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Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
ONLINE
SEMESTER II
SESSION 2019/2020**

- COURSE NAME : IMAGE PROCESSING
COURSE CODE : BIM 33203
PROGRAMME CODE : 3 BIM
EXAMINATION DATE : JULY 2020
DURATION : 2 HOURS AND 30 MINUTES
INSTRUCTION :
1. ANSWER **ALL** QUESTIONS
2. PLEASE MAKE SURE TO CLICK "SAVE ANSWER" BUTTON FOR SUBJECTIVE QUESTIONS.
3. THE STUDENT SHOULD UPLOAD THE ANSWER BOOKLET (PDF/WORD FORMAT) WITHIN 30 MINUTES AFTER EXAMINATION PERIOD.

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

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Q1 Most of the time (under untrained situation) human optical nerves will try to fill in non-existing information or wrongly perceives geometrical properties of objects. What visual process does this scenario refers to? (2 marks)

Q2 Recent development in visual and imaging technologies have reached a pinnacle that was once only can be dreamed of. With such level, based on your own words, what should electronics industries focus/concentrate on moving forward, resolution OR refresh rate? Should they focus on developing extra pixels on a screen OR provide better refresh rate? (Note: current benchmark resolution for gaming display is 4K and 240Hz for refresh rate.) (8 marks)

Q3 Describe the key factors that contribute to the efficacy of the convolutional process. (2 marks)

Q4 **Figure Q4** illustrates two matrices that represent an input image and a kernel, respectively.

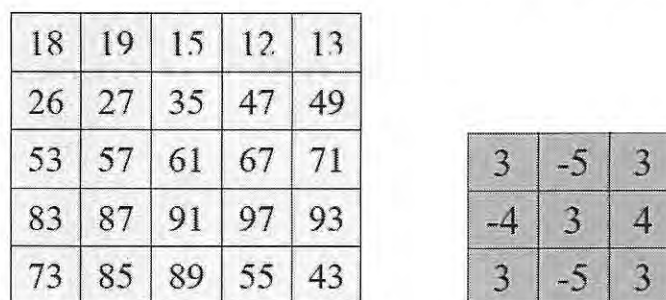


Figure Q4

(a) By using Cartesian coordinate system (in imaging) as standard and the kernel as **Figure Q4**, calculate the output result of input image at pixel (3, 4). (2 marks)

(b) By padding the input image matrix with zeros, demonstrate the corresponding result of the output image (including your calculation workout) via convolution process. (12 marks)

(c) Based on convolution operations above and your understanding about convolution in general, describe which procedure is best for feature extraction of an input image. (4 marks)

Q5 Image Processing Toolbox™ (IPT) in MATLAB is a powerful tool that provides a comprehensive set of reference-standard algorithms and workflow applications for image processing, analysis, visualization and algorithm development. IPT applications also let you perform image segmentation, image enhancement, noise reduction, geometric transformations and automate common image processing workflow.

- (a) By using `fsktm.png` as an image file, list down basic operations to display this image by using IPT in MATLAB. (2 marks)
- (b) Name **THREE (3)** functions in IPT that could perform contrast adjustment. (3 marks)
- (c) By applying `histeq` to the image, write the newly adjusted image to a disk file. Next, create an image with alternating rectangular regions from original image and processed image. (3 marks)
- (d) IPT has an MRI dataset which consists of 27 images. How do you view all the images in this dataset? Next, create a new montage containing only the first 9 images (4 marks)

Q6

- (a) Attempting to base enhancement on a uniform histogram is not always the best approach. Sometimes, it is useful to be able to specify the shape of the histogram that we wish the processed image to have. This method refers to a techniques known as? (2 marks)
- (b) **Figure Q6** shows the image of Mars moon, Phobos, and the output image results of the application of histogram equalization and histogram technique as in **Question 6(a)**, respectively, with their corresponding output of histogram graphs.

