Assignment 1 Report

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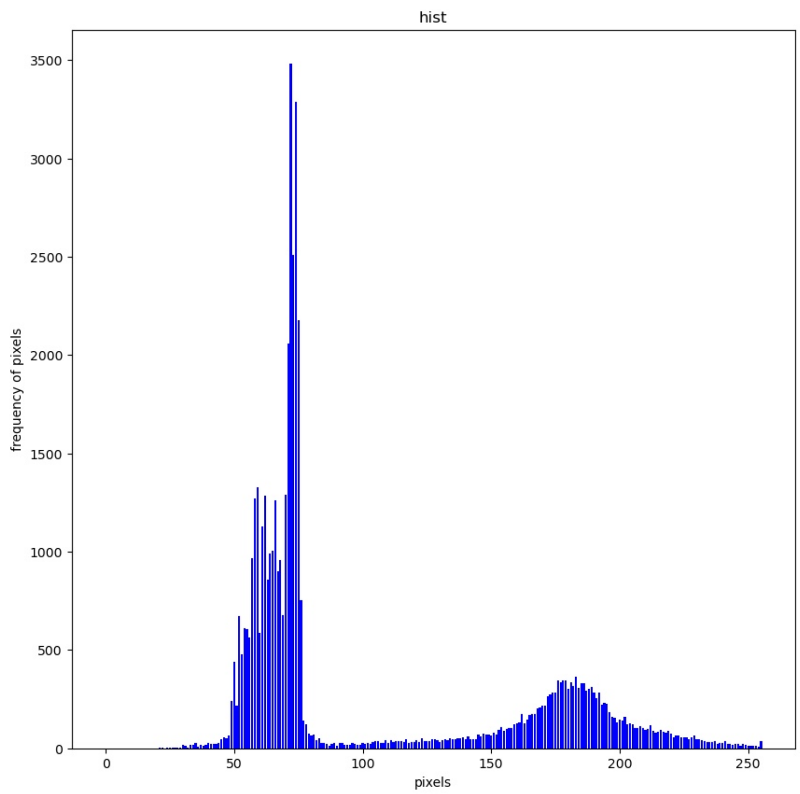
1. Histrogram Computation

Our task is to find the histogram for the given image through the frequency of the each pixels in range(0,256). plot it against the intensity. Compute average intensity through histogram and compare with actual average intensity.

$$AverageIntensity = \frac{\sum_{i=1}^{256} i * h(i)}{\sum_{i=1}^{256} h(i)} \tag{1}$$

$$ActualAverageIntensity = \frac{\sum_{Allpixels} Intensityofallpixels}{TotalnumberofPixels} \tag{2}$$



Inference: The Frequency of intensities with lower value(darker) are more compare to the larger intensities values(white). This shows the coin image mostly has darker pixels(we can see that in original image also). The average intensity comes out as **103.30500158906722** which is same as the value of Actual Average Intensity.

2. Otsu's Binarization:

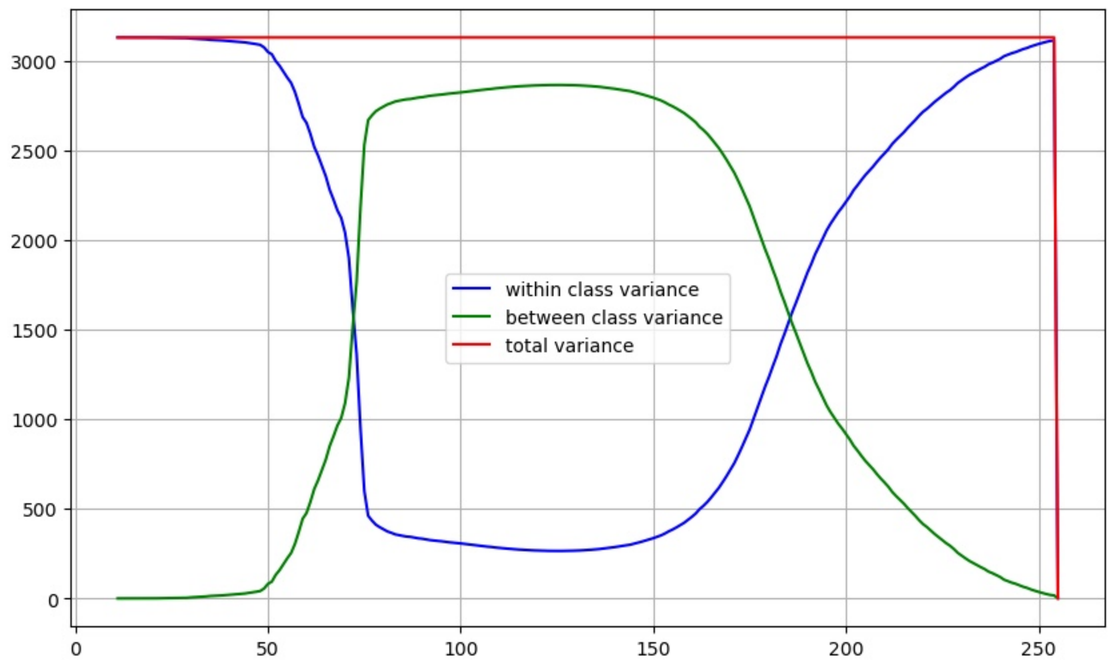
Our task is to find the optimal threshold for binarization of image through minimizing within class variance. Again find the threshold through maximizing between class variance. Verify they both are equal and plot within class variance, between class variance and total variance with respect to intensity. Last binarize the image using the optimal threshold.

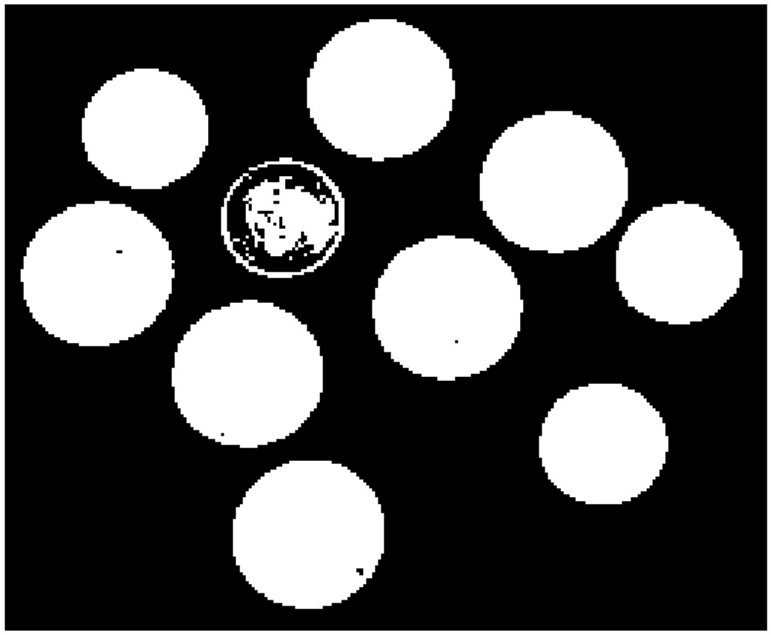
$$\sigma_w^2(t) + \sigma_b^2(t) = \sigma_T^2 \tag{3}$$

$$\sigma_w^2(t) = WithinClassVariance \tag{4}$$

$$\sigma_b^2(t) = BetweenClassVariance \tag{5}$$

$$\sigma_T^2 = TotalVariance \tag{6}$$





Inference: we found **125** as optimal threshold through minimizing within class variance and **125** as optimal threshold through maximizing between class variance. Hence both methods are equivalent. We Saw Total variance is constant with respect to intensity. In the

binarized image we saw one coin still has dark patch inside it, becuase we found optimal threshold at **125** and the pixel inside that coin is around the intensity so during binarization some pixel went to **0** and some went to **255**.

3. Adaptive Binarization:

Our goal is to divide the **N X N** image into blocks and apply otsu binarization on each of the blocks and then collect the all blocks together to get the binarized image.

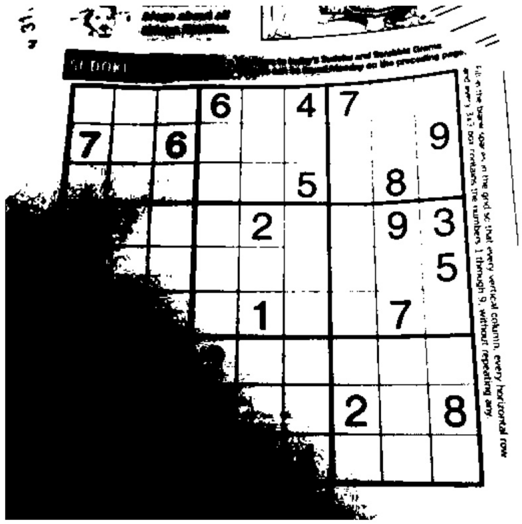


Figure 1: Only Binarized

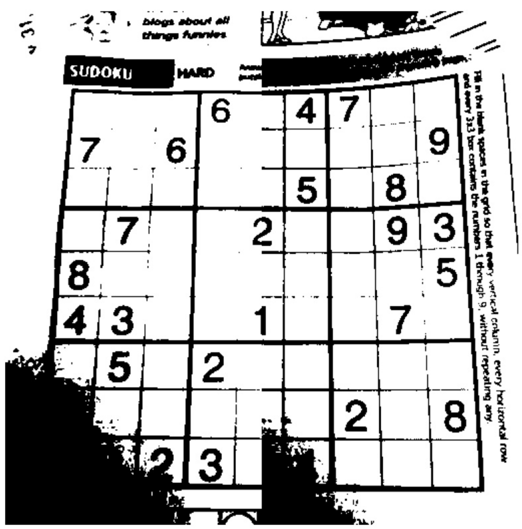


Figure 2: 2X2

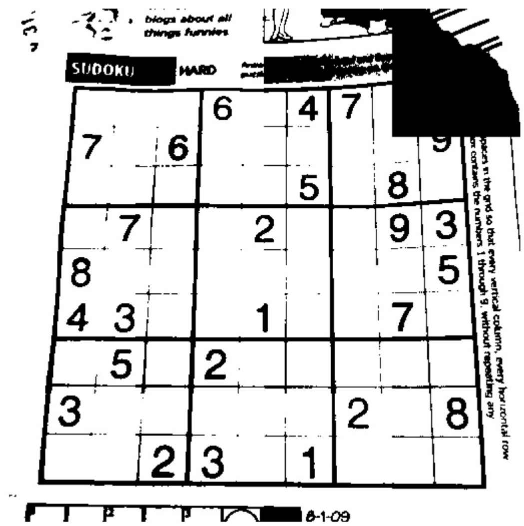


Figure 3: 4X4

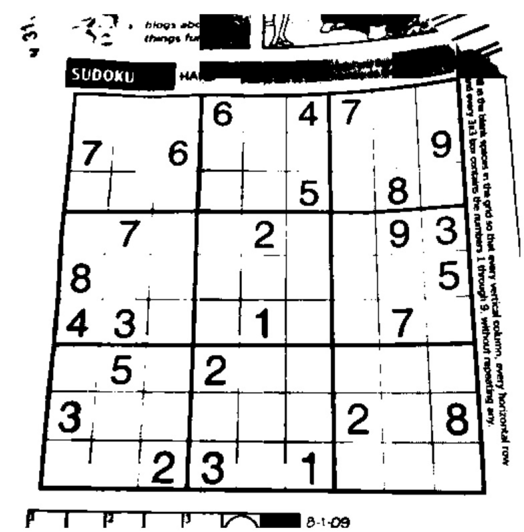


Figure 4: 8X8

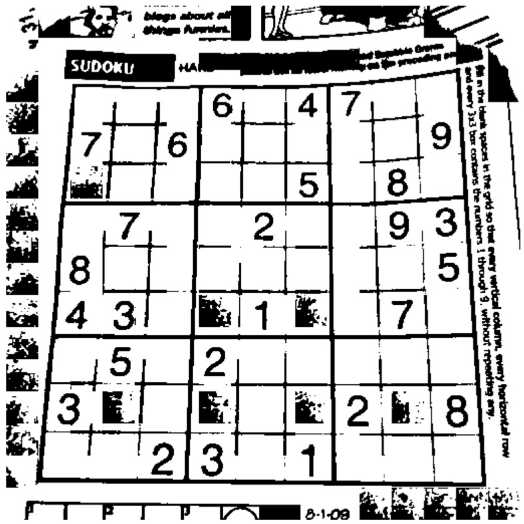


Figure 5: 16X16

Inference: First, we applied binarization to the full image, as shown in Figure 1. Some parts of the image turned black, which was not ideal. We then improved the process by dividing the image into four blocks, each 256 x 256 pixels, as seen in Figure 2. This approach provided a slight improvement over Figure 1. Next, we divided the image into 16 blocks, each 128 x 128 pixels, as shown in Figure 3, which was better than Figure 2. We achieved our optimal result in Figure 4 by dividing the image into 64 blocks, each 64 x 64 pixels. Increasing the number of blocks to 256, each 32 x 32 pixels, led to some dark patches in the image, though the boundaries were improved. While the boundaries were better than with the 64-block setup, dark patches appeared in the image.