Computer Vision-IT813

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MORPHOLOGICAL OPERATIONS

Dilation AND Erosion

Morphological operation

- It is a collection of non-linear operations related to the shape or morphology of features in an image.
- ie , we process images according to its shape
- 2 fundamental operations
  - Dilation
  - Erosion

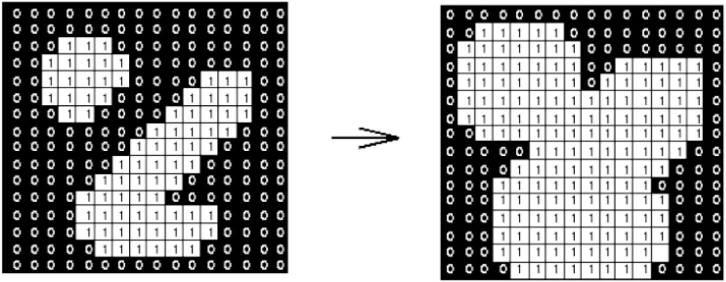
DILATION AND EROSION

- Dilation adds pixels to the boundaries of objects in an image
- Erosion removes pixels on object boundaries

DILATION

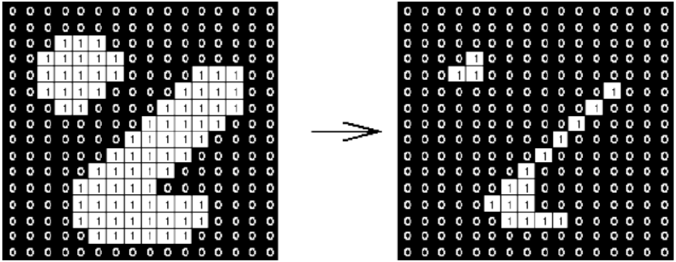
- It grows or thicken objects in a binary image
- Thickening is controlled by a shape referred to as structuring element
- Structuring element is a matrix of 1's and 0's

Applications of dilation
For bridging gaps in an image



Effect of dilation using a 3×3 square structuring element

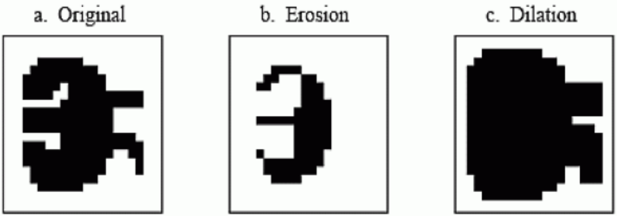
Applications of erosion : Eliminating unwanted detail



Effect of erosion using a 3×3 square structuring element

Opening and Closing operations

- Opening → An Erosion followed by a dilation
- Closing → A dilation followed by an erosion



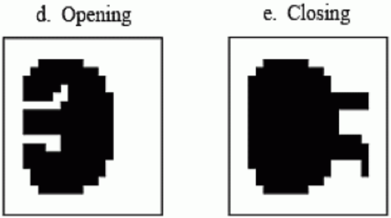
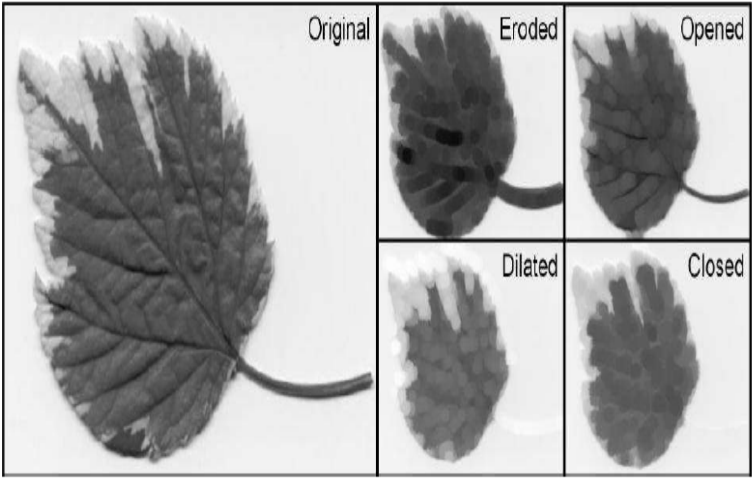


