

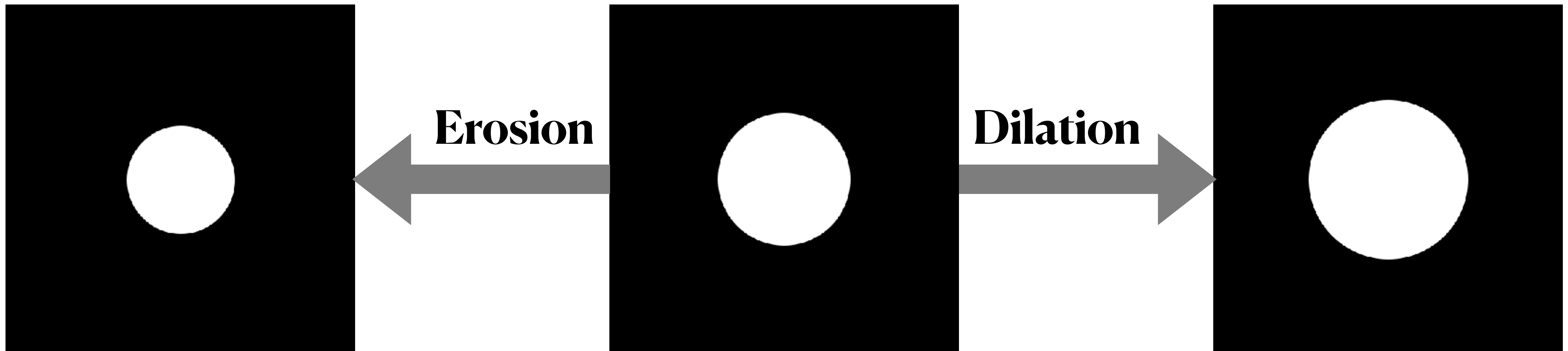
# **Morphological Filters**



# Two Primary Morphological Operations

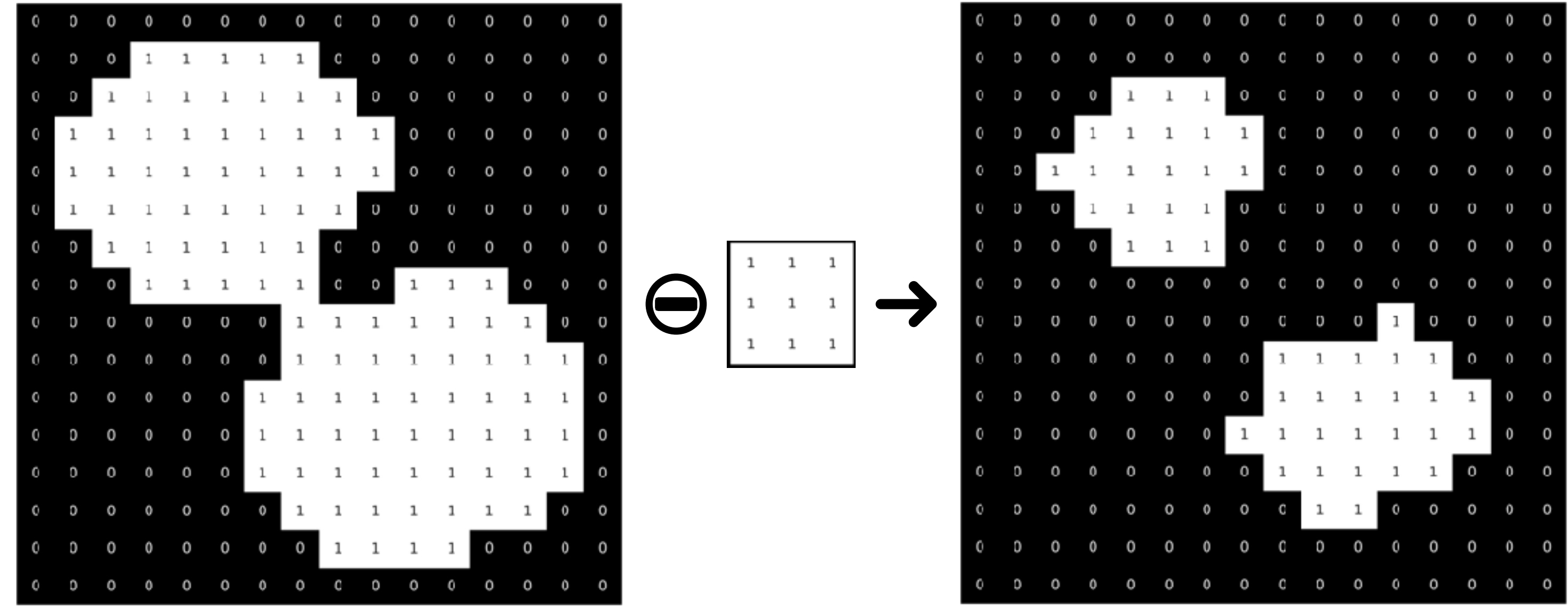
**Erosion**

**Dilation**



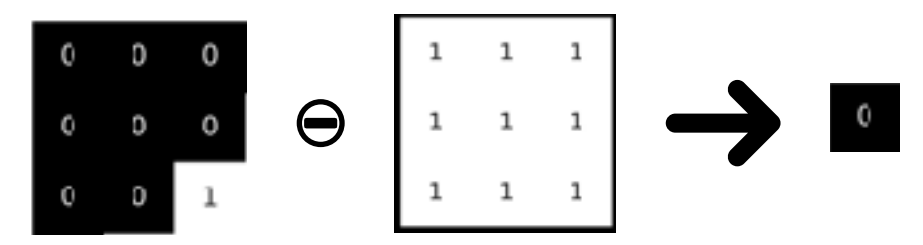
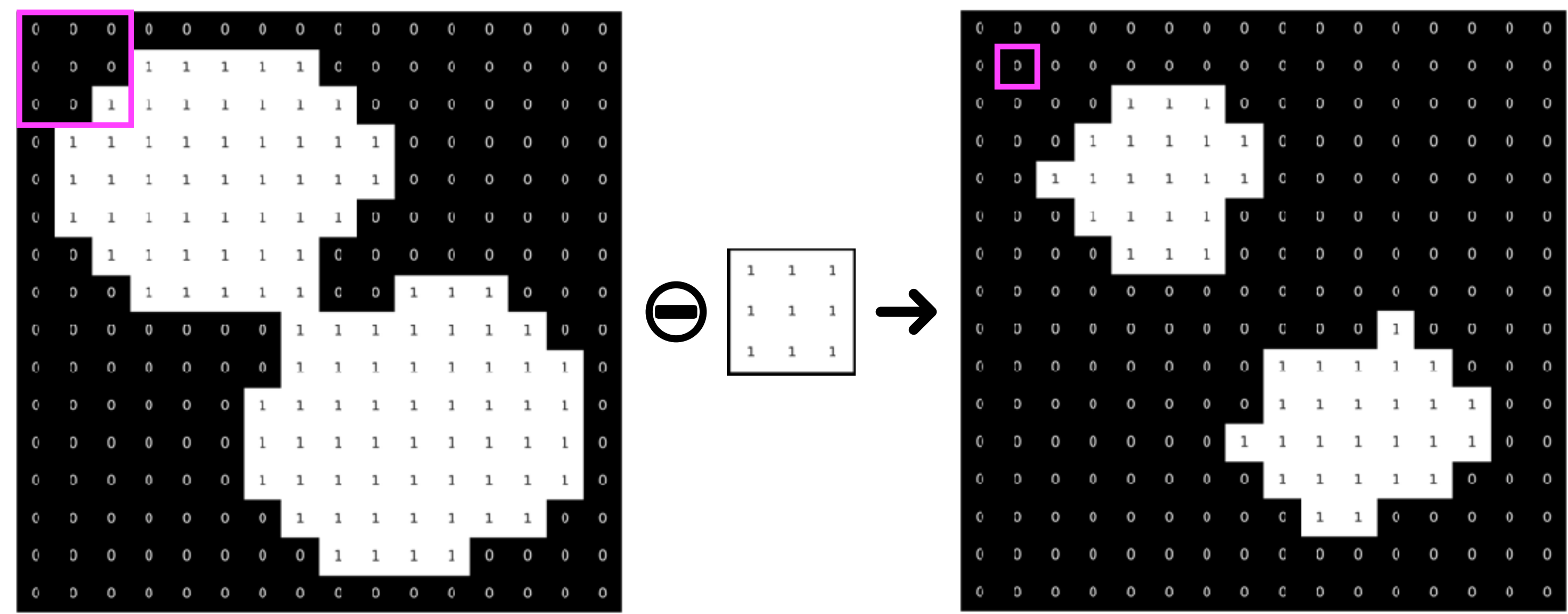


# Erosion Operation



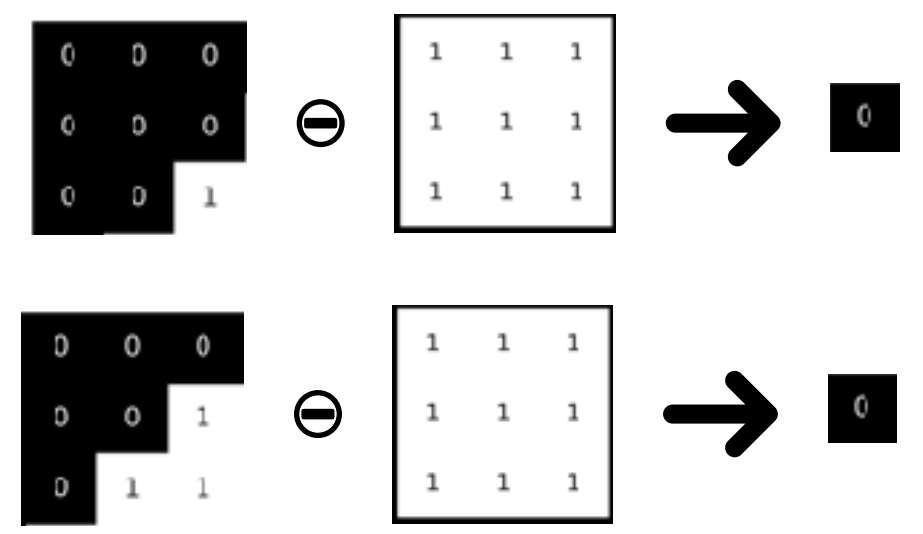
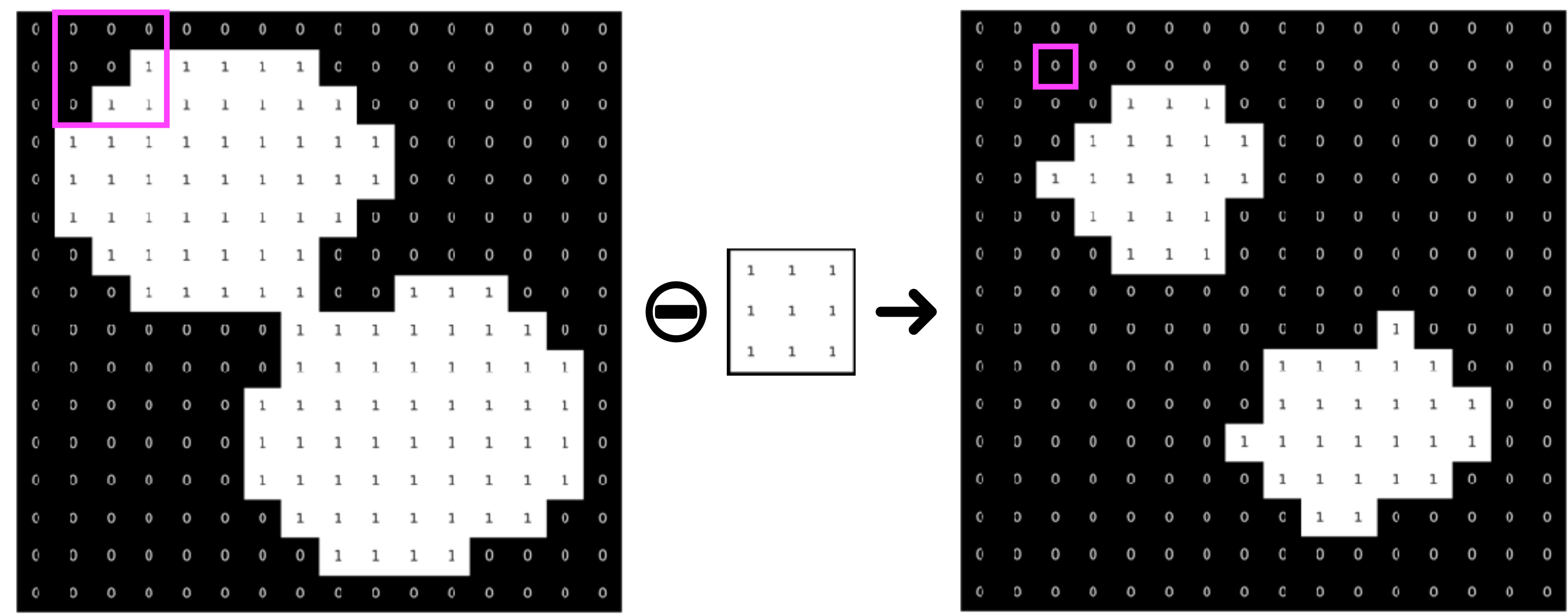


# Erosion Operation

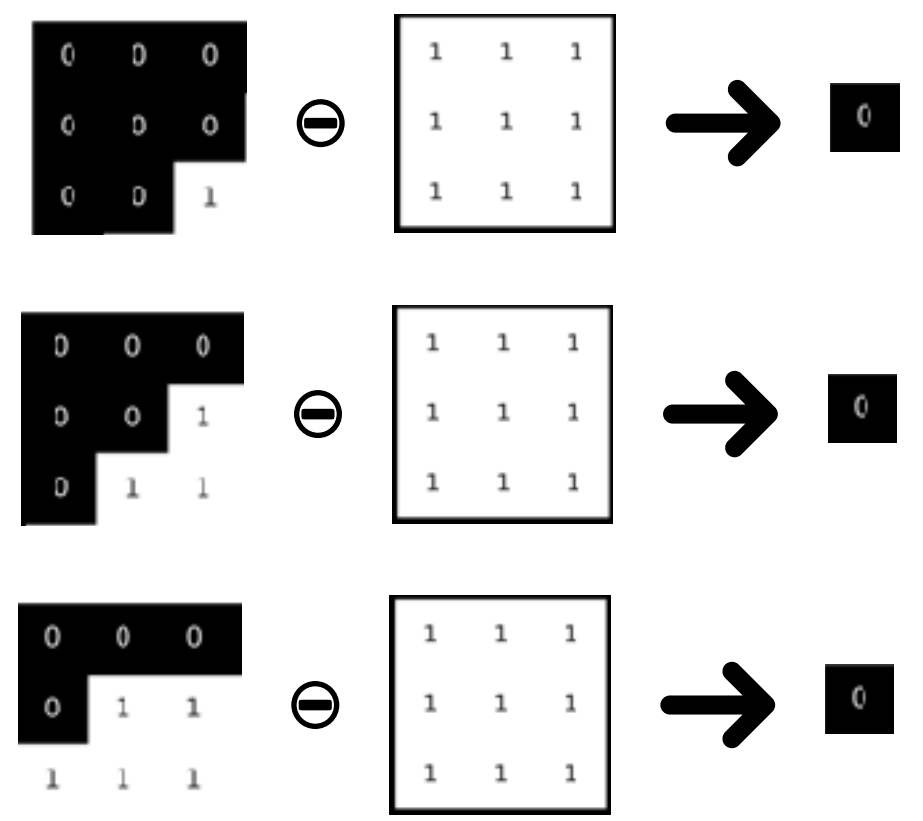
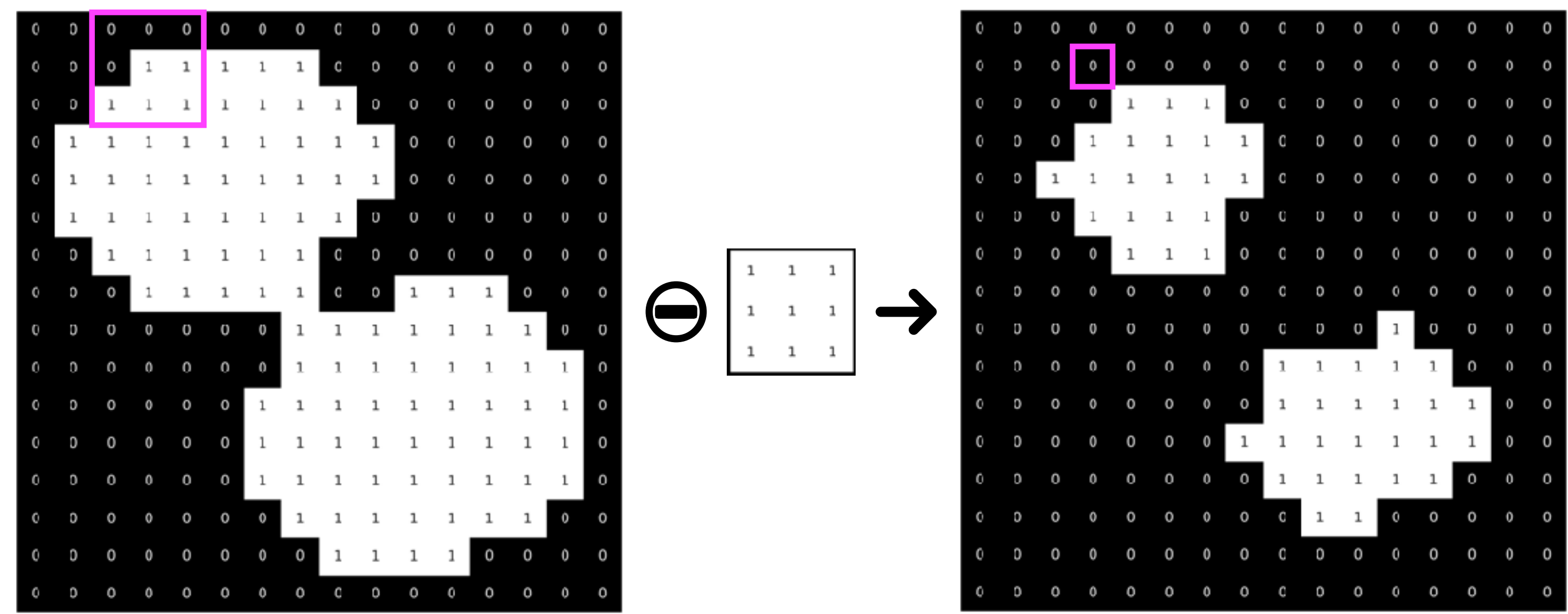




