

Hidden Surface Removal (visibility)

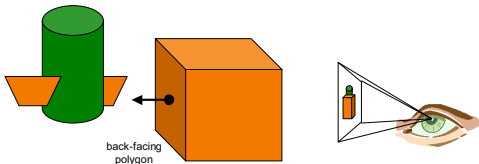
Adam Finkelstein
Princeton University
COS 426, Fall 2001

Overview

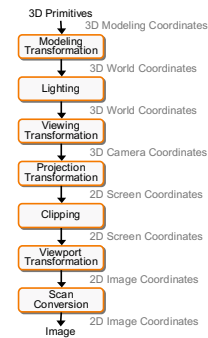
- Motivation
- Algorithms for HSR
 - Back-face detection
 - Depth sort
 - Ray casting
 - Scan-line
 - Z-buffer
 - Area subdivision
- Tradeoffs

Motivation

- Surfaces may be back-facing.
- Surfaces may be occluded.
- Surfaces may overlap in the image plane.
- Surfaces may intersect.



3D Rendering Pipeline



Somewhere in here we have to decide which objects are visible, and which objects are hidden.

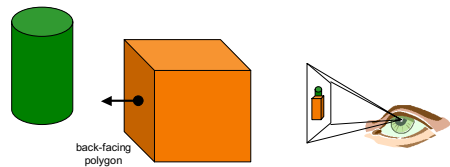
Overview

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Back-face detection

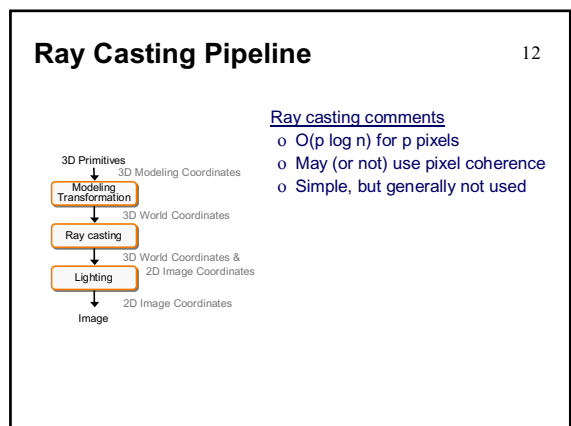
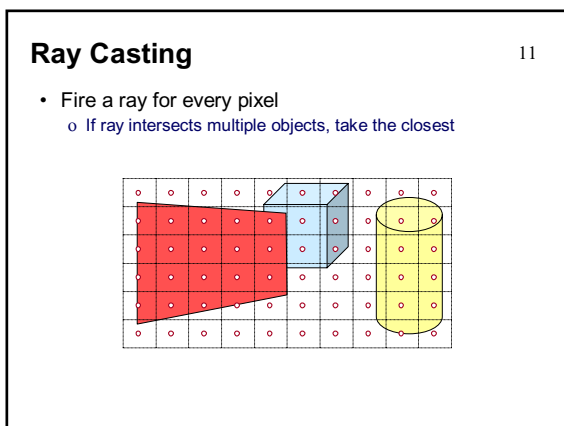
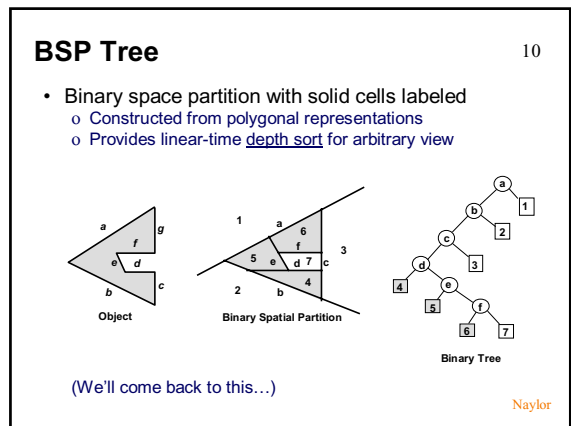
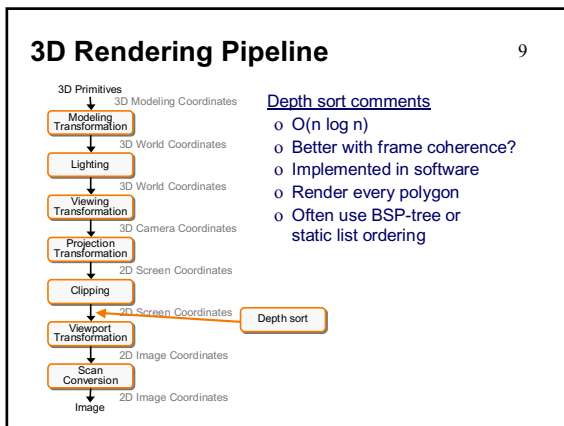
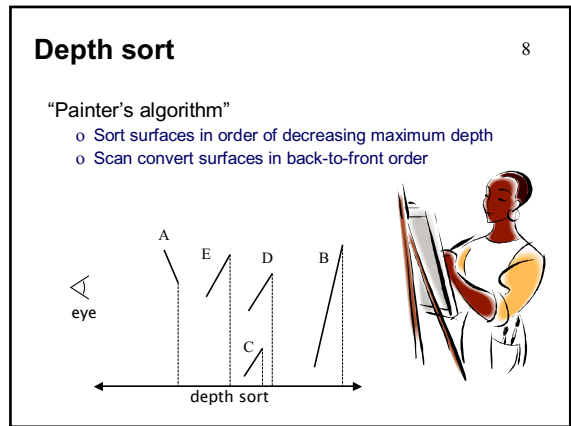
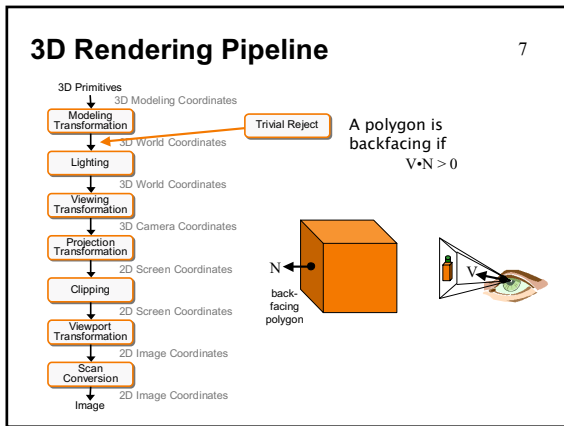
Q: When does this method break down?

