Image Segmentation

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2015-04544

Grayscale thresholding

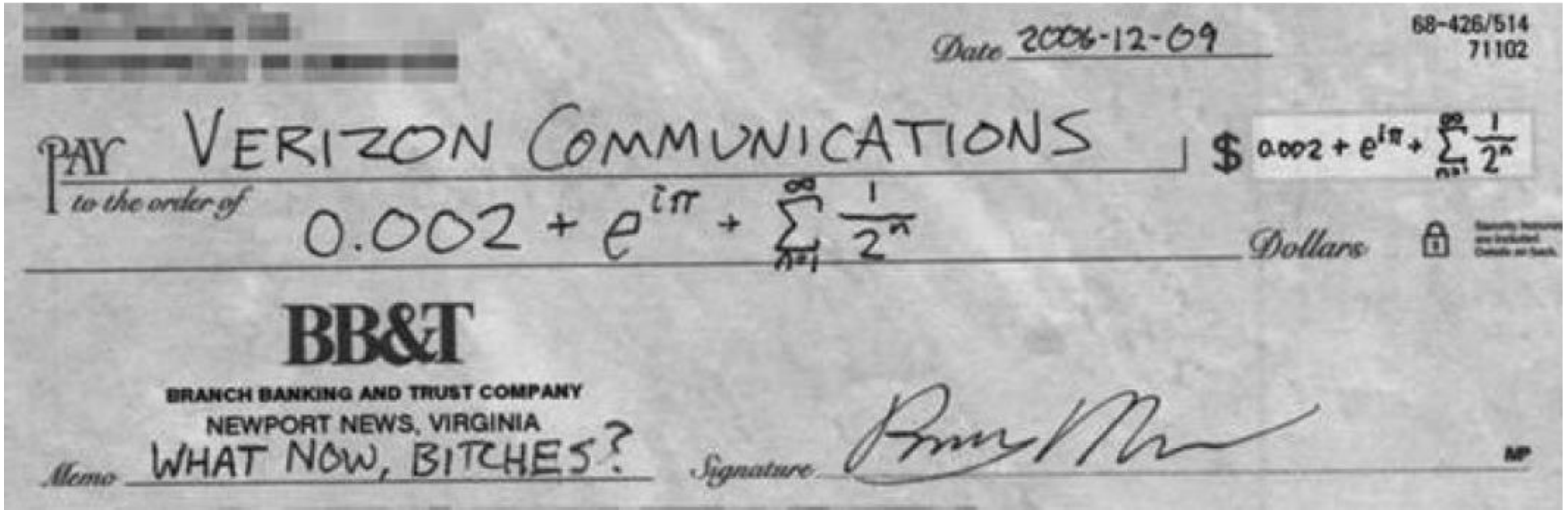
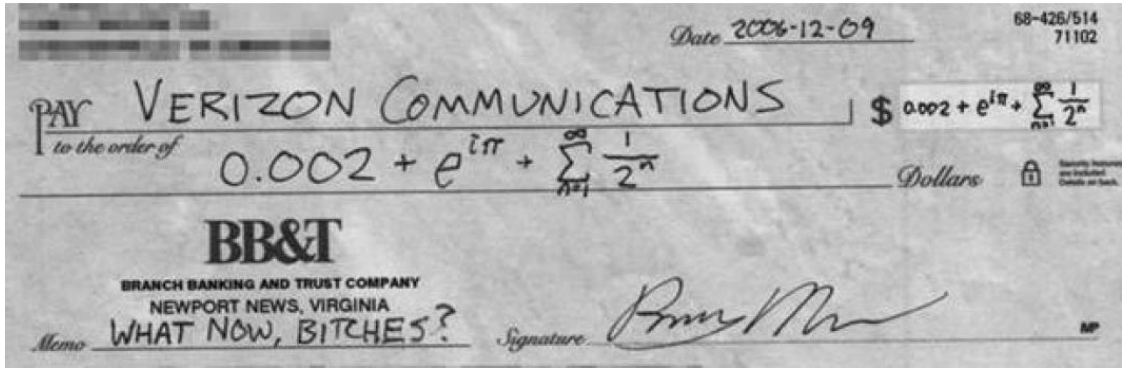


Figure 1. Original Image

Grayscale thresholding



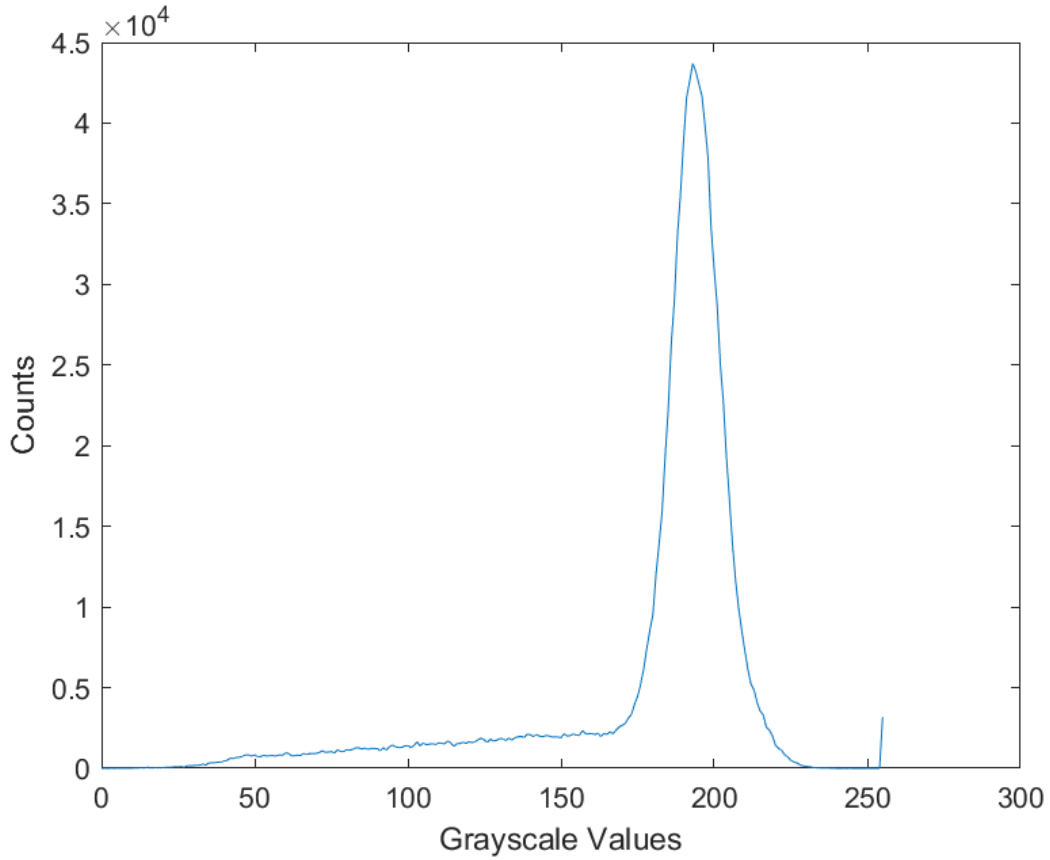


Figure 2. Original Image (left). Histogram of image values (right).

Grayscale thresholding

Figure 3. Original Image (top). Segmented image using threshold value of I<125.

Was able to successfully segment the handwriting on the written check through thresholding values at an estimate from the histogram.

Color Segmentation (Solid colors)

Figure 4. Original Image [1]

[1] underwater.png - http://mentalfloss.com/article/502294/can-you-spot-fish-bottom-ocean

Color Segmentation (Solid colors)

Patch selection

Figure 5. Selected solid color patch (left). 2D Histogram of color patch (right).