# Erosion Operation

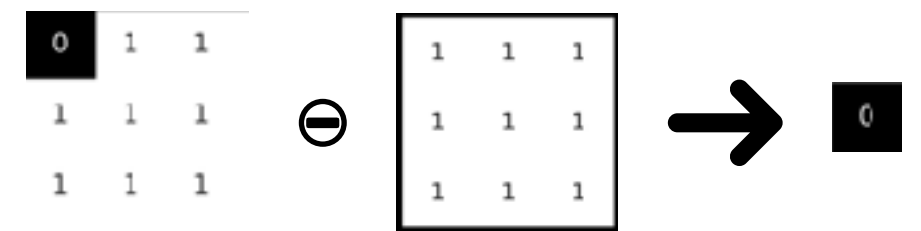
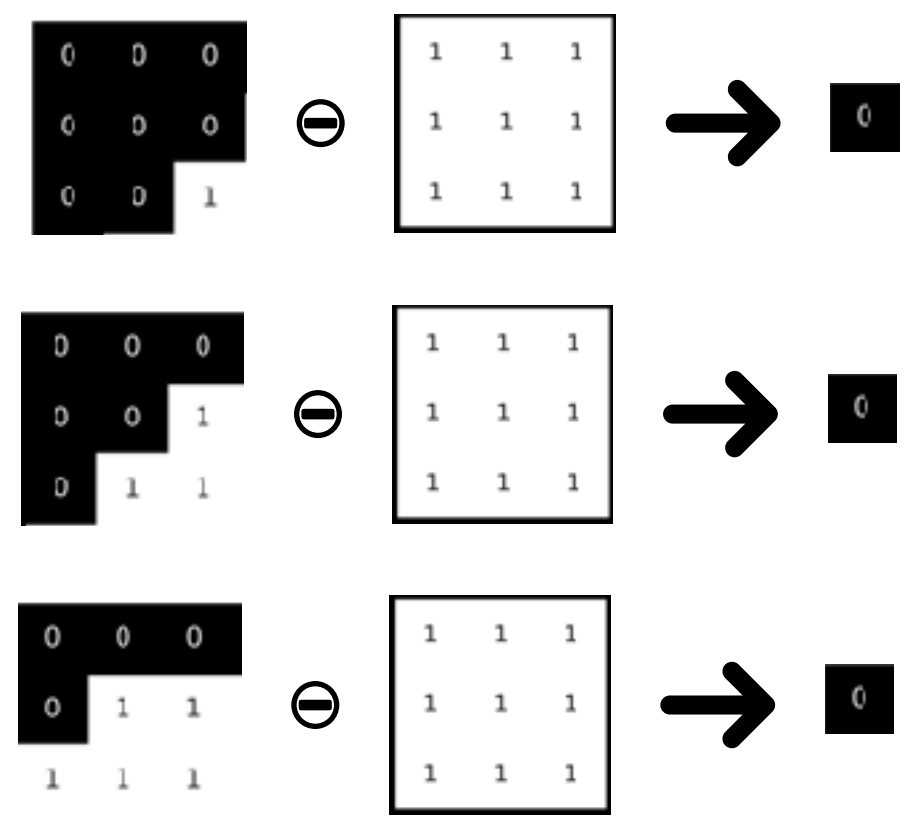
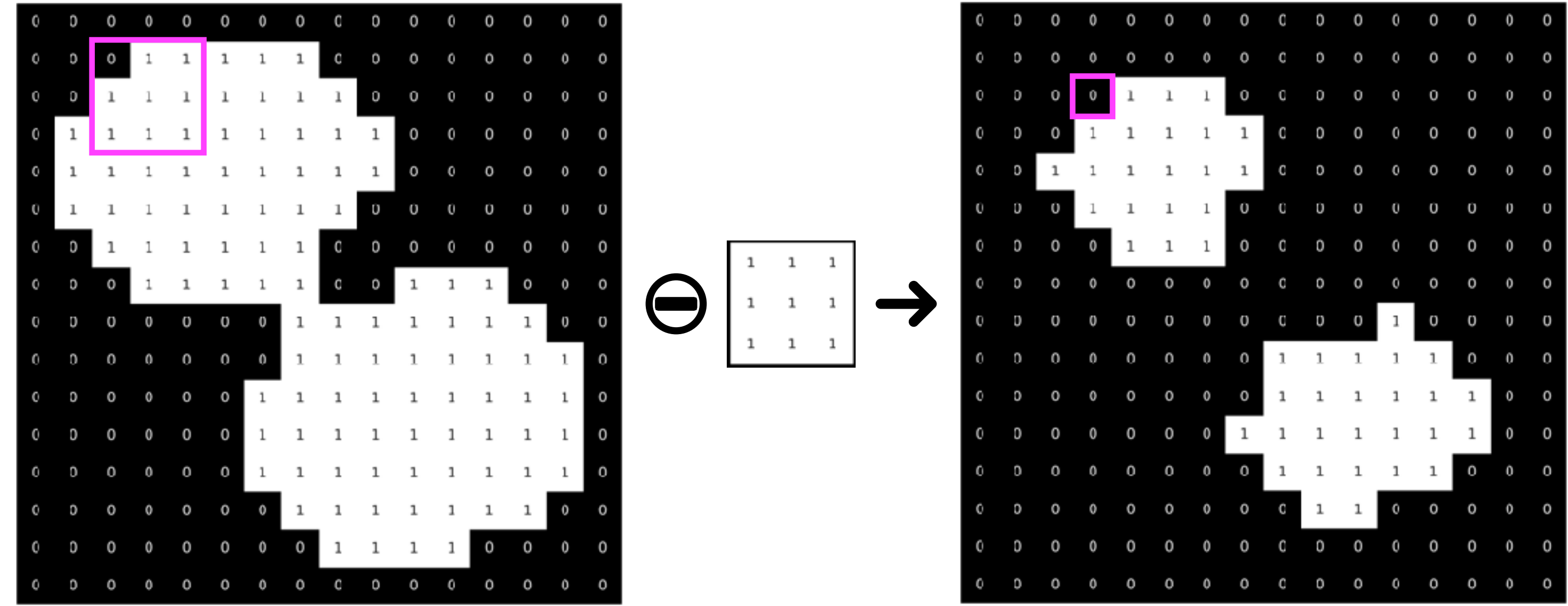


# Erosion Operation

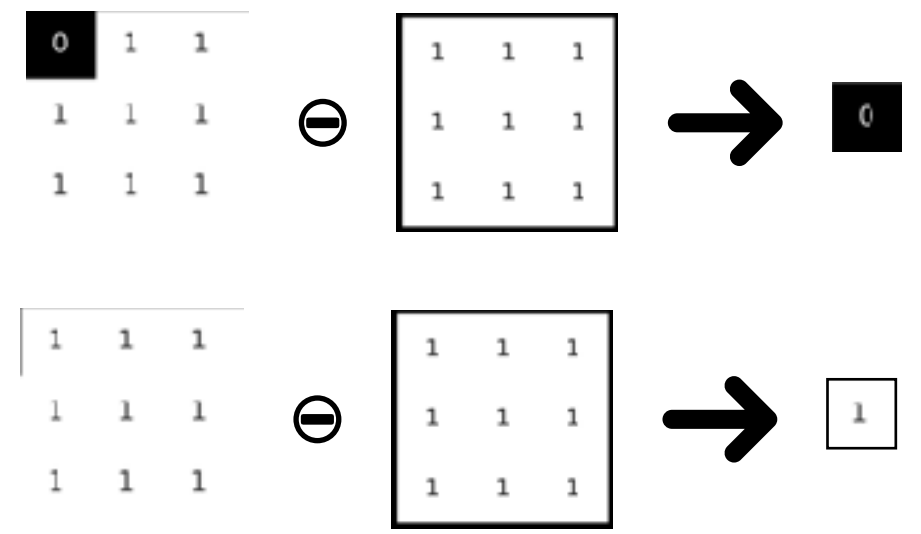
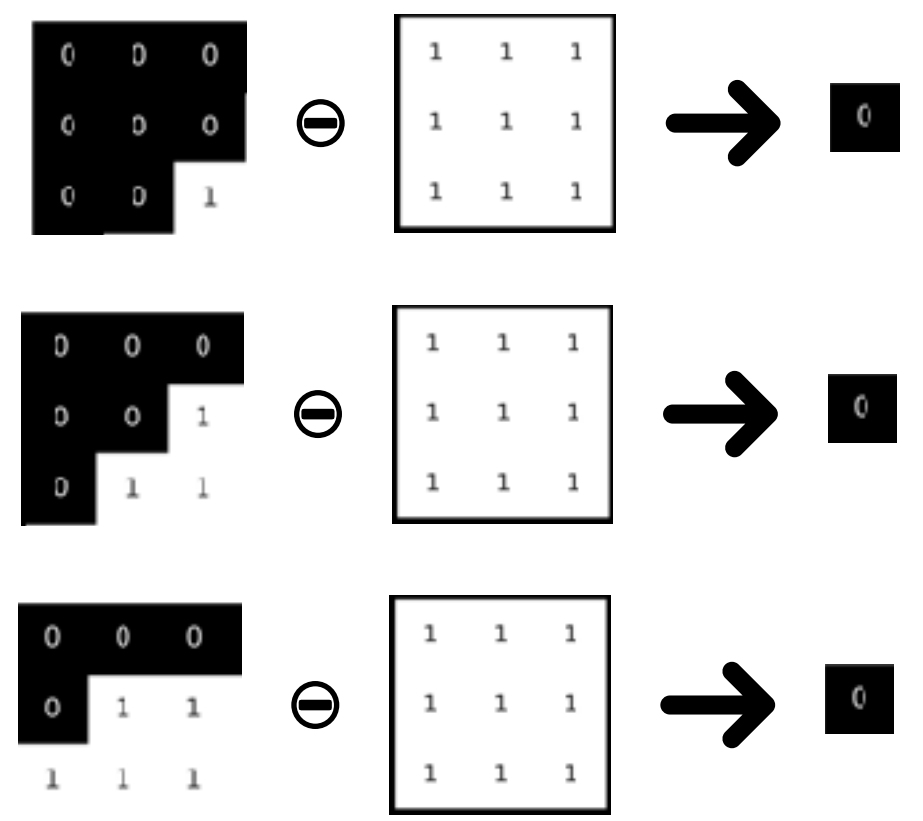
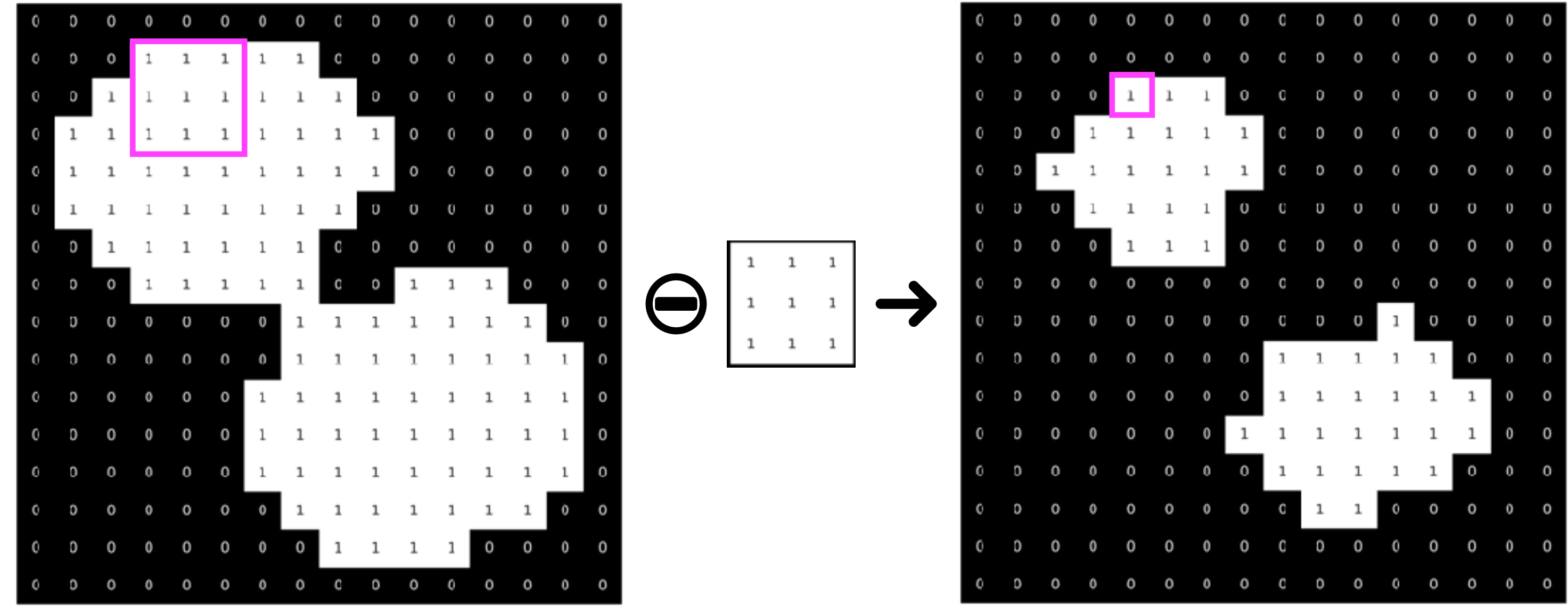




# Erosion Operation

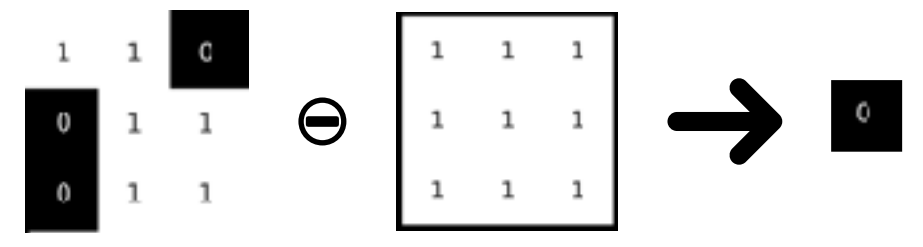
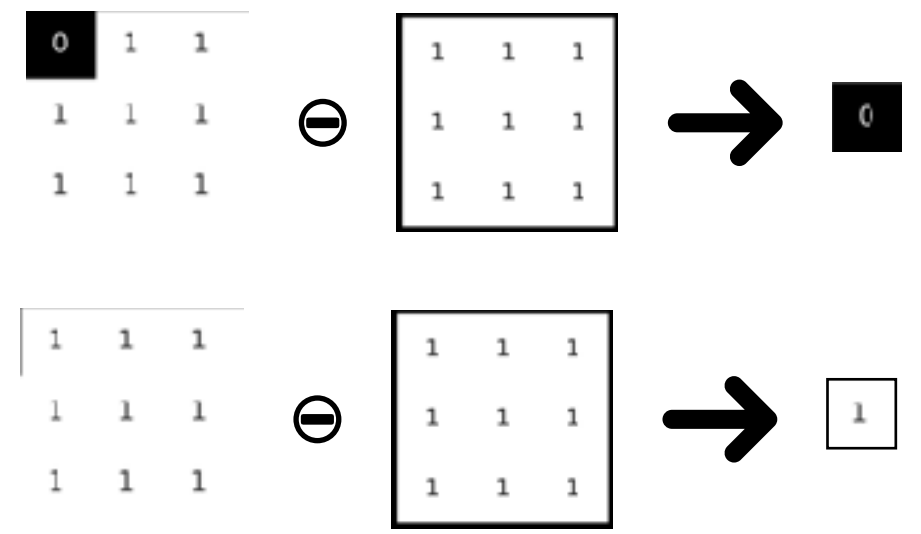
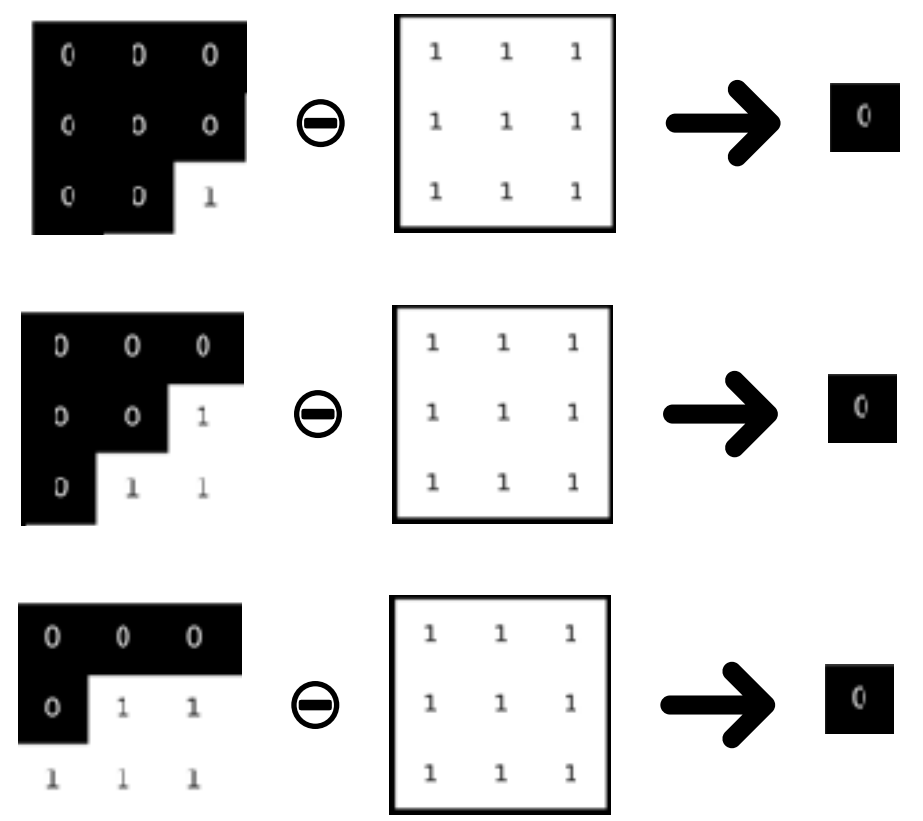
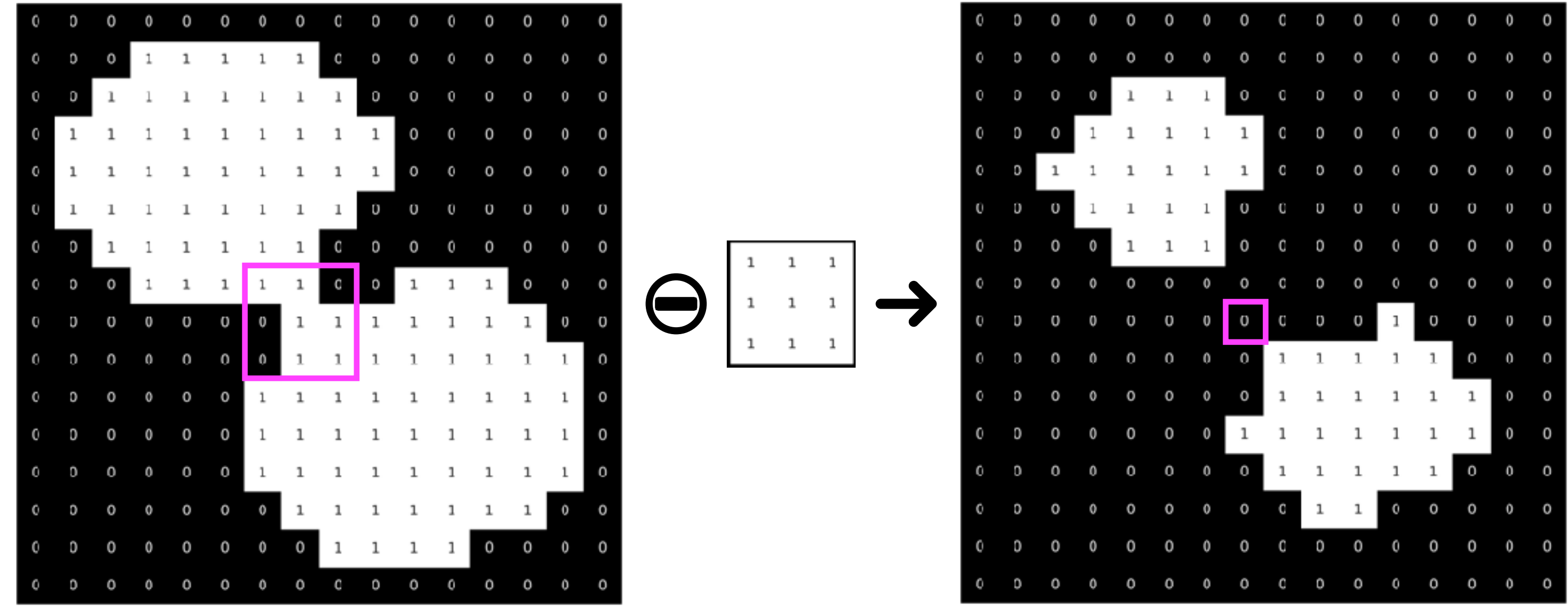


