CSMS 630 Project 2- Image Segmentation

By: Kirtan Shah

This project is combination of different filters and conversions. It is written in Python and process 499 images in a span of 2.5 hours. The GitHub link for this project is [here](). There is a configuration .ini file *(userConfiguration.ini)* attached with the project which must be place in the same folder as the main python file. The user my edit the .ini file to receive different results. To get the most optimum results please follow the format of the already established values within the ini file. The output and original images are store in Google drive.

The image path must complete path to the images:

- C:/Users/user/Cancerous cell smears/*

The output path must complete path to the directory to store the images:

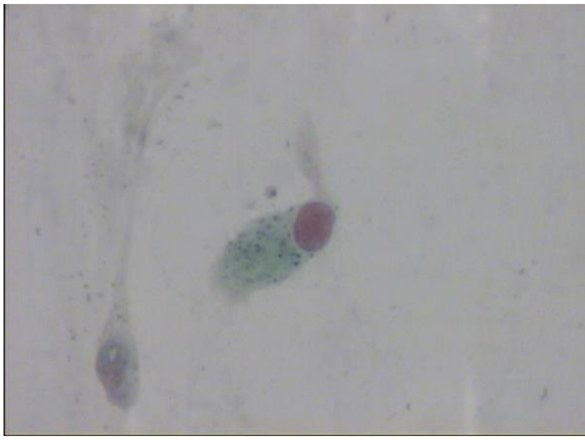
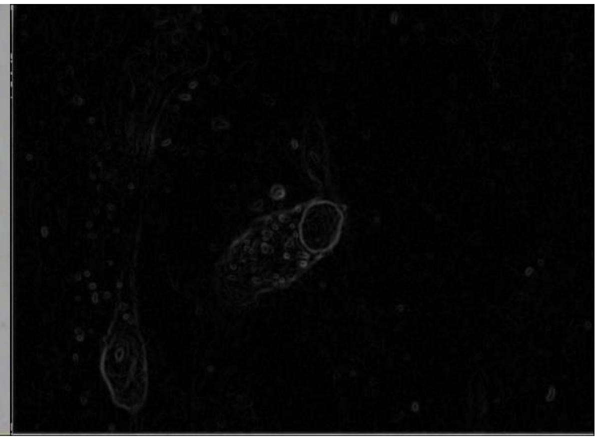
- C:/Users/user/Documents/output

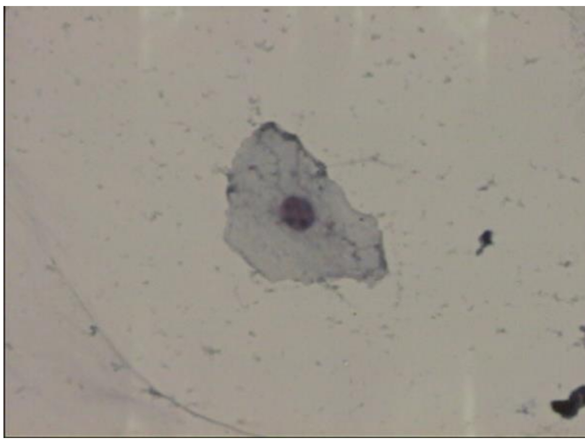
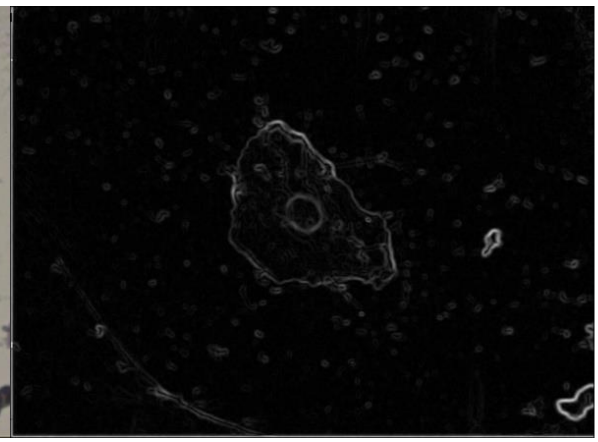
Edge Detection Operators

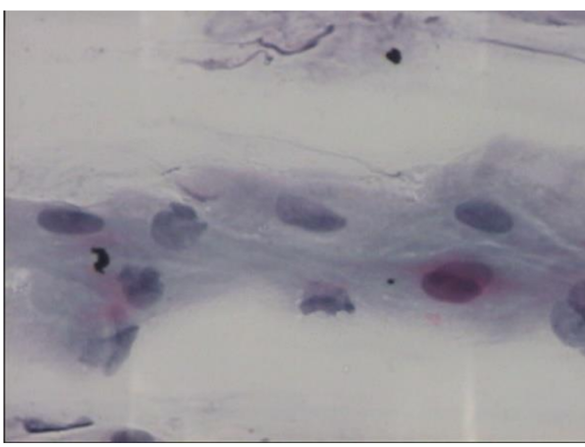
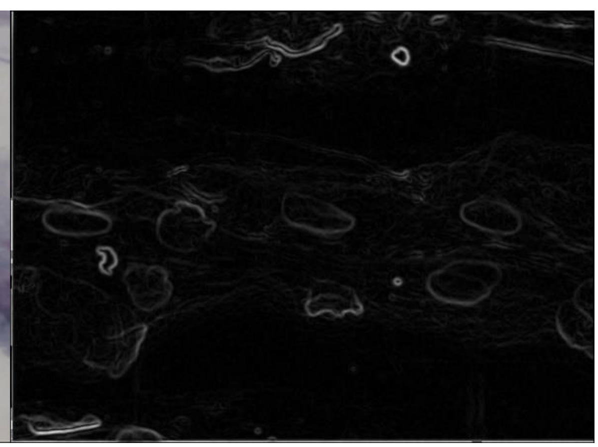
This operator uses a 3x3 gradient kernel with specific positive and negative weights. The kernel convolves over the image in both X and Y directions. The two images are then concatenated together to form an image with the edges viewable to the naked eye. The greater the weights the more defined the edges. For all operators the process was fairly similar. First, I prepared the filter then I selected 3x3 test area from the image and multiplied by the filter and appended to a list. Then I take the sum of the list and replace the targeted pixel value with the sum.

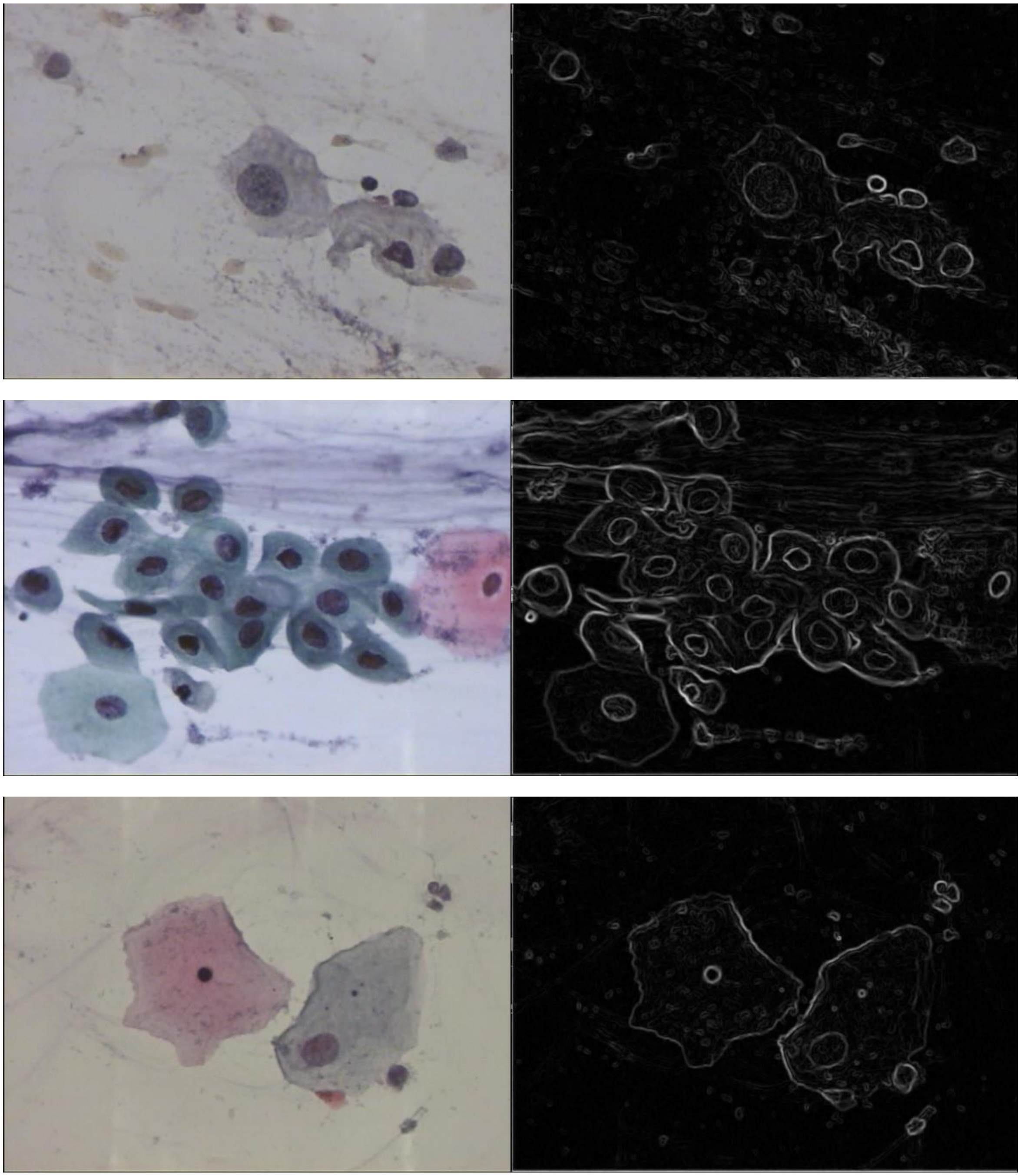
I have provided areas where the user could specify the directional (X,Y) weights for Sobel, Improved Sobel, Prewitt, and Roberts. I struggled a bit with the compass operator. I was not able to get the desired pixel value for the final image.

