1. What is computer graphics? State applications of CG.

Computer Graphics

- Computer graphics are pictures and films created using computers.
- It is an art of drawing pictures on computer screens with the help of programming.
- It involves computation, creation and manipulation of data.
- The computer graphics is a rendering tool for the generation and manipulation of images.
- In statistical analysis complex data is represented using graphs, charts, maps, and other diagrams are nothing but part of computer graphics.
- Animated movies, 2D movies, 3D movies are example of visualized data generated using computer graphics.

Applications of Computer Graphics

- **Entertainment** - It is used to create motion pictures, music videos, TV shows, games, Computer games, 3D movies and animated movies.

- **Computer-Aided Design (CAD)** - A graphic package used by engineers and architects to design a model before implementation.
- **Virtual Reality (VR)** - VR is a technology which allows user to interact with the computer simulated environment. The simulated environment can be similar to the real world for eg: VR games
- **Image processing** –Various kinds of photographs or images require editing. Processing of existing images into refined ones for better interpretations is one of the many applications of computer graphics.
- **Graphical User Interface (GUI)** –The use of pictures, images, icons, pop-up menus, graphical objects helps in creating a user friendly environment where working is easy and pleasant using computer graphics.
- **Digital Art** –Digital art most commonly refers to art created on a computer in digital forms. The impact of digital technology has transformed traditional activities such as painting, drawing and sculpture, while new forms such as net art, VR.
- **Web Design** –Web design is the skill of designing presentations of content usually hypertext that is delivered to end-user through the world wide web, by way of web browser.
- **Cartography** –It is graphical science of drawing maps.

2. Differentiate between Random and Raster Scan display.

0. Random scan/Vector scan

0. Raster scan

1. It has high Resolution

1. Its resolution is low.

2. It is more expensive

2. It is less expensive

3. Any modification if needed is easy

3.Modification is tough

4. Only screen with view on an area is displayed.

4. Whole screen is scanned.

5. Beam Penetration technology come under it.

5. Shadow mark technology came under this.

6. It is restricted to line drawing applications

6. It is suitable for realistic display.

7. Eg: Pen plotter

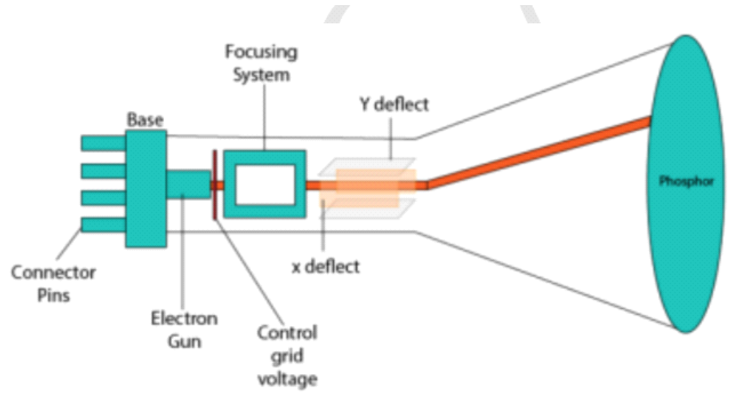
7. Eg: TV

3. Explain CRT with a diagram.

Cathode Ray Tube (CRT):

CRT stands for Cathode Ray Tube. CRT is a technology 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.

Once the electron heats 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.



Cathode Ray Tube

Components of CRT:

- **1. Electron Gun**: Electron gun consisting of a series of elements, primarily a heating filament (heater) and a cathode. The electron gun creates a source of electrons which are focused into a narrow beam directed at the face of the CRT.
- **2. Control Electrode**: It is used to turn the electron beam on and off.
- **3. Focusing system**: It is used to create a clear picture by focusing the electrons into a narrow beam.
- **4. Deflection Yoke**: It is used to control the direction of the electron beam. It creates an electric or magnetic field which will

bend the electron beam as it passes through the area. In a conventional CRT, the yoke is linked to a sweep or scan generator. The deflection yoke which is connected to the sweep generator creates a fluctuating electric or magnetic potential.

- **5. Phosphorus-coated screen**: The inside front surface of every CRT is coated with phosphors. Phosphors glow when a high-energy electron beam hits them. Phosphorescence is the term used to characterize the light given off by a phosphor after it has been exposed to an electron beam.

