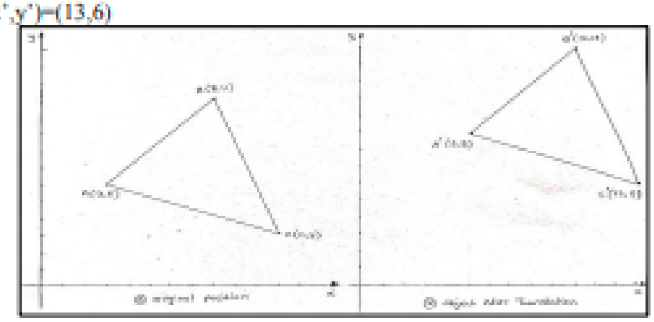
1. Give matrix representation for 2D scaling.
   S=S*P
   S=|sx 0| x |x|
   |0 sy| |y
   |
2. Translate the polygon with co-ordinates A (3, 6), B (8, 11), & C (11, 3) by 2units in X direction and 3 units in Y direction.

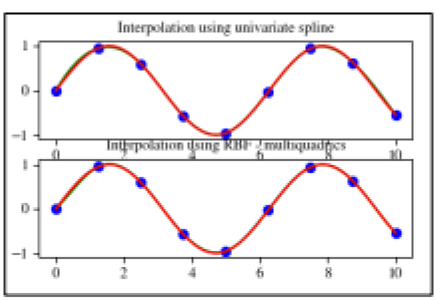
	c	**Translate the polygon with co-ordinates A (3, 6), B (8, 11), & C (11, 3) by 2 units in X direction and 3 units in Y direction.**	**4M for proper solution**
	Ans	X'=x+tx Y'=y+ty tx=2 ty=3 for point A(3,6) x'=3+2=5 y'=6+3=9 for point B(8,11) x'=8+2=10 y'=11+3=14 for point C(11,3) x'=11+2=13 y'=3+3=6 A'=(x',y')=(5,9)	

		B'=(x',y')=(10,14) C'=(x',y')=(13,6) 	

3. Define Window, Viewport, Clipping, World co-ordinate system.

Window – The process of selecting the part of real world scene to display on device is called windowing.
Viewport – An area on display device to which window is mapped is called viewport.
Clipping – Is the process of deciding and removing the portion of object which is outside the clipping window.
WCS - World Coordinate Systems (WCSs) describe the geometric transformations between one set of coordinates and another. A common application is to map the pixels in an image onto the celestial sphere. Another common application is to map pixels to wavelength in a spectrum.

4. List out different line clipping algorithm.
   1) Cohen Sutherland Line clipping algorithm.
   2) Cyrus Beck Line clipping algorithm.
   3) Liang Barsky Line Clipping Algorithm
   4) Midpoint Subdivision Line Clipping Algorithm
5. What is mean by interpolation?
   Specify a spline curve by giving a set of coordinate positions, called control points, which indicates the general shape of the curve These, control points are then fitted with piecewise continuous parametric polynomial functions in one of two ways. When polynomial sections are fitted so that the curve passes through each control point, the resulting curve is said to interpolate the set of control points. On the other hand, when the polynomials are fitted to the general control-point path without necessarily passing through any control point, the resulting curve is said to approximate the set of control points interpolation curves are commonly used to digitize drawings or to specify animation paths. Approximation curves are primarily used as design tools to structure object surfaces an approximation spline surface credited for a design application. Straight lines connect the control-point positions above the surface



6. Translate a triangle with vertices A(2,2,2),B(3,4,7)and C(8,9,12) by translation vector [2 4 5].

Q. Translate a triangle with vertices A(2,2,2), B(3,4,7) and C(8,9,12) by translation vector [2, 4, 5].

→

$$\boxed{P' = T \cdot P}$$

$$= \begin{bmatrix} 1 & 0 & 0 & 2 \\ 0 & 1 & 0 & 4 \\ 0 & 0 & 1 & 5 \\ 1 & 1 & 1 & 1 \end{bmatrix} \cdot \begin{bmatrix} 2 & 3 & 8 \\ 2 & 4 & 9 \\ 2 & 7 & 12 \\ 1 & 1 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 4 & 5 & 10 \\ 6 & 8 & 13 \\ 7 & 12 & 17 \\ 1 & 1 & 1 \end{bmatrix}$$

$\therefore A' = (4, 5, 7)$

$\therefore B' = (5, 8, 12)$

$\therefore C' = (10, 13, 17)$.

7. Write the midpoint subdivision algorithm for line clipping.

Midpoint Subdivision Line Clipping Algorithm:

1. Read two endpoints of the line say $P_1(x_1, y_1)$ and $P_2(x_2, y_2)$.
2. Read two corners (left-top and right-bottom) of the window, say $(W_{x1}, W_{y1}$ and $W_{x2}, W_{y2})$.

3. Assign region codes for two end points using following steps :

   Initialize code with bits 0000

   Set Bit 1 - if $(x < W_{x1})$

   Set Bit 2 - if $(x > W_{x2})$

   Set Bit 3 - if $(y < W_{y1})$

   Set Bit 4 - if $(y > W_{y2})$
4. Check for visibility of line
   a) If region codes for both endpoints are zero then the line is completely visible. Hence draw the line and go to step 6.
   b) If region codes for endpoints are not zero and the logical ANDing of them is also nonzero then the line is completely invisible, so reject the line and go to step 6.
   c) If region codes for two endpoints do not satisfy the conditions in (4a) and (4b) the line is partially visible.
5. Divide the partially visible line segment in equal parts and repeat steps 3 through 5 for both subdivided line segments until you get completely visible and completely invisible line segments.
6. Stop.

8. Explain differ types of Text clipping in brief.

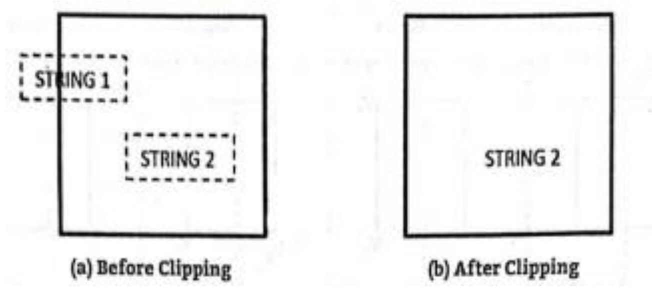
Many techniques are used to provide text clipping in a computer graphics. It depends on the methods used to generate characters and the requirements of a particular application. There are three methods for text clipping which are listed below −

1) All or none string clipping

2) All or none character clipping

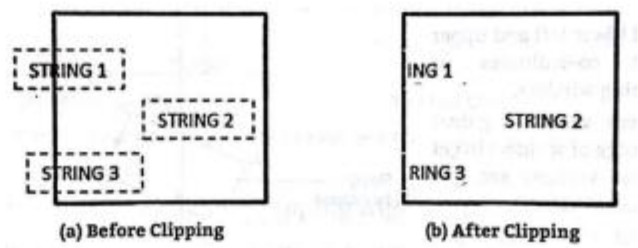
3) Text clipping

The following figure shows all or none string clipping −



In all or none string clipping method, either we keep the entire string or we reject entire string based on the clipping window. As shown in the above figure, Hello2 is entirely inside the clipping window so we keep it and Hello1 being only partially inside the window, we reject.

The following figure shows all or none character clipping –

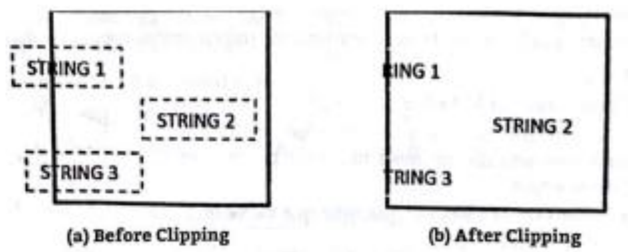


This clipping method is based on characters rather than entire string. In this method if the string is entirely inside the clipping window, then we keep it. If it is partially outside the window, then −

You reject only the portion of the string being outside

If the character is on the boundary of the clipping window, then we discard that entire character and keep the rest string.

The following figure shows text clipping –



This clipping method is based on characters rather than the entire string. In this method if the string is entirely inside the clipping window, then we keep it. If it is partially outside the window, then you reject only the portion of string being

9. Explain Koch curve with diagram.

   Koch Curve: - In Koch curve, begin at a line segment. Divide it into third and replace the center by the two adjacent sides of an equilateral triangle as shown below.

