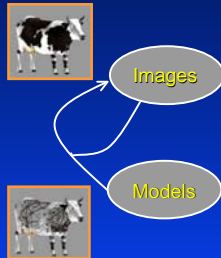


Geometry Graphics Pipeline

- Conventional Computer Graphics

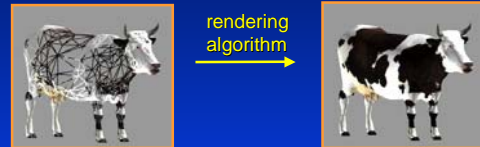


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Rendering Images

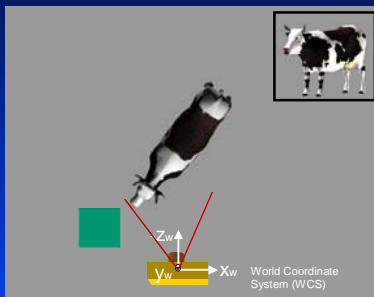
Geometric model

Picture



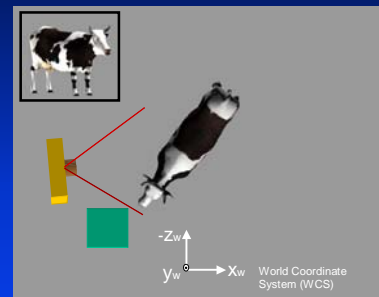
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The Visualization Problem



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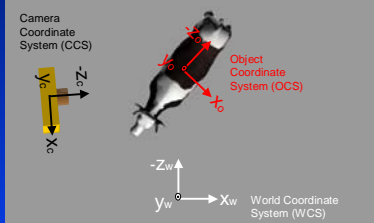
The Visualization Problem



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The Visualization Problem

Need to change coordinate systems!



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Geometric Models

- Polygonal Meshes (triangles - most common)
- Curved surfaces (e.g., Bezier)
- Implicit (e.g., sphere equation:

$$(x-x_c)^2 + (y-y_c)^2 + (z-z_c)^2 - r^2 = 0$$

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Triangular Meshes

- Why Triangles?

- Planar polygon

- Simplifies hardware design and implementation
 - Bilinear interpolation produces reasonable results for several attributes (e.g., color and depth)
 - Curved surfaces can be arbitrarily approximated by polygonal representations



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Rendering Pipeline

Z-buffer and Gouraud shading



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Rendering Pipeline



- Map from WCS to CCS
- Culling (vf, bf)
- Lighting

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Rendering Pipeline

Z-buffer and Gouraud shading



- Map from WCS to CCS
- Culling (vf, bf)
- Lighting
- Map from CCS to Screen CS
- Clipping
- Persp. division

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Rendering Pipeline



- Map from WCS to CCS
- Culling (vf, bf)
- Lighting
- Map from CCS to Screen CS
- Clipping
- Persp. division
- Color
- Visibility

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Rendering Pipeline



- Map from WCS to CCS
- Culling (vf, bf)
- Lighting
- Map from CCS to Screen CS
- Clipping
- Persp. division
- Color
- Visibility
- FB display

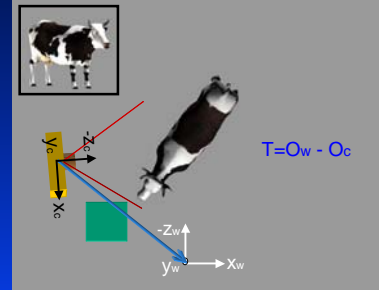
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Geometry Processing

- Map from WCS to CCS
- Culling
- Lighting

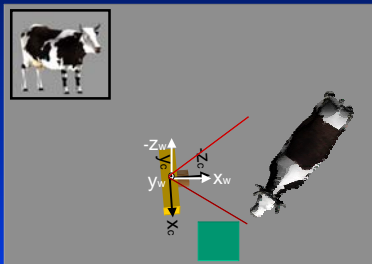
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Equivalent Views: View 1



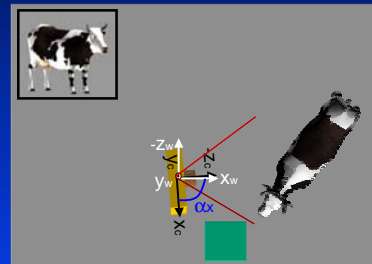
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Equivalent Views: View 2



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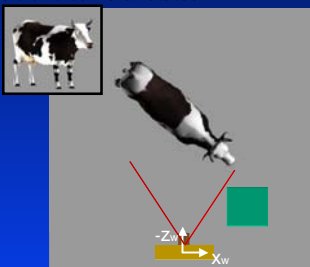
Angle between Frames



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Equivalent Views: View 3

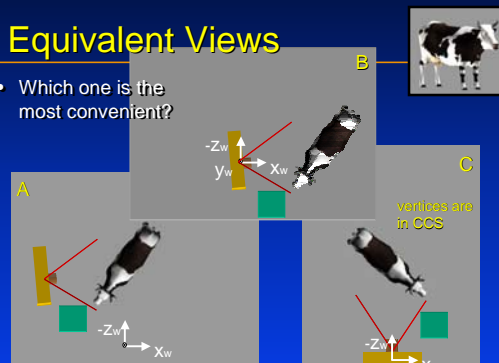
- Objects and camera rotated



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Equivalent Views

- Which one is the most convenient?



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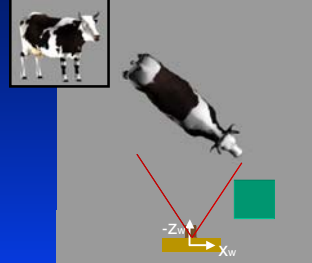
OpenGL Conventions

- Right-hand coordinate systems (world and camera)
- World and Camera coordinate systems aligned (camera at the origin)
- Translating and rotating the camera is equivalent to translating and rotating the scene (objects) in the opposite sense.

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Culling

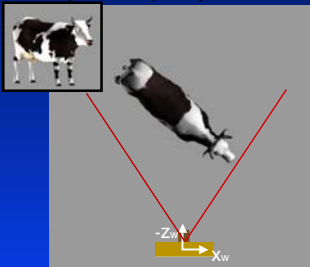
- Reduces the amount of primitives to be rendered



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View Frustum Culling

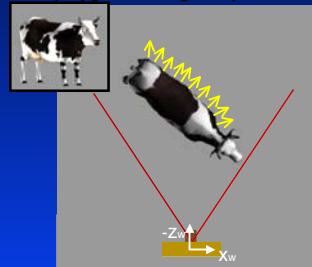
- Removes objects completely outside of the field of view



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Back Face Culling

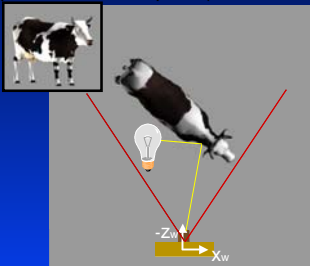
- Removes polygons facing away from the viewer



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Lighting

- Computed in camera space (or in an isomorphic space)



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Why?