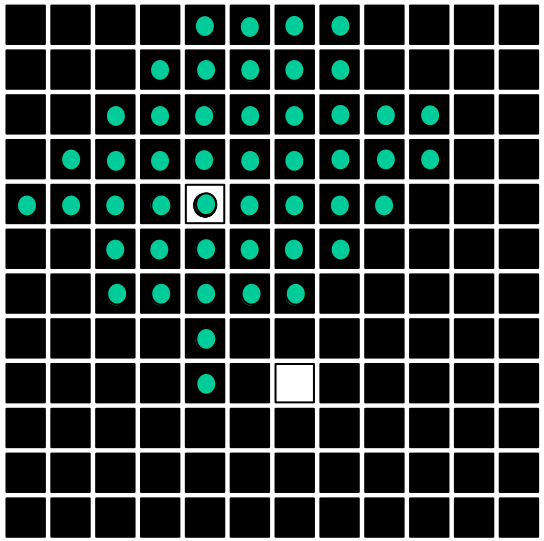
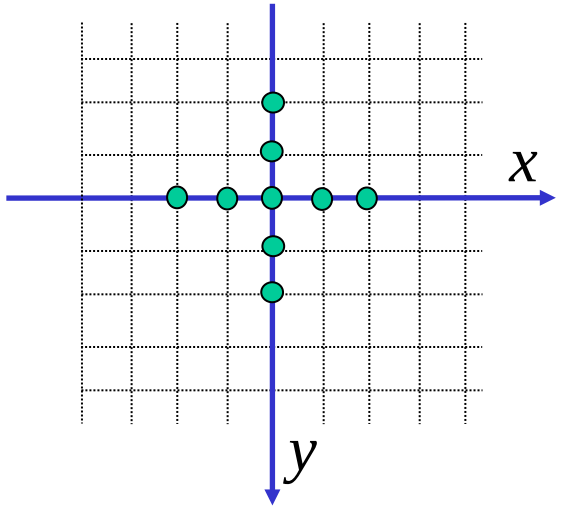
# Binary dilation

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



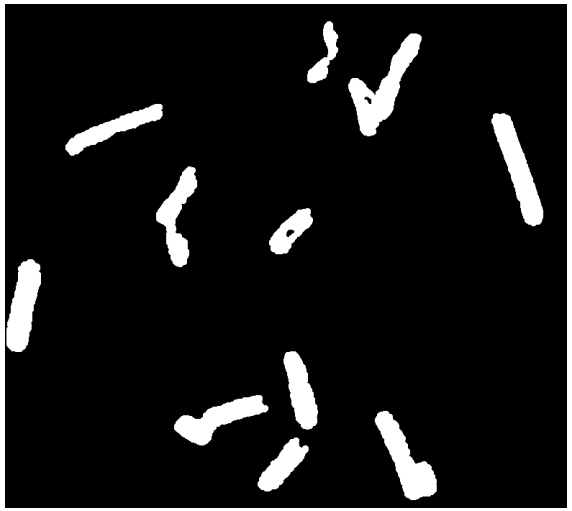
$f[x,y]$



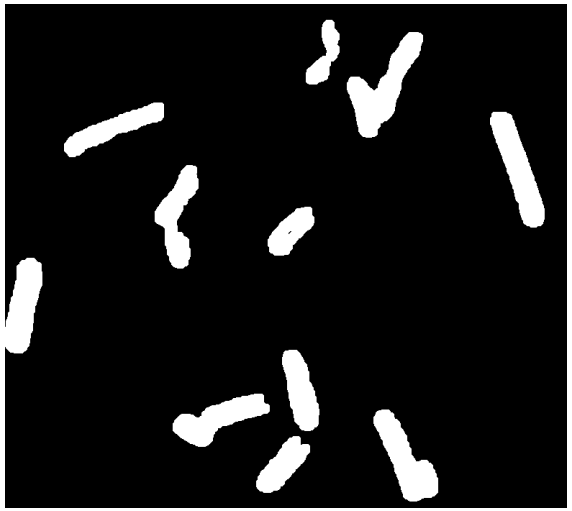

$\Pi_{xy}$

# Binary dilation with square structuring element

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



Original (701x781)



