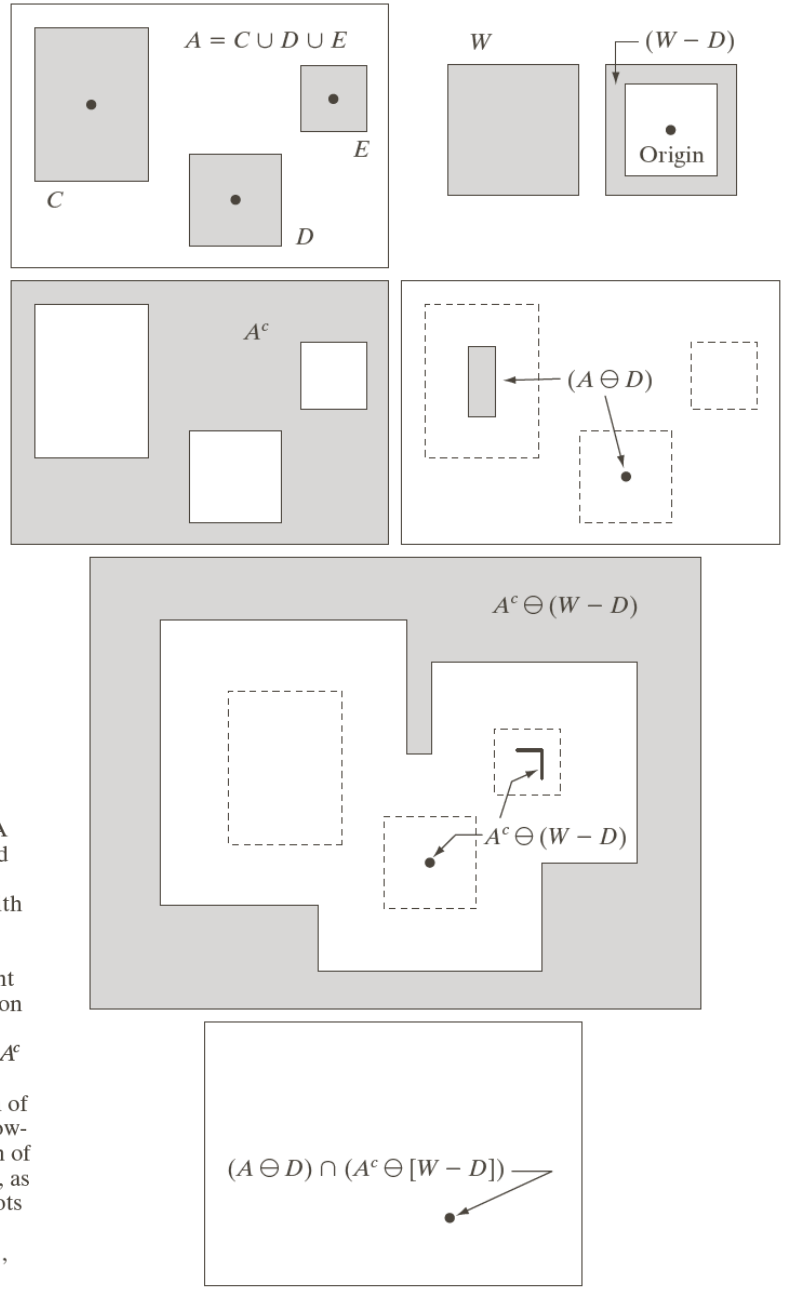
Basic Morphological Algorithms

- The Hit-or-Miss Transformation
- Convex Hull
- Thinning
- Thickening



a b
c d
e
f

FIGURE 9.12
(a) Set A. (b) A window, W, and the local background of D with respect to W, $(W - D)$. (c) Complement of A. (d) Erosion of A by D. (e) Erosion of A^c by $(W - D)$. (f) Intersection of (d) and (e), showing the location of the origin of D, as desired. The dots indicate the origins of C, D, and E.

