ICT 4203

Computer Graphics and Animation

Lecture 01

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Contents

Computer Graphics Basic

- Computer graphics is an art of drawing pictures on computer screens with the help of programming.
- It involves computations, creation, and manipulation of data.
- In other words, we can say that computer graphics is a rendering tool for the generation and manipulation of images.
- The process transforms and presents information in a visual form.
- The end product of the computer graphics is a picture, it may be a business graph, drawing, and engineering.
- In computer graphics, two or three-dimensional pictures can be created that are used for research.
- Many hardware devices algorithms have been developing for improving the speed of picture generation with the passes of time.

What is a graphic?

- A graphic can be a:
  - Chart
  - Drawing
  - Painting
  - Photograph
  - Logo
  - Navigation button
  - Diagram

What do graphics look like?

Graphics can be:

- Black and White
- Grayscale
- Color
- Still
- Animated

What do graphics do?

- Graphics can:
  - Illustrate or demonstrate procedures
  - Clarify data
  - Convey ideas
  - Tell stories
  - Add visual appeal

Why computer graphics used?

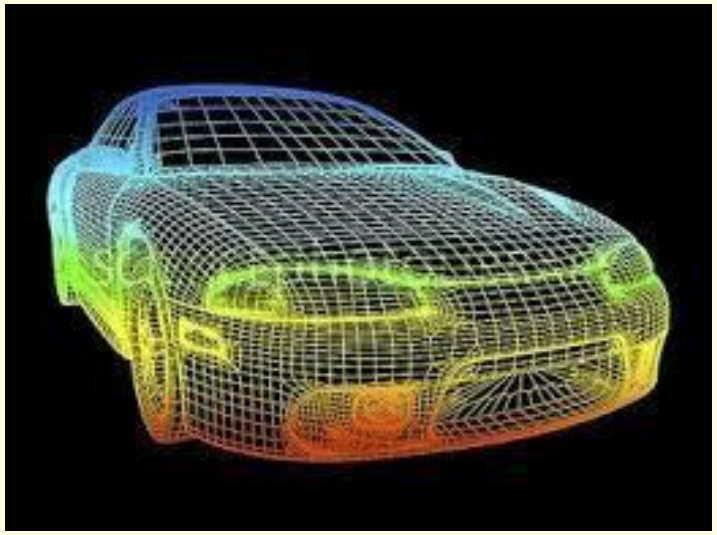
- Suppose a shoe manufacturing company want to show the sale of shoes for five years.
- For this vast amount of information is to store.
- So, a lot of time and memory will be needed.
- This method will be tough to understand by a common man.
- In this situation graphics is a better alternative.
- Graphics tools are charts and graphs.
- Using graphs, data can be represented in pictorial form.
- A picture can be understood easily just with a single look.

Applications

- Computer Aided Design(CAD)
- Presentation Graphics
- Computer Art
- Education and training
- Visualization
- Image processing
- Entertainment
  - Movies Industry
  - Gaming Industry
- Medical field
- Graphical User Interface(GUI)

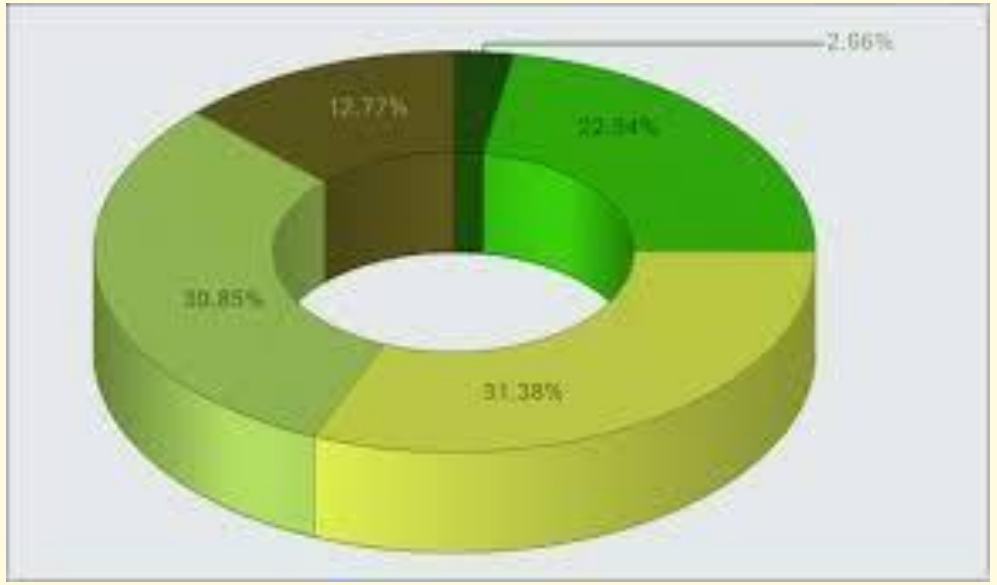
CAD

- Major use of computer graphics is in design process, particularly for engineering and architectural systems.
- This include design of buildings, automobiles, aircraft etc.



Presentation Graphics

- Used to summarize the financial, mathematical, scientific and economic data.
- Typical examples are bar charts, line graphs, pie charts etc.



Computer Art

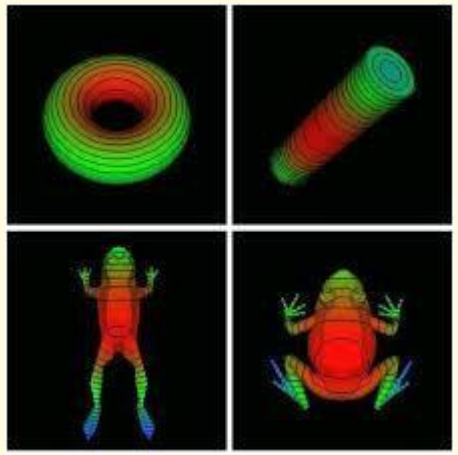
- Artist uses special purpose hardware and programs that provides facilities for designing object shapes and specifying object motion.
- Examples pixel paint, super paint etc.

Education and Training

- Computer-generated model of the physical, financial and economic system is often used as educational aids. Model of physical systems, physiological system, population trends or equipment can help trainees to understand the operation of the system.
- For some training applications, particular systems are designed. For example Flight Simulator.
- **Flight Simulator:** It helps in giving training to the pilots of airplanes. These pilots spend much of their training not in a real aircraft but on the ground at the controls of a Flight Simulator.

Visualization

- Various techniques can be used to represent the large amount of data obtained from scientific , medical or business analysis.
- These includes color coding, contour plots, graphs , charts etc.



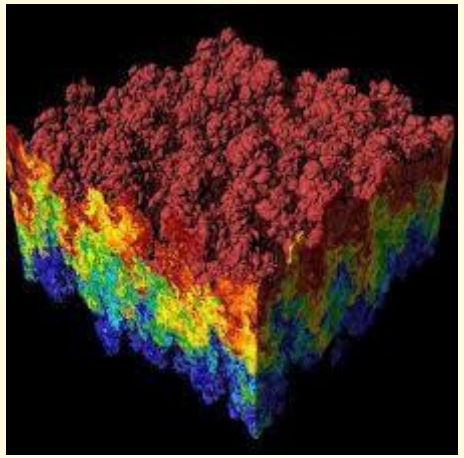


Image processing

- Computer graphics is used to create pictures.
- Image processing applies techniques to modify or interpret the existing pictures.
- It is used to:
  - Improve picture quality.
  - Machine perception of visual information.

