2	1
2	4	2
1	2	1

We are given a 3x3 mask for low-pass filtering, shown above. Describe an efficient method for convolving an image with this filter. Estimate the number of operations (additions and multiplications) required to convolve an nxn image using your method. (6 marks)

Q3

I. We wish to convolve a 1024 x 1024 image with a filter that has a support set 100x100 points. Describe how to do this with the FFT. Your method should avoid wraparound artifacts. (10 marks)

II. What is meant by histogram equalization? (2 marks)

III. What is meant by bit plane slicing? (2 marks)

IV. Differentiate linear spatial filter and non-linear spatial filter. (6 marks

Q4

I. Briefly describe the followings.

a. Image enhancement.

b. Image segmentation. (4 Mar

II. Describe the effects of using median filter and local averaging for noise removal giving advantages and disadvantages of each method. (4 Mar

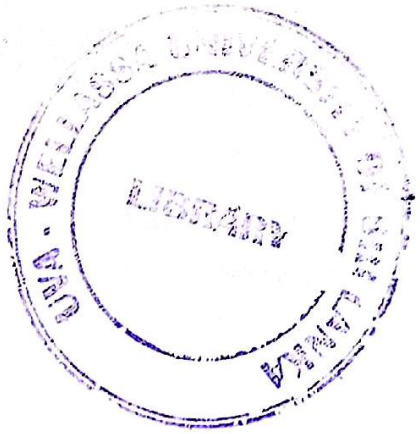
Q5

I. Describe in detail the basic steps for image enhancement in the frequency domain. (5 marks)

II. What is a notch filter used in image processing? Explain the effect of notch filter on the image if the notch is placed at (0,0) frequencies. Describe an example where one may need a notch filter at ($u0 \neq o$ and $v0 \neq o$). (5 marks)

III. Describe three (03) types of law pass filters for image processing, and compare the performances of each of these filters. (5 marks)

IV. Discuss the merits and demerits of frequency domain approach and spatial domain approach for image enhancement. (5 marks)

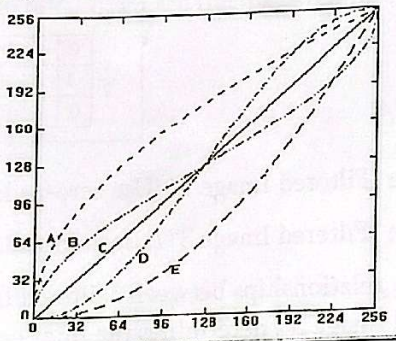


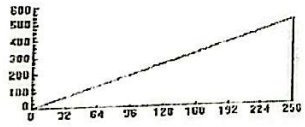
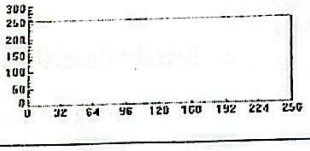
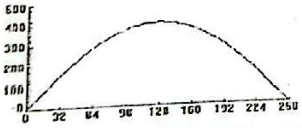
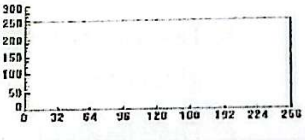
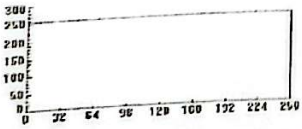
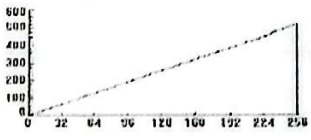
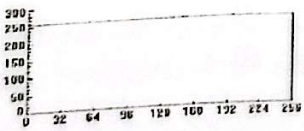
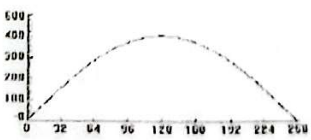
Uva Wellassa University, Sri Lanka
Computer Science and Technology
Second Semester Examination – Aug/September 2011
CST 304-3 Digital Image Processing
Time: Three (03) hours

Total five (05) questions, answer four (04) questions only.
Please return the question paper with answer script

Q1.

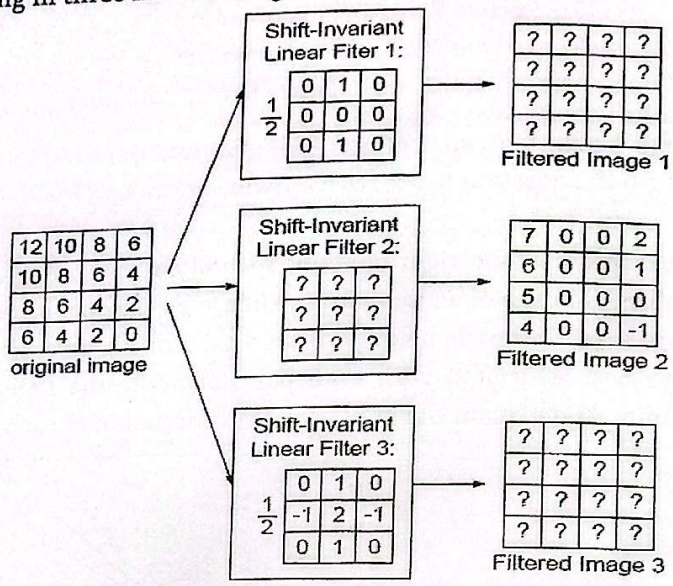
a. The diagram at the right contains several curves that could be used to transform the brightness values of a monochrome image by the operation B = T[A] where A and B are image arrays. Shown below are four pairs of histograms. Identify the transformation curve best associated with each pair and write the letter in the space in the center column. And explain the gray level transformation of each curve separately.



