Image Processing
Histogram

Lecture 6

Image Histogram

- An **Image Histogram** is a type of histogram that acts as a graphical representation of the lightness/color distribution in a digital image. It plots the number of pixels for each value.

- Histograms plots how many times (frequency) each intensity value in image occurs.

Image Histogram

- The histogram of an image is a plot of the gray-level values ~~*versus*~~ the number of pixels at that value(shows us the distribution of grey levels in the image).
- A histogram appear as a graph with ‘brightness‘ on the horizontal axis from 0 to 255 (for an 8-bit intensity scale) and ‘number of pixels’ on the vertical axis.
- To find the number of pixels having a particular brightness within an image, we simply look up the brightness on the horizontal axis .

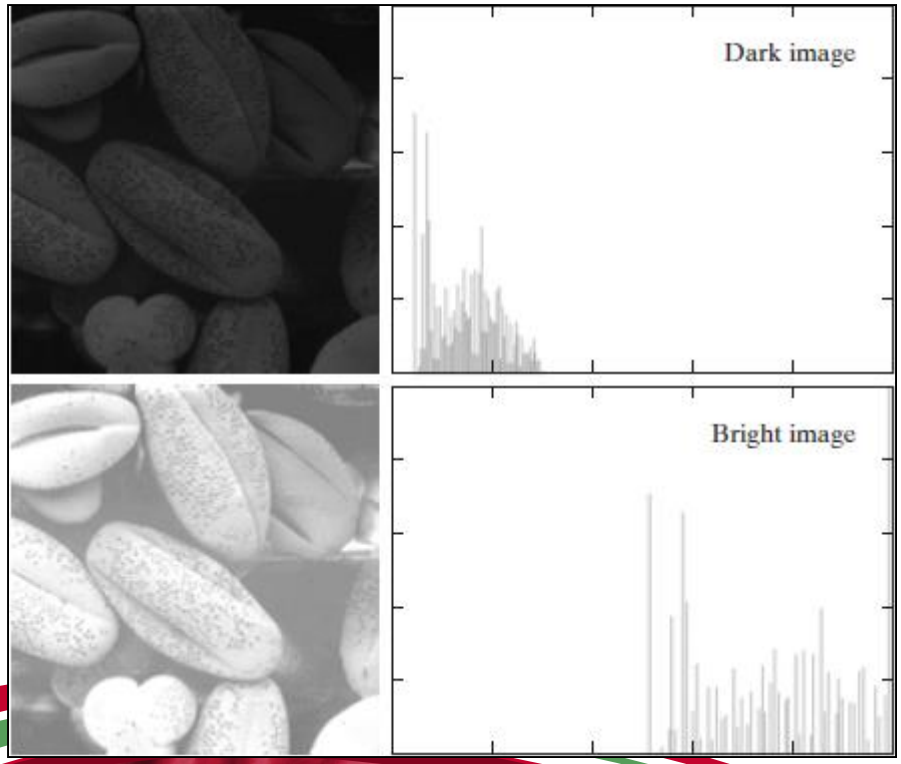
Why Histogram?

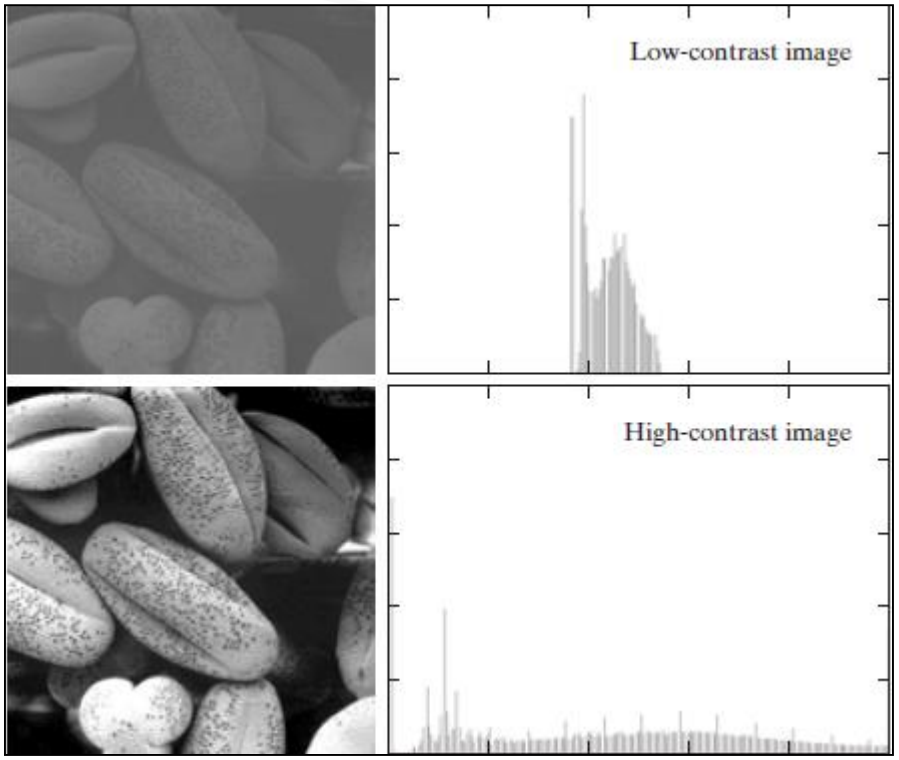
- Histograms are the basis for numerous spatial domain processing techniques
- Histogram manipulation can be used effectively for image enhancement
- Histograms can be used to provide useful image statistics
- Information derived from histograms are quite useful in other image processing applications, such as image compression and segmentation.

