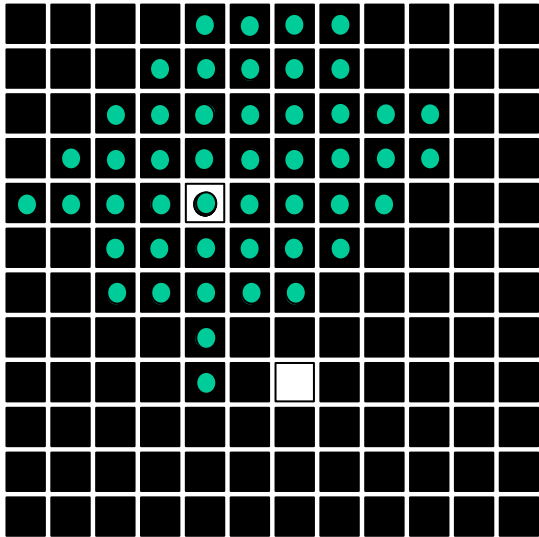
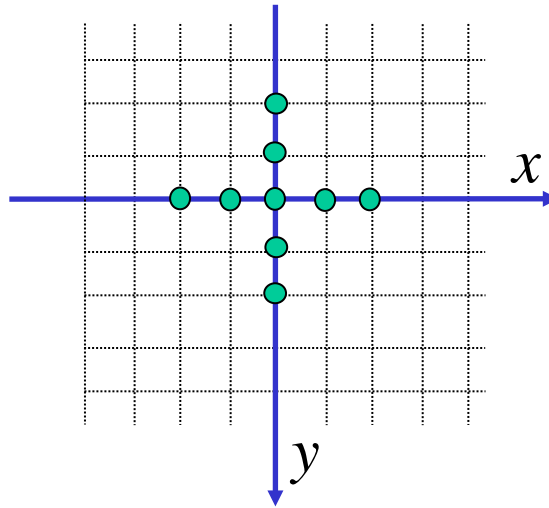


