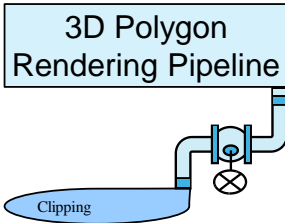


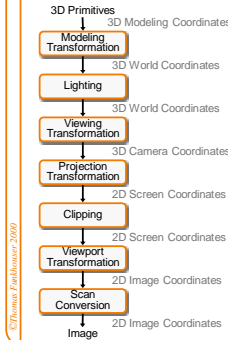
קורס גרפיקה ממוחשבת

2008 סמסטר ב'
ליאור שפירא

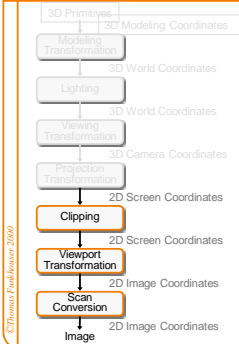


Thomas Funkhouser
Princeton University
C0S 426, Fall 1999

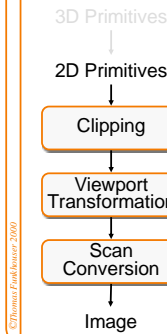
3D Rendering Pipeline (for direct illumination)



3D Rendering Pipeline (for direct illumination)



2D Rendering Pipeline

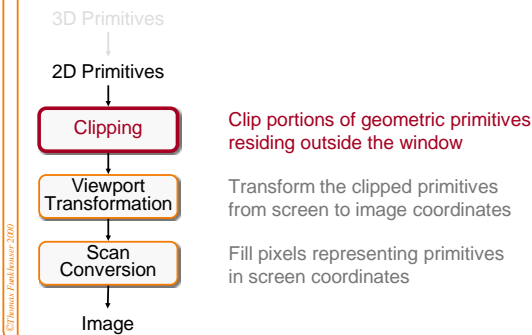


Clip portions of geometric primitives residing outside the window

Transform the clipped primitives from screen to image coordinates

Fill pixels representing primitives in screen coordinates

2D Rendering Pipeline



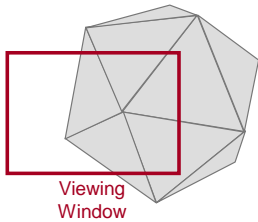
Clipping

- Avoid drawing parts of primitives outside window
 - Window defines part of scene being viewed
 - Must draw geometric primitives only inside window



Clipping

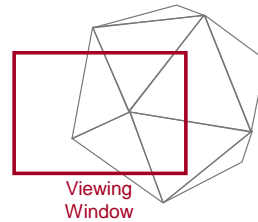
- Avoid drawing parts of primitives outside window
 - Window defines part of scene being viewed
 - Must draw geometric primitives only inside window



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Clipping

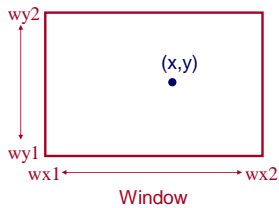
- Avoid drawing parts of primitives outside window
 - Points
 - Lines
 - Polygons
 - Circles
 - etc.



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Point Clipping

- Is point (x,y) inside the clip window?

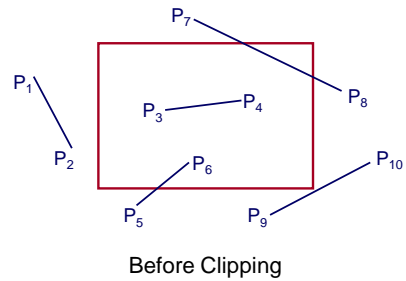


```
inside =
(x >= wx1) &&
(x <= wx2) &&
(y >= wy1) &&
(y <= wy2);
```

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Line Clipping

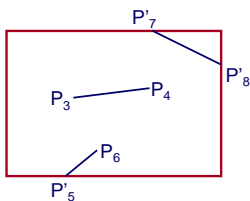
- Find the part of a line inside the clip window



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Line Clipping

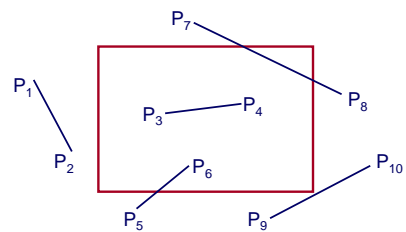
- Find the part of a line inside the clip window



