

Clipping

Clipping is the term used in computer graphics for cutting off basic objects at the edge of a desired screen section or window. A window can be any polygon.

Rectangular window

Given are the two endpoints of a line $P = (x_p, y_p)$, $Q = (x_q, y_q) \in \mathbb{R}^2$ and a window $\Omega = [x_{min}, x_{max}] \times [y_{min}, y_{max}] \subset \mathbb{R}^2$. The aim now is to determine the part of the line that is within the rectangular window.

There are four possible cases:

1. P and Q are in the rectangular window: Draw the entire straight line (red line in Fig. 1).
2. P and Q lie outside the rectangular window, but the straight line runs partly through the rectangular window: The two intersection points have to be calculated and the part between the two intersection points has to be drawn (green line in Fig. 1).
3. P and Q are in the window and the other point is outside. In this case, the part from the point in the window to the intersection with the window edge is drawn (blue line in Fig. 1).
4. P and Q lie outside the window in such a way that there is nothing to draw (yellow line in Fig. 1).

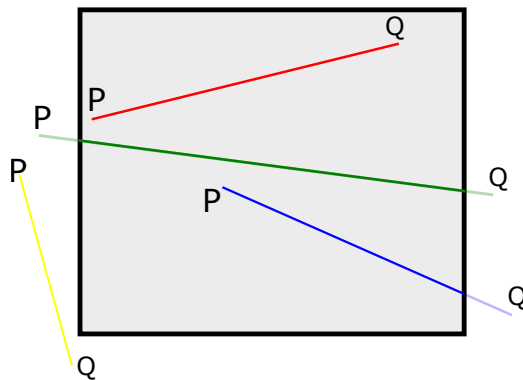


Figure 1: Case 1-4 for a rectangular clipping window.

Such problems are solved by the algorithms of *Cohen-Sutherland* [3], *Cyrus-Beck* [1] and *Liang-Barsky* [5].

Any polygons

Again there is a distance with endpoints P and Q as in Section . For the calculation of the parts, which lie within a polygon, the intersection points of the distance with the polygon window are determined under consideration of the *Inside Test* [2] and the *Max-Min Test* [4] . This procedure is performed by the *Scanline algorithm* for line by line drawing of polygons. Line by line points P and Q with $y_p = y_q$ are selected, which are located to the left or right of the polygon. By clipping this line to the polygon, the polygon portion of a complete line to be drawn is created line by line.

Polygon clipping

Polygon clipping is the clipping of any polygon with respect to a rectangular window or any polygon. Various situations occur:

- Edges of the polygon must be clipped completely, partially or not at all,
- new edges must be included,
- a polygon can become several polygons during clipping.

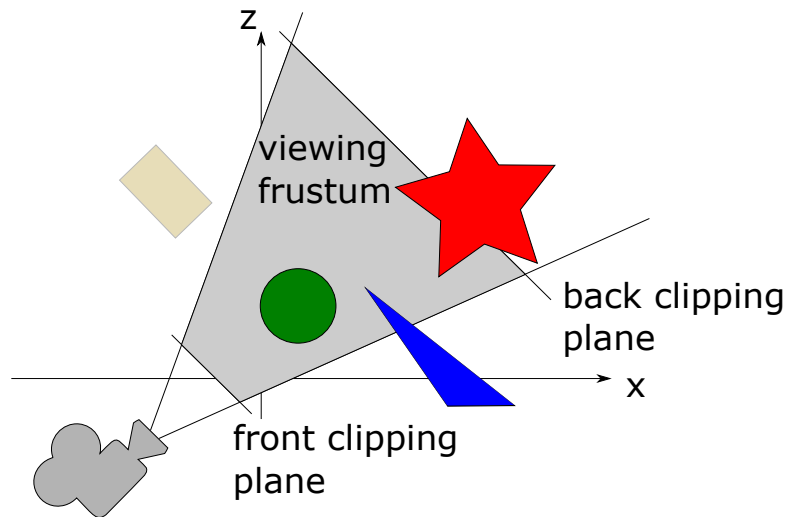


Figure 2: A visual volume (i.e. a *viewing frustum*, here light gray) that is limited by the clipping planes.

These problems are covered by the *Sutherland-Hodgman's algorithm* [6]. It considers a polygon to be a sequence of points that it processes and then

- includes the point,
- recalculates the point as the intersection of the polygon with the window polygon,
- removes the point.

Clipping plane

In 3D computer graphics, a clipping plane is a plane that limits the visible partial volume of the scene (visible volume) laterally to the viewing direction as shown in Fig. 2.

A distinction is made between different clipping levels:

- The front clipping plane (Near Clipping Plane) is the plane that limits the field of view at close range. This plane faces away from the viewer with its front side. All objects in front of the front clipping plane are too close to or behind the viewer.
- The rear clipping plane (Far Clipping Plane) is the plane that limits the field of view in the distance. The front side of this plane points to the viewer. All objects behind the rear clipping layer are too far away to be seen.

References

- [1] Mike Cyrus and Jay Beck. Generalized two-and three-dimensional clipping. *Computers & Graphics*, 3(1):23–28, 1978.
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- [4] Eric Haines. *'Point in Polygon Strategies' in Graphics Gems IV*. 1994.
- [5] You-Dong Liang and Brian A. Barsky. A new concept and method for line clipping. *ACM Transactions on Graphics (TOG)*, 3(1):1–22, 1984.
- [6] Ivan E Sutherland and Gary W Hodgman. Reentrant polygon clipping. *Communications of the ACM*, 17(1):32–42, 1974.