



UNIVERSITÀ DEGLI STUDI  
DI MILANO

MASTER DEGREE IN COMPUTER SCIENCE  
**Methods for Image Processing**  
academic year 2016–2017      teacher: Stefano FERRARI

### example — written exam

Surname \_\_\_\_\_ Name \_\_\_\_\_  
Matriculation number \_\_\_\_\_ Signature \_\_\_\_\_

scores																			
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20

#### Q 01

If each pixel is coded using 3 bits, the maximum number of gray shades is

- A. 3
- B. 7
- C. 8
- D. 6
- E. 256

#### Q 02

With reference to the following figure, the 4-neighborhood of the pixel  $p$ ,  $N_4$ , is

$p_1$	$p_2$	$p_3$
$p_4$	$p$	$p_5$
$p_6$	$p_7$	$p_8$

- A.  $N_4 = \{p_1, p_2, p_3, p_4\}$
- B.  $N_4 = \{p_1, p_3, p_6, p_8\}$
- C.  $N_4 = \{p_1, p_3, p_5, p_7\}$
- D.  $N_4 = \{p_2, p_4, p_5, p_7\}$
- E.  $N_4 = \{p_2, p_3, p_4, p_6\}$

#### Q 03

With reference to the following figure, the 8-adjacent pixels to the pixel  $p$  are

$p_1$	$p_2$	$p_3$
$p_4$	$p$	$p_5$
$p_6$	$p_7$	$p_8$

- A.  $\{p_2, p_3, p_5, p_6\}$
- B.  $\{p_2, p_5\}$
- C.  $\{p_3, p_6\}$
- D.  $\{p_1, p_4, p_7, p_8\}$

- E.  $\{p_1, p_3, p_6, p_8\}$

#### Q 04

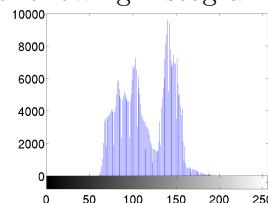
Given the following image (having  $L=8$  intensity levels), which of the following array can be its histogram?

6	7	2	7
7	5	4	1
1	0	7	7

- A.  $[-1 \ 1 \ 2 \ 0 \ 1 \ 1 \ 3 \ 5]$
- B.  $[1 \ 0 \ 1 \ 2 \ 5 \ 1 \ 1 \ 1]$
- C.  $[1 \ 1 \ 0 \ 1 \ 1 \ 5 \ 1 \ 2]$
- D.  $[1 \ 2 \ 1 \ 0 \ 1 \ 1 \ 1 \ 5]$
- E.  $[0 \ 1 \ 1 \ 1 \ 5 \ 2 \ 1 \ 1]$

#### Q 05

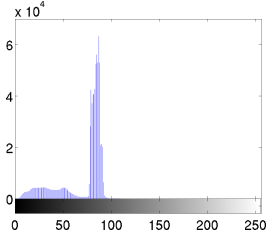
What can be inferred about the image that has the following histogram?



- A. Surely, it must be equalized
- B. Probably, it has a poor contrast
- C. Probably, there is an excess of white pixels
- D. It is the typical gamma function image
- E. Probably, it cannot be equalized

### Q 06

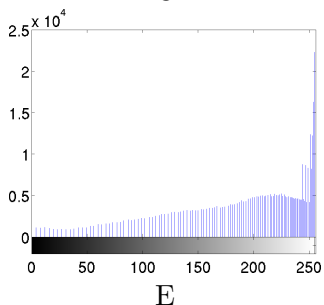
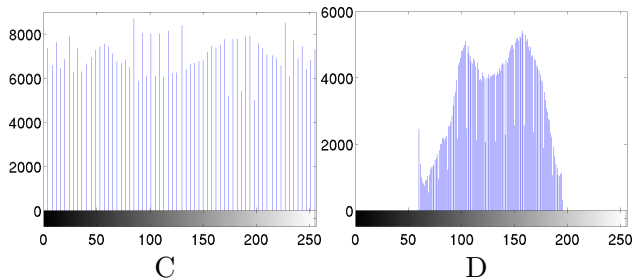
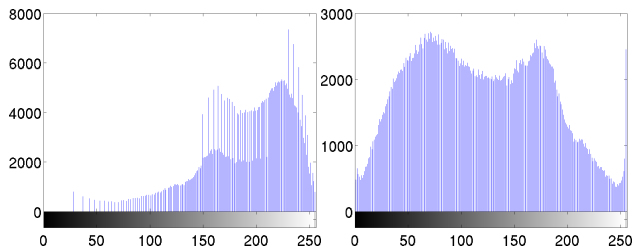
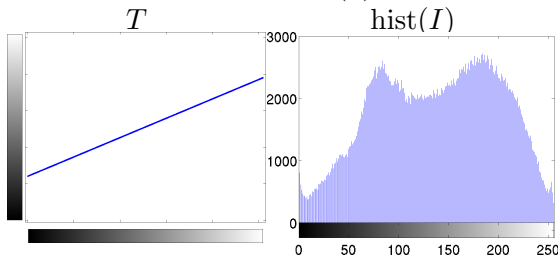
What can be inferred about the image that has the following histogram?



