Binary Images

Binary Images

- Images with only two values (0 or 1)

- Simple to process and analyze

- Very useful for industrial applications

Question: How do we actually determine which portion of the image is black or white?

Thresholding

Thresholding

- A natural way to segment image regions is through thresholding,

- The separation of light and dark regions.

- Thresholding creates binary images from grey-level ones by turning all pixels below some threshold to zero and all pixels about that threshold to one.

- (What you want to do with pixels at the threshold doesn't matter, as long as you're consistent.)
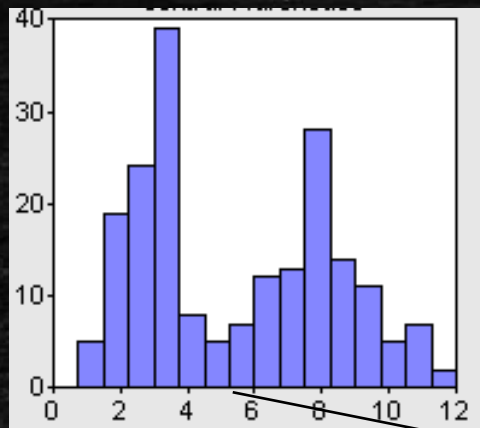
Thresholding Problems

- The major problem with thresholding is that we consider only the intensity, not any relationships between the pixels.

- There is no guarantee that the pixels identified by the thresholding process are contiguous.

- We can easily include extraneous pixels that aren't part of the desired region, and we can just as easily miss isolated pixels within the region (especially near the boundaries of the region).

- These effects get worse as the noise gets worse, simply because it's more likely that a pixels intensity doesn't represent the normal intensity in the region.

- When we use thresholding, we typically have to play with it, sometimes losing too much of the region and sometimes getting too many extraneous background pixels.

- (Shadows of objects in the image are also a real pain—not just where they fall across another object but where they mistakenly get included as part of a dark object on a light background.)

OCTAVE Function

BW = im2bw(I,level) converts the grayscale image I to binary image BW, by replacing all pixels in the input image with luminance greater than level with the value 1 (white) and replacing all other pixels with the value 0 (black).

