APPLIED PHYSICS 157

Activity 6

MORPHOLOGICAL OPERATIONS

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WFY-FX-2

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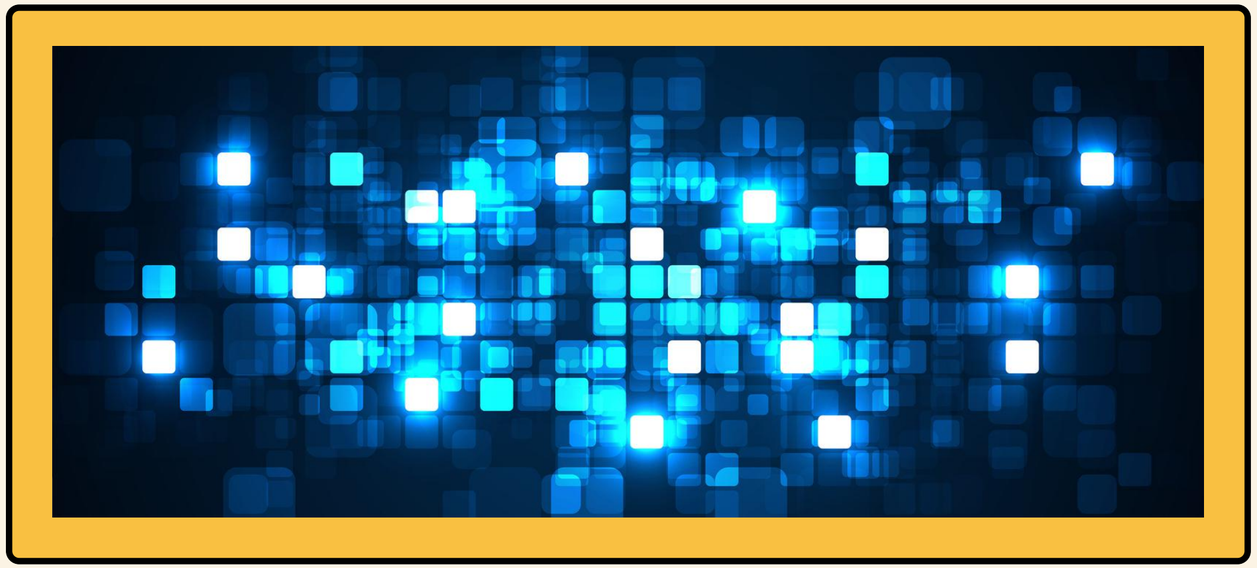
The outputs presented in the succeeding pages are created using MATLAB. Moreover, the codes are uploaded in Github.

ACTIVITY 6.1



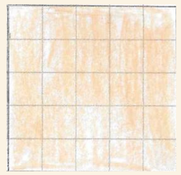
Objectives:

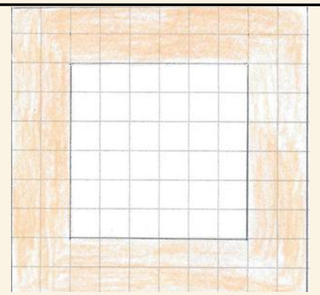
- Increase understanding of set theory and morphological operations

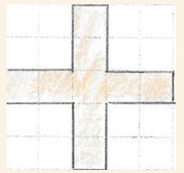
DILATION

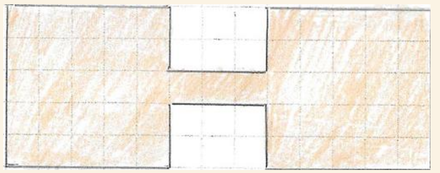
added pixels

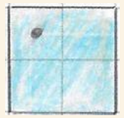
foreground pixels

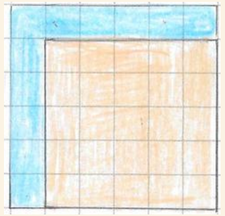


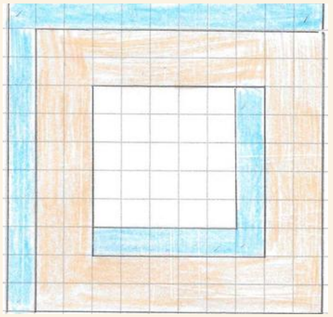


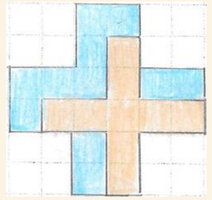


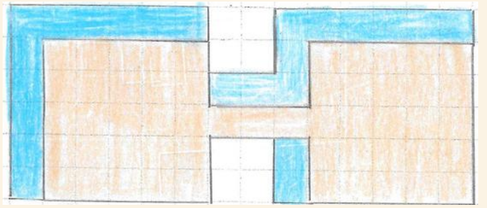


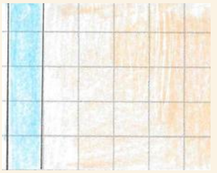


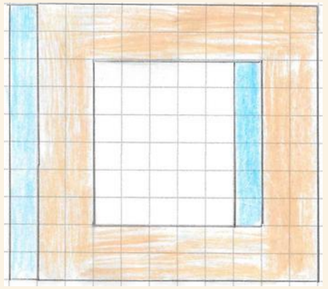


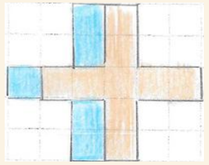


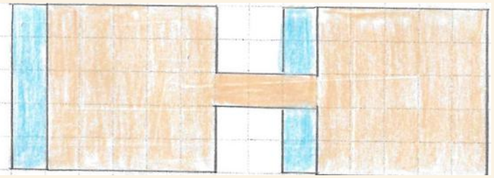


