

Morphological Image Processing

Image Processing

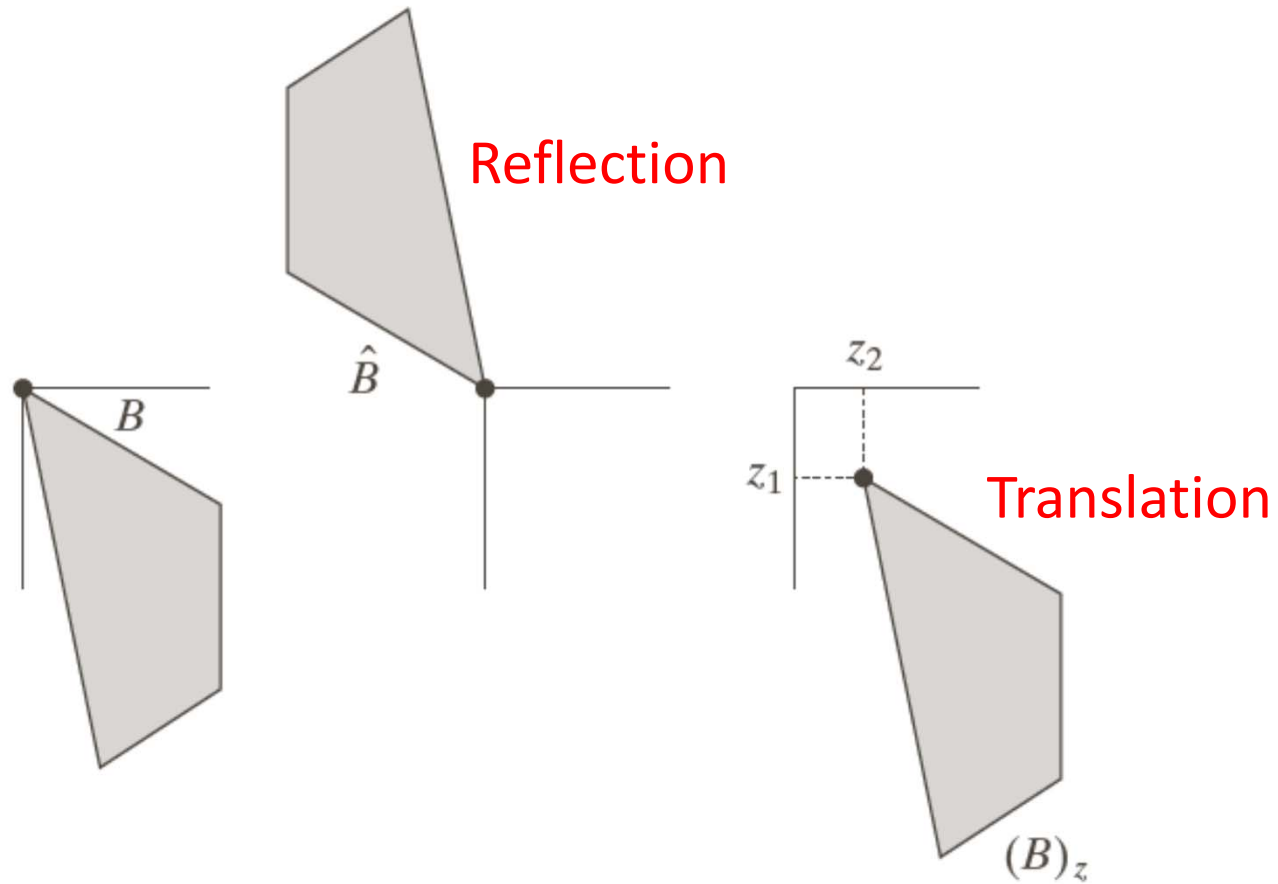
CSE 166

Lecture 15

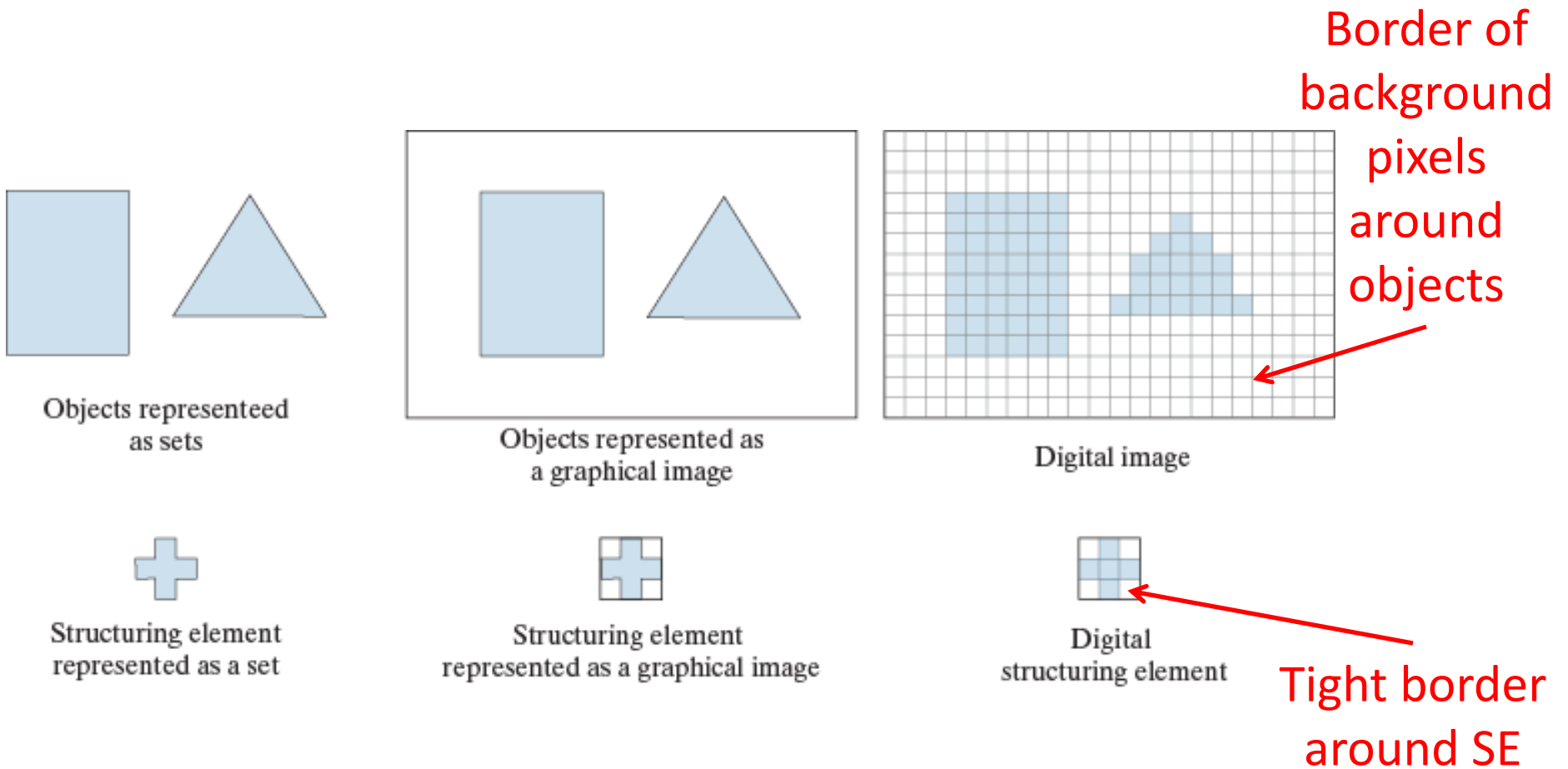
Reading

- Digital Image Processing, 4th edition
 - Chapter 9: Morphological image processing
 - Section 9.1: Preliminaries
 - Section 9.2: Erosion and dilation
 - Section 9.3: Opening and closing
 - Section 9.5: Some basic morphological algorithms
 - Through subsection connected components

