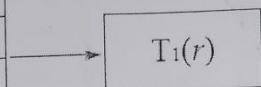


*Answer the following:*

- (a) A  $4 \times 4$ , 4bits/pixel image (shown below) passes through one point-wise intensity transformations given by

$$s = T_1(r) = \text{round}(5\sqrt{r})$$

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



?	?	?	?
?	?	?	?
?	?	?	?
?	?	?	?

- (b) A  $4 \times 4$ , 4bits/pixel original image is given by

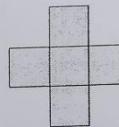
Apply full-scale contrast stretch to the image. Show your work and sketch the resulting image.

6	13	12	13
12	6	7	12
13	7	7	12
14	11	11	14

- (c) For the previous image in (b), apply histogram equalization to the image. Show your work and sketch the resulting image

- (d) A  $4 \times 4$  image is given by

Filter the image using a Median filter (after replicate-padding), where the filter mask is given by



0	0	0	0	0
9	8	7	6	0
8	7	13	5	0
0	7	6	5	4
0	6	1	4	3

07189

< GOOD LUCK >

678813  
06678

557713

03455

045613  
01466

00567  
445613

07789  
01345

067813

00344



**Benha University**

**1<sup>st</sup> Term (January 2015) Final Exam**  
**Class: 4<sup>th</sup> Year Students**  
**Subject: Image Processing**



**Faculty of Computers & Informatics**  
**Date: 10/1/2015**  
**Time: 3 Hours**  
**Examiner: Assoc. Prof.: Mazen Selim**

**Answer the following questions:**

**Question (1)**

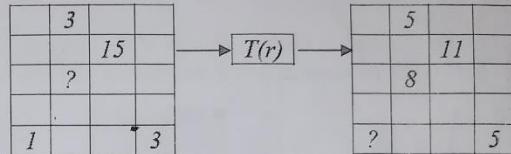
A  $4 \times 4$ , 4bits/pixel image passes through a point-wise intensity transformation given by

$$S = T(r) = a \log_2(1+r) + \beta$$

Where  $a$  and  $\beta$  are unknown parameters. Only a few pixels are available in the input and output images, as shown below.

- (a) Find  $a$  and  $\beta$ .
- (b) What's the value of the pixel with the "?" mark in the output image.
- (c) What's the value of the pixel with the "?" mark in the input image.

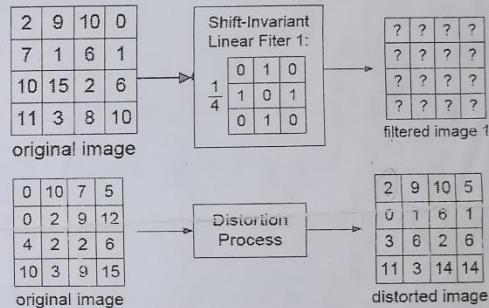
**(7 Marks) (3+2+2)**



**Question (2)**

- a) Using the figure to the right, find the filtered image using zero padding of the original image
- b) Explain with the aid of figure the most common types of image transformation functions?
- c) A  $4 \times 4$  Image, 4bits/pixel original image passes through a distortion process, resulting in a distorted image, as shown to right. Compute the mean absolute error (MAE), the mean squared error (MSE) and the (PSNR) between the original and the distorted images.

**(10 Marks) (3+3+4)**



**Question (3)**

**(13 Marks) (7+3+3)**

- a) Assume that an image of  $32 \times 32$  with 5-bit gray levels distributed as follow

Gray level	21	22	23	24	25	26	27	29	31
no. of pixels	74	50	100	250	150	280	30	50	40

- 1) Discuss using equations how to equalize an image, then find the Equalized Histogram.
- 2) Find the average (mean) Intensity and the variance in terms of gray levels probabilities.
- 3) Redistribute the image intensities in question according to a 6 bits/gray

Page 1 of 2

$$\begin{array}{ll} Y=0 & Y=0 \\ (0,0) & Y=1 \\ (0,1) & Y=2 \\ (0,2) & Y=3 \\ (0,3) & \end{array}$$

2-3

$y=0 \quad y=1$

1.2

Question (4)

(15 Marks) (3+3+2+5+2)

Based on the image information in question(3-a), perform the following :

- 1) Explain the types of data redundancies, give an examples?
- 2) Explain in details how to measure the image information?
- 3) Compute the entropy of the image:
- 4) Compress the image using Huffman coding.
- 5) Compute the compression achieved and the effectiveness of the Huffman coding

Question (5)

(10 Marks) (3+4+3)

a) Explain how to use the basic global threshold to partition an image which has a histogram like that in figure(1),

b) Write a matlab code to represent the method explained in part (a).