This range is relative to the signal levels possible for the image's class. Therefore, a level value of 0.5 corresponds to an intensity value halfway between the minimum and maximum value of the class.
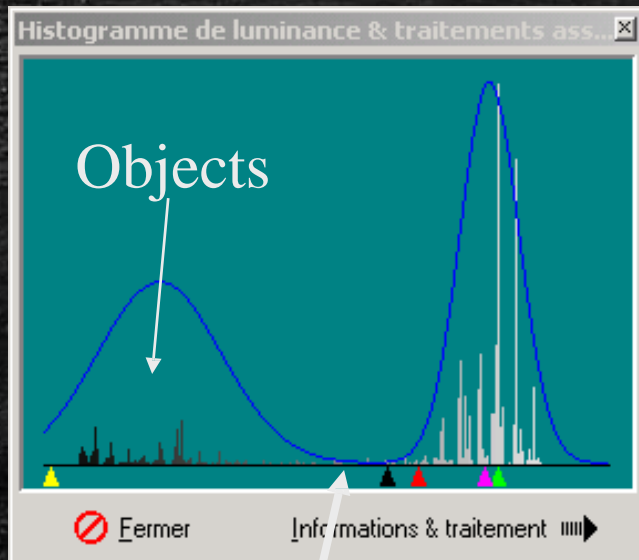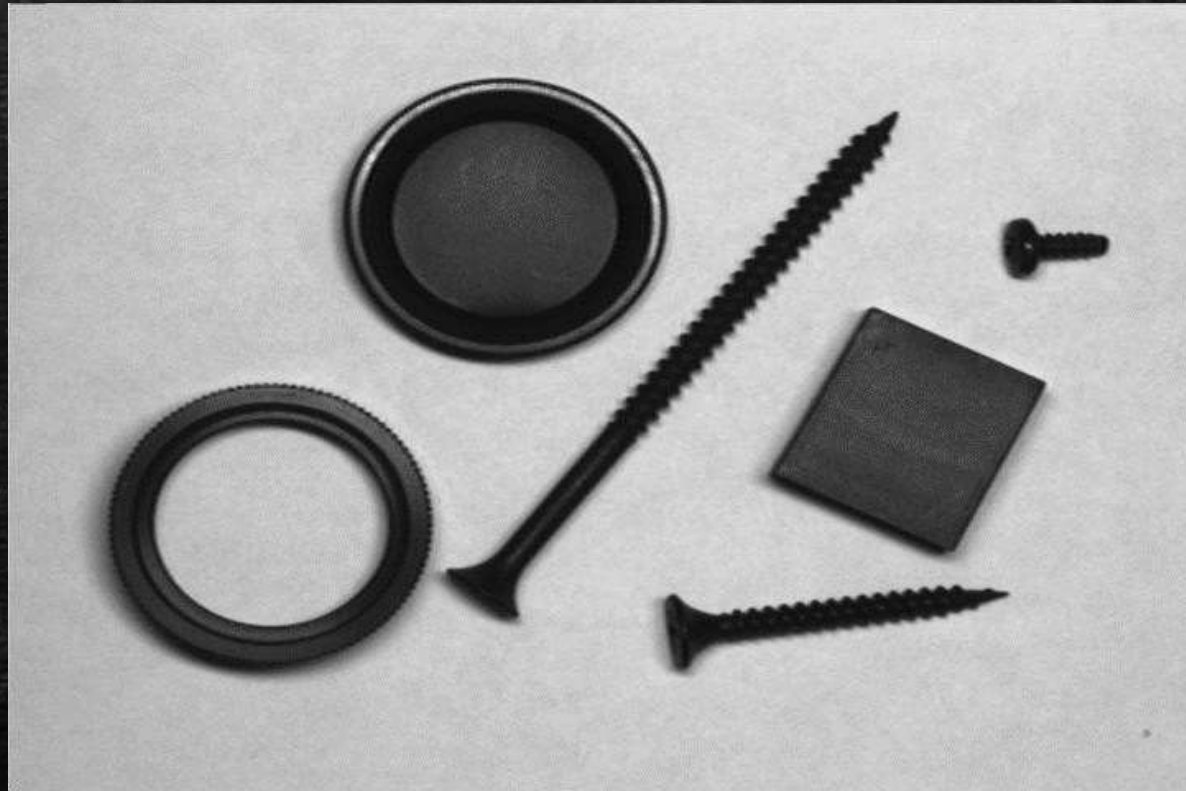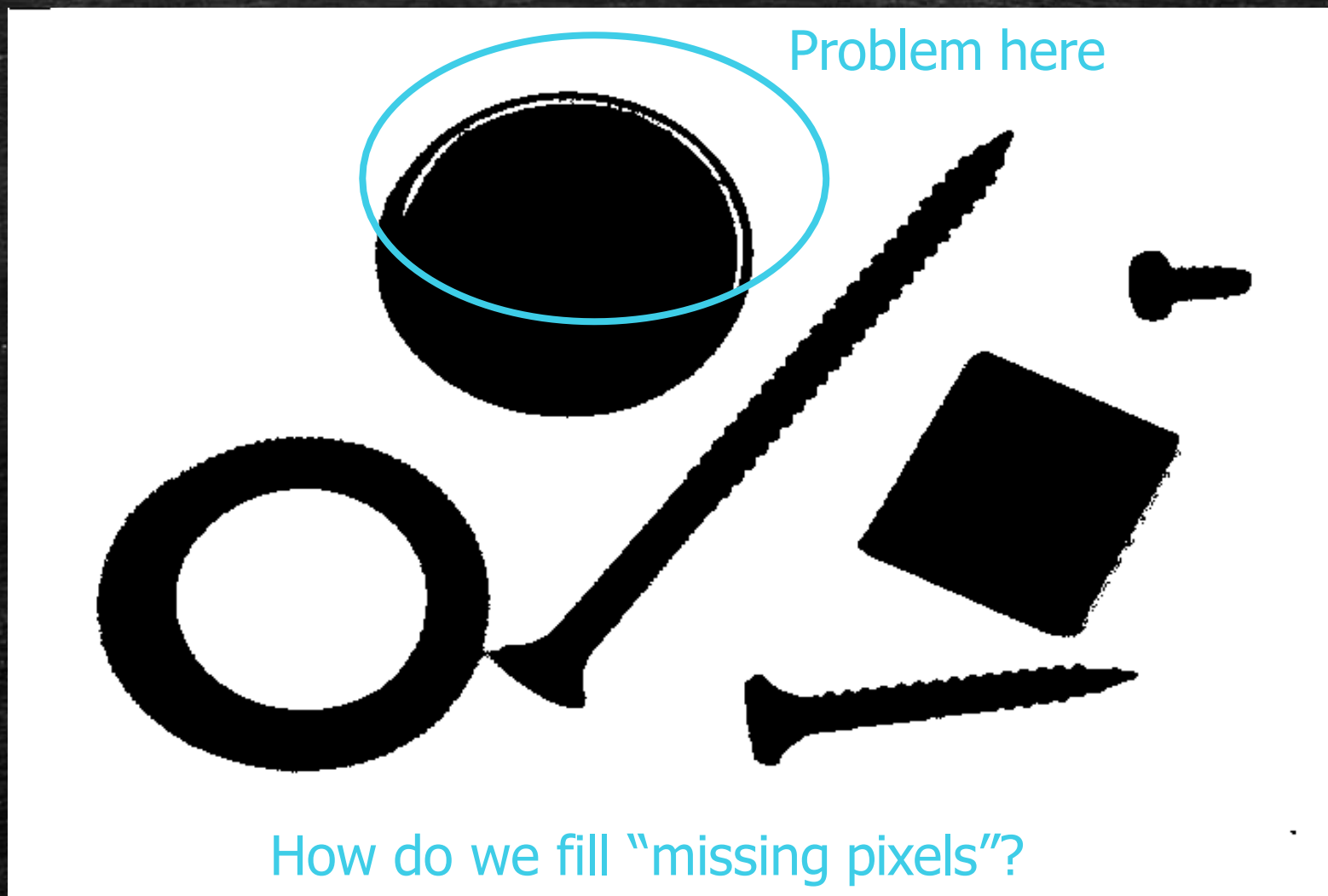
Selecting a Threshold

Bimodal Histogram

Threshold

Selecting a Threshold

Histogramme de luminance & traitements ass...

