HISTOGRAM OF AN IMAGE

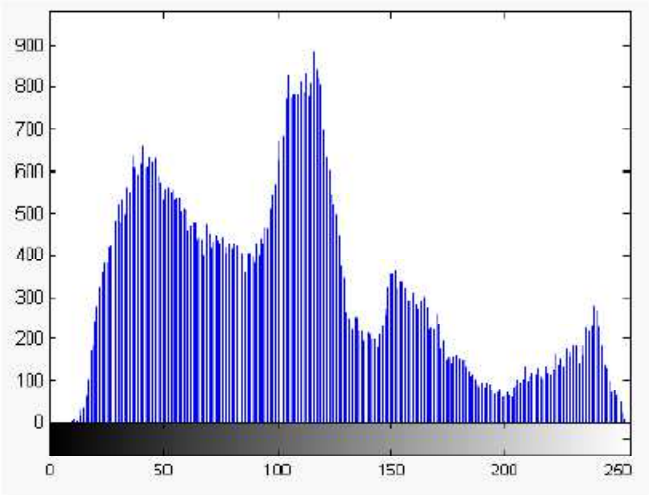
The histogram of grayscale image is a function that shows how often each grayscale (color) appears in the image.

-To compare two images obtained under different lighting

-To measure certain properties on image

-To improve the quality of an image (gray levels) The function of the histogram of image is defined by:

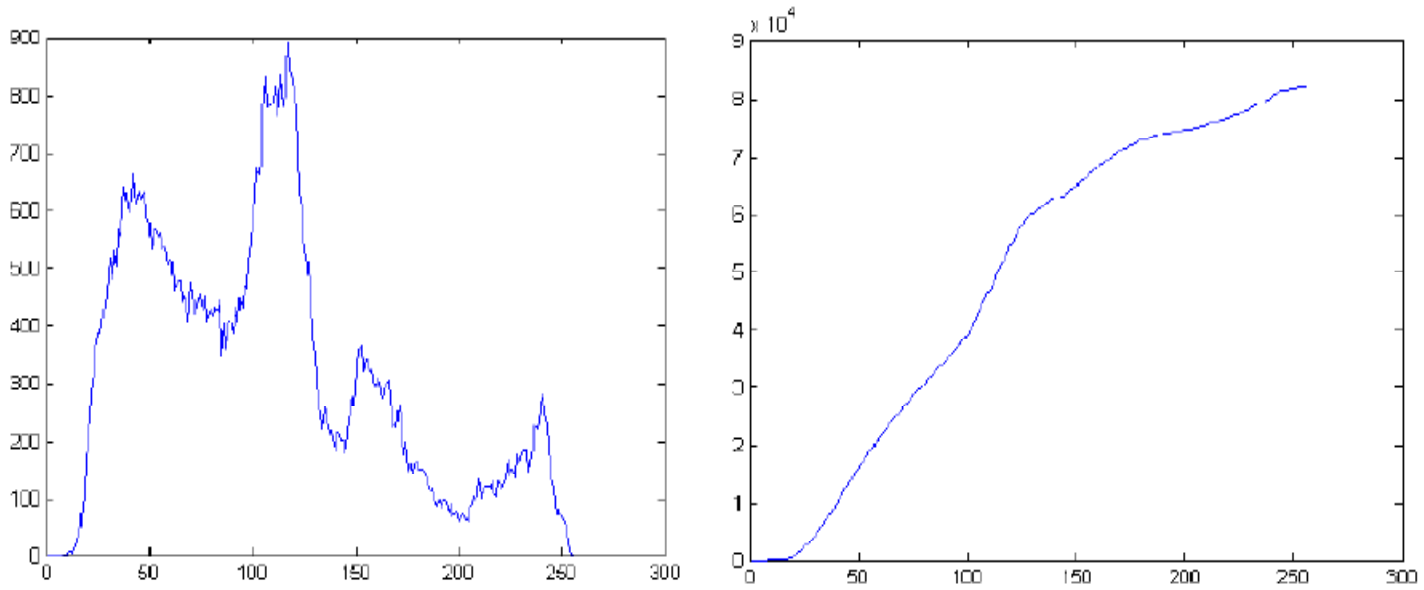
$\forall i \in \{0, \ldots, 255\}$ *h(i)* : number of pixels that had i as gray level.



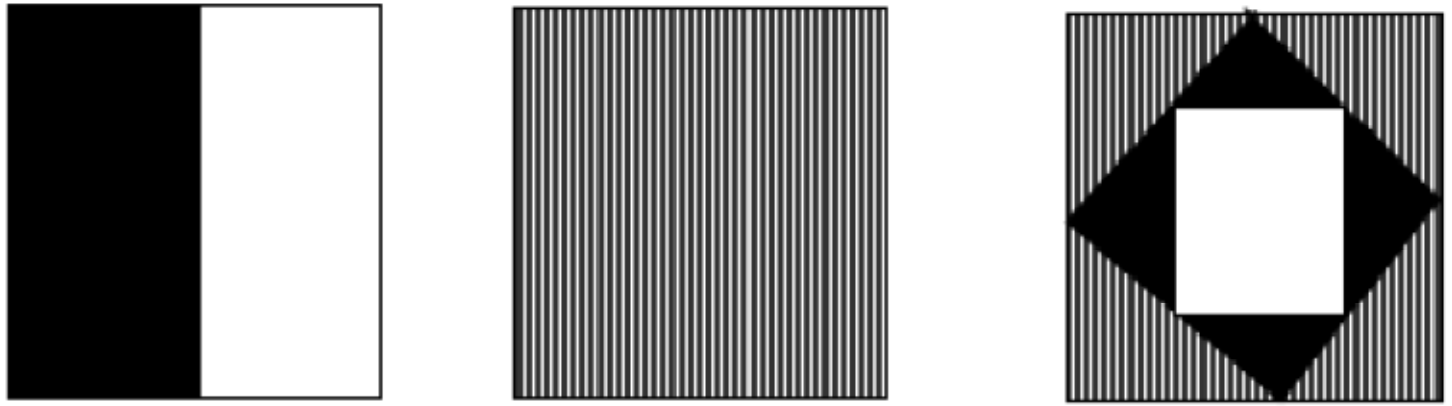
Cumulative histogram

It is also a vector of dimension 256. Each element $h_c(i)$ represents the number of pixels in the image having a gray level less than or equal to i.