Introductory Example of Histograms

- consider the Figure shown in four basic gray-level characteristics: dark, light, low contrast, and high contrast.
- The right side of the figure shows the histograms corresponding to these images.
- The horizontal axis of each histogram plot corresponds to gray level values, r_k.
- The vertical axis corresponds to values of $h(r_k)=n_k$ or $p(r_k)=n_k/n$ if the values are normalized.
- Thus, as indicated previously, these histogram plots are simply plots of $h(r_k)=n_k$ versus r_k or $p(r_k)=n_k/n$ versus r_k.

Introductory Example of Histograms… Cont.

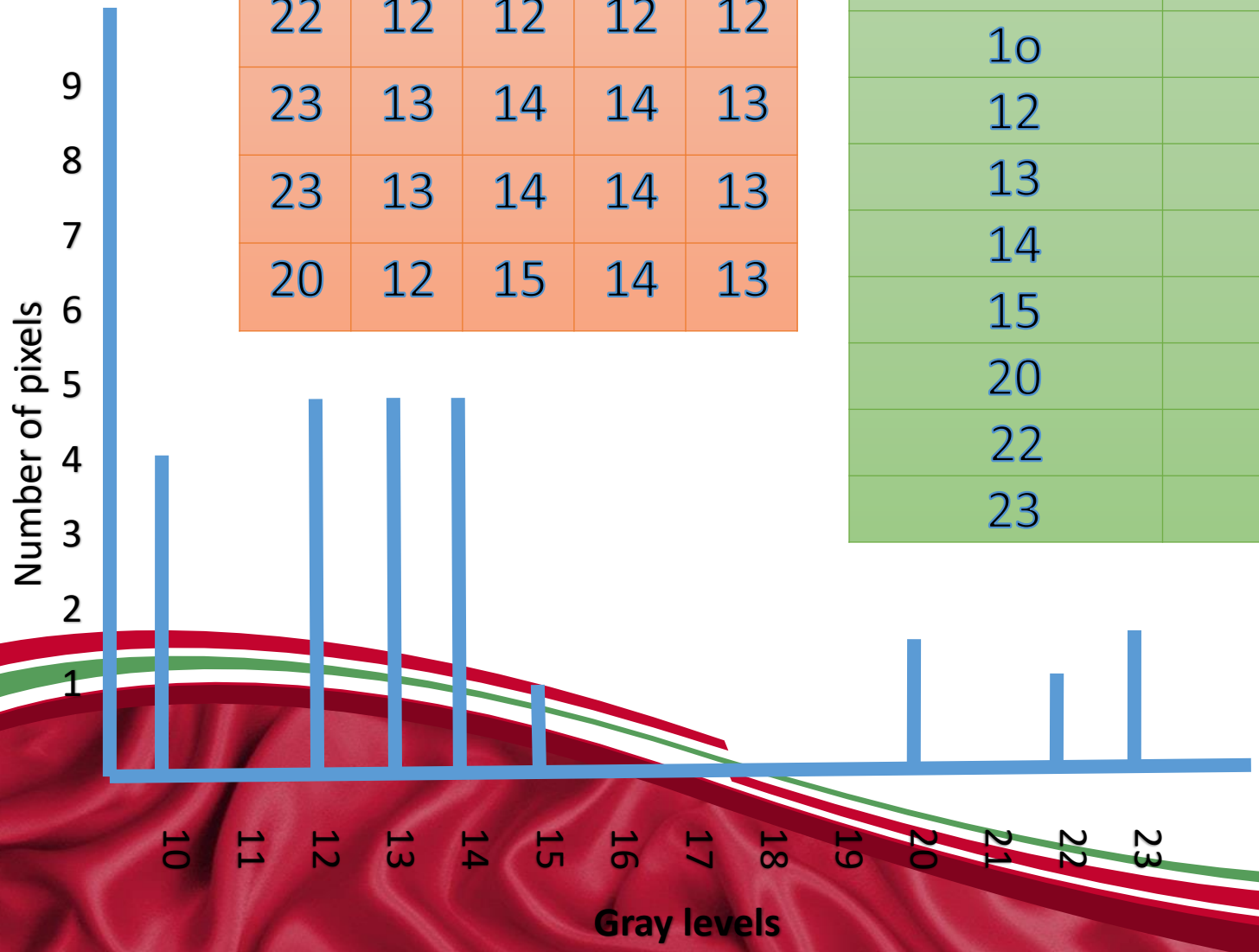




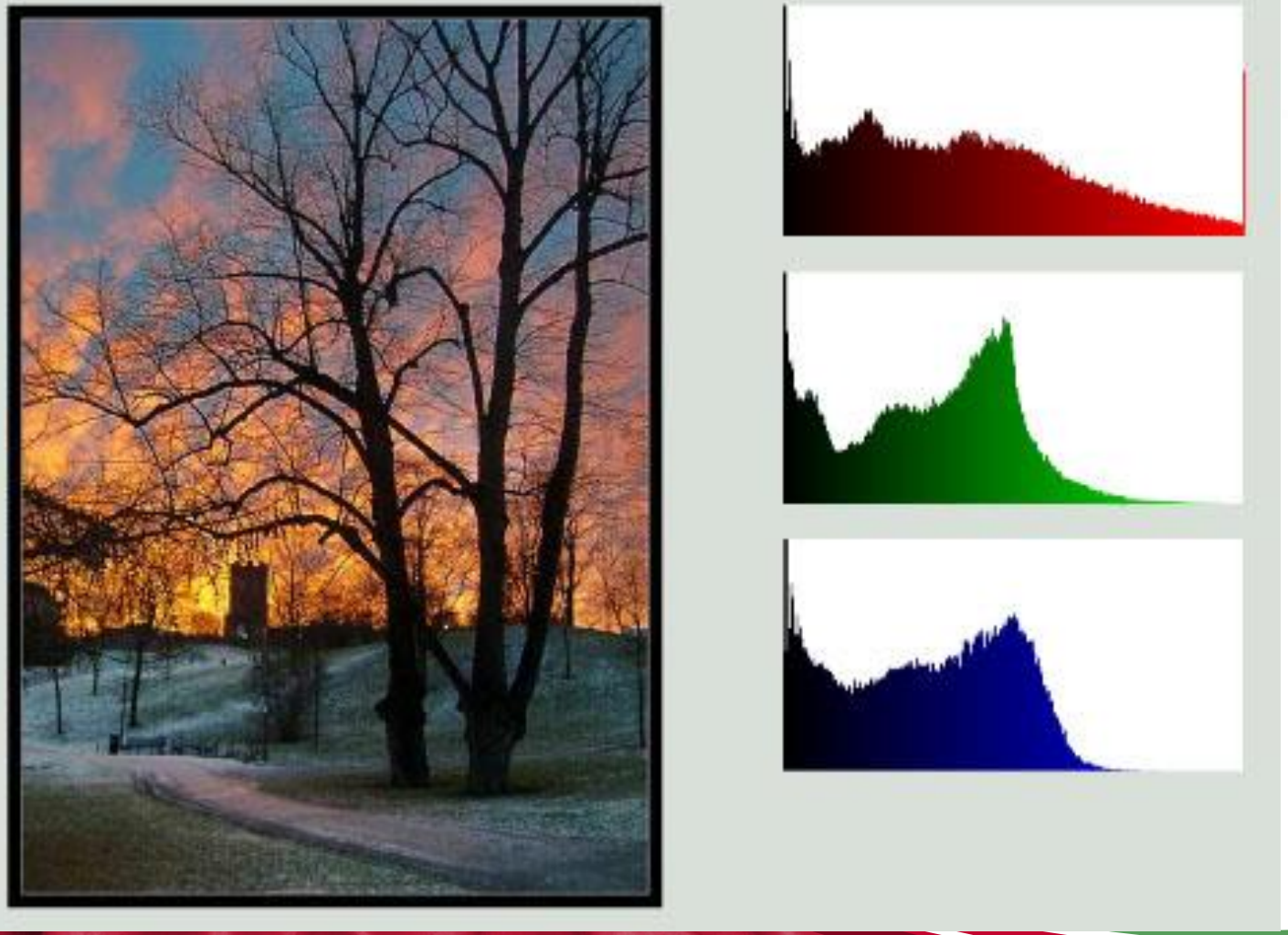
Example:- find & draw the histogram for the sub image

