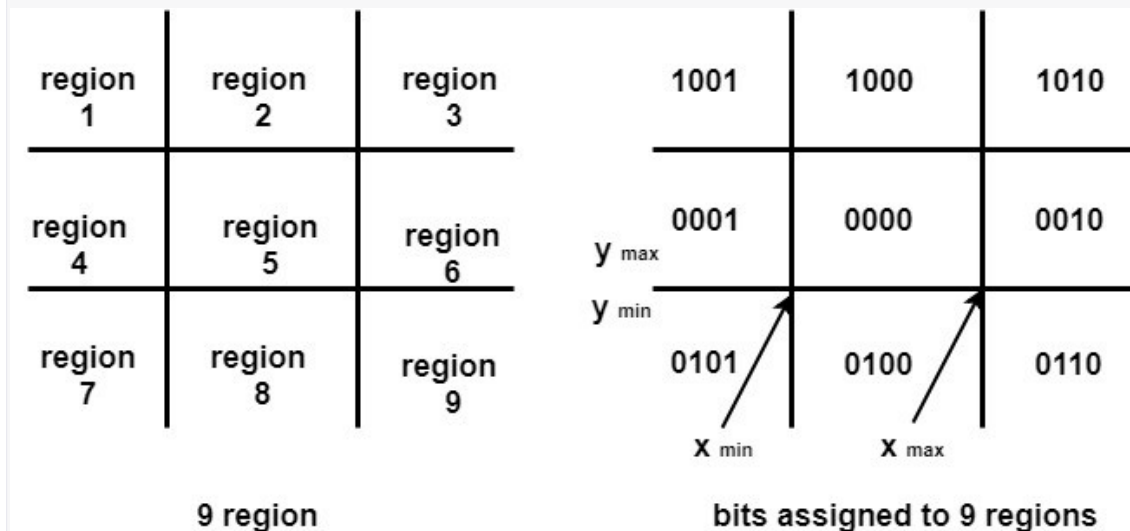## 7. Explain working of Cohen Sutherland Algorithm.

Cohen-Sutherland algorithm is a line clipping algorithm used to clip a line against a rectangular viewing window or viewport. The algorithm divides the viewport into 9 regions using 4 lines, which form a rectangular area known as the clipping window.

region 1	region 2	region 3
region 4	region 5	region 6
region 7	region 8	region 9

1001	1000	1010
0001	0000	0010
0101	0100	0110

y max
y min
X min   X max

9 region   **bits assigned to 9 regions**

The algorithm uses binary codes to represent the regions of the line endpoints and the clipping window. These codes are known as the outcodes and are defined as follows:

Top = 1000 Bottom = 0100 Right = 0010 Left = 0001

For each endpoint of the line, the algorithm computes its outcode by testing its position with respect to the clipping window. If the endpoint is inside the clipping window, its outcode is 0000. If it is outside the clipping window, its outcode is determined by the region in which it lies. For example, if the endpoint is above the top edge of the clipping window, its outcode will be 0001.

The algorithm then checks if both endpoints of the line lie inside the clipping window (i.e., both outcodes are 0000). If this is the case, the line is visible and is drawn in its entirety.

If one or both endpoints lie outside the clipping window, the algorithm computes the intersection points of the line with the clipping window. To do this, it uses the slope of the line to determine which edge(s) of the clipping window the line intersects. If the slope of the line is positive, it will intersect the left and/or right edges of the clipping window. If the slope is negative, it will intersect the top and/or bottom edges.

The algorithm then updates the outcodes of the endpoints based on their new positions. If an endpoint is moved outside the clipping window, its outcode is updated accordingly. The algorithm then repeats the above steps until both endpoints are inside the clipping window or the line is determined to be completely outside the clipping window (i.e., both outcodes have a common bit set).

Once the line has been clipped, the visible portion of the line is drawn using any line-drawing algorithm, such as Bresenham's algorithm.

Overall, the Cohen-Sutherland algorithm is a simple and efficient way to clip lines against a rectangular viewport, and it forms the basis for more advanced clipping algorithms such as the Sutherland-Hodgman algorithm.

