Computational Photography Assignment 1 - Pixel Operations

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1. Theory Question 1

    a. Yes

    b. Yes

    c. Yes

2. Theory Question 2

    a.

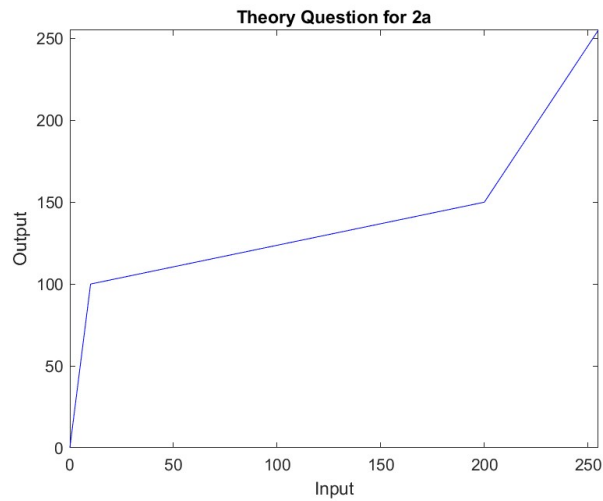

Figure 1: 2D Graph of mapped values

    b.

$$f(r) = \begin{cases} 10r & \text{if } 0 \le r \le 10 \\ \frac{5}{19}(r - 10) + 100 & \text{if } 10 < r \le 200 \\ \frac{21}{11}(r - 200) + 150 & \text{if } 200 < r \le 255 \end{cases}$$

c. Given $r = 50$

    With Second Piecewise Function: $\frac{5}{19}(r - 10) + 100$

    Substitute r with 50: $\frac{5}{19}(50 - 10) + 100$

    Solution: $f(r) = 110.526$

d. Contrast stretching improves an image's contrast by increasing the range of intensity values to fill the available dynamic range. The goal is to have a homogeneous distribution across the intensity range. This is performed via piecewise linear functions that modify the input pixel values to a larger range, making image details more visible. The transformations used in Part B are as follows:

    The first linear transformation is applied to pixel values ranging from 0 to 10, translating them to a new range of 0 to 100.

    The second transformation adjusts pixel values between 10 and 200 by scaling them to a new range of 100 to 150.

    Finally, for pixel values ranging from 200 to 255, the third transformation is applied, allocating them to the range 150 to 255.

    These piecewise functions will recalibrate the pixel values to take advantage of the full range of the display's capabilities, resulting in a more contrast-rich image.

3. RGB → Grayscale

Figure 2: Original Image

Figure 3: Grayscaled Image

4. RGB → Binary

Figure 4: Original Image

Figure 5: Converted Binary Image of 25% threshold

Figure 6: Converted Binary Image of 50% threshold

Figure 7: Converted Binary Image of 75% threshold

5. Gamma Correction

Figure 8: Original Image

Figure 9: Gamma Corrected Image with 0.2
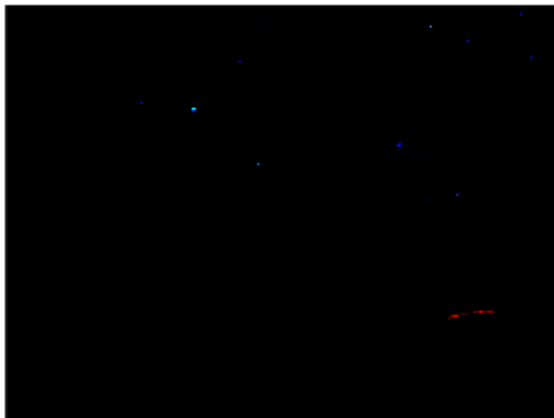
Figure 10: Gamma Corrected Image with 1.0

