UNIVERSITI KUALA LUMPUR
MALAYSIAN INSTITUTE OF INFORMATION TECHNOLOGY

FINAL EXAMINATION

JANUARY 2016 SEMESTER

SUBJECT CODE	:	IBB42303
SUBJECT TITLE	:	COMPUTER VISION
LEVEL	:	BACHELOR
TIME / DURATION	:	9.00 AM – 11.30 AM (2 1/2 HOURS)
DATE	:	24 MAY 2016

INSTRUCTIONS TO CANDIDATES

1. Please read CAREFULLY the instructions given in the question paper.
2. This question paper has information printed on both sides of the paper.
3. This question paper consists of ONE (1) section; Section A.
4. Answer only FOUR(4) questions in Section A.
5. Please write your answers on the answer booklet provided.
6. Answer ALL questions in English.

SECTION A (Total: 100 marks)

INSTRUCTION: Answer all questions.
Please use the answer booklet provided.

Question 1

(a) Explain why computer vision could be useful in medical imaging.

(2 marks)

(b) Many powerful tools have been available through image segmentation, machine learning, pattern classification, tracking, reconstruction to bring much needed quantitative information not easily available by trained human specialists. Describe how the use of image segmentation can be used to quantify the medical information.

(3 marks)

(c) Compare and contrast the operation of both Roberts edge detector and Kirsh edge detector. Which ones can serve as compass operators. List one application in which determining edge direction is important.

(5 marks)

(d) Describe when it would be suitable to use the Sobel edge detector. Use a diagram to illustrate these masks. Sketch the result when one of these masks is applied to the grayscale image as shown in Figure 1. You only need to compute the values for the central region of the image that is fully covered by the mask.

6	7	7	8	8	9
6	7	8	34	38	39
7	8	9	36	38	39
7	6	36	35	37	40
6	6	8	36	18	39
3	7	8	35	20	39

Figure 1

(10 marks)

[20 marks]

Question 2

(a) Image interpolation is a well known image resizing technique. Compare local averaging technique to point sampling technique. Use a diagram to illustrate these interpolation techniques.

(4 marks)

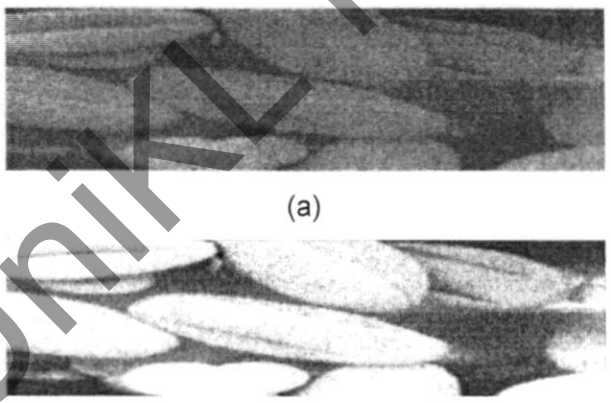
(b) Perform pixel replication and midpoint interpolation on the image shown in Figure 2.

3	5
9	11

Figure 2

(6 marks)

(c) Consider the image given in Figure 3a. After histogram equalization (Figure 3b), much more detail is visible. Does histogram equalization increase the amount of information contained in image data? Explain.



(a)

(b)

Figure 3

(2 marks)

(d) Determine a gray-scale transformation that maps the darkest 5% of image pixels to black(0), the brightest 10% of pixels to white (255), and linearly transform the gray-levels of all remaining pixels between black and white.

(6 marks)

[20 marks]

Question 3

(a) What are the two properties used for establishing the similarity of edge. Give the properties of the second derivative around an edge?.

(4 marks)

(b) How is line detected? Explain through the operators.

(4 marks)

(c) Describe color image segmentation using the k-means algorithm.

(6 marks)

(d) Describe the Canny edge detector. What are the steps involved in edge detection using this detector. Use diagrams where necessary in your explanation

(6 marks)

[20 marks]

Question 4

(a) Explain why subtraction of a second derivative of the image function from the original image results in the visual effect of image sharpening.

(4 marks)

(b) Consider the 3 images given in Figure 4. The first image is the original image and the next two images are the processed images. Explain what type of filters has produced the effects in these two images.

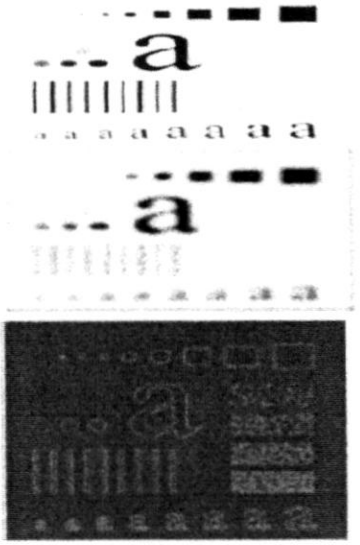


Figure 4

(2 marks)

(c) Discuss the difference in the results of using a smoothing filter at the borders of an image by comparing the case when the border is padded with zeros and the case of duplicating the required rows and columns.

(4 marks)

(d) Given 3x3 mask

$$\begin{bmatrix} 0 & -1 & 0 \\ -1 & 4 & - \\ 0 & -1 & 0 \end{bmatrix}$$

Answer the following questions:

(i) When applying this mask on an image, what kind of effect you will expect in the output image? **Why**? (Hint: is this mask an image smoothing filter, an image sharpening filter or an edge detector?)

(2 marks)

(ii) Perform the image **convolution** using **this mask** on a 3x3 image

$$\begin{bmatrix} 6 & 8 & 12 \\ 10 & 20 & 11 \\ 5 & 8 & 15 \end{bmatrix}$$

Give the **FULL** filtering result for the output image. (Hint: you need to assume an appropriate zero mapping.)

(8 marks)

[20 marks]

Question 5

A certain inspection application gathers black & white images of parts as they travel along a conveyor belt. It is necessary to sort the parts into two categories: parts with holes and parts without holes. An example of an image that might be taken by the inspection camera is shown in Figure 5.

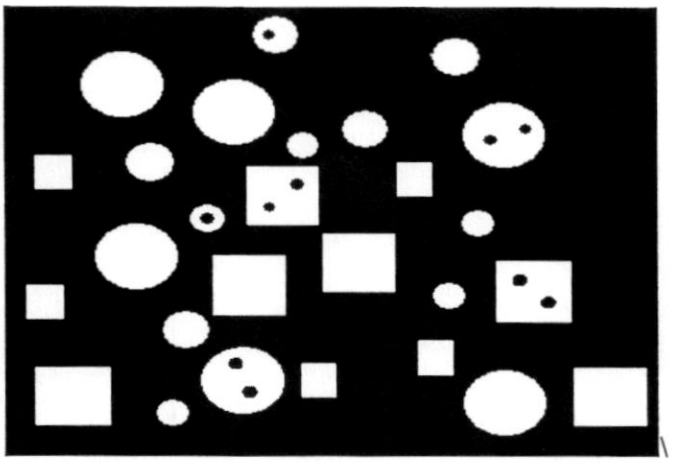


Figure 5

(a) Propose a method to identify and locate the objects of each category in the image so that they can be picked up by a robotic system and placed in different bins. Assume that the imaging system knows where each image pixel is located on the conveyor belt at every point in time.

(10 marks)

(b) Provide an annotated flowchart of the algorithm you propose.

(10 marks)

[20 marks]

END OF EXAMINATION PAPER