Color Segmentation (Solid colors)

Parametric Probability Distribution Estimation

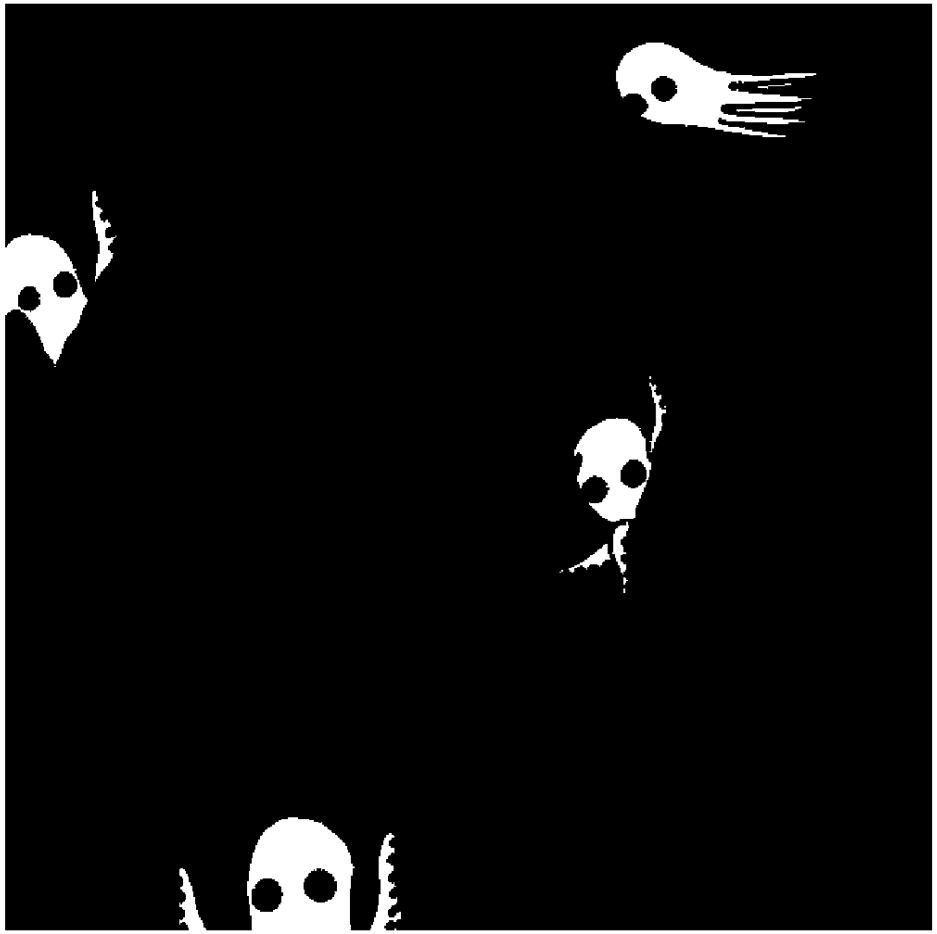
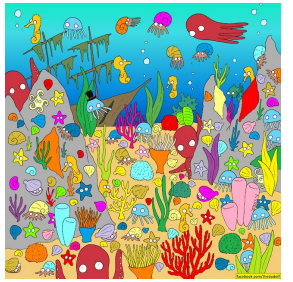


Figure 6. Segmented image using parametrization (left). Filled in colors from original image (right).

Color Segmentation (Solid colors)

Histogram backprojection (Non-parametric)



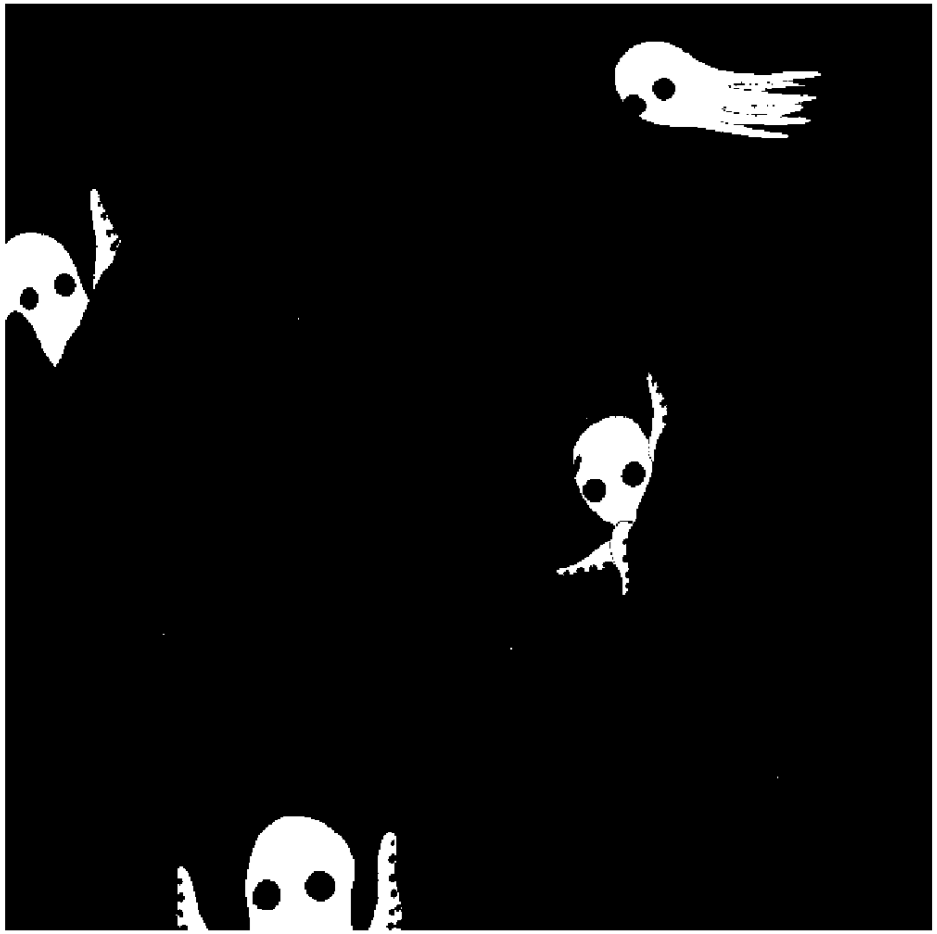


Figure 7. Segmented image using histogram backprojection (left). Filled in colors from original image (right).

Color Segmentation (Solid colors)

When segmenting a solid color from an image, the resulting histogram of the patch has only one pixel with a non-zero value as can be seen from Fig. 5.

Both methods, parametric, and histogram backprojection was able to successfully segment the octopi whose color is the input patch. Histogram backprojection was able to output all the parts of the image with the same color as the patch, however the parametric method seems to erode some of the borders of the image. If you compare Fig. 6 & Fig. 7, you can see that some colors are missing from Fig. 6

Color Segmentation (Multiple colors)

White blood cell identification

Blood is composed of different types of blood cells. Two of the many are red blood cells (RBC), and white blood cells(WBC). RBCs are characterized as small circular cells that can be visually described to having concentric rings. WBCs are described to be large cells that when stained becomes a bluish-purple color. Fig. 8 shows a picture of a blood smear with both RBCs, and WBCs. My goal is to identify and separate the two through color segmentation.

