Image Segmentation

Activity 7 Short Report

Lou Josef S. Tan

Tasks

- Grayscale Image Segmentation
  - Grayscale Thresholding
- Color Image Segmentation
  - Parametric Probability Distribution Estimation
  - Non-parametric Probability Distribution Estimation (Histogram Backprojection)

Grayscale Image Segmentation

Grayscale Thresholding

We were to take out the text from the image below via grayscale thresholding.

Figure 1. Original Image to be segmented.

Grayscale Image Segmentation

Grayscale Thresholding

To begin, the grayscale histogram of the image was taken. The peak we see there corresponds to the background pixels; these were removed via thresholding the image to a certain level. For my threshold, I used `graythresh()` to determine the global image threshold, which turned out to be around 144.

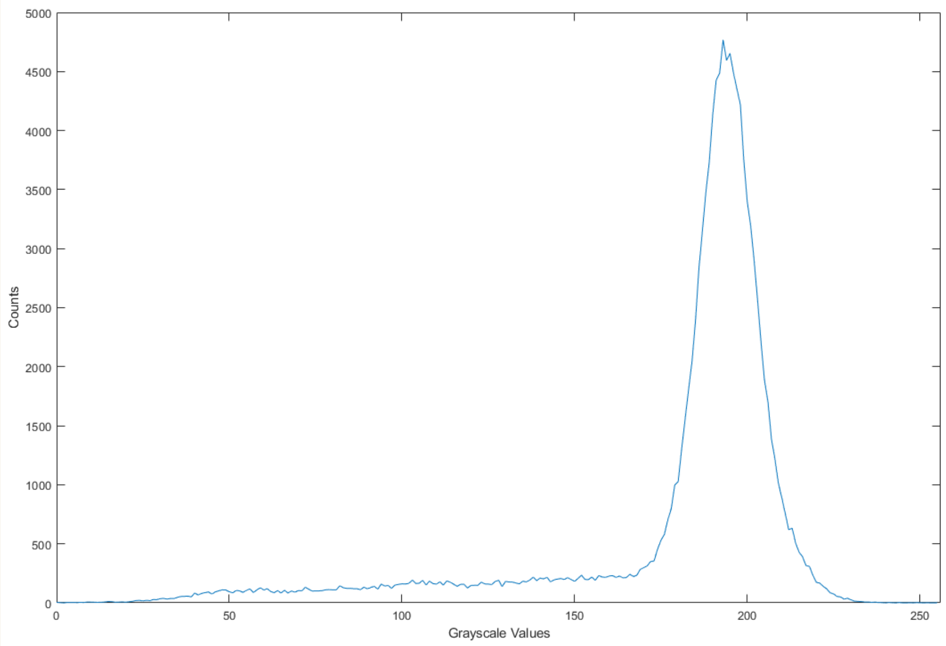

Figure 2. Grayscale histogram of original image.

Grayscale Image Segmentation

Grayscale Thresholding

The resulting segmented image is shown below.