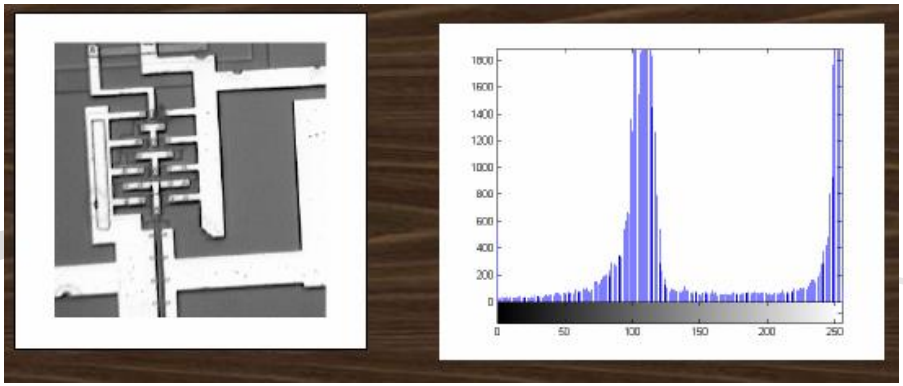
20	10	10	10	10
22	12	12	12	12
23	13	14	14	13
23	13	14	14	13
20	12	15	14	13

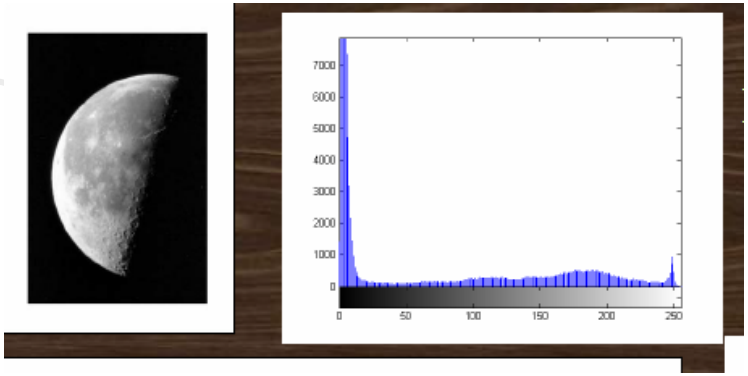
Gray level value	No pixels
1o	4
12	5
13	5
14	5
15	1
20	2
22	1
23	2

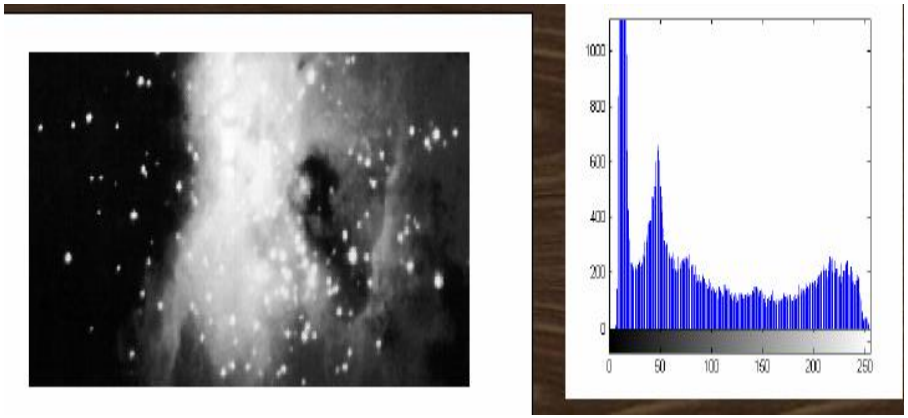


The Image Histogram









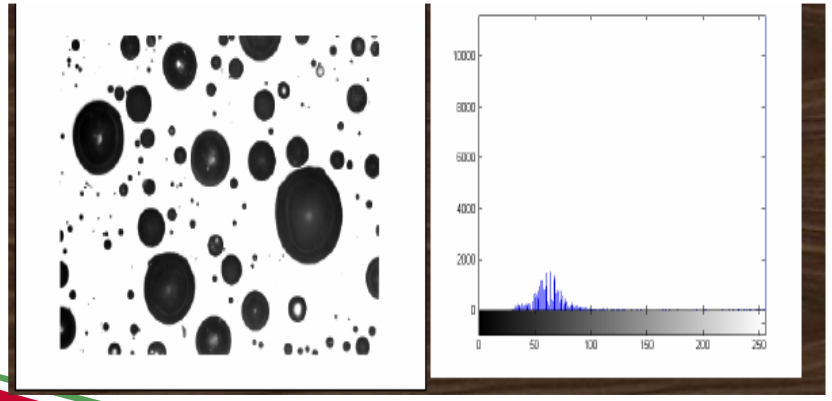


Image histogram modification :-

The histogram can be modified or scaled by three methods

1. histogram stretching
2. histogram shrinking
3. histogram sliding

Image Histogram Equalization

Histogram equalization is a technique where the histogram of the resultant image is as flat as possible (with histogram stretching the overall shape of the histogram remains the same)

The results in a histogram with a mountain grouped closely together to "spreading or flatting histogram makes the dark pixels appear darker and the light pixels appear lighter (the key word is "appear" the dark pixels in a photograph can not by any darker. If, however, the pixels that are only slightly lighter become much lighter, then the dark pixels will appear darker).