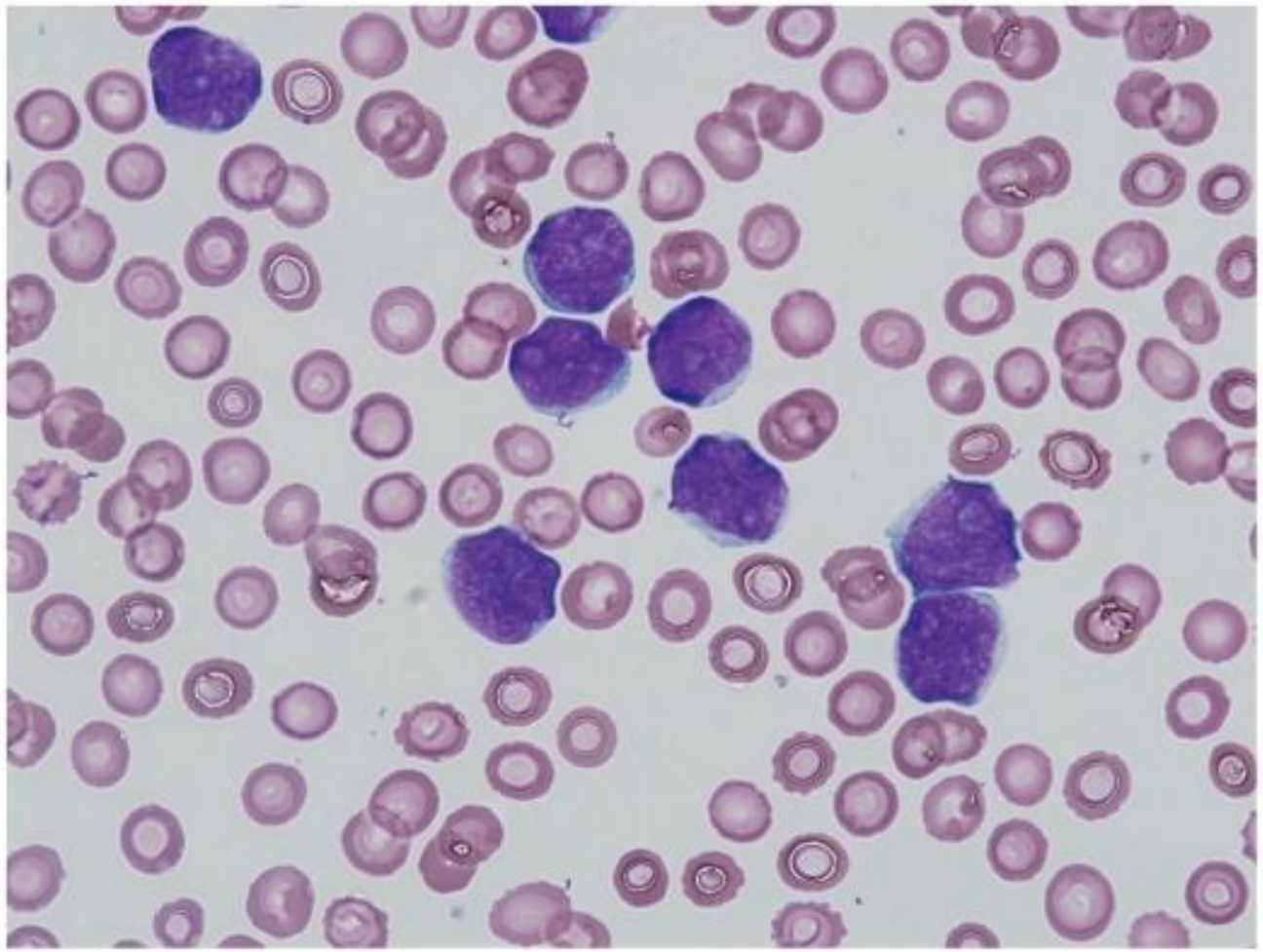


Figure 8. Magnified image of blood smear[1]

[1] https://www.researchgate.net/figure/The-peripheral-blood-smear-shows-an-increased-number-of-medium-to-large-sized-blastoid_fig1_221761459

Color Segmentation (Multiple colors)

Patch selection

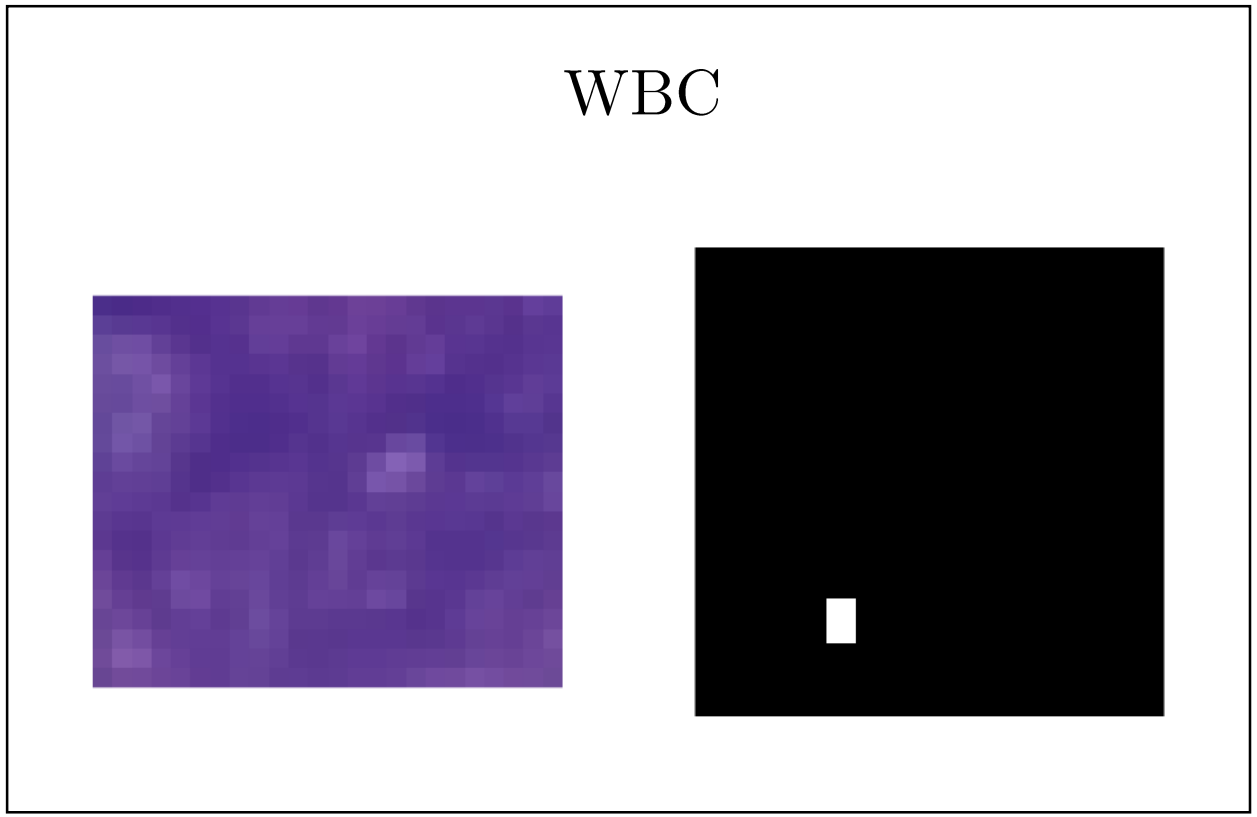


Figure 9. Selected color patch for WBC (left). 2D Histogram of color patch (right).

