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**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER II  
SESSION 2021/2022**

COURSE NAME : IMAGE PROCESSING  
COURSE CODE : BIM 33203  
PROGRAMME CODE : BIM  
EXAMINATION DATE : JULY 2022  
DURATION : 3 HOURS  
INSTRUCTION : 1. ANSWER ALL QUESTIONS.  
2. THIS FINAL EXAMINATION IS AN **ONLINE** ASSESSMENT AND CONDUCTED VIA **OPEN BOOK**.

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

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**Q1** Given a relative input data redundancy of 95.48%, calculate the size of the compressed output image when the input image carries a size of 5282Mb. Round your answer to four decimal places.

(4 marks)

**Q2** Construct a probability table and estimate the information entropy of a sample grayscale image below:

19	59	80	82	82	82	59	52
52	80	82	90	90	90	80	59
52	80	82	82	90	82	82	59
52	19	52	19	52	19	52	52

(6 marks)

**Q3** Working at Google Corp, one of your primary responsibilities will be to reduce the data size on your company's archive servers. Before carrying out this compression task autonomously, experimenting with a single data to observe for the correct coding cycle and output results seems like the right way moving forward. Please use the following information for executing a compression procedure on a truecolor image of this archive:

Image: 'arms.jpg'

Compression method: Adaptively Scanned Wavelet Difference Reduction ('aswmd')

Maxloop: 16

(a) Please use MATLAB® Online to run this procedure. What are results for both the compression ratio and the bit-per-pixel?

(2 marks)

(b) With correct labels, plot, and display both the original and compressed images.

(4 marks)

(c) Compute the mean square error (MSE) and the peak signal-to-noise ratio (PSNR) error values.

(4 marks)



**Q4** Image segmentation is a method in which a digital image is broken down into various subgroups called image segments, which helps in reducing the complexity of the image to make further processing or analysis of the image simpler. Segmentation in easy words is assigning labels to pixels.

(a) Distinguish two fundamental approaches of segmenting grayscale images. Please use appropriate figures (with descriptions) to support your answer. (4 marks)

(b) Region-based segmentation is a method that is applied to extract object of interest based on regional information of an input image. How do you distinguish between region growing, region splitting and region merging in this regard? (6 marks)

**Q5** Figure Q5 denotes an image that is applicable in MATLAB® Image Processing Toolbox™ (IPT).

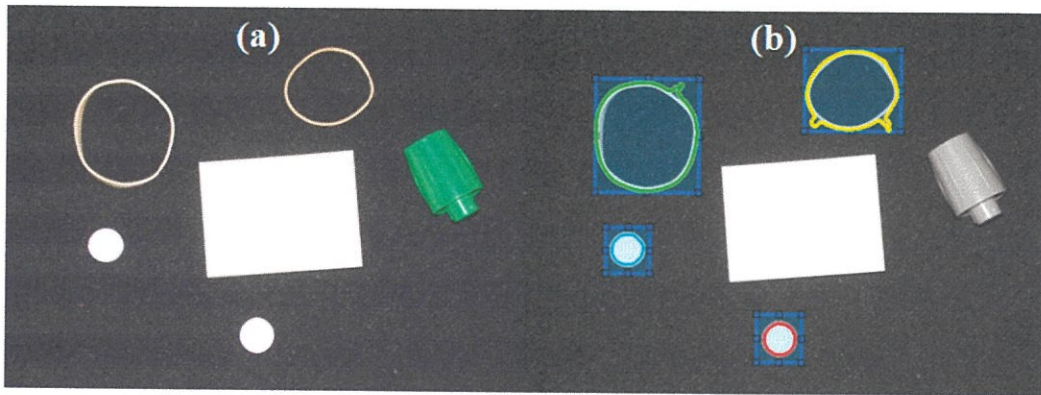


Figure Q5

(a) By utilizing its original name, pillsetc.png as an input image file, and IPT in MATLAB®, list down functions to segment **FOUR (4)** objects as shown in **Figure Q5(b)**. Your answer should include the drawing of **FOUR (4)** rectangles; the creation of **FOUR (4)** masks; segmentation operation by `activecontour` with 300 iterations (per object) and `'edge'` as the method; and **FOUR (4)** different contour colors to represent **FOUR (4)** segmented objects. You may use MATLAB® Online to demonstrate your answer. (10 marks)

(b) In your own words, why is the segmentation on both hollow circles not precise? (2 marks)

**Q6** Figure Q6 denotes objects A, B and C in an input image. Draw the outcome of possible set of morphological theory based on the required configuration.