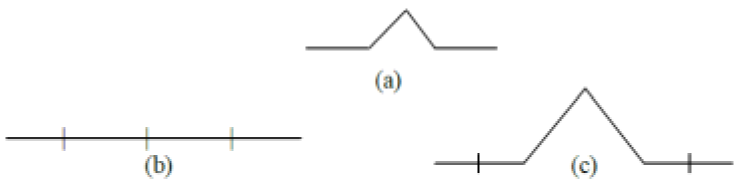


Fig 6.3 Replacement of Line Segment for Koch Curve

   This will give the curve which starts and ends at same place as the original segment but is built of 4 equal length segments, with each 1/3rd of the original length. So the new curve has 4/3 the length of original segments. Repeat same process for each of the 4 segment which will give curve more wiggles and its length become 16/9 times the original. Suppose repeating the replacements indefinitely, since each repetition increases the length

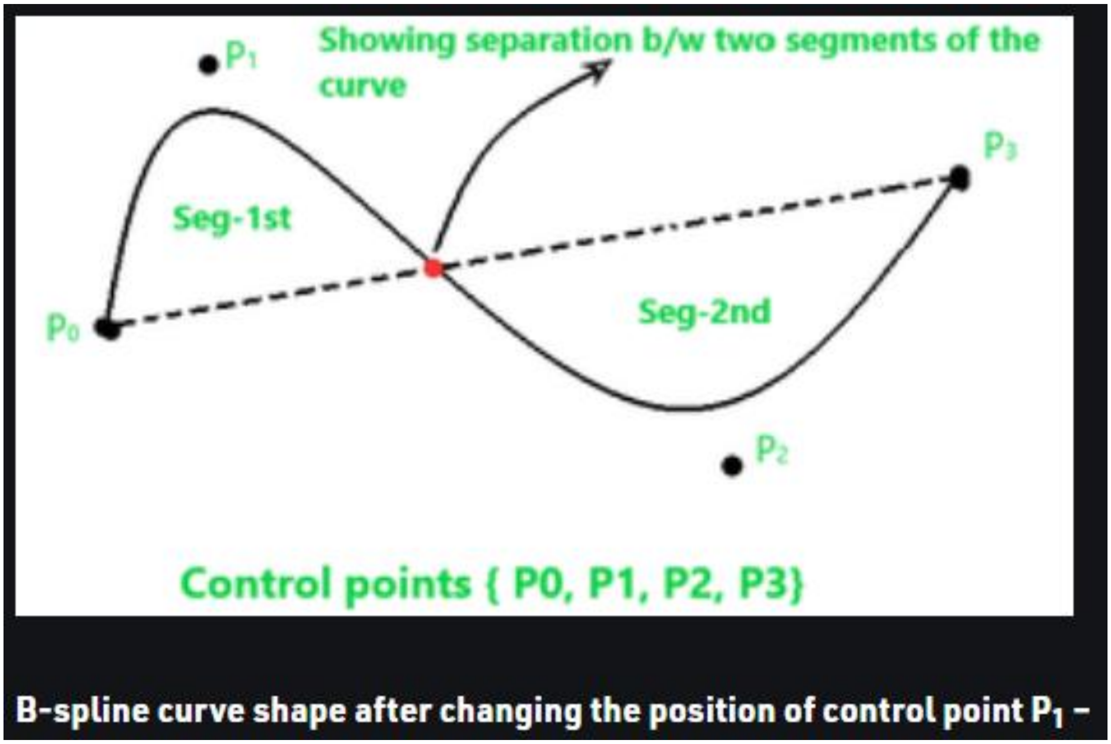
   by a factor of 4/3, the length of the curve will be infinite but it is folded in lots of tiny wiggles.

10. Describe B-spline curve.

    Concept of B-spline curve came to resolve the disadvantages having by Bezier curve, as we all know that both curves are parametric in nature. In Bezier curve we face a problem, when we change any of the control point respective location the whole curve shape gets change. But here in B-spline curve, the only a specific segment of the curve-shape gets changes or affected by the changing of the corresponding location of the control points.

    In the B-spline curve, the control points impart local control over the curve-shape rather than the global control like Bezier-curve.

