Activity 7: Image Segmentation

Mary Chris Go / 2014 11122

Goal

To find the best technique for image segmentation: parametric, non parametric, grayscale threshold

Mary Chris Go / 2014 11122

Grayscale Histogram Threshold

Using the grayscale histogram of the picture, this identifies the large peak that corresponds to the background pixels which can be removed by applying a threshold.

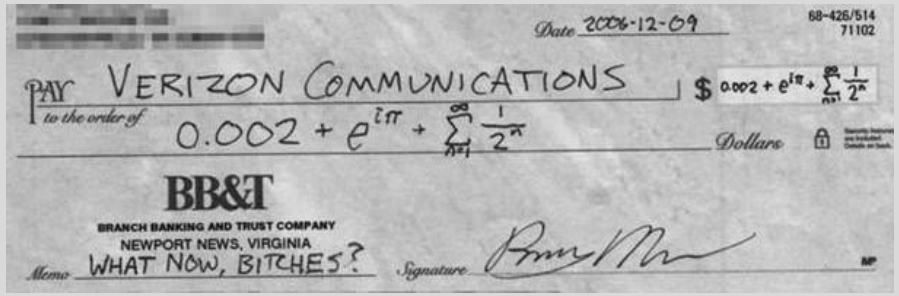
Parametric Probability Distribution Estimation

The Gaussian PDF for red and green values were derived separately. Using the equation, p(r) and p(g) were multiplied to produce the image.

$$p(r)=\frac{1}{\sigma_r\sqrt{2\pi}}\exp\left\{-\frac{(r-\mu_r)^2}{2\sigma_r^2}\right\}$$

Parametric Probability Distribution Estimation

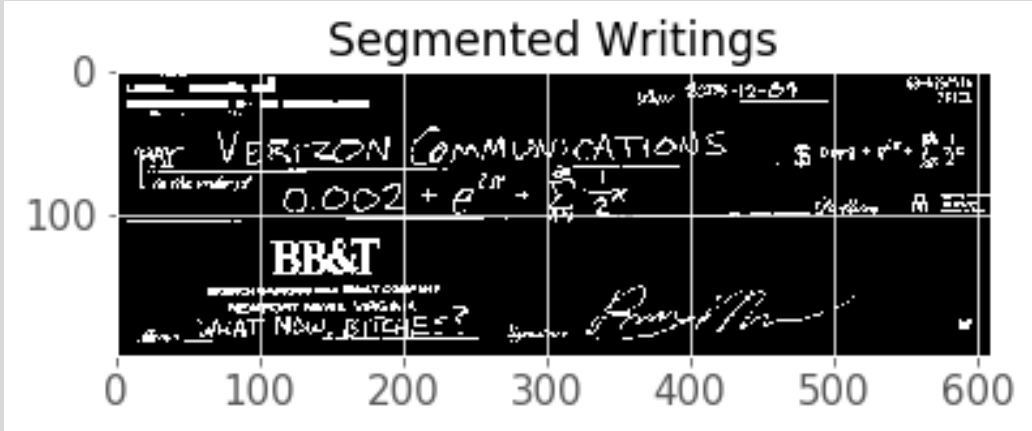
A 2D histogram of the region of interest was obtained. We set-up the original image in chromaticity in the red and green space. The histogram was back projected towards the original image.

