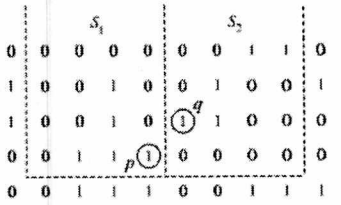
Dr Sabil Kumar Jain 29/11/2023 E 164

National Institute of Technology Hamirpur
Department of Mathematics & Scientific Computing
MA 450: Digital Image Processing
End-Term Examination, December 2023

Time: 3:00 hrs **Max. Mark: 50**

Note: All questions are compulsory.

1. Define the concept of 4, 8 and m-adjacency of a pixel. Consider the two image subsets S_1 and S_2, shown in the following figure. For $V = 1$, determine whether these two subsets are (i) 4-adjacent, (ii) 8-adjacent, or (iii) m-adjacent. [5]



2. (a) Commercial alternating current in the United States has a frequency of $60Hz$. What is the wavelength in kilometers of this component of the spectrum? [2]
   (b) Define the concept of image interpolation. [3]

3. (a) Write expression for Log and Gamma transformations for spatial domain processing. [2]
   (b) Using the following definition of Laplacian,

$$\nabla^2 f = f(x+1,y) + f(x-1,y) + f(x,y+1) + f(x,y-1) - 4f(x,y)$$

   Show that subtracting the Laplacian from an image is proportional to unsharp masking.[3]

4. Write detail note about Homomorphic filtering in frequency domain. [5]

5. Explain the mean and order-statistics filters with suitable examples. [5]

6. What is image restoration? Explain the minimum mean square error (Wiener) filtering in detail. [5]

7. For the image I (below) compute the gradient $(dI/dx, dI/dy)$, magnitude of gradient and the angle of gradient for pixel locations A, B and C marked below. You have to use the Sobel filters (below) to compute the derivatives (no normalization is needed). You need to write down how you derived each of these quantities. You may use arctan to represent the angles. [5]

Sobel Filters

-1	0	1
-2	0	2
-1	0	1

dx

-1	-2	-1
0	0	0
1	2	1

dy

Image

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

	A			
		B	C	

8. Explain Otsu's method in detail. [5]

9. The characters with the frequencies are given as

$$a_1 = 10, \quad a_2 = 40, \quad a_3 = 6, \quad a_4 = 10, \quad a_5 = 4, \quad a_6 = 30$$

   If Huffman Coding is used for data compression, determine (a) Huffman Code for each character (b) Average code length (c) Decoding string for Encoded string (010100111100). [5]

10. What is predictive coding? Explain encoding-decoding process of loss-less predictive coding in detail by considering the pixels $\{23, 34, 39, 47, 55, 63\}$. [5]

****