IMAGE Report 4 - Morphologie

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## Erosion and dilation of binary images

1.

    a. Erosion

        i. Erosion of an image X produces the subset of points where the structural object B is a subset of the image. It generally causes an image to shrink (become smaller) as parts of the original image in which the structural element cannot fit are removed.

        ii. Depending on the size and shape of the structural element, the transformation can have the effect of removing the small details of the image, such as small details sticking out from the edge, and small holes.

    b. Dilation

        i. Dilation of an image X produces a new set of points representing the intersection of the structural object B and the image. It generally causes an image to grow (become larger) as the shape of the structural image is added to all edges of the original image.

        ii. Depending on the size and shape of the structural element, dilation can fill in the gaps between fine details and small objects in the image, possibly connecting objects that were separate in the original image.

2.

    a. Erosion of an image produces the same result as taking complement of the dilation of the image. The same relationship is true for dilation: dilation of an image produces the same result as taking the complement of the erosion of that image. This is true for any shape and size of structural element.
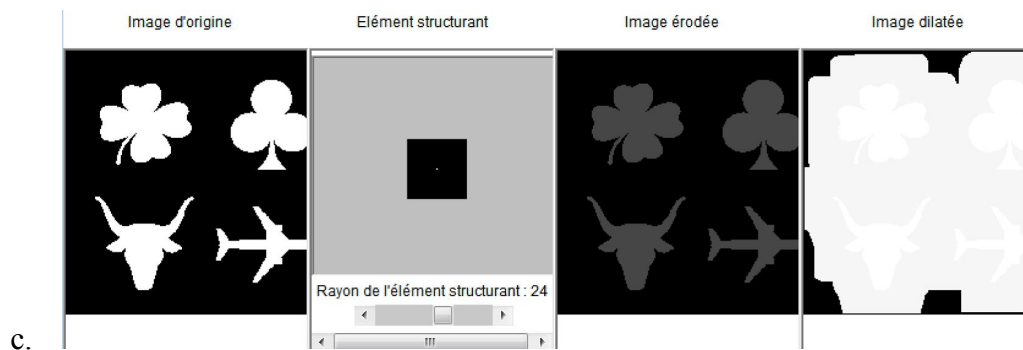
    b.

    c.
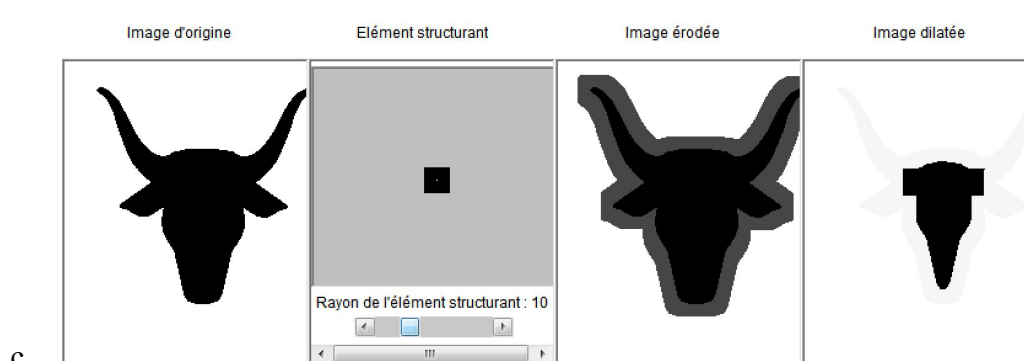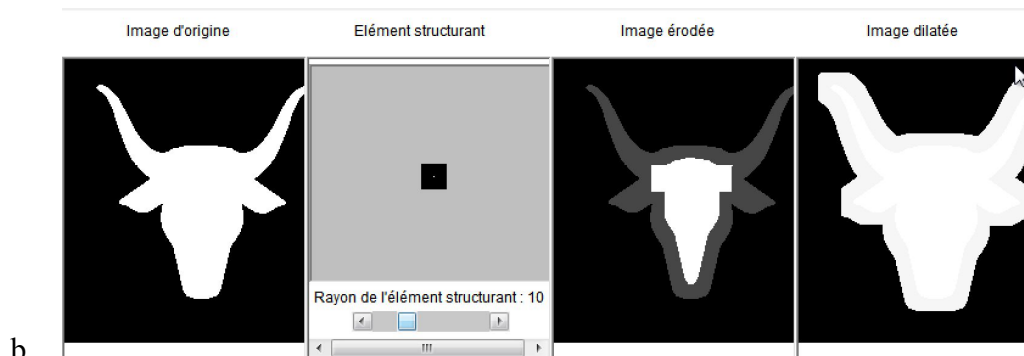
3.

