Histogram Equalization and Matching

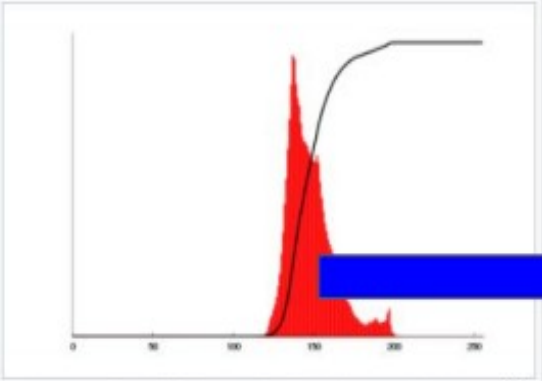
HISTOGRAM EQUALIZATION

- The fundamental idea of histogram equalization is to improve contrast of an image.
- Histogram equalization is a point process that redistributes the image's intensity distributions in order to obtain a uniform histogram for the image.
- Truly uniformed histograms for discrete images are difficult to obtained because of quantization . So we are going to implement the following formula to get the new pdf:

$$S_k = (L-1)cdf(x)$$

Low contrast image

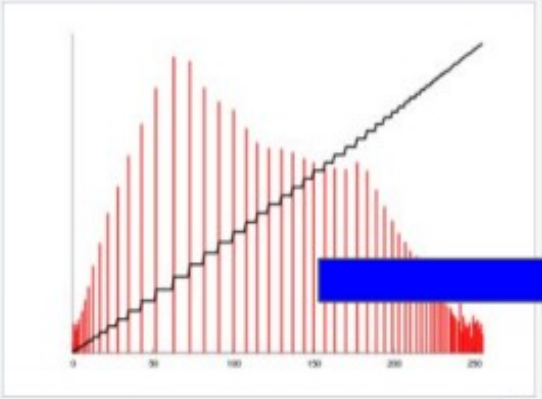
Before Histogram Equalization



Corresponding histogram (red) and cumulative histogram (black)

Concentrated Histogram
(Before Equalization)

After Histogram Equalization

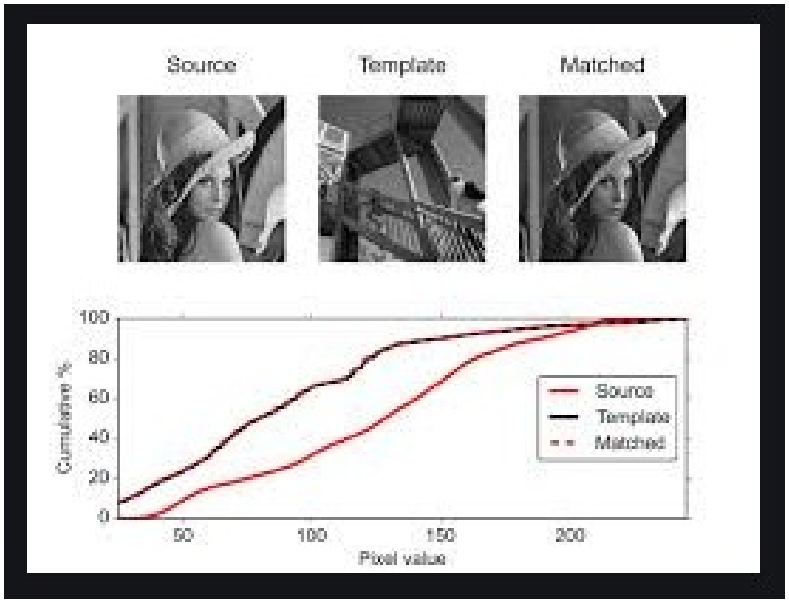


Corresponding histogram (red) and cumulative histogram (black)

