Mansoura University
Faculty of Engineering

Digital Image Processing
Spring Semester Exam.

CIE

Biomedical Engineering Program - Level 300
Communications & Information Engineering Program – Level 400
Exam Date: 5-6-2016
Allowed Time: 2 Hours

Attempt all questions. Assume any missed data. Full mark is 50

Q.1.a) Correct the errors, if any, in each of the following statements: **[5 Marks]**

إذا كانت الجملة صحيحة يكتب رقم الجملة وعلامة (√) فقط أمامها، أما إذا كانت الجملة خطأ فتوضع علامة (x) أمام رقم الجملة، وتعاد كتابة الجملة كاملة بعد تصحيحها.

a. Most color images have a small subset of the more than sixteen million possible colors.
b. The greater the spatial resolution, the less pixels are used to display the image.
c. Solarization of a grey-scale image is its photographic negative.
d. In a dark image, the grey levels (hence, the histogram) would be clustered at the lower end.
e. High frequency components are characterized by large changes in grey values over small distances.
f. It is more efficient to use the spatial filter than Fourier transform for a large filter.
g. Gaussian noise can be caused by sharp, sudden disturbances in the image.
h. Periodic noise can be cleaned by using spatial filtering techniques.
i. Median filtering seems almost tailor-made for removal of speckle noise.
j. Double thresholding brings out subtle features which single thresholding would be unable to do.
k. In a step edge, the grey values change slowly.
l. Hue is the amount by which the color has been diluted with white.

Q.2) Give a *short answer* to each of the following questions: **[15 Marks]**

i. *"Recently, diagnosis and treatment of several diseases can be improved using image processing*". Justify this statement supporting your answer with examples.

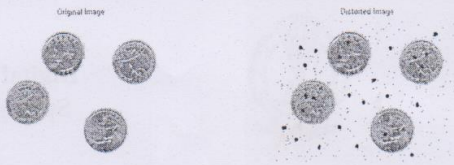
ii. *"Image processing operations may be divided into three classes based on the information required to perform the transformation".* Justify this statement and give an example for each class.

iii. *"Inverse filtering may lead to errors in the filtered image".* Explain the concept of inverse filtering and the procedures that must be followed to overcome its disadvantages.

iv. *"Thresholding can be useful in many situations".* Justify this statement. In which situations will adaptive thresholding be applied?

v. *"A color model is a method for specifying colors in some standard way".* Discuss the main three color models that are commonly used.

Q.3.a) Given an original image 'coins.tif' and a degraded version as shown in figure. What does the second image suffer from? Suggest a solution using a well commented MATLAB code segment. Enhance the original image using histogram equalization. **[5 Marks]**



Q.3.b) Given a 5x5 image, *X*, and a Laplacian edge detector, *H*

$$X = \begin{bmatrix} 115 & 110 & 105 & 105 & 350 \\ 105 & 100 & 100 & 100 & 355 \\ 100 & 140 & 120 & 100 & 350 \\ 110 & 130 & 145 & 115 & 345 \\ 120 & 130 & 130 & 125 & 345 \end{bmatrix} \quad \& \quad H = \begin{bmatrix} +1 & +1 & +1 \\ +1 & -8 & +1 \\ +1 & +1 & +1 \end{bmatrix}$$

Apply the given edge detector to the image? Modify values outside the range [0-255]. Then, apply a suitable threshold to transform the resulting image into a binary one. **[5 Marks]**

Q.3.c) Derive the parametric form of a straight line in an image. Use the Hough transform to detect the two strongest lines in the binary image shown below. **[10 Marks]**

y \ x	0	1	2	3	4	5	6
0	1	1	1	0	1	1	0
1	0	0	0	0	1	0	0
2	0	0	0	1	0	0	0
3	0	0	0	0	0	0	0
4	0	1	0	0	0	1	0
5	1	0	0	0	0	0	0
6	0	0	0	0	0	0	0

Q.3.a) The shown 3-bit grey scale image has values in the range 0 to 7.

i. Sketch the histogram of this image. What do you expect about the appearance of this image?
ii. Equalize this histogram. Sketch the result.
iii. Determine the entropy of the original image.
iv. Construct a Huffman code for the original image.
v. Determine the average bits/pixel for your code. Comment on results. **[15 Marks]**

$$\begin{bmatrix} 0 & 1 & 1 & 3 & 4 & 5 \\ 2 & 0 & 3 & 4 & 4 & 5 \\ 2 & 2 & 3 & 4 & 5 & 4 \\ 3 & 1 & 3 & 4 & 5 & 5 \\ 7 & 7 & 3 & 3 & 5 & 6 \\ 6 & 6 & 3 & 3 & 7 & 5 \\ 6 & 1 & 4 & 4 & 2 & 0 \end{bmatrix}$$

Q.4.b) Encode the following ***binary*** image using RLE. Use two different methods. **[5 Marks]**

$$\begin{bmatrix} 1 & 1 & 1 & 1 & 0 & 0 \\ 0 & 0 & 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 & 0 & 0 \\ 1 & 0 & 1 & 0 & 0 & 0 \end{bmatrix}$$

☺ ***Best wishes*** *Assis. Prof. Hossam El-Din Moustafa*