



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023**

COURSE NAME : VISION SYSTEM

COURSE CODE : BEJ 34202 / BEH 41902

PROGRAMME CODE : BEJ

EXAMINATION DATE : JULY/ AUGUST 2023

DURATION : 2 HOURS

INSTRUCTION : 1. ANSWER ALL QUESTIONS
2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK**.
3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

Q1 You have been given a task for processing and to segment out object of interest from image *A* and image *B* as shown in **Figure Q1**. For segmentation, the global method shall be executed using OTSU between class variance while the local method using *mean-C* with 3x3 kernel and $C=150$.

(a) Investigate the suitable method of segmentation to separate between the foreground and background of image *A* and image *B* respectively. (Please use illustration and provide clear explanation. Your first task is to segment out foreground using optimal threshold value).

(4 marks)

(b) Evaluate the optimal threshold value of image *A*.

(16 marks)

(c) From the threshold value obtained in **Q1(b)**, construct an edge map of image *A* by using Prewit operator given by:

$$dx = \begin{bmatrix} -1 & -1 & -1 \\ 0 & 0 & 0 \\ 1 & 1 & 1 \end{bmatrix}, \quad dy = \begin{bmatrix} -1 & 0 & 1 \\ -1 & 0 & 1 \\ -1 & 0 & 1 \end{bmatrix}$$

(5 marks)

Q2 You have been given a task to improve the image quality prior to the segmentation process at the pre-processing phase.

(a) Examine image *A* and image *B* from **Figure Q1** in term of the illumination condition and contrast of the image. (Please use illustration and provide clear explanation).

(4 marks)

(b) Image *B* will be undergoing series of consecutive pre-processing steps as follow:

(i) 1st step: Global illumination correction by gamma with $\gamma = 0.2$.

(ii) 2nd step: Contrast correction using histogram equalization.

Compare the differences between processed image and the original image in term of histogram distribution, illumination condition and its contrast for every stage of step.

(18 marks)

(c) If threshold value of the improved image quality is set to 150, determine the foreground objects perimeter and area

(3 marks)

- Q3** An engineer has been given a task to develop a system to automatically differentiate shape of objects by using Moment Invariant (MI) and sample of image is as depicted in **Figure Q3**.
- (a) Calculate m_{00} , m_{01} , m_{10} , \bar{x} , \bar{y} , μ_{00} , μ_{02} , μ_{20} , and μ_{11} .
(20 marks)
- (b) If the cross shape was shifted six steps to the right, analyze the new value of m_{00} , m_{01} , m_{10} , \bar{x} and \bar{y} .
(5 marks)
- Q4** By referring to Convolutional Neural Network (CNN) code in **Figure Q4**:
- (a) Illustrate the model structure with details of layer labelling.
(3 marks)
- (b) Analyze image output shape and its total trainable parameters for each stack of the CNN layer.
(20 marks)
- (c) Illustrate the new model structure if VGG pre-trained model is to be integrated to the existing CNN structure.
(2 marks)

- END OF QUESTION -

FINAL EXAMINATION

SEMESTER/SESSION : SEM II 2022/2023
 COURSE NAME : VISION SYSTEM

PROGRAMME CODE : BEJ
 COURSE CODE : BEJ 34202 / BEH 41902

110	110	110	110	110	110	110	110
120	120	160	160	180	120	120	110
120	150	150	150	180	180	180	120
120	120	160	160	180	180	130	120
120	180	180	180	180	130	130	130

Image A

120	120	120	120	110	110	130	130
120	130	130	150	160	180	160	150
120	110	150	130	160	180	180	150
110	110	150	150	180	180	180	130
110	110	160	110	180	180	180	160

Image B

Figure Q1

9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
6	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
5	0	0	1	1	1	0	0	0	0	0	0	0	0	0	
4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	
3	0	0	0	0	0	0	0	1	1	1	0	0	0	0	
2	0	0	0	0	0	0	0	1	1	1	0	0	0	0	
1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14

Figure Q3

FINAL EXAMINATION

SEMESTER/SESSION : SEM II 2022/2023
COURSE NAME : VISION SYSTEM

PROGRAMME CODE : BEJ
COURSE CODE : BEJ 34202 / BEH 41902

```
cnn_model = models.Sequential()  
cnn_model.add(layers.Conv2D(16,(11,11), activation='relu', input_shape=(256,256,3)))  
cnn_model.add(layers.MaxPooling2D((2,2)))  
cnn_model.add(layers.Conv2D(32,(7,7),activation='relu'))  
cnn_model.add(layers.MaxPooling2D((2,2)))  
cnn_model.add(layers.Conv2D(64,(1,1),activation='relu'))  
cnn_model.add(layers.Conv2D(128,(5,5),activation='relu'))  
cnn_model.add(layers.MaxPooling2D((2,2)))  
cnn_model.add(layers.Conv2D(256,(3,3),activation='relu'))  
cnn_model.add(layers.MaxPooling2D((2,2)))  
cnn_model.add(layers.Conv2D(512,(3,3),activation='relu'))  
cnn_model.add(layers.Flatten())  
cnn_model.add(layers.Dense(512, activation='relu'))  
cnn_model.add(layers.Dense(1,activation='sigmoid'))
```

Figure Q4