IMAGE PROCESSING
Lecture-8

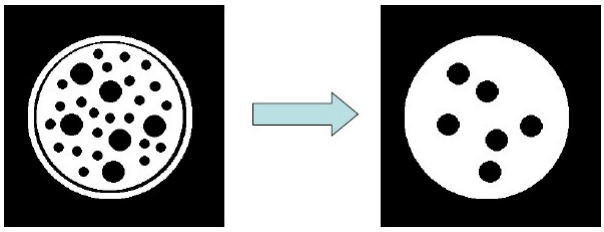
Morphological Image Processing

Prof. Dr. Sarp Ertürk

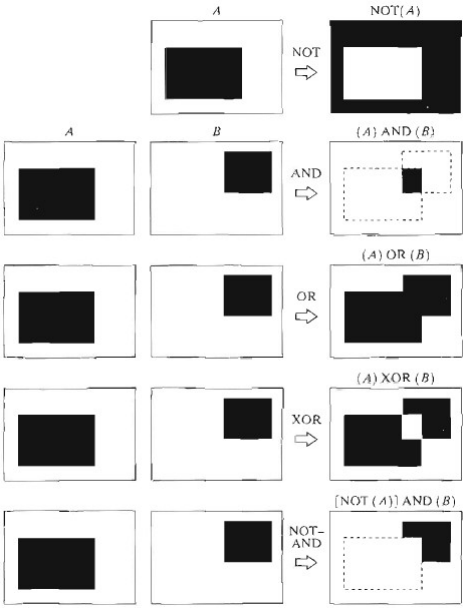
KULIS Kocaeli University Laboratory of Image and Signal Processing
Kocaeli Üniversitesi İşaret ve Görüntü İşleme Laboratuvarı

Morphology

- Morphology: Shape and Structure (TR: biçim bilim)
- Mathematical Morphology based on cluster operations.
- Possible Applications: extract shape borders/skeletons, define shapes, reduce noise, segment images
- Basic Operations:Erosion (TR: aşındırma) and Dilation(TR:yayma)
- Usually binary morphology.



Logic Operations in Binary Images



Erosion and Dilations

- Erosion: shape boundaries are eroded

- Dilation: shape boundaries are expanded

Dilation

- Two inputs:
  1. Image
  2. Structure element (yapı elemanı)

$$A \oplus B = \left\{ z \middle| \left(\hat{B} \right)_z \cap A \neq \varnothing \right\}$$

Dilation operand

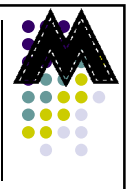
MATLAB: **imdilate**

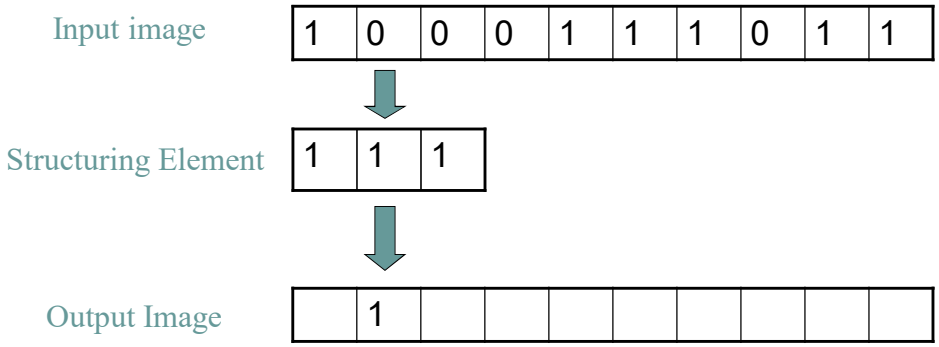
Dilation

- Structure Element defines expansion approach.

