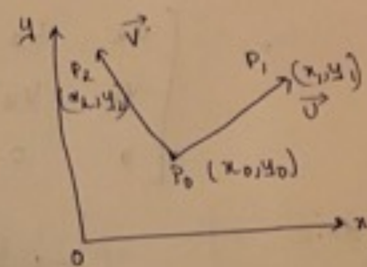
Graphics assignment 2 - PART A

① Initially we have to move (x_0, y_0) to origin

so, the transformation matrix for this translation is

$$\begin{bmatrix} 1 & 0 & -x_0 \\ 0 & 1 & -y_0 \\ 0 & 0 & 1 \end{bmatrix}$$

Now, we have to rotate the given image



Unit vector along $\vec{v}$

$$\hat{v} = \frac{(x_2 - x_0) + (y_2 - y_0)}{\sqrt{(x_2 - x_0)^2 + (y_2 - y_0)^2}}$$

Unit vector along $\vec{u}$

$$\hat{u} = \frac{(x_1 - x_0) + (y_1 - y_0)}{\sqrt{(x_1 - x_0)^2 + (y_1 - y_0)^2}}$$

Now Rotation matrix is $\begin{bmatrix} \hat{u}_x & \hat{u}_y & 0 \\ \hat{v}_x & \hat{v}_y & 0 \\ 0 & 0 & 1 \end{bmatrix}$

After rotation we have to reverse y axis of our axis

$$R_y \begin{bmatrix} u_x & u_y & 0 \\ v_x & v_y & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} \cdots & \cdots & \cdots \\ 0 & 1 & -y_0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} 1 & 0 & 0 \\ 0 & -1 & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} u_x & u_y & 0 \\ v_x & v_y & 0 \\ 0 & 0 & 1 \end{bmatrix} \begin{bmatrix} 1 & 0 & -x_0 \\ 0 & 1 & -y_0 \\ 0 & 0 & 1 \end{bmatrix}$$

$$= \begin{bmatrix} u_x & u_y & -x_0 u_x - y_0 u_y \\ -v_x & v_y & x_0 v_x + v_y y_0 \\ 0 & 0 & 1 \end{bmatrix}$$

↳ Final Result

2] $(0,b) \rightarrow (0,0)$ [Transformation]

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

Rotate the angle by θ. The Rotation matrix will be given by $\begin{bmatrix} \cos\theta & \sin\theta & 0 \\ -\sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$

Let point a be (x,y)

Now we have

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

Then we have

makes it

Inverse it ba

Inverse rot

and inverse

now we have to translate

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

Then we have to reflect along y axis which makes it

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

Inverse it back by Multiplying to $\begin{bmatrix} 1 & 0 & r \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$

Inverse rotation has to be done by $\begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ 0 & & b \\ 0 & 0 & \end{bmatrix}$

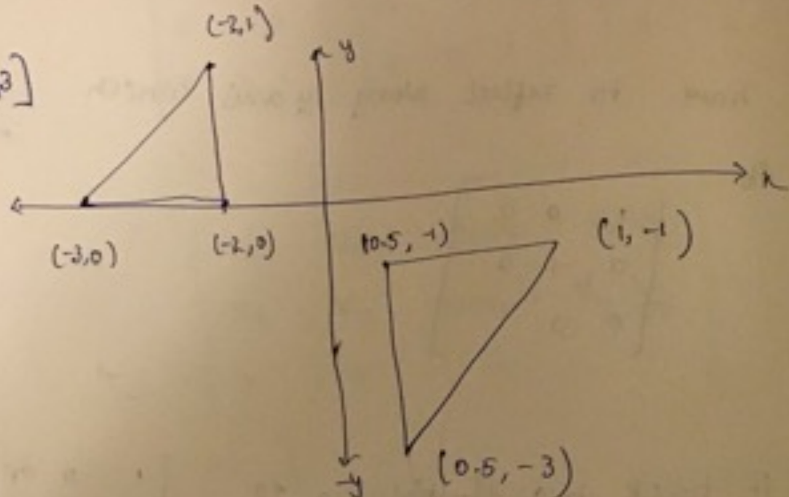
$$\begin{bmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{bmatrix}$$

and inverse translation Matrix is $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & b \\ 0 & 0 & 1 \end{bmatrix}$

