Polygon clipping

→ A polygon clipping is defined as the process of removing those parts of a polygon which lies outside the clipping window.

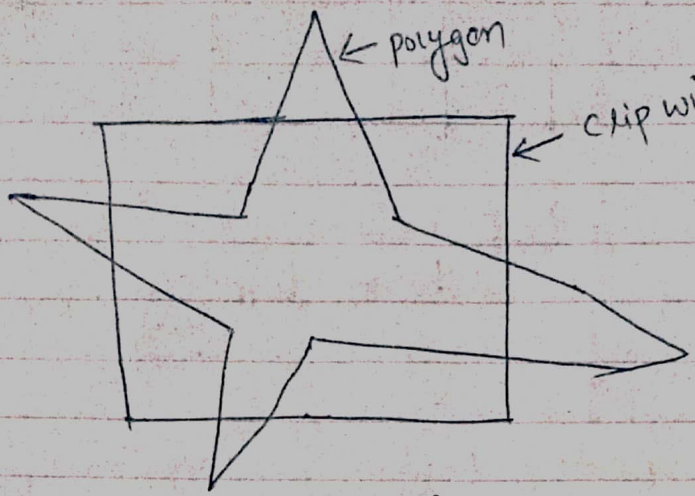


Fig ⓐ Before clipping

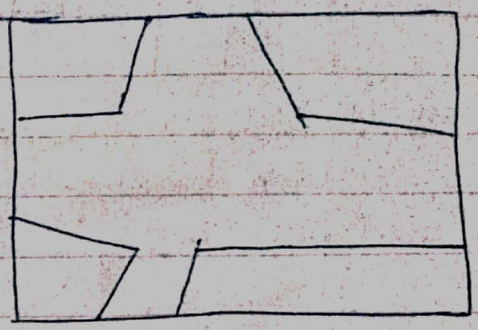


Fig ⓑ After clipping

Sutherland - Hodgman Polygon clipping Algorithm

→ Sutherland - Hodgman polygon clipping uses divide and conquer strategy to clip the given polygon against the edges of the clip-window.

→ It starts with the initial set of polygon vertices.

→ First start with the clipping polygon against the left boundary of the window. Then successively against the right boundary, bottom ~~top~~ boundary and finally against the ~~bottom~~ top boundary as shown in below figure.

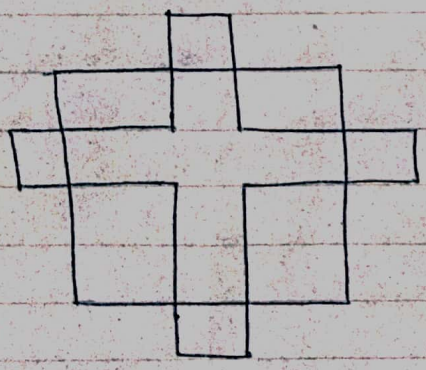


Fig ⓐ Original Figure

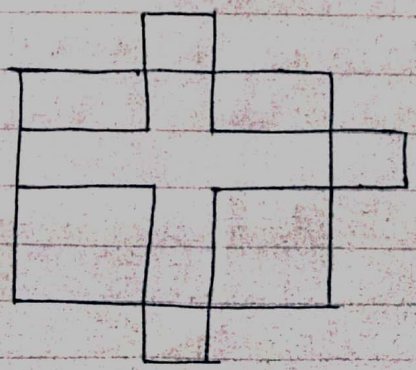


Fig ⓑ Clipping against left boundary

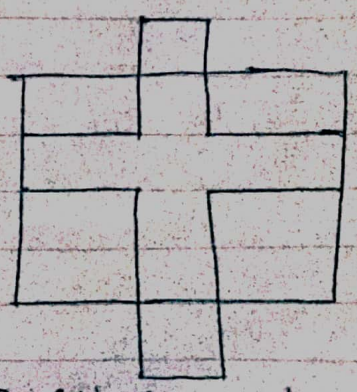


Fig ⓒ Clipping against right boundary

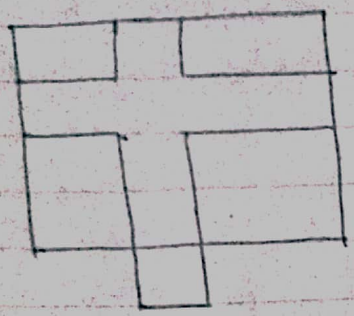


Fig (d) Clipping against top boundary

Fig (e) Clipping against bottom boundary.