Objects

Set threshold here

Fermer   Informations & traitement

Binary Image

Problem here

How do we fill "missing pixels"?

Mathematic Morphology

· used to extract image components that are useful in the representation and description of region shape, such as...

- · boundaries extraction
- · skeletons
- · convex hull
- · morphological filtering
- · thinning
- · pruning

Example
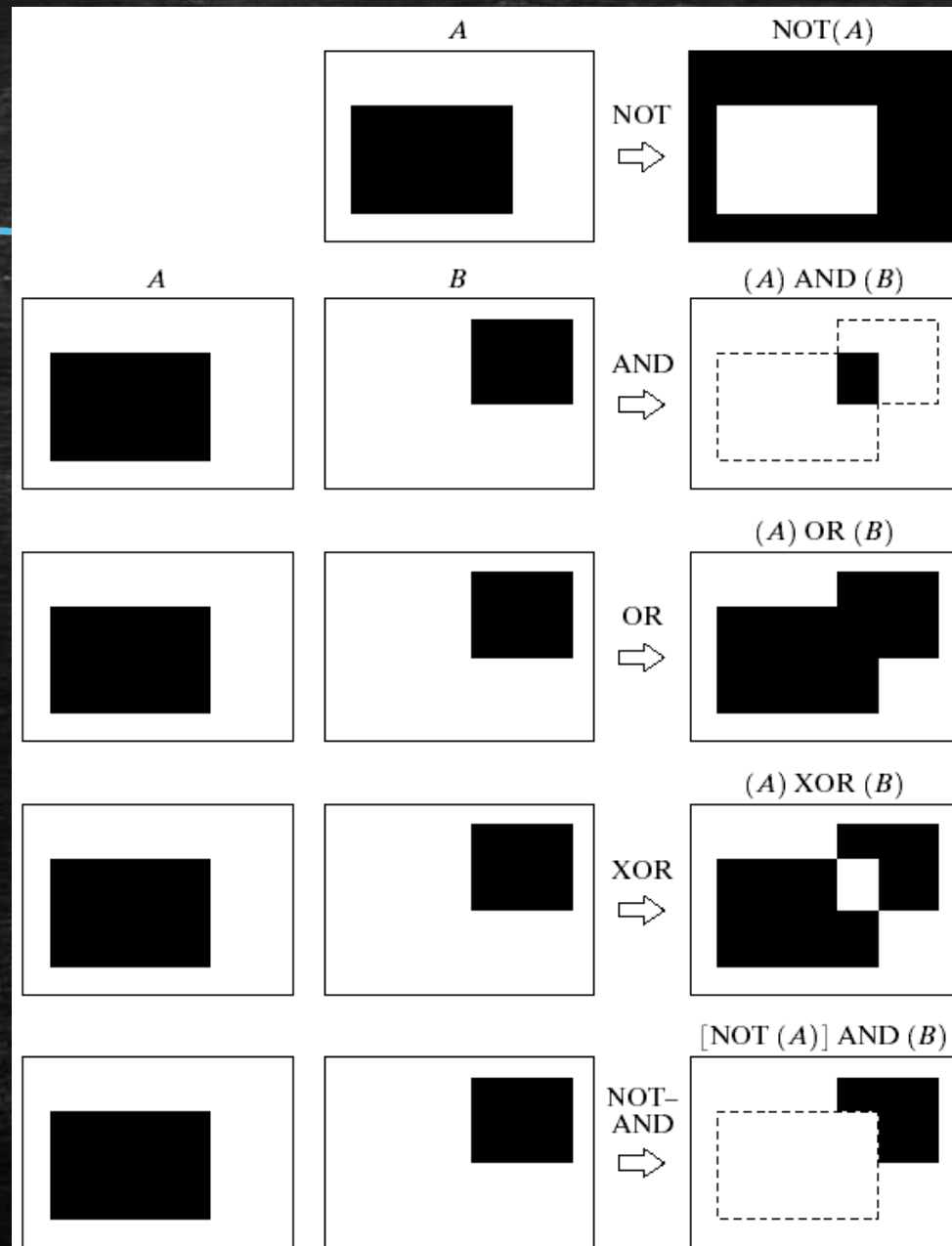
FIGURE 9.3 Some logic operations between binary images. Black represents binary 1s and white binary 0s in this example.

Structuring element (SE)

- small set to probe the image under study
- for each SE, define origo
- shape and size must be adapted to geometric properties for the objects
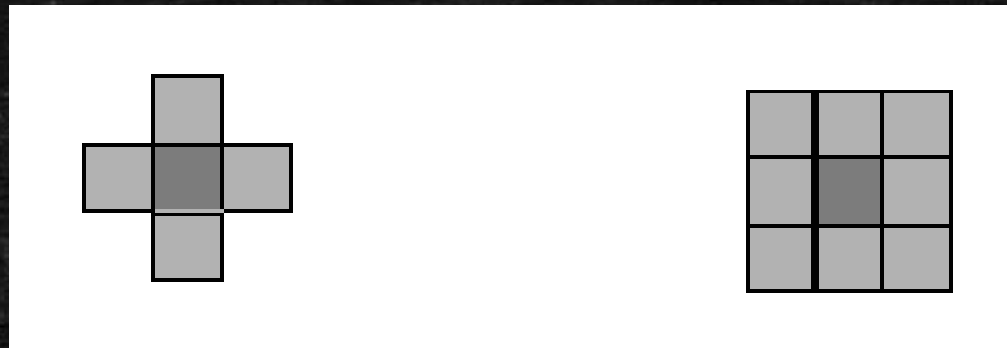
Basic idea

· in parallel for each pixel in binary image:

· check if SE is "satisfied"

· output pixel is set to 0 or 1 depending on used operation

pixels in output image if check is: SE *fits*
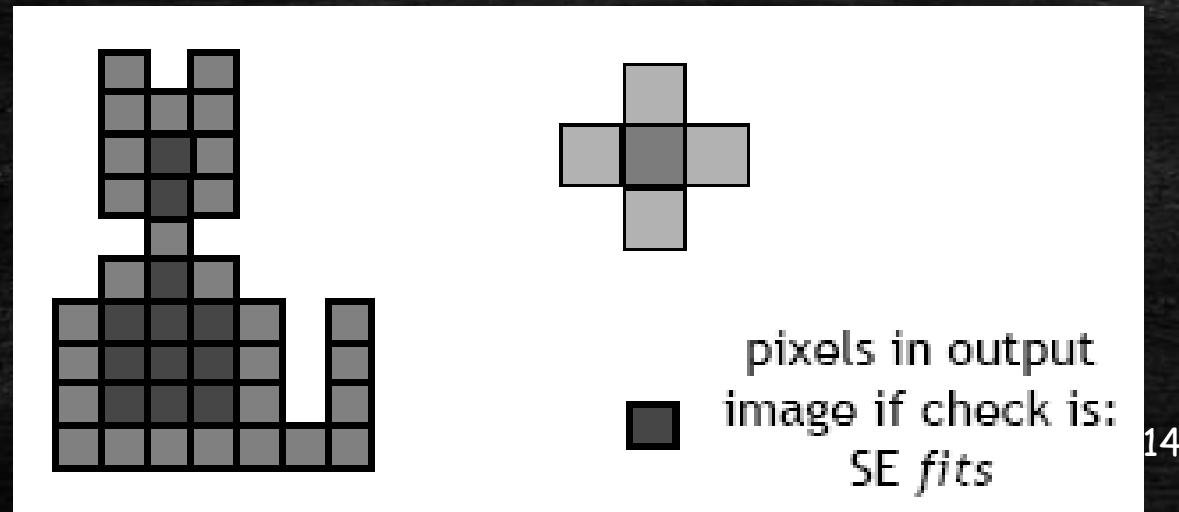
How to describe SE

- many different ways!
- information needed:
- position of origo for SE
- positions of elements belonging to SE

line segment

line segment
(origo is not in SE)

line segment
(origo is not in SE)

origo

pair of points
(separated by one pixel)
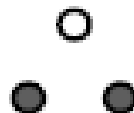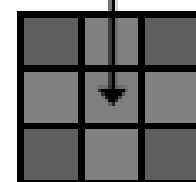
Basic morphological operations

