Erosion

$$\mathbf{B} \ominus \mathbf{S} = \{\, x', y' \mid \mathbf{S}(x' - x, y' - y) \subseteq \mathbf{B} \}$$

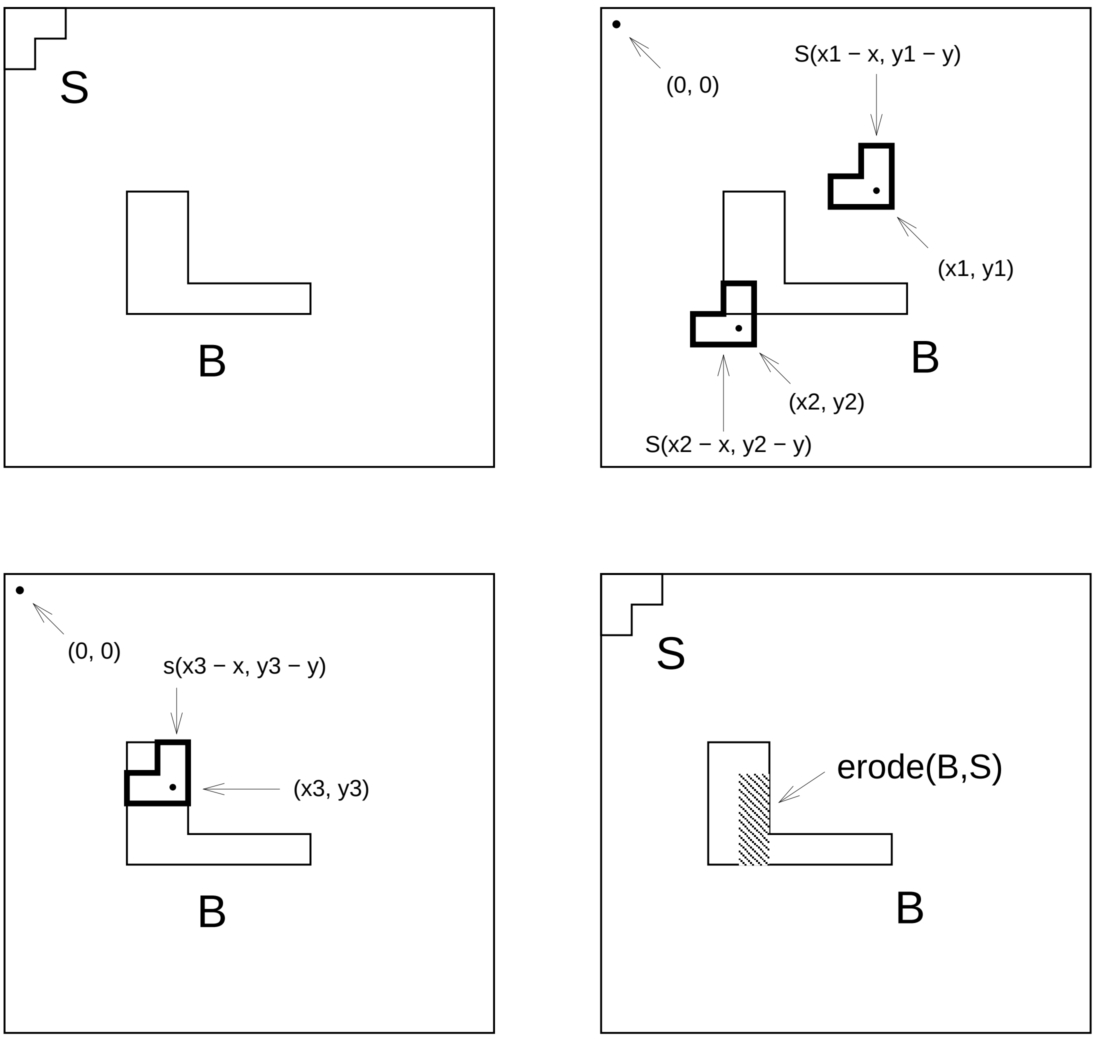

Figure 1: Erosion.

