

CS 2401 Computer Graphics

UNIT – I

Part - A

1. Define Computer Graphics

The term Computer Graphics was coined by William Feter in 1960. He defined CG as a consciously managed and documented technology directed toward communicating information accurately and descriptively.

Computer graphics may be defined as a pictorial representation or graphical representation of objects in a computer.

In general, Computer Graphics refers to,

- ✓ the representation and manipulation of image data by a computer.
- ✓ the various technologies used to create and manipulate images.
- ✓ the images so produced, and the sub-field of computer science which studies methods for digitally synthesizing and manipulating visual content.

2. What is scan conversion?

A major task of the display processor 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.

3. Write the properties of video display devices?

Properties of video display devices are persistence, resolution, and aspect ratio.

4. What is rasterization?

The process of determining the appropriate pixels for representing picture or graphics object is known as rasterization.

5. Write the two techniques for producing color displays with a CRT?

Beam penetration method, shadow mask method.

6. Write short notes on video controller?

Video controller is used to control the operation of the display device. A fixed area of the system is reserved for the frame buffer, and the video controller is given direct access to the frame buffer memory.

7. What is bitmap?

Some system has only one bit per pixel; the frame buffer is often referred to as bitmap.

8. What is resolution?

The maximum number of points that can be displayed without overlap on a CRT is referred to as the resolution.

9. What is Aspect ratio?

The ratio of vertical points to the horizontal points necessary to produce length of lines in both directions of the screen is called Aspect ratio. Usually the aspect ratio is $\frac{3}{4}$.

10. Define pixel?

Pixel is shortened forms of picture element. Each screen point is referred to as pixel or pel.

11. What is frame buffer?

Picture definition is stored in a memory area called frame buffer or refresh buffer.

12. Define Output Primitives

A picture can be defined as a set of complex objects positioned at specified coordinate locations within the scene. Graphics Programming packages provide functions to describe a scene in terms of basic geometric structures referred to as Output Primitives.

13. Name some of the output primitives.

- Points and Straight Lines
- Circles and other Conic sections
- Quadric Surfaces
- Spline curves and surfaces
- Polygon color areas
- Character strings

14. What is point in the computer graphics system?

The point is a most basic graphical element & is completely defined by a pair of user coordinates (x, y).

15. Write short notes on lines?

A line is of infinite extent can be defined by an angle of slope θ and one point on the line $P=P(x,y)$. This can also be defined as $y=mx+b$ where b is the Y intercept.

16. What are the disadvantages of DDA Line drawing algorithm?

- ✓ The Round off error in successive additions can cause the calculated pixel positions to drift away from the true line path.
- ✓ The floating point and rounding arithmetic operations are time consuming

17. What is a decision parameter?

A parameter that is used to decide which of the two possible pixel position is closer to the line path at each sample step, is known as decision parameter.

18. Define Circle

A circle is defined as the set of points that are all at a given distance r from a center position (x_c, y_c) . The distance relationship can be expressed as

$$(x - x_c)^2 + (y - y_c)^2 = r^2$$

19. Define Ellipse

An Ellipse is defined as the set of points such that the sum of the distances from two fixed positions (foci) is the same for all points. If the distances to the two foci from any point $P=(x,y)$ on the ellipse are labeled d_1 and d_2 , then the general equation of an ellipse can be stated as

$$d_1 + d_2 = \text{Constant}$$

20. What are the various attributes of a line?

The line type, width, color, pen and brush are the attributes of the line. The line type includes solid line, dashed lines, and dotted lines.

21. What is meant by tiling?

The process of filling an area with a rectangular pattern is called Tiling and the rectangular fill patterns are sometimes referred to as tiling patterns.

22. What is the purpose of soft fill and linear soft fill algorithms?

Soft fill algorithms will repaint the areas so that the fill color is combined with the background colors. These are also known as tint-fill algorithms.

Linear soft fill algorithm repaints an area that was originally painted by merging a foreground color F with a single background color B , where $F \neq B$.

23. What are the various attributes for Character?

Type of font, Height, width, orientation, path, and alignment.

24. Write and explain the various Line End caps

Butt Cap

- Thick line is displayed with square ends that are perpendicular to line path.
- If the thick line has slope m , then square end of thick line has slope $-1/m$.

Round Cap

- Obtained by adding a filled semicircle to each butt cap.
- The radius of the semicircle will be equal to line thickness.

Projecting Square Cap

- Extend the line and add butt caps that are positioned one half of the line width beyond the specified end points.

25. Write and explain the various Line Joins

Miter Join

- Accomplished by extending the outer boundaries of two lines until they meet.

Round Join

- Accomplished by round capping the connection between two line segments.

Bevel Join

- Accomplished by displaying the line segments with butt caps and filling in the triangular gap where they meet.

26. What are Aliasing and Antialiasing?

The distortion of information due to the low frequency sampling (under sampling) is called aliasing.

The compensation for the under sampling process that improves the appearance of the displayed raster lines are called antialiasing methods.

27. What are Marker Attributes?

A marker symbol is a single character that can be displayed in different colors and in different sizes.