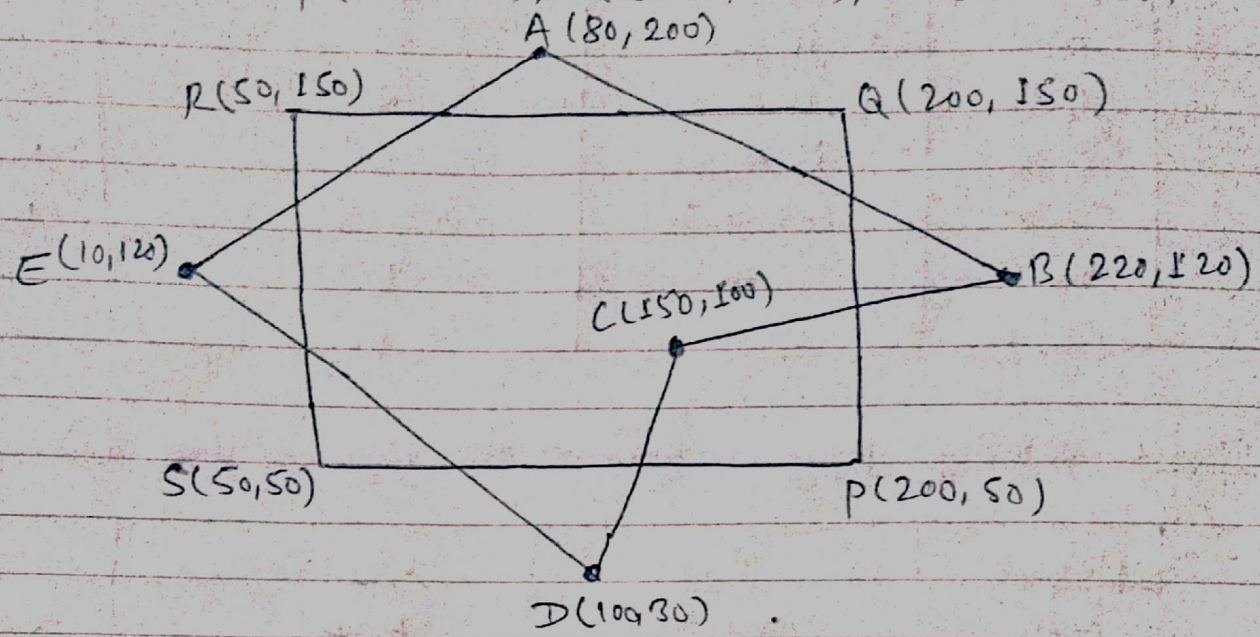
Algorithm

For each clip window boundary perform the following steps

(1) Construct an input vertex list $(v_0, v_1, \ldots v_n)$ where $v_0 = v_n$.
(2) Create empty output vertex list.
(3) For each pair of adjacent vertices v_i and v_{i+1} perform the following inside-outside test:
   (a) If out-in (v_i is outside and the window boundary and v_{i+1} is inside)
   - Add intersection point v_i' and v_{i+1} to the output vertex list.
   (b) If in-in (both v_i, v_{i+1} are inside the window boundary)
   - Add v_{i+1} to the output vertex list.
   (c) If in-out (v_i is inside the window boundary and v_{i+1} is outside)
   - Add intersection point v_i' to the output vertex list.
   (d) If out-out (both v_i, v_{i+1} are outside the window boundary)
   - Add nothing to output vertex list.

Example: Clip polygon ABCDE against window PQRS. The co-ordinates of the polygon are A(80, 200), B(220, 120), C(150, 100), D(100, 30), E(10, 120). The coordinates of the window are P(200, 50), Q(200, 150), R(50, 150), S(50, 50).

Soln:



Step (1) Clipping polygon against left edge of the window (left clipping)

Vertex	Case	output vertex	Remarks
AB	in → in	B	
BC	in → in	C	
CD	in → in	D	
DE	in → ~~out~~ out	D'	New vertex
EA	out → in	E'A	New vertex

Step (2) Clipping polygon against right edge of the window (Right clipping)

Vertex	Case	output Vertex	Remarks
AB	in → out	A'	New vertex
BC	out → in	B'C	New vertex
CD	in → in	D	
DD'	in → in	D'	
D'E'	in → in	E'	
E'A	in → in	A	

Step (3) Clipping polygon against bottom edge of the window (Bottom Clipping)

Vertex	Case	output vertex	Remarks
AA'	in → in	A'	
A'B'	in → in	B'	
B'C	in → in	C	
CD	in → out	C'	New vertex
DD'	out → in	D'' D'	New vertex
D'E'	in → in	E'	
E'A	in → in	A	

Step (4) Clipping polygon against top edge of the window (Top Clipping)

Vertex	Case	output vertex	Remarks
AA'	out → in	A'' A'	New vertex
A'B'	in → in	B'	
B'C	in → in	C	
CC'	in → in	C'	
C'D''	in → in	D''	
D''D'	in → in	D'	
D'E'	in → in	E'	
E'A	in → out	E''	New vertex

So, After Clipping