- Erosion

- Dilation

Erosion

- Does the structuring element **fit the set?**

erosion of a set A by structuring element B: all z in A such that B is in A when origin of B=z
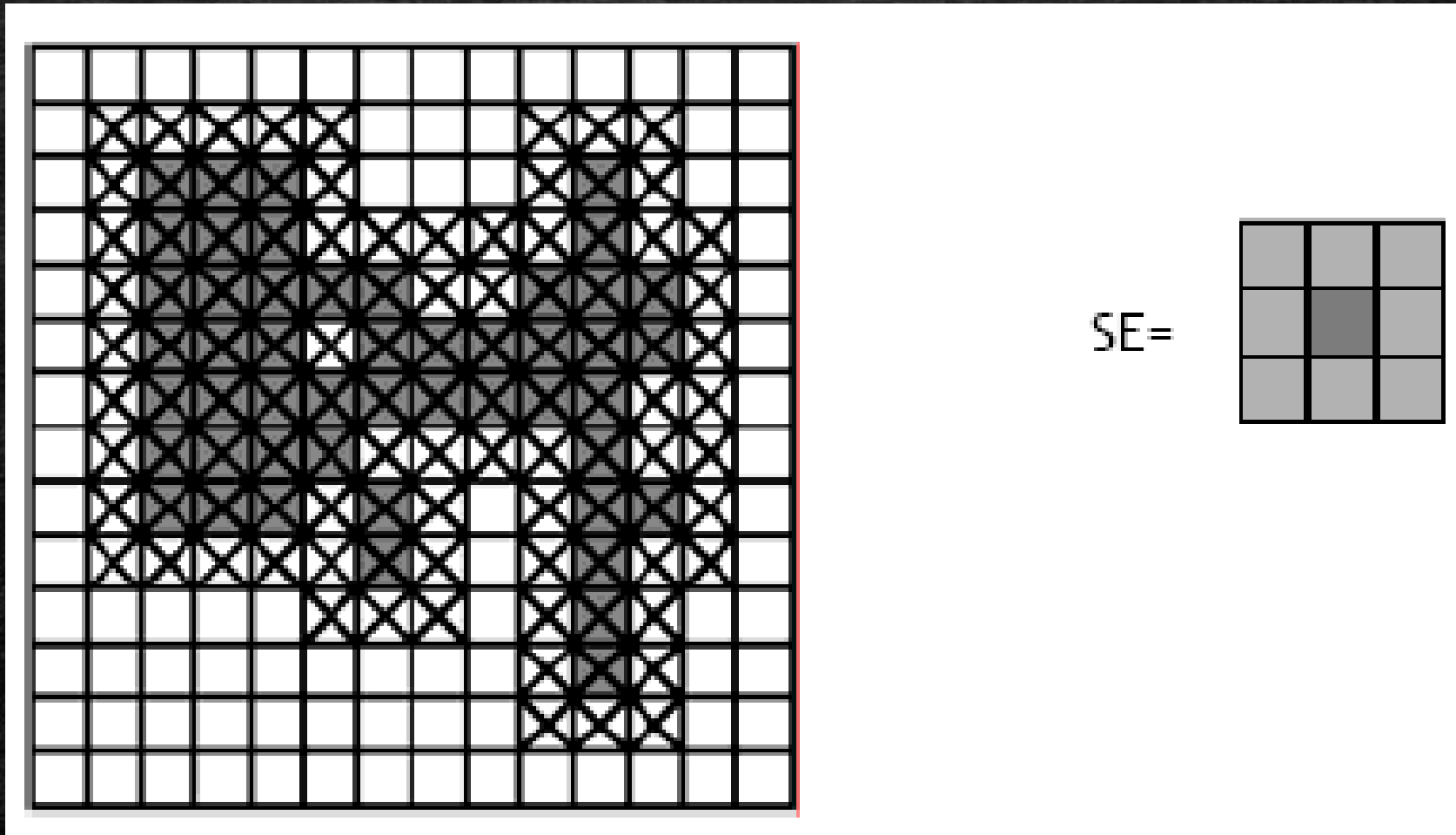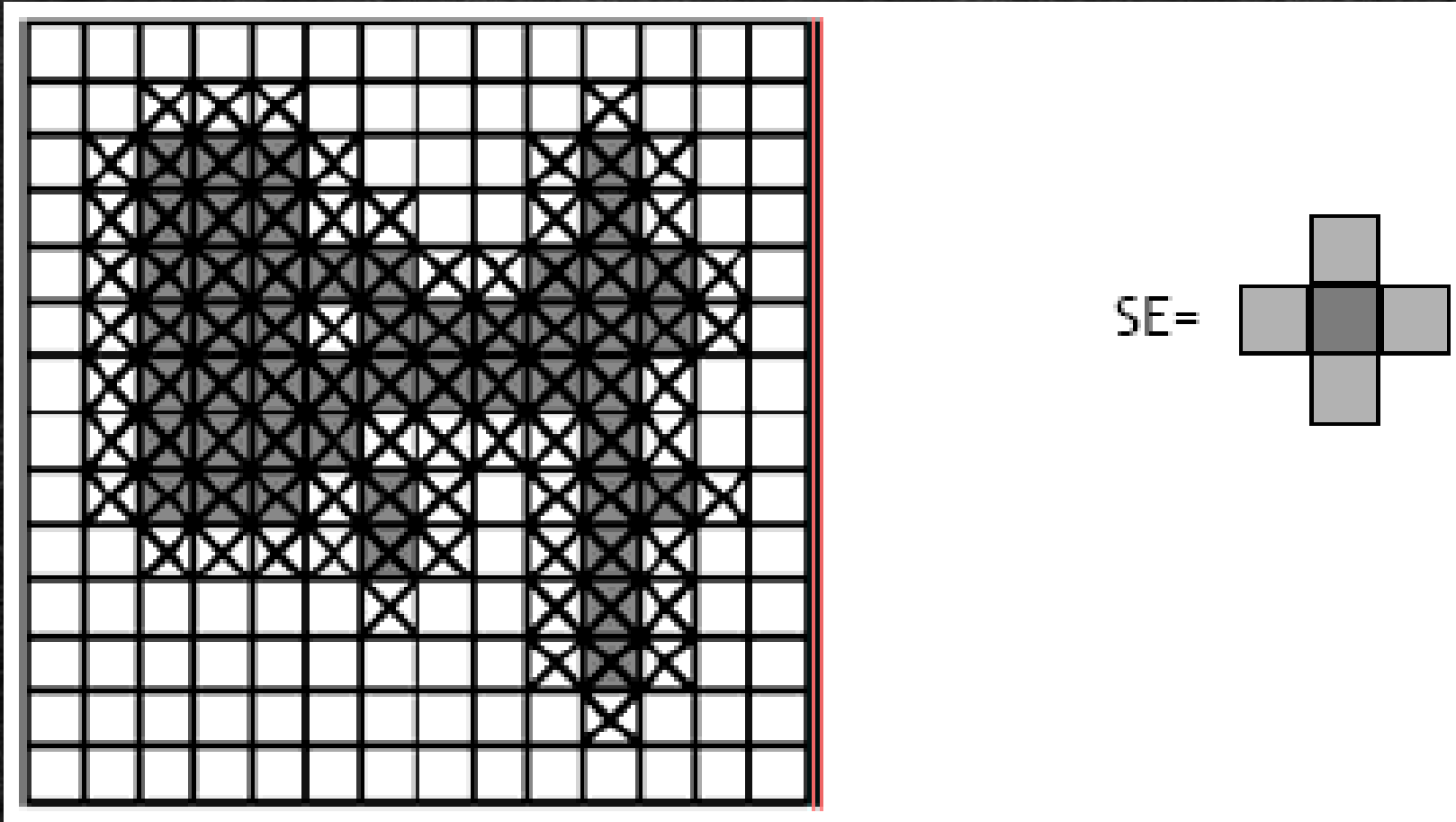
shrink the object