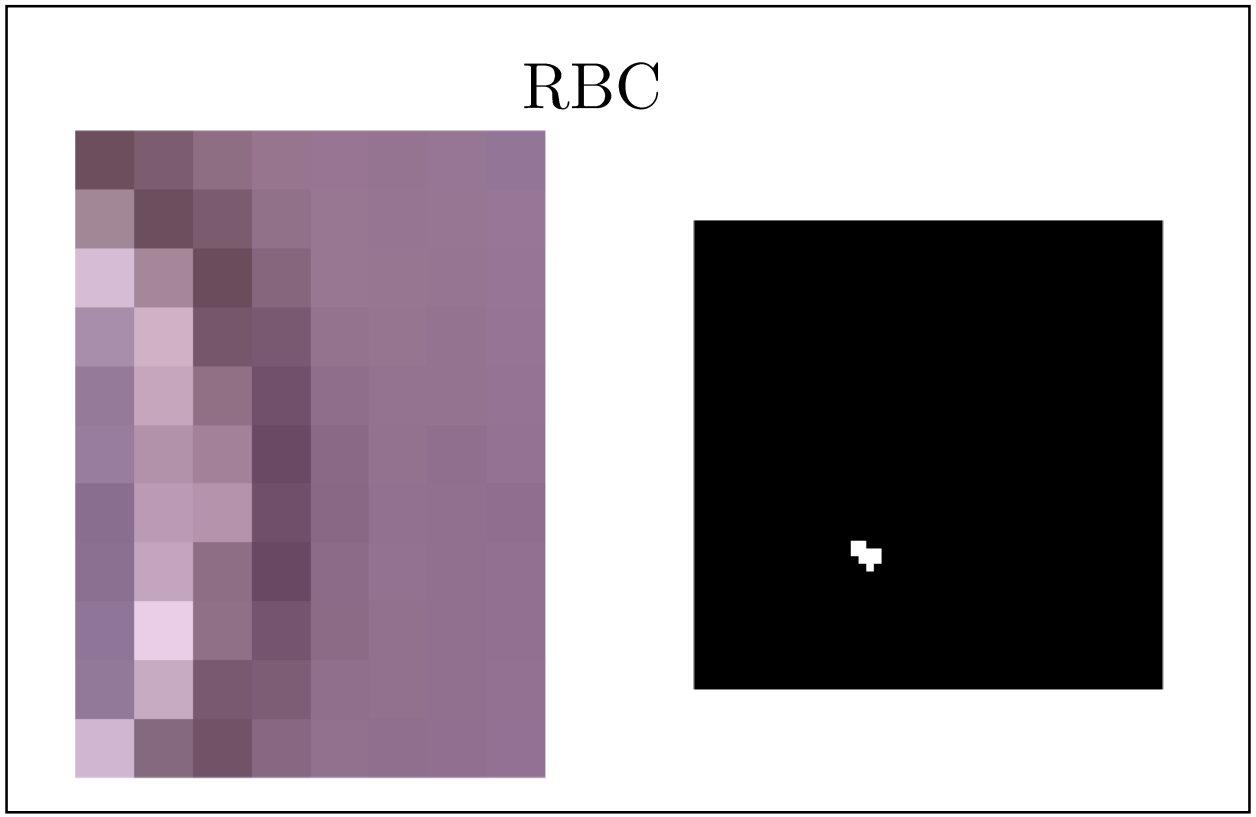
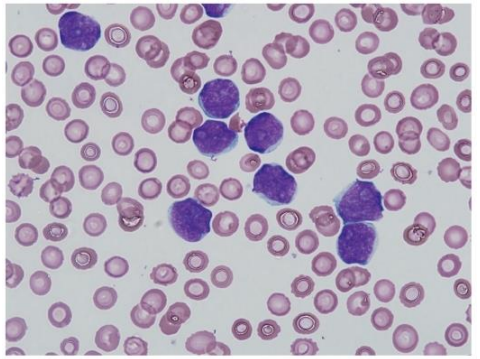


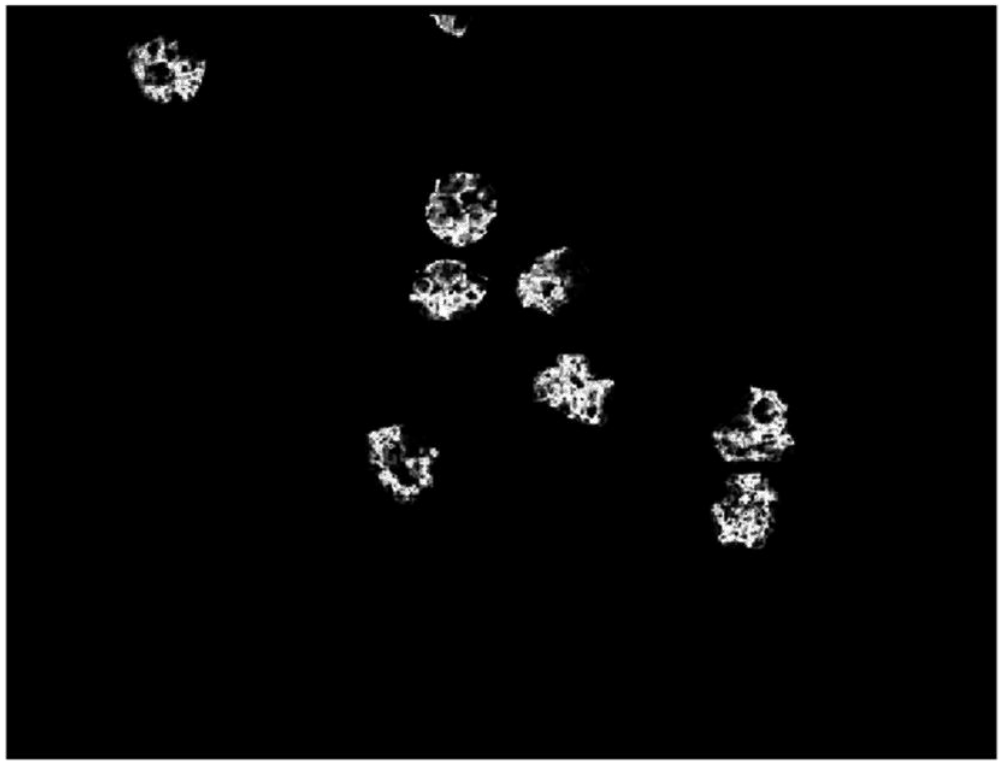
Figure 10. Selected color patch for RBC (left). 2D Histogram of color patch (right).

Color Segmentation (Multiple colors)

Parametric Probability Distribution Estimation



WBC



RBC

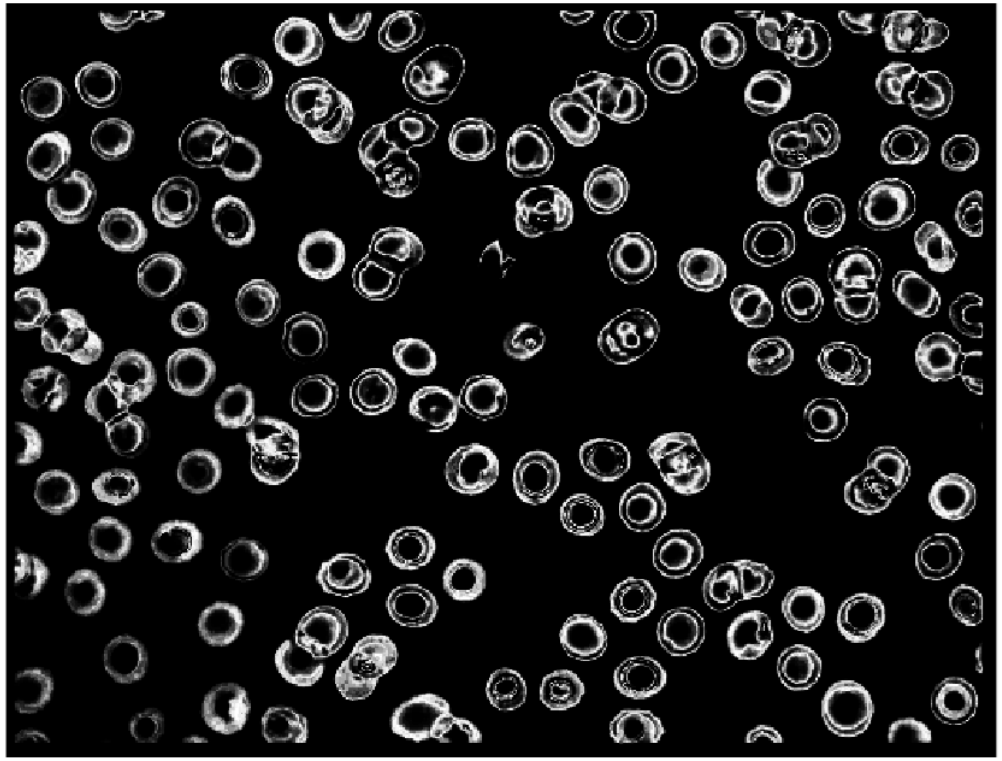
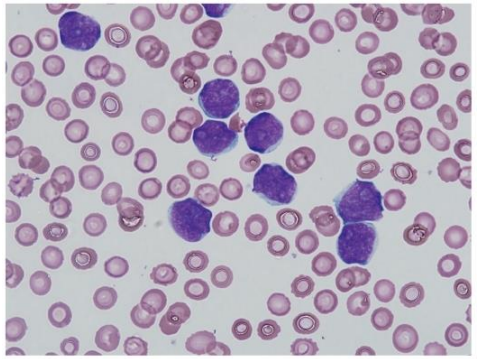