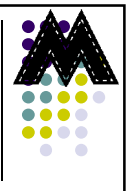
1	1	1
1	1	1
1	1	1

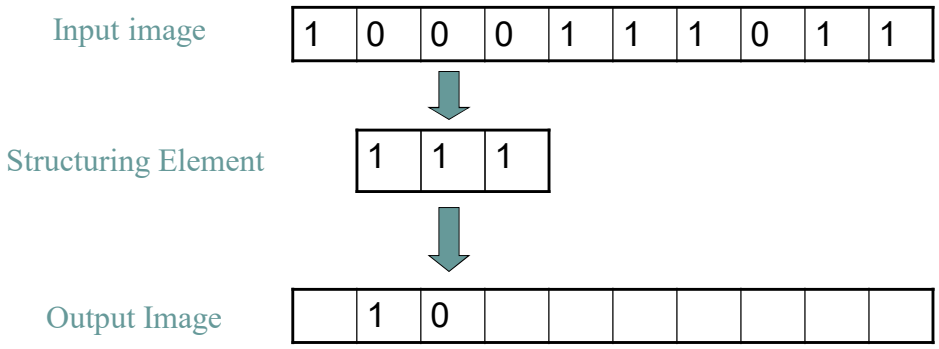
Dilation



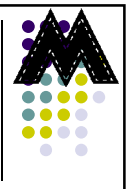


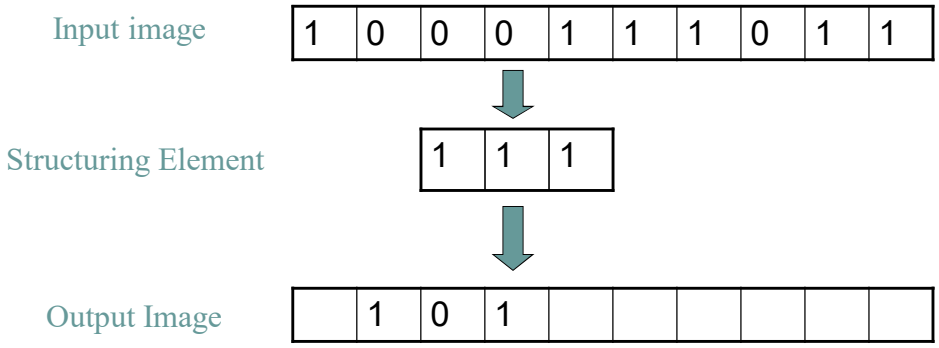
Dilation



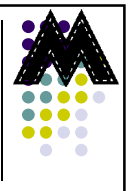


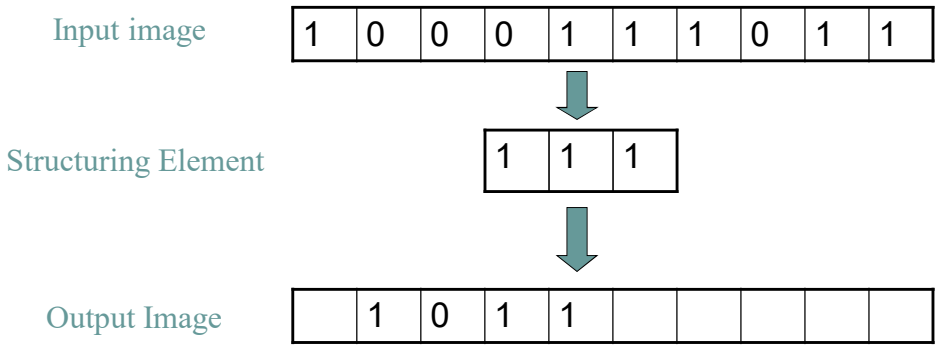
Dilation



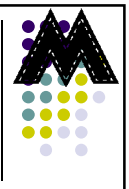


Dilation





Dilation



Input image

1	0	0	0	1	1	1	0	1	1

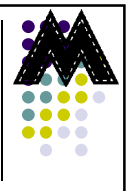
Structuring Element

1	1	1

Output Image

	1	0	1	1	1				

Dilation



Input image

1	0	0	0	1	1	1	0	1	1

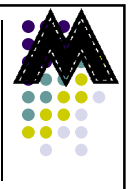
Structuring Element

1	1	1

Output Image

	1	0	1	1	1	1			

Dilation



Input image

1	0	0	0	1	1	1	0	1	1

Structuring Element

1	1	1

Output Image

	1	0	1	1	1	1	1		

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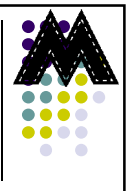
Dilation