# Erosion Operation



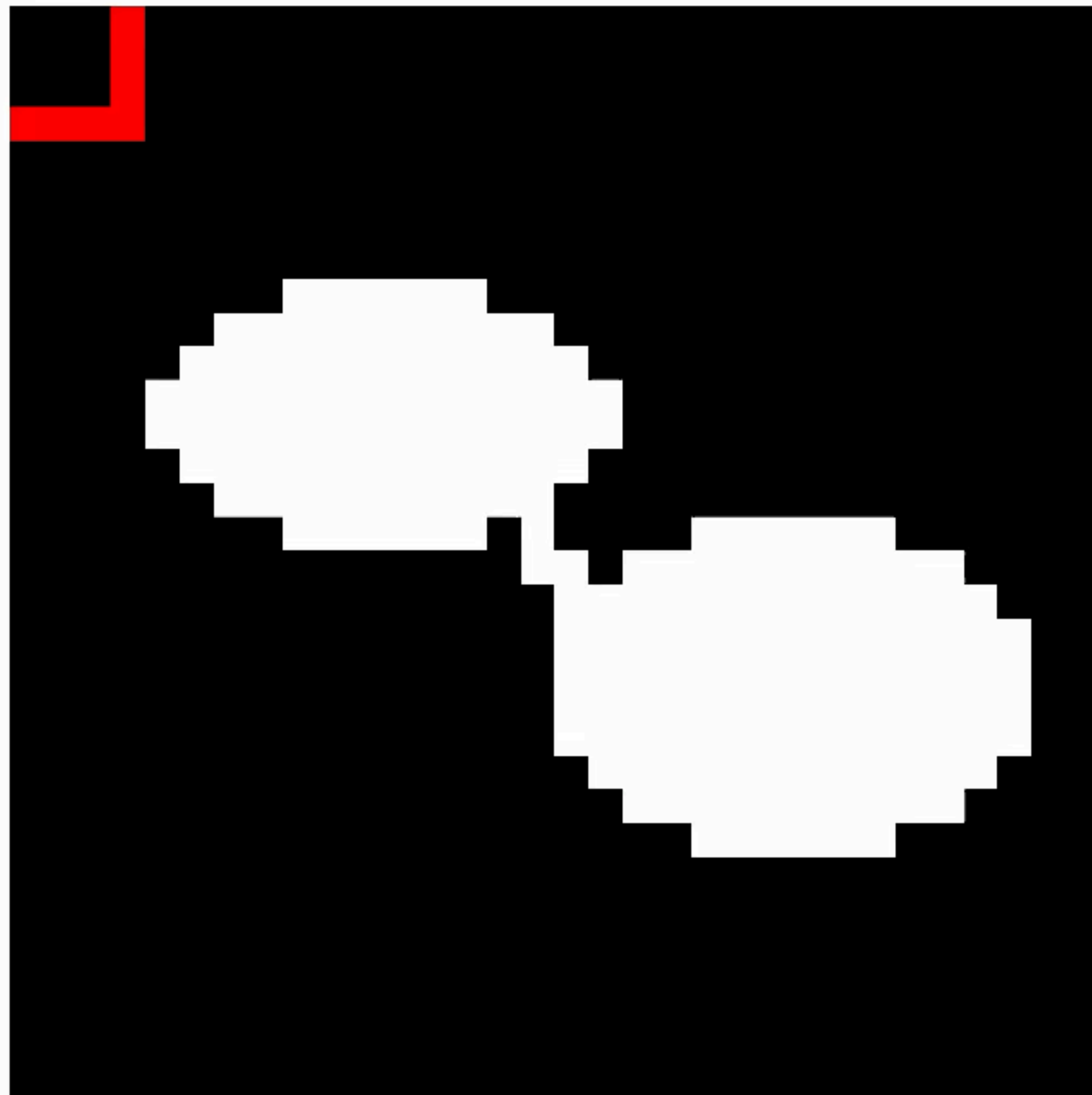


# Erosion Operation



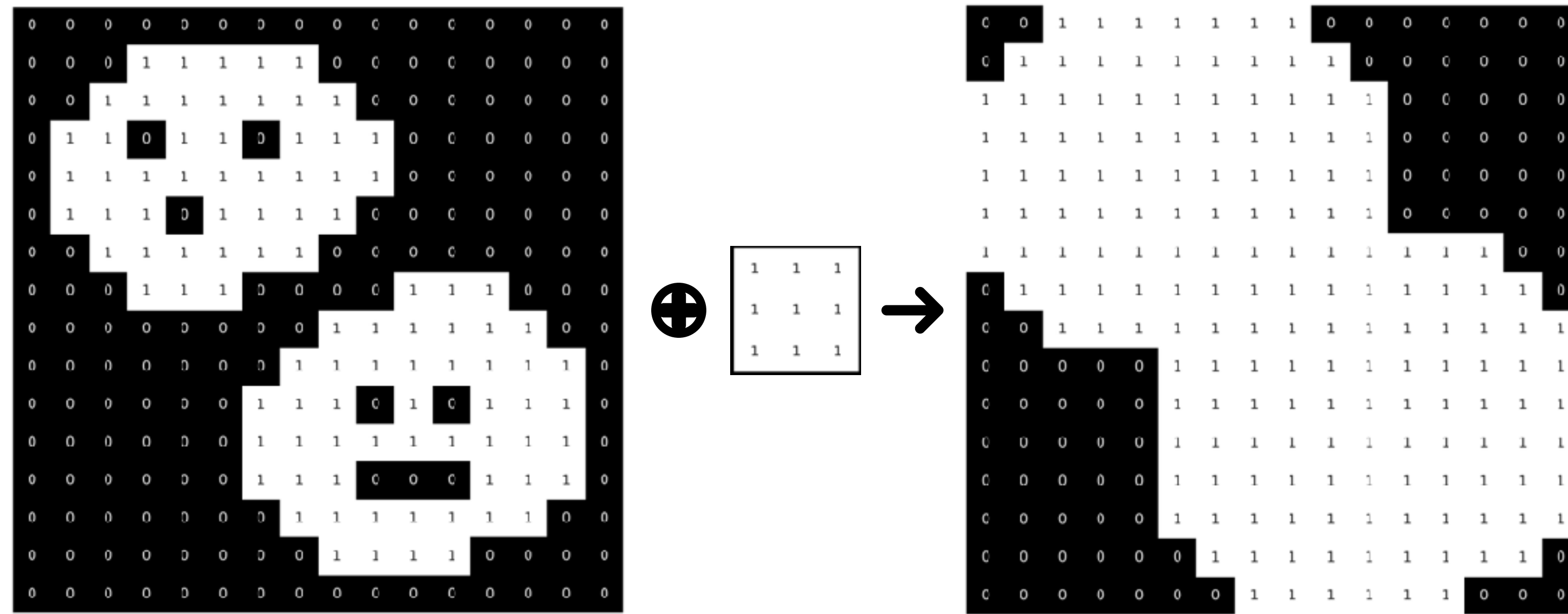


# Erosion - The Movie



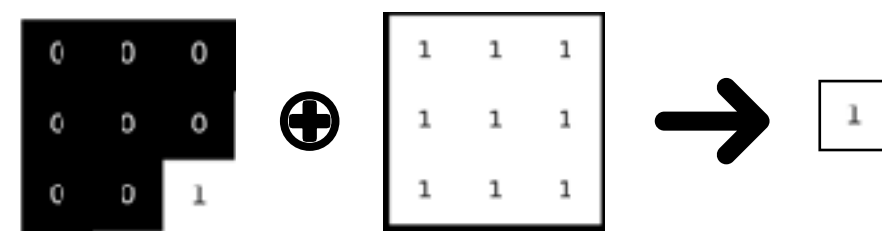
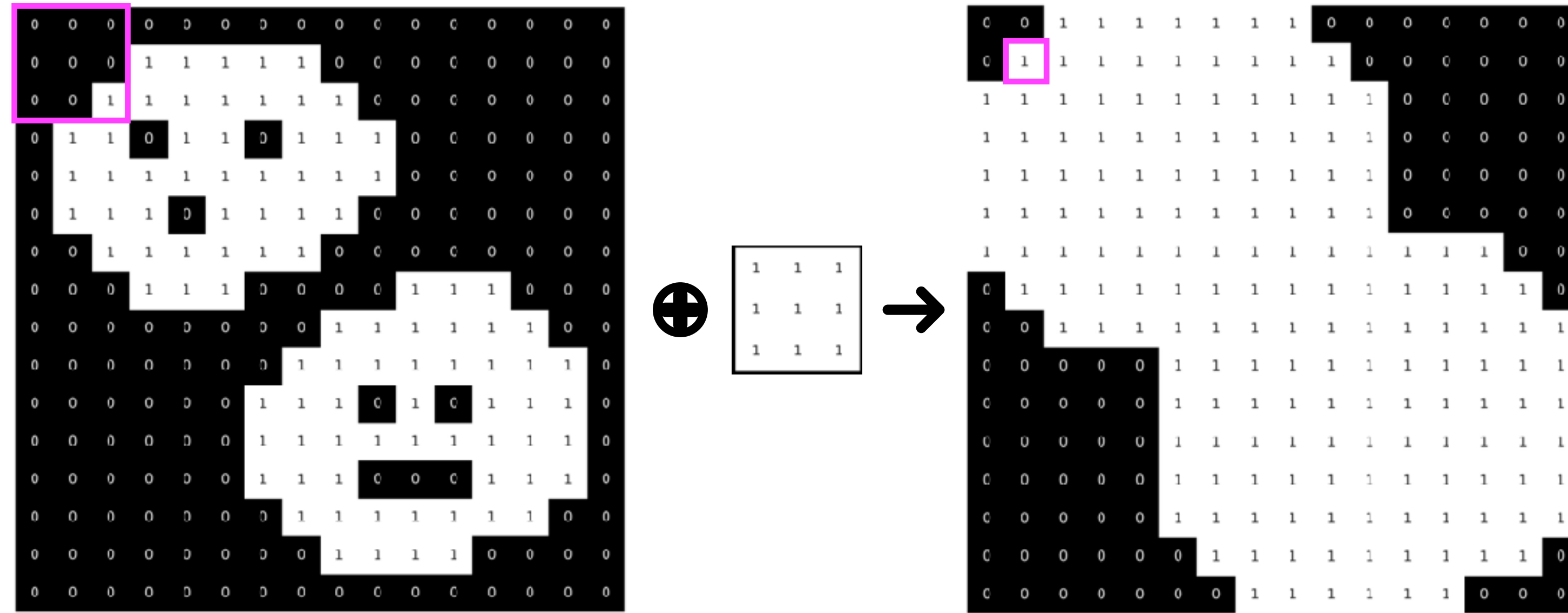


# Dilation Operation



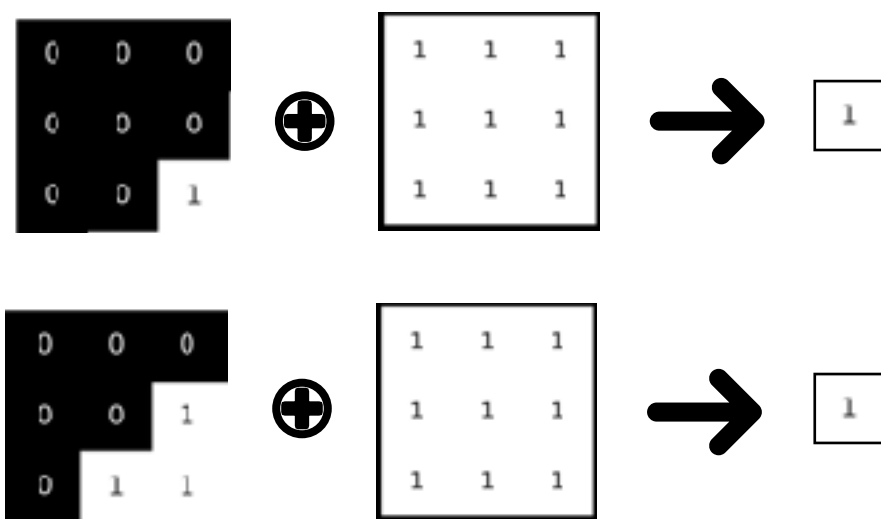
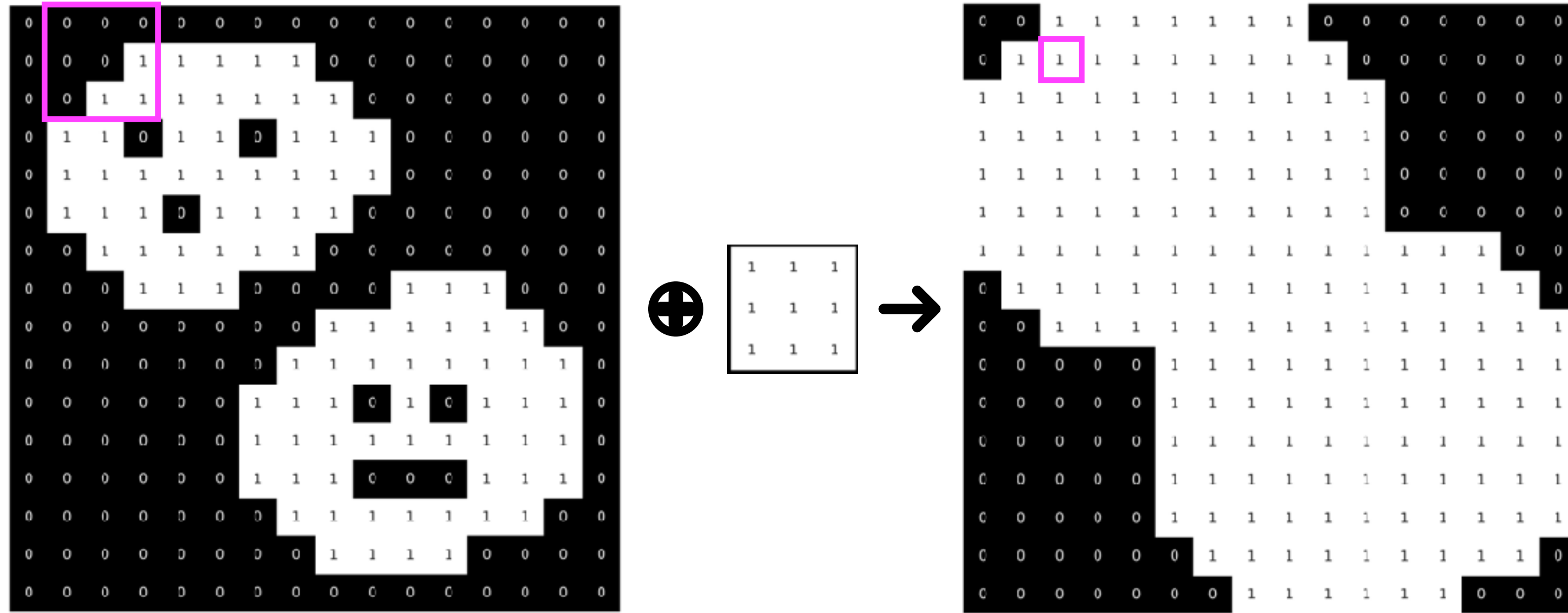


# Dilation Operation

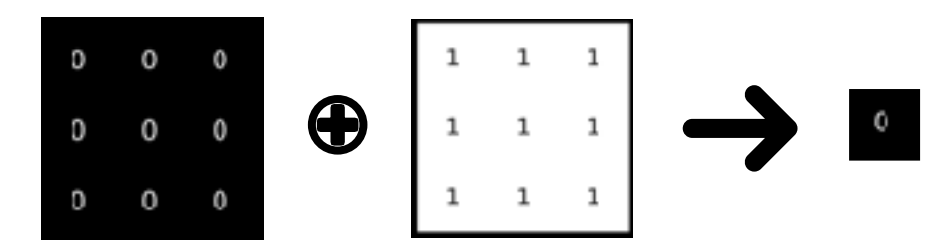
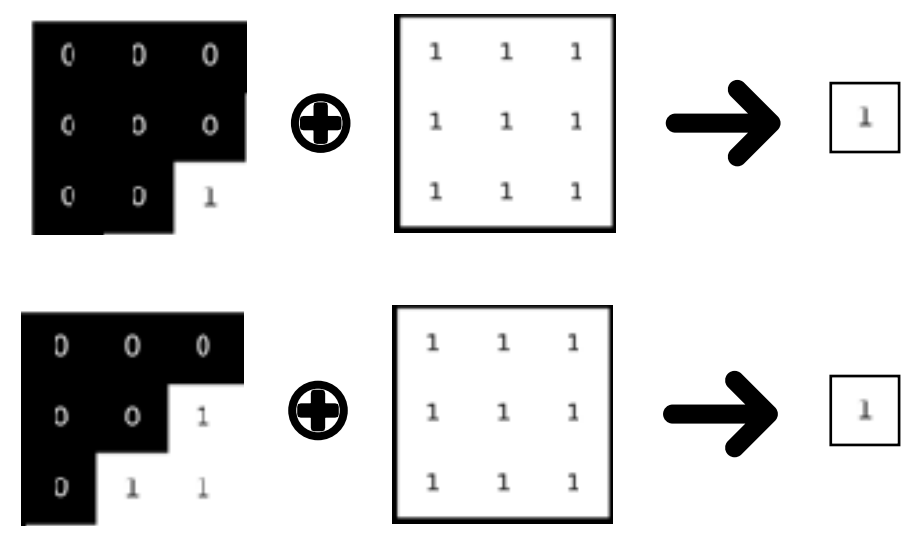
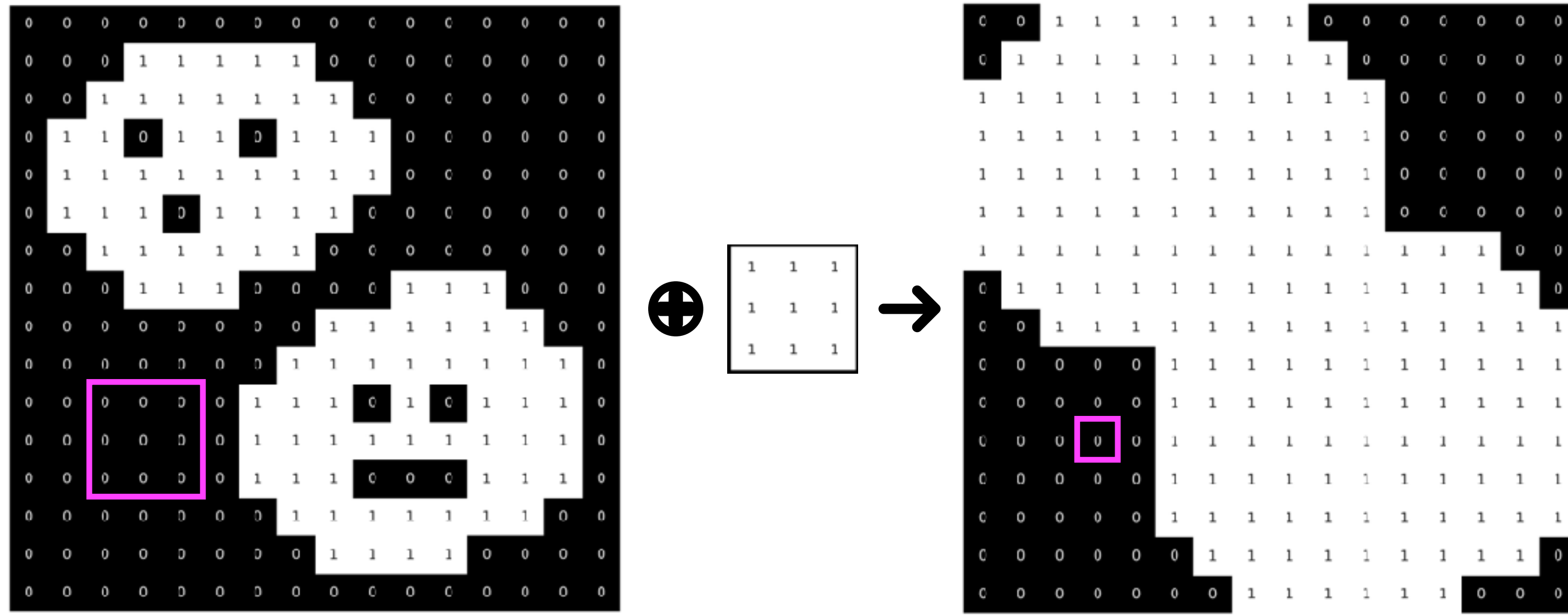




# Dilation Operation

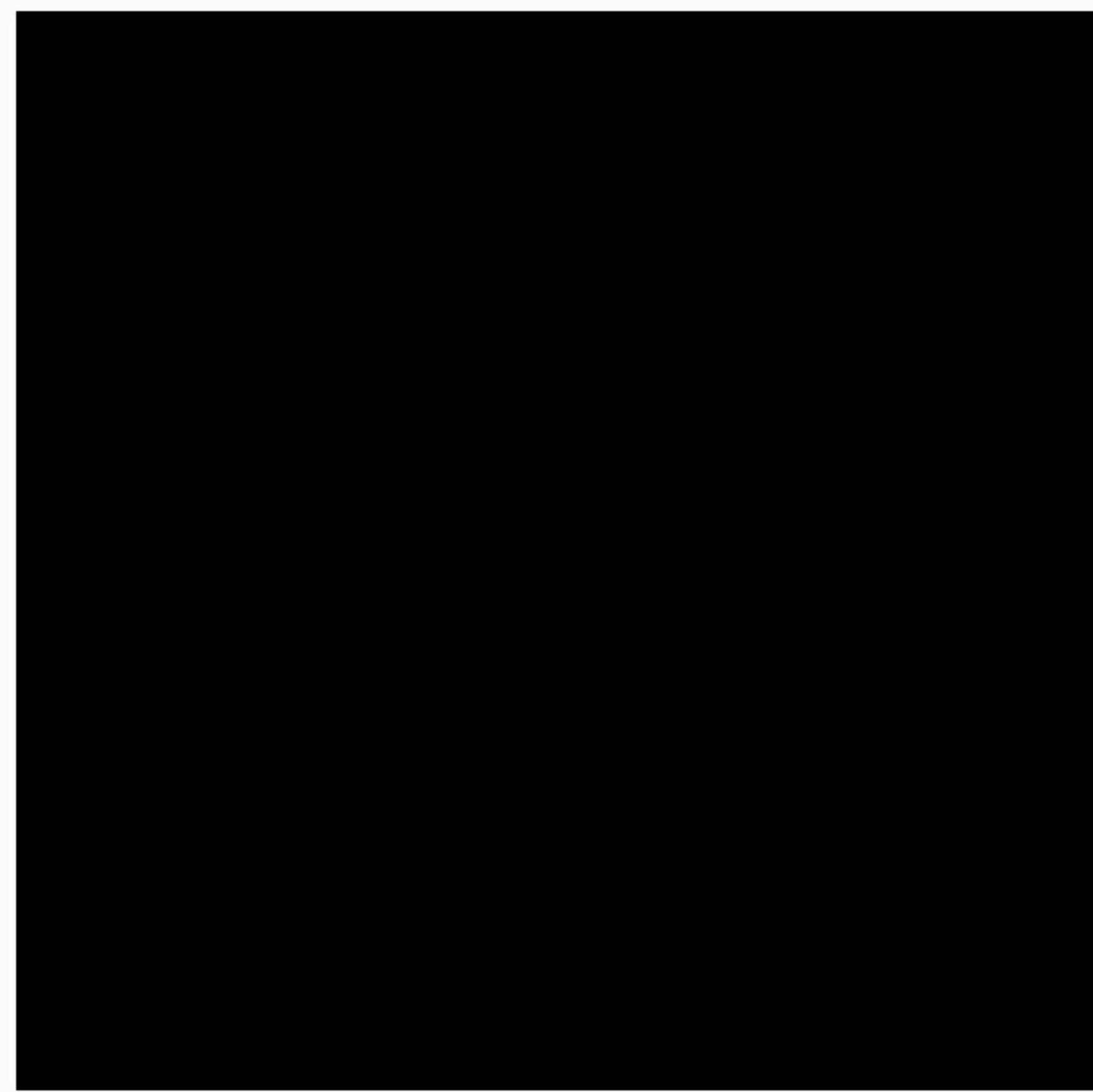
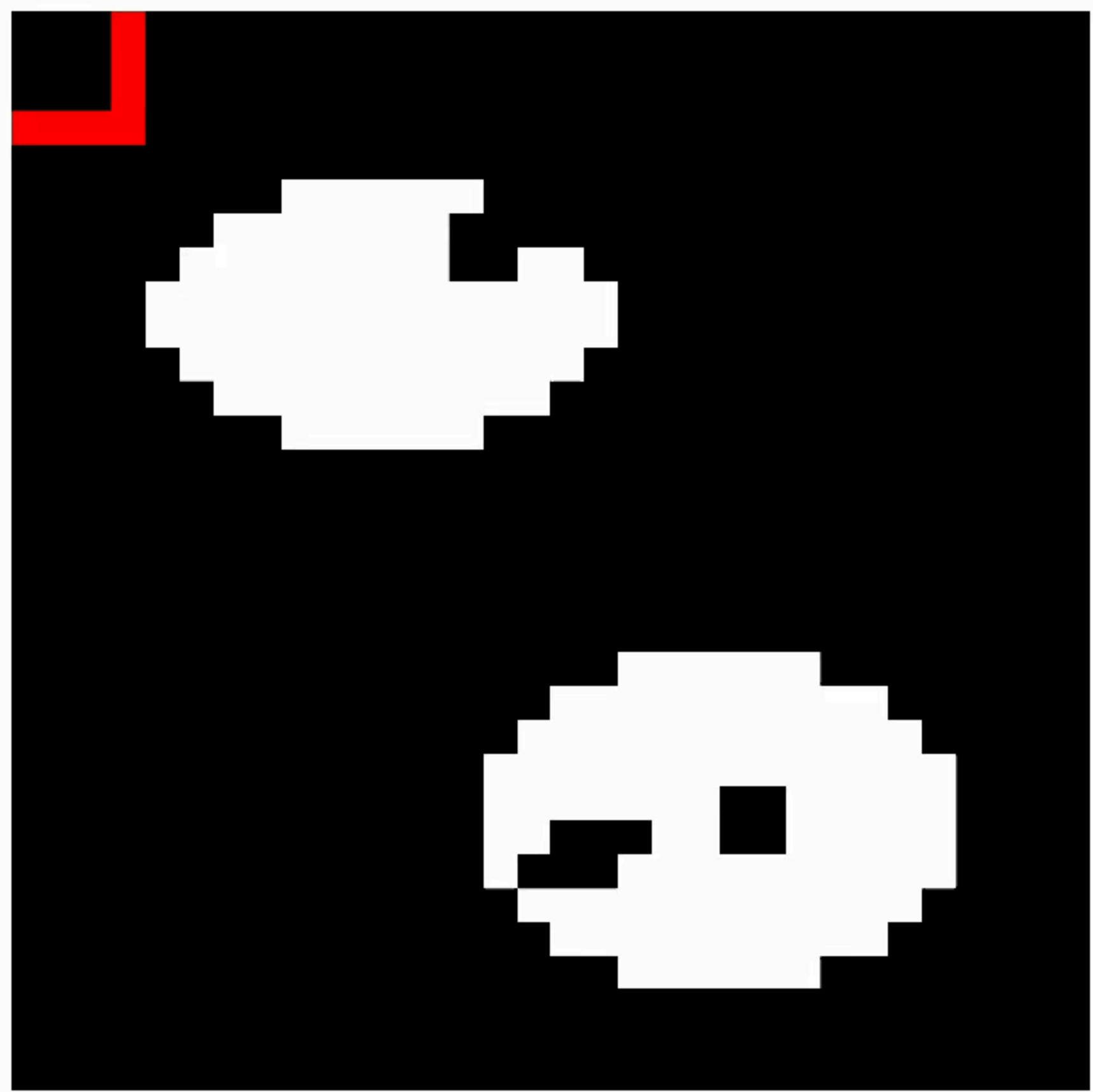


