LNMIIT

The LNM Institute of Information Technology

ECE and CCE

ECE4141: Introduction to Image Processing

End Term

Time: 3 hours | **Date:** 04/12/2019 | **Max. Marks: 50**

Instructions: *1) Start each answer on a fresh page of your answer book and highlight your answer number.*
*2) Check that your Question paper has 7 **Questions**.*

[5 x 2= 10]

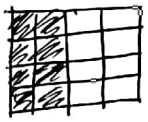
Q1. Short questions

a. Explain briefly the transform which is widely used to detect lines in an image?
b. What is the operator which can be used to detect edges in the image?
c. Can two different image have same histogram? Justify with an example.
d. What is the output if the starting point in the hole filling algorithm is outside of the boundary? Show with an example.
e. What is the limiting effect of repeatedly dilating an image? Support with an example.

Ans

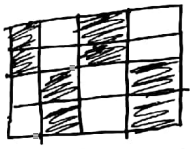
a. explain about the Hough Transform.
b. Gradient operator
c. Yes.
d. The background would be filled with 1s.
e. The dilated image will grow without bound and fill the entire image.

c. Eg:-



Black & white image.
Total pixels: 16.
Black: 8, White: 8

&

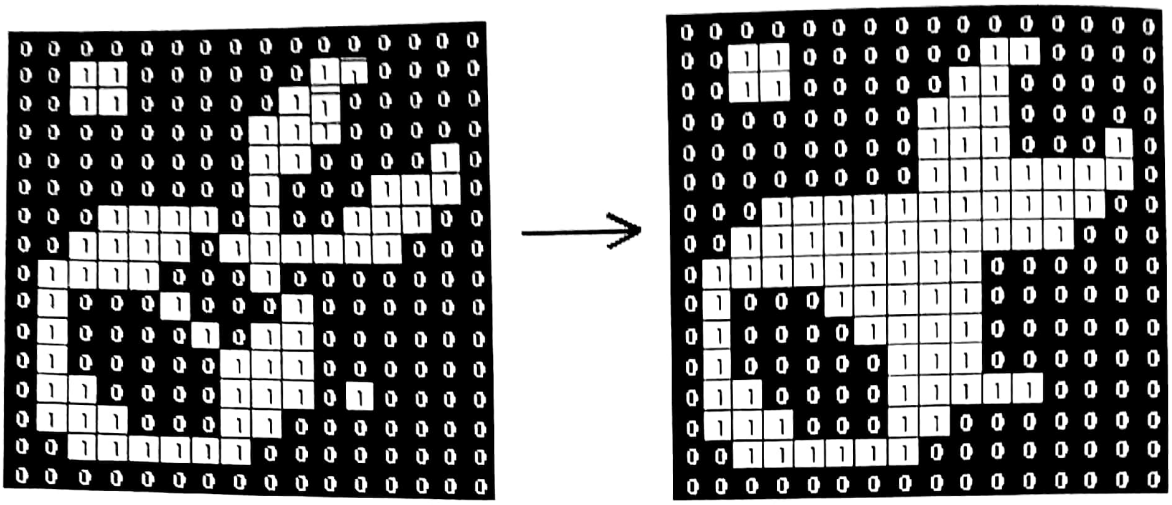


Total pixels: 16
Black: 8, white: 8.

d & e :- Any eg.

Q2. Answer the following questions from **Fig. 1** **[4+2+2=8]**

a. What is the operation used to get the output? Explain the steps used in the operation.
b. Draw the structuring element selected for getting the output?
c. What is the advantage of this operation in image processing applications?



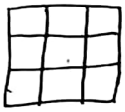
input output

Fig. 1

Ans

a. Morphological Closing (Dilation followed by Erosion)
b. 3 x 3 structuring element
c. One advantage is: It fills the object region detected as background.

b. The structuring element is :-



X ⟶ Centre.

