The LNM Institute of Information Technology

ECE and CCE

ECE4141: Introduction to Image Processing

End Term

Time: 3 hours **Date:** 05/12/2018 **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 **4 Questions** and **2 printed pages**.*

Q1.	**Short questions (Answer all questions)**	**[5 X 2M = 10M]**
	a) i) The transform which is widely used to detect lines in an image is Hough Transform.	
	ii) The operator which can be used to detect edges in the image is gradient.	
	b) What is the output if the starting point of the hole filling algorithm is a point on the boundary of the object? Ans: The entire image would be filled with 1s.	
	c) i) We can reconstruct the original image from its skeletonizing image since the skeleton is preserved. Ans: True	
	ii) The kernel [-1 2 -1] is meant to approximate first order derivative. (True / False) Ans: False, as 1st order derivative is given by f(x+1) – f(x). Similarly, for y axis. So, matrix will be [0 -1 1]	
	d) Rotate P(x,y) by an angle θ clockwise with respect to the reference point R(u,v). The resulting position is: **P'(cosθ(x-u)-sinθ(y-v)+u, sinθ(x-u)+cosθ(y-v)+v)**. (True/ False) Ans: True	
	e) What is the smallest image set to which you can apply the erosion process? Ans: The smallest set is the image set that contains the structuring element.	
Q2.	**Answer all questions**	**[4 x 5M = 20M]**
	a) Given below is a 3 x 3 image (Fig. 1). What will be the value of center pixel, when this image is passed through a i) Alpha-trimmed mean filter having d = 4 ii) Filter which is derived from Contra-harmonic mean filter when Q = 0 iii) Filter which is derived from Contra-harmonic mean filter when Q = -1 iv) Geometric mean filter 1 7 5 6 2 3 1 4 2 Fig. 1	

Ans:

i) Arrange the intensity values of different pixels in the ascending order:
[1 1 2 2 3 4 5 6 7]
As it is given d = 4, so d/2 = 2 pixels from both front and end will be removed, and finally mean will be calculated for remaining pixels.
Final/center value = mean (2, 2, 3, 4, 5) = 3.2

ii) When Q = 0, it acts as mean/averaging filter.
So, the value will mean (all pixel values) = 3.44

iii) When Q = -1, it acts as harmonic mean filter.

$$g(x,y) = \frac{mn}{\sum \frac{1}{f(x,y)}} = \frac{9}{[\frac{1}{1}+\frac{1}{1}+\frac{1}{2}+\frac{1}{2}+\frac{1}{3}+\cdots+\frac{1}{7}]}$$

Final value = 2.2

iv) Final value = (product (all pixel value))$^{1/9}$ = 2.78

b) We want to fill all the small cracks and holes in a segment but preserve big holes that can completely contain a circle of radius greater than *n*. Write the steps for the task using mathematical morphological operators, and specify the structure element.

Ans:

c) How can an image be restored when it is affected in presence of noise only?

Ans: When the only degradation present in an image is noise, the degradation image is given by:

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

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

- ➔ Take a small region from the degraded image which has uniform intensity.
- ➔ Estimate the noise N(u, v) from the spectrum/ histogram generated from the G(u, v) of the small region taken in the earlier step.
- ➔ After estimating the noise, proper filtering technique can be used to remove the noise. The following are the different filters that can remove different noise.

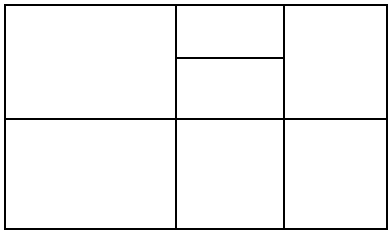
Filters	Noise removed
Arithmetic mean filter	Gaussian, Gamma, Uniform noise
Geometric mean filter	Gaussian noise
Harmonic mean filter	Gaussian, Salt noise (not pepper noise), exponential
Contraharmonic mean filter	Salt and pepper noise
Median filter	Salt and pepper noise
Max and min filter	Max- pepper noise, min- salt, rayleigh
Midpoint filter	Gaussian, Uniform noise
Alpha-trimmed mean filter	Gaussian, Salt and pepper noise

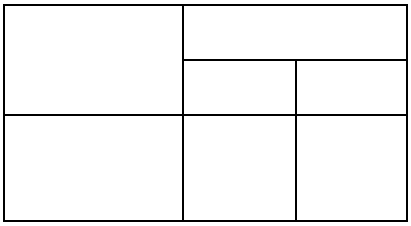
d) Perform Split and merge technique to segment the below given image (Fig. 2)

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

Fig. 2

Ans: Let threshold be 3.
So, final output after division may be (any one of the following):





Q3. **[4+2+2+2 = 10M]**

Suppose that the gray scale is of range [0, 9] for the image given below (Fig. 3).

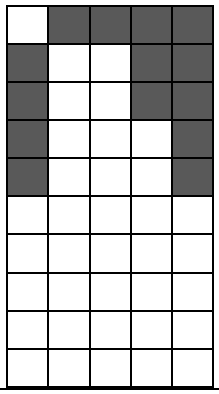
0	**5**	**7**	**7**	**5**
7	**2**	**6**	**2**	**6**
6	**9**	**7**	**7**	**0**
6	**6**	**1**	**7**	**6**
9	**6**	**0**	**7**	**8**

Fig. 3

i) Perform histogram equalization of the above image. Show the resultant image and its corresponding histogram.
ii) What will happen if we apply histogram equalization to the above result (part i).
iii) Can histogram equalization always provide a better result? State your reasons.
iv) "Histogram matching" is a useful contrast manipulation technique which transforms an image's histogram to match the one of another image. Describe clearly how you achieve it (in steps).

Ans:

ii) It will give same result.
iii) Not necessarily.
iv) Explain the Steps of histogram matching

Q4.	**[10M]**
	Perform the skeletonization for the following given image set. (white represents object pixels and black represents background pixels) 
Ans	Same as class problem

---------- *Good Luck* ----------