# Dilation Operation





# Dilation - The Movie



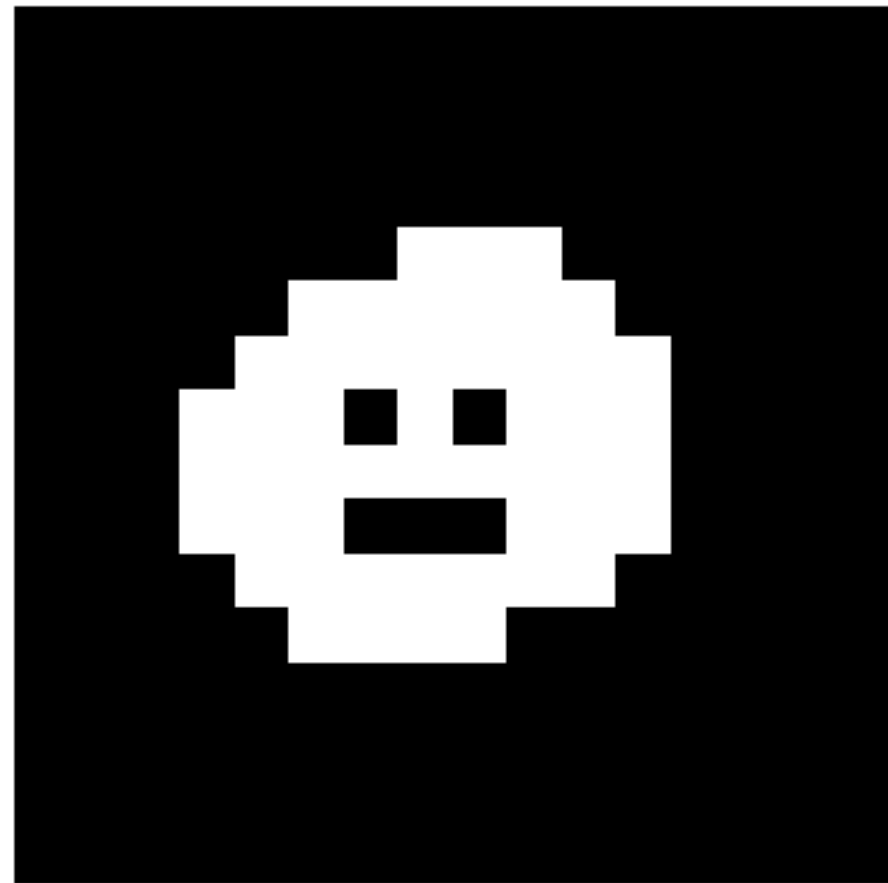
**But wait,  
there is a problem.**



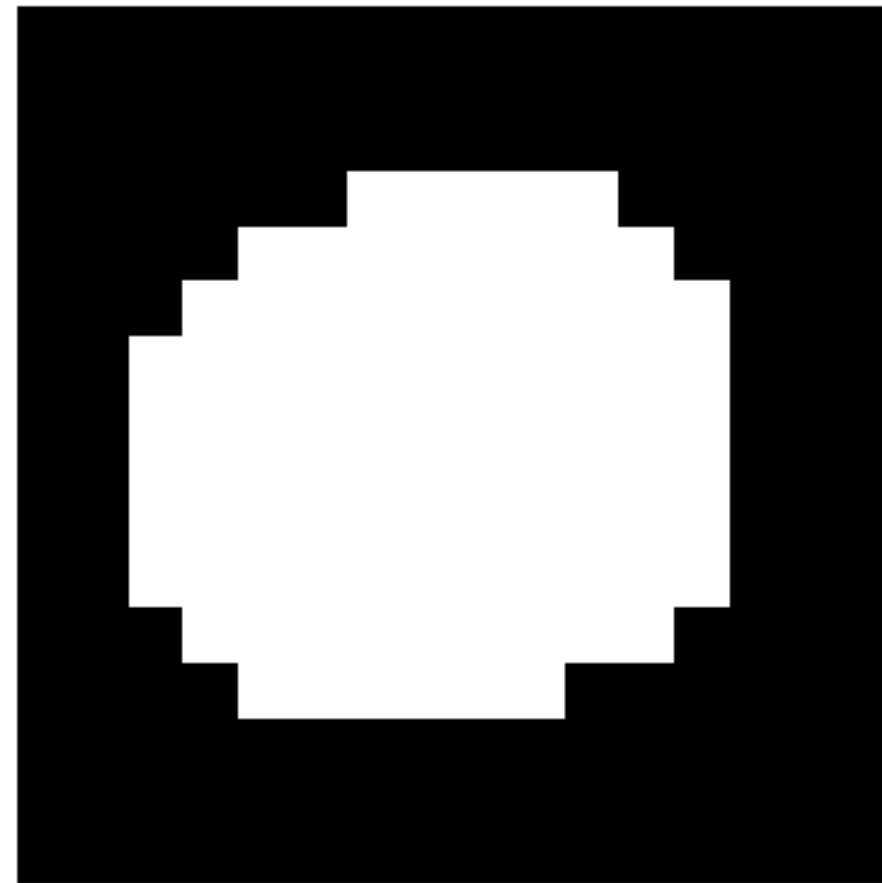


# Together We Stand

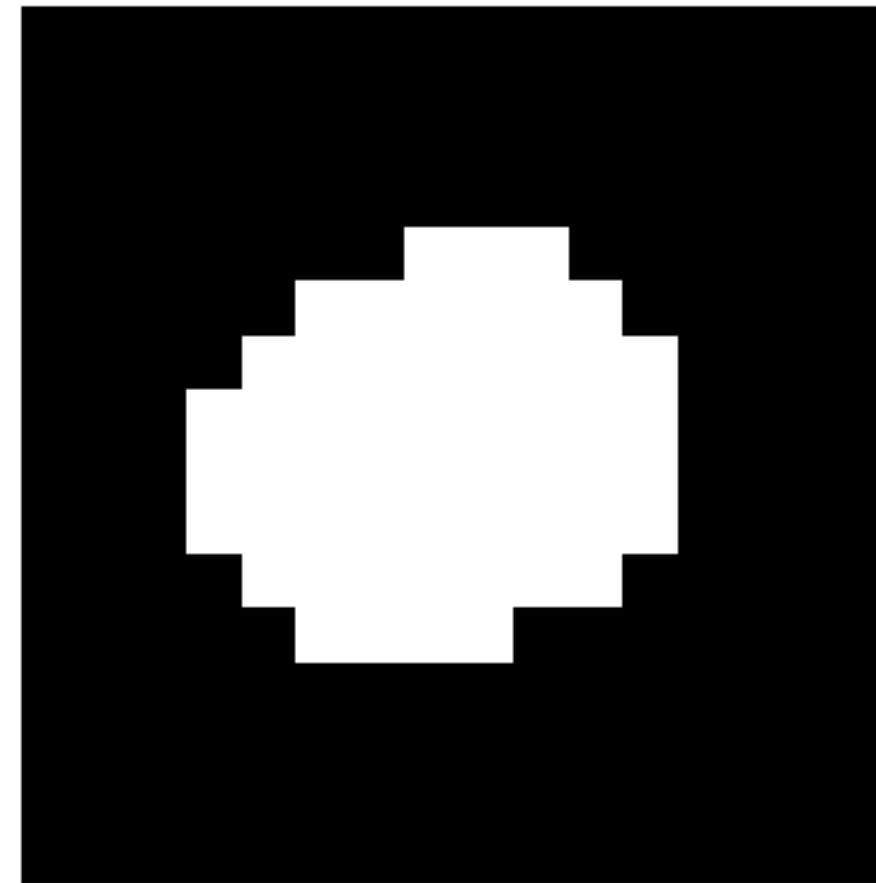
Main image



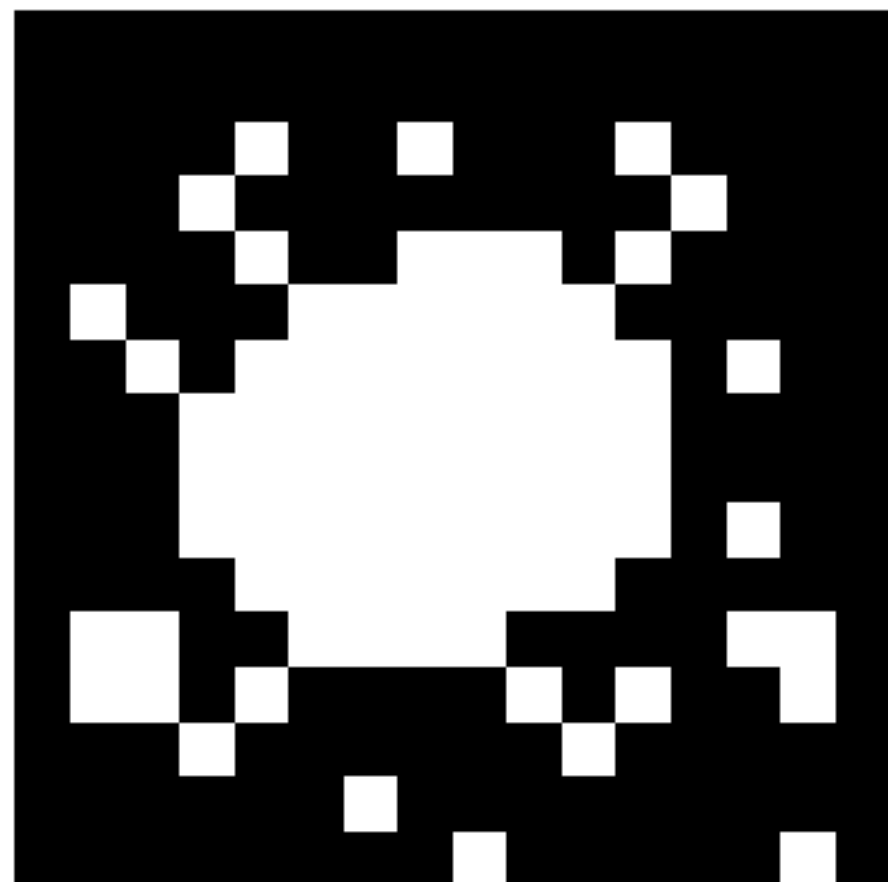
Dilated image



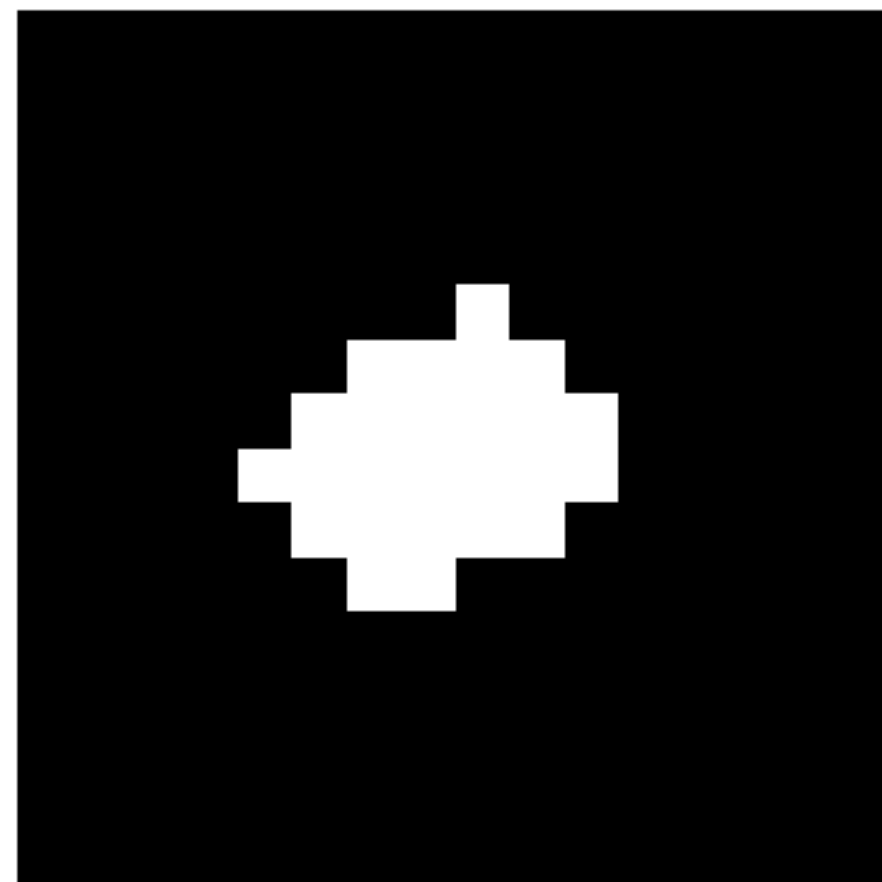
Closed image



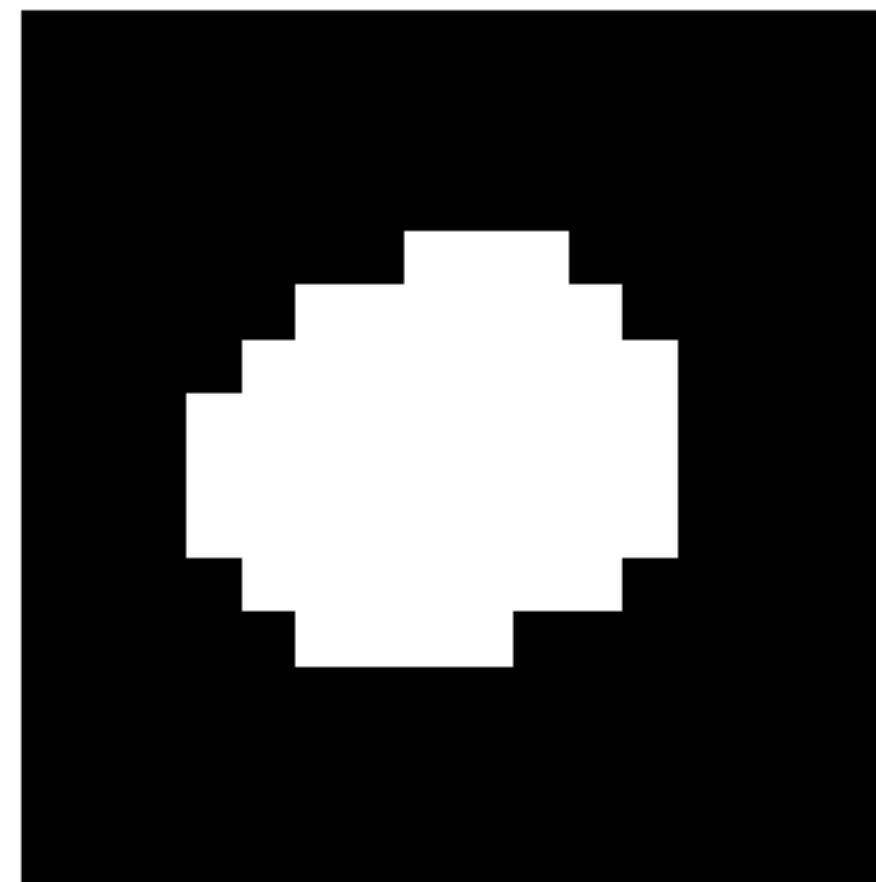
Main image



Eroded image



Opened image



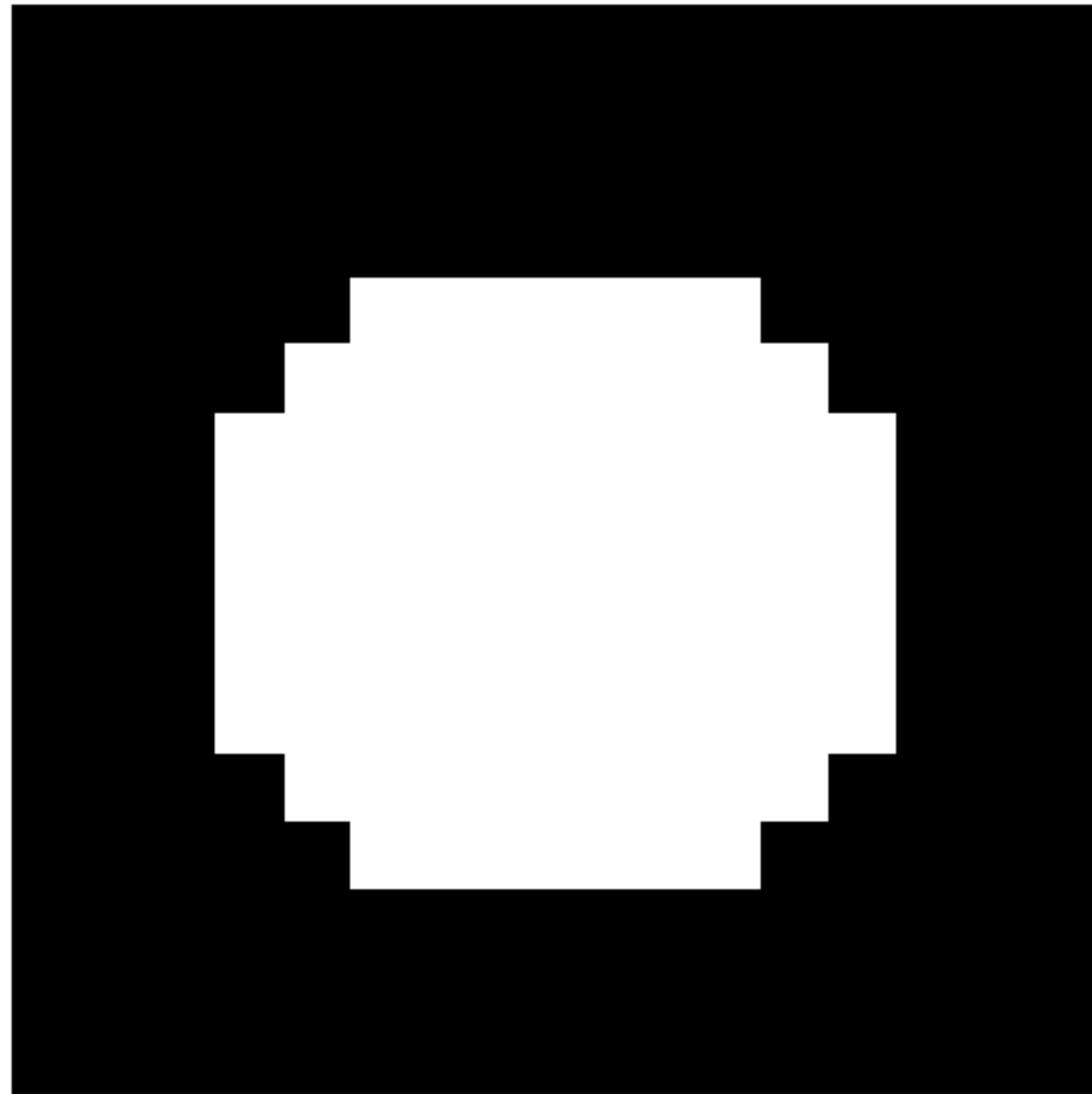
**Closing:**  
Erosion of the dilation.

