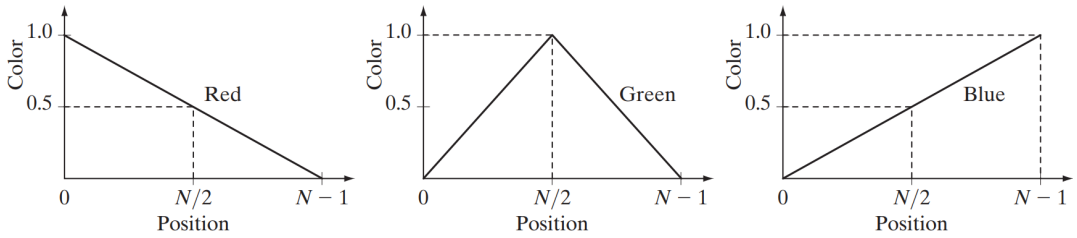
Introduction to Digital Image Processing HW #5 (Due 05/23/2024)

(Gonzalez 3rd edition)

1. Problem 6.5 (10%)

   In a simple RGB image, the R, G, and B component images have the horizontal intensity profiles shown in the following diagram. What color would a person see in the middle column of this image?



2. Problem 6.8 (10%)

   Consider the RGB color cube shown in Fig 6.8, and answer each of the following:

   (a) Describe how the gray levels vary in the R, G, and B primary images that make up the front face of the color cube.

   (b) Suppose that we replace every color in the RGB cube by its CMY color. This new cube is displayed on an RGB monitor. Label with a color name the eight vertices of the new cube that you would see on the screen.

   (c) What can you say about the colors on the edges of the RGB color cube regarding saturation?

Fig. 6.8

3. Problem 6.11 (10%)

   Consider the entire 216 safe-color array shown in Fig. 6.10 (a). Label each cell by its (row, column) designation, so that the top left cell is (1, 1) and the rightmost bottom cell is (12, 18). At which cells will you find

   (a) The purest green?

   (b) The purest blue?

Fig. 6.10(a)

4. Problem 6.13 (10%)

   Propose a method for generating a color band similar to the one shown in the zoomed section entitled Visible Spectrum in Fig. 6.2. Note that the band starts at a dark purple on the left and proceeds toward pure red on the right. (Hint: Use the HSI color model.)

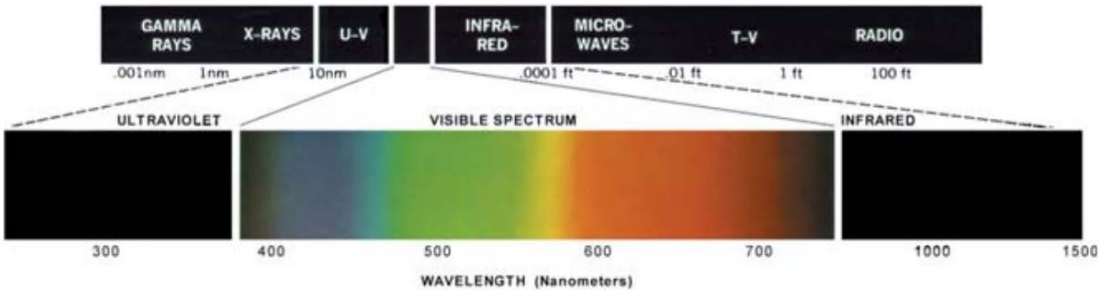


Fig. 6.2

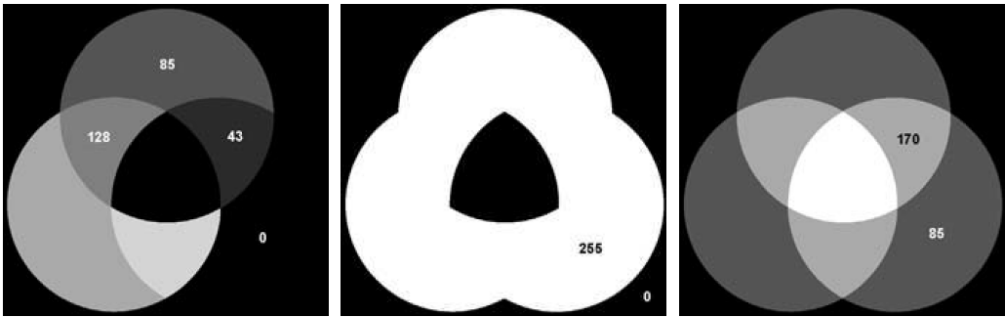
5. Problem 6.16 (10%)

   The following 8-bit images are (left to right) the H, S, and I component images from Fig. 6.16. The numbers indicate gray-level values. Answer the following questions, explaining the basis for your answer in each. If it is not possible to answer a question based on the given information, state why you cannot do so.

   (a) Give the gray-level values of all regions in the hue image.

   (b) Give the gray-level value of all regions in the saturation image.

   (c) Give the gray-level values of all regions in the intensity image.



(a) (b) (c)

Fig. 6.16

6. Problem 6.22 (10%)

   Assume that the monitor and printer of an imaging system are imperfectly calibrated. An image that looks balanced on the monitor appears yellowish in print. Describe general transformations that might correct the imbalance.

7. Problem 6.23 (10%)

   Compute the $L^*a^*b^*$ components of the image in Problem 6.6 assuming

This matrix equation defines the tristimulus values of the colors generated by standard

National Television System Committee (NTSC) color TV phosphors viewed under D65 standard illumination (Benson [1985]).

8. **Pseudo-Color Image Processing** (10%)

(a) Implement Fig. 6.23, with the characteristic that you can specify two ranges of gray-level values for the input image and your program will output an RGB image whose pixels have a specified color corresponding to one range of gray levels in the input image, and the remaining pixels in the RGB image have the same shade of gray as they had in the input image. You can limit the input colors to all the colors in Fig. 6.4(a).

(b) Download the image in Fig. 1.10(4) from the course web site and process it with your program so that the river appears yellow and the rest of the pixels are the same shades of gray as in the input image. It is acceptable to have isolated specs in the image that also appear yellow, but these should be kept as few as possible by proper choice of the two gray-level bands that you input into your program.

9. **Color Image Enhancement by Histogram Processing** (10%)

(a) Download the dark-stream color picture in Fig. 6.35 from the course web site. Convert the image to RGB. Histogram-equalize the R, G, and B images separately using the histogram-equalization program from Homework 2 and convert the image back to tif format.

(b) Form an average histogram from the three histograms in (a) and use it as the basis to obtain a single histogram equalization intensity transformation function. Apply this function to the R, G, and B components individually, and convert the results to tif. Compare and explain the differences in the tif images in (a) and (b).

10. **Color Image Segmentation** (10%)

Download Fig. 6.28(b) from the course web site and duplicate Example 6.15, but segment instead the darkest regions in the image.