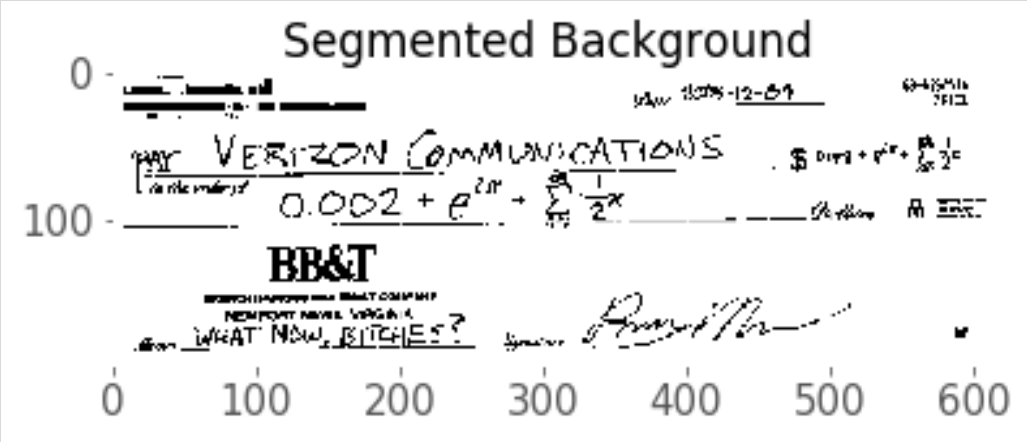


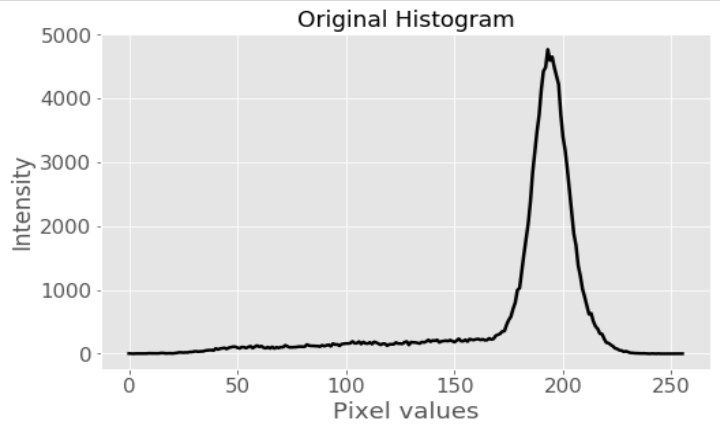
Original Image

These images were chosen to test different techniques in image segmentation. The first image (check) was used for the grayscale threshold while the *Teletubbies* image was used for the parametric and non parametric.

Grayscale Threshold





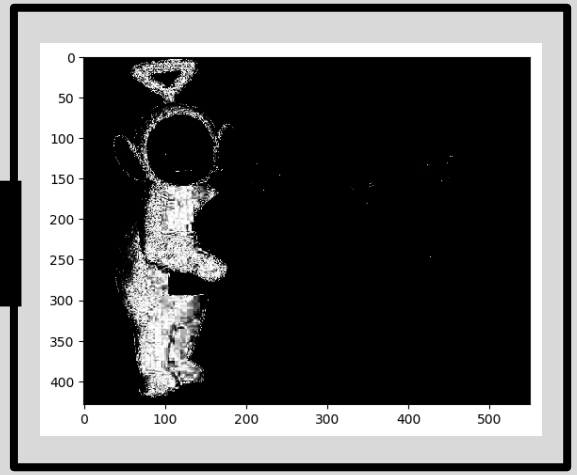


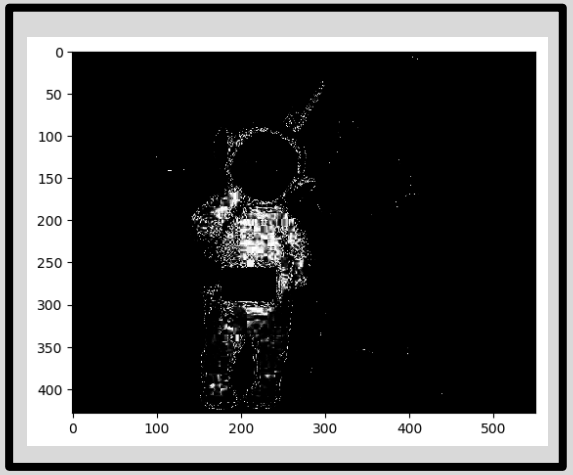
I converted the image into grayscale and obtained the histogram. Observing the graph, the largest peak showed the background and you want to cut this off to remove the background. Using < 125, the first image was produced.