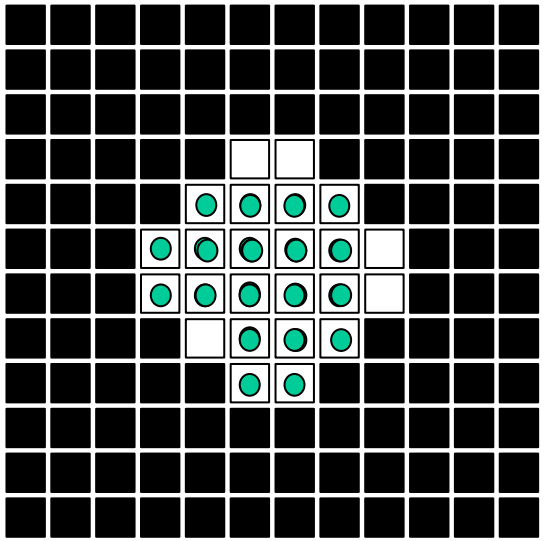
dilation with
3x3 structuring element

dilation with
7x7 structuring element

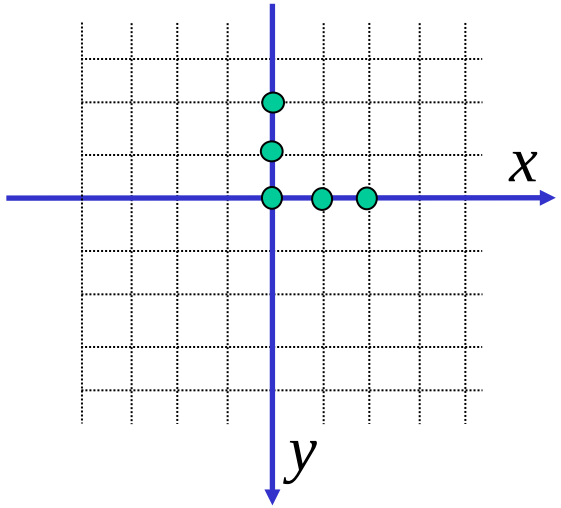
- Expands the size of 1-valued objects
- Smoothes object boundaries
- Closes holes and gaps

# Binary erosion

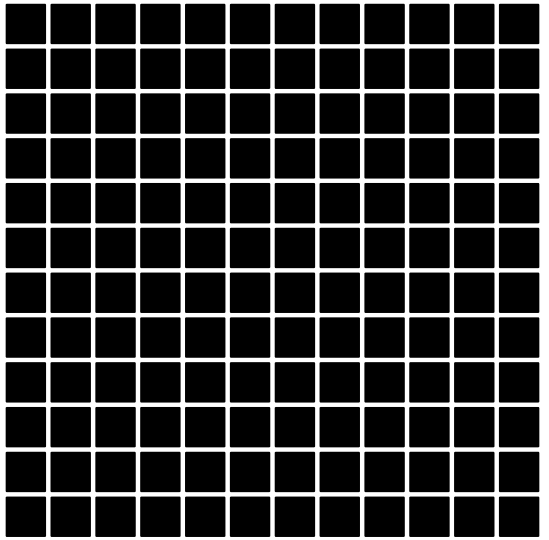
$$g[x,y] = AND\left[W\left\{f[x,y]\right\}\right] := erode(f,W)$$



$f[x,y]$



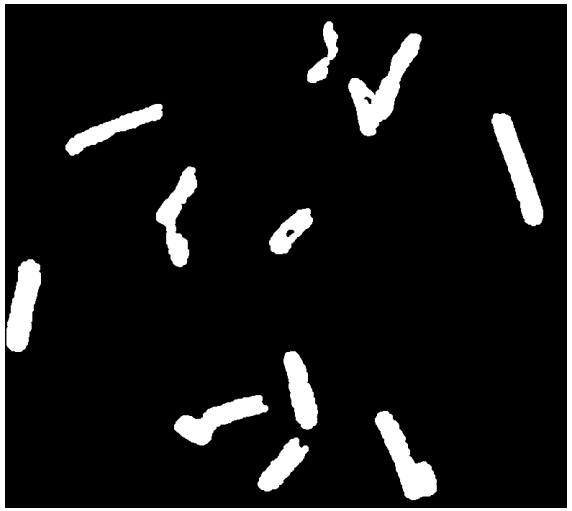

$\Pi_{xy}$



$g[x,y]$

# Binary erosion with square structuring element

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



Original (701x781)

erosion with
3x3 structuring element

erosion with
7x7 structuring element

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

# Relationship between dilation and erosion

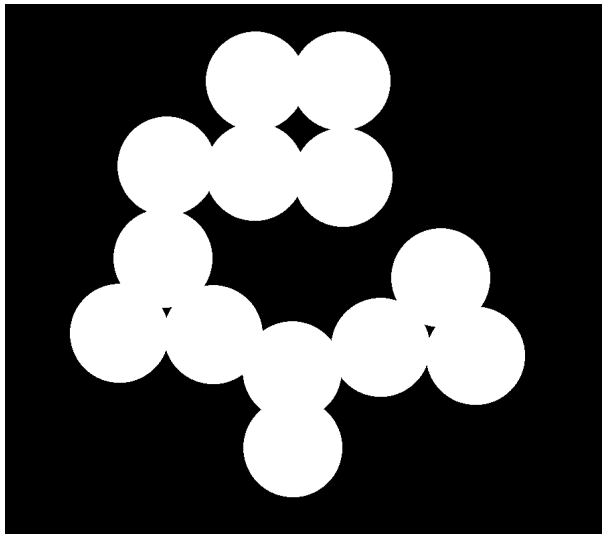
- Duality: erosion is dilation of the background

$$dilate\left(f,W\right)=NOT\left[erode\left(NOT\left[f\right],W\right)\right]$$
$$erode\left(f,W\right)=NOT\left[dilate\left(NOT\left[f\right],W\right)\right]$$

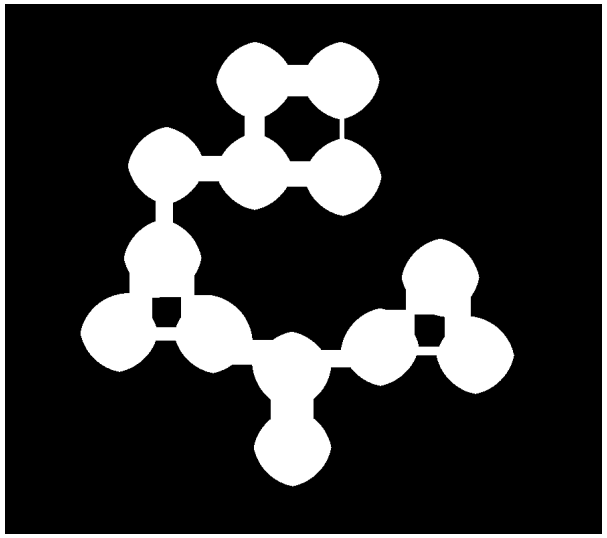
- But: erosion is not the inverse of dilation

$$f\left[x,y\right]\neq erode\left(dilate\left(f,W\right),W\right)$$
$$\neq dilate\left(erode\left(f,W\right),W\right)$$

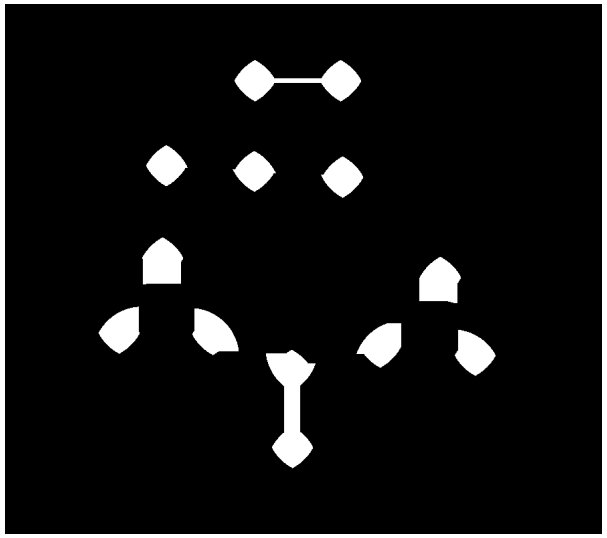
# Example: blob separation/detection by erosion



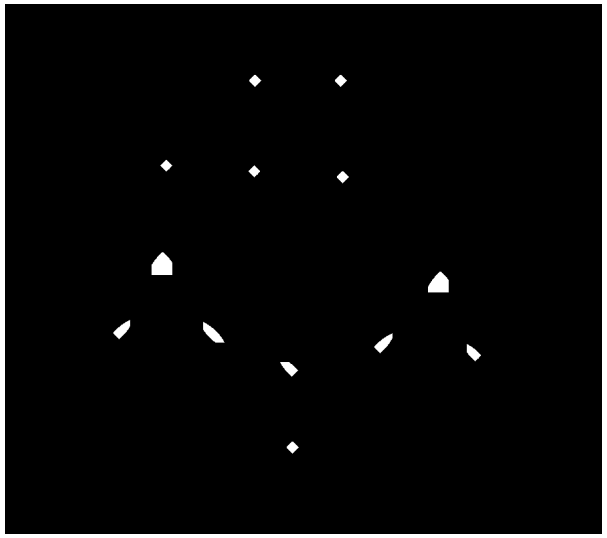
Original binary image
*Circles* (792x892)



