

International Islamic University Chittagong

Dept. of Computer Science & Engineering (CSE)

B.Sc. in CSE, Mid-Term Examination, Autumn 2023

Course Code: CSE-4875 Title: Pattern Recognition and image processing

Total Marks: 30 Time: 1.5 hours

[Answer all **three** questions]

- 1(a) "Nowadays image processing based autonomous vehicle and quadcopter are widely used" – Explain the fields of image processing used in the statement. 2 CO2 DL C2
- 1(b) A grayscale image has pixel intensities ranging from 0 to 255. Design a piecewise-linear transformation function to achieve the following: 2 CO2 C2
- Enhance contrast in the middle intensity range (50-150).
 - Clip low-intensity values (0-49) to black (0).
 - Clip high-intensity values (151-255) to white (255).
- 1(c) "A digital image is a representation of a two-dimensional image as a finite set of digital values" – do you agree with the statement? Explain the answer with mathematical formula. 3 CO2 C2
- 1(d) In some devices CCD based cameras are used where other use CMOS based cameras" Justify the significance of the statement and write the benefit of using both. 3 CO1 C2
- Or,**
Write the similarity and difference between eyes and camera.
- 2(a) At histogram equalization, why transform function must be behaved strictly monotonically increasing? Explain with proper diagram. 2 CO1 C2
- 2(b) A 4 x4 bits/pixel original image is given by (given with 3 bits/pixel) 5 CO3 C3

3	7	8	9
13	11	12	10
12	13	12	9
14	12	11	12

- i. Apply histogram equalization to the image by rounding the resulting image pixels to integer.
 - ii. Sketch the histograms of the original image and the histogram-equalized image.
 - iii. "When automatic enhancement is desired, histogram specification is a good approach"- Do you agree? Why?
- 2(c) Analyze the effect of adding a constant value to a grayscale image on its overall brightness and contrast. How image addition is used in image averaging? 3 CO2 C2

Or,

If we convolve and correlation an image with the matrix given below, what would be the relation between the original and modified image?

•0	•0	•0
•0	•0	•1
•0	•0	•0

- 3(a) "Median filter technique is the best way to de-noise the image" – Justify the statement with your own word with proper example. 3 CO2 C2
- 3(b) Write a short note with your own word to explain how do human beings perceive color? Given a color image represented in terms of RGB components, how are the corresponding CMY and HIS coordinates derived? 3 CO1 C2
- 3(c) A 4 x4 original image is given with 3 bits/pixel. 4 CO3 C3

2	3	2	0
1	1	5	2
2	7	1	5
2	5	3	1

- Perform Laplacian operator on the image (Use padding, Use any Kernel)
- Analyze the differences of both images.

Or,

A 4 x4 original image is given with 3 bits/pixel.

2	3	1	0
0	5	4	2
2	6	6	3
1	2	3	1

- Perform Lowpass and High-pass filter on the image separately (Use padding)
- Analyze the statement " Lowpass + Highpass = Original image".

International Islamic University Chittagong

Dept. of Computer Science & Engineering (CSE)

B.Sc. in CSE, Mid-Term Examination, Spring 2023

Course Code: CSE 4875 Title: Pattern Recognition and image processing

Total Marks: 30 Time: 1.5 hours

CO DL

- 1(a) "One picture is worth more than ten thousand words" – Explain the fields of image processing used in the statement. 2 CO1 C2
- 1(b) Find the resolution of a 20" monitor working with 1024x768. 2 CO1 C2
- 1(c) Explain the mathematical model of an analog image. How can we convert an analog image to digital image? 3 CO1 C2
- 1 (d) "On Aug. 23, 2023, the Indian Space Research Organization's (ISRO) Chandrayaan-3 mission landed near the Moon's south pole, and a day later, the rover took a walk on the lunar surface." - Write the applications of image processing used in this expedition. 3 CO1 C2

Or,

Write the similarity and difference between eyes and camera.

- 2 (a) Justify the statement, "Applying Low-pass filter on an image result in a blurrier image". Explain with proper example. 2 CO1 C2

Or,

Justify the statement, "Blurring of images can significantly reduce noise". Explain with proper example.

- 2(b) A 5x5 bits/pixel original image is given by (4 bits/pixel) 5 CO2 C3

15	12	8	9	14
12	12	12	14	11
13	13	10	9	10
15	12	10	12	11
13	14	13	13	14

- Apply histogram equalization to the image by rounding the resulting image pixels to integer.
- Sketch the histograms of the original image and the histogram-equalized image.
- Why histogram equalization not produce a perfectly flat histogram?

- 2(c) A 4 x4 original image is given with 3 bits/pixel. 3 CO2 C3

2	3	3	1
0	7	1	2
2	6	6	3
0	2	4	1

- Perform Median filtering of the above image. (Use padding if necessary)
- "Performance of Median filtering is better than Averaging filtering" - Explain

- 3(a) What are the differences between spatial domain and frequency domain enhancement? 2 CO2 C3
- 3(b) Write a short note with your own word to explain how do human beings perceive color? Given a color image represented in terms of RGB components, how are the corresponding CMY and HIS coordinates derived? 3 CO1 C2
- 3(c) A 4 x4 original image is given with 3 bits/pixel. 5 CO2 C3

2	3	4	0
1	7	5	2
2	7	6	5
2	1	3	1

- Perform Prewitt and Sobel operator on the image (Use padding)
- Analyze the differences of both images.

Or,

A 4 x4 original image is given with 3 bits/pixel.

1	3	4	0
0	7	4	2
2	6	7	4
1	2	3	1

- Perform Lowpass and High-pass filter on the image separately (Use padding)
- Analyze the statement “ Lowpass + Highpass = Original image”.

International Islamic University Chittagong
 Department of Computer Science & Engineering
Mid Term Exam, Autumn-2022
 4th Year 1st Semester
CSE-4875, Pattern Recognition and Image Processing
 Total marks: 30 Time: 1 hours 30 minutes

[The figures in the right-hand margin indicate full marks, Course Outcomes and Bloom's Levels are mentioned in additional Columns]

Course Outcomes (COs) of the Questions	
CO1	Explain basic image processing techniques for solving real problems
CO2	Apply and demonstrate image processing techniques for solving problems in computer science
CO3	Evaluate algorithms for higher level image processing
CO4	Develop an application using existing image processing algorithms with modern techniques

Bloom's Levels of the Questions						
Letter Symbols	R	U	Ap	An	E	C
Meaning	Remember	Understand	Apply	Analyze	Evaluate	Create

[Answer the questions from the followings]

- | | CO | B/L | |
|--|-----|-----|----|
| 1. a) "Image processing is developed for improvement of pictorial information for human interpretation" - explain. | CO1 | U | 02 |
| b) Consider the two image subsets, S1 and S2 in the following figure. and assuming that $V = \{1\}$, determine whether these two subsets are: | CO2 | Ap | 02 |

S_1	S_2
0	0
1	0
1	0
0	0
0	0

Figure 1

1. 4-adjacent.
2. 8-adjacent.

- | | | | |
|--|-----|----|----|
| c) Briefly state the working principle of camera. Write the similarity and difference between the eye and camera. | CO1 | R | 04 |
| d) A common measure of transmission for digital data is the baud rate, defined as symbols (bits in our case) per second. As a minimum, transmission is accomplished in packets consisting of a start bit, a byte (8 bits) of information, and a stop bit. Using these facts, answer the following: | CO2 | Ap | 02 |

How many seconds would it take to transmit a sequence of 500 images of size 1024×1024 pixels with 256 intensity levels using a 3M-baud (106 bits/sec) baud modem? (This is a representative medium speed for a DSL (Digital Subscriber Line) residential line.

Or,

If a color image has 2160×3240 pixels with resolution 200 dpi. What will be the space taken by the image? What will be the size of the image?

- | | | | |
|---|-----|---|----|
| 2. a) Write the mathematical model of analog and digital image. | CO1 | R | 03 |
| b) Discuss the effects of reducing the spatial resolution of a digital image and effects of varying the number of intensity levels in a digital image. Give | CO1 | U | 03 |

necessary example.

- c) How gray level slicing enhance the image? Why monotonically increasing function is used in special operation? CO1 R 02

Or,

is Monochrome image more suitable for image segmentation then color image? Why?

- d) "In digital image processing high color image is presented by 12 bit where 24 bit image is presented by true color"- justify the statement. CO2 U 02

Or

In industrial applications for detecting missing components in product assembly which image processing can be used ?

3. a) Find all the bit planes of the following 4-bit image CO3 Ap 04

```

0  1  8  6
2  2  1  1
1 15 14 12
3  6  9 10
    
```

Or

Suppose that a 3-bit image ($L = 8$) of size 64×64 pixels ($MN = 4096$) has the intensity distribution in the figure 3, where the intensity levels are integers in the range $[0, L-1] = [0, 7]$. Now sketch the original histogram, transformation function and equalized histogram.

r_k	n_k
$r_0 = 0$	790
$r_1 = 1$	1023
$r_2 = 2$	850
$r_3 = 3$	656
$r_4 = 4$	329
$r_5 = 5$	245
$r_6 = 6$	122
$r_7 = 7$	81

Figure3 : intensity distribution of a 3-bit image

- b) "The performance of Median filtering is better than low pass filtering for removing noise" - Why? Calculate median filtering of the following image. (Use padding, 3-bit image ($L = 8$)) CO3 Ap 04



- c) Explain spatial filtering in image enhancement. Explain different types of thresholding operation in short. CO1 R 02

END

International Islamic University Chittagong

Dept. of Computer Science & Engineering (CSE)

B.Sc. in CSE, Semester Mid-Term Examination, Spring 2022

Course Code: CSE 4875 Title: Pattern Recognition and image processing

Total Marks: 30 Time: 1.5 hours

CO DL

- 1(a) "One picture is worth more than ten thousand words" – Explain the fields of image processing used in the statement. 2 CO1 C2
- 1(b) Why convolution/mask operation and correlation is used in the image processing? Explain the answer with proper example. 2 CO1 C2
- 1(c) The continuum from image processing to computer vision can be broken up into low-, mid- and high-level processes. Explain why we need to process images in low, mid and high level processing with proper example. 3 CO1 C2
- 1(d) "A digital image is a representation of a two-dimensional image as a finite set of digital values" – do you agree with the statement? Explain the answer with mathematical formula. 3 CO1 C2

- 2(a) Justify the statement, "Applying Low-pass filter on an image result in a blurrier image". 2 CO1 C2

- 2(b) A 5x5 bits/pixel original image is given by (4 bits/pixel) 5 CO2 C3

15	12	8	9	14
12	12	12	14	11
13	13	10	9	10
15	12	10	12	11
13	14	13	13	14

- Apply histogram equalization to the image by rounding the resulting image pixels to integer.
- Sketch the histograms of the original image and the histogram-equalized image.
- Why histogram equalization not produce a perfectly flat histogram?

Or,

Find the optimal threshold of the following image using Otsu method.

0	1	4	0
0	2	1	2
2	1	4	4
0	2	3	1

- 2(c) A 4 x4 original image is given with 3 bits/pixel. 3 CO2 C3

2	3	3	1
0	7	1	2
2	6	6	3
0	2	4	1

- i. Perform Median filtering of the above image. (Use padding if necessary)
- ii. "Performance of Median filtering is better than Averaging filtering" - Explain

- 3(a) When automatic enhancement is desired, equalization is a good approach. Explain with example in which approach Histogram specification performs better. Justify your answer with the image provided in 2(b). 2 CO2 C3
- 3(b) Write a short note with your own word to explain how do human beings perceive color? Given a color image represented in terms of RGB components, how are the corresponding CMY and HIS coordinates derived? 3 CO1 C2
- 3(c) A 4 x4 original image is given with 3 bits/pixel. 5 CO2 C3

2	3	4	0
1	7	5	2
2	7	6	5
2	1	3	1

- i) Perform Prewitt and Sobel operator on the image (Use padding)
- ii) Analyze the differences of both images.

Or,

A 4 x4 original image is given with 3 bits/pixel.

1	3	4	0
0	7	4	2
2	6	7	4
1	2	3	1

- i) Perform Lowpass and High-pass filter on the image separately (Use padding)
- ii) Analyze the statement "Lowpass + Highpass = Original image".