    a. Neither erosion nor dilation are homotopic transformations:
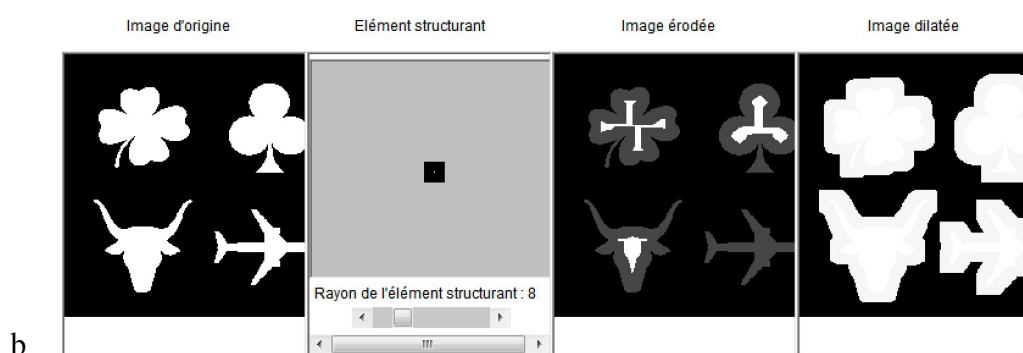
b.
  i. Here we can see that erosion is not a homotopic transformation as we have lost the aeroplane completely in the eroded image.

c.
  i. Here we can see that dilation is not a homotopic transformation as all four elements have merged into one single element in the eroded image.

4.

a. Erosion is anti-extensive because all the points of an eroded image are contained within the original image; it is a subset of the original image.

b. Dilatation is extensive as all points of the original image are contained within it; the original image is a subset of the dilation.

Opening and closing of binary images

5.

a. Opening of an image X is a dual operation of an erosion followed by a dilation. Using a structural element in the shape of a ball with radius r, an opening will cause the loss of all objects with a width less than 2*r. The resulting image is one where the outlines of the elements of the original are followed closely, except for areas where small details of the size described are present.

b. Closing of an image X is a dual operation of a dilation followed by an erosion. Using a structural element in the shape of a ball with radius r, a closing will cause the loss of all holes with a width less than 2*r. The resulting image is one where the outlines of the elements of the original are followed closely, except for areas where holes or gaps between other objects of the size described are present.
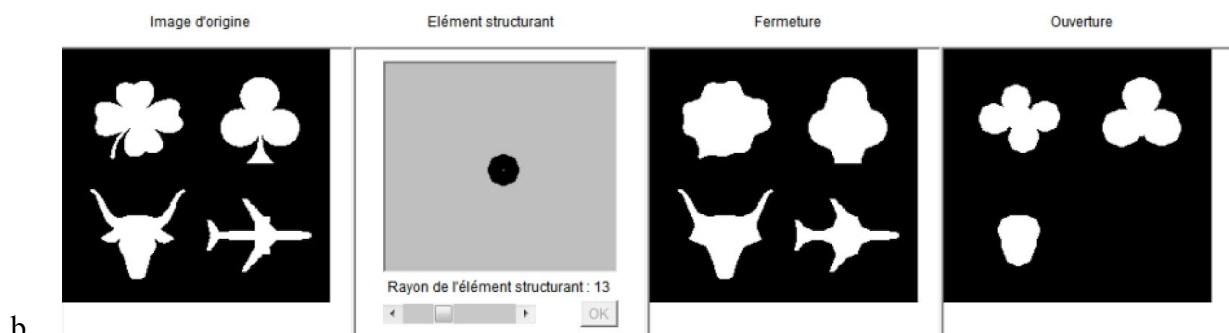

