

Mathematical Morphology

Yih-Lon Lin (林義隆)

Associate Professor,

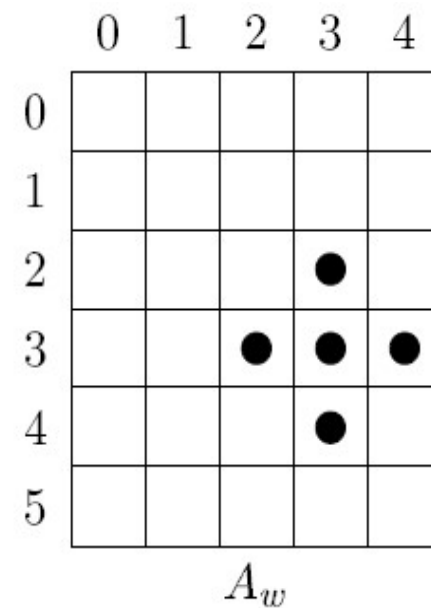
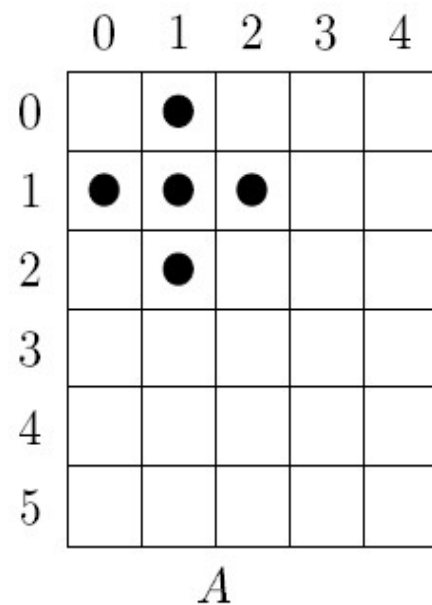
**Department of Computer Science and Information Engineering,
National Yunlin University of Science and Technology**