Input image histogram	Transform	Output image histogram
		
		
		
		

(16 Marks)

b. A 4×4 gray-scale original image passes through three spatial linear shift-invariant filters, resulting in three filtered images.



i. Compute "Filtered Image 1" (Use zero-padding of the original image). (3 Marks)

ii. Compute "Filtered Image 3" (Use zero-padding of the original image). (3 Marks)

iii. Based on relationships between "Filtered Image 1", "Filtered Image 2", and "Filtered Image 3", determines the filter coefficients in "Shift-Invariant Linear Filter 2." (3 Marks)

Q2.

a. Briefly describe the followings.

i. Image enhancement

ii. Image segmentation (4 Marks)

b. Describe the effects of using median filtering and local averaging for noise removal giving advantages and disadvantages of each method. (3 Marks)

c. Gray levels of an image region are shown below;

21	18	16	15	12	10
22	05A	17	13	16	20
22	23	16	15	12	30
18	26	14	73B	14	40
26	27	12	11	11	50
11	12	09	09	80	60
10	20	30	40	50	60

Compute the resulting gray levels for the pixels A and B (shown in bold) after performing;

i. Local averaging with a 3*3 mask (2 Marks)

ii. Median filtering with a 3*3 mask (2 Marks)

iii. Midpoint filtering with a 3*3 mask (2 Marks)

d. The line A'B' shown in the distorted image of figure Q4a below is to be corrected so that it appears as the line AB shown in figure Q4b. Derive the two functions ;

X=C1x' +C2y' and Y = C3x' +C4y' and find C1, C2, C3, C4

That can be used to correct the geometric distortion where (x, y) are the coordinates of points after correction and (x', y') are the distorted image coordinates.

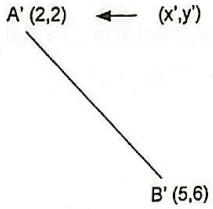


Figure Q4a

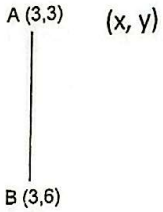


Figure Q4b

(5 Marks)

e. What is segmentation? (2 Marks)

f. Write two applications of segmentation. (2 Marks)

g. What are the three types of discontinuity in digital image? (3 Marks)

Q3.

a. Describe in detail the basic steps for image enhancement in the frequency domain. (5 marks)

b. What is a notch filter used in image processing? Explain the effect of notch filter on the image if the notch is placed at (0, 0) frequencies. Describe an example where one may need a notch filter at (u0 ≠o and v0≠o). (5 marks)

c. Describe three (03) types of law pass filters for image processing, and compare the performances of each of these filters. (5 marks)

d. Write the advantages and disadvantages of frequency domain approach and spatial domain approach for image enhancement. (5 marl

e. What is JPEG? (2 marl

f. Explain what are the basic steps in JPEG? (3 marl

Q4.

a. Describe what is global, local and dynamic (adaptive) threshold? (6 mark

b. Explain the segmentation techniques that are based on finding the regions directly. (3 marl

c. Specify the steps involved in splitting and merging? (3 mark

d. Define what are chain codes? (3 marl

e. Explain the steps involved in digital image processing. (3 marl

f. Explain the properties of 2D Fourier transform. (3 marl

g. Explain the types of gray level transformation used for image enhancement. (4 marl

Q5.

a. What do you meant by "color model"? (3 marl

b. Write 4 types of hardware oriented color models with the application of each model? (4 marl

c. What is hue of saturation? (3 marl

d. What is chromatic adoption? (3 marl

e. Define what is image resolution? (3 marl

f. What is meant by pixel of a digital image? (3 marl

g. Find the number of bits required to store a 256 X 256 image with 32 gray leve (6 mar

Uva Wellassa University of Sri Lanka
Faculty of Science & Technology
Department of Computer Science & Technology.
CST Degree Programme
Year III Semester II
End Semester Examination – September/October 2012

CST362-3 Digital Image Processing (theory)

Instructions
Answer all eight questions.
No. of questions: Eight (08)
No. of pages: Two (02)
Time: Two hours (2 hr)
Total marks allocated: 20%

Index No:

1. Determine the number of kilobytes necessary to store an uncompressed gray-scale image of size 640 × 480 pixels using 8 bits per pixel. [5 marks]

2. Answer the following questions about histograms:

   (i) How a histogram depends on the exposure of an image? Describe characteristic features of a histogram of an underexposed, overexposed and properly exposed images. [5 marks]

   (ii) How a histogram depends on the contrast of an image? Describe characteristic features of a histogram of images that have low contrast, high contrast, normal contrast. [5 marks]

   (iii) Explain the goal of histogram specification and describe how histogram specification is done. [10 marks]

   (iv) What kind of histograms are used for color images? [5 marks]

3. What are the similarities and differences between filters and point operations? [10 marks]

4. Explain how a mathematical operation of linear convolution is used to describe linear filters. [10 marks]

5. Describe principles and mathematical operations applied for detection of edges and corners in images. [5 marks]

6. Calculate the amount of memory required to represent a contour with 1000 points in the following ways:

(i) as a sequence of coordinate points stored as pairs of int values [5 marks]
(ii) as an 8-chain code using Java byte elements [5 marks]
(iii) as an 8-chain code using only 3 bits per element [5 marks]

7. Explain what is the "Hough transform", and how it is used. [10 mark

8. What are the main characteristic features of the following geometric transformations:

(i) Affine [10 mark
(ii) Projective [10 mark

Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Computer Science and Technology
End Semester Examination September/October 2013
CST362-3 Digital Image Processing

Instructions:

- Answer all the questions.
- Time Allowed: **Two (02) hours.**
- Removable storage devices / drivers are **not allowed.**
- You are allowed to refer your own notes but **sharing notes is strictly prohibited.**
- Download resource.zip file from the CMS which includes all the resource images for examination.
- Upload only your **cpp file** (C++ source file) to CMS.

Part (B)

1. Apply following filters to the *sample.jpg* image and show results on opencv windows with proper names.
   a. Gaussian Blur - use a value between 20 to 30 for the kernel size with 0 sigmaX.
   b. Median Blur - use a value between 10 to 20 for the kernel size.

2. Enhance *sample.jpg* image by histogram equalization technique and show the resultant image on an opencv window.

3. Assume *face.jpg* is your profile image on a social networking site and you need to apply a filter to make your image looks like oil painted image.
   You are required to:
   Write a program to convert this image into oil painted image.

4. *map.jpg* image includes a map of Sri Lanka and the provinces are marked as different color codes. This is a generated image from a map generating software, but there is no way to calculate the area of a particular province from this software.
   You are required to:
   a. Write a program to calculate the area of the "**North Central**" province.
   b. Print the area (in km^2) of North Central province on the console (Assume 1 area unit equal to 0.2573 km^2).
   Hint – Use threshold function to filter North Central province.

(100 mark)

Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Computer Science and Technology Degree Programme
3rd year 2nd Semester Examination August/September 2014
CST362-3 Digital Image Processing

This paper consists of **Two (02) parts.** Part-A, Part-B
Answer all Questions.
Mark allocation: Part-A: 50, Part-B: 50
Total time allocation: Three (03) hrs. **Part-A: One (01) hour. Part-B: Two (02) hours.**
Number of questions: Two (02)

Part (A)

1.

a. What is a digital Image? (2 mark)

b. Describe the key stages of digital image processing. (5 mark)

c. Describe the phenomenon of brightness adaption in the human eye. (2 mark)

d. Describe three (03) types of pixel relationships with suitable diagrams. (6 mark)

e. List four (04) geometric transformation methods. (2 mark)

f. Describe following distance measurers using appropriate diagrams

   i. Euclidean (2 mark)

   ii. Cityblock (2 mark)

   iii. Chessboard (2 mark)

g. Rotate following image segment by,

$$\begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \\ 10 & 11 & 12 \end{bmatrix}$$

   i. 90° counterclockwise. (1 mark)

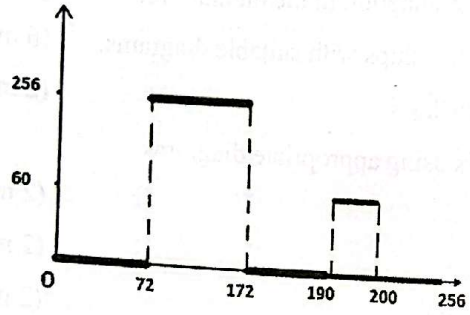
   ii. 180° counterclockwise rotation. (1 mark)

2.

a. A subset of a digital image is shown below.

130	108	119	218	16	197	62	235
61	182	45	60	203	60	34	196
117	150	149	94	124	33	225	249
246	166	246	89	187	211	40	168
155	105	137	133	78	235	6	245
227	172	198	172	32	82	115	100
96	12	237	48	152	14	123	42
239	214	118	171	204	92	50	132

Perform the gray level transformation according to the following graph below and write the resultant of image segment. (6 mark)



b. Differentiate time-varying signals from spatially-varying signals. (2 mark)

c. What is meant by Histogram Equalization? (2 mark)

d. Differentiate linear spatial filtering from non-linear spatial filtering.

