Morphological Image Processing

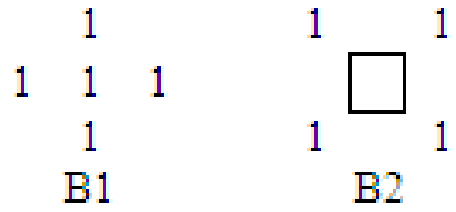
Dr. Eng Fitri Utaminingrum, ST., MT

Transformasi Hit-or-Miss

- Transformasi hit-or-miss A oleh B dinyatakan oleh $A \otimes B$

$$A \circledast B = (A \ominus B_1) \cap (A^c \ominus B_2)$$

- Kita bisa men-generalisasi notasi dengan menyatakan B=(B1, B2),
- Transformasi hit-or-miss didefinisikan dengan dua strel/konstruktor seperti:



Contoh pasangan strel

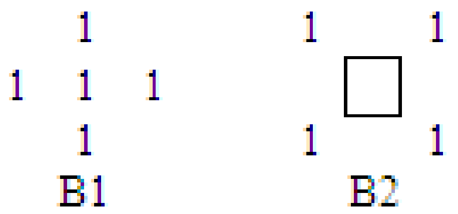
Contoh

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

a. Piksel citra asli A

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

b. Erosi A oleh B1



Pasangan strel yang digunakan

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

c. Komplemen citra A (Ac)

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

d. Erosi Ac oleh B2

Toolbox di MATLAB:

```
>> C = bwhitmiss(A, B1, B2)
```

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

e. Irisan b dan d

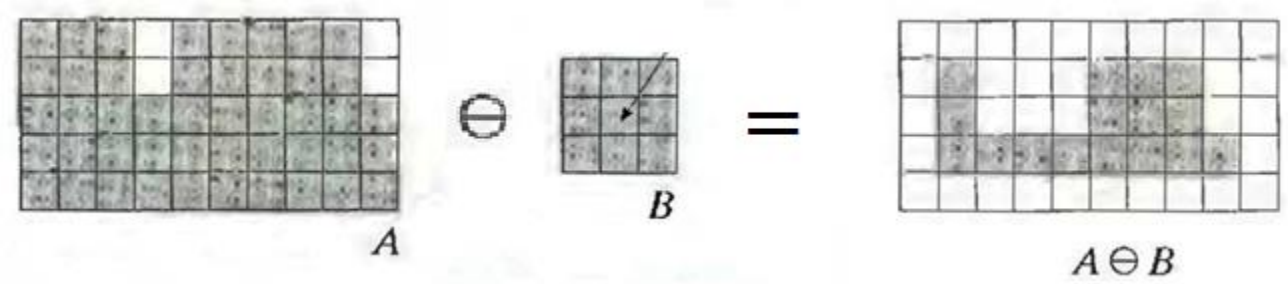
← Hasil transformasi Hit or Miss

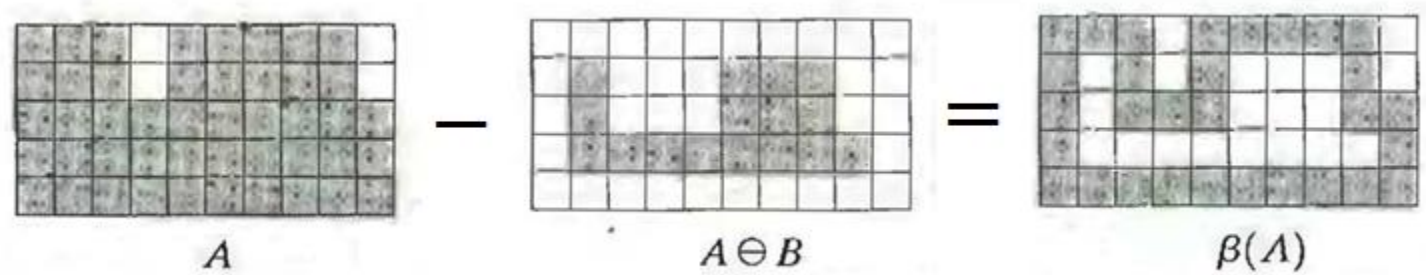
Boundary Extraction

- Pertama, erosi A dengan B, kemudian buat perbedaan set antara A dan Erosi
- Ketebalan kontur tergantung pada ukuran dari constructing object – B

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

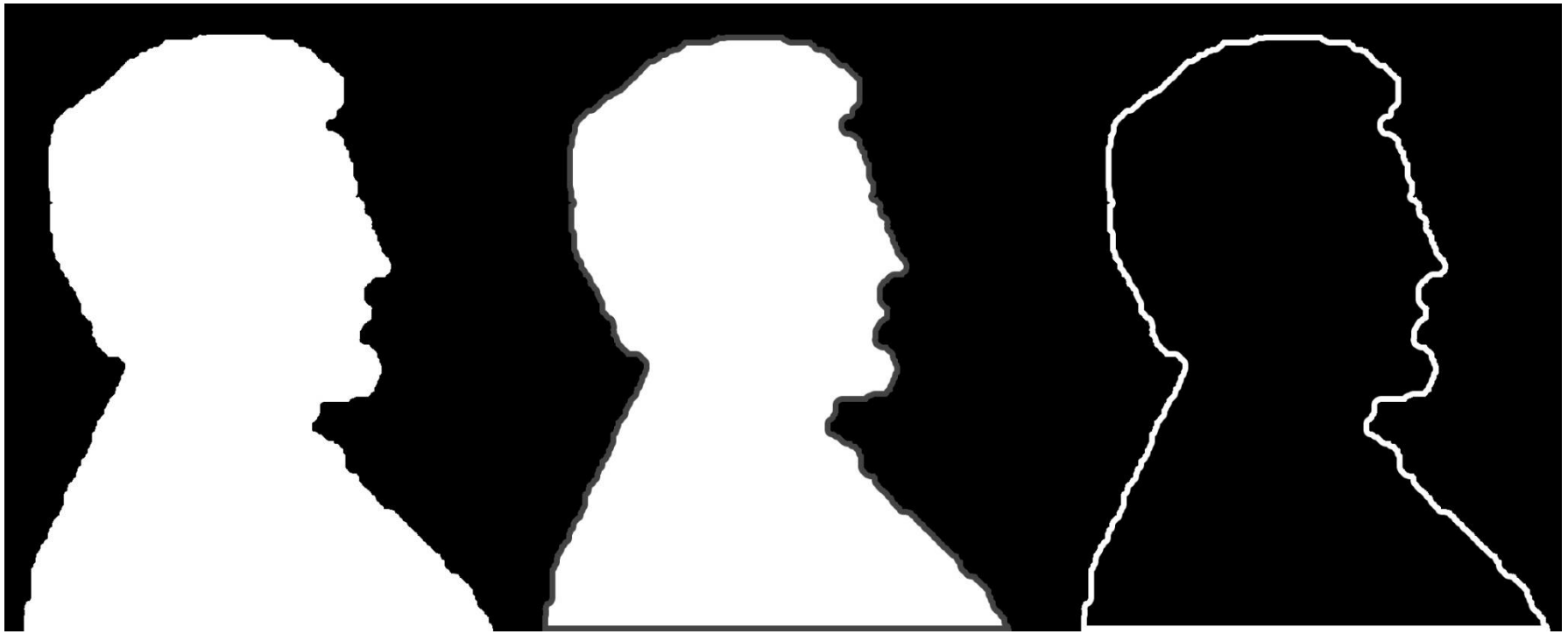
Contoh





$$\boldsymbol{\beta(A) = A - (A \ominus B)}$$

Boundary Extraction



Region Filling

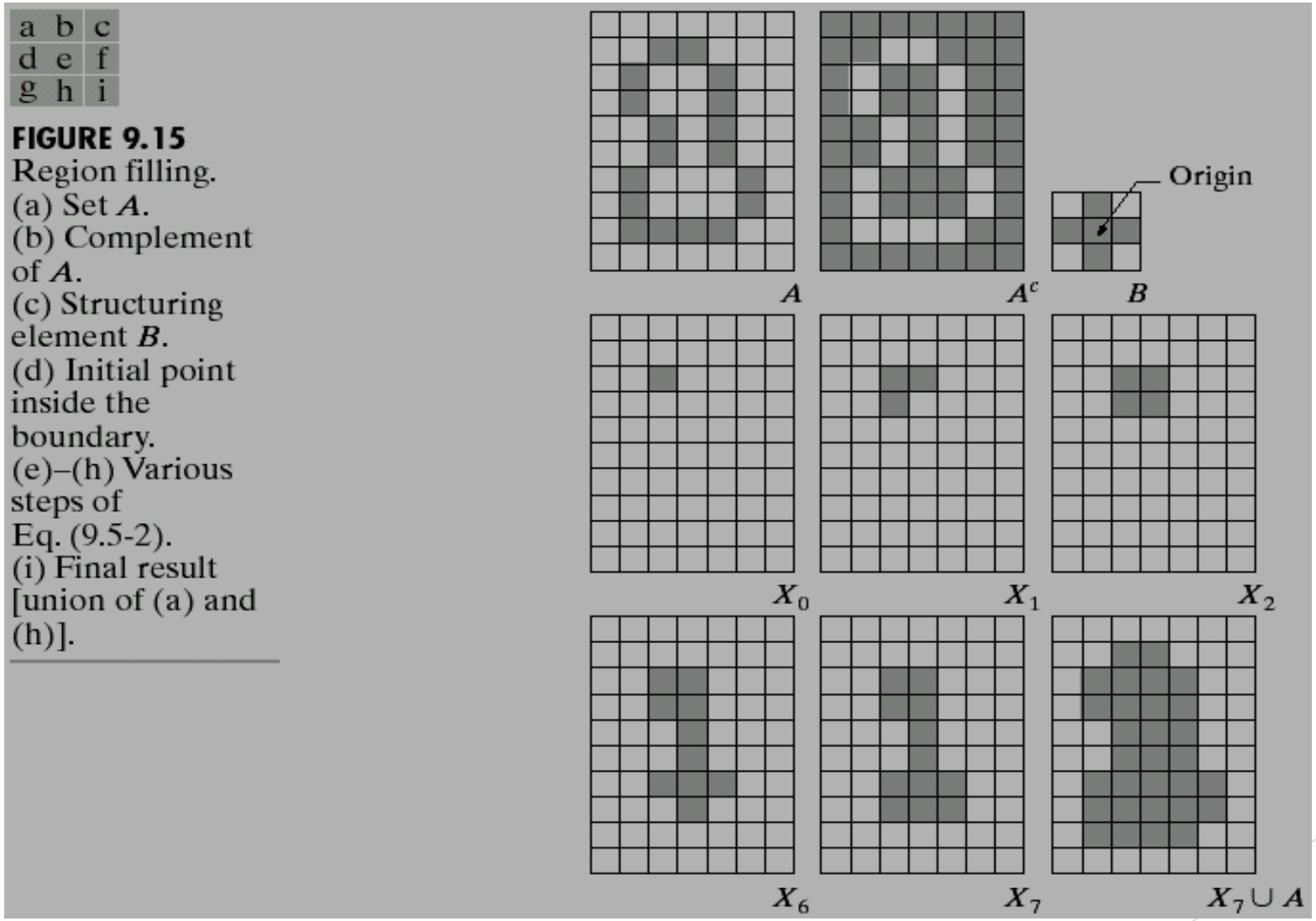
- Algoritma ini didasarkan pada set dari dilasi, komplemen dan intersections
- p is the point inside the boundary, with the value of 1
- X(k) = (X(k-1) xor B) conjunction denga complemented A, atau:

$$X_k = (X_{k-1} \oplus B) \cap A^c$$

- Proses akan berhenti jika X(k) = X(k-1)
- Hasil diberikan oleh union dari A dan X(k), adalah sebuah set yang berisi isi-set dan tepi.

Region Filling

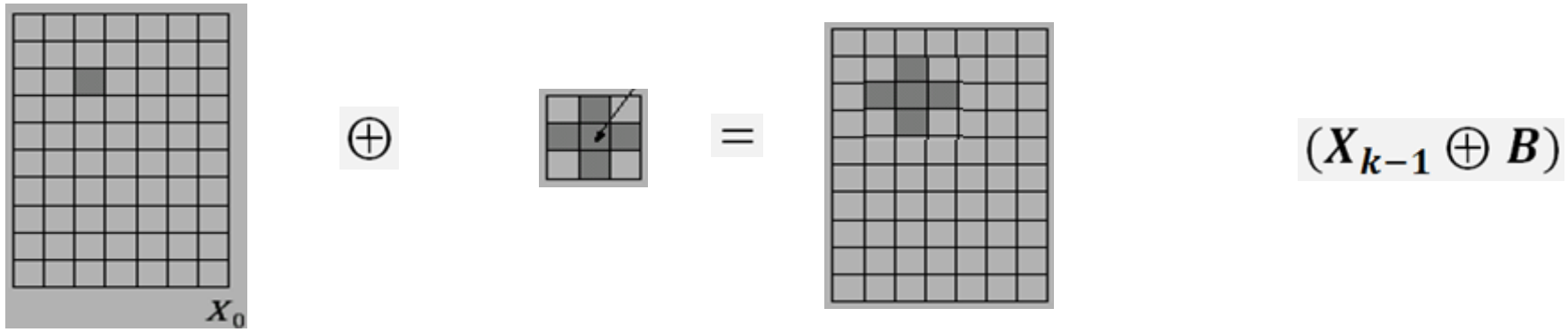
$$X_k = (X_{k-1} \oplus B) \cap A^c$$

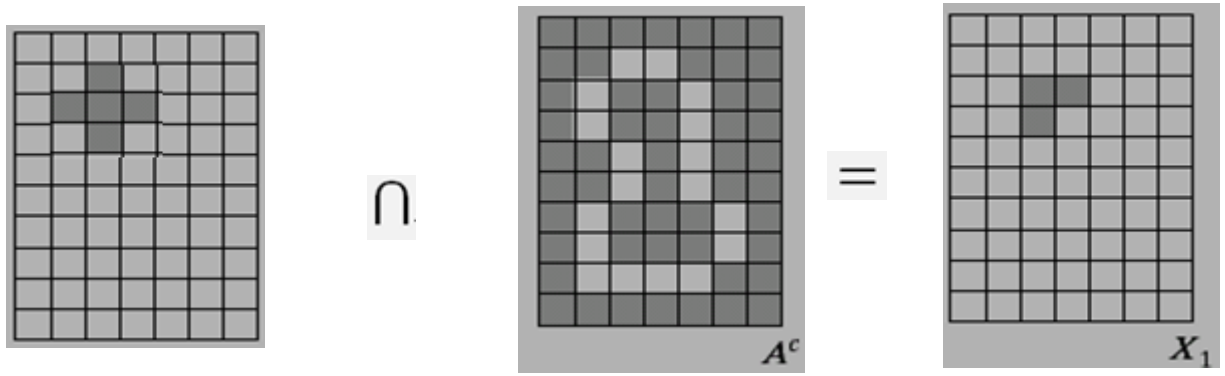


a b c
d e f
g h i

FIGURE 9.15
Region filling.
(a) Set A.
(b) Complement of A.
(c) Structuring element B.
(d) Initial point inside the boundary.
(e)–(h) Various steps of Eq. (9.5-2).
(i) Final result [union of (a) and (h)].

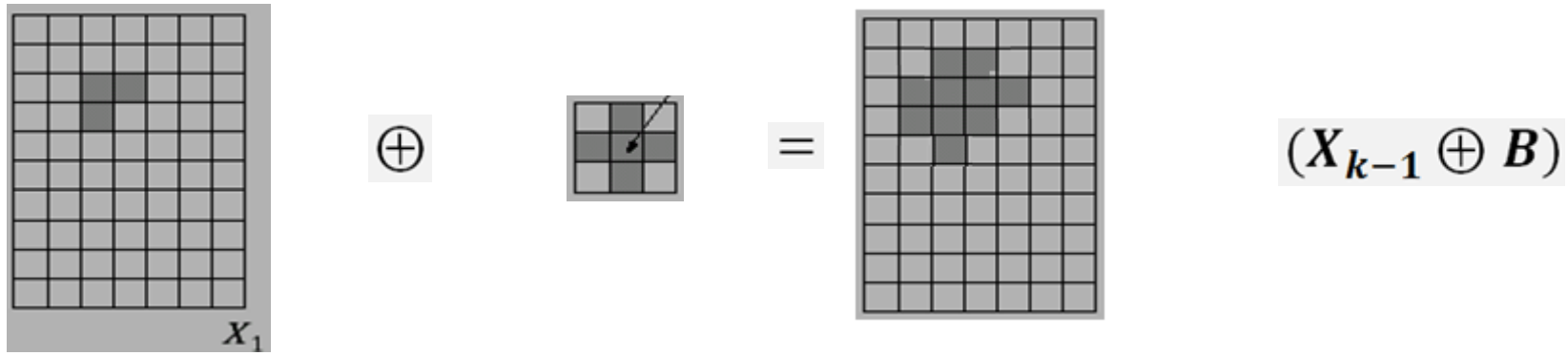
Detail Langkah-Langkah dari Region Filing
$X_1 \rightarrow X_{k-1} = X_0$



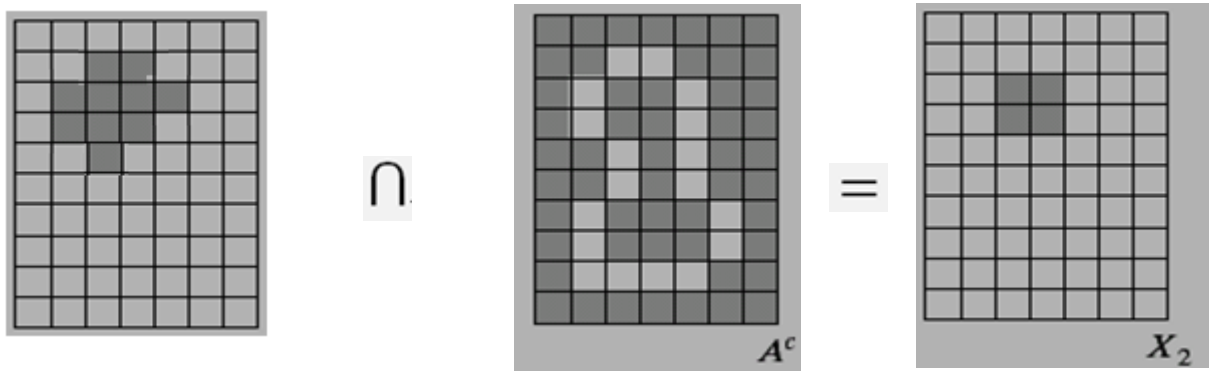


$$X_k = (X_{k-1} \oplus B) \cap A^c$$

$X_2 \rightarrow X_{k-1} = X_1$

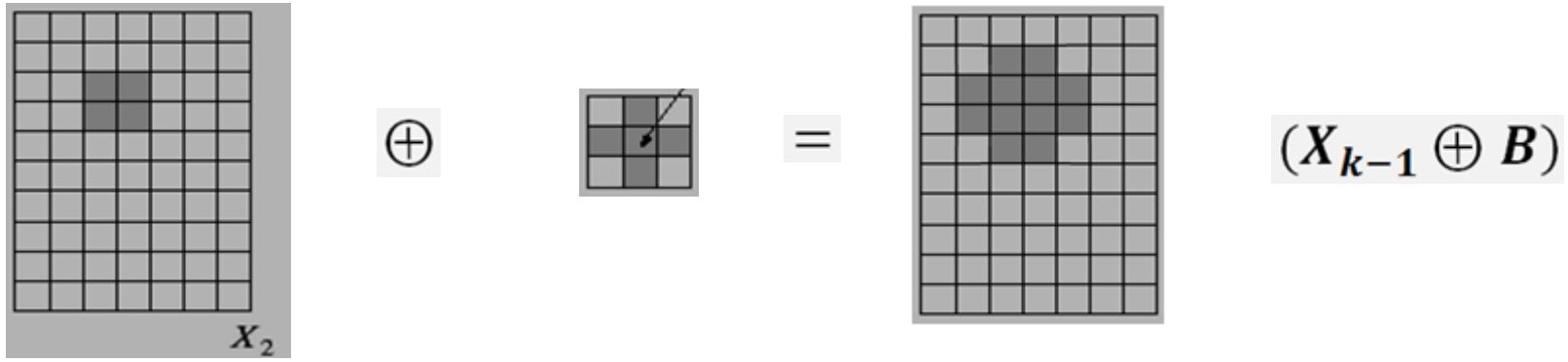


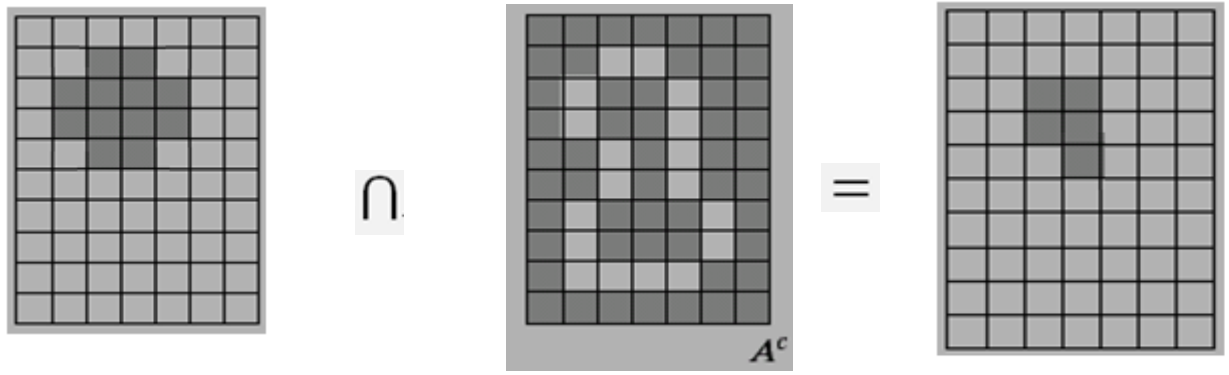
$$(X_{k-1} \oplus B)$$



$$X_k = (X_{k-1} \oplus B) \cap A^c$$

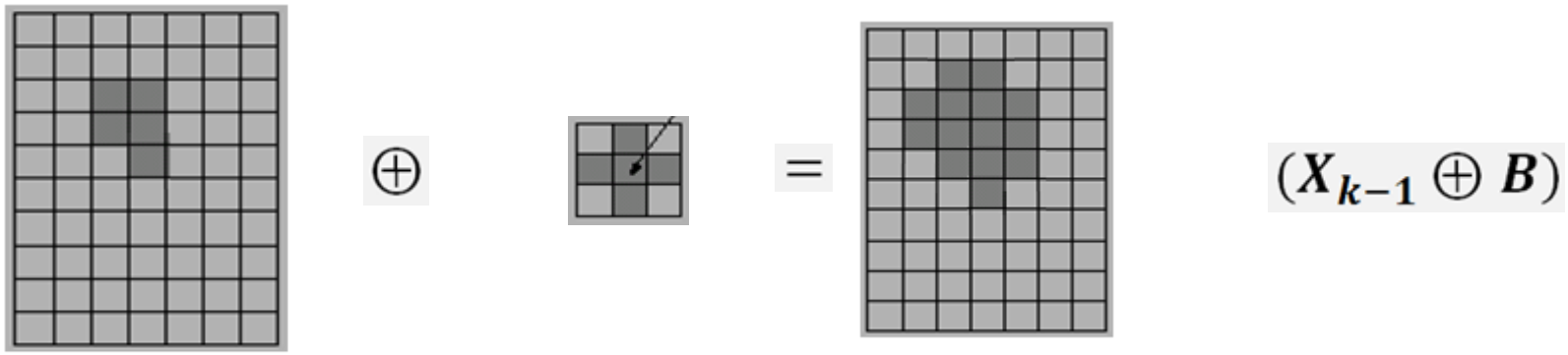
$X_3 \rightarrow X_{k-1} = X_2$





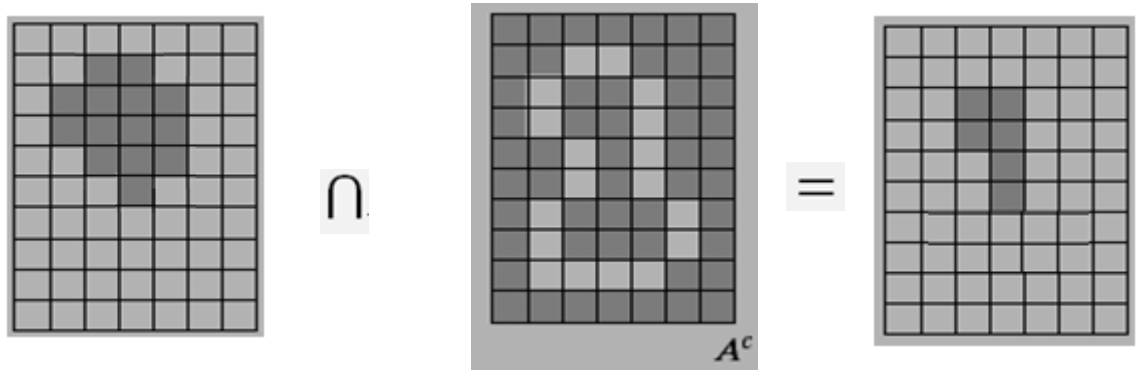
$$X_k = (X_{k-1} \oplus B) \cap A^c$$

$X_4 \rightarrow X_{k-1} = X_3$



X_3

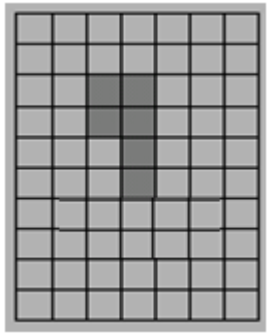
$(X_{k-1} \oplus B)$



X_4

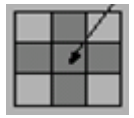
$$X_k = (X_{k-1} \oplus B) \cap A^c$$

$X_5 \rightarrow X_{k-1} = X_4$

