UCS1703 GRAPHICS AND MULTIMEDIA CSE-A

ASSIGNMENT-1 : CLIPPING ALGORITHMS 27.09.23

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1) Liang Barksy Line Clipping Algorithm:

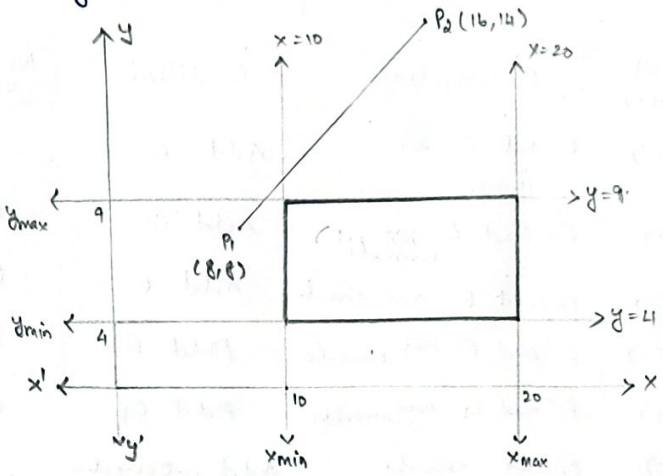
Given:

$(x_{min}, x_{max}) = (10, 20)$

$(y_{min}, y_{max}) = (4, 9)$

$P_1 = (8, 8)$

$P_2 = (16, 14)$



$\Rightarrow \Delta x = x_2 - x_1 = 16 - 8 = 8$

$\Delta y = y_2 - y_1 = 14 - 8 = 6$

W.K.T,

for an integer k, p_k and q_k are defined as

$k=1$: $-u\Delta x \le x_1 - x_{min} \Rightarrow p_1 = -\Delta x \quad q_1 = x_1 - x_{min} \Rightarrow u_1 = q_1/p_1$

$k=2$: $+u\Delta x \le x_{max} - x_1 \Rightarrow p_2 = \Delta x \quad q_2 = x_{max} - x_1 \Rightarrow u_2 = q_2/p_2$

$k=3$: $-v\Delta y \le y_1 - y_{min} \Rightarrow p_3 = -\Delta y \quad q_3 = y_1 - y_{min} \Rightarrow u_3 = q_3/p_3$

$k=4$: $v\Delta y \le y_{max} - y_1 \Rightarrow p_4 = \Delta y \quad q_4 = y_{max} - y_1 \Rightarrow u_4 = q_4/p_4$

$\forall k$, we have $p_k \neq 0 \Rightarrow$ we find all the intersection points (r_k)

k	q_k	p_k	$r_k = \frac{q_k}{p_k}$
1	8-10 = -2	-8	1/4
2	20-8 = 12	8	3/2
3	8-4 = 4	-6	-2/3
4	9-8 = 1	+6	1/6

W.K.T, for any k, $r_k \le 1$ and $r_k \ge 0$

$\Rightarrow$ we ignore r_2 ($\because r_2 > 1$) and r_3 ($\because r_3 < 0$)

Now, $\forall k$ for which $p_k < 0$, $u_{min} = \max(0, r_k)$

$\Rightarrow u_{min} = \max(0, r_1)$ ($\because p_1 < 0$)

$\Rightarrow \boxed{u_{min} = 1/4 = 0.25}$ ($r_1 = 1/4$)

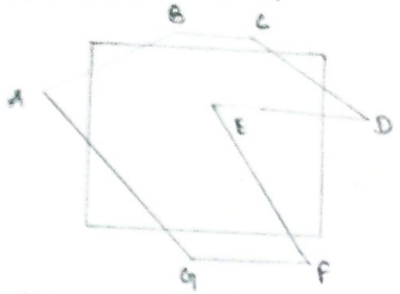
$\forall k$ for which $p_k > 0$, $w_{max} = \min(1, r_k)$

$\Rightarrow w_{max} = \min(1, r_4)$ ($\because p_4 > 0$)

$\Rightarrow \boxed{u_{max} = 1/6 = 0.17}$ ($\because r_4 = 1/6$)

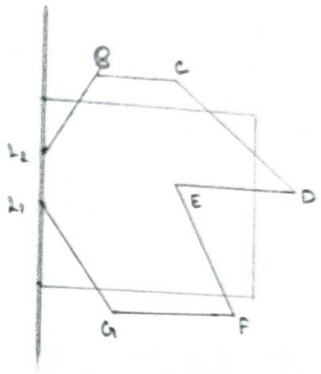
Here, $u_{min} > u_{max} \Rightarrow$ the line connecting points $P_1(8,8)$ and $P_2(16,14)$ is outside the clipping window.