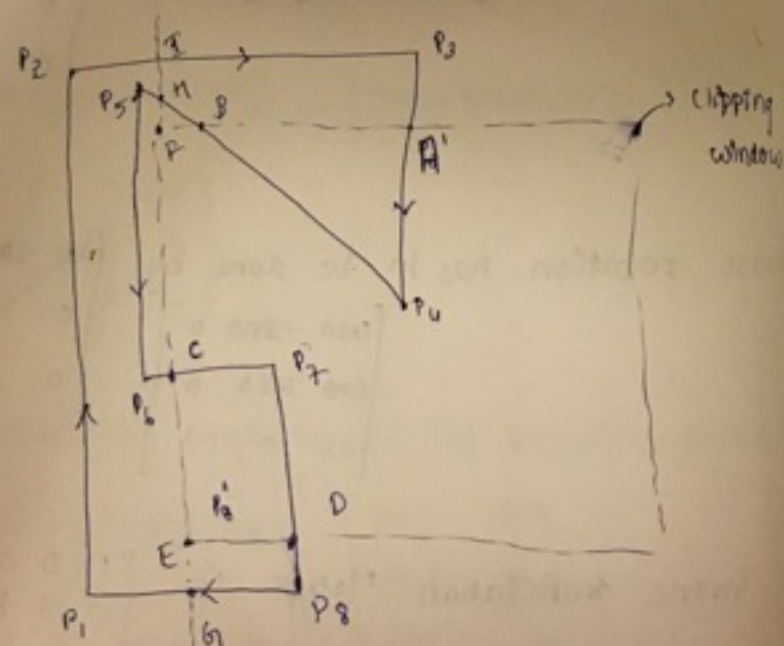
Which sums up to be

$$\begin{bmatrix} 0 & -1 & b + r(\sin\theta + \cos\theta) \\ 1 & 0 & b + r(\sin\theta - \cos\theta) \\ 0 & 0 & 1 \end{bmatrix}$$

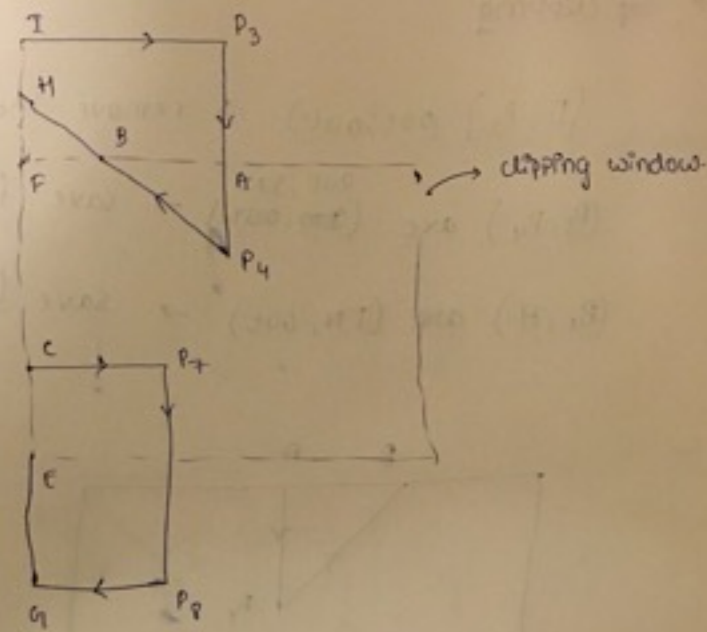
Q3]



Q5]



Now lets finally do the left clipping part



The complete out points have to be removed like (P, P_2) and (P_5, P_6).

and for (in, out) points we have to select the intersecting points (ie) $[P_4, P_5] \rightarrow [B]$

$[P_8, P_9] \rightarrow [G]$

and for (out, in] its (intersect, in) $\rightarrow$

$[P_2, P_3) \rightarrow [I, P_3]$; $[P_6, P_7] \rightarrow [C, P_7]$

Now we have to right clip it. Since all the Points are inside so, same results are main

(P8, G) are

and G.