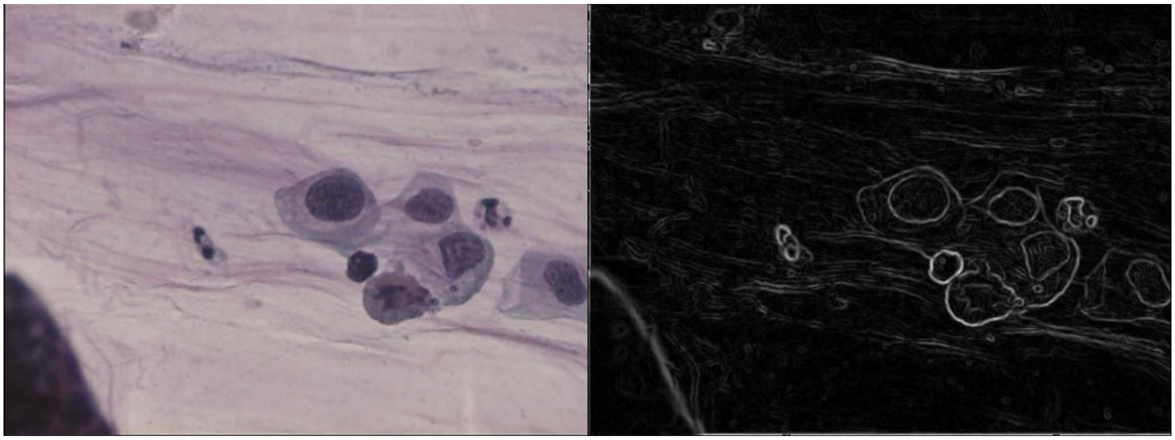
- Sobel Operator | X = {-1,0,1,-2,0,2,-1,0,1} | Y = {1,2,1,0,0,0,-1,-2,-1}

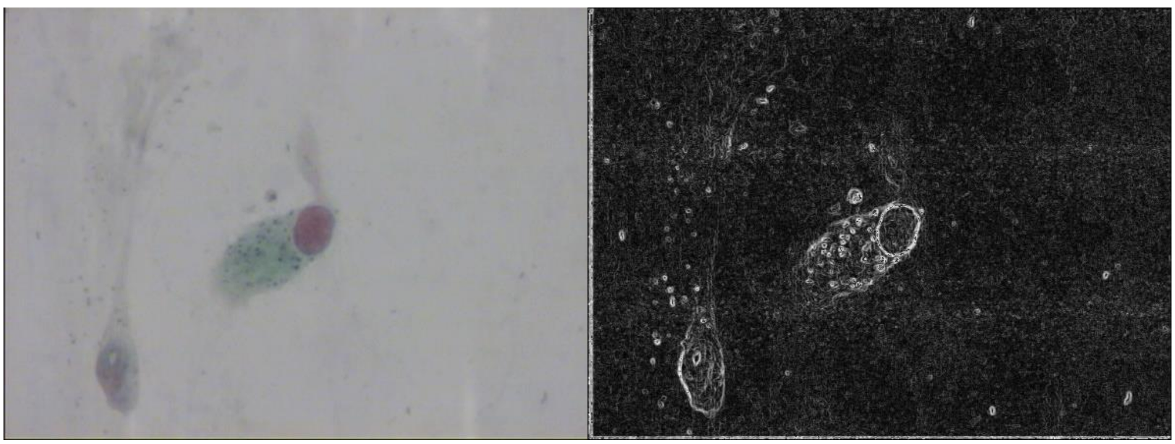



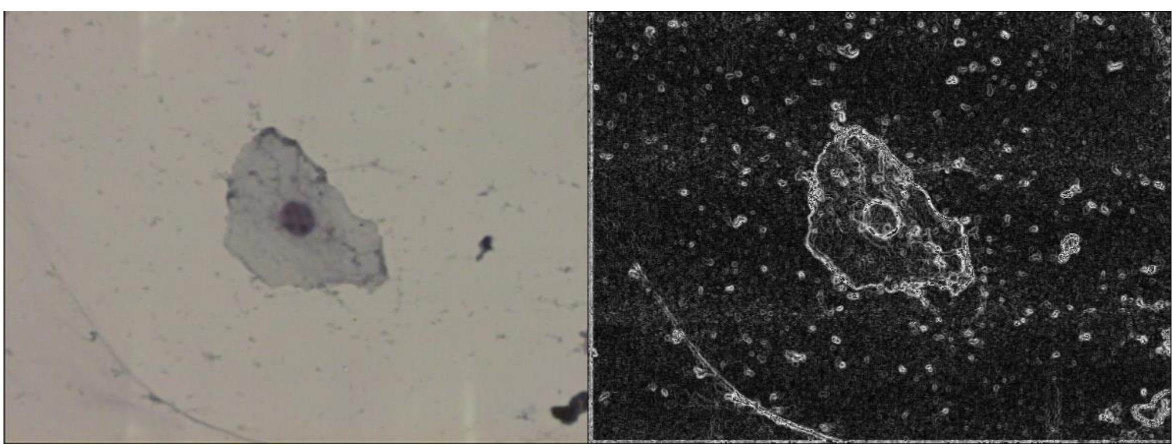



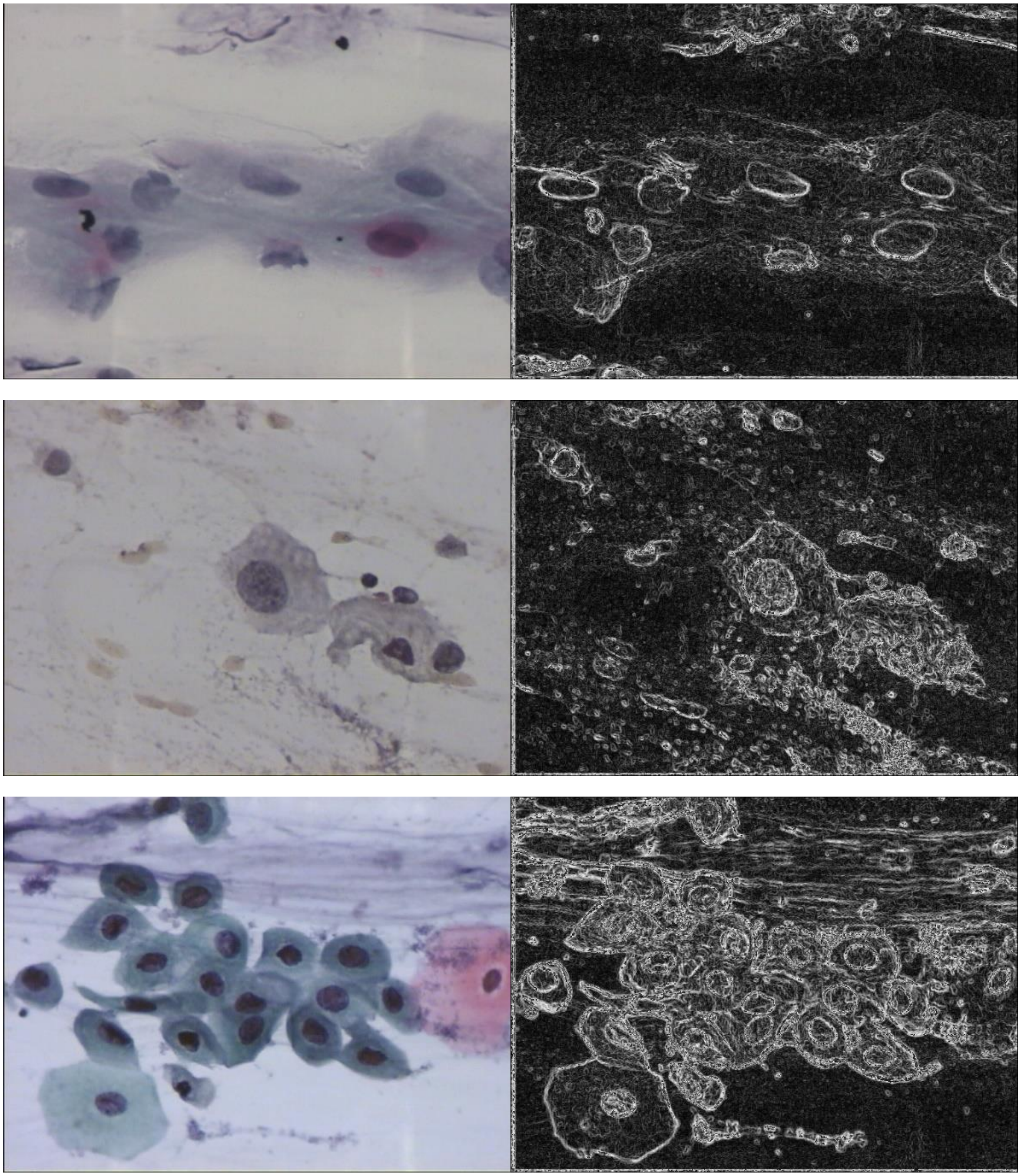


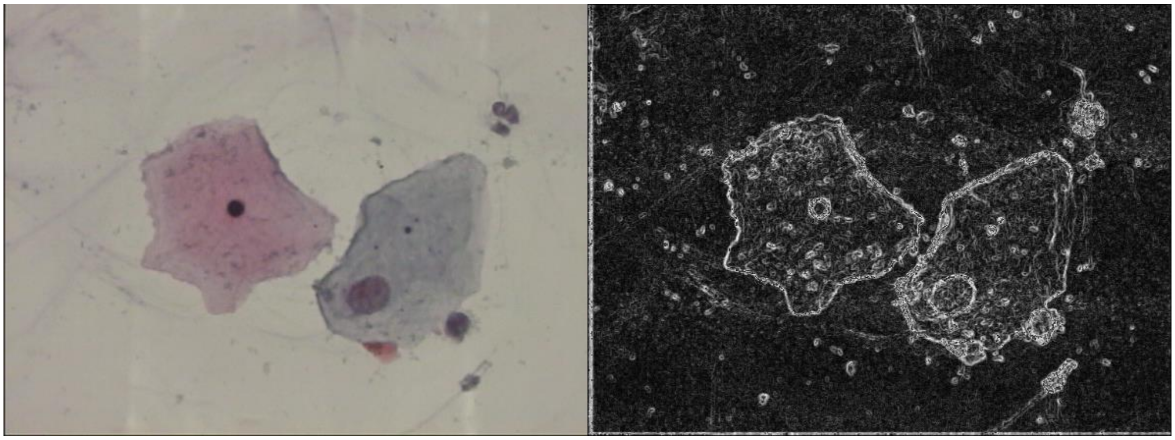


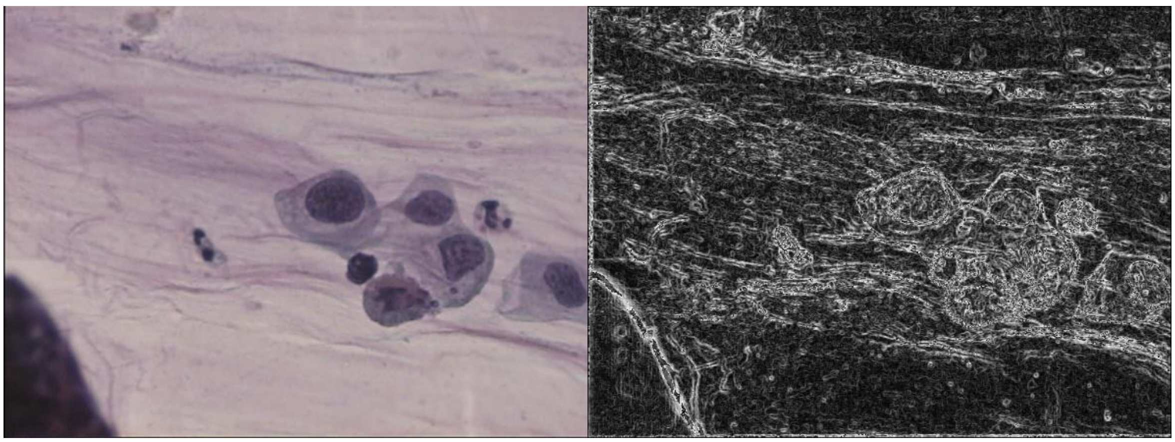
- Improved Sobel Operator | X = {-3,0,3,-10,0,10,-3,0,3} | Y = {3,10,3,0,0,0,-3,-10,-3}