Input image

1	0	0	0	1	1	1	0	1	1

Structuring Element

1	1	1

Output Image

	1	0	1	1	1	1	1	1	

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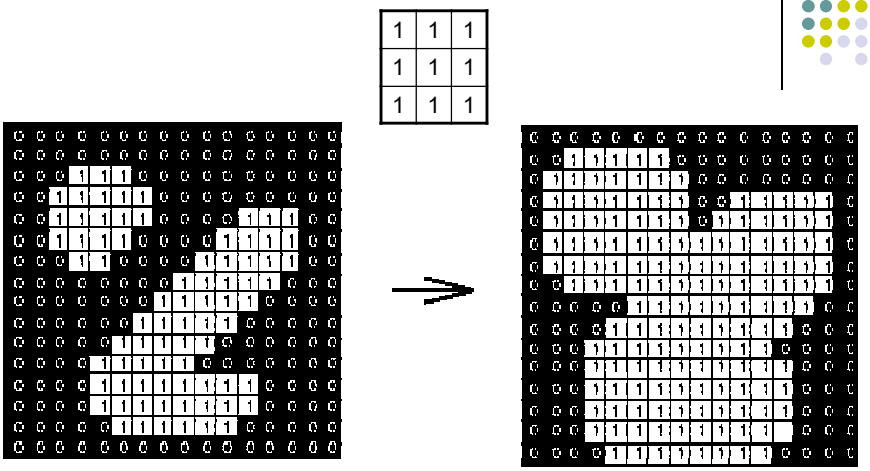
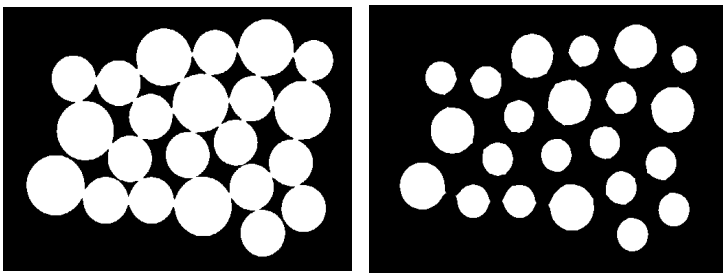
Dilation



Erosion

$$A \Theta B = \left\{ z \middle| (B)_z \subseteq A \right\}$$



MATLAB: **imerode**

Erosion

Input image

1	0	0	0	1	1	1	0	1	1

Structuring Element

1	1	1

Output Image

	0								

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Erosion

Input image

1	0	0	0	1	1	1	0	1	1

Structuring Element

1	1	1

Output Image

	0	0							

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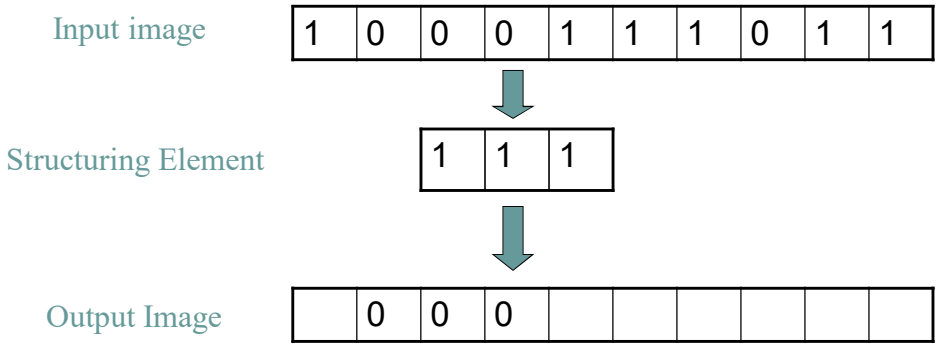
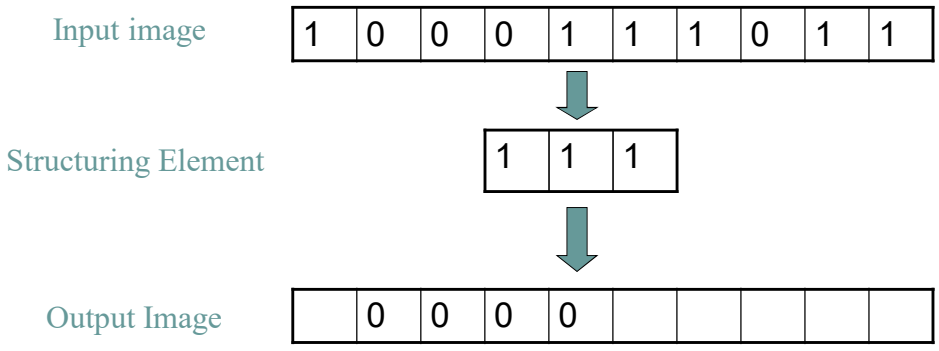
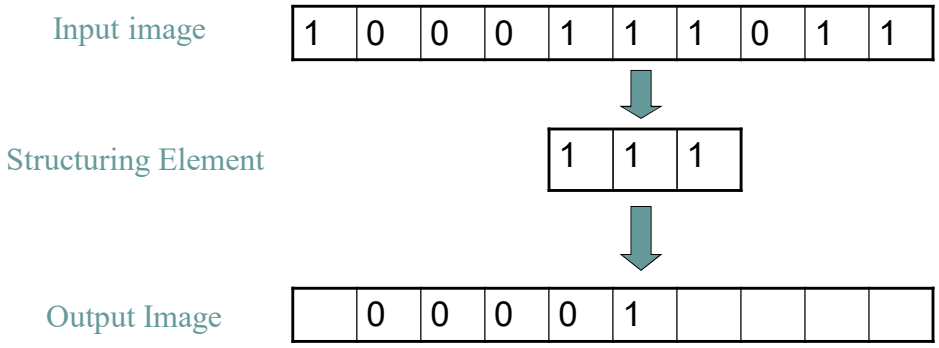
Erosion