Q3. **[3 x 2=6]**

Explain how image degradation is estimated using
a. Observation b. Mathematical modeling

Ans a. Observation

- Gather information from the image itself.
- Look for areas of strong signal content.
- Assume that the effect of noise is negligible because of our choice of a strong-signal area, it follows: $$H_s(u,v) = \frac{G_s(u,v)}{\hat{F}_s(u,v)}$$
- From the characteristics of this function, we deduce the complete function H(u,v) by making use of the fact that we are assuming position invariance.

$$g(x,y) = f(x,y) * h(x,y) + \eta(x,y)$$

$$G(u,v) = F(u,v)H(u,v) + N(u,v)$$

$$G_s(u,v) = F_s(u,v)H_s(u,v)$$

$$H_s(u,v) = \frac{G_s(u,v)}{F_s(u,v)}$$

$$H(u,v) \sim H_s(u,v)$$

b. Mathematical modeling

$$g(x,y) = \int_0^T f[x - x_0(t), y - y_0(t)]dt$$

$$G(u,v) = F(u,v)\int_0^T e^{-j2\pi[ux_0(t)+vy_0(t)]}dt$$

$$= F(u,v)H(u,v)$$

For given amount of displacement causing blurring, we can estimate H

Q4. **[3+3=6]**

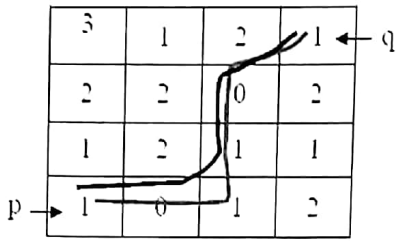
a. Let V={0,1}. Compute the lengths of the shortest 4-path, 8-path and m-path between 'p' and 'q' shown in **Fig. 2**. Also, show the paths formed.

b. Write the steps to determine horizontal lines in an image.

3	1	2	1	← q
2	2	0	2	
1	2	1	1	
p → 1	0	1	2	

Fig. 2

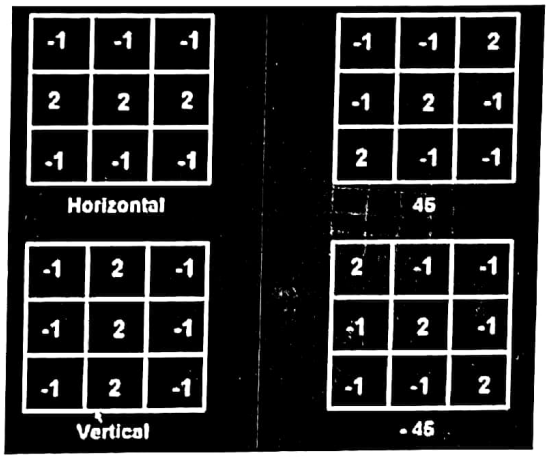
Ans a) When V={0, 1}, 4-path does not exist. The shortest 8-path has length = 4 (as shown in blue line fig. 1a) and the shortest m-path has length = 5 (as shown in red line in fig. 1a).



b) → We apply all the 4 mask into the input image.

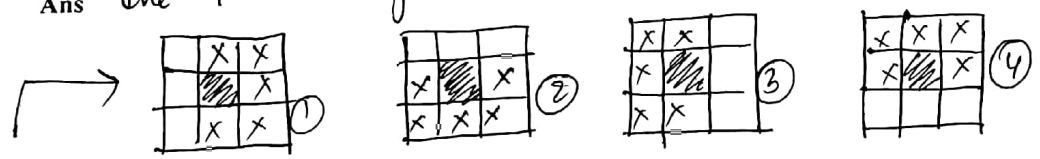
➔ We find the value of R. If at position (x,y), $|R_h| > |R_v|$, $|R_{45}|$, $|R_{-45}|$, then the point at (x,y) is said to lie in the horizontal line.

➔ If all are equal to 0 (all has same intensity value), it means it has no lines. Thus, the information about each point can be determined.