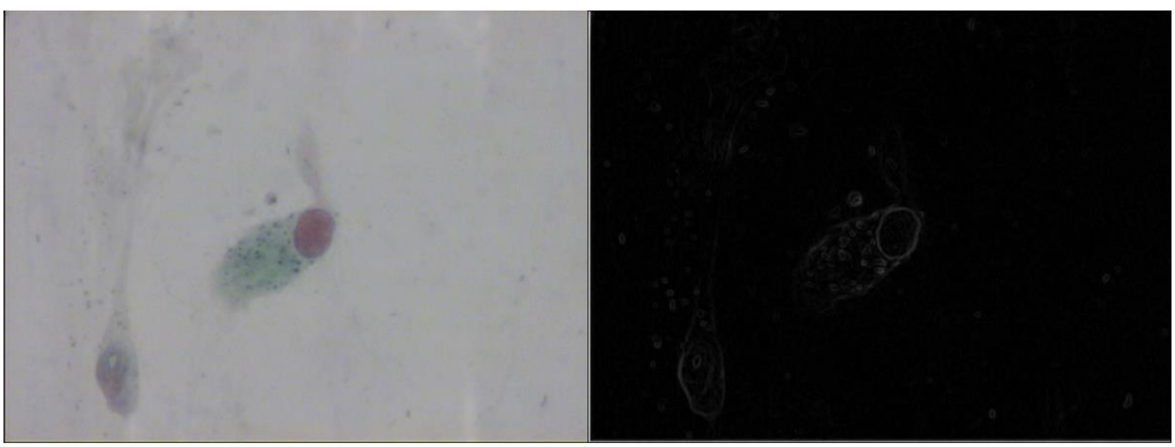


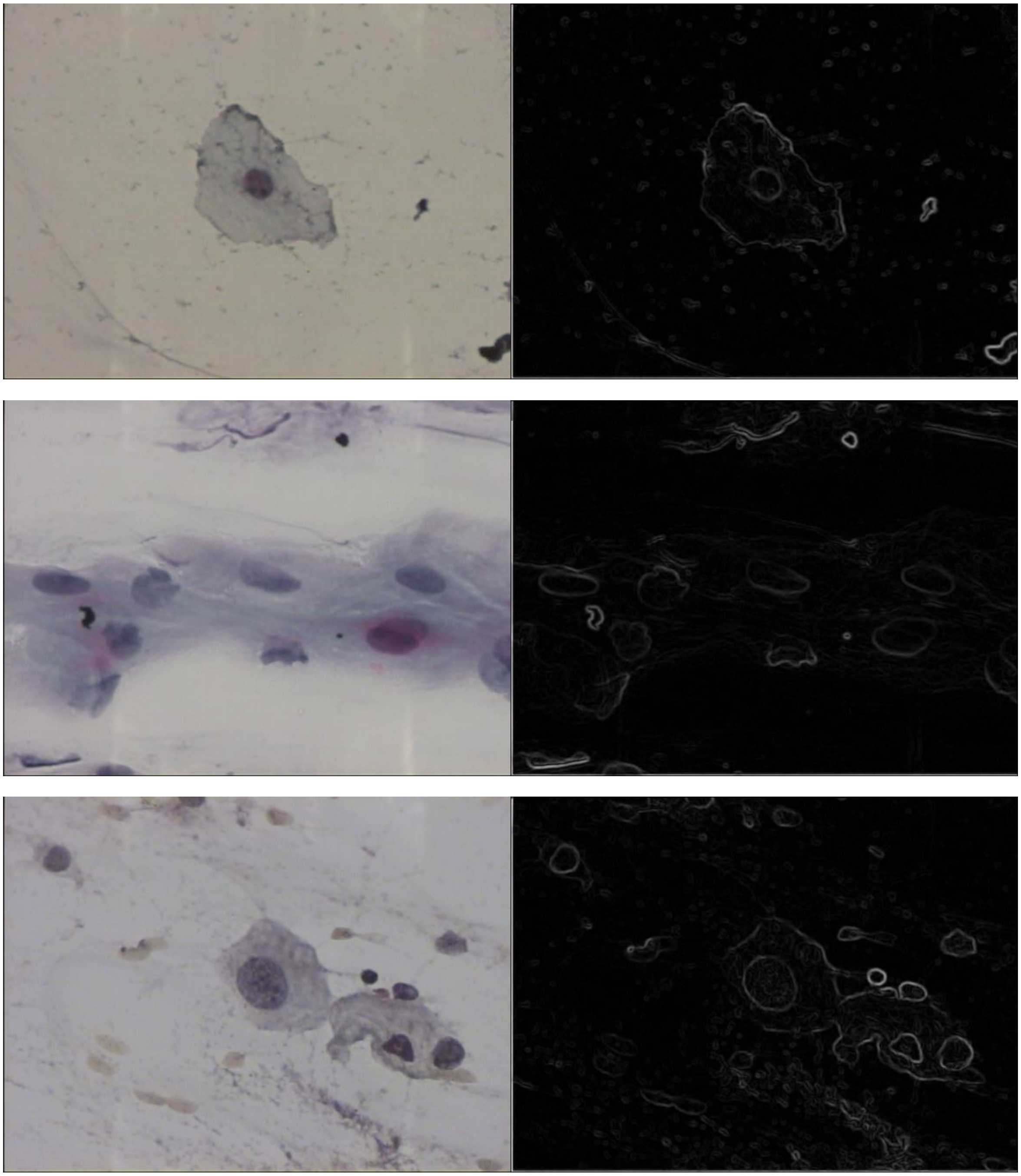


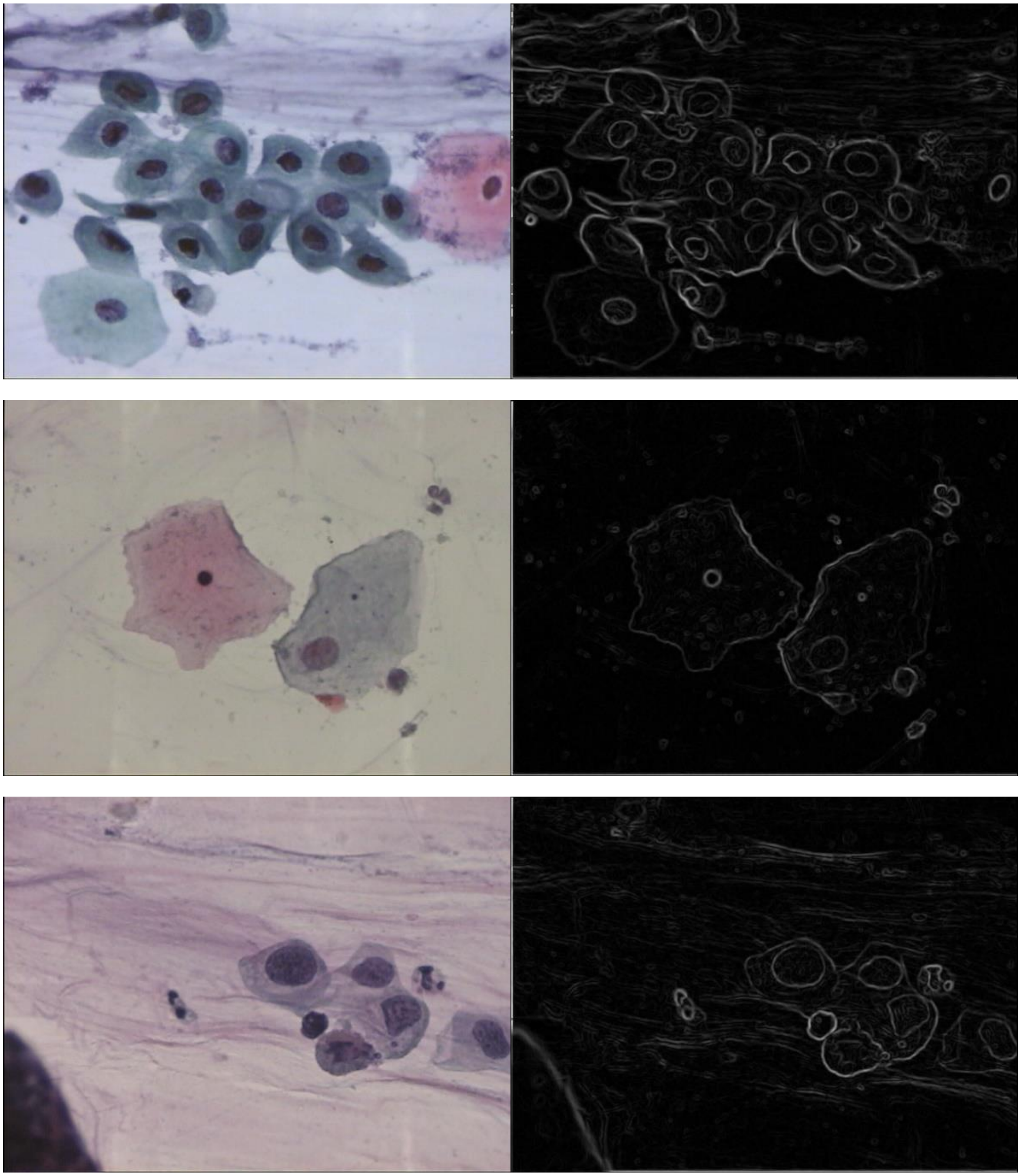




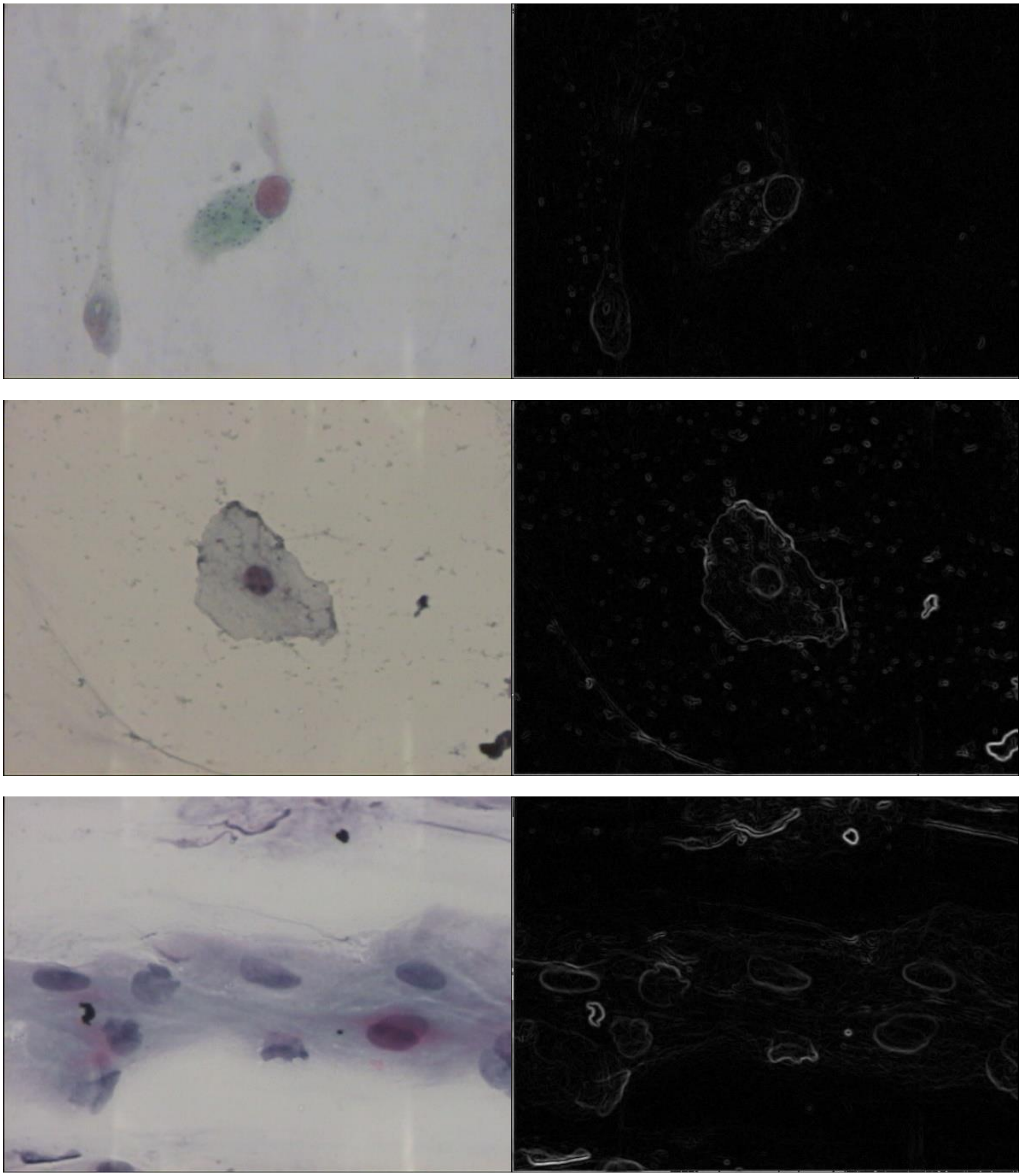
- Prewitt Operator | X = {-3,0,3,-10,0,10,-3,0,3} | Y = {3,10,3,0,0,0,-3,-10,-3}

