

Computer Graphics

Date _____

Computer graphics is one of the most effective and commonly used way to communicate the processed information to the user. It displays the information in the form of graphics objects such as pictures, charts, graphs and diagrams instead of simple text. ∴ we can say that computer graphics makes it possible to express data in pictorial form. The picture or graphics objects may be an engineering drawing, business graphs, architectural structures, a single frame from an animated movie or a machine parts illustrated for a service manual.

Advantages

- Ability to store complex drawings and display them whenever needed.
- Ability to visualize complex data in a simple and easy to understand manner. You can use graphs, pie charts etc to break down data and present it in a way that is easy to understand especially when you are communicating information to a non-technical audience.
- Ability to design various logos, posters and other promotional materials using computer graphics software without hiring a designer. It is a cost effective design solution.
- Ability to create a high quality visual experience for users.
- Computer graphics are available to everyone, regardless of location or ability.

Date	Date															
Disadvantages																
Complexity: with the rising demand for advanced tools applications are becoming complex for beginner users hence to participate in graphical application training	Scientific Visualization: CG have made it possible to gain insights into molecules structure.															
For eg AutoCAD																
Expensive: we need to participate in training sessions ∴ the cost on the other hand tools are very expensive for an individual user.	Entertainment: CG are now commonly used in making motion pictures, music videos and television shows															
Time: It takes a lot of time and effort to create computer graphics	Video Games: Many video games use 3D models to create a more realistic environment for players. Most of the popular games have been created using computer graphics.															
It is not easy to create effective computer graphics	Cartography: CG is used to represent geo maps, weather maps, oceanographic charts etc															
Graphics is the processing and memory unit of computers which consumes high energy and makes the computer costly.																
Applications	Uses of Computer Graphics															
Architectural Design: It involves the creation of 3D representations of buildings, landscapes, or other architectural designs. It shows how the design will look in real life	<table border="1"> <thead> <tr> <th>Type of Object</th> <th>Type of Interaction</th> <th>Pictorial Representation</th> </tr> </thead> <tbody> <tr> <td>2D 3D</td> <td>Controllable Non Controllable</td> <td>Line drawing colour black etc</td> </tr> <tr> <td></td> <td></td> <td>object imaging</td> </tr> <tr> <td></td> <td>Kind of Picture</td> <td>Role of Picture</td> </tr> <tr> <td></td> <td>Symbolic Realistic</td> <td>use for representation use as an end product such as drawing</td> </tr> </tbody> </table>	Type of Object	Type of Interaction	Pictorial Representation	2D 3D	Controllable Non Controllable	Line drawing colour black etc			object imaging		Kind of Picture	Role of Picture		Symbolic Realistic	use for representation use as an end product such as drawing
Type of Object	Type of Interaction	Pictorial Representation														
2D 3D	Controllable Non Controllable	Line drawing colour black etc														
		object imaging														
	Kind of Picture	Role of Picture														
	Symbolic Realistic	use for representation use as an end product such as drawing														
Education: 3D models of complex objects can be created thus enabling educators to create more interactive lessons and engage students. CG have changed the way to teach and learn																

Graphics Hardware

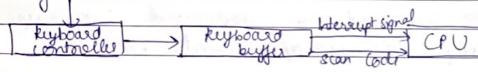
It is a computer hardware that generates computer graphics and allows them to be drawn on a display.

Input devices

1. Keyboard

It is used to enter text and numbers i.e. on graphic data that is associated with pictures such as labels x-y coordinates etc.

Keyboard



When we press a key on the keyboard, Keyboard controller places a code corresponding to key pressed into a part of its memory, called Keyboard buffer. This code is called scan code. The keyboard controller informs CPU of the computer about the key press with the help of intercept signal. The CPU then reads the scan code from the keyboard buffer.

2. Mouse

A mouse is a palm-sized box used to perform/position the screen cursor. It consists of ball on the bottom connected to wheels or rollers to record the amount and direction of movement. One, two or three buttons are usually included on the top of the mouse for signaling the execution of some operation. Nowadays mouse consists of two buttons with one more wheel on the top to scroll the screen pages.

Date _____

Date _____

3. Trackball and Spaceball

Trackball is a 2-D positioning device, it is a ball that can be rotated with the fingers or palm of the hand to produce screen cursor movement. The potentiometers attached to the trackball are used to measure the amount and direction of rotation.

Spaceball provides 6 degrees of freedom. It does not actually move. It consists of strain gauges which measure the amount of pressure applied to the spaceball. It is usually 3-D positioning and selecting operations in virtual-reality systems.

4. Joysticks

A joystick has a small, vertical lever (called the stick) mounted on the base and used to steer the screen cursor around. It consists of two potentiometers. The left or right movement is indicated by one potentiometer and forward or back movement is indicated by other potentiometer.

Output devices

- Cathode Ray Tube
- Vector scan display
- Raster scan display
- Coloured monitor
- LCD, LED, TFT

Graphics Software

- Photoshop
- Maya 3D
- CAD, GIF
- Corel draw

Spiral

Spiral

Display Devices

- Pixel
- Image resolution - PPI (Pixel density)
- Aspect Ratio
- CRT
- Vector scan display
- Raster scan display
- Diff b/w Vector and Raster
- Colour generation technique in colour CRT
 - Beam Penetration technique
 - Shadow Mask technique

PIXEL (Picture element)

Pixel is the smallest addressable screen element. It is the smallest piece of the display screen which we can control. The control is achieved by setting the intensity and colour of the pixel which compose the screen.

In digital imaging, it is the smallest item of information in an image, arranged in 2-D grid (Rows & cols) and are often represented as dots, square, rectangles

Pixel is the smallest unit of display on video monitor
Intensity of each pixel is variable

Pixel

R / \ G B
8 bits 8 bits 8 bits = 24 bits
(1 byte) (1 byte) (1 byte) = 3 bytes in 1 pixel

$$2^8 = 2 \times 2 \times 2 \times 2 \times 2 \times 2 = 256 \text{ numeric values}$$

Spiral

Date _____

Date _____

Total shades = $256 \times 256 \times 256 = 16.7$ millions shades
(composite of 3RGB value creates final colour for one that pixel resp area

$$\text{Image size} = \frac{w \times h}{1000 \times 750} = 750000 \text{ pixels}$$
$$750000 \times 3 = 2250000 \text{ bytes}$$

Resolution

The quality of the images printed or shown on a monitor is referred to as resolution. The resolution of a display is determined by counting the horizontal and vertical pixels. PPI is a resolution measurement used by printers (dots per inch)

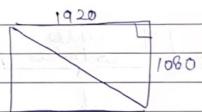
PPI (Pixel per inch)

It refers to the number of pixels contained within each inch of a digital image.
Higher the PPI, the better the image quality.
Lower resolution images contain larger pixels in fewer no.

Image Resolution

1920x1080

w x h



↑ Resolution → w x h of Image L
↓ Resolution → w x h of Image T

$$(1920)^2 + (1080)^2 = x^2$$

$$x = \sqrt{\frac{2205}{5}} = 440 \text{ PPI}$$

Aspect Ratio

It is the ratio of width to height of device

e.g. aspect ratio of 3:1 means width of the graphic is three times of the height of the image.

Spiral

6

Date _____

Frame Buffer

Frame buffer is a part of RAM in a computer allocated to hold the graphics data of one frame of image.

Frame buffer size determines the maximum depth resolution and color depth of the image.

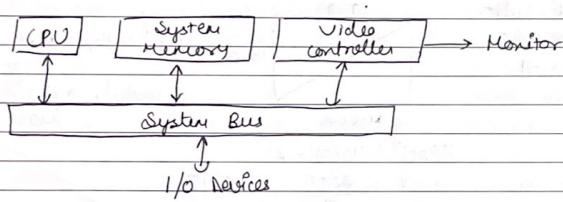
$$\text{FB size} = \text{resolution} \times \text{color depth}$$

$$\text{eg } 640 \times 480 \times 8 \text{ bit} = 2457600 \text{ bit} \\ = 307200 \text{ byte}$$

Frame buffer can be a part of Main memory, or on the video card.

Image is generated by CPU / GPU and sent (or load) into frame buffer.

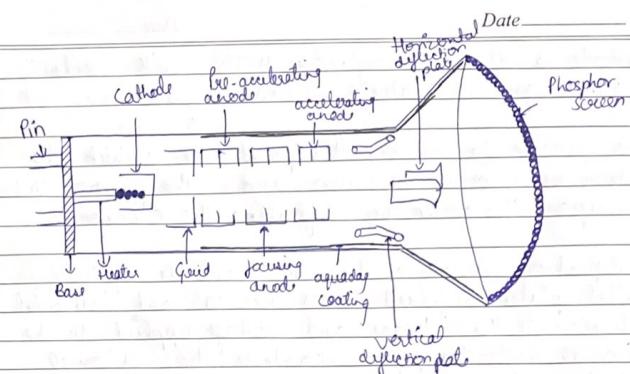
Image in frame buffer is read out by video controller to display on the screen.



Display Devices

Cathode Ray Tubes (CRTs)

Spiral



CRT stands for cathode ray tube. CRT technology is used in traditional computer monitors and televisions. The image on CRT display is created by firing electrons from the back of the tube of phosphorus located towards the front of the screen.

- CRT is a device which converts electrical signal (voltage, current) into visual signal
- Cathode emits e^- when it gets heat up by heater
- Grid focuses & pass e^- beam at high speed.
- Pre-accelerating anode → focusing anode → accelerating anode provide path
- Vertical deflection plate deflects e^- beam in up & down direction on screen
- Horizontal deflection plate deflects e^- beam in right & left direction
- Aquadag coating → if e^- comes out of their path then it repels them and helps e^- to come to focusing path
- Screen is coated with phosphorus
- Metal used in the screen is of zinc sulphate or zinc oxide or zinc tungsten.

Spiral

Date _____

- cathode is of nickel cylinder coated with oxide
- electron gun → heater + cathode + grid

It is possible to control the point at which the electron beam strike the screen and ∴ the position of the dot upon the screen by deflecting the e⁺ beam.

The deflection system of the CRT consists of two parallel plates, referred to as vertical and horizontal. Deflection of the e⁺ beam and voltage applied to the horizontal deflection plates controls the horizontal deflection of the e⁺ beam.

Once the electron hits the phosphorus, they light up and they are projected on a screen. The color you view on the screen is produced by a blend of red, blue and green light.

There are two techniques used for producing images on the CRT screen: Vector scan/random scan and Raster scan.

Vector scan / Random scan display
Cathigraphic display / stroke-writing display

Vector scan is a technique used for producing images on the screen.

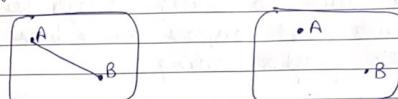
Beam is directed to the area on the screen where the picture is to be drawn.

If we want a line connecting point A and point B on vector graphics display, we simply direct the beam deflection circuitry, which will cause beam to go

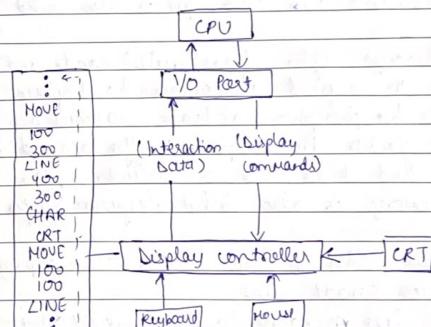
Spiral

Date _____

directly from point A to B. If we want to move the beam from point A to B without drawing a line between points, we can blank the beam as we move it. To move the beam across the CRT, the information about both magnitude and direction is required. This info is generated with the help of vector graphic generator.



vector scan CRT



"Architecture of a vector display"

Display
buffer
Memory

This architecture consists of display controller, CPU, display buffer memory and a CRT. A display controller is connected as an I/O peripheral to CPU. The display buffer memory stores the computer produced display list or display program. The program contains point

Spiral

10

Date _____

and line plotting commands with (x, y) or (x, y, z) end point coordinates, as well as character plotting commands. The display controller interprets commands for plotting points, lines and characters & sends digital and point coordinates to a vector graphics generator. The vector generator then converts the digital coordinate values to analog voltages for beam-deflection circuits that displace an e-beam resulting on the CRT's phosphor coating.