Binary dilation

$$g[x, y] = OR[W \{ f[x, y] \}] := dilate(f, W)$$



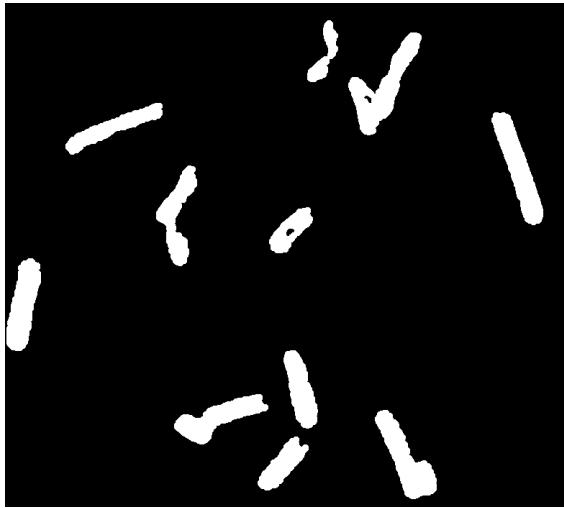
$f[x, y]$



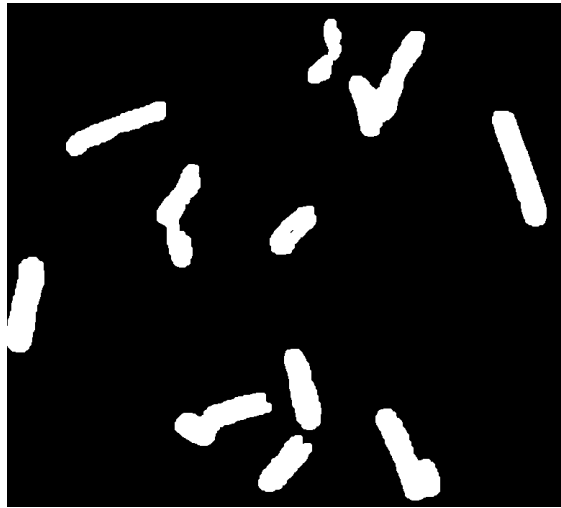
Π_{xy}

Binary dilation with square structuring element

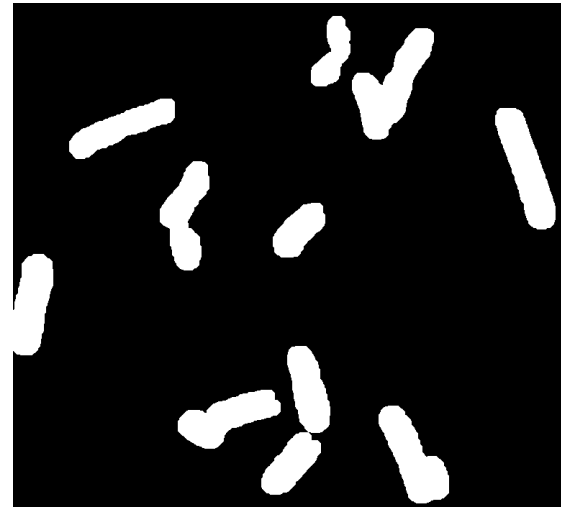
$$g[x, y] = OR[W \{f[x, y]\}] := dilate(f, W)$$



Original (701x781)



dilation with
3x3 structuring element



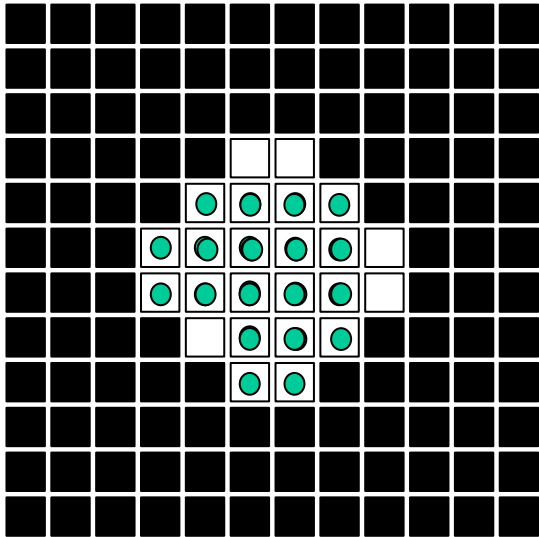
dilation with
7x7 structuring element

- Expands the size of 1-valued objects
- Smooths object boundaries
- Closes holes and gaps

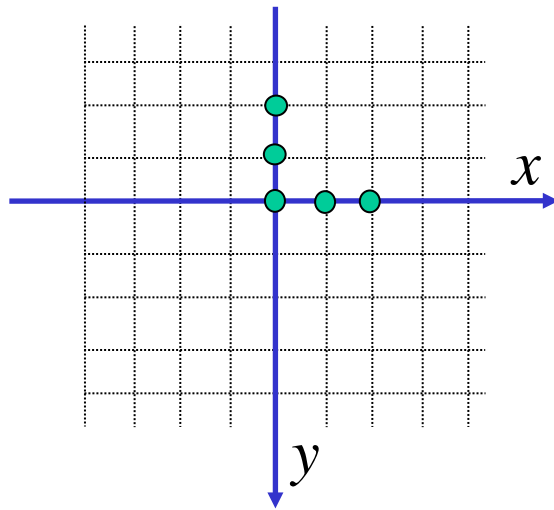


Binary erosion

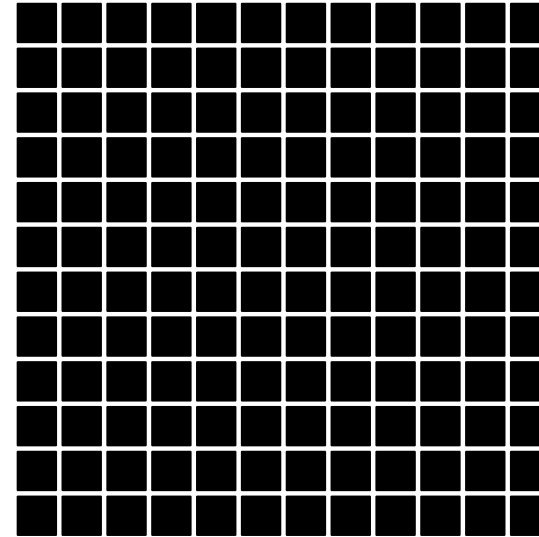
$$g[x, y] = \text{AND} \left[W \left\{ f[x, y] \right\} \right] := \text{erode}(f, W)$$