4. What is 2D transformation? Explain different transformations in 2D.

2D Transformation in computer graphics is a process of modifying and re-positioning the existing graphics in 2 dimensions. Transformations help change the object's position, size, orientation, shape, etc.

There are three basic rigid transformations: reflections, rotations, and translations.

Translation

- The translation transformation shifts a node from one place to another along one of the axes relative to its initial position. The initial position of the xylophone bar is defined by x, y, and z coordinates. Each bar of the xylophone is based on one of the base bars.

Rotation

- The rotation transformation moves the node around a specified pivot point of the scene. You can use the rotate method of the Transform class to perform the rotation.
- To rotate the camera around the xylophone in the sample application, the rotation transformation is used, although technically, it is the xylophone itself that is moving when the mouse rotates the camera.

Scaling

- The scaling transformation causes a node to either appear larger or smaller, depending on the scaling factor. Scaling changes the node so that the dimensions along its axes are multiplied by the scale factor. Similar to the rotation transformations, scaling transformations are applied at a pivot point. This pivot point is considered the point around which scaling occurs.

- To scale, use the Scale class and the scale method of the Transform class.
- In the Xylophone application, you can scale the xylophone using the mouse while pressing Alt and the right mouse button. The scale transformation is used to see the scaling.

Shearing

- A shearing transformation rotates one axis so that the x-axis and y-axis are no longer perpendicular. The coordinates of the node are shifted by the specified multipliers.
- To shear, use the Shear class or the shear method of the Transform class.
- In the Xylophone application, you can shear the xylophone by dragging the mouse while holding Shift and pressing the left mouse button.

Multiple Transformations

- You can construct multiple transformations by specifying an ordered chain of transformations. For example, you can scale an object and then apply a shearing transformation to it, or you can translate an object and then scale it.

5. Explain Window to viewport transformation.

Que: 2] Explain Window to viewport transformation.

Definitions:

- **World Coordinate System:**
  This is object space or the space in which the application model is defined.

- **World Window (or clipping):**
  This is the rectangle in the world defining the region that is to be displayed.

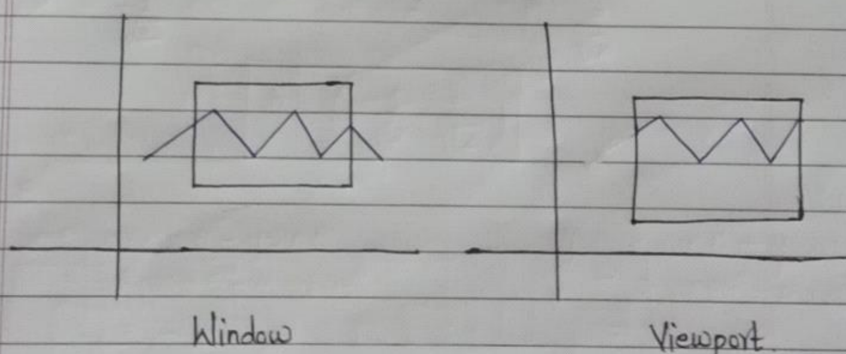
- **Viewport:**
  The rectangular portion of the interface window that defines where the image will actually appear (usually the entire interface window but in some cases modified to be a portion of the interface window).

- ## Viewing Transformation:

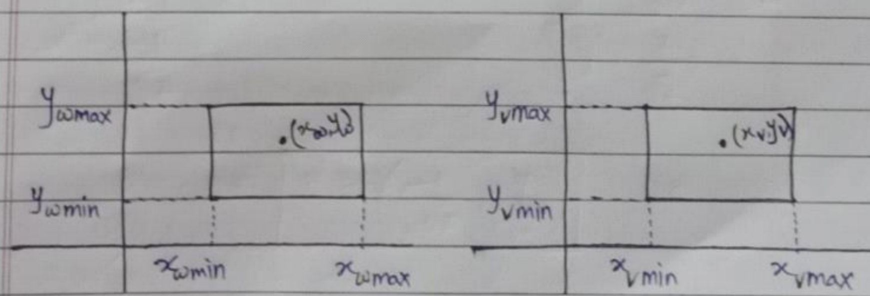
The process of mapping a world window in World Coordinates to the Viewport.

Window - to - Viewport mapping

Window-to-viewport mapping is the process of mapping or transforming a two dimensional, world-coordinate scene to device coordinates. In particular, objects inside the world or clipping window are mapped to the viewport. The viewport is displayed in the interface window on the screen. In other words, the clipping window is used to select the part of the scene that is to be displayed. The viewport then positions the scene on the output device.



