EE475 Homework 6

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I.

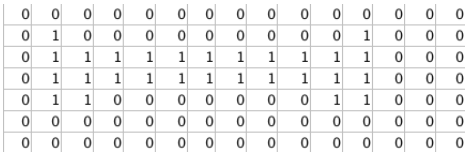


Fig. 1: eroded with the first structural element

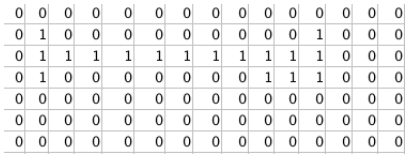


Fig. 2: eroded with the second structural element

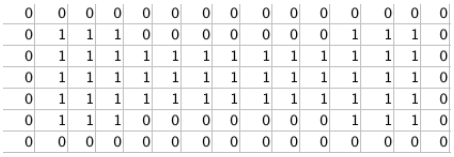


Fig. 3: eroded with the third structural element

II.

The answer to this question can be found on a seperate paper.

III.

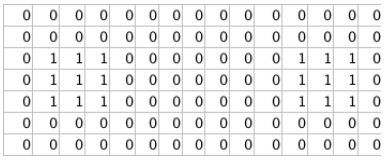


Fig. 4: opening of the given figure with a 3x3 structuring element of 1's

IV.

The first erosion take out all noise elements that do not touch the rectangle and increase the size of noise elements that are contained within the rectangle. The size of the rectangle is decreased too. Then the first dilation makes the noise components that were increased with erosion smaller. The size of the rectangle is increased and the corners are rounded after first dilation. The next dilation eliminates internal noise components completely and increases the size of the rectangle. The final erosion decreases the size of the rectangle. By the way the corners are still rounded.

V.

A.

We simply count the number of nonzero pixels as a fraction of the total number of pixels in the image. The result is 22.65% white pixels.

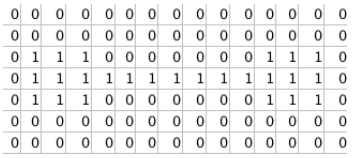


Fig. 5: closing of the given figure with a 3x3 structuring element of 1's

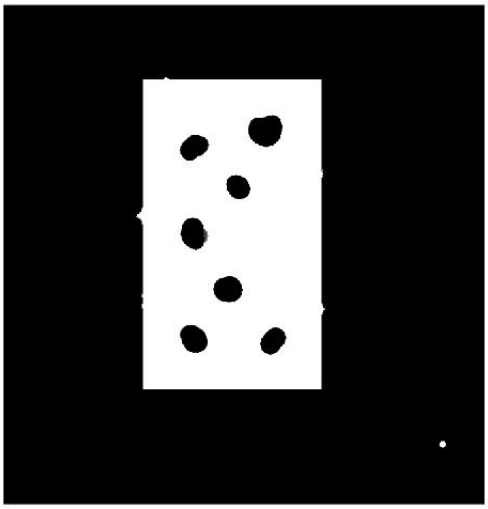


Fig. 6: erosion of the original

B.

There are 27 objects in the image. I first binarized the image and then used the function *bwconncomp()* to find connected components in a binary image.

C.

There are 10 holes in the image. I first took the complement of binarized image and then used the function *bwconncomp()* to find connected components. The result was 11, but one of them was the background itself. It's clear that the background cannot be counted as a hole. So there are 10 holes.

D.

In the beginning I labeled the binarized image with builtin function *bwlabel()*. With the help of this labeling I got the objects. Secondly I constrcuted a labeled image for holes after taking complement of the image and some preprocessing steps. Then I checked both labels and decide whether one object label corresponds to one hole label or more hole labels or no hole label. After checking I founded 6 objects with one or more holes.

E.