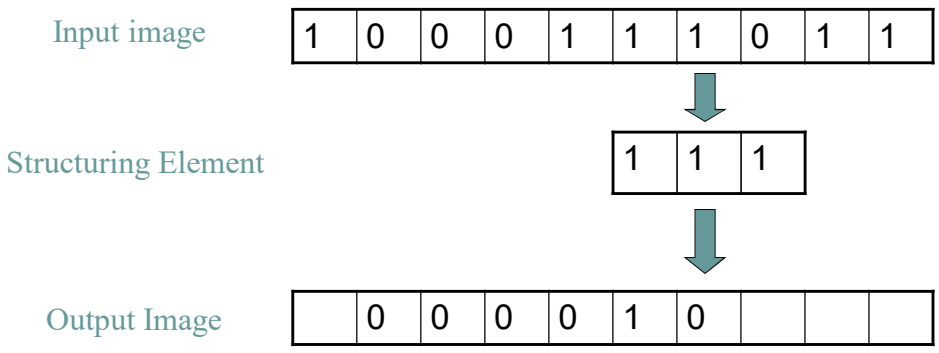
Erosion



Erosion



Erosion



Erosion

Input image

1	0	0	0	1	1	1	0	1	1

Structuring Element

1	1	1

Output Image

	0	0	0	0	1	0	0		

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Erosion

Input image

1	0	0	0	1	1	1	0	1	1

Structuring Element

1	1	1

Output Image

	0	0	0	0	1	0	0	0	

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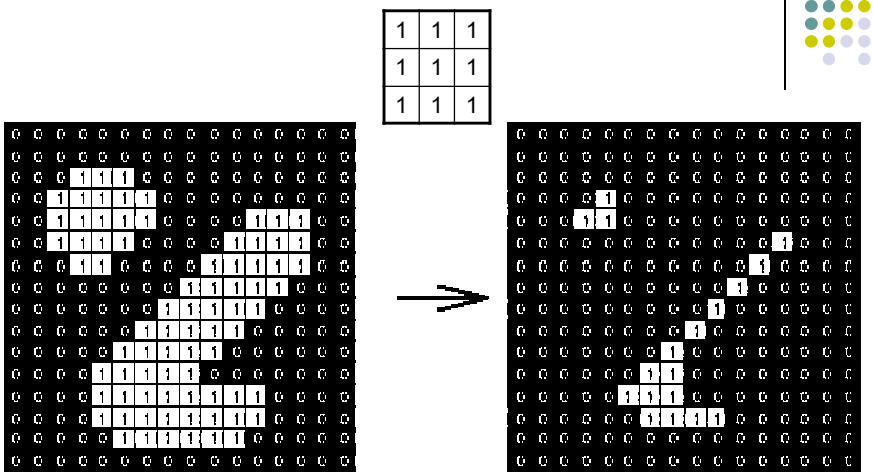
Erosion



Opening and Closing

- Opening:

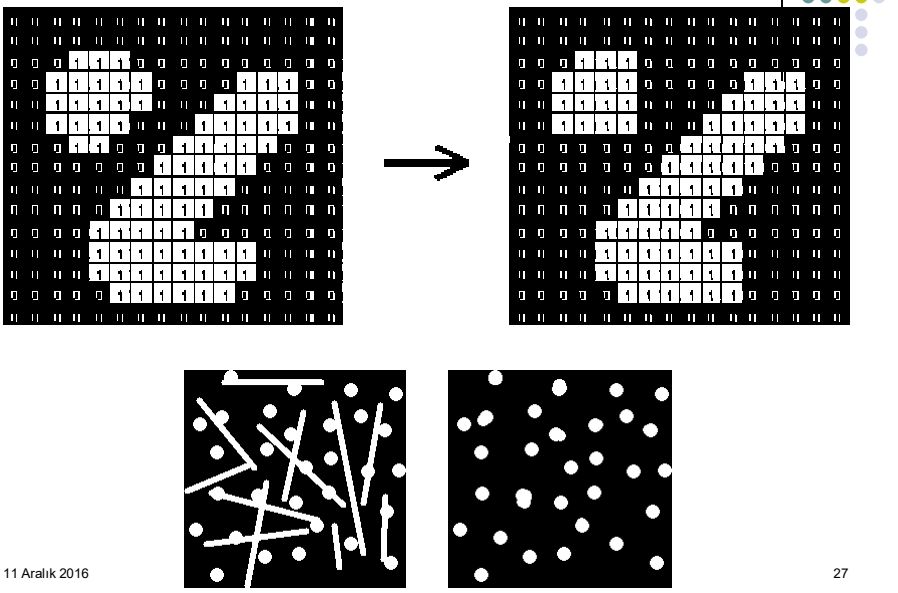
$$A \circ B = (A \Theta B) \oplus B$$

- Closing:

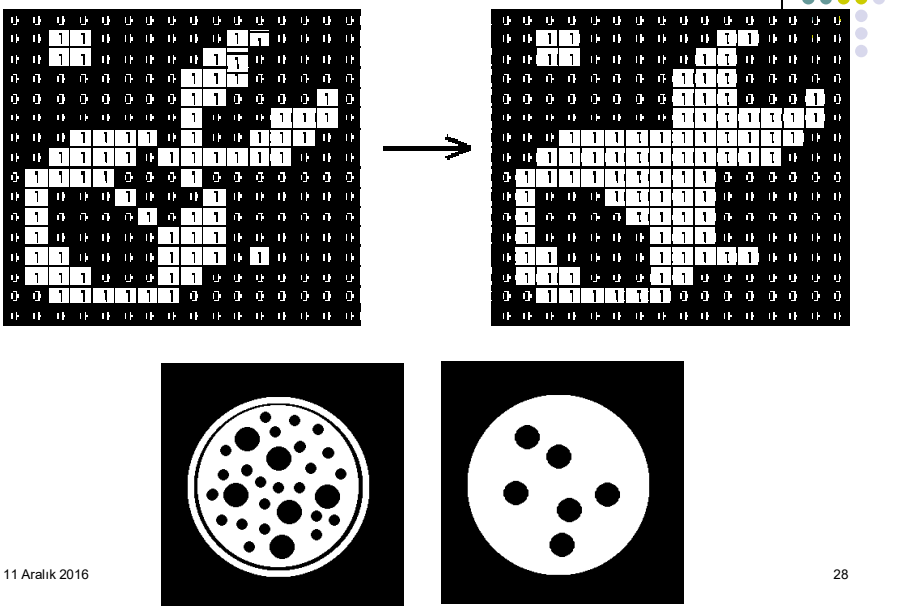
$$A \bullet B = (A \oplus B) \Theta B$$

MATLAB: **imopen**, **imclose**

Opening



Closing

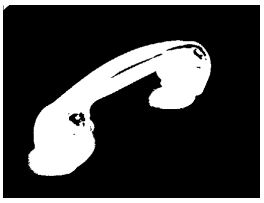


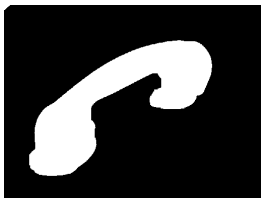
Boundary Extraction

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

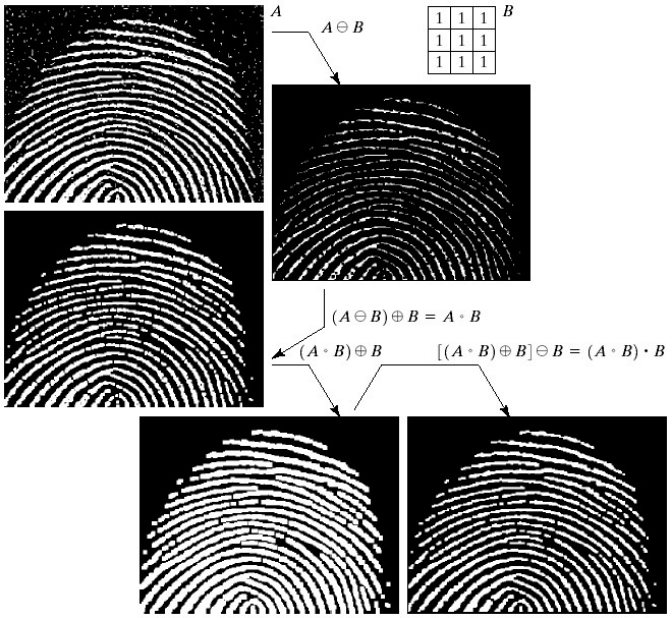
Boundary

Application



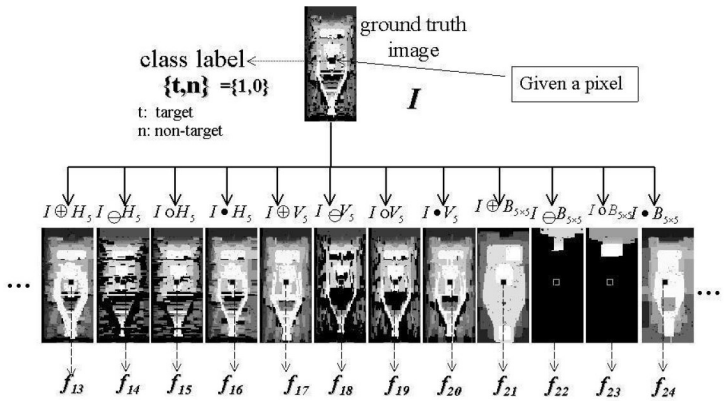


Application



a b
d c
e f

FIGURE 9.11
(a) Noisy image.
(c) Eroded image.
(d) Opening of A.
(d) Dilation of the opening.
(e) Closing of the opening. (Original image for this example courtesy of the National Institute of Standards and Technology.)

Application

Target Detection: