Mathematical Morphology

CS/BIOEN 6640
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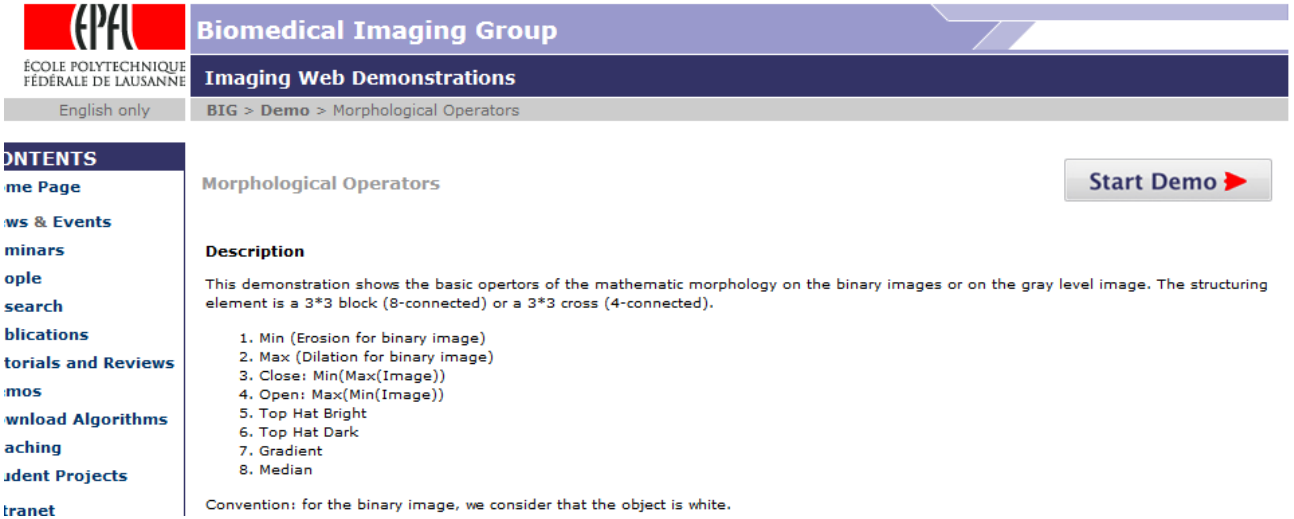
Chapter 9 DIP Textbook

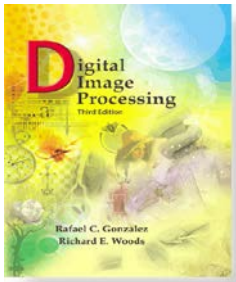
Materials

- Gonzales & Woods DIP Book Chapter 9
- Dougherty & Lotufo, Hands-on Morphological Image Processing
- Serra, 1982
- Matheron 1967
- PDFs, Slides (see course homepage):
  - Brian Morse Lectures (BYU)
  - R.A. Peters Lectures (EECE Vanderbilt)

Materials

- Nice Java Demonstrations (binary and gray-level morphological image processing:
- http://bigwww.epfl.ch/demo/jmorpho/start.php
- (hit: for binary, choose image “forms” to test)





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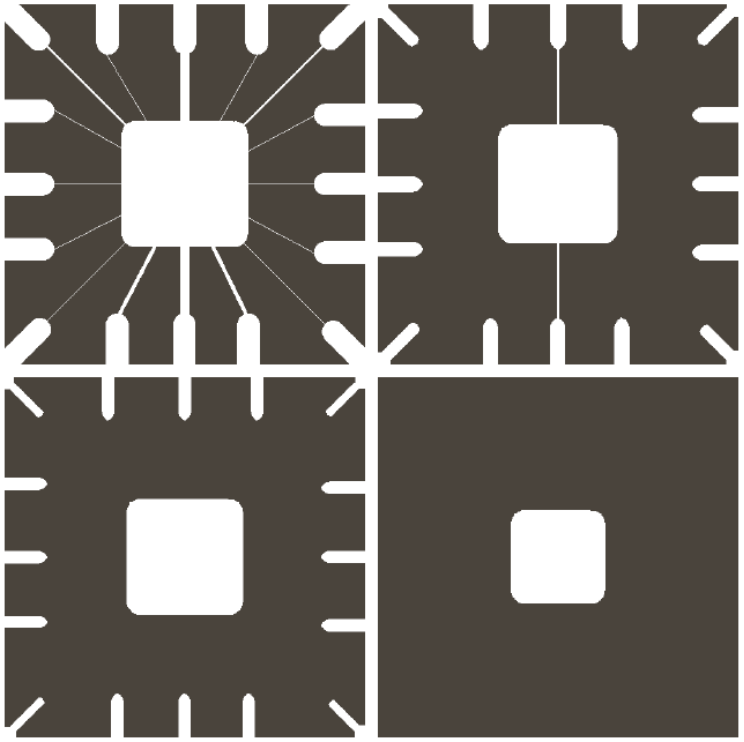
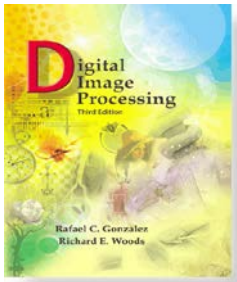
Morphological Image Processing



