

National University of Computer and Emerging Sciences, Lahore Campus



Course: Fundamentals of Computer Vision
Program: BS(Computer Science)
Duration: 180 Minutes
Paper Date: 15-Dec-16
Section: ALL
Exam: Final Exam

Course Code: CS495
Semester: Fall 2016
Total Marks: 80
Weight: 45%
Page(s): 8
Roll No:

Instruction/Notes:

Attempt all questions in the space provided to you.
Be Exact & to the point. There are no marks for **stories**.
Please don't attach extra sheet with this paper.

Problem 1: (2+ 8=10 marks)

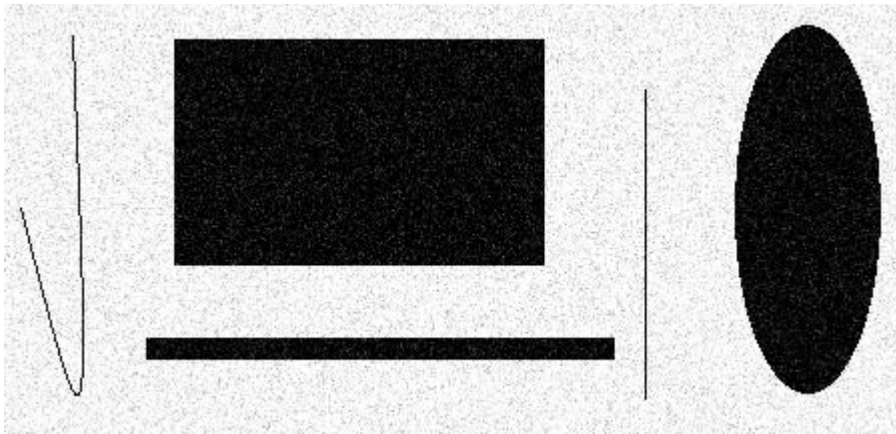
Describe when it would be suitable to use the Prewitt mask. Sketch the result when one of these masks is applied to the greyscale image below. You only need to compute the values for the central region of the image that is fully covered by the mask. Give answers correct to 2 decimal places.

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

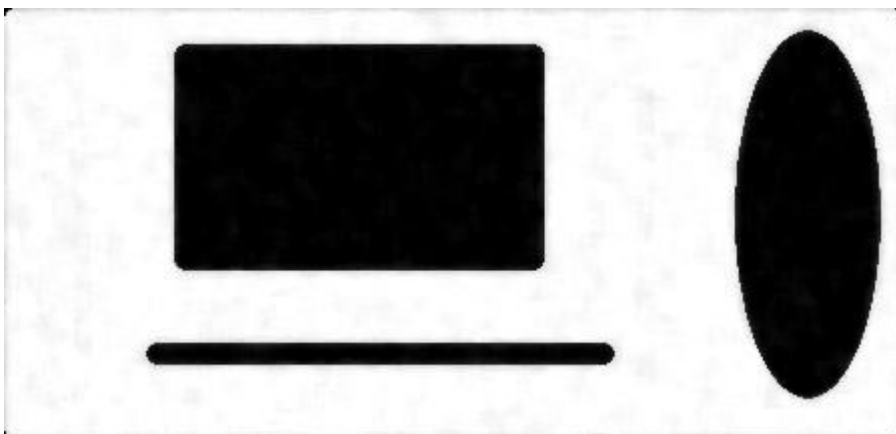
Problem 2: (7 marks)

Given the image below before (fig. a) and after (fig. b) a smoothing filter was applied. The size of the filter is a small square (its size is rather small compared to the image size). In your opinion, which one of the following filter types most likely produced the image (fig. b):

- 1) Mean filter,
- 2) Median filter,
- 3) Gaussian filter. Motivate your answer. No marks without proper justification



(a)



(b)

Problem 3: (2+4+2+4+1= 13 marks)

Compare the Canny edge detector and the Laplacian-of-Gaussian (LoG) edge detector for each of the following questions.

(a) Which of these operators is/are rotationally invariant and which is/are non-rotationally invariant?

(b) Canny algorithm depends on two parameters, what are they & how they affect the output?

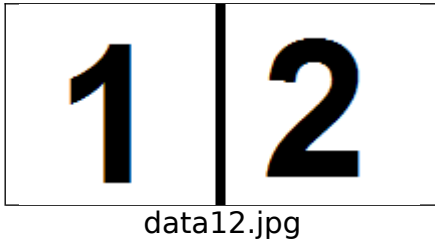
(c) Which of these two operators takes 2nd derivative? Any one (which one) or both?

(d) What is the basis for both these algorithms?

(e) Which of these is a Mexican hat operator?

Problem 4: (20 marks)

Suppose you are given the following image (data12.jpg) of size 100x200 [100 rows and 200 columns]. Line in the image divides the image into two equal halves. What will be the output of the following code? Discuss in detail.



```
X= imread('data12.jpg');
Spatial= rgb2gray(X);
freqA= fft2(Spatial(:,1:100));
shiftedA= fftshift(freqA);

freqB= fft2(Spatial(:,101:200));
shiftedB= fftshift(freqB);

[X,Y] = meshgrid(-50:49,-50:49);
Z= sqrt(X.^2+Y.^2);
C= Z<25;
D= Z>25;

A= shiftedA.*C;
B= shiftedB.*D;

shifted_back=ifftshift(A);
f(:,1:100)= ifft2(shifted_back);

shifted_back=ifftshift(B);
f(:,101:200)= ifft2(shifted_back);

cmin = min(min(abs(f)));
cmax = max(max(abs(f)));
figure, imshow(abs(f), [cmin cmax]), colormap gray
```

Problem 5: (15 marks)

Suppose you are given an image I of size 300×300 . You have to convolve the image with Gaussian filter to blur it. But unfortunately your convolution method is not working. Only way to do it is by converting it in frequency domain. Write Matlab code to blur the image by Gaussian filter in frequency domain.

You can use `fspecial` to generate Gaussian filter.

`h = fspecial('gaussian', hsize, sigma)` returns a rotationally symmetric Gaussian lowpass filter of size `hsize` with standard deviation `sigma` (positive). `hsize` can be a vector specifying the number of rows and columns in `h`, or it can be a scalar, in which case `h` is a square matrix. The default value for `hsize` is `[3 3]`; the default value for `sigma` is `0.5`.

Problem 6: (15 marks)

Apply isodata (iterative self-organizing data analysis technique) algorithm to determine the threshold of the following image using limit = 7. Show each step

20	200	202	150
10	105	170	250
4	150	185	140
90	2	200	110