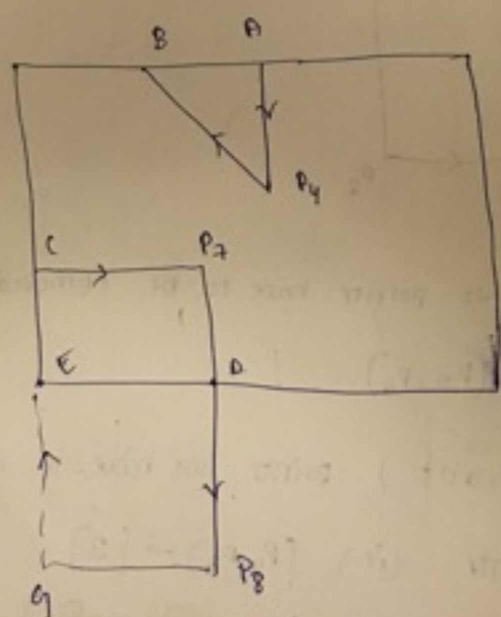
∴ The resol

→ Top clipping

(I, P3) (out, out) → remove them

(P3, P4) are (~~IN, out~~) OUT, IN → save (A, P4)

(P4, H) are (IN, out) → save (B).



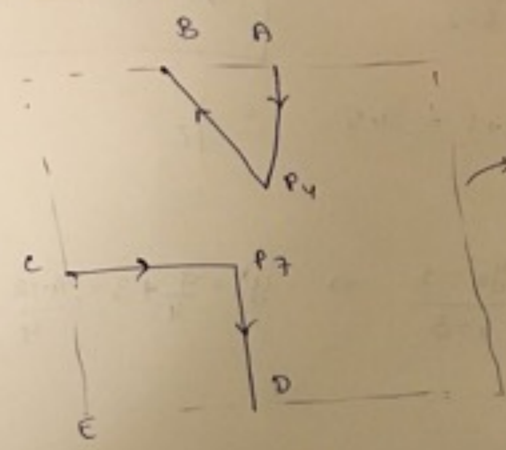
Bottom clipping.

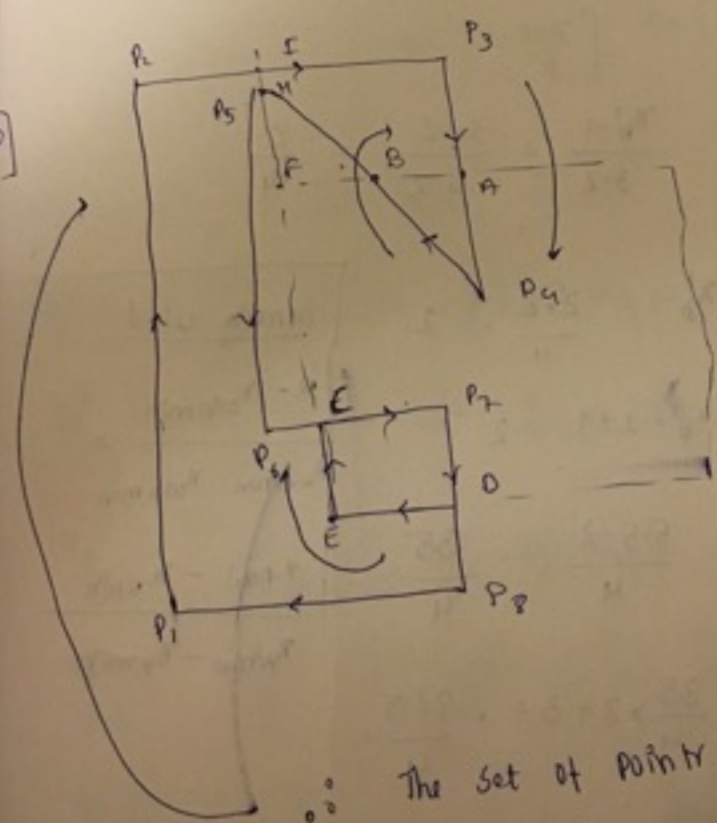
(C, P7) are in so (~~C~~ P7)

