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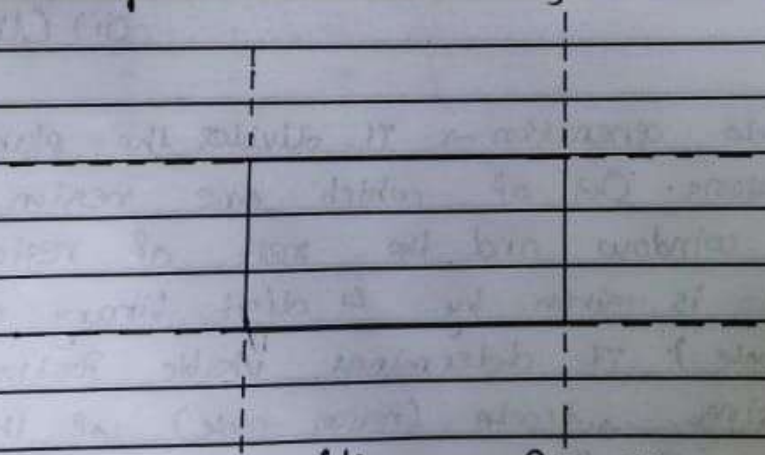
Experiment No - 8

Aim → To implement Cohen Sutherland line clipping algorithm.

Resource Required → Turbo C, Pointer, Printout.

Theory →

Line clipping is a computer graphics techniques used to determine which portions of a line segment are within a given rectangular boundary, known as clipping window. and to discard the portions that are outside. It is commonly used in 2D graphics applications, such as rendering or graphic editors, to efficiently draw only the visible parts of an object.



Line Clipping Algorithm.

There are several algorithms for line clipping the most commonly used being →

1) Cohen - Sutherland Algorithm
2) Liang - Barsky Algorithm
3) Cyrus - Beck Algorithm.

→ Cohen - Sutherland Algorithm

This algorithm is an efficient line clipping algorithm used to clip a line segment to a rectangle clipping window. It is 2D line clipping algorithms. The main advantage of the algorithm is that it vastly reduce the number of line intersections that must be calculated in scan conversion approach. It operates in two phases → (i) Region code generation
(ii) Clipping.

1) Region Code generation → It divides the plane into nine regions. Out of which one region is of the window and the rest of region are around it is given by 4 digit binary outcode (region code). It determines visible portion of the line using outcode (region code) of the endpoints of line.
Outcode → A 4-bit code that represent the location of a point relative to the clipping window.
The division of regions are based on (Xmax, Ymax) and (Xmin, Ymin)

		(Top)	
	1001	1000	1010
		(Window)	
(Left)	0001	0000	0010 (Right)
	0101	0100	0110
		(Bottom)	

The central part is the viewing region or window all the lines which lie within this region are completely visible. A region code is always assigned to the endpoints of the given line.

Formula to check Outcode → TBRL which can be defined as top, bottom, right, left accordingly.

0 0 0 0
↑ ↑ ↑ ↑
Top Bottom Right Left

2] Clipping Procedure → The algorithm quickly identifies if the line is completely inside or outside. If both the end points having same outputs i.e. 0000 then the line is completely inside the code and other than 0000 outcode the line is completely outside the code. If both endpoints are having different outcodes then by performing logical OR and logical AND operation, the condition is evaluated for

acceptance, rejection or partial visiblity of line.

→ Algorithm –

Step 1 :→ Read (X_{wmin}, Y_{wmin}) and (X_{wmax}, Y_{wmax}) for a clipping window.

Step 2 → Compute outcodes for both end posets using Region code.

Step 3 → If outcode A bitwise OR outcode B == 0000 then line is completely inside the clipping window and can be accepted Then goto step 5

Else →

Line is partially inside completely outside or partially inside if outcode of both end points bitwise AND operation is non-zero.

Step 4 → If the line cannot be accepted or rejected. it means the line is partially inside the clipping window compute intersecting points.

i.e,

For y-coordinate calculation as,

$y = mx + c$

$c = y - mx$ then,

$y = m x_{min} + c$ → Intersecting to left edge

$y = m x_{max} + c$ → Intersecting to right edge.

For X-coordinates calculation as,

$X = \frac{(y - c)}{m}$; $c = y - mx$

$X = \frac{y_{min} - c}{m}$ → Intersecting to bottom edge.

$X = \frac{y_{max} - c}{m}$ → Intersecting to top edge.

Advantages →

- It is easy to understand
- Simple to implement
- Best suitable for the lines fully inside or outside.
- It can be easily be extended for 3-D line clipping

Disadvantages →

- Repeted clipping is expensive.
- Only applicable to rectangular clipping window.
- It cannot handle any other shape.
- It can be improved using more regions.

Conclusion → We have successfully implemented Cohen Sutherland algorithm for the Clipping.