

# EE475 HOMEWORK4

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## I. PROBLEM 3: COLOR COORDINATES

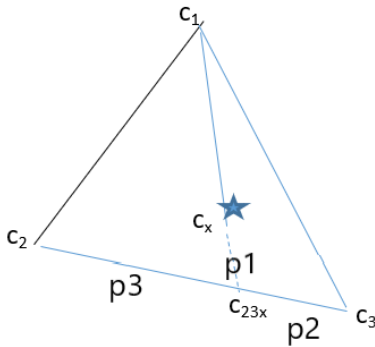


Fig. 1. color coordinates

P2 and P3 are the contributions of  $c_2$  and  $c_3$ , respectively for  $c_{23x}$  and their summation must be 1.

$$c_{23x} = c_2 + (c_3 - c_2)p_3$$

P1 and 1-P1 are the contribution of  $c_1$  and  $c_{23x}$ , respectively for  $c_x$ .

$$c_x = c_1 + (c_{23x} - c_1)(1 - p_1)$$

$$c_x = c_1 + (c_2 + (c_3 - c_2)p_3 - c_1)(1 - p_1)$$

## II. PROBLEM 8: UNDERSTANDING THE COLOR CUBE

A.

The RGB color cube represents the combination of R,G and B values and visualises them. Each axes identifies one color. The front face of the RGB cube is consisting of R values with 255 and changing B and G values. B values are increasing towards to the top face. In other words, first row has zero blue values and the last row(at the top face) has 255 blue values. G values are increasing to the right. The first column has zero green values and the last column has 255 green values.

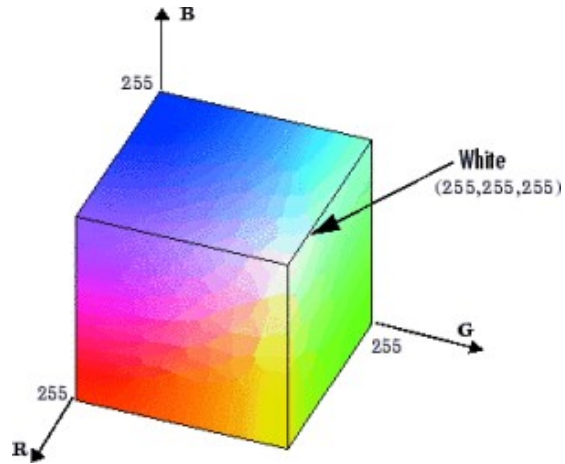


Fig. 2. RGB color cube

B.

000	001	010	011	100	101	110	111
white	yellow	magenta	red	cyan	green	blue	black

TABLE I  
CMY COLOR

C.

At the edges, one of the RGB components is changing and other two components are constant, they can be 0 or 255. The saturation value is about the difference between max and min of RGB values. Except the points where all components are 0 or 255 (black point and white point), all points are fully saturated. If the edge does not have one of these two points, all points at the edge are fully saturated.

## III. PROBLEM 15: SOLID COLOR SQUARES

A. Hue Image

Hue value depends on the angle on a color coordinate system and dominant color. The darkness: white = black = red > yellow > green > cyan > blue > magenta

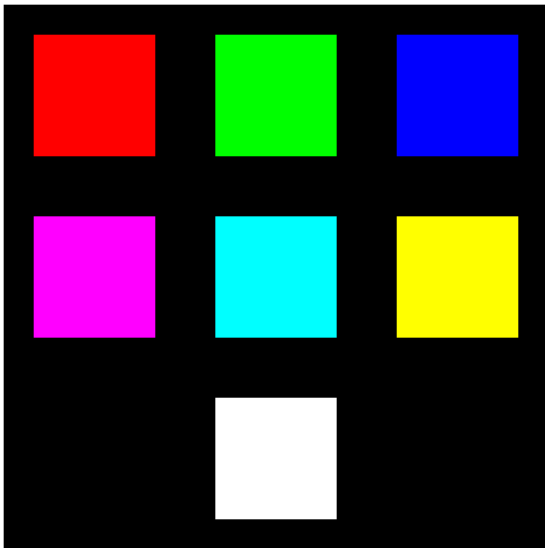


Fig. 3. solid color image

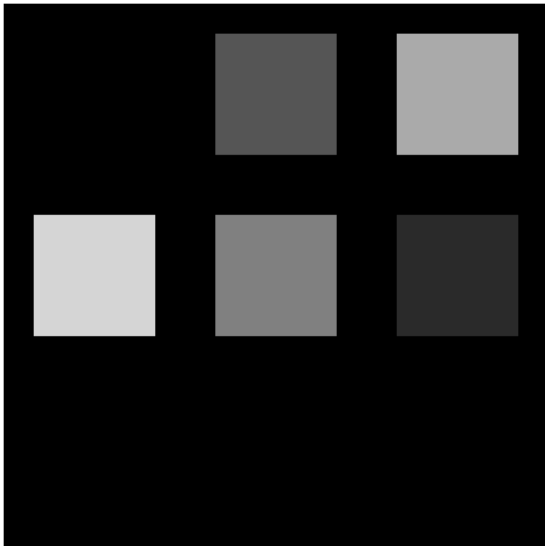


Fig. 4. hue image

### B. Saturation Image

The darkness: white = black > red = yellow = green = cyan  
= blue = magenta

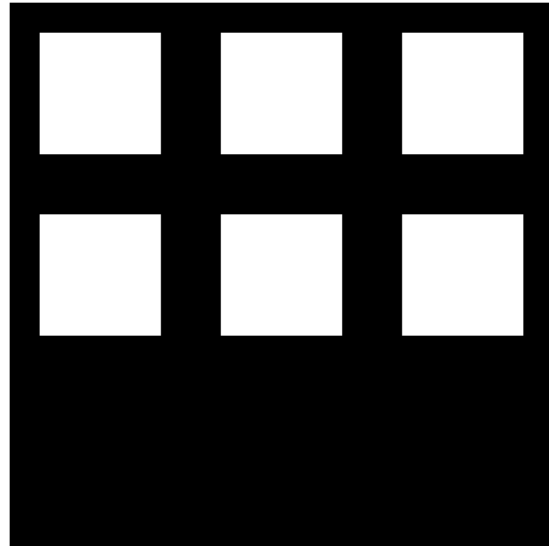


Fig. 5. saturation image

### C. Intensity Image

The darkness: black > red = green = blue > yellow = cyan  
= magenta > white

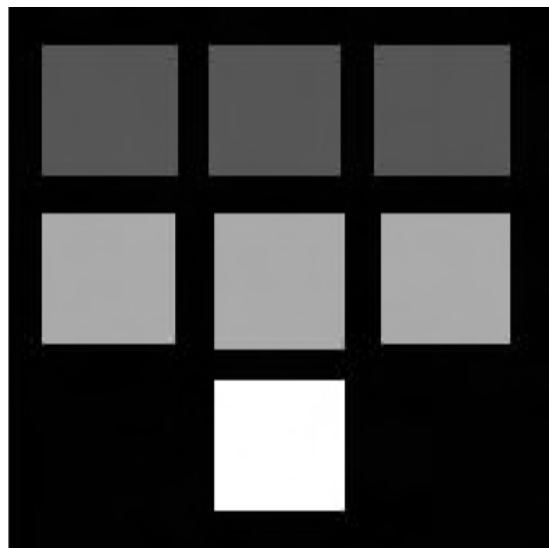


Fig. 6. intensity image

#### IV. PROBLEM 16: DISPLAY OF HIS COMPONENTS

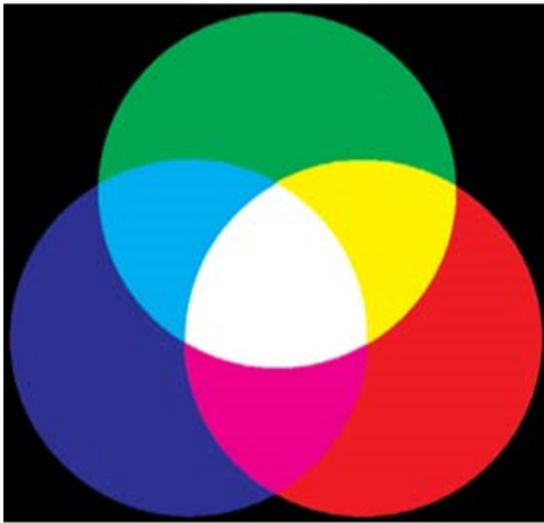


Fig. 7. Image

##### A. Hue

Hue values are between 0-360 degrees and 8 quanta levels give us the range 0-255. 0-360 must be scales with respect to 0-255. The conversion rate is  $255/360 = 0.708$ . At the hue system, red is 0, yellow is 60, green is 120, cyan is 180, blue is 240 and magenta is 300 degree. After conversion, red is 0, yellow is 43 (actually it is about 42.5 but it must be rounded because of 8 quanta level), green is 85, cyan is 128, blue is 170 and magenta is 213. White and black is zero. The darkness of the region depends on its color angle. The darkness: white = black = red > yellow > green > cyan > blue > magenta