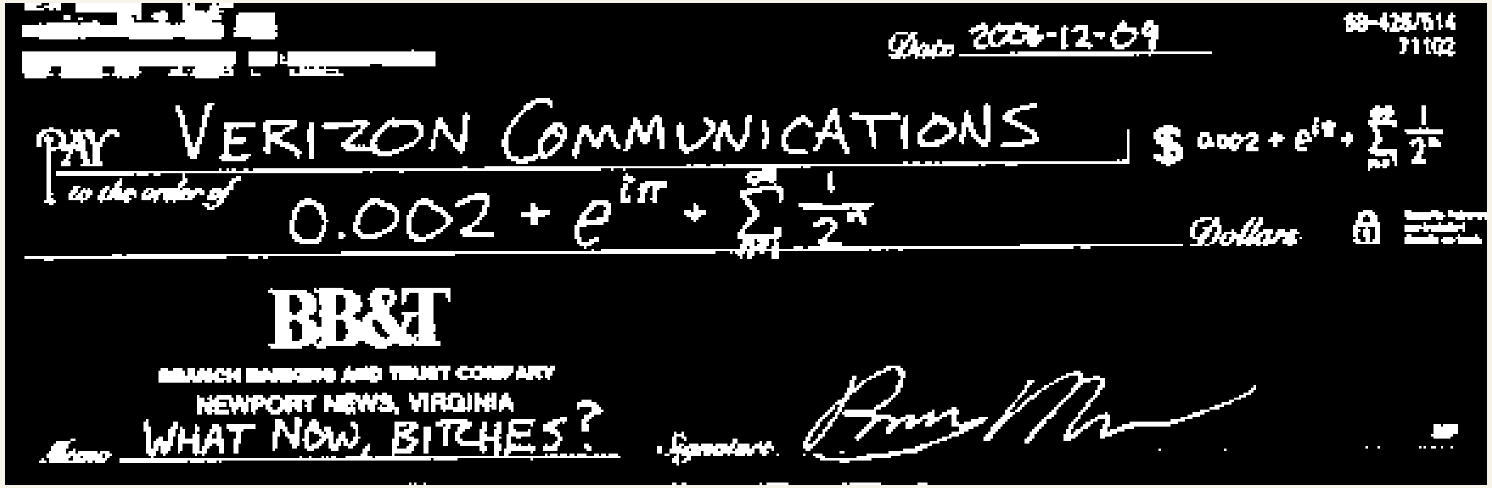

Figure 3. Segmented image via thresholding (I < 144).

Grayscale Image Segmentation

Grayscale Thresholding

We can see that the text from the check was successfully taken out via grayscale thresholding.

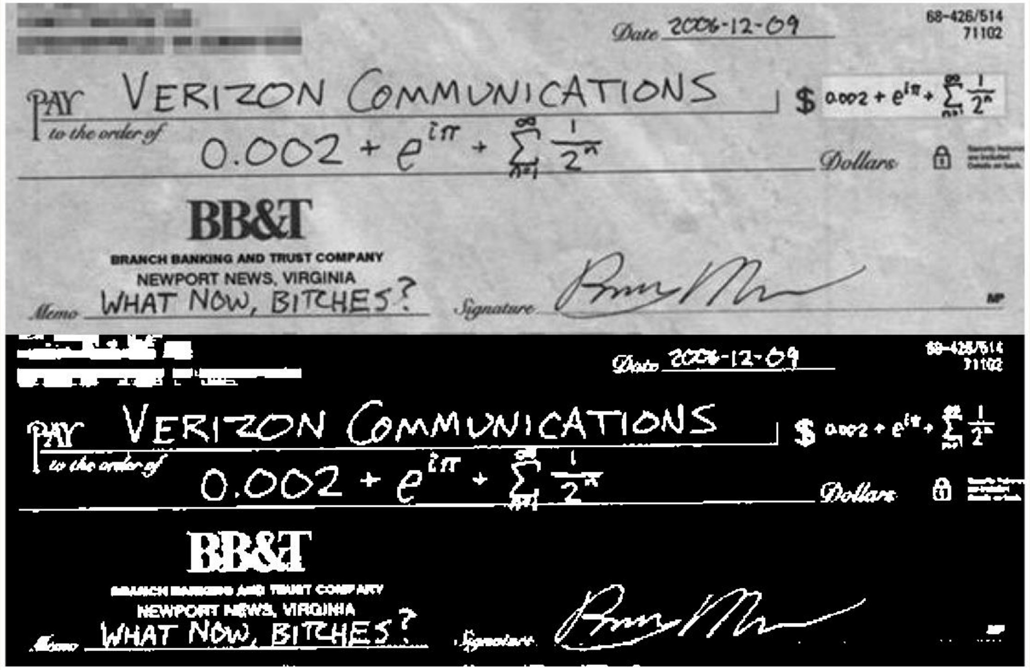

Figure 4. For comparison: original image (top), segmented image (bottom).

Color Image Segmentation

Preliminaries

To test the parametric and non-parametric (histogram backprojection) probability distribution estimation for color image segmentation, I first tried to segment a single color (yellow) from the Macbeth Color Checker[1].

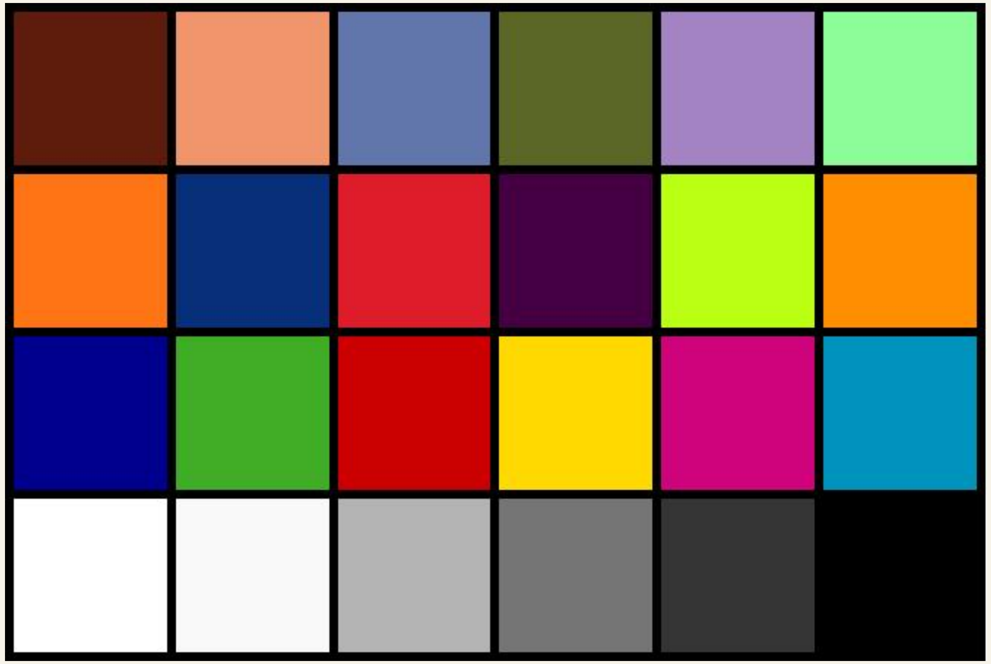

Figure 4. Macbeth Color Checker.

[1] – Taken from: https://www.dpreview.com/forums/post/5189991

Color Image Segmentation

Preliminaries

The patch below was my region of interest (ROI).

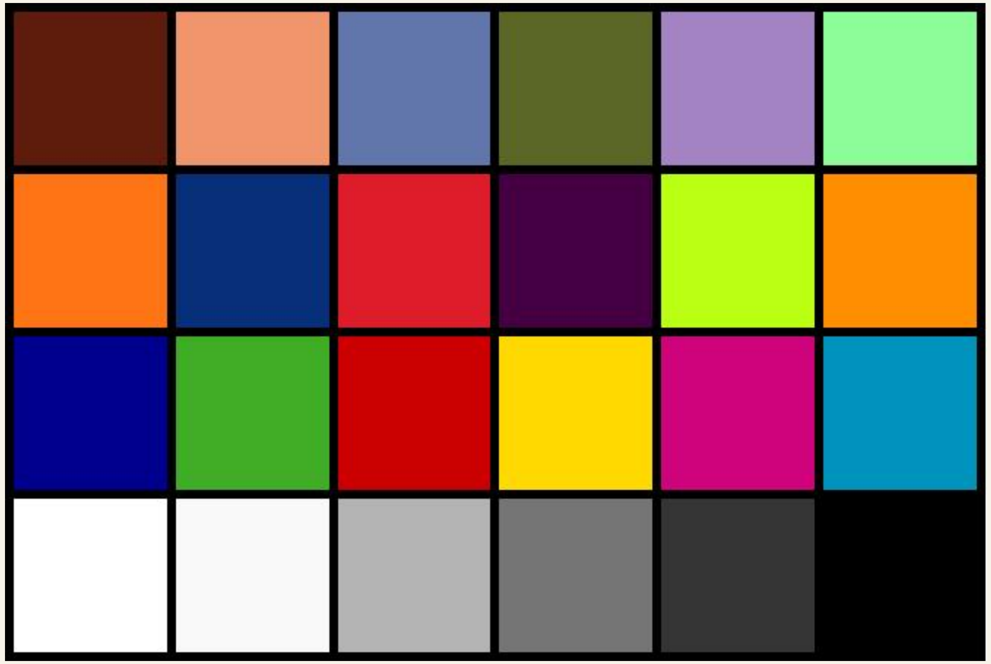

Figure 4. Macbeth Color Checker.