(P7, P8) are (In, out) save (~~P7~~ D)

(P_8, G) are both out so { }
and G, C are (out, in) save (E, C)

∴ The result is





∴ The set of points are

(A, P_4, B) & (P_7, D, E, C)

4] $A = (3,5)$ $B = (4.5, 5)$ $C = (5,4)$

formula

$\frac{\cancel{x_a' - x_{vmin}}}{\cancel{x_{vmax} - x_{vmin}}} = \frac{\cancel{x_a - x_{wmin}}}{\cancel{x_{wmax} - x_{wmin}}}$

for A

$$\frac{x_a' - 1}{3-1} = \frac{3-2}{6-2}$$

$$x' = \frac{1}{2} + 1 = 1.5 = 3/2$$

$$\frac{5-2}{6-2} = \frac{y_a' - 3}{6-3} \Rightarrow y' = \frac{9}{4} + 3 = \frac{9+12}{4} = \frac{21}{4}$$

for B

$$\cancel{\frac{x_b' - 2}{6-2}} = \frac{x_b' - 1}{3-2} = \frac{4-2}{6-2} = \frac{2}{4}$$

$$x_b' - 1 = \frac{2 \times 2}{4} = 1$$

$$x_b' = 1 + 1 = 2$$

$$\frac{y_b' - 3}{6-3} = \frac{5.5-2}{4} = \frac{3.5}{4}$$

$$y_b' = \frac{3.5}{4} \times 3 + 3 = \frac{22.5}{4}$$

formula used

$$\frac{x - x_{winmin}}{x_{winmax} - x_{winmin}} = \frac{x_{new} - x_{vmin}}{x_{vmax} - x_{vmin}}$$

for c,

$$\frac{x_c - 2}{6-2} = \ldots$$

$$\frac{x_c' - 1}{2}$$

$$\frac{y_c' - 3}{6-3} =$$

$A' = (3/2,$

Similarly for 2nd

$$\frac{x_a'' - 4}{7-4} = \frac{3-2}{4}$$

$$\frac{y_a'' - 5}{7-5} = \frac{5}{6}$$

$$\frac{y_b'' - 5}{7-5} =$$

$$\frac{x_b'' - 4}{7-4} =$$

$$\frac{x_c'' - 4}{7-4}$$

$$\frac{y_c'' - 5}{7-5} =$$

for c,

$$\frac{x_c - 2}{6-2} = \frac{x_c' - 1}{3-1}$$

$$\frac{x_c' - 1}{2} = \frac{3}{4} \Rightarrow x_c' = \frac{3}{2} + 1 = 1 + 1.5$$

$$x_c' = 2.5 \Rightarrow 5/2$$

$$\frac{y_c' - 3}{6-3} = \frac{4-2}{6-2} \Rightarrow y_c' - 3 = \frac{3 \cdot 2}{4}$$

$$y_c' = \frac{9}{2}$$

$$A' = \left(3/2, \frac{21}{4}\right) \quad B' = \left(2, \frac{22.5}{4}\right] \quad C = \left(5/2, 9/2\right)$$

Similarly for 2nd view port

$$\frac{x_a'' - 4}{7-4} = \frac{3-2}{4} \Rightarrow x_a'' = \frac{3}{4} + 4 = 19/4$$

$$\frac{y_a'' - 5}{7-5} = \frac{5-2}{6-2} \Rightarrow y_a'' = \frac{3}{2} + 5 = 13/2$$

$$\frac{y_b'' - 5}{7-5} = \frac{5.5-2}{6-2} \Rightarrow y_b'' = \frac{3.5}{4} \times 2 + 5 = 13.5/2$$

$$\frac{x_b'' - 4}{7-4} = \frac{3}{4} \Rightarrow x_b'' = 3/2 + 4 = 11/2$$

$$\frac{x_c'' - 4}{7-4} = \frac{5-2}{6-2} \Rightarrow \frac{9}{4} + 4 = 25/4$$

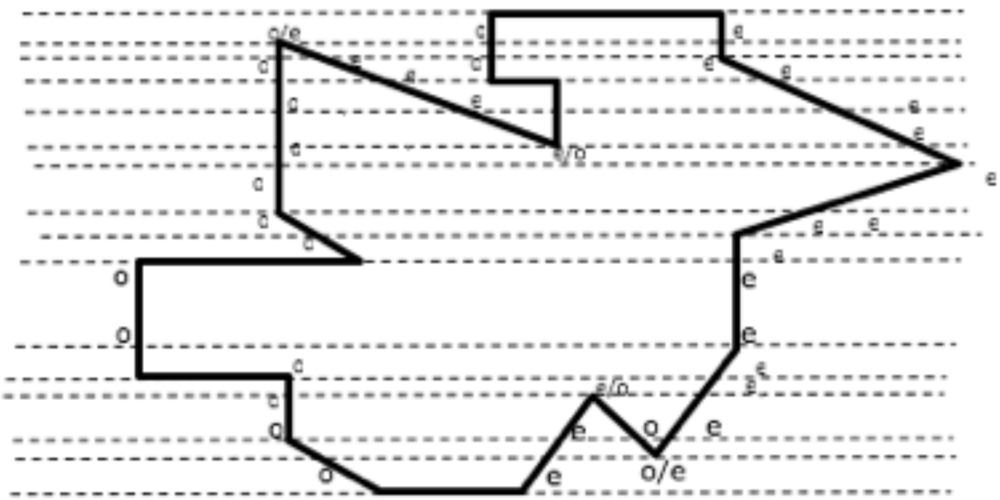
$$\frac{y_c'' - 5}{7-5} = \frac{4-2}{4} \Rightarrow y_c'' = 5 + 1 = 6.$$

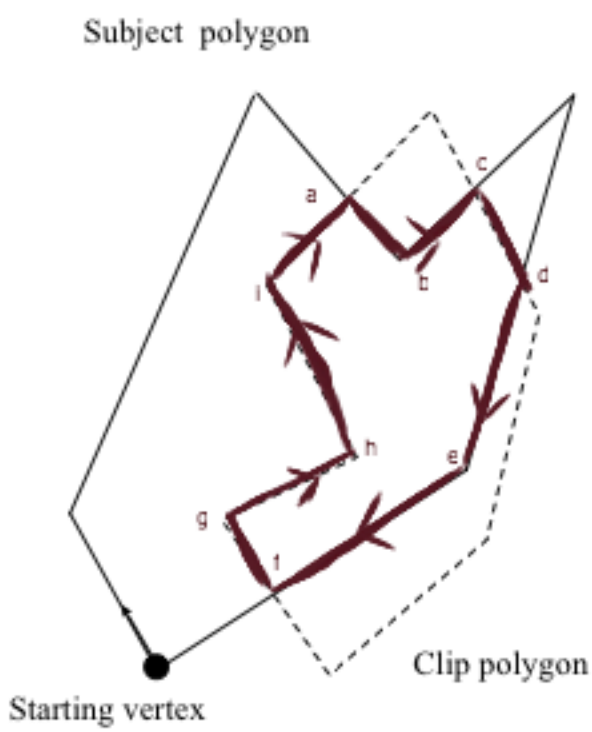
Therefore new cordinate are

$$A = \left(\frac{19}{4}, \frac{13}{2}\right)$$

$$B = \left(\frac{11}{2}, \frac{13.5}{2}\right)$$

$$C = \left(\frac{25}{4}, 6\right)$$




Subject polygon
a
b
c
d
e
f
g
h
i
Clip polygon
Starting vertex