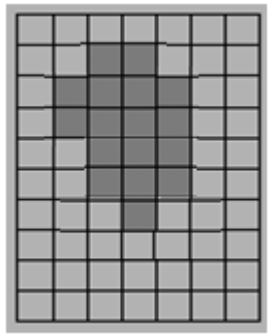


X_4

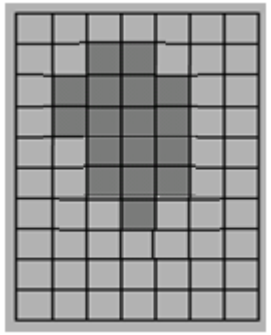
$\oplus$



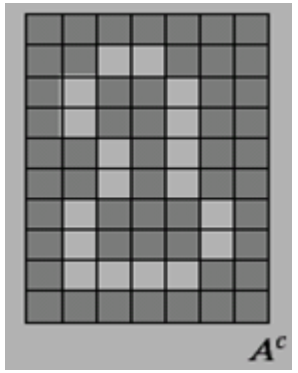
$=$



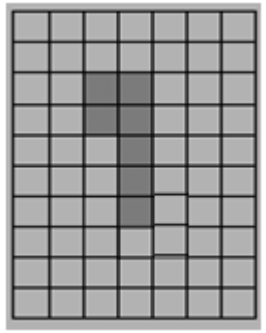
$(X_{k-1} \oplus B)$



$\cap$



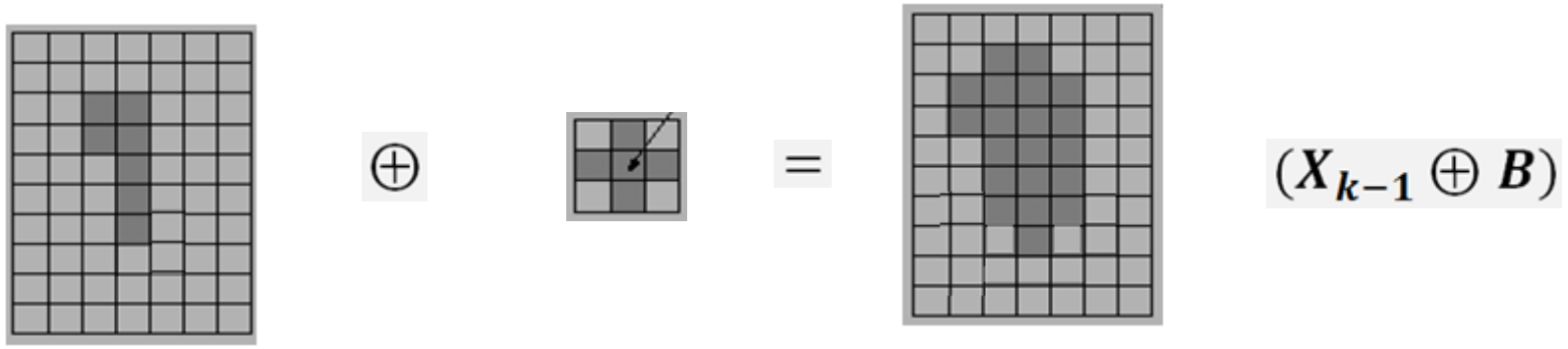
$=$



X_5

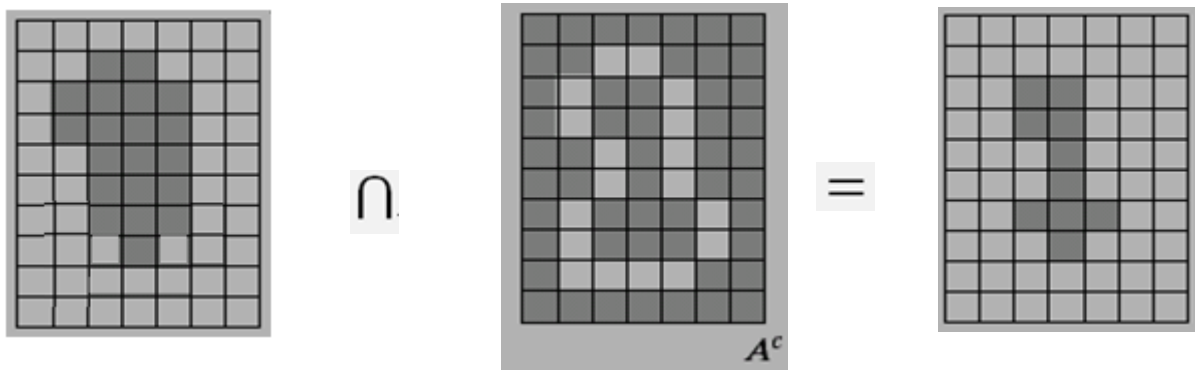
$$X_k = (X_{k-1} \oplus B) \cap A^c$$

$X_6 \rightarrow X_{k-1} = X_5$



X_5

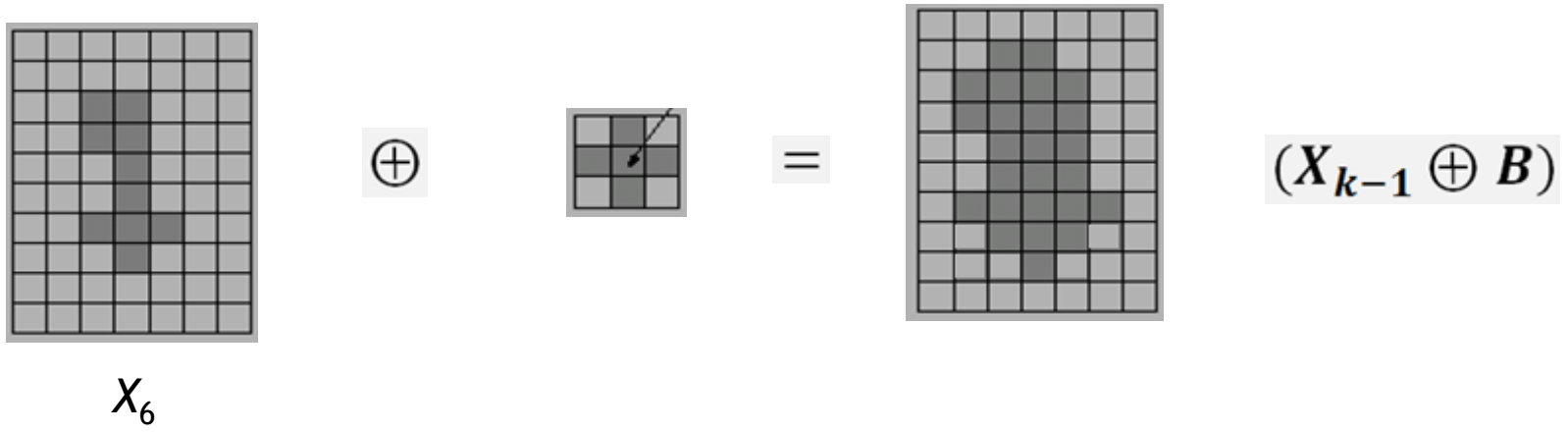
$(X_{k-1} \oplus B)$



X_6

$$X_k = (X_{k-1} \oplus B) \cap A^c$$

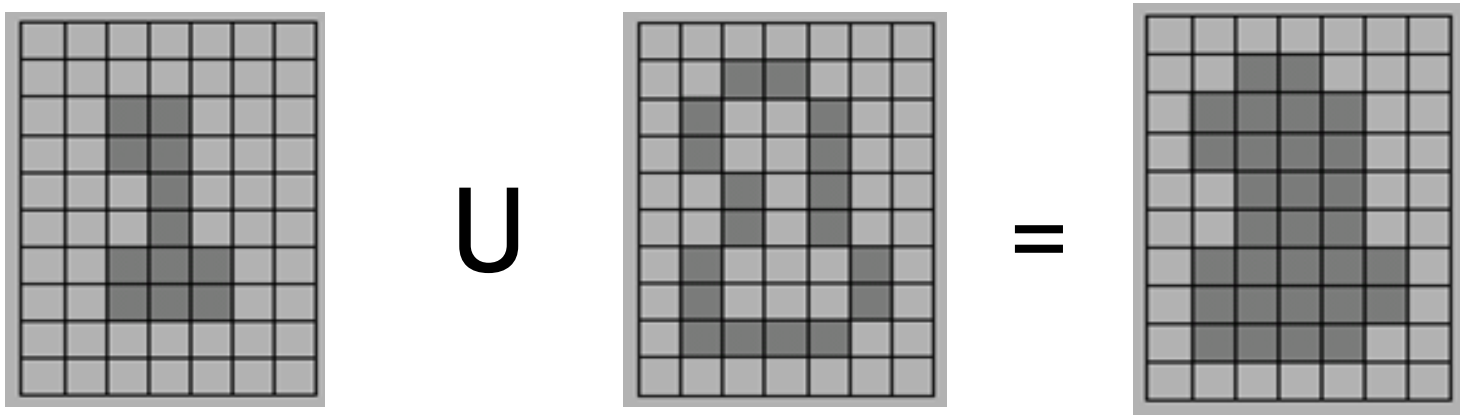
$X_7 \rightarrow X_{k-1} = X_6$



$X_8 \rightarrow X_{k-1} = X_7$

Dalam hal ini $X_8 = X_7$ sehingga proses dihentikan

- Dan hasil akhir adalah X_7 U A



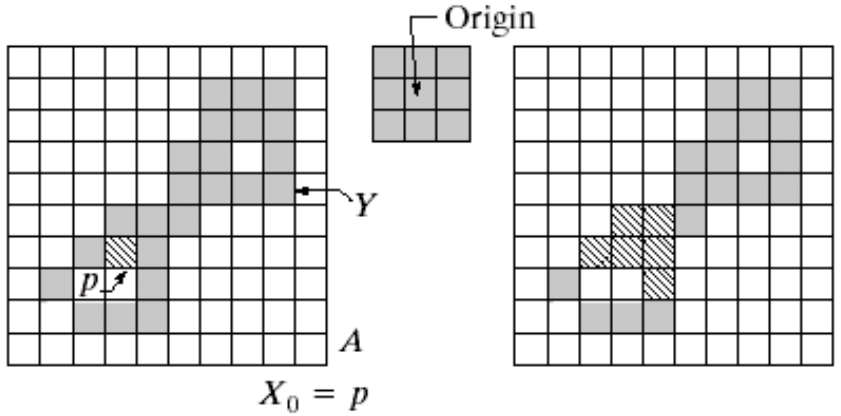
Extraction of Connected Components

- Algoritma ini mengekstrak sebuah komponenn dengan memilih sebuah titik pada binary object A
- Kerjanya mirip dengan region filling, namun disini menggunakan conjunction object A, instead of it's complement

$$X_k = (X_{k-1} \oplus B) \cap A \qquad k = 1,2,3,\ldots$$

- Proses iterasi akan berakhir jika $X_k = X_{k-1}$

Extraction of Connected Components

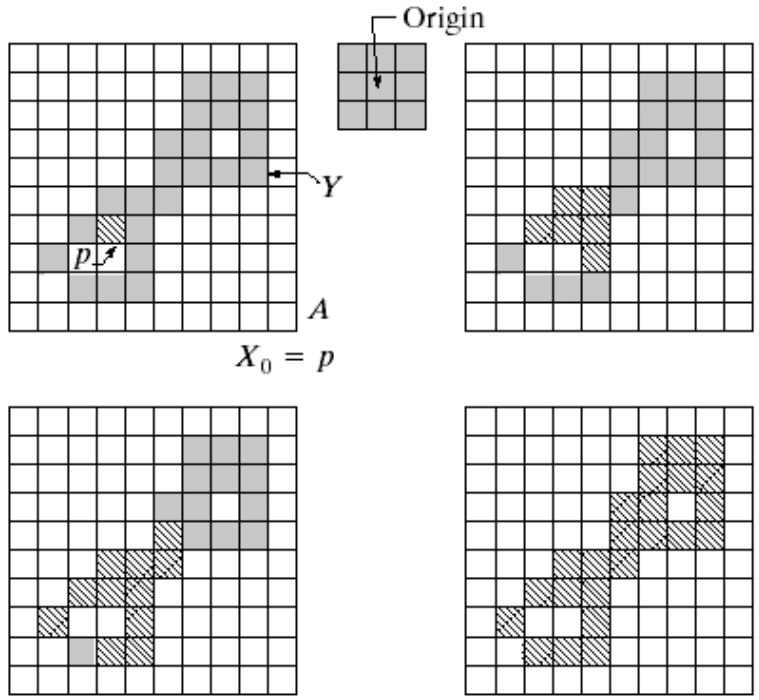


a b c
d e

FIGURE 9.17 (a) Set A showing initial point p (all shaded points are valued 1, but are shown different from p to indicate that they have not yet been found by the algorithm). (b) Structuring element. (c) Result of first iterative step. (d) Result of second step. (e) Final result.

TUGAS DIKERJAKAN:

- Jelaskan dan uraikannlah langkah demi langkah proses pemilihan sebuah obyek dari gambar dibawah mulai dari X_0 sampai dengan proses selesai/iterasinya berakhir.



a b c
d e

FIGURE 9.17 (a) Set A showing initial point p (all shaded points are valued 1, but are shown different from p to indicate that they have not yet been found by the algorithm). (b) Structuring element. (c) Result of first iterative step. (d) Result of second step. (e) Final result.

$$X_k = (X_{k-1} \oplus B) \cap A$$

$$k = 1,2,3,\ldots$$