→ c) Predict the outputs using the following correlation filters for the image in fig.(2)

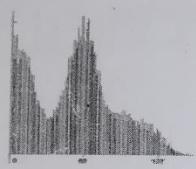


fig.(1)



fig.(2)

0	0	0
0	1	0
0	0	0

0	0	0
0	0	1
0	0	0

0	0	0
1	0	0
0	0	0

Question (6)

(10 Marks) (4+3+3)

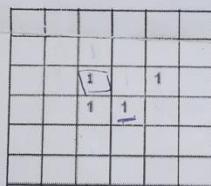
→ d) Explain in details how to use the laplacian for image sharpening?

e) Given the structure element S and an Image B, find the dilated image ?

f) Using the same structure element S with image C , find the eroded image ?

1		
1		1
1		

S



B

1	1	1	1	1
1	1	1	1	1
1	1	1	1	1
1	1	1	1	1

C

GOOD LUCK



End-of-Term Exam Jan 2009

Answer the following questions:-

[1] Assume that an image of 32x32 with 32 gray levels distributed as follow (20 Marks)

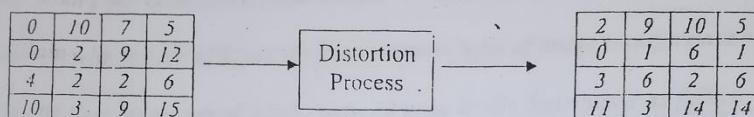
Gray level	22	23	24	25	26	27	28	29	30	31
no. of pixels	124	100	250	150	280	30	50	40		

- a. Draw the histogram, which type of images does we have?

- b. If the image is not normally distributed, draw the required transformation function.

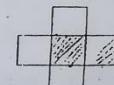
- c. Suggest a code to represent the gray levels other than the natural binary code, and then find the compression ration.

[2] A 4x4, 4bits/pixel original image passes through a distortion process, resulting in a distorted image as shown below (20 Marks)

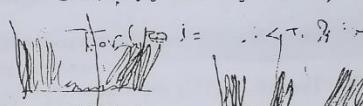


- a. Compute the MSE, and PSNR between the original and the distorted images.

- b. Filter the image using a minimum filter (after replicate padding) using the filter mask as the figure to right. (only filter the first raw)



[3] For the given image to the right: (20 Marks)



(20 Marks)

- a. What the histogram for this image would like?

- b. If we want to segment that image, explain with drawing what would happen if we used a single threshold value?

- c. Write a matlab function to isolate the contents of the bottles, suggest a method to find out the required gray levels for isolation.



[4] The Laplacian operator is given by  $\nabla^2 f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2}$  show that (20 Marks)

- a. How it can be used to highlights gray-level discontinuities, and then deduces the mask elements for such an operation.

- b. Improve the obtained mask such that it yield isotropic results for 45°.

- c. how it can be used to enhance an image.

[5] a. Explain with the aid of figures, the different models of noise that degrade an image? (20 Marks)

- b. Show that how can an image be filtered in the frequency domain, and then explain how to smooth an image.

< Best Wishes >

End-of-Term Exam Jan 2008

Attempt all the questions:-

- 1] (i) Explain in a short statements the different stages in digital image processing?  
 (ii) A  $4 \times 4$ , 4 bits/pixel image passes through a point-wise intensity transformation given by

$S = T(r) = \alpha \log_2(1+r) + \beta$   
 Where  $\alpha$  and  $\beta$  are unknown parameters.  
 Only a few pixels are available in the input and output images, as shown below.

(a) Find  $\alpha$  and  $\beta$ .

(b) What's the value of the pixel with the "?" mark in the output image?

(c) What's the value of the pixel with the "?" mark in the input image?

	3		
		15	
	?		
7		3	

 $\rightarrow T(r) \rightarrow$ 

	5		
		11	
	8		
?		5	

- 2] (i) Explain with the aid of figure the most common types of image transformation functions?

(ii) Assume that an image of  $32 \times 32$  with 32 gray levels distributed as follow

Gray level	21	22	23	24	25	26	27	28	31
no. of pixels	74	50	100	250	150	280	30	50	40

(a) Draw the histogram, which type of images does we have?

(b) If we want to improve our Image, draw the required transformation functions.