Erosion

Erosion

SE=
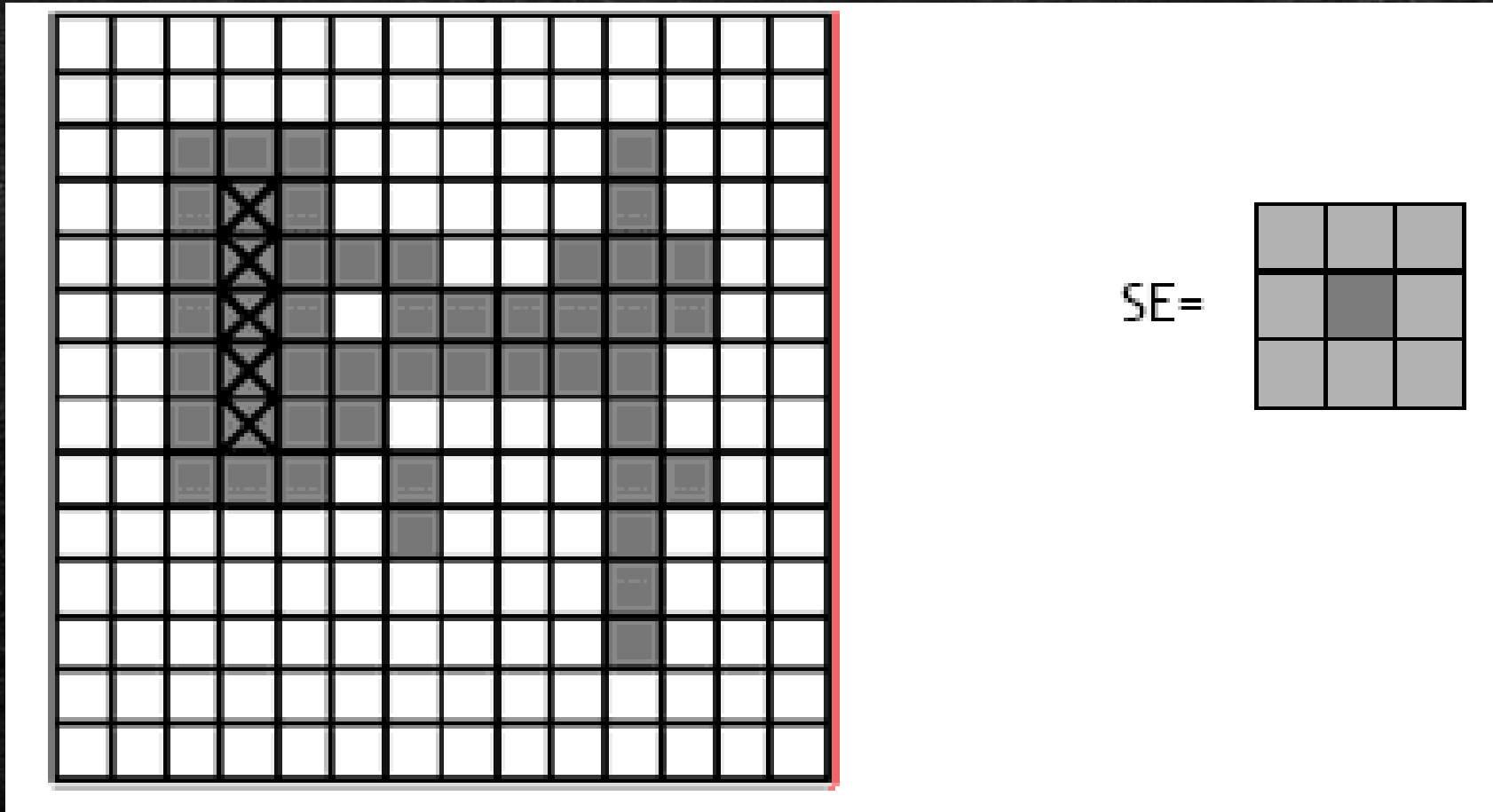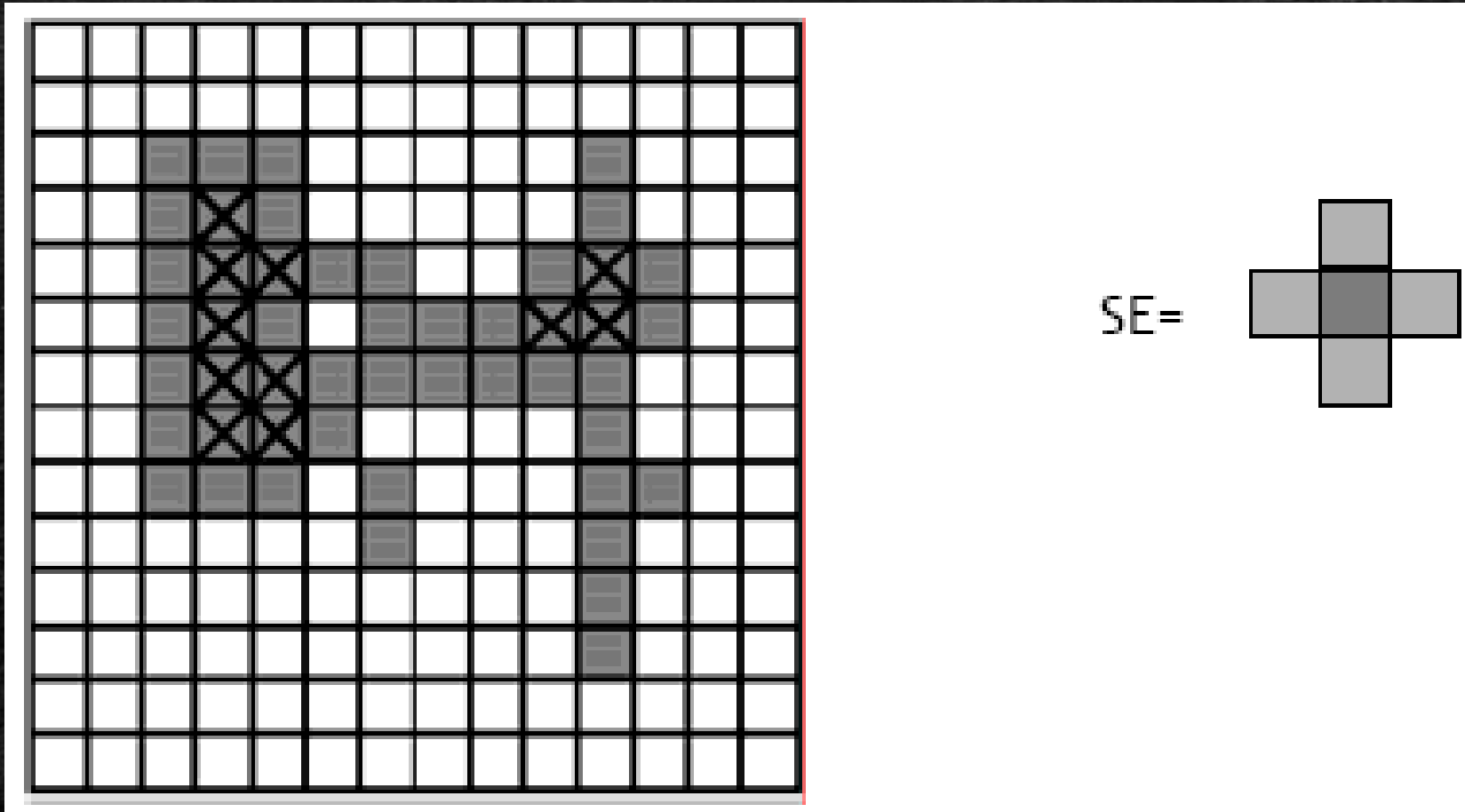
Dilation

- Does the structuring element **hit the set?**
- dilation of a set A by structuring element B: all z in A such that B hits A when origin of B=z
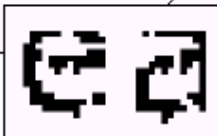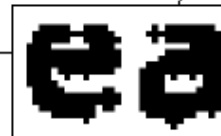
- **grow the object**

Dilation

SE=

Dilation

SE=

Dilation : Bridging gaps

FIGURE 9.5
(a) Sample text of poor resolution with broken characters (magnified view).
(b) Structuring element.
(c) Dilation of (a) by (b). Broken segments were joined.