c.
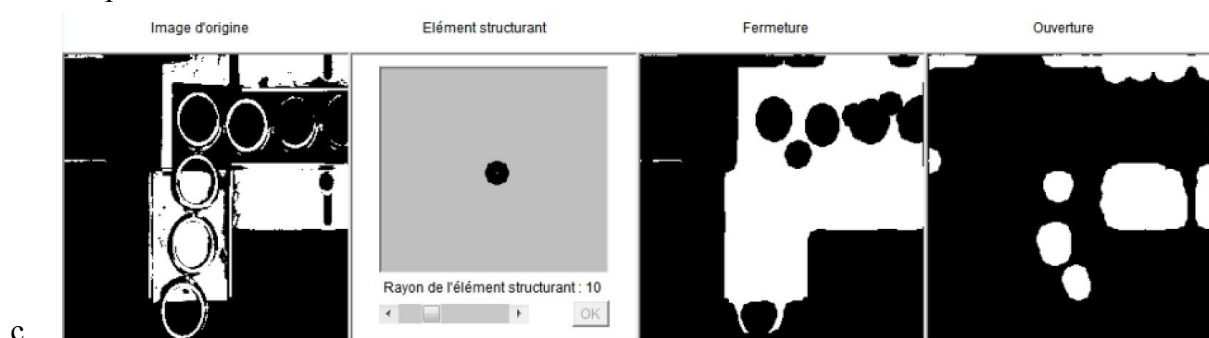
6.

a. Opening of an image produces the same result as taking complement of the closing of the image. The same relationship is true for closing: closing of an image produces the same result as taking the complement of the opening of that image. This is true for any shape and size of structural element.
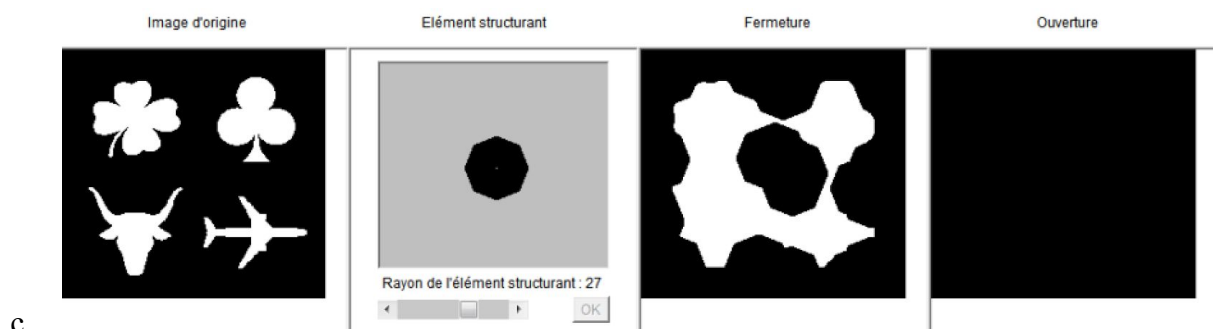

b.

