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PES University, Bangalore

(Established under Karnataka Act No. 16 of 2013)

UE16CS345

MAY 2019: END SEMESTER ASSESSMENT (ESA) B.TECH. VI SEMESTER

UE16CS345 DIGITAL IMAGE PROCESSING QP

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

1. a) What is knowledge base and what is its role in the steps of image processing? 2+2

b) Image subtraction is used often in industrial applications for detecting missing components in product assembly. The approach is to store a "golden" image that corresponds to a correct assembly; this image is then subtracted from incoming images of the same product. Ideally, the differences would be zero if the new products are assembled correctly. Difference images for products with missing components would be nonzero in the area where they differ from the golden image. What conditions do you think have to be met in practice for this method to work? 6

c) Consider the image segment shown.

i) Let **V= {7, 8}** and compute the lengths of the shortest 4-, 8-, and m-path between **p and q**. If a particular path does not exist between these two points, explain why.

ii) Repeat for **V= {5, 6, 7}.**

(p)7 8 7 6
5 6 9 8
9 7 8 6
5 6 7 7(q) 6

d) Using illumination and reflectance characteristics of an image briefly describe simple image model. 4

2. a) Consider a grayscale I image whose grayscale values I(r, c) of r^{th} row and c^{th} column is lying between 0 and 255.Let, for the range of all input gray level values from 30 to 75, we want to stretch the range of output gray levels from 45 to 255. Obtain the equation for such type of stretching 4

b) What is the basic mathematical principle behind sharpening of an image in spatial domain? What are the effects of sharpening spatial on the images? What are the steps to get a noise free sharpened image using Laplacian? 1+2+3

c) i) What do isopreference curves represent and when the points in the image become vertical?

ii) What effect would setting to zero the lower-order bit planes have on the histogram of an image in general?

iii) In Image Processing why Sampling and Quantization are done? 3*2

d) 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

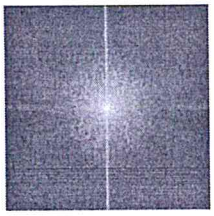
3 a) Find the Fourier Series of

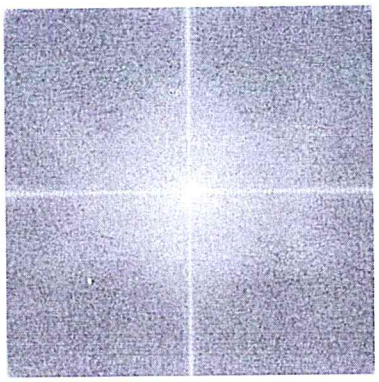
$$f(x) = \begin{cases} x & -\pi \le x < 0 \\ 0 & 0 \le x < \pi \end{cases} \qquad f(x+2\pi) = f(x)$$

5

b) The two Fourier spectra shown below are of the same image. The spectrum on the left

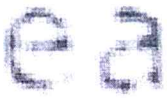
corresponds to the original image, and the spectrum on the right was obtained after the image was padded with zeroes. Explain (i) the difference of the overall contrast and (ii) the significant increase in signal strength along the vertical and horizontal axes of the spectrum shown on the right.





5

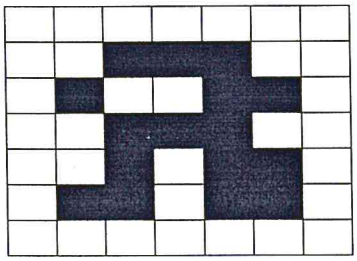
c) Given a sample of poor resolution of text (broken characters) on left hand side and suggest a suitable method by using FFT for its correction as shown on right hand side. (i) Write in detail all steps of whole process of FFT, ii) suggest suitable filter, and (iii) sketch it. 6

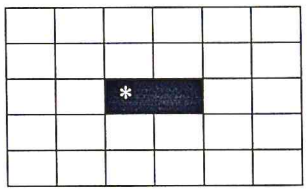


d) Given the inputs $\{x(0) = 3, x(1) = \sqrt{3}, x(2) = 1, x(3) = -\sqrt{3}\}$ compute DFT . Using IDFT get back the inputs. 4

4. a) What are the ideas for carrying out Region Filling and connected components using morphological operations? 4

b) What is done for dilate operation when the structural element is non symmetrical? Find opening of the image below, with a non-symmetrical structural element having origin at (3,3) immediately following the image.





6

c) Explain the differences between global, adaptive thresholding and local thresholding. Give examples of when each type should be used. 4

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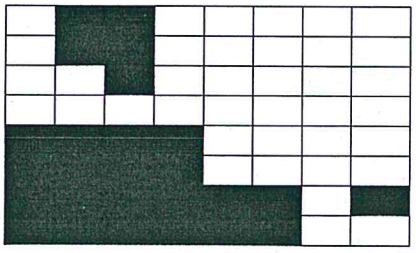
d) Show how the following small image (each square represents a binary pixel with the value 1 for white pixel and the value 0 for black pixel) could be represented using
i.) run length encoding (code the cell after last cell with -1)
ii.) a quadtree



2+4

5. a) Looking at the deficiency of RGB Colour Model give an alternate colour Model and briefly explain it. 1+3

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, 0.2) on this device? 6

c) With the Lok Sabha election process getting over in another two days, the much awaited counting process will start. In this context encode the first 3 characters of the word COUNT using Arithmetic Coding. 5

d) What is the principle of Differential Pulse Code Modulation (DPCM)? What are the applications of DPCM? 5