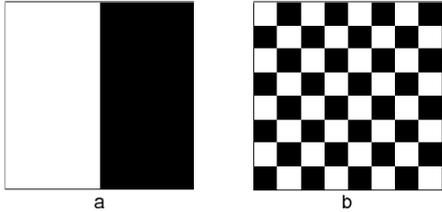


Video Processing

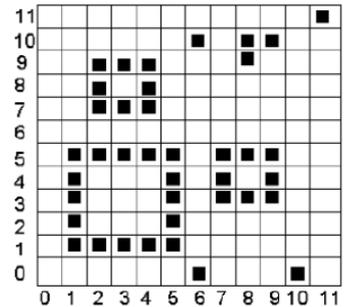
Date: 4/9/2013

Ex.1.[5 Pt] The two texture images shown below are quite different, but their histograms are identical. Both images have size 80×80 , with black (0) and white (1) pixels.



Suppose that both images are blurred with a 3×3 average filter. Would the resultant histograms still be the same? Draw an approximate representation of the two histograms and explain your answer.

Es.2. [10 pt] In the Hough Transform, a point (x_0, y_0) in the xy -plane is mapped into a curve in the (ρ, θ) -parameter space. Write down the equation of the curve. If we apply the Hough transform on the image on the right, what would be the maximum value for the accumulator cell in the (ρ, θ) space? What is the corresponding (ρ, θ) value?



Es. 3 [7 pt] The following figure shows a 3-bit image of size 5-by-5 image in the square, with x and y coordinates specified,

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

Only for the central point $(x=2, y=2)$ evaluate the new output for:

1. A 3×3 mean filter
2. A 3×3 median filter
3. The 3×3 laplacian filter at the right.

Evaluate the histogram of the whole image.

Laplacian filter

0	1	0
1	-4	1
0	1	0

Es.4. [11 pt] Given a truecolor image in the file *image.bmp* with 8 bit per channel, implement in Matlab the following operations:

- a) Read the image, load it in the workspace and visualize it.[1Pt]
- b) Flip vertically and horizontally the image.[2Pt]
- c) Rescale the image to triplicate its original horizontal and vertical size using the bicubic filtering.
- d) Apply a 5×5 median filter to the resulting image and rescale the result to the size of the original image.
- e) Evaluate the SNR (signal to noise ratio) assuming the noise as the difference between the original image and the one obtained at point d)

Matlab

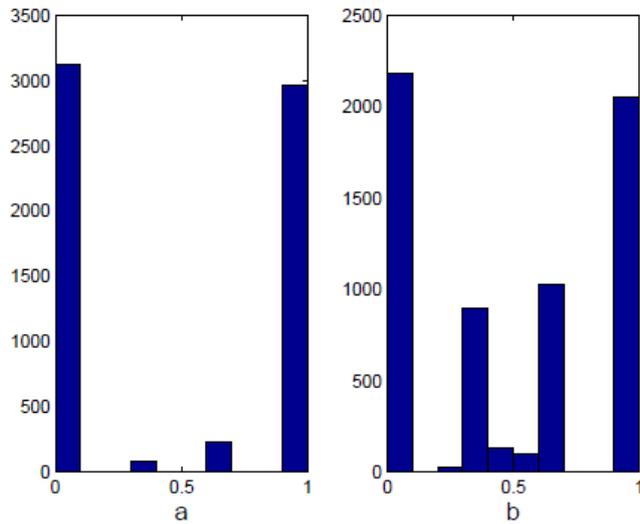
List of functions

```
figure
fspecial
im2double
imclose
imfilter
imopen
imread
imresize
imshow
size
sqrt
strel
zeros
```

Solutions

Ex.1

The histograms will no longer be the same. They are plotted as follows:



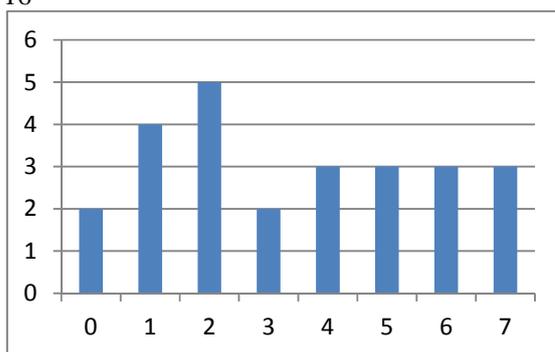
Ex.2

$$x \cos(\theta) + y \sin(\theta) = \rho$$

The maximum value is 8, corresponding to the horizontal line with vertical coordinate 5, because there are 8 points lying on this line. This line has the parameter $\rho = 5, \theta = \pi/2$.

Ex.3

- 1) 3.66 rounded to 4
- 2) 4
- 3) 16



Ex.4

```
img_rgb = imread('image.bmp');
figure, imshow(img_rgb);
im_flipped=zeros(size(img_rgb));
im_flipped(:,:,1)=flipud(img_rgb(:,:,1));
im_flipped(:,:,2)=flipud(img_rgb(:,:,2));
im_flipped(:,:,3)=flipud(img_rgb(:,:,3));
im_flipped(:,:,1)=fliplr(im_flipped(:,:,1));
im_flipped(:,:,2)=fliplr(im_flipped(:,:,2));
im_flipped(:,:,3)=fliplr(im_flipped(:,:,3));
img_big = imresize(img_rgb, 3, 'bicubic');
im_median= medfilt2(img_big,5);
img_small = imresize(img_big, 1/3, 'bicubic');
noise= img_rgb- img_small;
SNR=10*log10( sum(sum(sum(img_rgb.^2)))/ sum(sum(sum(noise.^2))) );
```