In vector display the beam is deflected from end point to end point, hence this technique is also called sequential scan.

Phosphor light decays after few milliseconds and it is necessary to repeat through the display list to refresh the phosphor at least 30 times per second to avoid flicker. As display buffer is used to store display list and it is used for refreshing, the display buffer memory is also called refresh buffer.

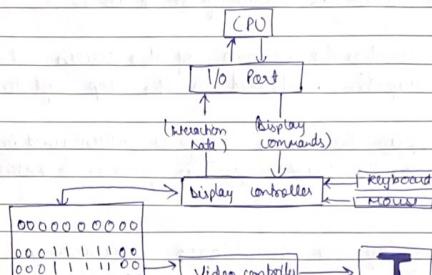
Advantages :-

- higher resolution than raster scan display
- produce smooth lines
- need less memory to store picture definition

Disadvantages :-

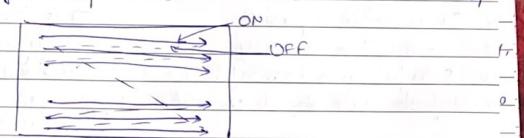
- can't draw realistic image
- limited colors to be displayed - Max 4
- depends how deep beam penetrates.

Raster scan display



Refresh Buffer

The display image is stored in the form of ls and as in the refresh buffer. The video controller reads the refresh buffer and produces the actual image on the screen. It does this by scanning one line at a time, from top to bottom and then back to top.



Raster scan CRT

It is the most common method of displaying images on the CRT screen.

In this horizontal and vertical deflection signals are generated to move the beam all over the screen.

The beam is swept back and forth from the left to the right.

Date _____
height, it is ON when the beam is moved from L to R
it is OFF when beam is moved from R to L

When the beam reaches the bottom of the screen, it is turned OFF and rapidly retracted to the top left to start again.

In raster scan display, the screen image is maintained by repeatedly scanning the same image. This process is known as refreshing of screen.

In raster scan display a special area of memory is dedicated to graphics only known as frame buffer which holds the set of intensity values for all the screen points.

Each screen point is referred to as pixel which is specified by its row and col no.

Random Scan

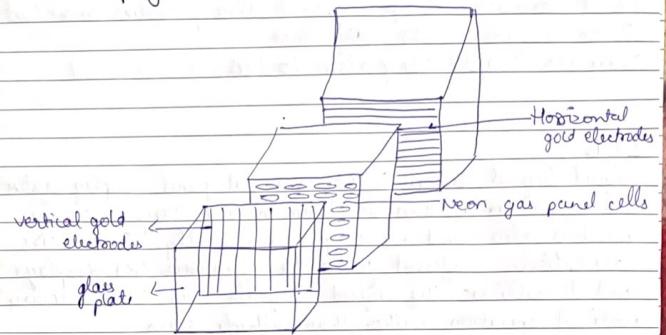
1. It has high resolution
2. It is more expensive
3. Modification is easy
4. Solid pattern is tough to fill
5. Refresh rate depends on resolution
6. Only screen with view on an area is displayed
7. Beam penetration technology comes under it
8. It does not use interlacing method
9. It is restricted to live drawing applications

Raster Scan

1. It has low resolution
2. It is less expensive
3. Modification is tough
4. Solid pattern is easy to fill
5. Refresh rate does not depend on the picture
6. Whole screen is scanned
7. Shadow mask technology comes under this
8. It uses interlacing
9. It is suitable for realistic display

Spiral

Plasma Display



Plasma display is composed of two parallel sheets of glass that enclose a mixture of discharge gases composed of helium, neon and xenon.

On the inner side of the glass plates are ribs, which help keep the glass plates parallel.

As another name of the plasma panel is gas discharge display, because of the gases filled in b/w the parallel plates. Plasma panel is available in both the colors black & white and also color type.

- Plasma displays are thinner than cathode ray tube and brighter than LCDs.
- A plasma display panel is a type of flat panel display common to large TV displays 30 inches or larger.
- It consumes more power.
- They have poor performance at high altitudes due to the pressure in between the gases and also high air pressure at altitude.

Spiral

Date _____

It has lower brightness, so it is viewed in darkened rooms.
As it consumes more power, so it also produce more heat.
Screen surface is less reflective.
They are cheaper in comparison to LCD.

LCD

Liquid Crystal Display (LCD) is a flat panel display system that is primarily seen in television and computer screens, which is also used by cell phones presently. Such LCDs are entirely different from the previous CRT displays and it utilizes the liquid crystals as their primary mode of operation rather than cathode rays.

LCD consists of millions of pixels created from crystals and organized in a rectangular pattern on the LCD panel. LCD has backlights that bring light to every pixel. Every pixel has a sub-pixel (RGB), red, green & blue which can be switched off or on. When all subpixels are switched off, it is black, while all subpixels are switched on a hundred percent, then it is white.

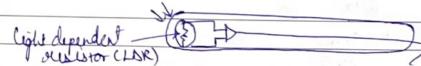
LCD is used in various devices like mobile devices, laptops, computers, digital clocks, gaming systems etc.

LED has low cost, energy efficiency & less power consumption.
LCD is smaller and thinner and is very flexible.
LCD screen radiation is slightly less than the CRT monitors.

- Date _____
- LED
- LED has a better response time than LCD
 - LED consumes more power in comparison to LCD
 - LED is costlier
 - It delivers good picture quality than LCD
 - It has better black level and contrast
 - It delivers better color accuracy
 - LED uses gallium arsenide phosphide
 - no mercury is used
 - Range upto 90 inches
 - It has wider view angle
- LCD
- LCD is slower than LED in terms of response time
 - LCD consumes less power in comparison to LED
 - LCD is less costly
 - It also delivers good picture but less than LED
 - It has not good black level and contrast
 - It also delivers better color accuracy but there is a difference between LED and LCD
 - LCD uses liquid crystals and glass electrodes
 - It requires mercury range 13 - 57 inches
 - wide-angle less with 30°

Light pens

Light pen is a pencil shaped device used to select positions by detecting the light coming from points on the CRT screen.
It consists of a photoelectric cell housed in a pen-like case.



A light pen is a light sensitive computer input device, basically a stylus, that is used to select text, draw pictures and interact with user interface elements on a computer screen or monitor. The light pen works well with CRT monitors.

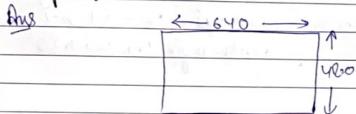
Date _____
 Q How many K bytes does a frame buffer need for a 600×400 pixel?

Ans Resolution = 600×400

$$\begin{aligned} \text{Size of frame buffer} &= \text{Resolution} \times \text{bits per pixel} \\ &= 600 \times 400 \times n \\ &= 2400000 \text{ bits} \end{aligned}$$

$$\begin{aligned} \text{Wkt } 1 \text{ Kb} &= 1024 \text{ bytes} \\ 1 \text{ byte} &= 8 \text{ bit} \\ &= 2400000 \times n \\ &\quad 1024 \times 8 \\ &= 29.30 n \text{ Kb} \end{aligned}$$

Q Compute the size of 640×480 image at 340 pixels per inch



$$\begin{aligned} 340 \text{ pixels} &= 1 \text{ inch} \\ 1 \text{ pixel} &= \frac{1}{340} \text{ inches} \end{aligned}$$

$$\begin{aligned} W &= 640 & H &= 480 \\ 340 & 240 & 240 & \end{aligned}$$

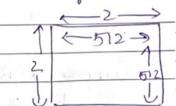
$$\begin{aligned} \text{Total size} &= W \times H \\ &= 640 \times \frac{480}{240} \\ &= 12 \times 240 \\ &= 5.33 \text{ inch} \end{aligned}$$

Date _____

Q Compute the resolution of a 2×2 inch image that has 512×512 pixels

Ans Resolution means no of pixels per unit length

$$\frac{512 \times 512}{2 \times 2} = 256 \times 256$$



Q If an image has height of 2 inch and aspect ratio is 1.5 calculate its width

Ans Aspect ratio = $\frac{W}{H} = 1.5$

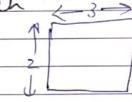
$$\frac{W}{H} = 1.5$$

$$W = 3 \text{ inch}$$

Q Calculate total no of pixels for a 3×2 inch image at a resolution of 300 pixels per inch

Ans

$$\begin{aligned} 1 \text{ inch} &= 300 \text{ pixels} \\ 2 \text{ inch} &= 600 \text{ pixels} \\ 3 \text{ inch} &= 900 \text{ pixels} \end{aligned}$$



$$\text{Total no of pixels} = 600 \times 900 \text{ pixels.}$$

Q Resize a 1024×768 image to one that is 640 pixel wide with the same aspect ratio, find its height.

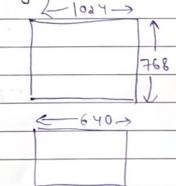
Ans Aspect ratio = $\frac{1024}{768}$

$$\text{Aspect ratio}_2 = \frac{640}{n}$$

$$640 = 1024$$

$$n = 768$$

$$n = 468$$



Spiral

Spiral

Date _____

Date _____

Q Find out the aspect ratio of the raster system using 8x10 inches screen and 100 pixels/inch

$$\text{Ans} \quad AR = \frac{W}{H} = \frac{8 \times 100}{10 \times 100} = 4 : 5$$

Q Suppose RGB raster system is to be designed using 8 inch x 10 inch screen with a resolution of 100 pixels per inch in each direction. If we want to store 6 bits per pixel in the frame buffer, how much storage (in bytes) do we need for frame buffer?

$$\begin{aligned} \text{Ans} \quad \text{Resolution} &= 8 \times 10 \\ &= 8 \times 100 \times 10 \times 100 \\ &= 800 \times 1000 \text{ pixels} \\ &\text{1 pixel can store 6 bits} \\ \text{size of frame buffer} &= 800 \times 1000 \times 6 \text{ bits} \\ &= 800 \times 1000 \times 6 \text{ bytes} \\ &= 6 \times 10^5 \text{ bytes} \end{aligned}$$

Q How much time is spent scanning ^{across} each row of pixels during screen refresh on a raster system with resolution of 1280 x 1024 and a refresh rate of 60 frames per second?

$$\begin{aligned} \text{Ans} \quad \text{Resolution} &= 1280 \times 1024 \text{ pixels} \\ \text{refresh rate} &= 60 \text{ frames/second} \\ 1 \text{ frame} &= \frac{1}{60} \text{ sec} \\ \text{Time of scanning on row} &= \frac{1}{60} \times 1024 \\ &= 1.627 \times 10^{-5} \text{ sec} \end{aligned}$$

Spiral

Q Consider three different raster systems with resolutions of 640 x 480, 1280 x 1024 and 2560 x 2048

a) What size is frame buffer (in bytes) for each of these systems to store 12 bits per pixels

$$\text{frame buffer} = \frac{640 \times 480 \times 12}{8} = 450 \text{ bytes}$$

$$\text{frame buffer} = \frac{1280 \times 1024 \times 12}{8} = 1920 \text{ bytes}$$

$$\text{frame buffer} = \frac{2560 \times 2048 \times 12}{8} = 7680 \text{ bytes}$$

b) How much storage (in bytes) is required for each system if 24 bits per pixel are to be stored?

$$\text{frame buffer} = \frac{640 \times 480 \times 12 \times 2}{8} = 900 \text{ bytes}$$

$$= \frac{1280 \times 1024 \times 12 \times 2}{8} = 2840 \text{ bytes}$$

$$= \frac{2560 \times 2048 \times 12 \times 2}{8} = 15360 \text{ bytes}$$

Q Consider two raster systems with the resolutions of 640 x 480 and 1280 x 1024

a) How many pixels could be accessed per second in each of these systems by a display controller that refreshes the screen at a rate of 60 frames per second?

$$\begin{aligned} \text{Ans} \quad \text{Resolution} &= 640 \times 480 \\ &= 640 \times 480 \times 60 = 1.8432 \times 10^7 \text{ p/s} \end{aligned}$$

$$= 1280 \times 1024 \times 60 = 7.86432 \times 10^7 \text{ p/s}$$

b) What is the access time per pixel in each system?

