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MMTE-003

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

00991 **Term-End Examination**

June, 2019

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) An image scan centre needs to store medical images whose resolution is $1024 \times 1024 \times 24$ bits. A total of 10,000 images are present. How much storage and transmission time will they require at 64 kbps ? 2

(b) Match the equivalent terms in Statistical approach and Neural-Network based approach of pattern recognition. 3

Statistical Approach		Neural-Network Approach	
(i)	Model	(a)	Output
(ii)	Estimation	(b)	Input
(iii)	Regression	(c)	Weights
(iv)	Parameters	(d)	Supervised learning
(v)	Independent variables	(e)	Learning
(vi)	Dependent variables	(f)	Network

(c) What is DFT ? Compute the DFT of the 4×4 grayscale image given below : 5

$$f(m, n) = \begin{bmatrix} 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 \end{bmatrix}$$

2. (a) What is intensity slicing ? Show a bit plane slicing of the following image : 5

$$\begin{bmatrix} 7 & 6 & 5 \\ 4 & 3 & 2 \\ 1 & 1 & 0 \end{bmatrix}$$

(b) How does the histogram of an image determine the quality of the image ? What is the need of the histogram equalization technique in image processing ? Perform the histogram equalization of the image. 5

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

3. (a) Perform the linear convolution between two matrices X(m, n) and h(m) given below :

$$X(m, n) = \begin{bmatrix} 11 & 12 & 13 \\ 14 & 15 & 16 \\ 17 & 18 & 19 \end{bmatrix} \text{ and } h(m) = [3, 4, 5].$$

Also obtain the linear correlation between X(m, n) and h(m) and comment on the results obtained. *5*

(b) What is digital image watermarking ? Give block diagrams for embedding and extraction. *5*

4. (a) Consider a problem that involves classification of an image pixel using a single feature colour into two classes — forest and non-forest. Let the prior probability of forest class be 0·6, the feature i of colour green belonging to the forest image in the training set be 0·2, and the probability of the green pixel feature belonging to the forest in the overall population be 0·4. What is the probability that an image is a forest image, given that the image contains the green colour features ? *3*

(b) What is thresholding ? When do we use the technique of optimal thresholding ? Find an optimal threshold for the image where the probability distribution of grey level z is given as follows : 4

$$p_1(z) = \{0 \text{ if } z < 1;\ \frac{1}{2}z + 1 \text{ if } 1 \le z \le 3;$$
$$0 \text{ when } z > 3\}$$

$$p_2(z) = \{0 \text{ if } z < 1; -\frac{1}{2}z + 5 \text{ if } 1 \le z \le 2;$$
$$0 \text{ when } z > 2\}$$

Assume $p_1 = p_2$.

(c) Write the MPP algorithm. Explain how the MPP algorithm behaves when 1-pixel wide and 1-pixel deep are desired. 3

5. (a) Image f(m, n) is given below. What will the value of F(0, 0) be ? 5

$$f(m, n) = \begin{bmatrix} 0 & 1 & 2 & 1 & 4 \\ 4 & 1 & 4 & 5 & 6 \\ 1 & 2 & 1 & 0 & 4 \\ 5 & 4 & 1 & 3 & 5 \\ 4 & 2 & 4 & 5 & 6 \end{bmatrix}$$

(b) Given a four-symbol source {a, b, c, d} with source probabilities {0·1, 0·4, 0·3, 0·2}, encode the sequence b b a d c arithmetically. 5

6. (a) Illustrate the Marr-Hildreth edge detector algorithm giving each step involved in the algorithm. 5

(b) Apply the perceptron algorithm to the following pattern classes :

w_1 : {(0, 0, 0), (1, 0, 0), (1, 0, 1), (1, 1, 0)}

and w_2 : {(0, 0, 1), (0, 1, 1), (0, 1, 0), (1, 1, 1)}.

Use $c = 1$ and $\mathbf{w}(1) = (-1, -2, -2, 0)$,

where c is a positive correction increment. 5

7. Define the following. Also, give example of each. 10

(a) Image Restoration and its technique

(b) Image Compression and its technique

(c) Image Segmentation and its technique

(d) Object Recognition and its technique