



Recapitulation

- Boundary extraction
- Region filling
- Extraction of connected components
- Convex hull
- Thinning
- Thickening

A B

$$A \otimes B = \boxed{A - (A \otimes B)}$$
$$= A \cap (A \otimes B)$$

$$\{B\} = \{B^1, B^2, B^3, \dots, B^n\}$$

$B^i \Rightarrow$ rotated version B^{i-1}

$$A \otimes \{B\} = \left[\dots \left(\underbrace{(A \otimes B^1)} \otimes B^2 \right) \dots \otimes B^n \right]$$



Thinning

B_1

B_2

B_3

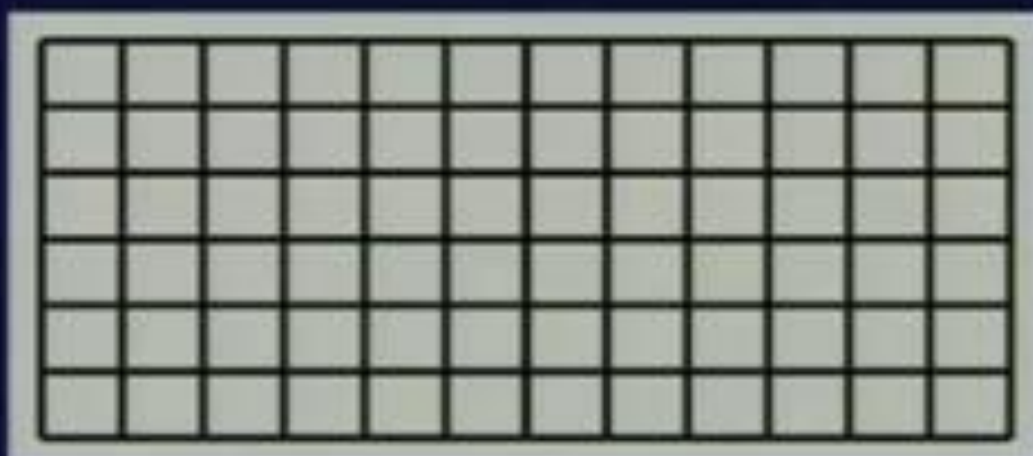
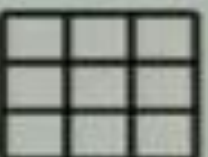
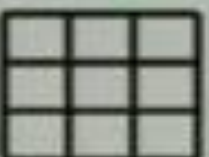
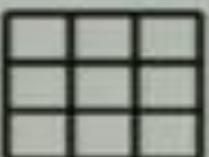
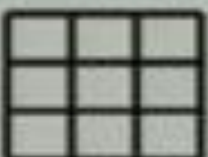
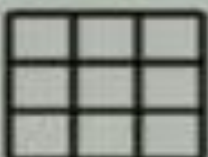
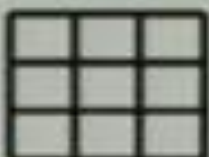
B_4