28. What is Transformation?

Transformation is the process of introducing changes in the shape, size and orientation of the object using scaling, rotation, reflection, shearing & translation etc.

29. What is translation?

Translation is the process of changing the position of an object in a straight-line path from one coordinate location to another. Every point (x, y) in the object must undergo a displacement to (x', y') . the transformation is: $x' = x + tx$; $y' = y + ty$.

30. What is scaling?

Scaling alters the size of an object by multiplying the coordinate values (x, y) of each vertex by scaling factors s_x and s_y to produce the transformed coordinates (x', y') .

$$x' = x * s_x \quad \text{and} \quad y' = y * s_y$$

31. What is rotation?

A 2-D rotation is done by repositioning the coordinates along a circular path, in the x-y plane by making an angle with the axes. The transformation is given by: $X = r \cos (\theta + \varphi)$ and $Y = r \sin (\theta + \varphi)$.

32. Distinguish between uniform scaling and differential scaling?

When the scaling factors s_x and s_y are assigned to the same value, a uniform scaling is produced that maintains relative object proportions. Unequal values for s_x and s_y result in a differential scaling that is often used in design application.

33. What is fixed point scaling?

The location of a scaled object can be controlled by a position called the fixed point that is to remain unchanged after the scaling transformation.

34. What is shearing?

The shearing transformation actually slants the object along the X direction or the Y direction as required. ie; this transformation slants the shape of an object along a required plane. Two types of Shearing are X-Shear and Y-Shear

35. What is reflection?

The reflection is actually the transformation that produces a mirror image of an object. Reflection will be done with respect to x-axis, y-axis or xy-axis.

36. What is the need of homogeneous coordinates?

To perform more than one transformation at a time, we use homogeneous coordinates or matrixes. They reduce unwanted calculations intermediate steps saves time and memory and produce a sequence of transformations.

37. Differentiate Rigid body and Affine transformation?

Rigid body transformation moves objects without deformation. For example, in translation, every point on the object is translated by the same amount.

Affine transformations have the properties that parallel lines are transformed into parallel lines and finite points map to finite points.

38. Define Window and Viewport.

A world coordinate area selected for display is called a Window.

An area on a display device to which a window is mapped is called a Viewport.

The window defines what is to be viewed and the viewport defines where it is to be displayed.

39. Define Viewing Transformation

The mapping of a part of a world coordinate scene to device coordinates is referred to as a viewing transformation.

It is simply known as window-to-viewport transformation of windowing transformation.

40. Briefly explain the various steps in viewing transformation pipeline

- 1) Construct world coordinate scene using modeling coordinate transformations.
- 2) Convert world coordinates into viewing coordinates.
- 3) Map viewing coordinates to normalized viewing coordinates using window viewport specifications.
- 4) Map normalized viewport to device coordinates.

41. Define clipping

Any procedure that identifies those portions of a picture that are inside or outside of a specified region of space is referred to as a clipping algorithm or simply clipping.

The region against which an object is to be clipped is called a clip window.

42. What are the various primitives for which clipping can be applied?

Point, Line, Area, Curve, and Text

43. What are the various techniques available for text clipping?

- 1) All or none string clipping
- 2) All or none character clipping
- 3) Individual character clipping

Part – B

1. Explain DDA algorithm for line.
2. Explain Bresenham's algorithm for line, circle, ellipse.
3. Explain Attributes of Output primitives.
4. Explain 2D Transformations.
5. Explain 2D viewing.
6. Explain Sutherland-Hodgman algorithm for polygon clipping.

**UNIT I-2D PRIMITIVES
PART – A**

1. Define Computer graphics.
2. Define refresh buffer/frame buffer.
3. What is pixel?
4. Define aspect ratio.
5. What is Output Primitive?
6. What is DDA?
7. What are the disadvantages of DDA algorithm?
8. Digitize a line from (10,12) to (15,15) on a raster screen using Bresenham's straight line algorithm.
9. What is attribute parameter?
10. What are the basic lines attributes?
11. What is meant by antialiasing?
12. Define Translation.
13. Define Rotation.
14. Define Scaling.
15. Define Reflection.
16. Define Shear.
17. Define Window.
18. Define view port.
19. What is viewing transformation?
20. Define Clipping.
21. What are the types of Clipping?
22. What is the purpose of presentation graphics?
23. What is frame buffer?

PART-B

1. Explain DDA line drawing algorithm with Example.
2. Explain about Bresenham's circle generating algorithm.
3. Write down and explain the midpoint circle drawing algorithm. Assume 10 cm as the radius and co-ordinate as the centre of the circle.
4. Explain about Bresenham's ellipse generating algorithm.
5. Write down and explain the Bresenham's line drawing algorithm with an example.
6. Write short notes on attributes of output primitives.
7. Explain in detail the Sutherland-Hodgeman clipping algorithm with an example.
8. Write about Cohen-Sutherland line clipping algorithm with an example.
9. Explain about two dimensional geometric transformations.
10. Write short notes on clipping operations.
11. Calculate the pixel location approximating the first octant of a circle having centre at (4,5) and radius 4 units using Bresenham's algorithm.
12. Discuss in brief Antialiasing techniques.