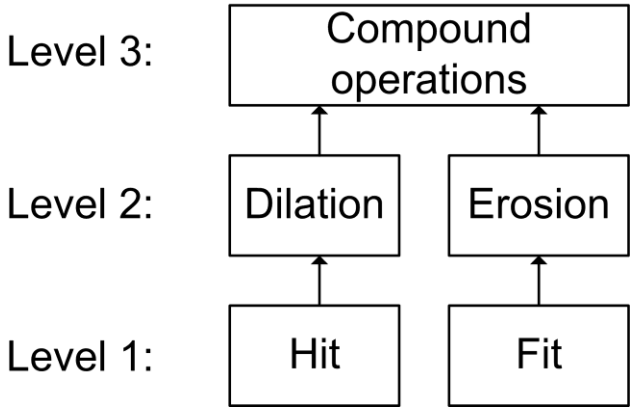
Morfologi Citra

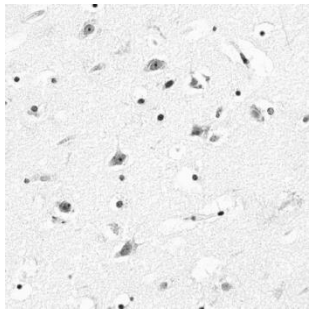
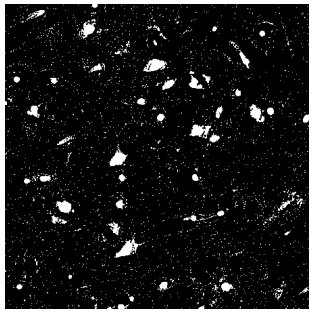
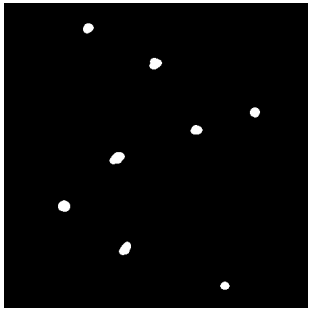
Morfologi Citra

- Apa yang bisa dilakukan oleh morfologi citra ?
- Operasi morfologi :
  - Fit dan Hit
  - Erosi (Erosion)
  - Dilasi (Dilation)
  - Operasi Gabungan (Compound Operations)

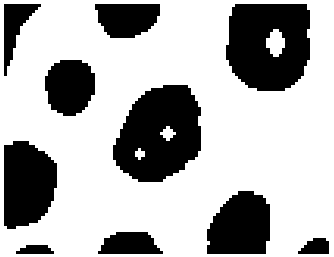


Kegunaan Morfologi

- Remove Noise
  - Small Objects

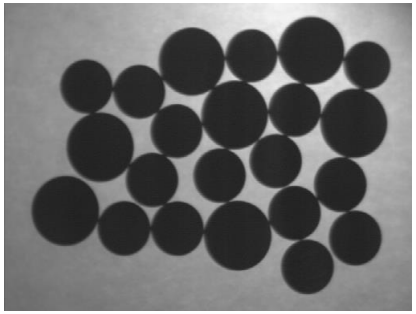
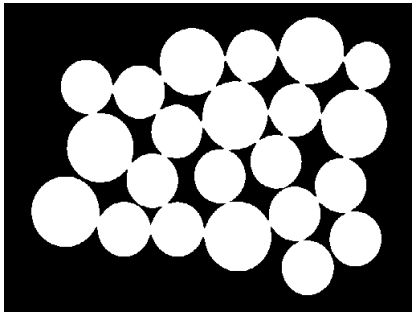
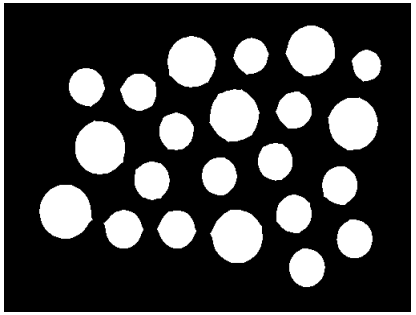




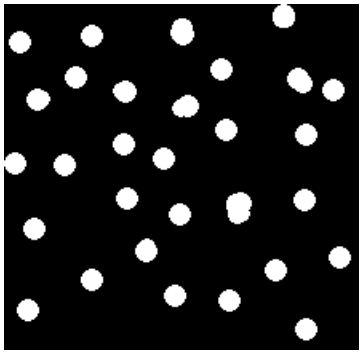
  - Fill holes




Kegunaan Morfologi

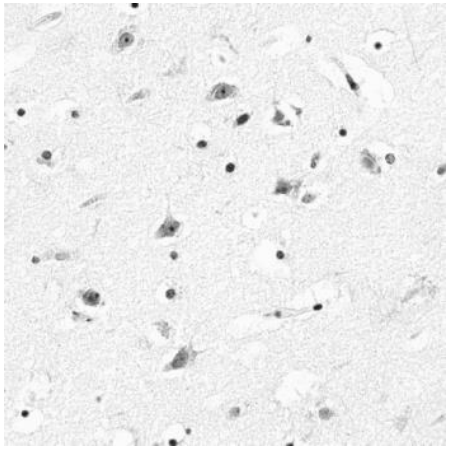
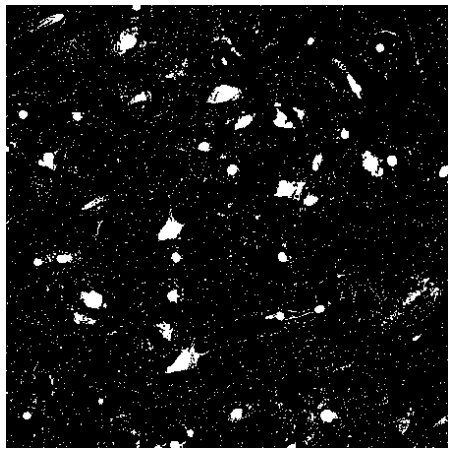
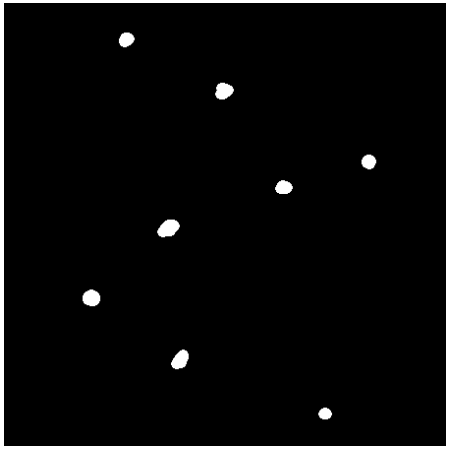
- Isolate Objects



Cara Kerja Morfologi Citra

- Konversi citra ke dalam bentuk Grayscale
- Lakukan binerisasi citra → Thresholding
- Morfologi

- Dapat juga diterapkan pada citra grayscale

Hit dan Fit untuk Citra 1D

Input image

1	0	0	0	1	1	1	0	1	1

Structuring Element (SE)

1	1	1

Desain SE sesuai keinginan

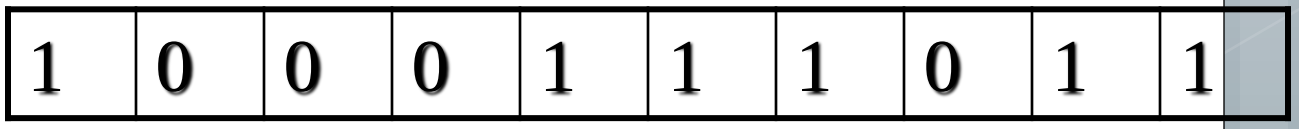
Output Image

		0/1							

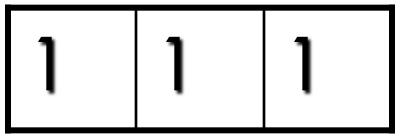
Hit: If just one of the '1's in the SE match with the input =>
output = 1, otherwise output = 0
Fit: If all '1's in the SE match with input =>
output = 1, otherwise output = 0

Dilasi (Dilation) berdasarkan Operasi Hit

Input image



Structuring Element (SE)

