15EEE337 Digital Image Processing

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Last lecture

- Intensity transformations
- Log transformation
- Power law transformation
- Contrast stretching
- Intensity-level slicing

Agenda

- Histograms
- Understanding histograms
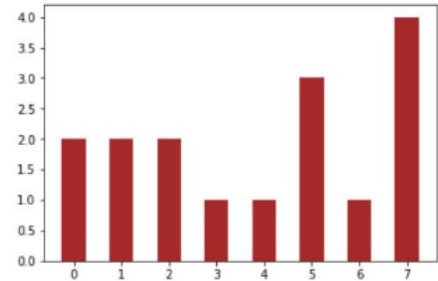- Equalization
- Matching.
- Color histograms

Image Histogram

- An image histogram tells us how the intensity values are distributed in an image.
- we plot the intensity values on the x-axis and the no. of pixels corresponding to intensity values on the y-axis
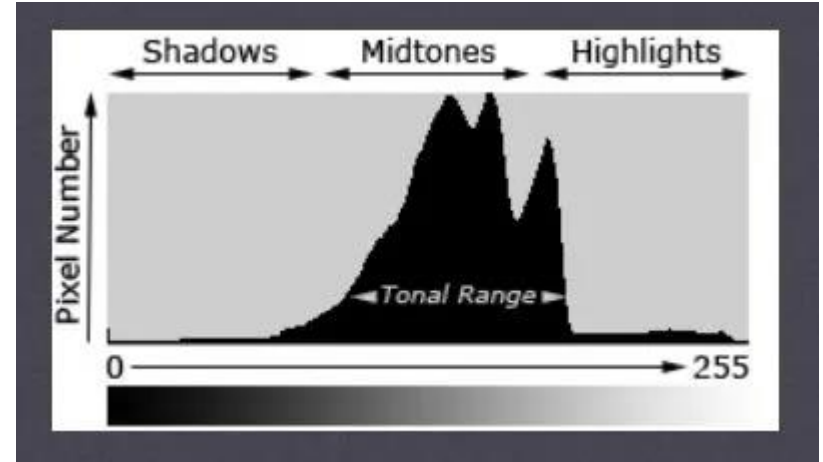- 1D histogram
- only one feature into our consideration


4x4 , 3-bit image

Terminologies

- Tonal range
- Shadows
- Midtones
- Highlights

Image histograms

- By looking at the histogram for a specific image a viewer will be able to judge the entire tonal distribution at a glance.
- The horizontal axis of the graph represents the tonal variations, while the vertical axis represents the total number of pixels in that particular tone
- the histogram for a very dark image will have most of its data points on the left side and center of the graph.
- Conversely, the histogram for a very bright image with few dark areas and/or shadows will have most of its data points on the right side and center of the graph.
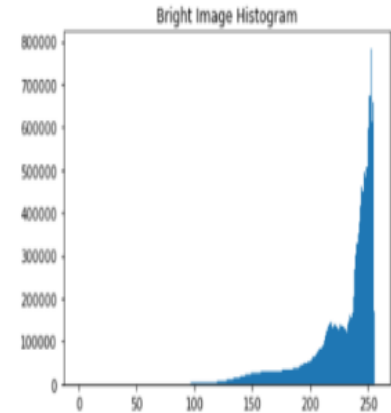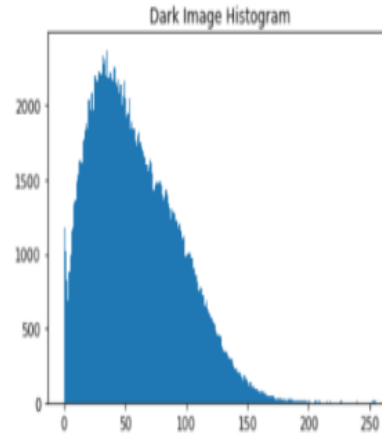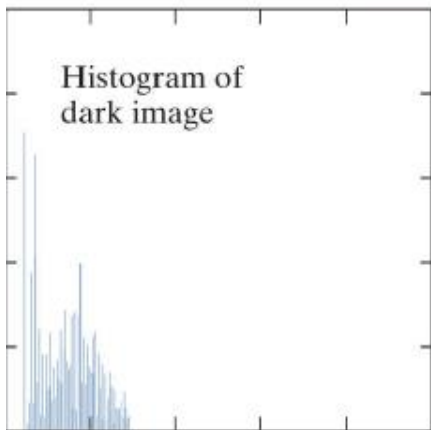
- $h(r_k) = nk \quad for \ k = 0,1,2,\ldots L-1$
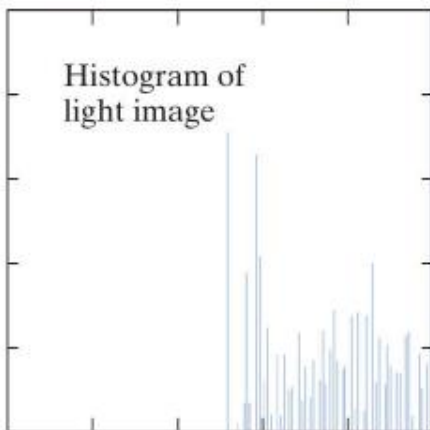- $p(r_k) = \frac{h(rk)}{MN} = \frac{n_k}{MN}$