$$h_i(i) = \sum_{j=0}^{i} h(j)$$

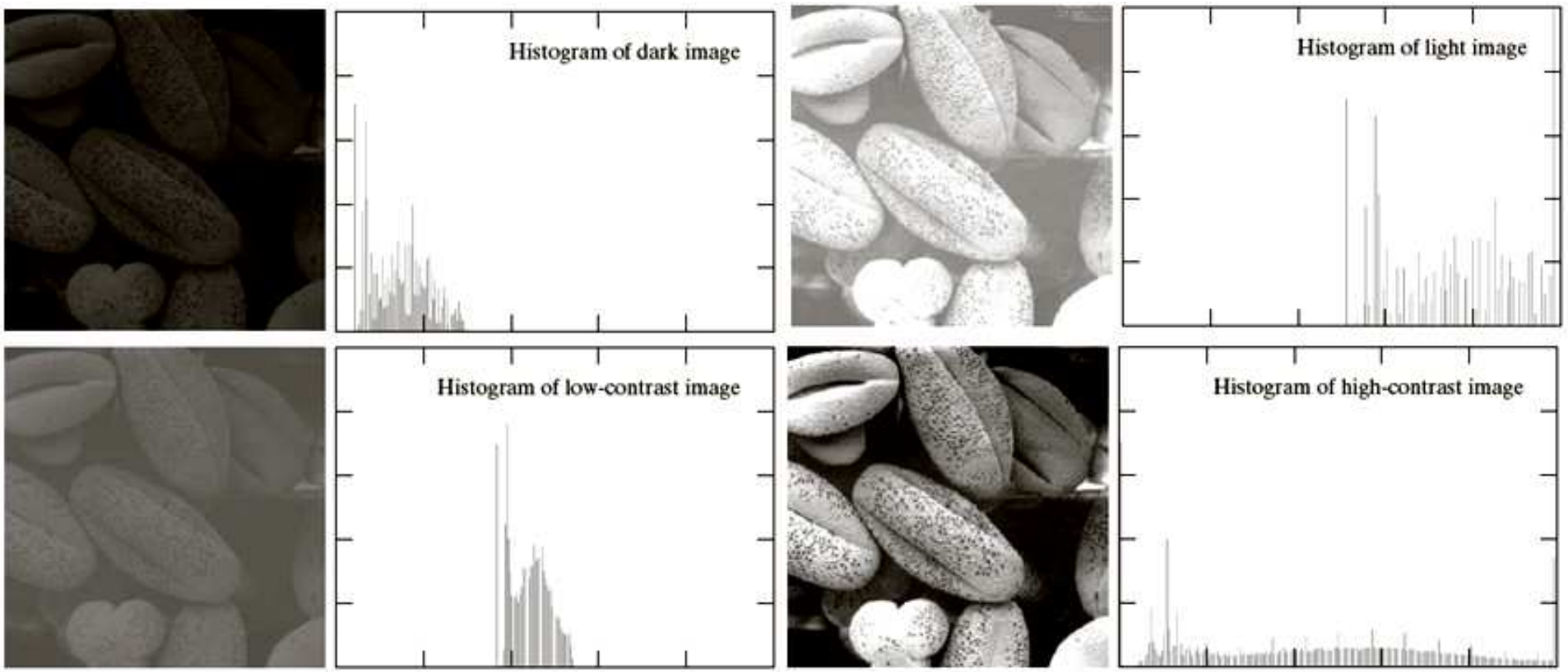


Note 1: The histogram gives an indication of the dynamics of the image (distribution of gray levels).



Some images that have the same histogram

Types of images and their histograms



Statistical parameters

From the histogram, the following characteristics can be calculated.

Mean

Variance

Entropy

Mean : The mean of a statistical variable is defined by the following formula:

$$\mu = \frac{\sum_{i=0}^{255} iH(i)}{\sum_{i=0}^{255} H(i)}$$

0	3	3	2	5	5
1	1	0	3	4	5
2	2	2	4	4	4
3	3	4	4	5	5
3	4	5	5	6	6
7	6	6	6	6	5

Variance: The variance of a statistical vari defined by the following formula:

$$\sigma^2 = \frac{\sum_{i=0}^{255}(i-\mu)^2 H(i)}{\sum_{i-0}^{255} H(i)}$$

Entropy: Entropy gives information on the dispersion of gray levels.

$$b_e = -\sum_{i=0}^{l} P(i)\log_2 P(i)$$ bit by symbol

With: P (i) = Prob {I (x, y) = i}, P (i) = H (i) / $\sum H(i)$

Exercise

Consider the following image.

0	3	3	2	5	5
1	1	0	3	4	5
2	2	2	4	4	4
3	3	4	4	5	5
3	4	5	5	6	6
7	6	6	6	6	5

1- Draw the corresponding histogram.

2- Calculate the mean and entropy of this image.

Image Enhancement Techniques

For f'= t (f) is type transformation that changes the dynamics of gray levels in order to improve the visual appearance of the image.

Intensity Transformation function :

Assume a that f is an image with a concentrated histogram in the interval [a, b]. The a, b values correspond to the extreme gray levels present in this image.

$$t(f) = \begin{cases} 255\dfrac{f-a}{b-a} & pour \;\; a \leq f \leq b \\ 0 & si\; f < a \\ 255 & si\; f \geq b \end{cases}$$

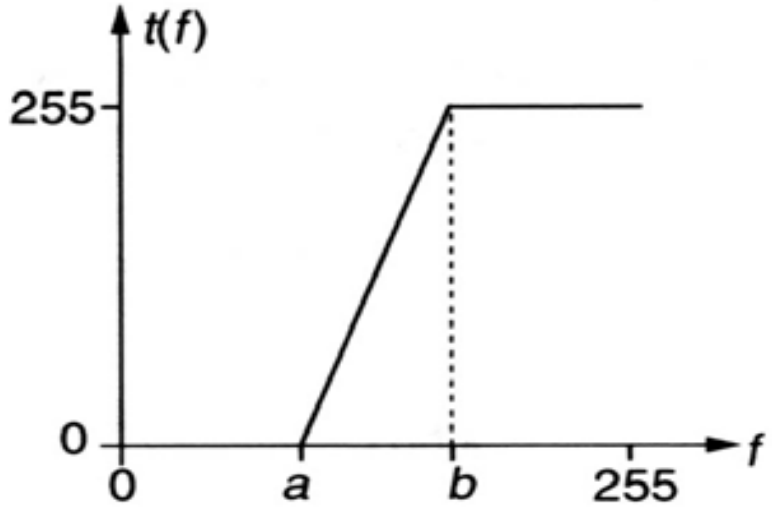


Image originale

Image a= 30, b= 200