② Sutherland - Hodgeman Clipping Algorithm:

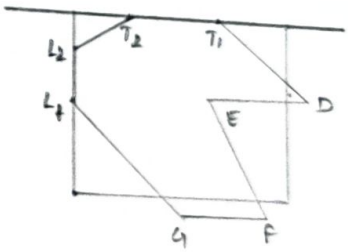


Pair of vertices	Description	Condition	New vertex list
(B, C)	B and C are inside	Add C	C
(C, D)	C and D are inside	Add D	D
(D, E)	D and E are inside	Add E	E
(E, F)	E and F are inside	Add F	F
(F, G)	F and G are inside	Add G	G
(G, A)	G is inside A is outside	Add intersection point, L_1	L_1
(A, B)	A is outside B is inside	Add intersection point, L_2 and B	L_2 B
(B, C)	B and C are outside	Nothing	
(C, D)	C is outside D is inside	Add intersection point, T_1 and D	T_1 D
(D, E)	Both are inside	Add E	E
(E, F)	E and F are inside	Add F	F
(F, G)	F and G are inside	Add G	G
(G, L_1)	G and L_1 are inside	Add L_1	L_1
(L_1, L_2)	L_1 and L_2 are inside	Add L_2	L_2
(L_2, B)	L_2 is inside B is outside	Add intersection	
(T_2, T_1)	T_2 and T_1 are inside	Add T_1	T_1
(T_1, D)	T_1 is inside D is outside	Add intersection point, R_1	R_1
(D, E)	D is outside E is inside	Add intersection point, R_2 & E	R_2 E
(E, F)	E and F are inside	Add F	F
(F, G)	F and G are inside	Add G	G
(G, L_1)	G and L_1 are inside	Add L_1	L_1
(L_1, L_2)	L_1 and L_2 are inside	Add L_2	L_2
(L_2, T_2)	L_2 and T_2 are inside	Add T_2	T_2

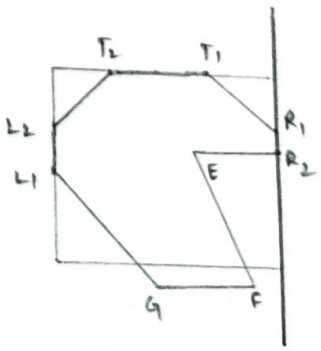
Left:



Top:

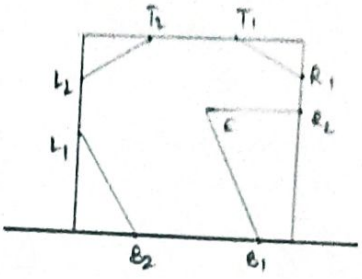


Right:

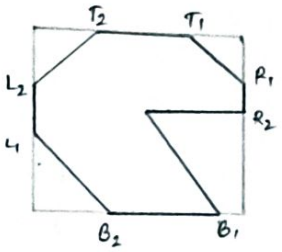


(T_2, T_1)	T_2 and T_1 are inside	Add T_1	T_1
(T_1, R_1)	R_1 and T_1 are inside	Add R_1	R_1
(R_1, R_2)	R_1 and R_2 are inside	Add R_2	R_2
(R_2, E)	R_2 and E are inside	Add E	E
(E, F)	E is inside F is outside	Add intersection point, B_1	B_1
(F, G)	F and G are outside	-	
(G, L_1)	G is outside L_1 is inside	Add intersection point, B_2 & L_1	B_2 L_1
(L_1, L_2)	L_1 and L_2 are inside	Add L_2	L_2
(L_2, T_2)	L_2 and T_2 are inside	Add T_1	T_1

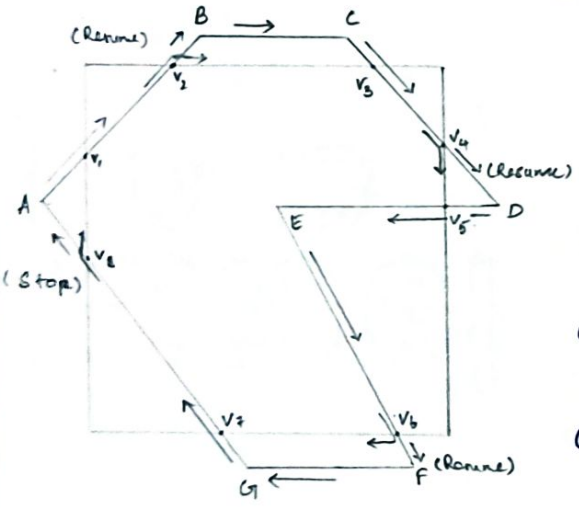
Bottom :



Clipped Polygon



③ Weiler - Atherton Clipping Algorithm:



For the given polygon, mark the intersection points of the sides with the clipping window as $V_1, V_2, V_3, V_4, V_5, V_6, V_7$ and V_8. Inside the clipping window,

(1) $V_1 \rightarrow V_2$ is going from outside to inside,
⇒ follow the polygon boundary $(V_1 - V_2)$

(2) $V_2 \rightarrow B$ is going from inside to outside,
⇒ follow the clipping window $(V_2 - V_3)$

(3) $V_3 \rightarrow V_4$ is going from outside to inside,
⇒ follow the polygon $(V_3 - V_4)$

(4) $V_4 \rightarrow$ is going from inside to outside ⇒ follow the window $(V_4 \rightarrow V_5)$

(5) $V_5 \rightarrow E$ is going from outside to inside ⇒ follow the polygon $(V_5 - E - V_6)$

(6) $V_6 \rightarrow F$ is going from inside to outside ⇒ follow the window $(V_6 - V_7)$

(7) $V_7 \rightarrow V_8$ is going from outside to inside ⇒ follow the polygon $(V_7 - V_8)$

(8) $V_8 \rightarrow A$ is going from inside to outside ⇒ follow the window $(V_8 - V_1)$

$G \rightarrow A$: stop clipping

Clipped Polygon: