Clipping

1 Purpose

Processing fragments takes time. In large scenes, many polygons project partially or completely outside the viewport or are outside or stick out of the viewing volume. Such primitives or their parts which stick out do not need be scan-converted.

Clipping allows to compute the (parts of) primitives which are inside the viewing volume or viewport. Mathematically speaking, this is equivalent to computing intersection of a triangle with the view volume (if clipping is done before projection in 3D).

2 Pipeline approach

The view volume is an intersection of six half-spaces, defined by the view. The problem of computing intersection of a triangle and the view volume can be reduced to the problem of computing intersection of a convex polygon with a half-space. Basically, to clip against view volume we need to clip against each of the 6 half-spaces which define it. Note that the result of clipping a convex polygon has to be convex (intersection of convex sets is convex), so we'll focus on convex polygons here.

2.1 Clipping a polygon against half-space

Note that clipping a polygon may potentially change its number of edges. To list the vertices of a polygon clipped against a half-space we need to do the following. Walk around the boundary of the polygon, starting from some vertex until you return back to that very vertex. Whenever you encounter a vertex which is inside the half-space, output it. Do not output vertices which are outside the half-space. Also, whenever the line bounding the half-space is crossed, output the crossing point. This should be implemented in such a way that the intersection point is computed only when it exists (endpoints of the edge are on different sides of clipping plane). See Figure 1 for an example.

2.2 The clipping pipeline

The procedures for clipping a polygon against a half-space can be put together in a pipeline as shown in Figure 2.

2.3 Clipping against a view volume

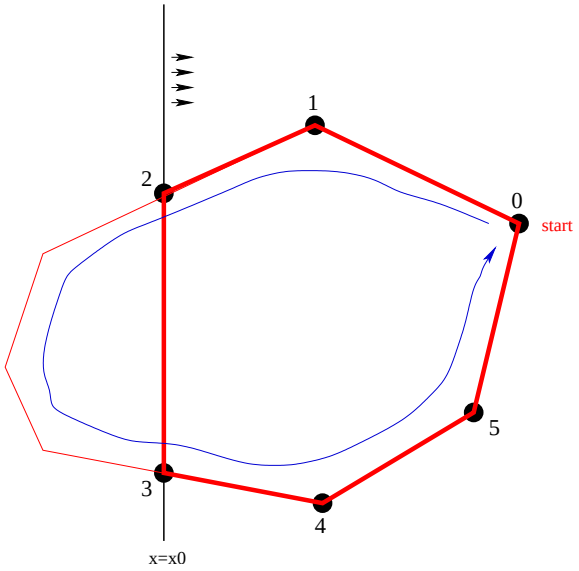

Figure 1: Clipping a polygon against a halfplane. Thick red lines show the clipped polygon; the black dots are the output vertices and crossings i.e. the vertices of the clipped polygon, with the numbers indicating their order.

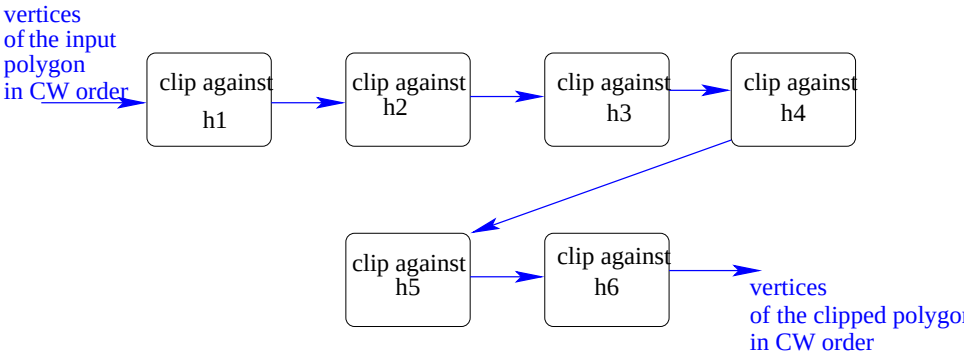

Figure 2: Clipping a polygon against a view volume using the procedures for clipping against half-spaces as pipeline stages.