Dilation

$$\mathbf{B} \oplus \mathbf{S} = \{ x', y' \mid \mathbf{S}(x' - x, y' - y) \cap \mathbf{B} \neq \emptyset \}$$

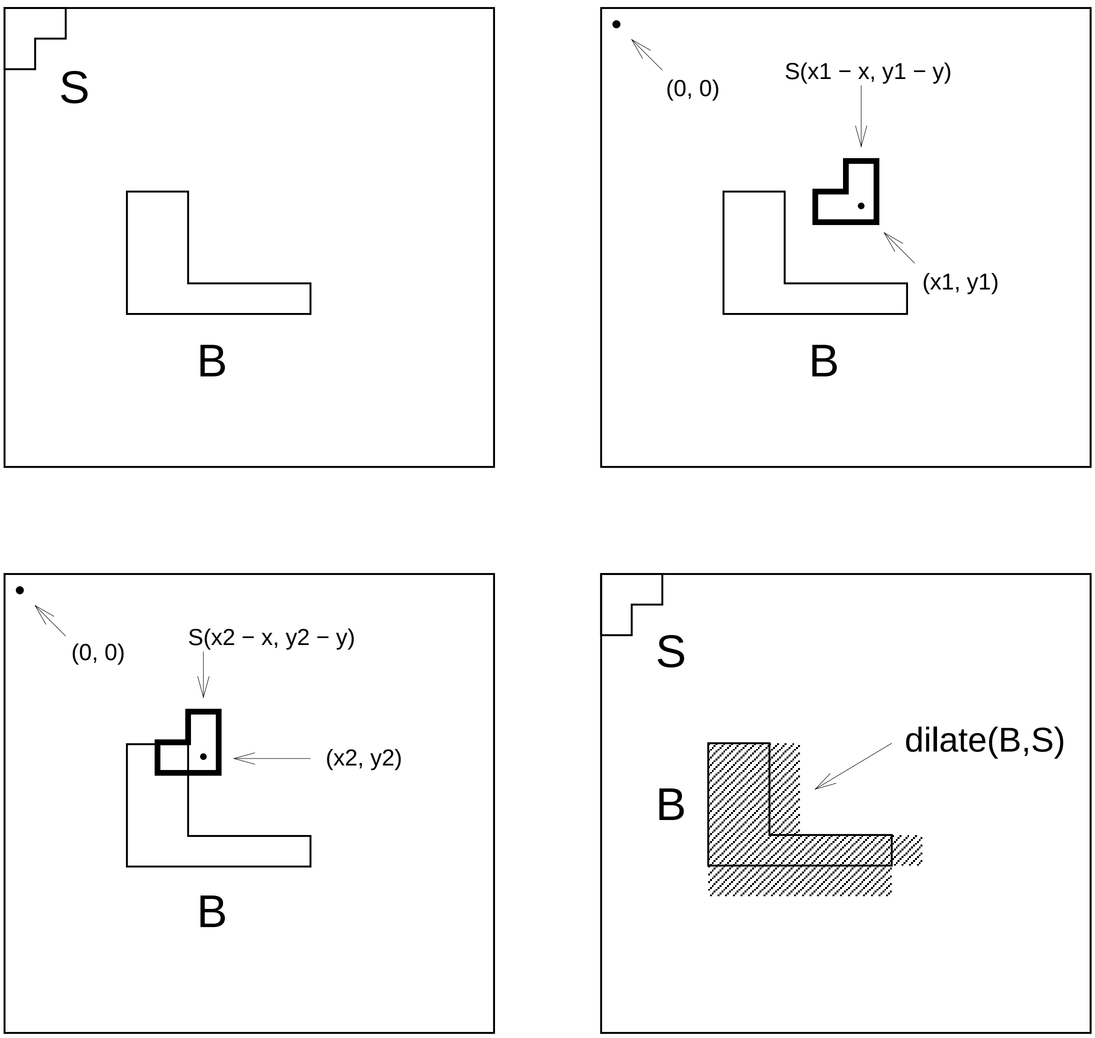

Figure 2: Dilation.

Opening

$$\mathbf{B} \circ \mathbf{S} = (\mathbf{B} \ominus \mathbf{S}) \oplus \mathbf{S}$$