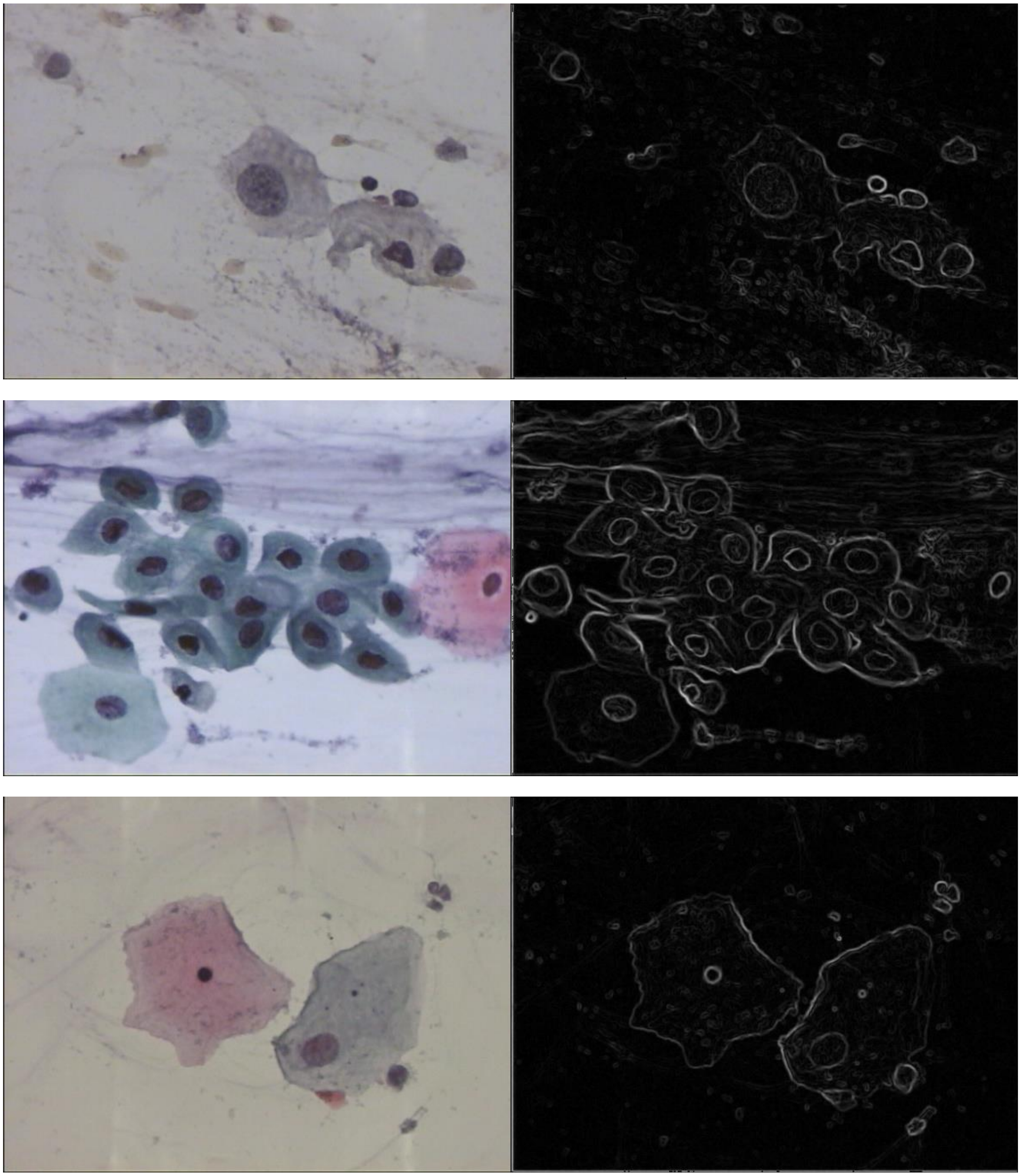


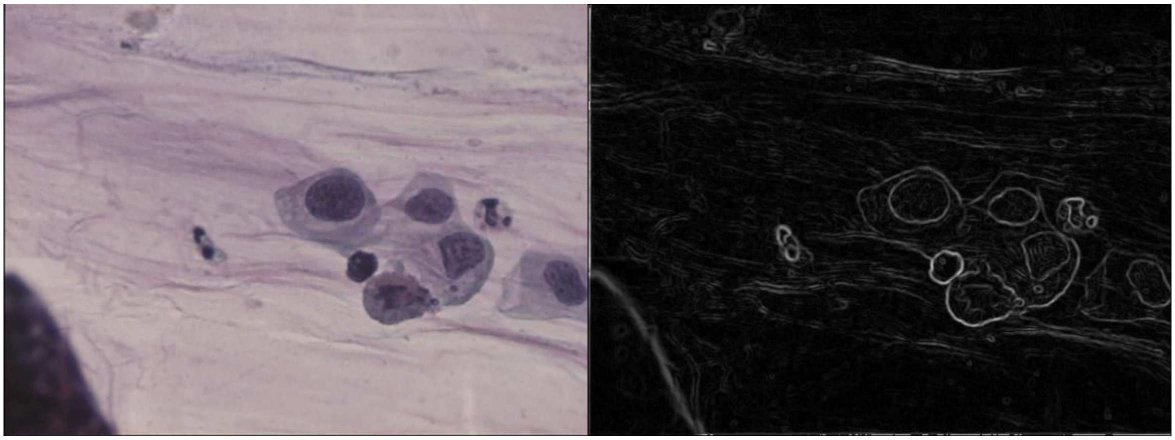




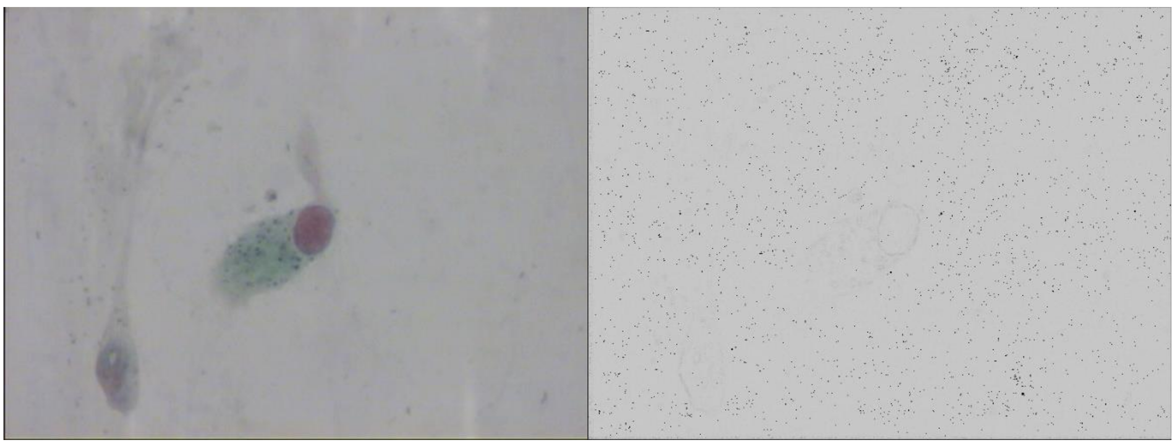
- Roberts Operator | X = {5,0,0,-5} | Y = {0,5,-5,0}

