Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2019/2020

COURSE NAME	:	IMAGE PROCESSING
COURSE CODE	:	BEC 42203
PROGRAMME CODE	:	BEJ
EXAMINATION DATE	:	DECEMBER 2019/ JANUARY 2020
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWERS **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

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Q1 The following matrices represent an image A and structuring elements B. Assume that the intensities of the object and background are 1 and 0, respectively.

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

A

0	0	0
0	0	0
0	0	0

B

Figure Q1

(a) State the equation for dilation, erosion, opening and closing for A and B, respectively.
(8 marks)

(b) Create the output matrix D for the dilation for A and B.
(10 marks)

(c) Based on the result in **Q1(b)**, explain the effect of dilation to image A.
(2 marks)

(d) If we continue to apply dilation to image A, predict what will happened to the output image.
(2 marks)

Q2 The first step in image restoration is finding an appropriate image degradation model. The most common choice is: $g(x,y) = f(x,y)*h(x,y) + n(x,y)$.

(a) Explain briefly what do $g(x,y)$, $f(x,y)$, $h(x,y)$ and $n(x,y)$ represent in the above equation?
(4 marks)

(b) How would you model the image degradation situation where the camera is out of focus when the image is taken? Specifically, how will $h(x,y)$ and $n(x,y)$ be effected?
(4 marks)

(c) List **TWO (2)** types of noise.
(2 marks)

(d) Explain briefly the characteristics of each noise type listed in **Q2(c)**.
(4 marks)

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Q3 A simple 1D wavelet transform works by performing just two operations: taking averages of two values and differencing. Given a vector:

$$V = [71, 67, 24, 26, 36, 32, 14, 18]$$

(a) Create a new vector *V1* of four elements, which consist of the averages of the pairs of elements from *V*.

(8 marks)

(b) Create a new vector *V2* of four elements, which consist of the differences of the first four elements of *V* with the elements of *V1*.

(8 marks)

(c) Create a new vector *d1*, which is the discrete wavelet transform at decomposition level 1 of the original vector *V*.

(8 marks)

(d) Image compression is useful to reduce the amount of data required to represent an image. Draw a diagram showing forward wavelet transform with decomposotion level 2 for low pass filter output image for decomposition level 2, $fLL(x,y)$, and high pass filter output image for decomposition level 2, $fLH(x,y)$. Given the original image is represented as $f(x,y)$, lowpass filter as *H_bar*, highpass filter as *G_bar*, $fL(x,y)$ as low pass filter output image for decomposition level 1 and $fH(x,y)$ as high pass filter output image for decomposition level 1, respectively.

(10 marks)

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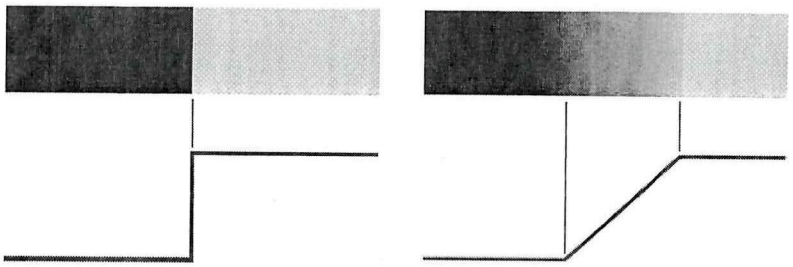
Q4 Most common techniques for edge detection make use of the first and second derivatives of an image to locate discontinuities in image intensity.

(a) A binary image contains straight lines oriented vertically and 45 degree. Assume that the intensities of the lines and background are 1 and 0, respectively. Provide **TWO (2)** 3x3 masks that can be used to detect 1-pixel breaks in these respective lines. Use coefficients valued -1 and 2 for the mask.

(10 marks)

(b) Edge models can be classified according to their intensity profiles. Categorize the following edge models.

(2 marks)



Fiigure Q4(b)

(c) Propose a set 3x3 masks of Prewitt method for finding horizontal edges and vertical edges, respectively.

(10 marks)

(d) Give **ONE (1)** advantage of the second-order derivative over the first-order derivative.

(2 marks)

(e) One important uses of thresholding is to isolate objects from their background. Give an example where a single threshold value will not isolate an object and its background completely.

(2 marks)

(f) Explain briefly the condition of threshold value, T, for global and adaptive thresholding scheme.

(4 marks)

- END OF QUESTIONS -

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