

Homework #2
Due Tu. 9/29

Be sure to show all your work for credit. You must turn in your code as well as output files (**code attached at the end of the report**).

Please generate a report that contains the code and output in a single readable format using Latex.

0. Getting Started

- Download the homework images from the class website.
<http://www.ee.unlv.edu/~b1morris/ecg782/hw/hw02>

1. (GW 6.17) Perform the operation in Matlab for parts (b) and (c).

Solution

- (a) Because the infrared image which was used in place of the red component image has very high graylevel values.
- (b) The water appears as solid black (0) in the near infrared image [Fig. 6.27(d)]. Threshold the image with a threshold value slightly larger than 0. The result is shown in Fig. P6.17. It is clear that coloring all the black points in the desired shade of blue presents no difficulties.
- (c) Note that the predominant color of natural terrain is in various shades of red. We already know how to take out the water from (b). Thus a method that actually removes the "background" of red and black would leave predominantly the other man made structures, which appear mostly in a bluish light color. Removal of the red [and the black if you do not want to use the method as in (b)] can be done by using the technique discussed in Section 6.7.2.

2. (GW 6.28) Use Matlab to plot the surface. *Hint: ellipsoid.m.*

Solution

The sketch is an elongated ellipsoidal figure in which the length lined up with the R-axis is 8 times longer than the other two dimensions. In other words, the figure looks like a blimp aligned with the R-axis.

3. Prove the validity of the duality expressions:

- (a) $(A \oplus B)^C = A^C \ominus \hat{B}$
- (b) $(A \bullet B)^C = (A^C \circ \hat{B})$
- (c) $(A \circ B)^C = (A^C \bullet \hat{B})$

Solution

- (a)

$$\begin{aligned}
 (A \bullet B)^c &= [(A \oplus B) \ominus B]^c \\
 &= (A \oplus B) \oplus \hat{B} \\
 &= (A^c \ominus \hat{B}) \oplus \hat{B} \\
 &= A^c \circ \hat{B}
 \end{aligned}$$

4. Dilate the image given in Figure 13.50(a) with the structuring element in (b). Do this by hand and using Matlab.

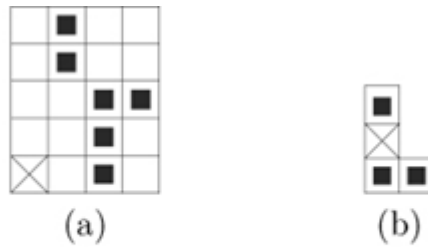


Figure 13.50: (a) Image to be processed. Assume that image data are undefined outside of the image domain. (b) Structuring element.
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Solution

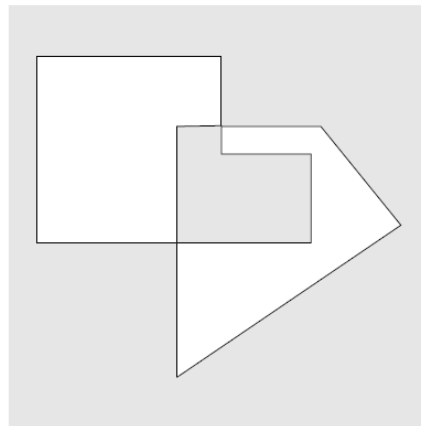
Remember that dilate has to look at the reflection of the structuring element. $A \oplus B = \{z | (\hat{B})_z \cap A \neq \emptyset\}$.

$$\begin{array}{ccccc} 0 & 1 & 0 & 0 \\ 0 & 1 & 1 & 1 \\ 0 & 1 & 1 & 0 \\ 0 & 0 & 1 & 1 \\ 0 & 0 & 1 & 1 \end{array}$$

5. (GW 2.23)

Solution

- (a) See sketch below

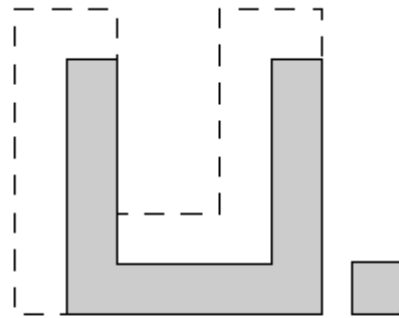


$$(A \cap B) \cup (A \cup B)^c$$

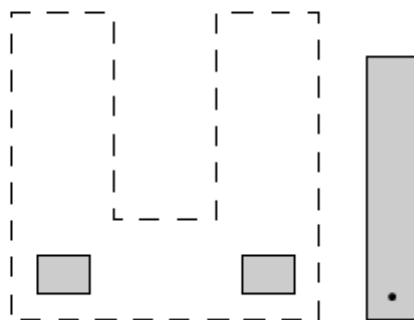
- (b) With reference to the sets shown in the problem statement, the answers are, from left to right,

$$\begin{aligned} & (A \cap B \cap C) - (B \cap C) \\ & (A \cap B \cap C) \cup (A \cap C) \cup (A \cap B) \\ & \{B \cap (A \cup C)^c\} \cup \{(A \cap C) - [(A \cap C) \cap (B \cap C)]\} \end{aligned}$$

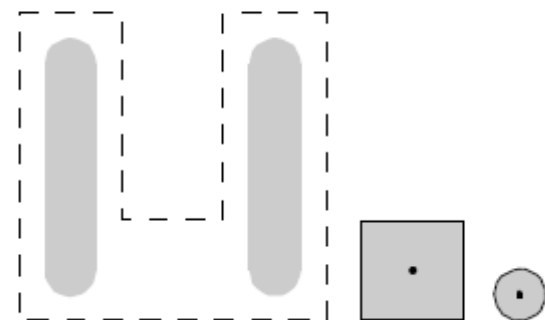
6. (GW 9.5)