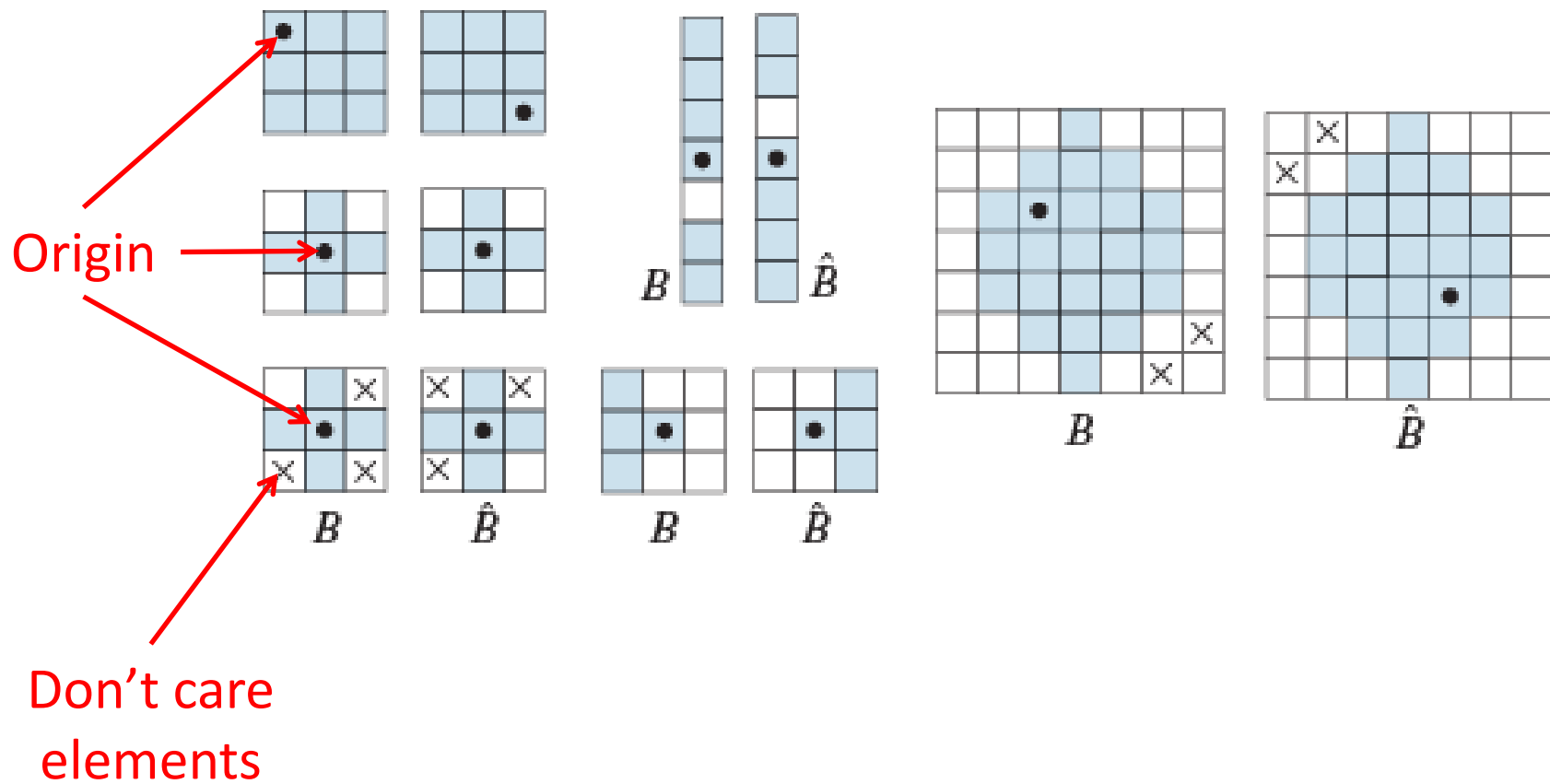
Reflection and translation



Sets of pixels: objects and structuring elements (SEs)