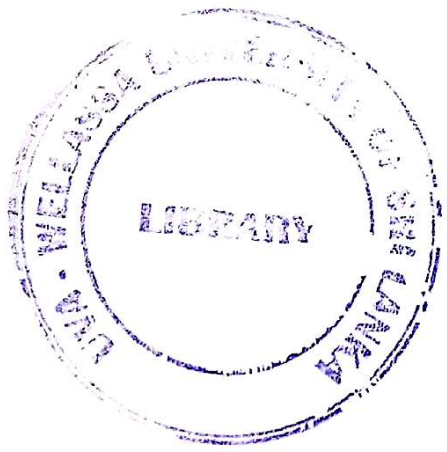
e. Common measure of transmission for a digital data is the Baud rate, defined as the number of bits transmitted per second. Generally, transmission is accomplished in packets consisting of a start bit, a byte (8 bits) of information, and a stop bit. Using these facts answer the following:

i. How many minutes it would take to transmit a 1024 X 1024 image with 256 gray levels, using a 56K baud modem.

ii. What would the time be at 750K baud, a representative speed of a phone DSL (Digital Subscriber Line) connection? (4 mark)

(4 mark)

f. High-definition television (HDTV) generates images with a resolution of 1125 horizontal TV lines interlaced (where every other line is painted on the tube face in each of two fields, each field being 160th of a second in duration). The width to-height aspect ratio of the images is 16:9. The fact that the horizontal lines are distinct fixes the vertical resolution of the images. A company has designed an image capture system that generates digital images from HDTV images. The resolution of each TV (horizontal) line in their system is in proportion to vertical resolution, with the proportion being the width-to-height ratio of the images. Each pixel in the color image has 24 bits of intensity resolution, 8 pixels each for a red, a green, and a blue image. These three "primary" images form a color image. How many bits would it take to store a 2-hour HDTV program/movie? (7 mark)



Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Computer Science and Technology Degree Programme
3rd year 2nd Semester Examination August/September 2014
CST362-3 Digital Image Processing

Uva Wellassa University

- Answer all the questions.
- Time Allowed: **Two (02) hours.**
- Download resource.zip file from the CMS which includes all the resource images for examination.
- Upload only your **cpp file** (C++ source file) to the CMS.
- You are allowed to refer your own notes but **sharing notes** is **strictly prohibited.**

Part (B)

1. Enhance *xray.png* image by applying an appropriate image enhancement method and show both source and enhanced image in OpenCV windows. Note that your final image should be more descriptive than the source image.

(10 mark)

2. The *signals.jpg* image includes two (2) traffic signals. You are required to identify these traffic signals separately by applying image processing techniques. Write a program to do this identification and output your results as an image, your final output should be similar to the *signalOutput.jpg* image. Continue your coding in a one source file by answering to the following questions.

   a. Open *signals.jpg* and change the color space from RBG to Gray Scale.
   b. Apply the fixed-level threshold of 128 to the gray scaled image and show the output in an OpenCV window. Note that type of the thresholding should be Binary.
   c. Find the contours in the binary image by using mode of CV_RETR_TREE.
   d. Draw and show all the contours detected by the algorithm on an OpenCV window.
   e. Identify the two (2) rectangles by examining the hierarchy of the contours and show only these two (2) contours on an OpenCV window.
   f. Differentiate two figures by examining child contours of determined contours. Draw number of child contours on each contours as shown in signalOutput.jpg image.
   g. Draw the texts 'STOP' and 'FALING ROCKS' on corresponding figures and show your final output to the user.
   h. Save your final output with *signalOutput.jpg* file name.

(40 mark)

40

Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Computer Science and Technology
300 Level 2nd Semester Examination – Jan. / Feb. 2016
CST 362-3 Digital Image Processing

Uva Wellassa University

tructions to candidates
ration: Three (03) hours
mber of questions: Seven (07) essay questions
swer six (06) questions **including question 01.**
irk allocation: 160

a. Describe the key stages of digital image processing. (4 mark)

b. Briefly describe the term **Intensity** of an Image. (4 mark)

c. What is meant by **Sampling** in image acquisition ? (4 mark)

d. Describe any three (03) colour models. (5 mark)

e. List any four (04) applications of image processing and describe any two (02) of them. (5 mark)

f. List any three (03) digital image sensors. (3 mark)

g. An image can be represented as product of **reflection** and **light source**. Briefly explain the statement with aid of diagrams and equations. (5 mark)

h. Determine the number of kilobytes(kB) required in order to store an uncompressed gray scale image of size **1024 x 1024** pixels using eight (08) **bits** depth. (5 mark)

a. State the significant differences between **RGB** and **gray scale** image. (3 mark)

b. Briefly explain what is **thresholding** in image processing. (3 mark)