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Cohen Sutherland Line Clipping

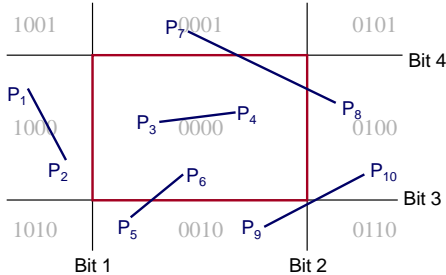
- Use simple tests to classify easy cases first



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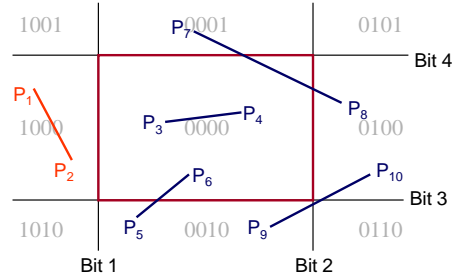
Cohen Sutherland Line Clipping

- Classify some lines quickly by AND of bit codes representing regions of two endpoints (must be 0)



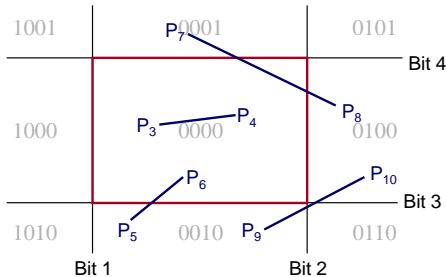
Cohen Sutherland Line Clipping

- Classify some lines quickly by AND of bit codes representing regions of two endpoints (must be 0)



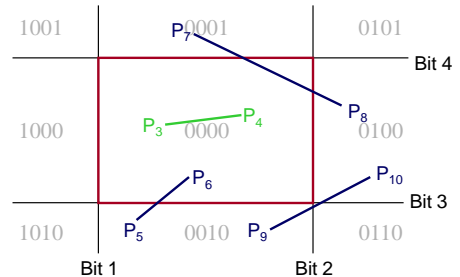
Cohen Sutherland Line Clipping

- Classify some lines quickly by AND of bit codes representing regions of two endpoints (must be 0)



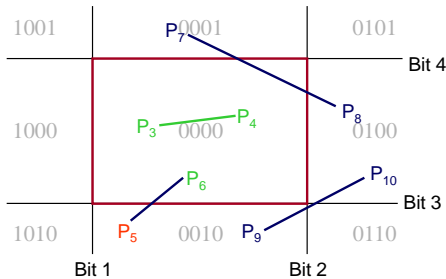
Cohen Sutherland Line Clipping

- Classify some lines quickly by AND of bit codes representing regions of two endpoints (must be 0)



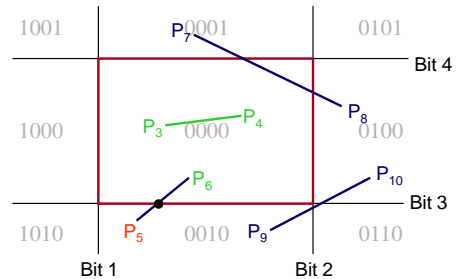
Cohen-Sutherland Line Clipping

- Compute interesections with window boundary for lines that can't be classified quickly



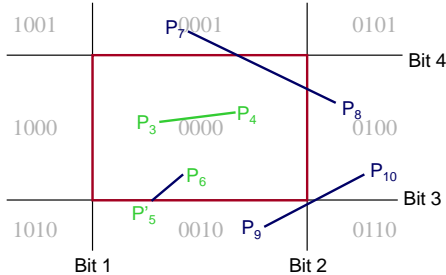
Cohen-Sutherland Line Clipping

- Compute interesections with window boundary for lines that can't be classified quickly



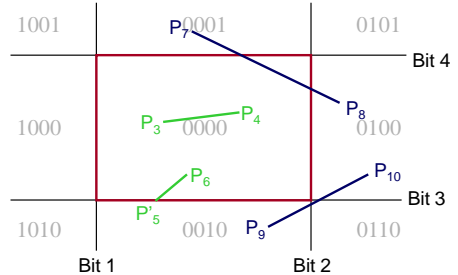
Cohen-Sutherland Line Clipping

- Compute intersections with window boundary for lines that can't be classified quickly



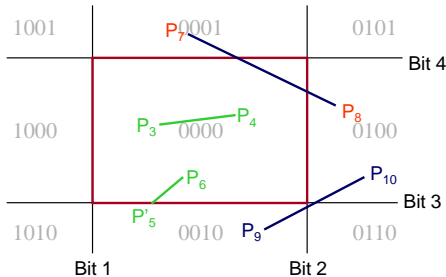
Cohen-Sutherland Line Clipping

- Compute intersections with window boundary for lines that can't be classified quickly



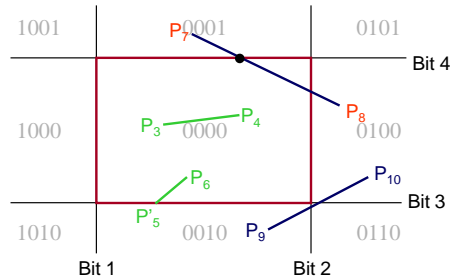
Cohen-Sutherland Line Clipping

- Compute intersections with window boundary for lines that can't be classified quickly



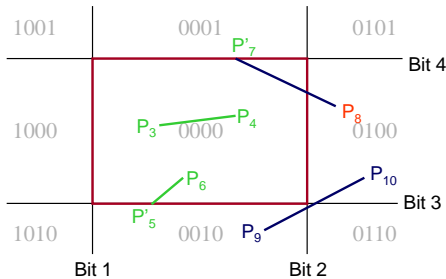
Cohen-Sutherland Line Clipping

- Compute intersections with window boundary for lines that can't be classified quickly



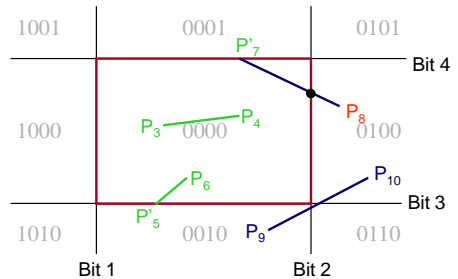
Cohen-Sutherland Line Clipping

- Compute intersections with window boundary for lines that can't be classified quickly



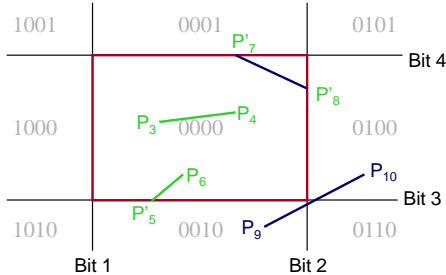
Cohen-Sutherland Line Clipping

- Compute intersections with window boundary for lines that can't be classified quickly



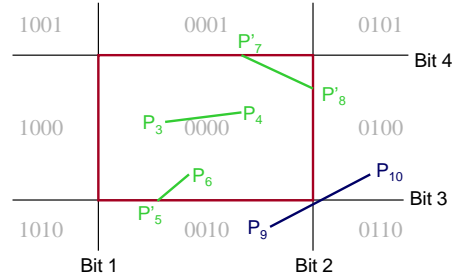
Cohen-Sutherland Line Clipping

- Compute intersections with window boundary for lines that can't be classified quickly



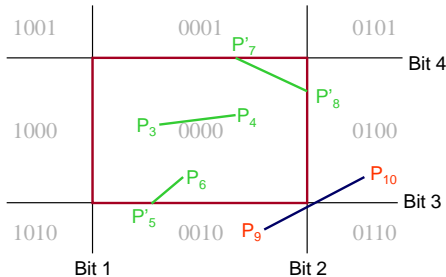
Cohen-Sutherland Line Clipping

- Compute intersections with window boundary for lines that can't be classified quickly