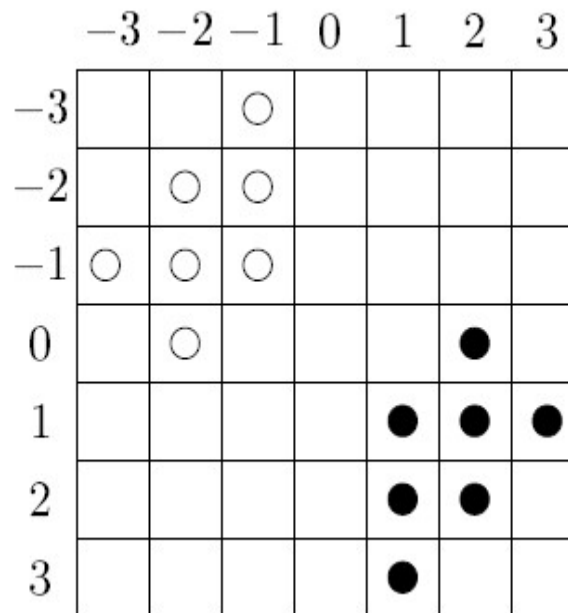
國立雲林科技大學

National Yunlin University of Science and Technology

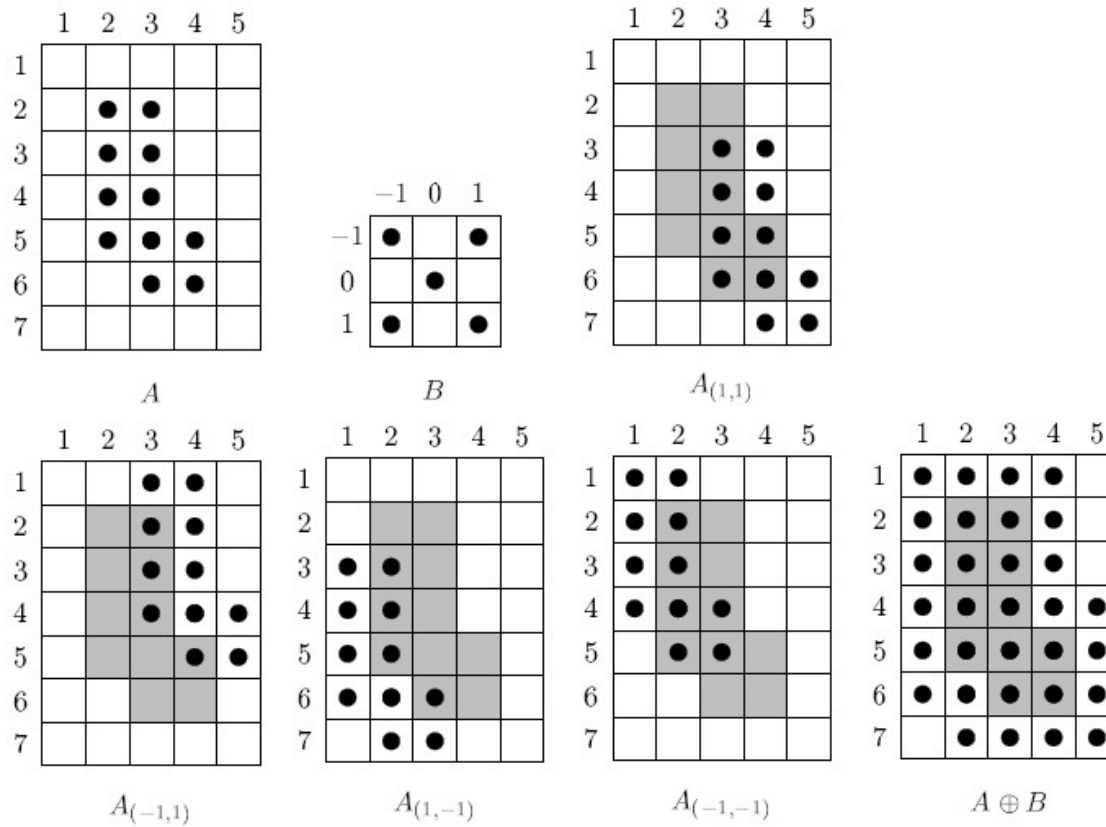
Translation



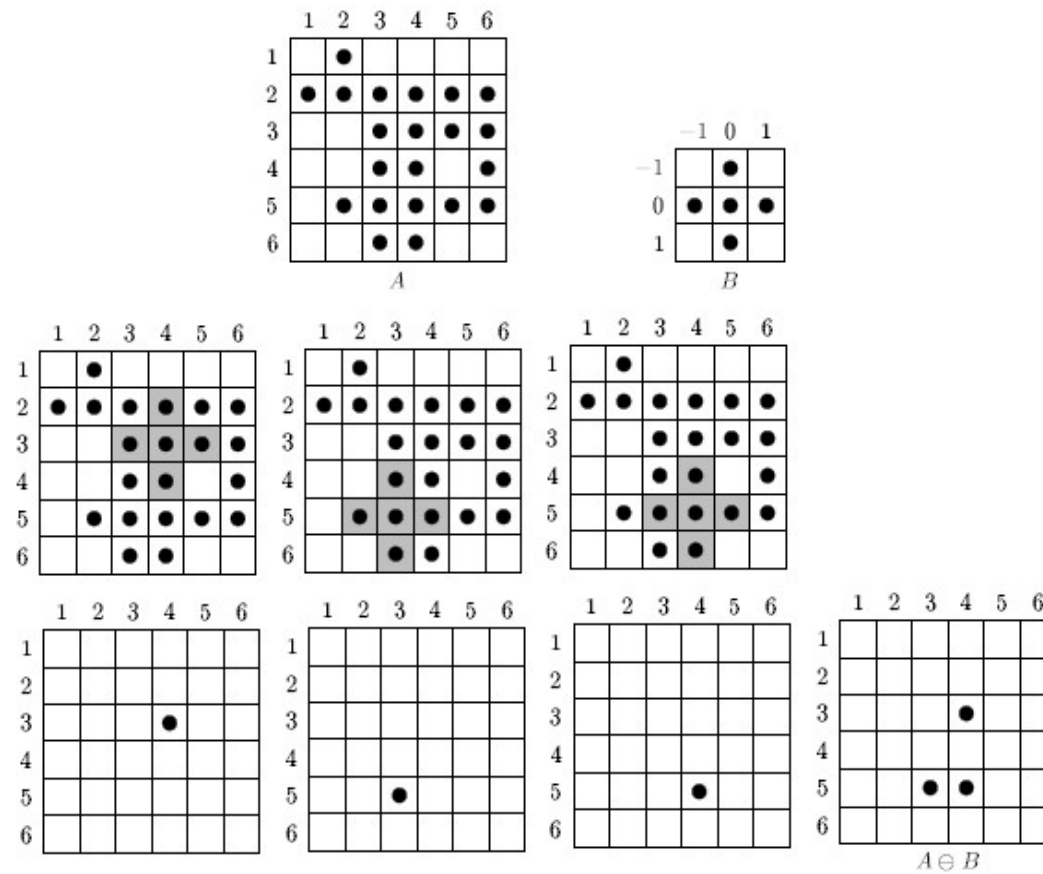
Reflection



Dilation



Erosion



Application

Cross-Correlation Used
To Locate A Known
Target in an Image

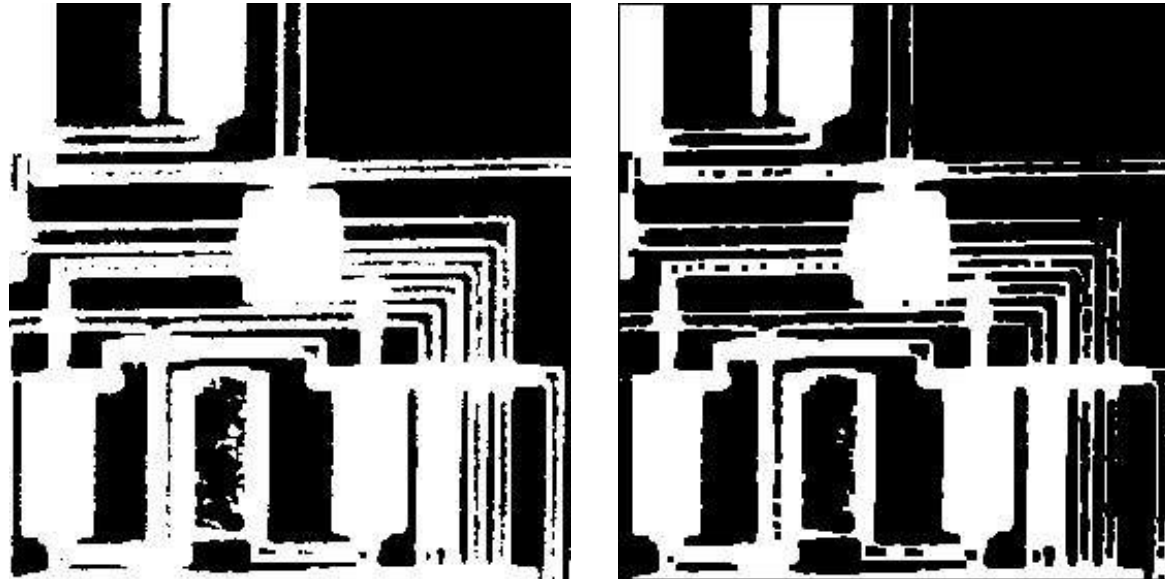
Text Running
In Another
Direction

**Cross-Correlation Used
To Locate A Known
Target in an Image**

**Text Running
In Another
Direction**



Application



Boundary Detection

	0	1	2	3	4	5
0			●	●		
1		●	●	●	●	
2	●	●	●	●	●	●
3	●	●	●	●	●	●
4		●	●	●	●	
5			●	●		

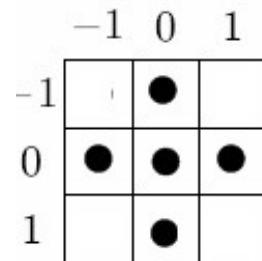
A

	-1	0	1	2	3	4	5	6
-1				●	●			
0			●	●	●	●		
1		●	●	●	●	●	●	
2	●	●	●	●	●	●	●	●
3	●	●	●	●	●	●	●	●
4		●	●	●	●	●	●	
5			●	●	●	●		
6				●	●			

