

# Session Plan

Session No.	Unit No & Title	Topics	Sub-Topic	Learning Objectives
1	Unit 1 Introduction to Computer Graphics and Graphics System	<b>Overview of computer graphics and its applications</b>	Image processing and visualization, interactive and passive graphics	Discuss the overview and advantages of interactive graphics
			RGB Models, Direct Coding, Lookup tables, Graphics devices	Explain visualization, lookuptables, RGB color models
2	Unit 2: Scan Conversion	<b>Scan Conversion of Lines, Circles, boundary and flood fill algorithms</b>	Point and Lines, Line Drawing Algorithms- DDA line drawing, Bresenham's Line drawing, Circle Generating algorithms, Ellipse Generating Algorithms, Scan line fill algorithm, Boundary fill algorithms, Flood Fill algorithms	Explain the role of Points, lines and circles in graphics Describe boundary and flood fill algorithms
3	Unit 3: 2D Transformation	Basic and composite Transformation and homogenous matrix representation Transformation between coordinates	Translation, rotation, scaling Transformation, Matrix Representation and homogenous Coordinates, Transformation between Coordinates Systems, other and Composite transformations like reflection, shearing etc	Explain the basic transformations of 2D Explain matrix representation and homogeneous coordinates Analyze transformations between coordinate system Discuss the other transformations of 2D Describe the composite transformations of 2D.
4	Unit 4: 2D Viewing	2D window pipeline, windows to viewport Coordinate Transformation, Clipping point, line, polygon	windows to viewport transformation point and line clipping cohen sutherland line clipping algorithm,, Liang-Barsky Line Clipping Algorithm , Sutherland-Hodgman Polygon Clipping , Weiler-Atherton Polygon Clipping	Discuss 2D viewing pipeline Explain window to viewport coordinate transformation List and explain the clipping operation Define polygon clipping
5	Unit 5: 3D Transformation & Viewing	3- D coordinate System, Basic and composite transformation in 3 D 3- D viewing	Methods for modeling and performing geometric transformation in 3D- translation, scaling, rotation, reflection and Methods for obtaining views of a 3D space.	Explain the transformations of 3D. Describe reflection and shear transformations of 3D. Explain the rotation about an arbitrary axis in space Explain reflection through an arbitrary plane Explain projections and 3D viewing
6	Unit 6: Curves	Introduction to curve surfaces and their types	Spline curves, Bezier Curves, B-Spline Curves, Relational B-Spline Curves, Bezier and B-Spline Surface.	Discuss the spline curves Explain Bezier and B-Spline curves Explain Non uniform rational B-Spline curves Explain Bezier and B-Spline surfaces.



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7	Unit 7: Hidden Surfaces	Hidden surface determination, visible surface detection, Back face Detection	BSP Method, Depth sorting method, Z-buffer algorithm, Scan-line method, Fractal Geometry, wireframe method.	Explain the hidden surface determination Discuss object-based and image-based methods Explain the BSP tree and Scan line method Discuss the depth-sort algorithm. Explain wire frame methods and fractal geometry
✓8	Unit 8: Coloring and Shading Models	Light and Colour model, shading and texture	Process of altering the Color of An object/surface/polygon, light and color model, Interpolative shading and texture.	Explain the color models in graphics. Discuss basic lighting and reflection List and discuss shading Explain the role of texture mapping
9	Unit 9, Multimedia	Multimedia and its applications	Introduction and Concepts of Multimedia, Uses of Multimedia, Role of Hypertext and Hypermedia, Images and Video, Standards in Multimedia	Discuss the basic concepts of multimedia. List and explain the various mediums of multimedia Explain the uses of multimedia Differentiate and explain hypertext and hypermedia Discuss the image, video and audio standards
10	Unit 10, Audio	Audio and its standards, Digital audio, MIDI and Compression	Standard and the compression technique, Digital Audio, MIDI, Processing and Sampling Sound, Compression.	Explain the concepts of standards in audio. Explain the concepts of digital audio Discuss the MIDI concepts Explain the concept of processing and sampling sound List and discuss various audio compression techniques
11	Unit 11, Video	Concepts of Video, types, formats and compression techniques	The concept of video in Multimedia, Compression Techniques, MPEG Compression Standard, Redundancy.	List and discuss various MPEG compression standards Discuss the techniques of compression through redundancy. list and explain the types of frames. Explain the concept of interframe and intraframe compression
12	Unit 12, Animation	Animation in multimedia, types of animation, Morphing, Virtual Reality	Animation and its role in multimedia, types of animations, key- animationwrapping and cross-dissolving, virtual reality	Explain the concept of Animation. List and explain the techniques of animation. The role of keyframe animation Explain morphing Analyse the concepts of virtual reality.



## Unit- 1: Introduction to Computer Graphics and Graphics System

### Course Overview

- Introduction to Computer Graphics**
- Scan Conversion**
- 2D Transformations**
- 2 D Viewing**
- 3D Transformation & Viewing**
- Curves**
- Hidden Surface**
- Coloring and Shading Models**
- Multimedia**
- Audio**
- Video**
- Animation**



## Unit- 1: Introduction to Computer Graphics and Graphics System

**Computer Graphics, Image processing and Visualization, Interactive and non-interactive graphics, RGB Color Model, Direct Coding, Lookup tables, Graphics Devices**

### Learning Objectives

*At the end of this topic, you will be able to:*

- Overview of Computer Graphics**
- Explain the Interactive and Non-interactive Graphics**
- Discuss Visualization and Image processing**
- Discuss Direct and lookup tables**
- Explain Graphics Devices**

## Unit- 1: Introduction to Computer Graphics and Graphics System

### Computer Graphics

- The term computer graphics includes almost everything on computers that is not text or sound. Today almost every computer can do some graphics, and people have even come to expect to control their computer through icons and pictures rather than just by typing. **Here in our lab at the Program of Computer Graphics, we think of computer graphics as drawing pictures on computers, also called rendering.**
- The pictures can be photographs, drawings, movies, or simulations - pictures of things, which do not yet exist and maybe could never exist. Or they may be pictures from places we cannot see directly, such as medical images from inside your body. We spend much of our time improving the way computer pictures can simulate real world scenes

## **Unit- 1: Introduction to Computer Graphics and Graphics System**

### **What is Computer Graphics?**

- ▶ Creation, Manipulation, and Storage of geometric objects (modeling) and their images (rendering)
- ▶ Display those images on screens or hardcopy devices
- ▶ Image processing
- ▶ Others: GUI, Haptics, Displays (VR)...

# What drives computer graphics?

- ▶ Movie Industry
    - Leaders in quality and artistry
    - Not slaves to conceptual purity
    - Big budgets and tight schedules
    - Reminder that there is more to CG than technology
    - Hey, How'd they do that?
    - Defines our expectations



## Unit- 1: Introduction to Computer Graphics and Graphics System

### What drives computer graphics?

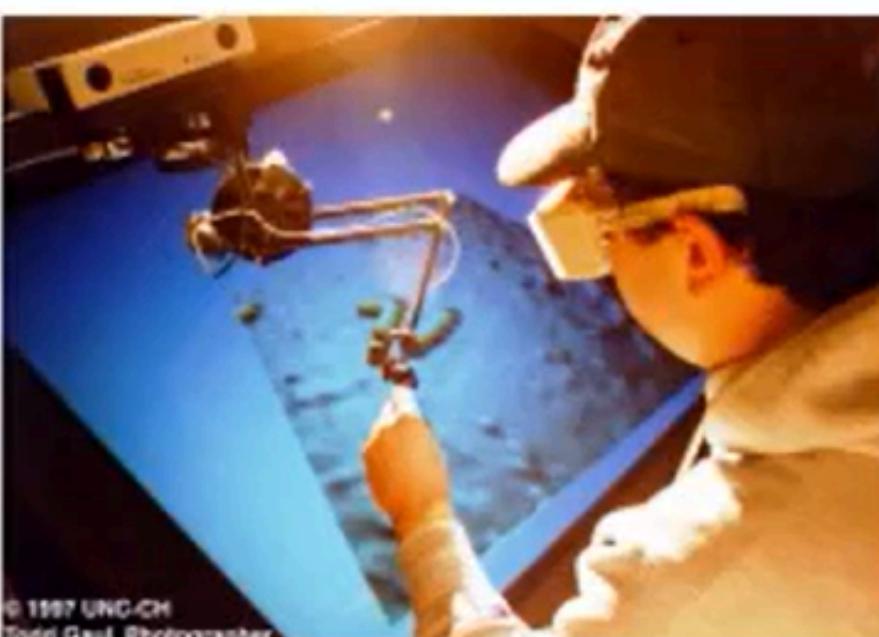
- ▶ Game Industry
  - The newest driving force in CG
    - Why? Volume and Profit
    - This is why we have commodity GPUs
  - Focus on interactivity
  - Cost-effective solutions
  - Avoiding computation and other tricks
  - Games drive the baseline



## Unit- 1: Introduction to Computer Graphics and Graphics System

### What drives computer graphics?

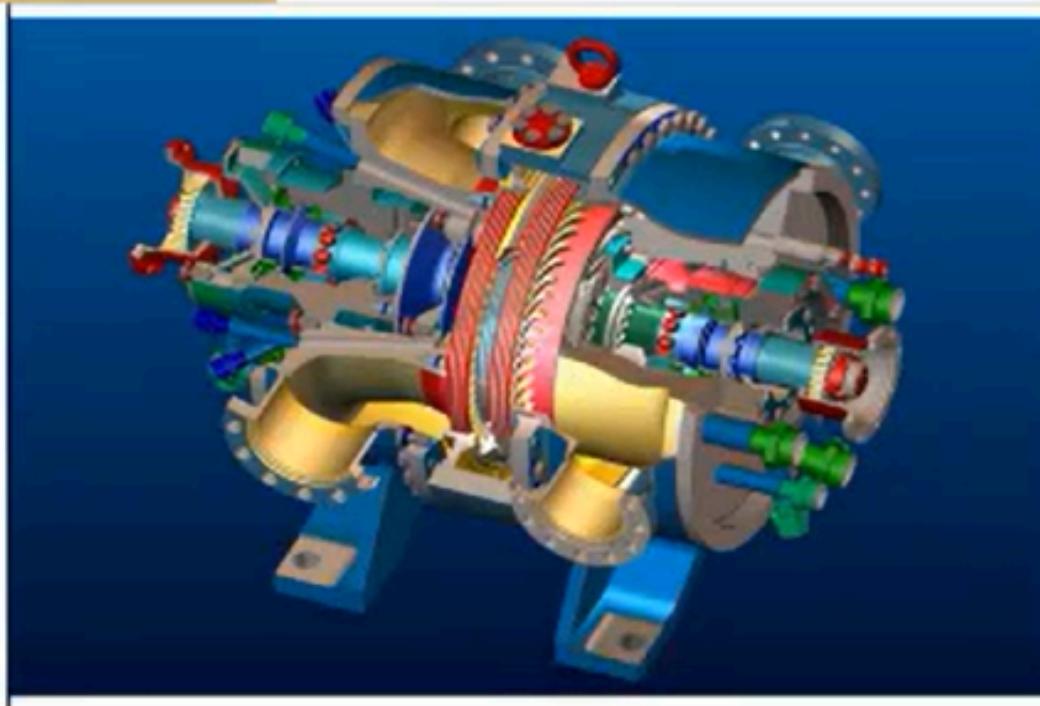
- ▶ Medical Imaging and Scientific Visualization
  - Tools for teaching and diagnosis
    - No cheating or tricks allowed
  - New data representations and modalities
  - Drive issues of precision and correctness
  - Focus on presentation and interpretation of data
  - Construction of models from acquired data the



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### What drives computer graphics?

- Computer Aided Design
  - Mechanical, Electronic, Architecture,...
  - Drives the high end of the hardware market
  - Integration of computing and display resources
  - Reduced design cycles == faster systems, sooner





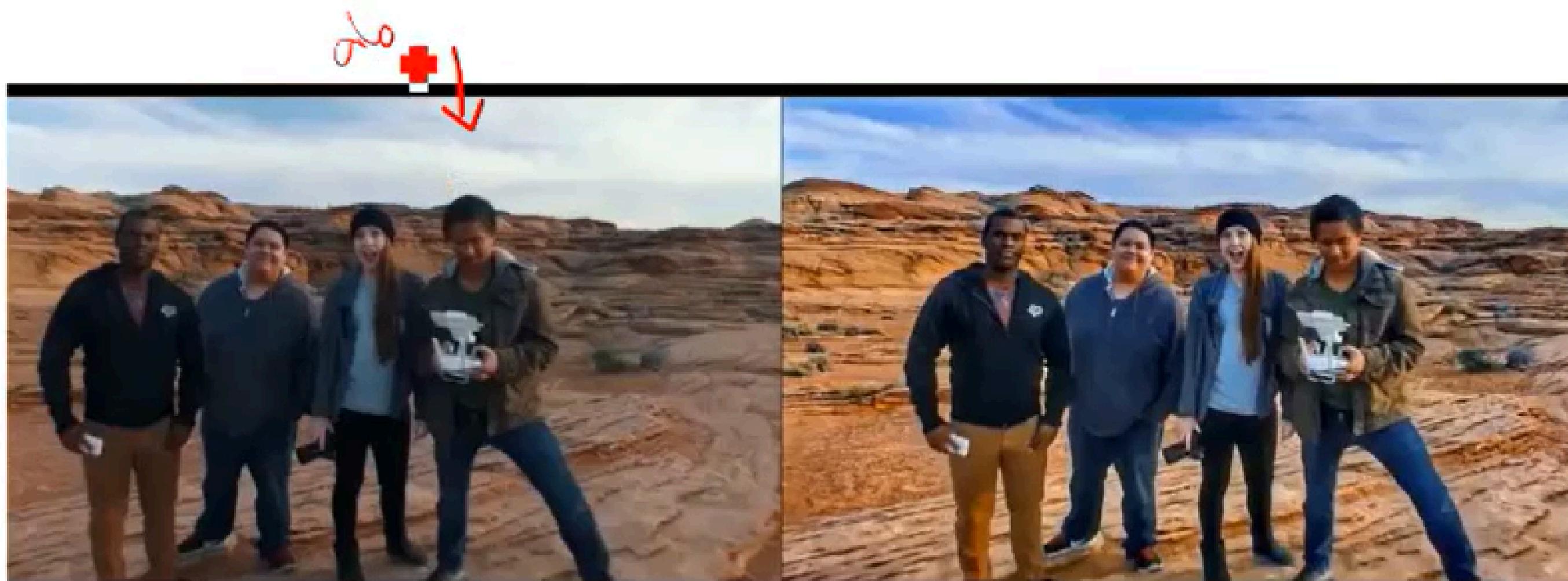
## **Unit- 1: Introduction to Computer Graphics and Graphics System**

### **Image Processing and Visualization**

- Computer graphics is a collection, contribution, and representation of real or imaginary objects from their computer-based models.
- However, the related field of image processing sometimes called picture analysis concerns the analysis of scenes or the reconstruction of models of 2D or 3D objects from their picture. The image processing can be classified as-
  - Image enhancement
  - Pattern recognition
  - Scene Analysis

## Unit- 1: Introduction to Computer Graphics and Graphics System

### Image Enhancement



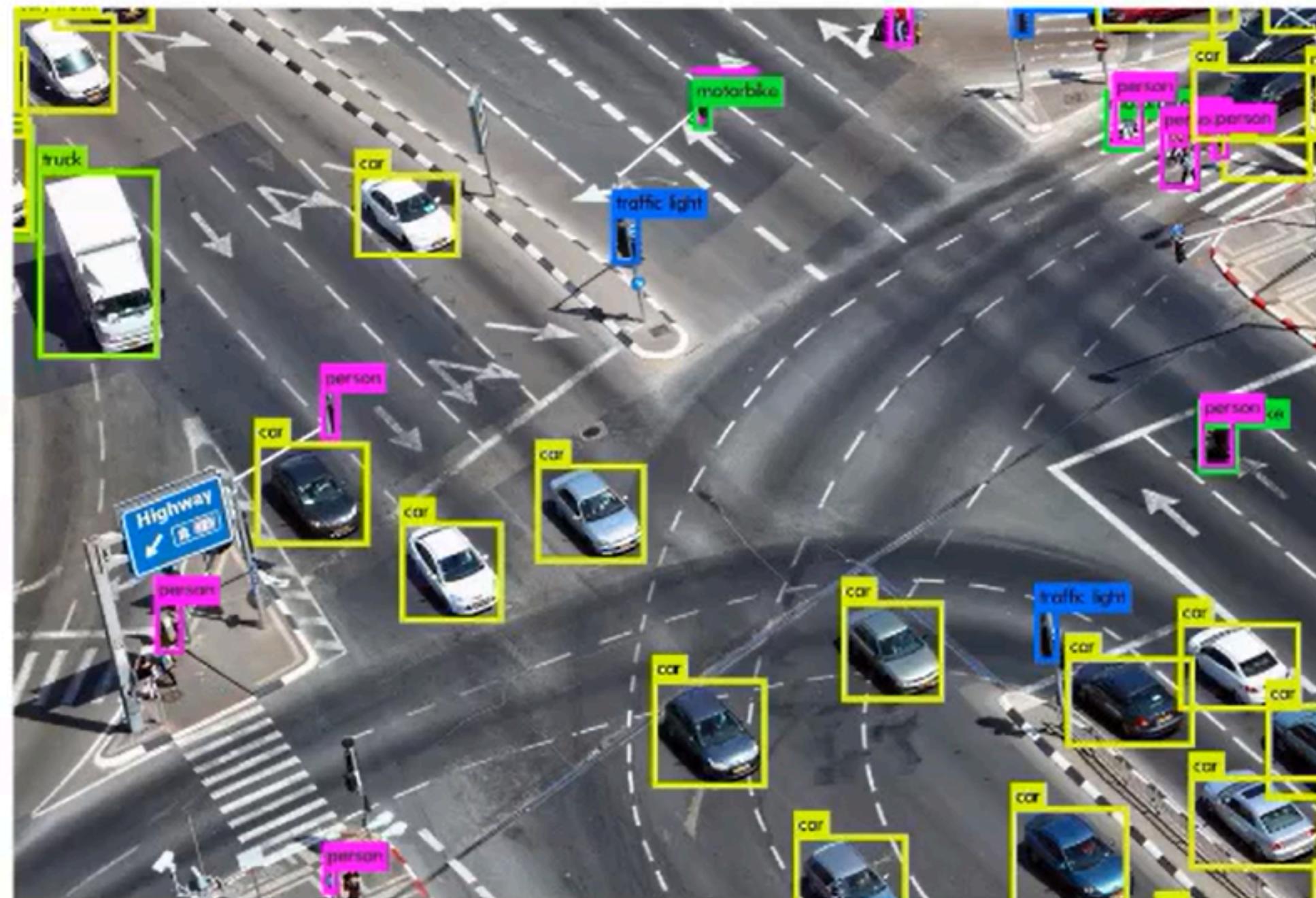
## **Unit- 1: Introduction to Computer Graphics and Graphics System**

### **Pattern recognition**



## Unit- 1: Introduction to Computer Graphics and Graphics System

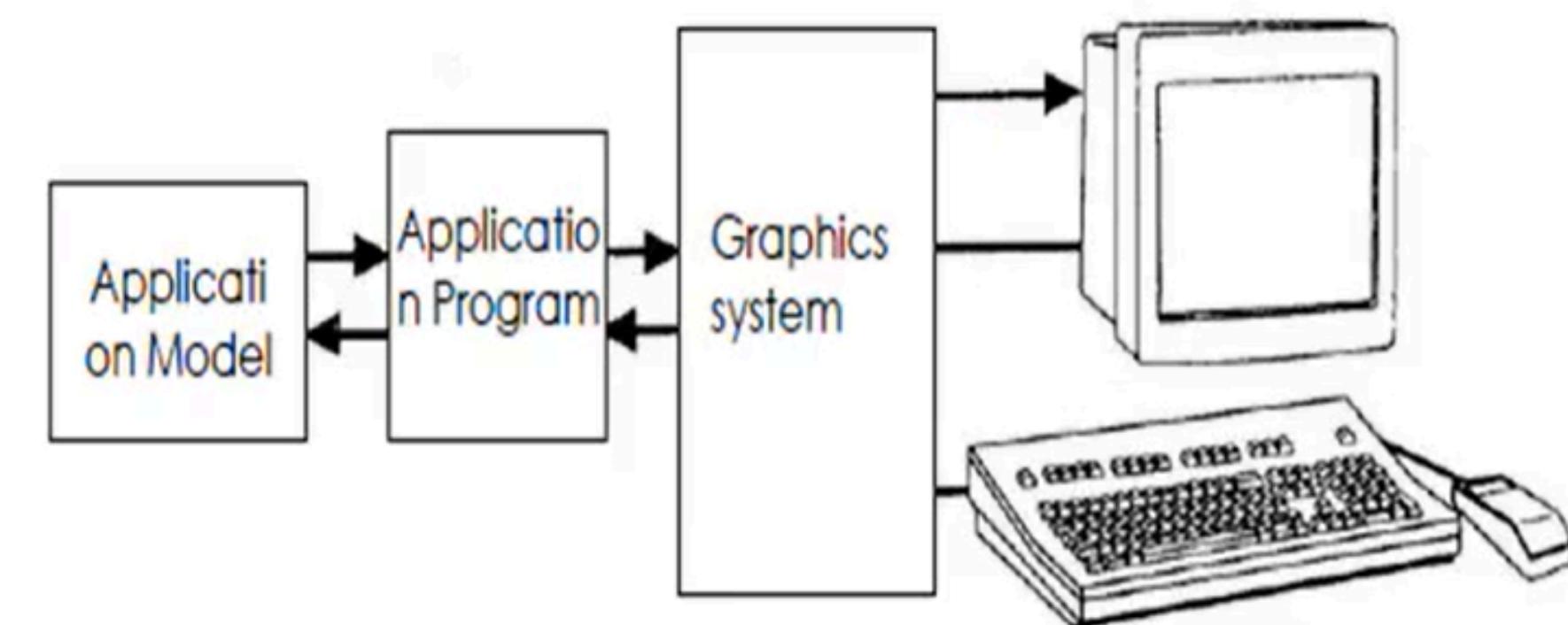
### Scene Analysis



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### Interactive Graphics

- In interactive computer graphics users have some control over the picture i.e. user can make any change in the produced image. One example of it is the ping pong game.



### Unit- 1: Introduction to Computer Graphics and Graphics System

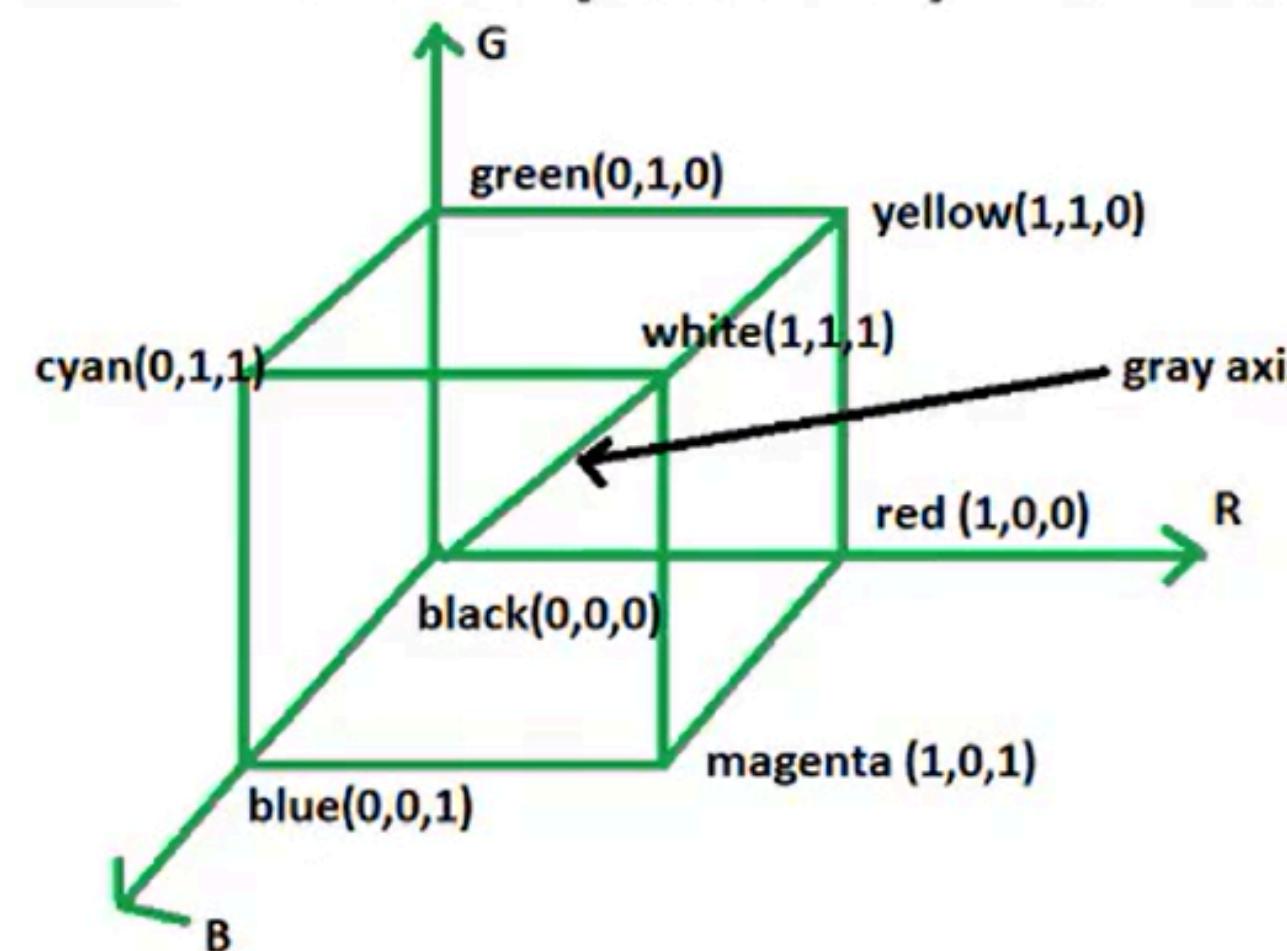
#### Non-Interactive (Passive) CG

- ▶ A computer graphics operation that transfers automatically and without operator intervention. Non-interactive computer graphics involves one way communication between the computer and the user. Picture is produced on the monitor and the user does not have any control over the produced picture for eg. In TV

## Unit- 1: Introduction to Computer Graphics and Graphics System

## RGB Colour Model

- The RGB color model is one of the most widely used color representation method in computer graphics. It uses a color coordinate system with three primary colours.