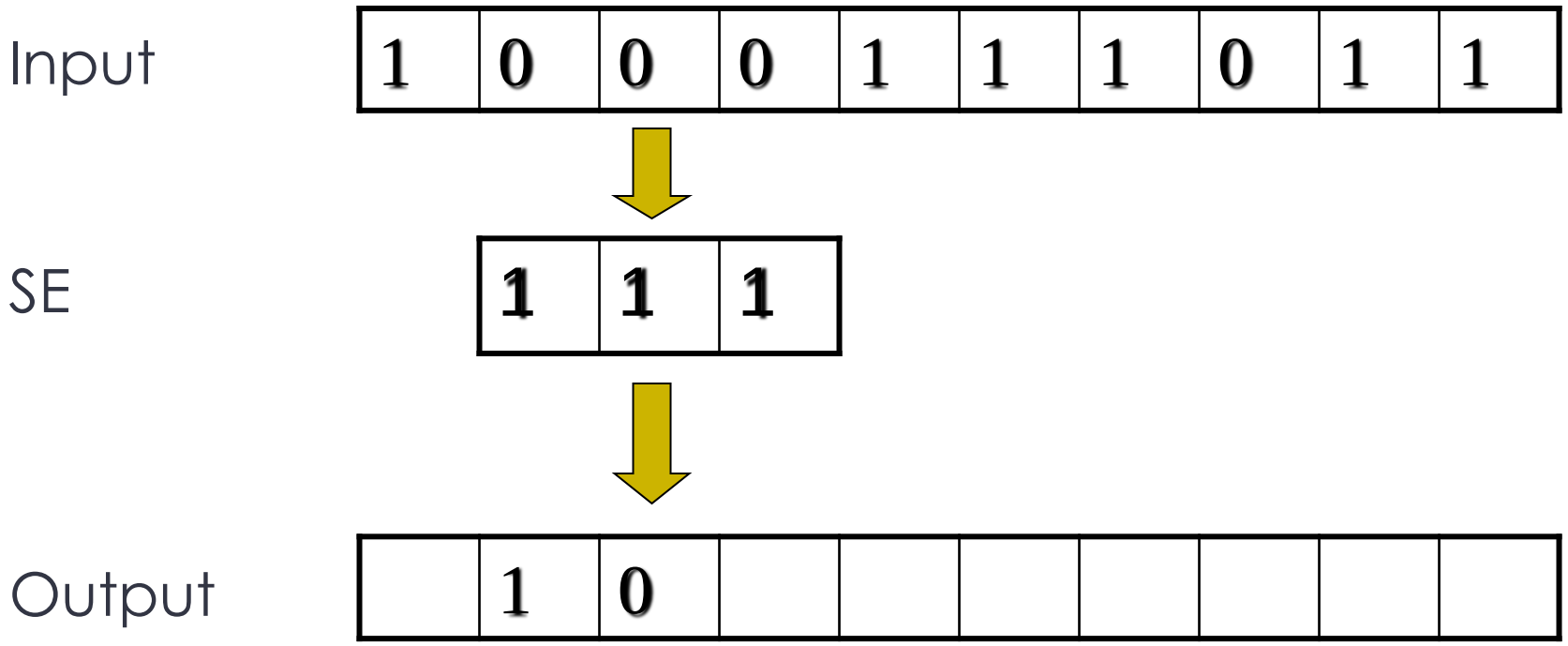


$$g(x) = f(x) \oplus SE$$

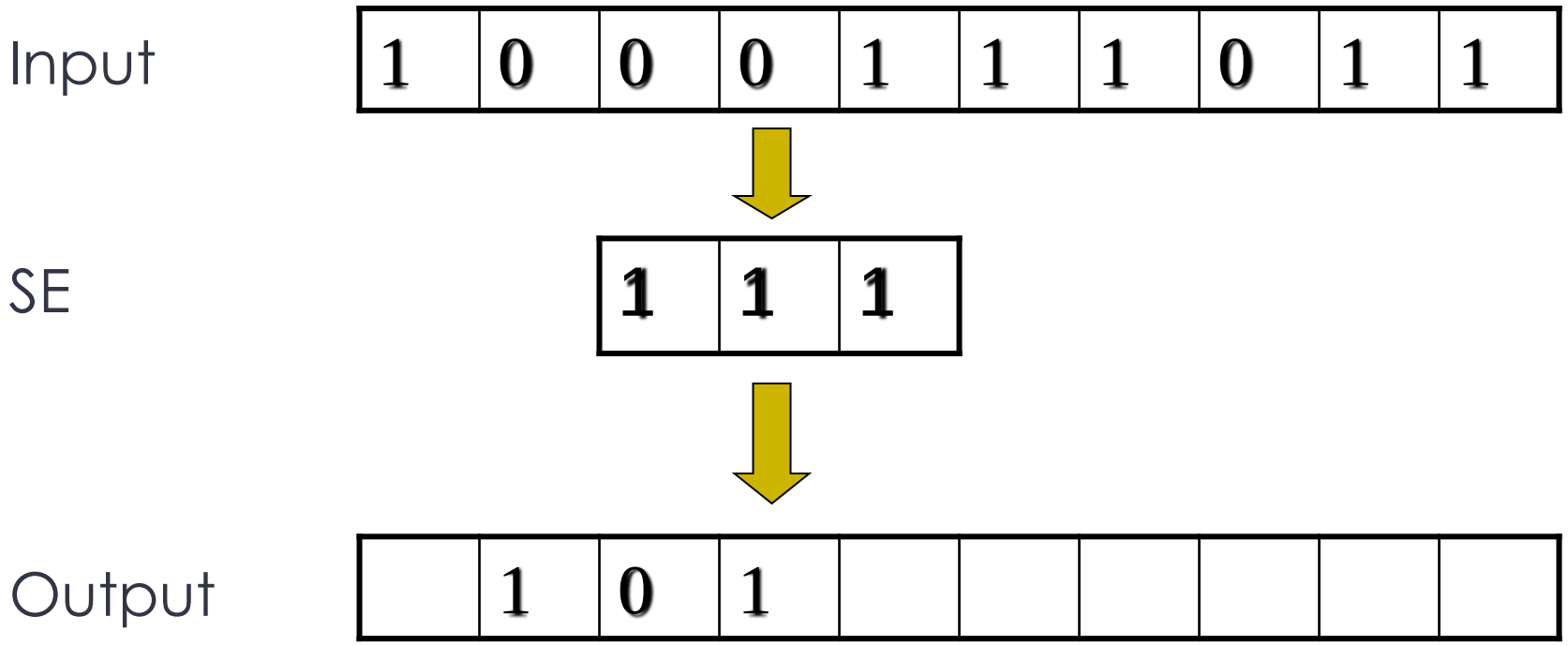
Output Image

Hit: If just one of the '1's in the SE match with the input => output = 1, otherwise output = 0

