Chapter 6: Color Image Processing

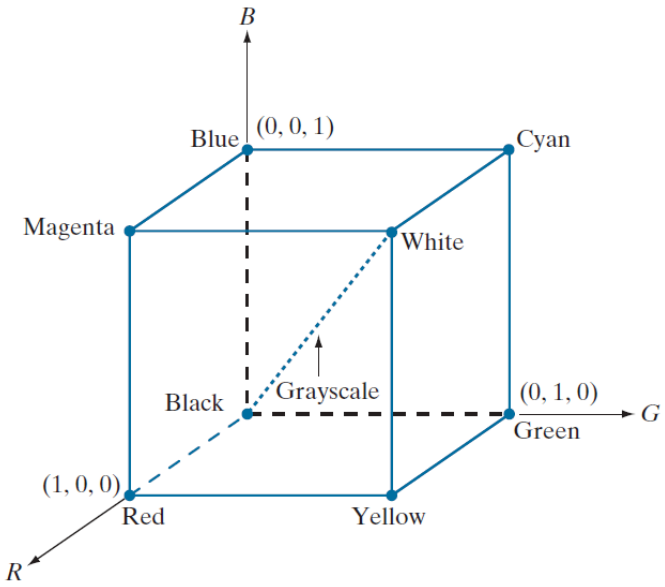
Origin42

Question 7. [Marks: 13]

a) Describe the RGB color model with schematic of RGB color cube. [5]

7.a. Solution: 024

RGB COLOR MODEL:

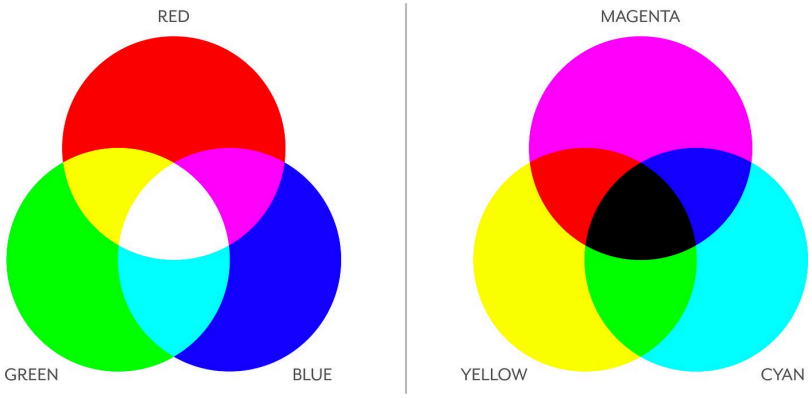


In the RGB model, each color appears in its primary spectral components of red, green, and blue. This model is based on a Cartesian coordinate system. The color subspace of interest is the cube shown in Fig, in which RGB primary values are at three corners; the secondary colors cyan, magenta, and yellow are at three other corners; black is at the origin; and white is at the corner farthest from the origin. In this model, the grayscale (points of equal RGB values) extends from black to white along the line joining these two points. The different colors in this model are points on or inside the cube, and are defined by vectors extending from the origin. For convenience, the assumption is that all color values have been normalized so the cube in Fig. is the unit cube. That is, all values of R, G, and B in this representation are assumed to be in the range [0, 1]. Here the sequence is RGB. So, Red's position is [1, 0, 0], Green's position is [0, 1, 0] and Blue's position is [0, 0, 1].

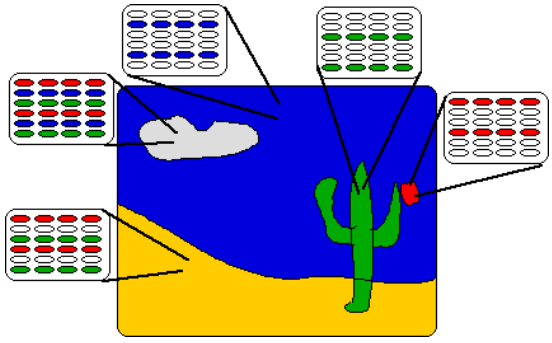
b) i. Why RGB color model is called *'Additive'* where as CMYK is called *'Subtractive'*? [4] [8]

ii. What is the basic differences between RGB image and Indexed color image? Which representation is preferred in case of storage and transmission? [4]

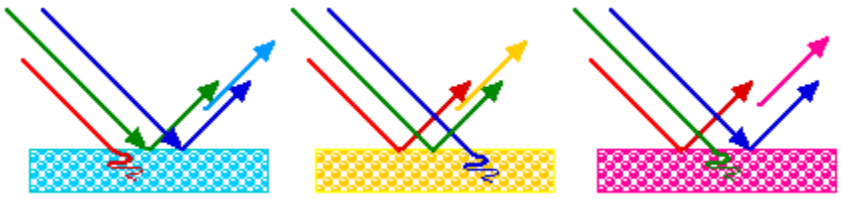
7.b. .i. Solution: 024



RGB is used primarily in digital displays, such as computer monitors, television screens, and projectors. It is based on the principle of adding light to create colors. In RGB, each color channel (Red, Green, and Blue) starts at zero intensity, and as we increase the intensity of each channel, we add more light to the mix. When all channels are set to their maximum intensity, we get white light, when all are at zero intensity, we get black. As we are getting colors by emitting and adding different spectrums of light, it is called additive.

