GENERAL SIR JOHN KOTELAWALA DEFENCE UNIVERSITY
Faculty of Engineering
Department of Electrical, Electronic and Telecommunication Engineering

BSc Engineering Degree
4th Semester Examination – November/December2016
Intake 32

IMAGE PROCESSING
(ET2223)

Time allowed: 3 hours 18 Nov, 2016

ADDITIONAL MATERIAL PROVIDED

Nil

INSTRUCTIONS TO CANDIDATES

This paper contains 4 questions on 5 pages

Answer all questions

THIS IS AN CLOSED BOOK EXAMINATION

This examination accounts for 80% of the module assessment. A total maximum mark obtainable is 100. The marks assigned for each question and parts thereof are indicated in square brackets

If you have any doubt as to the interpretation of the wordings of a question, make your own decision, but clearly state it on the script

Assume reasonable values for any data not given in or provided with the question paper, clearly make such assumptions made in the script

All examinations are conducted under the rules and regulations of the KDU

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Use the given space to answer the all questions. You may use calculator.

1. Arrange the given image processing steps in the correct order to achieve the given task.

a). Extract urban areas in an aerial image. (5 Marks)

1. Apply a smoothing filter **2.** Morphological closing **3.** Edge detection **4.** Morphological opening **5.** Mask the original image

b). Count number of moving vehicles using a fixed camera. (5 Marks)

1. Count connected components **2.** Calculate frame difference. **3.** Morphological opening **4.** Connected component labeling **5.** Morphological closing

c). Locate address region on an envelope. (5 Marks)

1. Dilate **2.** Suppress smaller components **3.** Erode **4.** Apply Threshold **5.** Connected component labeling

d). Extract road marks (center line and lane separation lines) using a camera, mounted in a car buffer to use in an autonomous driving application. (5 Marks)

1. Apply an average filter **2.** Obtain Hough transformation **3.** Filter out the points with unnecessary angles **4.** Apply Threshold **5.** Detect Hough extreme points

[20 marks]

2. a). Define the following morphological operations by means of morphological dilation and erosion. (Note: Specify the exact order of usage of the dilation and erosion) (2 Marks)

   i. Morphological Opening : .....

   ii. Morphological Closing : .....

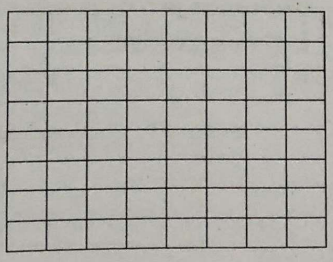
b). Show the result after dilating the following image. (5 Marks)

0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0
0	0	1	1	1	0	0	0
0	1	1	0	1	1	0	0
0	0	1	0	0	0	0	0
0	0	0	1	1	0	0	0
0	1	0	0	0	0	1	0
0	0	0	0	0	0	0	0

$\oplus$

	1	
1	1	1
	1	

$=$



/20

c). Suggest a structuring element to do the morphological closing for filling only the smaller hole in the following image. Specify the center point of the structuring element as well.

(5 Marks)

0	1	1	1	1	1	0	0
1	1	0	0	0	1	0	0
1	1	1	1	1	1	1	0
1	1	0	0	0	0	1	1
1	1	0	0	0	0	0	1
0	1	0	0	0	0	0	1
0	1	1	1	1	1	0	1
0	0	1	1	1	1	1	1

.....

d). Specify all the adjacency types which are suitable to describe the adjacency of each pair of shaded pixels in the below images. (8 Marks)

(i)

0	0	1	1
0	0	1	1
1	1	0	1
0	0	1	0

.....
.....
.....

(ii)

0	1	1	1
0	1	1	0
0	1	1	0
0	1	1	0

.....
.....
.....

(iii)

1	1	1	0
1	0	0	1
1	1	1	1
1	0	0	0

.....
.....
.....

(iv)

1	1	1	1
1	0	1	1
1	1	0	1
0	0	1	1

.....
.....
.....

[20 marks]

3. a). List **two** strengths and **two** weaknesses of K-Means clustering algorithm. (8 Marks)

Strengths	**Weaknesses**
i.	**i.**
.....	.....
.....	.....
ii.	**ii.**
.....	.....
.....	.....

b). Suggest **two** techniques which can be used to improve the selection of initial codebook in K-Means algorithm. (8 Marks)

i.

.....
...
.....
.....

ii.

.....
...
.....
.....

4.

Assume that the following image should be segmented using K-Means clustering based on the both pixel **location** and its **gray value**. You may use the pixels at **(2, 2)** having the gray value of **9** and **(2, 3)** having the gray value of **3** to generate the initial codebook.

	1	2	3
1	9	8	3
2	1	9	2
3	2	3	2

c). Calculate the distance matrix using the initial codebook and the pixels in the image.

(9 Marks)

(.....) (.....) (.....) (.....) (.....) (.....) (.....) (.....) (.....)

(.....) ....

(.....) ....

d). Calculate the new cluster centers: .....

.....

(5 Marks)

[30 marks]

4. a). List the three redundancy types which can be found in image data. (3 Marks)

i...... **ii.**..... **iii.**.....

Use the following image to answer the (b), (c) and (d) parts of the question.

20	20	200	75	90	210	210	210
20	20	200	75	90	210	210	210
20	20	200	75	75	210	210	210
20	20	200	75	75	210	210	210
20	20	200	75	75	210	210	210

b). Calculate the probability of each of the symbols in the image. (Use Table 1) (10 Marks)

c). Generate the Huffman codes for the image. (Use the Table 1) (10 Marks)

r	b). Probability : P(r)	c). Huffman Code
210		
20		
75		
200		
90		

Table 1: Probabilities and Huffman Codes

d). Calculate the relative redundancy of the image after compressing using the above generated codes. (7 Marks)

.....

[30 marks]

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