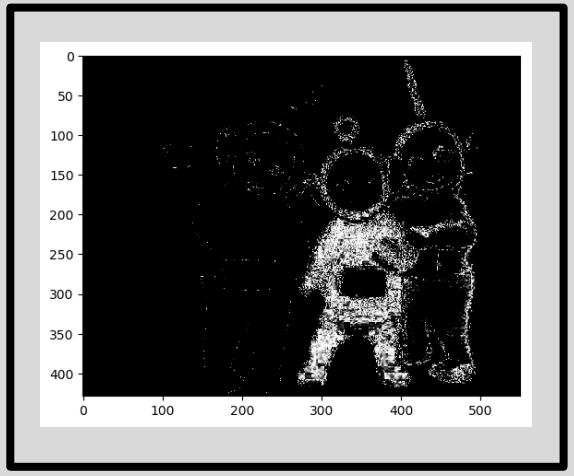
Now, if you want the background, assign > 125, you will get the second image.

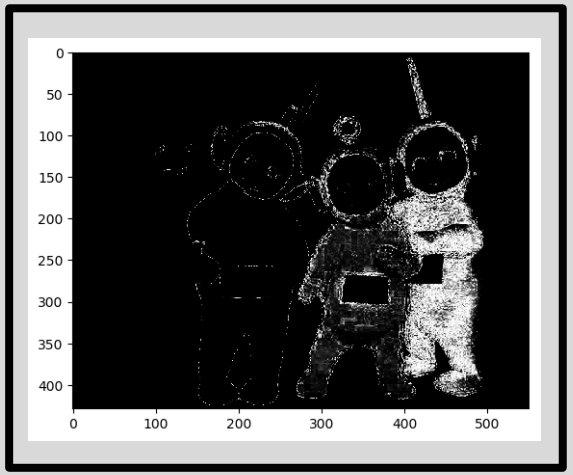
Mary Chris Go / 2014 11122

Parametric Distribution Estimation







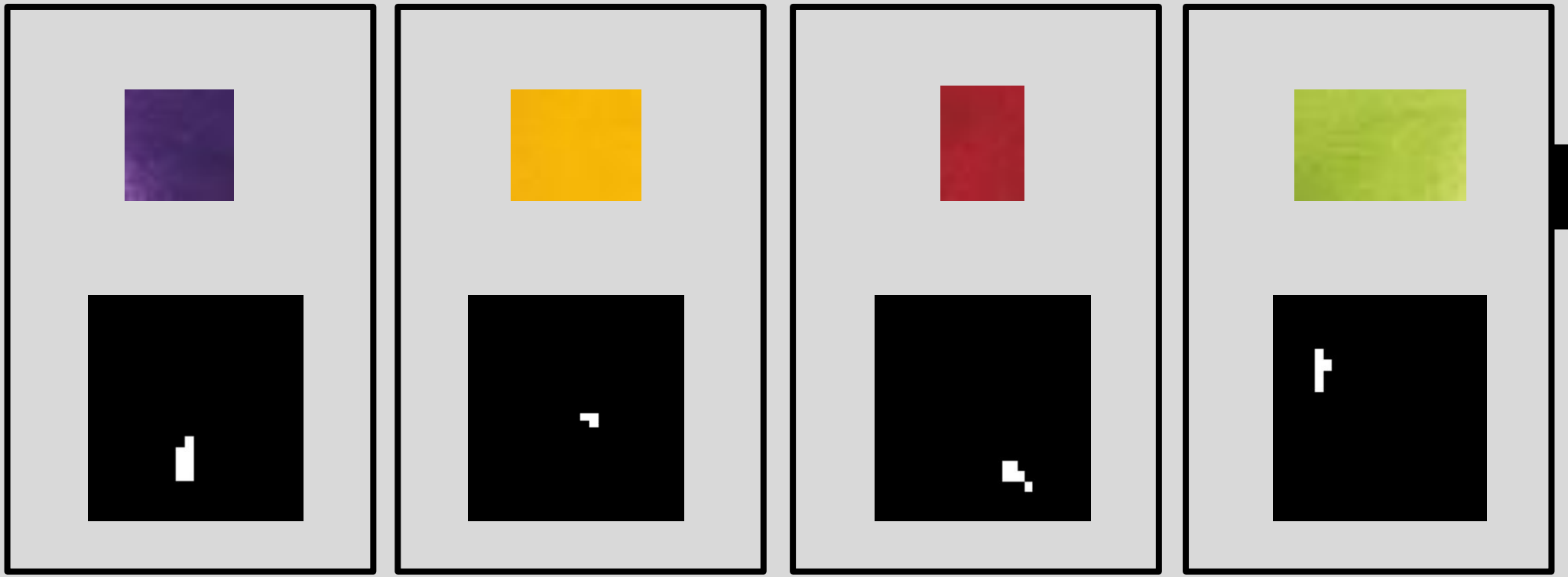


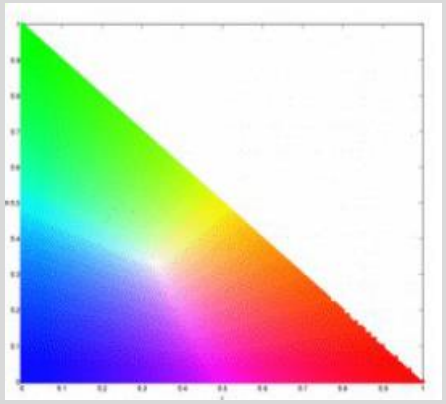

```python
def division(x,y):
    try:
        return x/y
    except ZeroDivisionError:
        return 0

#monochromatic Region
mug = cv2.imread("purple.jpg")
mug = np.float64(mug)
R = mug[:,:,0]
G = mug[:,:,1]
B = mug[:,:,2]
I = R+G+B
r = division(R, I)
g = division(G, I)

#parametric values
meanr = np.mean(r)
sigmar = np.std(r, ddof=1)
meang = np.mean(g)
sigmag = np.std(g, ddof=1)
sigmarr = sigmar**2
sigmagg = sigmag**2
```

Using python, these were produced from the algorithm made. For the violet, it perfectly segmented the *teletubby*, while for the rest of the colors, it was not able to segment it properly. This is a problem you can encounter when segmenting depending on colors. From the original photo, we observe various gradients. Since the chosen region is a solid color, a slight difference to it would not be identified and part of the segmented.