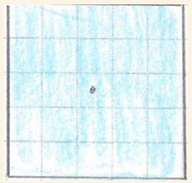


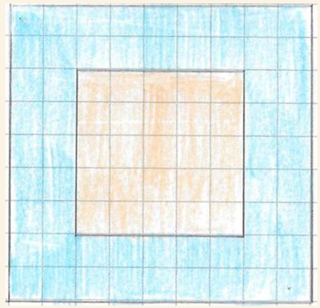


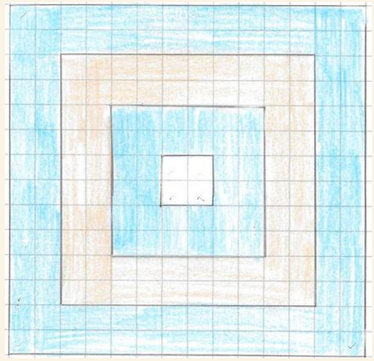


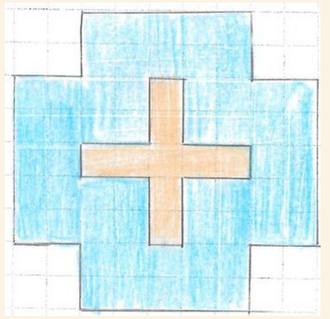


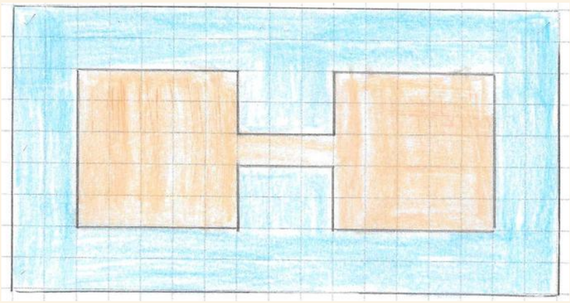








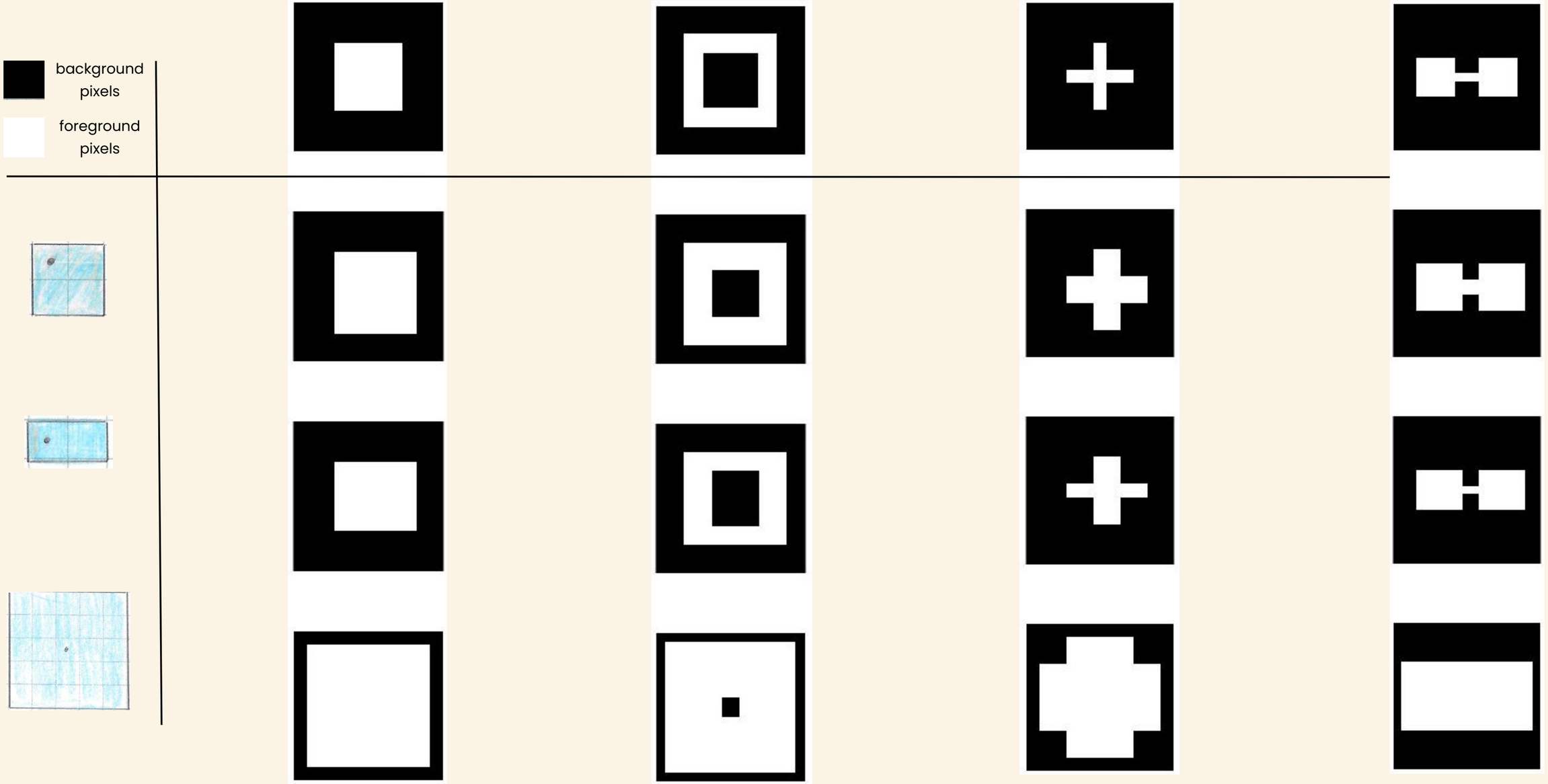




DILATION

background pixels

foreground pixels

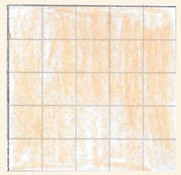


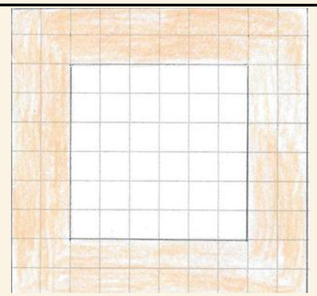
The predictions created on the paper were the same with the images formed in MATLAB.

