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MMTE-003

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

00045 **Term-End Examination**

June, 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) Apply DFT to the following image (I). Recover the original image (I) from the transformed image and verify the loss of information. 5

$$I = \begin{bmatrix} 2 & 0 & 0 & 0 \\ 0 & 1 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & 0 & 0 & 2 \end{bmatrix}$$

(b) Perform Histogram Equalisation of the image (I) given below : 5

$$I = \begin{bmatrix} 4 & 4 & 4 & 4 & 4 \\ 3 & 4 & 5 & 4 & 3 \\ 3 & 5 & 5 & 5 & 3 \\ 3 & 4 & 5 & 4 & 3 \\ 4 & 4 & 4 & 4 & 4 \end{bmatrix}$$

2. (a) Perform Grey Level Slicing on the following image (I) without background and region limit 3 to 6. 5

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

(b) Use the LZW coding algorithm to encode the seven-bit ASCII string aaaaaaaaaab. 5

3. (a) Determine the value of the central pixel (marked by round) for the given image f, if it is smoothened by a 3×3 box filter. 4

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

(b) Write short notes on following : 6

(i) Principal Component Analysis

(ii) Digital Image Watermarking

4. (a) Give the mathematical expression for a Wiener filter. Also, give advantages and drawbacks of a Wiener filter over Inverse filter. *4*

(b) Prove that the Wiener filter reduces to an Inverse filter when noise is negligible. *3*

(c) Determine the storage and transmission time requirement for a video of 30 frames, where size of each frame is 640 × 480 and 3 bytes/pixel. It is assumed that the video is taken at 30 frames/second and Data Transmission Rate (DTR) is 64 kbps. *3*

5. (a) Compare Canny edge detector and Laplacian of Gaussian edge detector. What is the difference between boundary detection and edge detection ? *4*

(b) Determine Linear Convolution and Linear Correlation between two matrices x(m, n) and h(m, n), given as

$$x(m, n) = \begin{bmatrix} 11 & 12 & 13 \\ 14 & 15 & 16 \\ 17 & 18 & 19 \end{bmatrix} \text{ and}$$

h(m, n) = [3 4 5] *6*

6. (a) Give steps to decode the exponential Golomb Code $G_{exp}^{k}(n)$. *6*

(b) Show that subtracting the Laplacian of an image from the image is proportional to the unsharp masking. *4*

7. (a) The following pattern classes have Gaussian probability density functions :

C_1 : {(0, 0), (2, 0), (2, 2), (0, 2)} and

C_2 : {(4, 4), (6, 4), (6, 6), (4, 6)}.

Obtain the equation of Bayes' decision boundary between these two classes when

$$P(C_1) = P(C_2) = \frac{1}{2}.$$ *6*

(b) Perform subtraction and division operations $\left(f_2 - f_1 \text{ and } \frac{f_2}{f_1}\right)$ on the following two images f_1 and f_2 : *4*

$$f_1 = \begin{bmatrix} 1 & 3 & 7 \\ 5 & 15 & 75 \\ 100 & 50 & 100 \end{bmatrix} \text{ and}$$

$$f_2 = \begin{bmatrix} 50 & 100 & 150 \\ 35 & 45 & 90 \\ 120 & 70 & 150 \end{bmatrix}$$

Assume that both the images are of 8-bit integer type.