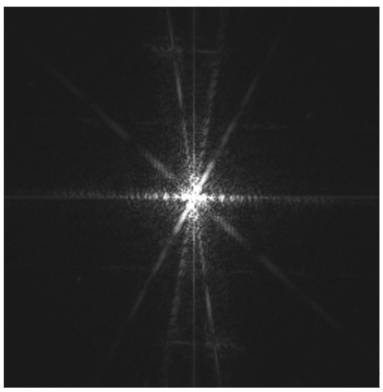
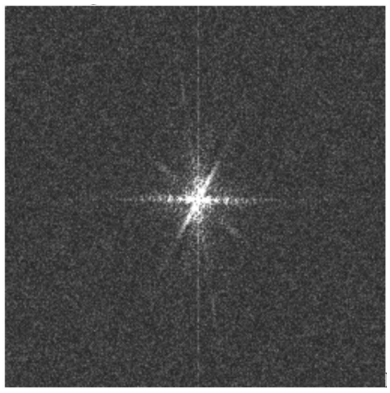
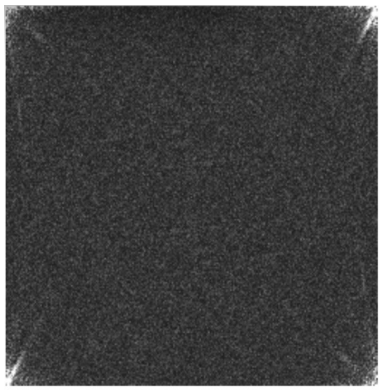
For many questions, there are, possibly, multiple correct answers (1, 2, 3 or 4). Mark the answers you consider correct. Explain why?

1. Consider the image from Fig. a) (an original image affected by salt and pepper noise). Most likely, the Fourier amplitude spectrum of this image will look:

(a)







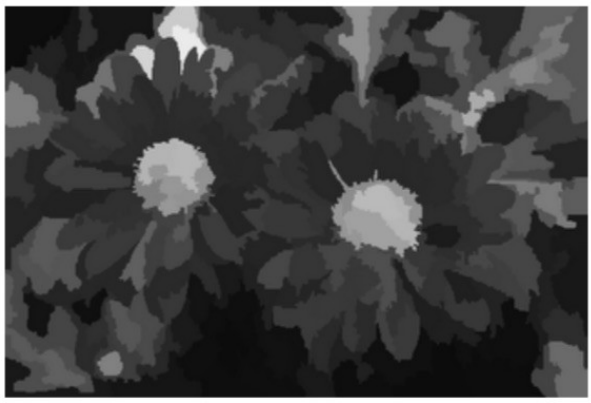
2.In order to obtain the image in Fig. b from the original image in Fig. a, the following point processing operation should be applied:

a) contrast compression;

b) negativation (image inversion);

c) histogram equalization;

d) histogram modification.



(a)

(b)

3. ----------Filter cannot be implemented using convolution mechanism.
a) Average b) Gaussian c) Median d) Disk

4. One of the following filters is nonlinear
   a) Gaussian Filter
   b) Averaging Filter
   c) Laplacian Filter
   d) Median

5. To remove "salt-and-pepper" noise (there are white and black pixels in image, see Question 1) without blurring we use
   a) Max Filter
   b) Median Filter
   c) Min Filter
   d) Smoothing Filter

6. Both the -------- and -------- filters are used to enhance horizontal edges (or vertical if transposed).

   a) Prewitt and Sobel

   b) Sobel and Gaussian

   c) Prewitt and Laplacian

   d) Sobel and Laplacian

Remind: Laplacian filters (H=[0 1 0;1 -4 1; 0 1 0])

7. The following figures show
(a) a 3-bit image of size 5-by-5 image in the square, with x and y coordinates specified,
(b) a Laplacian filter and
(c) a low-pass filter.

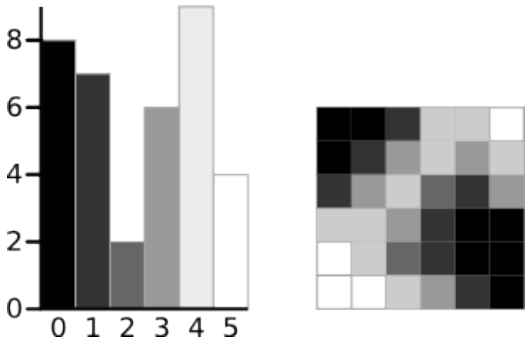
Compute the following:
(a) The output of a 3 × 3 mean (average) filter at (3, 3).
(b) The output of the 3 × 3 Laplacian filter shown above at (3, 3).
(c) The output of the 3 × 3 low-pass filter shown above at (3, 3).
(d) The histogram of the whole image.

Y/X	Image				
	1	2	3	4	5
1	3	7	6	2	0
2	2	4	6	1	1
3	4	7	2	5	4
4	3	0	6	2	1
5	5	7	5	1	2

Laplacian mask		
0	1	0
1	-4	1
0	1	0

Low pass filter		
0.01	0.1	0.01
0.1	0.56	0.1
0.01	0.1	0.01

8. The below figure shows a 6 × 6 image (with values in {0, 1, . . . , 5}) along with its histogram. Using Otsu's method, find the value of an optimal threshold to be used for image segmentation/binarization. (Recall: the Otsu's method was used in the assignment of Fingerprint recognition)



9. Remind how to compute the HOG descriptor.

10. Consider an image of 320x320 pixels. To compute its HOG descriptor, the following parameters are used: the Sobel filters, 9 orientations (9 bins), histograms are computed on 32x32 regions (non-overlapping). What is the dimension of the final HOG vector? Why should you not compute the HOG vector for the whole image (instead of dividing the image into smaller regions)?

11. If on the image in Fig. 11.a) one applies a convolution with the 3×3 pixels mask **H** = 1/8[0 1 0; 1 4 1;0 1 0], and the absolute values of the convolution results are displayed, then most likely, the result of this operation is:

a) the image in Fig. 11.b);

b) the image in Fig. 11.c);

c) the image in Fig. 11.d);

d) the image in Fig. 11.e).

Fig. 11.a)

Fig. 11.b)

Fig. 11.c)

Fig. 11.d)

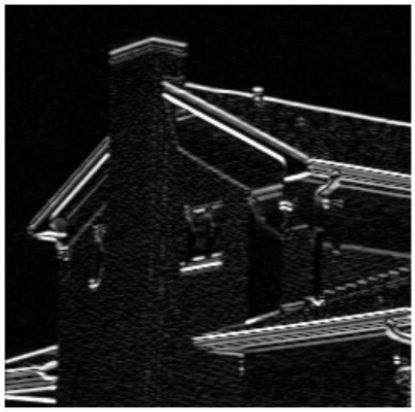


Fig. 11.e)

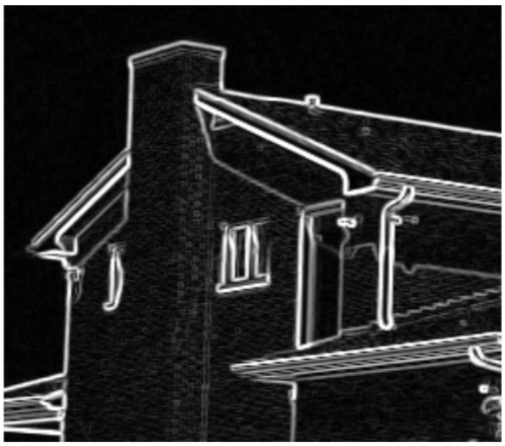
12. If the original image is the one in Fig. a), and the resulting image after some processing is the one in Fig. b), what is the most likely processing from the list below to give this result?

a) Edge detection by a Laplacian operator; (H=[0 1 0;1 -4 1; 0 1 0])

b) High pass filtering, by subtracting a low pass filtered version of the image from the original image;

c) Median filtering followed by an edge detection;

d) Edge detection followed by a median filtering.



13.Remind image clipping function (also know as stretching or scaling an image).

14. What is dilation, erosion, opening, closing? (dilatation, érosion, ouverture, fermeture)

15. What is distance transform?
16. What is the purpose of interpolation (when would you use it)? Name at least two methods of interpolation.
17. Que représente une quantification sur 24 bits d'une image couleur.\l
18. Quelle taille mémoire (en octets) occupe une image « Noir & Blanc » de dimension 1024 x 1024 pixels codée sur 16bits.
19. Consider a grey image with an locally adaptive quantification. The image is divided into small blocks of 16x16 pixels and then each block is quantized with 4 bits. Compute the compression rate of this algorithm. (see slide compression, page 21).

20. The matrix **V** represents, most likely:

a) the distance transform of a 9×9 square of object pixels, placed on a uniform background;

b) the distance transform of a 7×7 square of object pixels, placed on a uniform background;

c) the amplitude spectrum of the Fourier transform of an image containing a 7×7 pixels black square, placed on a uniform background;

d) the result of thresholding an image containing a 7×7 pixels black square, placed on a uniform background.

$$\mathbf{V} = \begin{bmatrix} 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 1 & 2 & 2 & 2 & 2 & 2 & 1 & 0 \\ 0 & 1 & 2 & 3 & 3 & 3 & 2 & 1 & 0 \\ 0 & 1 & 2 & 3 & 4 & 3 & 2 & 1 & 0 \\ 0 & 1 & 2 & 3 & 3 & 3 & 2 & 1 & 0 \\ 0 & 1 & 2 & 2 & 2 & 2 & 2 & 1 & 0 \\ 0 & 1 & 1 & 1 & 1 & 1 & 1 & 1 & 0 \\ 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \end{bmatrix}.$$

TO BE CONTINUED