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MMTE-003

M.Sc. (MATHEMATICS WITH APPLICATIONS IN COMPUTER SCIENCE)
M.Sc. (MACS)

00942

Term-End Examination

December, 2018

MMTE-003 : PATTERN RECOGNITION AND IMAGE PROCESSING

Time : 2 hours *Maximum Marks : 50*

Note : *Attempt any **five** questions. All questions carry equal marks. Use of calculator is **not** allowed.*

1. (a) What is 'histogram equalization' ? How is it applied in image processing ? Verify the statement, "The second pass of histogram equalization will produce exactly the same results as the first pass has produced." 5

   (b) Apply the Bayesian classifier on the following dataset, and predict the class of (2, 2). 5

a_1	2	0	2	0	3
a_2	0	2	4	2	2
Class (i)	C_1	C_1	C_2	C_2	C_2

2. (a) What is 'Huffman coding' ? How many bits are required to code the data given below, using Huffman coding ? 5

Symbol	a	b	c	d	e	f
Frequency	21	16	15	18	32	8

(b) List all the important components of image processing. Describe any two of these components briefly. 3

(c) Determine the normalized starting point of the code 11076765543322. 2

3. (a) Find the Discrete Fourier Transform (DFT) of the function

$$f(x, y) = \sin(2\pi u_0 x + 2\pi v_0 y).$$ 5

(b) Show that the Radon transform of the Gaussian shape

$$f(x, y) = A e^{-(x^2+y^2)} \text{ is } g(\rho, \theta) = A\sqrt{\pi}\, e^{-\rho^2}.$$ 5

4. (a) What are Median filters ? Compute the median value of the pixel circled below, using the 3 × 3 mask. 5

$$\begin{bmatrix} 1 & 5 & 7 \\ 2 & 4 & 6 \\ 3 & 2 & 1 \end{bmatrix}$$

(b) Differentiate between the following, and illustrate the differences through an example for each : 5

(i) Clustering and Classification

(ii) Supervised learning and Unsupervised learning

5. (a) Why do we determine the Laplacian of an image ? What are the drawbacks of the Laplacian operator ? Show that subtracting the Laplacian of an image from the image concerned is proportional to the unsharp masking of the image. 5

(b) For a reference image

$$f(x, y) = \begin{bmatrix} 3 & 2 & 1 \\ 1 & 2 & 1 \\ 3 & 2 & 2 \end{bmatrix} \text{ and}$$

$$\hat{f}(x, y) = \begin{bmatrix} 3 & 1 & 1 \\ 1 & 1 & 2 \\ 1 & 1 & 1 \end{bmatrix},$$

compute the MSE, SNR and PSNR for an 8-bit image. 5

6. (a) Distinguish between the Decision-theoretic approach and Structural approach of pattern recognition. *3*

(b) What is a KL transform ? Compute the basis of the KL transform for the input data $X_1 = (4, 4, 5)^T$, $X_2 = (3, 2, 5)^T$, $X_3 = (5, 7, 6)^T$ and $X_4 = (6, 7, 7)^T$. *7*

7. (a) Derive Prewitt operators and Sobel operators for the image given by

$$\begin{bmatrix} a_1 & a_2 & a_3 \\ a_4 & a_5 & a_6 \\ a_7 & a_8 & a_9 \end{bmatrix}.$$

5

(b) Let the salt and pepper noise have the following pdf :

$$f(z) = \begin{cases} p_a & \text{if } z = -127 \\ p_b, & \text{if } z = 127 \\ 1 - (p_a + p_b), & \text{if } z = 0 \end{cases}$$

Obtain the mean and variance of the distribution. *5*