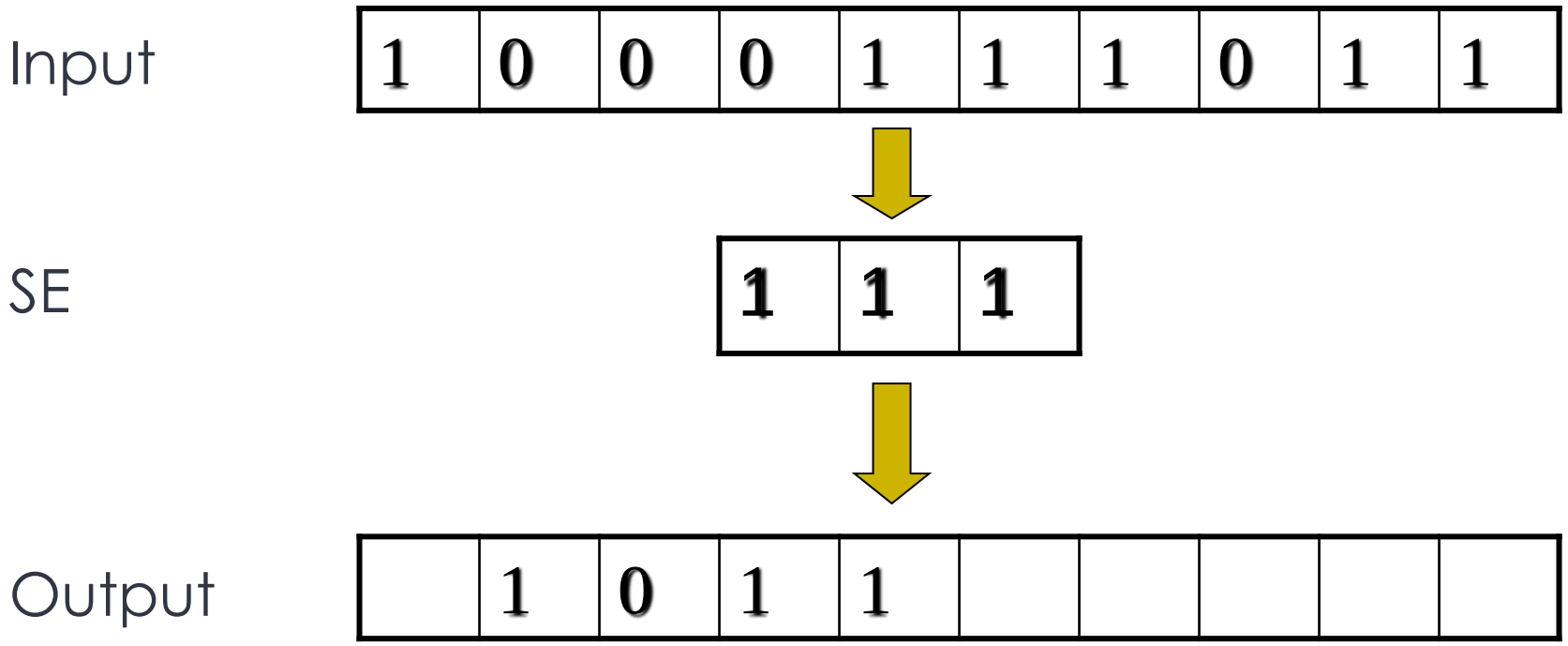
Contoh Dilasi



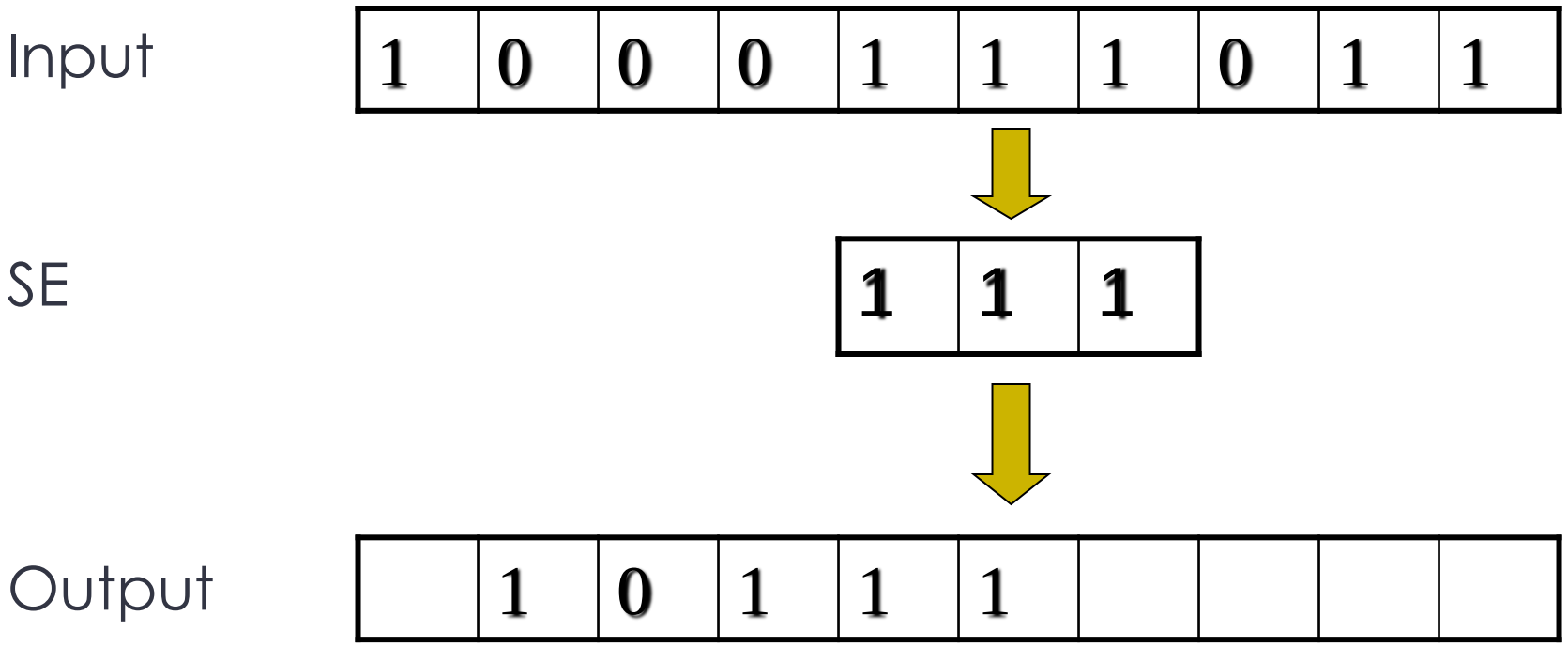
Contoh Dilasi



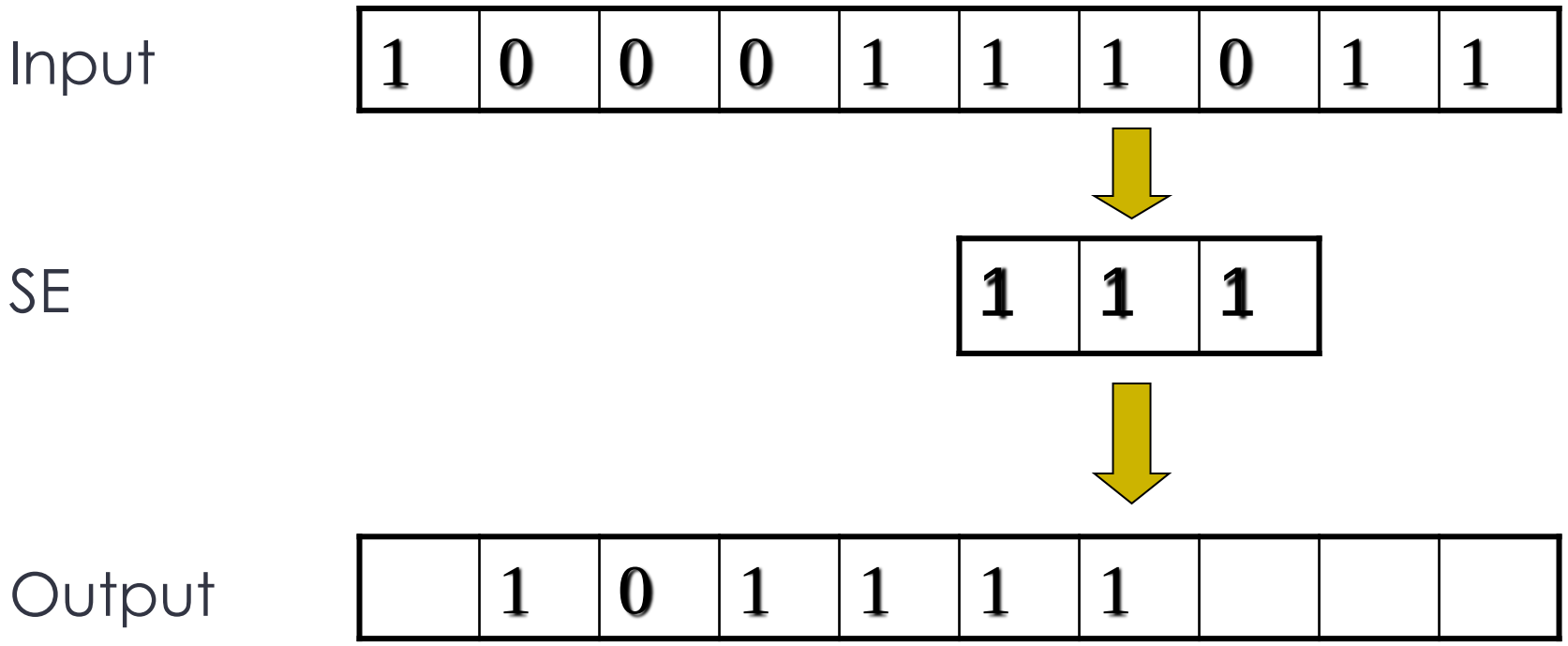
Contoh Dilasi



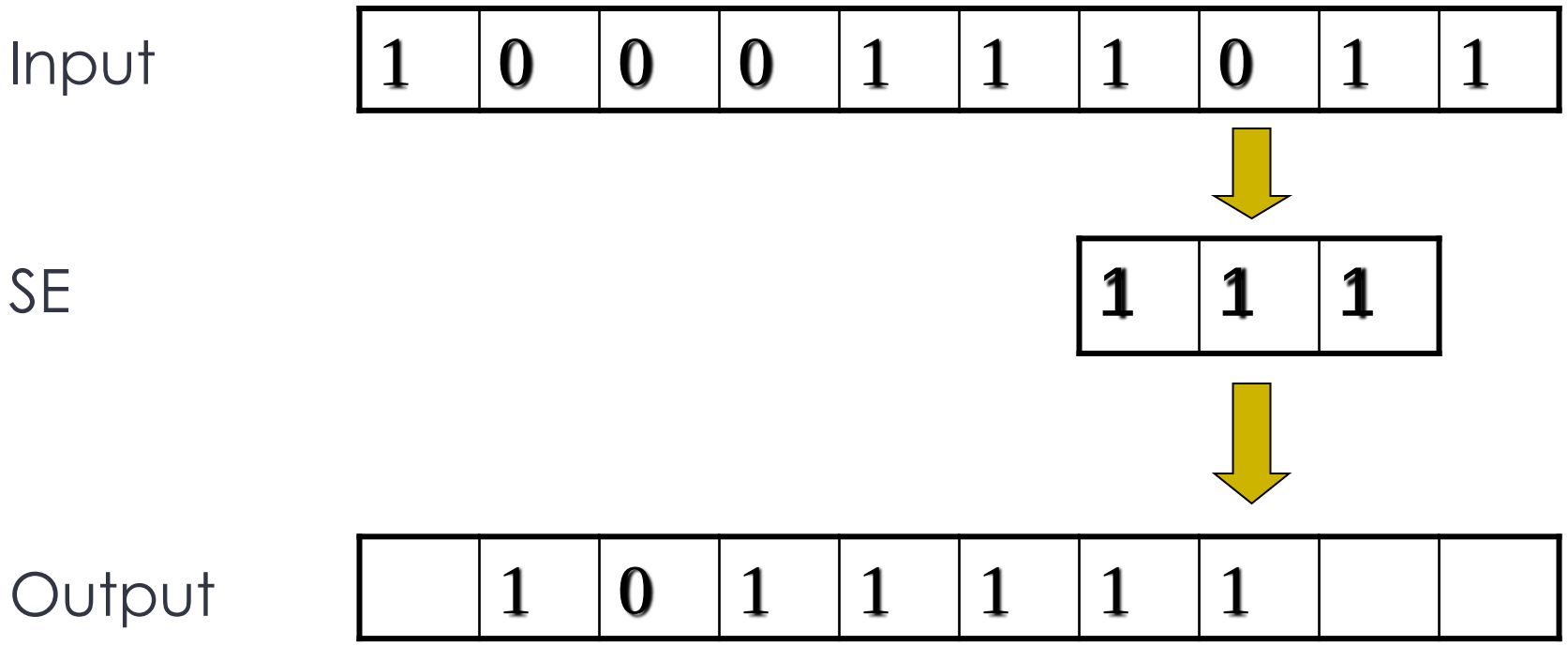
Contoh Dilasi



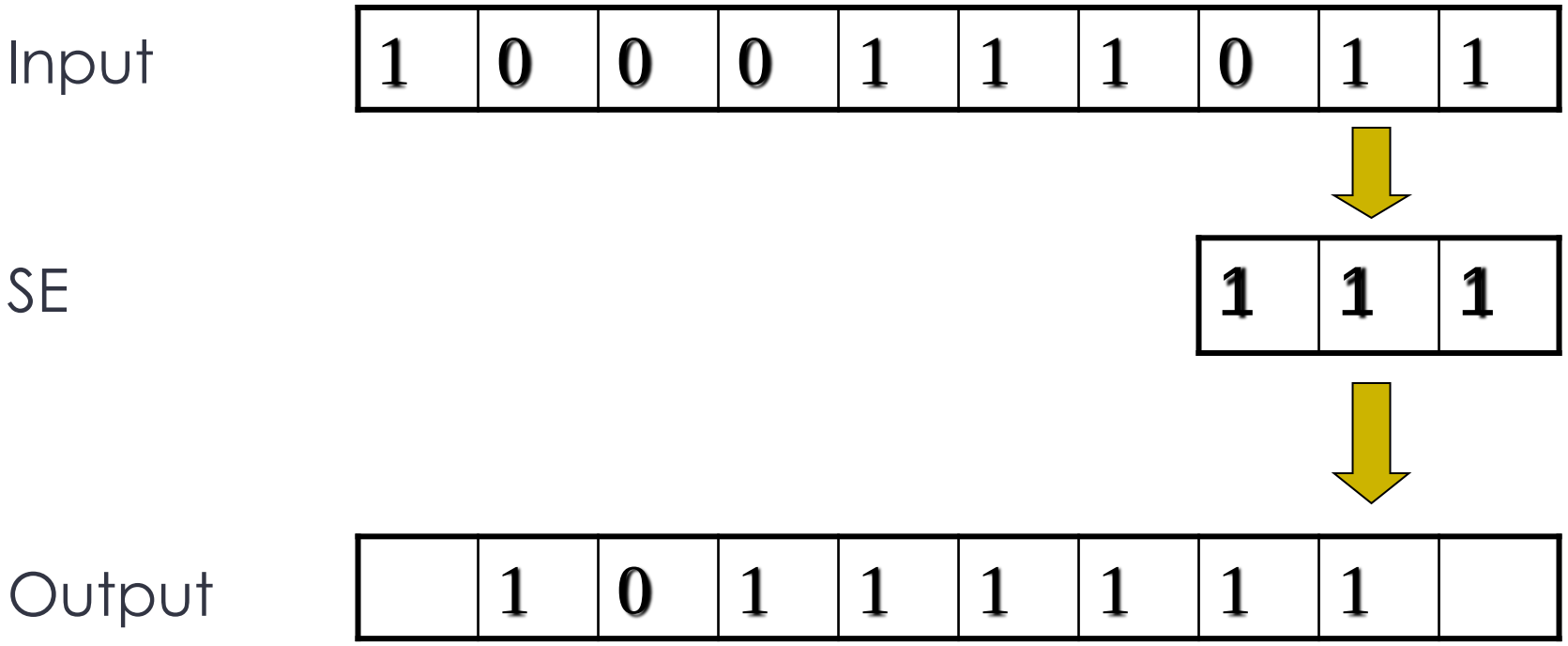
Contoh Dilasi



Contoh Dilasi

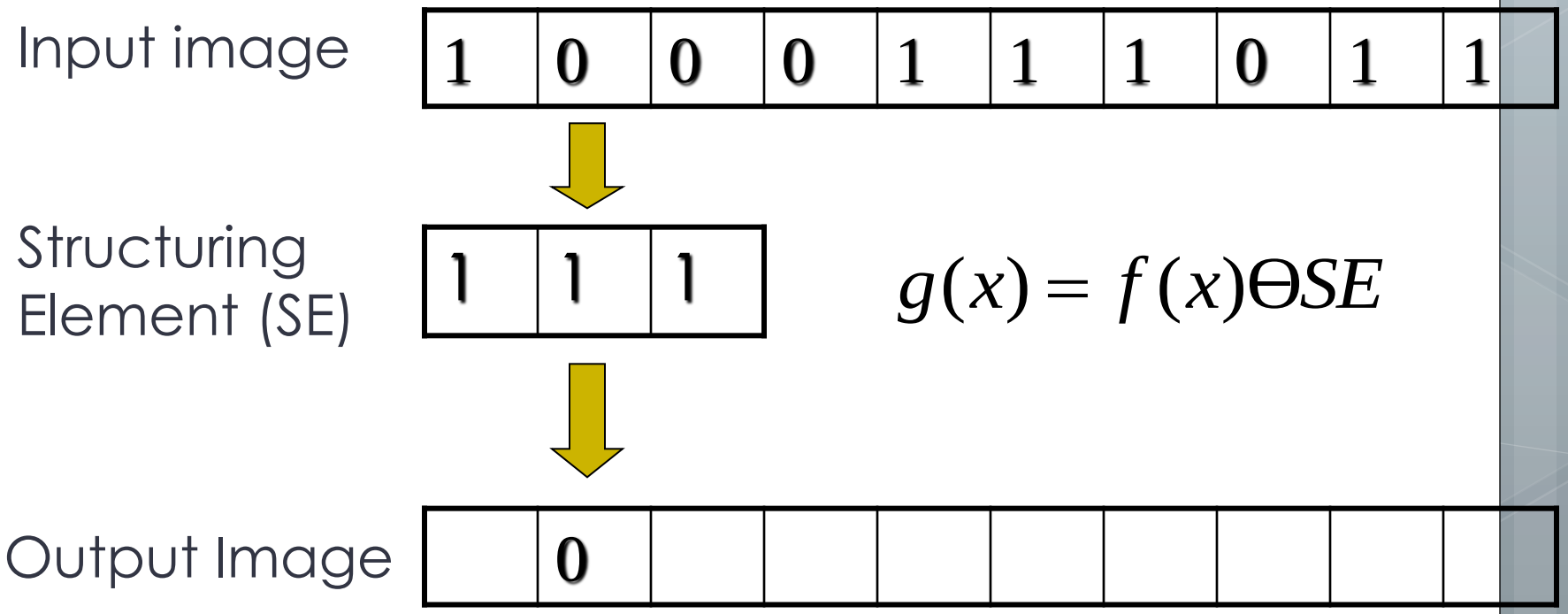


Contoh Dilasi



Object (1) menjadi lebih besar dan holes (0) menjadi terisi dengan object atau hilang

