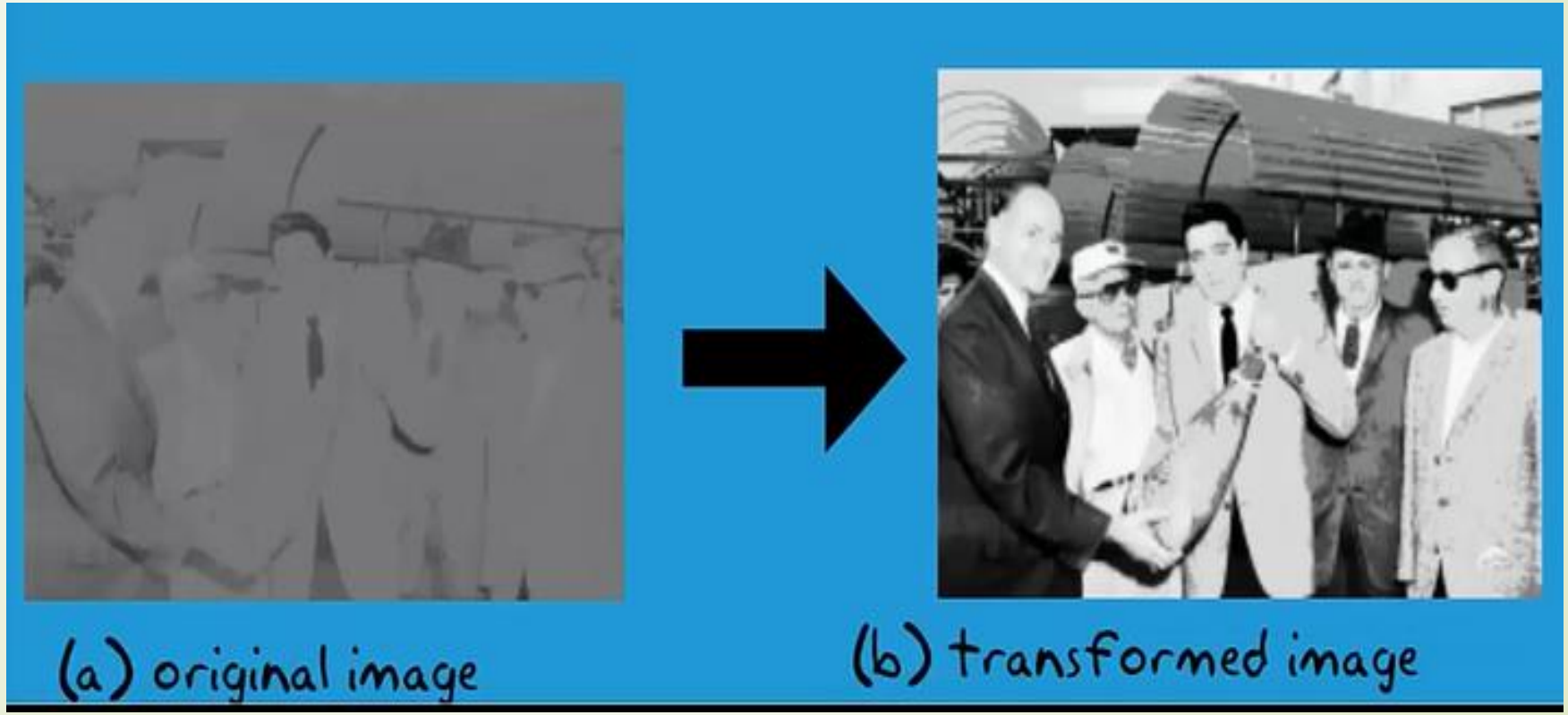
Histogram Equalization

Grayscale Image

- Grayscale Image is also known as black and white image and each pixel has only one value which is the intensity of the pixel. The value may range from 0 to 255.
- A grayscale or greyscale digital image is an image in which the value of each pixel is a single sample, that is, it carries only intensity information.
- Grayscale Images are composed exclusively of shades of gray, varying from black at the weakest intensity to the white at the strongest.

