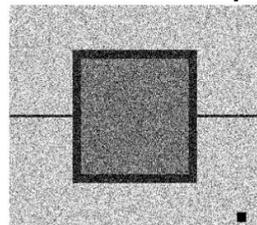


**Question I: Answer the following by selecting the most appropriate choice [10 marks]**

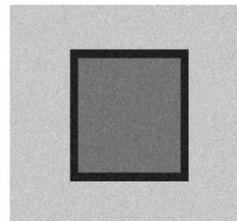
1. ----- is the process of using known data to estimate values at unknown locations.  
a) Decimation      b) Interpolation      c) Formulation      d) All of the above
2. An ----- a place where there is a rapid change in the brightness (or other property) of an image.  
a) Edge      b) Point      c) Line      d) None
3. Image restoration usually uses a model that is based on -----  
a) Additive noise      b) Multiplicative noise      c) Division noise      d) Subtractive noise
4. Which type of enhancement operations are used to modify pixel values according to the value of the pixel's neighbors?  
a) Point operations      b) local operations      c) global operations      d) mask operations
5. A generalization of unsharp masking is -----  
a) high boost filtering      b) low boost filtering      c) a & b      d) None
6. Bipolar impulse noise is also called -----  
a) salt and pepper noise      b) white noise      c) Gaussian noise      d) None
7. A ----- achieves smoothing comparable to the arithmetic mean filter, but it tends to lose less image detail in the process.  
a) Arithmetic mean filter      b) geometric mean filter      c) spatial filter      d) None
8. The harmonic mean filter works well for ----- but fails for pepper noise.  
a) salt and pepper noise      b) salt noise      c) pepper noise      d) None
9. .... should be serious consideration prior to the use of derivatives in applications where noise is likely to be present.  
a) Image smoothing      b) image compression      c) image enhancement      d) None
10. Smoothing spatial filters are used for -----  
a) blurring      b) noise reduction      c) a & b      d) None

**Question II: The following 4-bit image is shown [10 marks]**

In the figure below, 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.



Original image



filtered image

- a) For each of the four possible filters listed above, give at least one reason why you think it was, or was not, the filter actually used.
- b) If the size of the mask were tripled, and the same filter you selected in (a) used, how would the appearance of the image after filtering be changed?

**Question III: State whether the following sentences are TRUE or FALSE, and correct the FALSE sentences: [10 marks]**

1. Both the *FT* (Fourier Transform) and *DFT* (Discrete Fourier Transform) of a signal  $f(x)$  are periodic functions.
2. JPEG compression standard uses DFT for compression.
3. Hauffman coding results in a lossy compression.
4. Fourier transform of an image will clearly indicate how much bright or dark the image is.
5. The value of the Fourier Transform at  $(0, 0)$  is always real value.
6. The idea behind contrast stretching is to increase the dynamic range of the gray levels in the image being processed.
7. An image with low contrast has wide histogram distribution
8. Power-law function maps a narrow range of low gray-level values in the input image into a wider range of output levels.
9. Laplacian filter replaces the pixel value by the median value in the neighborhood.
10. Frequency domain enhancement techniques enable the user to know the frequency content of the image and work on filtering them according to his needs.

**Question IV [10 marks]**

1. [1 mark] What is the goal of histogram equalization?
2. [1 mark] "An intensity histogram of an image gives some useful clues about the shape of the objects in the image". Can you agree with this statement? Give your reasons.
3. [8 marks] Consider an 8-bit grayscale image ( $L=8$ ) of size  $64 \times 64$  pixels ( $MN = 4096$ ) has the intensity distribution shown in following table.
  - a) Draw the histogram corresponding to these grey levels
  - b) Perform histogram equalization and draw the histogram after equalization.
  - c) Get the histogram equalization transformation function.

Gray level	0	1	2	3	4	5	6	7
Number of Pixels	123	78	281	417	639	1054	816	688

**Question V [20 marks]**

For the following image which consists of 8 symbols, (a) Determine the probability of each symbol based on its occurrence frequency; (b) Find its entropy; (c) Design a codebook for these symbols using Huffman coding method. Calculate the average bit rate and compare it to the entropy.

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