Figure 11. Segmented image using parametrization: WBCs (left), and RBCs (right)

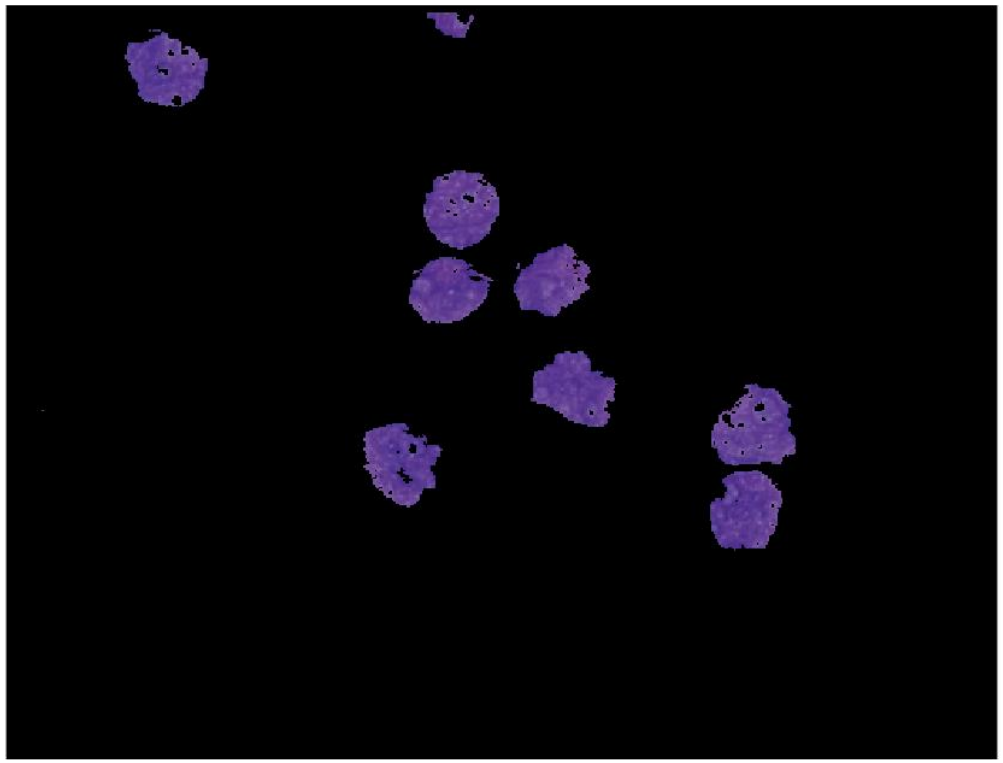
Color Segmentation (Multiple colors)

Parametric Probability Distribution Estimation



WBC

RBC



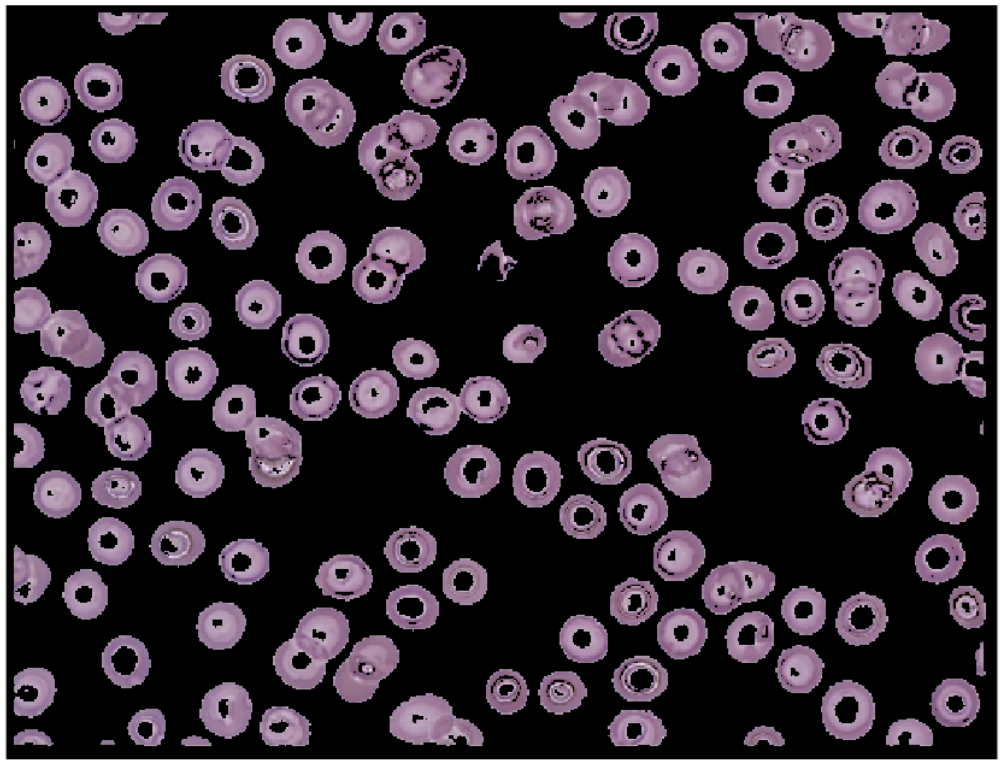
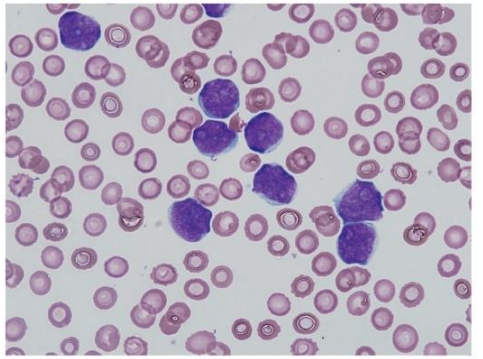