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-

Histogram Equalisation, E(I)

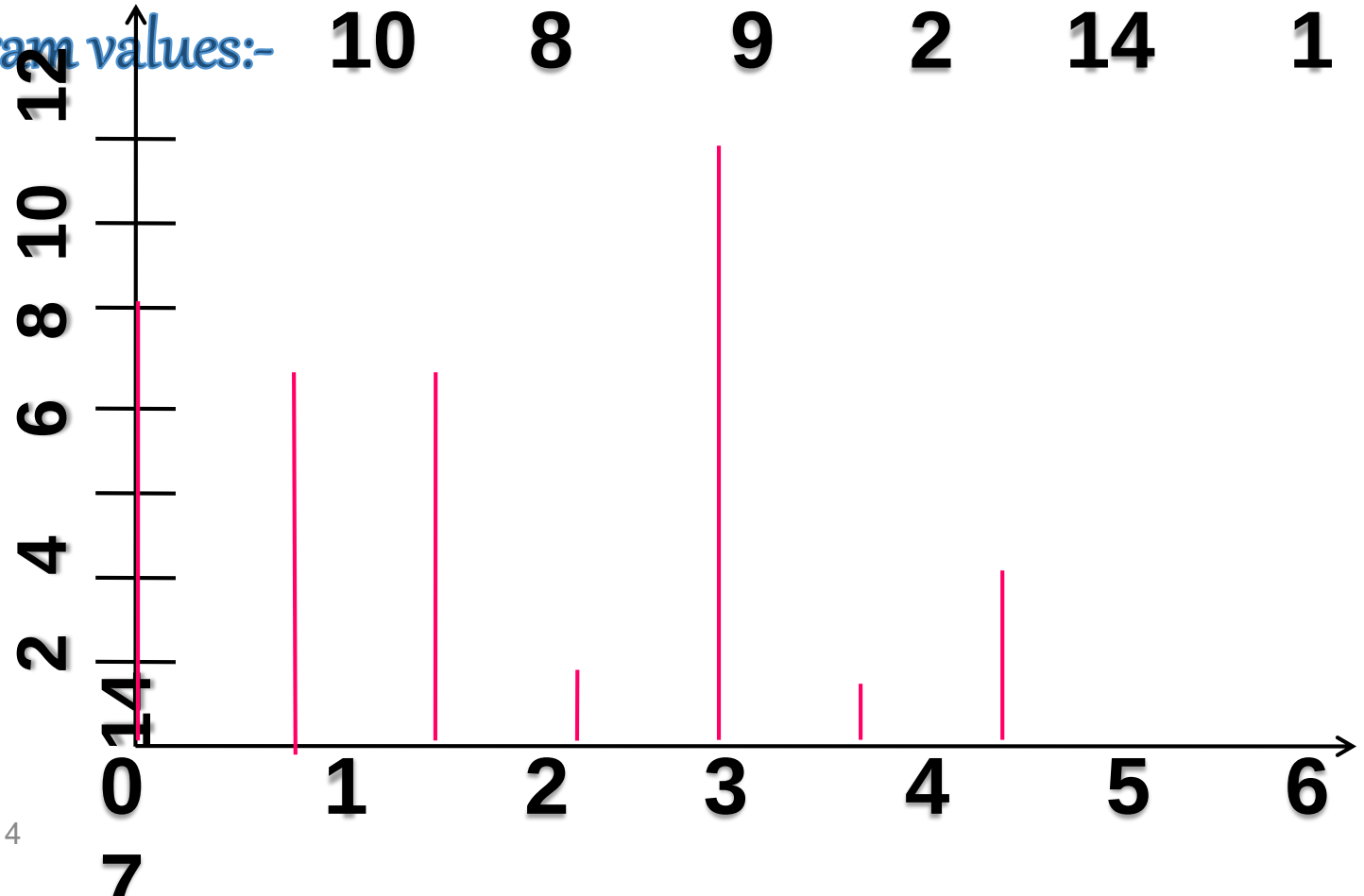
- Increases dynamic range of an image
- Enhances contrast of image to cover all possible grey levels
- Ideal histogram = flat
  - same no. of pixels at each grey level
- *Ideal no. of pixels* at each grey level =