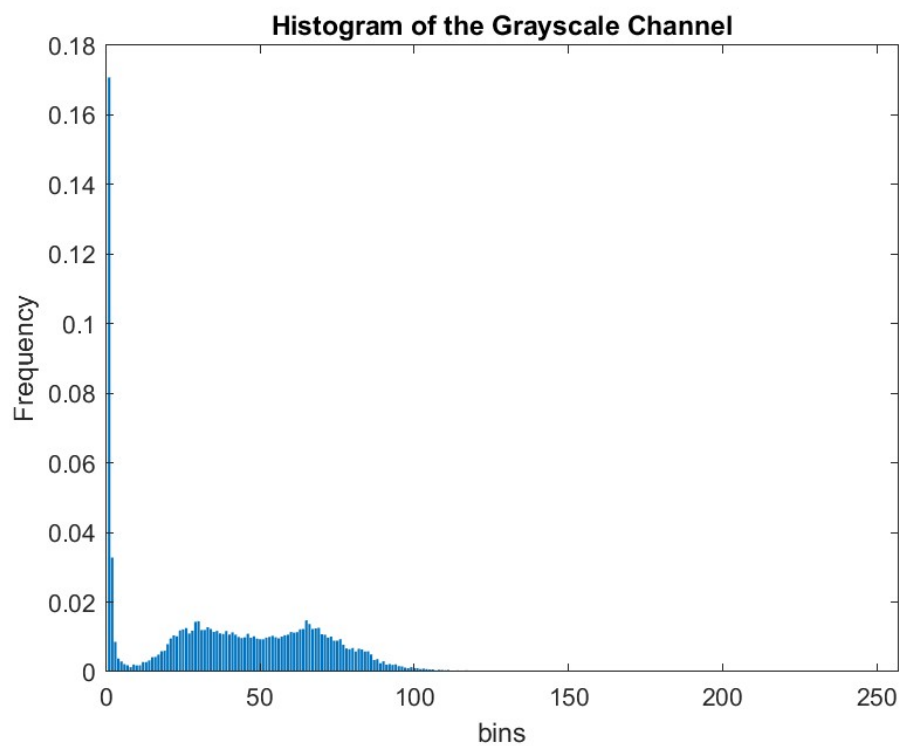Figure 11: Gamma Corrected Image with 50.0

