

# Ray Tracing II

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## 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

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# Advanced Ray Tracing

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

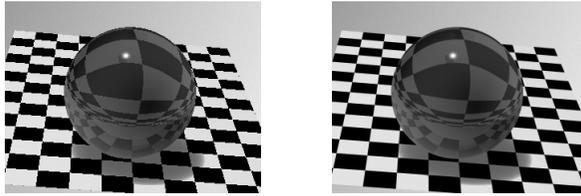
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## Make It Fast

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

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# Anti-Aliasing

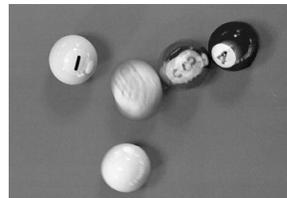


- Super(or Over)-sampling
- Adaptive vs. Non-adaptive
- Uniform vs. Jittered
- Detail coming in a future lecture

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# 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.

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# Space Partitions

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## Common Operations in 3D

- Line/object intersection
  - Given a ray or line, which object will it intersect?
- View frustum culling
- Collision detection

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## 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”

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## 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).

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# K-D Tree

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

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## Kd-tree Example

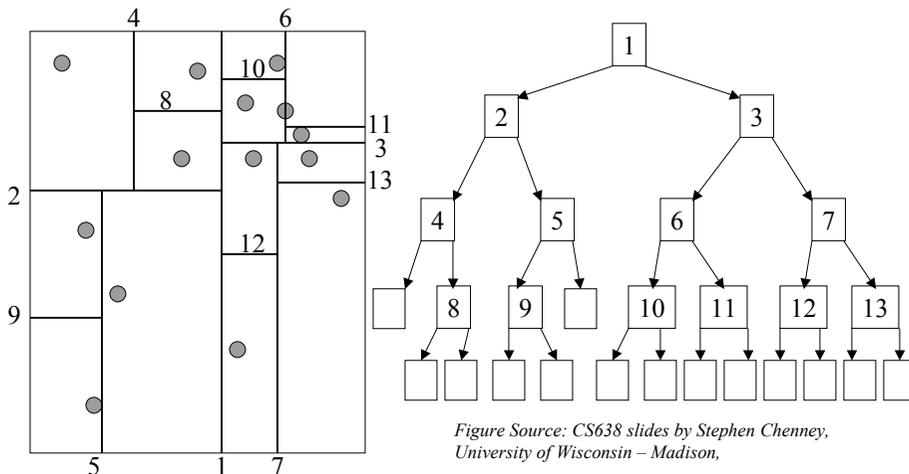


Figure Source: CS638 slides by Stephen Cheney,  
University of Wisconsin – Madison,

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# 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

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# Drawing Order from BSP Trees

- BSP trees 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.

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# BSP Example

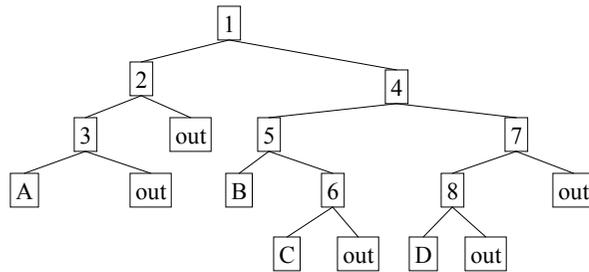
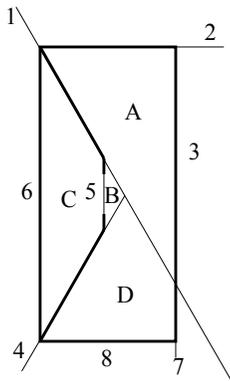
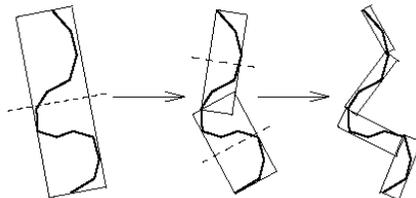


Figure Source: CS638 slides by Stephen Cheney, University of Wisconsin – Madison,

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# OBB Tree

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



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