

MILITARY COLLEGE OF SIGNALS
MIDTERM EXAM
BESE 13, 14A & 14B
EE 481 Digital Image Processing

Instructor: A/P Dr. Imran Siddiqi

Time: 90 Minutes

Max Marks: 30

Note: This question paper comprises **3** pages.

(3+1+1)

1. You need to send your **16-digit** credit card number to your agent through email. Since writing the card number in textual form may not be secure, you decide to hide this number in **4x4** grayscale (**8-bit**) image.
- List the steps (or show a block diagram) that you will follow to perform this operation.
 - Assuming that the value of the first pixel in the image is **255**, what would be the value of this pixel if you hide a value of **4** in it.
 - What operation your agent will need to perform to extract the credit card number?

(5+3)

2. a. Using 4-connectivity, perform Connected Component (CC) labeling on the following binary image and show:
- The result after first pass of the CC labeling algorithm
 - The equivalence table
 - The final result after the second pass of the labeling algorithm

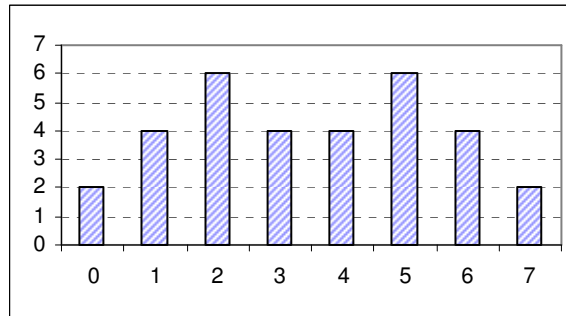
0	0	0	0	0	0	0	0
0	0	0	0	1	1	0	0
0	0	1	1	1	1	0	0
0	1	1	0	0	1	0	0
0	0	0	0	0	0	0	0
0	0	0	1	1	1	0	0
0	0	0	0	0	1	1	0
0	0	1	1	1	1	0	0

- b. Give short answers to the following:
- Recognizing individual alphabets in an example of clustering or classification?
 - Which of these is a linear operator: *Max*, *Add*
 - For a **4-bit** image of size **MxM** and histogram **h**, what does the following expression give:

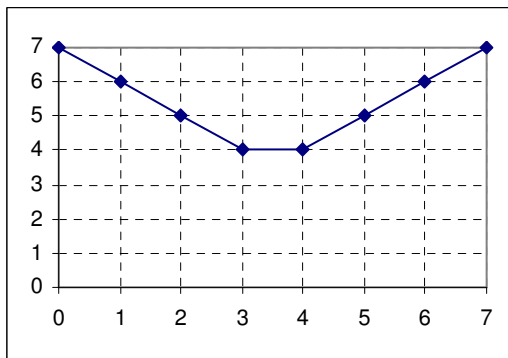
$$\sqrt{\sum_{k=0}^{15} h(k)}$$

(3+3)

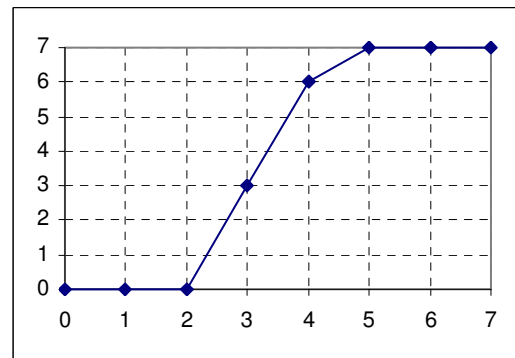
3. a. The histogram of a **3-bit** image is shown in the following:



What would be the histograms of the output image if the following transformations are applied to this image?

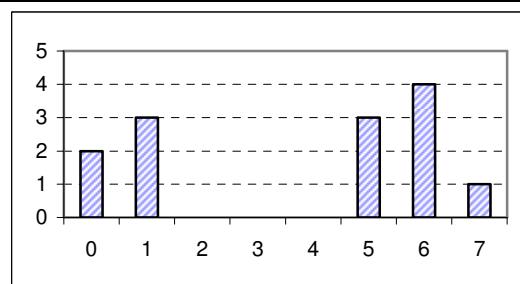


T1

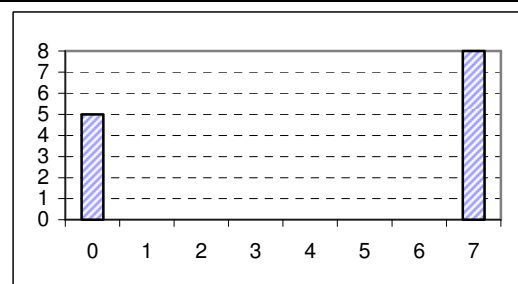


T2

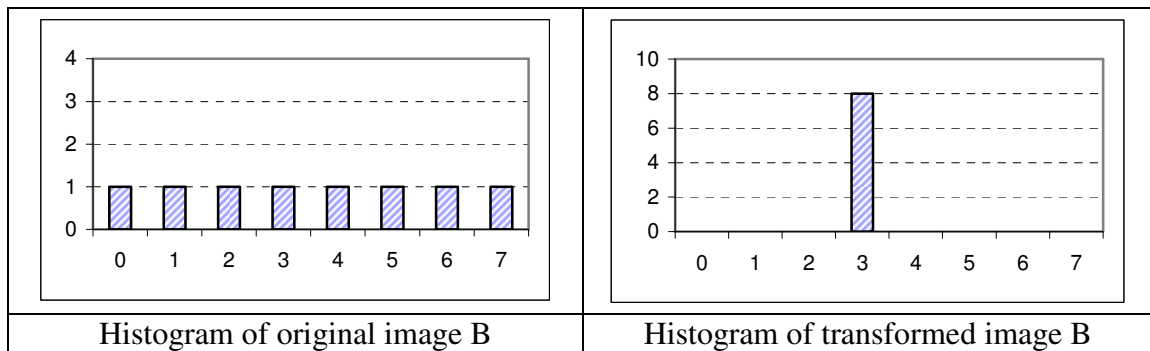
- b. In the following are shown the histograms of two **3-bit** images **A** and **B** in the left column. Transformation **T1** is applied to image **A** and **T2** to image **B** and the histograms of the output images are shown in the right column. Show the transformation functions (graphs) **T1** and **T2**. (Since the solution is NOT unique, you may show any of the possible transformations)



Histogram of original image A



Histogram of transformed image A



(5+4+2)

4. a. Perform histogram equalization on the following **8-bit** image and show the histogram of the resulting image.

10	20	50	100	200
10	20	50	100	200
10	20	50	100	200
10	20	50	100	200
10	20	50	100	200

- b. The cumulative histograms (cdf) of two **3-bit** images are shown below. Illustrate the histograms of these images.

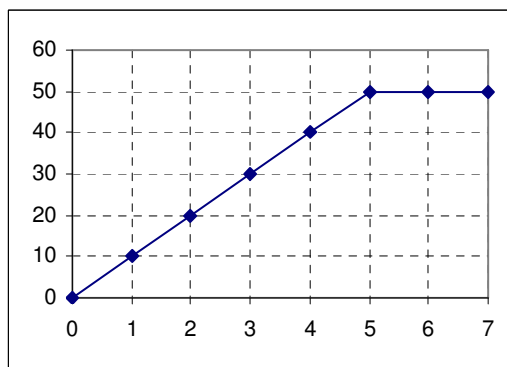


Image A

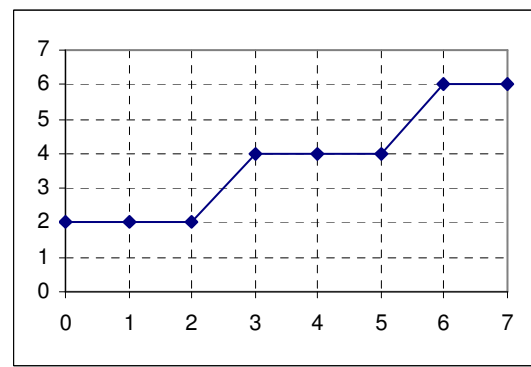


Image B

- c. Show the convolution masks/filters to implement the following:

i. $2f(x,y) - f(x+1,y+1) - f(x-1,y-1)$

ii. $f(x-2,y-2) + f(x+2,y+2) - 2f(x,y)$

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