- A. Surely, it has a high contrast
- B. It has too many white pixels
- C. This histogram cannot belong to an image
- D. It should be darkened
- E. Probably, it is dark

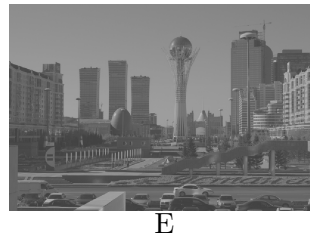
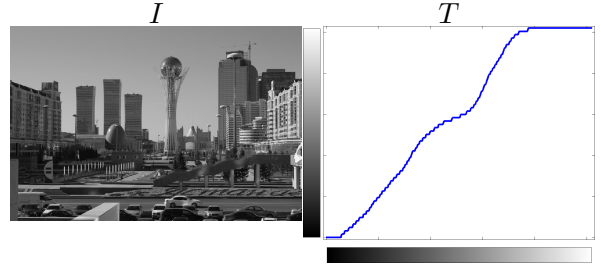
### Q 07

Given the following transformation  $T$  and the histogram of an image  $I$ , which of the following is the histogram of the image  $T(I)$ ?



### Q 08

Given the following image  $I$  and the transformation  $T$ , which of the following is the transformed image  $T(I)$ ?



### Q 09

Giving the following image,  $f$ , and filter,  $w$ , the value for the central pixel resulting from the filtering is

$$f: \begin{array}{|c|c|c|} \hline 2 & 3 & 0 \\ \hline 1 & 4 & 3 \\ \hline 0 & 2 & 3 \\ \hline \end{array} \quad w: 1/9 \times \begin{array}{|c|c|c|} \hline 1 & 1 & 1 \\ \hline 1 & 1 & 1 \\ \hline 1 & 1 & 1 \\ \hline \end{array}$$

- A. 3
- B. 2.4
- C. 2
- D. 0
- E. 4

### Q 10

Which kind of filter is the following filter,  $w$ :

$$w: 1/5 \times \begin{array}{|c|c|c|} \hline 0 & 1 & 0 \\ \hline 1 & 1 & 1 \\ \hline 0 & 1 & 0 \\ \hline \end{array}$$

- A. smoothing
- B. derivative

- C. Gaussian
- D. sharpening
- E. Huffman

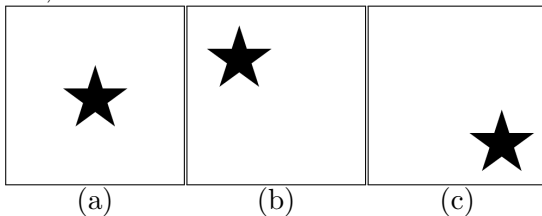
**Q 11**

Which of the statements about a sharpening filter are correct?

- A. it enhance the noise
- B. it operates on the border of the image
- C. it is based on the integral of the image
- D. it is a non-linear filter
- E. all of the above

**Q 12**

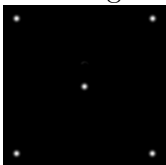
Given the three images following reported, what can be inferred of their FFT?



- A. They have the same spectrum and the same phase angle
- B. (b) and (c) have the same spectrum, but (a) has a different one
- C. All of them have the same spectrum
- D. All of them have the same phase angle
- E. Their spectrum is the same, but rotated

**Q 13**

What can be inferred about the image having the following FFT?



- A. It must have some high frequency pattern
- B. It has a dotted pattern
- C. It has two diagonal lines
- D. It is dark at the border and shading to white radially to the center
- E. None of the above

**Q 14**

Which of the following statements about the Canny edge detector are true?

- A. it computes the zero crossing as final stage
- B. it uses a Gaussian smoothing as preprocessing
- C. it uses the direction for selecting the more robust edge points
- D. it uses the weak edge points as candidates to increase the strong edge point set
- E. it uses a double threshold to select those points that are likely to be edge points

**Q 15**

The Hough transform can be used for

- A. detecting those pixels that belongs to an edge
- B. improving the efficiency of the spatial filtering
- C. finding the most probable lines in the image
- D. smoothing the edges
- E. none of the above

**Q 16**

Otsu's method

- A. identifies the value of the threshold adaptively with respect to the position
- B. is a smoothing procedure based on the histogram of the classes
- C. is an iterative method based on the gradient information
- D. aims to find the optimal value of the threshold
- E. makes use of filtering to improve its efficiency

**Q 17**

Watershed is a technique used for

- A. edge smoothing
- B. image sharpening
- C. histogram matching
- D. image segmentation
- E. image linear filtering

**Q 18** Given the following image, how many regions will result after applying the watershed technique?

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

- A. 1
- B. 2
- C. 3

D. 4

E. 5

**Q 19**

Which of the following sequences can be coded with the number 0.3 using the arithmetic coding, using the given symbol distribution:

Symbol	Probability	Initial Partition
$a1$	0.2	$[0.0, 0.2)$
$a2$	0.2	$[0.2, 0.4)$
$a3$	0.4	$[0.4, 0.8)$
$a4$	0.2	$[0.8, 1.0)$

A.  $a2 a3$

B.  $a1 a3$

C.  $a2 a1$

D.  $a3 a4$

E.  $a2 a4$

**Q 20**

Given the symbol probability distribution reported in the following table, which code can be a Huffman code?

symb.	prob.	code A	code B	code C	code D	code E
$a1$	.2	101	11	011	101	11
$a2$	.1	100	00	010	100	0
$a3$	.4	0	0	1	01	100
$a4$	.3	11	1	001	10	101