- 3] (i) Show that subtracting the Laplacian from an image is proportional to unsharp masking. Use the definition for the Laplacian given below

$$\nabla^2 f = [f(x+1,y) + f(x-1,y) + f(x,y+1) + f(x,y-1) - 4f(x,y)]$$

- (ii) Draw an approximate histogram for each of the two figures to the right. Based on the histogram, show how these figures can be segmented using the threshold method and how the threshold ( $T$ ) can be obtained for each case?



$$T = \frac{M_1 + M_2}{2}$$

- (i) Explain with the aid of figures, the different models of noise that degrade an image?  
 (ii) Different forms of spatial filters can be used to remove noise from a degraded image, write only the filter name, equation, and the type of noise it removes?

noise pepper

noise salt

med. salt & pepper  
<Good Luck>

rand pair uniform

random Gaussian

air

$$f'(x,y) = \sum_{m,n} g(m,n) \cdot \text{gaussian}$$

gauss

$$f'(x,y) = \left\{ T(g(m,n)) \right\}_{m,n} \text{ gauss star}$$

gauss star

Gaussian

$$f'(x,y) = \frac{m}{\sqrt{n}} \text{ salt}$$

salt

spur noise

$$f'(x,y) = \frac{\sum g(m,n)}{n^{0.5}} \text{ Pepper salt}$$

pepper

salt



End-of-Term Exam Jan 2011

Answer the following questions:-

Question (1)

$2^8 = 256$        $2^8 = 256$        $L = 256$  (28 Marks)

Assume that an image of  $32 \times 32$  with 8 bit gray levels distributed as follow

Gray level	3	5	6	8	10	12	13	15
no. of pixels	124	50	100	245	150	275	30	50

- Draw the histogram, which type of images does we have?
- Draw the transformation function  $T(r)$ , and then draw the equalized histogram
- Write a computer program for computing the histogram of an image using mat-lab.
- Rescaling the image such that the intensity values will be in the range (0-60).

Question (2)

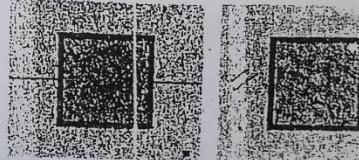
- a) A  $4 \times 4$ , 4bits/pixel image passes through a point-wise intensity transformation given by
- $$S = T(r) = \alpha \log_2(1+r) + \beta$$
- Find  $\alpha$  and  $\beta$ . What's the value of the pixel with the "?" mark in the input & output image.
- b) Show that subtracting the Laplacian from an image is proportional to unsharp masking.

Question (3)

- a) What are the three basic redundancies that can be identified in digital images?
- b) Based on question (1) Deduce the Huffman code for such an image, and then find the compression ratio.
- c) A Sobel operator uses two masks,  $H_x$  and  $H_y$  to process an image. Explain why are two masks needed and what do they measure? What mathematical operation on an image array is approximated by the Sobel operator?

Question (4)

- In the figures shown, when the image on the left was filtered using a smoothing filter, the result was the image on the right. The filter used was one of these: 1. averaging filter; 2. Ideal lowpass filter; 3. Gaussian lowpass filter; 4. median filter. The small black square on the lower right hand corner of the original image shows the size of the mask that was used. That small square is not part of the image.
- Explain with the aid of figures, the different models of noise that degrade an image?
- Show that how can an image be filtered in the frequency domain, and then explain how to smooth an image.



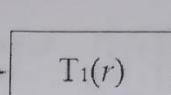
< Best Wishes >

*Answer the following:*

- (a) A  $4 \times 4$ , 4bits/pixel image (shown below) passes through one point-wise intensity transformations given by

$$s = T_1(r) = \text{round}(5\sqrt{r})$$

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



?	?	?	?
?	?	?	?
?	?	?	?
?	?	?	?

- (b) A  $4 \times 4$ , 4bits/pixel original image is given by

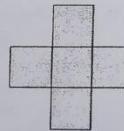
Apply full-scale contrast stretch to the image. Show your work and sketch the resulting image.

6	13	12	13
12	6	7	12
13	7	7	12
14	11	11	14

- (c) For the previous image in (b), apply histogram equalization to the image. Show your work and sketch the resulting image

- (d) A  $4 \times 4$  image is given by

Filter the image using a Median filter (after replicate-padding), where the filter mask is given by



0	1	0	0	0
9	8	7	6	0
8	7	13	5	0
7	6	5	4	0
6	1	4	3	0

07789

678813

< GOOD LUCK >

045613

01466

01345

06678

067813

00567 445613

55778

03452

00344



Benha University

1<sup>st</sup> Term (November 2012) Mid-Term Exam  
Class: 4<sup>th</sup> Year Students  
Subject: Image Processing

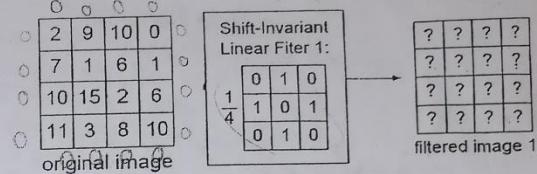


Faculty of Computers & Informatics  
Date: 12/11/2012  
Time: 60Minutes  
Examiner: Dr. Mazen Selim