**Opening:**  
Dilation of the erosion.



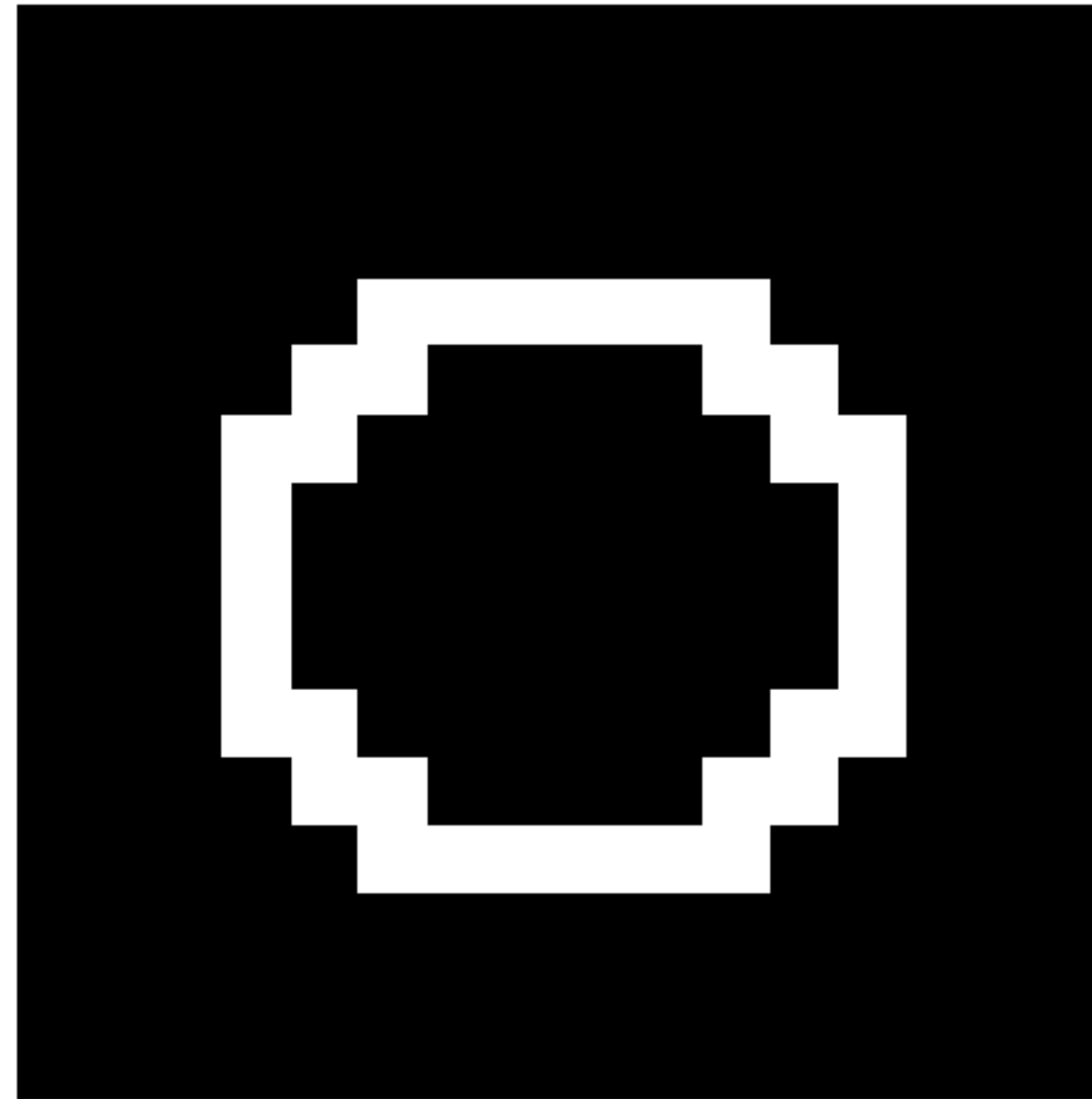
# Bonus Example

**Main image**



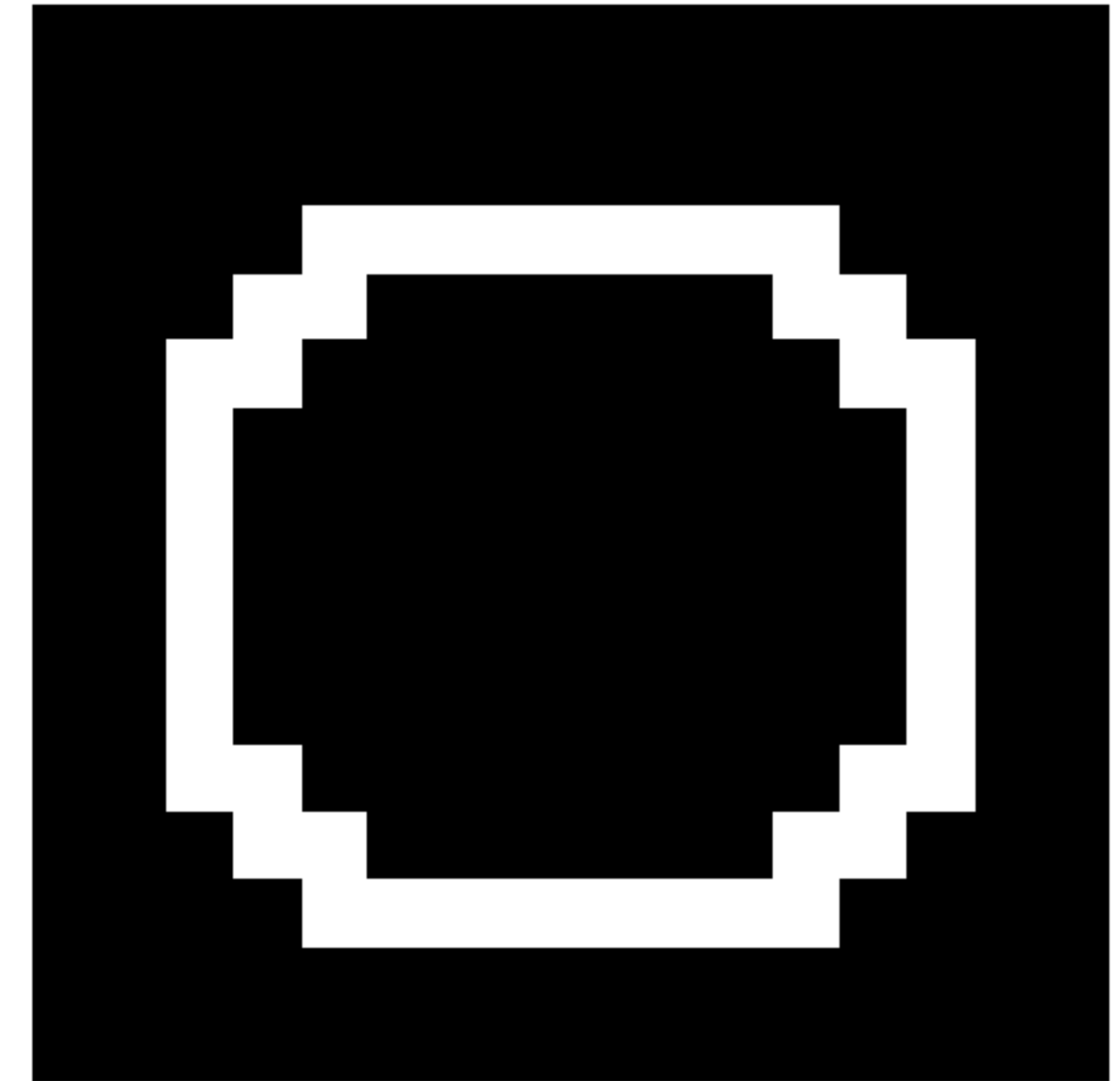
**Inner edge**

Erode more, dilate less, then subtract



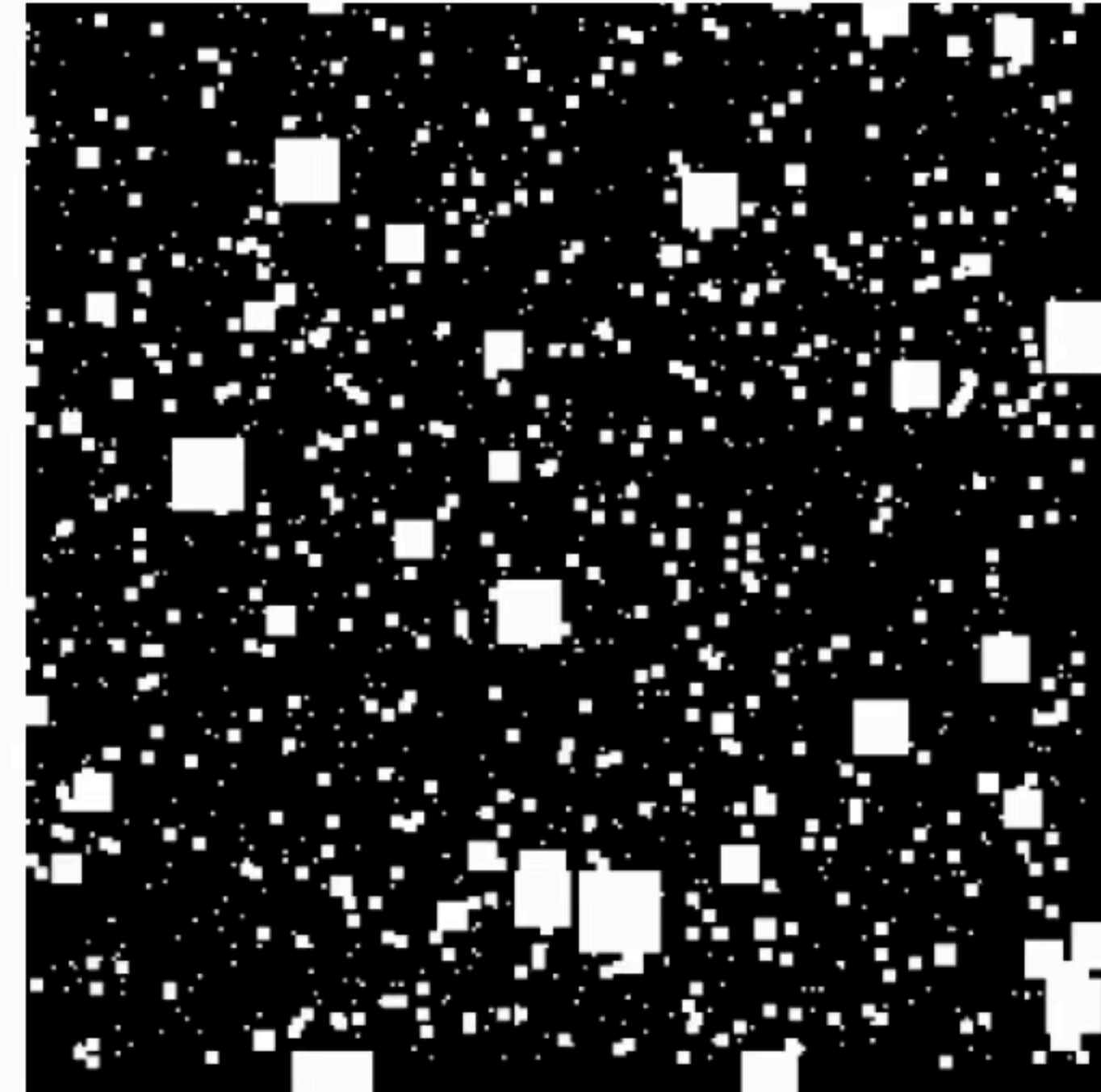
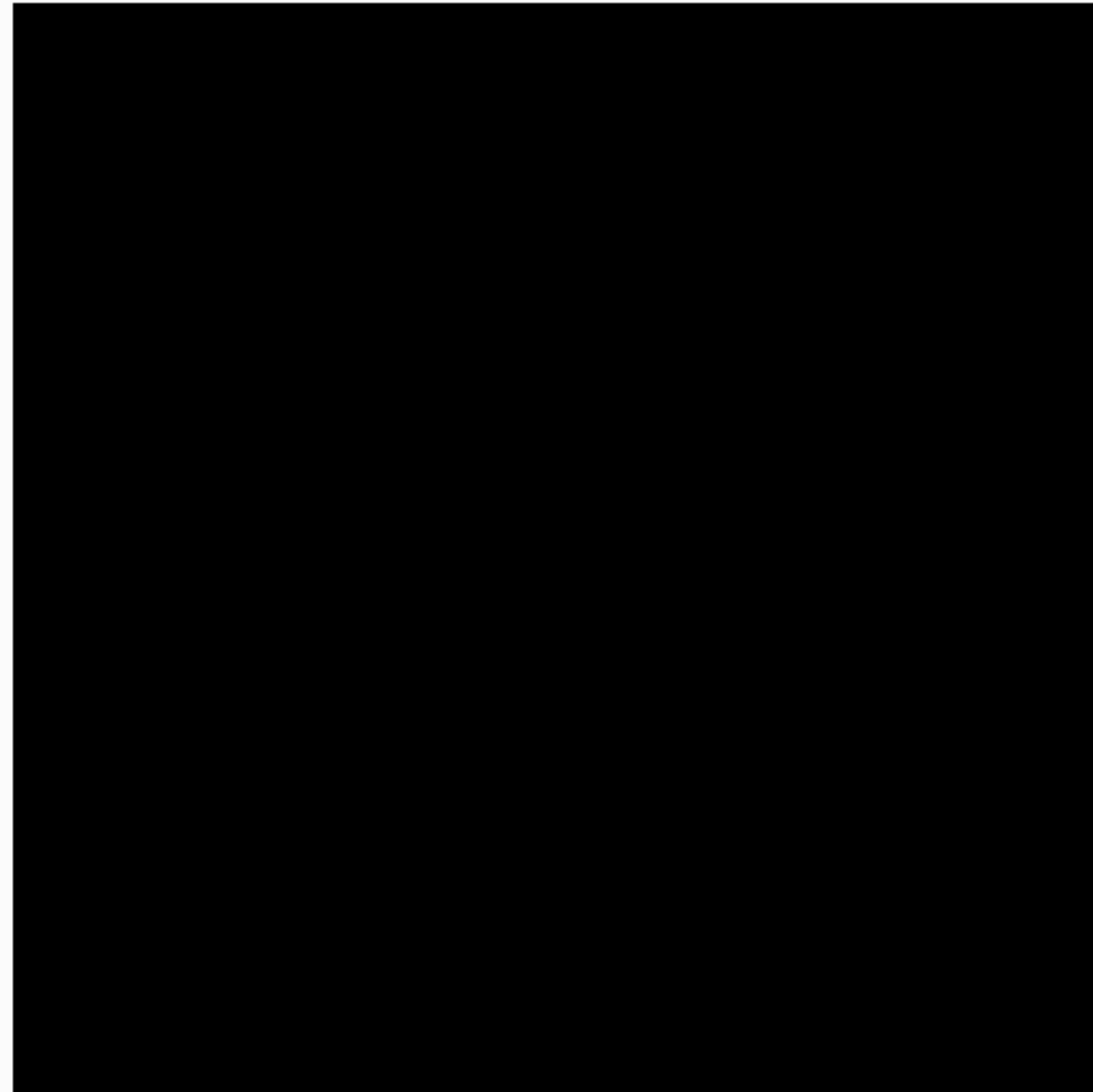
**Outer edge**

Dilate more, erode less, then subtract



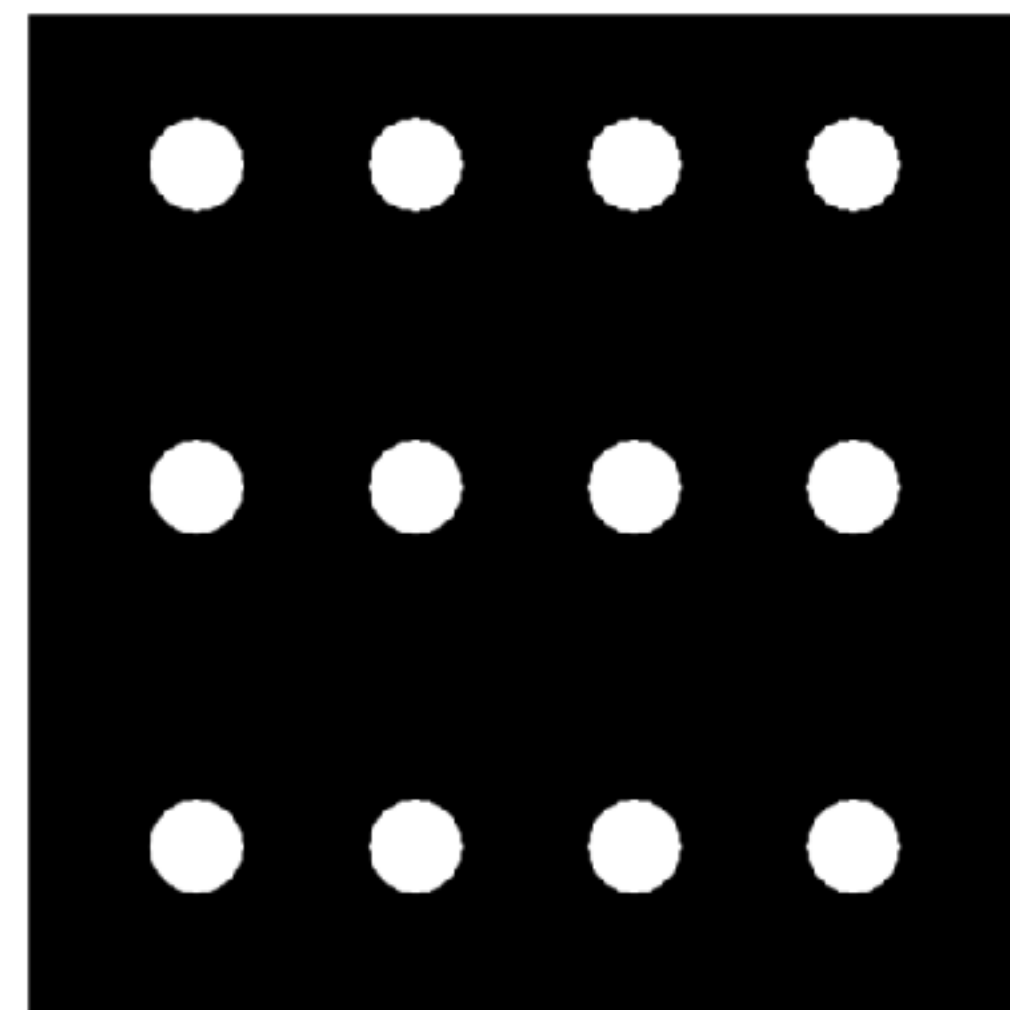
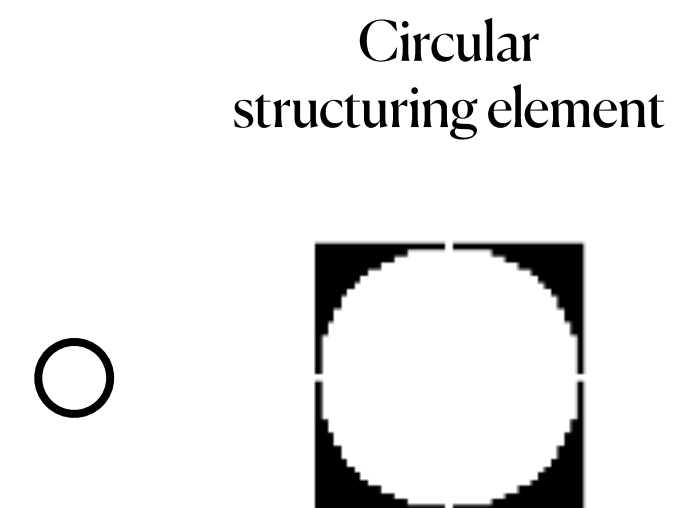
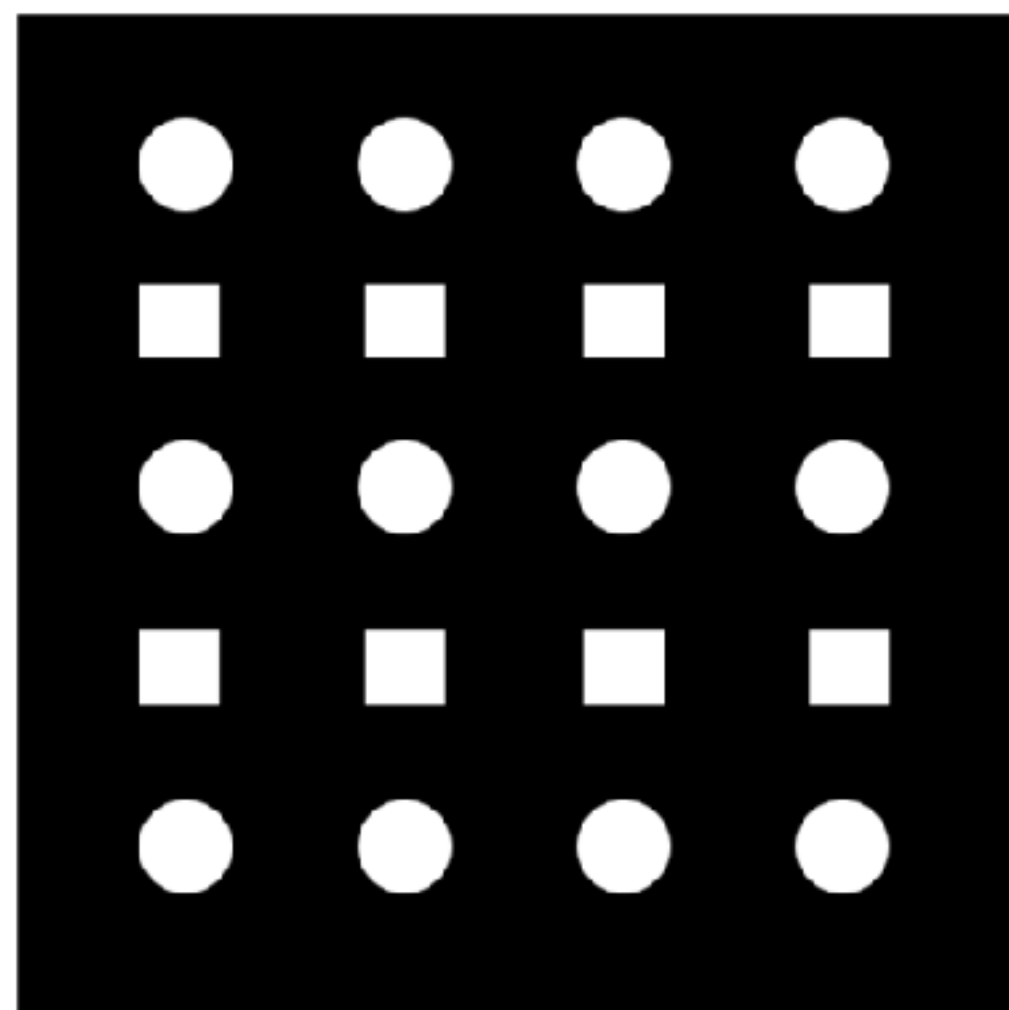
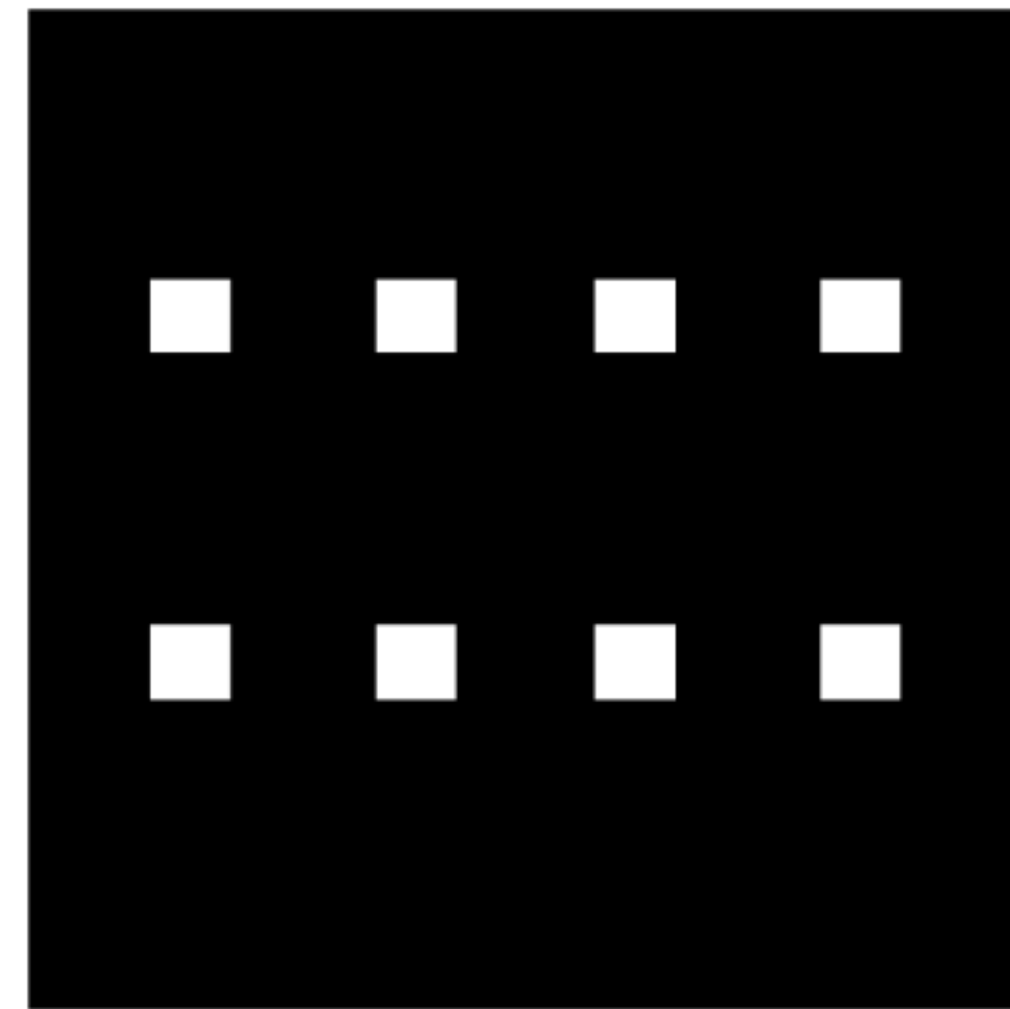
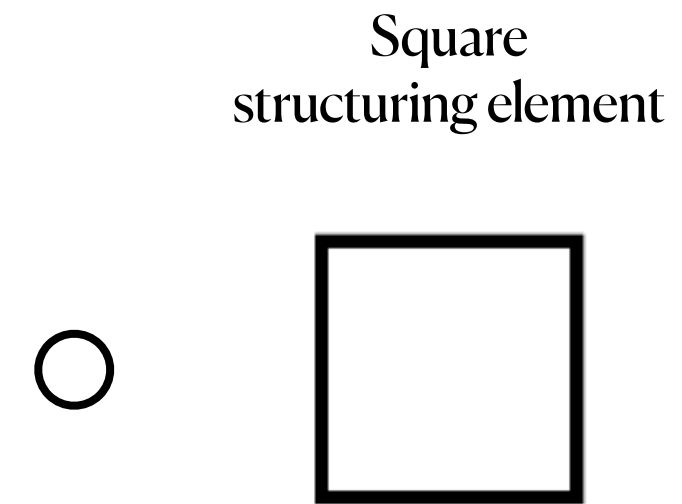
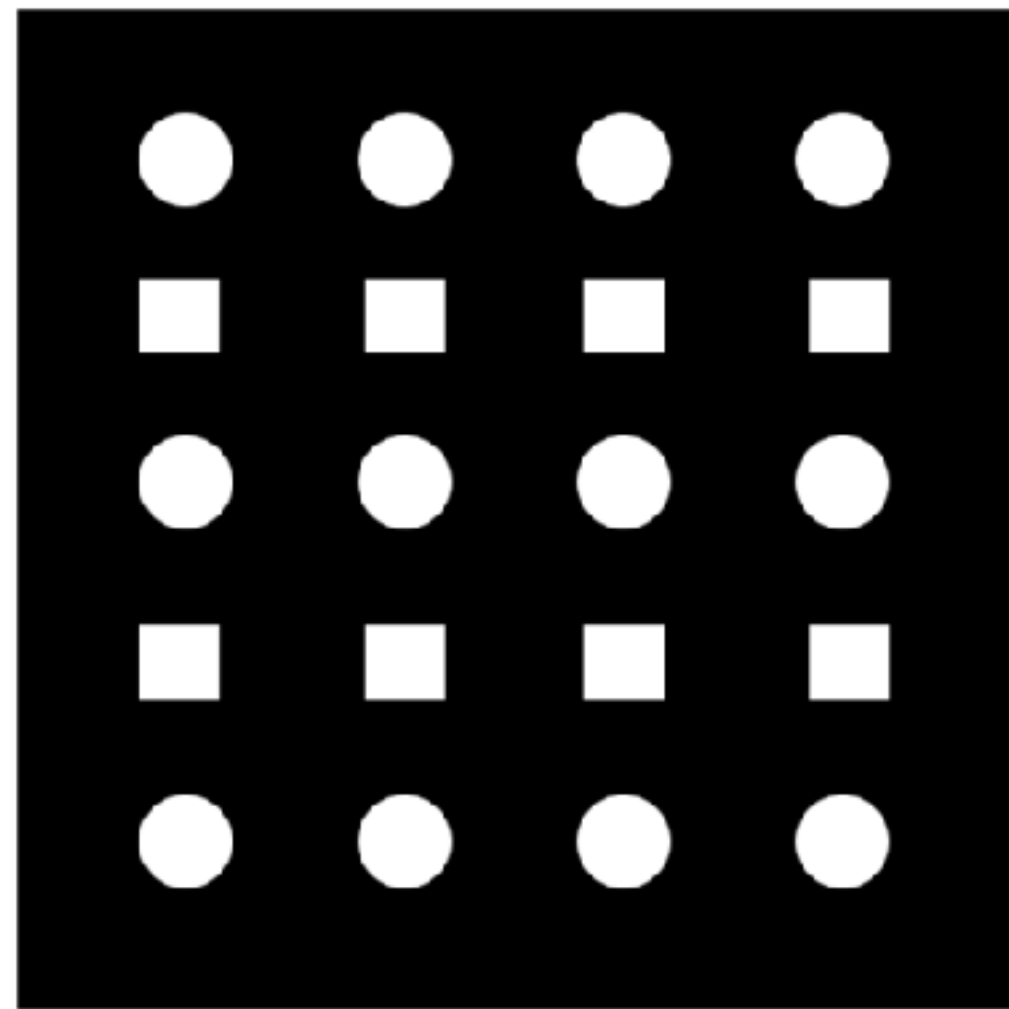