Erosion by 30x30
structuring element

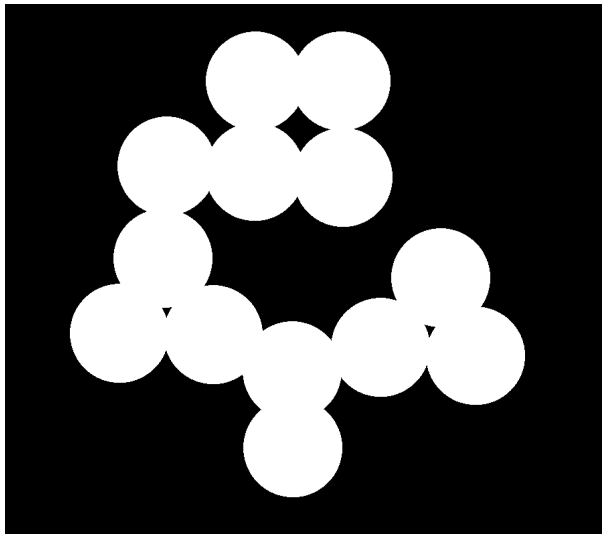


Erosion by 70x70
structuring element

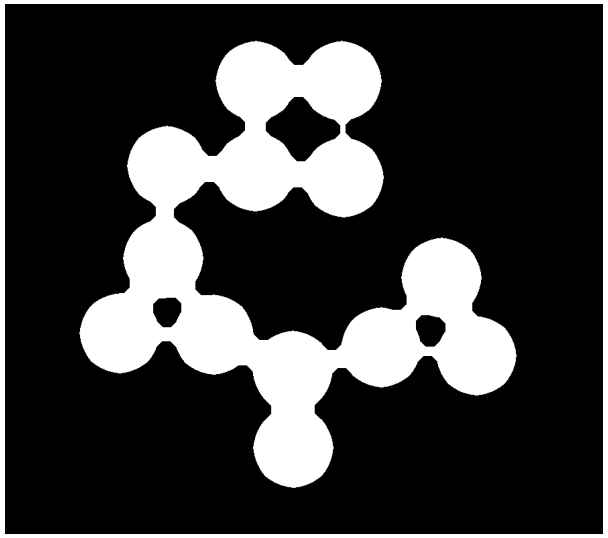


Erosion by 96x96
structuring element

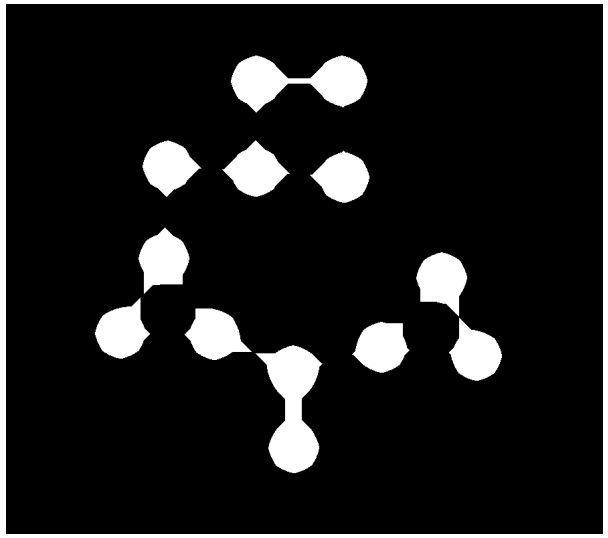
# Example: blob separation/detection by erosion



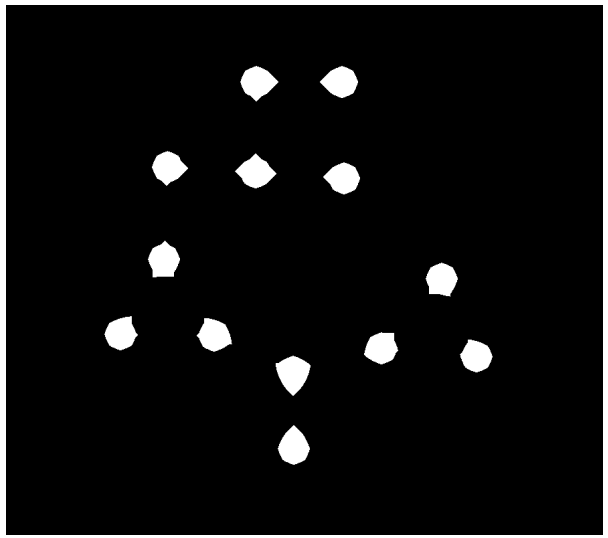
Original binary image
*Circles* (792x892)



