# Parallel Histogram Equalization of Gray Scale Images

Description:

Histogram equalization is a technique for adjusting image intensities to enhance contrast in input image. In gray images, each pixel has only one value which is the intensity of the pixels. The value may range from 0 to 255. The values are varying from black at the weakness intensity to white at strongest

Input and Output:

Steps:

$$input\ image = \begin{matrix} 3 & 2 & 4 & 5 \\ 7 & 7 & 8 & 2 \\ 3 & 1 & 2 & 3 \\ 5 & 4 & 6 & 7 \end{matrix}$$
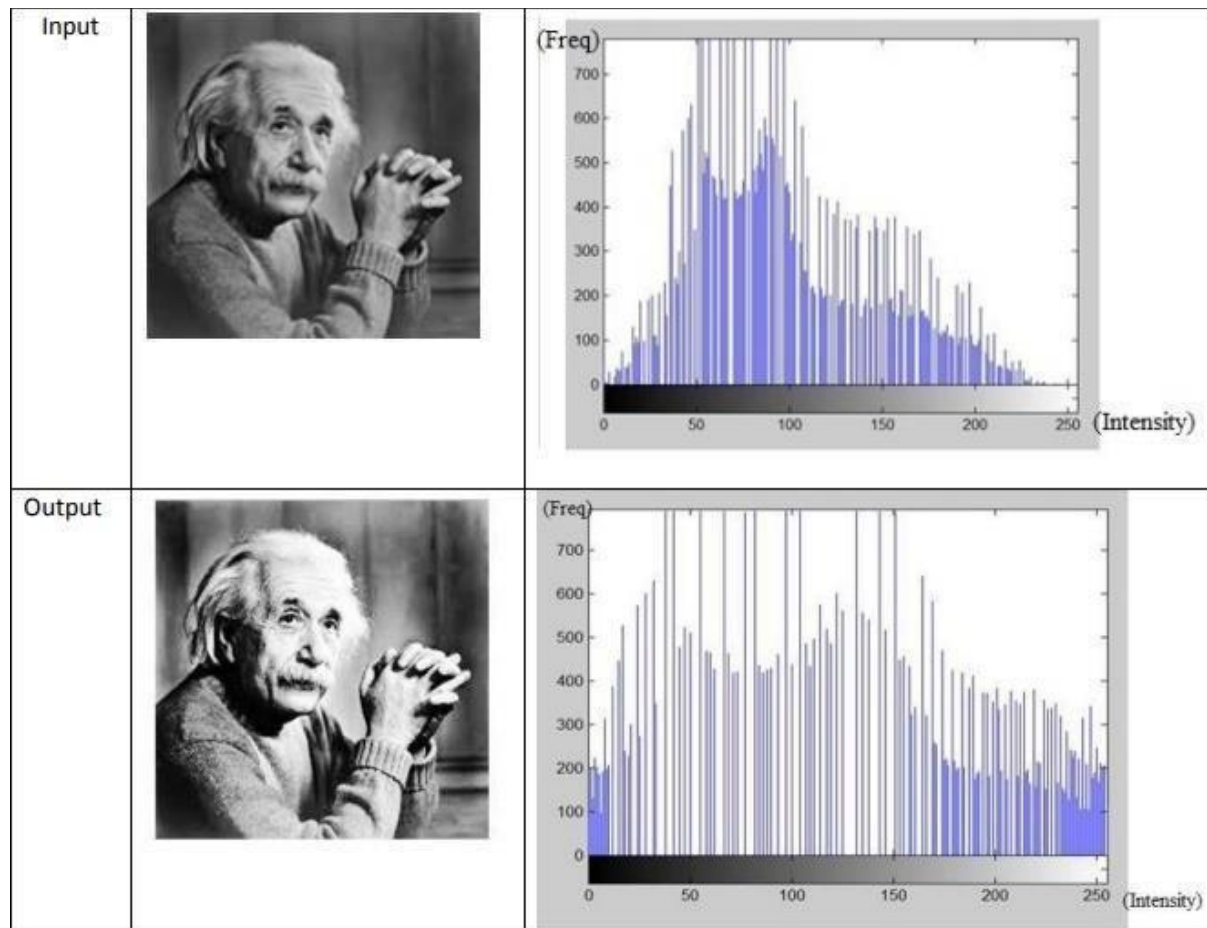
Here, The intensity of values vary between 1-8 . The goal , perform histogram equalization and scale to 1-20

1. Count the total number of pixel s associated with each pixel intensity.

Pixel Intensities	1	2	3	4	5	6	7	8	9	10
No. Pixels	1	3	3	2	2	1	3	1	0	0

2. Calculate probability of each pixel intensity in the image matrix.
   a. Total No.of Pixels = 16
   b. probability $= \dfrac{no.pixels}{Total\ No.of\ pixels}$

Pixel Intensities	1	2	3	4	5	6	7	8	9	10
No. Pixels	1	3	3	2	2	1	3	1	0	0
probability	0.0625	0.1875	0.1875	0.125	0.125	0.0625	0.1875	0.0625	0	0

3. Calculate Cumulative probability

Pixel Intensities	1	2	3	4	5	6	7	8	9	10
No. Pixels	1	3	3	2	2	1	3	1	0	0
probability	0.0625	0.1875	0.1875	0.125	0.125	0.0625	0.1875	0.0625	0	0
Cum.Prob.	0.0625	0.25	0.437	0.562	0.6875	0.75	0.9375	1	1	1

4. To change the intensity range to 1-20
   a. Multiply cumulative probability by 20
   b. Floor round (a.)

Pixel Intensities	1	2	3	4	5	6	7	8	9	10
No. Pixels	1	3	3	2	2	1	3	1	0	0
probability	0.0625	0.1875	0.1875	0.125	0.125	0.0625	0.1875	0.0625	0	0
Cum.Prob.	0.0625	0.25	0.437	0.562	0.6875	0.75	0.9375	1	1	1
Cum.Prob * 20	1.25	5	8.75	11.25	13.75	15	18.75	20	20	20
Floor round	1	5	8	11	13	15	18	20	20	20

5. Final image output $= \begin{matrix} 8 & 5 & 11 & 13 \\ 18 & 18 & 20 & 5 \\ 8 & 1 & 5 & 8 \\ 13 & 11 & 15 & 18 \end{matrix}$ when $input\ image\ was = \begin{matrix} 3 & 2 & 4 & 5 \\ 7 & 7 & 8 & 2 \\ 3 & 1 & 2 & 3 \\ 5 & 4 & 6 & 7 \end{matrix}$

Check this document which illustrates the idea much deeper.