FIGURE 25-10
Morphological operations. Four basic morphological operations are used in the processing of binary images: *erosion*, *dilation*, *opening*, and *closing*. Figure (a) shows an example binary image. Figures (b) to (e) show the result of applying these operations to the image in (a).


Original
Eroded
Opened
Dilated
Closed

morphology

Set theory.

4	0	0	0	0
3	0	1	1	1
2	0	0	1	1
1	0	1	0	1
0	0	0	0	0
	0	1	2	3

$V = \{(1,3), (1,1), (2,2), (2,3), (3,3), (3,2), (3,1$

New concepts

1) Reflection

Reflection of v

$\hat{V} = \{ \omega \mid \omega = -v \text{ for } v \in V \}$

eg.

$\hat{V} = \{(-1,-3), (-1,-1), (-2,-2), (-2,-3), (-3,-3), (-3,-$

$(-3,-1)\}$

				0	0	0	0
				0	0	1	1
				0	0	1	1
				0	1	0	1
-4	-3	-2	-1	0	0	0	0
0	0	0	0	0	1	2	3
0	1	0	1	-1			
0	1	1	0	-2			
0	1	1	1	-3			
0	0	0	0	-4			

$$V = \{(1,3),(1,1)(2,2),(2,3)(3,3)(3,2)(3,1)\}$$

Translation. Let $z = \{z_1, z_2\}$

$$(V)_z = \{ c \mid c = v + z, \text{ for } v \in V \}$$

eg. $z = \{1, 1\}$

$$(V)_z = \{(2,4),(2,2),(3,3),(3,4),(4,4)(4,3)(4,2)\}$$

4	0	0	1	1	1
3	0	0	0	1	1
2	0	0	1	0	1
1	0	0	0	0	0
0	0	0	0	0	0
	0	1	2	3	4

~~Dialed~~ Dilation

① $X \oplus B = \{ p \in Z^2 \mid p = x+b,\ x \in X,\ b \in B \}$

② $X \oplus B = \{ p \mid (\hat{B})_p \cap X \neq \phi \}$

eg.

Let

$$X = \begin{array}{c} 4 \\ 3 \\ 2 \\ 1 \\ 0 \\ \\ \end{array} \begin{array}{c} \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix} \\ \begin{array}{cccc} 0 & 1 & 2 & 3 \end{array} \end{array}$$

$$B = \begin{array}{c} 0 \\ \\ \end{array} \begin{array}{c} \begin{bmatrix} 1 & 1 \end{bmatrix} \\ \begin{array}{cc} 0 & 1 \end{array} \end{array}$$

let

$$X = \begin{array}{c|cccc} 4 & 0 & 0 & 0 & 0 \\ 3 & 0 & 1 & 1 & 1 \\ 2 & 0 & 0 & 1 & 1 \\ 1 & 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 & 0 \\ \hline & 0 & 1 & 2 & 3 \end{array}$$

