CS 91R: The Computational Image

Assignment 4: Otsu Thresholding

DUE February 26th at 11:59 PM

In this lab, we will implement a more sophisticated method for thresholding grayscale images to binary images. We'll use the Otsu method for developing models of the foreground and background.

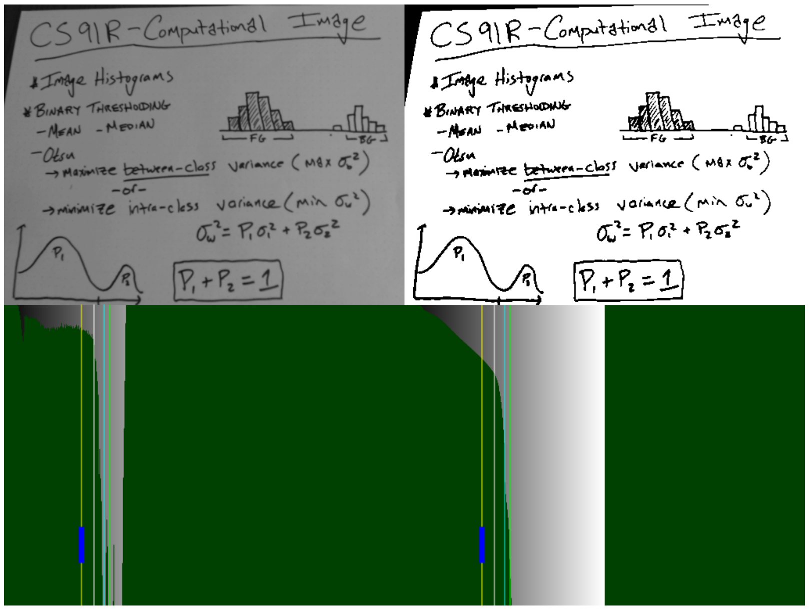
CS 91R - Computational Image
* Image Histograms
* Binary Thresholding
- Mean - Median
- Otsu
→ maximize between-class variance (max σ_b^2)
- or -
→ minimize intra-class variance (min σ_w^2)
$\sigma_w^2 = P_1\sigma_1^2 + P_2\sigma_2^2$
$P_1 + P_2 = 1$
FG
BG
P_1
P_2

Figure 1: `otsu`

1 Implementation

1. `calchist(img: p5.Image): List`

- Compute & return the histogram (256 bins) of grayscale `img`.

2. `calcmode(h: list): Number`

- Given a histogram (256 bins), return the mode.

3. `calcmean(h: list): Number`

- Given a histogram (256 bins), return the mean/average.

4. `calcmaxotsu(h: list): Number`

- Given the histogram, return the otsu threshold by maximizing the between-class variance.

5. `calcminotsu(h: list): Number`

- Given the hisgtogram, return the otsu threshold by minimizing the within-class variance (should give the same answer as the `calcmaxotsu` method).

2 Reflection

1. Include your results for the different thresholds (median, mean, mode, otsu).
2. Find an image where Otsu fails. Reflect on why it failed.
3. Describe another method for picking the threshold.

3 Challenges

1. Implement your alternative thresholding method from the last section.
2. Calculate the maximum entropy threshold.
3. Use Otsu for three classes.
4. Use Otsu for RGB images.

4 Learning Objectives

- use histograms to compute statistics
- think about an image as a mixture of foreground and background
- threshold images using statistics

5 Deliverables

1. Commit the javascript `sketch.js` to the repo. Your sketch should use `key` to toggle between the different ways of thresholding.
2. Write the reflection (as a markdown document named `reflection.md`) about what you were able to accomplish in this lab including the questions above. Don't forget the collaboration statement!