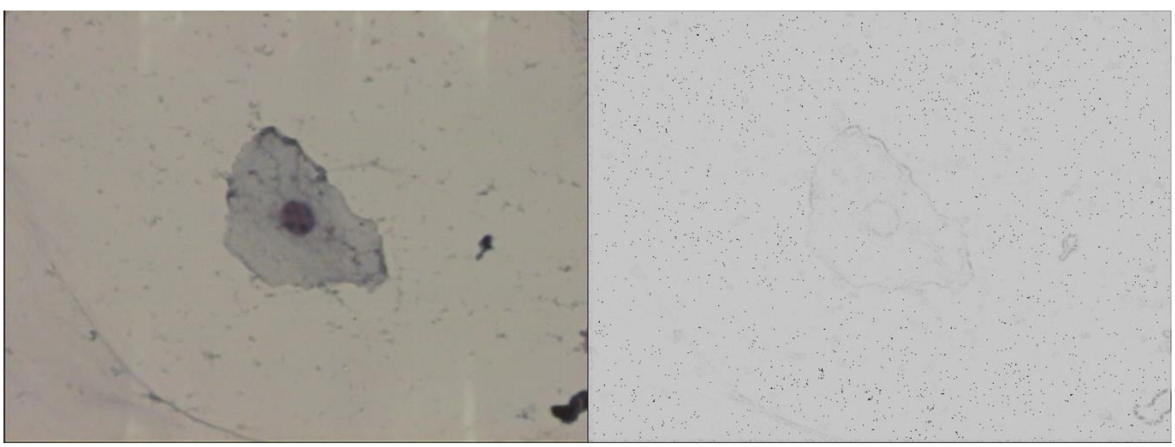


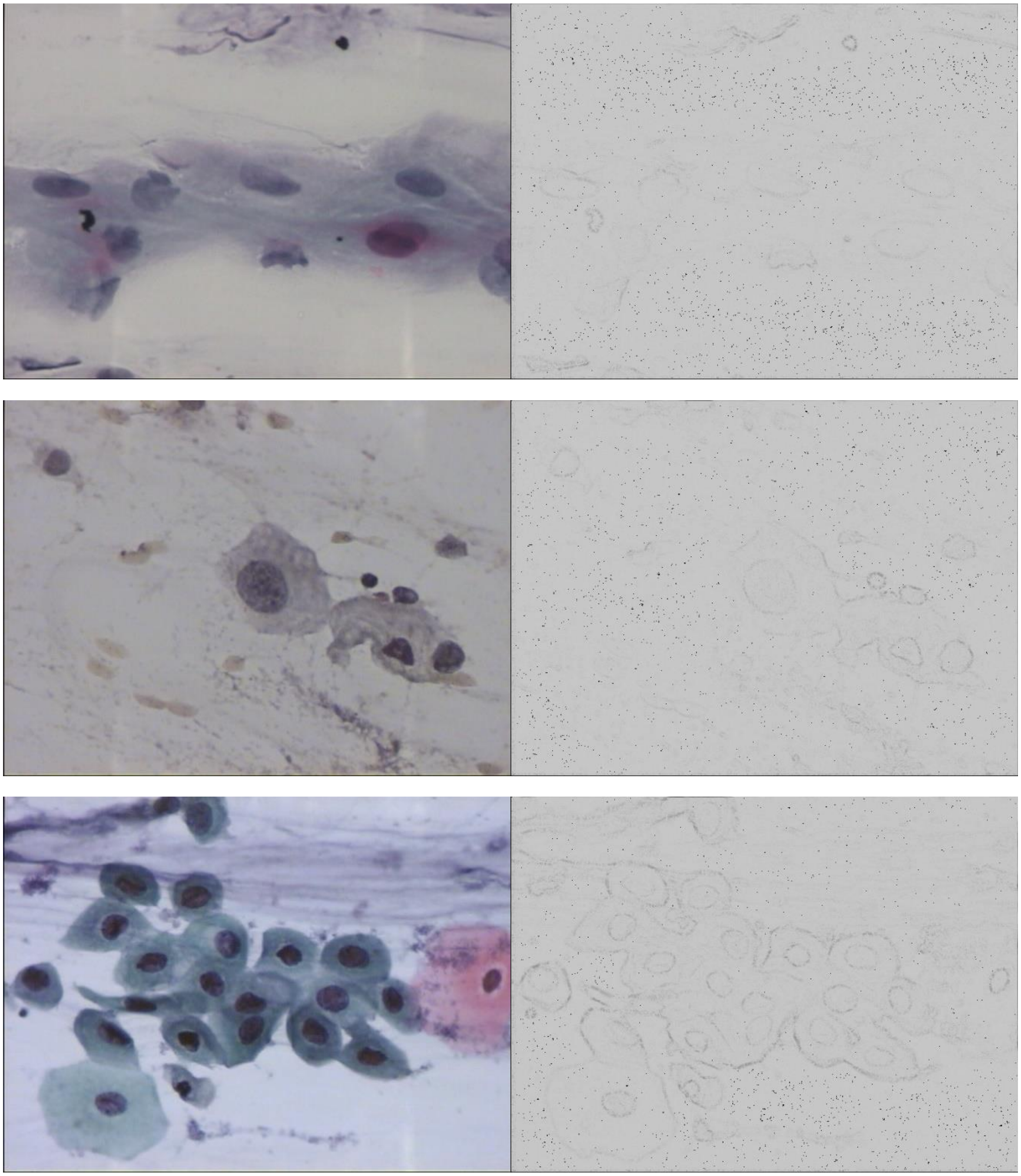




- Compass Operator







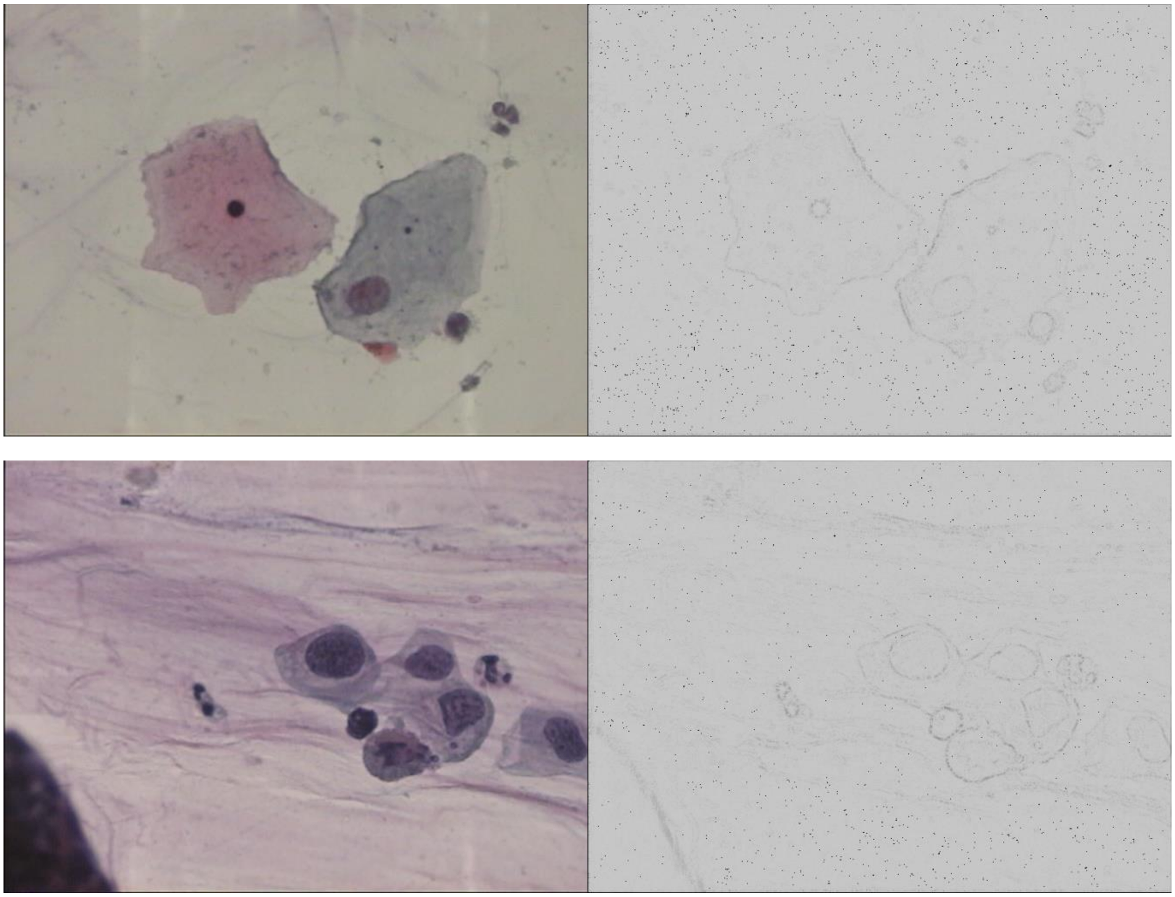
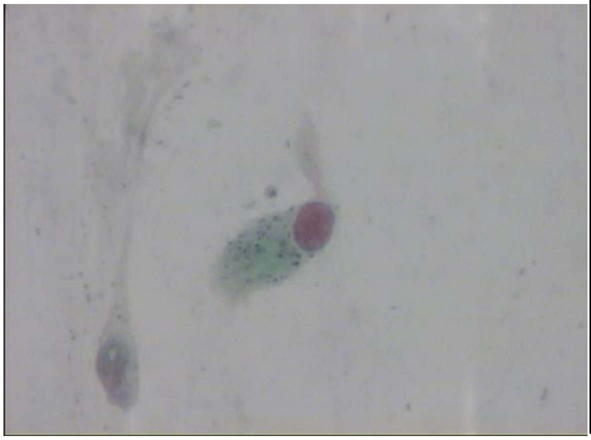
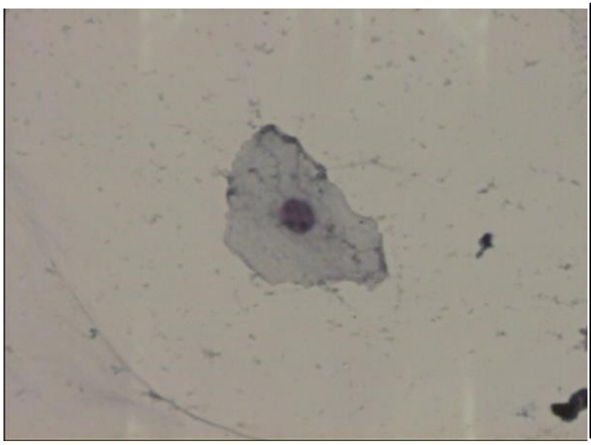
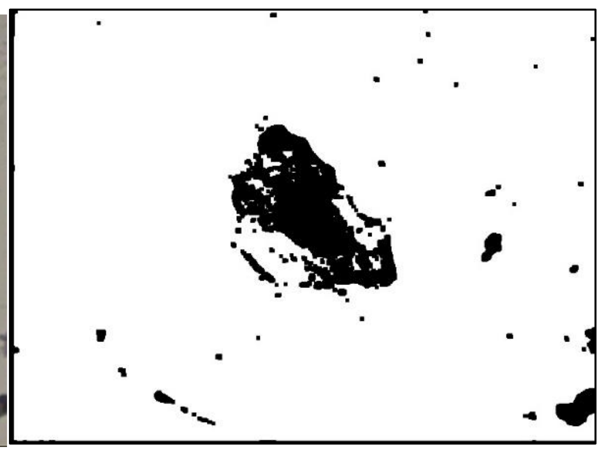