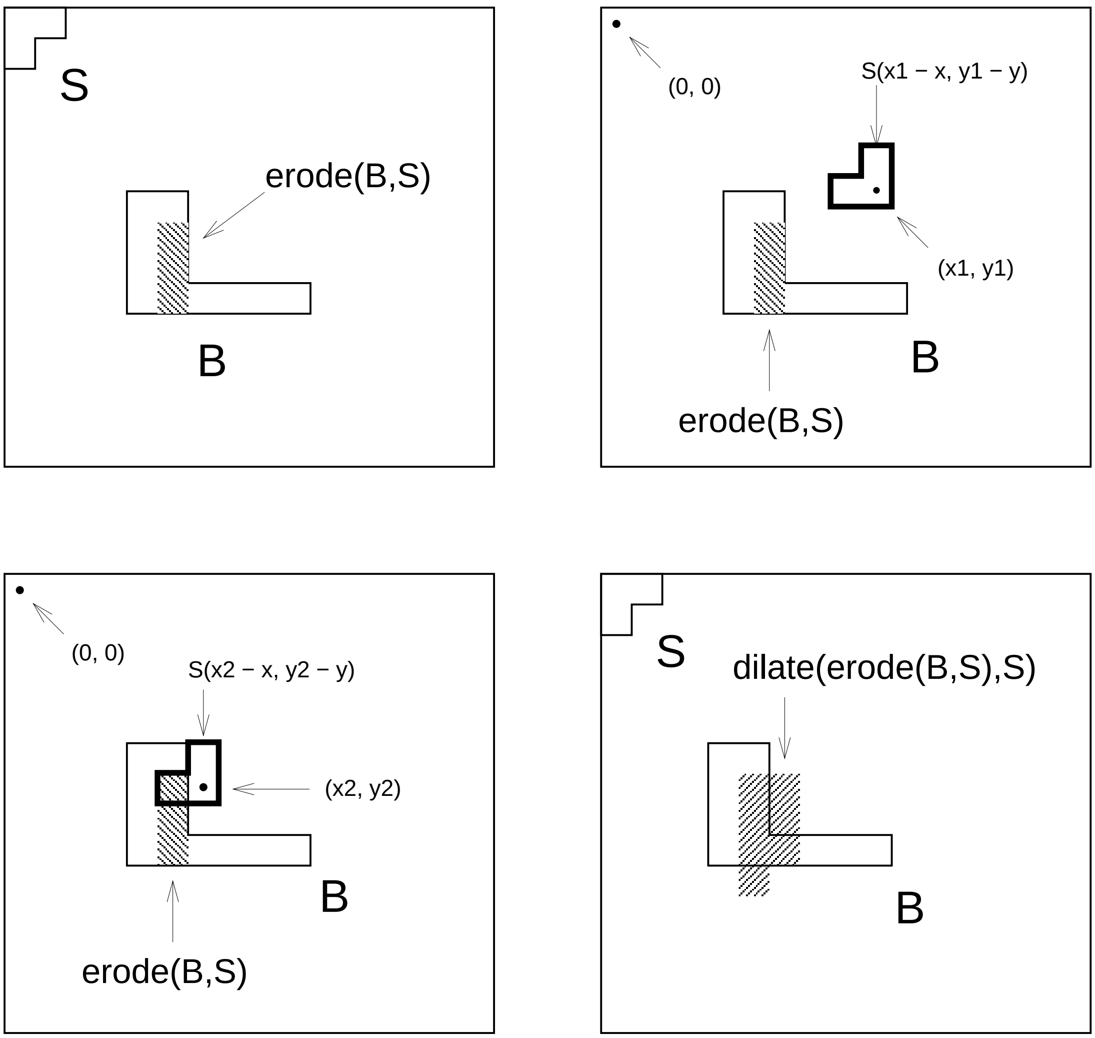

Figure 3: Opening.

Closing

$$\mathbf{B} \bullet \mathbf{S} = (\mathbf{B} \oplus \mathbf{S}) \ominus \mathbf{S}$$

