

# Lecture 03 - Morphology

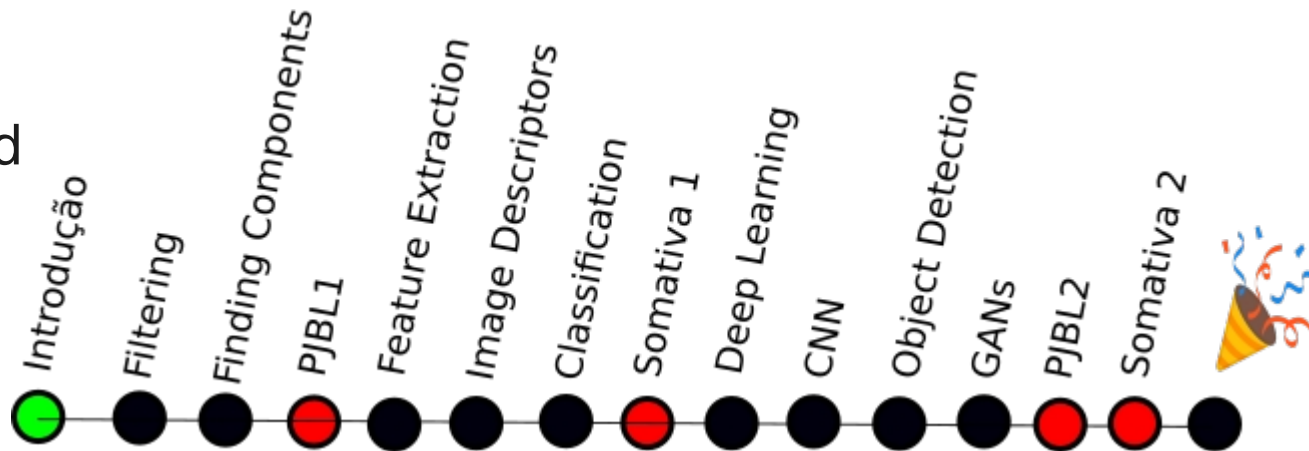
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# Topics

- Discussion of Practice 02
- Mathematical Morphology
  - Structuring Element (or Kernel)
  - Erode /Dilate
  - Open / Close
  - Gradients
  - Watershed
- Practice



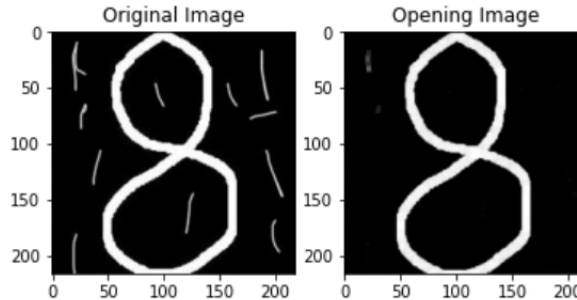
# Mathematical Morphology

- Morphology (Nature): Branch of Biology that study the form and structure of animals and plants
- Morphology (Image Processing): Mathematical operations to extract image components based on pixel neighborhood.
- Increase/Decrease Objects Size. Reduce Noise. Closing or Open (GAPS)



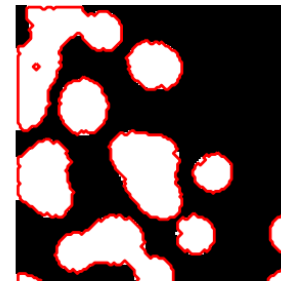
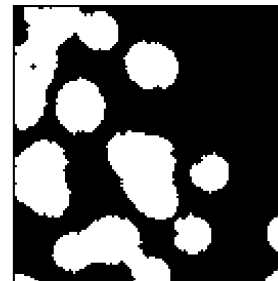
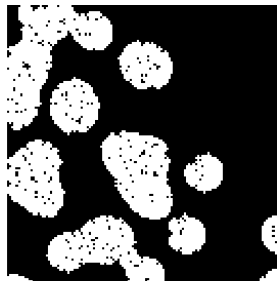
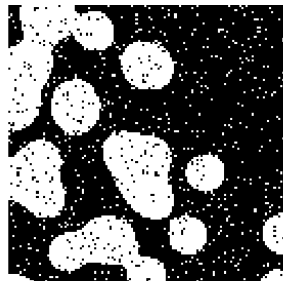
Image after segmentation

