Chapter 9 Morphological Image Processing

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In asymmetric structure elements we don't use the original structure element we mirror it around it's origin.









We have 2 main morphological operations

Dilation

<u>The rule is:</u>

if the structure element has at least one pixel of binary 1, the origin will be 1



Erosion

<u>The rule is:</u>

if the structure element has at least one pixel of binary 0, the origin will be 0. The structure element should be totally contained inside the body to give 1 at the origin.



For simplicity we imagine a moving origin on the boundary of the body and the whole structure element to be changed

Dilation

<u>The rule is:</u>

The origin moves on boundary and the structure element draw ones.



Erosion

<u>The rule is:</u>

The origin moves on boundary and the structure element draw zeros.



Dilating point Structure element Eroding a body with an structure element of the same shape □ point Dilation **Erosion**









Find object of size 15 "max size"

1- erode by structure element 15, will give pixel 1 at the origin of objects 15, and zero otherwise.



Find object of size 15 "max size"

2- dilate by structure element 15, will retrieve the objects of size 15.



Problem 9.6

- (a) $(A \ominus B^4) \oplus B^2$
- **(b)** $(A \ominus B^1) \oplus B^3$
- (c) $(A \oplus B^1) \oplus B^3$
- (d) $(A \oplus B^3) \ominus B^2$





Problem 9.6

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Open and Close

Open:

Erode first then Dilate.

 $A \circ B = (A \ominus B) \oplus B$

Close:

Dilate first then Erode.

 $A \cdot B = (A \oplus B) \ominus B$

open

1- Erode



•

open

2- Dilate





Close

1- Dilate



 $\overline{\mathbf{\cdot}}$

Close

2- Erode





We want to identify specific object.

- 1. Make a structure element with the same shape of the required object,
- 2. Erode the image with the structure element,
- 3. The required object and bigger will be replaced by 1 pixel at the origin.
- 4. Complement the image , complement the structure element,
- 5. Erode the inverted image with the inverted structure element.



Image

0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	7	0	0	0	0	0	0	0	0	0	0	Ж	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Structure							
ele	eme	ent					
0	1	0					

 $\begin{array}{c} 0 & 1 & 0 \\ 1 & 1 & 1 \\ 0 & 1 & 0 \end{array}$

We want elements of cross of ones with 4 zeros at the corners not this

 $\begin{array}{cccc}1&1&0\\1&1&1\end{array}$

0 1 0

Here we will check the 4 zeros at the corners



Hit or Miss Anding the 2 output images

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Find X



While eroding Z the structure element hit the gap of X creating the L shape



Boundary Extraction

Eroding an object by small structure element then substitute the original image – the result of erosion will give you the boundary of the object.



Region Filling

It needs many iterations to be done.

Starting by point inside the region, dilate with cross structure element (+), And the output with the complement of original image.













































Anding Dilate The last 2 Iterations are the same Stop

The Result is the union of the region fill and the boundary

It needs many iterations to be done.

Starting by point inside the component, dilate with square structure element , And the output with the original image.

Anding Dilate

Anding Dilate

After many iterations we will get this shape

By dilating this shape then anding this shape with the original image we will get the same shape. The last 2 iterations are the same stop

Problem 9.36

A preprocessing step in an application of microscopy is concerned with the issue of isolating individual round particles from similar particles that overlap in groups of two or more particles. Assuming that all particles are of the same size, propose a morphological algorithm that produces three images consisting respectively of (a) Only of particles that have merged with the boundary of the image. (b) Only overlapping particles.

(c) Only nonoverlapping particles.

(c) Only Non overlapping particles:

Hit or miss

(a) Only of particles thathave merged with boundaryof the image

1- make a boundary of the image.

2- And the image with the boundary.

3- Extract Connected

Component by expansion starting with this seed.

(b) Only Overlapped particles:

Original Image – the 2 previous results , such that the image only contain 3 types of particles:

- Overlapped.
- non overlapped.
- On boundary.

Thanks