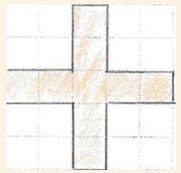
EROSION

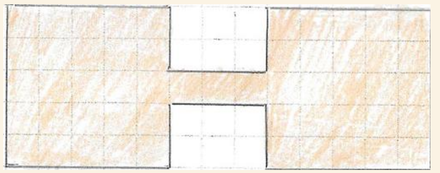
removed pixels

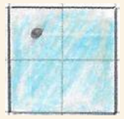
foreground pixels

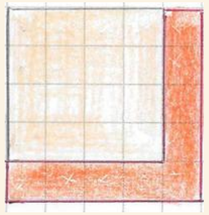


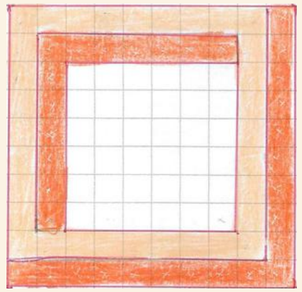


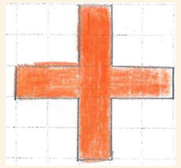


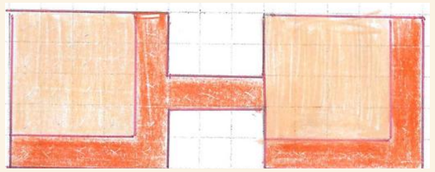


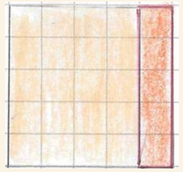


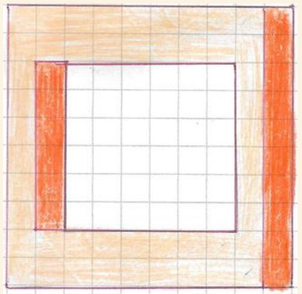


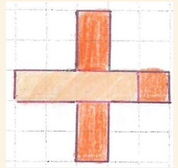


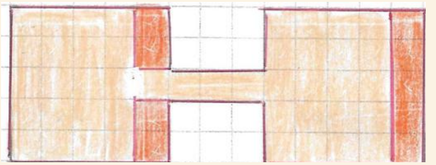


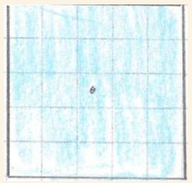


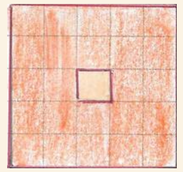


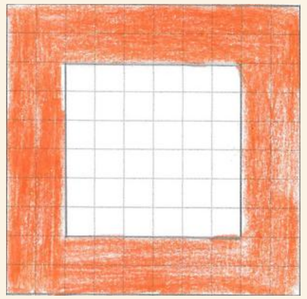


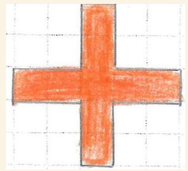


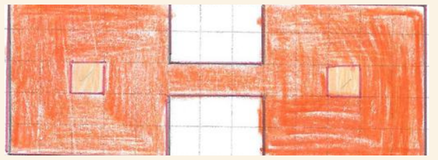








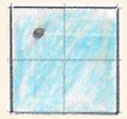


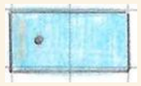


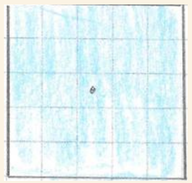
EROSION

background pixels

foreground pixels





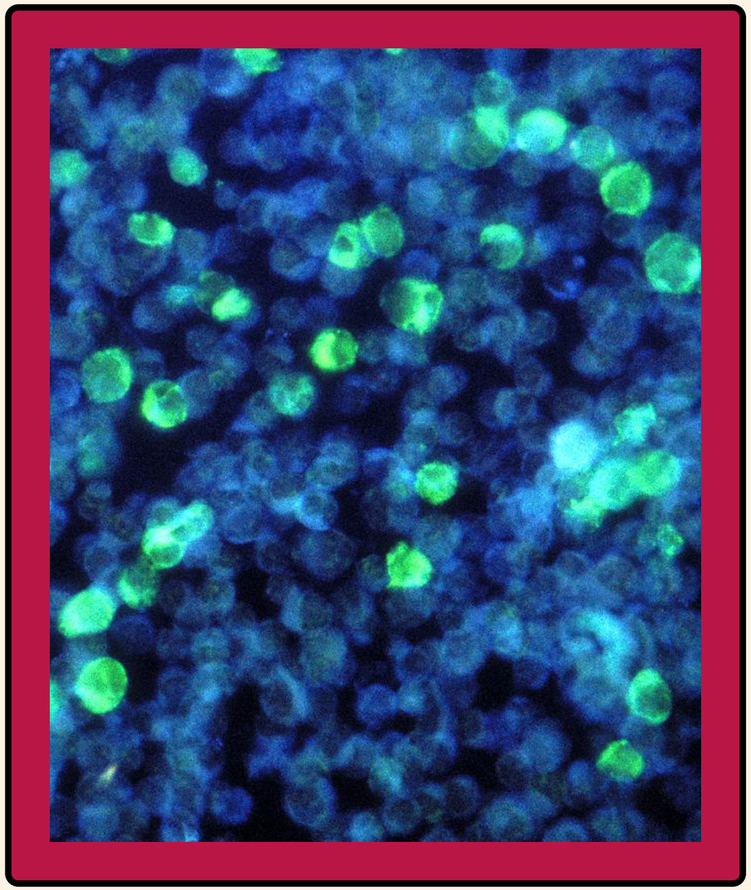


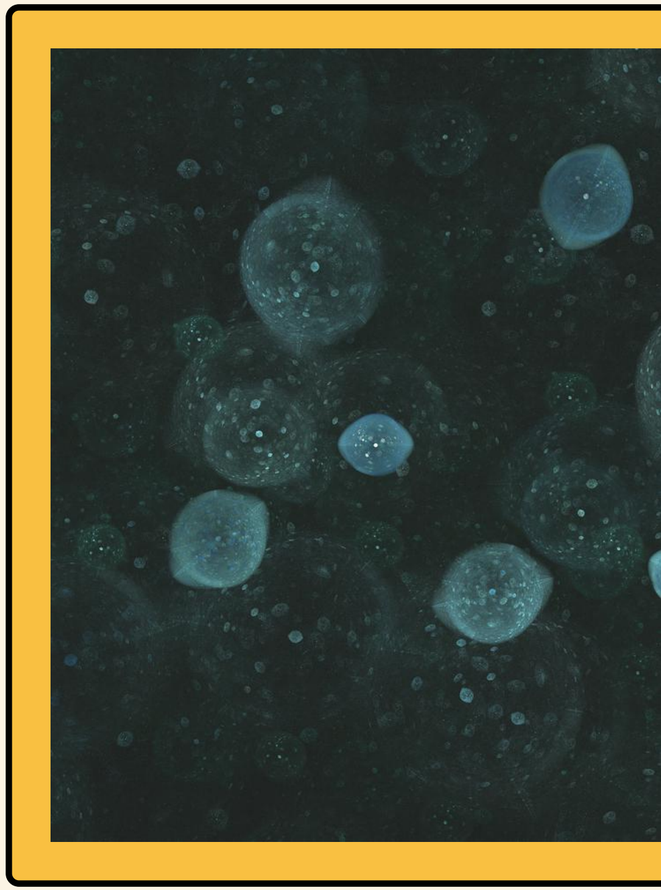
The predictions created on the paper were the same with the images formed in MATLAB.

ACTIVITY 6.2

Objectives:

- Use morphological operations in preparation for feature extraction





ACTIVITY 6.2

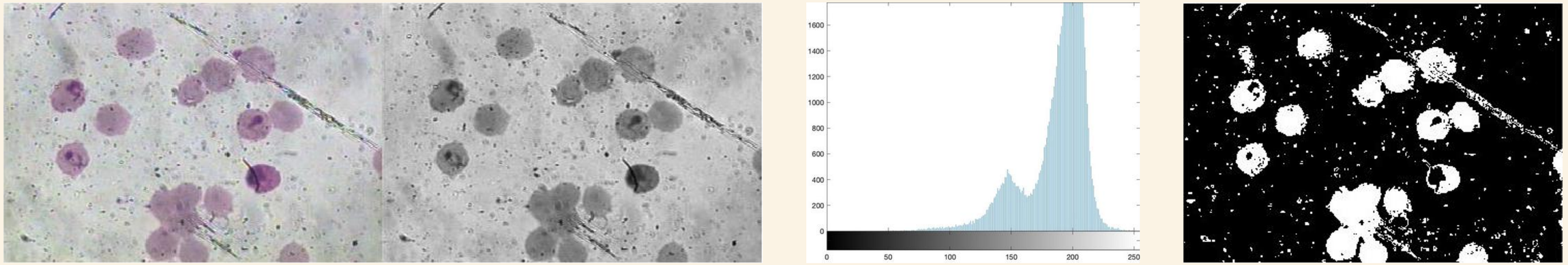


Figure 1. From left to right: original image, grayscale image, histogram of the grayscale image, and thresholded image such that the threshold is from 100 to 164 only.

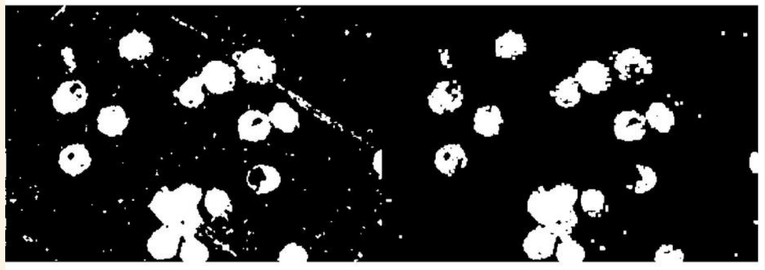


Figure 2. From left to right: using bwmorph with operation majority and open respectively.

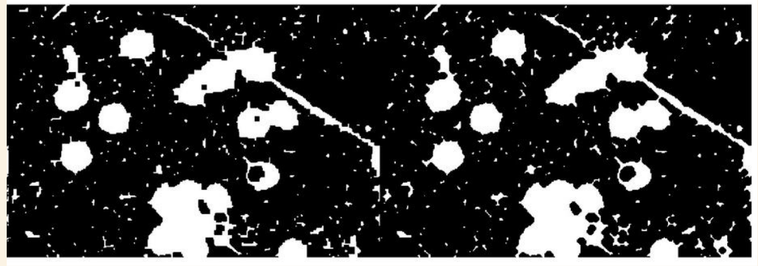


Figure 3. From left to right: using imclose with SE disk of radius 3 and 4, respectively.

Figure 4. From left to right: using imopen with SE disk of radius 3 and 4, respectively.

From the succeeding images above, we can see that the function that did the best in separating the cells in the image was the image produced by using imopen with structural element of a disk with radius 4. On the other hand, using bwmorph with operation *open* and *majority* also did a good job but some artifacts were still present.

ACTIVITY 6.2

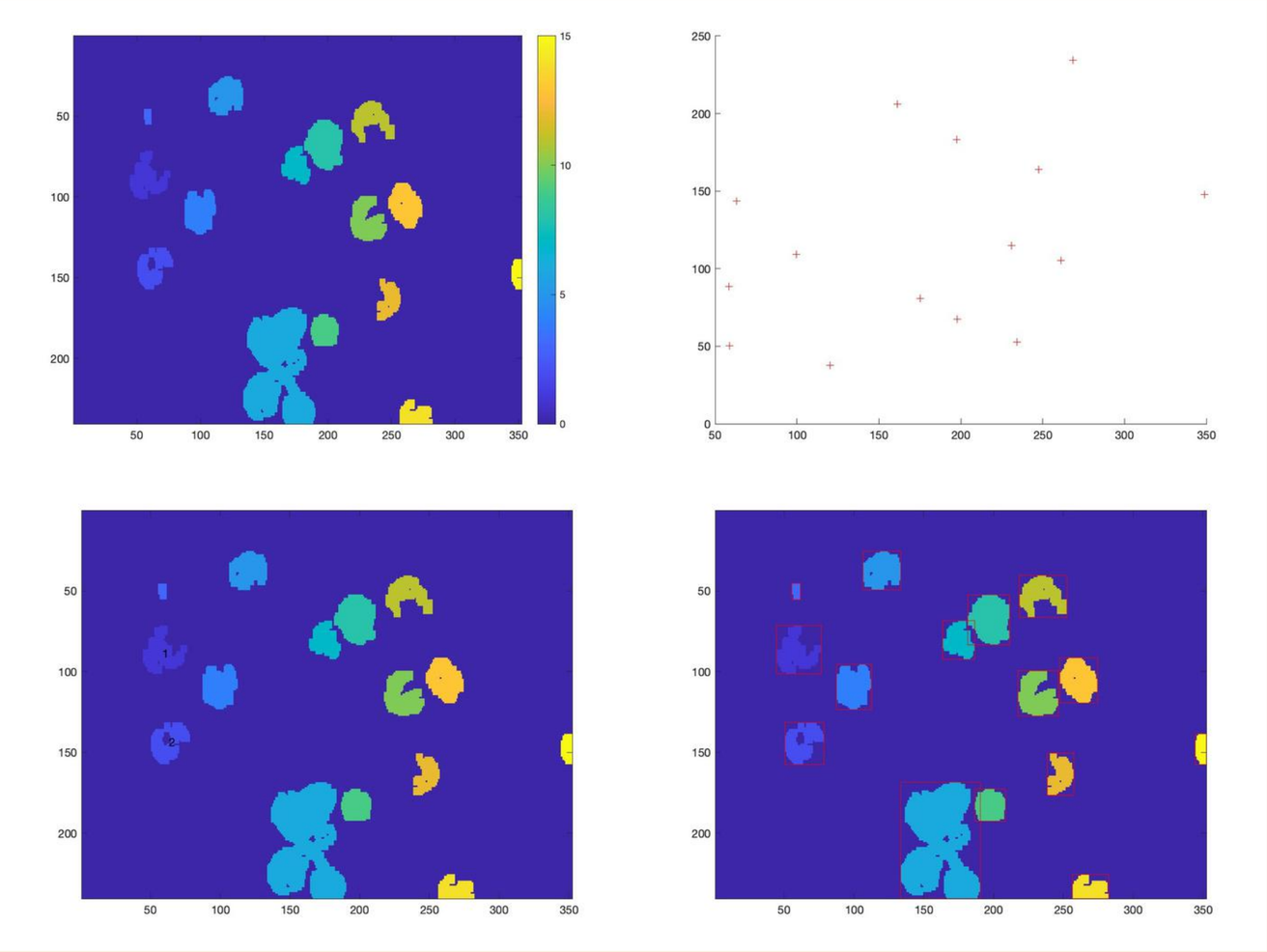


Figure 5. Regionprops of the image produced by imopen with SE of disk of radius 3

Here, we first assigned unique labels to the connected components in the binary image using **bwlabel**. Afterwards, we used **regionprops** to calculate the centroid and bounding box for the connected components. Although **regionprops** can also calculate other properties, I've limited my codes to only getting the centroid and bounding boxes.

- **imdilate** expands regions and **imerode** shrinks regions in a binary image.
- **bwmorph** is a versatile function that allows wide range of morphological operations such as close and open on binary images. This can be used as an alternative for **imclose** and **imopen** although with some limitations such as not being able to decide the structural element to be used.
- **imclose** closes small gaps or breaks in binary images (dilation then erosion), while **imopen** removes small structures and separates touching objects (erosion then dilation).
- **regionprops** is used to compute properties of connected components or regions in binary or labeled images such as area, perimeter, centroid, etc.

REFLECTION

RATING: 100 / 100

Although I was busy for the past weeks, engaging in this type of activity not only excites me but also fuels my curiosity and enthusiasm. It's a rewarding experience that motivates me to continue exploring and learning more regarding image processing and later on machine learning. I would like to thank my VIP lab mates for their continuous support and guide in doing this activity. They sure know how to lighten the burden that every tasks carry.

References

https://www.mathworks.com/help/images/morphological-filtering.html
https://towardsdatascience.com/understanding-morphological-image-processing-and-its-operations-7bcf1ed11756