$$A \circledast B = (A \ominus D) \cap \left[A^c \ominus (W - D)\right]$$

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

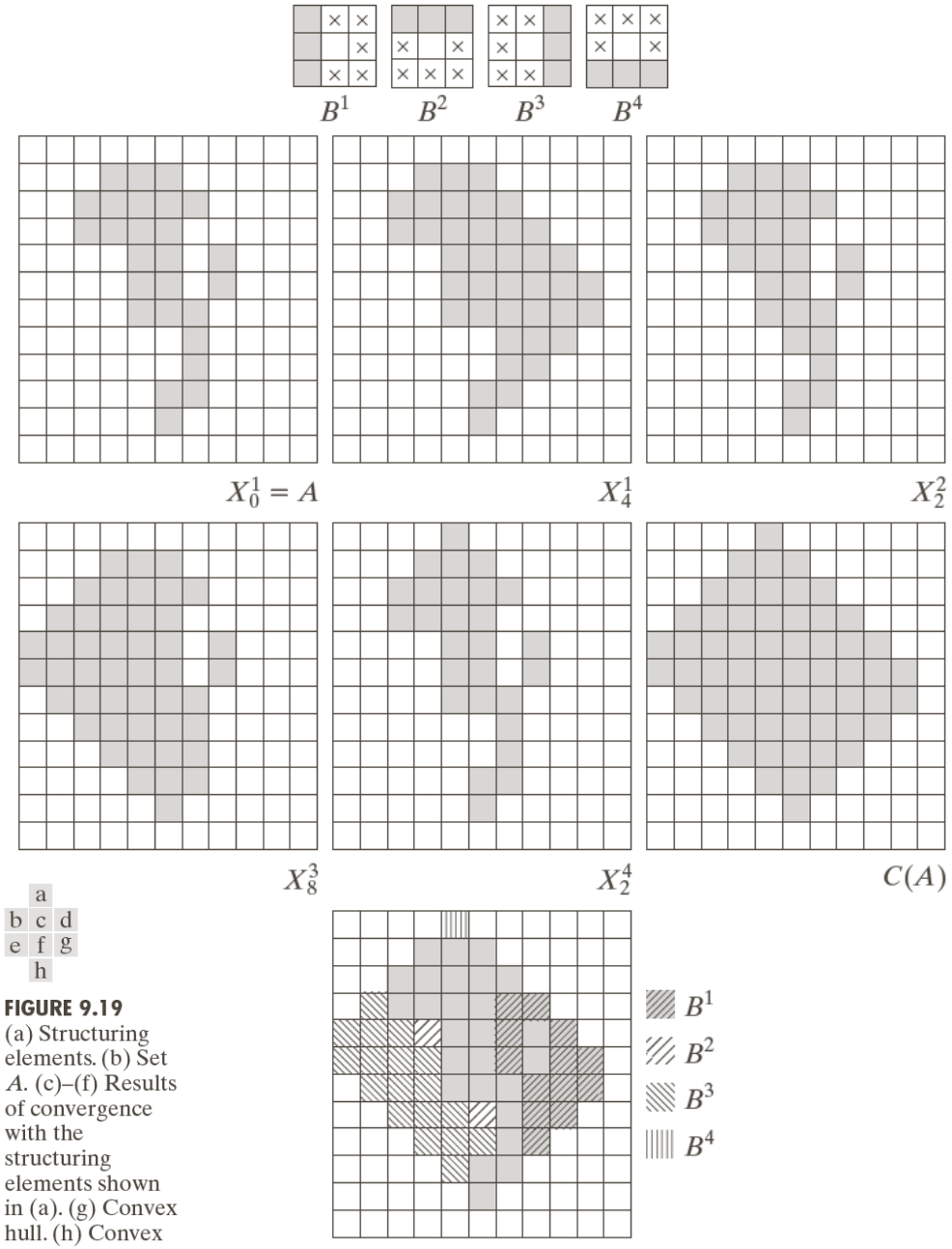
The Hit-or-Miss Transformation

$$A \circledast B = (A \ominus B_1) - (A \oplus \hat{B}_2)$$

Convex Hull

$$X_k^i = (X_{k-1} \circledast B^i) \cup A \quad i = 1, 2, 3, 4 \quad \text{and} \quad k = 1, 2, 3, \ldots$$

$$C(A) = \bigcup_{i=1}^{4} D^i$$



a
b c d
e f g
h

FIGURE 9.19
(a) Structuring elements. (b) Set A. (c)–(f) Results of convergence with the structuring elements shown in (a). (g) Convex hull. (h) Convex hull showing the contribution of each structuring element.