$f[x, y]$



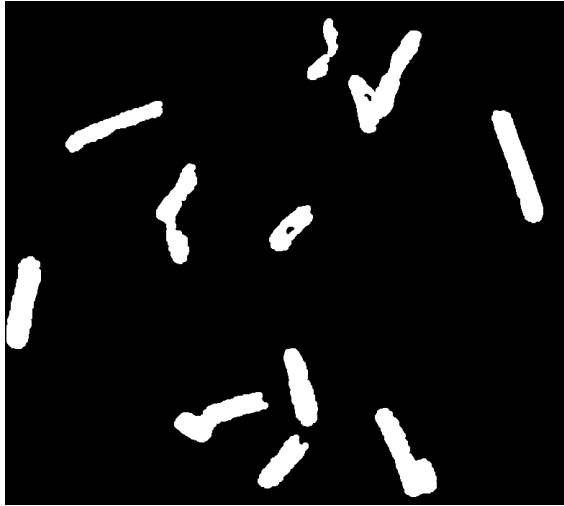
Π_{xy}



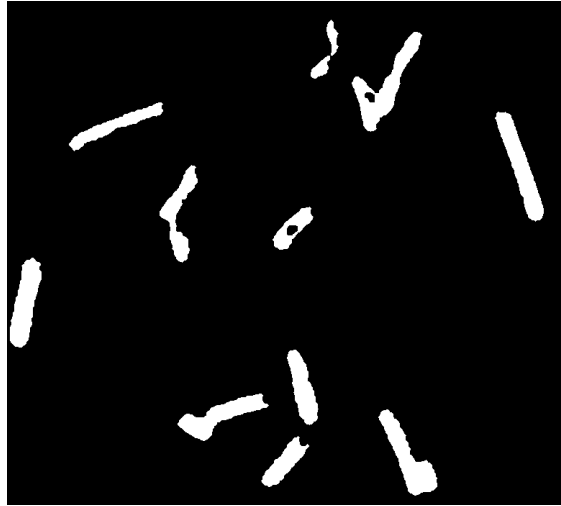
$g[x, y]$

Binary erosion with square structuring element

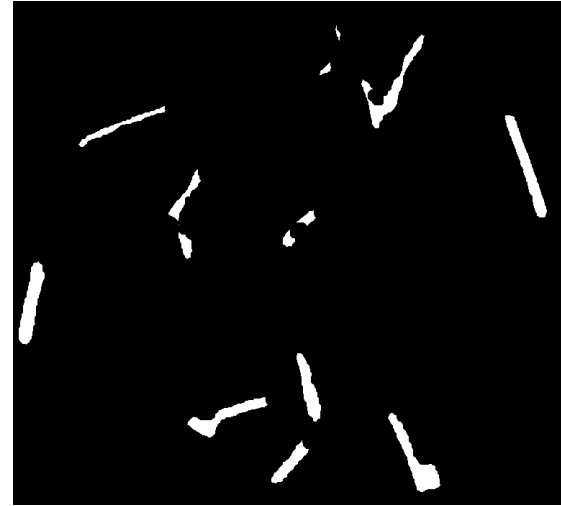
$$g[x, y] = \text{AND} \left[W \left\{ f[x, y] \right\} \right] := \text{erode}(f, W)$$



Original (701x781)



erosion with
3x3 structuring element



erosion with
7x7 structuring element

- Shrinks the size of 1-valued objects
- Smooths object boundaries
- Removes peninsulas, fingers, and small objects



Relationship between dilation and erosion

- Duality: erosion is dilation of the background

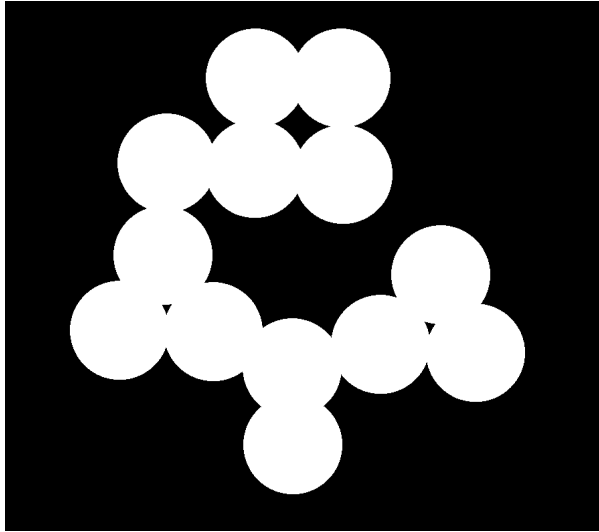
$$\textit{dilate}(f, W) = \textit{NOT}[\textit{erode}(\textit{NOT}[f], W)]$$

$$\textit{erode}(f, W) = \textit{NOT}[\textit{dilate}(\textit{NOT}[f], W)]$$

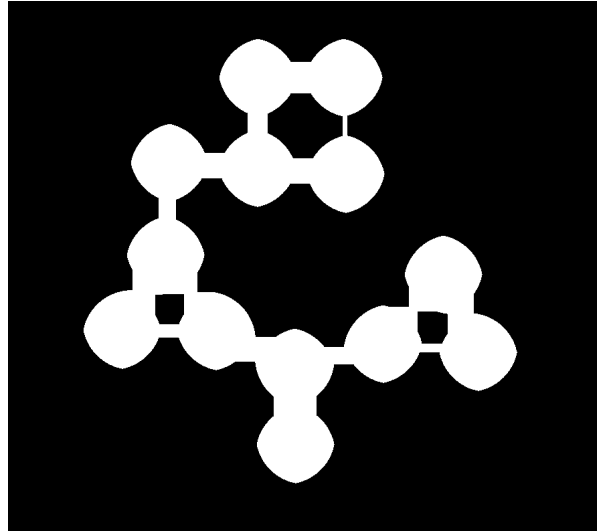
- But: erosion is not the inverse of dilation

$$\begin{aligned} f[x, y] &\neq \textit{erode}(\textit{dilate}(f, W), W) \\ &\neq \textit{dilate}(\textit{erode}(f, W), W) \end{aligned}$$

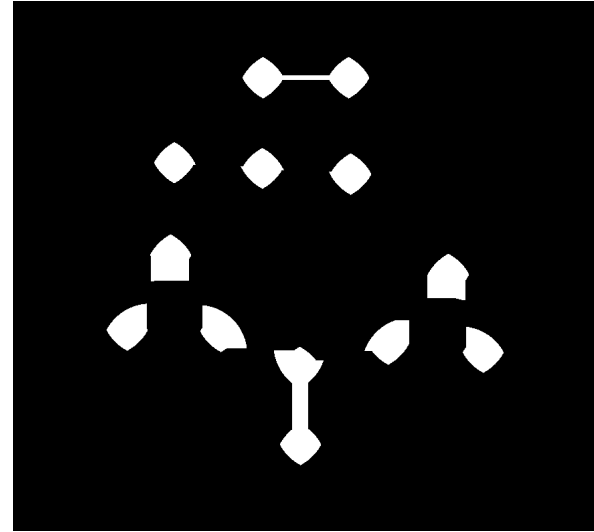
Example: blob separation/detection by erosion



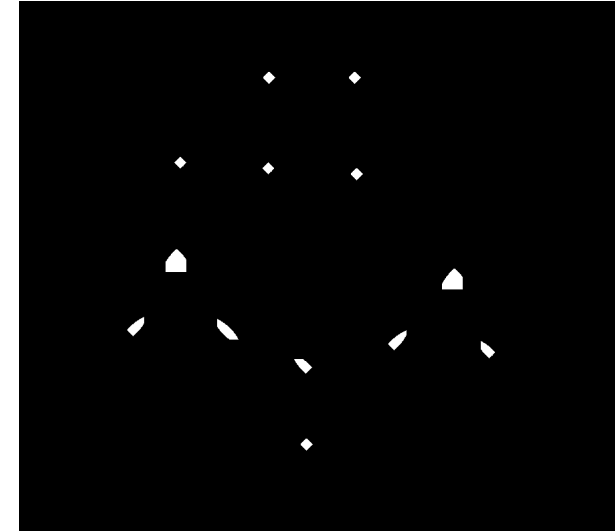
Original binary image
Circles (792x892)



