Chapter-11

Image Morphology

1. What is the erosion and dilation of the image.

Solution:

The non-zero element (1) of the image coordinates are { (0,0), (1,0)}

The coordinates of the structuring element is { (0,0), (0,1)}

The binary dilation is given as

A + (0,0)

(0,0) + (0,0) = (0,0)

(1,0) + (0,0) = (1,0)

A + (0,1)

(0,0) + (0,1) = (0,1)

(1,0) + (0,1) = (1,1)

The union of these is the dilation result.

The union is { (0,0),(1,0),(0,1),(1,1) }

The intersection of these is the erosion result.

The intersection is null.

2. Let the image A be

$$\begin{pmatrix} 11 & 18 & 13 & 12 \\ 12 & 2 & 22 & 22 \\ 22 & 22 & 22 & 2 \\ 1 & 68 & 70 & 6 \end{pmatrix}$$

Let the image B be

$$\begin{pmatrix} 1 & 1 & 1 \\ 1 & 1 & 1 \\ 1 & 1 & 1 \end{pmatrix}$$

The dilation is given as

$$\begin{pmatrix} 11+1 & 18+1 & 13+1 \\ 12+1 & 2+1 & 22+1 \\ 22+1 & 22+1 & 22+1 \end{pmatrix} = \begin{pmatrix} & & \\ & 23 & \\ & & \end{pmatrix}$$

$$\begin{pmatrix} 18+1 & 13+1 & 12+1 \\ 2+1 & 22+1 & 22+1 \\ 22+1 & 22+1 & 22+1 \end{pmatrix} = \begin{pmatrix} & & \\ & 23 & \\ & & \end{pmatrix}$$

$$\begin{pmatrix} 12+1 & 2+1 & 22+1 \\ 22+1 & 22+1 & 22+1 \\ 1+1 & 68+1 & 70+1 \end{pmatrix} = \begin{pmatrix} & & \\ & 71 & \\ & & \end{pmatrix}$$

$$\begin{pmatrix} 2+1 & 22+1 & 22+1 \\ 22+1 & 22+1 & 2+1 \\ 68+1 & 70+1 & 6+1 \end{pmatrix} = \begin{pmatrix} & & \\ & 71 & \\ & & \end{pmatrix}$$

So the result is $\begin{pmatrix} 23 & 23 \\ 71 & 71 \end{pmatrix}$

The erosion is given as

$$\begin{pmatrix} 11-1 & 18-1 & 13-1 \\ 12-1 & 2-1 & 22-1 \\ 22-1 & 22-1 & 22-1 \end{pmatrix} = \begin{pmatrix} & & \\ & 1 & \\ & & \end{pmatrix}$$

$$\begin{pmatrix} 18-1 & 13-1 & 12-1 \\ 2-1 & 22-1 & 22-1 \\ 22-1 & 22-1 & 22-1 \end{pmatrix} = \begin{pmatrix} & & \\ & 1 & \\ & & \end{pmatrix}$$

$$\begin{pmatrix} 12-1 & 2-1 & 22-1 \\ 22-1 & 22-1 & 22-1 \\ 1-1 & 68-1 & 70-1 \end{pmatrix} = \begin{pmatrix} & & \\ & 0 & \\ & & \end{pmatrix}$$

$$\begin{pmatrix} 2-1 & 22-1 & 22-1 \\ 22-1 & 22-1 & 2-1 \\ 68-1 & 70-1 & 6-1 \end{pmatrix} = \begin{pmatrix} & & \\ & 1 & \\ & & \end{pmatrix}$$

So the result is $\begin{pmatrix} 1 & 1 \\ 0 & 1 \end{pmatrix}$

3. The original 7 X 7 image is given as

$$\begin{pmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{pmatrix}$$

The next Iteration gives

$$\begin{pmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 2 & 2 & 2 & 2 & 2 & 1 \\ 1 & 2 & 1 & 1 & 1 & 2 & 1 \\ 1 & 2 & 1 & 1 & 1 & 2 & 1 \\ 1 & 2 & 1 & 1 & 1 & 2 & 1 \\ 1 & 2 & 2 & 2 & 2 & 2 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{pmatrix}$$

The next iteration gives

$$\begin{pmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 2 & 2 & 2 & 2 & 2 & 1 \\ 1 & 2 & 3 & 3 & 3 & 2 & 1 \\ 1 & 2 & 3 & 1 & 3 & 2 & 1 \\ 1 & 2 & 3 & 3 & 3 & 2 & 1 \\ 1 & 2 & 2 & 2 & 2 & 2 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{pmatrix}$$

The last iteration gives

$$\begin{pmatrix} 1 & 1 & 1 & 1 & 1 & 1 & 1 \\ 1 & 2 & 2 & 2 & 2 & 2 & 1 \\ 1 & 2 & 3 & 3 & 3 & 2 & 1 \\ 1 & 2 & 3 & 4 & 3 & 2 & 1 \\ 1 & 2 & 3 & 3 & 3 & 2 & 1 \\ 1 & 2 & 2 & 2 & 2 & 2 & 1 \\ 1 & 1 & 1 & 1 & 1 & 1 & 1 \end{pmatrix}$$

Similarly for the 7 X 5 matrix, this gives

$$\begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \\ 1 & 1 & 1 & 1 & 1 \end{pmatrix}$$

The next iteration gives

$$\begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 2 & 2 & 2 & 1 \\ 1 & 2 & 1 & 2 & 1 \\ 1 & 2 & 1 & 2 & 1 \\ 1 & 2 & 1 & 2 & 1 \\ 1 & 2 & 2 & 2 & 1 \\ 1 & 1 & 1 & 1 & 1 \end{pmatrix}$$

The last iteration gives $\begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 2 & 2 & 2 & 1 \\ 1 & 2 & 3 & 2 & 1 \\ 1 & 2 & 3 & 2 & 1 \\ 1 & 2 & 3 & 2 & 1 \\ 1 & 2 & 2 & 2 & 1 \\ 1 & 1 & 1 & 1 & 1 \end{pmatrix}$

$$\begin{pmatrix} 1 & 1 & 1 & 1 & 1 \\ 1 & 2 & 2 & 2 & 1 \\ 1 & 2 & 3 & 2 & 1 \\ 1 & 2 & 3 & 2 & 1 \\ 1 & 2 & 3 & 2 & 1 \\ 1 & 2 & 2 & 2 & 1 \\ 1 & 1 & 1 & 1 & 1 \end{pmatrix}$$