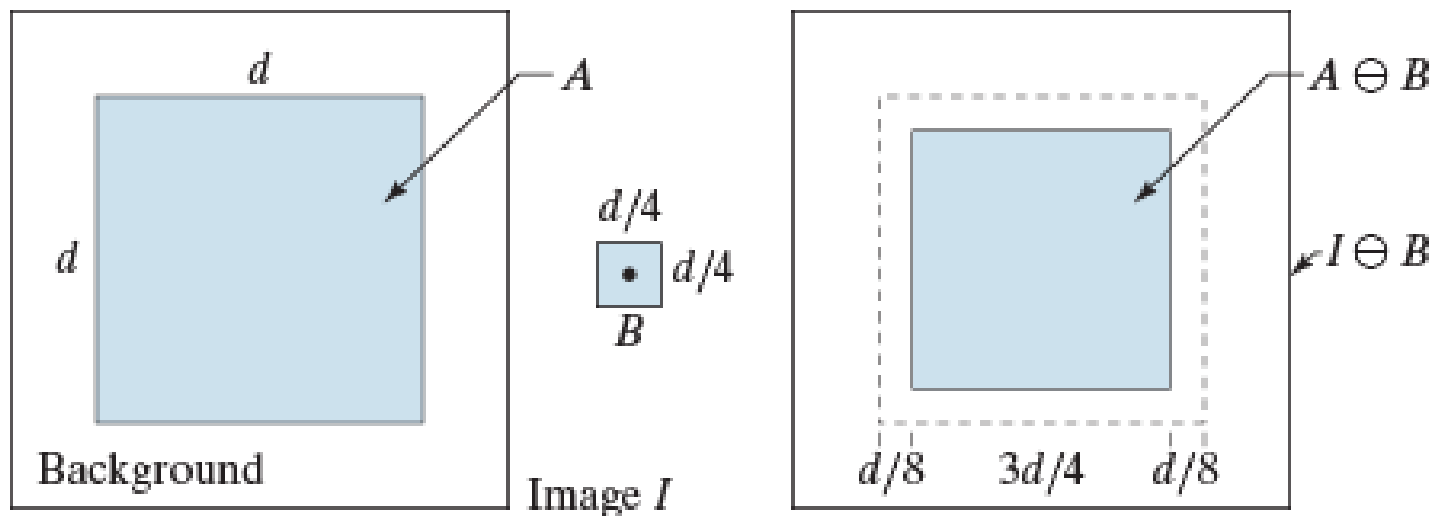


Reflection about the origin



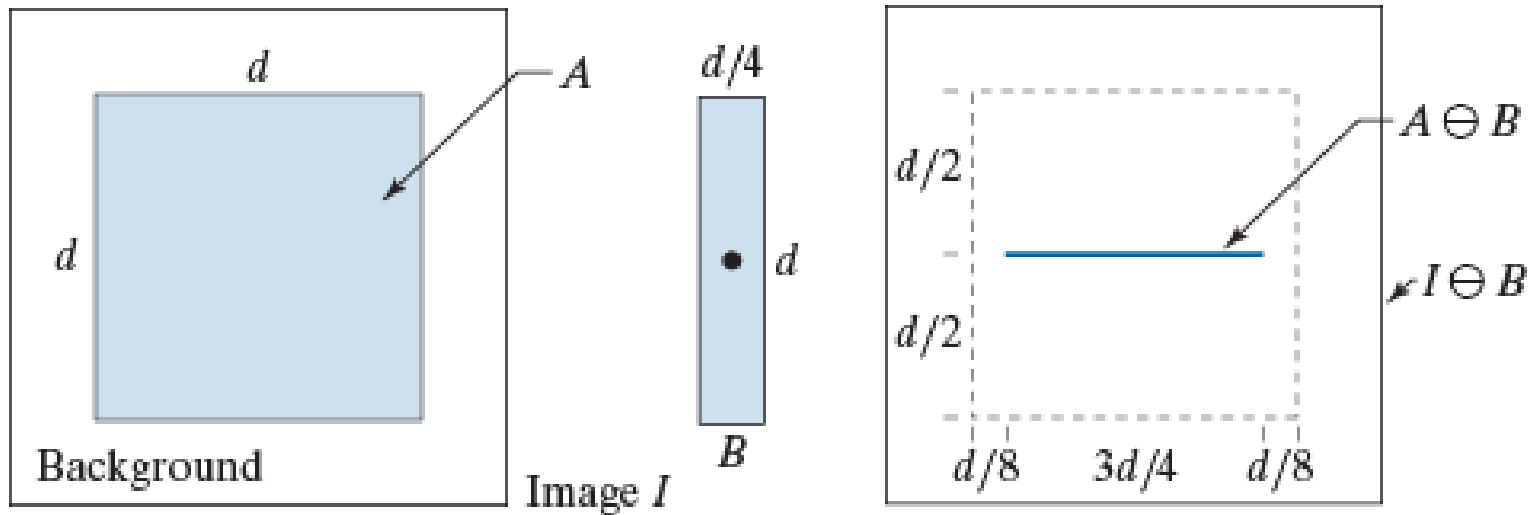
Erosion

Example: square SE



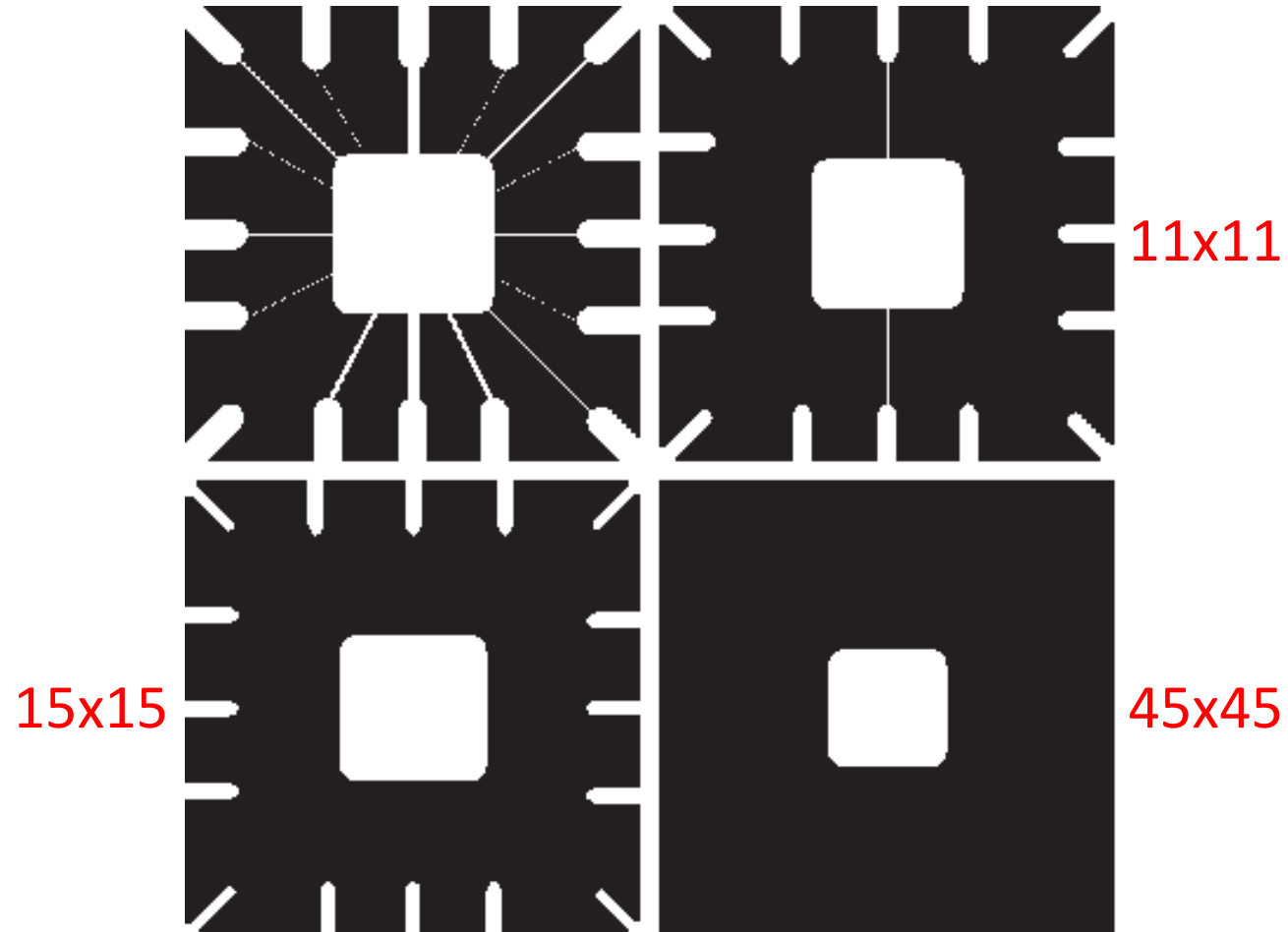
Erosion

Example: elongated SE



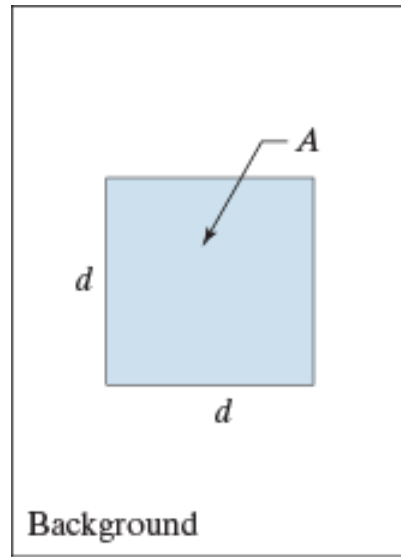
Erosion

Shrinks

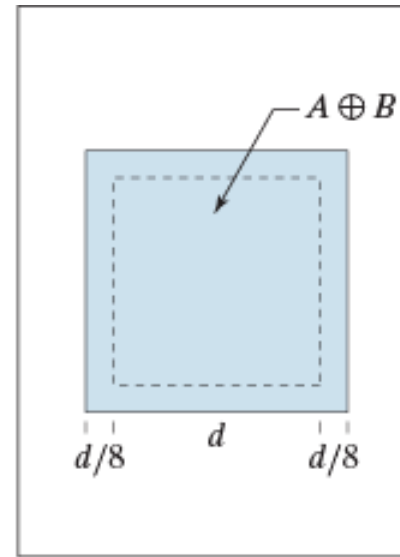
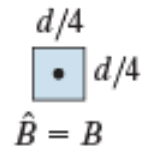


Dilation

Examples

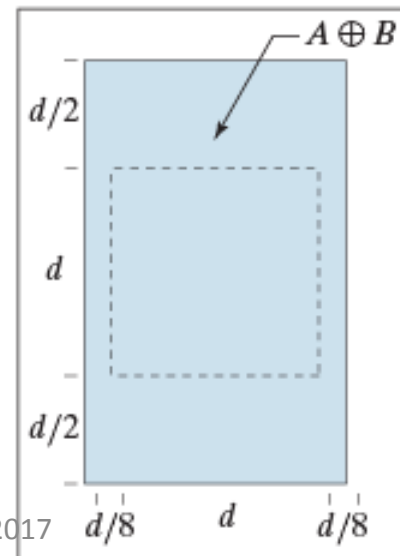
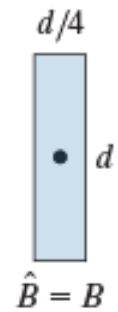


Image, I



$I \oplus B$

Square SE



$I \oplus B$

Elongated SE

Dilation

Expands