There are 11 sqaure objects in the image. I used the function *bwhitmiss()*. The inputs were the binarized image and two structural elements which were [1,1,1,1;1,0,0,0;1,0,0,0;1,0,0,0] and [0,0,0;0,1,0;0,0,0]. The hit miss operation preserves pixels

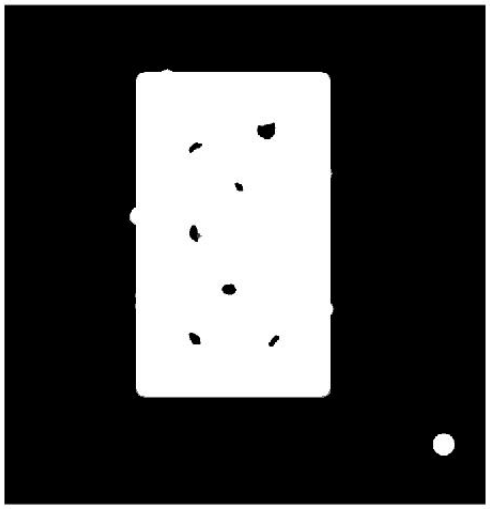


Fig. 7: dilation of figure 6

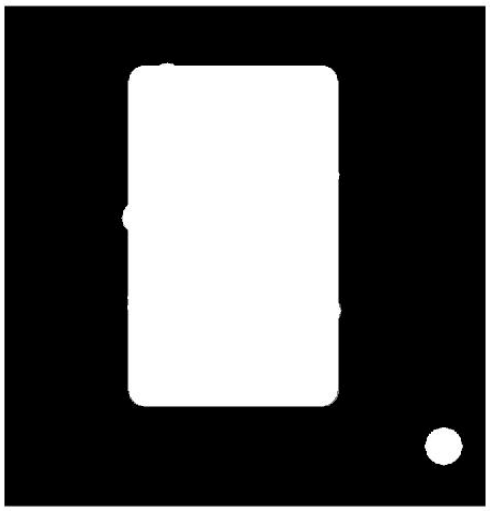


Fig. 8: dilation of figure 7

in binary image whose neighborhoods match the shape of first structural element and don't match the shape of second structural element. As ouput I get a binary image which have just 11 true values. The output can be seen on figure 10.

F.

First I found the square objects as I did in the previous question(See Figure 10.) Then I dilated the image on figure 10 to see the exact places of squares better. Then I detected the objects with holes and labeled them. After these steps I founded out the number of square objects that have holes as 2.

G.

I have already markers for the square objects. The only thing to do is to label the objects that have no holes and then compare these two labeled images and determine how many of them are not a sqaure. Labeling the objects that have no holes is as simple as labeling the objects that have holes. For further details please see my code, I used the builtin functions like *imdilate(), imcomplement(), bwlabel(), imbinarize()*.