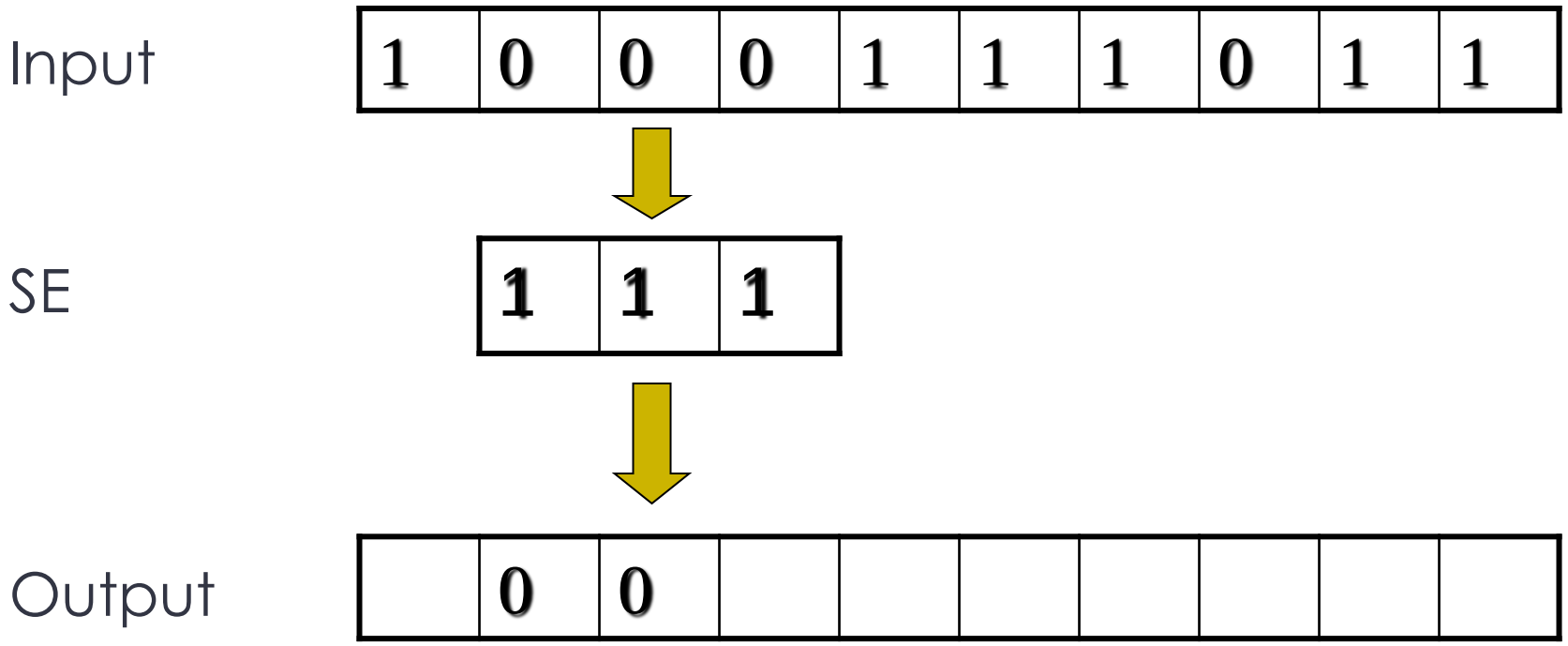
Erosi (Erosion) berdasarkan Operasi Fit



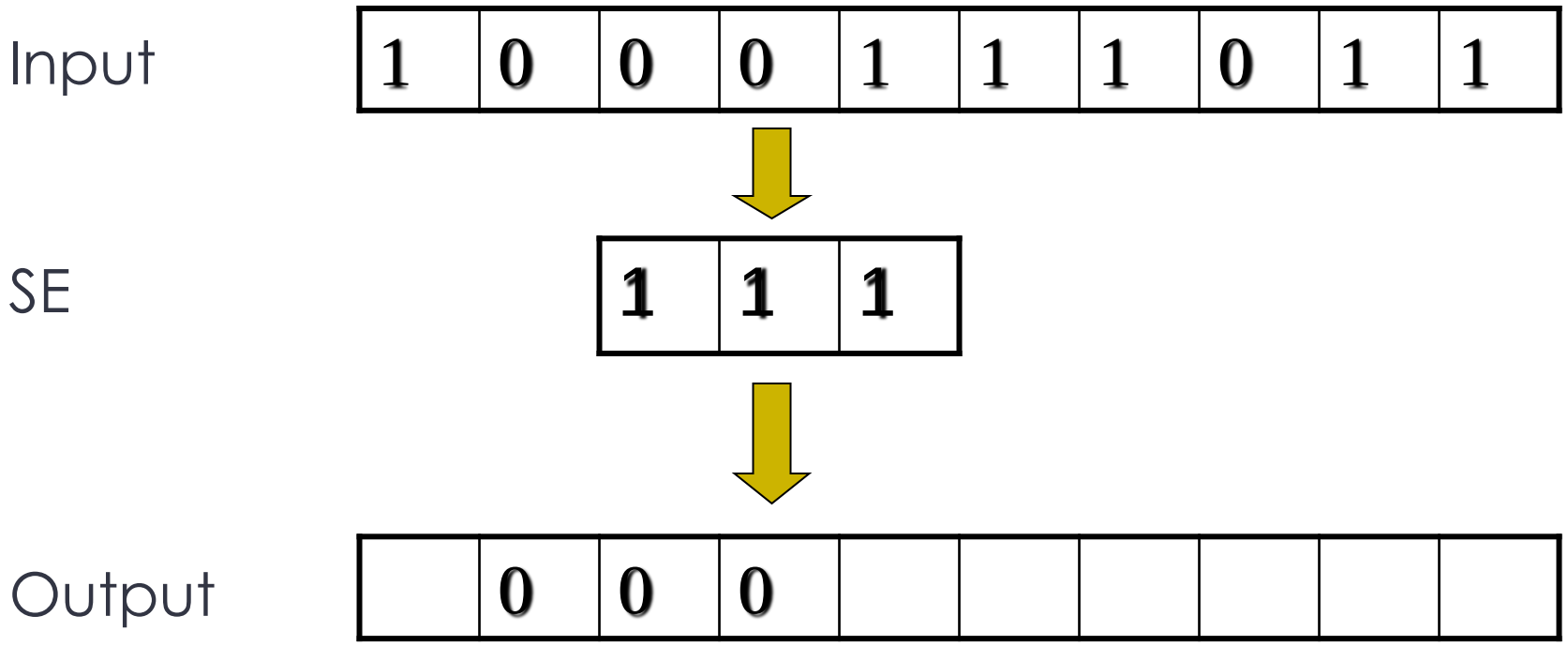
$$g(x) = f(x) \ominus SE$$

Fit: If all '1's in the SE match with input => output = 1, otherwise output = 0

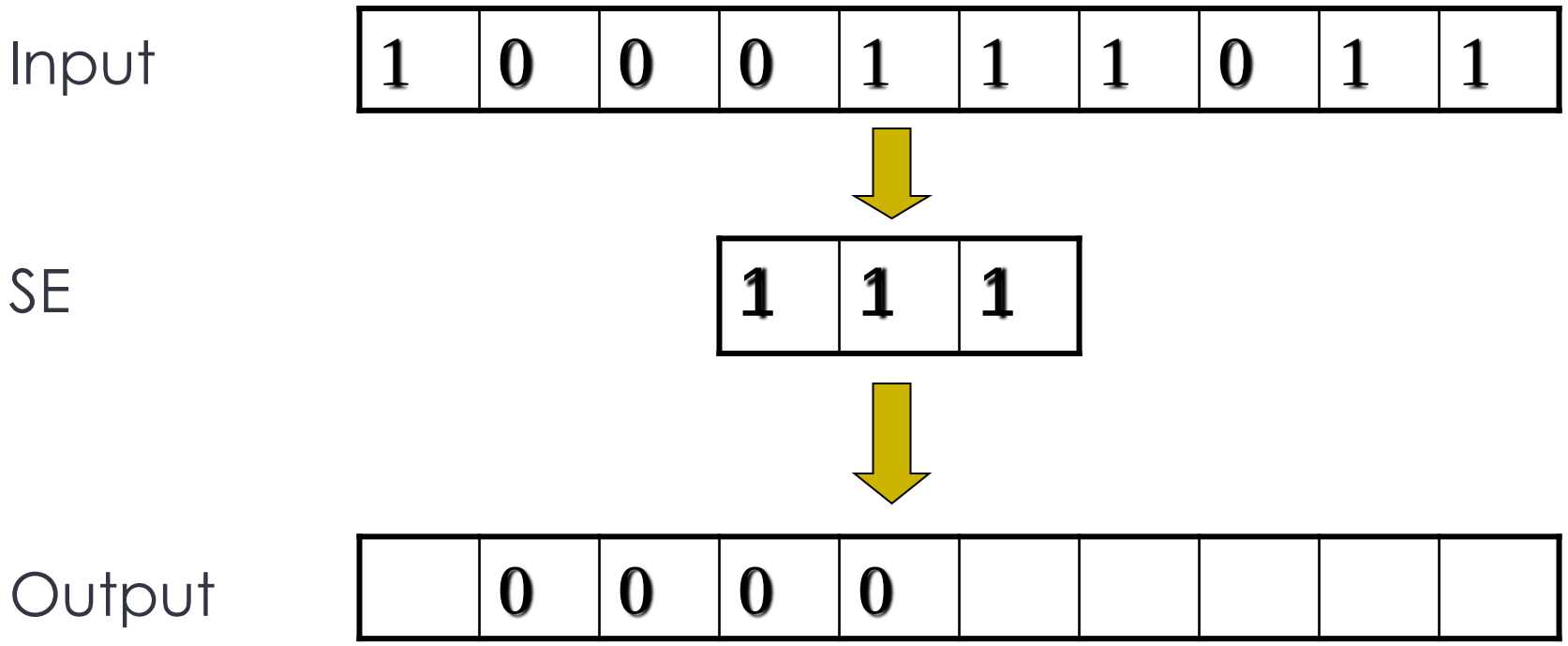
Contoh Erosi



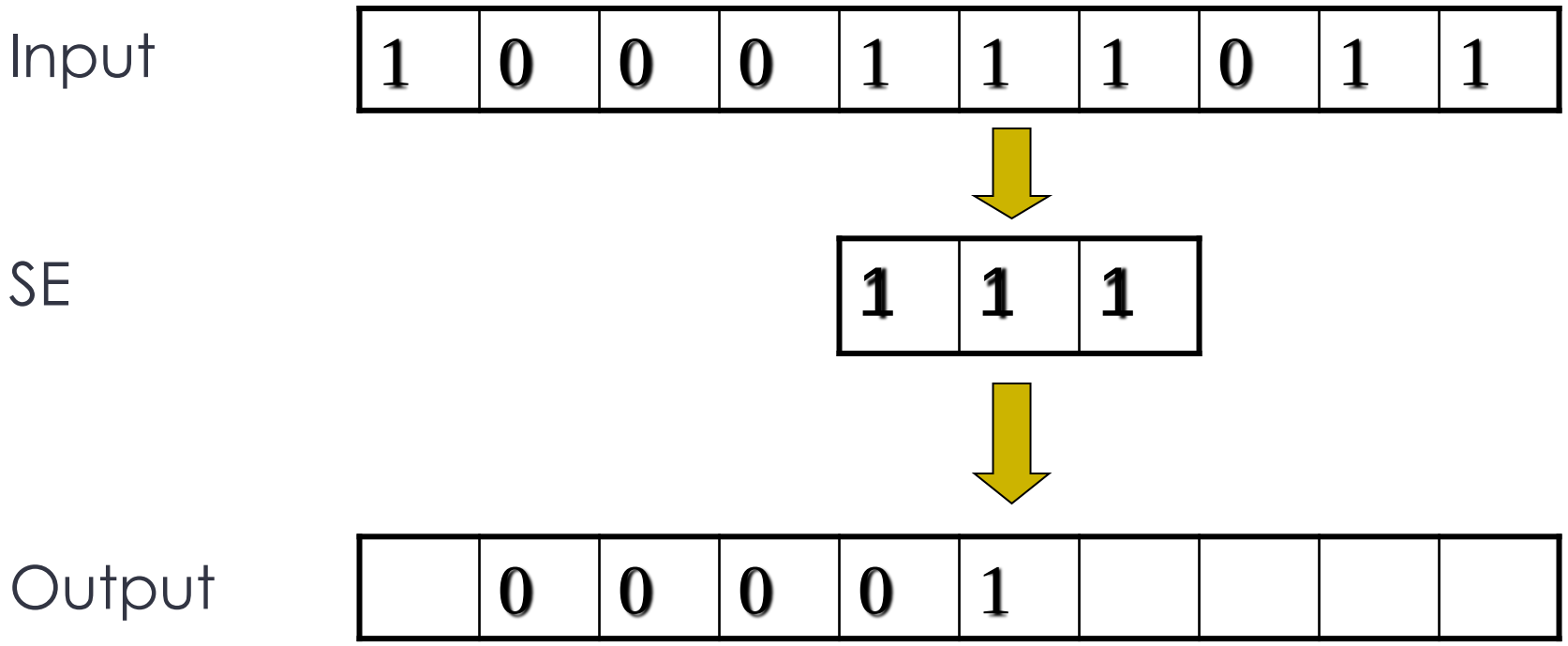
Contoh Erosi



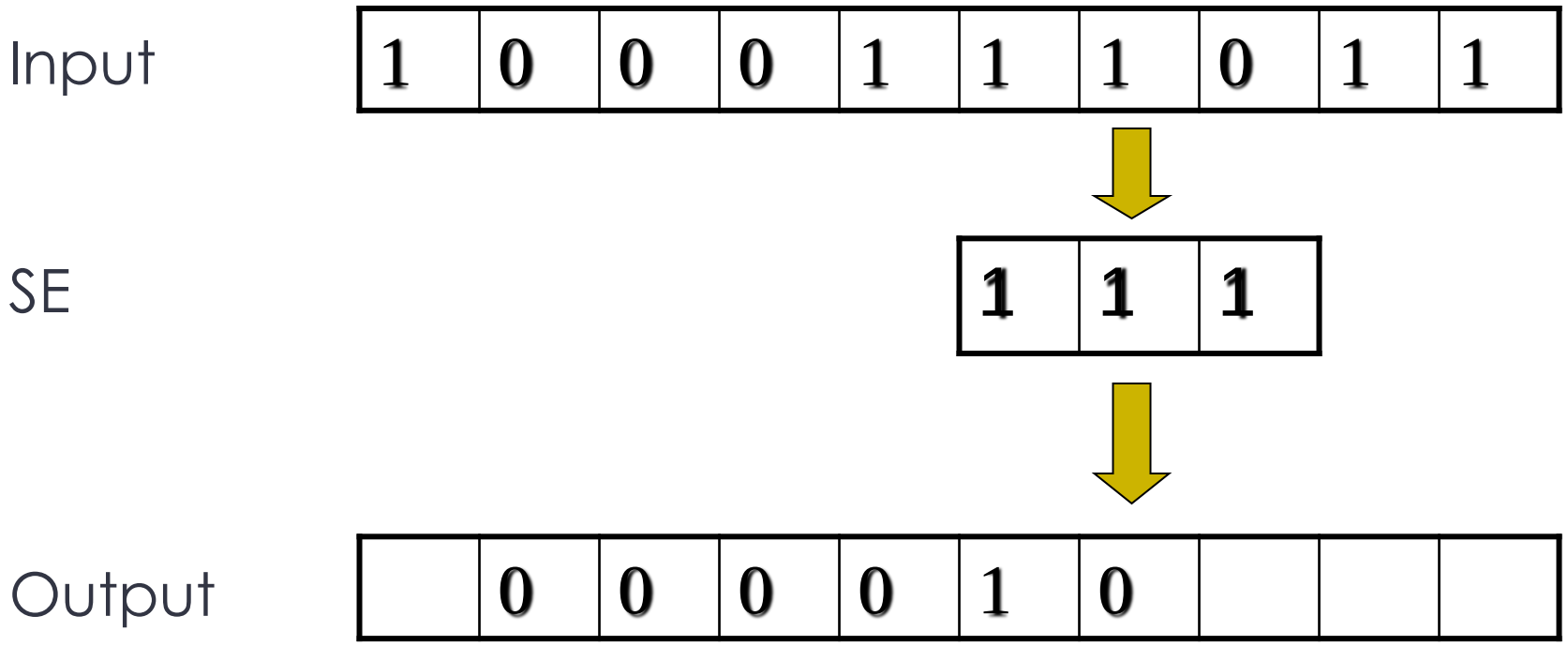
Contoh Erosi



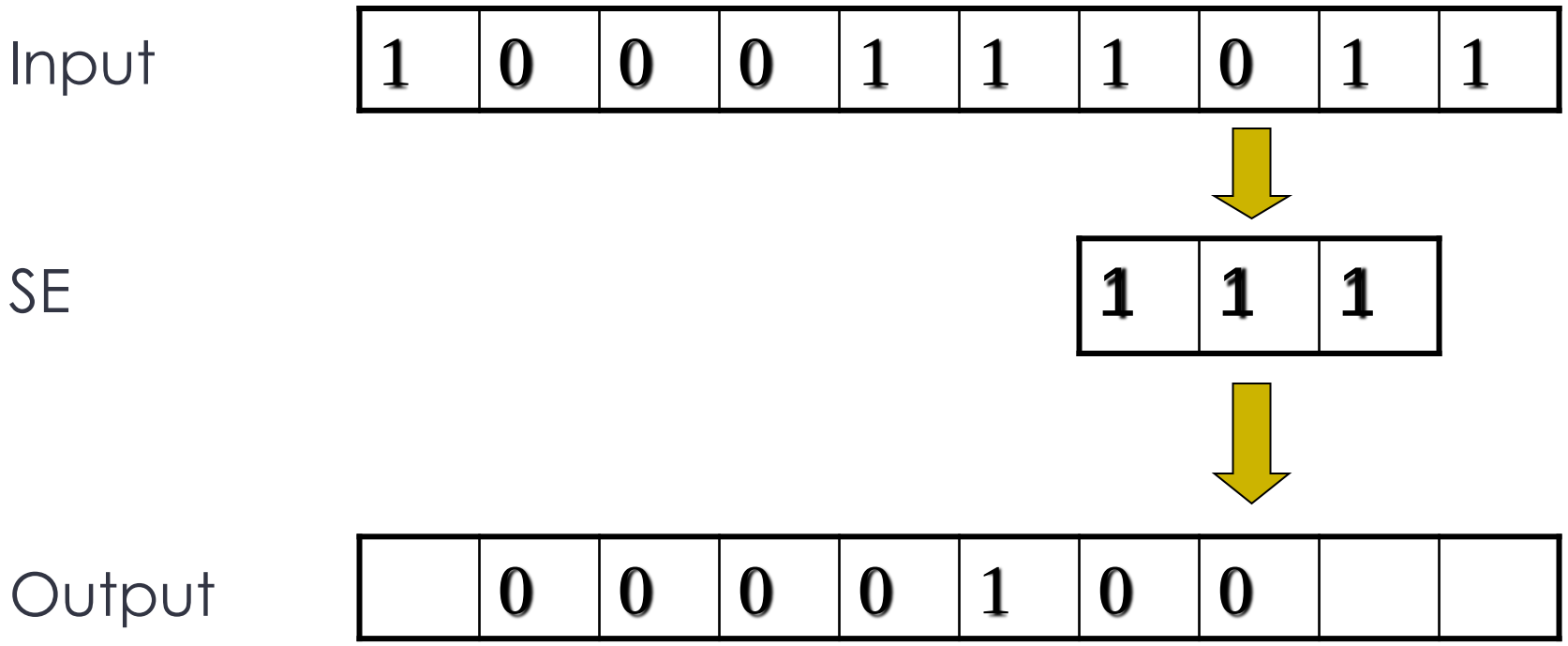
