**HW3 Report**

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**Introduction**

This program consists of three parts:

**Part 1.** Read the input source image and generate its original histogram.

**Part 2.** Adjust the intensity of the original image by 1/3 and generate its histogram.

**Part 3.** Apply histogram equalization to the darken image in Part 2 and generate its histogram.

**Usage**

Place the source image and main.py under the same directory. Run the following command in the terminal.

python3 main.py -s <source> -m <intensity\_multiplier>

Parameters

-s <source> : the file path of source image, default = lena.bmp

-m <intensity\_multiplier> : the multiplier for intensity adjustment in Part 2, default = 1/3

**Part 1. Original image and histogram**

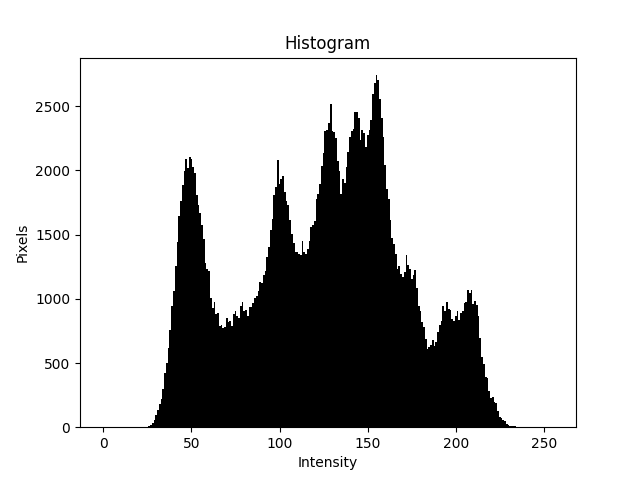
* 1. **Method**

First, source image is read with grayscale mode.

For each pixel, increment the pixel count of the its corresponding intensity in the histogram.

* 1. **Result**

The result image and histogram are saved as original\_image.bmp and original\_histogram.png as shown below.

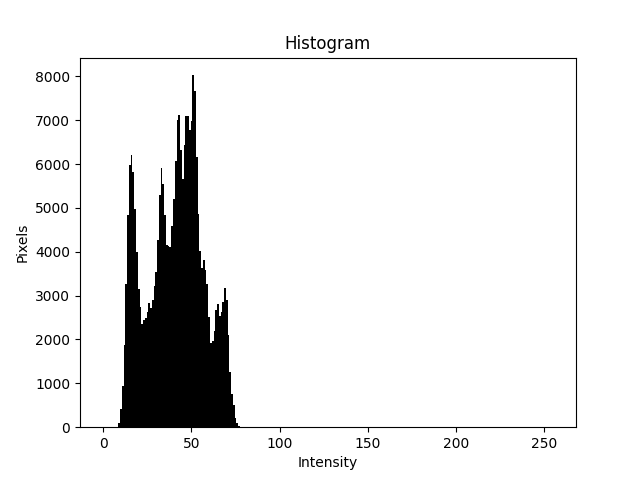
**Part 2. Darken image and histogram**

* 1. **Method**

For each pixel in the original image, multiply the pixel’s intensity and then generate its histogram as did in Part 1.

* 1. **Result**

The result image and histogram are saved as dark\_image.bmp and dark\_histogram.png as shown below.

**Part 3. Histogram equalization**

* 1. **Method**

The darken image and histogram generated in Part 2 is taken as the input for this process. The goal is to normalize the distribution of intensity within the image, i.e. to flatten the probability density function of intensity (). The integral of a is known as the cumulative distributive function (). For a flatten , it would have a linearized across the value range. Hence we can derive the following histogram equalization formula:

|  |  |
| --- | --- |
|  |  |

For each intensity value within 0-255, we calculate its value with the input histogram, and scale by 255 to get the transformed intensity value . Finally, we process each pixel in the input image and reassign its intensity with the transformed value.

The picture shown below are the before and after equalization. We can see that the has be linearized across 0-255 after equalization as mentioned earlier.

|  |  |
| --- | --- |
| Darken image | Equalized image |

* 1. **Result**

The result image and histogram are saved as equalized\_image.bmp and equalized\_histogram.png as shown below.