Ray Tracing II

About Assignment 1

• Start from module definitions (C/C++ header files).
• A good chance to learn C++.
• Late Penalty
  – All assignments due at 23:59'59.99"
  – 10% penalty for each day late

✓ Just Do It
Advanced Ray Tracing

• Make it fast.
• Make it better.
  – Anti-aliasing
  – Distributed Ray Tracing

Make It Fast

• From Pharr’s Chapter 4
  – Object subdivision (i.e., bounding volume)
  – Spatial subdivision (e.g., grid, octree, kd-tree)
  – Ray coherence.
Anti-Aliasing

- Super(or Over)-sampling
- Adaptive vs. Non-adaptive
- Uniform vs. Jittered
- Detail coming in a future lecture

Distributed Ray Tracing

- Published by R. L. Cook in 1984.
- Antialiasing
- Motion blur
- Depth of field (camera)

- Ideas behind other so-called Monte Carlo methods.
Space Partitions

Common Operations in 3D

• Line/object intersection
  – Given a ray or line, which object will it intersect?

• View frustum culling

• Collision detection
Sorting/Indexing in 3D

• Sequential search is too slow for large models.
• How about storing them in a 3D array?
  – Size will be overwhelming
• Think “hierarchy”

Octree

• Divide the space in halves in X/Y/Z.
  – Always split in the middle.
  – You may also consider them as splitting in X, then in Y, then in Z.
• If too many objects are in a partition, divide them again (recursively).
K-D Tree

- More flexible than octree:
  - Not always split in the middle.
  - Split in X, then in Y, then in Z, or any order.

Kd-tree Example

Figure Source: CS638 slides by Stephen Chenney,
University of Wisconsin – Madison,
BSP Trees

• From the paper by Fuchs et al, “On visible surface generation by a priori tree structures” SIGGRAPH 80.
• *Binary Space Partition* trees
  – A sequence of cuts that divide a region of space into two
• Cutting planes can be of any orientation

Drawing Order from BSP Trees

• BSP tress can be used to order polygons from back to front, or visa-versa
  – Descend tree with viewpoint
  – Things on the same side of a splitting plane as the viewpoint are always in front of things on the far side
• Can draw from back to front
  – Gives the correct order for rendering transparent objects with a z-buffer, and by far the best way to do it
• Can draw front to back too.
BSP Example

OBB Tree

- OBB stands for Oriented Bounding Box.
- OBB is a rectangular bounding box at an arbitrary orientation.
- Asymptotically faster for close proximity situations.

Figure Source: CS638 slides by Stephen Chenney, University of Wisconsin – Madison.