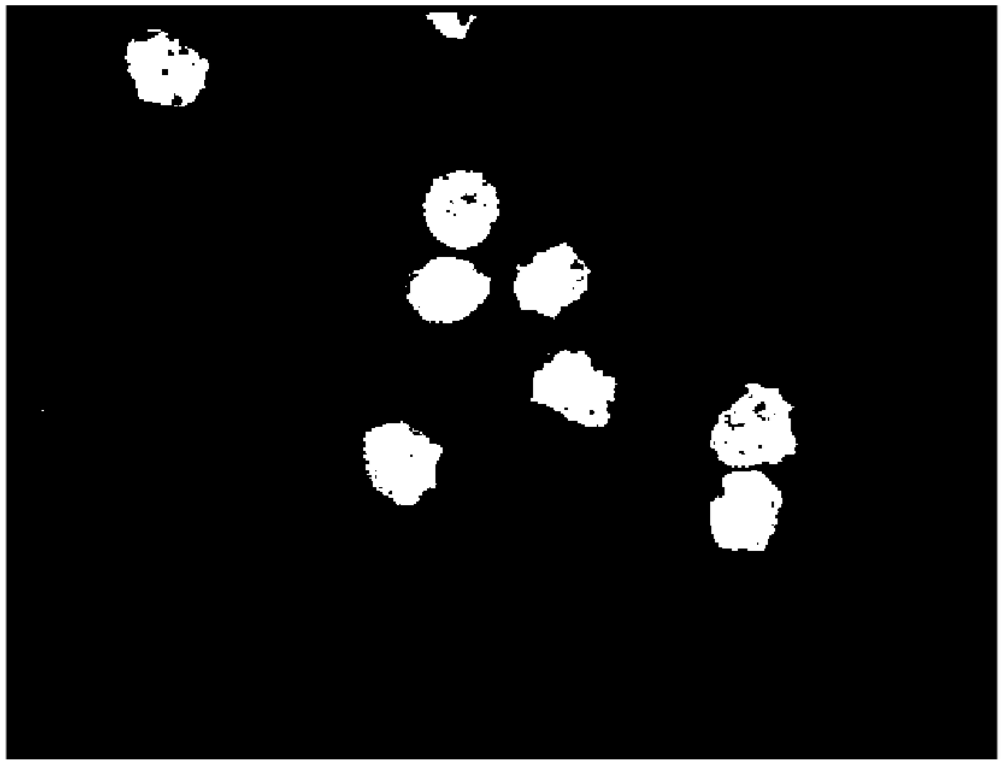
Figure 12. Final colored segmented image from Fig. 11: WBCs (left), and RBCs (right)

Color Segmentation (Multiple colors)

Histogram backprojection (Non-parametric)



WBC



RBC

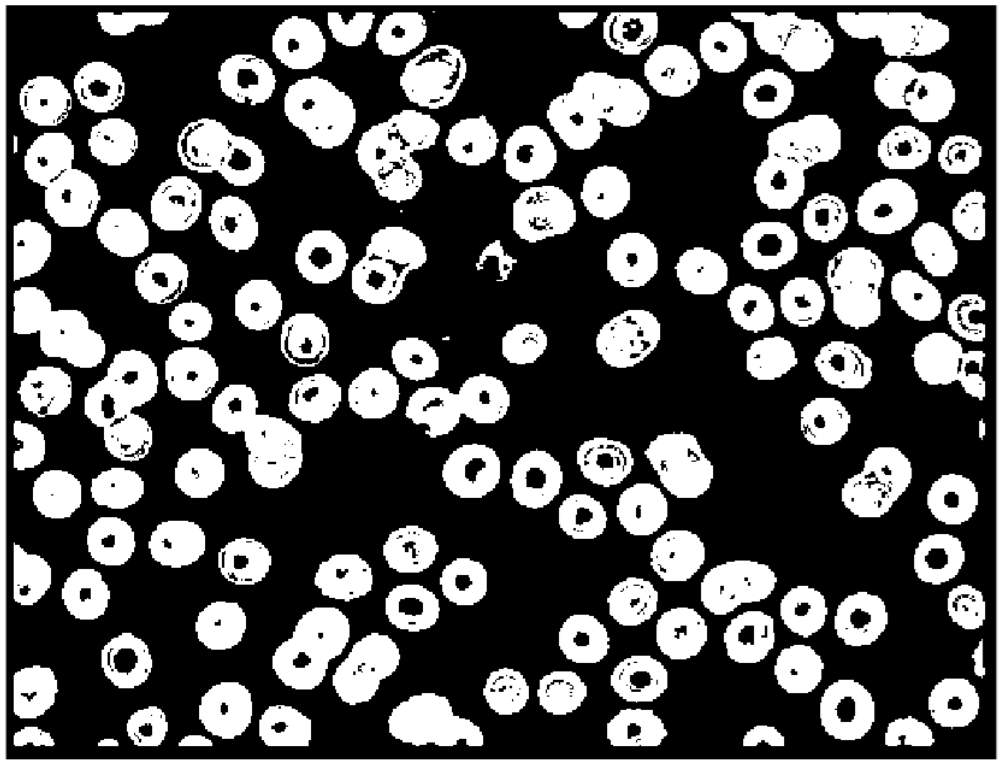
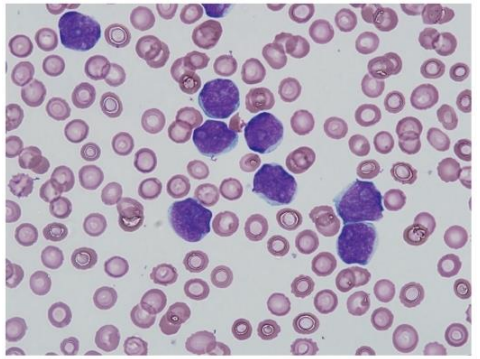


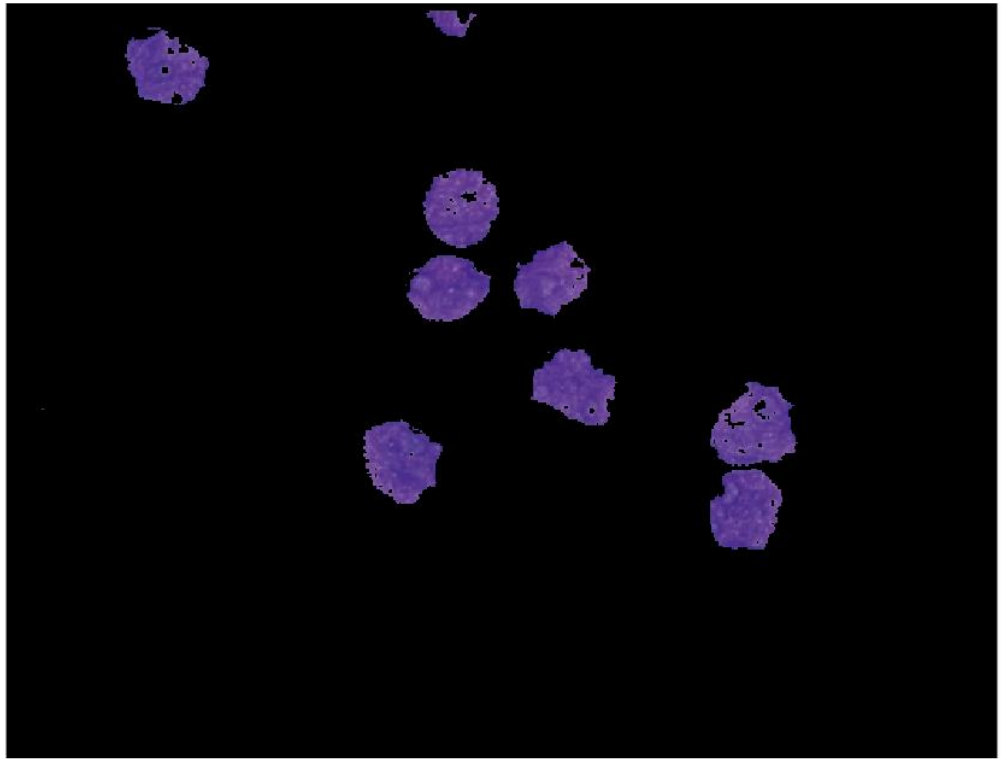
Figure 13. Segmented image using histogram backprojection: WBCs (left), and RBCs (right)