B_5

B_6

B_7

B_8





Thinning

B_1

B_2

B_3

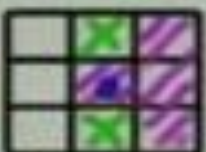
B_4

B_5

B_6

B_7

B_8





Thinning

B_1

B_2

B_3

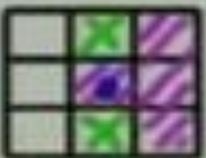
B_4

B_5

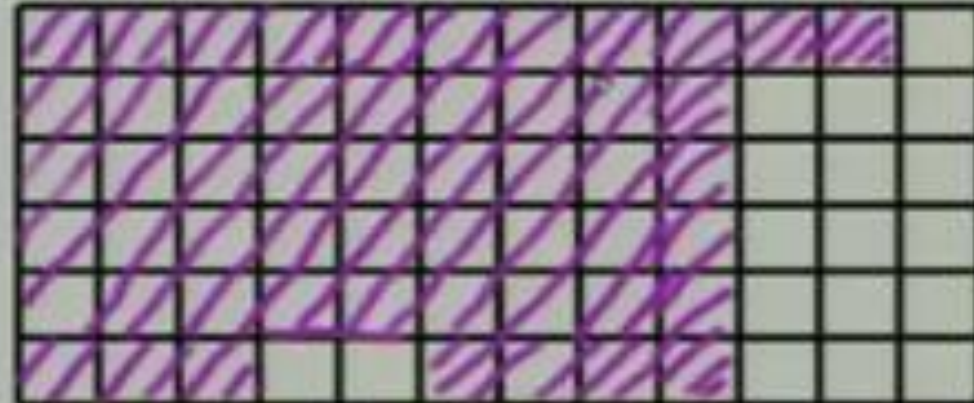
B_6

B_7

B_8



$A \Rightarrow$





Thinning

B_1

B_2

B_3

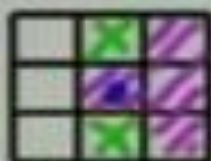
B_4

B_5

B_6

B_7

B_8



$A \Rightarrow$





Thinning

B_1

B_2

B_3

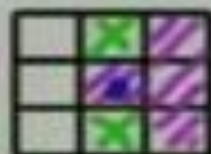
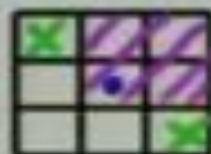
B_4