Contoh Erosi



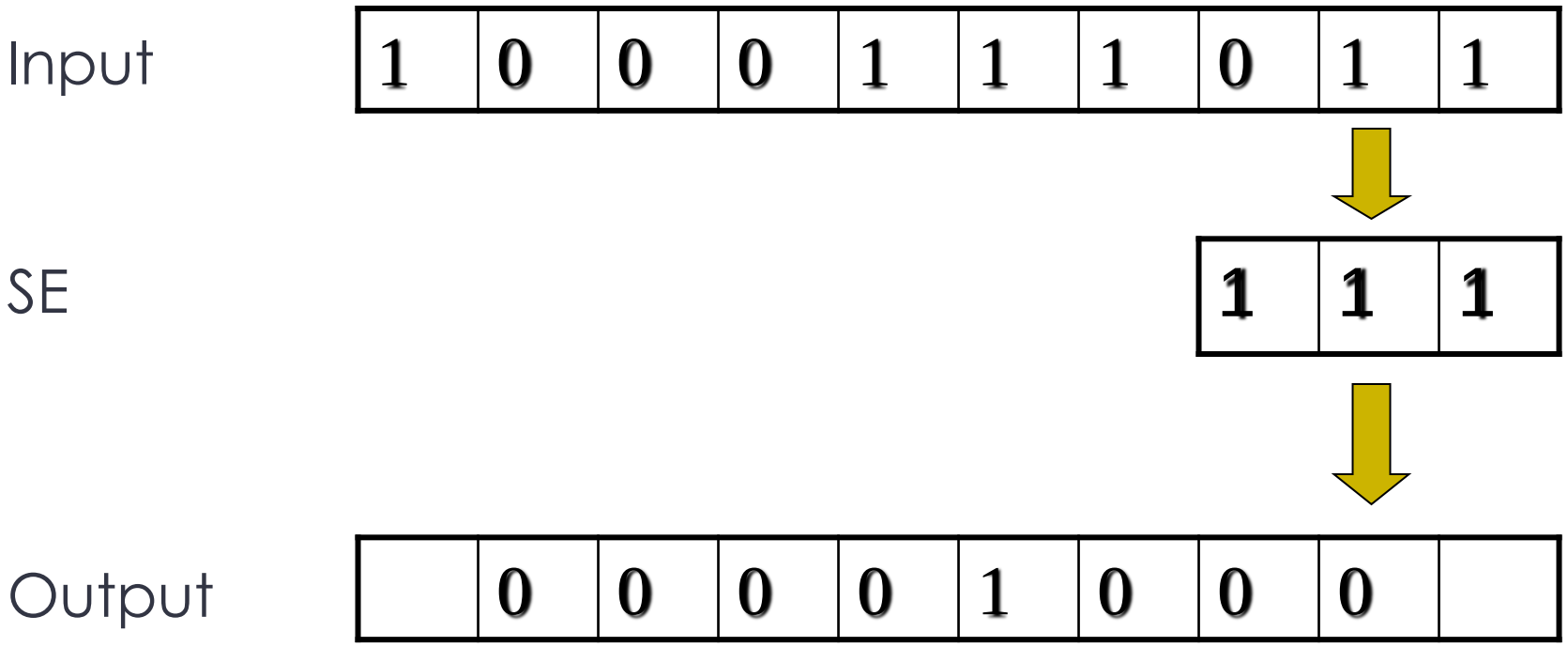
Contoh Erosi



Contoh Erosi



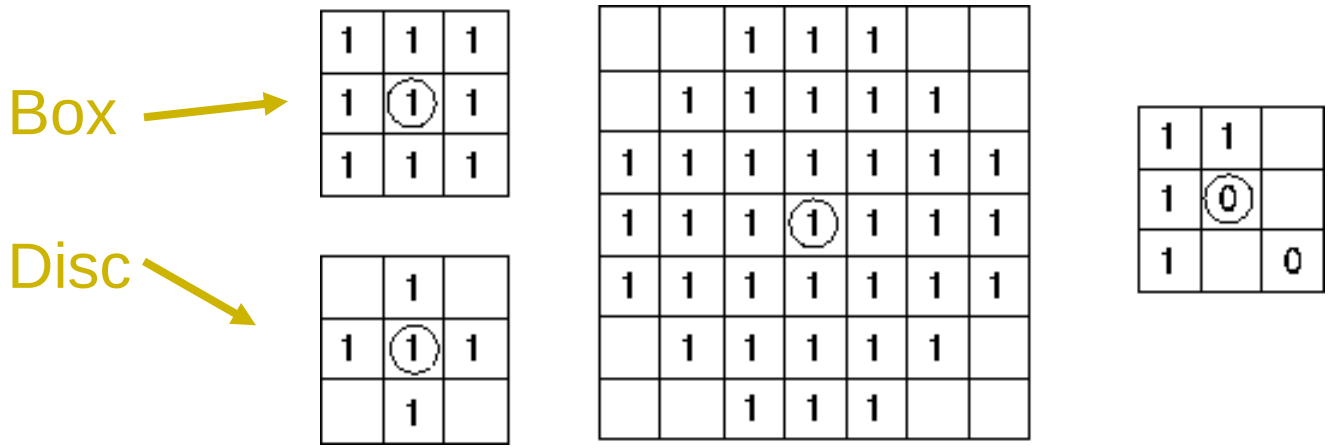
Contoh Erosi



Object (1) menjadi lebih kecil

Morfologi Citra

- Structuring Elements (SE) dapat terdiri dari sebarang ukuran sesuai dengan kebutuhan
- Nilai dari elemen adalah **0** atau **1**, namun dimungkinkan memiliki nilai yang lain (termasuk tidak ada nilainya)
- Nilai kosong pada SE berarti bebas (*don't care*)