$$i = \frac{N * M}{L}$$

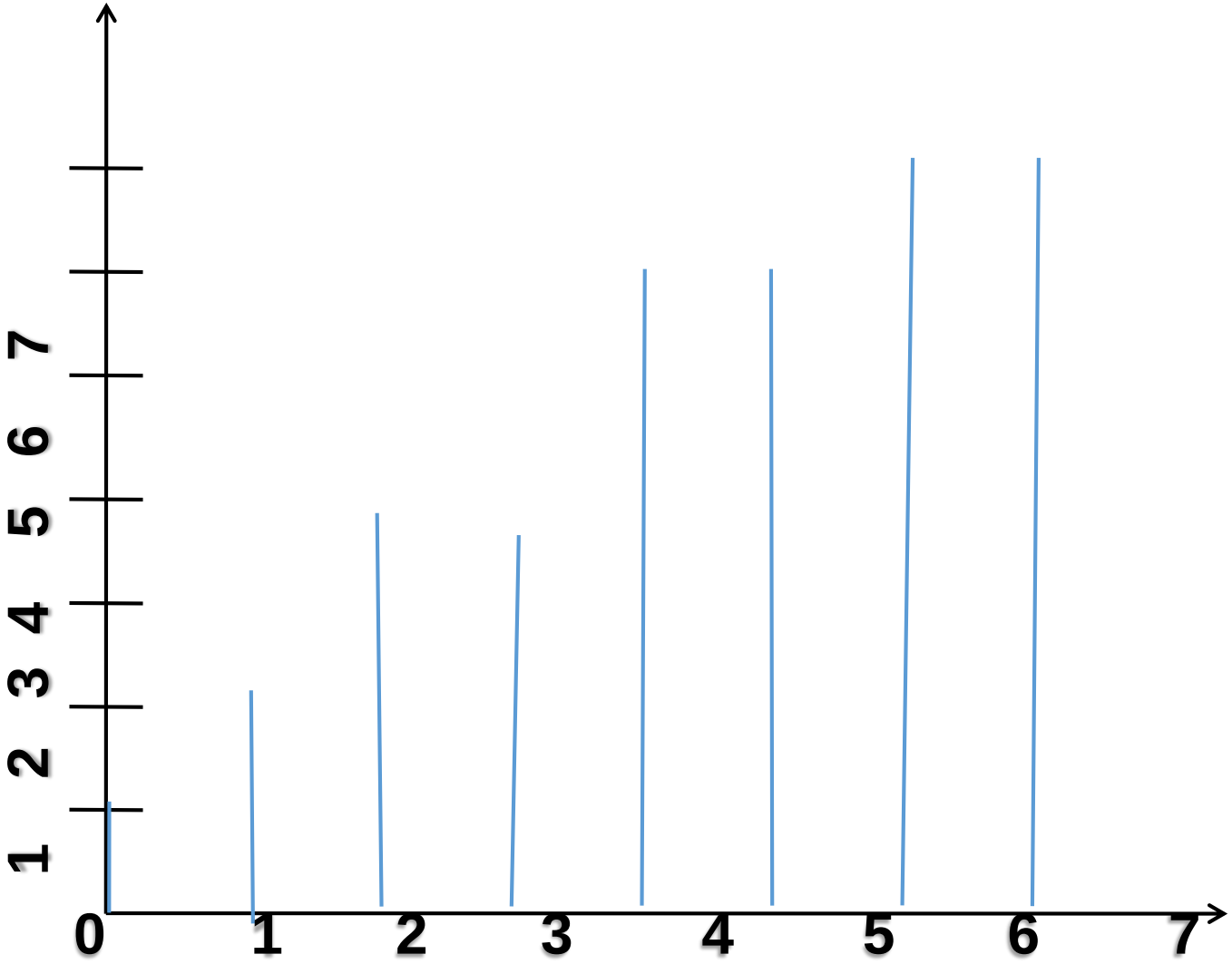
Example: apply histogram equalization for the following gray-level values

