233

B.Sc. Engg. CSE 7th Semester — 11 March 2019 (Afternoon)

ISLAMIC UNIVERSITY OF TECHNOLOGY (IUT)
ORGANISATION OF ISLAMIC COOPERATION (OIC)
Department of Computer Science and Engineering (CSE)

MID SEMESTER EXAMINATION — **WINTER SEMESTER, 2018-2019**

DURATION: 1 Hour 30 Minutes — **FULL MARKS: 75**

CSE 4733: Digital Image Processing

Programmable calculators are not allowed. Do not write anything on the question paper.

There are **4 (four)** questions. Answer any **3 (three)** of them.

Figures in the right margin indicate marks.

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1. a) Define the following terms: 2×5
   i. 24-bit Color Image
   ii. Chromatic Light
   iii. Spatial Resolution
   iv. Image Interpolation
   v. Photon

   b) Explain the main steps involved in image digitization and how they affect the image quality. 10

   c) The median, ζ, of a set of numbers is such that half the values in the set are below ζ and the other half are above it. For example, the median of the set of values {2, 3, 8, 20, 21, 25, 31} is 20. Show that an operator that computes the median of a sub-image area, S, is nonlinear. 5

2. a) What is a contrast stretching transformation? Show how such transformation function can expand a narrow range of intensity levels of an image to a much higher range of intensity. Justify your answer with the help of an intensity mapping function. 1+6

   b) Propose a set of intensity-slicing transformations capable of producing all the individual bit planes of an 8-bit monochrome image. 8

   c) Provide the final intensity mapping table for performing histogram equalization (HE) on the data given in Table 1. 10

Table 1

r_k	n_k	$p_r(r_k) = n_k/MN$
$r_0 = 0$	790	0.19
$r_1 = 1$	1023	0.25
$r_2 = 2$	850	0.21
$r_3 = 3$	656	0.16
$r_4 = 4$	329	0.08
$r_5 = 5$	245	0.06
$r_6 = 6$	122	0.03
$r_7 = 7$	81	0.02

3. a) Show that 2-D filtering with separable, symmetric filters can be computed by (1) computing 1-D convolution along the individual rows (columns) of the input, followed by (2) computing 1-D convolution along the columns (rows) of the result from step (1). 8

   b) Give the mathematical equation representing the correlation of a filter $w(x,y)$ with an image $f(x,y)$. Show the results of applying a 3×3 Weighted Average filter on a gray-scale image of size 5×5 pixels. Assume all intensity values for the image are 0, except for two positions {at pixel location (2,2), (3,3)}, where intensity value is 255. Explain any three different correlation responses in the neighborhood of that position obtained with that filter. 3×4

   c) "Median filtering is sharpening filter" – Do you agree or disagree with this statement. Justify your choice. 5

4. a) Describe the working principle of the following morphological operations: 4+4
   i. Hit-or-Miss Transformation
   ii. Closing for Gray-scale image

   b) Opening or Closing with circular structuring element (SE) produces round corners which were sharp beforehand. Describe when and why these inward and outward sharp corners are rounded. Draw necessary illustrations. 7

   c) In the application of microscopy, one issue that frequently arises is to count particles of different sizes. One example image is shown in Figure 1 (assume the particles do not overlap). Assume the image has binary pixel values, i.e., particles have value 1 and background has value 0. Assume there are three different sizes. Propose a morphological algorithm to compute the number of particles of each size. Please sketch a flowchart or schematic diagram of your algorithm, plus some explanation of each step. 10

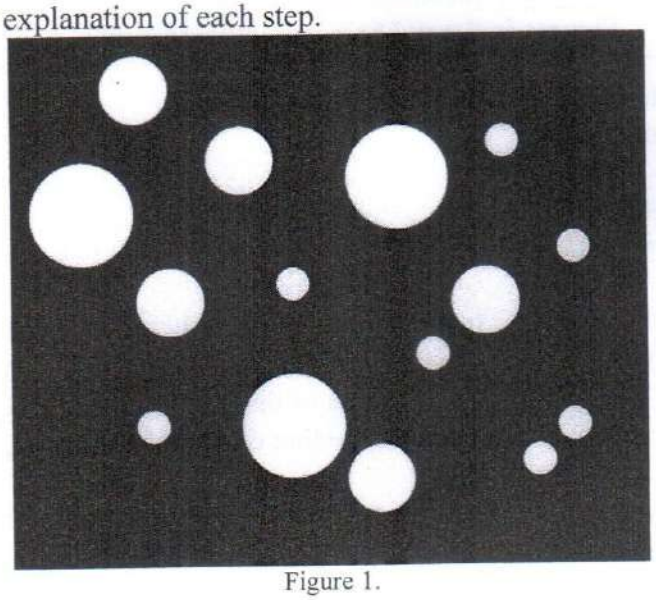

Figure 1.