a b
c d

FIGURE 9.5 Using erosion to remove image components. (a) A 486 × 486 binary image of a wire-bond mask. (b)–(d) Image eroded using square structuring elements of sizes 11 × 11, 15 × 15, and 45 × 45, respectively. The elements of the SEs were all 1s.



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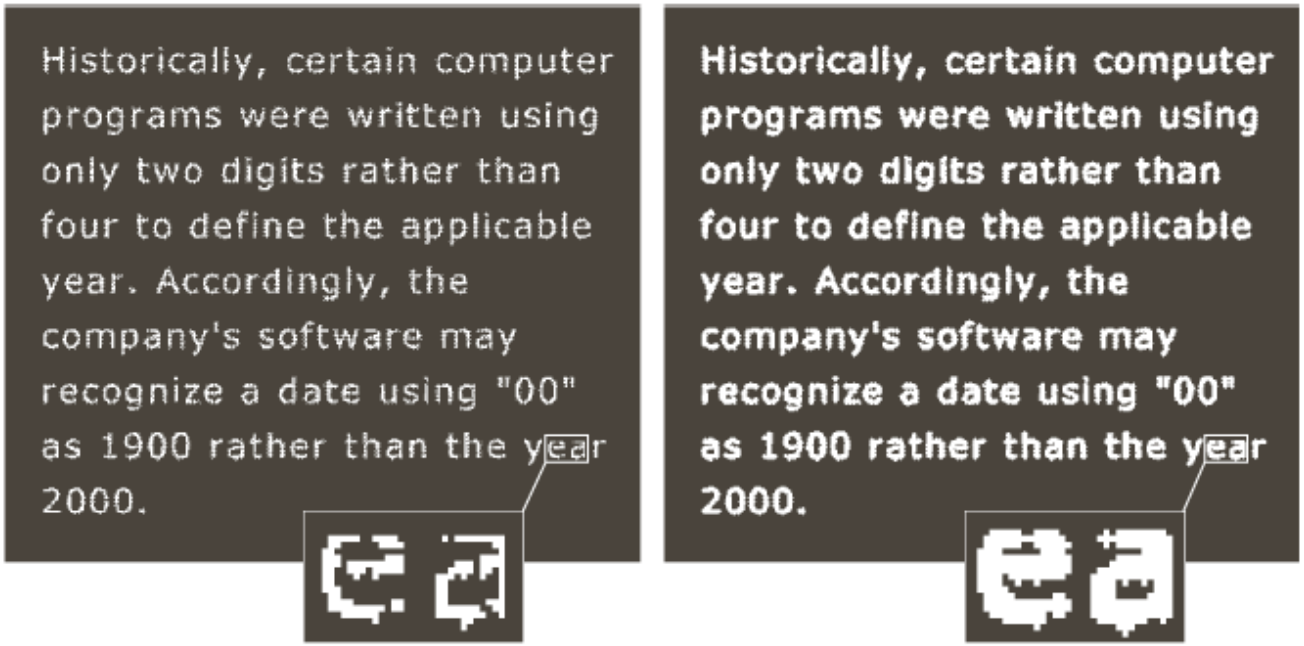
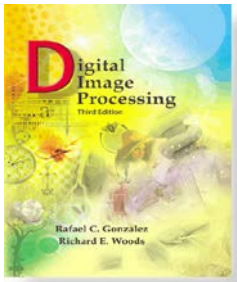


0	1	0
1	1	1
0	1	0

a c
b

FIGURE 9.7
(a) Sample text of poor resolution with broken characters (see magnified view). (b) Structuring element. (c) Dilation of (a) by (b). Broken segments were joined.