Gray-level values:- 0 1 2 3 4 5 6 7

Histogram values:- 10 8 9 2 14 1 5



Gray-level	0	1	2	3	4	5	6	7

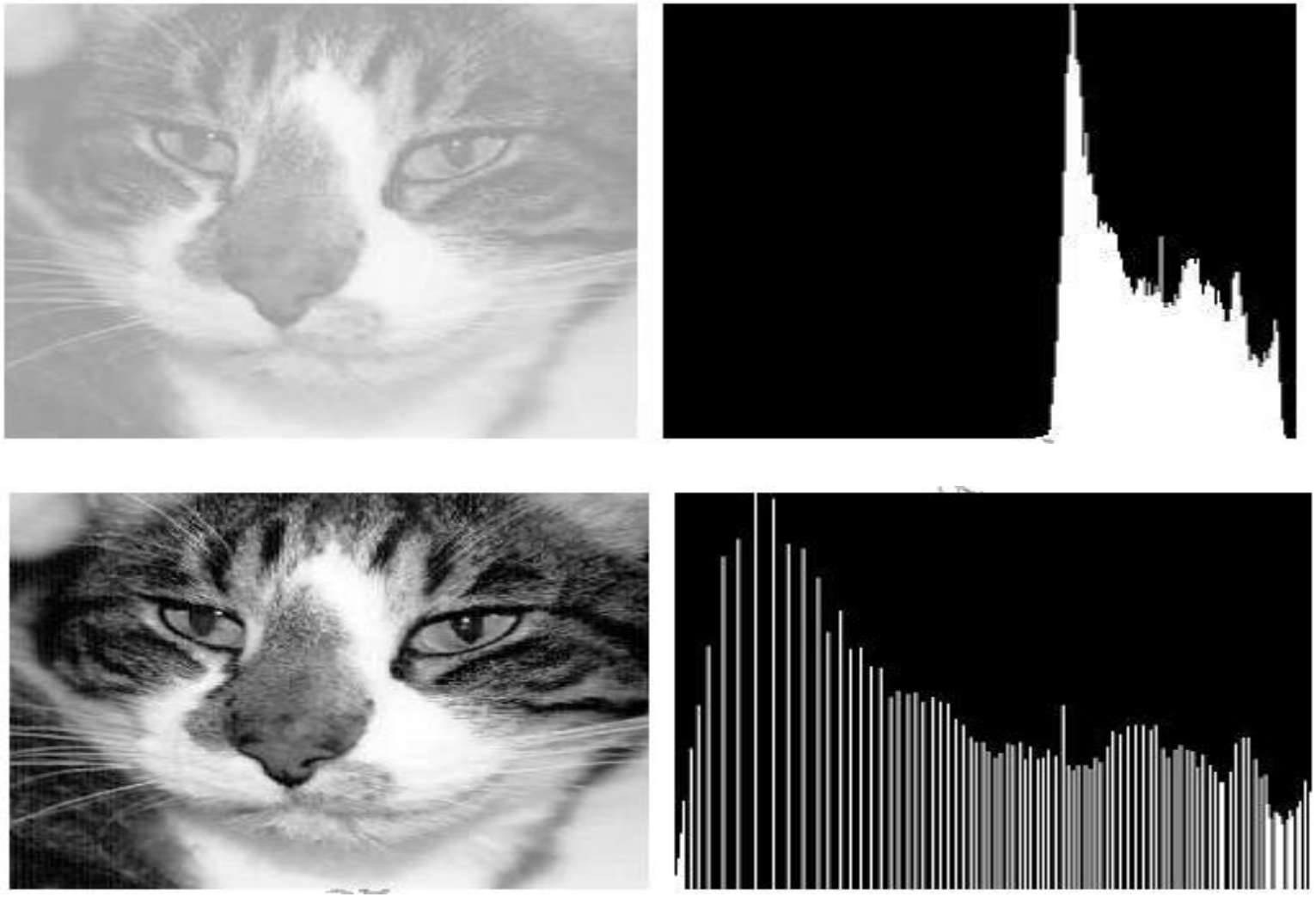

1 2 3 4 5 6 7
0 1 2 3 4 5 6 7

Step 1: Great a running sum of histogram values. This means that the first values is 10, the second is 10+8=18, next is 10+8+9=27, and soon. Here we get 10,18,29,43,44,49,51.

Step 2: Normalize by dividing by total number of pixels. The total number of pixels is 10+8+9+2+14+1+5+0=51.

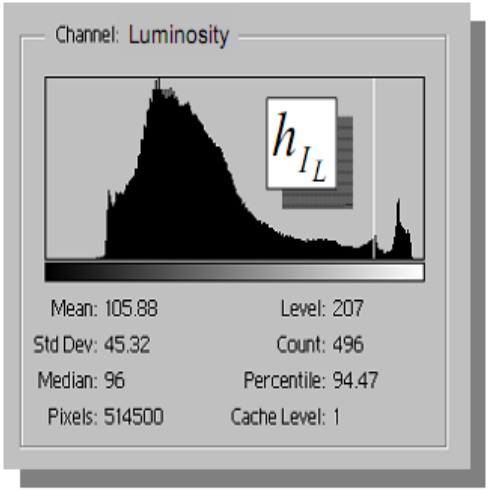
Step 3: Multiply these values by the maximum gray – level values in this case 7 , and then round the result to the closet integer. After this is done we obtain 1,2,4,4,6,6,7,7.

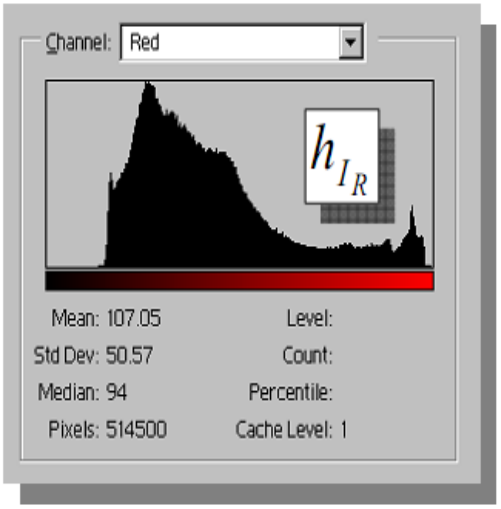
Step 4: Map the original values to the results from step3 by a one –to- one correspondence.