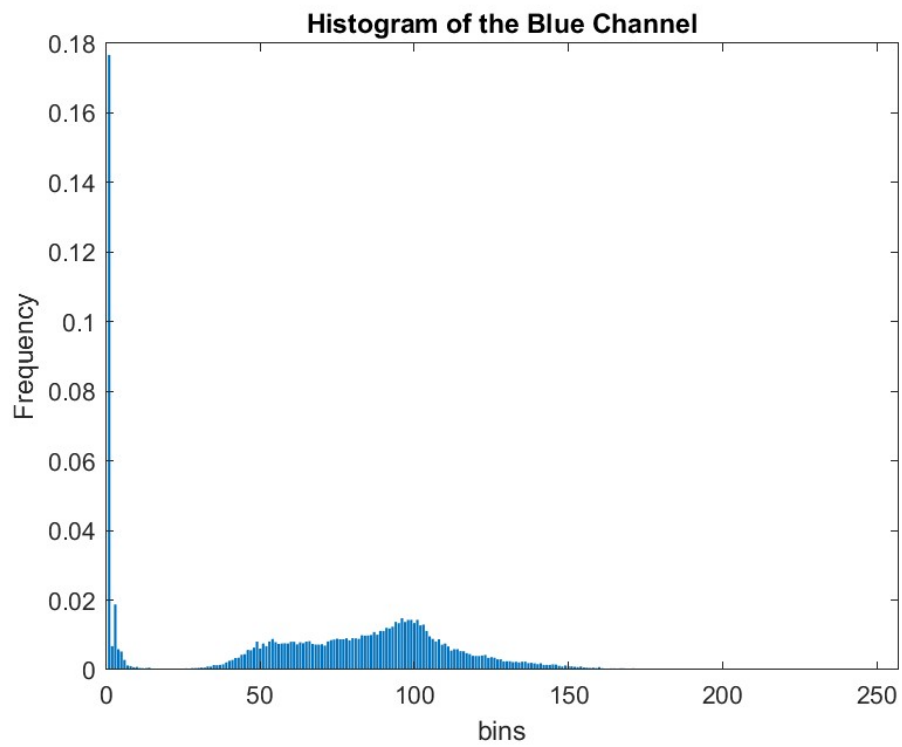# 6. Histograms

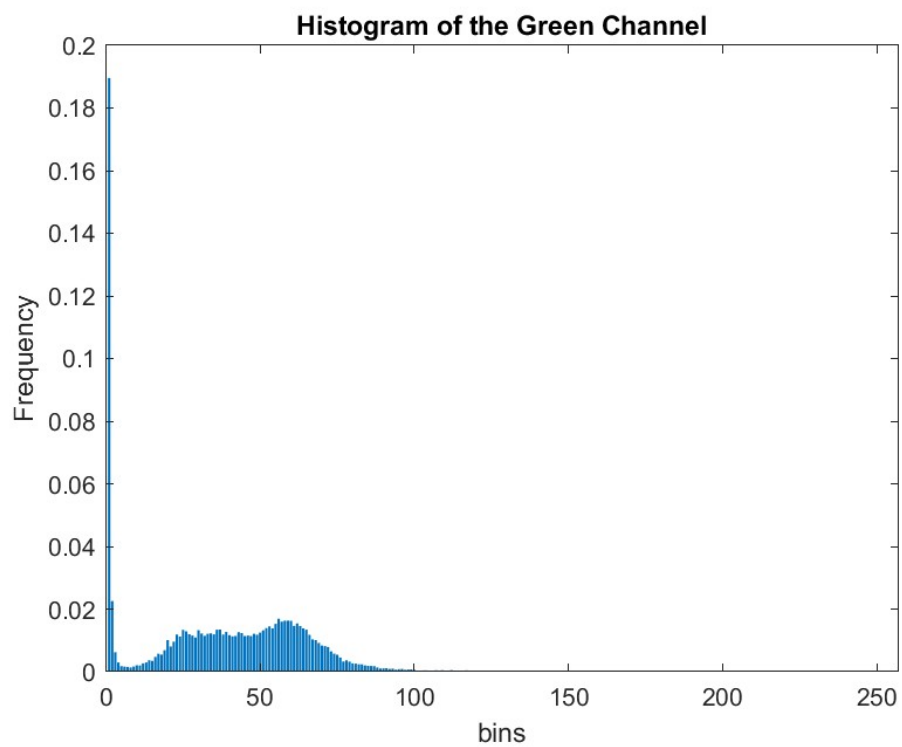

Figure 12: Grayscale Histogram
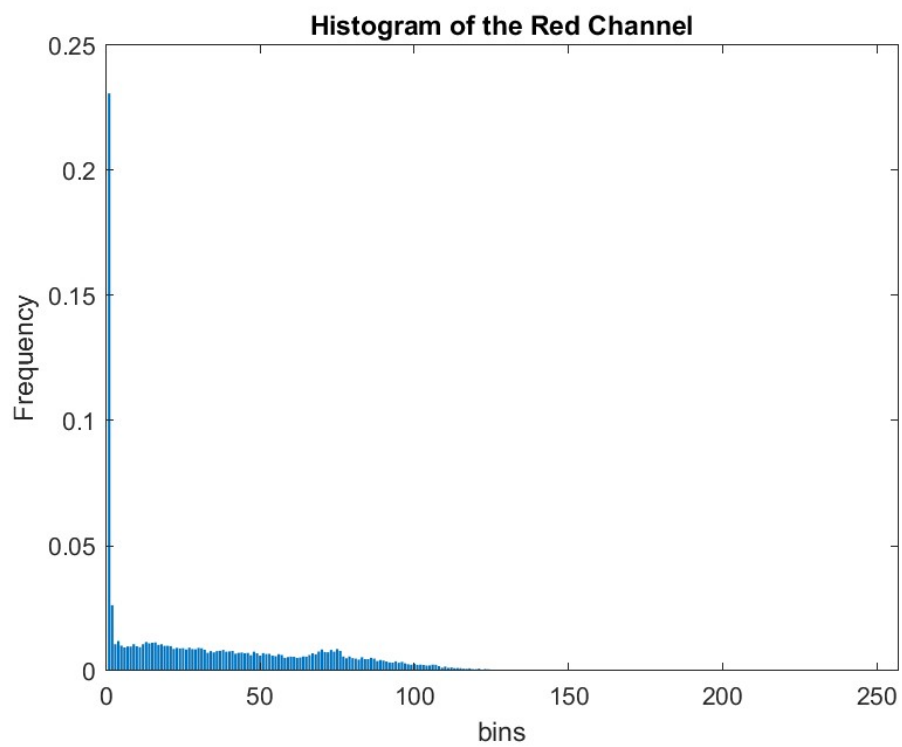
Figure 13: Blue Histogram

Figure 14: Green Histogram

Figure 15: Red Histogram