Convex Hull

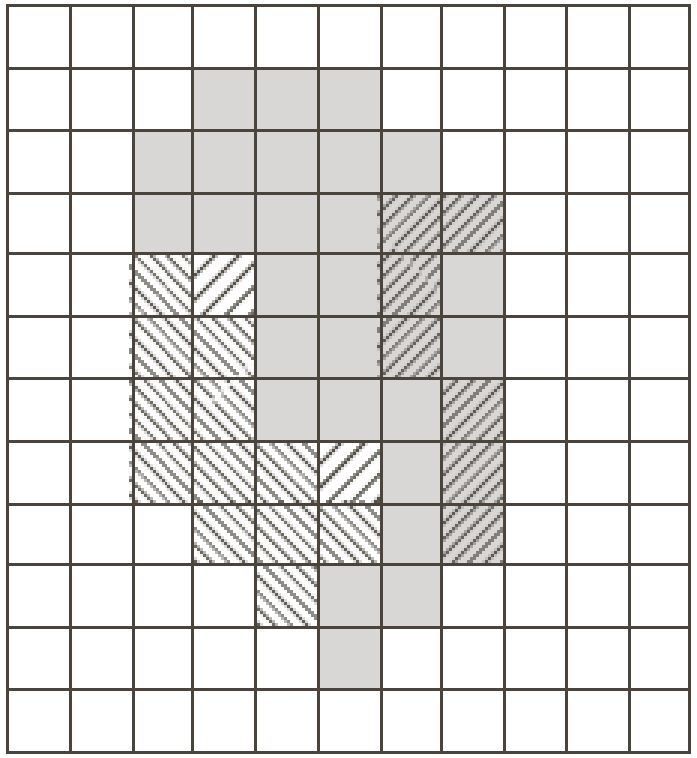
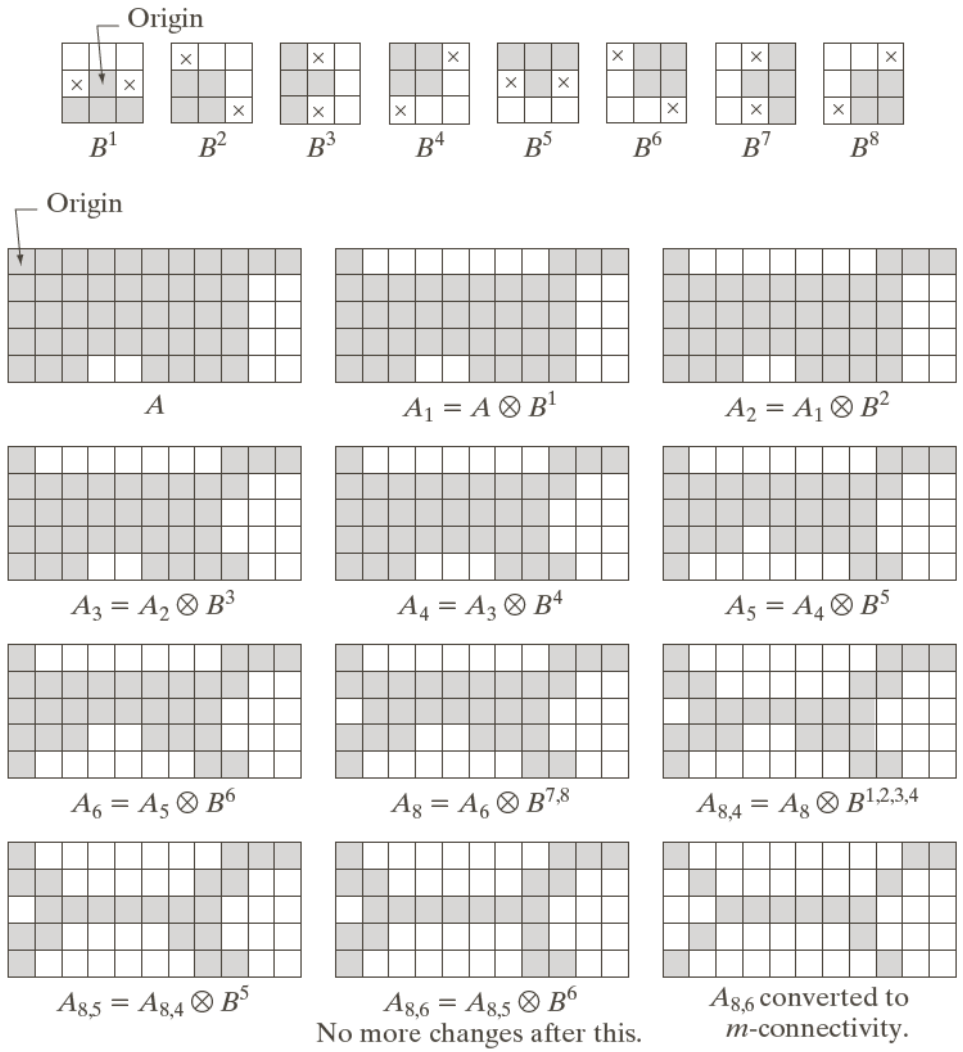


