

Tutorial 5 – Clipping

Exercise 1.

Given:

- a triangle with screen coordinates $v_0 = (-2,1)$, $v_1 = (1,-1)$ and $v_2 = (4,4)$
- a screen with a resolution of 512x384 pixels.

- a) Calculate the intersections of the triangle with the left side of the screen.
- b) Use Sutherland-Hodgeman to clip the triangle against the left side of the screen.
- c) Calculate the intersections of the n-gon obtained in b) with the top of the screen.
- d) Use Sutherland-Hodgeman to clip the triangle against the top of the screen.

Note: as usual, it helps to draw a sketch of the situation.

Exercise 2.

Given:

- a triangle with screen coordinates $v_0 = (-512,0)$, $v_1 = (640,-64)$ and $v_2 = (512,999)$
- a screen with a resolution of 512x384 pixels.

Determine the clipped n-gon that remains after clipping it to the screen boundaries.

Exercise 3.

Given:

- a plane defined as $\frac{3}{7}x + \frac{2}{7}y + \frac{6}{7}z + 2 = 0$
- a triangle with vertex coordinates $v_0 = (0,0,0)$, $v_1 = (3,1,4)$ and $v_2 = (-3,0,-2)$

- a) Calculate the signed distances of the three vertices to the plane.
- b) Calculate the intersection points of the triangle edges and the plane.
- c) Determine the clipped n-gon on the positive side of the plane.
- d) Determine the clipped n-gon on the negative side of the plane.

Exercise 4.

Given:

- a z-buffer which stores depths as $\frac{2^{32}-1}{-z+1}$
 - a view frustum with near and far planes $n = 0$ and $f = 2^{32} - 1$.
- a) Calculate the resolution of the z-buffer at the near clipping plane, i.e. the camera-space distance between two unique values in the z-buffer.
- b) What happens to accuracy at the far clipping plane?

Exercise 5.

Given:

- a square screen of 512x512 pixels
 - a camera located at the origin
 - a field of view of 45°.
- a) If we do not know the z-value for screen pixel (0,0), it could be anywhere on a line in camera space. Write down the parametric equation for this line.
- b) Likewise, the first column of pixels on the screen (where screen $x = 0$) lies on a plane. Write down the implicit representation of this plane.
- c) An object with an y- and z-position of 1 is bounded by a sphere of radius 3. For which x-positions do we cull the object against the left side of the frustum?

The End

(is near)