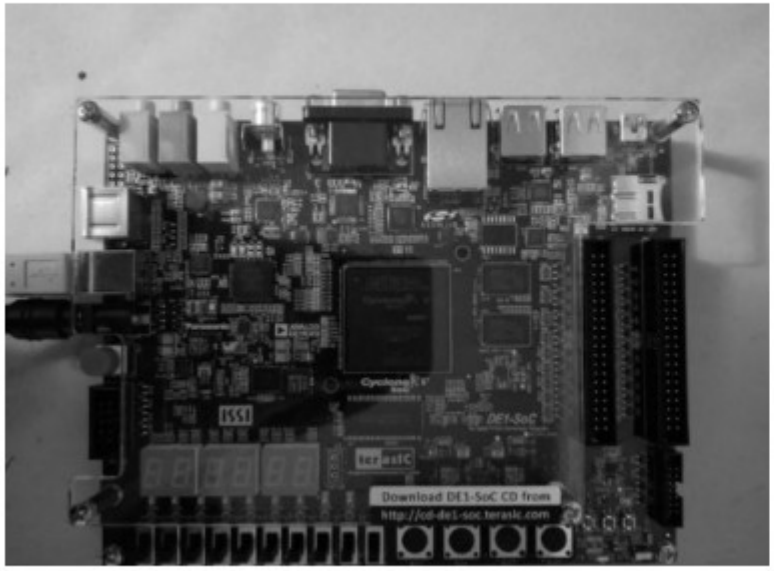
"Almost" uniform Histogram
(After Equalization)

HISTOGRAM MATCHING

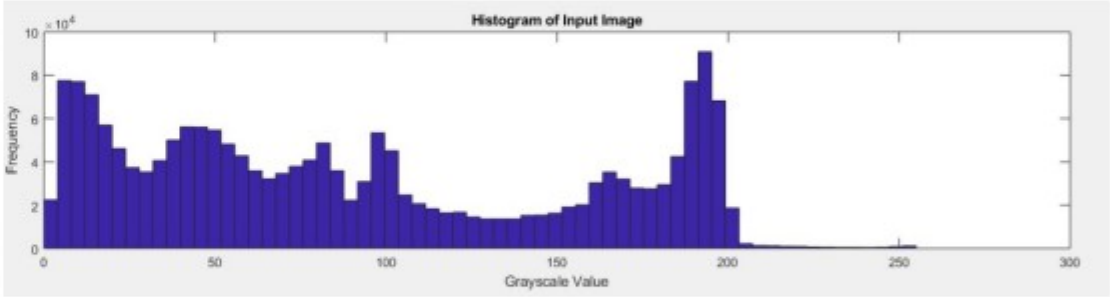
- In image processing, histogram matching or histogram specification is the transformation of an image so that its histogram matches a specified histogram.
- Histogram equalization method is a special case in which the specified histogram is uniformly distributed.



