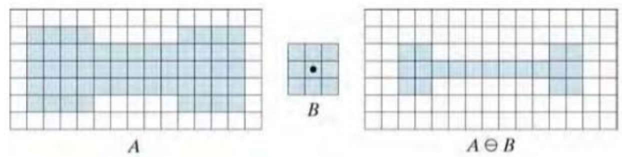
Solutions to Optional Homework (Lecture 10)

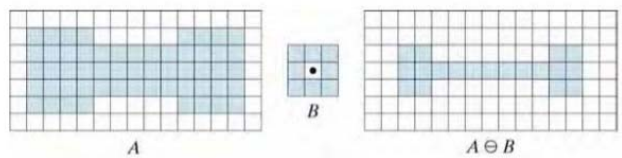
Problem 9.2

[Note: We recommend that you solve this problem by hand to gain experience. However, if you use **imerode** (MATLAB Image Processing Toolbox) to solve the problem or check your hand-solution, be sure to construct your structuring element using `B = strel('arbitrary', SE)`, where SE is one of the structuring elements in the problem statement. Failure to do this can lead to unexpected results in some cases.]

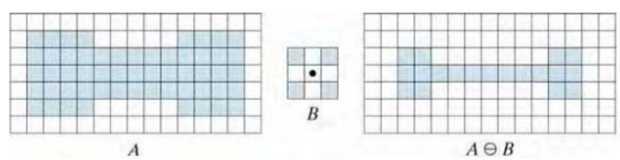
(a)



(b)

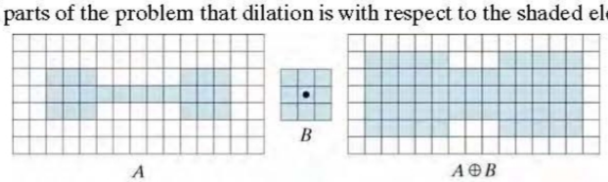


(c)

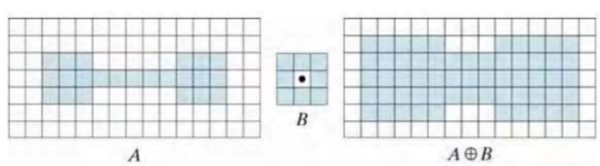


Problem 9.6

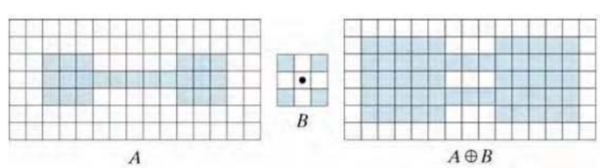
(a) Keep in mind in all parts of the problem that dilation is with respect to the shaded elements of B.



(b)



(c)



Problem 9.8

In the following, the origin of the structuring elements is shown as a black dot.

(a) Erode the original set (shown dashed) with the structuring element shown (note that the origin is at the bottom, right).

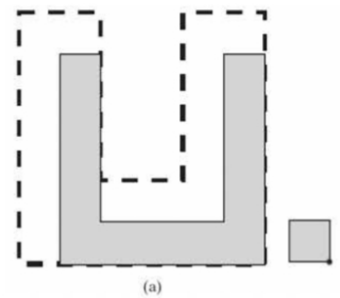


Figure P9.8(a)

(b) Erode the original set (shown dashed) with the tall rectangular structuring element shown.

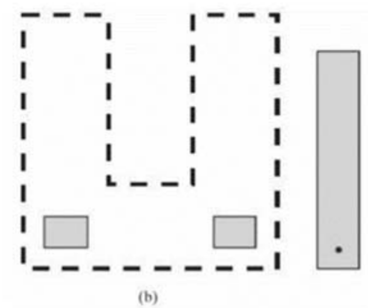


Figure P9.8(b)

(c) First erode the set down to two vertical lines using the rectangular structuring element (note that this element is slightly taller than the center section of the "U" figure). Then dilate the result with the circular structuring element.

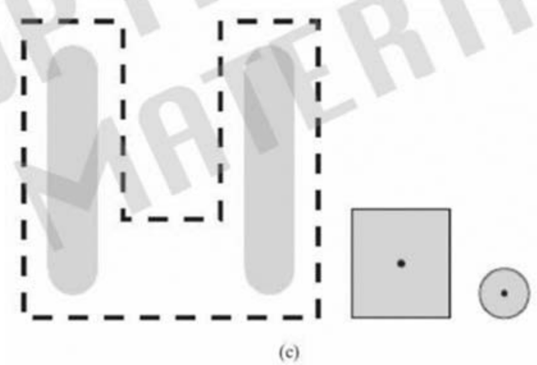
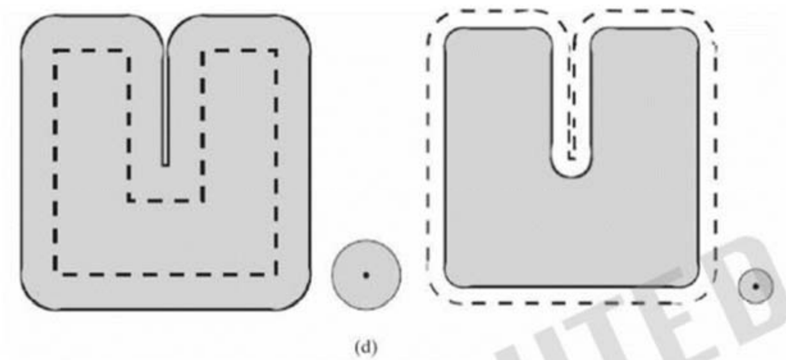


Figure P9.8(c)

(d) First dilate the original set with the large disk shown. Then erode the dilated image with a disk whose diameter was equal to one-half the diameter of the disk used for dilation.



(d)

Figure P9.8(d)

Problem 9.12

We have to show that

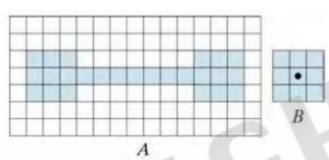
$$A \ominus B = \left\{ w \in Z^2 \middle| w + b \in A \text{ for every } b \in B \right\} = \left\{ w \in Z^2 \middle| (B)_w \subseteq A \right\}$$

The right side follows directly from the definition of translation because the set $(B)_w$ has elements of the form $w + b$ for $b \in B$. That is, $w + b \in A$ for *every* $b \in B$ implies that $(B)_w \subseteq A$. Conversely, $(B)_w \subseteq A$ implies that *all* elements of $(B)_w$ are contained in A, or, equivalently, that $w + b \in A$ for every $b \in B$.

Problem 9.18

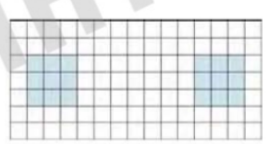
(a)

Set A and structuring element B:



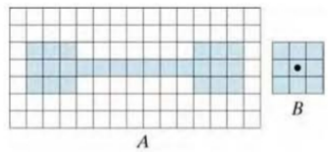
Erosion of A by B:

Dilation of the Erosion (Opening)

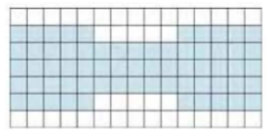


(b)

Set A and structuring element B:



Dilation of A by B:



Erosion of the Dilation (Closing):