Answer the following questions:

(1)

- (a) Using the figure to the right, find the filtered image using zero padding of the original image (3 Marks)



- (b) Write a MatLab function called "ImageAdjust" that accepts an input image and returns an enhancement image, using the following linear level adjustment formula:

$$Padjus(m,n) = Bottom + (P(m,n)-L)/(H-L)*(Top-Bottom) \text{ Where}$$

P(m,n) original image pixel

Padjus(m,n) desired image pixel

H maximum pixel level in the original image

L minimum pixel level in the original image

Top maximum pixel level in the image desired

Bottom minimum pixel level in the desired image

Check the class of the input image in your code, to determine the correct values for Bottom and Top.

Use low level processing.

The output image must be in uint8 class.

(8 Marks)

- (2) Assume that an image of 32x32 with 32 gray levels distributed as follow (2+5+7)

Gray level	12	14	15	16	18	19	20	21	22
no. of pixels	74	50	100	250	150	280	30	50	40

For the image represented in the previous table

- Draw the image histogram
- Find the average(mean) intensity and the standard deviation
- Find the equalized histogram

$$\sum_{i=1}^{n-1} r_i p_{ri} \quad M = \bar{r}_i = \frac{\sum_{i=1}^n r_i}{n}$$

< Good Luck >





Benha University

1<sup>st</sup> Term (January 2013) Final Exam  
Class: 4<sup>th</sup> Year Students  
Subject: Image Processing



Faculty of Computers & Informatics  
Date: 9/1/2013  
Time: 3 Hours  
Examiner: Dr. Mazen Selim

Answer the following questions:

Question (1)

(15 Marks) (5+10)

(a) Write a MatLab function called "ImageAdjust" that accepts an input image and returns an enhancement image, using the following linear level adjustment formula:

$$Padjust(m,n) = Bottom + (P(m,n)-L)/(H-L) * (Top-Bottom) \text{ Where}$$

P(m,n) original image pixel

Padjust(m,n) desired image pixel

H maximum pixel level in the original image

L minimum pixel level in the original image

Top maximum pixel level in the image desired

Bottom minimum pixel level in the desired image

Check the class of the input image in your code, to determine the correct values for Bottom and Top.

The output image must be in uint8 class.

(b) Assume that an image of 32x32 with 32 gray levels distributed as follow

Gray level	12	14	15	16	18	19	20	21	22
no. of pixels	74	50	100	250	150	280	30	50	40

For the image represented in the previous table

(i) Draw the image histogram

(ii) Find the average(mean) intensity and the standard deviation

(iii) Find the equalized histogram

(iv) Find the specified histogram according the following values?

Zq	4	6	8	10	12	16	18	20	22
Specified Pz(zq)	0.05	0.1	0.1	0.15	.2	0.15	0.1	0.1	0.05

Question (2)

(16 Marks) (4+12)

a) Explain the types of data redundancies, give an examples?

b) Consider the simple 4X7, 8-bit image:

a. Compute the entropy of the image:

b. Compress the image using Huffman coding

c. Compute the compression achieved and the effectiveness of the Huffman coding

d. Redistribute the image intensities according to 7 bits/gray

Sample	
22	22
22	22
22	22
25	25

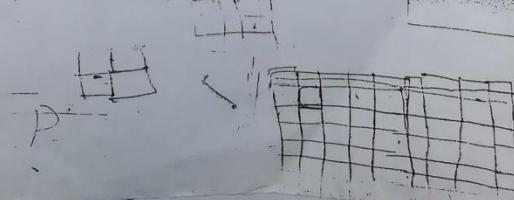
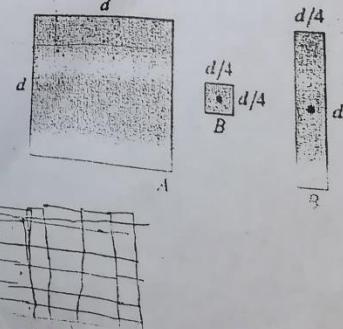
CODE  
interpixel  
psychovisual  
psyg  
psychic

Question (3)

(12 Marks) (4+8)

a) Explain with the aid of figure the most common types of image transformation functions?

b) Define the erosion and dilation processes in terms of set theory, give an equation. For the figures shown to the right, find the result of eroding and dialating of A by B



Question (4)

a) A  $4 \times 4$  Image is given by figure (i). Filter the image using a Median filter (after replicate-padding), where the filters mask is given as in figure (ii).

