Erosion

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

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

\[ B \circ S = (B \ominus S) \oplus S \]

Figure 3: Opening.
\( B \ast S = (B \oplus S) \ominus S \)
Outlining

$$\delta B = B - (B \ominus S)$$

Figure 5: Outlining.
Distance Transform

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

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

where

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