c.
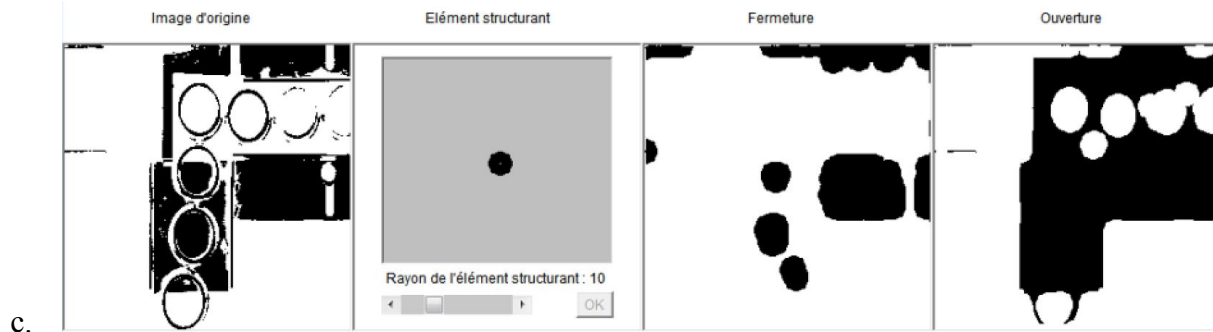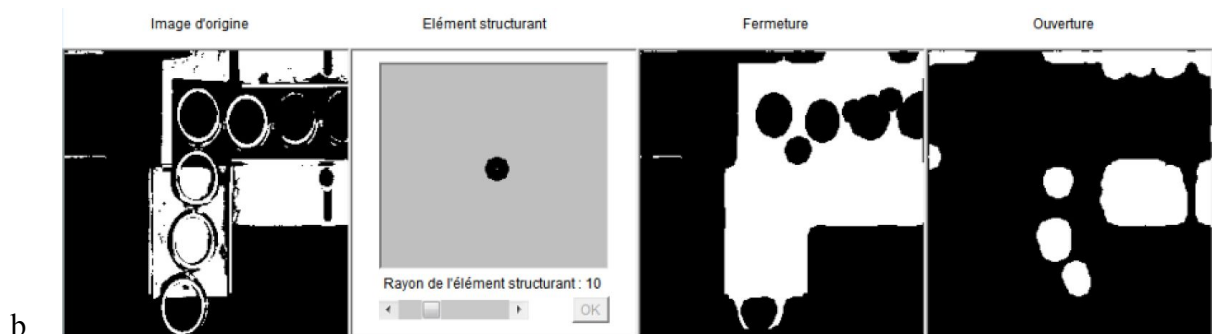
7.

a. Neither opening nor closing are homotopic transformations:

b.
    i. Here we can see that opening is not a homotopic transformation as we have lost the aeroplane completely in the transformed image.

c.
    i. Here we can see that closing is not a homotopic transformation as all four elements have merged into one single element in the transformed image.

8.

a. Opening is anti-extensive because all the points of the transformed image are contained within the original image; it is a subset of the original image.

b. Closing is extensive as all points of the original image are contained within it; the original image is a subset of the transformed image.

Erosion and dilation of grey levels

9.
   a. For a particular pixel of a grayscale image, erosion takes the minimum grey level of the image (the darkest grey level) within the area defined by the structural element, and transforms the pixel value into this value. The effect on the image is to magnify the size of small dark objects, and reduce the size of small light coloured objects. The overall effect on the image is to make it darker.