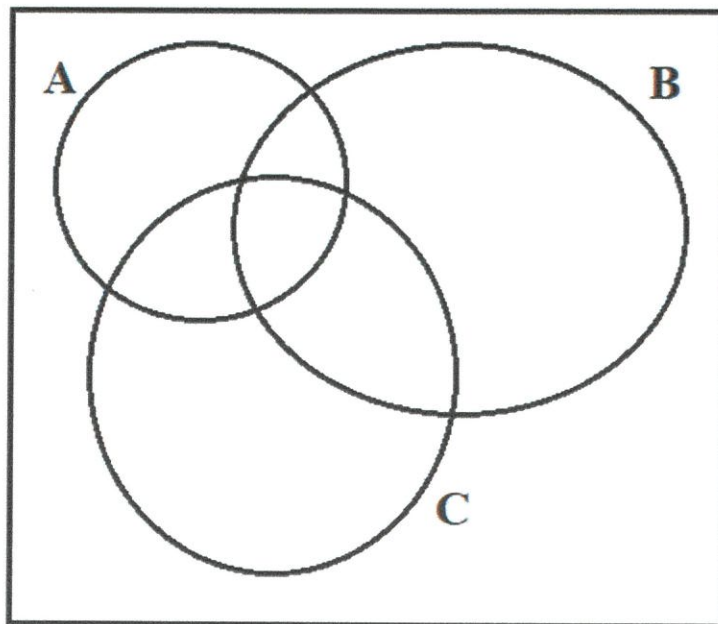
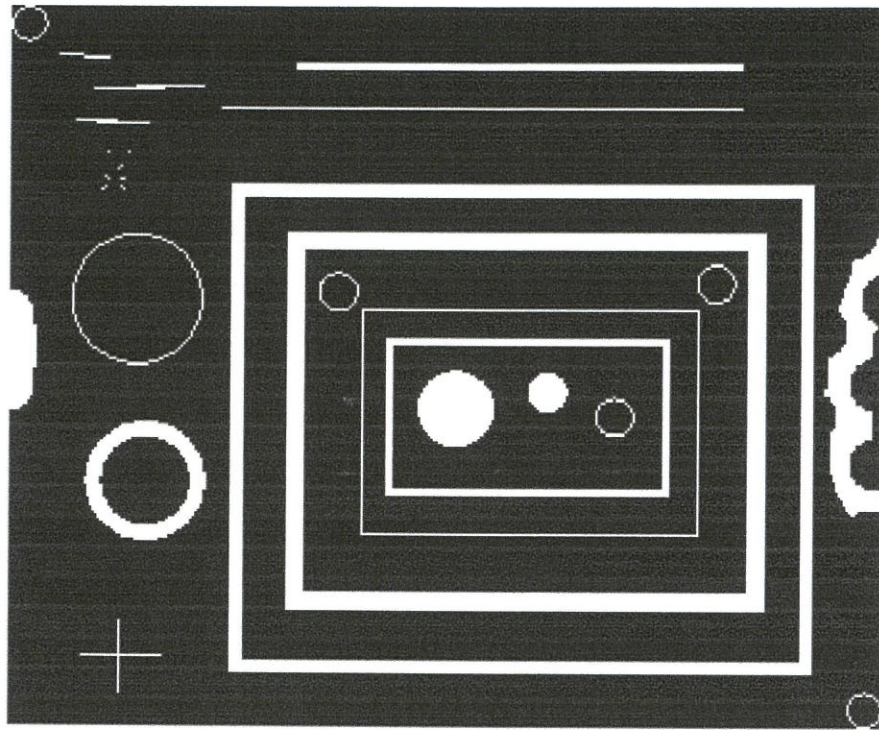


Figure Q6

- (a)  $(B \cup C) \cap A$  (2 marks)
- (b)  $(C \cup A^c) \cap B^c$  (2 marks)
- (a)  $(A \cap B^c) \cup (B \cap C^c) \cup (C^c \cap A)$  (2 marks)
- (b)  $(C - (B \cap A)) \cup ((A \cap B) - C)$  (2 marks)

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**Q7** Figure Q7 exhibits an image of `blobs.png` (applicable in MATLAB®) that contains multiple objects in it.



**Figure Q7**

- (a) By using MATLAB® Online, display the results of both the original image and the output image that has been morphologically opened by a rectangle structuring element with a size of  $[5 \ 5]$ . Please write down your codes and display both images side by side. (2 marks)
- (b) Now, by using an octagon structuring element with distance of 3, perform both erosion and dilation to your output image in **Q7(a)**. Write down your codes and display results for both morphological operations side by side. (2 marks)
- (c) Next, fill all possible holes in the eroded image in **Q7(b)**. Write down your codes and display the output result. (2 marks)
- (d) Perform `imclearborder` to remove any objects that are located within image border of **Q7(c)**. Write down your codes and display the output result. (2 marks)

- (e) Find object perimeter of your result in **Q7(d)**. Write down your codes and display the output result. Finally, how many objects from the original input image have you removed? Note: you may use this line of code to extract your answer:

```
[labeledImage, numberOfObject] = bwlabel(binaryImage);
```

(2 marks)

- Q8** In your own words, describe about components of a pattern recognition method. Please include at least **ONE (1)** real-world pattern recognition framework in your description with its respective flow chart.

(10 marks)

- Q9** MATLAB<sup>®</sup> Computer Vision System Toolbox<sup>™</sup> (CVST) offers a variety of techniques for handling challenges in object detection.

- (a) How does `detectSURFFeatures` works and how can it be linked to `SURFPoints`?

(4 marks)

- (b) By using `llama.jpg` as the input image and MATLAB<sup>®</sup> Online, demonstrate how you could extract llama features on this image. On top of your codes, your answer should also include a figure to the input image, 50 strongest plots to this object of interest, an appropriate title to this figure and the final matrix size of extracted llama features.

(6 marks)

- END OF QUESTIONS -

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