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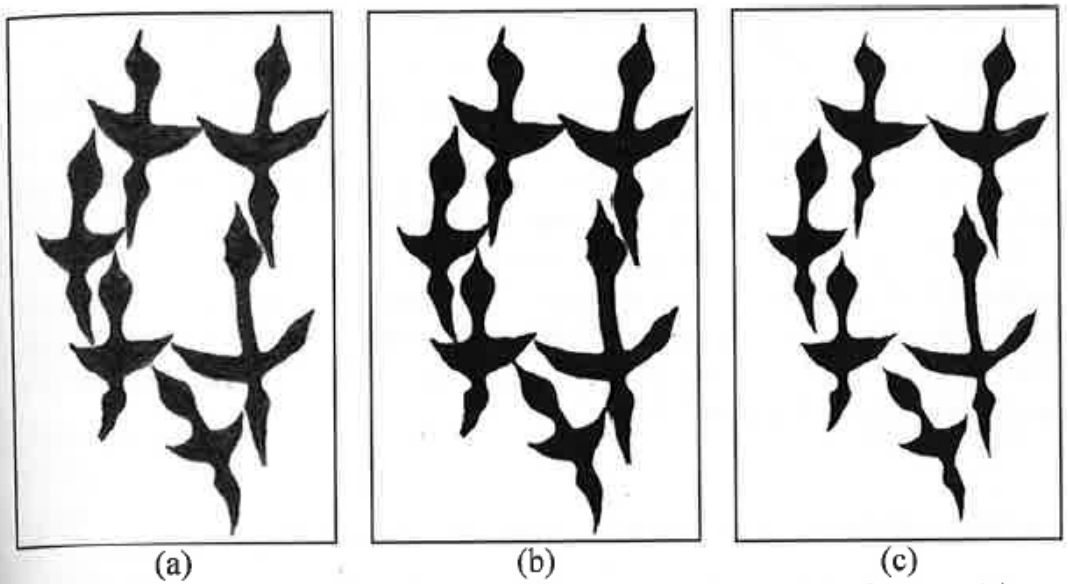
a b c

FIGURE 9.16 (a) Binary image (the white dot inside one of the regions is the starting point for the hole-filling algorithm). (b) Result of filling that region. (c) Result of filling all holes.

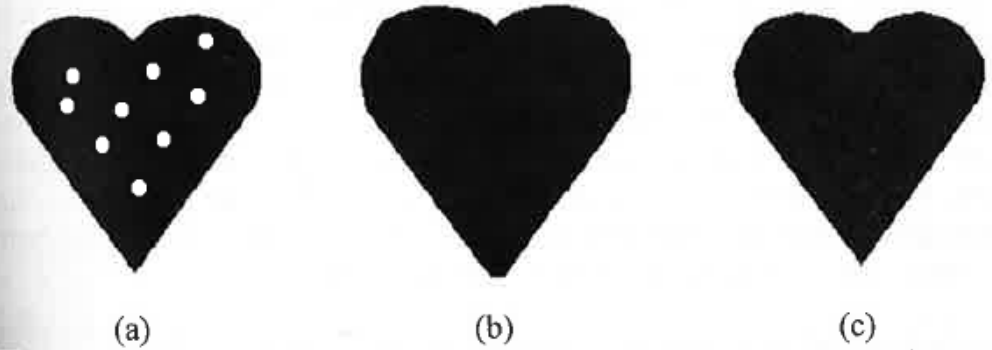
Typical Applications



(a) (b) (c)

Figure 3.41: *Practical application of image erosion: original image (a); segmented image(b); and eroded image yielding the separated objects (c).*

