Computer Graphics

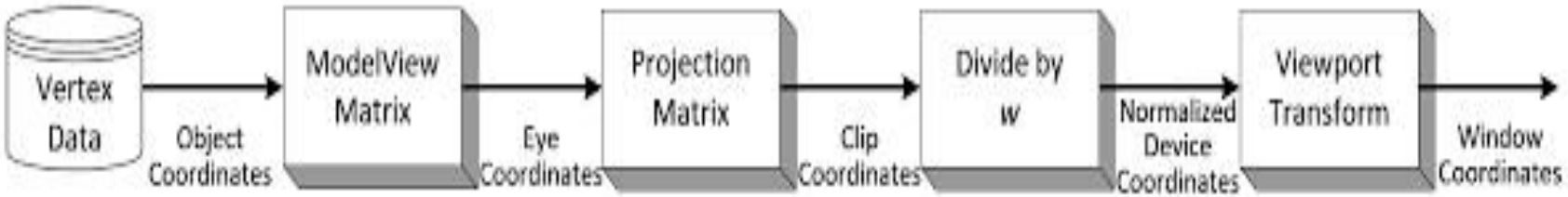
Unit 3 – Part 1

-By Manjula. S

Clipping

- The portion left outside the region of the window in Computer Graphics is called the **Clipped Part**.
- The process of display inside image of the window is called **Clipping**.
- The only part of the scene that shows up on the screen is what is inside the clipping window.
- Sometimes the clipping window is suggested to as the *world window* or the *viewing window.*

Clipping Window



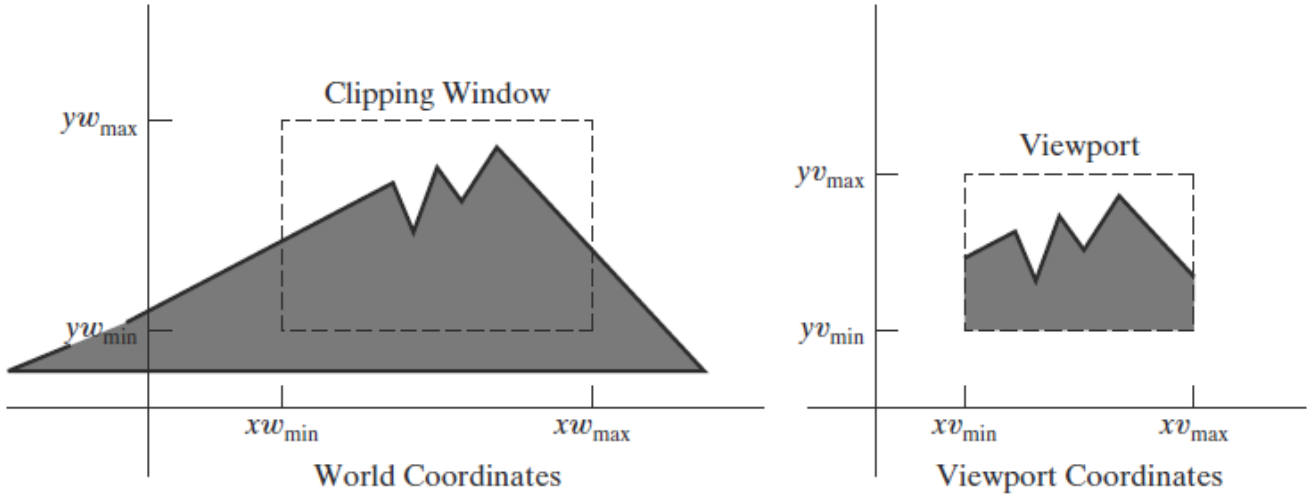


FIGURE 1
A clipping window and associated viewport, specified as rectangles aligned with the coordinate axes.

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Clipping Window

- Graphics packages allow us also to control the placement within the display window using another "window" called the **viewport.**
- Objects inside the clipping window are mapped to the viewport, and it is the viewport that is then positioned within the display window.
- clipping window selects *what* we want to see; the viewport indicates *where* it is to be viewed on the output device.
- By changing the position of a viewport, we can view objects at different positions on the display area of an output device.