Why useful?

- **Erosion**
  - removal of structures of certain shape and size, given by SE
- **Dilation**
  - filling of holes of certain shape and size, given by SE

Combining erosion and dilation

- WANTED:
  - remove structures / fill holes
  - without affecting remaining parts

- SOLUTION:
- combine erosion and dilation
- (using same SE)
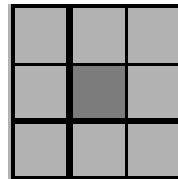
Erosion : eliminating irrelevant detail
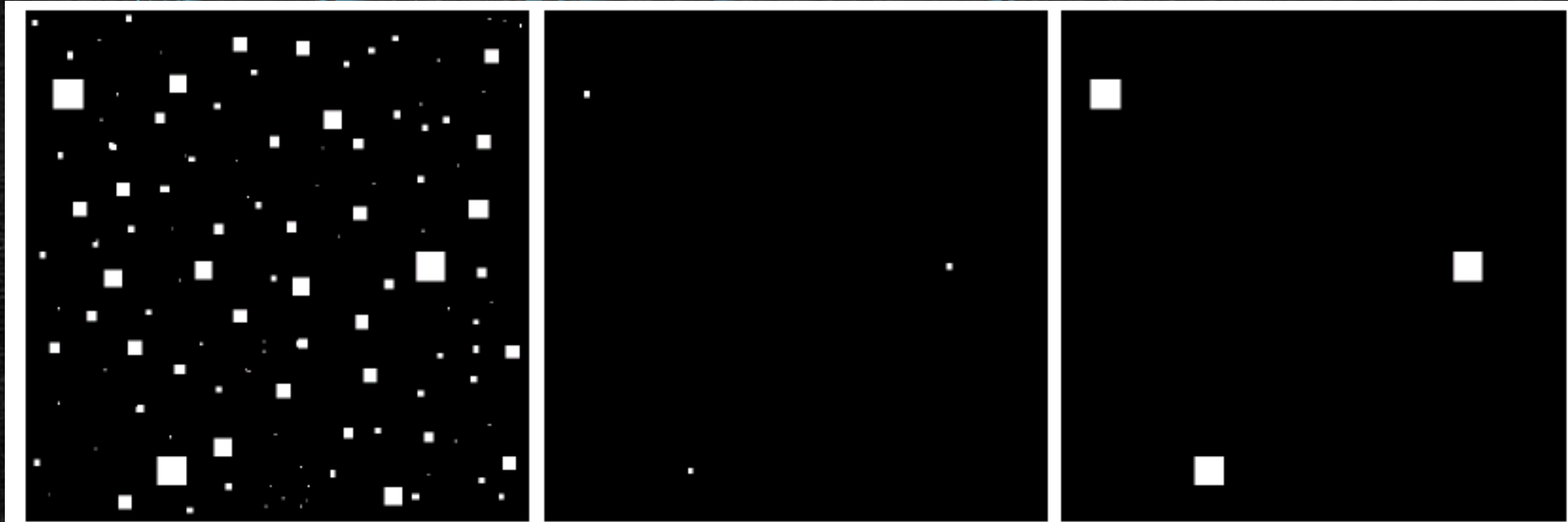
a b c

FIGURE 9.7 (a) Image of squares of size 1, 3, 5, 7, 9, and 15 pixels on the side. (b) Erosion of (a) with a square structuring element of 1's, 13 pixels on the side. (c) Dilation of (b) with the same structuring element.

structuring element B = 13x13 pixels of   level 1
gray level 1

Application: filtering
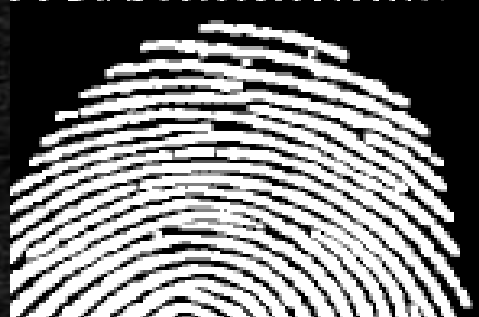
Boundary Extraction

a b
c d

FIGURE 9.13 (a) Set A. (b) Structuring element B. (c) A eroded by B. (d) Boundary, given by the set difference between A and its erosion.

$$\beta(A) = A - (A \ominus B)$$

Example

a b

FIGURE 9.14
(a) A simple binary image, with 1's represented in white. (b) Result of using Eq. (9.5-1) with the structuring element in Fig. 9.13(b).

Questions?