MASTER DEGREE IN COMPUTER SCIENCE

Image Processing

academic year 2013–2014   Teacher: Stefano FERRARI

UNIVERSITÀ DEGLI STUDI DI MILANO

Written exam example

scores   **1** (2) _____   **2** (3) _____   **3** (3) _____   **4** (4) _____   **5** (4) _____   **6** (4) _____

Surname _____   Name _____

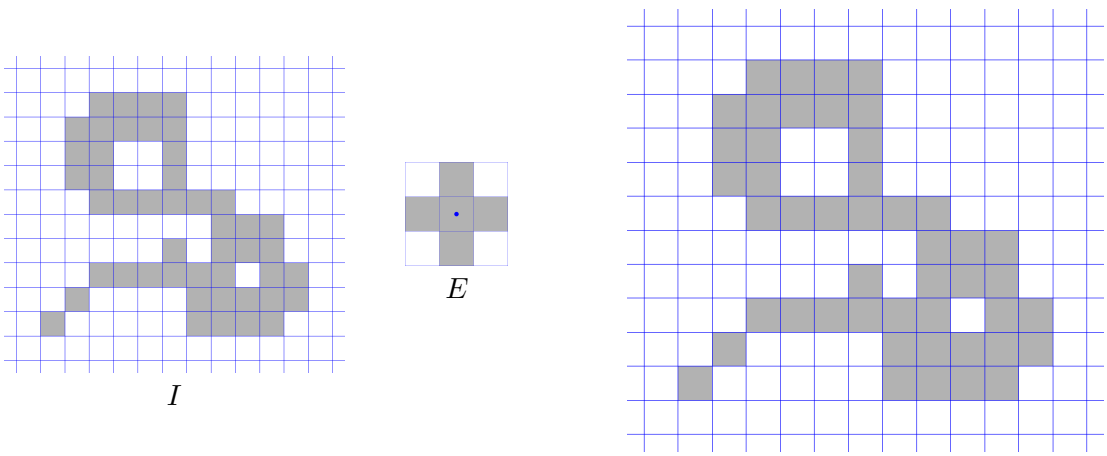Matriculation number _____   Signature _____

Question 1

Using the 8-adjacency relation, identify in the bitmap (where 0 is the background):

(a) the pixels that are adjacent to the pixel α;

(b) the shortest path connecting the pixel α to the pixel β;

(c) the connected regions.

0	1	0	1	0	1	1		0	1	0	1	0	1	1		0	1	0	1	0	1	1
1	1	1^{α}	1	0	0	1		1	1	1^{α}	1	0	0	1		1	1	1^{α}	1	0	0	1
0	0	1	1	1	0	1		0	0	1	1	1	0	1		0	0	1	1	1	0	1
0	0	0	0	1	0	0		0	0	0	0	1	0	0		0	0	0	0	1	0	0
0	1	1	0	1	1	1		0	1	1	0	1	1	1		0	1	1	0	1	1	1
1	1	0	0	0	1^{β}	1		1	1	0	0	0	1^{β}	1		1	1	0	0	0	1^{β}	1
1	1	1	1	0	1	1		1	1	1	1	0	1	1		1	1	1	1	0	1	1

(a)   (b)   (c)

Question 2

Compute the opening of the image I operated by the structuring element E.
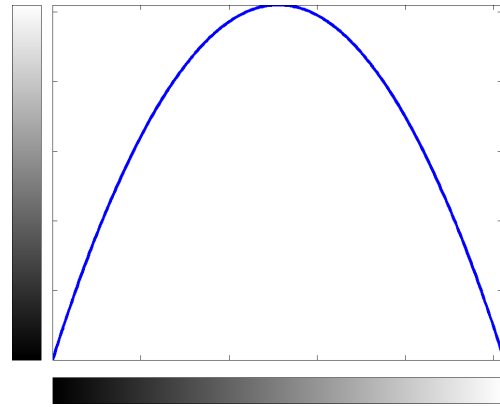

I E

Question 3

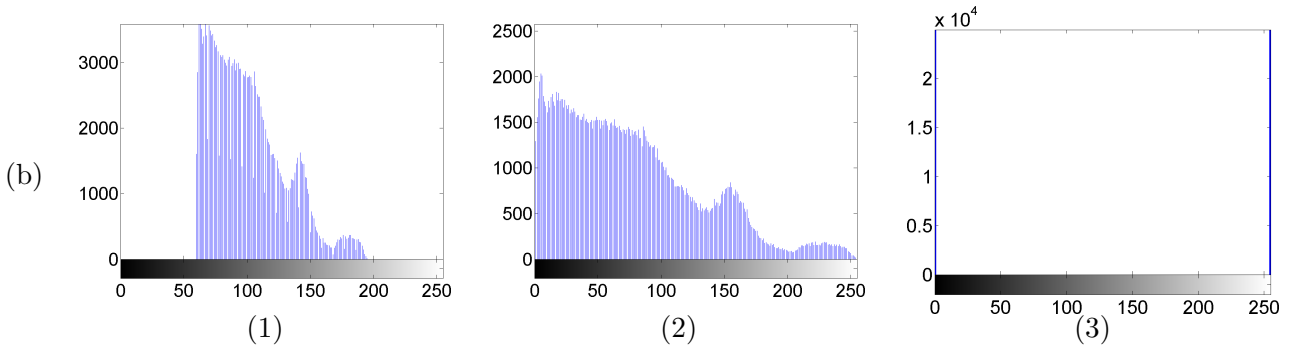Given the image I and the transformation T, indicate (justifying the choice):

(a) which among the following images is $T(I)$;

(b) which among the following histograms corresponds to I.

I

T

(a)

(1)   (2)   (3)   (4)

(b)

(1)   (2)   (3)

Question 4

Intensity based transformations.

Describe the fundamental concepts and the applications of these techniques.

Question 5

Frequency domain filtering techniques.

Describe the motivations for the use of these techniques and summarize an overview of the approaches belonging to this field.

Question 6

Design a system for capturing the trajectory of billiard balls.

A project is aimed at implementing a system for improving the replays of a billiard shot.

The scene is acquired by a camera and the position of the balls in each frame is detected. Then, the balls detected in subsequent frames are matched and the trajectory of each ball is reconstructed. Finally, the trajectories can be overimposed to the original frames, enriching the replay with the trajectories that will be covered by the balls.

Point out the techniques that can be used for obtaining the required data, explaining the motivations for those choices.