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Experiment – 05: Morphological operations

Date: _____

1. **Aim :** To implement image Morphological operations, Erosion and Dilation

2. **Requirements:** Python

3. **Pre-Experiment Exercise**

3.1 Brief Theory

Morphological image processing pursues the goals of removing these imperfections by accounting for the form and structure of the image. Morphological operations rely only on the relative ordering of pixel values, not on their numerical values, and therefore are especially suited to the processing of binary images. Morphological operations can also be applied to greyscale images such that their light transfer functions are unknown and therefore their absolute pixel values are of no or minor interest. The two principal morphological operations are dilation and erosion. Dilation allows objects to expand, thus potentially filling in small holes and connecting disjoint objects. Erosion shrinks objects by etching away (eroding) their boundaries. These operations can be customized for an application by the proper selection of the structuring element, which determines exactly how the objects will be dilated or eroded.

Dilation:

The dilation is an operation used to grow or thicken objects in binary images. The dilation process is performed by laying the structuring element B on the image A and sliding it across the image in a manner similar to convolution. The difference is in the operation performed. It is best described in a sequence of steps:

If the origin of the structuring element coincides with a 'white' pixel in the image, there is no change; move to the next pixel.

If the origin of the structuring element coincides with a 'black' in the image, make black all pixels from the image covered by the structuring element.

$$A \oplus B(x, y) = \max_{i,j \in B} \{A(x+i, y+j) + B(i, j)\}$$

The structuring element can have any shape. Typical shapes are presented below:

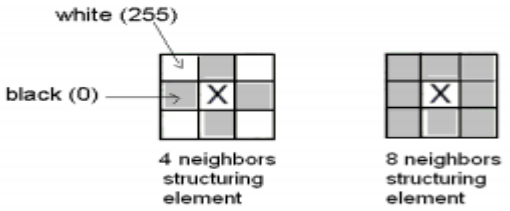

Fig. 1: Typical shapes of the structuring elements

An example is shown in Fig. 2. Note that with a dilation operation, all the 'black' pixels in the original image will be retained, any boundaries will be expanded, and small holes will be filled.

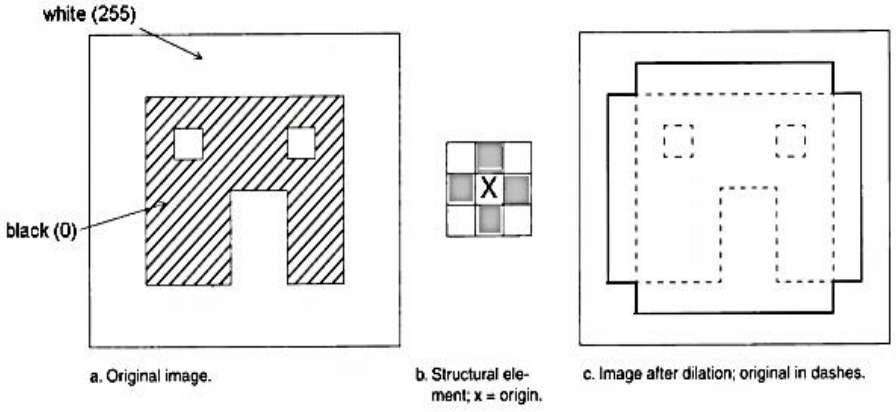

Fig. 2 Illustration of the dilatation process

Erosion:

Erosion is used to shrink or thin objects in binary images. The erosion process is similar to dilation, but we turn pixels to 'white', not 'black'. Erosion can be used to remove isolated features. As before, slide the structuring element across the image and then follow these steps:

If the origin of the structuring element coincides with a 'white' pixel in the image, there is no change; move to the next pixel.

If the origin of the structuring element coincides with a 'black' pixel in the image, and at least one of the 'black' pixels in the structuring element falls over a white pixel in the image, then change the 'black' pixel in the image (corresponding to the position on which the center of the structuring element falls) from ‘black’ to a 'white'.

$$\text{A } \Theta \text{ B}\mathbf{(x,y)} = \min_{i,j \in B} \{A(x+i, y+j) - B(i,j)\}$$

In Fig. 3 the only remaining pixels are those that coincide to the origin of the structuring element where the entire structuring element was contained in the existing object. Because the structuring element is 3 pixels wide, the 2-pixel-wide right leg of the image object was eroded away, but the 3-pixel-wide left leg retained some of its center pixels.

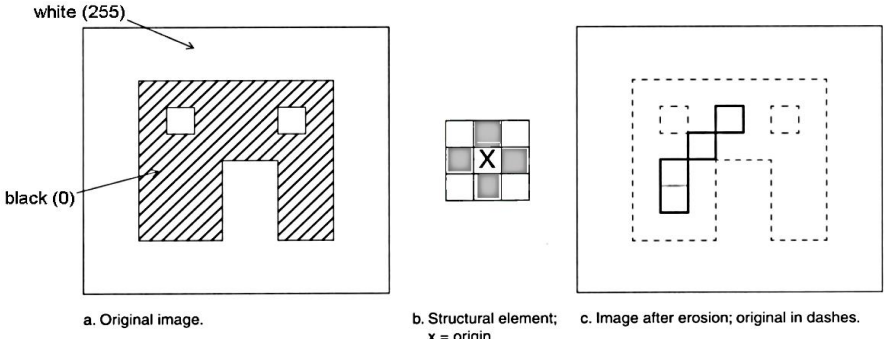

Fig. 3 Illustration of the erosion process

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Boundary Extraction:

If A is an image and structuring element is B then Boundary Extraction can be given as,

Boundary (A) = A - (A Θ B)

4. Laboratory Exercise

4.1 Algorithm :

1. Accept the binary as an input and 3 x 3 structuring element with all ones
2. Perform the required morphological operation.
3. Display all input and output images.

5. Post Experiment

5.1 Conclusion

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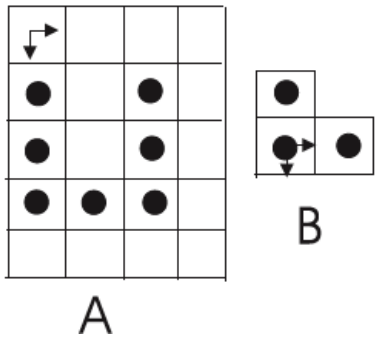
5.2 Questions

i. What are the advantage of opening and closing morphological operation?

ii. Define Hit or Miss Transform.

iii. Find the opening of A by B



iv. Find the dilation and erosion of following A by B element