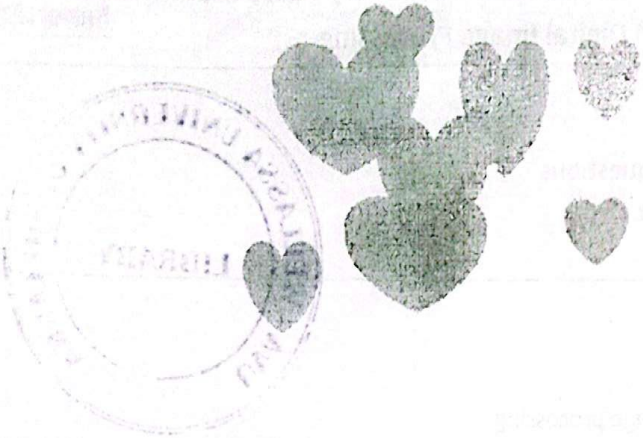
c. Explain how to convert a **gray scale** image into **black and white** image. (5 mark)

d. Use the above given method (2c) to derive the black and white image matrix for gray scale image matrix given below using **any** threshold value.

240	112	210	100
75	16	15	15
72	251	251	251
71	241	247	85

(7 mark)

e. Develop an image processing method to count the objects (heart shape) in the image given below and list all the steps.



(7mark)

3.

a. Briefly describe any two (02) **image enhancement** techniques.

(4 mark)

b. Describe the basic steps for **image enhancement** technique in detail in frequency domain.

(4 mark)

c. Explain what is **filtering** in image enhancement with a suitable example.

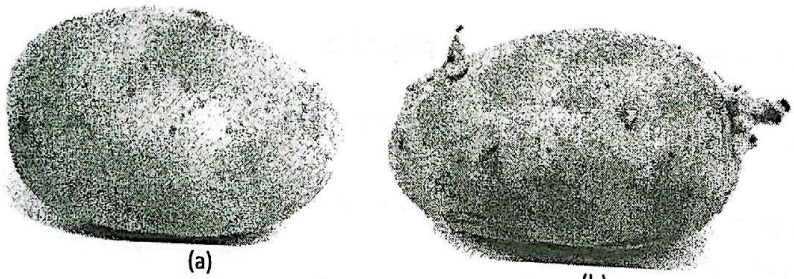
(4 mark)

d. Describe how **median filter** works and perform **median filtering** to the image region given below.

18	24	15	06
16	16	19	15
15	45	45	65
200	180	210	18

(6 mark)

e. Analyze how image processing technique can be used to find the **sprouted potatoes** in the sorting line of a potato chips manufacturing company using the images given below.



(a) (b)

(a) normal sample (b) sample with tuber sprouts

(7 mark)

a.

i. What is meant by **histogram** in image processing? (5 mark)

ii. Construct a histogram for the image region given below.

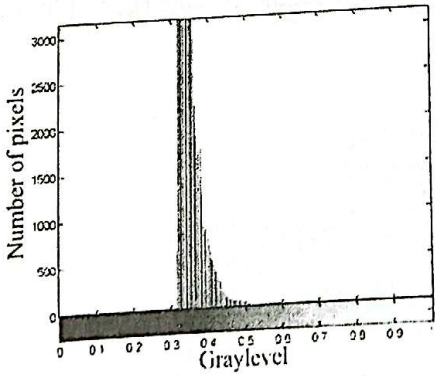
0	1	2	2	1	3
0	0	1	2	2	2
1	0	1	0	2	3
2	1	1	2	3	3
2	1	0	2	4	4
1	2	2	4	4	4

(7 mark)

b. Propose an image processing method to use the palm print to recognize the person using the image given below and list all the steps.

(7 mark)

c. Draw the equalized histogram for the histogram given below.

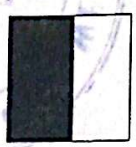


(6 mark)

a. Briefly describe what is an edge in an image. (3 mark)

b. Explain how an **edge** can be detected in an image. (5 mark)

c. Draw the Brightness against Spatial Coordinates graphs for the portion of images given below (A&B).



A

B

(9 mark)

d. List any three (03) edge detection filters.

(3 mark)

e. Describe the importance gradient $\nabla f = \left[\frac{\partial f}{\partial x}, \frac{\partial f}{\partial y}\right]$ in edge detection.

(5 mark)

6.

a.

i. Describe what is meant by **image segmentation**.

(5 mark

ii. List any two (02) segmentation techniques.