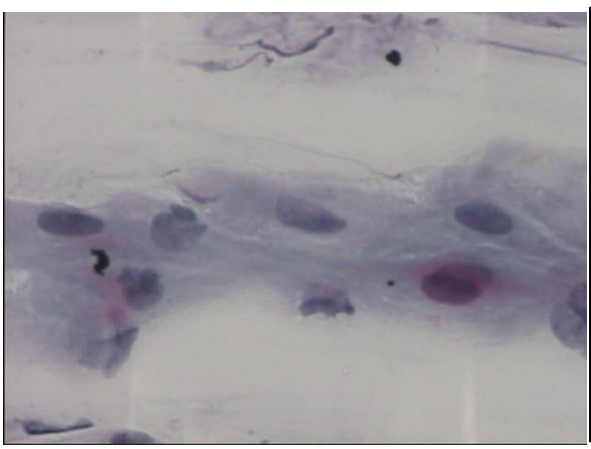
Image Erosion and Dilation

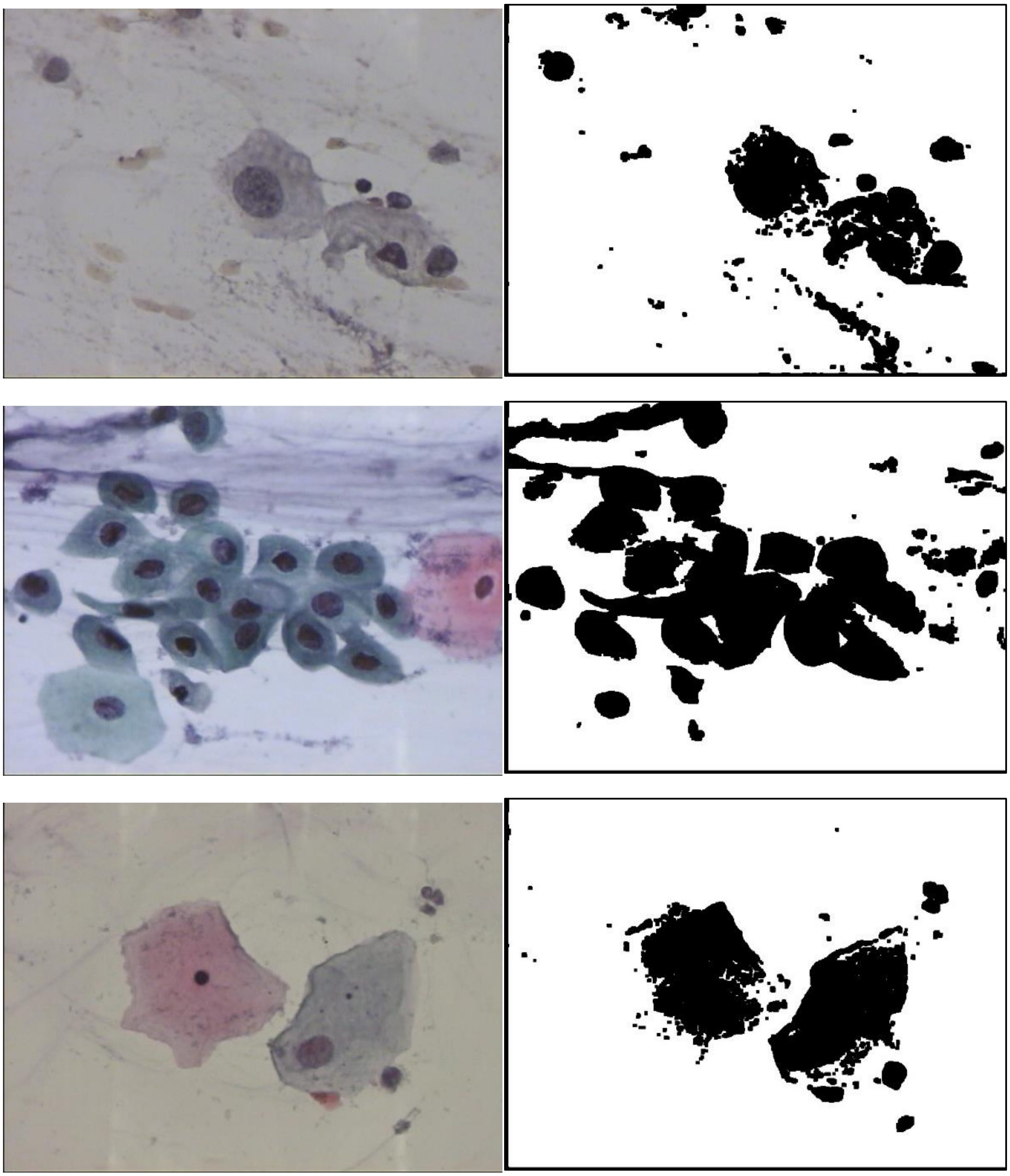
This process either enlarges or shrinks the objects within the images. Dilating the image removes blanks and also helps separate the objects within the image. Erosion, make the image smaller. Removing an arbitrary pixel and helps focuses the main objects within the image.

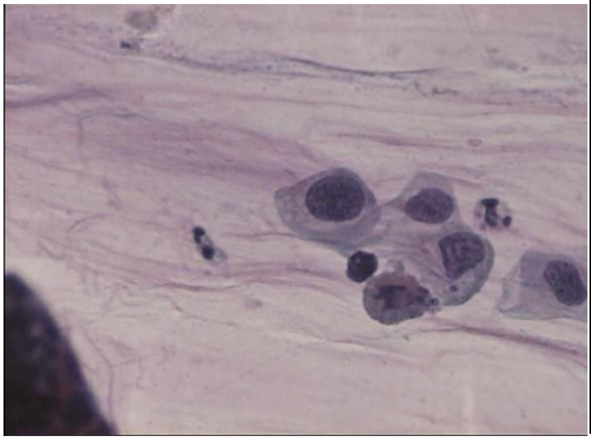
- Erosion Operator | Box Kernel | Kernel = {1,1,1,1,1,1,1,1,1}



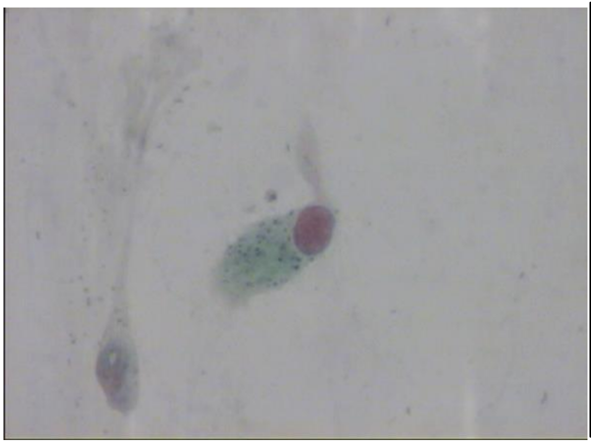
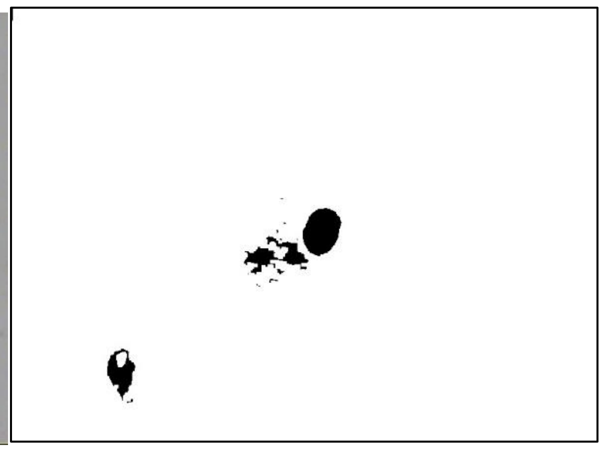




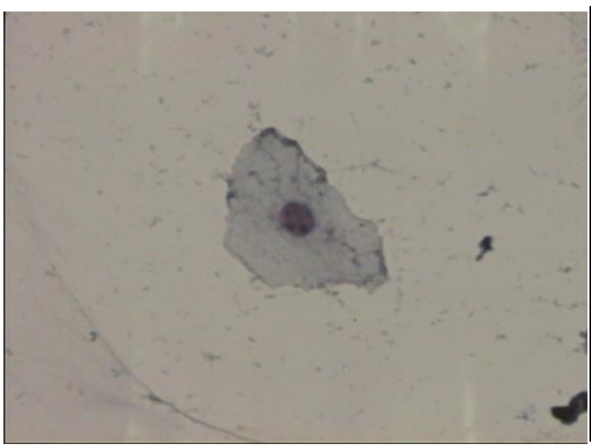
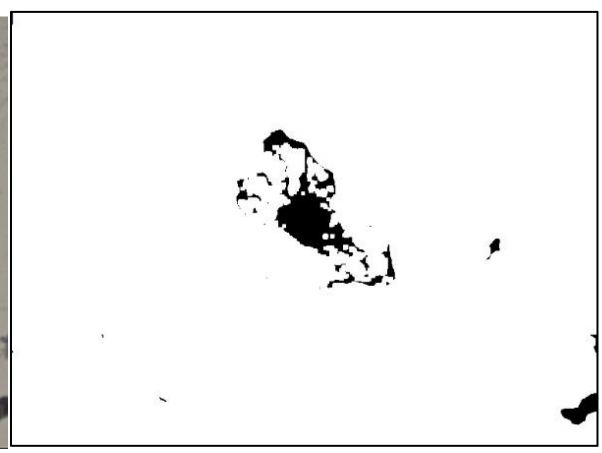