### Unit- 1: Introduction to Computer Graphics and Graphics System

#### RGB Colour Model

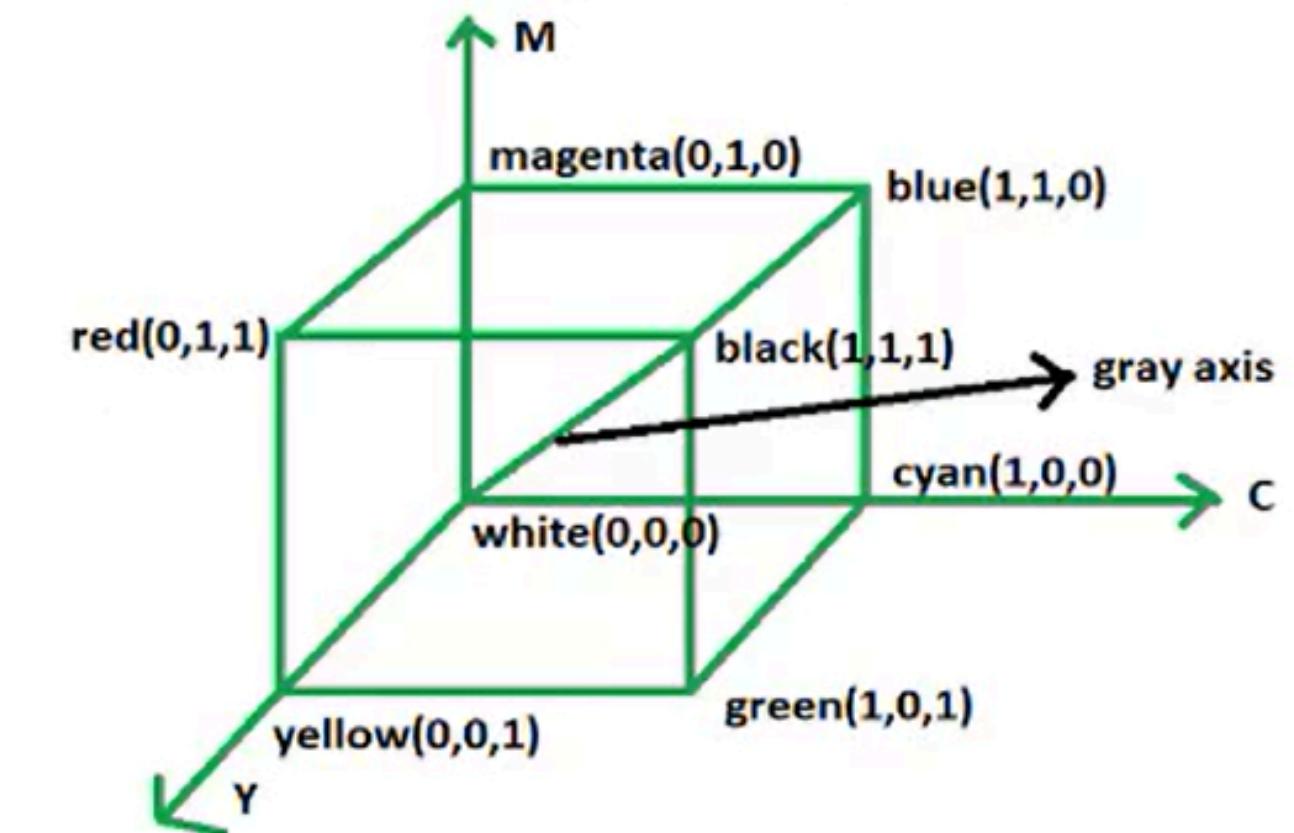
- Typical RGB input devices are video cameras, image scanners, and digital cameras
- Typical RGB output devices are TV sets of various technologies (CRT, LCD, plasma, and so on.), computer and mobile phone displays, video projectors, multicolor LED displays, and large screens such as JumboTron.
- Colour printers, on the other hand, are not RGB devices, but subtractive colour devices (typically CMYK colour model).

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## CMY Colour Model

- The CMY colour 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 colour.

The corner of the CMY colour cube that is at  $(0, 0, 0)$  corresponds to white, whereas the corner of the cube that is at  $(1, 1, 1)$  represents black.





## Conversion between RGB and CMY Colour Model

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

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

## Unit- 1: Introduction to Computer Graphics and Graphics System

### Director Coding

- ❖ In computer graphics, direct coding is an algorithm that allocates storage space for each pixel so that it can be assigned a colour.
- ❖ Images are just collections of pixels with colours. For example, one may allocate 3 bits for each pixel, with one bit for each primary colour

	bit 1: r	bit 2: g	bit 3: b	color name
	0	0	0	black
	0	0	1	blue
	0	1	0	green
	0	1	1	cyan
	1	0	0	red
	1	0	1	magenta
	1	1	0	yellow
	1	1	1	white

