Class 3 (More on Image Thresholding)

Topics:

- Previous Class - Global Thresholding
- Adaptive thresholding
- Otsu's Binarization

Global Thresholding:

cv.THRESH_BINARY
cv.THRESH_BINARY_INV
cv.THRESH_TRUNC
cv.THRESH_TOZERO
cv.THRESH_TOZERO_INV

1. Single Threshold Value: A single threshold value is chosen for the entire image. This value is used to classify each pixel as either part of the foreground or the background.

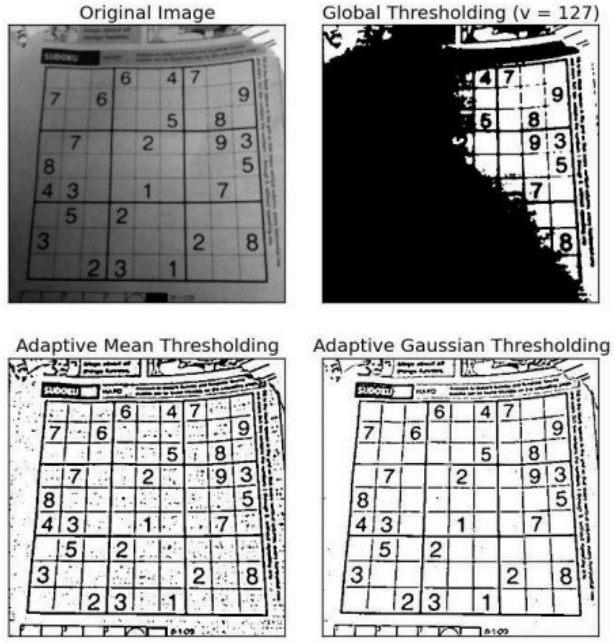
2. Binary Segmentation: Each pixel in the image is compared to the threshold value:
- If the pixel value is greater than the threshold, it is set to one value (e.g., white).
- If the pixel value is less than or equal to the threshold, it is set to another value

3. Output: The result is a binary image where the pixels are either black or white, representing the segmented regions.

Application:
- **Document Scanning:** Converting scanned documents to binary images for better readability.

Cons:
Not good for different lighting conditions in different areas in an image.
In such cases, adaptive thresholding methods, which calculate different thresholds for different regions of the image, can be more effective

Adaptive Thresholding:



Original Image

Global Thresholding (v = 127)

Adaptive Mean Thresholding

Adaptive Gaussian Thresholding

OpenCV

- determines the threshold for a pixel based on a small region around it.
- different thresholds for different regions of the same image
- gives better results for images with varying illumination.

Syntax:

cv.adaptiveThreshold(input_img, maxValue, adaptiveMethod, thresholdType, blockSize, C)

- The **adaptiveMethod** decides how the threshold value is calculated
- **blockSize** determines the size of the neighbourhood area
- **C** is a constant that is subtracted from the mean or weighted sum of the neighbourhood pixels.

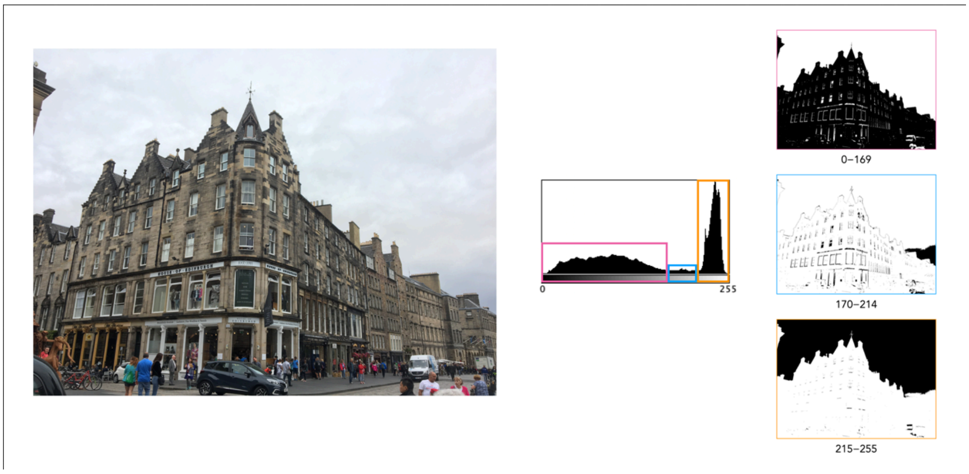
cv.ADAPTIVE_THRESH_MEAN_C: The threshold value is the mean of the neighbourhood area minus the constant **C**.

cv.ADAPTIVE_THRESH_GAUSSIAN_C: The threshold value is a gaussian-weighted sum of the neighbourhood values minus the constant **C**.

$$G(x, y) = \frac{1}{2\pi\sigma^2} e^{-\frac{x^2 + y^2}{2\sigma^2}}$$

- (x, y) are the coordinates of a pixel relative to the center of the neighborhood.
- sigma is the standard deviation, which controls the spread of the Gaussian function.

Otsu's Binarization:



pixelcraft

The right peak is associated with the overcast sky (and white van). The left shallow mound comprising both midtones and shadows makes up most of the remaining image content.

- Otsu's method avoids having to choose a value and determines it **automatically**.
- Otsu's method determines an optimal global threshold value from the image histogram.
- The **result of the process is a binary image**, where each pixel is assigned one of two possible values.
- Otsu's method was introduced by Nobuyuki Otsu in 1979

Syntax: Almost same as the global thresholding

cv2.threshold(input_img, arbitary_threshold, max_val, thresh_method + cv2.THRESH_OTSU)

- cv.THRESH_OTSU is passed as an extra flag
- The threshold value can be chosen arbitrary.

The **algorithm then finds the optimal threshold value** which is returned as the first output.