Mary Chris Go / 2014 11122

Testing Non Parametric Distribution Estimation

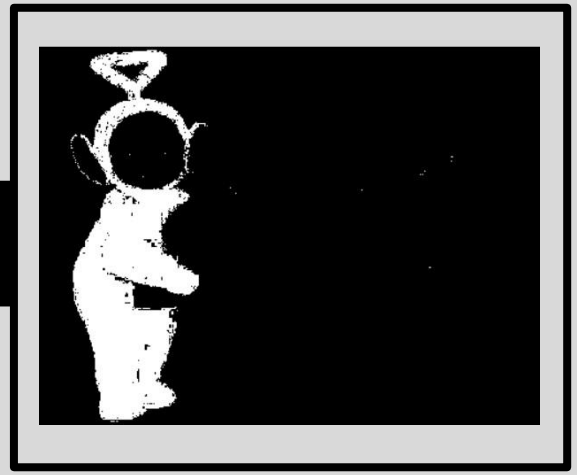


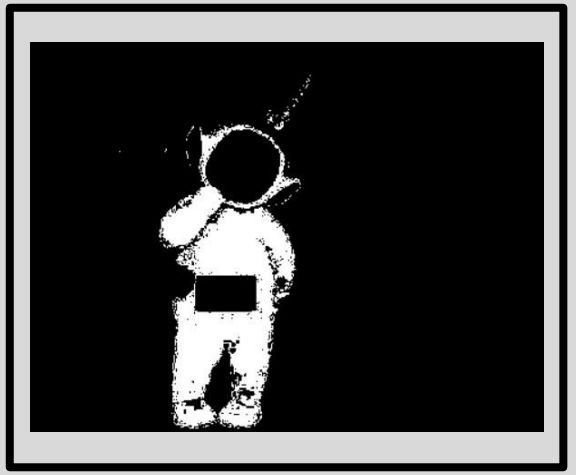


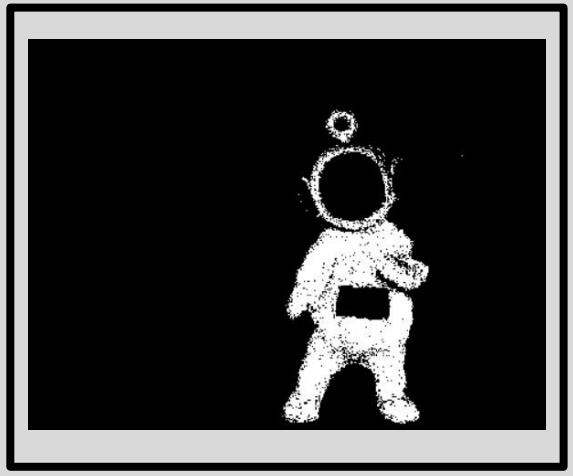
Beside is a normalized chromaticity coordinates (NCC) space. We consider x-axis to be red, while y-axis to be green. The 2D histogram of regions were calculated and were mapped individually into the NCC space. The number of bins is 32, therefore the resulting histogram is a 32 x 32 image. From this method, we can verify the location of the high intensities of NCC space. This method is to test the algorithm made first. Now, we back project this histogram to the actual image.

Mary Chris Go / 2014 11122

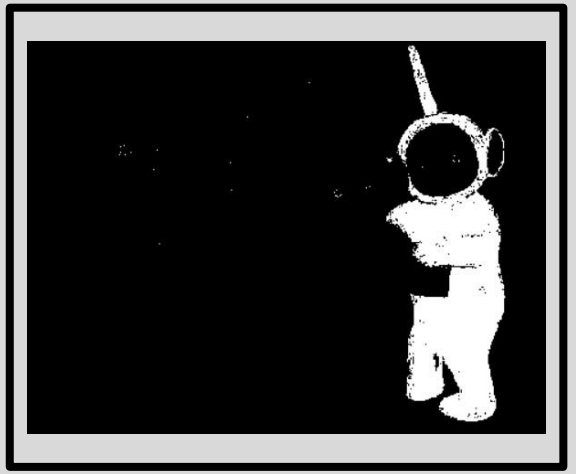