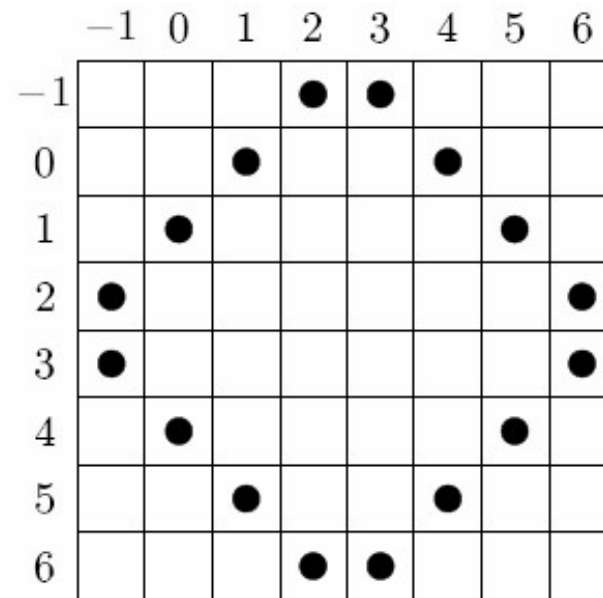
$A \oplus B$



Boundary Detection



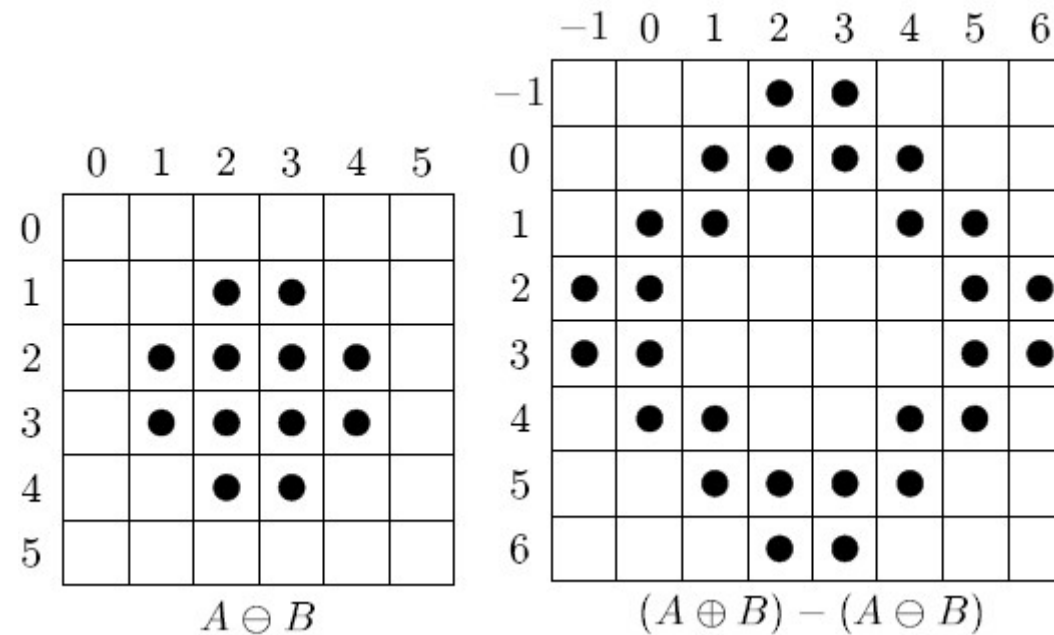
B



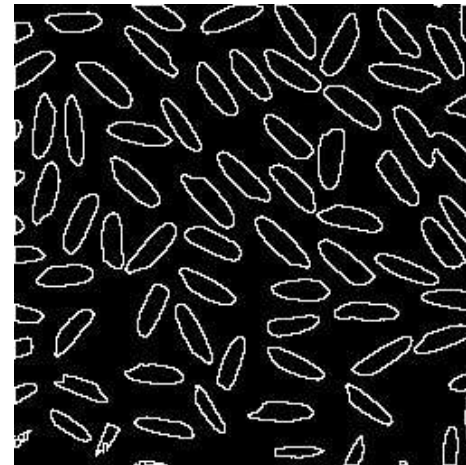
$(A \oplus B) - A$



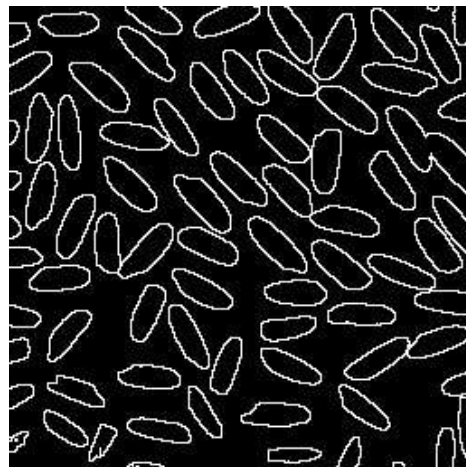
Boundary Detection



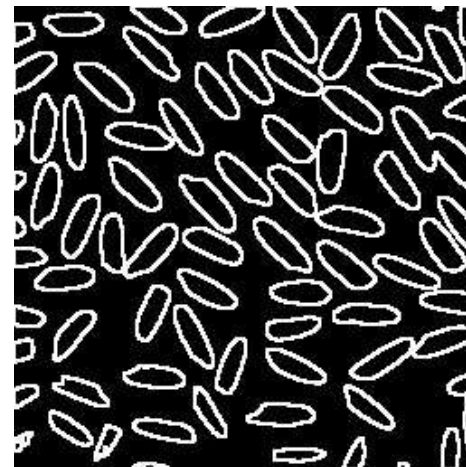
Boundary Detection



$$A - (A \ominus B)$$