Color Segmentation (Multiple colors)

Histogram backprojection (Non-parametric)



WBC



RBC

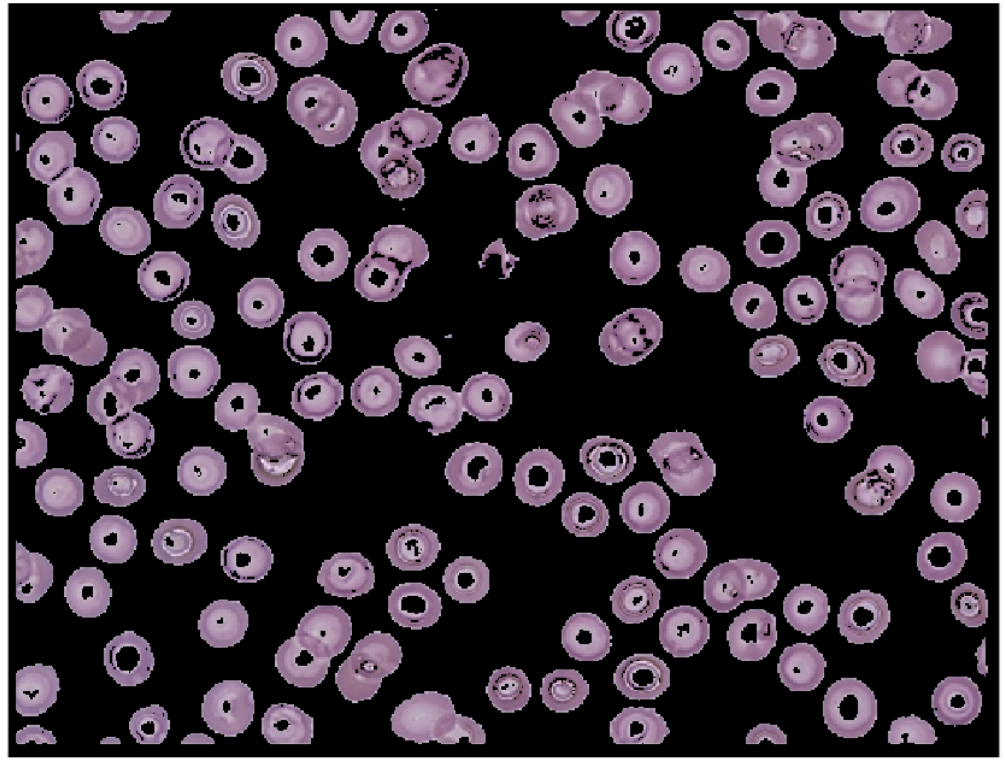


Figure 14. Final colored segmented image from Fig. 13: WBCs (left), and RBCs (right)

Color Segmentation (Multiple colors)

I was able to successfully differentiate the white blood cells from the red blood cells <3 using both segmenting methods. However, between the two methods the histogram backprojection was able to segment the full cell, unlike the parametric method wherein you can see visible holes from the segmented image of the WBC in Fig. 11. The holes on the RBCs are acceptable since the center of the cell's color already resembles the background color.

Application: Extract green spaces of the UP Diliman Campus

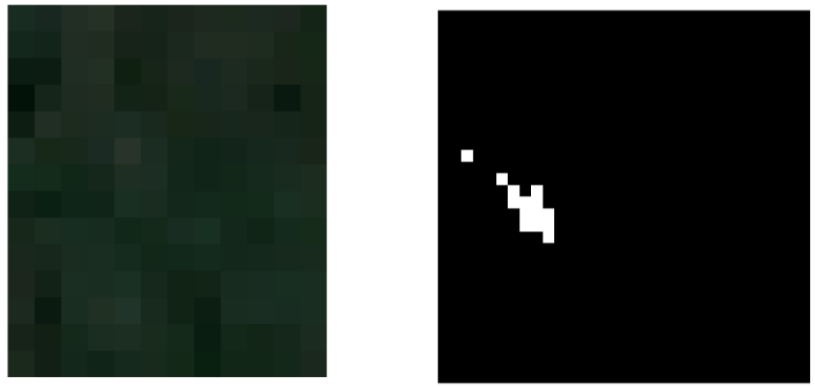
Color patching limited to greens (e.g. grass, trees). Could not include brown patches which represent empty lots since some buildings are of the same color.

Figure 15. Google maps screenshot UP Diliman campus. Non-UP spaces were filled with black.

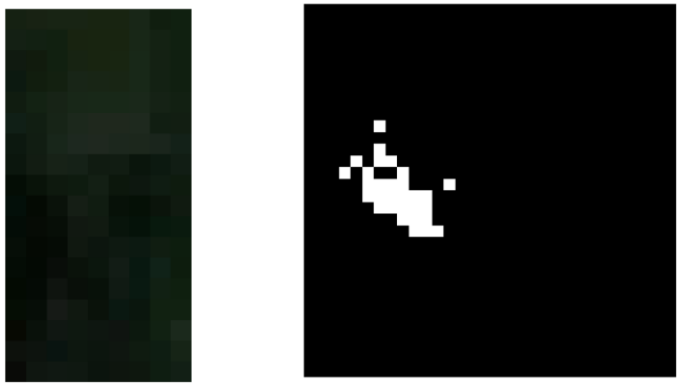
Application: Extract green spaces of the UP Diliman Campus

Patch selection

Patch 1



Patch 2



Patch 3

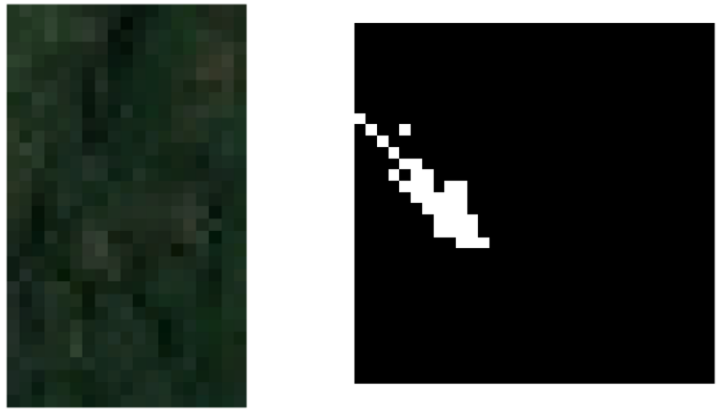
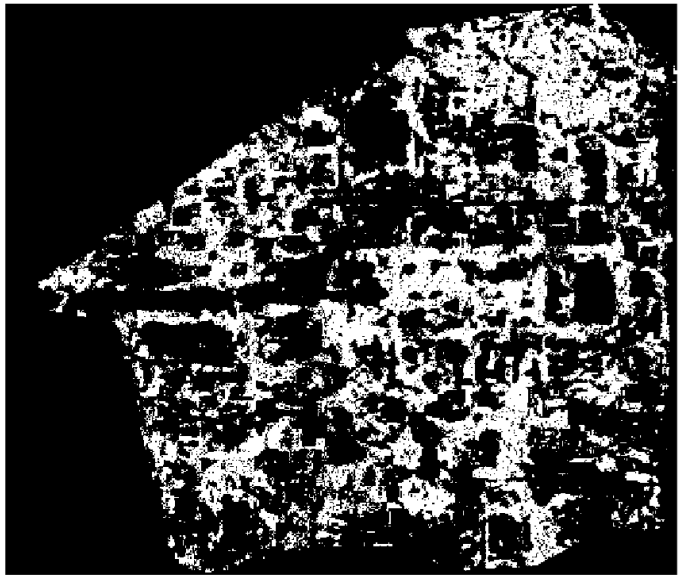


Figure 16. Three different patch selection of trees on the Fig. 15 photo. Patch selection (left). 2D histogram (right).

