



Dept. of Computer Engineering
 Final Exam, First Semester: 2010/2011

Course Title:	Topics in Computer and Software Engineering	Date:	30/01/2011
Course No:	630593	Time Allowed:	2 Hours
Lecturer:	Dr. Qadri Hamarsheh	No. Of Pages:	5

Information for candidates

1. This examination paper contains 8 questions totaling 50 marks
2. The marks for parts of questions are shown in round brackets.

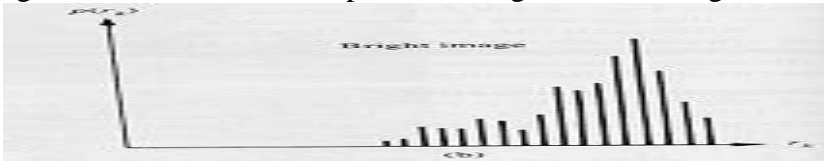
Advices to candidates

1. You should attempt all questions.
2. You should write your answers clearly.

Basic notions: The aims of the questions in this part are to evaluate the required minimal student knowledge and skills. Answers in the pass category represent the minimum understanding of basic concepts: Image Processing Systems, Relationships between pixels, Distance Measures, Intensity Transformation, Histograms, Spatial and Frequency Domains Filtering.

Question 1 True/False Questions

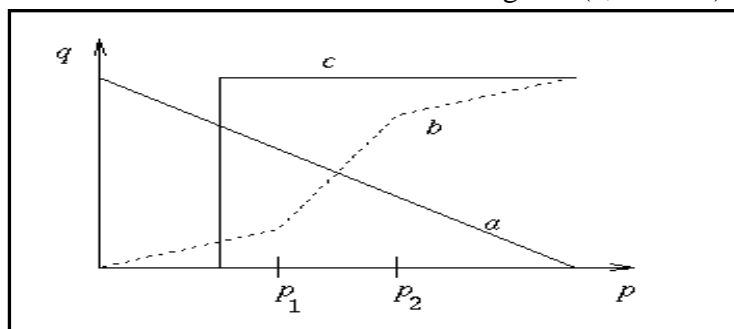
(4 marks)

a) Unsharp masking is a high-pass filtering technique.	
b) Transforming the pixel values of an image using the $\log()$ transformation is an example of contrast compression of the dark pixels.	
c) Median filtering can be implemented using convolution.	
d) The Laplacian operator can be used for estimating edge direction.	
e) Median filtering is a linear filter.	
f) The FFT-based convolution method is most often used for large inputs.	
g) The histogram shown below corresponds to a high contrast image.	
	
h) For large inputs it is generally faster to use <code>imfilter</code> IPT function.	

Question 2

(10 marks)

- a) What are the fundamental steps in Image processing? (2 marks)
- b) Write the grey scale transformation method for each of figures (a, b and c) (3 marks)



c) Write short notes on neighbors of a pixel.

(3 marks)

d) List 4 types of edge detectors.

(2 marks)

Question 3

(6 marks)

Discuss the use of Lowpass Filters and fill the table about formulas and visual representations of these filters (as discussed in the lecture notes).

Lowpass Filters using

LOWPASS FILTER TYPE	Equation	Mesh	Image
Ideal:			
Butterworth			
Gaussian			

Familiar Problems Solving: The aim of the questions in this part is to evaluate that the student has some basic knowledge of the key aspects of the lecture material and can attempt to solve familiar problems of Intensity Transformation, Histograms, Spatial and Frequency Domains Filtering, image enhancement and programming these concepts using MATLAB.

Question 4

(4 marks)

Summarize the different image types, values and data types (fill the table).

Ñ	Image Type	Intensity Values/Ranges and Data Types
1		
2		
3		
4		

Question 5

(10 marks)

Write a matlab function with the following prototype:

function spatialfilter(imagefilename,filtertype)

where **imagefilename** parameter is the image file name and the parameter **filtertype** is the filter type.

The function implements the following types of linear spatial filters:

- 3x3 Median Filter.
- Prewitt Derivative Filter with the following h mask:

1	1	1
0	0	0
-1	-1	-1

- Sobel Derivative Filter with the following h mask:

1	2	1
0	0	0
-1	-2	-1

- High Boosting Filter with the following equation:

$$\text{High boost} = A \cdot \text{Original image} - \text{Low pass filter}$$

(use 3x3 Averaging Filter).

Parameter **A** must be entered interactively.

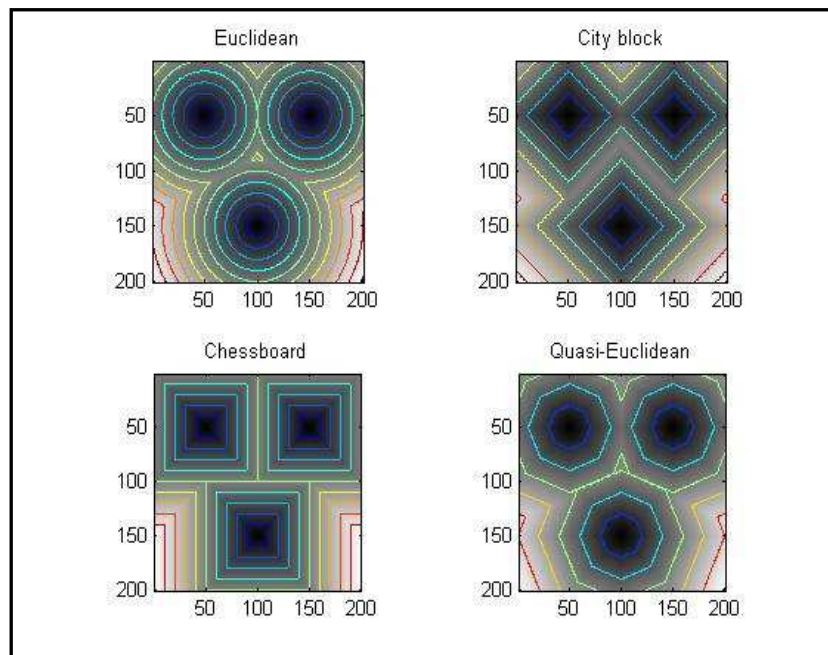
- Use preallocating array for each filtered image.
- Use low-level processing.
- Use the mask values directly in your code.
- Don't use any built-in Matlab function to generate the filter mask
- Don't use any built-in Matlab function to perform the spatial filtering.
- Display the original and the filtered image after enhancement in each case.

Question 6

(5 marks)

Write a matlab script that calculates and displays the distance functions of an image as described below:

- ✓ Create an image call it **'bw'** that conatins a matrix of **200x200** zeros.
- ✓ Write code to write ones in the following image coordintaes:
(200,200), (50,50), (50,150) and (150,100) in **'bw'** image.
- ✓ Use the **'bwdist'** built-in matlab function to calculate the **Euclidean, Cityblock, Chessboard and Quasi-Euclidean distances** of the image.
- ✓ Display these distances as shown in the following figure.



Unfamiliar Problems Solving: The aim of the questions in this part is to evaluate that the student has knowledge of the key aspects of the lecture material and can attempt to solve unfamiliar problems of Intensity Transformation, Histograms, Spatial and Frequency Domains Filtering and image enhancement, image restoration and programming these concepts using MATLAB.

Question 7 Write a matlab function with the following prototype: (5 marks)

function PQ = paddedsize(AB, CD, PARAM)

The function computes padded sizes useful for FFT-based filtering with the following syntax:

- **PQ = paddedsize (AB)**, where **AB** is a two-element size vector, the function computes the two-element size vector **PQ = 2*AB**.
- **PQ = paddedsize (AB, 'PWR2')**, the function computes the vector **PQ** such that it is suitable for fast Fourier transform.
- **PQ = paddedsize (AB, CD)**, where **AB** and **CD** are two-element size vectors, the function computes the two-element size vector **PQ**. The elements of **PQ** are the smallest even integers greater than or equal to **AB + CD -1**.
- **PQ = PADDEDSIZE(AB, CD, 'PWR2')** the function computes the vector **PQ** such that it is suitable FFT.

Question 8 (6 marks)

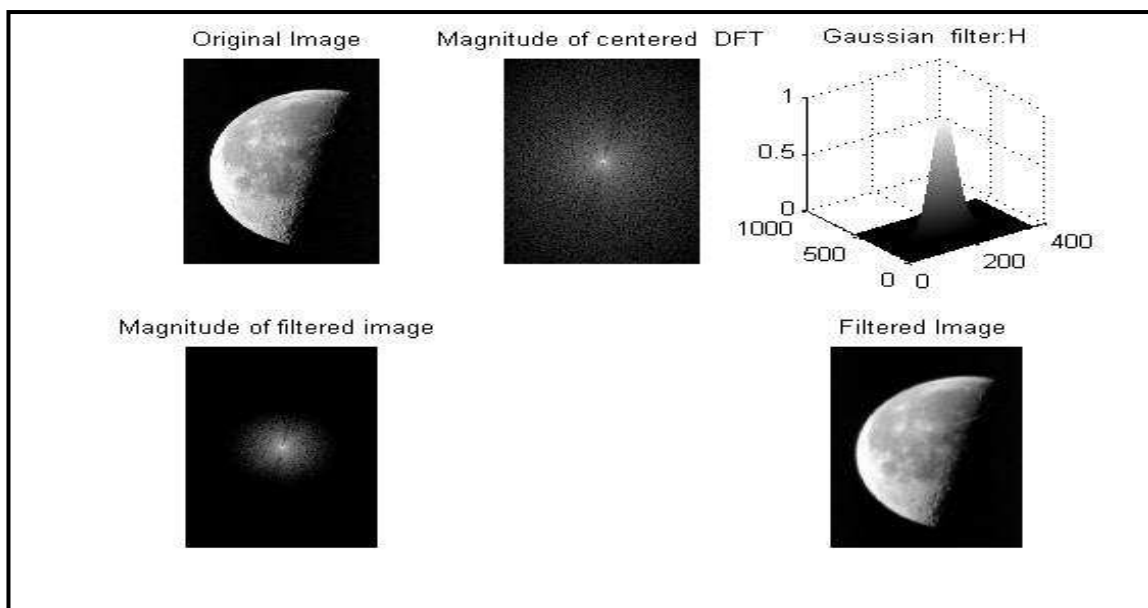
Write a matlab script that implements the **Gaussian low pass filter** as described below:

- ✓ Read the image with suitable conversions.
- ✓ Compute (centered) DFT of the image.
- ✓ Display the magnitude of the transform in logarithm scale.
- ✓ Create Gaussian low-pass filter directly in frequency domain using the following equation:

$$H = e^{-0.5 * D * D / (D_0)^2}$$

and display the filter mask using 3D plots.

- ✓ Perform the image filtering in frequency domain and display the magnitude of the transform in logarithm scale.
- ✓ Compute inverse DFT and display it.
 - Don't use any Matlab function discussed in the lecture notes.
 - You can use any built-in Matlab function.
 - Display the output as shown in the following figure.



GOOD LUCK