Object Separation for Segmentation



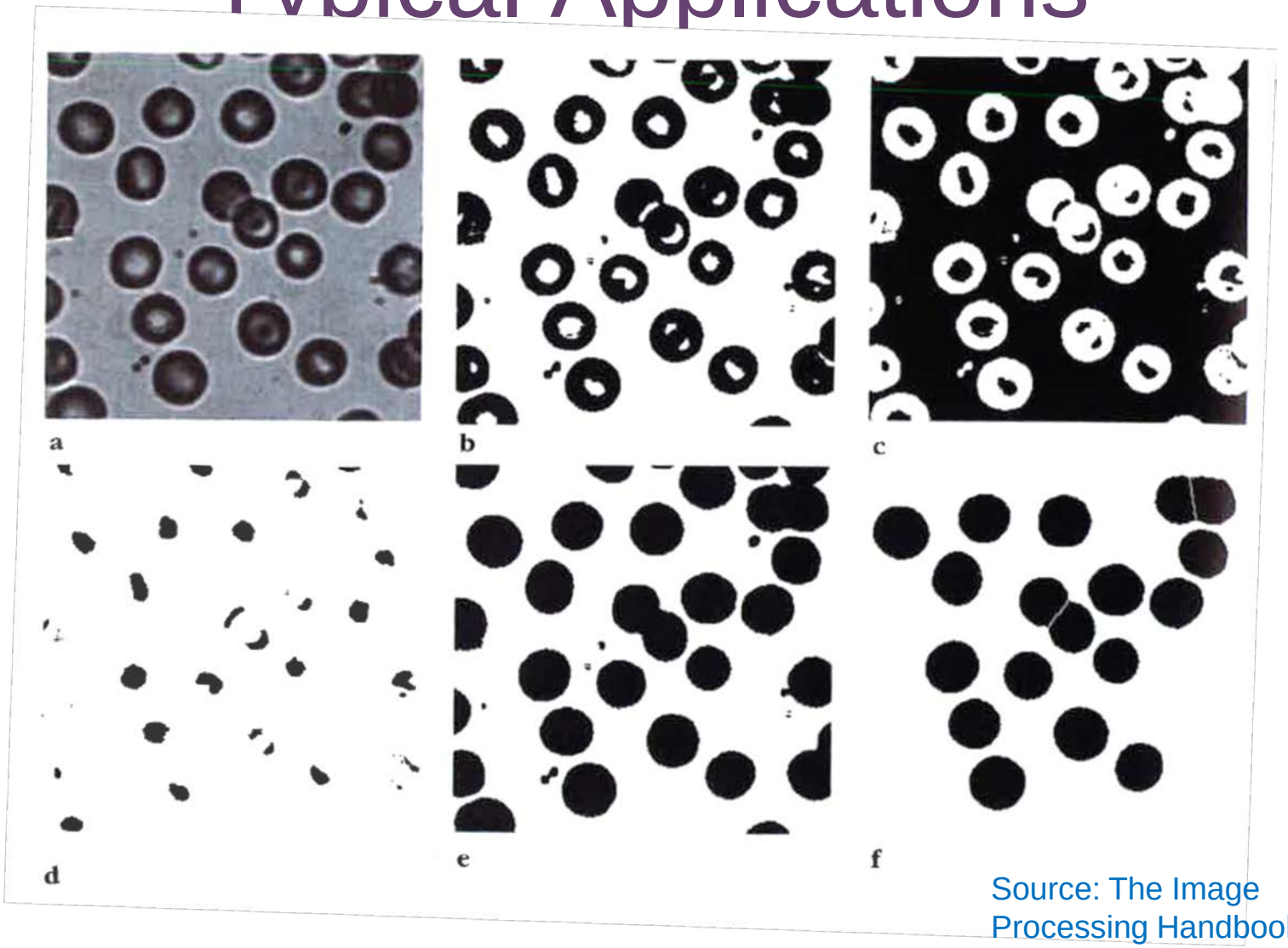
(a) (b) (c)

Figure 3.42: *Original shape (a); its dilated version (b); and shape obtained by morphological closing (c). The structuring element was a 3×3 square.*

Closing holes (noise removal)

Source: Shape Analysis and Classification, Costa & Cesar

Typical Applications



Source: The Image Processing Handbook, John C. Russ, p. 394

Typical Applications

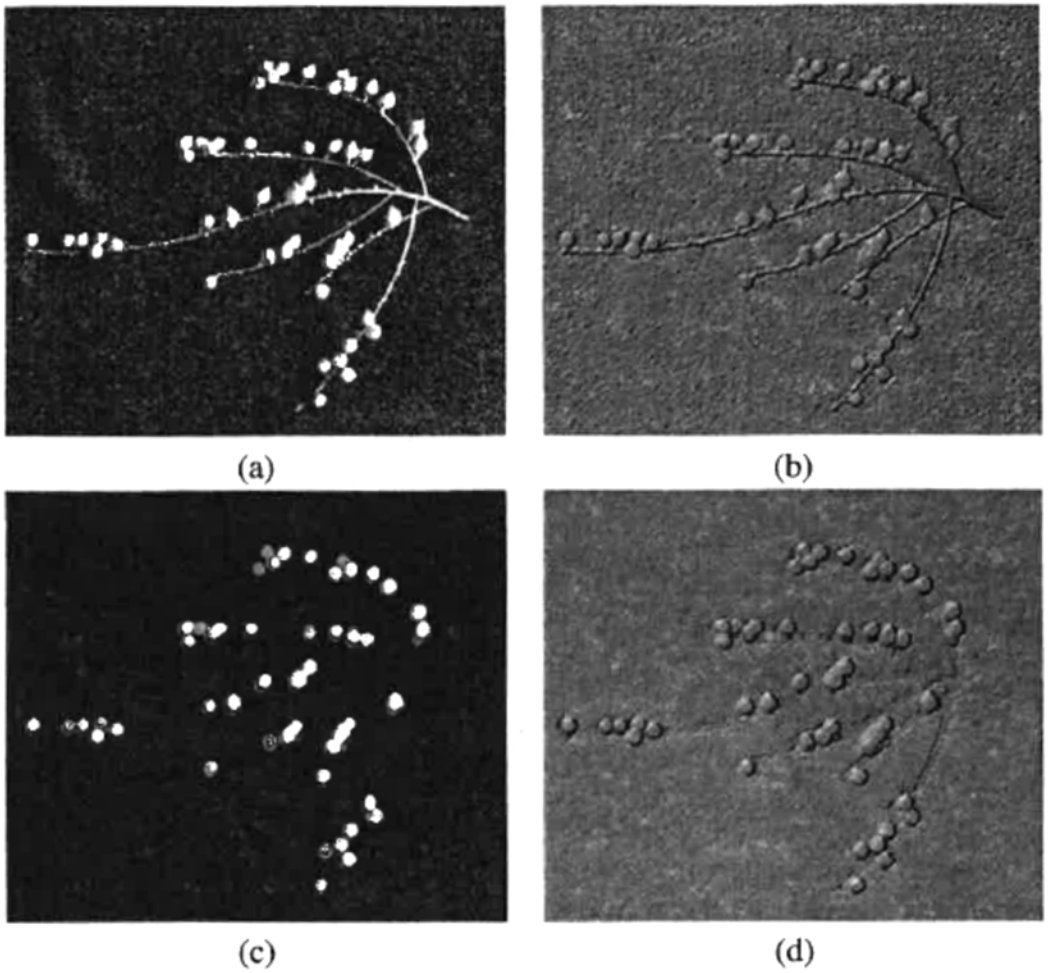
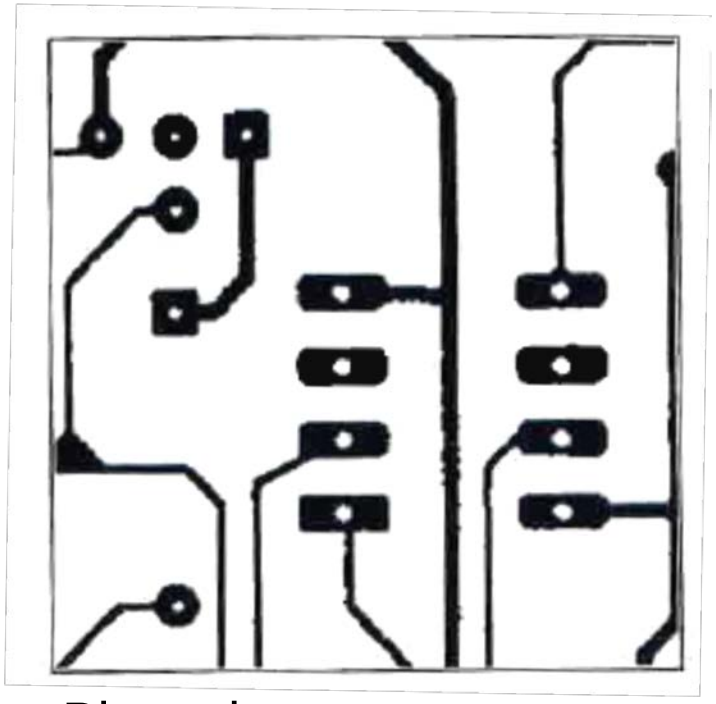


Figure 5.29 Illustration of gray-scale opening by a flat disk: (a) input image f, (b) surface view of f, (c) opened $f \circ D$, (d) surface view of $f \circ D$.

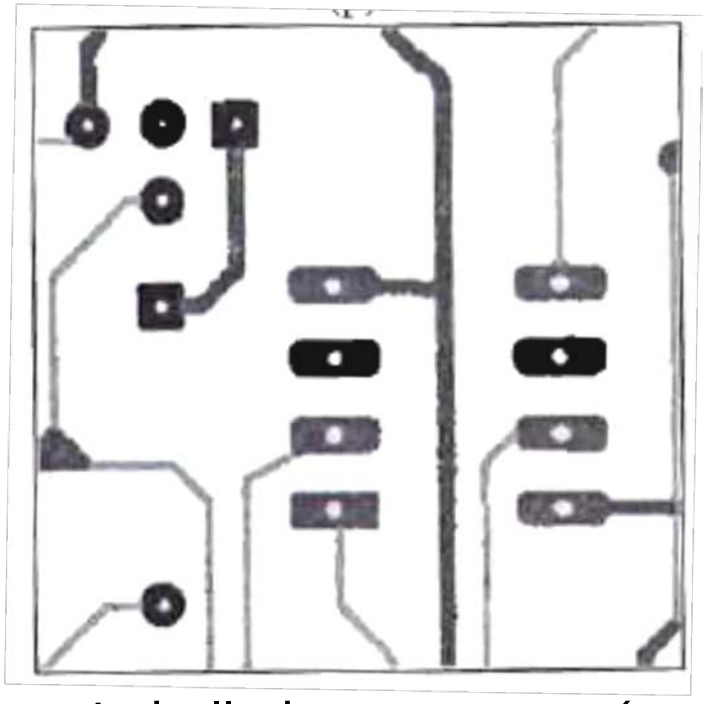
Source: Hands-on Morphological Image Processing, Dougherty & Lotufo, p. 120

Typical Applications: PCB Component Detection

Printed circuit board:
Automatic quality control and error detection?