Clipping Window

- The mapping of a two-dimensional, world-coordinate scene description to device coordinates is called a **two-dimensional viewing transformation.**
- This transformation is simply referred to as the *window-to-viewport transformation* or the *windowing transformation.*
- In analogy with three-dimensional viewing, we can describe the steps for two-dimensional viewing as indicated in Figure 2.

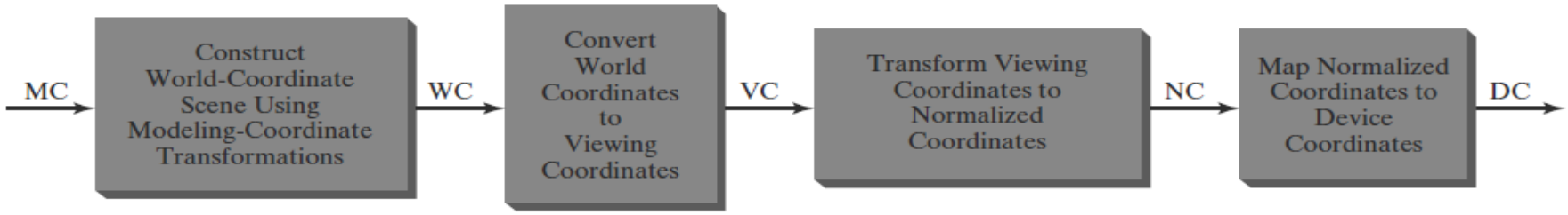

FIGURE 2
Two-dimensional viewing-transformation pipeline.

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Clipping Types

Clipping Types:

- Point Clipping
- Line Clipping
- Polygon Clipping(Fill area Clipping)
- Curve Clipping
- Text Clipping

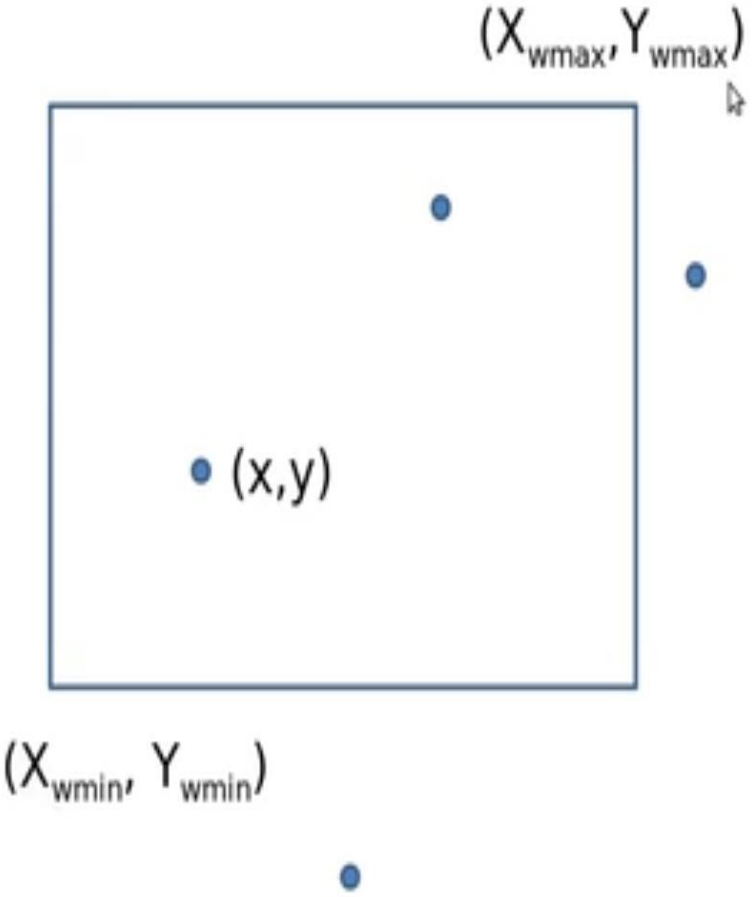
Point Clipping

- Point with coordinate (x,y) can be clipped against the window with coordinates X_{wmin}, Y_{wmin}, X_{wmax}, Y_{wmax}
- using following inequalities:

$$X_{wmin} \leq x \leq X_{wmax}$$

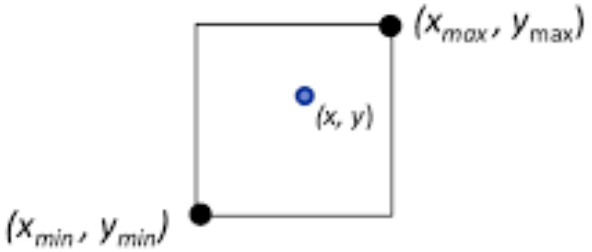
$$Y_{wmin} \leq x \leq Y_{wmax}$$

- Point will be accepted if it satisfies both inequalities.

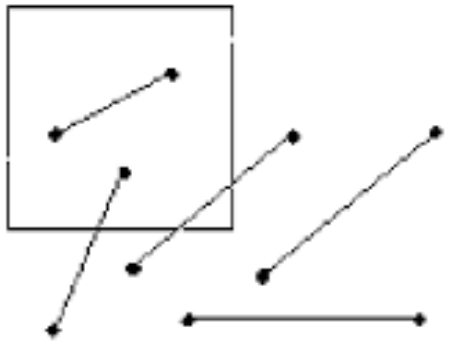


Line Clipping

- Clipping a point (x, y)
  - if ($x_{min} < x < x_{max}$) && ($y_{min} < y < y_{max}$)
  - Then: (x, y) is inside



- For lines:
  - If both endpoints are in, do "trivial acceptance"
  - If one endpoint in, one endpoint out, must clip
  - If both endpoints out:
    - Could be out
    - Could be clipped



- Brute force clip: solve simultaneous equations using $y = mx + b$ for the line, and the four edges (of the region)
  - Slope-intercept formula handles infinite line only
  - Doesn't handle vertical lines

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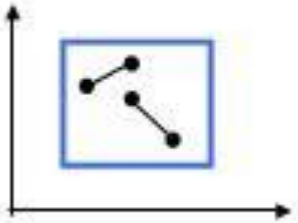
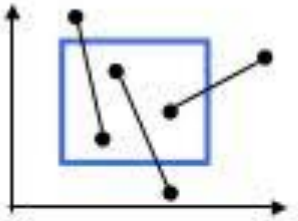
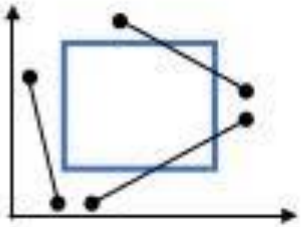
Line Clipping

Harder - examine the end-points of each line to see if they are in the window or not

Situation	Solution	Example
Both end-points inside the window	Don't clip	
One end-point inside the window, one outside	Must clip	
Both end-points outside the window	Don't know!	

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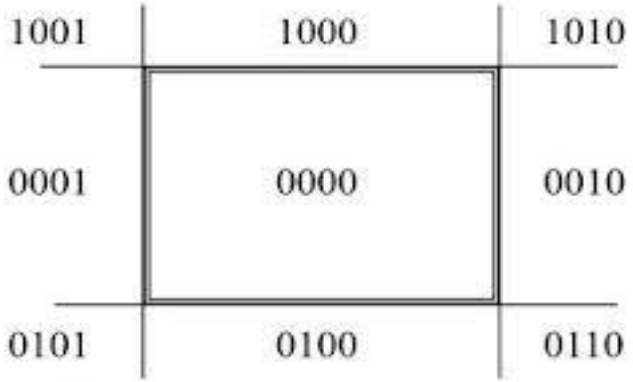
Cohen-Sutherland Clipping (cont.)

Bit 1: Above
Bit 2: Below
Bit 3: Right
Bit 4: Left



- A line can be trivially accepted if both endpoints have an outcode of 0000.
- A line can be trivially rejected if any corresponding bits in the two outcodes are both equal to 1. (This means that both endpoints are to the right, to the left, above, or below the window.)
- if (outcode 1 & outcode 2) != 0000, trivially reject!

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Polygon Clipping

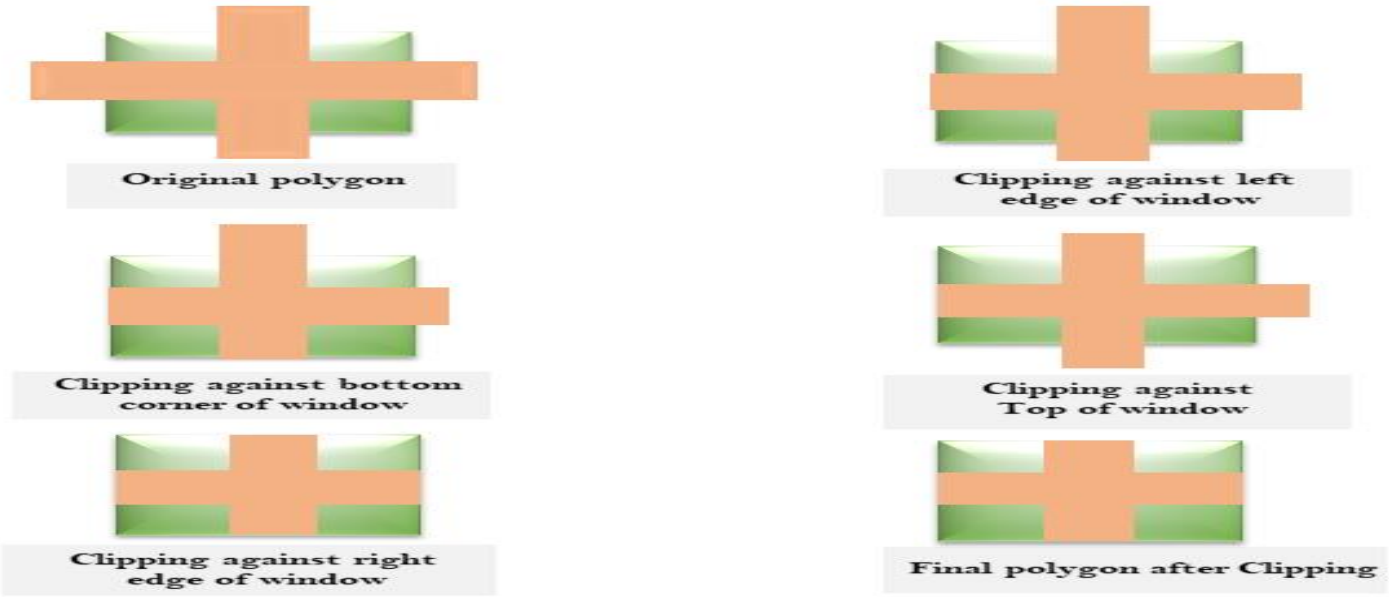
- Not as simple as line segment clipping
  - Clipping a line segment yields at most one line segment
  - Clipping a polygon can yield multiple polygons

- However, clipping a convex polygon can yield at most one other polygon

Sutherland-Hodgman Polygon

Sutherland-Hodgman Polygon :

Clipping of polygon is done starting from Lift **Clipper**,Right **Clipper,** Bottom **Clipper** and Top **Clipper.** At each step, a new sequence of output vertices is generated and passed to the next window boundary **clipper.**