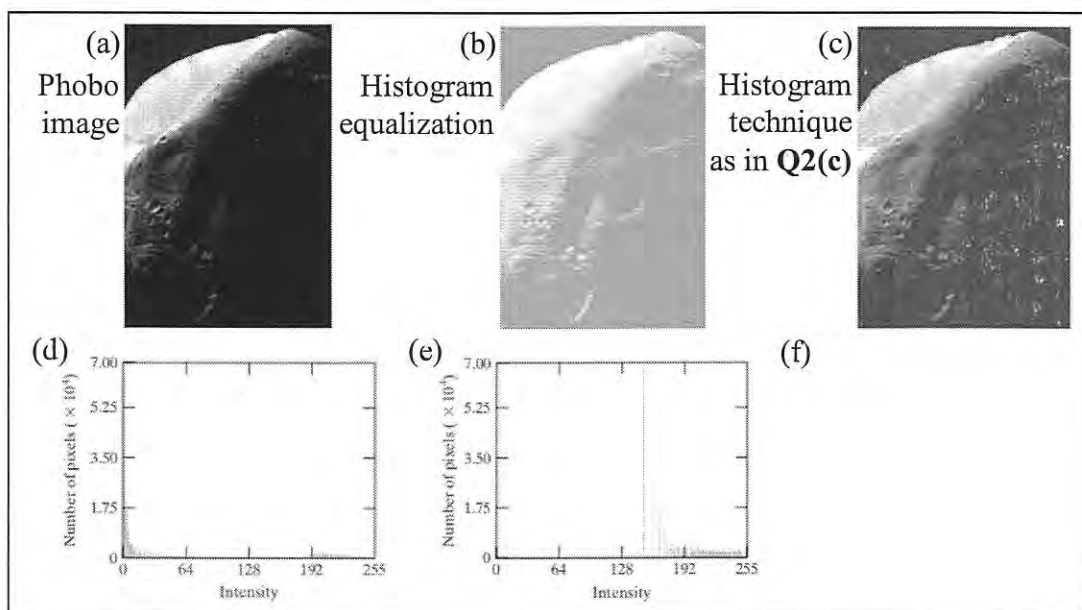


Figure Q6

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Based on information in **Figure Q6**, draw and label histogram graph that represent **Figure Q6(f)**.

(4 marks)

Q7 (a) Discrete Fourier Transform (DFT) is one of the technique for image enhancement. Name **THREE (3)** steps to filter an image in the frequency domain via DFT. (6 marks)

(b) Next, draw the diagram to demonstrates the relationship of input image, $f(x,y)$, and processed output (enhanced) image, $g(x,y)$, based on processing steps in **Q7(a)**. (6 marks)

(c) Performing straight bandpass filtering on an image is not a common procedure due to the process generally removes too much details on an image. Write down:

(i) The equation associated with bandpass filter. (2 marks)

(ii) Its (bandpass filtering) role in image processing. (2 marks)

(iii) Expected output result of the input image with uniform noise. (2 marks)

Q8 (a) Consider a simple 8-bit of image as follows:

11	97	97	191	234	234	234	234
11	97	97	191	234	234	234	234
11	97	97	191	234	234	234	234
11	97	97	191	234	234	234	234

Construct a probability table and calculate the entropy estimation of the image.

(8 marks)

(b) Based on data of original source below, rearrange the values accordingly and construct a source reduction table using forward pass Huffman coding.

$$a_1 = 0.02; a_2 = 0.125; a_3 = 0.25; a_4 = 0.3; a_5 = 0.25; a_6 = 0.055$$

(5 marks)

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Q9 By using Image Processing Toolbox™ (IPT) in MATLAB, `coins.png` as an input image and a region-based deformable model algorithm as the main function, explain (in the form of pseudocode only) how you could segment the coins accurately. (11 marks)

Q10 Figure Q10 depicts a sample black and white input image.

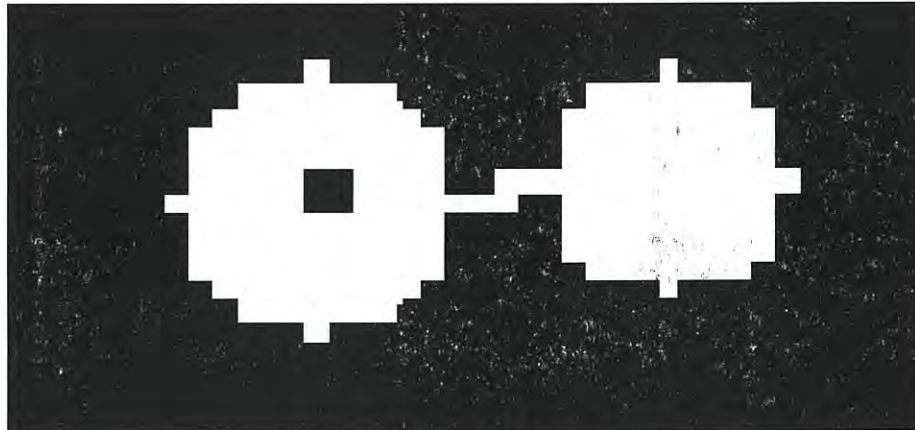


Figure Q10

Draw the output image to the corresponding image morphological procedures:

- (a) Opening (2 marks)
- (b) Closing (2 marks)
- (c) Boundary extraction (2 marks)
- (d) Region filling (2 marks)
- (e) Convex hull (2 marks)

– END OF QUESTION –

