POINT OPERATION

MODIFICATION OF THE PIXEL VALUE

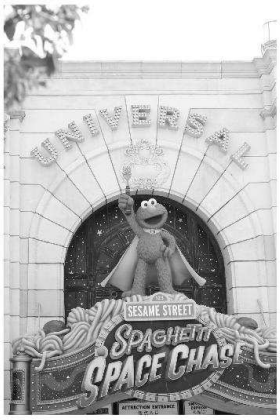
WITHOUT CHANGING OF SIZE, GEOMETRY AND STRUCTURE.

1. INTENSITY CHANGIN

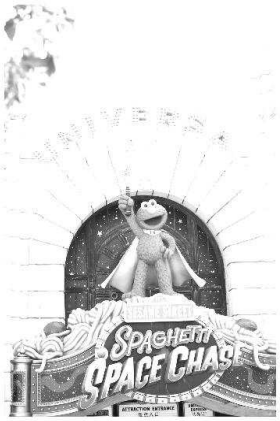
1.1. CONTRAST&BRIGHTNESS

Increasing the image's contrast by 50% or raising the brightness by 10 units can be expressed by the mapping functions

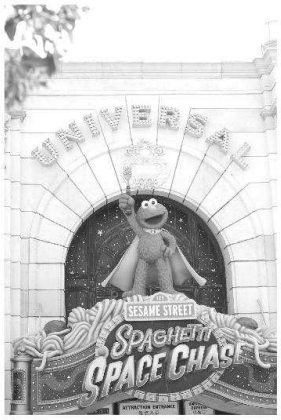
$$\mathbf{f_{contr}(a) = a \cdot 1.5} \quad \& \quad \mathbf{f_{bright}(a) = a + 10}$$



Original Image



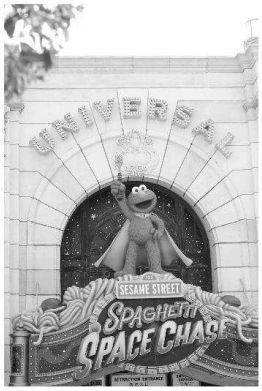
Contrast



Brightness

1.2 INVERSTING

$$\mathbf{f_{inv}(a) = a_{max} - a} \quad ; \mathbf{a_{max} = 255\ (8bit\ image)}$$

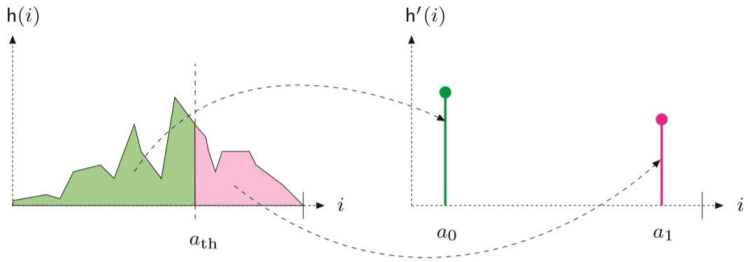


Original Image

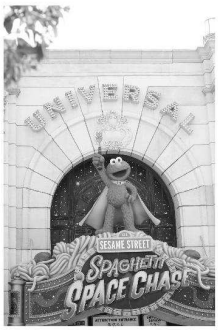
Inversting

1.3 THRESHOLD

Mapping all pixels to 2 fix intensity value a_0 and a_1 or we can call “Binarizing” if we change pixel value to 0 and 1.



$$\mathbf{f_{th}(a)} = \begin{cases} \mathbf{a_0} & ; \mathbf{a < a_{th}} \\ \mathbf{a_1} & ; \mathbf{a \geq a_{th}} \end{cases}$$



a_{th} = 128

a_0 = 0

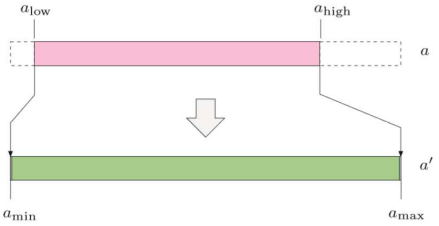
a_1 = 255

Original Image

Threshold

2. AUTOMATIC CONTRAST ADJUSTMENT

Automatic contrast adjustment is the method to extend range of pixel value of the image to min and max value that image can be. In case 8 bits image, min and max value are 0 and 255.



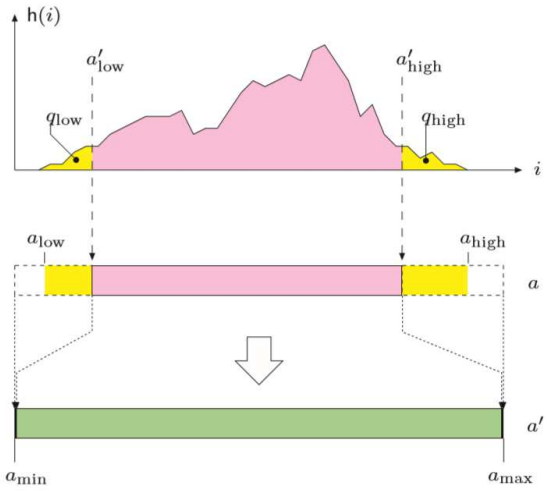
$$\mathbf{f_{ac}(a)} = \mathbf{a_{min}} + (\mathbf{a} - \mathbf{a_{low}})\left(\frac{\mathbf{a_{max}} - \mathbf{a_{min}}}{\mathbf{a_{high}} - \mathbf{a_{low}}}\right)$$

For an 8 bits image: a_{min} = 0 and a_{max} = 255, the equation will change as

$$\mathbf{f_{ac}(a)} = (\mathbf{a} - \mathbf{a_{low}})\left(\frac{\mathbf{255}}{\mathbf{a_{high}} - \mathbf{a_{low}}}\right)$$

3. MODIFIED AUTO-CONTRAST

This method is a modification of the previous method by adds a cutting of head and tail of the histogram as the picture below to reduce outliner noise.

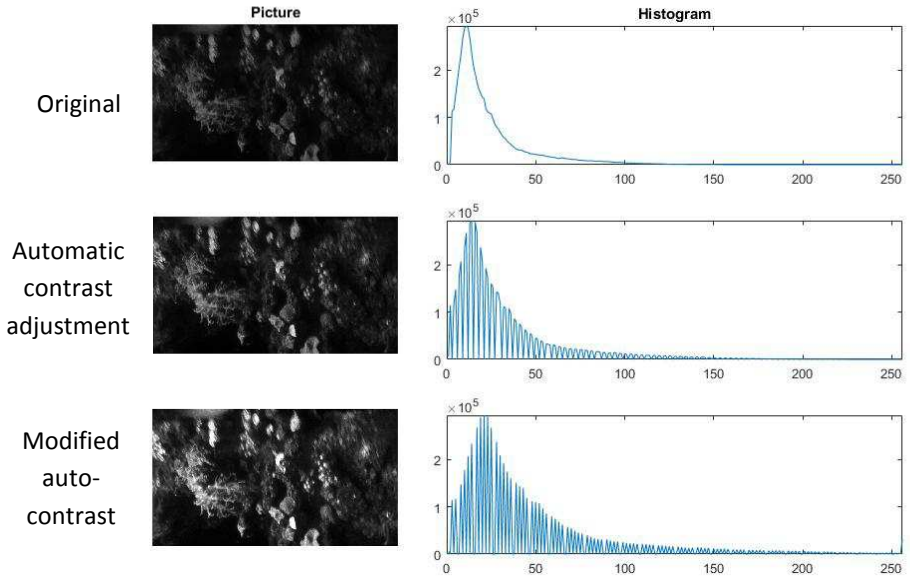


It can write as equation

$$\mathbf{f_{ac}(a)} = \begin{cases} \mathbf{a_{min}} & ; \mathbf{a} \le \mathbf{a'_{low}} \\ \mathbf{a_{min}} + (\mathbf{a} - \mathbf{a'_{low}})\left(\frac{\mathbf{a_{max}} - \mathbf{a_{min}}}{\mathbf{a'_{high}} - \mathbf{a'_{low}}}\right) & ; \le \mathbf{a'_{low}} < \mathbf{a} < \mathbf{a'_{high}} \\ \mathbf{a_{max}} & ; \mathbf{a} \ge \mathbf{a'_{high}} \end{cases}$$

For an 8 bits image: $a_{min} = 0$ and $a_{max} = 255$, the equation will change as

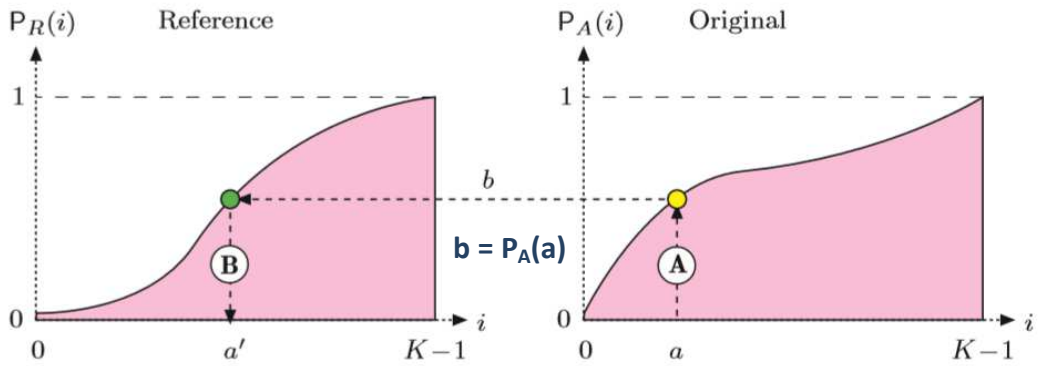
$$\mathbf{f_{ac}(a)} = \begin{cases} \mathbf{0} & ; \mathbf{a} \le \mathbf{a'_{low}} \\ (\mathbf{a} - \mathbf{a'_{low}})\left(\frac{\mathbf{255}}{\mathbf{a'_{high}} - \mathbf{a'_{low}}}\right) & ; \le \mathbf{a'_{low}} < \mathbf{a} < \mathbf{a'_{high}} \\ \mathbf{255} & ; \mathbf{a} \ge \mathbf{a'_{high}} \end{cases}$$



In this example, you can see the changing of the image when did Automatic contrast adjustment and Modified auto-contrast. The images have more contrast especially images from Modified auto-contrast method. The image from this method has more contrast than Image from Automatic contrast adjustment.

4. HISTOGRAM SPECIFICATION

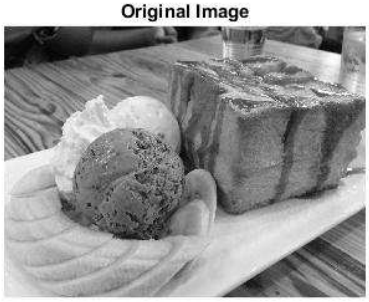
Mapping cumulative distribution function (CPF) of the target image to be the same as reference image as possible by the method that show in the image below.



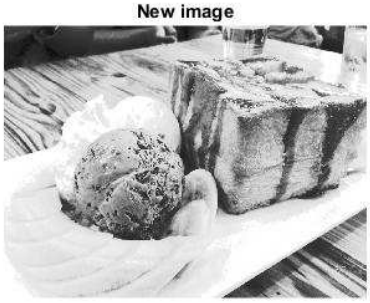
$b = P_A(a)$

$a' = P_R^{-1}(b)$

Original Image

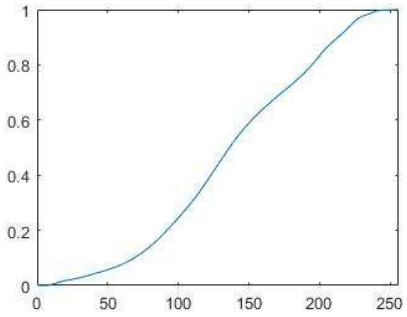


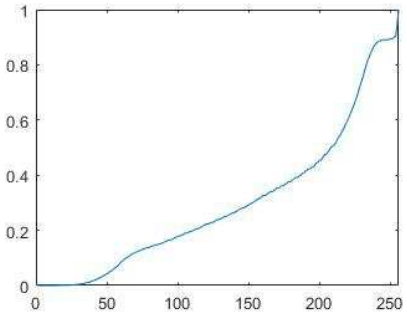
New image

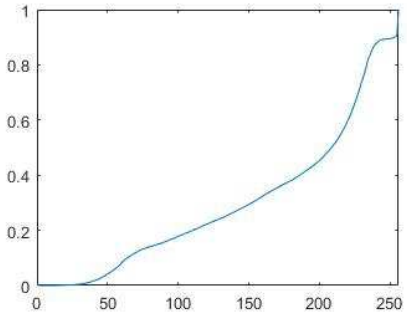


Reference Image

CPF







You can see that new image that already do a histogram specification have CPF same as reference image