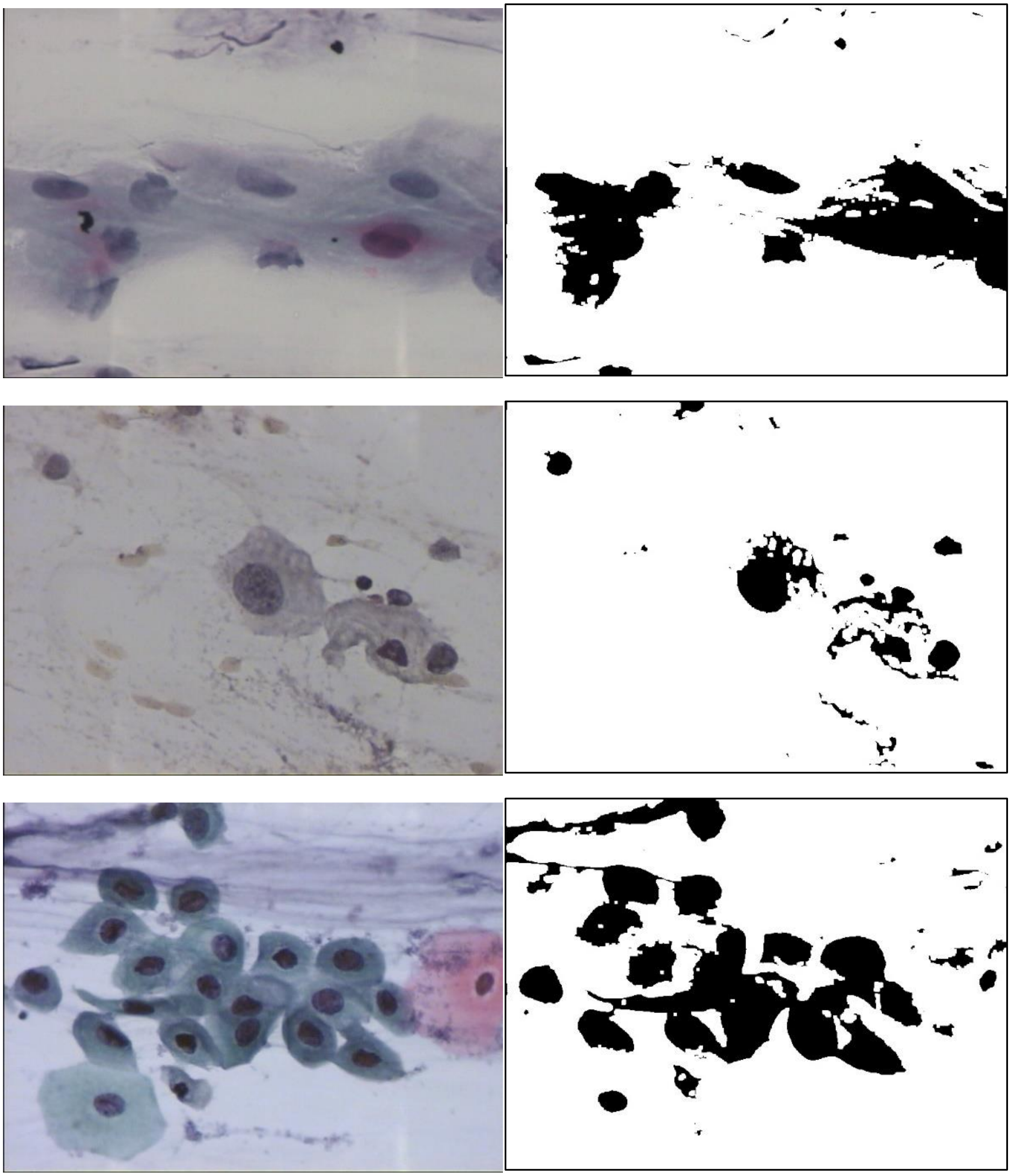



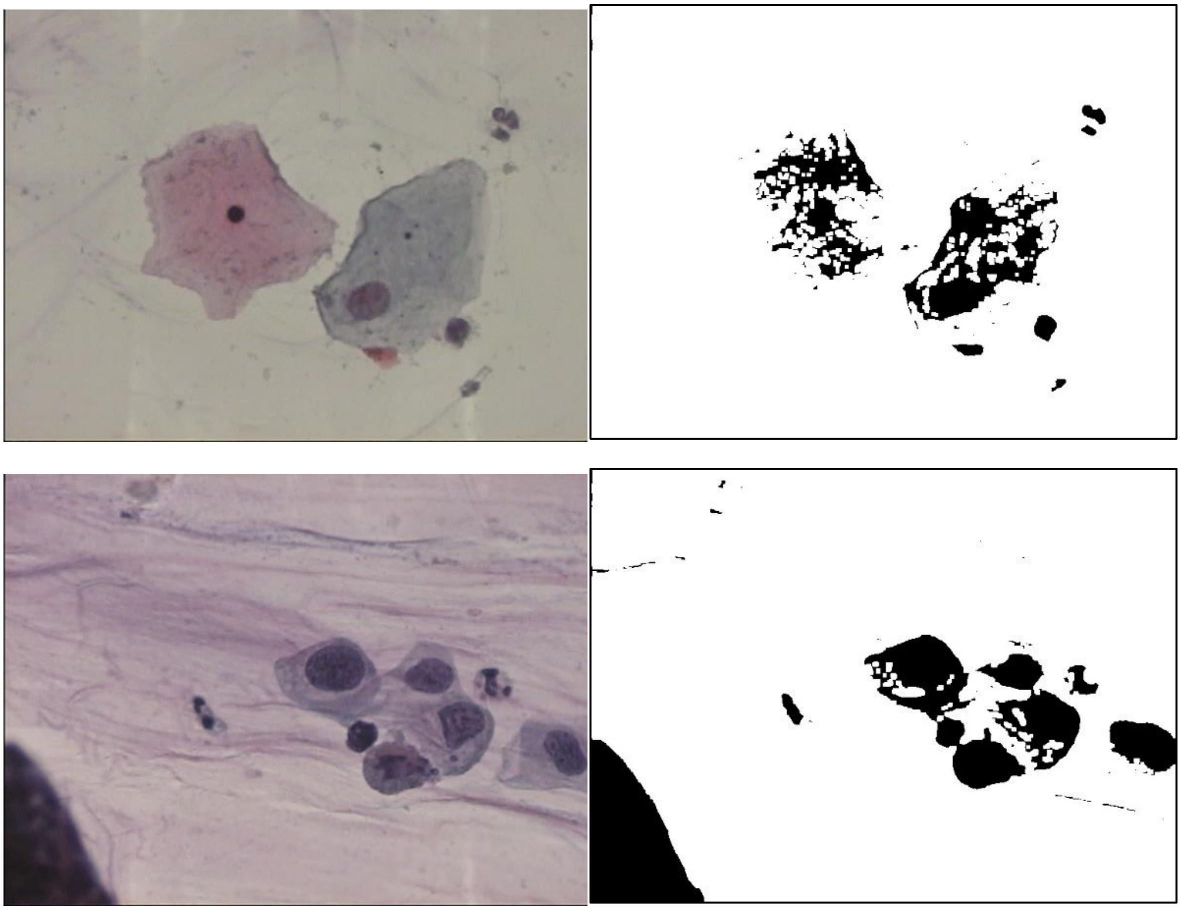



- Dilation Operator | Box Kernel | Kernel = {1,1,1,1,1,1,1,1,1}

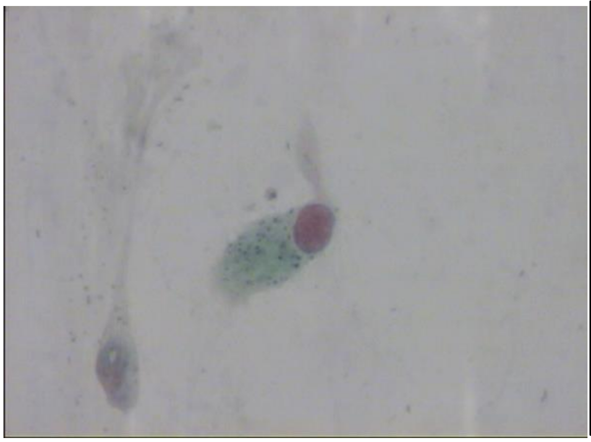


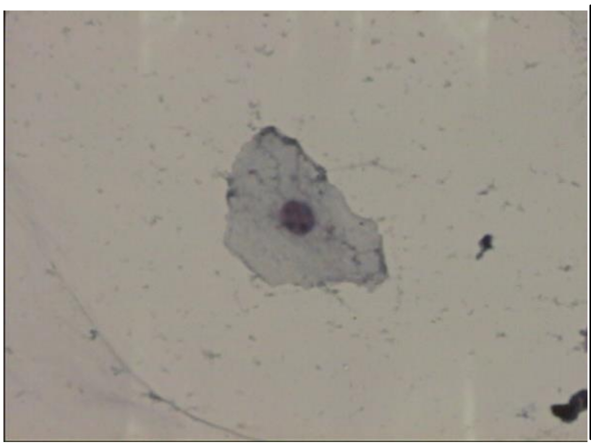
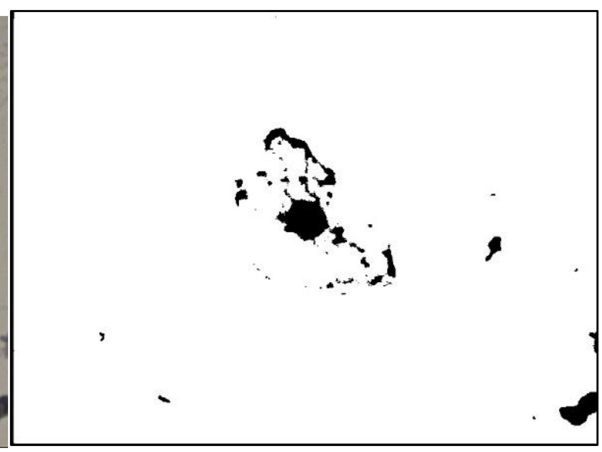


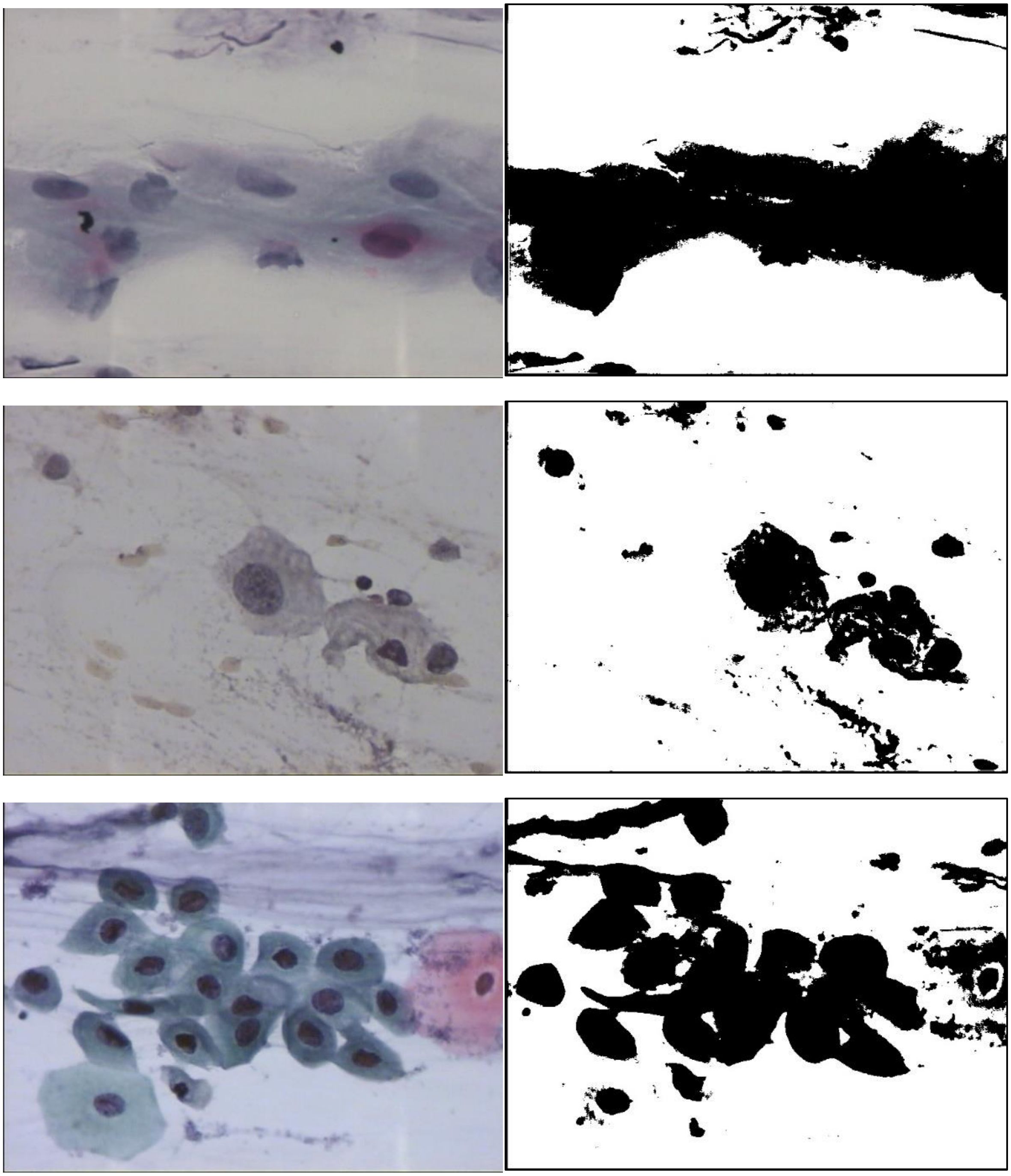
Segmentation Techniques

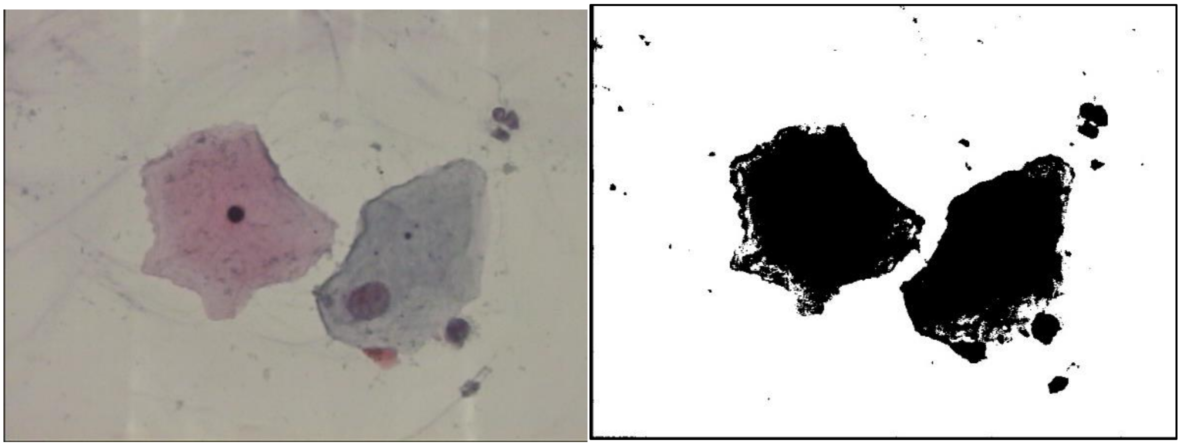
These techniques are used to distinguished the objects within the images by either darkening the object and bringing it to the foreground while simultaneously lightening the background. This is used throughout the Histogram thresholding method. Multiple images can be found using the K Mean segmentation method where the number the of clusters could identify different levels of depth. Level of depth could identify the multiple objects. The greater number of clusters the more objects can be highlighted.