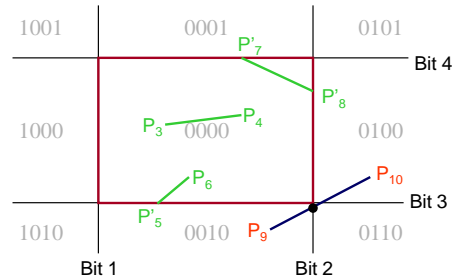
Cohen-Sutherland Line Clipping

- Compute intersections with window boundary for lines that can't be classified quickly



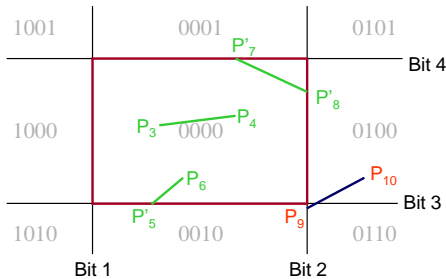
Cohen-Sutherland Line Clipping

- Compute intersections with window boundary for lines that can't be classified quickly



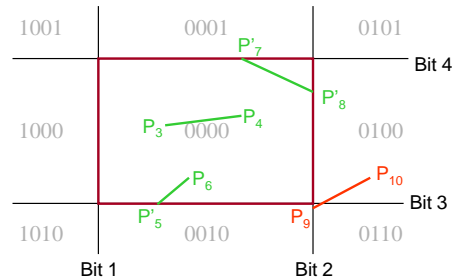
Cohen-Sutherland Line Clipping

- Compute intersections with window boundary for lines that can't be classified quickly



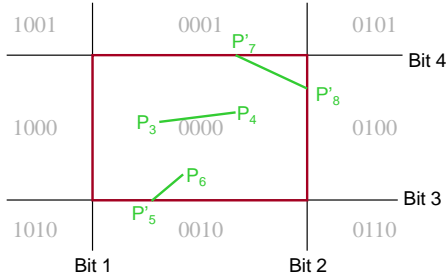
Cohen-Sutherland Line Clipping

- Compute intersections with window boundary for lines that can't be classified quickly



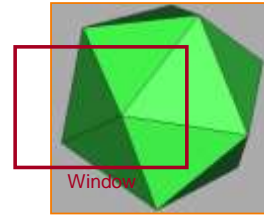
Cohen-Sutherland Line Clipping

- Compute intersections with window boundary for lines that can't be classified quickly



Clipping

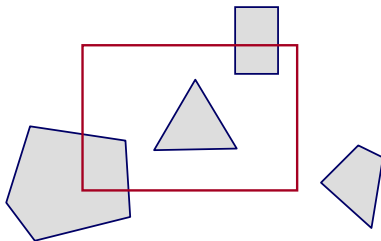
- Avoid drawing parts of primitives outside window
 - Points
 - Lines
 - Polygons
 - Circles
 - etc.



2D Screen Coordinates

Polygon Clipping

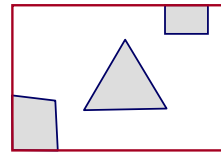
- Find the part of a polygon inside the clip window?



Before Clipping

Polygon Clipping

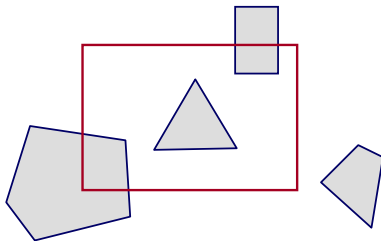
- Find the part of a polygon inside the clip window?



After Clipping

Sutherland Hodgeman Clipping

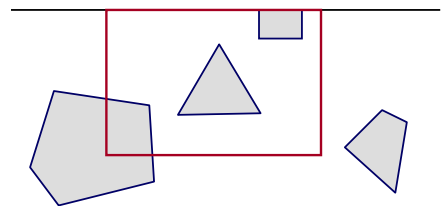
- Clip to each window boundary one at a time



Before Clipping

Sutherland Hodgeman Clipping

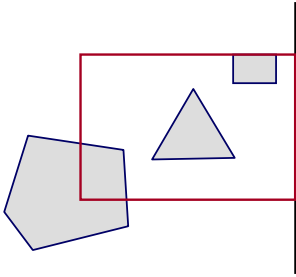
- Clip to each window boundary one at a time



Before Clipping

Sutherland Hodgeman Clipping

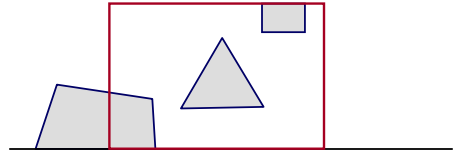
- Clip to each window boundary one at a time



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Sutherland Hodgeman Clipping

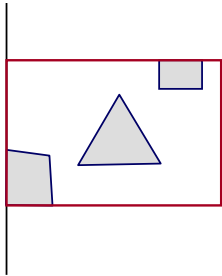
- Clip to each window boundary one at a time



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Sutherland Hodgeman Clipping

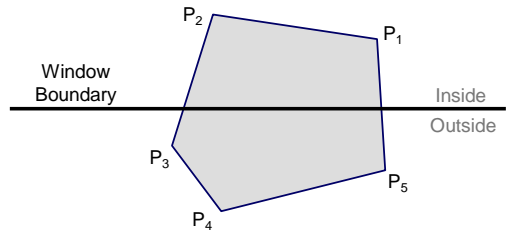
- Clip to each window boundary one at a time



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Clipping to a Boundary

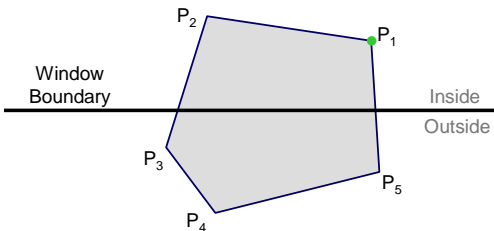
- Do inside test for each point in sequence, Insert new points when cross window boundary, Remove points outside window boundary



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Clipping to a Boundary

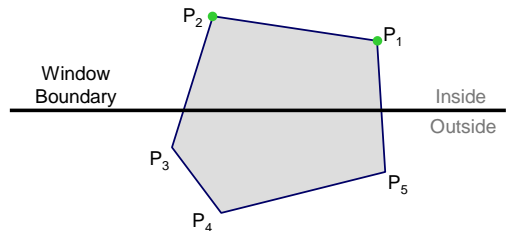
- Do inside test for each point in sequence, Insert new points when cross window boundary, Remove points outside window boundary



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Clipping to a Boundary

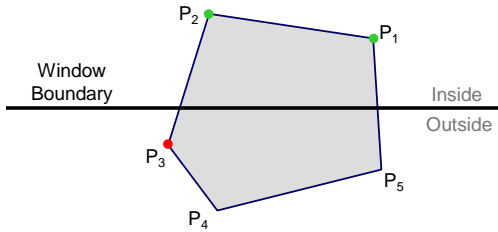
- Do inside test for each point in sequence, Insert new points when cross window boundary, Remove points outside window boundary



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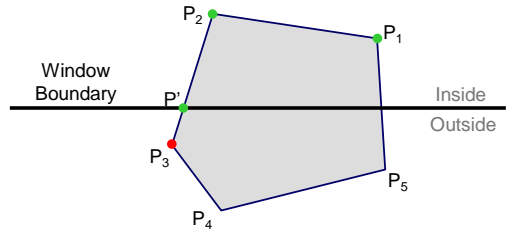
Clipping to a Boundary

- Do inside test for each point in sequence, Insert new points when cross window boundary, Remove points outside window boundary



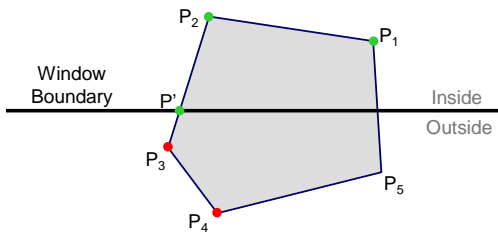
Clipping to a Boundary

- Do inside test for each point in sequence, Insert new points when cross window boundary, Remove points outside window boundary



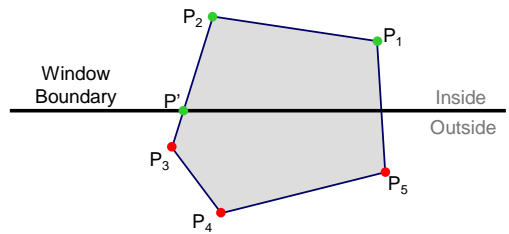
Clipping to a Boundary

- Do inside test for each point in sequence, Insert new points when cross window boundary, Remove points outside window boundary



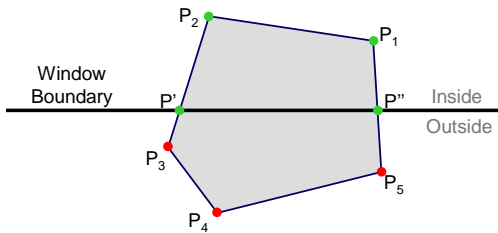
Clipping to a Boundary

- Do inside test for each point in sequence, Insert new points when cross window boundary, Remove points outside window boundary



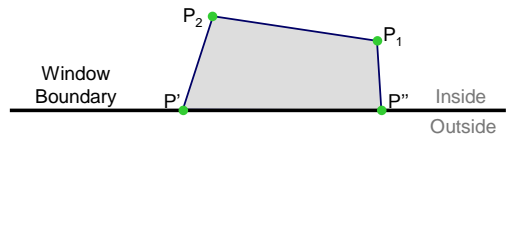
Clipping to a Boundary

- Do inside test for each point in sequence, Insert new points when cross window boundary, Remove points outside window boundary

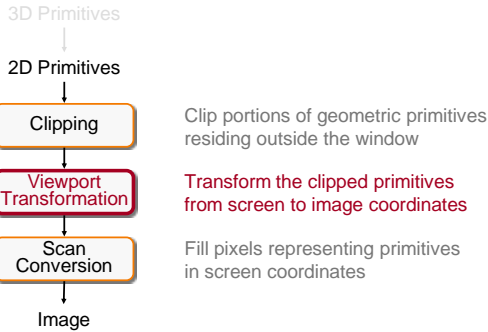


Clipping to a Boundary

- Do inside test for each point in sequence, Insert new points when cross window boundary, Remove points outside window boundary

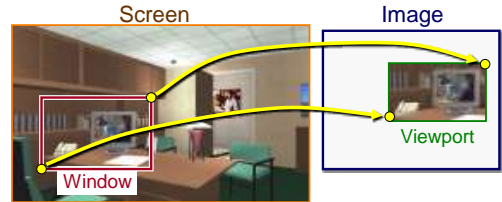


2D Rendering Pipeline



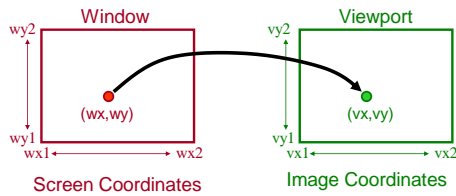
Viewport Transformation

- Transform 2D geometric primitives from screen coordinate system (normalized device coordinates) to image coordinate system (pixels)



Viewport Transformation

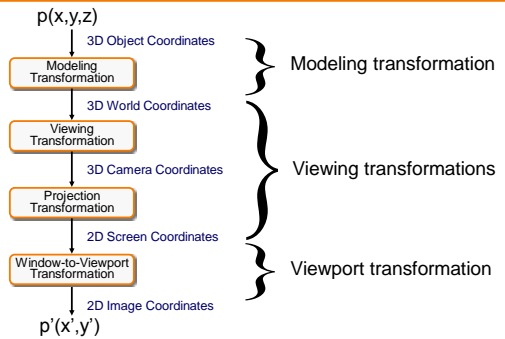
- Window-to-viewport mapping



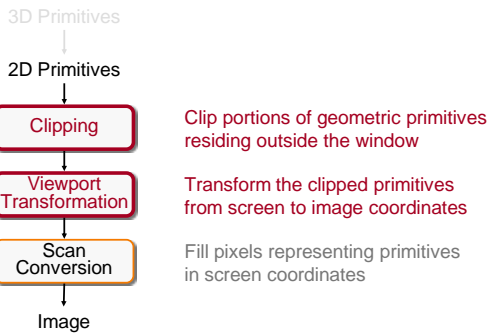
$$vx = vx1 + (wx - wx1) * (vx2 - vx1) / (wx2 - wx1);$$

$$vy = vy1 + (wy - wy1) * (vy2 - vy1) / (wy2 - wy1);$$

Summary of Transformations



Summary



Summary