8. Using Sutherland Hodgman Polygon Clipping Algorithm clip the following polygon.

Ans- It is performed by processing the boundary of polygon against each window corner or edge. First of all entire polygon is clipped against one edge, then resulting polygon is considered, then the polygon is considered against the second edge, so on for all four edges.

Four possible situations while processing
- If the first vertex is an outside the window, the second vertex is inside the window. Then second vertex is added to the output list. The point of intersection of window boundary and polygon side (edge) is also added to the output line.
- If both vertexes are inside window boundary. Then only second vertex is added to the output list.
- If the first vertex is inside the window and second is an outside window. The edge which intersects with window is added to output list.
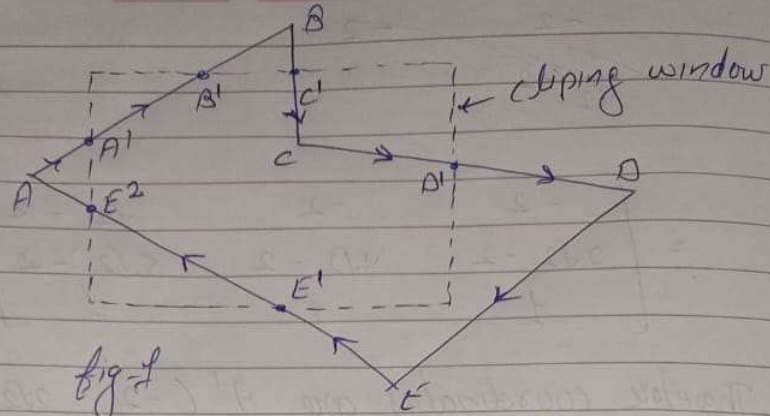- If both vertices are the outside window, then nothing is added to output list.

Ans
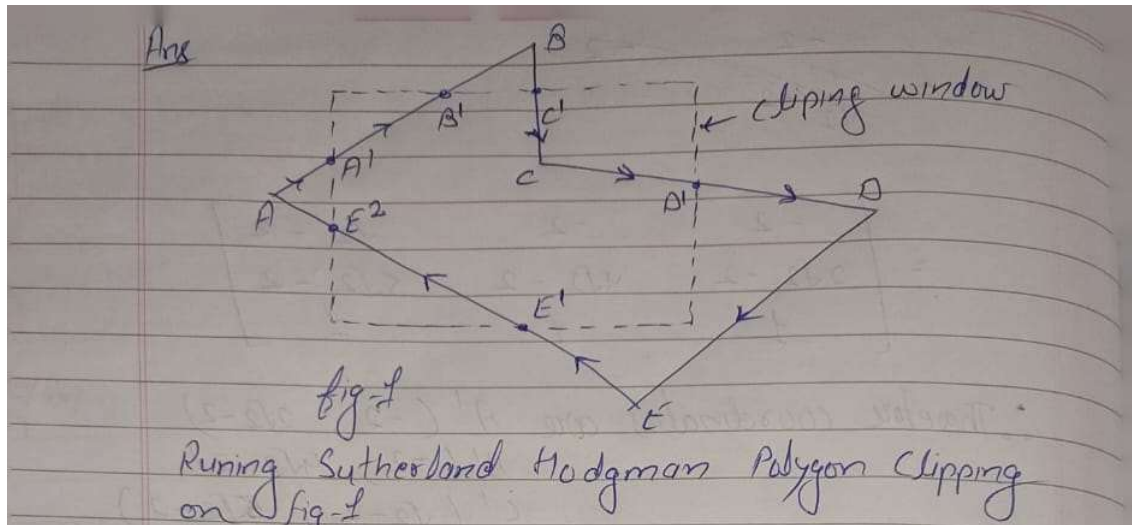
fig-1

Runing Sutherland Hodgman Polygon Clipping
on fig-1

List ⟶ vertices of inside and intersect

① outside → inside
   A' save
② inside → outside
   B' save
③ outside → inside
   c' save
④ ~~outside~~ inside → outside
   D' save
⑤ outside → inside
   E' save
⑥ inside → outside
   E² save

List $\boxed{A' \mid B' \mid c' \mid D' \mid E' \mid E^2}$

Then after cliping the figure will appeare

Image after cliping the window