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Cohen Sutherland line clipping algorithm

Cohen Sutherland line clipping algorithm divides a two-dimensional space into 9 regions and then efficiently determines the lines and portions of lines that are inside the given rectangular area.

The algorithm can be outlined as follows-

Nine regions are created, eight "outside" regions and one "inside" region.

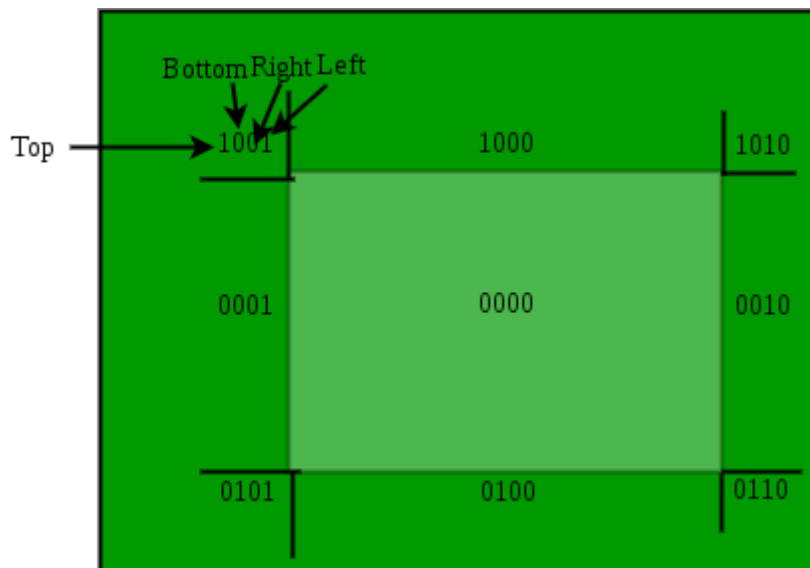
For a given line extreme point (x, y), we can quickly find its region's four-bit code. Four-bit code can be computed by comparing x and y with four values (x_min, x_max, y_min and y_max).

If x is less than x_min then bit number 1 is set.

If x is greater than x_max then bit number 2 is set.

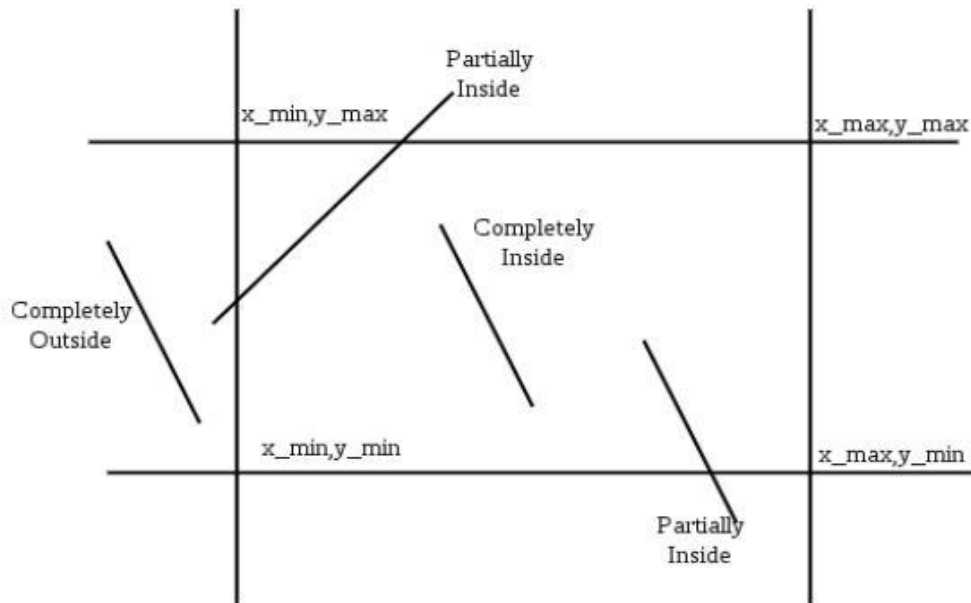
If y is less than y_min then bit number 3 is set.

If y is greater than y_max then bit number 4 is set



There are three possible cases-

1. **Completely inside the given rectangle:** Bitwise OR of region of two end points of line is 0 (Both points are inside the rectangle)
2. **Completely outside the given rectangle:** Both endpoints share at least one outside region which implies that the line does not cross the visible region. (bitwise AND of endpoints! = 0).
3. **Partially inside the window:** Both endpoints are in different regions. In this case, the algorithm finds one of the two points that is outside the rectangular region. The intersection of the line from outside point and rectangular window becomes new corner point and the algorithm repeats.



Algorithm

Step 1: Assign a region code for two endpoints of given line.

Step 2: If both endpoints have a region code 0000 then given line is completely inside.

Step 3: Else, perform the logical AND operation for both region codes.

Step 3.1: If the result is not 0000, then given line is completely outside.

Step 3.2: Else line is partially inside.

Step 3.2.1: Choose an endpoint of the line that is outside the given rectangle.

Step 3.2.2: Find the intersection point of the rectangular boundary (based on region code).

Step 3.2.3: Replace endpoint with the intersection point and update the region code.

Step 3.2.4: Repeat step 2 until we find a clipped line either trivially accepted or trivially rejected.

Step 4: Repeat step 1 for other lines.

The Cohen–Sutherland algorithm can be used only on a rectangular clip window. For other convex polygon clipping windows, Cyrus–Beck algorithm is used.

References

[1] <https://www.geeksforgeeks.org/line-clipping-set-1-cohen-sutherland-algorithm/>

[2] Amrendra N Sinha and Arun D Udai,” Computer Graphics”, TMH

[3] Udit Agarwal “Computer Graphics”, KATSON