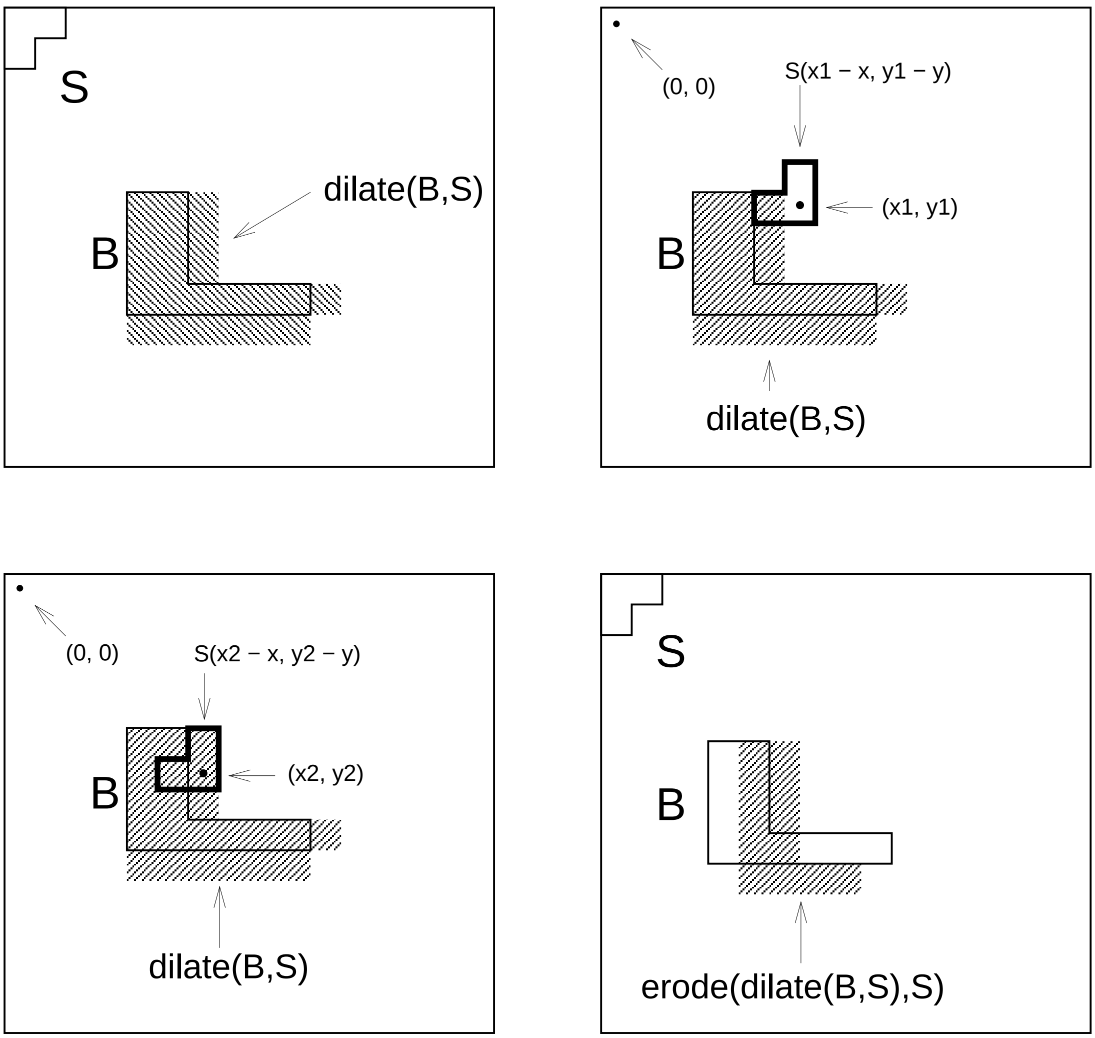

Figure 4: Closing.

Outlining

$$\delta\mathbf{B} = \mathbf{B} - (\mathbf{B} \ominus \mathbf{S})$$

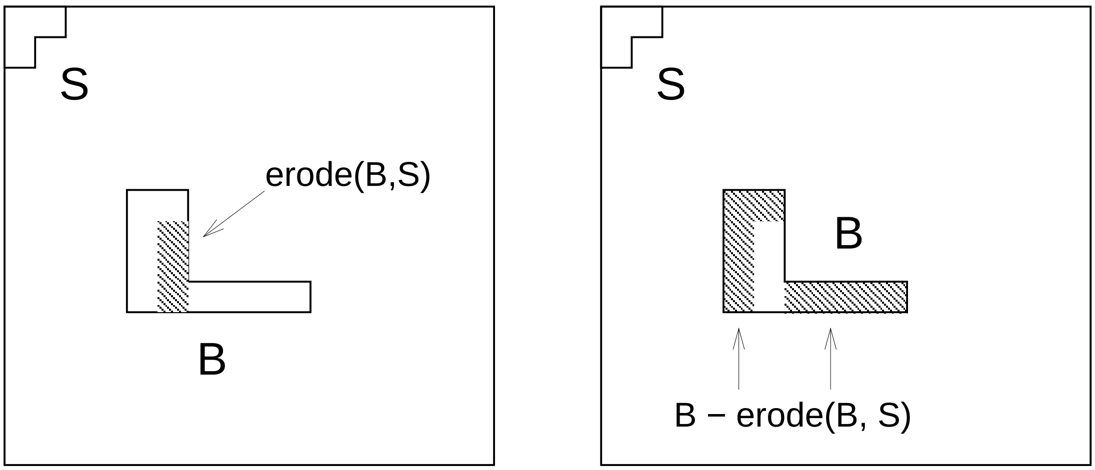

Figure 5: Outlining.

Distance Transform

$$d^{(0)}(x,y) = \begin{cases} 0 & \text{if } (x,y) \in \delta\mathbf{B}, \\ \infty & \text{otherwise.} \end{cases}$$

$$d^{(t+1)}(x,y) = \min_{i,j} \left[d^{(t)}(x+i, y+j) + m(i,j) \right]$$

where

$$m = \begin{bmatrix} \sqrt{2} & 1 & \sqrt{2} \\ 1 & 0 & 1 \\ \sqrt{2} & 1 & \sqrt{2} \end{bmatrix}$$