UNIVERSITÀ DEGLI STUDI
DI MILANO

Master Degree in Computer Science

Image Processing

academic year 2011–2012 Teacher: Stefano Ferrari

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

(a)

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

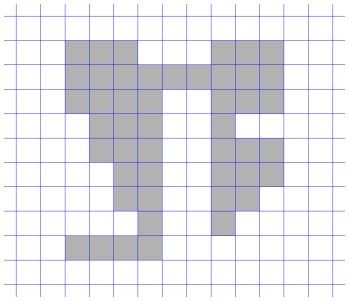
(b)

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

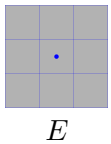
(c)

Question 2

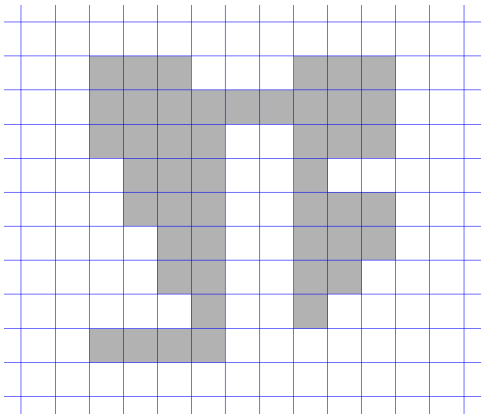
Compute the closing of the image I operated by the structuring element E.



I



E



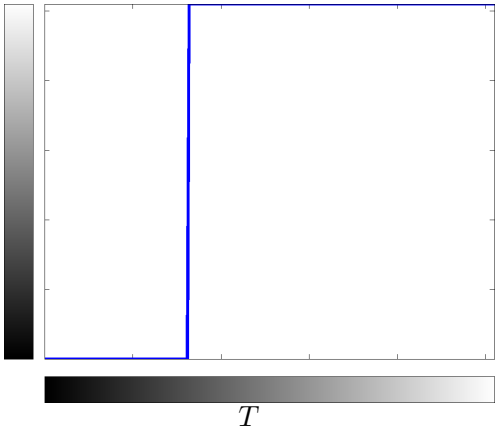
Question 3

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

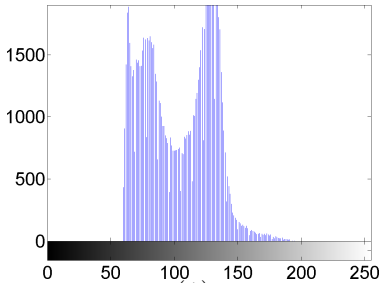


T

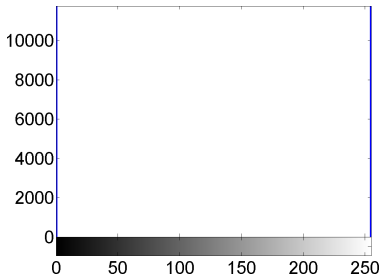
(a)

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

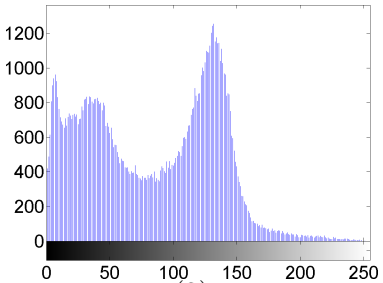
(b)



(1)



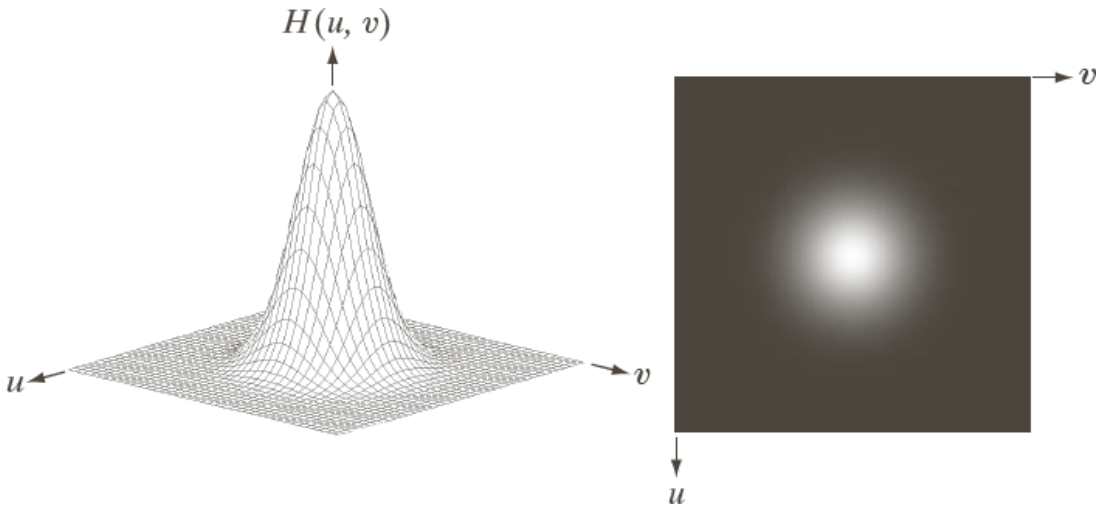
(2)



(3)

Question 4

The following figure depicts the Fourier transform of a function, h, both as diagram and image. Describe the processing steps required for using the function h as filter in the frequency domain and the expected effects of the processing on an image.



Question 5

Thresholding based segmentation 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 measuring the geometry of a key.

A project is aimed at implementing a system for acquiring the geometrical structure of a classical key (such as that depicted in the figure above).

In order to duplicate a key, the key geometry has to be known. The system here considered will obtain this information from images of the object.

Point out the techniques that can be used for obtaining the required data, explaining the motivations for those choices. Since the system has to be designed, feel free to add some considerations or requirements on the image capturing module in order to improve the results.