**Direct coding of colors using 3 bits.**

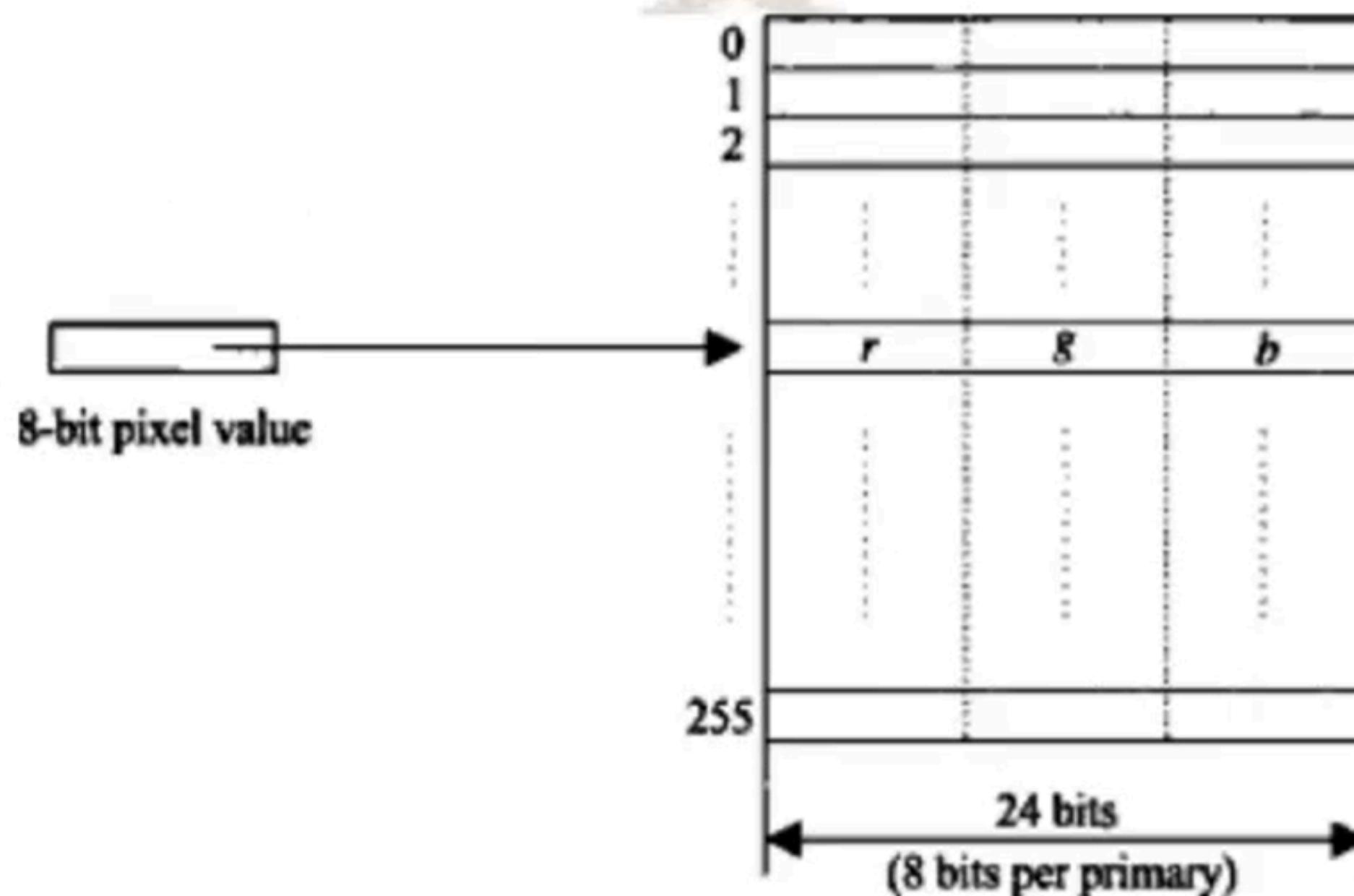
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#### Lookup Tables

- ❖ Image representation using a lookup table can be viewed as a compromise between the desire to have a lower storage requirement and the need to support a reasonably sufficient number of simultaneous colours.
- ❖ In this approach pixel values do not code colours directly. Instead, they are addresses or indices in a table of colour values. The colour of a particular pixel is determined by the colour value in the table entry that the value of the pixel references.

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### Lookup Tables



**24-bits 256-entry lookup table**

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### GRAPHICS DEVICES

#### Input Device

- ▶ Keyboards
- ▶ Mouse
- ▶ Trackball
- ▶ Joysticks
- ▶ Data Glove
- ▶ Digitizers
- ▶ Image Scanners
- ▶ Touch Panels
- ▶ Light Pens

#### Output Devices

- Monitors
- Printers
  - Dot-Matrix Printers
  - Inkjet Printers
  - Drum Printers
  - Laser Printers
- Plotters
  - Drum Plotters
  - Flatbed Plotters

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## **GRAPHICS DEVICES**

**Types of graphics software are**

- ▶ Vector graphics software
- ▶ Raster graphics software
- ▶ 3D graphics software
- ▶ Animation software:

## Unit- 1: Introduction to Computer Graphics and Graphics System

### Terminal Questions

1. Give the overview of computer graphics.
2. List the advantages of interactive graphics.
3. Explain image processing as picture analysis.
4. Define visualization.
5. Explain RGB colour model.
6. Explain direct coding and lookup tables.
7. How has graphics improvised the field of architecture?
8. What are two types of graphic input devices?
9. Explain Scientific Visualization.
10. What are the different types of computer software