Erosion by 30x30
structuring element



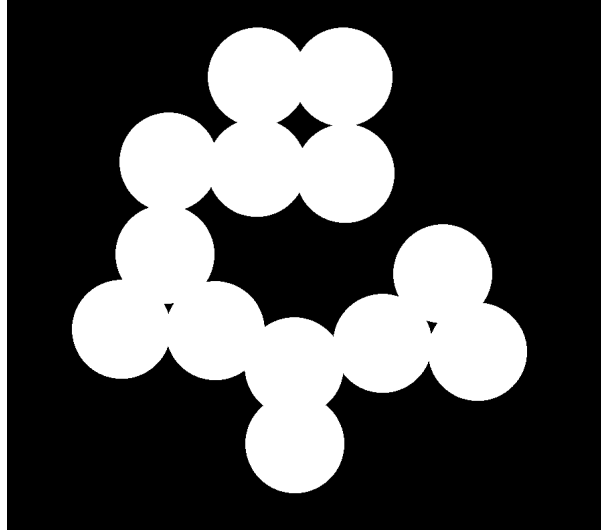
Erosion by 70x70
structuring element



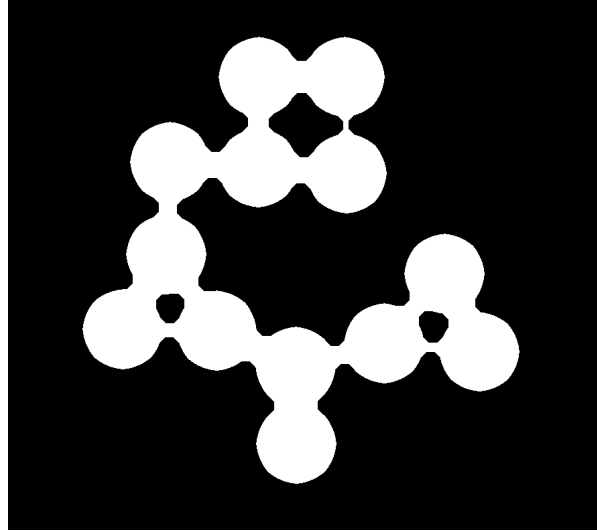
Erosion by 96x96
structuring element



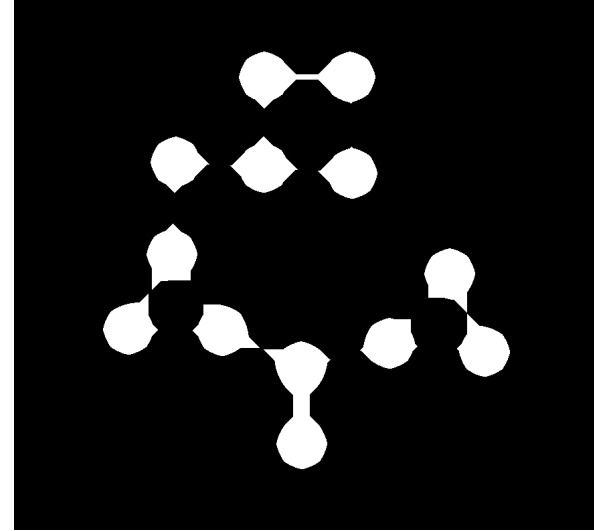
Example: blob separation/detection by erosion



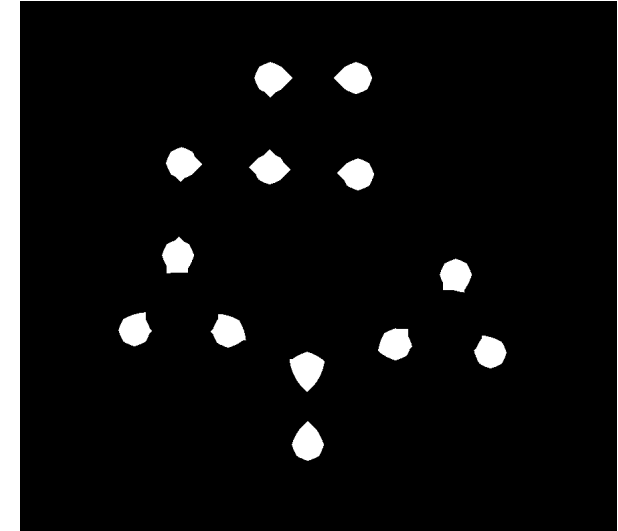
Original binary image
Circles (792x892)



