Accelerated ray tracing

Reading

Required:

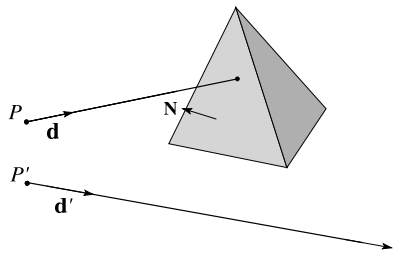
- Watt, sections 12.5.3 – 12.5.4, 14.7

Further reading:

- A. Glassner. An Introduction to Ray Tracing. Academic Press, 1989. [In the lab.]

Faster ray-polyhedron intersection

Let's say you were intersecting a ray with a polyhedron:



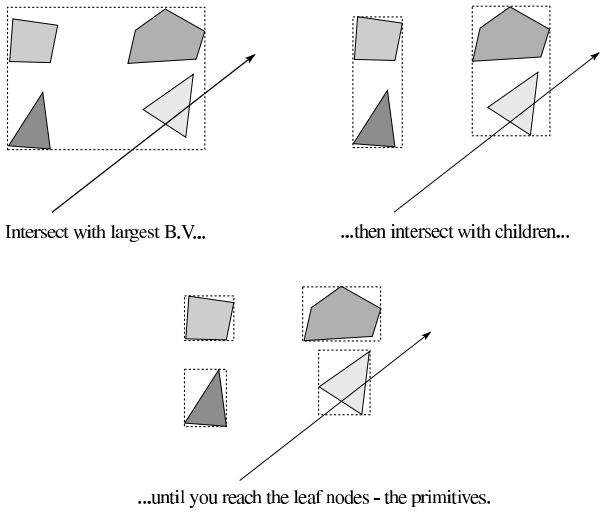
Straightforward method

- intersect the ray with each triangle
- return the intersection with the smallest *t*-value.

Q: How might you speed this up?

Hierarchical bounding volumes

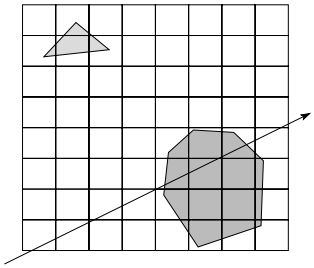
We can generalize the idea of bounding volume acceleration with **hierarchical bounding volumes**.



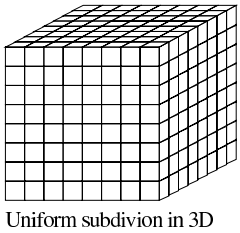
Key: build balanced trees with *tight bounding volumes*.

Uniform spatial subdivision

Another approach is **uniform spatial subdivision**.



Uniform subdivion in 2D



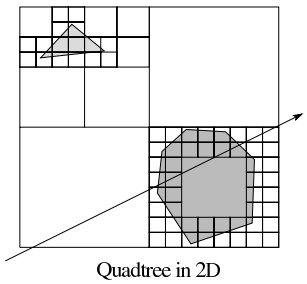
Uniform subdivion in 3D

Idea:

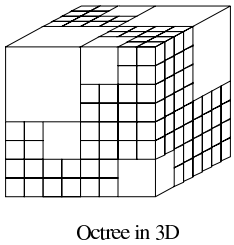
- Partition space into cells (voxels)
- Associate each primitive with the cells it overlaps
- Trace ray through voxel array *using fast incremental arithmetic* to step from cell to cell

Non-uniform spatial subdivision

Still another approach is **non-uniform spatial subdivision**.



Quadtree in 2D



Octree in 3D

Other variants include k-d trees and BSP trees.

Various combinations of these ray intersections techniques are also possible. See Glassner for more.

Summary

What to take home from this lecture:

1. The meanings of all the boldfaced terms.
2. An intuition for how ray tracers can be accelerated.