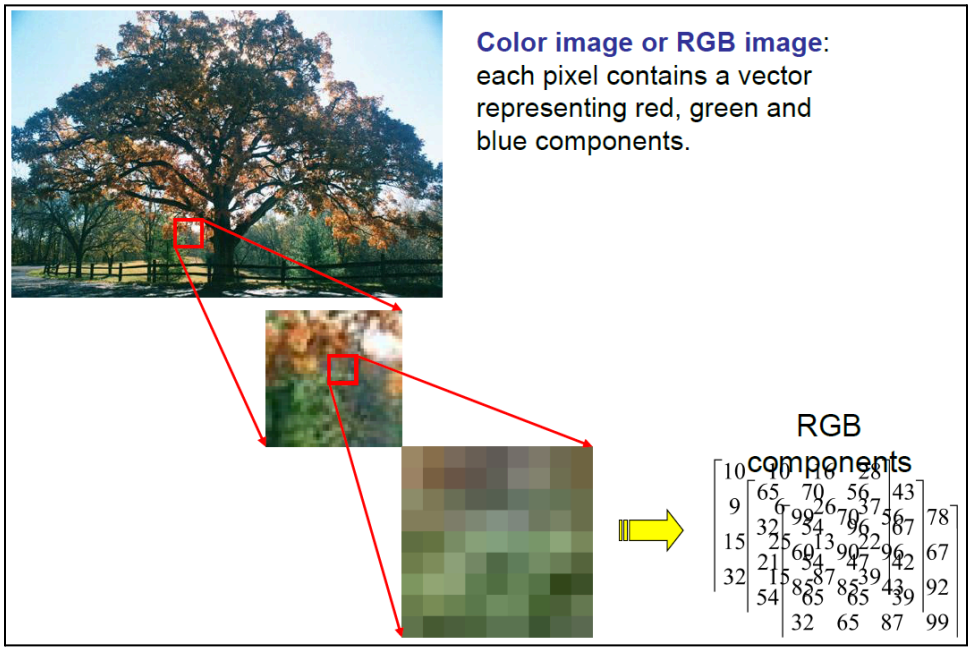


CMYK is primarily used in color printing, such as in magazines, brochures, and posters. It is based on the principle of subtracting color to create colors. In CMYK, each color channel (Cyan, Magenta, Yellow, and Key/Black) starts at its maximum intensity (100%), and as we decrease the intensity of each channel, we subtract color from the mix. When all channels are at maximum intensity, we get a dark, muddy color or black. When all are at zero intensity, we get white. As we are decreasing the intensity of C, M, Y to get various colors, it is called subtractive.

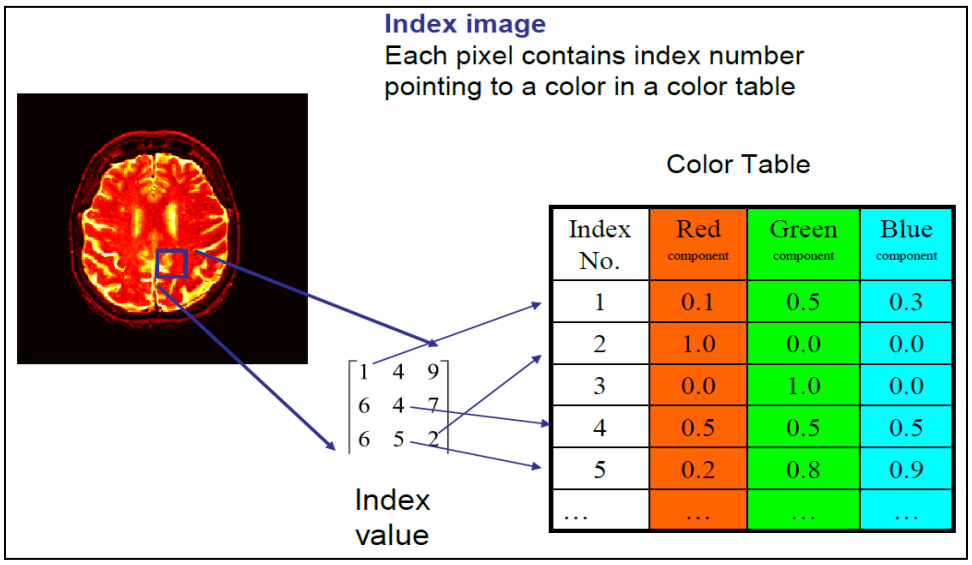


7.b. .ii. Solution: 024

RGB image:



Indexed Color image:



Here we can see, each RGB pixel needs 8+8+8=24 bits whereas each indexed pixel needs very less bits compared to RGB, as the indexed table's max value is 1.