(3 mark

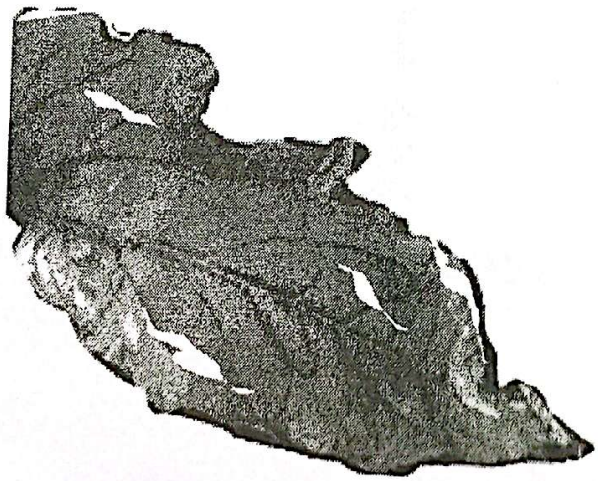
b. Briefly describe how **clustering** works with an example.

(4 mark

c. Describe the use of segmentation in medical image processing.

(5 mark

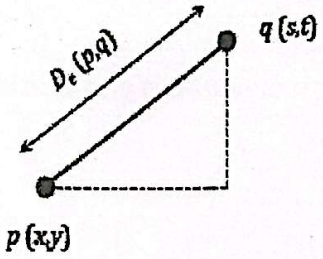
d. Explain an appropriate method to extract the affected region (disease) of the image of the leaf given below.



a. Briefly describe the connectivity paths given below with suitable diagrams.
   i. 4 way
   ii. 8 way
   iii. M way

(8 mark)

b. Find the equation for **Euclidean Distance** between p and q using the figure given below.

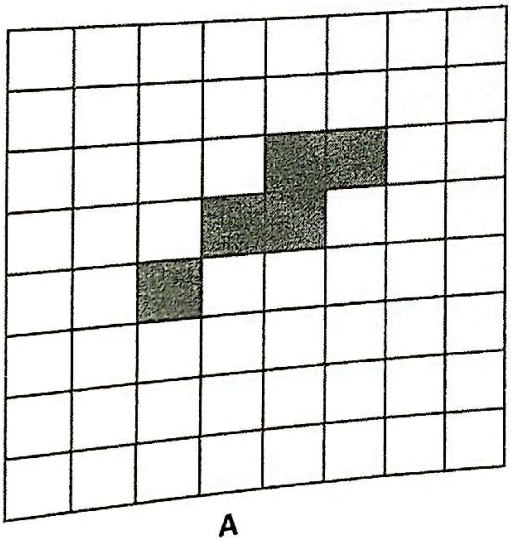


(3 mark)

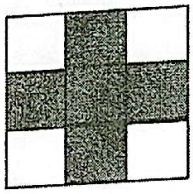
c. Explain the terms **HIT** and **FIT** in morphological operation based on **Structuring Elements.**

(4 mark)

d. Draw the output for morphological operation **A ⊕ B.**



A



B

(10 mark)

Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Computer Science and Technology
300 level 2nd Semester Examination – Dec. / Jan. 2017
CST362-3 Digital Image Processing

Uva Wellassa University

Instructions to candidates
Duration: Three (03) hours
Number of questions: Seven (07)
Mark allocation: 160
Answers only six (06) questions including Question 1.

1.

a. Briefly describe the computational representation of 8x8 RGB image. (4 mark)
b. Illustrate the image acquisition process using light source and reflection. (5 mark)
c. Briefly describe the sensors and how they have been used to sense a scene. (5 mark)
d. Analyze the major goals of image processing. (5 mark)
e. Give an example for each Low, Mid and High-level image processing activities. (3 mark)
f. Argue on the role of image processing in Law and Policy enforcement. (5 mark)
g. Write any use of image processing in any other domain other than computer science. (5 mark)
h. Give any three (03) tools that can be used for image processing. (3 mark)

2.

a. What is meant by a pixel? (3 mark)
b. Briefly describe any two (02) adjacencies in pixel relationship with examples. (4 mark)
c. Use any two (02) neighborhoods to find the number of objects in Figure 01 and give all the steps clearly.

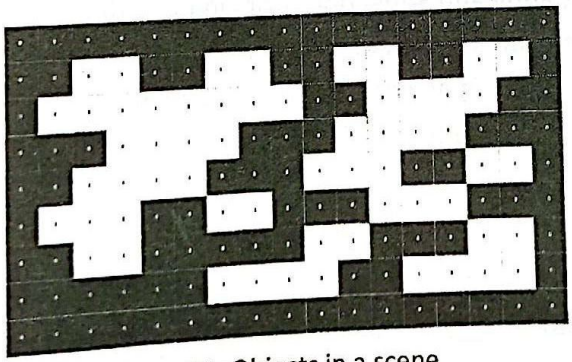


Figure 01: Objects in a scene (7 mark)

d. Derive the equation for Euclidian distance with the aid of a diagram. (5 mark)
e. Describe the use of 'connected component counting' to identify the defects in gears. (6 mark)

3

a. Describe the use of histogram in image processing applications. (4 mar
b. Briefly, explain how histogram can be used for image enhancement. (4 mar
c. Perform histogram equalization for the following piece of image.