   b. The reverse is true for dilation. For a particular pixel of a grayscale image, dilation takes the maximum grey level of the image (the lightest grey level) within the area defined by the structural element, and transforms the pixel value into this value. The effect on the image is to magnify the size of small light objects, and reduce the size of small dark coloured objects. The overall effect on the image is to make it lighter.
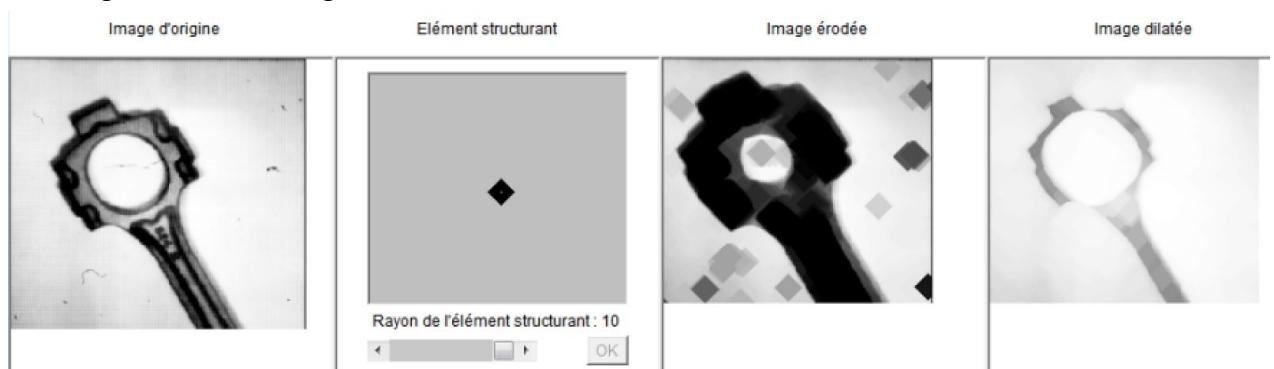
   c.

10.
   a. As with binary images, erosion of a grayscale image produces the same result as taking the complement of the dilation of the image. The same relationship is true for dilation: dilation of a grayscale image produces the same result as taking the complement of the erosion of that image. This is true for any shape and size of structural element.
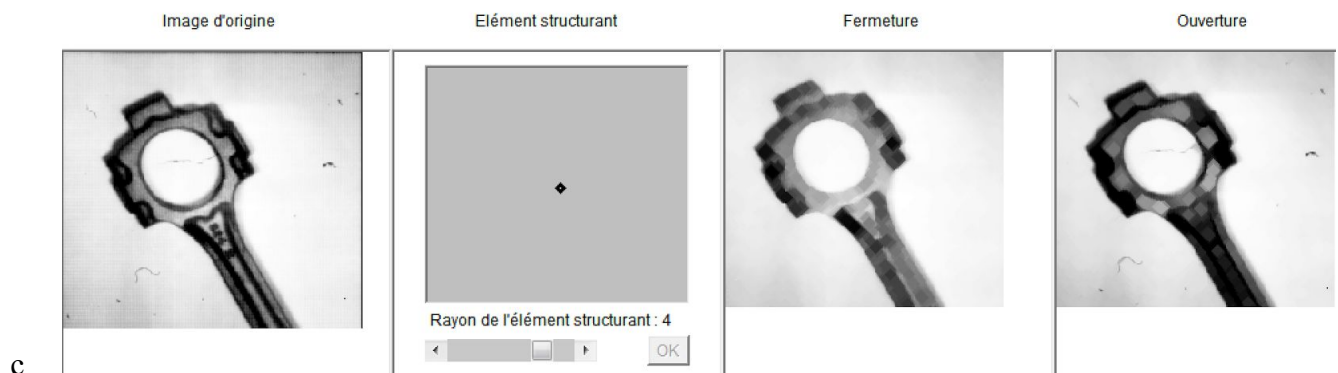
   b.

   c.
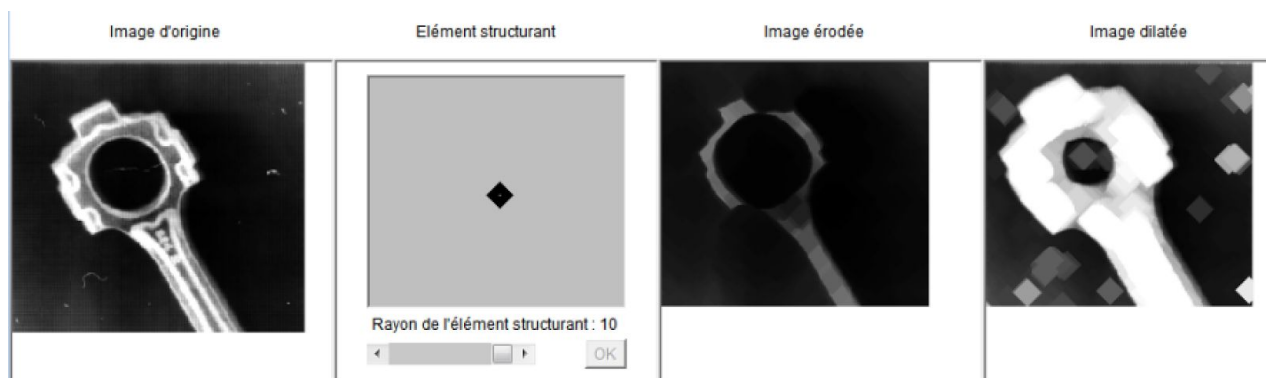
11.
   a. As with binary images, erosion of a grayscale image is anti-extensive because all the pixels of an eroded image have a gray level that is equal to or lower than their corresponding pixel within the original image.

   b. As with binary images, dilation of a grayscale image is extensive as all points of the original image have a gray level that is equal to or higher than their corresponding pixel within the original image.

Opening and closing of grey levels

12.

a. Opening of a grayscale image has the effect of removing the small light coloured objects, as it takes the minimum local, thereby reducing their gray level so they match the surrounding dark pixels. This has the secondary effect of increasing the size of the adjacent dark objects. On the other hand, opening leaves small dark coloured object as they are, because they are already at a minimum local.

b. Closing has the opposite effect, in that it removes the small dark coloured objects, as it takes a local maximum, thereby increasing their gray level so they match the surrounding dark pixels. This has the secondary effect of decreasing the size of the adjacent dark objects. On the other hand, closing leaves small light coloured object as they are, because they are already at a maximum local.

c.

13.

a. Opening of a grayscale image produces the same result as taking complement of the closing of the image. The same relationship is true for closing: closing of a grayscale image produces the same result as taking the complement of the opening of that image. This is true for any shape and size of structural element.

b.

14.
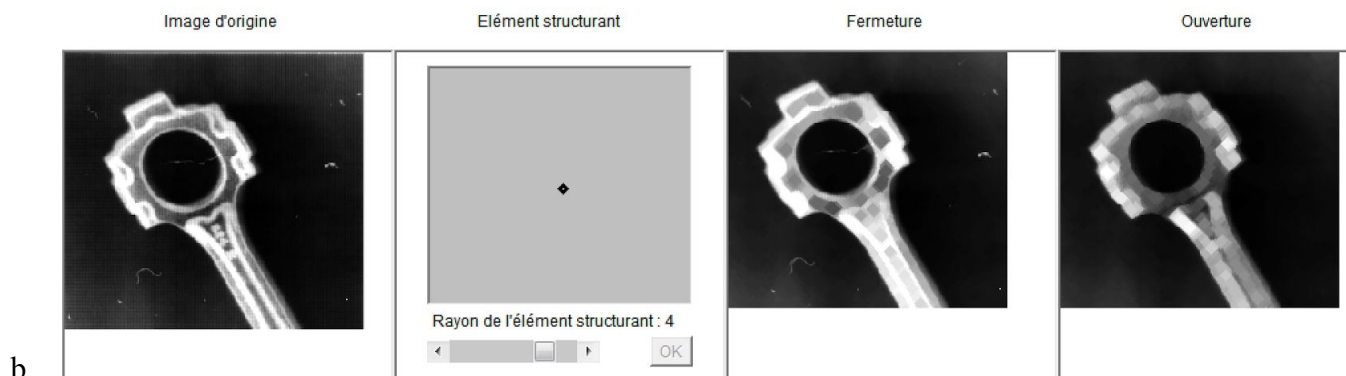
a. Opening is anti-extensive because all the pixels of the transformed image have a gray level that is equal to or lower than their corresponding pixel within the original image.

b. Closing is extensive as all points of the transformed image have a gray level that is equal to or higher than their corresponding pixel within the original image.