# Structuring Element Size



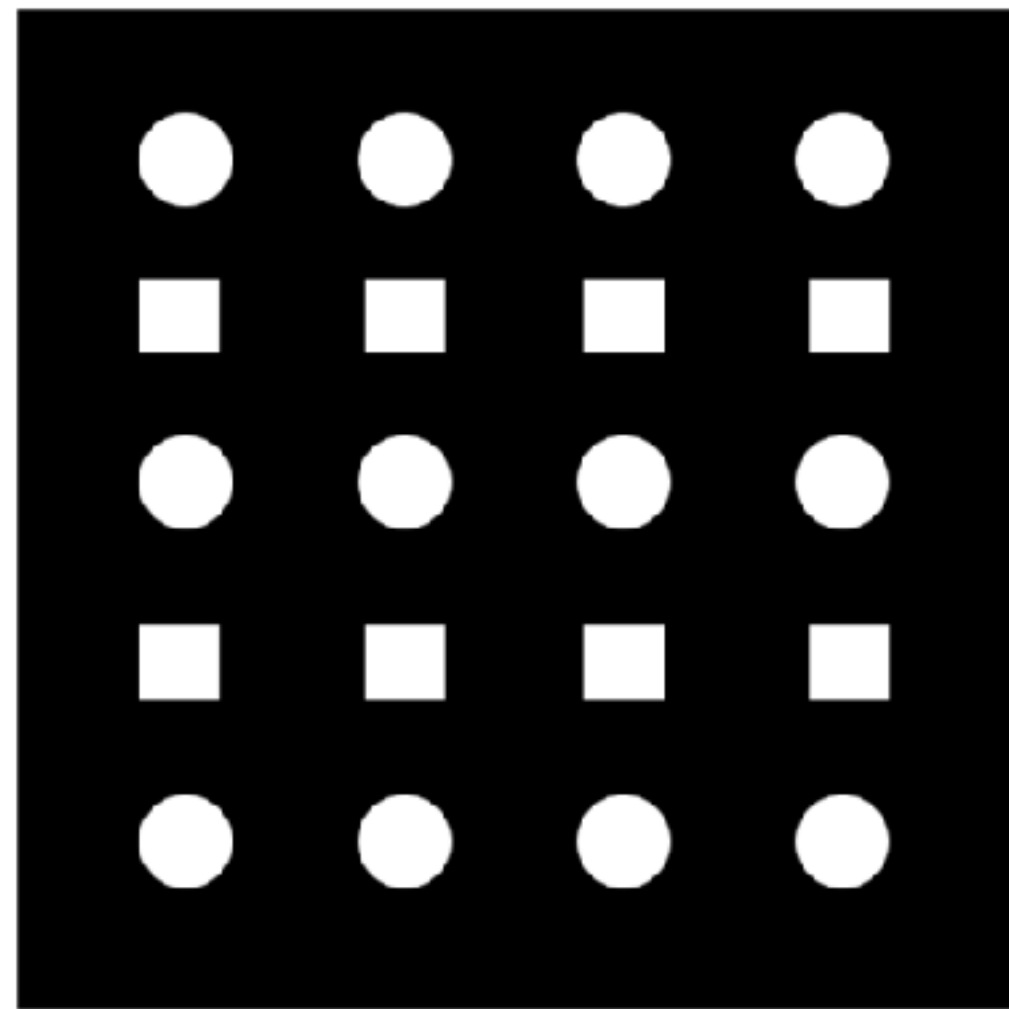


# Structuring Element Shape

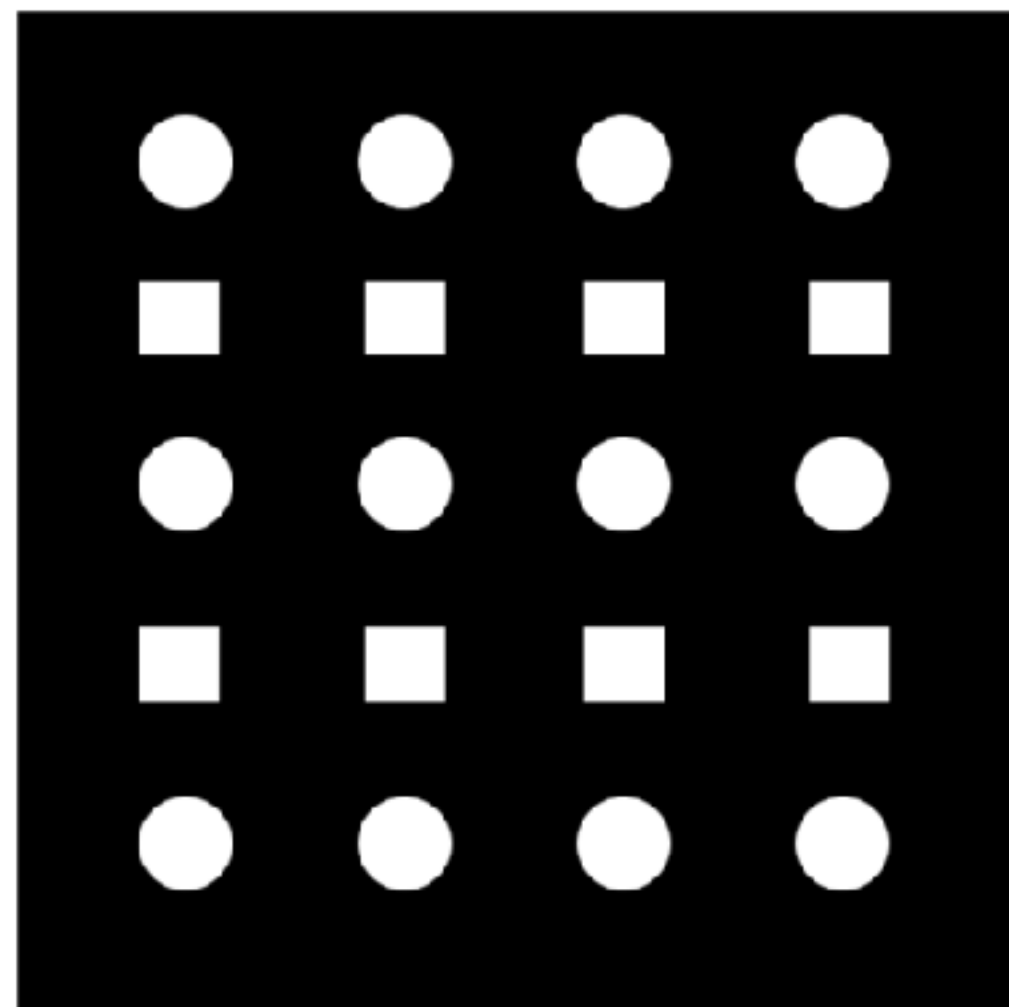
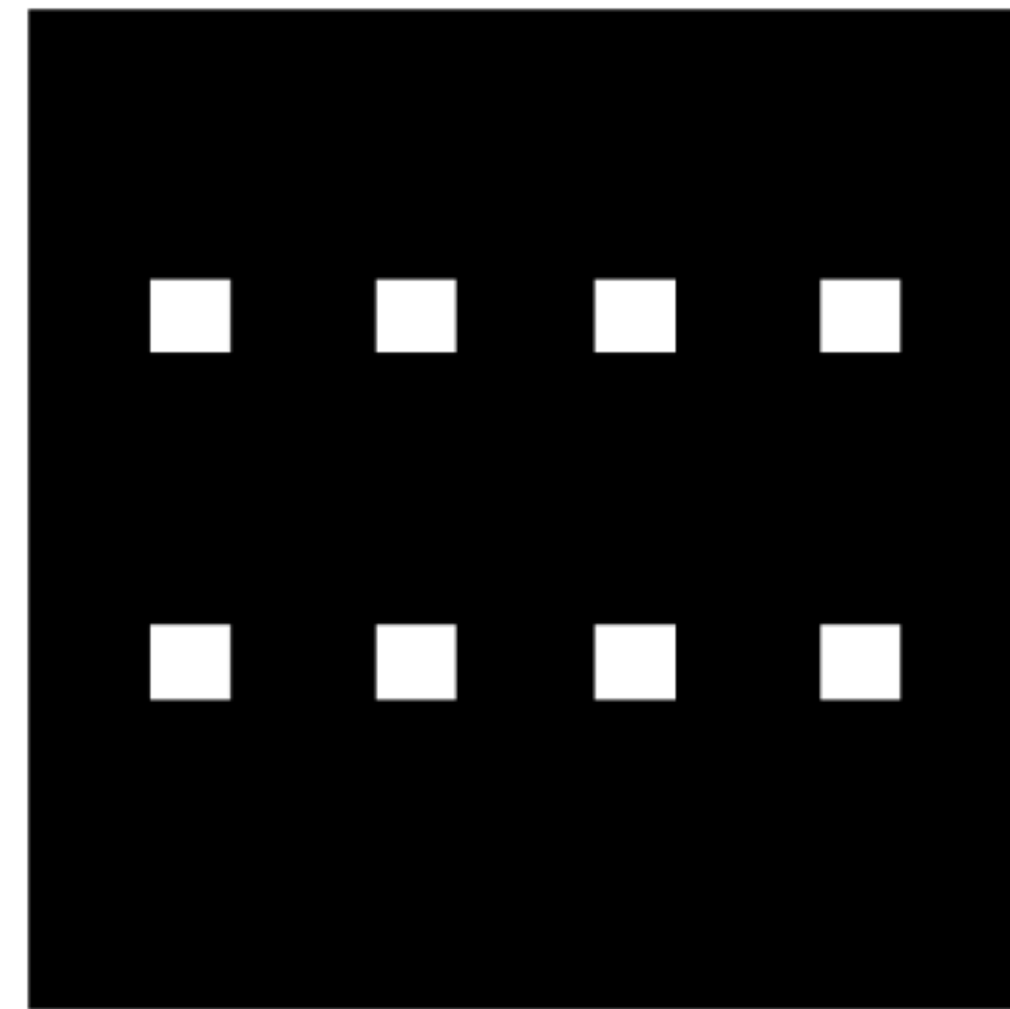
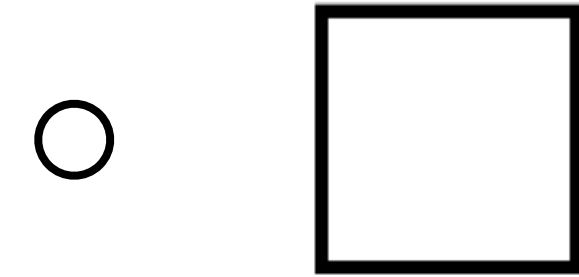




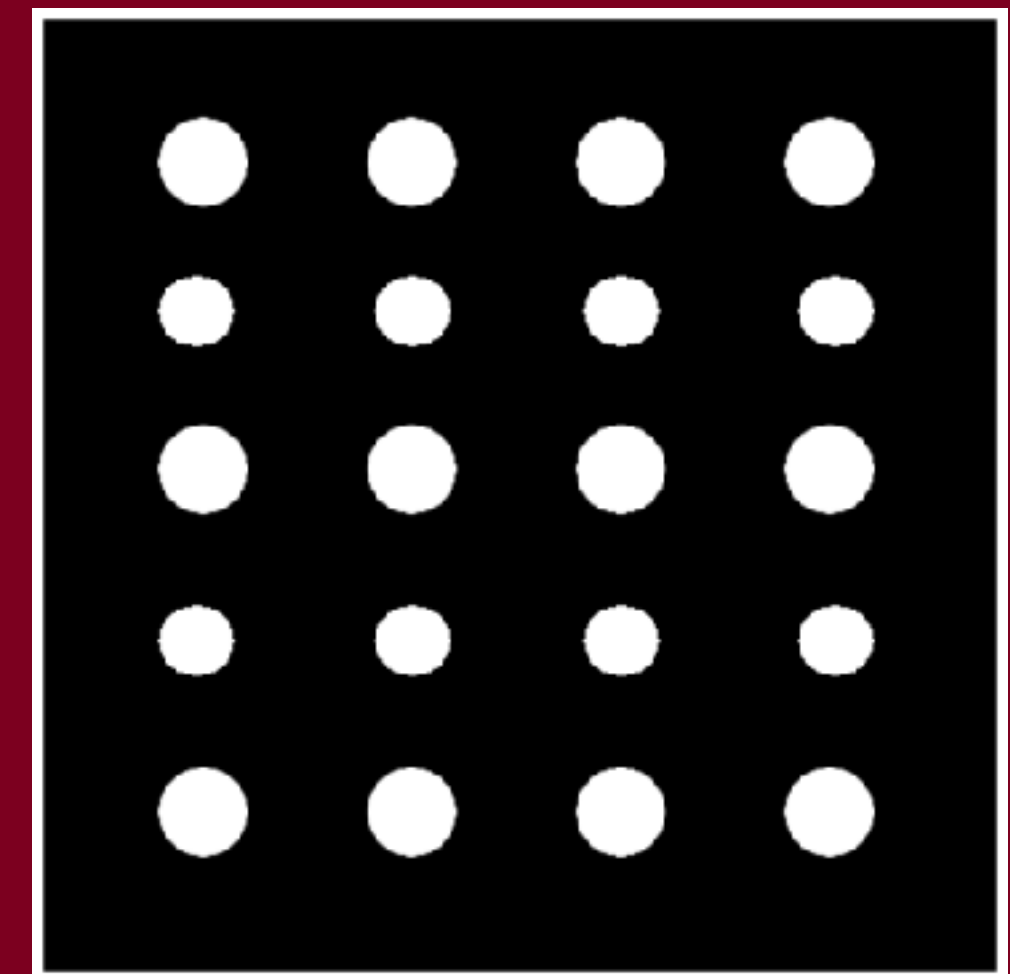
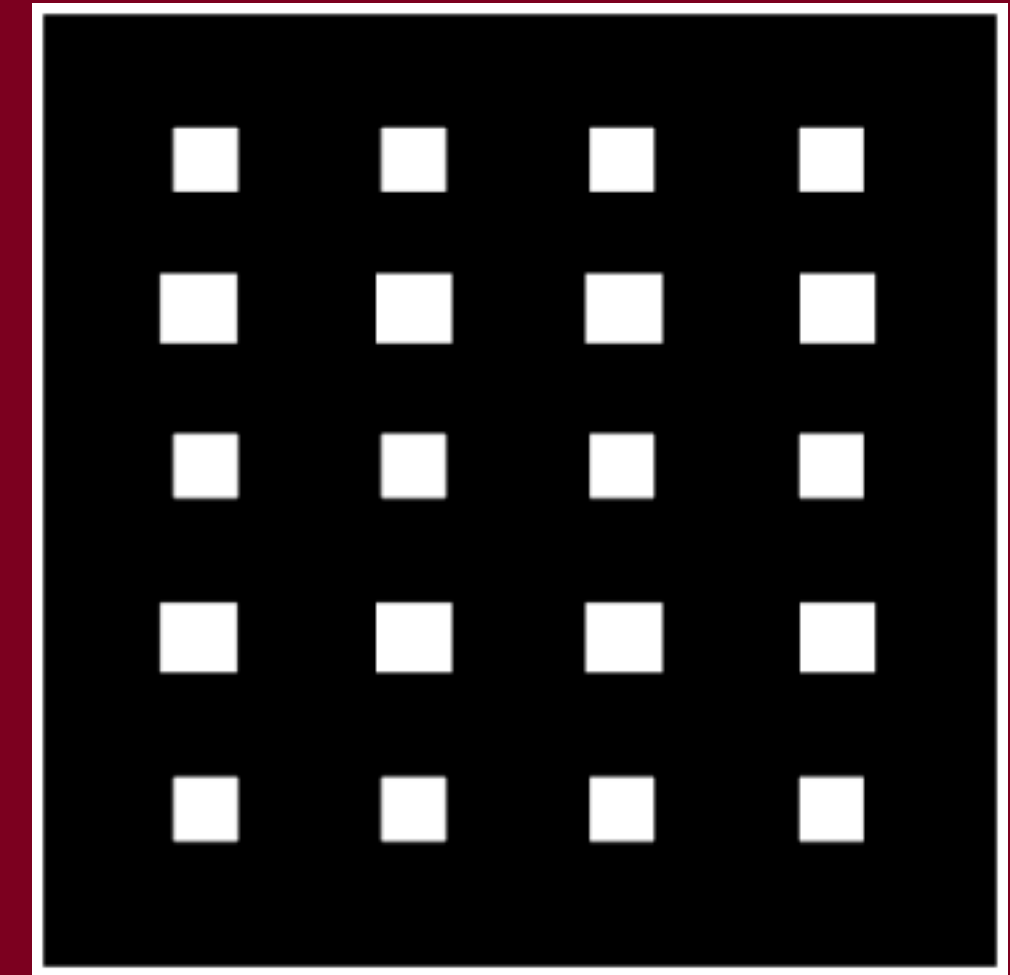
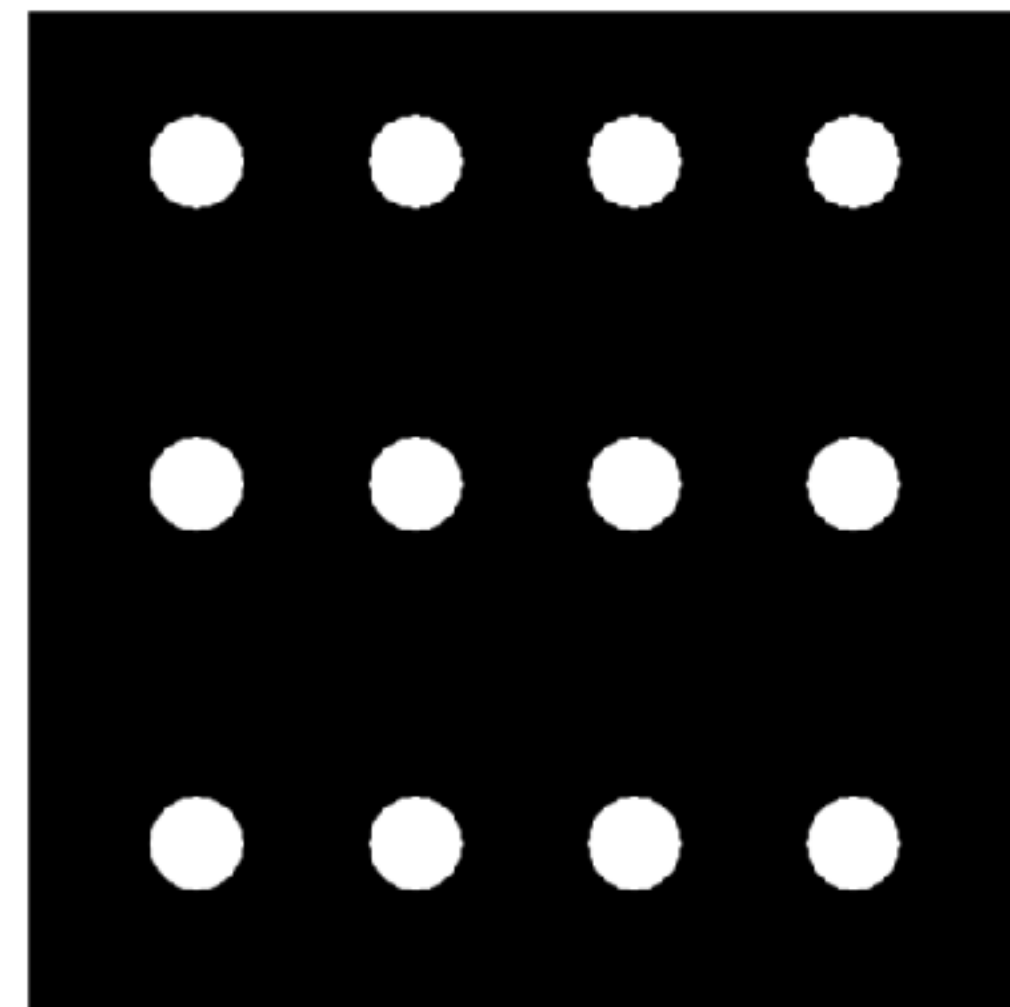
# Structuring Element Shape