FIGURE 9.20
Result of limiting growth of the convex hull algorithm to the maximum dimensions of the original set of points along the vertical and horizontal directions.

Convex Hull



a
b c d
e f g
h i j
k l m

FIGURE 9.21 (a) Sequence of rotated structuring elements used for thinning. (b) Set A. (c) Result of thinning with the first element. (d)–(i) Results of thinning with the next seven elements (there was no change between the seventh and eighth elements). (j) Result of using the first four elements again. (l) Result after convergence. (m) Conversion to m-connectivity.

Thinning

$$A \otimes B = A - (A \circledast B)$$
$$= A \cap (A \circledast B)^c$$

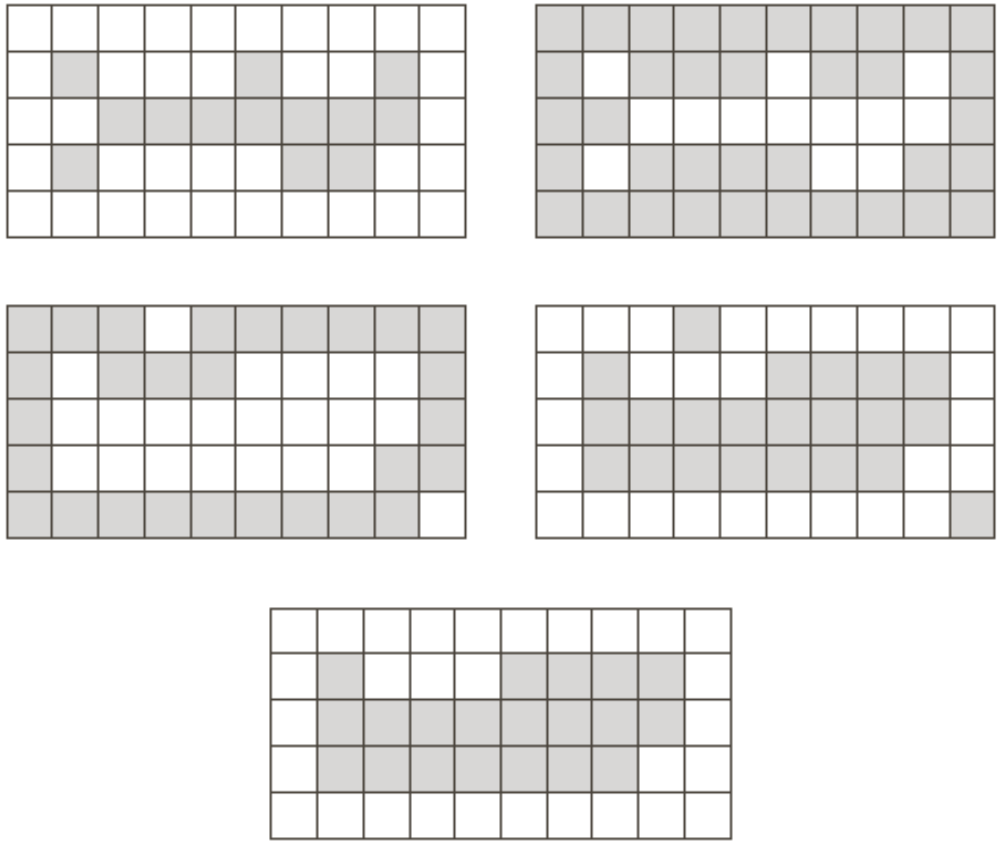


FIGURE 9.22 (a) Set A. (b) Complement of A. (c) Result of thinning the complement of A. (d) Thickened set obtained by complementing (c). (e) Final result, with no disconnected points.

Thickening

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