(22 Marks)(6+6+10)

b) Describe an algorithm to locate all of the large boxes in the image below in figure (iii).

c) Explain how can the laplacian be used for image sharpening and then write an algorithm in MatLab code to represent the process

$$\nabla^2 f = \frac{\partial^2 f}{\partial x^2} + \frac{\partial^2 f}{\partial y^2}$$

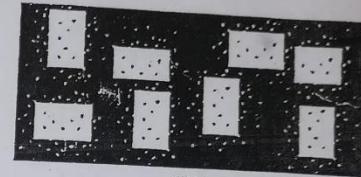
mean

9	8	7	6
9	8	7	6
8	7	13	5
7	6	5	4
6	1	4	3
6	1	4	3
6	1	4	3

(i)



(ii)



(iii)

function

15677

77989

455613

88999

median

677813  
678813  
56667

9	9	9	7	6	6
9	9	8	7	13	5
8	8	7	13	5	5

788889999

8

GOOD LUCK

$$\begin{array}{r}
 22 - 0.29 \\
 245 - 0.14 \\
 \hline
 98 - 0.14 \\
 25 - 0.14 \\
 \hline
 99 - 0.11 \\
 50 - 0.11 \\
 253 - 0.07
 \end{array}$$



Benha University  
1<sup>st</sup> Term (December 2017) Final Exam  
Class: 4th Year Students  
Department: Computer Science  
Subject: Image Processing



Faculty of Computers & Informatics  
Date: 27/12/2017  
Time: 3 Hours  
Examiner: Assoc. Prof. Mazen Selim

Answer the following questions:

Question (1) please make a table of two columns, one for the question no. and the other for your selection (10 Marks)

- 1) Example of discontinuity approach in image segmentation is  
a) edge based      b) boundary based      c) region based      d) Both A and B
- 2) Sobel is better than prewitt in image  
a) sharpening      b) blurring      c) smoothing      d) contrast
- 3) For line detection we use mask that is  
a) Gaussian      b) Laplacian      c) ideal      d) butterworth
- 4) Replication of pixels is called  
a) coding redundancy      spatial redundancy      c) temporal redundancy      d) both b and c
- 5)  $(A \otimes B) \circ B$  is equal to  
a)  $A \cdot B$       b)  $A + B$       c)  $A \circ B$       d)  $A \times B$
- 6) Smoothing filters are mostly used in  
a) blurring      b) noise reduction      c) contrast      d) Both A and B
- 7) Equation that describes hue is  
a)  $H=H-90$       b)  $H=H-100$       c)  $H=H-120$       d)  $H=H-180$
- 8) In expression  $s = Tr$ ,  $Tr$ , in range  $0 \leq r \leq L-1$  is the  
a) monotonically increasing      b) monotonically decreasing      c) linearly increasing      d) linearly decreasing
- 9) Probability density functions are always  
a) decreasing      b) increasing      c) positive      d) negative
- 10) In bit plane slicing most of information of an image is contained by  
a) highest order plane      b) lowest order plane      c) mid order plane      d) all planes

(10 Marks : 3 + 4 + 3)

Question (2)

- a) Explain with graphs the most common intensity transformation functions?
- b) Write a Matlab script code to Read an image "pout.tif" (256 gray levels). Calculate and plot the Cumulative Distribution Function for the image 'pout.tif'. Add labels, text and title for your plot.
- c) Let  $f = [1, 3, -1, 2, 0, -3]$  and  $h = [-1, 3, -2]$ . Calculate the convolution  $f * h$  assuming zero padding.

**(15 Marks 9+3+3 )**

**Ben**

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**Question (3)**

- a) For the histogram given in fig.(A), it's desired to transform this histogram so that it will have the values specified in histogram given in fig(B)
- b) Calculate the entropy of the source Image
- c) Sketch an appropriate transformation function for image in fig.(C) that will likely improve its contrast.
- The resulting image pixel value should have a range of 0-255.

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

Fig. A

0	0	0	0	3
0	0	0	3	3
0	0	3	3	0
0	3	3	0	0
3	3	0	0	0

Fig. B

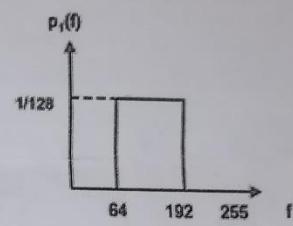


Fig. C

**Question (4)**

**(14 Marks 6+8)**

- a) The Gradient was used as an edge detector,
- i. Give a short note about the gradient and its properties,
  - ii. show how it can be used to determine the edge direction
  - iii. state the different types using a mask of  $2 \times 2$  and  $3 \times 3$ ,
- b) The arithmetic decoding process is the reverse of the encoding procedure.  
Decode the message 0.23355 given the coding model as in figure

Symbol	Probability
a	0.2
e	0.3
i	0.1
o	0.2
u	0.1
!	0.1

**(16 Marks 4+8+4)**

**Question (5)**

- a) A hole is defined as a background region surrounded by a connected border of foreground pixels. Deduce an algorithm for filling holes in an image.?
- b) State the equations which represent the opening and closing of a set A by a SE B, then find the Closing and Opening of the binary image, F, in Fig. (a) by the structuring element H in Fig. (b). Show any intermediate work. Comment on the effect of closing and grayscale opening.
- c) Give a short notes about HSI coloring model, show the relation between the HSI and RGB coloring model?

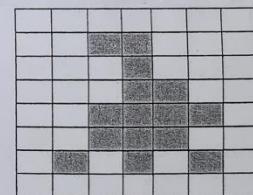


Fig. a



Fig. b

**GOOD LUCK**



**Benha University**

**1st Term (January 2016) Final Exam**  
**Class: 1<sup>st</sup> Term Post Graduates students**  
**Subject: Image Processing**



**Faculty of Computers & Informatics**

**Date: 11/1/2016**  
**Time: 3 Hours**  
**Examiner: Assoc. Prof. Mazen Selim**

**Answer the following questions:**

**Question (1) please make a table of two columns, one for the question no. and the other for your selection (10 Marks)**

- 1) The process of moving a filter mask over the image and computing the sum of products at each location is defined by \_\_\_\_\_
  - a) Convolution
  - b) Rotation
  - c) Linearity
  - d) Correlation
  - e) None of the above
- 2) The sum of all components of a normalised histogram is equal to \_\_\_\_\_
  - a) Size of the image
  - b) Size of rows of the image
  - c) Size of columns of the image
  - d) One
  - e) MxN
- 3) Image restoration usually uses a model that is based on \_\_\_\_\_
  - a) Additive noise
  - b) Multiplicative noise
  - c) Division noise
  - d) Subtractive noise
  - e) None of the above
- 4) Convolution is usually used in the \_\_\_\_\_ domain.
  - a) Frequency
  - b) Spatial
  - c) Feature
  - d) Featureless
  - e) None of the above
- 5) Fourier transform is a \_\_\_\_\_ transform
  - a) Linear
  - b) Nonlinear
  - c) Bilinear
  - d) Bicubic
  - e) None of the above
- 6) Ideal filters can be \_\_\_\_\_
  - a) LPF
  - b) HPF
  - c) BPF
  - d) All of the above
  - e) None of the above
- 7) The Rayleigh density can be used to approximate \_\_\_\_\_
  - a) Ideal histograms
  - b) Non-Ideal histograms
  - c) Butterworth histograms
  - d) Gaussian histograms
  - e) Skewed histograms
- 8) Which of the following filters is effective in the presence of salt-and-pepper noise?
  - a) Average filter
  - b) Median filter
  - c) Sobel filter
  - d) Robert filter
  - e) All of the above
- 9) \_\_\_\_\_ is the process of using known data to estimate values at unknown locations.
  - a) Decimation
  - b) Interpolation
  - c) Formulation
  - d) All of the above
  - e) None of the above
- 10) An image element is usually called a \_\_\_\_\_
  - a) Pixel
  - b)  $f(x,y)$
  - c) picture point
  - d) All of the above
  - e) None of the above

**Question (2)**

**(10 Marks)**

- a) For the image shown in Fig.(1), find a transformation function (i.e. a look-up-table) that will change its histogram to match the one shown in Table 1. Draw the transformed image. Also determine the histogram of the transformed image. Assume that the processed images can only take integer values between 0 and 7 (including 0 and 7).
- b) Briefly explain the operation of the Alpha-trimmed mean filter. What are its uses for image processing?

**Question (3)**

**(10 Marks)**

- a) List the major steps needed for performing edge detection of an image by thresholding the gradient magnitude computed using **Sobel operator**. For simplicity, assuming the threshold value is given in advance, denoted by T.
- b) Deduce the enhanced sharpened Image filter using the Laplacian Method..

**Question (4)**

(10 Marks)

- a) Explain the differences between regular and adaptive thresholding. Give examples of when each type should be used.
- b) Given an input image of size  $7 \times 7$  shown below, was filtered using  $3 \times 3$  adaptive median filter with maximum allowed size of  $5 \times 5$ . What are the values of the pixels  $x$ ,  $y$ , and  $z$  in the output image?