Color Image Segmentation

Preliminaries

The patch below was my region of interest (ROI). Beside it is the 2D histogram I obtained for my ROI.

Figure 5. Left: Region of interest, Right: 2D histogram of ROI.

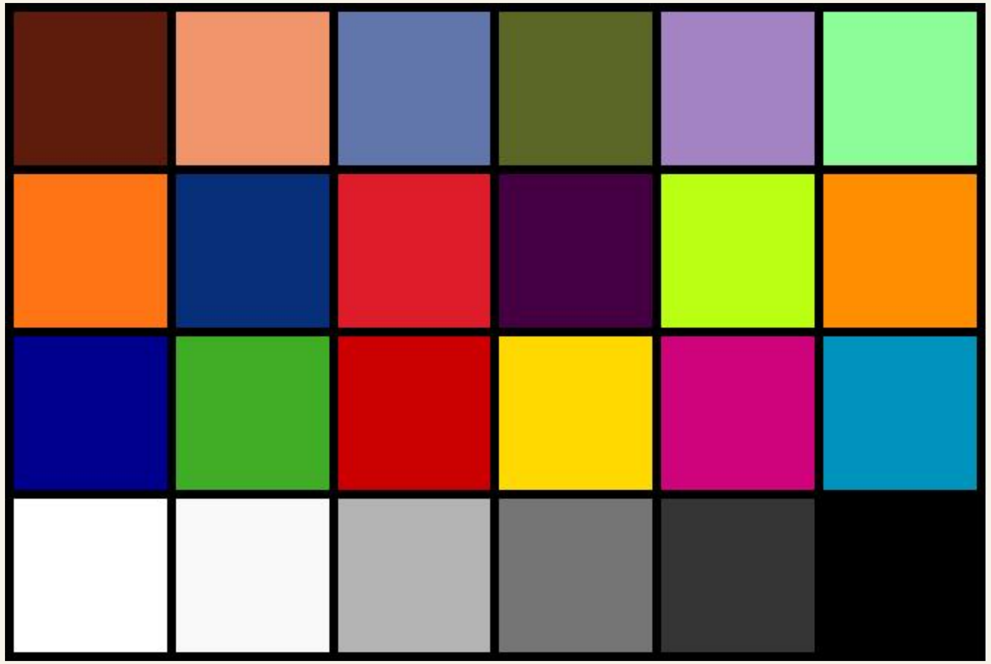

Figure 4. Macbeth Color Checker.

Color Image Segmentation

Preliminaries (Parametric Segmentation)

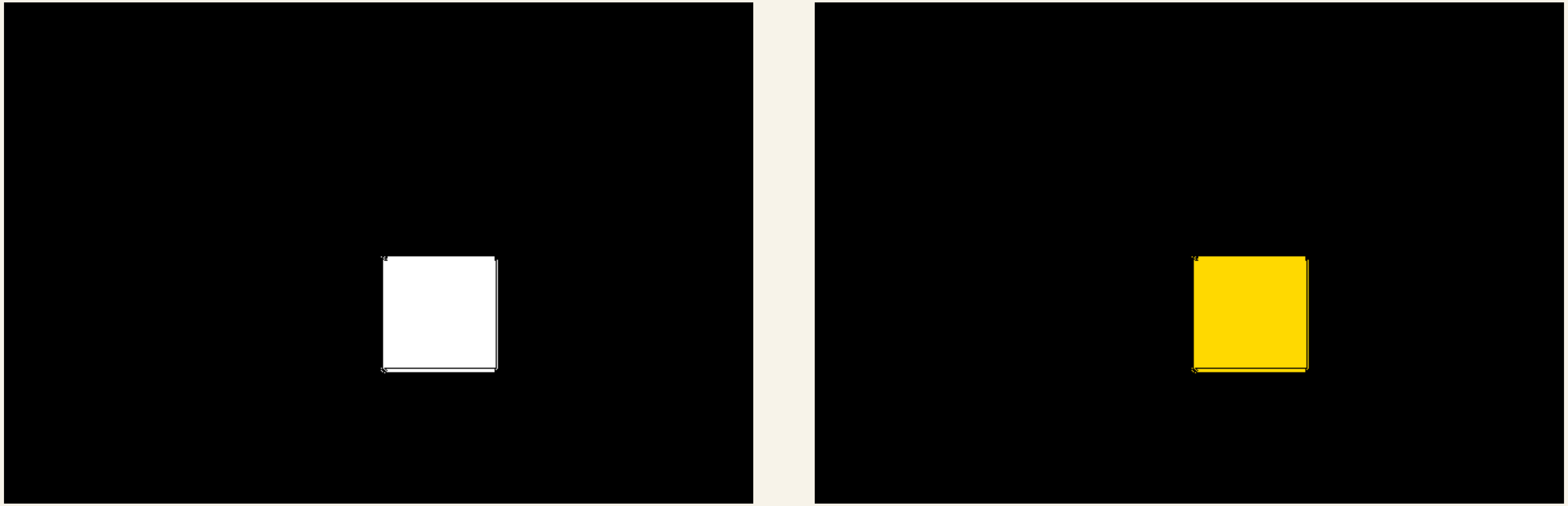

Figure 6. Left: Segmented image via parametric segmentation, Right: Masked image from the segmented image.

Color Image Segmentation

Preliminaries (Non-parametric Segmentation)

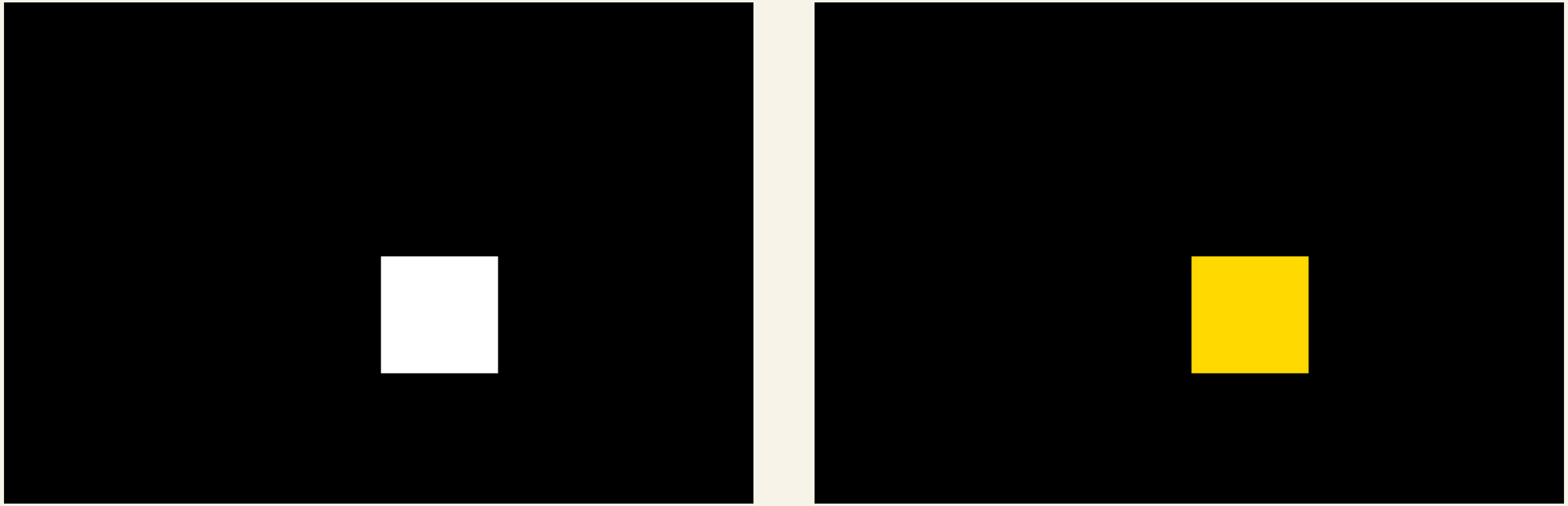

Figure 7. Left: Segmented image via non-parametric segmentation, Right: Masked image from the segmented image.