Erosion by disk-shaped
structuring element
Diameter=15



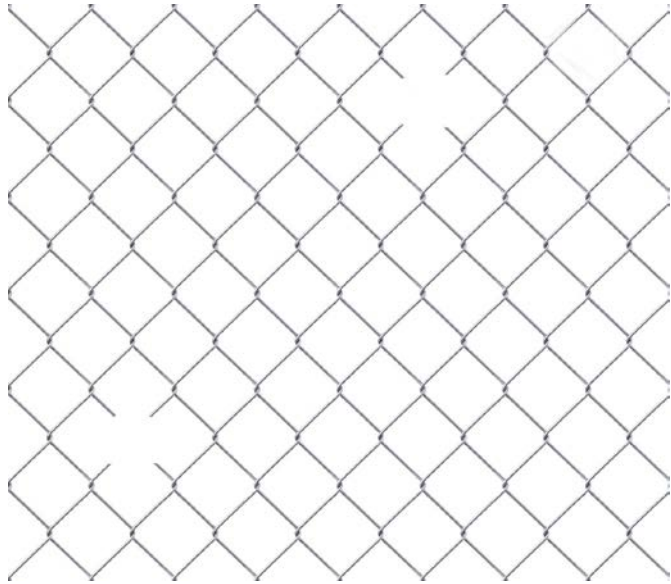
Erosion by disk-shaped
structuring element
Diameter=35



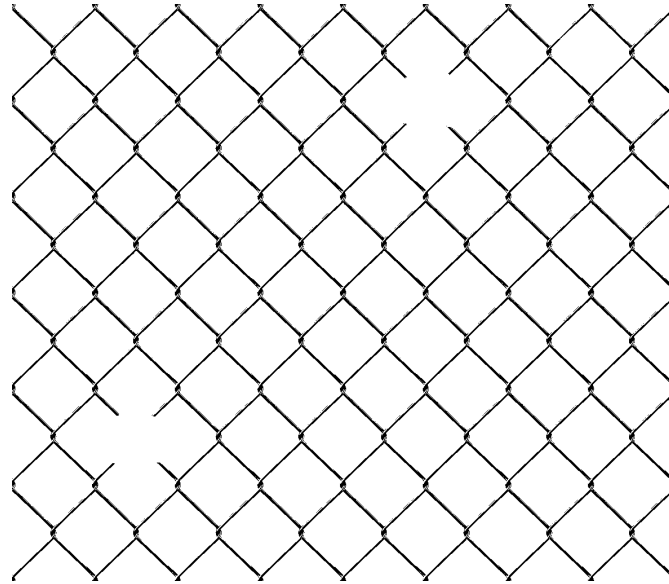
Erosion by disk-shaped
structuring element
Diameter=48



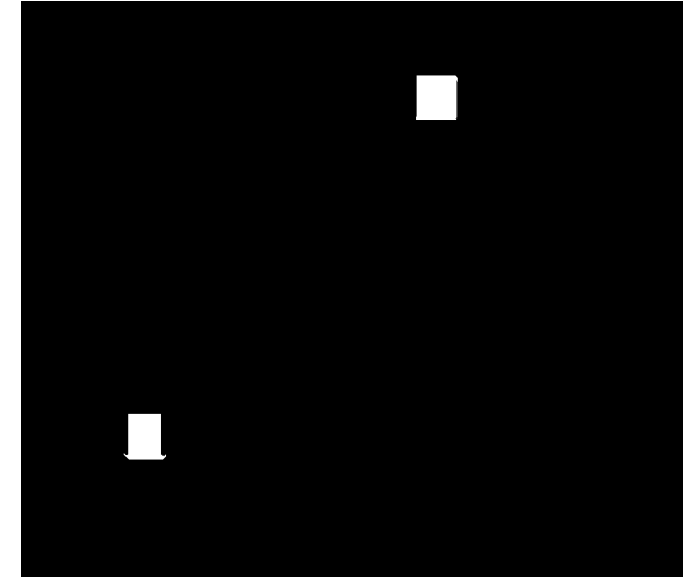
Example: chain link fence hole detection



Original grayscale image
Fence (1023 x 1173)



Fence thresholded
using Otsu's method



Erosion with 151x151
"cross" structuring element

