



UNIVERSITÀ DEGLI STUDI
DI MILANO

MASTER DEGREE IN COMPUTER SCIENCE
Methods for Image Processing
academic year 2018–2019 teacher: Stefano FERRARI

example — written exam

Surname _____ Name _____
Matriculation number _____ Signature _____

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

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

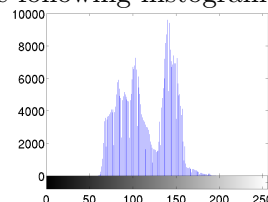
Given the following image (having $L=8$ intensity levels), which of the following array can be its histogram?

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

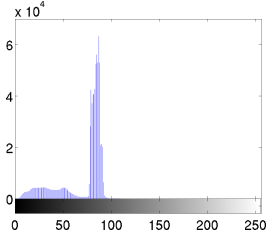
What can be inferred about the image that has the following histogram?



- 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

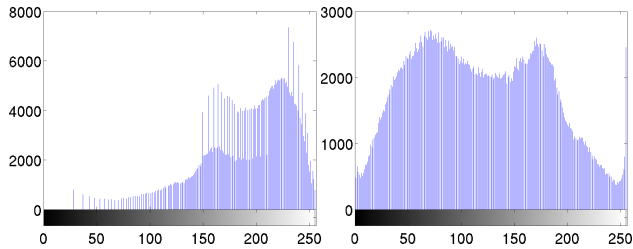
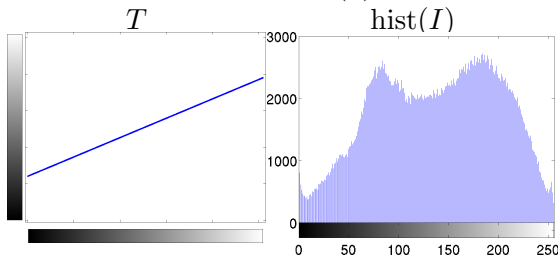
What can be inferred about the image that has the following histogram?



- 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

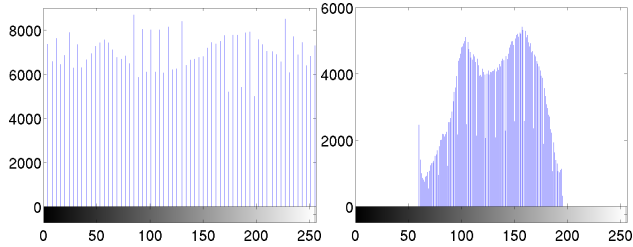
Q 07

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



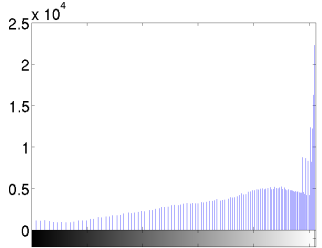
A

B



C

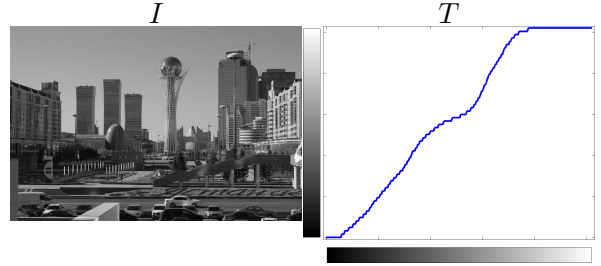
D



E

Q 08

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



A

B



C

D



E

Q 09

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

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

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

Q 10

Which kind of filter is the following filter, w :

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

- A. smoothing
- B. derivative

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

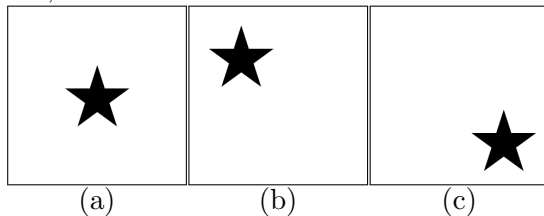
Q 11

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

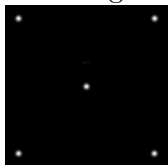
Given the three images following reported, what can be inferred of their FFT?



- 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