Soution

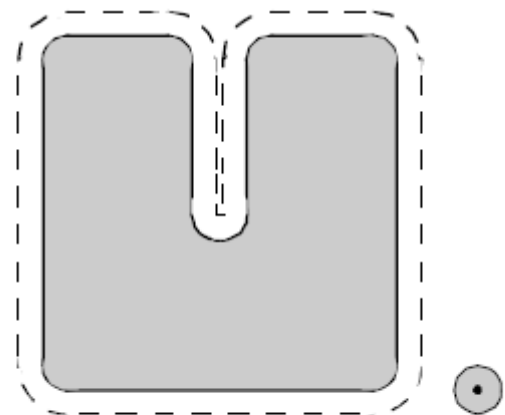
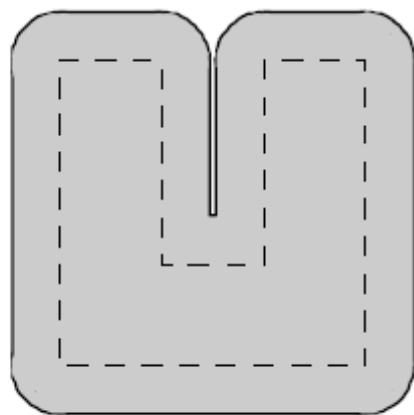
(a)



(b)

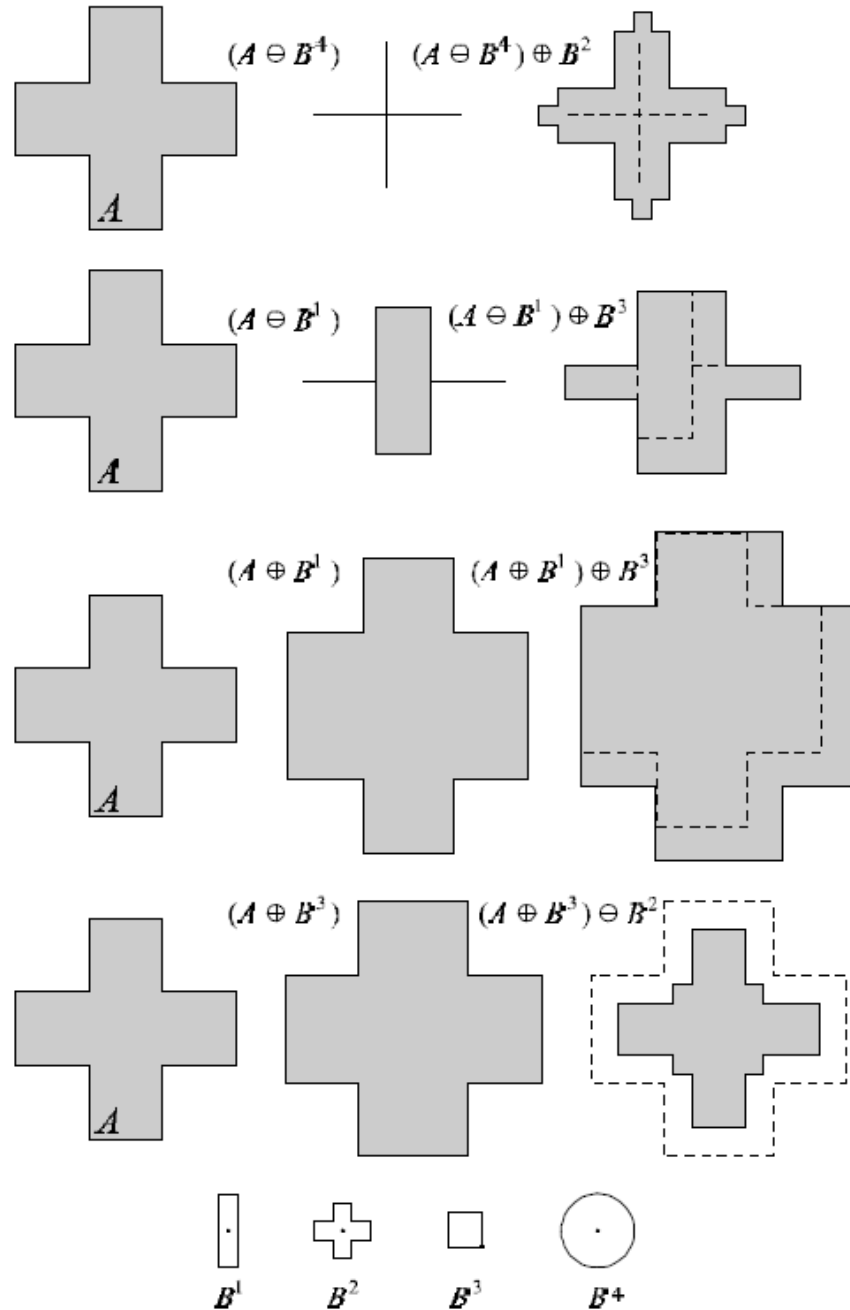


(c)



(d)

7. (GW 9.6)

Soution

8. (GW 9.19)

Solution

Select a one pixel border around the image of the T, assuming that the resulting subimage is odd, let the origin be located at the horizontal/vertical midpoint of this subimage (if the dimensions were even, we could just as easily select any other point). The resulting of applying the hit-or-miss transform would be a single point where the two T's were in perfect registration. The location of the point would be the same as the origin of the structuring element.