A: More than one object. Object not closed. Interreflect?



Q: How do we test for back-facing polygons?

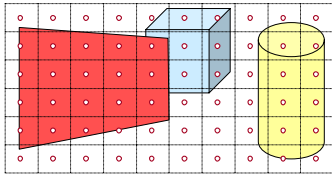
A: Dot product of the normal and view directions.



Z-Buffer

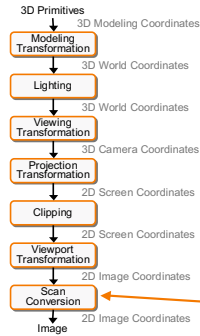
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- Store color & depth of closest object for every pixel
 - Update only pixels whose depth is closer than in buffer
 - Depths are interpolated from vertices, just like colors



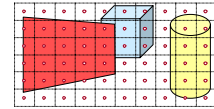
3D Rendering Pipeline

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Z-buffer comments

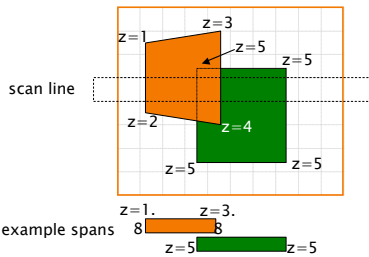
- Polygons rasterized in any order
- Requires lots of memory
 - 1K x 1K x 24bits
 - Was expensive, cheap now
- Subject to aliasing (A-buffer)
- Commonly in hardware



Scan-Line Algorithm

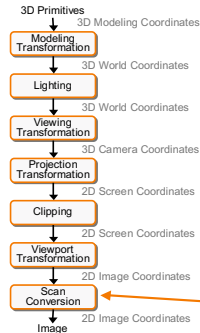
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- For each scan line, construct spans
 - Sort by depth



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Scan-line comments

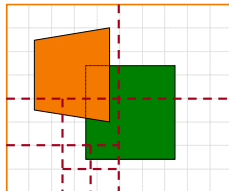
- Fully compute only visible pixels
- Coherence among along scans
- Commonly in software

Area Subdivision

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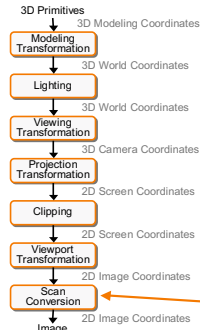
Warnock's algorithm

- Fill area if:
 - » All surfaces are outside area,
 - » Only one surface intersects area,
 - » One surface occludes other surfaces in area
- Otherwise, subdivide



3D Rendering Pipeline

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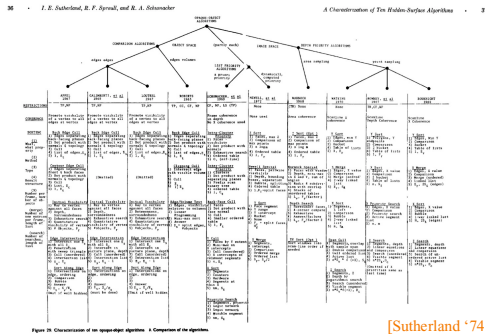


Area subdivision comments

- Augments scan conversion
- Polygon coherence
- Commonly in software

Algorithms for HSR

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[Sutherland '74]

Conclusions

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Algorithms for HSR

- o Back-face detection
- o Depth sort
- o Ray casting
- o Scan-line
- o Z-buffer
- o Area subdivision
- Where in pipeline?
- Hardware / Software?
- Trends in hardware.