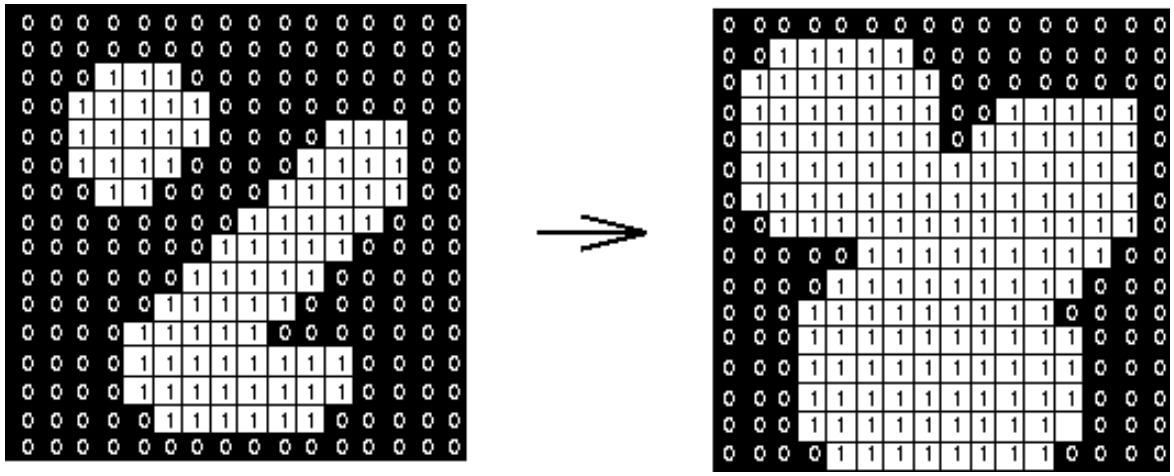


Dilasi (2-Dimensi) ← Hit

$$g(x,y) = f(x,y) \oplus SE$$

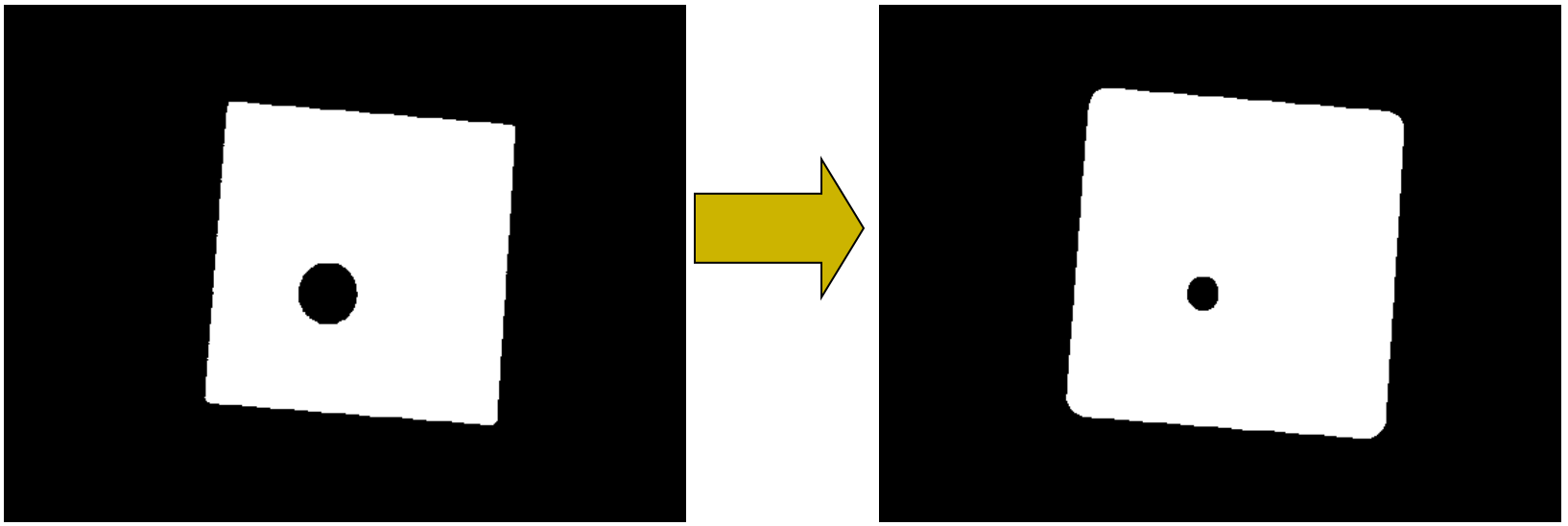
Structuring Element

1	1	1
1	1	1
1	1	1



- Objects tergabung (holes terisi object)
- Sudut yang tajam dihaluskan

Contoh Dilasi



		1	1	1		
	1	1	1	1	1	
1	1	1	1	1	1	1
1	1	1	(1)	1	1	1
1	1	1	1	1	1	1
	1	1	1	1	1	
		1	1	1		

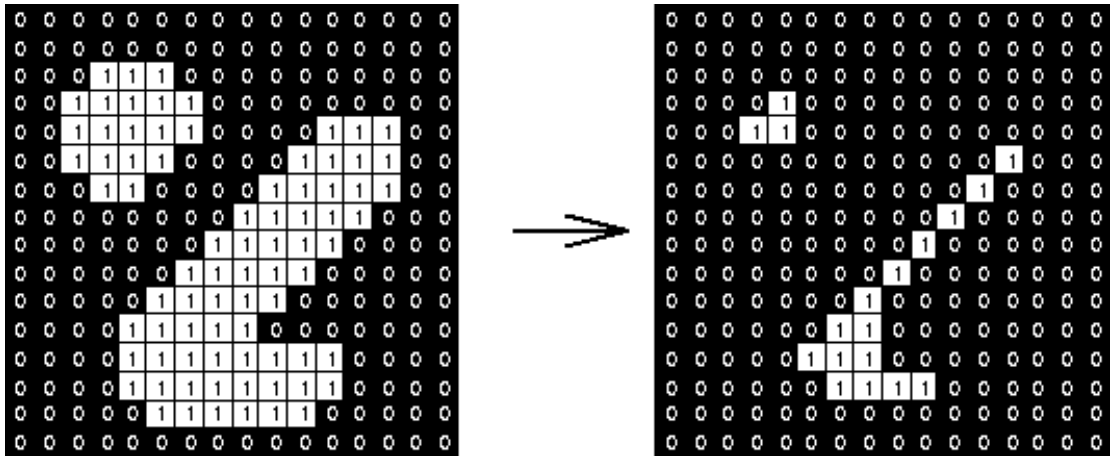
Structuring element:
disc => rounded corners

Erosi (2-Dimensi) ← Fit

$$g(x,y) = f(x,y) \ominus SE$$

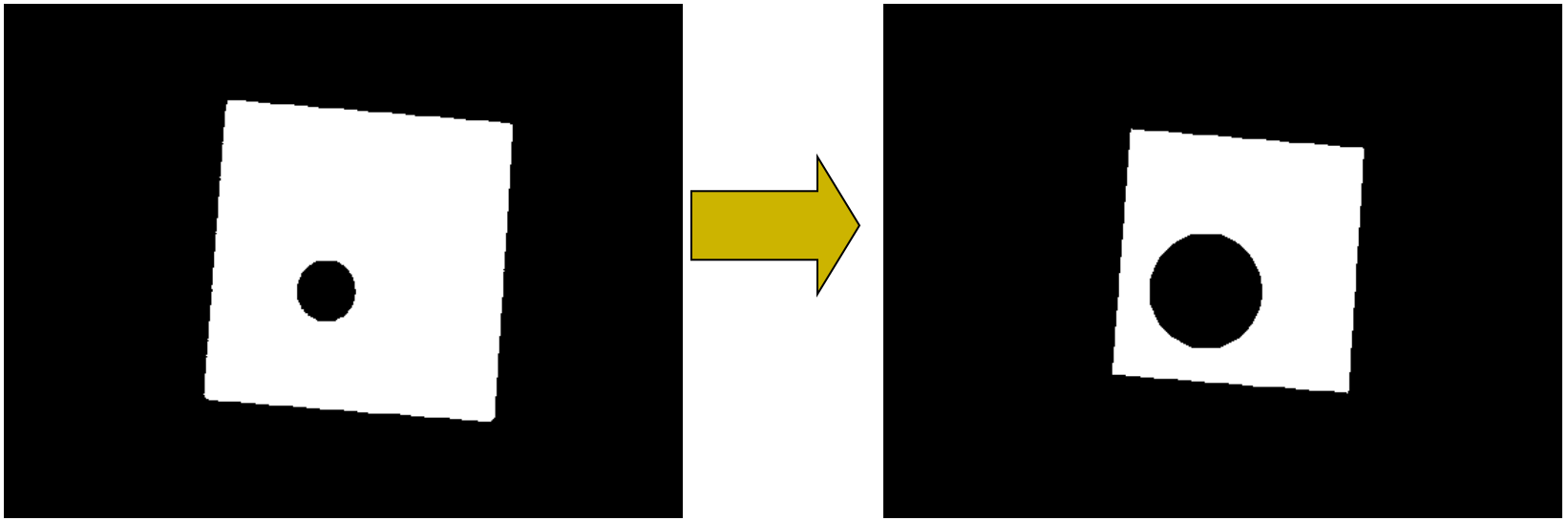
Structuring Element

1	1	1
1	1	1
1	1	1



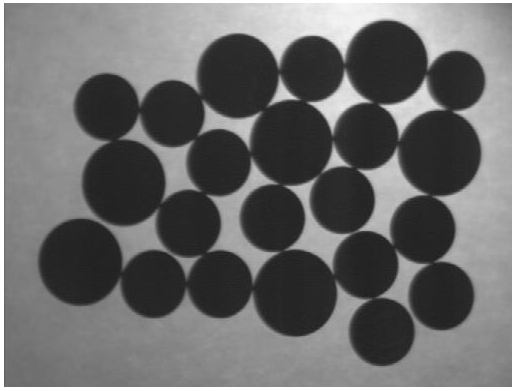
- Objects menjadi lebih kecil

Contoh Erosi

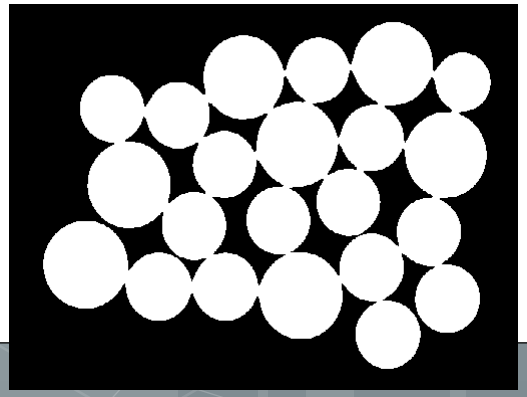


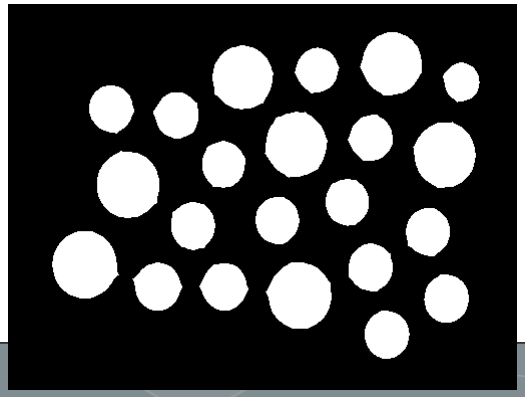
Aplikasi Menghitung Koin

- Kesulitan menghitung koin pada gambar di bawah disebabkan tergabungnya object koin



- Solusi: Thresholding dan Erosi utk memisahkannya!



