

# Morphological Image processing

→ shape based image processing

Morphological operators take a set of pixels and convert them to a fixed set of pixels.

STRUCTURING ELEMENT → SE

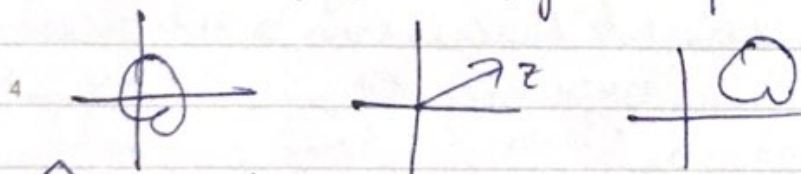
A set of pixels is just a list of  $(x, y)$  Co-ordinates.

Simple operation on a set B:-

→  $B_z$ : Translation of B by a vector  $z$ .

$$\{C \mid C = b + z, b \in B\}$$

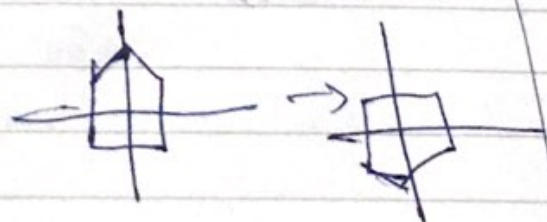
$$= \{(x+z_1, y+z_1) \mid (x, y) \in B\}$$



→  $\hat{B}$ : Reflection of B

$$\{C \mid C = -b, b \in B\}$$

$$\{(x, -y) \mid (x, y) \in B\}$$



→ Erosion →  $A \ominus B = \{z \mid B_z \subseteq A\}$

$\uparrow$  original set       $\uparrow$  structuring element  
 $\ominus$

Set of points  $z$  such that the STRUCTURING ELEMENT translated by  $z$  fits fully inside  $A$ .

Structure  
y →

y →

10

11

12

1

DECEMBER 20

M T W T F

6 7 8 9 1

13 14 15 16

20 21 22 23

27 28 29 31

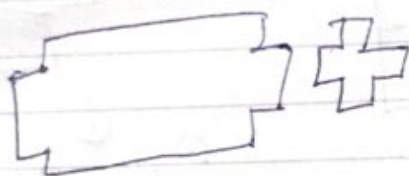
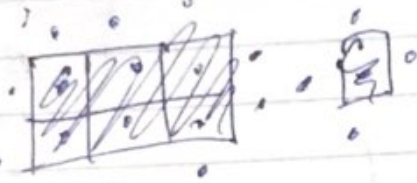
8

9

10

11

12


 $A \oplus B$ 

A better thing would be to: use operators that bridge gaps / fill holes but don't change overall size of object in img.

→ Opening:  $A \circ B = (A \ominus B) \oplus B$   
Erode, then dilate.

Breaks narrow bridges, eliminates thin structures

→ Closing:  $A \bullet B = (A \oplus B) \ominus B$   
Dilate then, erode.

Fixes narrow breaks, eliminates small holes.

There are many other combinations of erosion, dilation.

→  $\partial A = A - A \ominus B$

FLOOD FILLING / HOLE FILLING

keep dilating until hitting black.

DECEMBER 2010

M	T	W	T	F	S	S
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

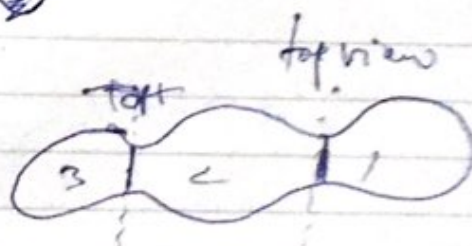
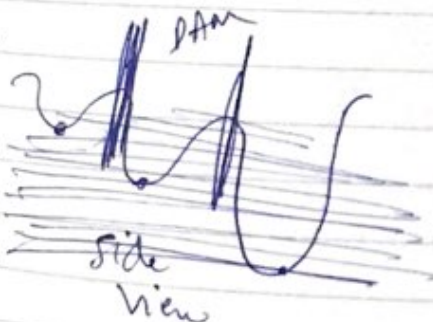
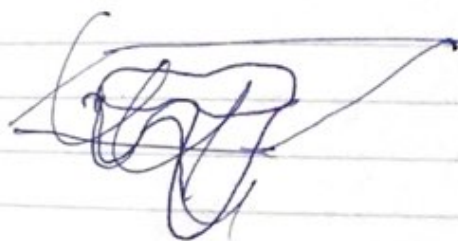


# Watershed Segmentation



Grayscale image

Darker spots on a light Bk.



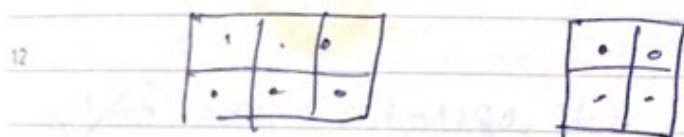
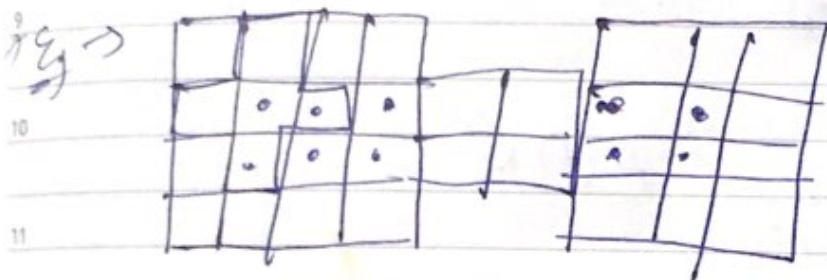
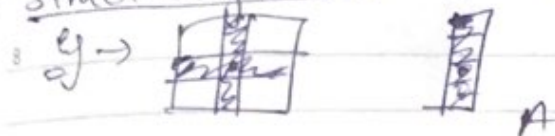
- 1) Find local minimum
- 2) Punch a hole in each one.
- 3) Start raising water level from bottom, one unit at a time.

4) Keep track of points associated with which minimum.

5) When two basins are about to merge, build a single point.

JANUARY 2011						
M	T	F	S	S		
31						
1	5	6	7	8	9	
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

? Structuring element  $\rightarrow$  A small binary array



Diff SE  
 $\Rightarrow$  diff  
 $A \oplus B$

1  $A \oplus B$   
Erosion removes thin lines,

2 removes isolated dots leaving cross details.  
3  $\downarrow$  PEELS away details.

$$A \oplus B \leq A$$

4  $\rightarrow$  DILATION  $\rightarrow$  opp of erosion fattens things.

5  $A \oplus B = \{ z / B_z \cap A \leq A \}$   
6 find pixels such that shifted SE has ANY overlap in

JANUARY 2011						
M	T	W	T	F	S	S
31					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30