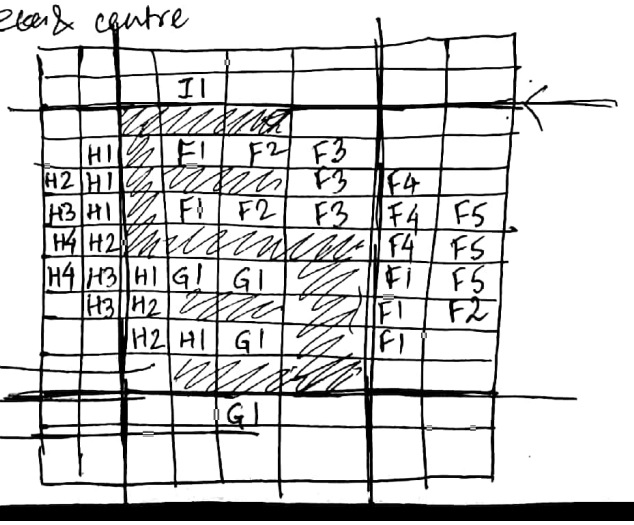
Q5. Show each step for the convex hull formation for the given input non-convex image (**Fig. 3**). **[6]**

Ans The 4 structuring element are :-



→ Black denotes centre

Final o/p :-



→ White

F 1 to 5 :- Structuring elem 1st Iterations

G 1 to 1 :- " " 2nd " "

H 1 to 4 :- " " 3rd " "

I 1 to 1 :- " " 4th " "

Convex Hull.

Q6. **[2+6=8]**

a. What is the segmentation approach that is based on seed point, connectivity and similarity?

b. Perform the segmentation approach as said in part (a) for **Fig. 4** [white indicates object and black is the background]. Take seed point = 6 and three threshold corresponding to 3 object:

$$\begin{cases} Object\ 1, & if \quad Threshold \leq 1 \\ Object\ 2, & if\ 1 < Threshold \leq 4 \\ Object\ 3, & if\ 4 < Threshold \leq 6 \end{cases}$$

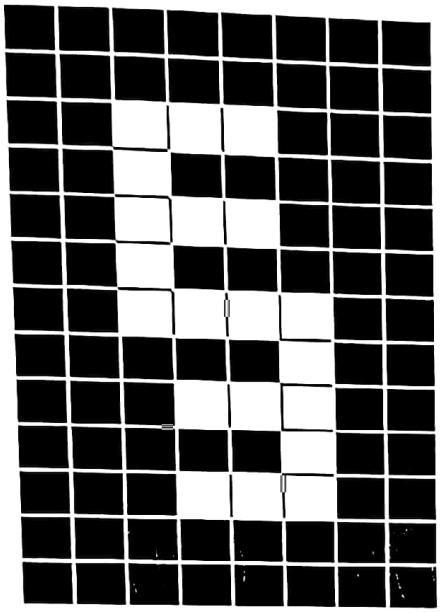


Fig. 3

5	6	1	1	1	0	0
6	7	7	1	1	1	6
3	6	7	7	7	6	5
4	3	7	7	7	5	3
3	3	2	1	3	3	4
2	2	1	2	1	2	3
1	1	1	1	1	2	2

Fig. 4

Ans

1). Region Growing.

01 – Obj 1
02 – Obj 2
03 – Obj 3.

Q7. [6]

A publishing house, whose policy is printing only the RGB color images, purchased one 24-bit RGB color image from an amateur photographer. The printing editor, to give a better look and feel of the image, sharpen only the intensity plane (I-plane) of the input image using high boost filtering in the spatial domain before sending it for printing.

Develop an algorithm/steps that will take the purchased image as input and outputs sharpen processed image as per the printing policy of the publishing house. Assume that the size of the image is 320 x 480. Clearly mention the input, output, any equations you are using in the steps of your algorithm.

Note: I-plane is computed as $I = \frac{(R+G+B)}{3}$

Ans

********** All the best **********

i/p : RGB color image

high boost :- $(A+1) f(x,y) - f_b(x,y)$

any amplitude

$= A f(x,y) - \nabla^2 f(x,y)$

Steps.

0	-1	0
-1	A+4	-1
0	-1	0

mask

Mathematical steps

o/p :- Concatenation of all the components.

equations