Color Image Segmentation

Preliminaries (Comments)

For both methods, parametric and non-parametric, I was able to segment the desired color. As expected from my ROI containing only a single color, my 2D histogram only had a single non-zero pixel pertaining to the color yellow in the Normalized Chromaticity Coordinate (NCC) space.

Comparing the two methods, it seems that non-parametric segmentation produced better results than parametric segmentation. Looking closely, we can see that some details around the edges were lost using parametric segmentation; on the other hand, the desired color patch was completely segmented using non-parametric segmentation.

Color Image Segmentation

Application

One practical application of color image segmentation would fall on the medical field. Say we want to detect all lymphoblasts in a microscopic image such as in Fig. 8. This procedure could be an additional/supplementary diagnostic test for Acute Lymphoblastic Leukemia (ALL) if we see that there is a disturbing accumulation of lymphoblasts in our results.

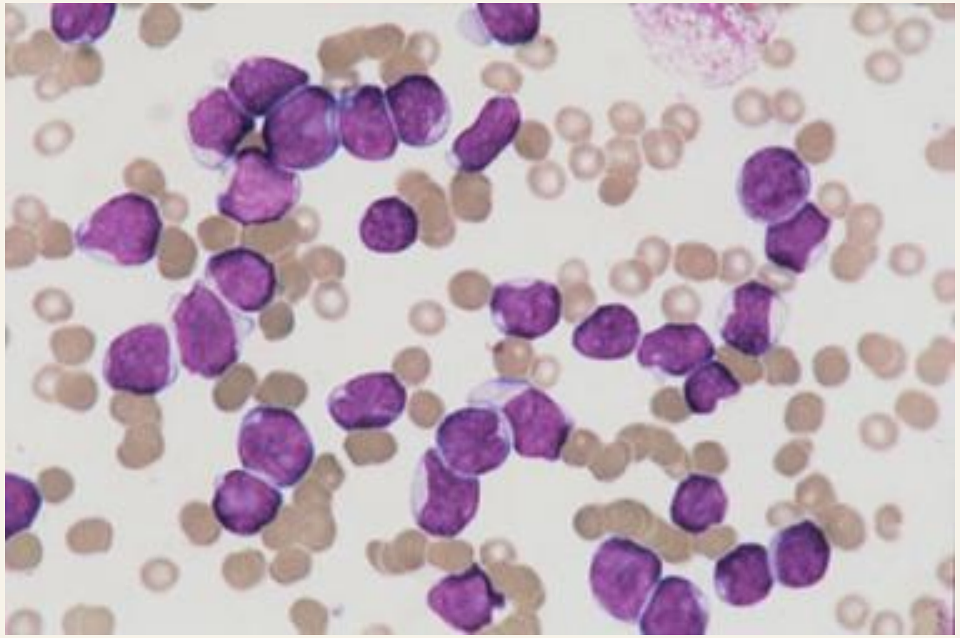

Figure 8. Lymphoblasts (stained in purple) in the bone marrow[2].

[2] – Taken from: https://www.medgurus.org/acute-lymphoblastic-leukemia-all-best-hospitals-doctors-cost-in-india/

Color Image Segmentation

Application

To proceed, we once again take our ROI, and its corresponding 2D histogram as shown below.

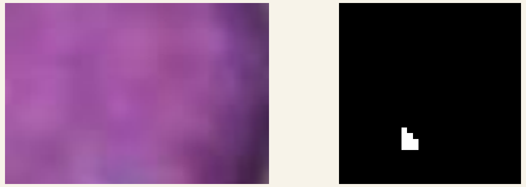

Figure 9. Left: ROI for lymphoblast, Right: 2D histogram of ROI.

