# Morphological Transformations

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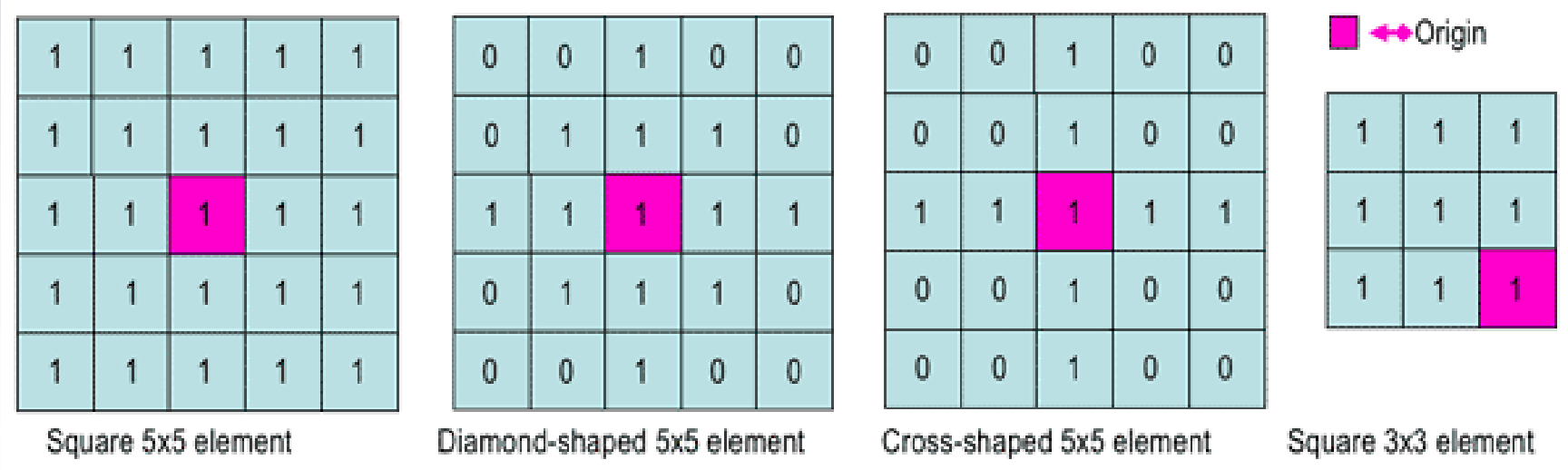
# Terms

- Morphological Image Processing
  - Collection of non-linear operations related to the shape of the  shape or morphology of  features in an image.
- Binary Image
  - Images whose pixel values have only two possible values (1 or 0)

# Terms

- Structuring element
  - A small binary image .
    - The matrix dimension specify the size of the structuring element.
    - The pattern of ones and zeroes specifies the shape of the structuring element.
    - The origin of the structuring element is usually one of its pixels , although generally the origin can be outside the structuring element

# Terms



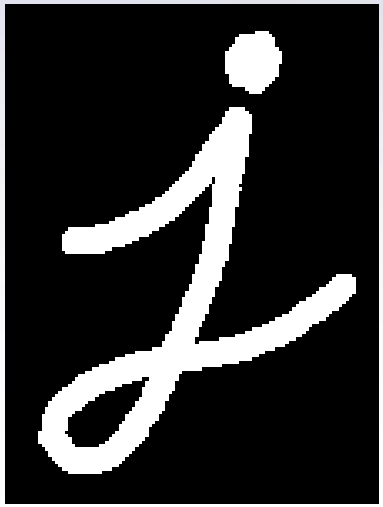
# Morphological Transformations

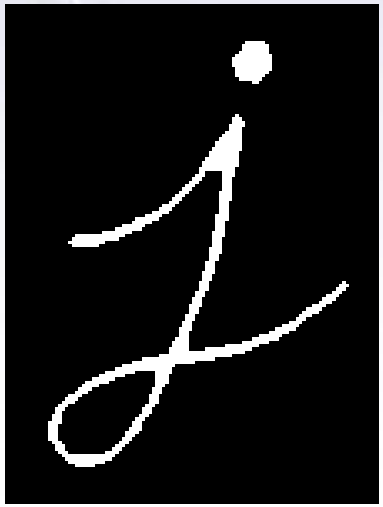
- Morphological transformations are some simple operations based on the image shape.
- It is normally performed on binary images.
- It needs two input, one is the original image and the other is the structuring element or kernel which decides the nature of operation.
- Two basic morphological operations are erosion and dilation.