Square  
structuring element



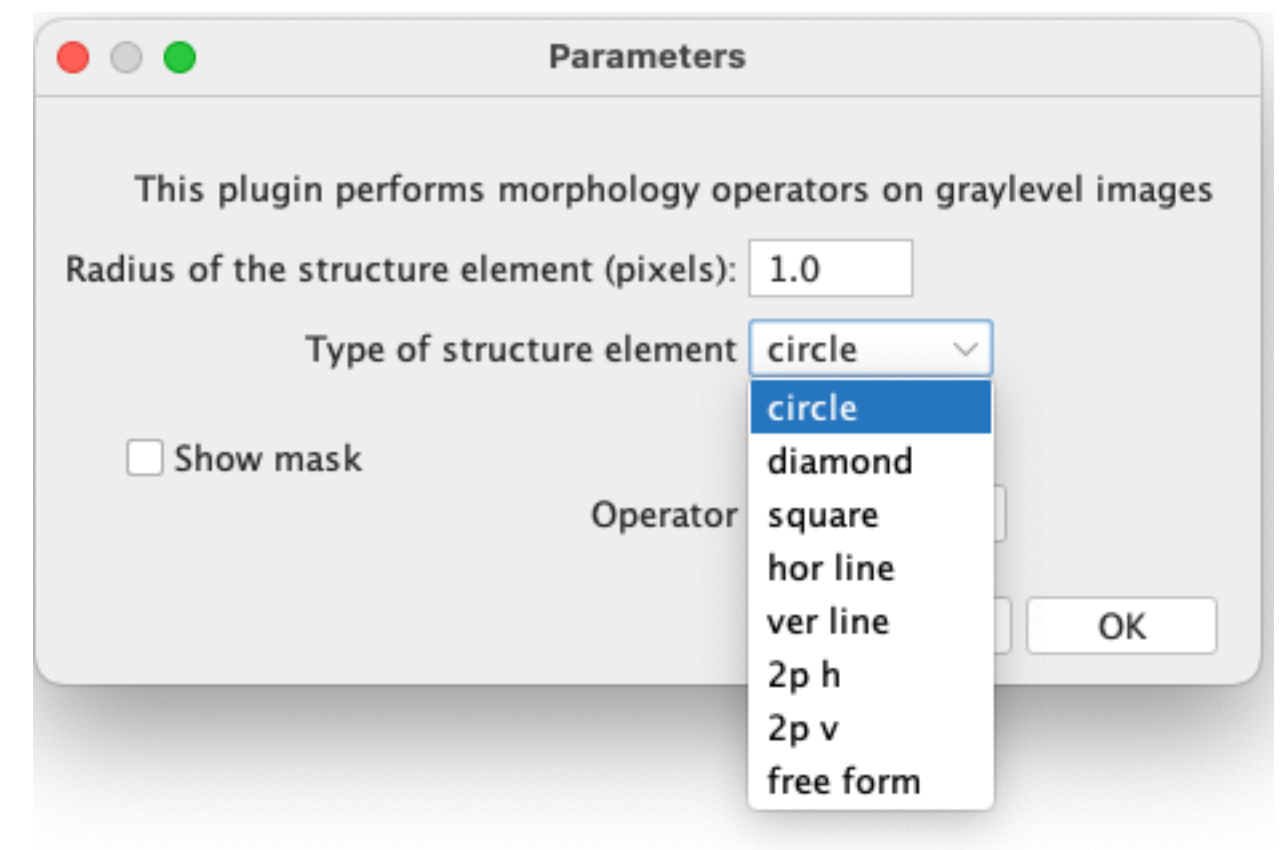
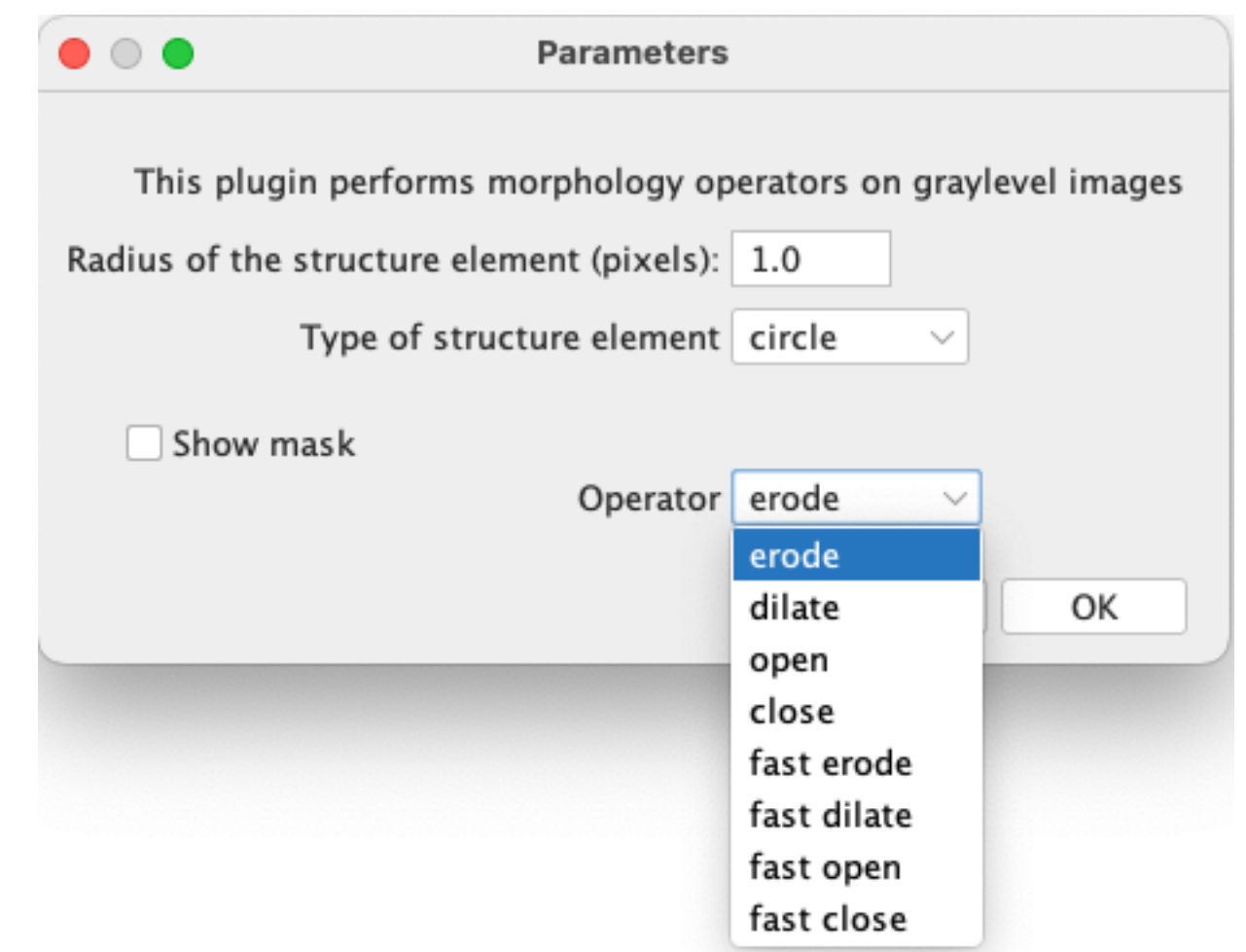
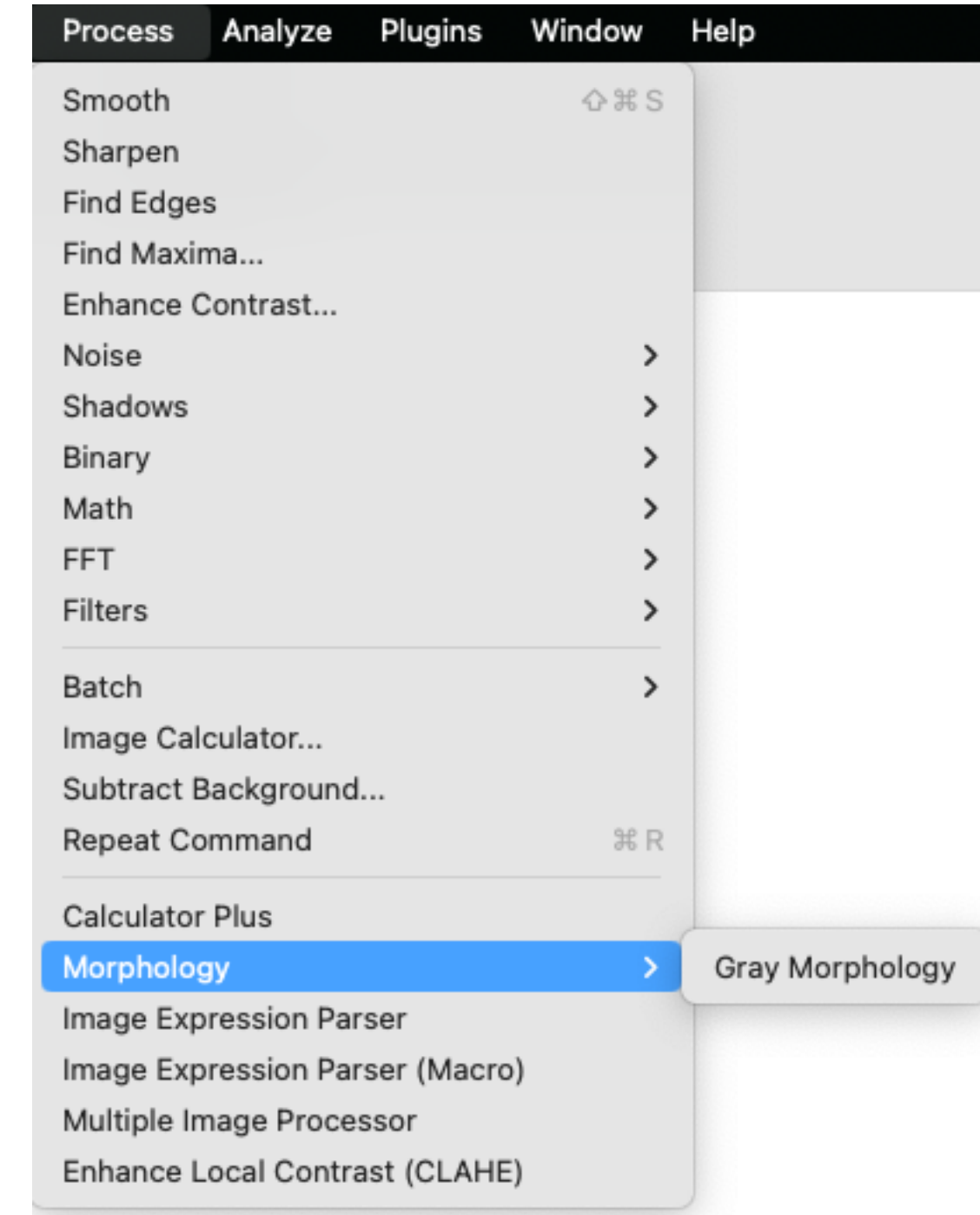
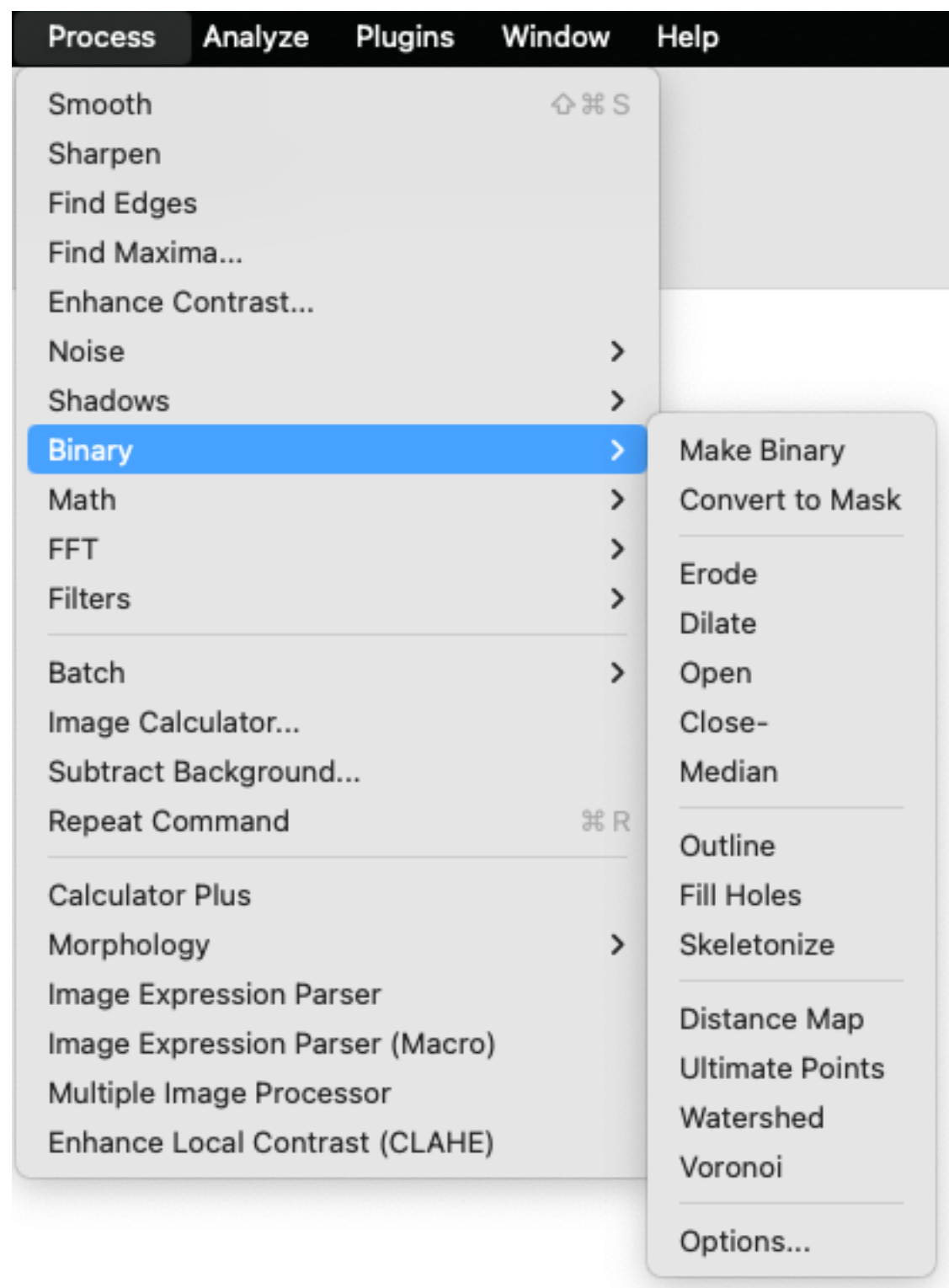
Circular  
structuring element



**BE CAREFUL!**



# Morphology in Fiji



# Morphology — exercises



**3.7 morphological filters 1**  
**3.8 morphological filters 2**



# 3.7 morphological filters

- Open image exercise\_morphology.tif
- duplicate the image 4 times and name each copy as following
  - Eroded
  - Dilated
  - Closed
  - Opened
- Apply binary morphological filters
  - *Process > Binary (Erode, Dilate, Close, Open)*
  - **Note:** Make sure you apply the operation that corresponds to the name of each image.
- **Report findings**



# 3.8 morphological filters

- Open image exercise\_morphology.tif
- Apply Gray Morphological filters:
  - *Process > Morphology > Gray Morphology*
- Apply Image opening with circular structuring element with radius 3 - *removes noise*
- **Report: did it get rid of the noise?**
- Apply Image opening with circular structuring element with radius 5
- **Report: did it get rid of the tentacles from the top-left object?**
- With the line tool, measure the diameter of the holes in the bottom-right object.
- Apply Image closing with circular structuring element with radius slightly larger than the radius
- **Report: did it get rid of the tentacles from the top-left circle?**