Image after segmentation and morphological processing



Original Image

Opening Image



# Structuring Element (Kernel)

- Defines the shape of the structure to be applied
- The structure is slid through the image
- Erosion or Dilate operations are applied
- The origin determines the pixel be changed

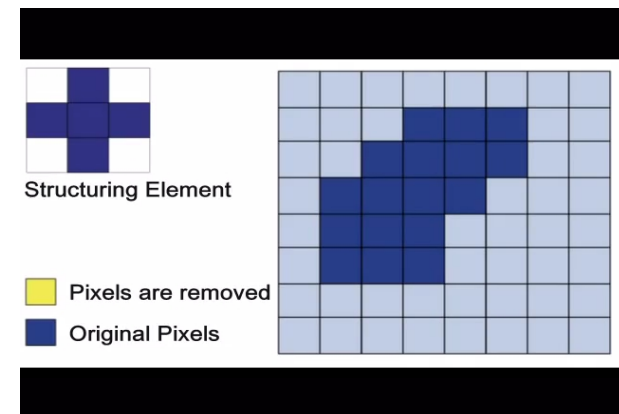
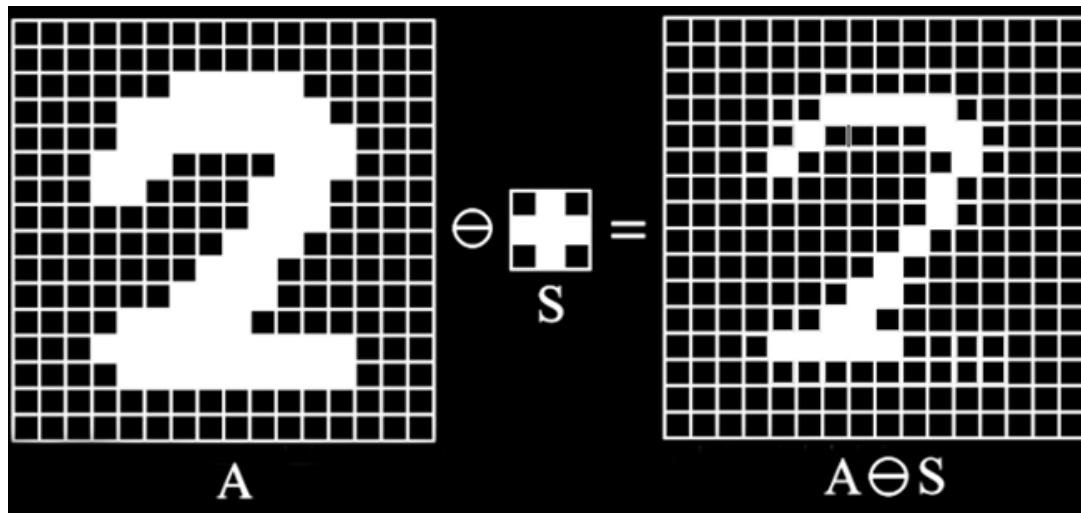
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1	1	1

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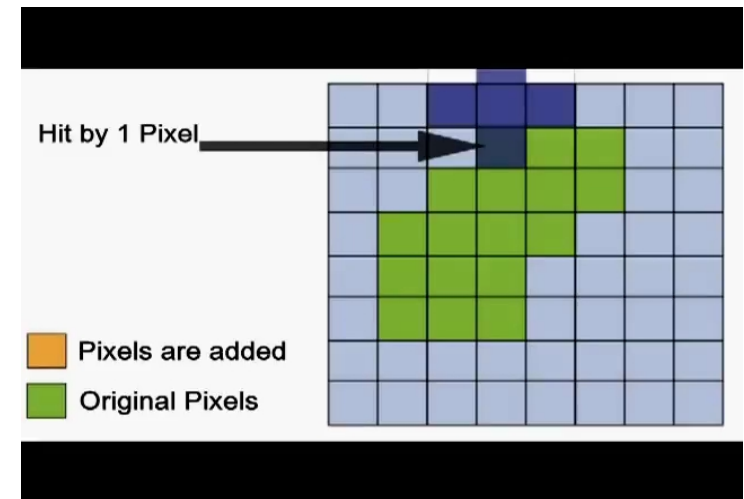
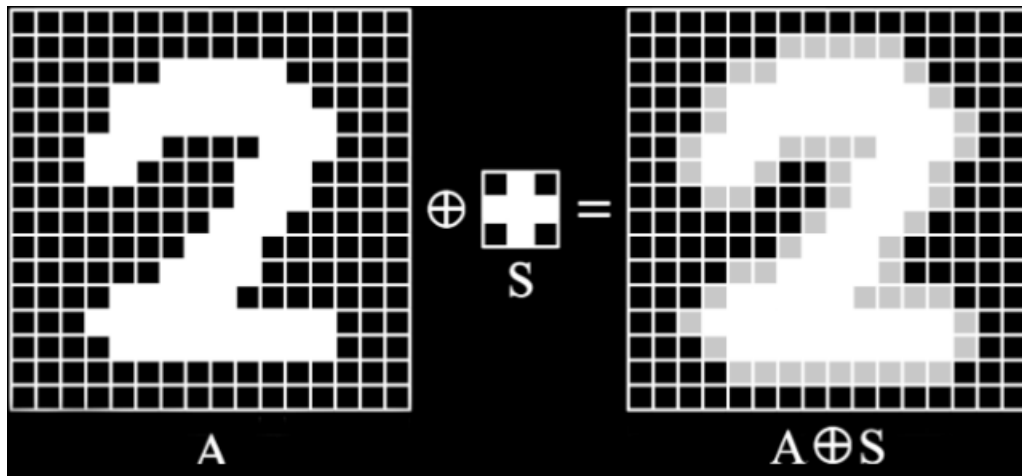
# Erosion

- Moves one's to zero's
- Binary 'AND' Operation
- Reduces Noises and Contours



# Dilation

- Moves zero's to one's
- Binary 'OR' Operation
- Increases Objects, connects contours, and fill holes.



# Opening and Closing

- Combined morphological operations that preserve the shape and size of large objects in the image

- Opening: Erode + Dilate
  - Removes small objects, noises, and thin lines



- Closing: Dilate + Erode
  - Fill small holes and connect segmented contours

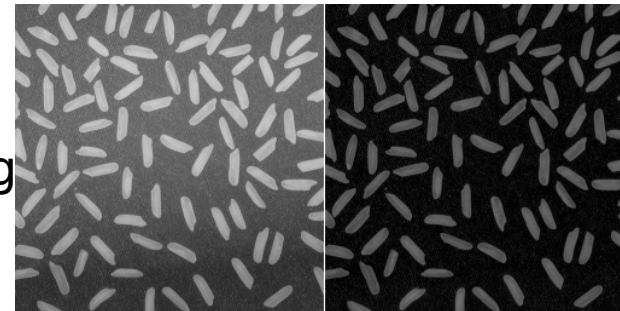


# Others Morphological Operations

- Gradient: Dilate - Erosion
  - Outline de Object



- TopHat: Open - Original Image
  - Reduce the effect of brightness change
  - Isolates brightness objects





# Let's code!

- [Link: Morphology Operators](#)