Entertainment

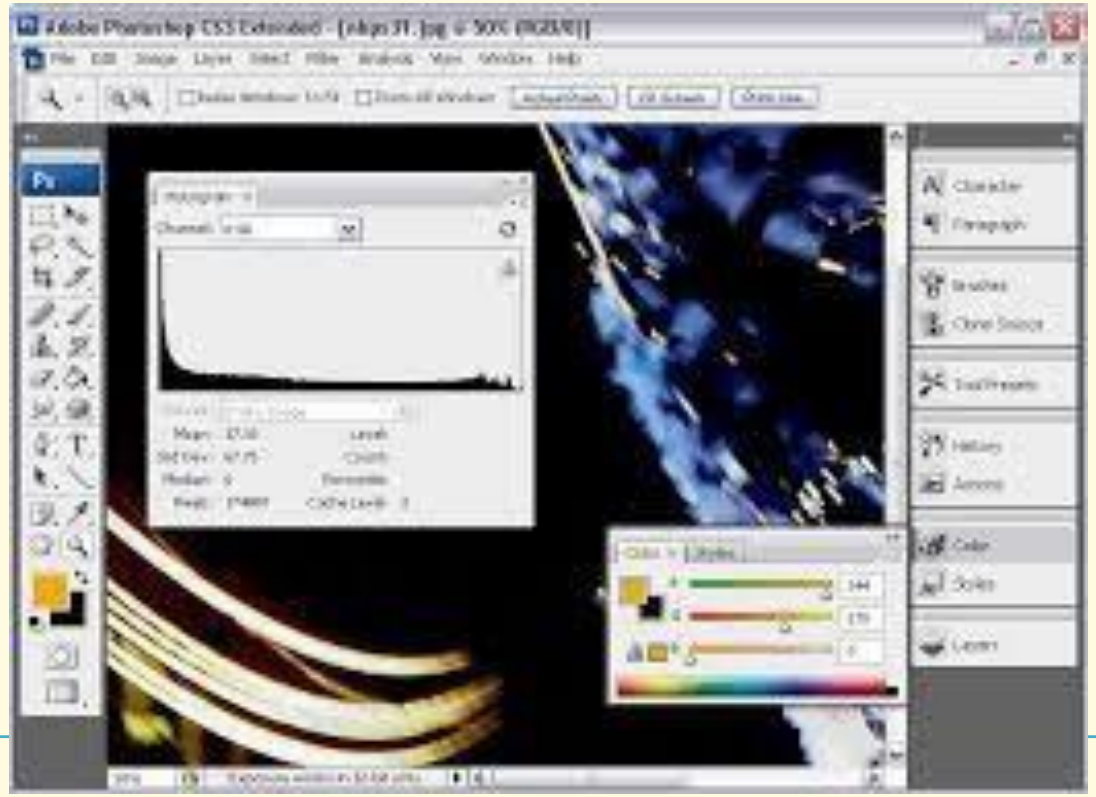
- Computer graphics methods are now commonly used in making motion pictures, music videos , games and televisions shows.
- Sometime graphics pictures are displayed by themselves and sometime combined with the actors and live scenes.

Medical Field

- Computer graphics can also be used to represent the various internal parts and process of the human body.

GUI

- It is the interface of the software that communicates with the user with help of some input devices.
- It contains number of windows , menus and icons for fast selection of processing options.



Types of Computer Graphics

- Raster Graphics vs. Vector Graphics.
- Passive vs. Interactive Graphics.

Raster Graphics:

- Raster graphics is also known as Bitmapped graphics.
- It consist of grids of tiny dots called pixels.
- Each pixel is assigned a color.
- In raster graphics pixels are used for an image to be drawn.
- It can be a continuous-tone image, such as a photograph.
- Bitmap graphic editors are called paint programs.
- Enlarging a bitmap graphic may cause the image to lose crispness and clarity .

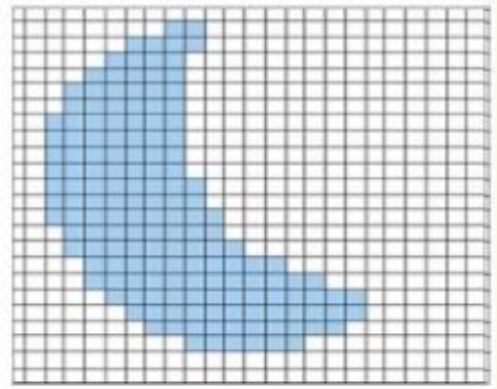
Vector Graphics:

- In vector graphics, mathematical formulae are used to draw different types of shapes, lines, objects etc.
- Vector graphics use mathematical formulas to define lines, curves, and other attributes.
- Generally much smaller than raster graphic files.
- Vector graphic editors are called draw programs.
- Do not lose clarity as you enlarge them.

