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MMTE-003

00473

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

Term-End Examination

December, 2013

MMTE-003 : PATTERN RECOGNITION AND IMAGE PROCESSING

Time : 2 hours *Maximum Marks : 50*

(Weightage : 50%)

Note : *Attempt any **five** questions. Each question carries **equal** marks. Use of Calculator is **not** allowed.*

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1. (a) What effect would setting to zero the lower-bit planes have on the histogram of an image in general ? **2**

(b) What would be the effect on histogram of an image if we set to zero the higher order bit planes ? **2**

(c) Given $L = 8$ and $n_k = [790, 1023, 850, 656, 329, 245, 122,8)]$ perform histogram equalization. **6**

2. (a) Given the following images : **4**

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

Obtain the linear convolution between the two matrices $x(m, n)$ and $h(m, n)$.

(b) Describe any two applications of 2D convolution in the filed of image processing. 2

(c) Obtain the correlation between two matrices x_1 (m,n) = $\begin{bmatrix} 3 & 1 \\ 2 & 4 \end{bmatrix}$ and 4

x_2 (m,n) = $\begin{bmatrix} 1 & 5 \\ 2 & 3 \end{bmatrix}$

3. (a) Compare and Contrast aliasing and Moire' patterns. 3

(b) Given that $f(x,y)$ is real and odd, show that F(u, v) is imaginary and odd. F(u,v) is DFT of $f(x, y)$. 3

(c) Show that the 4 point DFT matrix is unitary and hence obtain its sequency. 4

4. (a) Describe the adaptive median filtering operation. Give two examples of it. 5

(b) Given an image of size 3×3 as 5

$$I\,(m,n) = \begin{bmatrix} 128 & 212 & 255 \\ 54 & 62 & 124 \\ 140 & 152 & 156 \end{bmatrix}$$

Determine the output image g(m,n) using the following transformation:

$g(m,n) = C \log_{10}(1 + I(m,n)$

where $C = L/\log_{10}[1 + L]$. You may like to use the following values.

$\log_{10} 256 = 2.4080$ $\log_{10} 63 = 1.7992$

$\log_{10} 129 = 2.1106$ $\log_{10} 153 = 2.1846$

$\log_{10} 55 = 1.7403$ $\log_{10} 125 = 2.0967$

$\log_{10} 141 = 2.1492$

$\log_{10} = 213 = 2.32$ $\log_{10} 157 = 2.1958$

5. (a) Define principal component analysis. Derive the transformation where the data belongs to $\mathbf{R}^d$. Interpret the transformation and its siginificance. 5

(b) Apply the perceptron algorithm to the following pattern classes: 5

$W_1 = \{(0,0,0)^T, (1,0,0)^T, (1,0,1)^T, (1,1,0)^T\}$

and

$W_2 = \{(0,0,1)^T, (0,1,1)^T, (0,1,0)^T, (1,1,1)^T\}$

Let $C = 1$ and $W_0 = (-1,-2,-2,0)^T$.

6. (a) Obtain the Huffman code for the source symbols S_0, s_1 __________ s_7 having respective probabilities 0.25, 0.21, 0.18, 0.14, 0.0625, 0.0625, 0.0625, 0.0625. Also calculate average code length and code efficiency. 6

(b) Differentiate between image enhancement and image restoration techniques with the help of two examples from two different situations. 4

7. (a) Briefly describe three boundary descriptors. 6

(b) The following pattern classes have Gaussian probability density functions 4

$W_1 : \{(0,0)^T, (2,0)^T, (2,2)^T, (0,2)^T\}$ and

$W_2 : \{(4,4)^T, (6,4)^T, (6,6)^T, (4,6)^T\}$

Assume $P(W_1) = P(W_2) = 1/2$ and obtain the equation of Bayes decision boundary between these two classes.