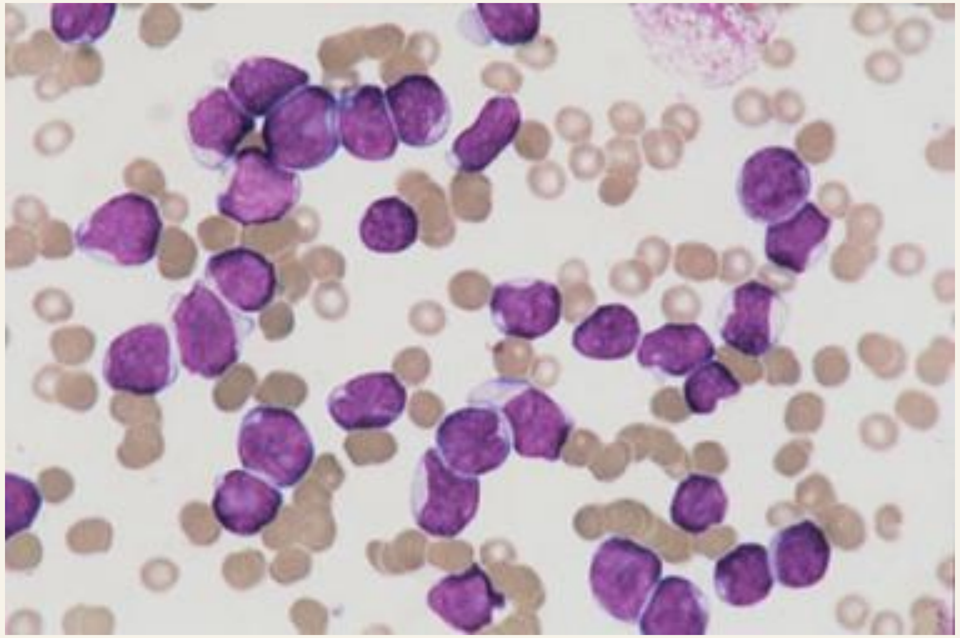

Figure 8. Lymphoblasts (stained in purple) in the bone marrow[2].

[2] – Taken from: https://www.medgurus.org/acute-lymphoblastic-leukemia-all-best-hospitals-doctors-cost-in-india/

Color Image Segmentation

Application (Parametric Segmentation)

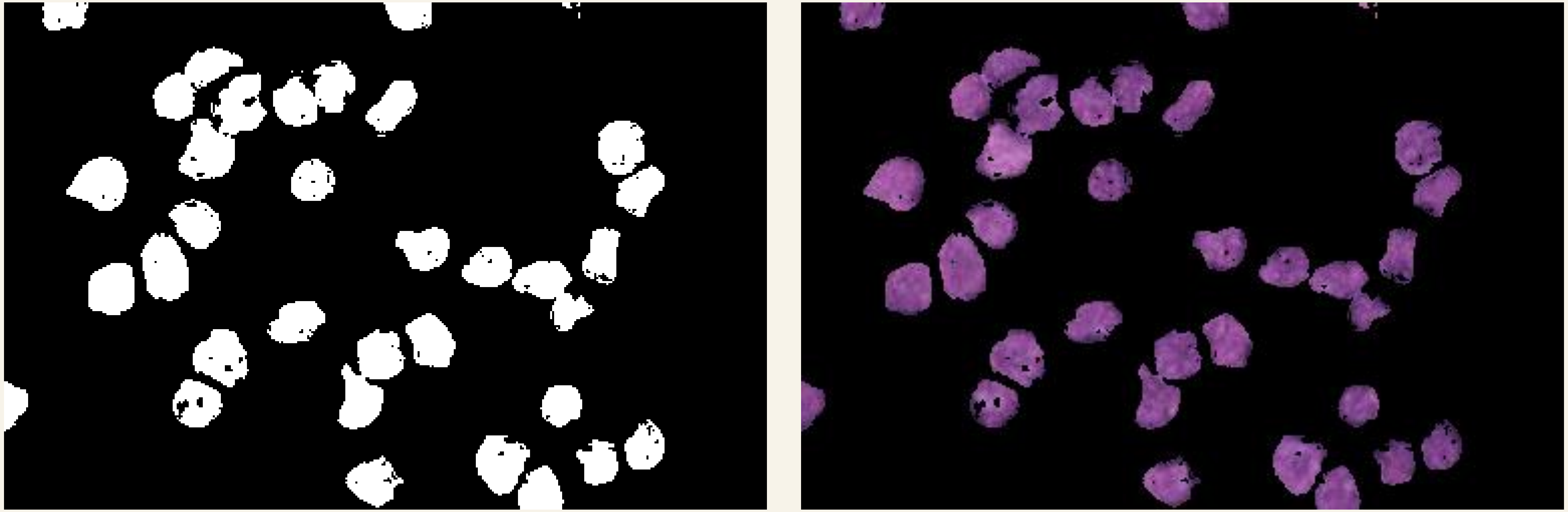

Figure 10. Left: Segmented image of lymphoblasts via parametric segmentation, Right: Masked image from the segmented image.

Color Image Segmentation

Application (Non-parametric Segmentation)

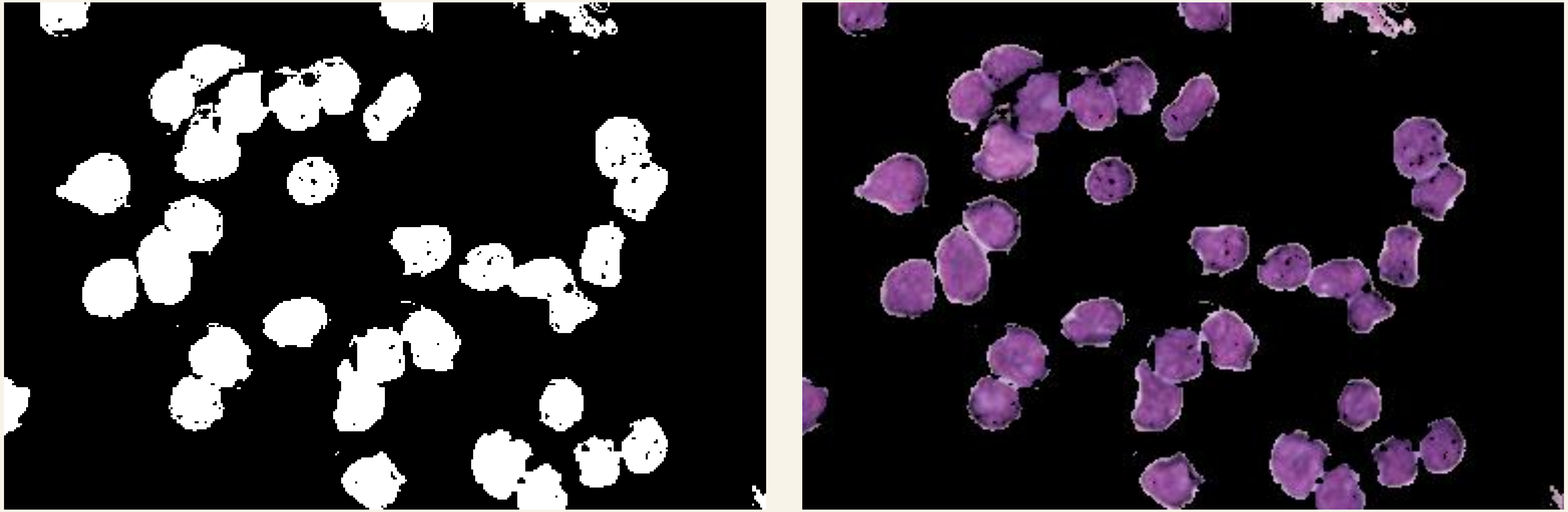

Figure 11. Left: Segmented image of lymphoblasts via non-parametric segmentation, Right: Masked image from the segmented image.

Color Image Segmentation

Application (Comments)

The lymphoblasts were detected using both methods, parametric and non-parametric. The image that was used here was actually an image of lymphoblasts from ALL.

Once again, non-parametric segmentation yielded relatively better results than parametric segmentation (where some information was lost along the edges and the insides).

Evaluation

For this activity, I rate myself a grade of 10/10 for producing all required outputs. I also tested the techniques on other samples (segmenting lymphoblasts from image).

I would like to thank my seatmates Andy and Rhei for all the brainstorming and help they've offered me. I'd also like to acknowledge Mr. Martin Bartolome's blog on this activity [https://barteezy.wordpress.com/2015/10/05/activity-7-image-segmentationo/], for the much extensive discussions he's made about the topic which helped me in understanding the idea behind the methods.