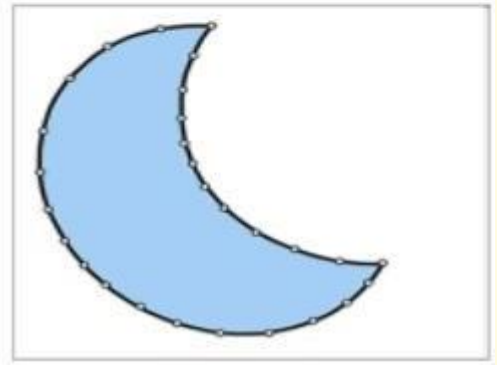
Raster vs. Vector Graphics

- Raster Programs
  - Photoshop, Fireworks, Paint
- Vector Programs
  - Illustrator, Flash

- Raster file extensions
  - Png – portable network graphic
  - Psd – Photoshop document
  - Jpg – joint photographic experts group
  - Gif – graphics interchange format
  - Bmp – Bitmap
- Vector File Extensions
  - Ai – Adobe Illustrator
  - Eps – Encapsulated Postscript
  - Wmf – Windows Metafile



Raster Graphics



Vector Graphics

Passive vs. Interactive Graphics

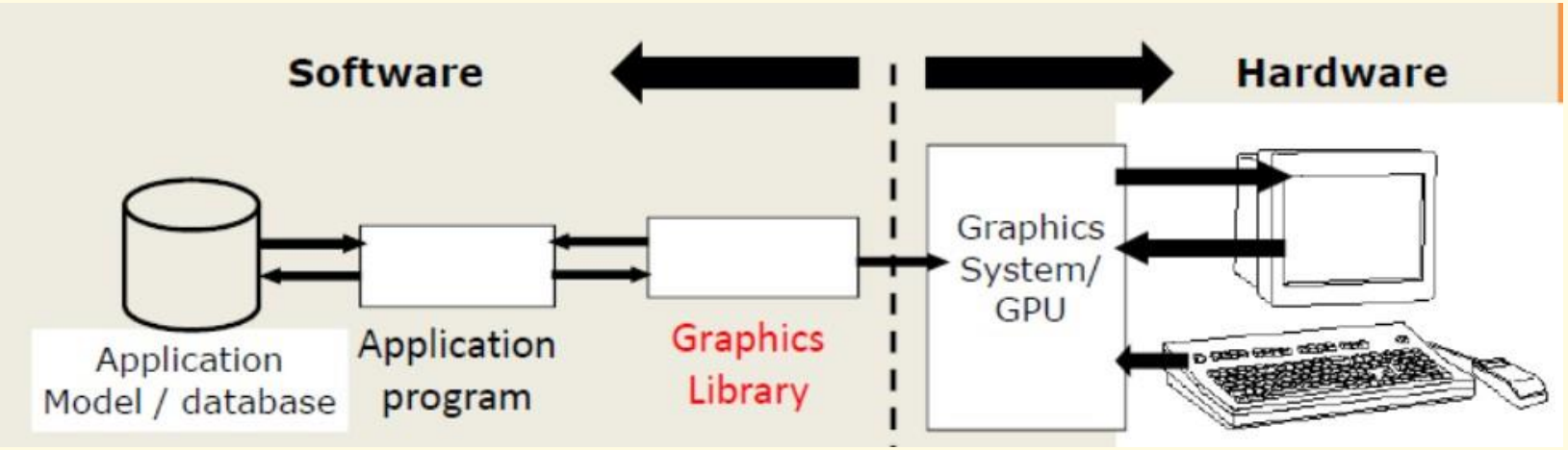
Non-interactive:

- In non-interactive computer graphics, the picture is produced on the monitor, and the user does not have any controlled over the image, i.e., the user cannot make any change in the rendered image. One example of its Titles shown on T.V.
- Non-interactive Graphics involves only one-way communication between the computer and the user, User can see the produced image, and he cannot make any change in the image.

Interactive Graphics:

- In interactive Computer Graphics user have some controls over the picture, i.e., the user can make any change in the produced image. One example of it is the ping-pong game.
- Interactive Computer Graphics require two-way communication between the computer and the user. A User can see the image and make any change by sending his command with an input device.
- Advantages:
  - Higher Quality
  - More precise results or products
  - Greater Productivity
  - Lower analysis and design cost
  - Significantly enhances our ability to understand data and to perceive trends.