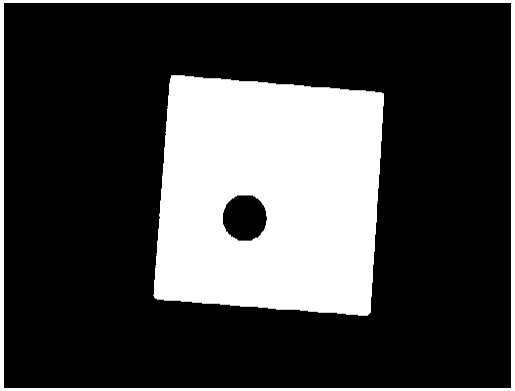
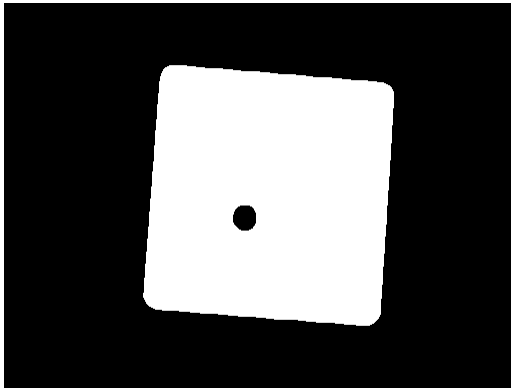
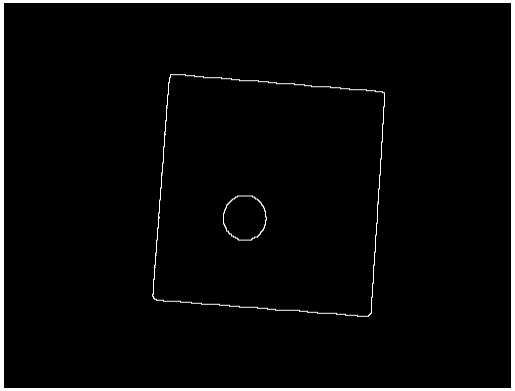


Compound Operations

- Menggabungkan operasi Erosion dan Dilation kedalam level operasi yang lebih tinggi (more advanced)
  - Mencari garis tepi (*outline*)
  - *Opening*: mengisolasi objects dan menghilangkan object-object kecil (lebih baik daripada Erosion)
  - *Closing*: mengisi holes pada citra (lebih baik daripada Dilation)

Mencari garis tepi (outline)

- Operasi Dilasi (object menjadi lebih besar)
- Substraksi citra asal dengan citra hasil dilasi
- Didapatkan outline

Opening

- Motivasi: menghilangkan object-object kecil TETAPI tetap mempertahankan ukuran aslinya
- Opening = Erosion + Dilation
  - Gunakan SE yang sama
  - Hampir sama dengan erosi tetapi tidak terlalu *destructive*
- Math:

$$f(x,y) \circ SE = (f(x,y) \ominus SE) \oplus SE$$

- Opening adalah *idempotent*: operasi opening yang diulang-ulang tidak memberikan dampak yang berkelanjutan!

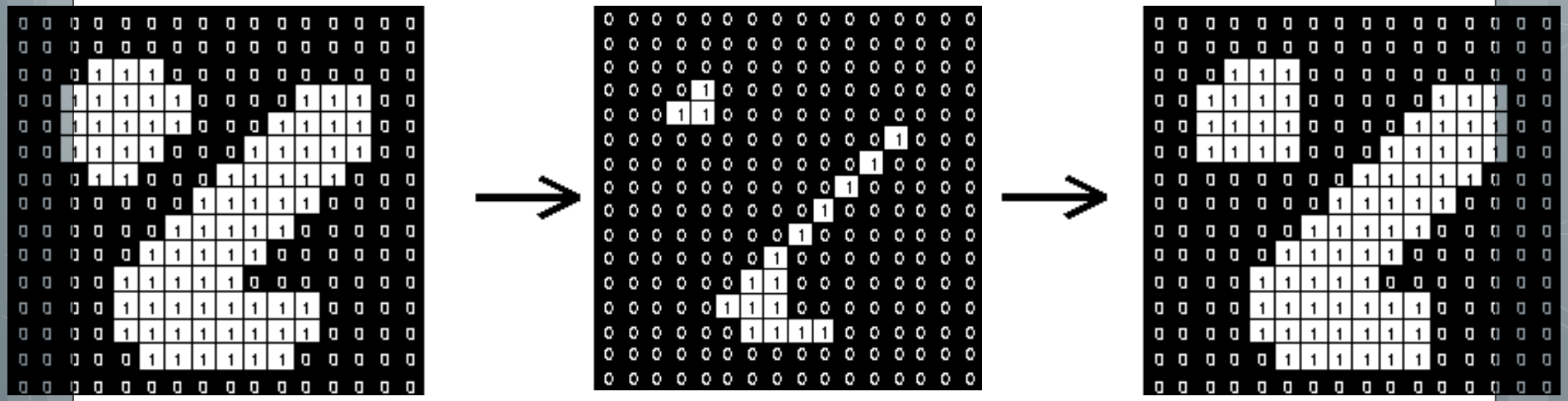
Contoh Opening

SE

1	1	1
1	1	1
1	1	1

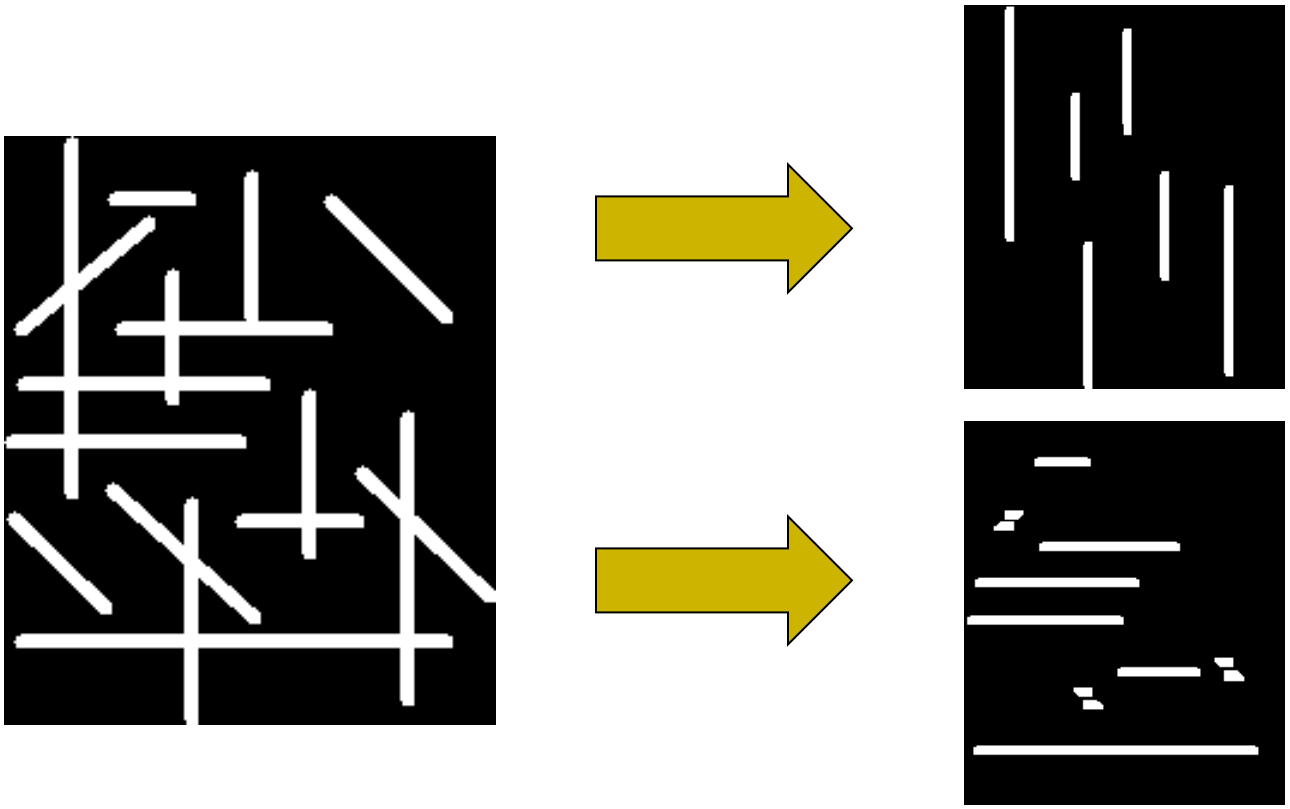
Erosion

Dilation



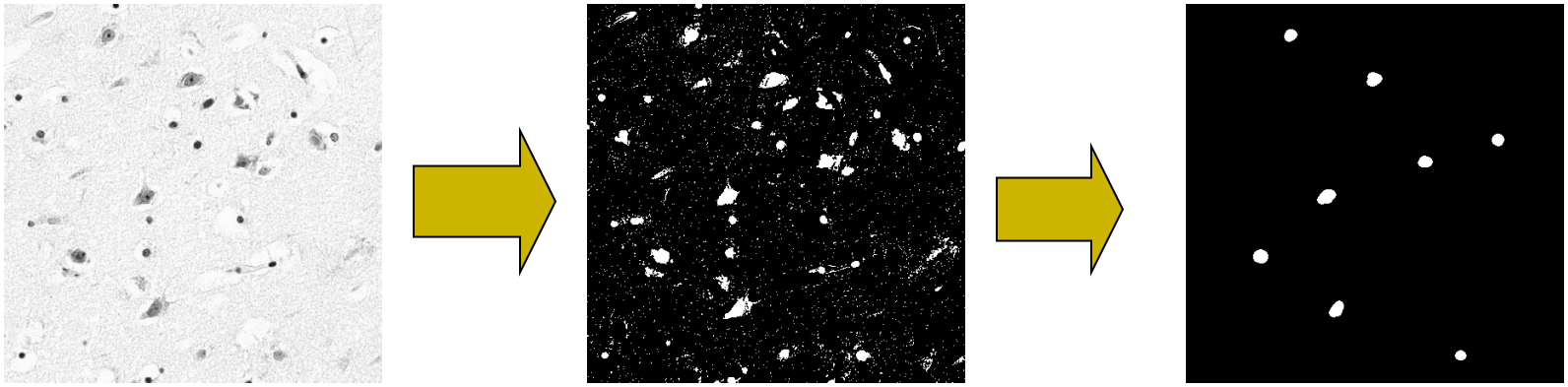
Contoh Opening

- 9x3 and 3x9 Structuring Elements



Contoh Opening

- Structuring Element: 11 pixel disc



(show: cell_colony, 3 x erosion, 3 x dilation)

Closing

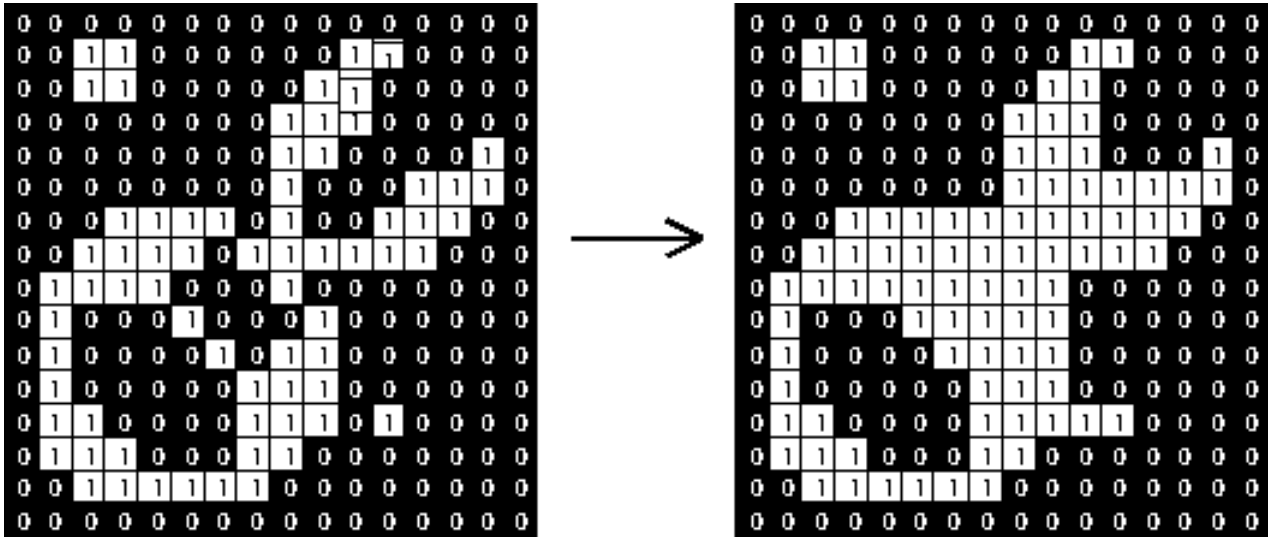
- Motivasi: Mengisi holes TETAPI tetap menjaga ukuran aslinya
- Opening = Dilation + Erosion
  - Gunakan SE yang sama
  - Hampir sama dengan dilasi tetapi tidak terlalu *destructive*
- Math:

$$f(x,y) \bullet SE = (f(x,y) \oplus SE) \ominus SE$$

- Closing adalah *idempotent*: operasi closing yang diulang-ulang tidak memberikan dampak yang berkelanjutan!

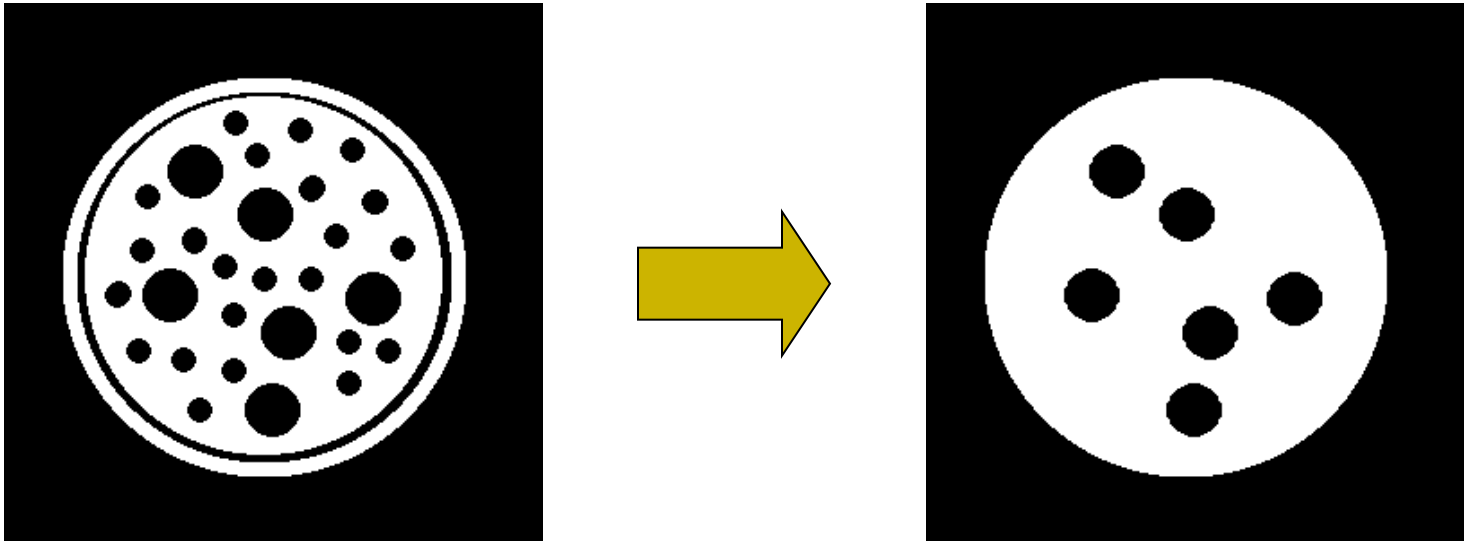
Closing

- Structuring element: 3x3 square



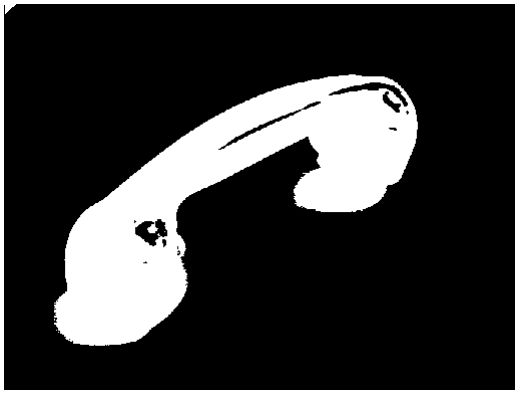
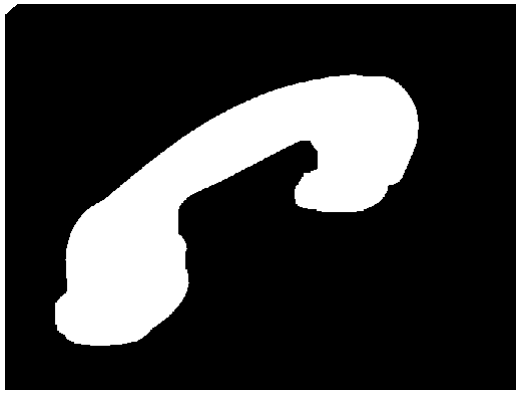
Contoh Closing

- Operasi Closing dengan 22 piksel disc
- Menutupi holes yang kecil



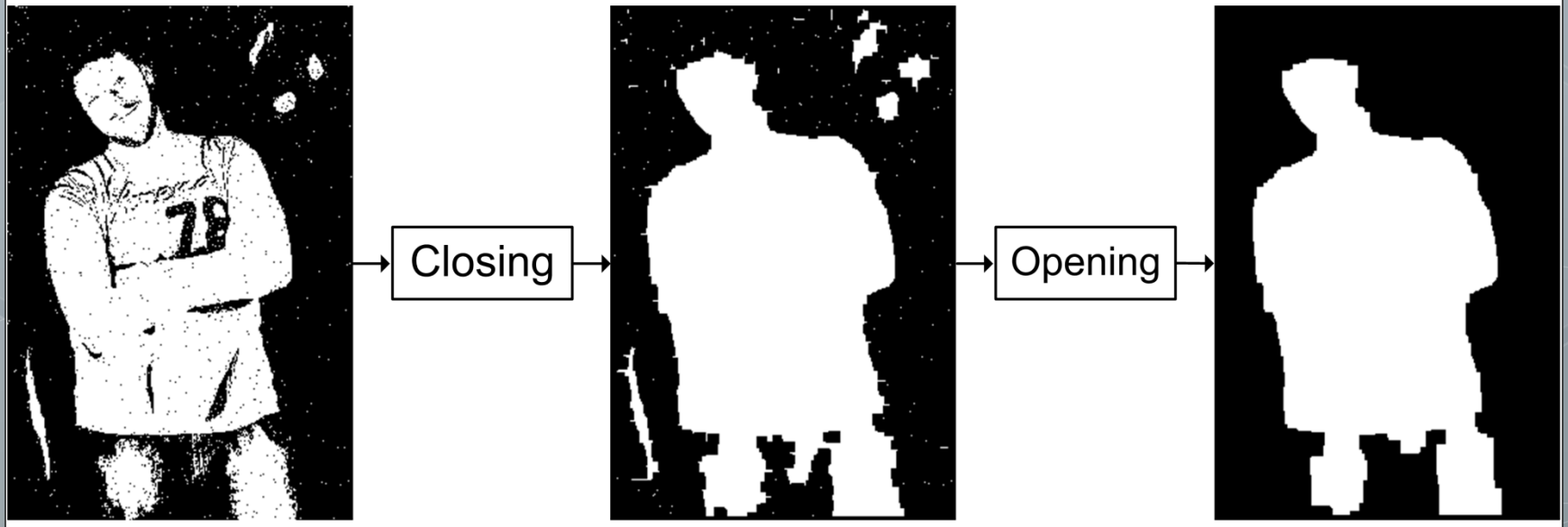
Contoh Closing

- Improve segmentation
  1. Threshold
  2. Closing dengan ukuran 20 piksel disc

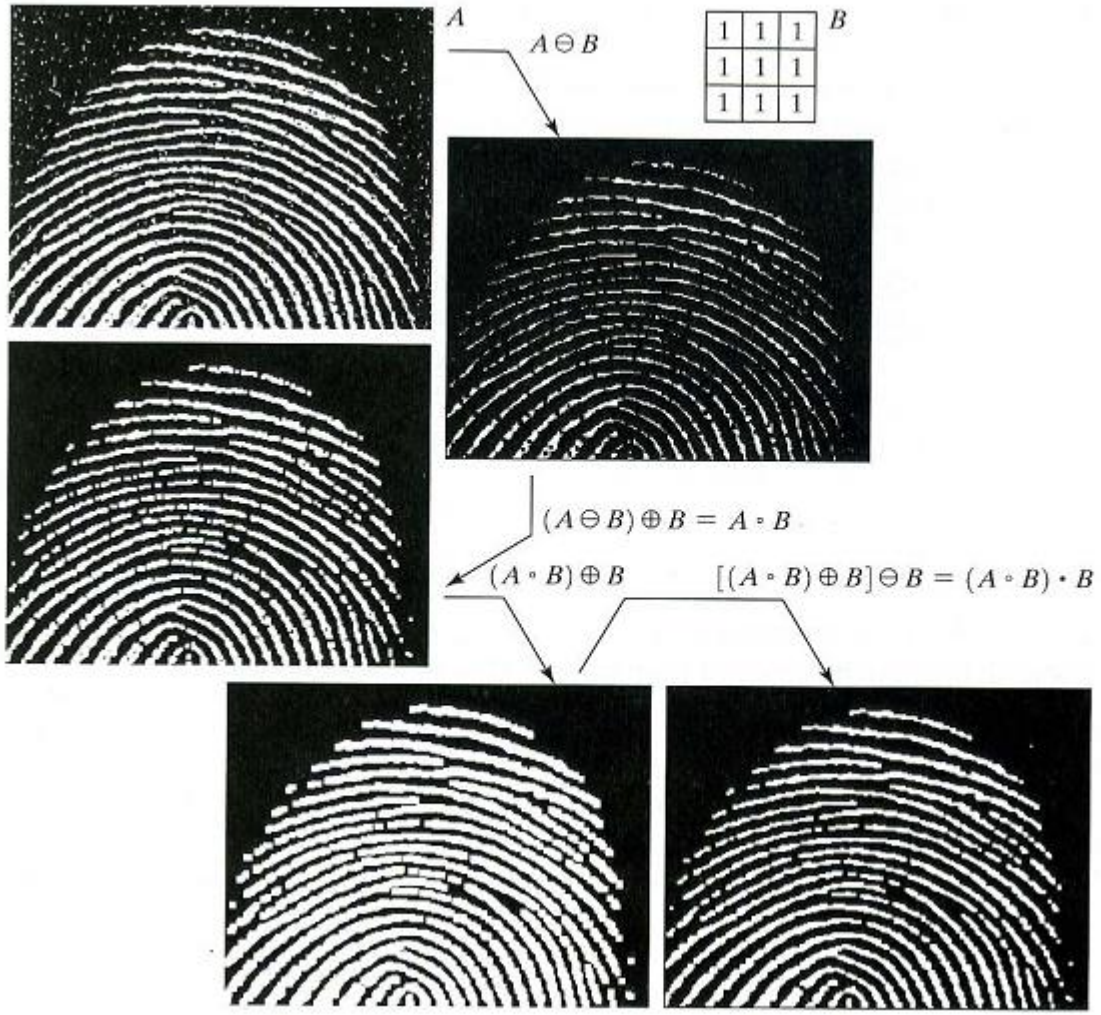




(show: blobs-holes, 1 x dilation, 1 x erosion)

Kombinasi Opening dan Closing



Kombinasi Opening dan Closing



a b
d c
e f

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

Ringkasan

- Morphology
- Fit and Hit operations
- Erosion (based on Fit): Make objects smaller
  - Separate objects, remove small objects (noise)
- Dilation (based on Hit): Make objects bigger
  - Remove holes in objects
- Compound operations
  - Finding the outlines of the objects
  - Opening (Erosion + Dilation)
    - As Erosion but less destructive
  - Closing (Dilation + Erosion)
    - As Dilation but less destructive

Latihan

- Diberikan citra biner:
  - Dilation
  - Erosion
  - Closing
  - Opening
- Structuring element:

1	1	1
1	1	1
1	1	1

0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	1	1	0	0	1	0	0	0
0	0	0	1	1	1	1	1	0	0
0	0	1	1	1	1	1	0	0	0
0	0	1	1	1	1	0	0	0	0
0	0	1	1	1	1	1	0	0	0
0	0	0	1	1	1	1	0	0	0
0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0

Thank You !