Historically, certain computer programs were written using only two digits rather than four to define the applicable year. Accordingly, the company's software may recognize a date using "00" as 1900 rather than the year 2000.

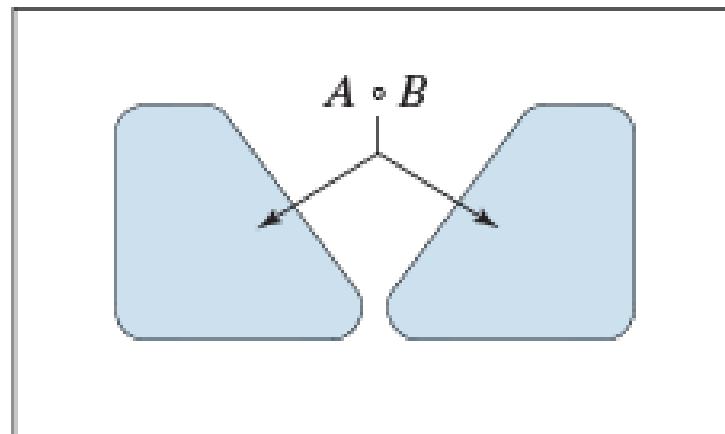
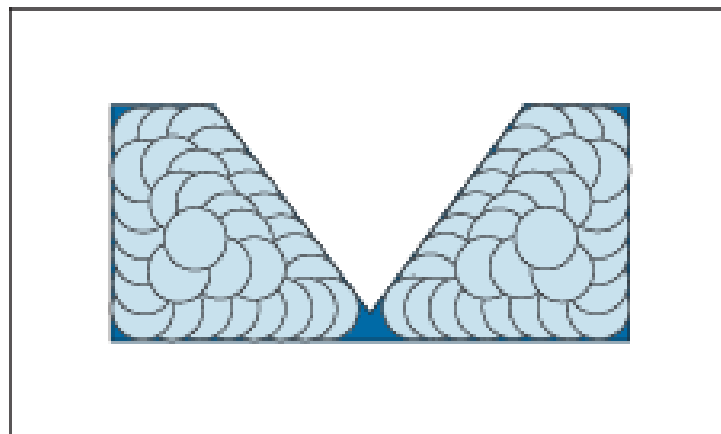
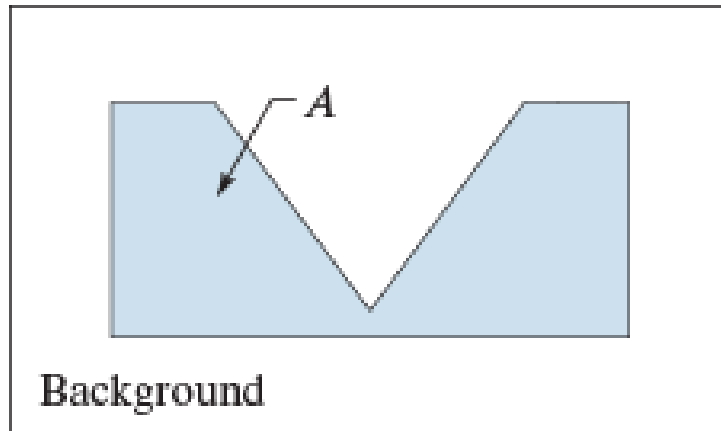


Historically, certain computer programs were written using only two digits rather than four to define the applicable year. Accordingly, the company's software may recognize a date using "00" as 1900 rather than the year 2000.



