Clipping

CS 130

1. Goal of clipping
   - Rasterization is rather expensive
   - Involves doing work for every pixel that is inside each triangle
   - Would be nice to avoid doing this work for pixels that cannot be seen
   - Discard triangles that are outside the canonical viewing volume
   - Cut up triangles that partially leave the canonical viewing volume

   ![Diagram of clipping process]

   - All triangles being rasterized are now fully in the viewing area
   - They might still be behind something.

2. Segment-plane
   - Representation
     - Segment: \( f(s) = p + s(q - p); \ 0 \leq s \leq 1 \)
     - Plane: \( g(x) = (x - r) \cdot n = 0 \) \((g(x) > 0 \text{ is outside})\)
• Cases
  – \( g(p) \leq 0 \) and \( g(q) \leq 0 \): inside
  – \( g(p) > 0 \) and \( g(q) > 0 \): outside
  – Otherwise, the segment intersects the plane

• Intersection location
  – Intersection: \( z \)
  – On segment: \( z = p + s(q - p) \)
  – On plane: \((z - r) \cdot n = 0\)

\[
0 = (z - r) \cdot n \\
= (p + s(q - p) - r) \cdot n \\
= (p - r) \cdot n + s(q - p) \cdot n \\
s = \frac{(r - p) \cdot n}{(q - p) \cdot n}
\]

3. Triangle-plane

• Discard triangle if all vertices outside plane
• Accept triangle if all vertices inside plane
• Otherwise, need to clip triangle
• Compute intersection points (segment-plane intersections)
• Triangulate new region; creates one or two triangles

4. Triangle-box

• Clip against walls one at a time
• May produce many triangles