

Date of Examination: 25 September 2023

AHSANULLAH UNIVERSITY OF SCIENCE AND TECHNOLOGY

Department: Computer Science and Engineering

Program: Bachelor of Science in Computer Science and Engineering

Semester Final Examination: Fall 2022

Year: 4th

Semester: 2nd

Course Number: CSE 4227

Course Name: Digital Image Processing

Time: 3 (Three) hours

Full Marks: 70

Instruction: *There are two parts, PART A and PART B. Use different script for different part. Question no 1 of PART A is mandatory for all. Marks allotted are indicated in the right margin.*

PART A

Question 1. Answer all the questions.

[Marks: 9x2=18]

- a)
 - i. Explain how you can smooth an image. If you subtract your smoothed image from the original image, what will happen if you add the subtracted result back to the original image? [3+6]
 - ii. Suppose, you and your batch mates of *Integer 43* took group selfies during the farewell event, but some of the selfies suffer from salt-and-pepper noise that affects the overall image quality. Apply the de-noising process and explain which filtering is most effective to these group selfies to create clean and clear images that capture the joy of the moment? Describe how this filtering enhances the aesthetics of group photographs and contributes to fond memories.
- b)
 - i. Suppose, you are working on tumor detection from some medical scans images. Explain which transformation function can be applied to highlight specific ranges of pixel values in medical scans of tumor detection. [3+6]
 - ii. The locations of two points (r_1, s_1) and (r_2, s_2) control the shape of transformation function in Piecewise Linear Transformation. Now illustrate the relation between (r_1, s_1) and (r_2, s_2) for Linear Identity, Thresholding and Contrast Stretching functions.

Question 2. Answer any TWO (2) questions

[Marks: 5x2=10]

- a) What do you understand by image compression? Why do we need image compression? How can image compression be implemented? Explain briefly. [1+1+3]
- b) What is histogram of an image? Describe how the histogram differs for the dark, bright, low contrast or high contrast image of the same scene. Write the steps of histogram equalization algorithm [1+2+2]
- c) What is Structuring Element? What are the effects of Erosion and Dilation operation? Explain briefly with applications. [1+2+2]

Question 3. Answer any TWO (2) questions

[Marks: 8x2=16]

a) Consider the following 4x5, 6 bit image.

[3+3+2]

3	10	3	24	35
3	10	10	24	3
3	10	10	24	35
3	10	10	24	35

- Compress the image using Huffman Coding.
- Compress the image using Run Length Coding.
- Calculate Compression Ratio for (ii) and (iii).

b) Consider the histogram of an image shown in the following table.

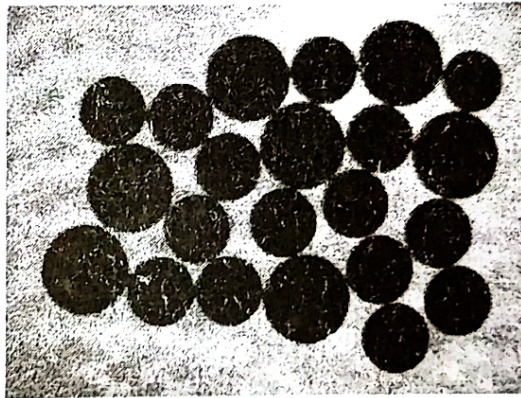
[2+4+1+1]

Gray levels(r)	0	1	2	3	4	5	6	7
No of pixels	790	1023	850	656	329	245	122	81

- Compute and sketch the normalized histogram for it.
- Compute and sketch the equalize histogram for it.
- Show the mapping of the new gray level values into number of pixels.
- Plot the curve of transformation function of (ii).

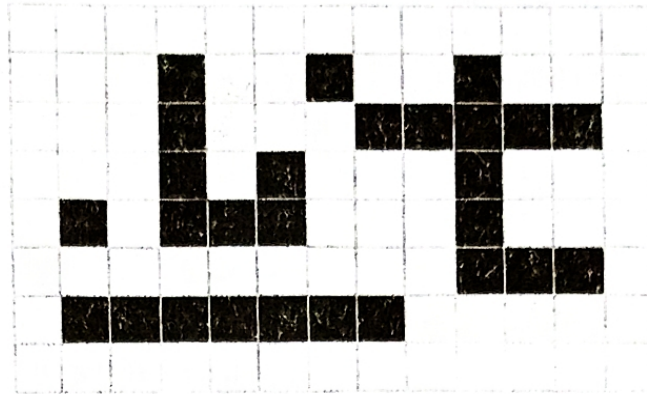
c) Consider the following image.

[4+2+2]



- Which morphological operation can be used to count the number of coins? Explain briefly your process.
- Design Hit-or-Miss transformation SEs for locating 4-connected endpoints of an image.

- iii. Locate all the 4-connected endpoints of the following image using SEs obtained from the previous question ii and draw each result with the combined one.



PART B

Question 4. Answer any *TWO* (2) questions

[Marks: 5x2=10]

- Write down the types of image segmentation based on two basis properties of intensity values. Explain three main criteria of Canny edge detection algorithm. [2+3]
- Define Sampling and Quantization. If we want to represent 512 intensities of grayscale, how many bits do we need? Suppose, you have an image named *Integer.png* of size 7x5. What is the Spatial Resolution and Bit Size of *Integer.png*? [2+1+2]
- Draw the RGB color model. How are different colors formed in RGB color cube? Explain briefly with figure. [1+4]

Question 5. Answer any *TWO* (2) questions

[Marks: 8x2=16]

- Derive the limitation in the parameter space of Hough transform algorithm. Consider the following 7x7 image and use Region Growing algorithm to segment the object. The seed for the object is at the center of the image. Region is grown in horizontal, vertical and diagonal direction when the difference between two pixel values is less than or equal to 4. Also apply Region Splitting and Merging algorithm to segment the object from the given image considering $T \leq 5$. [1+2+5]

15	15	15	15	15	15	15
15	15	15	68	69	15	15
64	64	63	67	70	68	15
15	15	70	65	61	71	66
15	15	69	73	58	15	15
15	15	15	15	15	15	15
15	15	15	15	15	15	15

- b) How Image Restoration is different from Image Enhancement? Consider the following images Fig6(a) and Fig6(b). Fig6(a) represents an image with noise and Fig6(b) represents the histogram of that noisy image. Which noise effects the image? Explain how do you restore the image mentioning the name of the filter you will apply for it. [2+1+5]

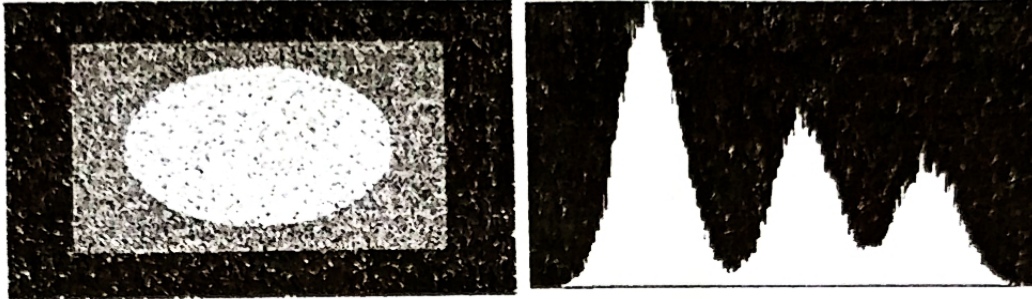


Fig6(a): Image with noise

Fig6(b): Histogram of image with noise

- c) Explain the HSI color model with appropriate example. What are the differences between additive and subtractive color? How does the combination of cyan, magenta, and yellow pigments create different colors? Explain with examples. [3+2+3]

Best of Luck!!!