Spiral

Date _____

$$\text{access time per pixel} = \frac{1}{\text{access rate}} = \frac{1}{640 \times 480 \times 60} = 54 \text{ nanoseconds}$$

$$= \frac{1}{1280 \times 1024 \times 60} = 12.7 \text{ nanoseconds.}$$

Q Consider a master system with the resolution of 1024×768 pixels and the color palette calls for 65536 colors. What is the minimum amount of video RAM that the computer must have to support the above mentioned resolution and number of colors?

A no of colors = 65536

$$\text{no of bits per pixel} = \log_2(65536) = 16 \text{ bit/color}$$

$$\text{Resolution} = 1024 \times 768$$

$$\begin{aligned}\text{Total no of bits} &= 1024 \times 768 \times 16 \\ &= 1572864 \text{ bytes} \\ &= 1536 \text{ KB} \\ &= 1.5 \text{ MB}\end{aligned}$$

Q How long does it take to load a 640×480 frame buffer with 12 bits per pixel, if 105 bits can be transferred per second?

A resolution = 640×480

$$\text{no of bits} = 640 \times 480 \times 12$$

$$= 3686400 \text{ bits}$$

$$1 \text{ sec} = 10^5 \text{ bits}$$

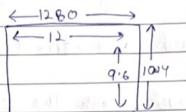
$$10^5 \text{ bits} = 3686400 \text{ bits}$$

$$\frac{3686400}{10^5} = 36.864 \text{ second}$$

Spiral

Date _____

Q Suppose we have a video monitor with a display area with 12 inches width and 9.6 inches high. If the resolution is 1280×1024 and the aspect ratio is 1, what are the width and the height of each pixel on the screen?



$$\frac{1280}{1024} = \frac{12}{9.6} = 1$$

$$\text{pixel width} = \frac{12}{1024} = 0.009375 \text{ inches}$$

$$\text{pixel height} = \frac{9.6}{1024} = 0.009375 \text{ inches}$$

Q What do you mean by computer graphics?

The branch of science and technology concerned with methods and techniques for converting data to an from visual presentation using computers.

- Create an image
- Store the image in the memory
- Display the image on display device
- Make a processing on the image
- Interact with the image

Q What are the applications of computer graphics?

Computer Aided Design

Computer Generated Art

Graphical User Interface

Scientific visualization

Entertainment

Image Processing

Simulation and Training

Virtual reality

Education and Presentation

Spiral

Date _____

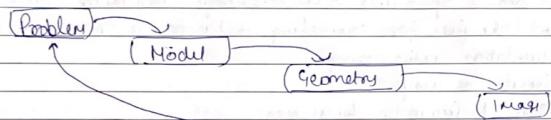
Q What can the programmers do in computer graphics?

- Develop the geometric representation for the geometric objects of the images
- Assemble these objects into an appropriate geometric space
- Define some animation for the image
- Specify how the scene is to be viewed and how it will be displayed on the graphic device
- Design ways for the user to interact with the scene as it is presented

Q How can the computer graphics used in solving problems?

GC can solve a lot of problems

- Identifying a problem
- Building the model
- Represent the problem geometrically and create an image
- Use the image to understand the problem and try find a possible solution.



Q Computer Graphics API

Graphic API's is a set of tools that allows a programmer to create applications that include the use of interactive computer graphics without dealing with system details for tasks such as window handling and interactions.

Date _____

Q What do you mean by GUI?

GUI stands for Graphical user interface. A major component of a GUI is a window manager that allows a user to display multiple windows areas. To make a particular window active we simply click on that window using an interactive pointing device. Interfaces also display menus and icons for fast selection of processing options or parameter values.

Q What does it mean by RGB?

The RGB is a color model, in which red, green and blue light are added together in various ways to reproduce a different array of colors. The name of the model comes from the initials of the three additive primary colors red, green and blue.

Q Define refresh buffer / frame buffer

Picture definition is stored in a memory area called the refresh buffer or frame buffer. This memory area holds the set of intensity values for all the screen points.