B_5

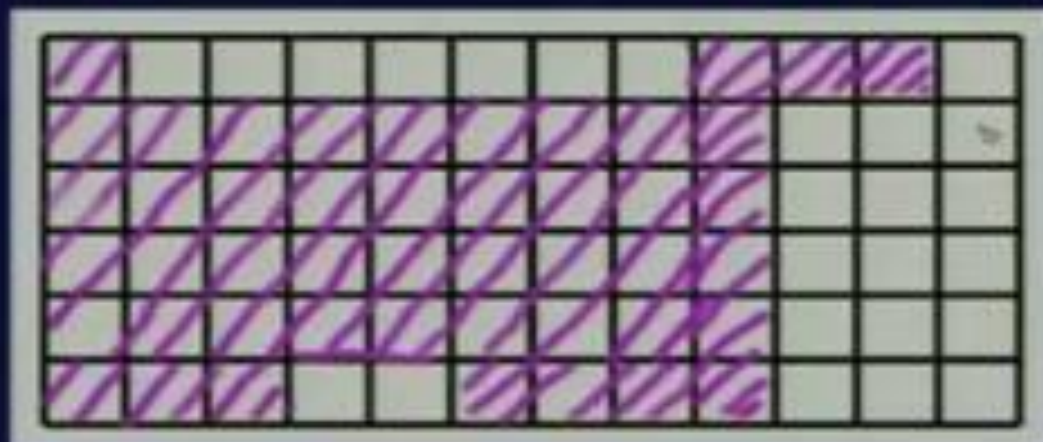
B_6

B_7

B_8



$A \Rightarrow$





Thinning

B_1

B_2

B_3

B_4

B_5

B_6

B_7

B_8



$A \Rightarrow$





Thinning

B_1

B_2

B_3

B_4

B_5

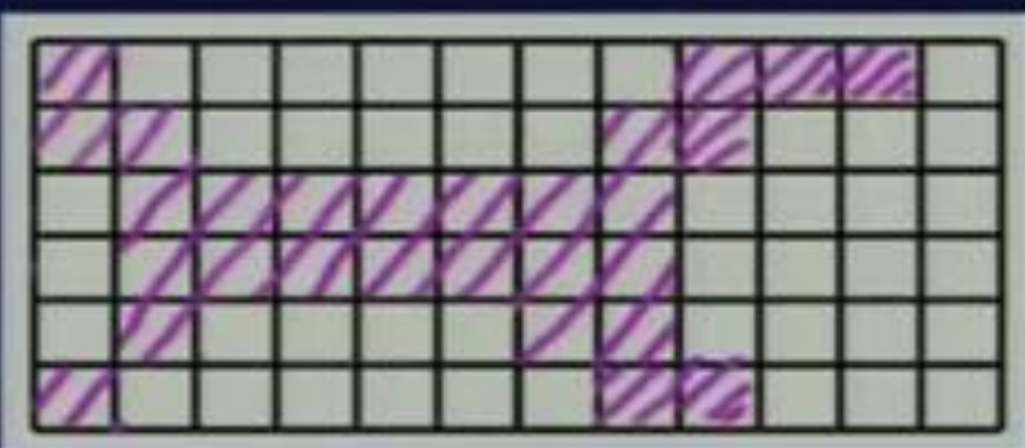
B_6

B_7

B_8



$A \Rightarrow$





Thinning

B_1

B_2

B_3

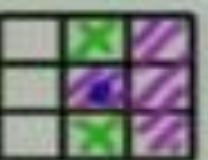
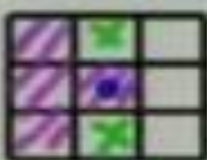
B_4

B_5

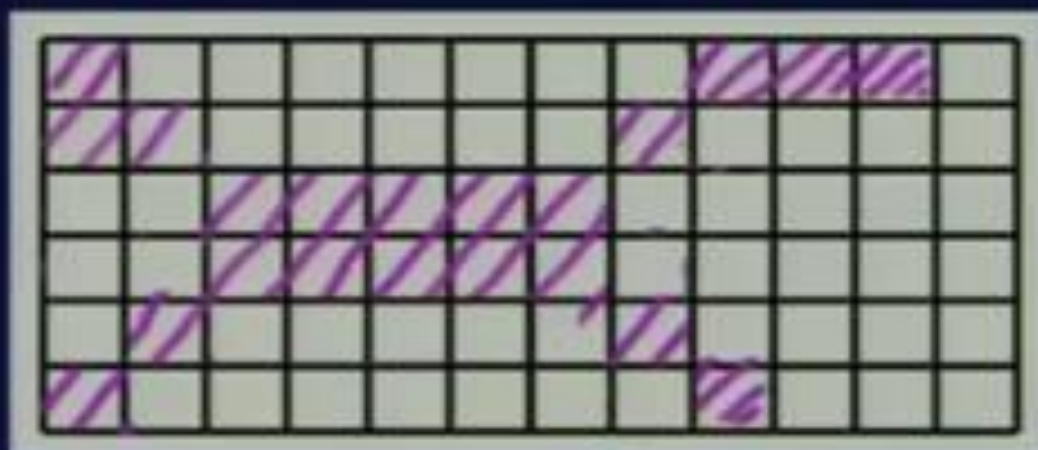
B_6

B_7

B_8



$A \Rightarrow$



Thickening

$$A \odot B = A \cup (A \otimes B)$$

$$A \odot \{B\} = \{ \dots ((A \odot B^1) \odot B^2) \dots \odot B^n \}$$

$$A \Rightarrow A^c$$

$$C = A^c \otimes \{B\}$$

$$A \odot \{B\} = C^c$$

Skeletonization

A

$$S(A) = \bigcup_{k=0}^M S_k(A)$$

$$S_k = \left\{ (A \ominus k B) - [(A \ominus k B) \circ B] \right\}$$

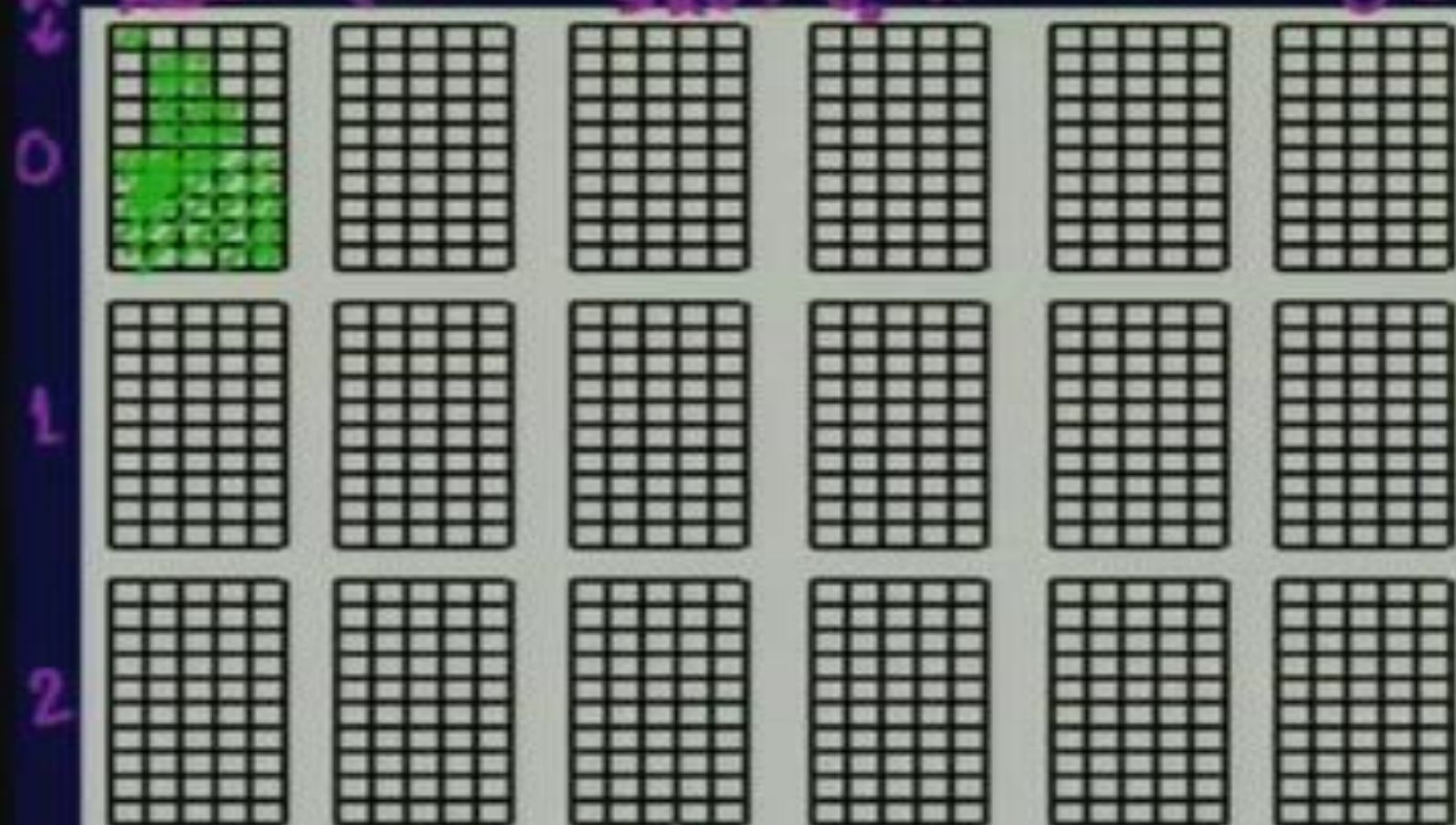
$$M = \max \{ k \mid (A \ominus k B) \neq \emptyset \}$$

$$A = \bigcup_{k=0}^M (S_k(A) \oplus k B)$$



Skeletonization

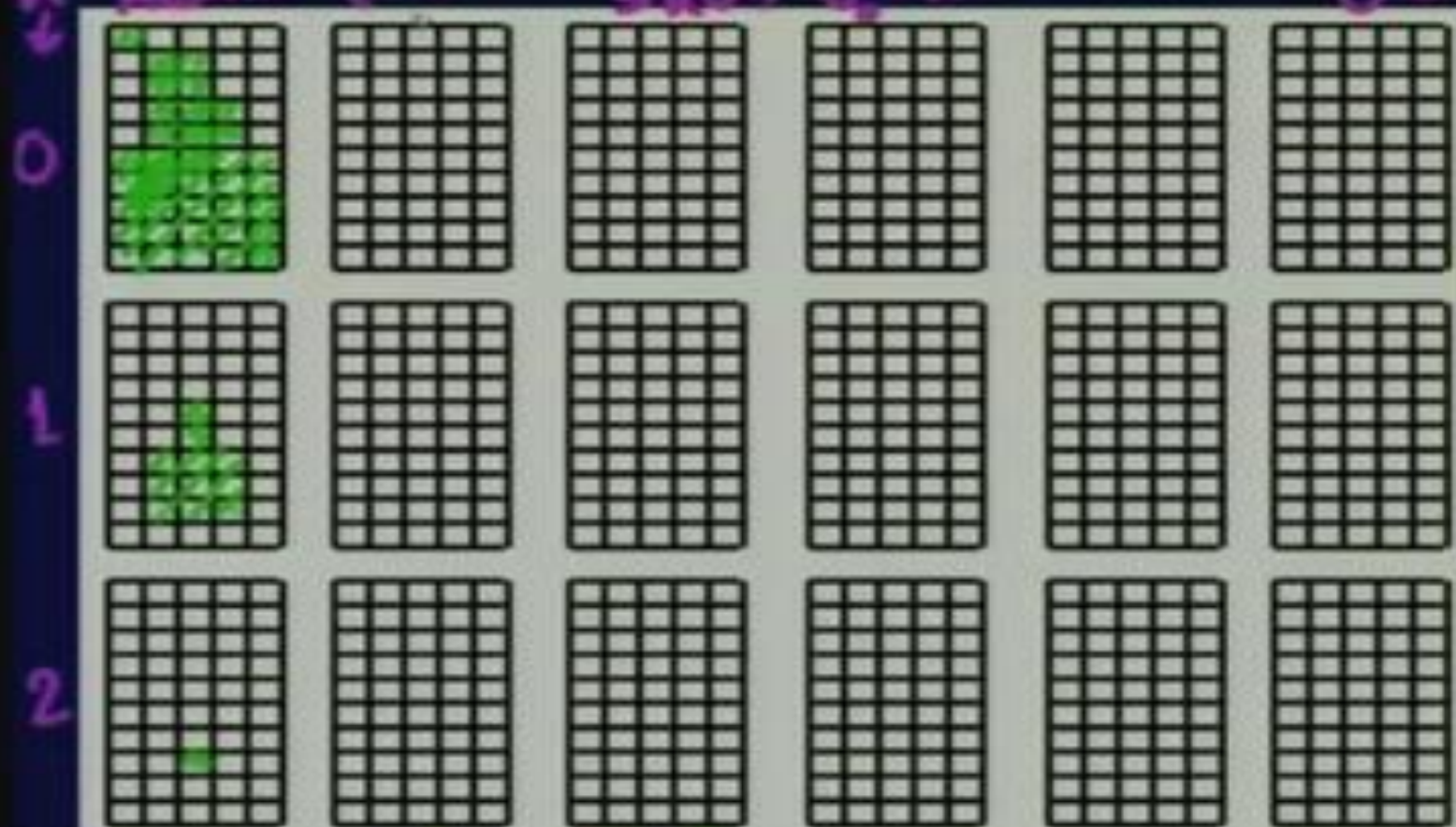
$$K \downarrow \quad A \oplus B \quad (A \oplus B) \oplus B \quad S_K(A) \quad \bigcup_{k=0}^{K-1} S_K(A) \quad S_K(A) \oplus \bigcup_{k=2}^{K-1} B$$





Skeletonization

$$A \ominus B \quad (A \ominus B) \oplus B \quad S_k(A) \quad \bigcup_k S_k(A) \quad S_k(A) \oplus \bigcup_k B$$





Skeletonization

$$K \downarrow \quad A \oplus B \quad (A \oplus B) \ominus B \quad S_K(A) \quad \bigcup_{K=1}^n S_K(A) \quad S_K(A) \oplus \bigcup_{K=2}^n B$$

