

Hidden Surface Removal

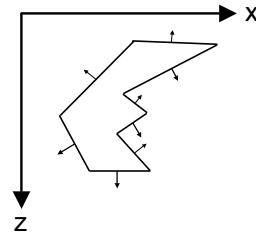
Hidden Surface Removal

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

Algorithm Classifications

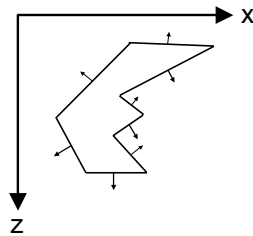
- Object-Space Methods:
 - Visibility is decided by comparing objects in object-space.
 - e.g. painter's algorithm.
- Image-Space Methods:
 - Visibility is decided at each pixel position in the projection plane.
 - e.g. Z-Buffer algorithm

Back Face Culling



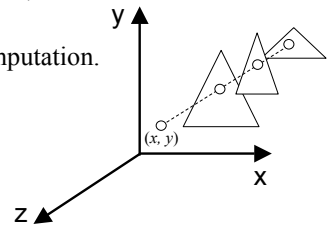
Back Face Culling

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

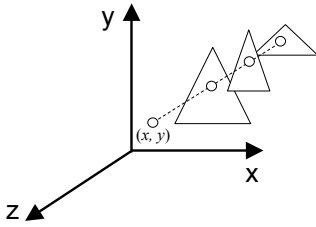


Z-Buffer Algorithm

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



Z-Buffer Algorithm



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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.

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

$$\text{then } a \Delta x + b \Delta y + c \Delta z + d = 0$$

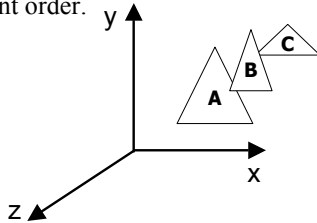
$$\text{since } \Delta x = 1, \Delta y = 0, \text{ then } \Delta z = -a/c.$$

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Painter's Algorithm

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

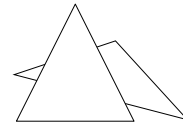


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Painter's Algorithm

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



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