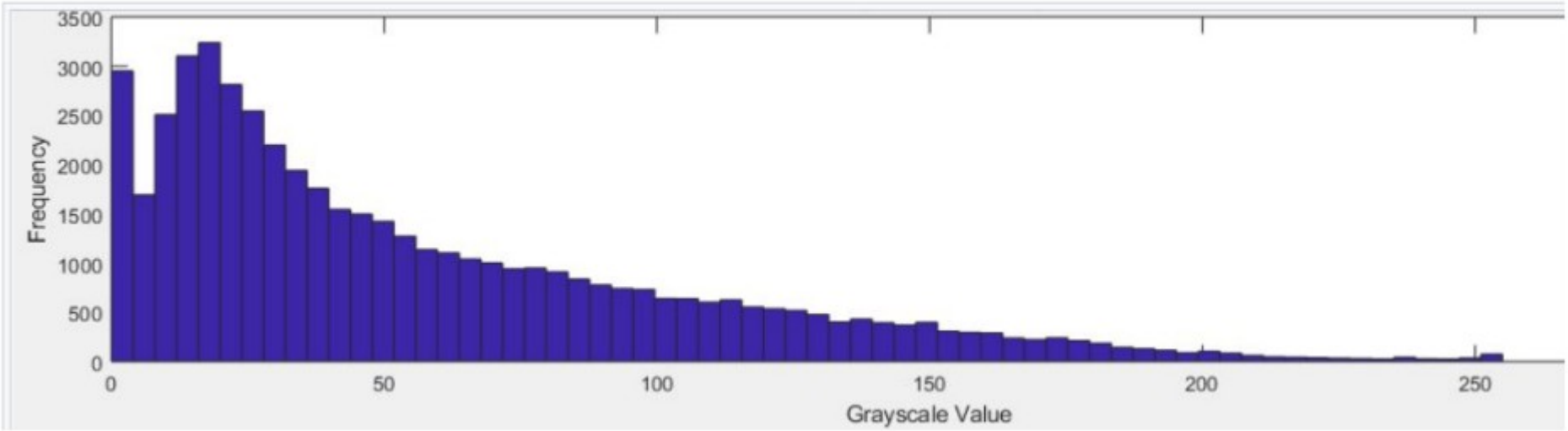
Input Image



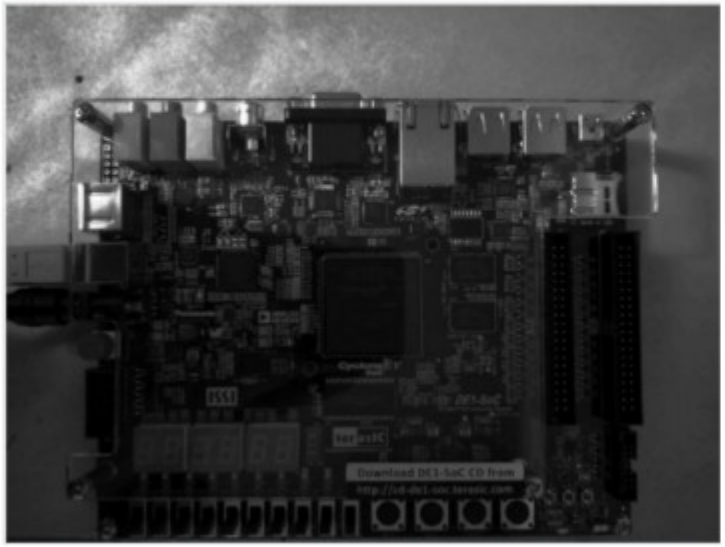
Histogram of Input Image



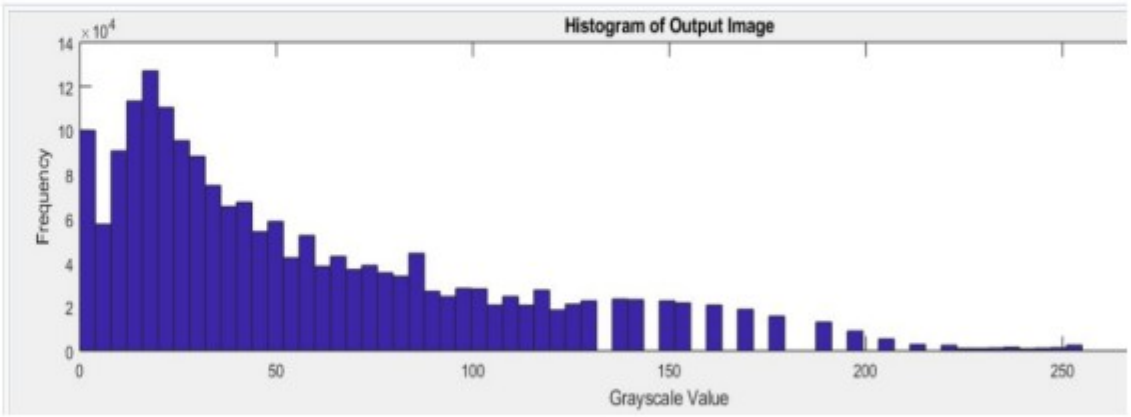
Reference Histogram



Output Image



Histogram after matching



Histogram Matching: Algorithm

1. Given two images, the reference and the target images, we compute their histograms. Following, we calculate the ***cumulative distribution*** functions of the two images' histograms: G(.) for reference image and H(.) for the target image.

2. Then for each grey level, x_s in [0, 255] we find the grey level x_T for which $G(x_S) = H(x_T)$ and this is the result of histogram matching function: $M(x_S) = x_T$.

3. Finally, we apply the function M() on each pixel of the reference image.

4. That means, in above example, original intensity x_S is replaced by x_T in the matched image

Problem Objective

Write C++/Image-J modular functions to

a) Perform histogram equalization on the *given set of* (gray/colored) images.

b) Perform histogram matching of the input image with respect to Target image.

Display the

a) histograms of the original image and Histogram equalized image

b) histograms of the original image, Target image and Histogram matched image

Document the observations.

Note

1. **Do not** hardcode the filenames and/or image size into the code.
2. Use proper code commenting and documentation.
3. Use self-explanatory identifiers for variables/functions etc.
4. Make separate programs for equalization and matching.