3	3	4	3	3	3	0
3	0	0	0	0	0	3
3	4	0	0	4	4	3
4	5	7	7	0	0	3
3	3	6	0	0	7	0
3	0	4	3	3	5	3
3	4	3	3	0	0	4

Fig.(a)

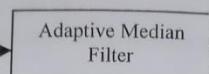



Fig.(b)

**Question (5)**

(10 Marks)

- a) Explain with examples the type of data redundancies?
- b) You have a source with 6 symbols  $\{a_1, a_2, a_3, a_4, a_5, a_6\}$ . The probability for each symbol is  $p = [0.15, 0.25, 0.05, 0.05, 0.4, 0.1]$ .
1. Calculate the entropy of the source.
  2. Create a Huffman code for the source.
  3. Calculate the average word length of the source.
  4. Calculate the coding efficiency for the Huffman code.

**Question(6)**

(10 Marks)

- a) Find the opening of the binary image,  $F$ , in Fig. (2-a) by the structuring element  $H$  in Fig. (2-b).
- b) An image is given as in Fig.(3), use iterative quadtree split-and-merge algorithm to segment the image. Give the result after each step (split or merge) in each iteration.

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

Fig.(1)

Table 1: Desired histogram

Gray level $f$	0	1	2	3	4	5	6	7
Histogram $h(f)$	8	6	4	2	2	1	1	1

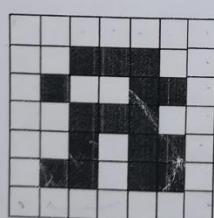


Fig. (2-a)

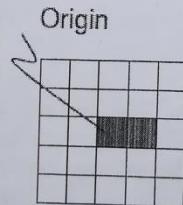


Fig.(2-b)

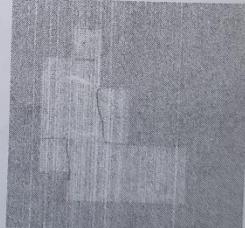


Fig. (3)

GOOD LUCK

**Answer the following questions:****Question (1)** please make a table of two columns, one for the question no. and the other for your selection (10 Marks)

- 1) The process of moving a filter mask over the image and computing the sum of products at each location is defined by  
a) Convolution b) Rotation c) Linearity d) Correlation e) None of the above
- 2) The sum of all components of a normalised histogram is equal to  
a) Size of the image b) Size of rows of the image c) Size of columns of the image d) One e)  $M \times N$
- 3) Image restoration usually uses a model that is based on  
a) Additive noise b) Multiplicative noise c) Division noise d) Subtractive noise  
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— nuclear — geometric  
— harmonic — median  
— median —

**Question (4)**

(10 Marks)

- a) Explain the differences between regular and adaptive thresholding. Give examples of when each type should be used.
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3	3	4	3	3	3	0
3	0	0	0	0	0	3
3	4	0	0	4	4	3
4	5	7	7	0	0	3
3	3	6	0	7	0	
3	0	4	3	3	5	3
3	4	3	3	0	0	4

Fig.(a)

Adaptive Median Filter


Fig.(b)

(10 Marks)

**Question (5)**

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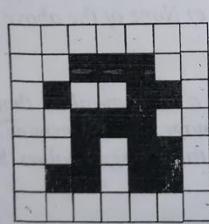


Fig. (2-a)

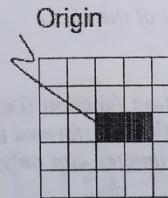


Fig.(2-b)

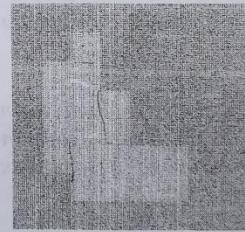


Fig. (3)

GOOD LUCK

Answer the following Questions

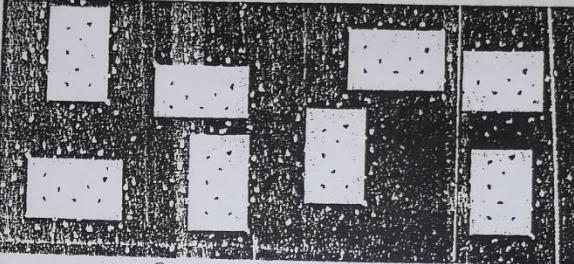
[1] Assume that an image of  $32 \times 32$  with 32 gray levels distributed as follow

Gray level	22	23	24	25	26	27	29	31
no. of pixels	124	100	250	150	280	30	50	40

- a. Draw the histogram, which type of images does we have?
- b. If the image is not normally distributed, draw the required transformation function.

[2] Describe an algorithm to locate all of the large boxes in the image below.

- 1. convert to binary
- 2. use median filter to remove noise

A noisy grayscale image containing several white rectangular boxes of varying sizes.

Detect start point and end point of each box

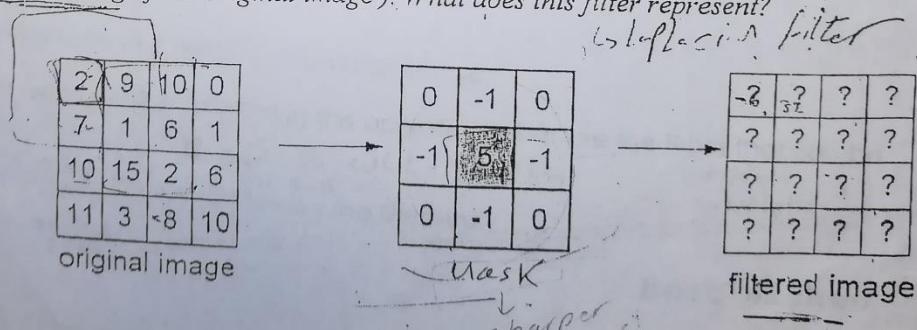
[3] A  $4 \times 4$ , 5 bits/pixel original image is given by

Apply full-scale contrast stretch to the image. Show your work and sketch the resulting image.

$$\text{Pixel} = \frac{\text{Pixel} - \text{min}}{\text{max} - \text{min}} * 255$$

6	13	12	13
12	6	7	12
13	7	7	12
14	11	11	14

[4] A  $4 \times 4$  gray-scale original image passes through a spatial linear shift-invariant filter, resulting in a filtered image. Find the filtered image (Use zero-padding of the original image). What does this filter represent?



mean — arithmetic

Mid Term ExamQ1

a/ Resolution: How much is enough?

Discuss this statement regarding the 2 pictures to the right?

b- Define image enhancement process?

State the reasons for using such a process.

Q2

Assume that an image of 32x32 with 32 gray levels distributed as follow

Gray level	12	13	14	15	16	17	18	19	20	$= 1024$
no. of pixels	74	50	100	250	150	280	30	50	40	

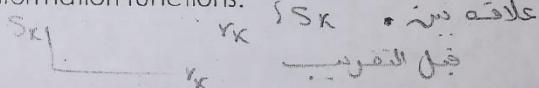
for this reason  
draw Tr. function

a. Draw the histogram, which type of images does we have? low contrast

b. If we want to improve our image, Explain with equations the required process, and draw the required transformation functions.

Q3

Linear Spatial filters are used to smooth an image:



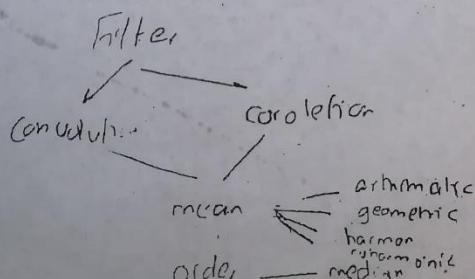
a- Write an equation expressing this operation, what are the types that can be used

$$\text{Average} \quad R = \sum_{b=0}^B \sum_{k=0}^K w(b, k) v(b, k) \quad \begin{matrix} \text{Convolution} \\ \text{Correlation} \end{matrix}$$

b- Explain the effect of increasing the filter size.

filtering

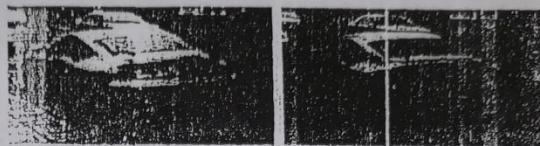
Best wishes



Mid Term ExamQ1

a/ Resolution: How much is enough?

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State the reasons for using such a process.

Q2

Assume that an image of 32x32 with 32 gray levels distributed as follow

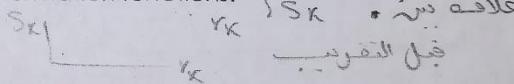
Gray level	12	13	14	15	16	17	18	19	20	$= 10^{24}$
no. of pixels	74	50	100	250	150	280	30	50	40	<i>Draw Histogram Draw Transformation Functions</i>

c. Draw the histogram, which type of images does we have? low contrast

d. If we want to improve our image, Explain with equations the required process, and draw the required transformation functions.

Q3

Linear Spatial filters are used to smooth an image:



a- Write an equation expressing this operation, what are the types that can be used

$$A = \sum_{b=0}^B \sum_{k=0}^K w(b, k) v(k)$$

*Convolution  
Correlation*

b- Explain the effect of increasing the filter size.

plusing

Best wishes