Erosion by disk-shaped structuring element
Diameter=15

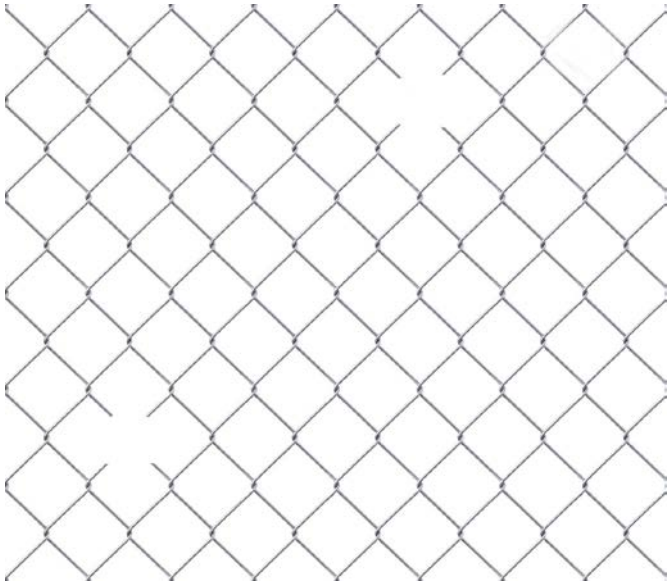


Erosion by disk-shaped structuring element
Diameter=35

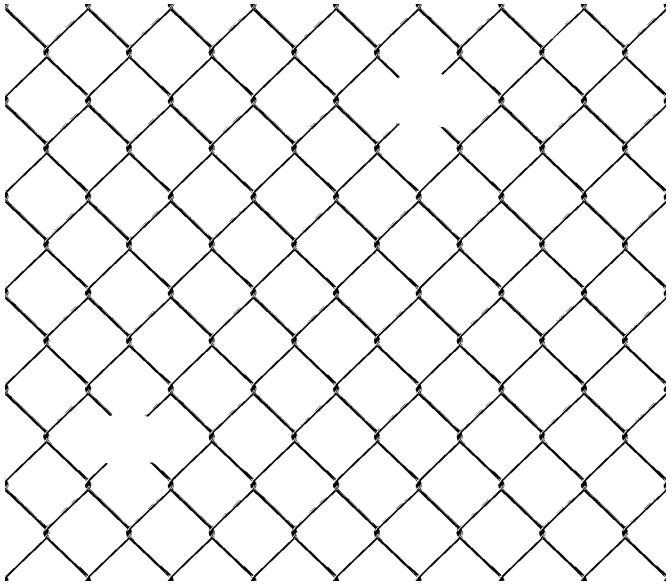


Erosion by disk-shaped structuring element
Diameter=48

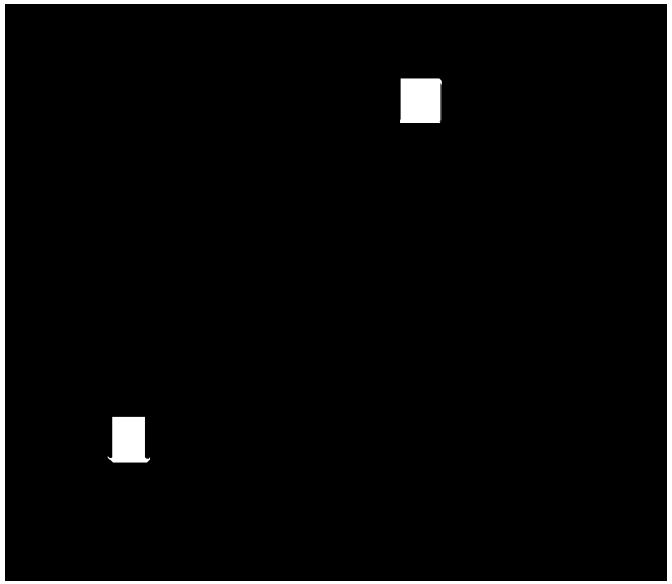
# Example: chain link fence hole detection



Original grayscale image
*Fence (1023* x 1173*)*



*Fence* thresholded
using Otsu's method



Erosion with 151x151
"cross" structuring element