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MMTE-003

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

00676

M.Sc. (MACS)

Term-End Examination

June, 2014

MMTE-003 : PATTERN RECOGNITION AND IMAGE PROCESSING

Time : 2 hours *Maximum Marks : 50*

(Weightage : 50%)

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

1. (a) Explain why discrete histogram equalization does not, in general, yield a flat histogram. 3

(b) Explain why we apply histogram specification rather than equalization for certain applications. 2

(c) An image has 8 levels of representation with probabilities 0, 0, 0, 0·15, 0·20, 0·30, 0·20, 0·15 respectively. Obtain its histogram specification. 5

2. (a) Explain two similarities and two differences between the spatial convolution and spatial correlation. *4*

(b) Perform the linear convolution between two matrices x(m, n) and h(m, n) given as

$$x(m, n) = \begin{bmatrix} 1 & 2 & 3 \\ 4 & 5 & 6 \\ 7 & 8 & 9 \end{bmatrix} \text{ and}$$

h(m, n) = [3, 4, 5]. Also obtain the linear correlation between x and h and comment on the result obtained. *6*

3. (a) Discrete derivative is based on computing differences of the form $f(x + 1, y) - f(x, y)$ and $f(x, y + 1) - f(x, y)$. Find the equivalent filter H(u, v) in the frequency domain. *5*

(b) Find the one-dimensional Walsh basis for fourth order system. *5*

4. (a) Explain the limitations of inverse filtering and describe how Wiener filtering overcomes this problem. *4*

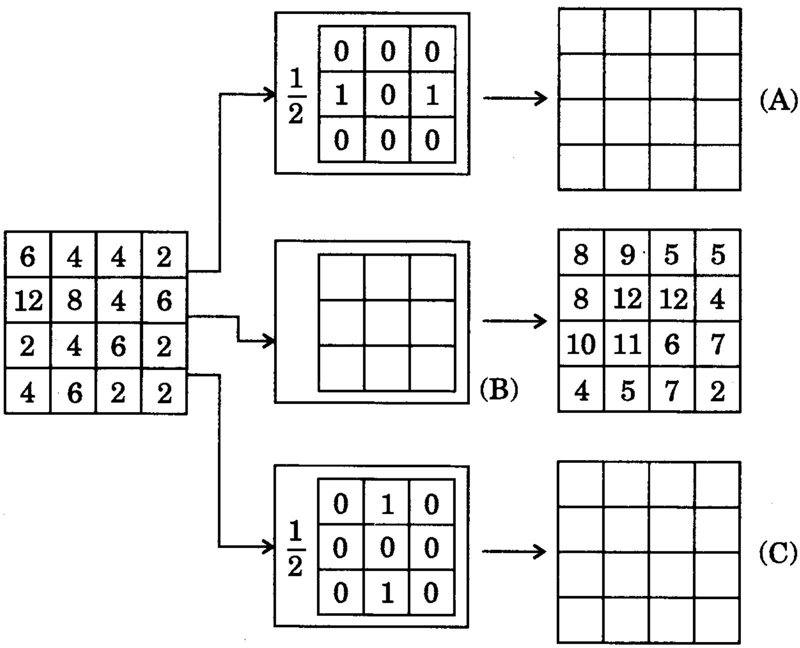
(b) Describe optimal notch filtering with the help of an example. *4*

(c) Obtain the DFT of $f(x, y) = 1$. *2*

5. (a) State and prove the Fourier – Slice theorem. How can it be used for reconstruction using parallel-beam filtered back projections ? *6*

(b) What will be obtained if the arithmetic mean filter is applied to an image again and again ? What will happen if median filter is used instead of mean filter ? *4*

6. A 4 × 4 gray image passes through three spatial linear, shift and invariant filters, resulting in three filtered output. *10*



Obtain (A), (B) and (C).

7. (a) Apply the perceptron algorithm to the following pattern classes :

$$W_1 : \left\{ \begin{pmatrix} 0 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 \\ 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 \\ 0 \\ 1 \end{pmatrix}, \begin{pmatrix} 1 \\ 1 \\ 0 \end{pmatrix} \right\}$$

$$W_2 : \left\{ \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}, \begin{pmatrix} 0 \\ 1 \\ 1 \end{pmatrix}, \begin{pmatrix} 0 \\ 1 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 \\ 1 \\ 1 \end{pmatrix} \right\}$$

Let $C = 1$ and $\overline{W}(1) = \begin{bmatrix} -1 \\ -2 \\ -2 \\ 0 \end{bmatrix}$. 5

(b) Briefly explain any 5 pattern recognition component approaches, giving an example of each. 5