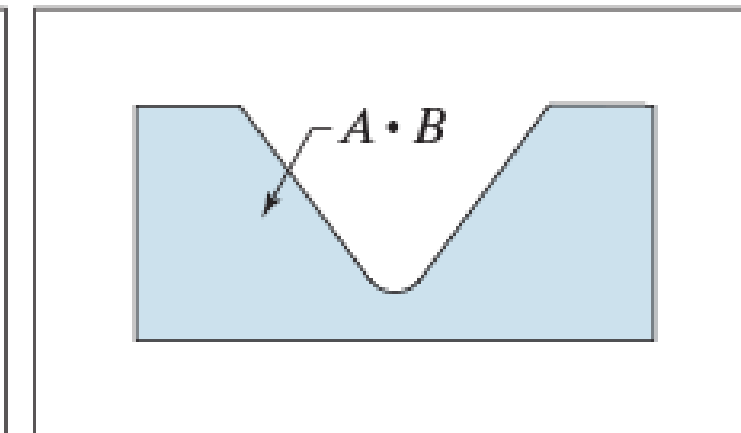
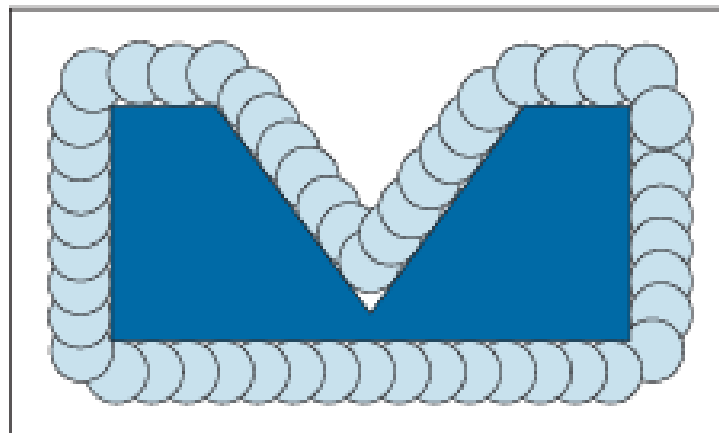
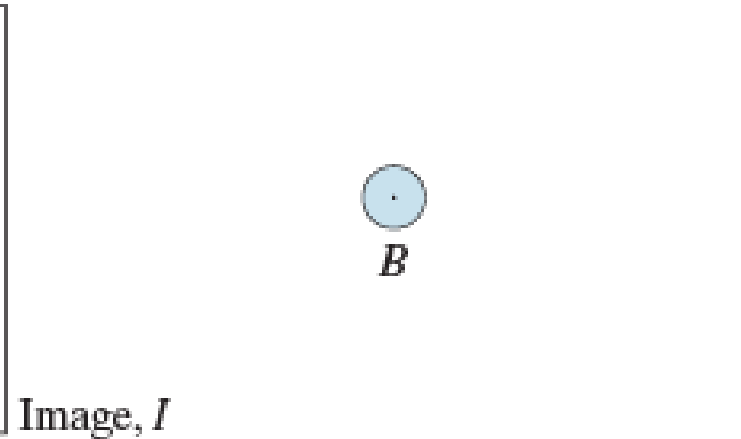
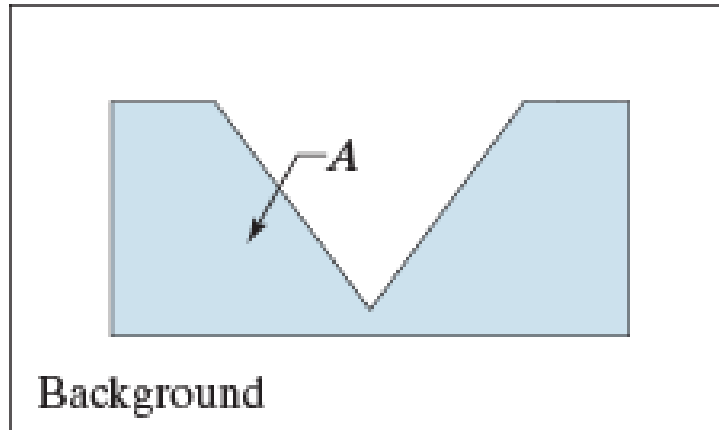
1	1	1
1	1	1
1	1	1

Opening



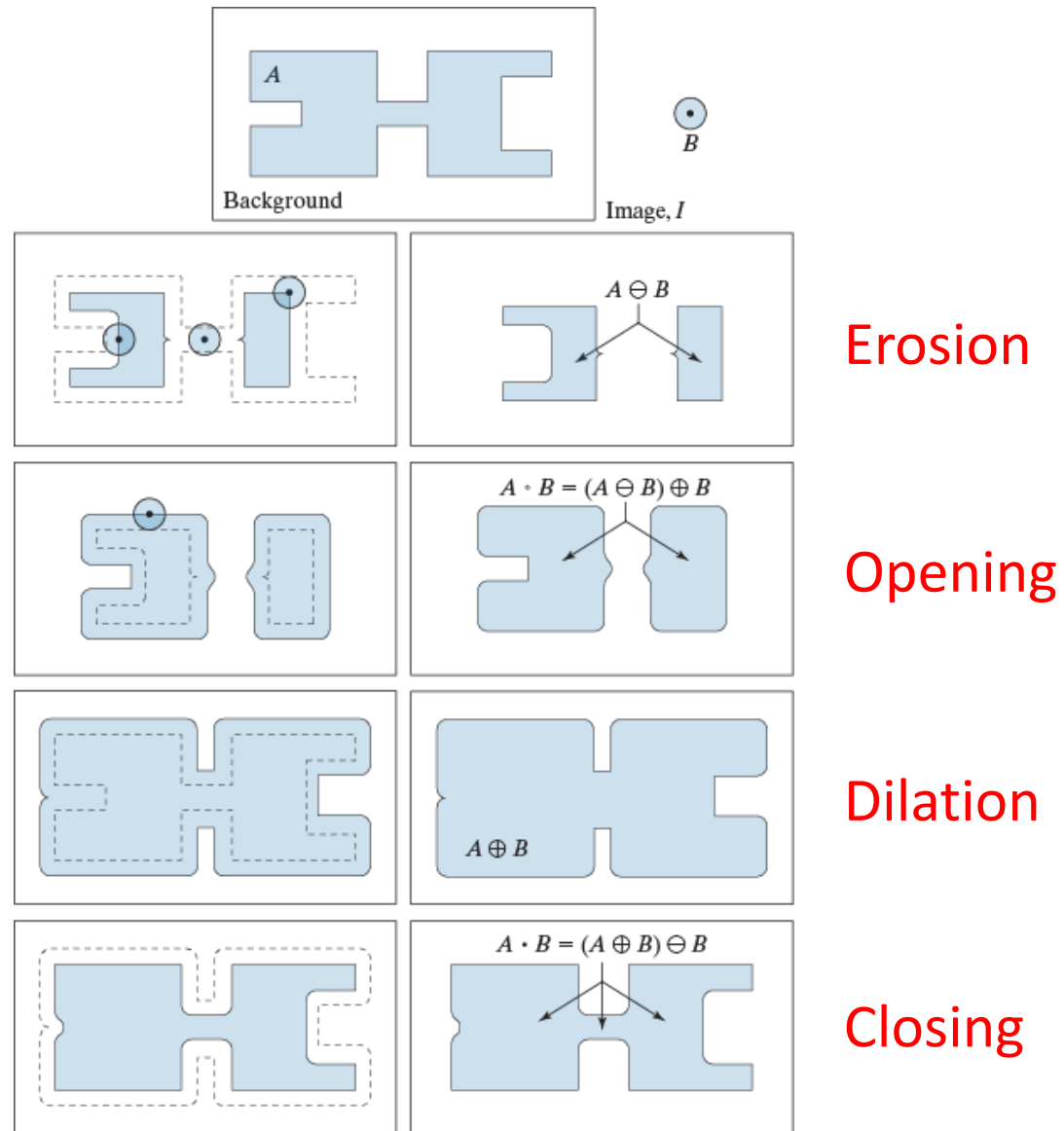
Structuring element rolls along **inner** boundary