So, in case of storage and transmission, indexed images are more suitable.

Enigma41

Question 3. [Marks: 14]

a) Suppose you have bought an inkjet printer recently. Besides, your father has bought a computer for your birthday gift. Describe the color model used in your computer monitor and printer. Among red, green and blue, which light will appear brightest followed by others? Justify your answer. Also, discuss the two major areas of color image processing. **[8]**

3.a. Solution: 024

Color model…

In computer monitor RGB color model is used.
In printer CMYK color model is used.

Among red, …

Light intensity formula for human eye, intensity = 0.299 x RED + 0.587 x GREEN + 0.144 x BLUE
So, the green light will appear brightest followed by red and blue.

Discuss the two…

Color Image Processing is divided into two major areas:

1. Full-color processing
    - Images are acquired with a full-color sensor, such as a color TV camera or color scanner.
    - Used in publishing, visualization, and the Internet.
2. Pseudo color processing
    - Assigning a color to a particular monochrome intensity or range of intensities.

b) Consider, AUST.png is a 256x256 image where the number of gray levels is 64. Calculate the bit depth and size in bytes of AUST.png. Describe Mach Band effect. What do you understand by index image? "The more intensity level used, the finer level of detail discernible in an image"-explain why? **[6]**

3.b. Solution: 024

Calculation …

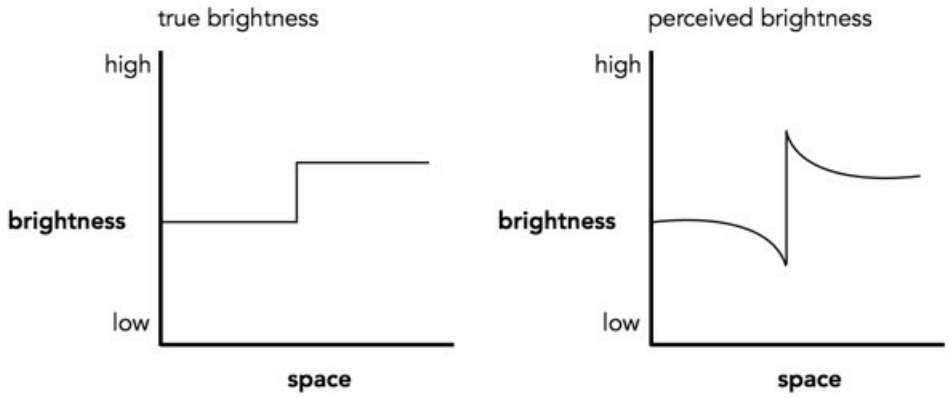
Given, image row, M = 256, column, N = 256, gray level = 64

Gray level = 2^bit_depth(k)
=> 64 = 2^bit_depth(k)
=> Bit depth(k) = 6

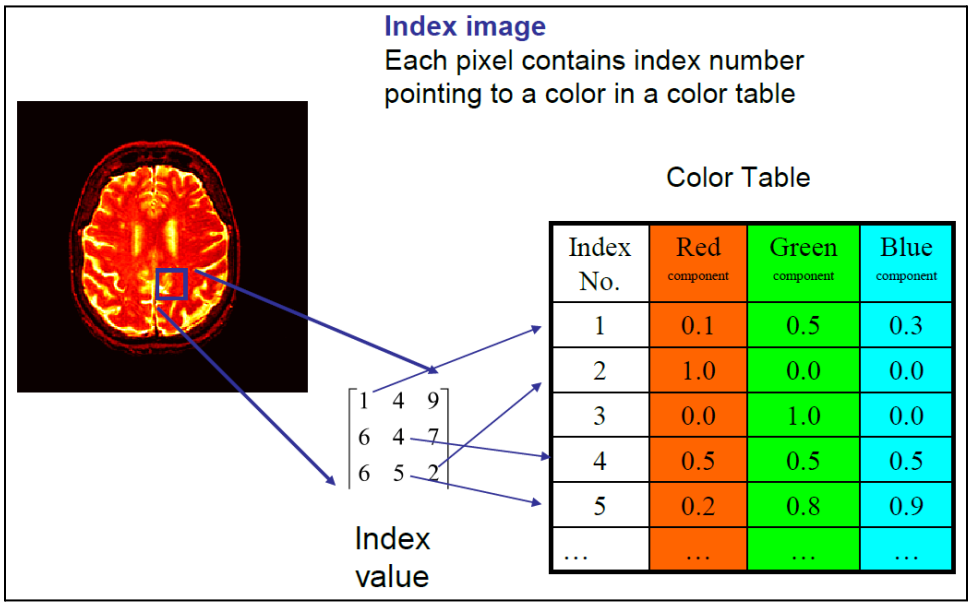
Image size = M x N x k = 256 x 256 x 6 = 393216 bits = 49152 bytes

Mach Band Effect:

Mach bands are an optical illusion. It exaggerates the contrast between edges of the slightly differing shades of gray, as soon as they contact one another, by triggering edge-detection in the human visual system.



Indexed Color image:



The more intensity level …

Let intensity level = 3. So, max intensity = 2^3 = 8

Let intensity level = 5. So, max intensity = 2^5 = 32

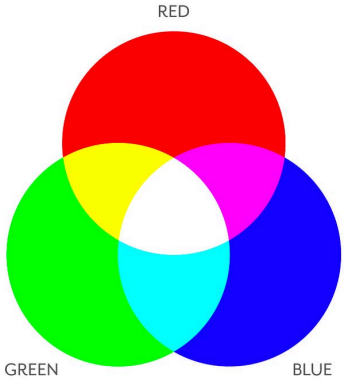
For intensity level 3 an image will have 8 different types of shades, but for intensity level 5 the same image will have 32 different types of shades in the same image, which will make the image more clear and vivid.

Return38

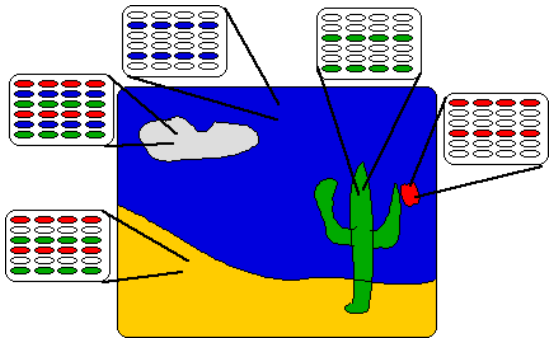
6.

c) Why RGB colour model is called ***'Additive'*** schematic of RGB colour cube.

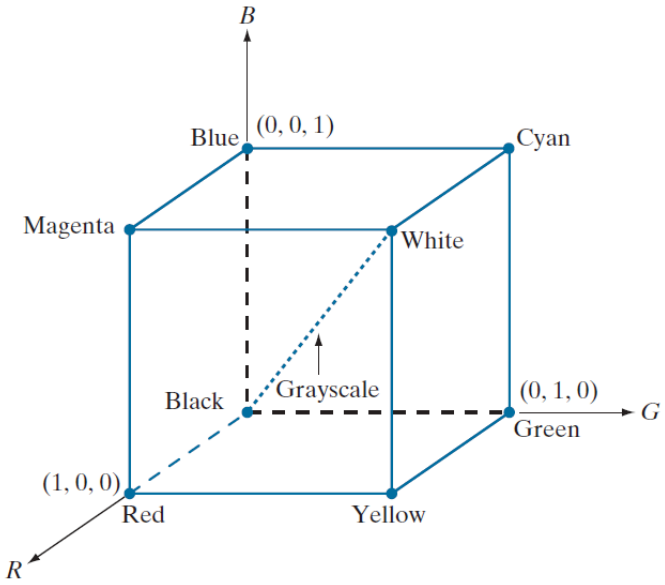
Solution: 024



RGB is used primarily in digital displays, such as computer monitors, television screens, and projectors. It is based on the principle of adding light to create colors. In RGB, each color channel (Red, Green, and Blue) starts at zero intensity, and as we increase the intensity of each channel, we add more light to the mix. When all channels are set to their maximum intensity, we get white light, when all are at zero intensity, we get black. As we are getting colors by emitting and adding different spectrums of light, it is called additive.



RGB COLOR MODEL:



In the RGB model, each color appears in its primary spectral components of red, green, and blue. This model is based on a Cartesian coordinate system. The color subspace of interest is the cube shown in Fig, in which RGB primary values are at three corners; the secondary colors cyan, magenta, and yellow are at three other corners; black is at the origin; and white is at the corner farthest from the origin. In this model, the grayscale (points of equal RGB values) extends from black to white along the line joining these two points. The different colors in this model are points on or inside the cube, and are defined by vectors extending from the origin. For convenience, the assumption is that all color values have been normalized so the cube in Fig. is the unit cube. That is, all values of R, G, and B in this representation are assumed to be in the range [0, 1]. Here the sequence is RGB. So, Red's position is [1, 0, 0], Green's position is [0, 1, 0] and Blue's position is [0, 0, 1].