Non-Parametric Distribution Estimation



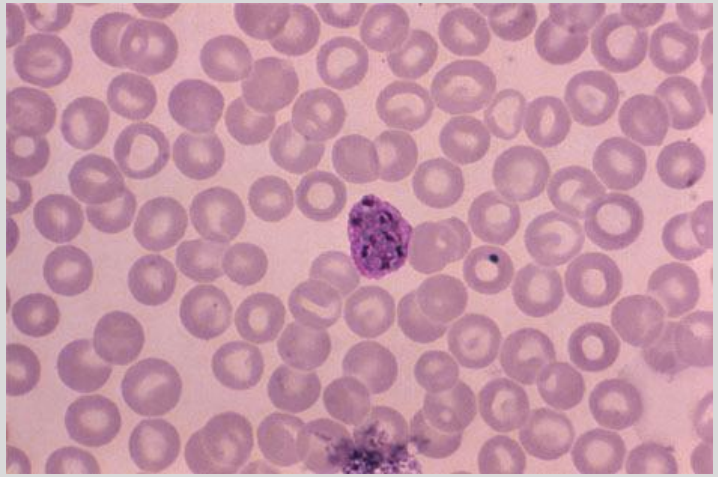




From this method, we see the perfect segmentation of each colors. I can say for colors with various gradients, a non parametric method is more helpful. In here, I used the Scilab code from our professor, Ma'am Jing, that helped us in creating the 2D histogram.

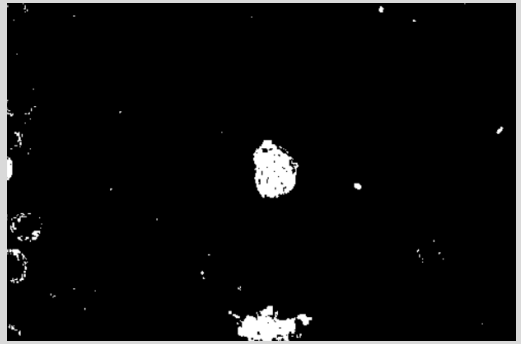


Mary Chris Go / 2014 11122

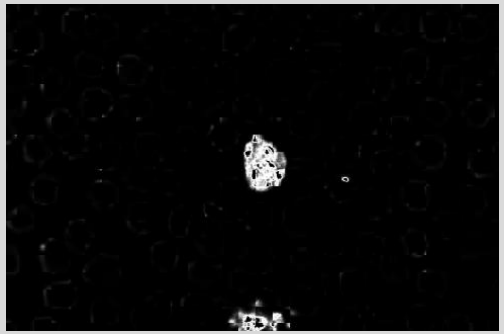


And because I enjoyed the segmentation, I tried applying it with **Malaria**. I want to be able to detect Malaria from the images of the cells. This one was easier to detect as the color will differentiate from the rest. From this test (with less gradient), a parametric method was the most suitable.

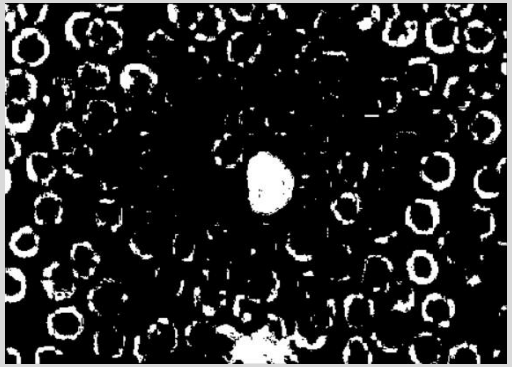
Mary Chris Go / 2014 11122



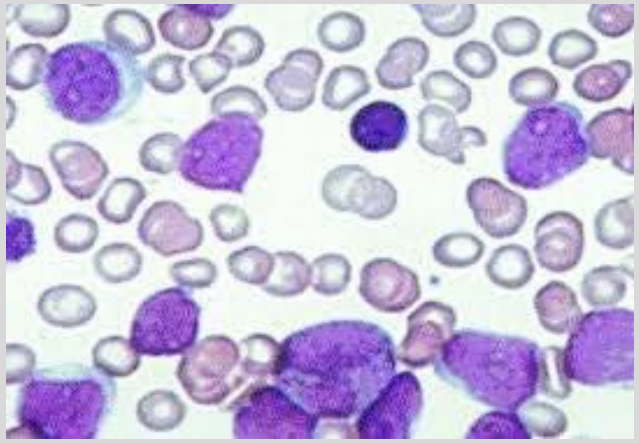
Grayscale Threshold



Parametric

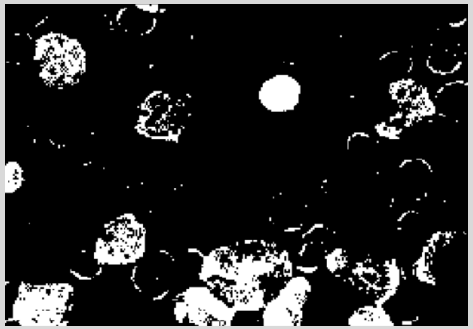


Non-Parametric

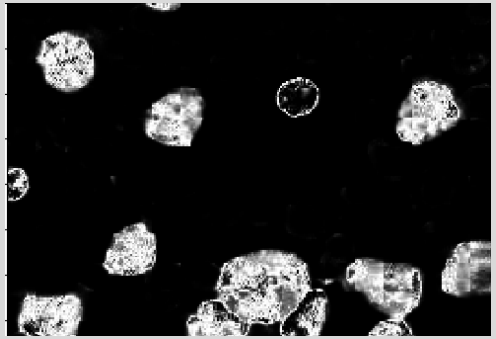


For the **cancer cells**, we can observe that the non-parametric method was better. Observing the original image, there were more shades of violet, therefore we expect the non-parametric to be better.