    B-spline curve shape before changing the position of control point P1 –



B-spline curve shape after changing the position of control point P_1 –

11. Write an algorithm for DDA arc generation.

    Step 1: Read the center of curvature, say (x0, y0)

    Step 2: Read the arc angle thita, say thita

    Step 3: Read the starting point of the arc, say (x, y)

    Step 4:

    Calculate d thita

    D thita = Min(0.01, 1/(3.2X(|x-x0|+|y-y0|)))

    Step 5: Initialize angle = 0

    Step 6: while(angle < thita){

            Plot(x,y)

    X=x-(y-y0)*d thita

    Y=y-(x-x0)*d thita

    Angle = angle + d thita

    }

12. Explain Hilbertz Curve.

    The Hilbert curve is a space filling curve that visits every point in a square grid with a size of 2×2, 4×4, 8×8, 16×16, or any other power of 2. It was first described by David

Hilbert in 1892. Applications of the Hilbert curve are in image processing: especially image compression and dithering. It has advantages in those operations where the coherence between neighbouring pixels is important (see Douglas Voorhies's contribution to the "Graphic Gems" series). The Hilbert curve is also a special version of a quadtree; any image processing function that benefits from the use of quadtrees may also use a Hilbert curve.

13. Write an algorithm for Cohen-sutherland line clipping algorithm.

8 Cohen Sutherland Line Clipping Algorithm:

Step 1 : Assign a region code for two endpoints of given line

Step 2 : If both endpoints have a region code 0000 then given line is completely inside and we will keep this line

Step 3 : If step 2 fails, perform the logical AND operation for both region codes.

Step 3.1 : If the result is not **0000**, then given line is completely outside.

Step 3.2 : Else line is partially inside.

Step 3.2.a : Choose an endpoint of the line that is outside the given rectangle.

Step 3.2.b : Find the intersection point of the rectangular boundary (based on region code).

Step 3.2.c : Replace endpoint with the intersection point and update the region code.

Step 3.2.d : Repeat step 2 until we find a clipped line either trivially accepted or rejected.

Step 4 : Repeat step 1 for all lines

- The equation for line passing through points $P_1(x_1, y_1)$ and $P_2(x_2, y_2)$ is

$$y = m(x - x_1) + y_1$$

or

$$y = m(x - x_2) + y_2 \qquad \ldots (4.3.1)$$

where

$$m = \frac{y_2 - y_1}{x_2 - x_1} \quad \text{(slope of the line)}$$

- Therefore, the intersections with the clipping boundaries of the window are given as :
  - Left : $x_L, \; y = m(x_L - x_1) + y_1; \quad m \neq \infty$
  - Right : $x_R, \; y = m(X_R - x_1) + y_1; \quad m \neq \infty$
  - Top : $y_T, \; x = x_1 + \left(\frac{1}{m}\right)(y_T - y_1)\; ; \; m \neq 0$
  - Bottom : $y_B, \; x = x_1 + \left(\frac{1}{m}\right)(y_B - y_1)\; ; \; m \neq 0$

14. Explain Bezier Curve.

A Bézier curve is a parametric curve that uses the Bernstein polynomials as a basis. A Bézier curve of degree (order) is represented by. (1.40) The coefficients, , are the control points or Bézier points and together with the basis function. determine the shape of the curve.

15. A square is defined by 4 vertices A(0,0,0),B(2,0,0),C(2,2,0)and D(0,2,0) rotate this in clockwise direction to x-axis by 90.

Q. A square defined by 4 vertices A(0,0,0), B(2,0,0), C(2,2,0) and D(0,2,0) rotate this in clockwise direction to x-axis by 90.

→

$$P' = R_x * P$$

$$= \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & \cos\theta & -\sin\theta & 0 \\ 0 & \sin\theta & \cos\theta & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \cdot \begin{bmatrix} x \\ y \\ z \\ 1 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 0 & 1 & 0 \\ 0 & -1 & 0 & 0 \\ 0 & 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 0 & 2 & 2 & 0 \\ 0 & 0 & 2 & 2 \\ 0 & 0 & 0 & 0 \\ 1 & 1 & 1 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 0 & 2 & 2 & 0 \\ 0 & 0 & 2 & 2 \\ 0 & 0 & -2 & -2 \\ 1 & 1 & 1 & 1 \end{bmatrix}$$

$\therefore A' = (0,0,0)$

$\therefore B' = (2,0,0)$

$\therefore C' = (2,2,-2)$

$\therefore D' = (0,2,-2)$