$$B = \begin{array}{c|cc} 0 & 1 & 1 \\ \hline & 0 & 1 \end{array}$$

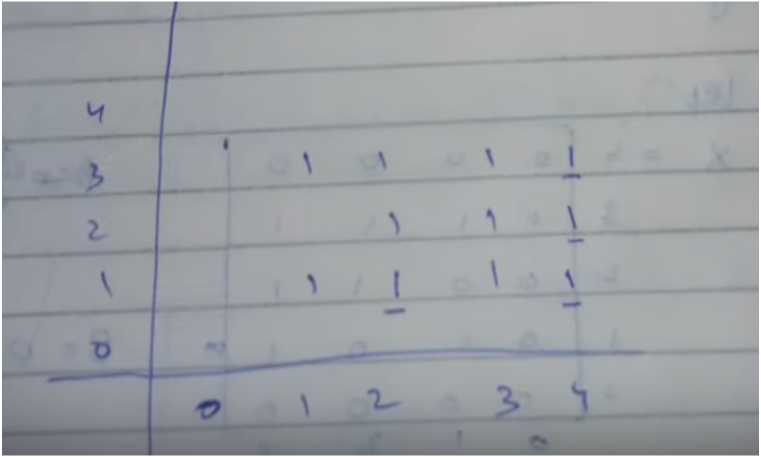
$X = \{(1,3), (1,1), (2,2), (2,3), (3,3), (3,2), (3,1)\}$

$B = \{(0,0), (\phi,0)\}$

$$X = \{(1,3),(1,1),(2,2),(2,3),(3,3),(3,2),(3,1)\}$$

$$B = \{(0,0),(1,0)\}$$

$$X \oplus B = \{(1,3),(1,1),(2,2),(2,3),(3,3),(3,2),(3,1),\\ (2,3),(2,1),(3,2),(3,3),(4,3),(4,2),(4,1)\}$$


4
3
2
1
0
0 1 2 3 4

Erosion

$$X \ominus B = \{p \mid (B)_p \subseteq X\}$$

$$X \ominus B = \{p \in Z^2 \mid p + b \in X \text{ for every } b \in B\}$$

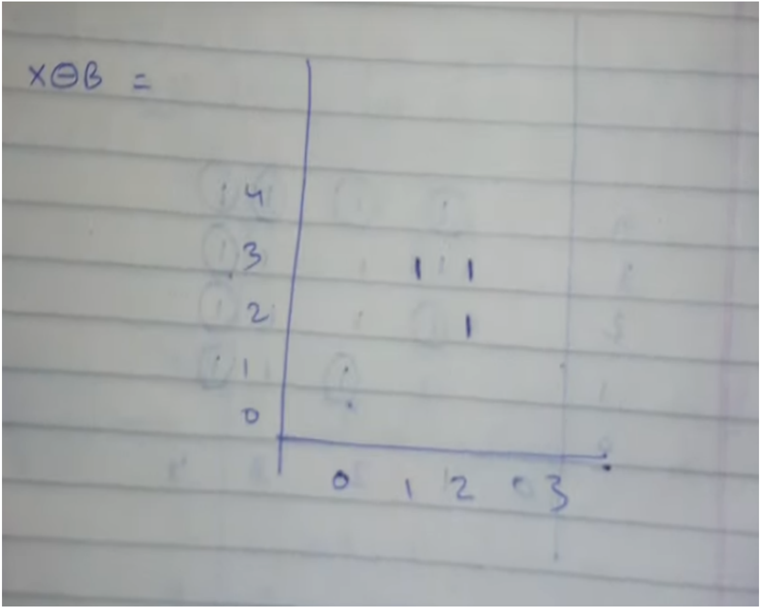
$$X = \begin{array}{c} 4 \\ 3 \\ 2 \\ 1 \\ 0 \end{array} \begin{bmatrix} 0 & 0 & 0 & 0 \\ 0 & 1 & 1 & 1 \\ 0 & 0 & 1 & 1 \\ 0 & 1 & 0 & 1 \\ 0 & 0 & 0 & 0 \end{bmatrix} \qquad B = {}^{0}\begin{array}{c} \boxed{1 \mid 1} \\ 0 \quad 1 \end{array}$$

$$X = \{(1,3),(1,1),(2,2),(2,3),(3,3),(3,2),(3,1)\}$$

$$\cancel{X \ominus B \in \{}$$

$$B = \{(0,0),(1,0)\}$$

$$X \ominus B = \{(1,3),(2,3),(2,2),\}$$


X⊖B =
4
3
2
1
0
1 1
1
0 1 2 3