Maharaja Agrasen Institute of Technology
ETCS 211
Computer Graphics & Multimedia
UNIT 2

LINE CLIPPING ALGORITHM

COHEN SUTHERLAND CLIPPING ALGORITHM

What is line clipping?

line clipping is the process of removing **lines** or portions of **lines** outside an area of interest.

Any line segment which lies outside the view window is removed.

Line clipping evolves two method:

i) Tests are conducted on a given line segment to find out whether it lies outside the view window.

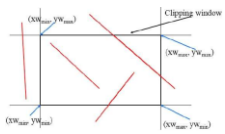
ii) intersection calculations are carried out with one or more clipping boundaries.

Line clipping algorithm : Cohen Sutherland Algorithm

Cohen–Sutherland algorithm is named after Danny Cohen and Ivan Sutherland.

In Cohen Sutherland algorithm the 2D space into 9 regions out of which only the middle part (viewport) is visible.

Line clipping algorithm : Cohen Sutherland Algorithm



To determine whether endpoints are inside or outside a window, the algorithm sets up a **half-space code** for each endpoint. Each edge of the window defines an infinite line that divides the whole space into two half-spaces, the **inside half-space** and the **outside half-space**,

Line clipping algorithm : Cohen Sutherland Algorithm

The 4 bits in the code then identify each of nine regions

For any endpoint **(x , y)** of a line we can determined that in which region the endpoint lies.

1001	0001	0101
1000	0000 Window	0100
1010	0010	0110

Line clipping algorithm : Cohen Sutherland Algorithm

The code's bits are set according to the following conditions:

1. If first bit is set as 1, then point lies left of the window.

   X < Xmin

2. If second bit is set as 1, then point lies on the right side of th window

   X > Xmax

3. If third bit is set as 1, then the point lies below the window.

   Y < Ymin

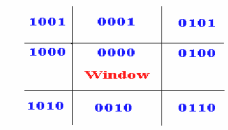
4. If fourth bit is set as 1, then the point lies above the window.

   Y > Ymax

1001	0001	0101
1000	0000 Window	0100
1010	0010	0110

Line clipping algorithm : Cohen Sutherland Algorithm

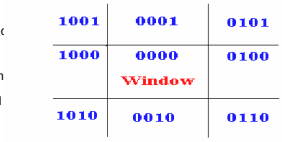
- **Step 1** : Assign a region code for two endpoints of given line
- **Step 2** : If both endpoints have a region code 0000 then given line is completely inside and we will keep this line
- **Step 3** : If step 2 fails, perform the logical AND operation for both region codes.
  - **Step 3.1** : If the result is not **0000**, then given line is completely outside.
  - **Step 3.2** : Else line is partially inside.



Line clipping algorithm : Cohen Sutherland Algorithm

- **Step 3.2.a** : Choose an endpoint of the line that is outside the given rectangle.
- **Step 3.2.b** : Find the intersection point c the rectangular boundary (based on region code).
- **Step 3.2.c** : Replace endpoint with the intersection point and update the region code.
- **Step 3.2.d** : Repeat step 2 until we find clipped line either trivially accepted or rejected.

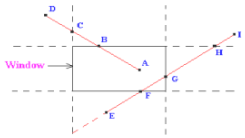
- **Step 4** : Repeat step 1 for all lines



Line clipping algorithm : Cohen Sutherland Algorithm Example

Consider the line segment **AD**

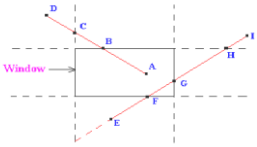
1. Point **A** has an out code of **0000** and point **D** has an out code of **1001**.
2. The logical AND of these out codes is zero therefore, the line cannot be trivially rejected. Also, the logical OR of the out codes is not zero therefore, the line cannot be trivally accepted.
3. The algorithm then chooses **D** as the outside point (its out code contains 1's).
4. use the top edge to clip **AD** at **B**.
5. The algorithm then recomputes **B**'s outcode as **0000**. With the next iteration of the algorithm, **AB** is tested and is trivially accepted and displayed.



Line clipping algorithm : Cohen Sutherland Algorithm Example

Consider the line segment **EI**

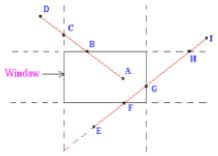
1. Point **E** has an out code of **0100**, while point **I**'s out code is **1010**.
2. The result show that the line can neither be trivally rejected or accepted.
3. Point **E** is determined to be an outside point, so the algorith clips the line against the bottom edge of the window.
4. Now line **EI** has been clipped to be line **FI**.
5. Line **FI** is tested and cannot be trivially accepted or rejectec



Line clipping algorithm : Cohen Sutherland Algorithm Example

Consider the line segment **EI**

6. Point **F** has an out code of **0000**, so the algorithm chooses point **I** as an outside point since its out code is**1010**.
7. The line **FI** is clipped against the window's top edge, yielding a new line **FH**.
8. Line **FH** cannot be trivally accepted or rejected. Since **H**'s out code is **0010**, the next iteration of the algorithm clips against the window's right edge, yielding line **FG**.
9. The next iteration of the algorithm tests **FG**, and it is trivially accepted and display.



Line clipping algorithm : Cohen Sutherland Algorithm Example

After clipping

After clipping the segments **AD** and **EI**, the result is that only the line segment **AB** and **FG** can be seen in the window.