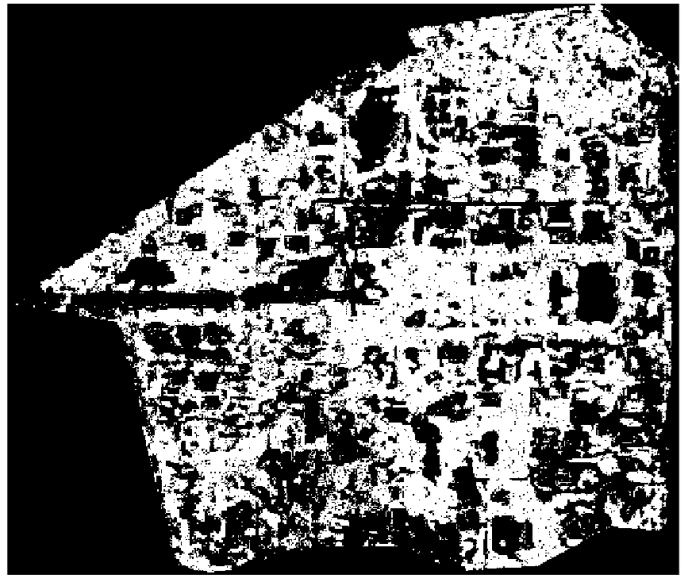
Application: Extract green spaces of the UP Diliman Campus

Parametric Probability Distribution Estimation

Patch 1



Patch 2



Patch 3

Figure 17. Segmented trees using parametrization. Different patch samples (left to right).

Application:Extract green spaces of the UP Diliman Campus

Parametric Probability Distribution Estimation

Patch 1

Patch 2

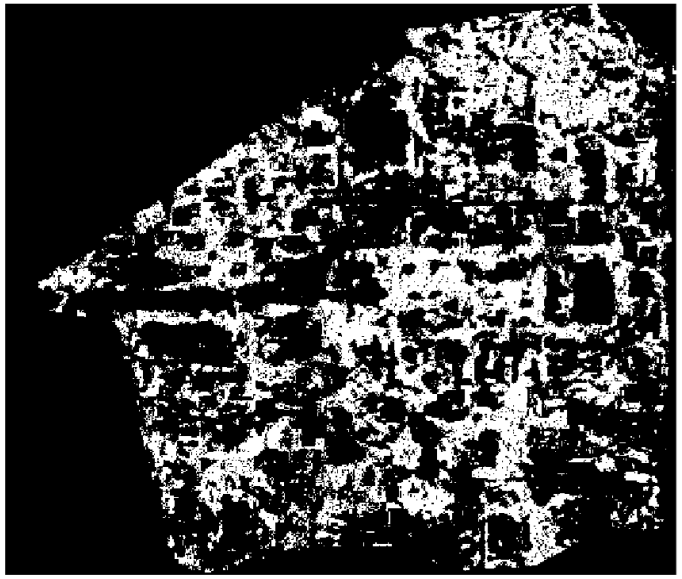
Patch 3

Figure 18. Final colored segmented image from Fig. 17. Different patch samples (left to right).

Application: Extract green spaces of the UP Diliman Campus

Histogram backprojection (Non-parametric)

Patch 1



Patch 2

Patch 3

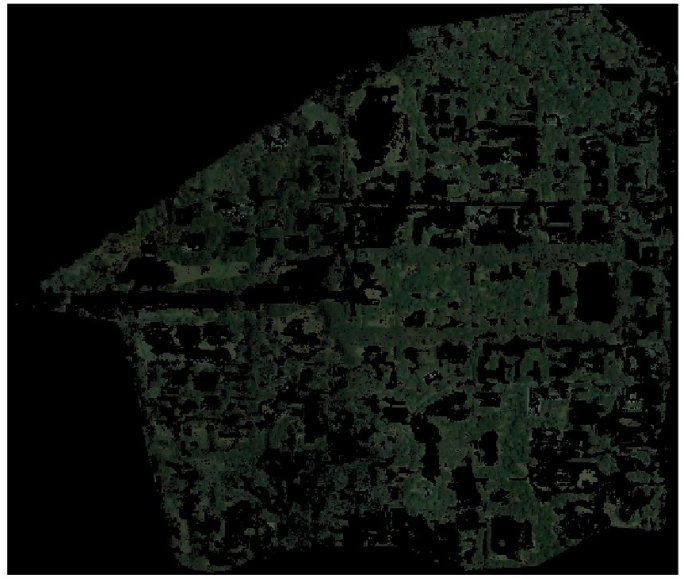
Figure 19. Segmented trees using histogram backprojection. Different patch samples (left to right).

Application: Extract green spaces of the UP Diliman Campus

Histogram backprojection (Non-parametric)

Patch 1

Patch 2



Patch 3

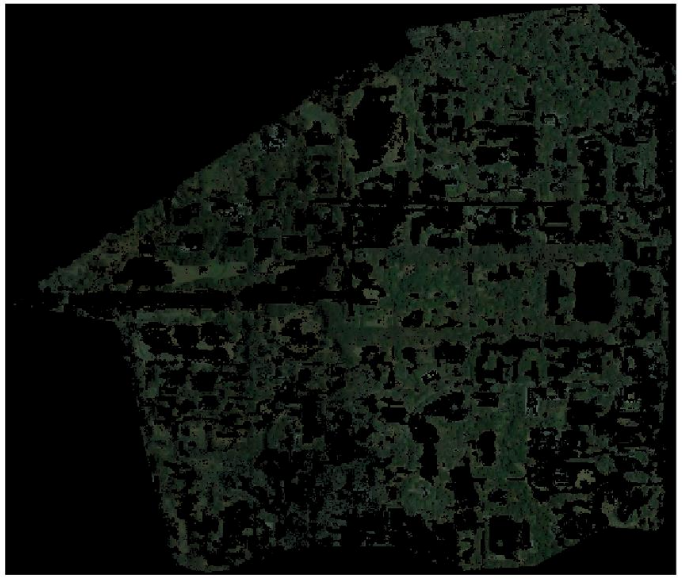


Figure 20. Final colored segmented image from Fig. 19. Different patch samples (left to right).

Application: Extract green spaces of the UP Diliman Campus

The parametric method was not able to successfully segment green spaces only, it included some buildings and roads which should not be. The wider the range of colors included in the patch, the more buildings it was able to segment. The histogram backprojection was able to segment the green spaces in UP, the better the selected patch, the better the resulted segmentation. The first patch was able to give the worst result for histogram backprojection, but the best result for parametric. The third patch was able to give the worst result for parametric, but the best result for histogram backprojection. The clear difference between patch 1 and patch 3 is that the former has less colors than the latter. The more colors included for your segmentation the more successful the histogram backprojection method is. However, having more colors on your patch leads the parametric method to widen the colors included for segmentation

I rate myself a 12/10 for accomplishing the required tasks and going beyond what is required. I was able to separate WBCs, from RBCs in a blood smear and extract the green spaces from the university.

I would like to acknowledge Kuya Alfred's blog, pedabellable.blogspot.com which served as a guide for me throughout the activity. I also thank my AP 186 seatmates, Rhei, and LJ for helping me understand the concepts behind this activity. I would like to thank Jayson for encouraging us to apply the skills here to various possibilities beyond what is required.