$$(A \oplus B) - A$$



$$(A \oplus B) - (A \ominus B)$$



Opening

	0	1	2	3	4	5
0	●	●	●			
1	●	●	●			
2	●	●	●	●		
3			●	●	●	●
4				●	●	●
5				●	●	●

A

	0	1	2	3	4	5
0						
1		●				
2			●			
3				●		
4					●	
5						

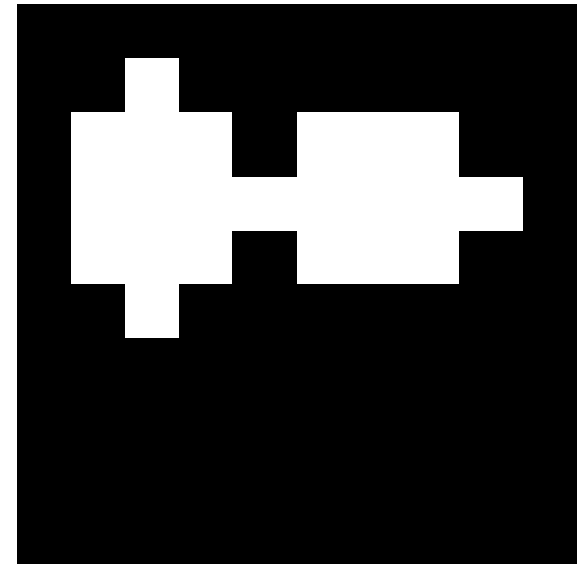
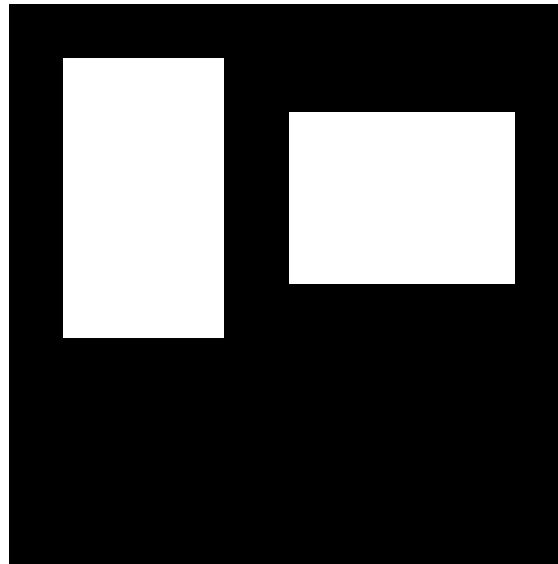
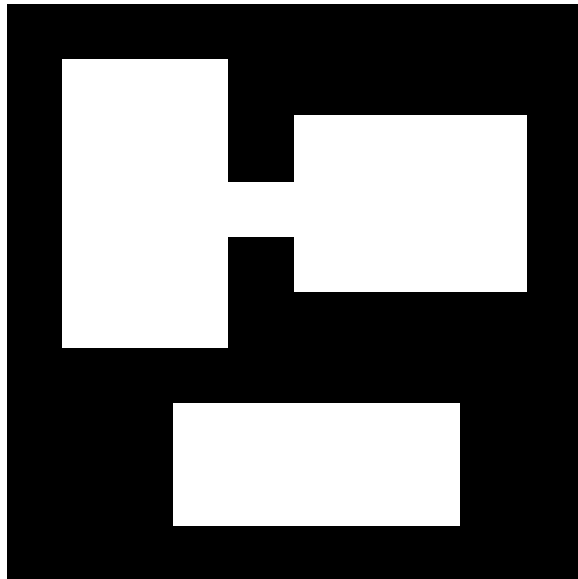
$A \ominus B$

	0	1	2	3	4	5
0		●				
1	●	●	●			
2		●	●	●		
3			●	●	●	
4				●	●	●
5					●	

$A \circ B$



Opening



1 1 1
1 1 1
1 1 1

0 1 0
1 1 1
0 1 0



Closing

	0	1	2	3	4	5	6
0							
1		●	●	●		●	
2		●		●			
3		●	●	●		●	
4							
5		●	●	●	●		
6							

A

	0	1	2	3	4	5	6
0		●	●	●		●	
1	●	●	●	●	●	●	●
2	●	●	●	●	●	●	
3	●	●	●	●	●	●	●
4		●	●	●	●	●	
5	●	●	●	●	●	●	
6		●	●	●	●	●	

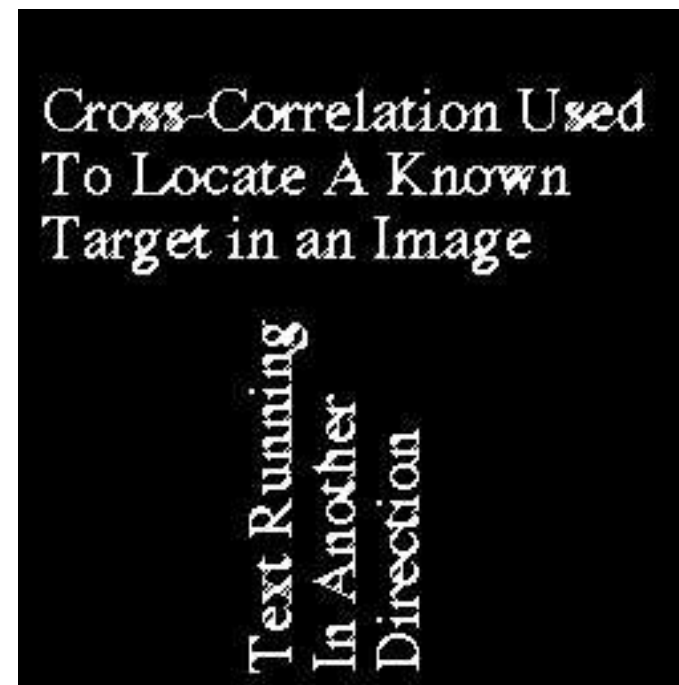
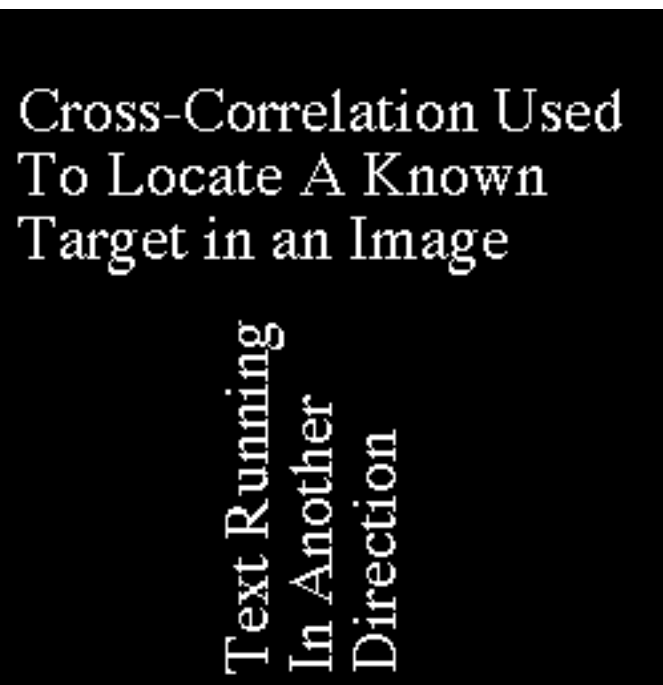
$A \oplus B$

	0	1	2	3	4	5	6
0							
1		●	●	●		●	
2		●	●	●	●		
3		●	●	●	●	●	
4			●	●	●		
5		●	●	●	●		
6							

$A \bullet B$



Closing



0 0 1
0 1 0
1 0 0



Noise Removal

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

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

$$(A \circ B) \bullet B$$

1 1 1

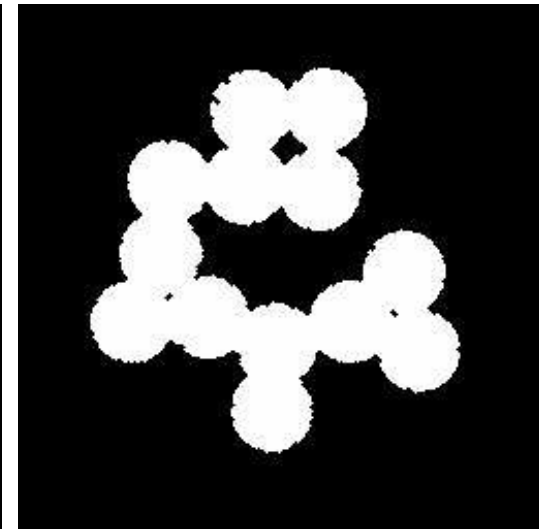
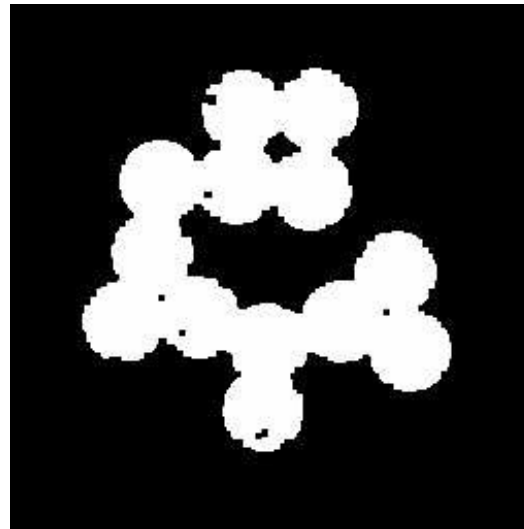
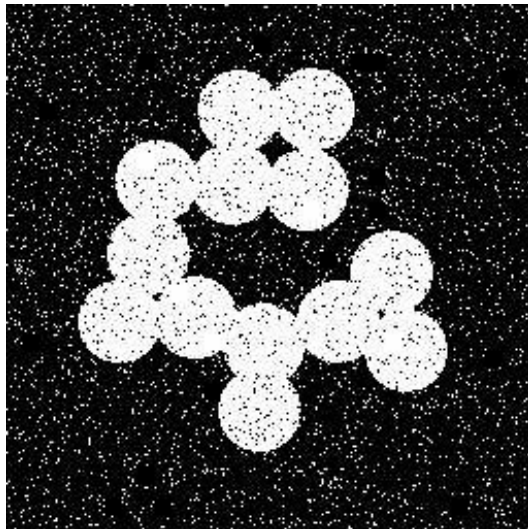
1 1 1

1 1 1

0 1 0

1 1 1

0 1 0



Question

