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PES UNIVERSITY

PES University, Bangalore

(Established under Karnataka Act No. 16 of 2013)

UE18CS333

AUG 2021: END SEMESTER ASSESSMENT (ESA) B.TECH. VI SEMESTER

UE18CS333 DIGITAL IMAGE PROCESSING QP

Time: 3 Hrs | Answer All Questions | Max Marks: 100

1. a) (i) How do you distinguish between Image Processing, Computational Photography, Computer Graphics and Computer Vision?
(ii) Do you think Computational Photography and Computer Vision are related? If yes, justify it and if not refute it. **3+2**

b) (i) Give a set of gray-level slicing transformations capable of producing the bit planes 7, 6, 5 and 4 of an 8-bit monochrome image, a transformation function with the property

$$T(r) = \begin{cases} 0 & 0 \le r \le 127 \\ 255 & 128 \le r \le 255 \end{cases}$$

producing an image of bit-plane 7 (most significant bit) in an 8-bit image etc.
(ii) What is the output of the pixel values of the 4 bit image for the two cases when MSB is set to 0 and when LSB is set to 0?

15	9	6
4	5	11
7	10	12

2+4

c) For the following image data in binary form find the following between those in **bold font**: (6,1) to (1,5) (i) Euclidean distance (ii) Manhattan distance and (ii) Chessboard distance

0	0	0	0	**1**
0	0	1	1	1
0	1	1	0	0
0	1	0	0	0
1	1	0	0	0
1	0	0	0	0

4

d) Describe the image acquisition system in terms of either (i) single imaging sensor or (ii) line sensor. **5**

2. a) Given following 4x4 image, perform the second derivative on the same (using Laplacian) (3 rows)

6	8	9	3
5	6	8	2
4	6	7	8
2	3	5	6

4

b) The Histogram of the original image and the specified image are given below.

Histogram of original image

Value	0	1	2	3	4	5	6	7
Count	2	3	5	6	9	12	14	13

Specified Histogram of the image

Value	0	1	2	3	4	5	6	7
Count	13	12	14	14	11	0	0	0

Compute the final mapping of the value based on Histogram Matching. **6**

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c) Compute the 2D DFT of the 4 X 4 gray scale image

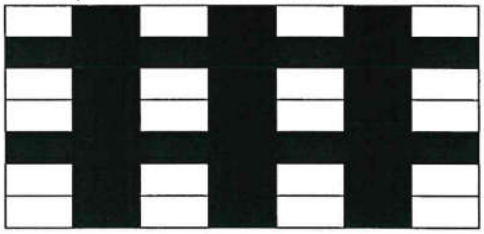
1	1	1	1
1	1	1	1
1	1	1	1
1	1	1	1

4

d) i) What is wavelet and mother wavelet?
ii) What are Haar Wavelets?
iii) For the image [10 8 8 6 6 4 4 2] compute Haar Transform 6

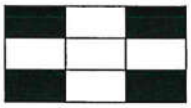
3 a) Mention two effects each of dilation and erosion morphological process. Is it possible for the erosion operation to be outside the input image? If so, give an example. 2+2

b) The input image A (7 x 7 matrix) and structuring elements B (3 x 3 matrix) and W-B (3 x 3 matrix) are shown below. Find the hit or miss transformation for the input image.



A

B

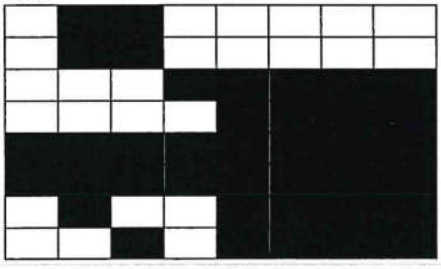


W-B

6

c) Trace Hough Transform algorithm for the set of points (0, 0), (1, 1), (2, 2), (3, 3) and (2, 4) as data, for the angles $-45^0.0^0$, 45^0 and 90^0. Creating initially the table for (x,y) for angles $-45^0, 0^0, 45^0$ and 90^0 follow it by creating another table of radius vector and angle to get the point which has highest count in the accumulator (no need to plot the lines). 4

d) Show how the following small 8 x 8 image (each square represents a binary pixel with the value 1 for white pixel and the value 0 for black pixel) could be represented using
i.) run length encoding (code the cell after last cell with -1)
ii.) a quadtree



2+4

4. a) Looking at the drawbacks of RGB Colour Model suggest an alternative colour model and briefly explain the model with a diagram. 4

b) Consider a linear display whose red, green and blue primaries have chromaticity coordinates of (0.5, 0.4), (0.2, 0.5) and (0.1, 0.1) respectively. The maximum intensity (defined by X+Y+Z) of white is 1000 cd/m2 respectively. The white point of the display is (0.33, 0.37) Generate the matrix that converts the RGB coordinates for this device to the XYZ coordinates. What is the XYZ coordinates of the colour generated by the RGB input (0.5, 0.75, and 0.2) on this device? 6

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	c)	For the image with 4 gray levels, compute the degree of compression that can be achieved using Huffman coding 2 2 2 2 2 3 3 3 2 1 3 3 2 1 3 2 2 3 3 3 0 0 0 0 0 0 0 0 0 0	4
	d)	Explain the LZW coding scheme by using the following image 123 123 42 42 123 123 42 42 123 123 42 42 123 123 42 22	6
5	a)	Describe briefly the steps involved in Scale Invariant Feature Transform (SIFT).	6
	b)	As you know, Covid-19 tests are common nowadays, but some results of tests are not true. Let's assume that we have 100 test samples and a diagnostic test has 99% accuracy and 60% of all people have Covid-19. If a patient tests positive, what is the probability that they actually have the disease using Bayes Theorem?	4
	c)	i) If the input image in matrix form is of size 28 x 28 a kernel (filter) of size 7 x 7 with a stride of 1, what will be the size of the convolved image? ii) If a data block in a convolutional network has dimension H×W× D = 200 × 200 ×128 , and we apply a convolutional filter to it of dimensions $H_f \times W_f \times D = 7 \times 7 \times 128$, what is the dimension of the output data block? You may assume that the stride is 1 and there is no padding	2+2
	d)	Compare GoogLeNet and Residual networks (ResNets). What are the main architectural features of each, and how did they lead to improvements over previous design? Use diagrams of the networks as appropriate	6