240	112	210	100
75	16	15	15
72	251	251	251
71	241	247	85

(7 mar
d. Describe the use of Fourier Transform (FT) in image processing. (4 mar
e. Propose any two (02) different methods to automate Sri Lankan currency note detection. (6 mar

4.

a. Write any three (03) methods to improve the quality of an image. (6 mar
b. Compare 3x3 Mean and 3x3 Median filter used in Gaussian noise removal. (4 mar
c. Suggest a method to remove Salt and Pepper noise in an image. (2 mar
d. Briefly describe how the brightest point of an image can be found. (3 mar
e. Compare and contrast Low pass and High pass filters. (5 mar
f. Briefly, explain how median filter works. (5 mar

5.

a. Briefly describe any two (02) use of edge detection in image processing techniques. (4 mark
b. Compare and contrast the Canny and Sobel operators in edge detection. (5 mark
c. Analyze the use of derivation function in edge detection techniques. (4 mark
d. Discuss the use of edge detection in *Malaria parasite recognition in a blood sample*. (6 mark
e. Analyze the use of filters to improve the quality of space-related images taken by telescope like Hubble. (6 mark

6.

a. Briefly, explain the purpose of morphological operations. (5 mark
b. Describe the dilation process with the aid of a diagram. (5 mark
c. State that how morphological operations can be used to detect the boundary of an objec with an example (use the notations and equations). (7 mark
d. State the role of morphological operation in fingerprint matching. (3 mark
e. Propose a method to extract the region of interest from an raw image. (5 mark

7.

a. What is meant by segmentation in image processing? (3 mark)
b. Critically argue on the statement "Histograms are useful to segment an image". (5 mark)
c. Compare and contrast the Otsu and Watershed methods. (5 mark)
d. Briefly describe the use of region growing techniques with the help of a sample 5x5 image matrix. (6 mark)
e. Explain the role of segmentation in calculating total values of coins given in Figure 02. (6 mark)

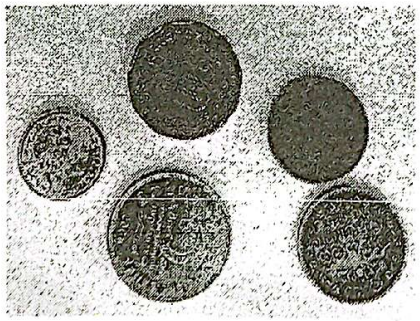


Figure 02: Coins

45

Uva Wellassa University of Sri Lanka
Faculty of Science and Technology
Department of Computer Science and Technology
300 level 2nd Semester Examination – Dec. 2018 / Jan. 2019
CST 382-3 Digital Image Processing

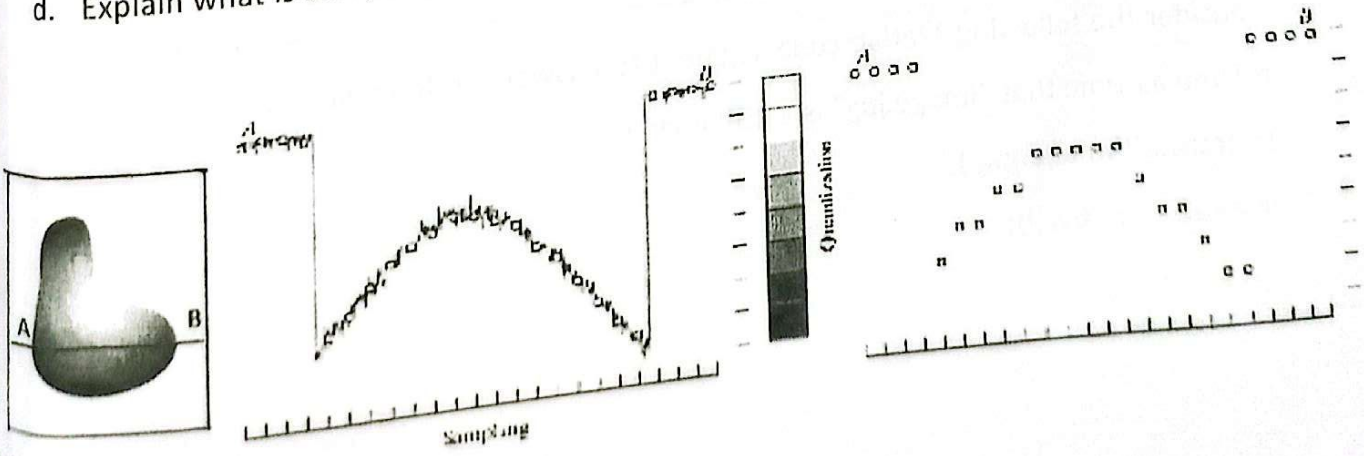
Uva Wellassa University

Instructions to candidates
Duration: Three (03) hours
Number of questions: 1 Structured and 5 Essays
Mark allocation: 100 mark
Answer all questions and attach the question paper with answer script.

