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ASSIGNMENT-2

Q1) Prove that two Scaling transformation compute ie $S_1 S_2 = S_2 . S_1$

Let S_1 is scaling by factor 'm' about origin and S_2 is a scaling by factor 'n' after S_1

$$S_1 = \begin{bmatrix} m & 0 & 0 \\ 0 & m & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$\text{and } S_2 = \begin{bmatrix} n & 0 & 0 \\ 0 & n & n \\ 0 & 0 & 1 \end{bmatrix}$$

$$S_1 S_2 = \begin{bmatrix} m & 0 & 0 \\ 0 & m & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} n & 0 & 0 \\ 0 & n & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} mn & 0 & 0 \\ 0 & mn & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Now = $S_2 S_1 = \begin{bmatrix} n & 0 & 0 \\ 0 & n & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} m & 0 & 0 \\ 0 & m & 0 \\ 0 & 0 & 1 \end{bmatrix} = \begin{bmatrix} mn & 0 & 0 \\ 0 & mn & \\ 0 & 0 & \end{bmatrix}$

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so $S_1 S_2 = S_2 S_1$

2. a write a short note on:

- Generalized clipping :- In generalized clipping operation, both the objects being drawn and clipping region are represented as generalized polygons with a non-zero window number an object may be entered and clipping by simply tracing its boundary and clipping region boundary

- Multiple windowing :- A windowing system for sharing a computer graphical display presentation resource use a window manager to keep track of where each window is located on the display screen and its size and Status.

(3) use cohen ~~sum~~ sutherland algorithm to find the visible portion of line P(40, 80) Q(120, 30), inside the window the window is defined as ABCD : A(20, 20) B(60, 20) C(60, 40), D(20, 40)

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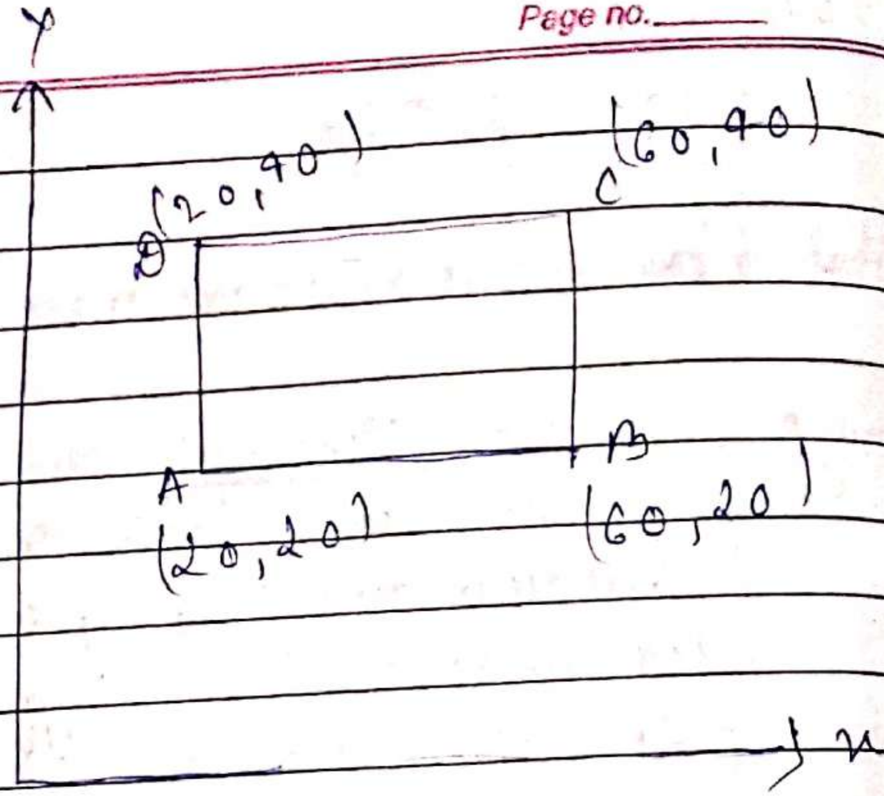

Here $xL = 20$; $YB = 20$
$xR = 60$; $YT = 40$

The outcodes can be calculated as

Bit 1 = sign of $(y - Yx)$
Bit 2 = sign of $(YB - y)$
Bit 3 = sign of $(x - xR)$
Bit 4 = sign of $(xL - x)$

and sign = 1 if value is +ve and sign = 0 if value is -ve

Thus the outcodes of P (40, 30) is 1000 and Q (20, 30) is 0010

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Both end codes are not zero there Logical AND is zero, Hence line can't be rejected is invisible.

Slope of PQ(M) = $\frac{y2-y1}{x2-x1} = \frac{30-80}{120-40}$

$= -\frac{5}{8}$

and Intersection point are calculated as Left intersection point

$y = m(xl - x1) + y1 = -\frac{5}{8}(120-40) + 80$

$= 92.5$

Right Intersection point.

$y = m(xR - x1) + y1 = -\frac{5}{8}(60-40) + 80$

$= 67.5$

Top Intersection point

$x = x_1 + \frac{1}{m}(yT - y1) = 40 + \frac{1}{-5/8}(40-80)$

$\Rightarrow 104$

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Bottom Intersection point

$$x = x_1 + \frac{1}{m}(y_B - y_1) = 40 + \frac{1}{\frac{1}{3}}(20 - 80)$$

$\Rightarrow 136$

Since Both the value of y are greater then yT and xR therefore the Line segment PQ is complete outside the window.

(4) The reflection along the line y = x is equivalent to reflection along the x axis followed counter clock-wise rotation by θ degrees find the values of θ Degrees.

→ The transformation matrix for reflection about the line y = x is

$$\begin{bmatrix} 0 & 1 & 0 \\ 1 & 0 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

Reflection about the x axis the matrix is.

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

and for counter clockwise rotation by θ about the origin is :-

$$\begin{bmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

For successive application, the resultant transformation is

It is given that

$$\begin{bmatrix} \cos\theta & \sin\theta & 0 \\ \sin\theta & -\cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

ie $\cos\theta = 0$ and $\sin\theta = 1$
and $-\cos\theta = 0$, $\underline{\theta = 90°}$]

(5) write the short note on

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- **Point clipping** :- Assuming that the clip in the standard position we save a point P (x, y) for display if the following Inequalities are satisfied

$$x_{wmin} \le x \le x_{wmax}$$
$$y_{wmin} \le y \le y_{wmax}$$

- **Line clipping** :- Lines that do not Intersect the clipping window are either completely inside the window or completely inside the window or completely outside the window. All line segment fall into one of the following clipping categories.

* visible.
* Non-visible.
* partially visible.

$$x_1, x_2 > x_{max}, \; y_1, y_2 >$$
$$x_1, x_2 < x_{min} \; y_1, y_2 < y_{min}.$$

- **Text clipping** :- text clipping is a clipping in which we clip the whole characters or any part of it and depends on the requirement.

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of the application.

- curve clipping :- curve clipping procedures will involve non-linear equation however. this requires more processing that for objects with linear boundaries
the boundaries rectangle for a circle or other curved object can be used first other curved objects to test for overlap with the rectangular clip window.
If the bounding rectangle for the objects is completely inside the window we save the objects

(6) Suppose there is rectangle ABCD whose coordinates are A(1,1), B (4,1), C (4, 4) and D (1, 4) and the window co-ordinates are (2,2), (5,2), (5,5), (2,5) and
san. the given viewport location is [(0.5), 0], (1, 0), (1, 0.5) (0.5, 0.5) ~~viewport location~~, Drive the viewing transformation matrix.

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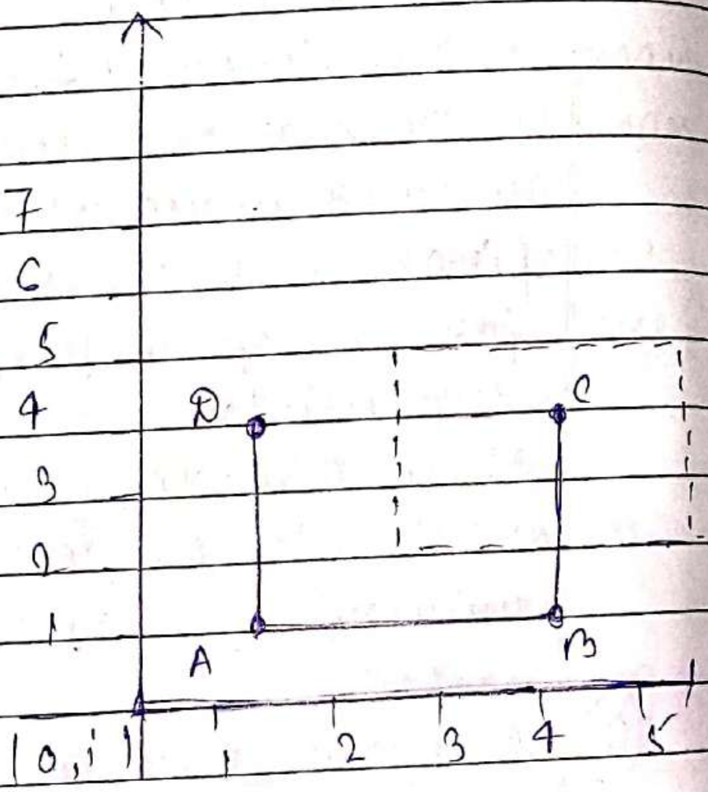
- first we draw the rectangle ABCD and window

For viewing transformation first step translation

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

Scaling in x direction.



$$S_x = \frac{\text{width of viewport}}{\text{width of window}}$$

$$\frac{1-0.5}{5-2} = \frac{0.5}{3} = 0.16$$

similarly $S_y = \dfrac{\text{height of viewport}}{\text{height of window}}$

$$\frac{1-0.5}{5-2} = \frac{0.5}{3} = 0.10$$

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Scaling matrix = $\begin{bmatrix} 0.16 & 0 & 0 \\ 0 & 0.16 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

In the third step we have to translate the viewport to desired location on the screen so translation matrix will be

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0.5 & 0 & 1 \end{bmatrix}$$

viewing transformation matrix will be

$$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ -2 & -2 & 1 \end{bmatrix} \times \begin{bmatrix} 0.16 & 0 & 0 \\ 0 & 0.16 & 0 \\ 0 & 0 & 1 \end{bmatrix} \times \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0.5 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 0.16 & 0 & 0 \\ 0 & 0.16 & 0 \\ 0.18 & -0.32 & 1 \end{bmatrix}$$

(7) Magnify the triangle with vertices A (0, 0) B (1, 1) and (5, 2) to twice its size while keeping (5, 2) fixed.

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Transformation matrix.

2)
$$\begin{bmatrix} 1 & 0 & 5 \\ 0 & 1 & 2 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 2 & 0 & 0 \\ 0 & 2 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & -5 \\ 0 & 1 & -2 \\ 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 2 & 0 & -5 \\ 0 & 2 & -2 \\ 0 & 0 & 1 \end{bmatrix}.$$

triangle ABC in matrix form as follows.

$$\begin{bmatrix} 0 & 1 & 5 \\ 0 & 1 & 2 \\ 1 & 1 & 1 \end{bmatrix}$$

Transformation matrix.

$$\begin{bmatrix} 2 & 0 & -5 \\ 0 & 2 & -2 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 0 & 1 & 5 \\ 0 & 1 & 2 \\ 1 & 1 & 1 \end{bmatrix} = \begin{bmatrix} -5 & -3 & 5 \\ -2 & 0 & 2 \\ 1 & 1 & 1 \end{bmatrix}$$

i.e the new co-ordinates after transformation are

$A \rightarrow (-5, -2)$
$B \rightarrow (-3, 0)$
$C \rightarrow (5, 2)$

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(8). Explain and state the advantages of weiler - Atherton polygon clipping algorithm.

→ weiler Atherton polygon clipping

(1) In the algorithm the vertex processing procedure is modified so that the concave polygons are display correctly

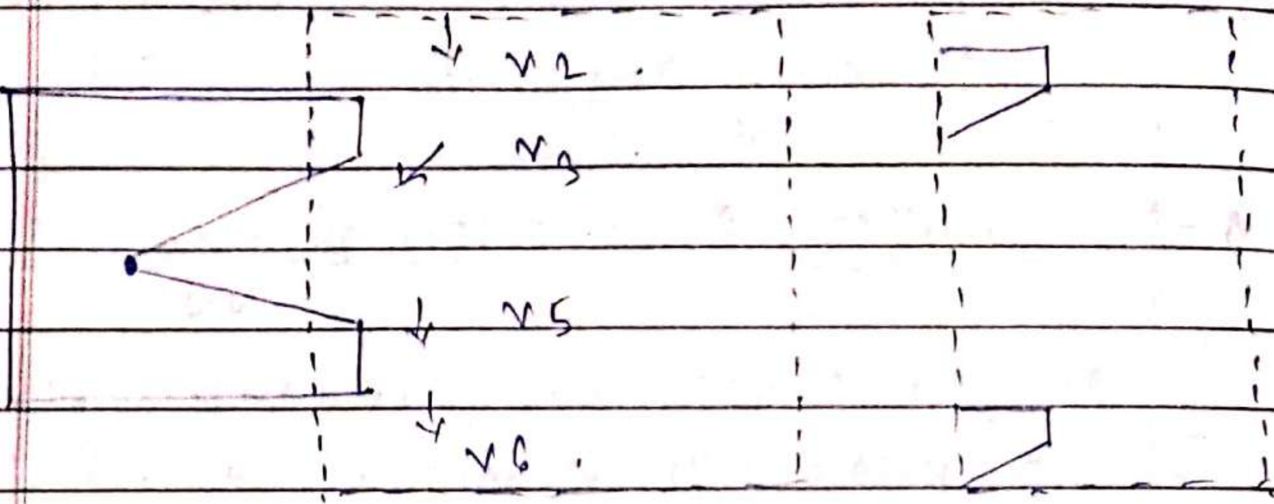
(2) This algorithm depends on clipping surface as shown in figure.

(3) There are two directions (clockwise and anticlockwise) that exist to process the polygon vertices

(4) For clockwise processing a polygon vertices we use the following rules.

(a) For an outside to inside pair of vertices follows the polygon boundary.

(b) For an inside pair of vertices, follows the window boundary in a clockwise direction.



clipping a concave polygon by applying weiler Atherton algorithm.

output {two separate polygon area}