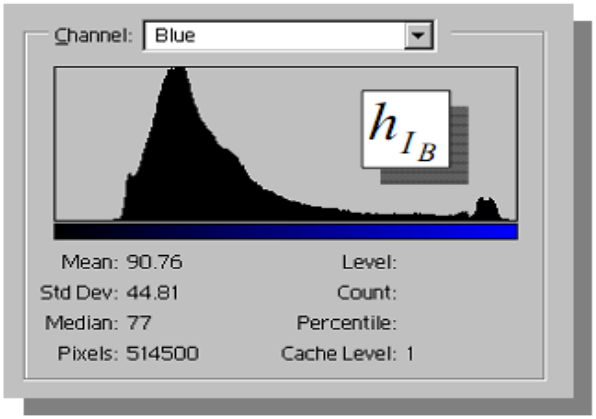


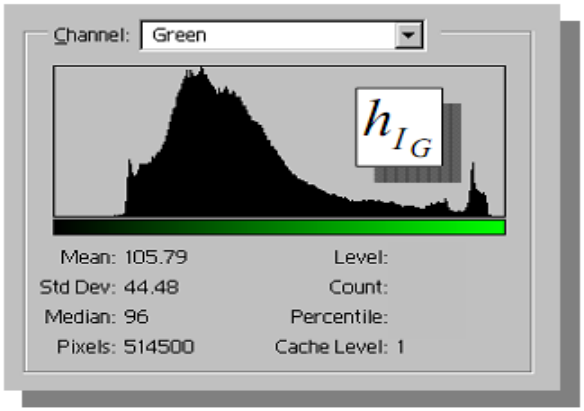
4 Histogram of the color image:

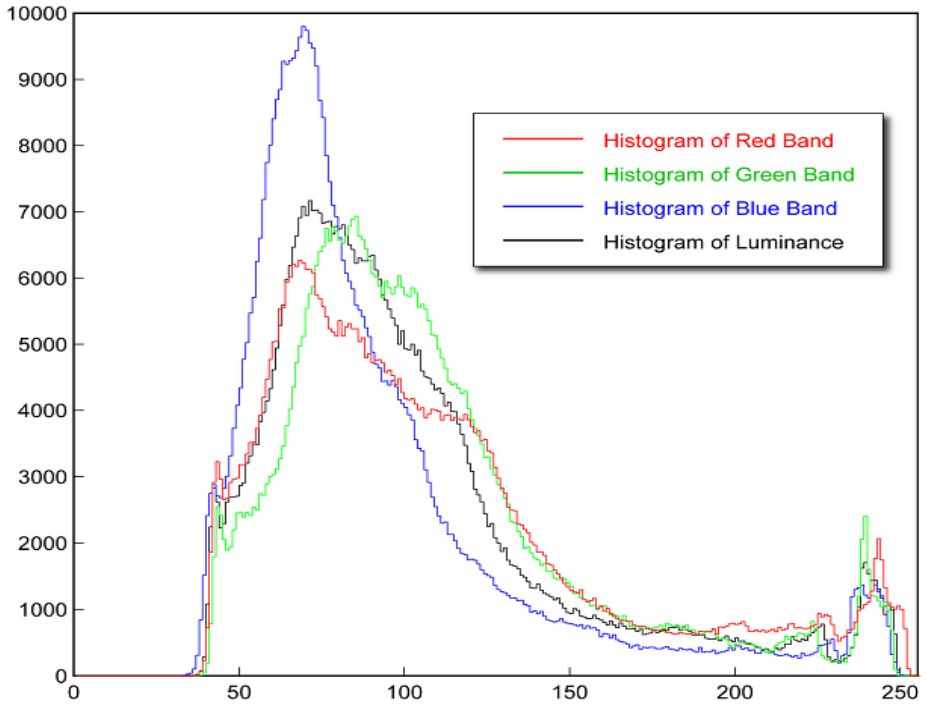
There is one histogram per color band R, G, & B. Luminosity histogram is from 1 band = (R+G+B)/3 There is one histogram per color band R, G, & B. Luminosity histogram is from 1 band = (R+G+B)/3






Channel: Blue
h_{I_B}
Mean: 90.76
Std Dev: 44.81
Median: 77
Pixels: 514500
Level:
Count:
Percentile:
Cache Level: 1


Channel: Green
h_{I_G}
Mean: 105.79
Std Dev: 44.48
Median: 96
Pixels: 514500
Level:
Count:
Percentile:
Cache Level: 1


10000
9000
8000
7000
6000
5000
4000
3000
2000
1000
0
0
50
100
150
200
250
Histogram of Red Band
Histogram of Green Band
Histogram of Blue Band
Histogram of Luminance

Histogram Equalization for the color image: