Hidden Surface Removal

- Object-Space and Image-Space Approaches
- Back-Face Culling
- Z-Buffer Algorithm
- Depth Sort and Painter’s Algorithm

Algorithm Classifications

- Object-Space Methods:
  - Visibility is decided by comparing objects in object-space.
  - e.g. painter’s algorithm.
- Image-Space Methods:
  - Visibility is decided at each pixel position in the projection plane.
  - e.g. Z-Buffer algorithm

Back Face Culling

- A polygon is a back face if $V \cdot N > 0$.
- For OpenGL, $N = (0,0,-1)$

Z-Buffer Algorithm

- Most widely used Image-space algorithm.
- Easy to implement, both in software and hardware.
- Incremental computation.
Z-Buffer Algorithm

- Can be conducted with scan-conversion.
- Assume the plane equation of the triangle is
  \[ ax + by + cz + d = 0 \]
- Let \((x_1, y_1, z_1)\) and \((x_2, y_2, z_2)\) be two points on the triangle.

\[ \Delta x = x_2 - x_1, \Delta y = y_2 - y_1, \Delta z = z_2 - z_1 \]

Then

\[ a \Delta x + b \Delta y + c \Delta z + d = 0 \]

Since \( \Delta x = 1, \Delta y = 0 \), then \( \Delta z = -\frac{a}{c} \).

Painter’s Algorithm

- Back-to-front rendering: polygons are sorted by z-coordinates in object space, and are rendered in back-to-front order.

- Need to check for overlapping using BSP tree or Octree.
  - Overlapped triangles need to be spitted.