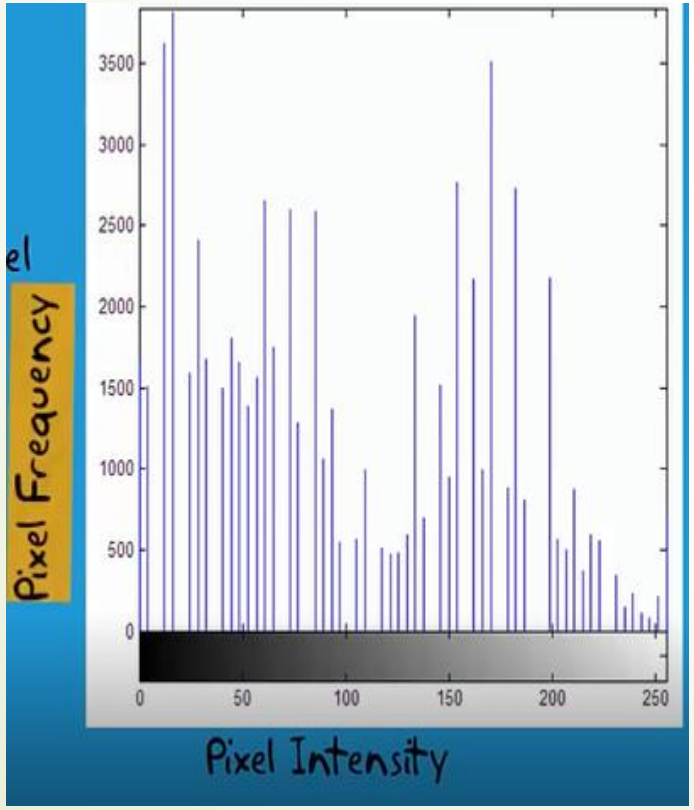
Histogram Equalization

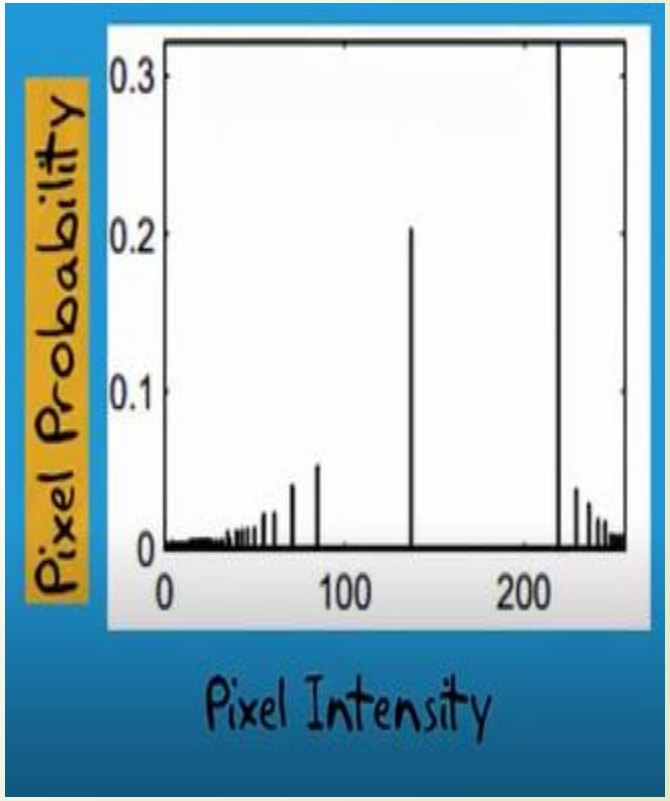
- Histogram equalization is a technique for adjusting image intensities to enhance contrast.



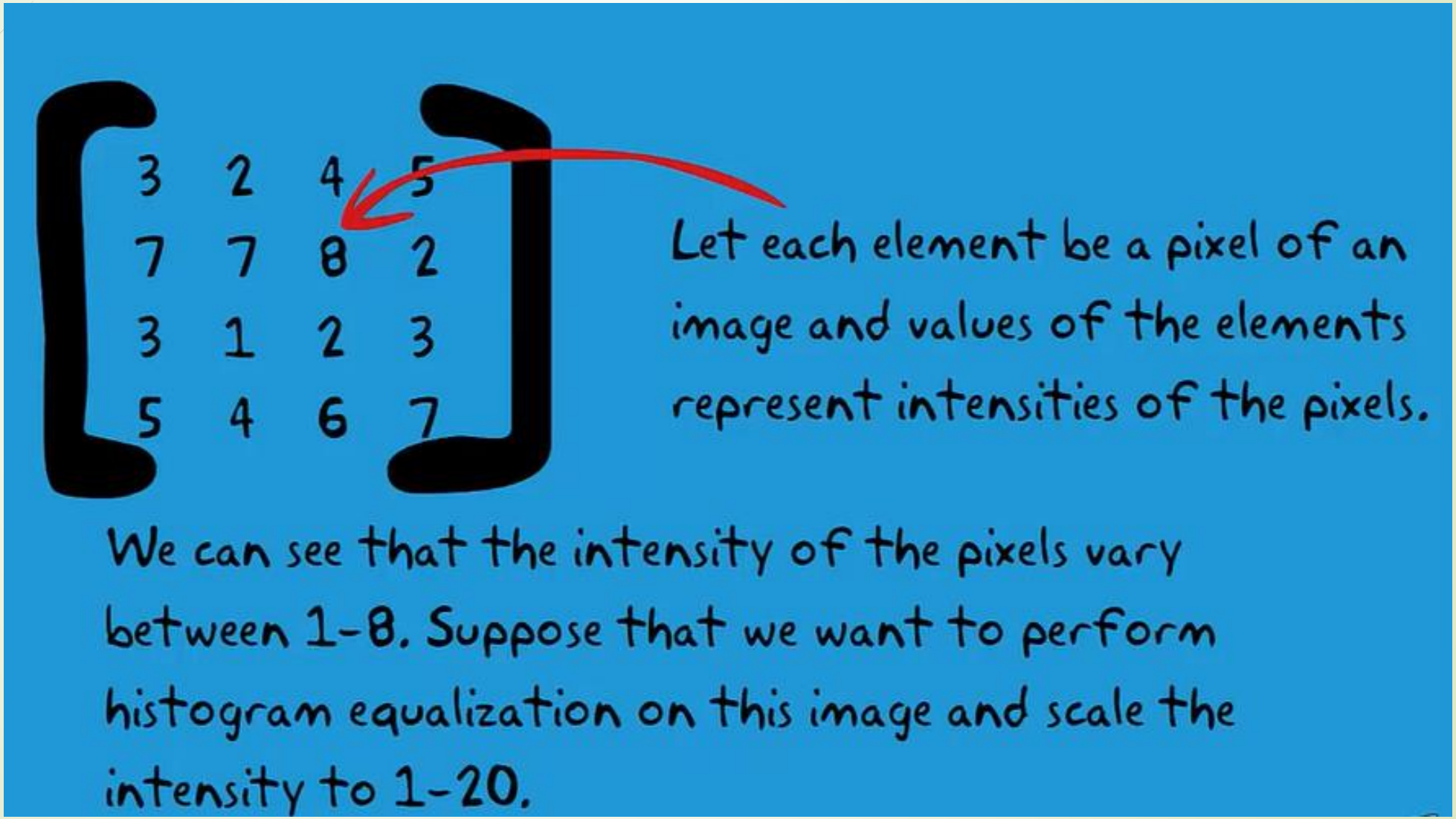
Plotting Histogram

- One way of getting histogram is to plot pixel intensities vs pixel frequencies
- Another way of getting histogram is to plot pixel intensities vs pixel probabilities.



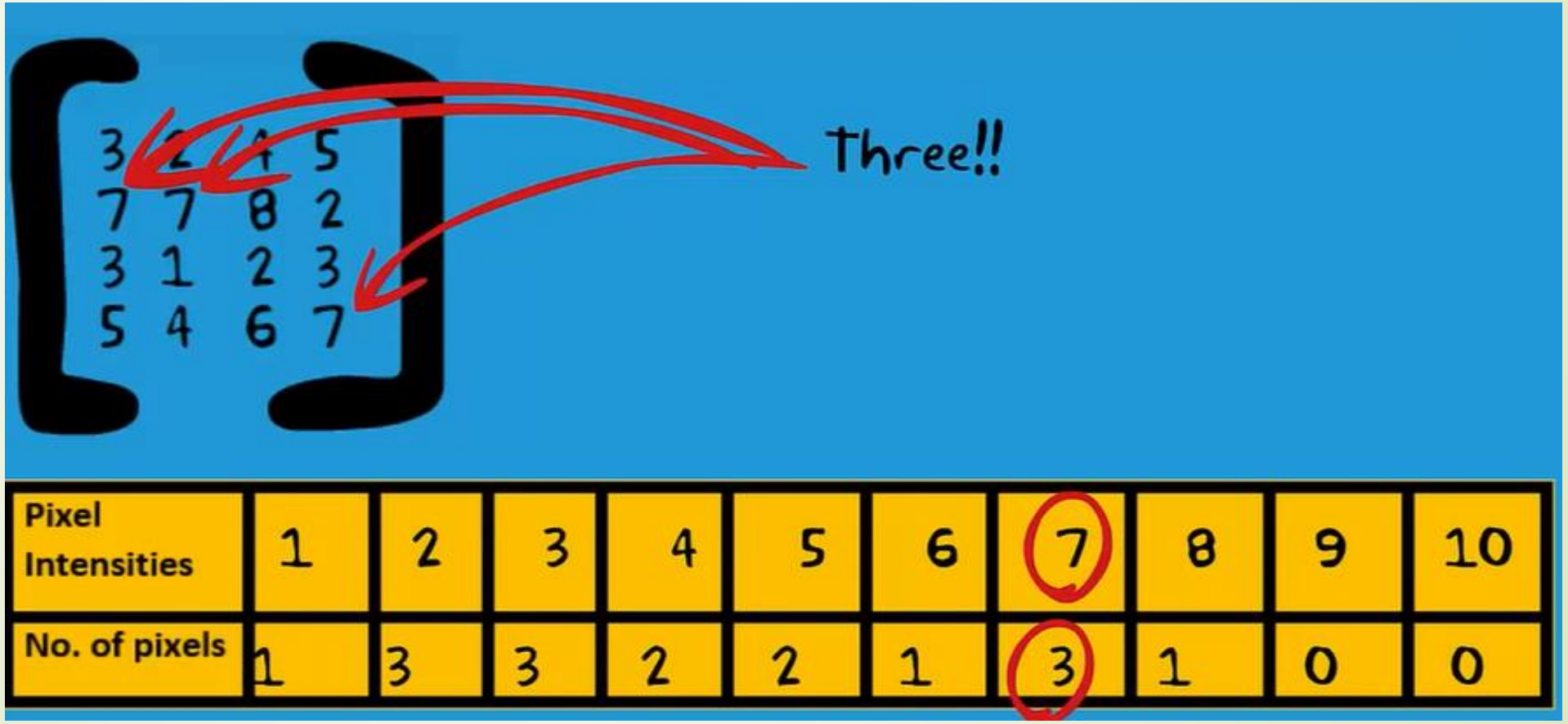


Example of Histogram Equalization

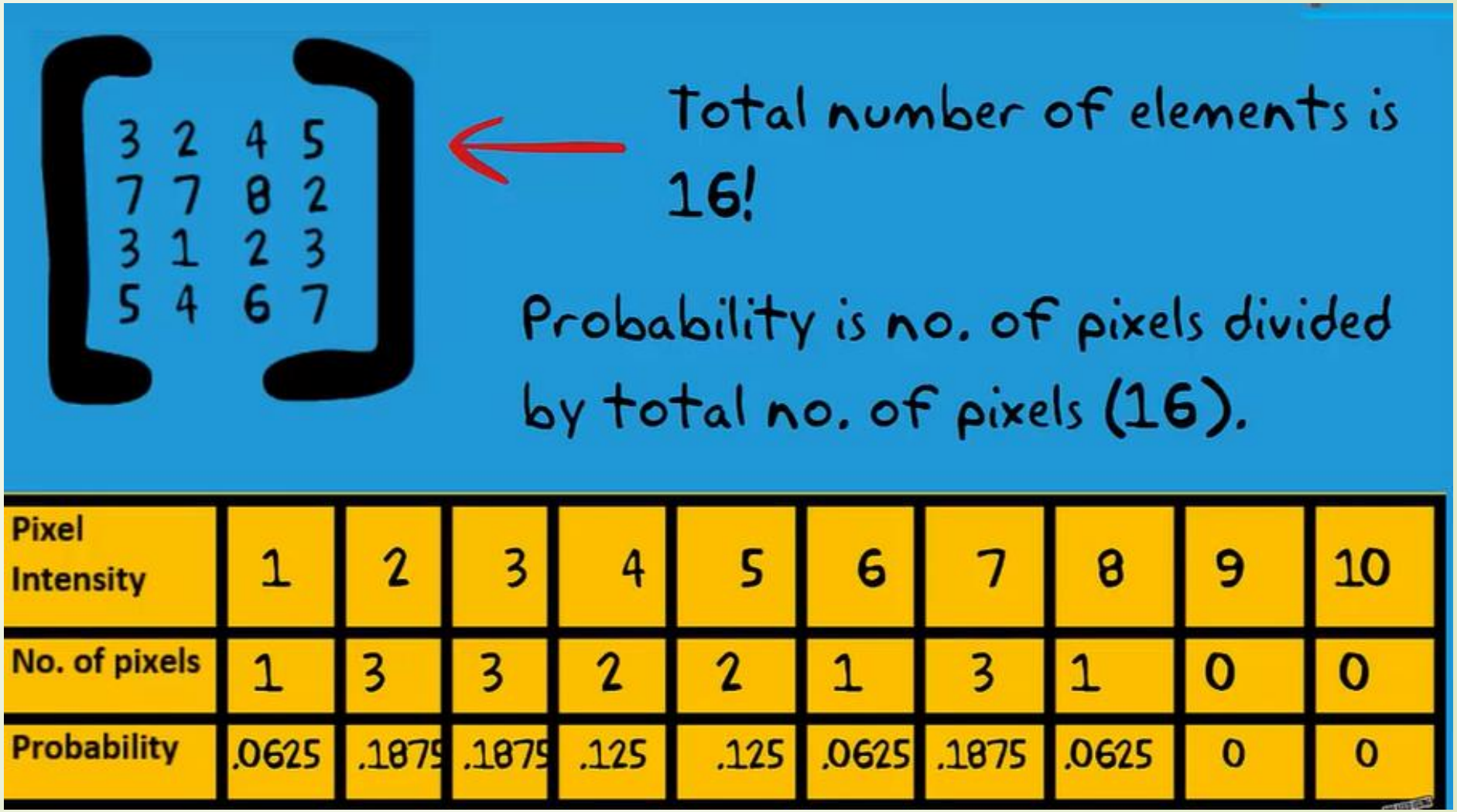


Steps for Histogram Equalization

- First step is to count the total number of pixels associated with each pixel intensity



- Second step is to calculate probability of each pixel intensity in the image matrix



Pixel Intensity	1	2	3	4	5	6	7	8	9	10
No. of pixels	1	3	3	2	2	1	3	1	0	0
Probability	.0625	.1875	.1875	.125	.125	.0625	.1875	.0625	0	0

- The next step is to calculate cumulative probability

Pixel Intensity	1	2	3	4	5	6	7	8	9	10
No. of pixels	1	3	3	2	2	1	3	1	0	0
Probability	,0625	.1875	.1875	.125	.125	.0625	.1875	.0625	0	0
Cumulative probability	,0625	.25	.4375	.5625	.6875	.75	.9375	1	1	1

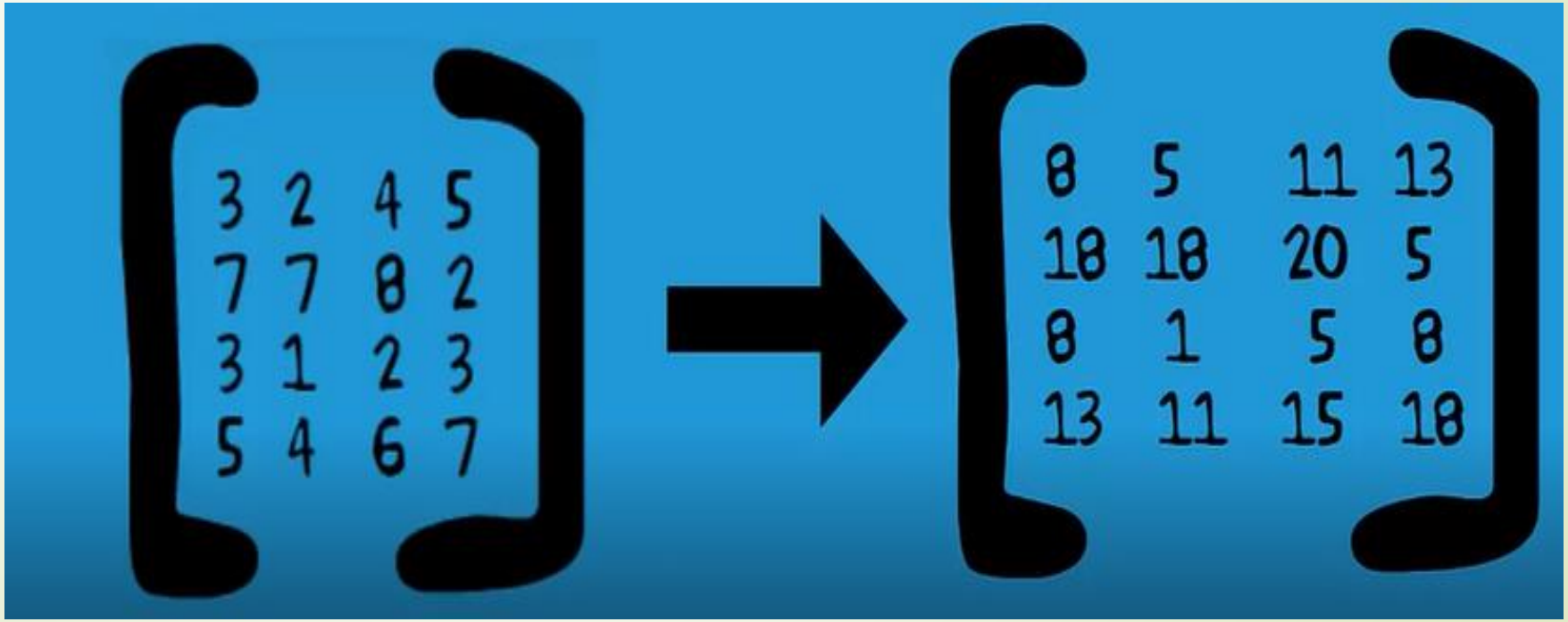
- Since we want to change the intensity range to 1-20, we shall multiply cumulative probability by 20

Pixel Intensity	1	2	3	4	5	6	7	8	9	10
No. of pixels	1	3	3	2	2	1	3	1	0	0
Probability	.0625	.1875	.1875	.125	.125	.0625	.1875	.0625	0	0
Cumulative probability	.0625	.25	.4375	.5625	.6875	.75	.9375	1	1	1
C.P * 20	1.25	5	8.75	11.25	13.75	15	18.75	20	20	20

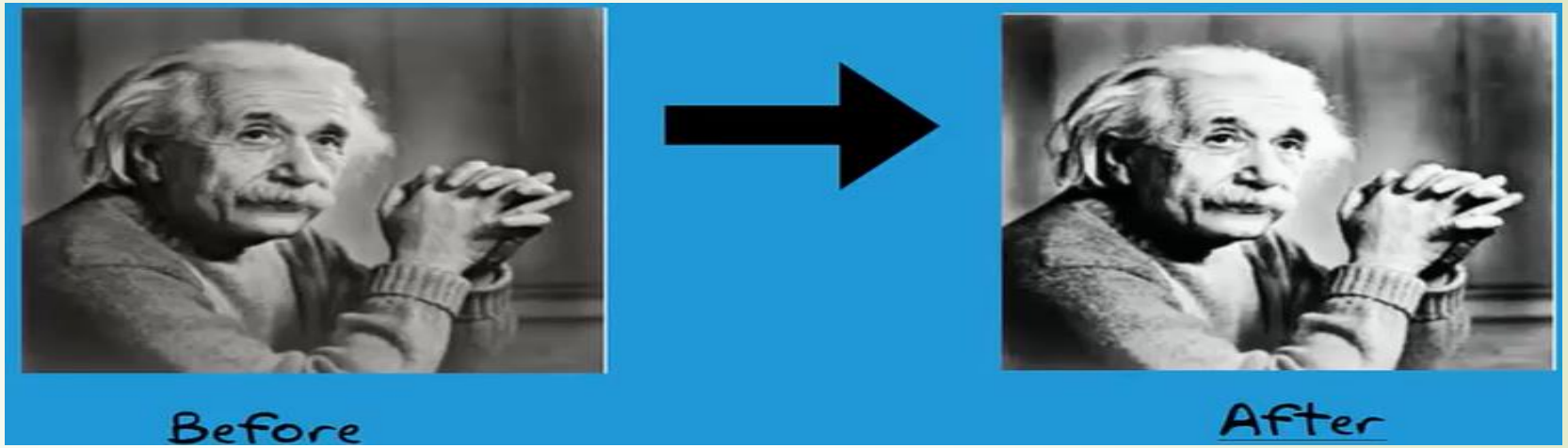
- Finally, we round the decimal values obtained to the lower integer values(also known as floor rounding) eg: 15.75 to 15

