

Problem 2: Morphology

- a) (4 pt) What is the result of eroding image A1 with the structuring element $B1=\{(0,0), (1,0)\}$? Draw your result in the provided blank image.

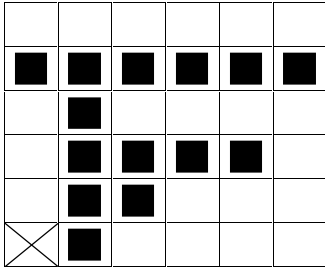
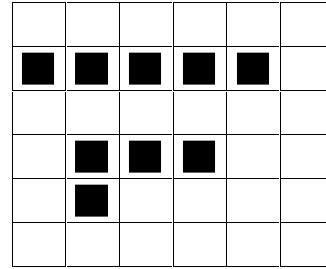


Image A1



Structuring Element B1



$A1 \ominus B1$

- b) (4 pt) What is the result of dilating image A2 with the structuring element $B2=\{(0,0), (1,0), (-1,0), (0,1)\}$? Draw your result in the provided blank image.

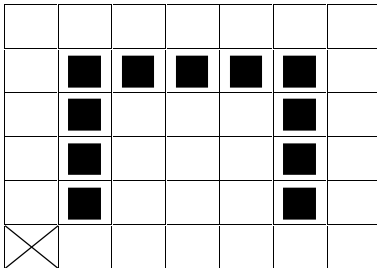
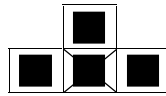
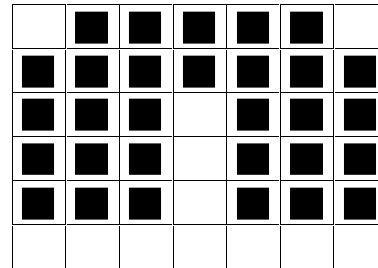


Image A2



Structuring Element B2



$A2 \oplus B2$

- c) (4 pt) What is the result of eroding image A3 with the structuring element $B3=\{(1,1), (0,1), (-1,1), (-1,0), (-1,-1), (0,-1), (1,-1)\}$? Draw your result in the provided blank image.

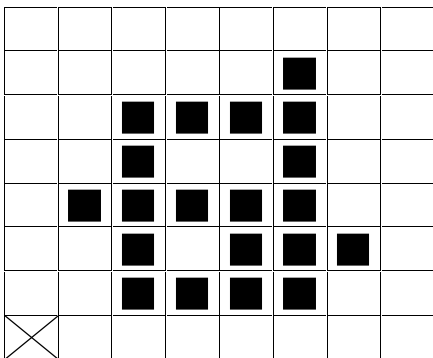
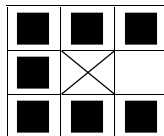
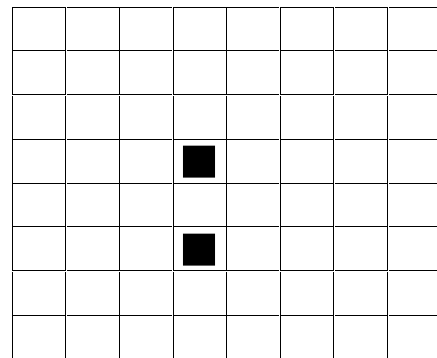


Image A3

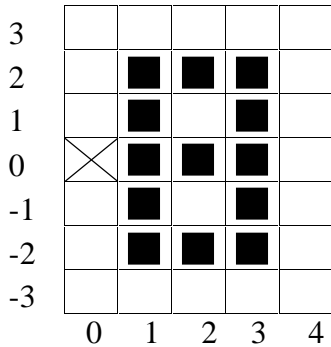


Structuring Element B3



$A3 \ominus B3$

d) (4 pt) d) Given the image below calculate its absolute moments m_{00} , m_{10} , m_{01} and the translation invariant moments m_{20} , m_{02} , m_{11} . Use back of sheet if necessary.



Consult Jim Rehg’s Lecture on moments for definitions.

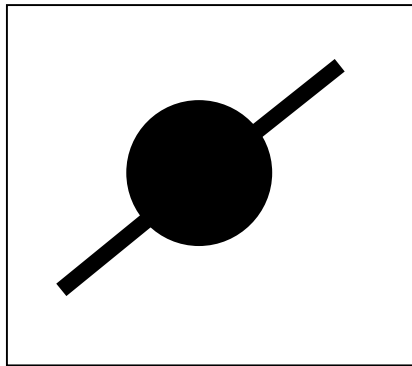
Assuming the pixels are centered as shown and noticing the symmetry about the y axis which simplifies calculations a lot:

$$m_{00} = 13 \text{ (This is the area)} \quad m_{10} = 26 \quad m_{01} = 0$$

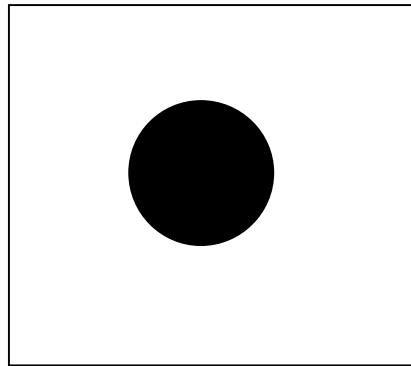
$$X_c = m_{10} / m_{00} = 2 \quad Y_c = m_{01} / m_{00} = 0$$

$$m_{20} = 10 \quad m_{02} = 28 \quad m_{11} = 0$$

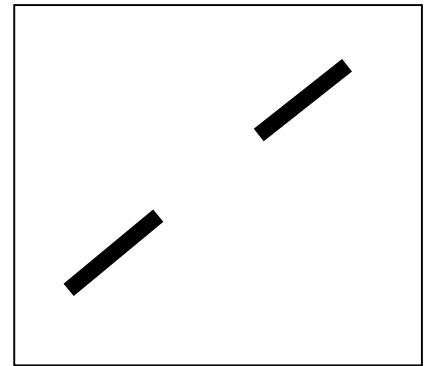
f) (5 pt) Using morphological operations, explain how to segment the image on the left into its two components as shown in the images on the right. Be as specific as possible.



Original Image A



Result 1



Result 2

To decompose image A into its two parts we open it with a structuring element B which is a small disk with radius slightly larger than the width of the line.

$$\text{Result}_1 = A \circ B$$

To get Result_2 we subtract Result_1 from the original image.

$$\text{Result}_2 = A - A \circ B$$

e) (4 pt) Given the image below calculate its horizontal and vertical projections.