Q Define pixel

Each screen point is referred to as a pixel or pel (picture element).

Q Define bitmap

On a black and white system with one bit per pixel, the frame buffer to refresh the screen.

Q What is the role of a video controller?

It is used to control the operation of the display device by accessing the frame buffer to refresh the screen.

Spiral

Spiral

- Date _____
- Q Define Graphics controller/Display controller/ Display processor
 The purpose of the display processor is to free the CPU from graphic chores. (A major task of the display process is digitizing a picture definition given in an application program into a set of pixel intensity values for storage in the frame buffer.) — This digitization process is called Scan conversion
- Q Describe the basic components of computer graphics system?
 A computer graphics system is a computer system that have all the components of a general-purpose computer system.
 There are six major elements in our system
- Input devices
 - Central Processing Unit
 - Graphics Processing Unit
 - Memory
 - Frame Buffer
 - Output devices
- Q Define persistence in terms of CRT phosphors
 Persistence is the one of the major property of phosphors used in CRTs. It means how long they continue to emit light after the electron beam is removed
- Q Define resolution
 The maximum no of points that can be displayed without overlap on a CRT monitor
- Q What do you mean by an aspect ratio?
 Aspect ratio is the ratio of vertical pixels to horizontal pixels necessary to produce equal length lines in both directions on the screen. An aspect ratio of 3:4 means that a vertical line plotted with three points has same length as a horizontal line plotted with 4 points
- Q What are the different properties of phosphors?
 (color
 persistence)
- Q What are the different types of flat-screens and what is the difference between them?
 Light-emitting diodes (LEDs) - light-emitting diodes that can be turned on and off
 Liquid-crystal displays (LCDs) - polarization of the liquid crystals in the middle panel
 Plasma panels - voltages on the grids to energize gases.
- Similarities
- All uses a 2-D grid to address individual light-emitting elements
 - The two outside plates each contain perpendicular parallel grids of wires
 - sending electrical signals to a wire in each grid, generates electrical field at the intersection of two wires, can control the corresponding element in the middle plate.
- Q What do you mean by retracing? Define horizontal as well as vertical retracing.
 Retracing → At the end of each scan line, the e-beam returns to the left side of the screen to begin displaying the next scan line.
- Horizontal retrace → The return to the left of the screen, after refreshing each scan line

Date _____

Date _____

vertical retrace → At the end of each frame, the e-beam returns to the top left corner of the screen to begin the next frame.

Q What is a Beam penetration method?

This technique is used in random scan display systems. Two layers of phosphor (red and green) are coated onto the inside of the CRT screen, the displayed colors depends on how far the e-beam penetrates into the phosphor layer. A slow e-beam excites only the outer red layer. A very fast e-beam penetrates through the red layer and hence excites the green layer. An average e-beam gives the combination of red and green color. That is yellow and orange. This technique only provides four colors.

Q Define shadow masking.

This technique is used in raster scan display devices. It gives more colors than a beam penetration method.

A shadow mask CRT has three phosphor color dots at each pixel location (red light, green light and blue light).

This type of CRT also has 3 e-guns one for each color dot.

A shadow mask grid is installed just behind the phosphor coated screen.

When the three beams pass through a hole in the shadow mask they activate a dot triangle which appears as small color spot on the screen.

More than 17 million different colors can be obtained in a full color system.

Q what are the popular image storage formats?

The popular image storage formats are

Jpg format

This lossy format compresses image blocks based on thresholds in the human visual system. This format works well for natural images.

Tiff format

This format is most commonly used to hold binary images or lossless compressed 8 or 16 bit RGB although many other options exist.

Ppm format

A lossless, uncompressed format is most often used for 8 bit RGB images although many options exist.

Png format

This is a set of lossless formats with a good set of open source management tools.

Q what do you mean by interlacing?

It is the method of incrementally displaying a visual on a CRT. On some raster scan systems, each frame is displayed in two passes using an interlaced refresh procedure. In the first pass, the beam sweeps across every other scan line from top to bottom. Then after the vertical retrace, the beam sweeps out the remaining scan lines.

Spiral

Spiral