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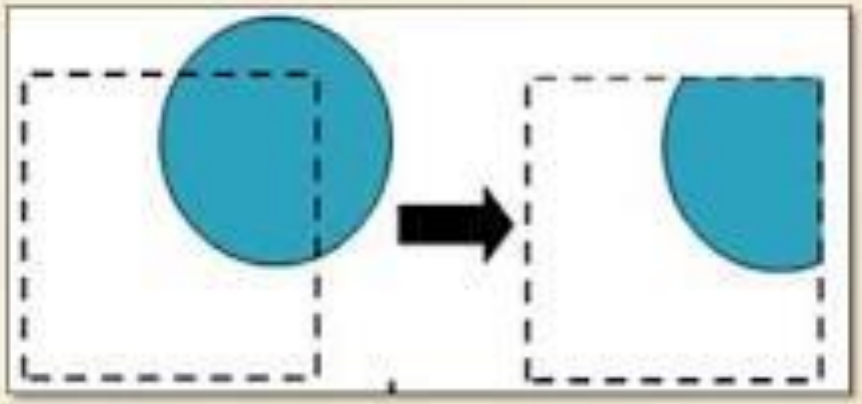
CURVE CLIPPING

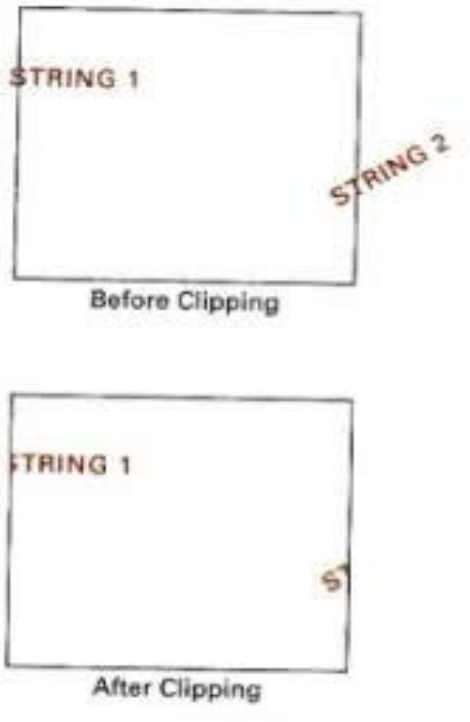
- Curve clipping procedures will involve non-linear equations (so requires more processing than for objects with linear boundaries In general, methods depend on how characters are represented).
- Clipping curves requires more work

  For circles we must find the two intersection points on the window boundary



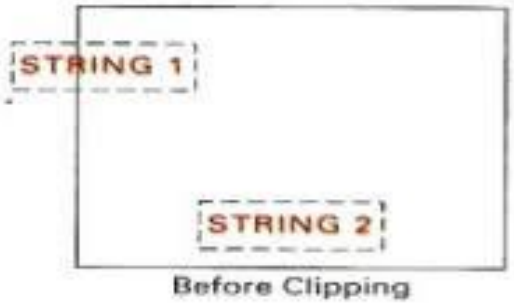
TEXT CLIPPING (cont)

- **Clip the components of individual characters**
  - Treat characters same as lines
  - If individual char overlaps a clip window boundary, clip off the parts of the character that are outside the window.



Text clipping performed on the components of individual characters.

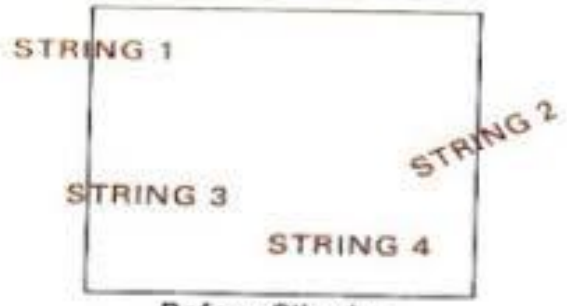
TEXT CLIPPING (cont)



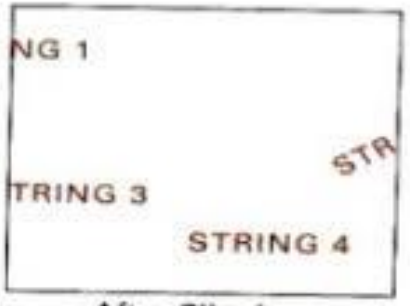
Before Clipping

After Clipping

Text clipping using a bounding rectangle about the entire string.



Before Clipping



After Clipping

Text clipping using a bounding rectangle about individual characters.

Thank You

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