Window Viewport



$$\frac{x_v - x_{vmin}}{x_{vmax} - x_{vmin}} = \frac{x_w - x_{wmin}}{x_{wmax} - x_{wmin}}$$

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$$x_v = \frac{(x_w - x_{wmin}) \cdot (x_{vmax} - x_{vmin})}{x_{wmax} - x_{wmin}} + x_{vmin}$$

$$\frac{y_v - y_{vmin}}{y_{vmax} - y_{vmin}} = \frac{y_w - y_{wmin}}{y_{wmax} - y_{wmin}}$$

$$y_v = \frac{(y_w - y_{wmin}) \cdot (y_{vmax} - y_{vmin})}{y_{wmax} - y_{wmin}} + y_{vmin}$$

6. Perform reflection on point (4,5) through x-axis and y-axis.

???

7. Perform scaling on ABCD, A(0,3) B(3,3) C(3,0) D(0,0) where, Sx = 2 and Sy = 3.

Given-

Old corner coordinates of the square = A (0, 3), B(3, 3), C(3, 0), D(0, 0)

Scaling factor along X axis = 2

Scaling factor along Y axis = 3

- For Coordinates A(0, 3)

Let the new coordinates of corner A after scaling = (Xnew, Ynew).

Applying the scaling equations, we have-

Xnew = Xold x Sx = 0 x 2 = 0

Ynew = Yold x Sy = 3 x 3 = 9

Thus, New coordinates of corner A after scaling = (0, 9).

- For Coordinates B(3, 3)

Let the new coordinates of corner B after scaling = (Xnew, Ynew).

Applying the scaling equations, we have-

Xnew = Xold x Sx = 3 x 2 = 6

Ynew = Yold x Sy = 3 x 3 = 9

Thus, New coordinates of corner B after scaling = (6, 9).

- For Coordinates C(3, 0)

Let the new coordinates of corner C after scaling = (Xnew, Ynew).

Applying the scaling equations, we have-

Xnew = Xold x Sx = 3 x 2 = 6

Ynew = Yold x Sy = 0 x 3 = 0

Thus, New coordinates of corner C after scaling = (6, 0).

- For Coordinates D(0, 0)

Let the new coordinates of corner D after scaling = (Xnew, Ynew).

Applying the scaling equations, we have-

Xnew = Xold x Sx = 0 x 2 = 0

Ynew = Yold x Sy = 0 x 3 = 0

Thus, New coordinates of corner D after scaling = (0, 0).

8. Explain Sutherland Hodgeman Algorithm for polygon clipping with example.

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9. Difference between active & passive graphics device?

0.Actice Graphic Design

0.Passive Graphic Design

1 It is dynamic in nature.

1 It is static in nature.

2 It provides two way communication between user and computer.

2 It provides one way communication only through computer.

3 Control is provided to user to manipulate the graphics.

3 Control is not provided to user to manipulate the graphics. It works on

already written instructions.

4 Modern application.

4 Older application.

5 Higher bandwidth user interaction with hardware devices.

5 No interaction between user and hardware devices.

6 Facility available which supports 2D and 3D transformation.

6 No facility available which supports 2D and 3D transformation.

7 Eg: Resistors

7 Eg: CRT, LED

10. Translate a triangle ABC with coordinates A(0,0) B(5,0) C(5,5) by 2 units in x direction and 3 units in y direction.

Explanation:

- Given the directions and measures of translation to be done in XY-coordinate system the new coordinates can be easily drawn from them.
- Let the coordinate of a point P in the XY-coordinate system be (x, y)
- You have to translate the point by 'a' in the right direction (i.e, x-direction) and 'b' units upwards (i.e, y-direction). Then the translated point is given by ($x + a,\ y + b$).
- The coordinates of the square are $a(0,0),\ b(5,0),\ c(5,5)\ and\ d(0,5)$.
- Here we have $a = 2,\ b = 3$. The points a', b', c', and d' of the translated square are,
  $a'(0+2, 0+3) \qquad -> a'(2,3)$
  $b'(5+2, 0+3) \qquad -> b'(7,3)$
  $c'(5+2, 5+3) \qquad -> c'(7,8)$
- $a'(0+2, 5+3) \qquad -> d'(2,8)$ **------->ANSWER**