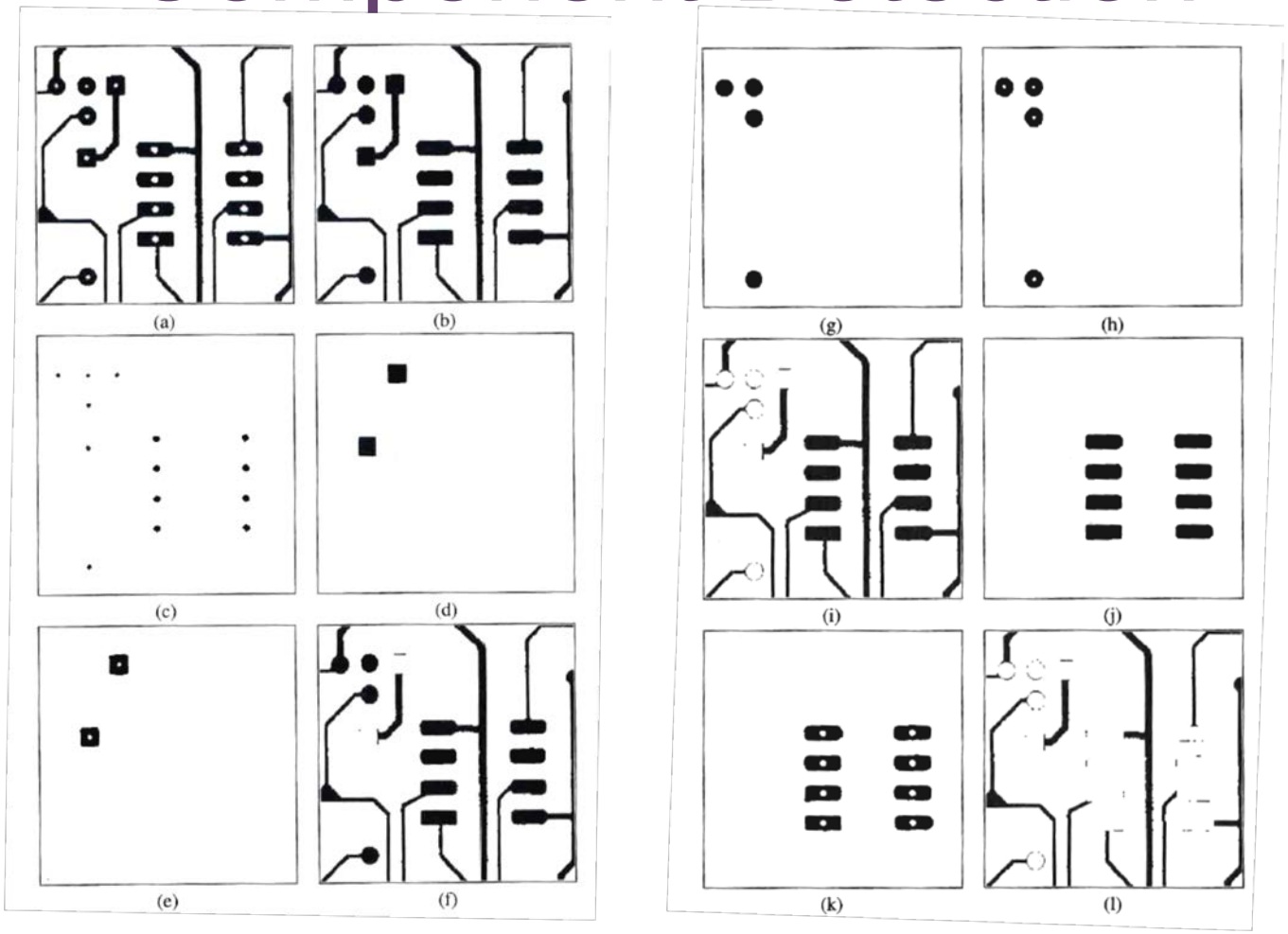
Binary image



Labelled components (gray)

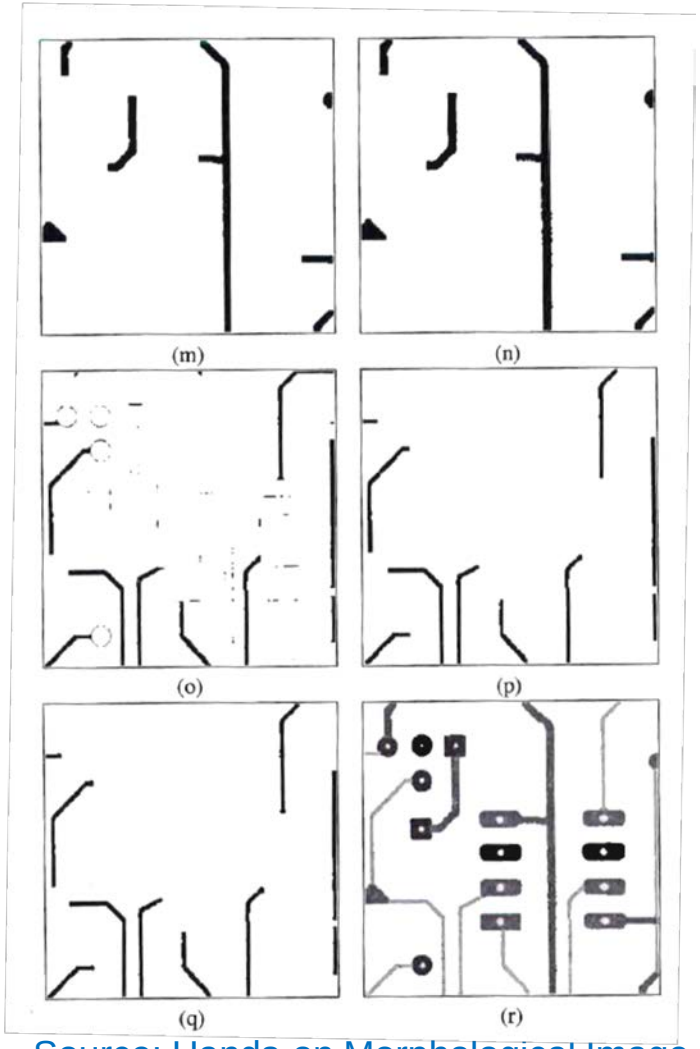
Source: Hands-on Morphological Image Processing, Dougherty & Lotufo, pp. 37-41

Typical Applications: PCB Component Detection



Source: Hands-on Morphological Image Processing, Dougherty & Lotufo, pp. 37-41

Typical Applications: PCB Component Detection



Source: Hands-on Morphological Image Processing, Dougherty & Lotufo, pp. 37-41