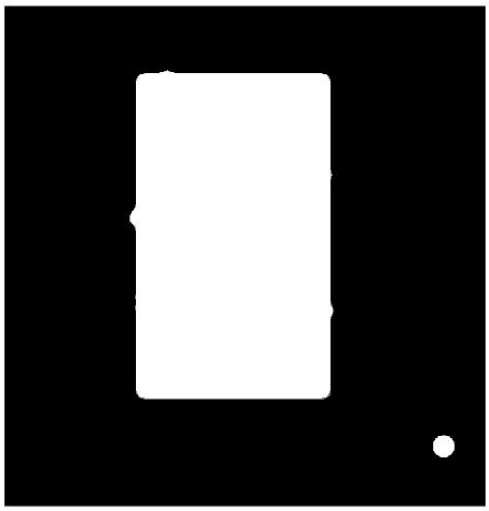


Fig. 9: final erosion

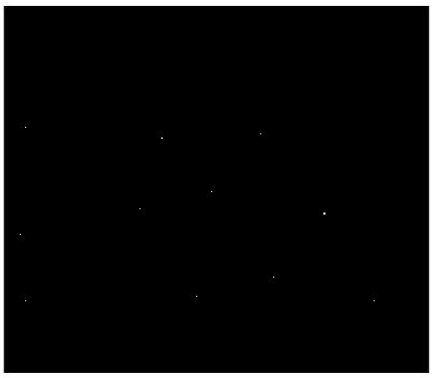


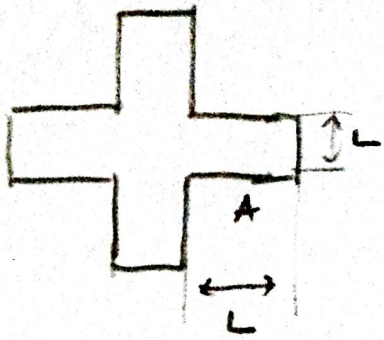
Fig. 10: output of square detector

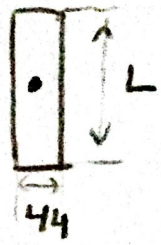
II)

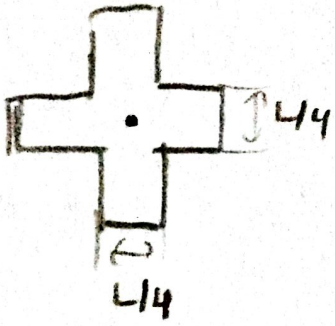
a) $(A \ominus B^4) \oplus B^2$

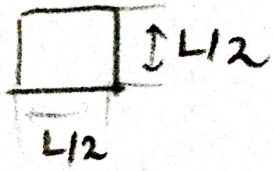
b) $(A \ominus B^1) \oplus B^3$

c) $(A \oplus B^4) \oplus B^3$

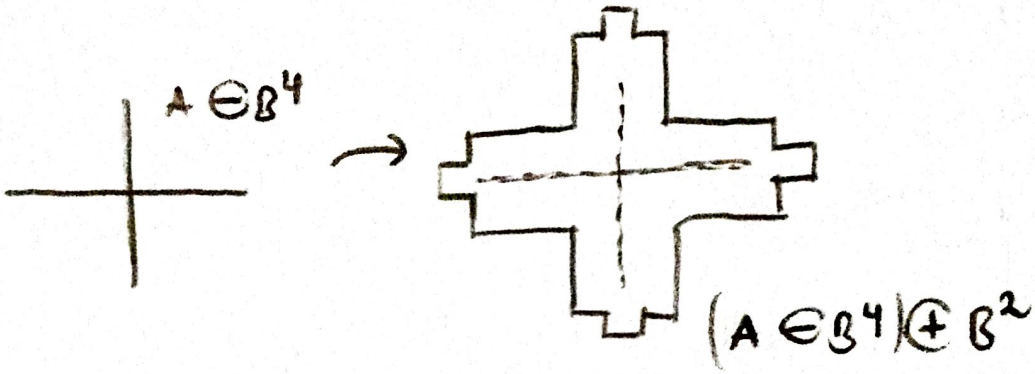


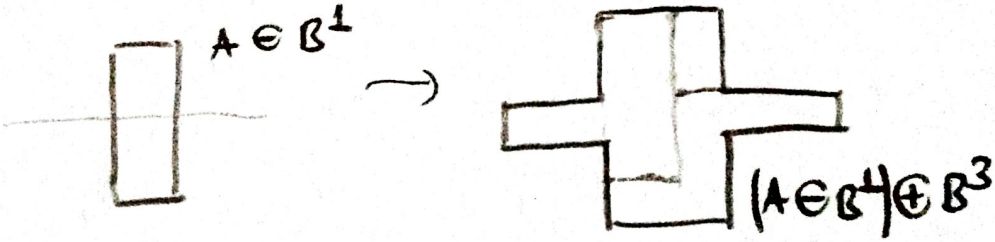
B^1 

B^2 

B^3 

B^4 

a) 

b) 

c)