Pixel Intensity	1	2	3	4	5	6	7	8	9	10
No. of pixels	1	3	3	2	2	1	3	1	0	0
Probability	.0625	.1875	.1875	.125	.125	.0625	.1875	.0625	0	0
Cumulative probability	.0625	.25	.4375	.5625	.6875	.75	.9375	1	1	1
C.P * 20	1.25	5	8.75	11.25	13.75	15	18.75	20	20	20
Floor Rounding	1	5	8	11	13	15	18	20	20	20

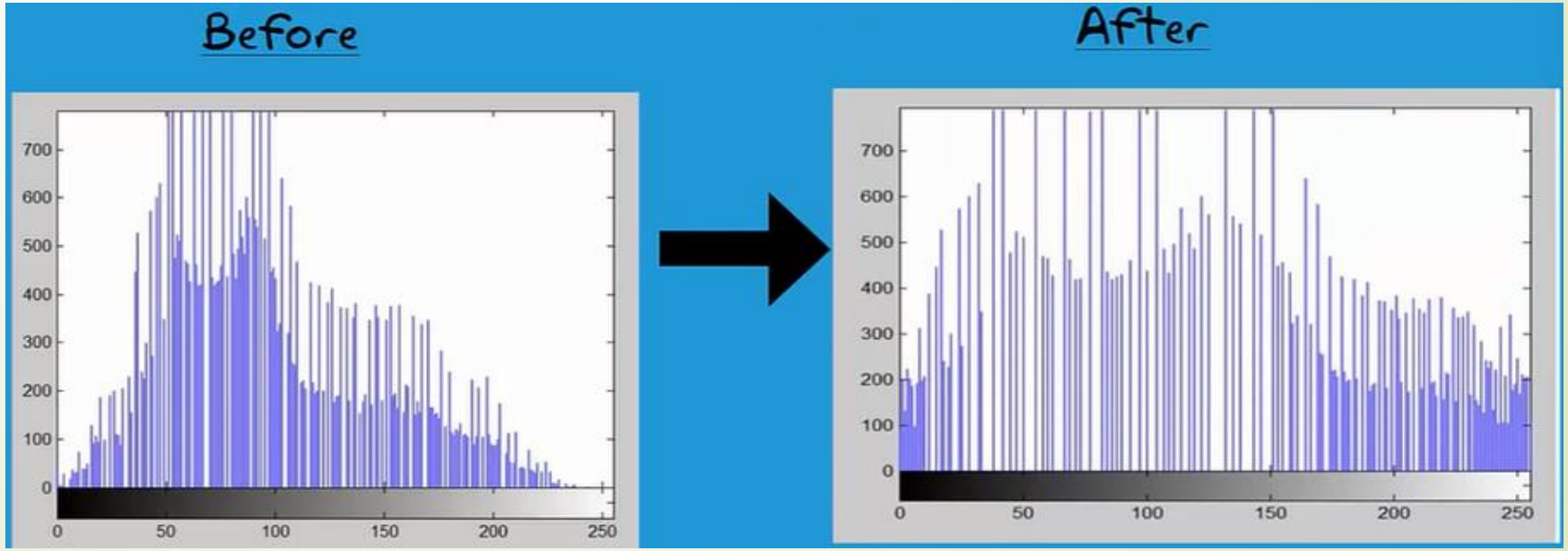
- So the original image has been transformed to the equalized image with different intensity on each pixel.
- We can see that the intensity range of the pixels have been increased and hence the histogram of the image will look more spread. This in turn is called Histogram Equalization.



- Image before equalization and the same after equalization.



- Histogram of the equalized image before equalization and after equalization



Thank You