## Erosion

- It erodes away the boundaries of foreground object.
- Always try to make the foreground white.
- A pixel in the original image will be considered as 1 only if all the pixels under the kernel is 1, otherwise it is eroded( made to zero).
- It is useful for removing small white noises.

# Erosion

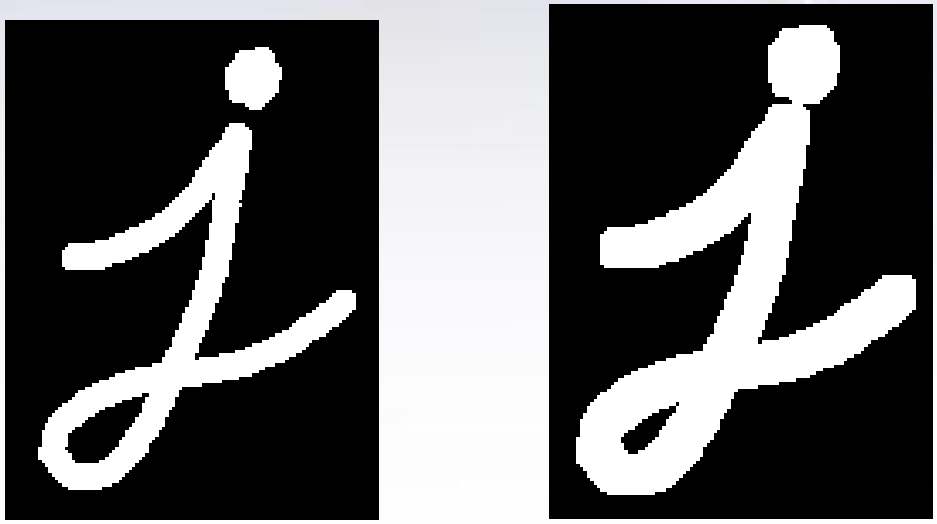




# Dilation

- The  opposite of erosion.
- A pixel element is “1” if at least one pixel under the kernel is 1.
- It increases the white  region in the  image or size or size of the foreground object increases.
- Normally in case of noise removal, erosion is followed by dilation.

# Dilation

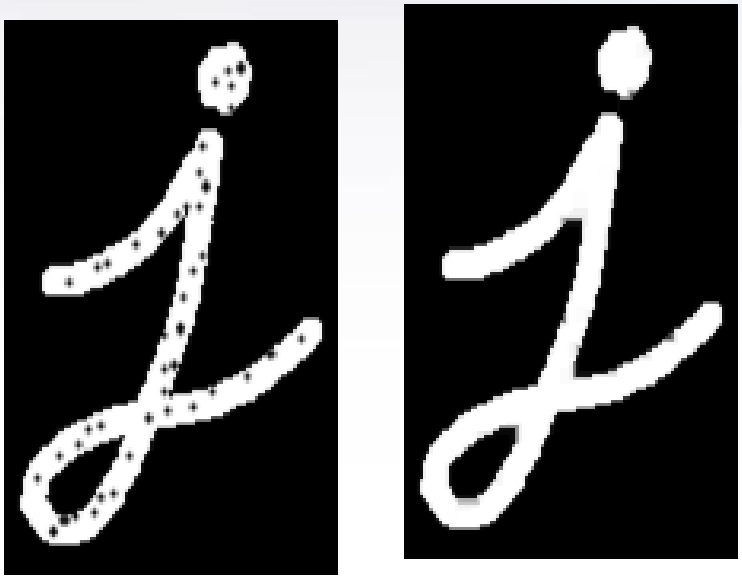


# Opening

- It is just another name for erosion followed by dilation.
- It is useful in removing noise.

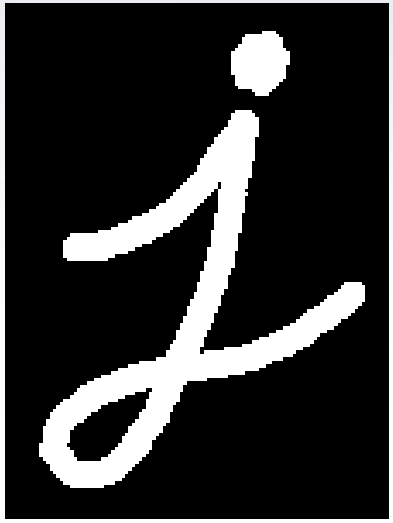
# Closing

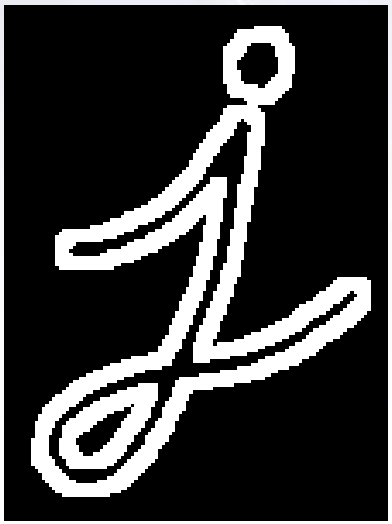
- Dilation followed by erosion.
- It is useful in making small holes inside the foreground objects or small black points on the object.



# Morphological Gradient

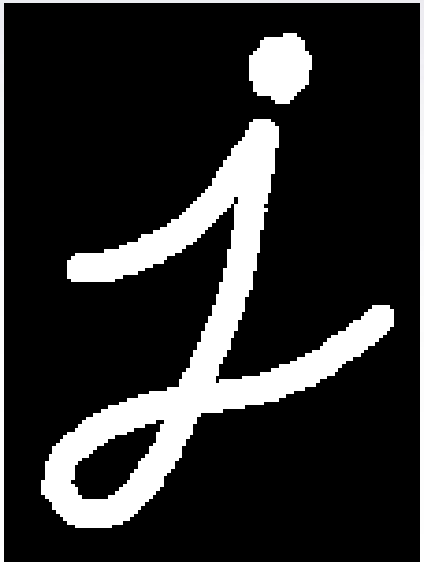
- It is the difference between dilation and erosion.
- The result will look like the outline of the object.

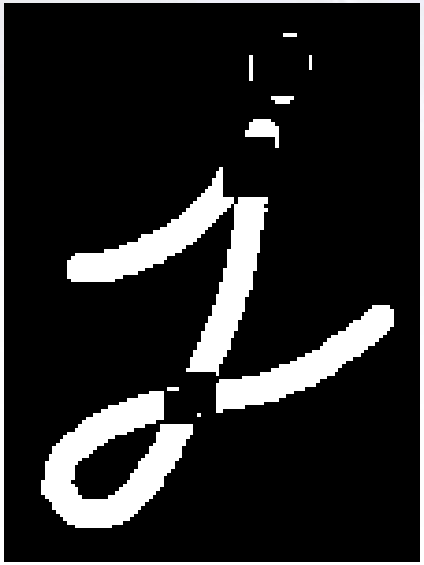




# Top Hat

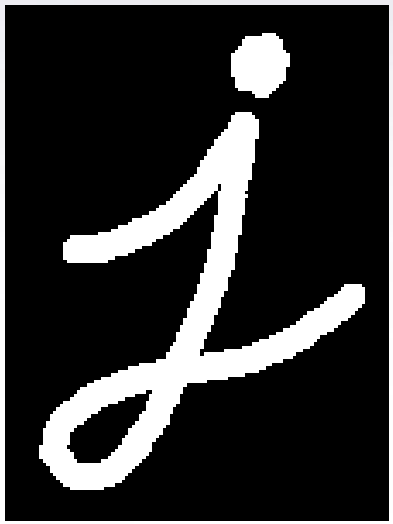
- It is the difference between input image and opening of the  image.

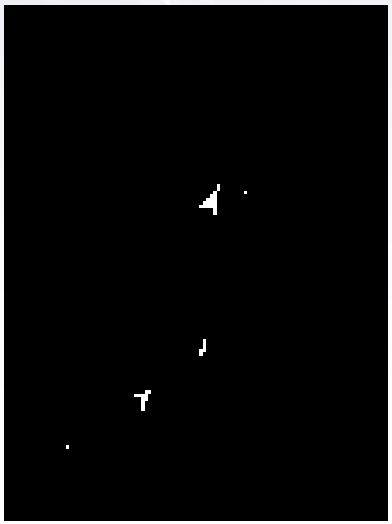




# Black Hat

- It is the  difference between closing of the  input image and the  input image.





## References :


- http://docs.opencv.org/trunk/d9/d61/tutorial_py_morphological_ops.html
- https://www.cs.auckland.ac.nz/courses/compsci773s1c/lectures/ImageProcessing-html/topic4.htm