

Universidade da Beira Interior
Departamento de Informática
2011/12

1. Consider the following function $f(x,y)=x+y+xy$. Is it possible to regard this function as a linear system? Justify your answer in a formal way.
2. Implement a MATLAB function that receives a scale-space representation of a given image (with size of all images normalized), and returns the position and scale of local extrema in a given radius. (Example: `img(R,C,S)` represents “S” images with “R” rows and “C” columns. `img(:, :, 1)` is the first-scale image). Please note that regions near the image borders should be ignored.

Prototype: `extrema findExtrema(img, radius)`

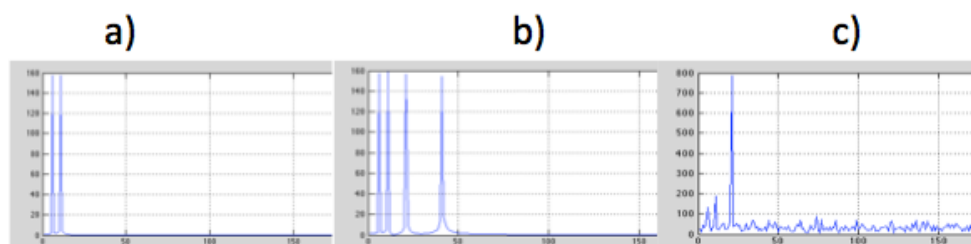
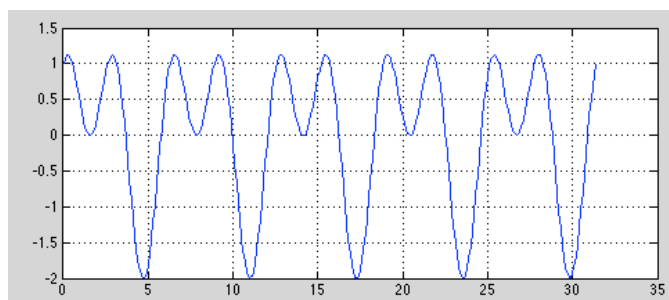
3. Consider a matrix of keypoint correspondences between two images, in the following form:

`[row1 col1 row1 col1; row2 col2 row2 col2; ...]`

Implement a MATLAB function that receives a matrix of point correspondences and returns the subset that complies the projective transform.

Prototype: `comply filterCorrespondences(transfMatrix, correspondences)`

4. Analyze the following 1D signal and three possibilities for the magnitude of its Fourier transform. Which one corresponds to the true Fourier transform? Justify your answer.

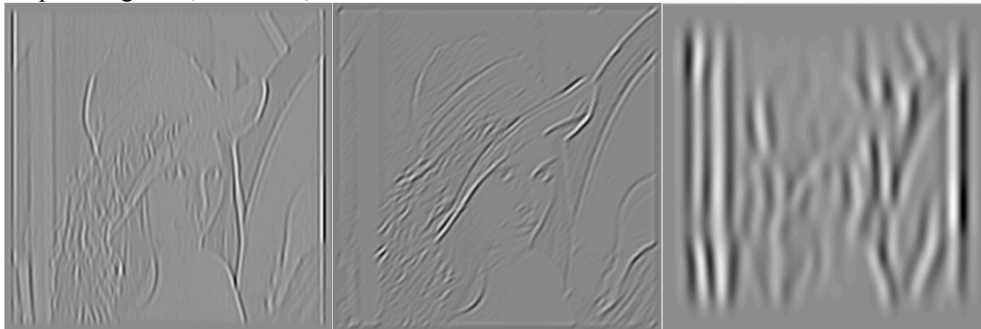


5. Consider the widely known “Lena” image:

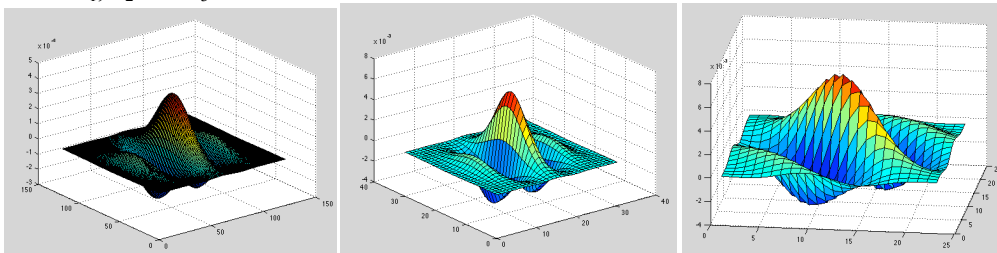


Each of the Gabor filters below was used to obtain a corresponding output image. Associate each Gabor filter to an output image.

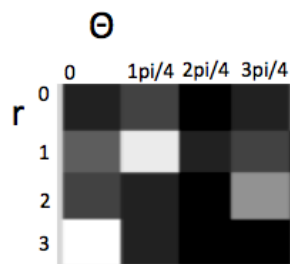
Output Images O_1 , O_2 and O_3 .



Filters F_1 , F_2 and F_3 .



6. Suppose that the following image is the matrix accumulator resultant of the line Hough transform ($r = x_0 \cos(\Theta) + y_0 \sin(\Theta)$). Draw an image and the two most probables straight lines on that image, according to the accumulator values.



7. Implement a MATLAB function to obtain the Hessian matrix of a point in an image. If its not possible to obtain the Hessian, the function should return an empty matrix.

Prototype: hessian getHessian(img, row, col)

8. Implement a MATLAB function to verify if a given chain code corresponds to a contour, represented by white pixels in a black background (0=no, 1=yes). We consider 4-neighborhood here.

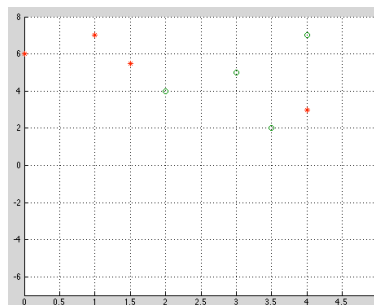
Prototype: yn chainCorrespond(img, chainCode).

9. Determine, from the following vectors, which are eigenvectors of the matrix given below and, if positive, obtain the corresponding eigenvalues.

1	2	1
6	-1	0
-1	-2	-1

- a) [1, 6, -13];
b) [-1, 0, 13];
c) [1, -6, 3];

10. Observe the following 2D data set. Obtain two equations for straight lines that correspond to:



- a. A *good* projection into 1D space, for binary classification purposes
b. A *bad* projection into 1D space, for binary classification purposes.