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MMTE-003

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

Term-End Examination

December, 2020

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) Perform histogram equalization for the 8×8 image shown in the table below : 5

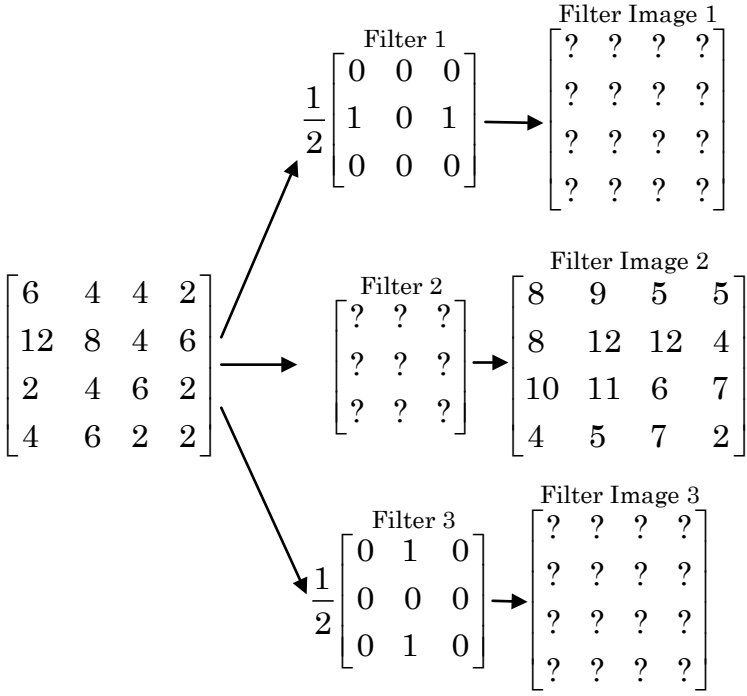
Grey level (r_k)	No. of pixels (p_k)
0	8
1	10
2	10
3	2
4	12
5	16
6	4
7	2

(b) Perform the linear convolution between $x(m,n)$ and $h(m,n)$ as given below : 5

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

2. (a) How are first order derivatives used for sharpening of image ? Include suitable example in support of your answer. 4

(b) A 4 × 4 gray scale image passes through three spatial linear shift-invariant filters, resulting in the following three filtered images :



Compute the following :

(i) Filtered image 1

(ii) filtered image 3

(iii) Filter 2

You may assume zero padding. 6

3. (a) What is periodic noise ? Discuss the parameters of noise estimation. 4

(b) Compute the image quality metrics; MSE, SNR and PSNR for the following image $f(x, y)$ and $\hat{f}(x, y)$: 6

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

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

4. (a) Obtain the Huffman code for the word 'COMMITTEE'. 6

(b) Differentiate between supervised and unsupervised learning with suitable examples. 4

5. (a) Consider the image segment :

$$\begin{bmatrix} 128 & 128 & 128 & 64 \\ 64 & 64 & 128 & 128 \\ 32 & 8 & 64 & 128 \\ 8 & 128 & 128 & 64 \end{bmatrix}.$$

Based on the histogram, segment the image into two regions. 4

(b) Find the discrete Fourier transform of the image : 6

$$\begin{bmatrix} 2 & 8 & 6 & 4 \\ 4 & 2 & 8 & 6 \\ 6 & 4 & 2 & 8 \\ 8 & 6 & 4 & 2 \end{bmatrix}$$

6. (a) Write the condition when Wiener filter reduces to :

(i) Inverse filter

(ii) All pass filter

Justify your answer. 6

(b) Consider two images f_1 and f_2 as given below :

$$f_1 = \begin{bmatrix} 11 & 13 & 17 \\ 15 & 25 & 85 \\ 210 & 60 & 160 \end{bmatrix}$$

and $$f_2 = \begin{bmatrix} 60 & 160 & 135 \\ 55 & 65 & 165 \\ 210 & 60 & 85 \end{bmatrix}$$

find $f_1 - f_2$, $f_1 + f_2$, $f_1 f_2$ and f_1 / f_2. 4

7. (a) Draw the block diagram of digital image water marking embedding and its extraction. 4

(b) Obtain the transfer function X (w_1, w_2) of a 3 × 3 mean filter $x(m, n)$ and show that X (0, 0) = 1. 6