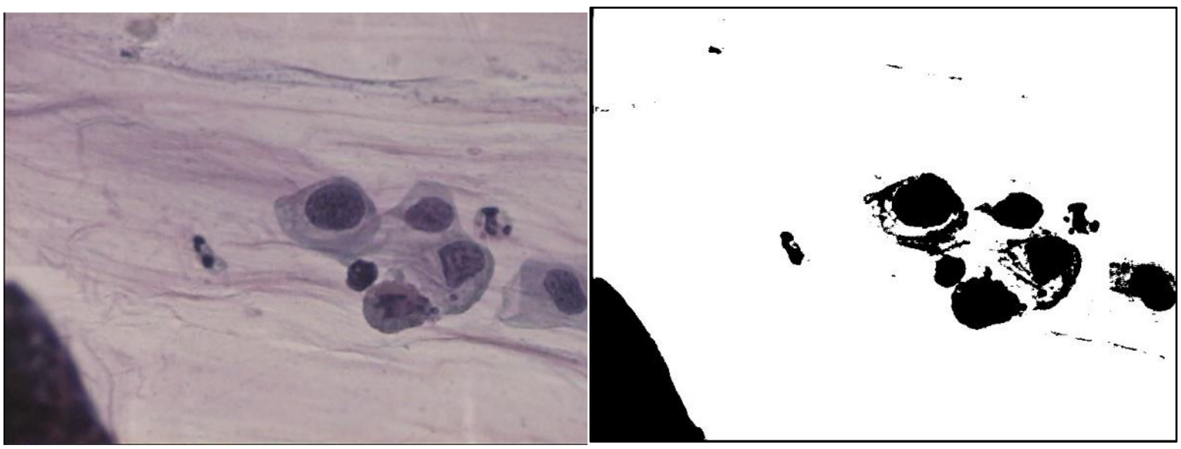
- Histogram Thresholding



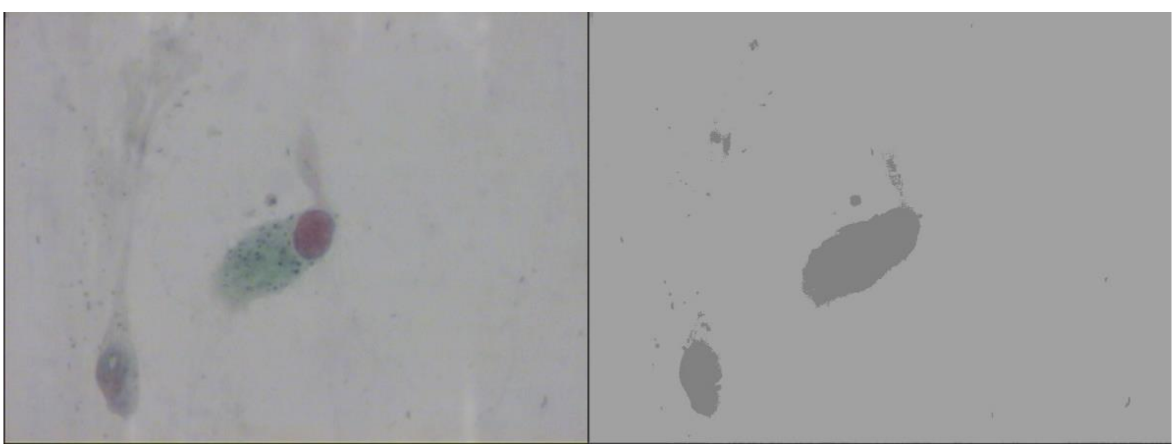



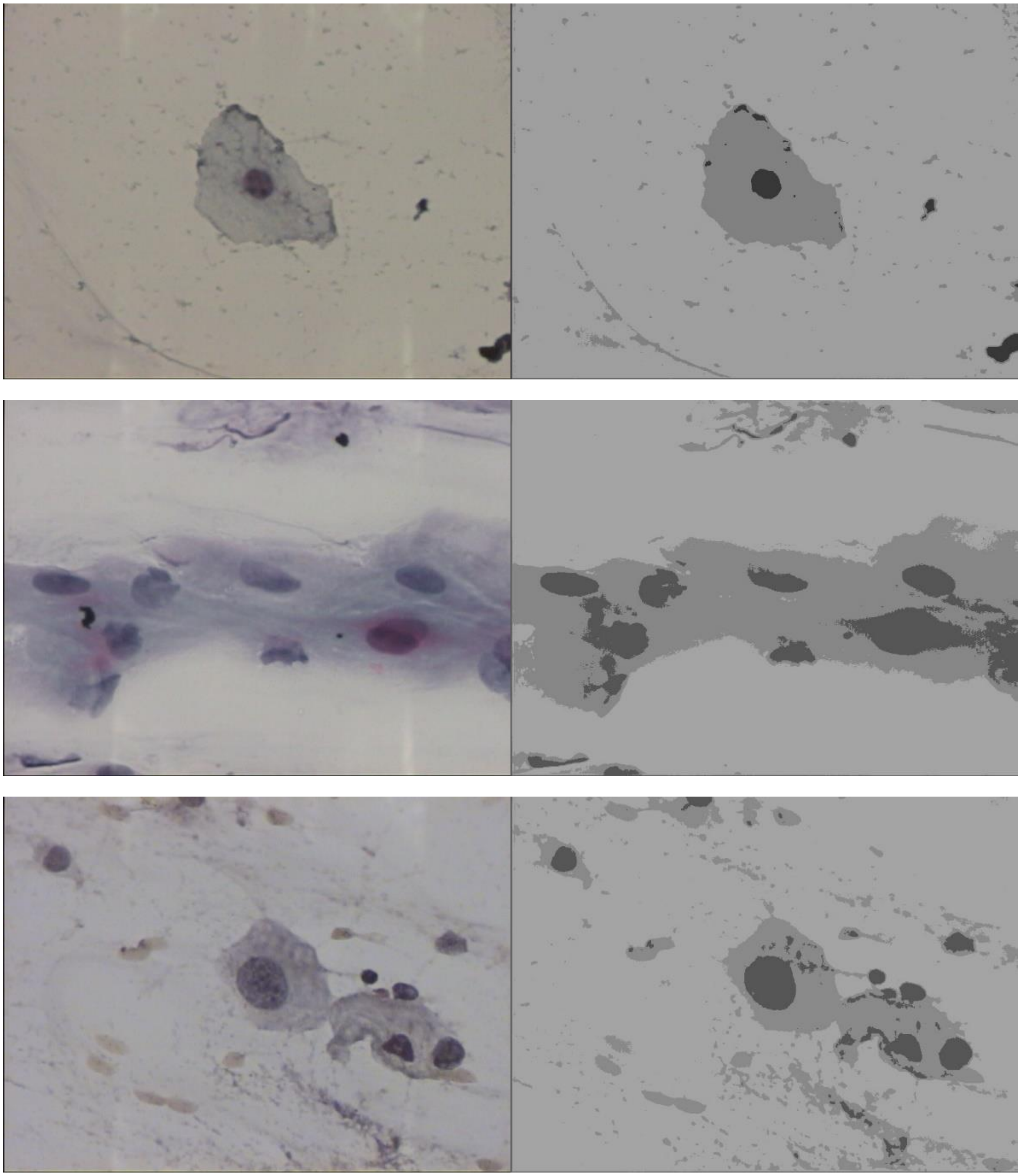


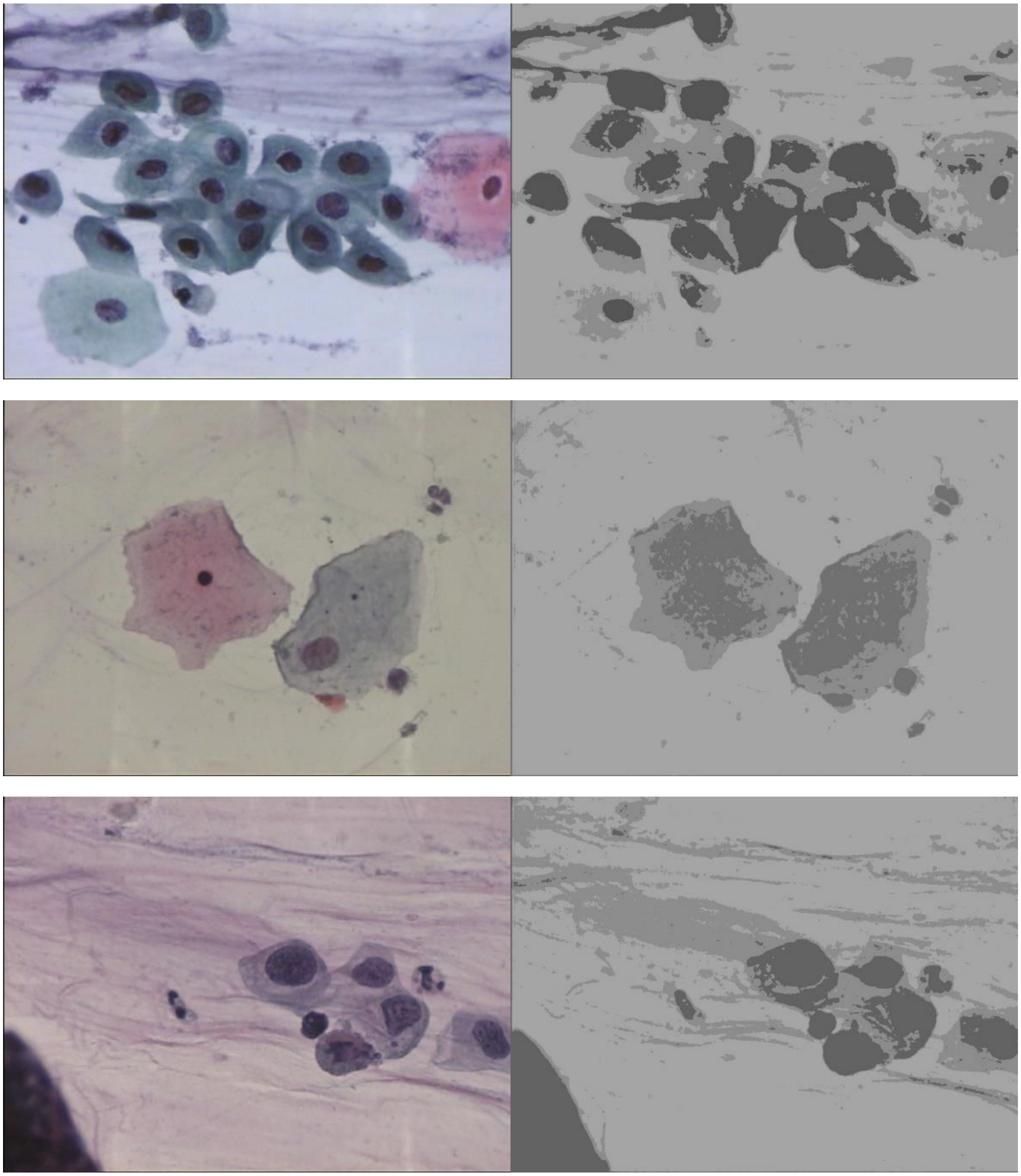




- K Means Clustering | 2 Clusters







Metrics

Method	Average Time per image in seconds	Total Time in Seconds
Sobel	22.86383929	11409.0558
Improved Sobel	22.55580357	11255.34598
Prewitt	22.71205357	11333.31473
Roberts	13.34821429	6660.758929
Compass	20.80133929	10379.8683
Erosion	5.258928571	2624.205357
Dilation	5.008928571	2499.455357
Histogram Thresholding	0.7589285714	378.7053571
K Means	0.640625	319.671875
Total	113.9486607	56860.3817

The average time per image in seconds: 12.6609623

The total Process time in seconds: 56860.3817