Closing

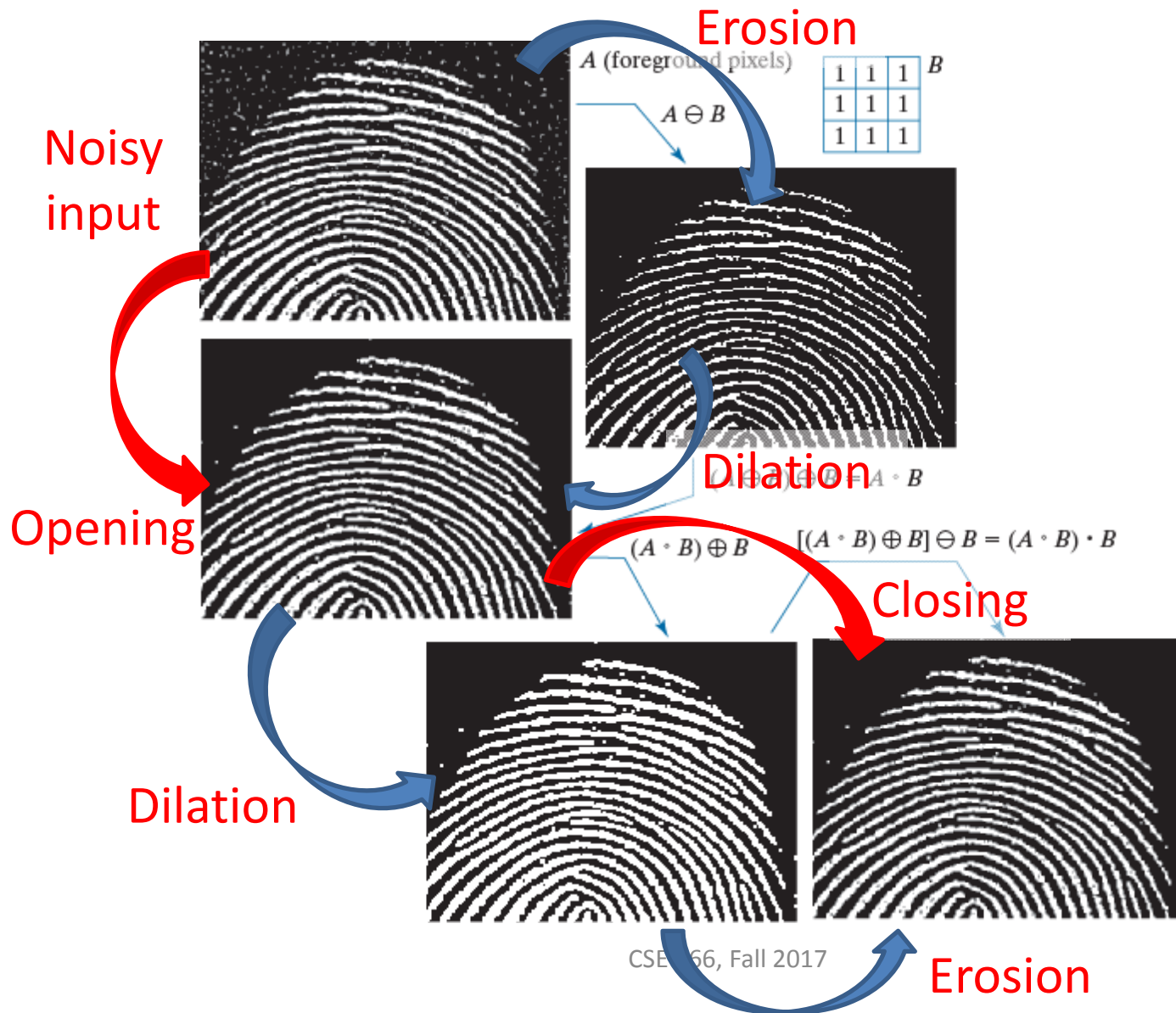


Structuring element rolls along **outer** boundary

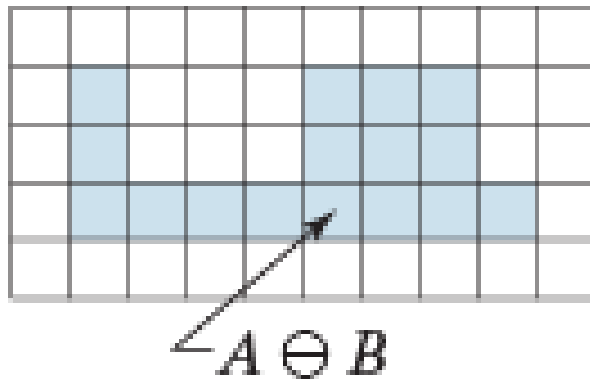
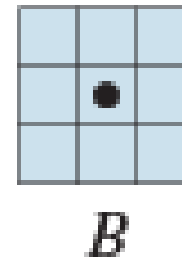
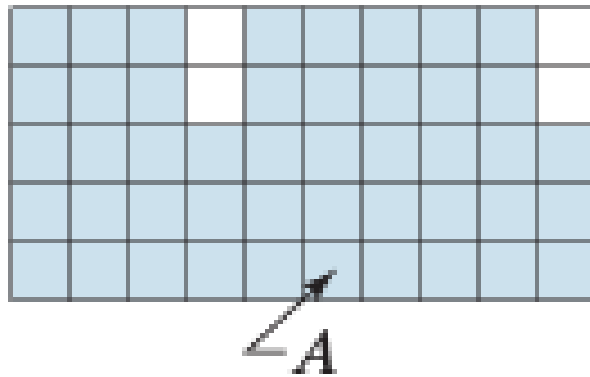
Opening and closing