- Proportion of pixels that have an intensity less than or equal to a particular value.
- It's a non decreasing function of intensity
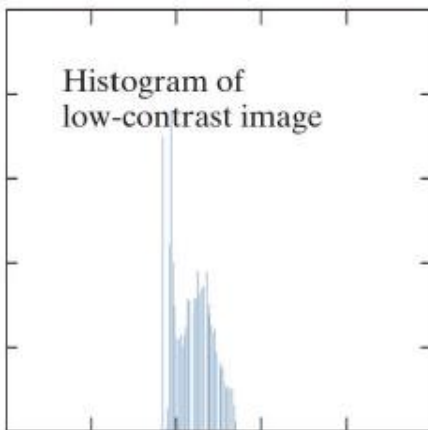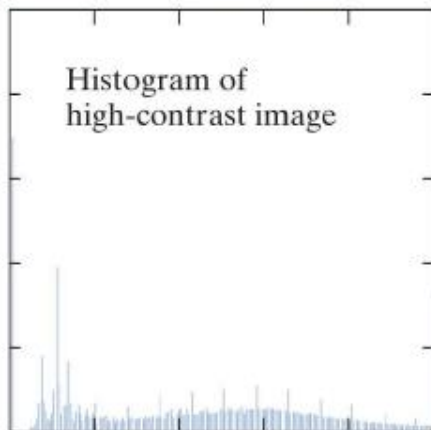- Always ends with
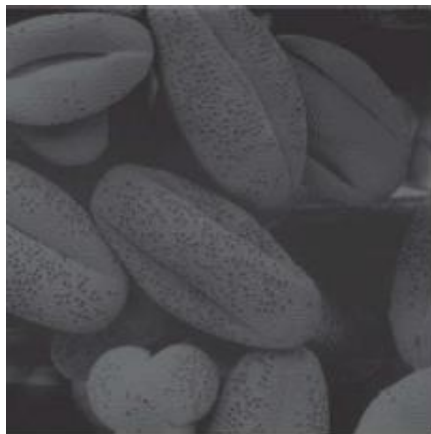
Histogram of dark image

Histogram of light image

Histogram of low-contrast image

Histogram of high-contrast image

Histogram equalization

- Process images in order to adjust the contrast of an image by modifying the intensity distribution of the histogram
- Objective of this technique is to give a linear trend to the **cumulative probability function** associated to the image

- Histogram equalization is a method in image processing of contrast adjustment using the image's histogram.

- What we want as output of hist equalization..
- Two ways . One get linear histograms
- Another perpespective -- cdf
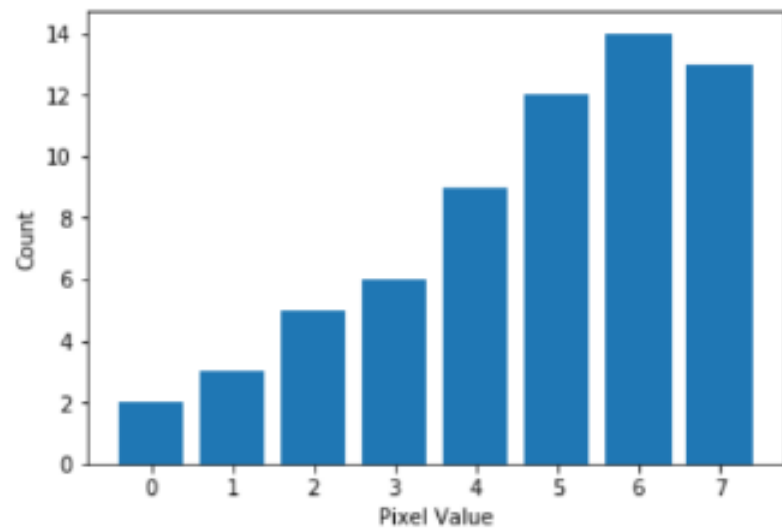
- Consider a 3 bit, 8x8 image

r_k	n_k
0	2
1	3
2	5
3	6
4	9
5	12
6	14
7	13

$$s_k = T(r_k) = (L-1)\sum_{j=0}^{k} p_r(r_j)$$

$$p_r(r_j) = \frac{n_j}{MN}$$

r_k	n_k	Pr(rk)	Sk
0	2	0.03	0.21
1	3	0.05	0.56
2	5	0.08	1.12
3	6	0.09	1.75
4	9	0.14	2.73
5	12	0.19	4.06
6	14	0.22	5.60
7	13	0.22	7.00

r_k	n_k	Pr(rk)	Sk	Round
0	2	0.03	0.21	0
1	3	0.05	0.56	1
2	5	0.08	1.12	1
3	6	0.09	1.75	2
4	9	0.14	2.73	3
5	12	0.19	4.06	4
6	14	0.22	5.60	6
7	13	0.22	7.00	7

Original

Equalized

THANK YOU