Adaptive Thresholding

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Introduction

- **Definition of Thresholding:** A technique in image processing used to create binary images from grayscale ones by turning all pixels below a certain threshold to black and all above to white.
- **Application of Thresholding:** Essential in various tasks such as edge detection, image segmentation, and object recognition, and multispectral transformation.
- The Challenge: finding the value of threshold

Global Thresholding

Determines the threshold value based on the histogram of the overall pixel intensity distribution of the image.

Simple thresholding: binary thresholding, inverse binary thresholding, triangle thresholding and etc.

Ridler-Calvard (Iterative based),

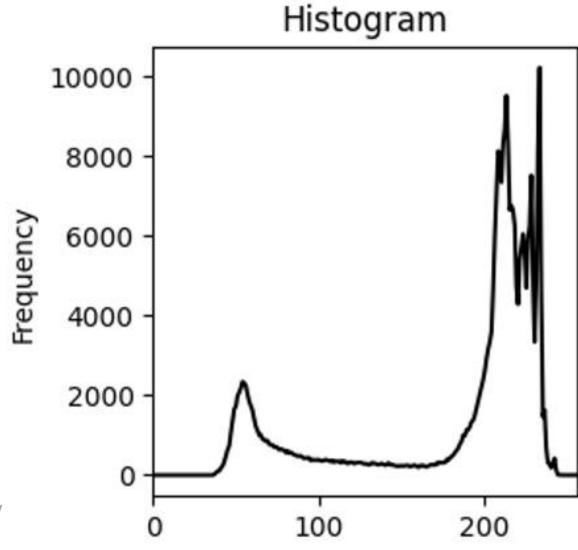
Otsu's method,

Problem: Does not work well for images with uneven illumination.

Original Image



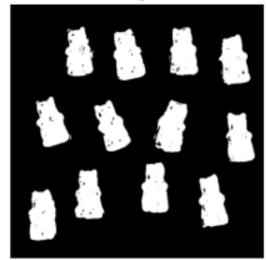
https://amagicalmess.com/juice-gummy-bears/



Binary



Binary Inv



Ridler-Calvard after 4 iteration





Otsu



Triangle



Adaptive Thresholding

Adaptive Thresholding: Threshold values adjust dynamically according to the characteristics of the local image region.

Best suited for images with shadows, uneven illumination.

Samples of shadowed images

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Original Image

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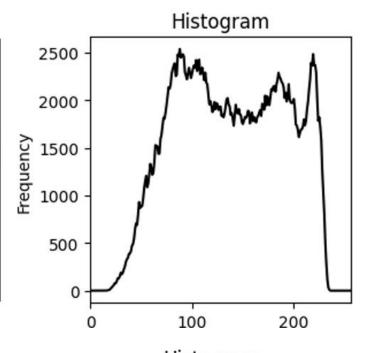
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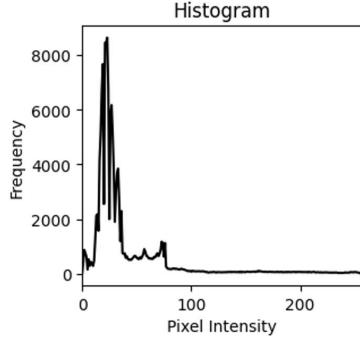
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Original Image





Global methods applied

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Global methods applied don't show good results!



Binary Inv



Otsu



Triangle



Adaptive thresholding Methods

- ✓ adaptive mean thresholding
- √ adaptive Gaussian thresholding
- ✓ Niblack
- ✓ Sauvola

Adaptive mean and Adaptive Gaussian Thresholding

Overview:

- The method calculates the mean of the pixel intensities in the predefined neighborhood and sets this as the threshold value for each pixel (depends on kernel size).
- Library: OpenCV
- Method's parameter: C is a constant subtracted from the mean to fine tune the threshold

Original Image

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Adaptive Mean

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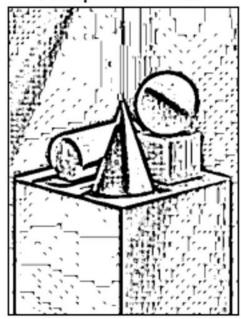
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Original Image

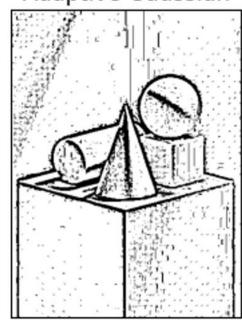


Adaptive Mean

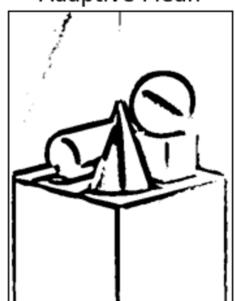


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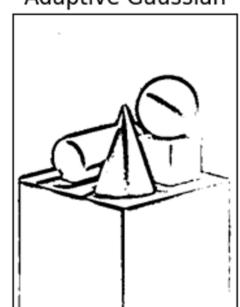
Adaptive Gaussian



Adaptive Mean Adaptive Gaussian



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Niblack and Sauvola Methods

Overview:

- considers both the mean and standard deviation of the pixel values in the neighborhood
- Library: *scikit-image*
- Method parameters:
 - K: to control noise sensitivity.
- Niblack is sensitive to noise, When the variance is too small in the local area it is almost the same as mean or Gaussian adaptive thresholding
- Sauvola is the improved version of Niblack

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Niblack Threshold

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Sauvola Threshold

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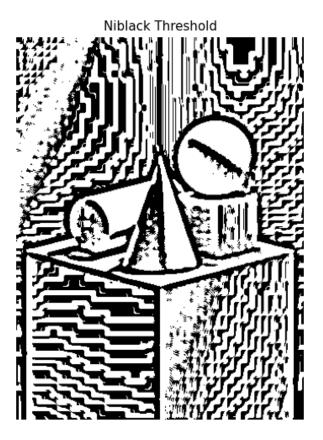
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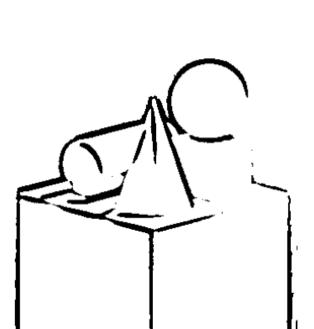
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Sauvola Threshold

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Conclusion

- Global methods works well for images with bimodal histograms which have 2 distinct peaks and distanced means
- Adaptive methods shows better results for images with uneven illumination. Especially for text images.
- With the same filter size local Gaussian shows better result with less noise than the local Mean
- Between Sauvola and Niblack's methods Sauvola shows better result with the right window size , K ,and r tuning.