Part B

1.
a. Define the term **digital image** in your own words. (2 mark)
b. List five (05) applications of Digital Image Processing. (2.5 mark)
c. What are the basic components comprising a General-purpose Image Processing System? (3 mark)
d. Briefly explain the three (03) levels of image processing by providing suitable examples. (5 mark)
e. Briefly describe the key stages of Digital Image Processing. (6 mark)

2.
a. What is the **resolution** of a digital image and how it affects the image interpretation? (2.5 mark)
b. List three (03) principle imaging sensor arrangement and mention the application of each arrangement. (3 mark)
c. Briefly explain the types of pixel neighborhood by providing suitable examples. (4.5 mark)
d. Explain what is sampling and quantization while describing the picture below. (5.5 mark)



3.

a. What is meant by the process **filtering** and why filters are used in Digital Image Processing? (2.5 mark)

b. Differentiate max and min filters of spatial filtering. (2 mark)

c. List degradations that affect the digital images. (2.5 mark)

d. What are the advantages of constructing histogram for gray level images? (2.5 mark)

e. Construct the histogram for the following image segment. (6 mark)

10	10	11	14	12
12	11	10	10	10
15	11	10	10	10
11	16	12	12	10
10	12	14	11	12

4.

a. What are the arithmetic operations that can be performed in images? (2.5 mark)

b. Briefly describe the operations **rounding** and **clipping** performed in arithmetic operations by providing suitable examples. (3 mark)

c.

i. Define **edge** of an image. (1 mark)

ii. What are the importance of Edge Detection? (2 mark)

d. List the various discontinuities that cause edges in an image. (2 mark)

e. Compute the G_x gradients for the given image segment using the Sobel kernel provided below. (7 mark)

$$\textbf{Sobel kernel} = \begin{matrix} -1 & 0 & 1 \\ -2 & 0 & 2 \\ -1 & 0 & 1 \end{matrix}$$

10	50	50	10
10	55	55	10
10	60	60	10
10	55	55	10

5.

a.

i. Define **Image Segmentation** and list four (04) applications of it. (3.5 mark)

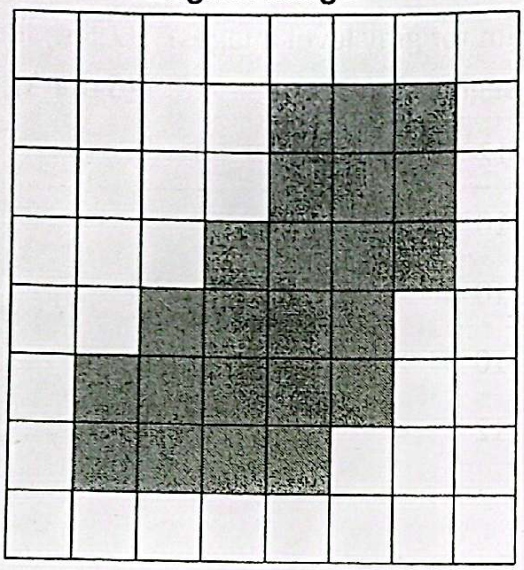
ii. Briefly explain why Image Segmentation is important in Image Processing. (2.5 mark)

b.

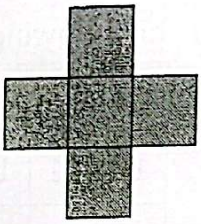
i. Differentiate the morphological operations **erosion** and **dilation.** (3 mark)

ii. Perform both **erosion** and **dilation** for the image below using the given structuring element and draw the resultant images separately in the grids given below in the question paper. (14 mark)

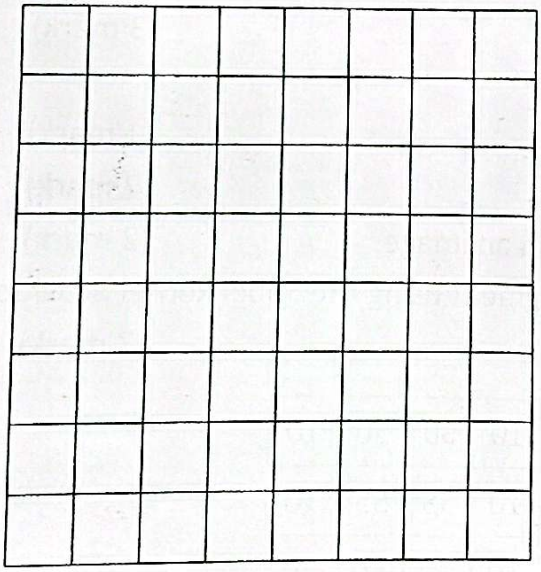
Original Image



Structuring Element



Resultant Image from Erosion



Resultant Image from Dilation