Conceptual Framework of Interactive Graphics



- Graphics library/package is intermediary between application and display hardware (Graphics System).
- Application program maps application objects to views (images) of those objects by calling on graphics library.
- Application model may contain lots of non-graphical data (e.g., non-geometric object properties).
- User interaction results in modification of image and/or model.

Graphics Quality

- Two factors that determine graphics quality are:
  - Resolution
  - Color depth

  - **Resolution** is the number of pixels per inch.
  - **Color depth** refers to the number of distinct colors an image can contain. It can range from 2-bit (black and white) to 24-bit (16.7 million colors).

Animation

- Animation means giving life to any object in computer graphics.
- The basic idea behind animation is to play back the recorded images at the rates fast enough to fool the human eye into interpreting them as continuous motion.
- Animation can make a series of dead images come alive. Animation can be used in many areas like entertainment, computer aided-design, scientific visualization, training, education, e-commerce, and computer art.

Simple Animation

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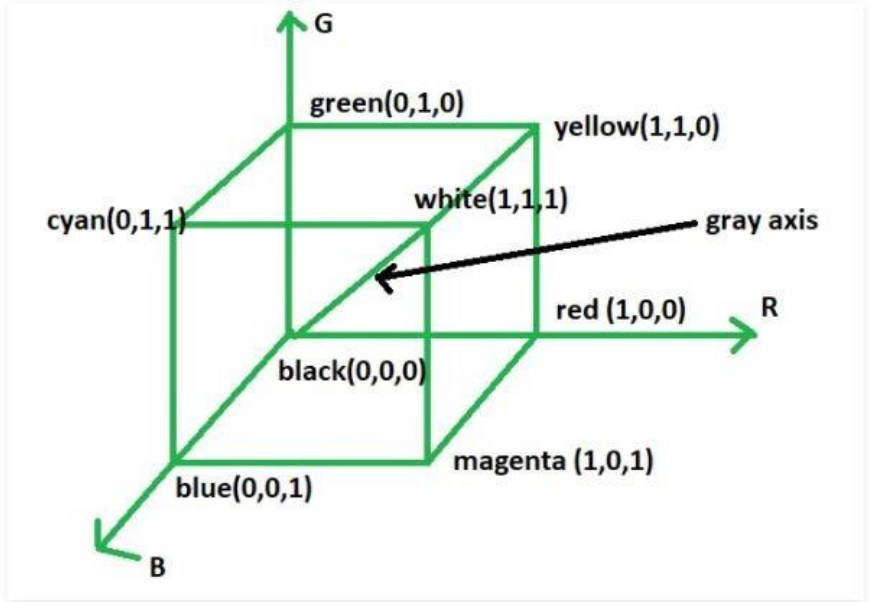
The Action: Zoom!!

Termination: Proof! Gone!

Color Theory

- The RGB color model is one of the most widely used color representation method in computer graphics. It use a color coordinate system with three primary colors:
- **R (Red), G (Green), B (Blue).**
- Each primary color can take an intensity value ranging from 0(lowest) to 1(highest). Mixing these three primary colors at different intensity levels produces a variety of colors. The collection of all the colors obtained by such a linear combination of red, green and blue forms the cube shaped RGB color space.



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- The corner of RGB color cube that is at the origin of the coordinate system corresponds to black, whereas the corner of the cube that is diagonally opposite to the origin represents white. The diagonal line connecting black and white corresponds to all the gray colors between black and white, which is also known as **gray axis**.
- In the RGB color model, an arbitrary color within the cubic color space can be specified by its color coordinates: (r, g.b).

Example:

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(0, 0, 0) for black, (1, 1, 1) for white,
(1, 1, 0) for yellow, (0.7, 0.7, 0.7) for gray
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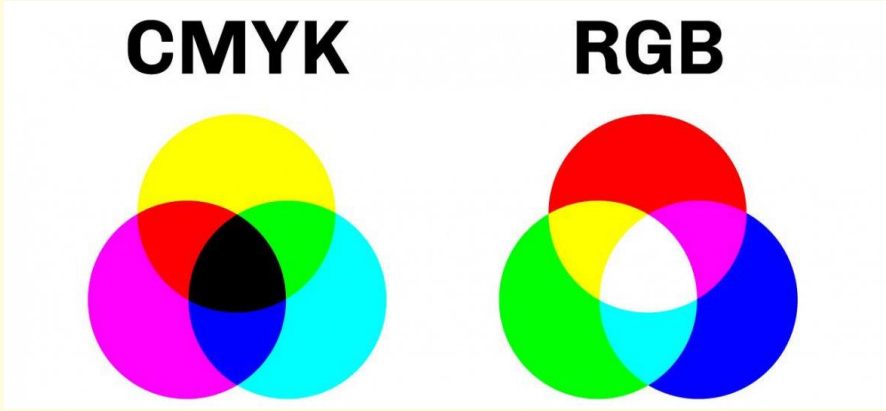

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- Color specification using the RGB model is an **additive process**. We begin with black and add on the appropriate primary components to yield a desired color. The concept RGB color model is used in **Display monitor**. On the other hand, there is a complementary color model known as **CMY color model**. The CMY color model use a **subtraction process** and this concept is used in the **printer**.
- In CMY model, we begin with white and take away the appropriate primary components to yield a desired color.

Example:

If we subtract red from white, what remains consists of green and blue which is cyan. The coordinate system of CMY model use the three primaries' complementary colors:

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C(cray), M(magenta) and Y(yellow)
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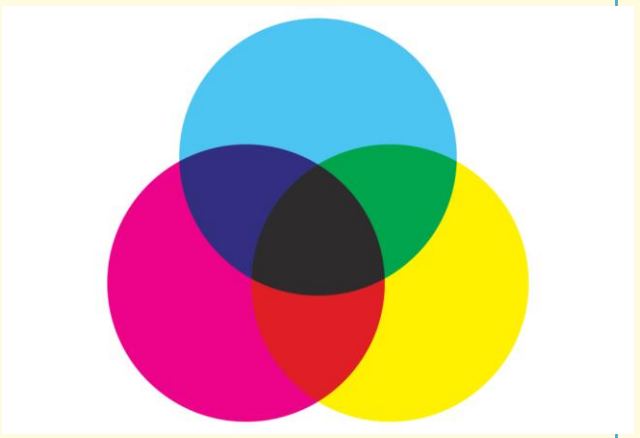

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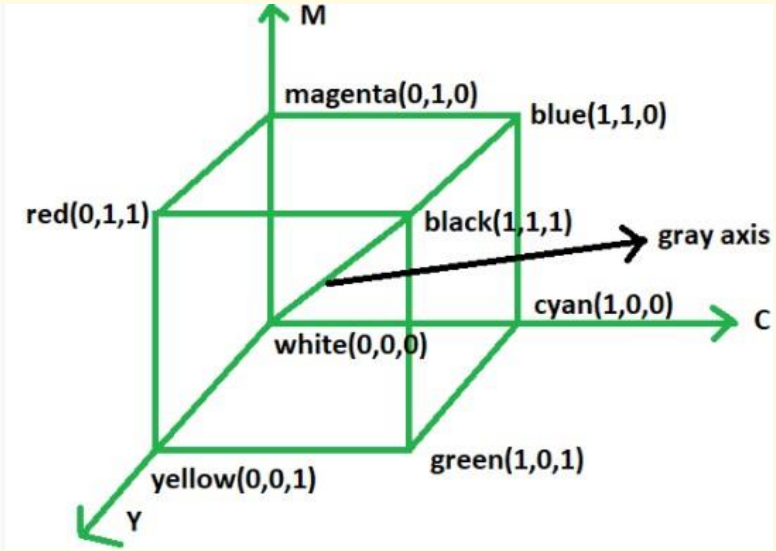

- The corner of the CMY color cube that is at (0, 0, 0) corresponds to white, whereas the corner of the cube that is at (1, 1, 1) represents black. The following formulas summarize the conversion between the two color models:

$$\begin{bmatrix} R \\ G \\ B \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} - \begin{bmatrix} C \\ M \\ Y \end{bmatrix} \qquad \begin{bmatrix} C \\ M \\ Y \end{bmatrix} = \begin{bmatrix} 1 \\ 1 \\ 1 \end{bmatrix} - \begin{bmatrix} R \\ G \\ B \end{bmatrix}$$

Thank You