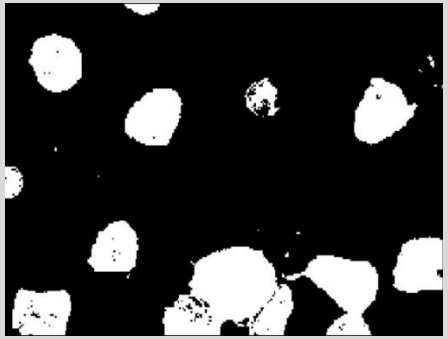
Mary Chris Go / 2014 11122



Grayscale Threshold



Parametric



Non-Parametric

Summary

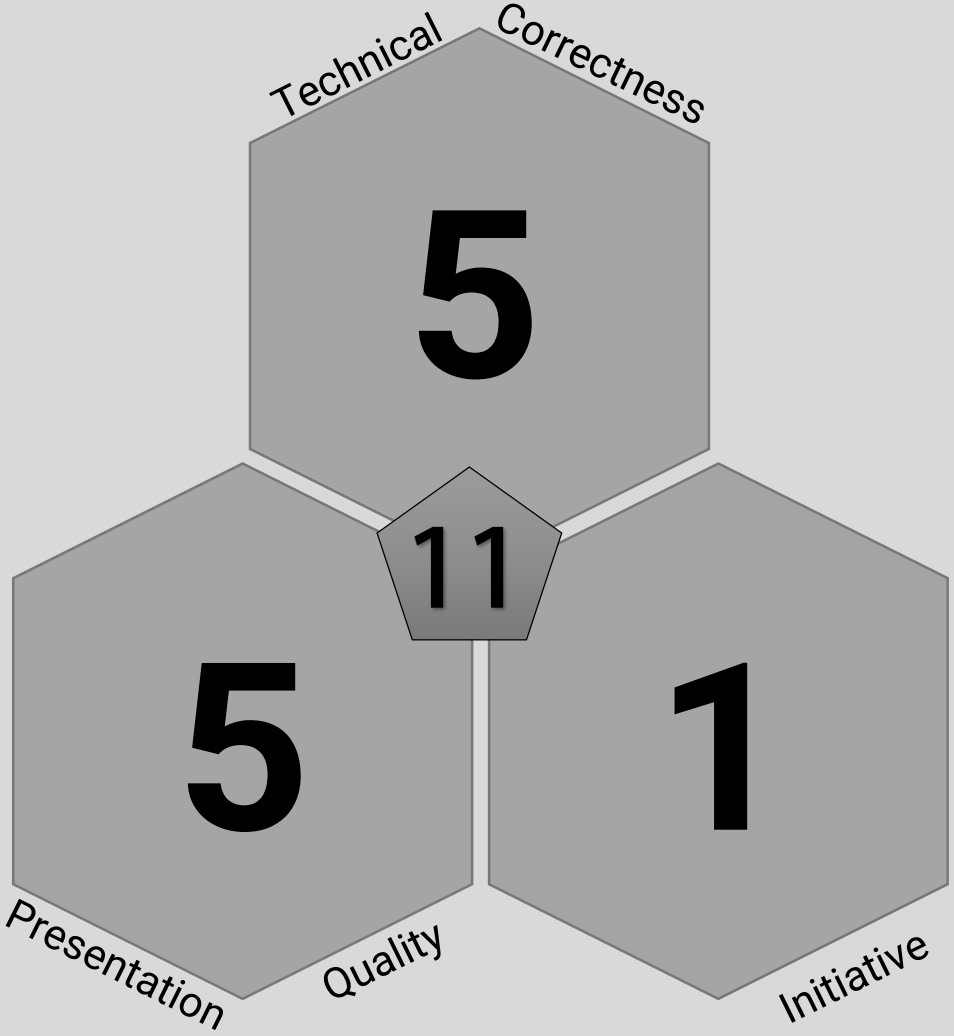
Based from the many trials I have tried, if there are gradients of a certain color that can be observed in the original image, a non-parametric distribution estimation is the most suitable. But for solid colors, such as the image for malaria cells, a parametric distribution estimation will do the work. For grayscale images and a large difference in white and black, setting a threshold is the most suitable method.

The three methods mentioned worked depending on the input image. I see segmentation as a good application for medical images. It can be a good tool to assist the doctors in detecting certain diseases.

The activity was so far my favorite as it can be applied to many things.

Mary Chris Go / 2014 11122

Self-Evaluation



References

- M. (2015, October 5). ACTIVITY #7 – IMAGE SEGMENTATION. Retrieved from https://barteezy.wordpress.com/2015/10/05/activity-7-image-segmentationo/
- Soriano, M., “Image Segmentation,” 2019.
- Teletubbies Picture: https://kiddipedia.com.au/teletubbies-celebrate-20-years-of-global-success/
- Cancer Cells picture given by Ma’am Jing (via Facebook Group)
- Malaria Cells : https://www.hsph.harvard.edu/news/features/malaria-parasite-invasion-doorway/