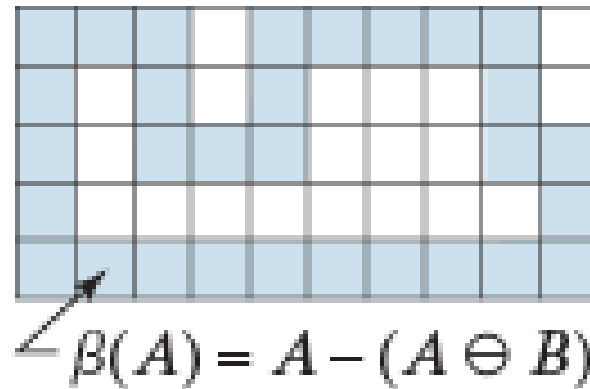
Morphological image processing



Boundary extraction

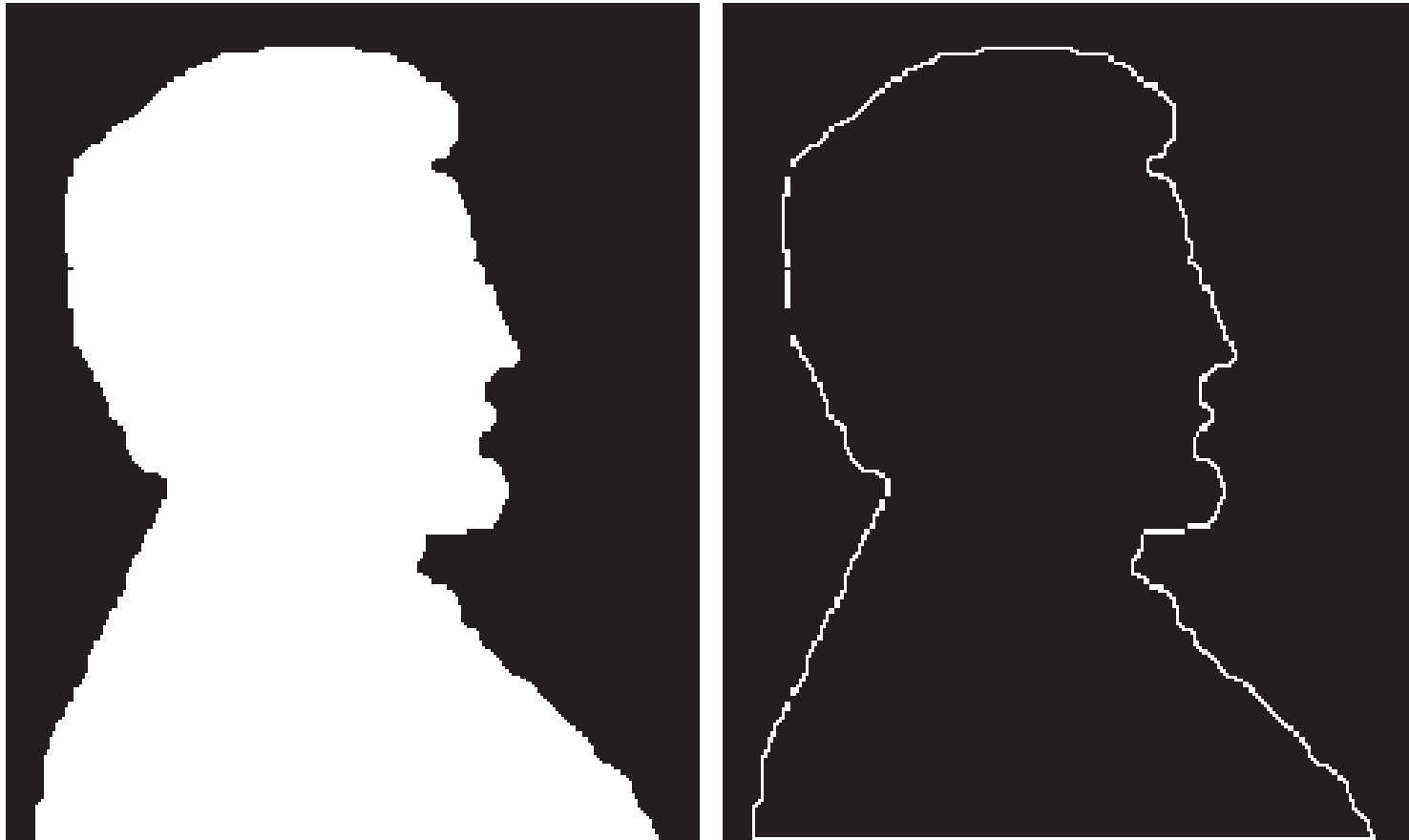


Dilation



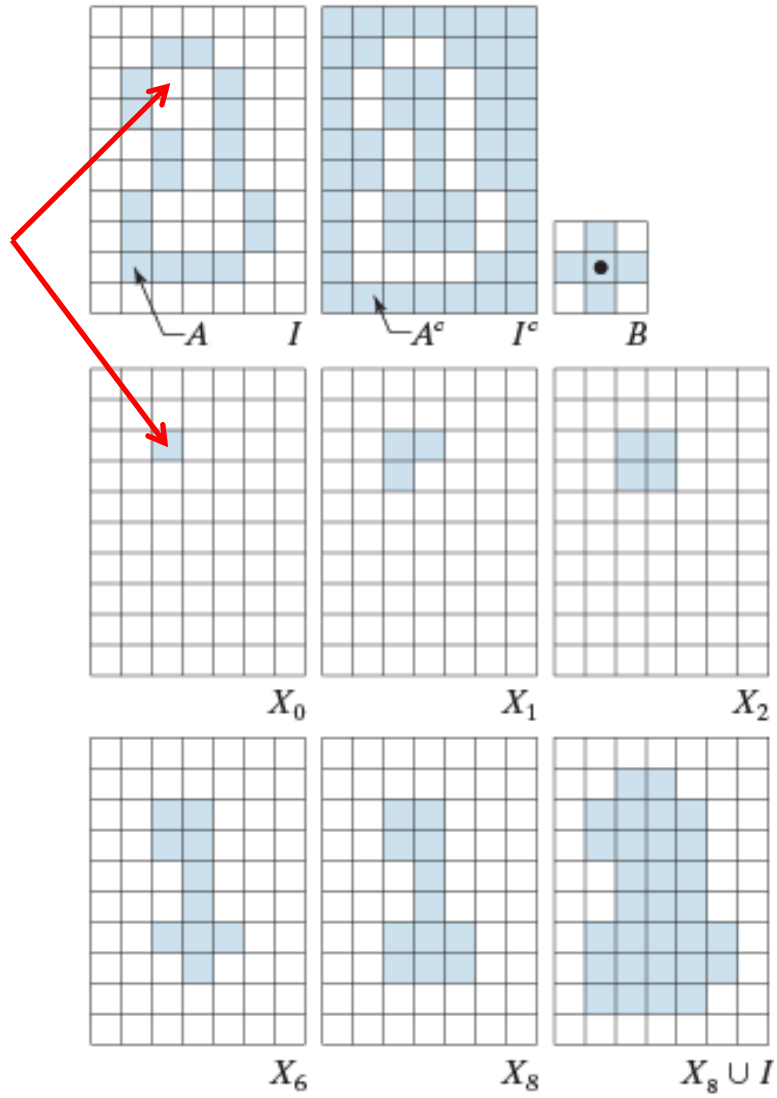
Set difference

Boundary extraction



Hole filling

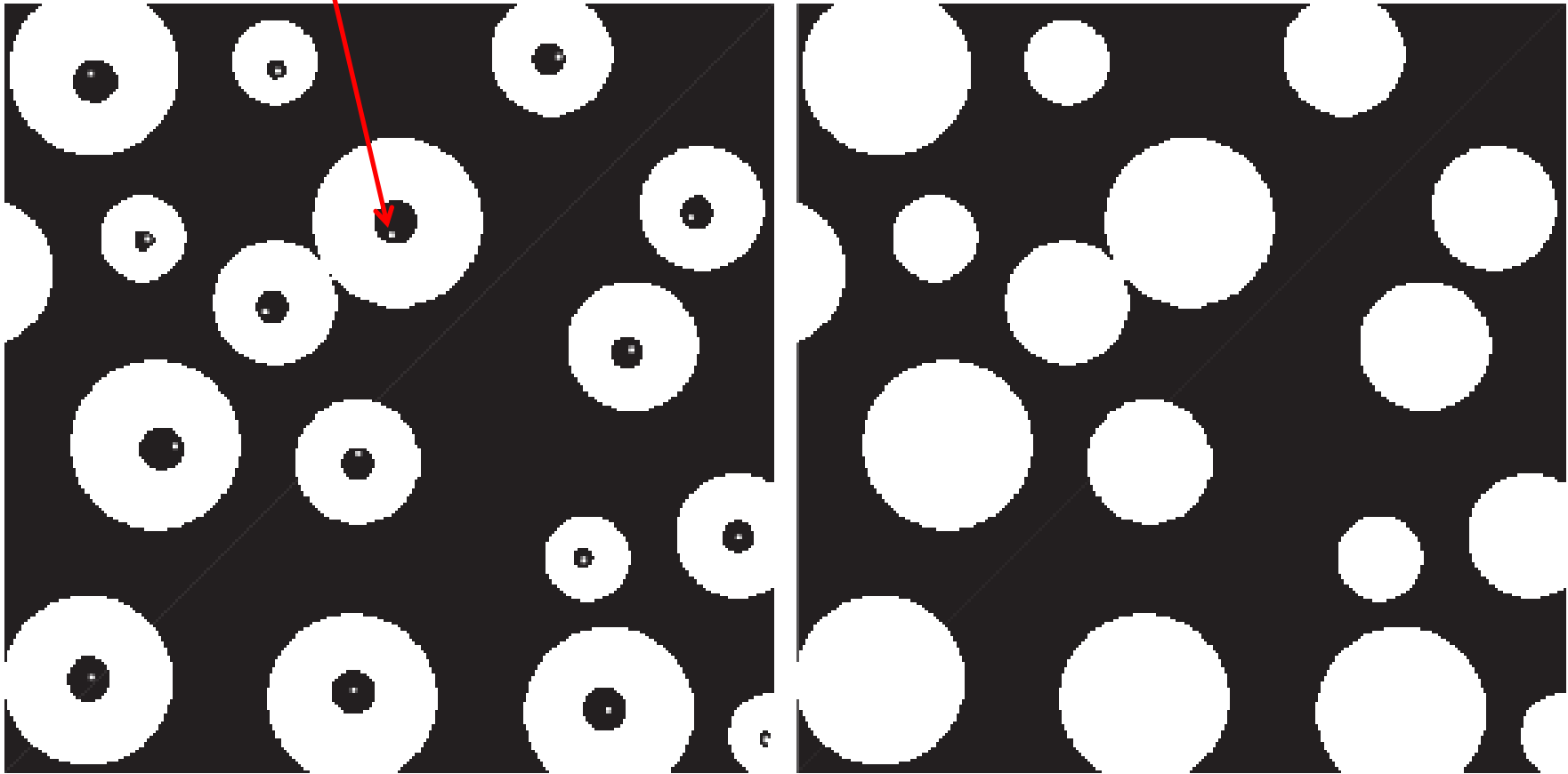
Given point
in hole



Hole filling

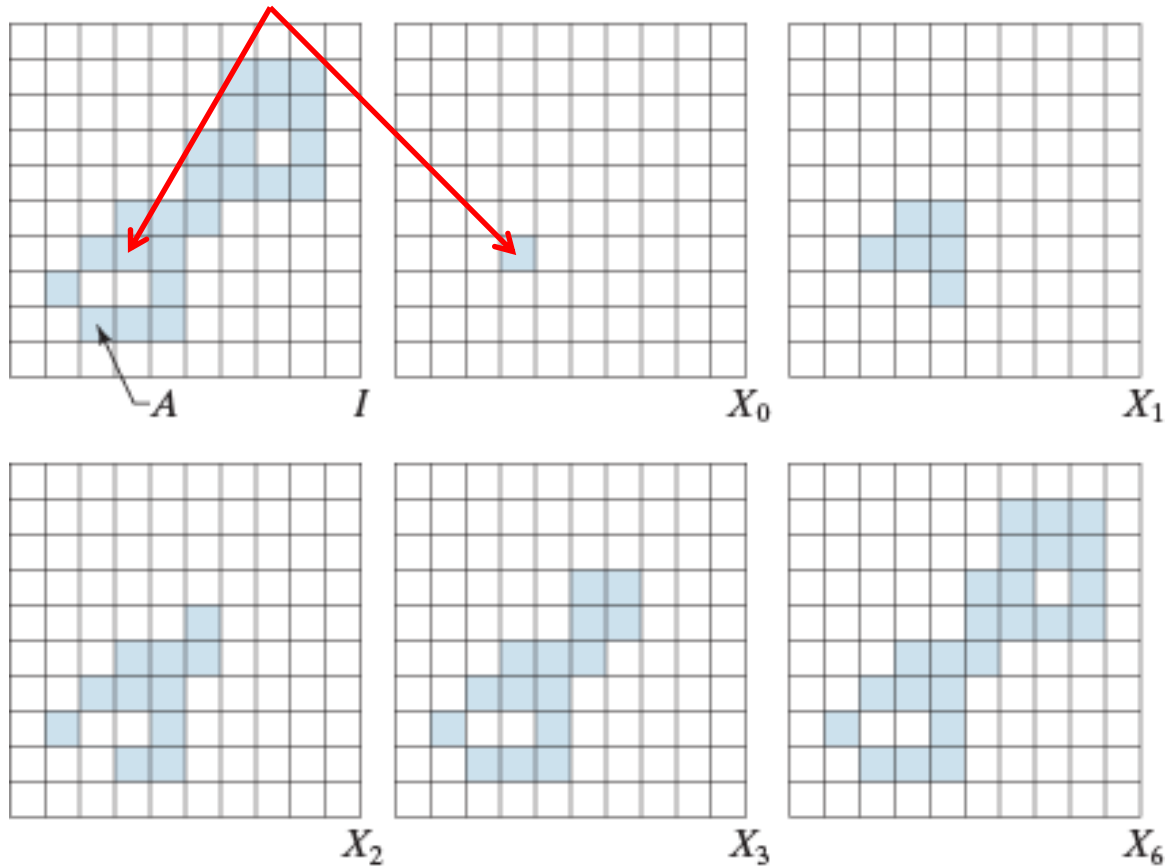
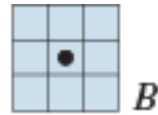
Given points in holes

All holes filled

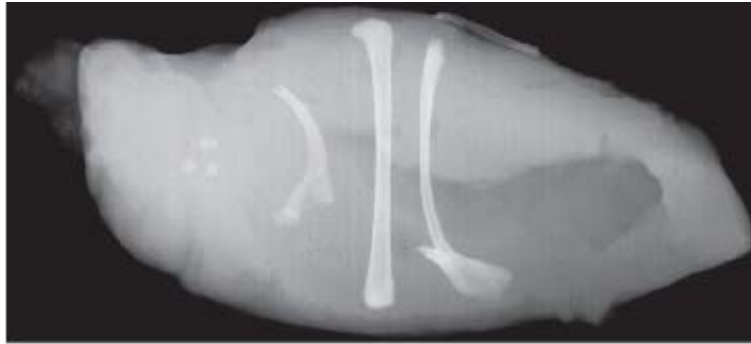


Connected components

Given point
in A



Connected components



X-ray image



Connected component	No. of pixels in connected comp
01	11
02	9
03	9
04	39
05	133
06	1
07	1
08	743
09	7
10	11
11	11
12	9
13	9
14	674
15	85

15
connected
components