Fig. 8. Hue Image

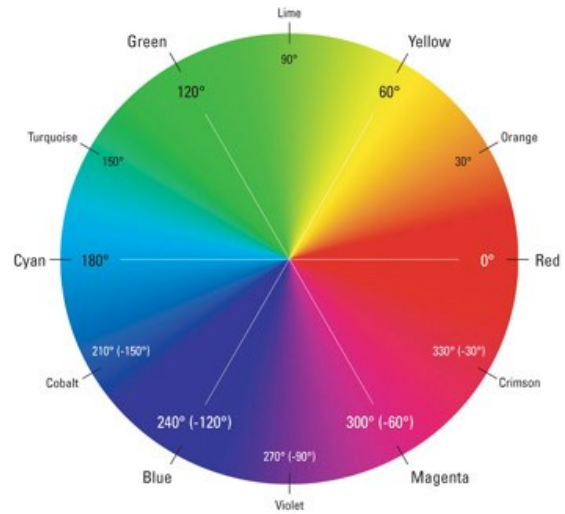


Fig. 9. Hue Angles

##### B. Saturation

Saturation value is about min and max values of RGB components as we discussed at question 2. At the white and black regions the max values and min values are same and their differences are zero. So, these regions are black. At the other regions, there is at least one component with 0 and one component with 255. So, at these regions are fully saturated and white. Red, green, blue, yellow, cyan and magenta regions have RGB components with both 0 and 255. So, their results are white. Black region's all RGB components are 0 and white region's all components are 255. So, these regions are black.

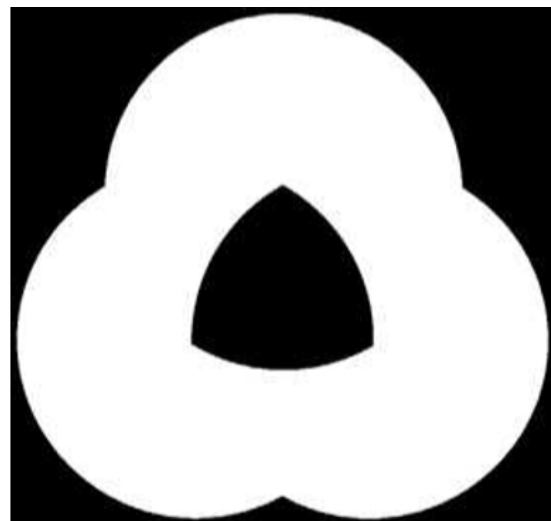


Fig. 10. Saturation Image

##### C. Intensity

Intensity is about the average of the components. If the one RGB component of the region is 255, its intensity is  $255/3=85$ . If the two RGB components is 255, its intensity is 170. If the all RGB components are 255, its intensity is 255.

Oppositely, none of RGB components is 255, its intensity is 0. Red, green and blue regions have only one RGB components with 255 value, so their intensities are 85. Yellow, cyan and magenta regions have two components with 255 values, so their intensities are 170 and they are lighter than red, green and blue regions. White region has three components with 255 value and the intensity is 255. Black region doesn't have any component with 255 value, so its intensity is zero. The darkness: black > red = green = blue > yellow = cyan = magenta > white

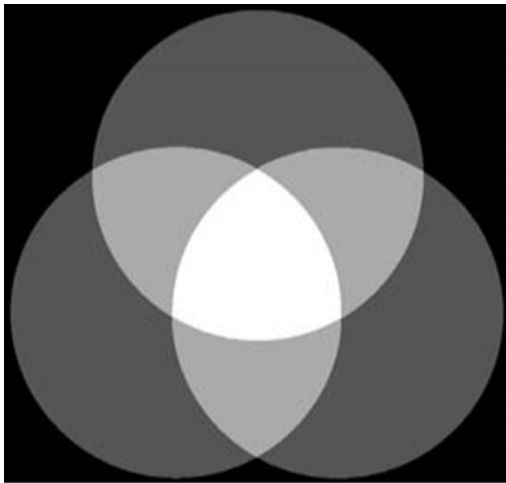


Fig. 11. Intensity Image