CS-184: Computer Graphics

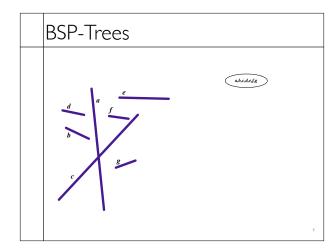
Lecture #7: BSP and AABB Trees

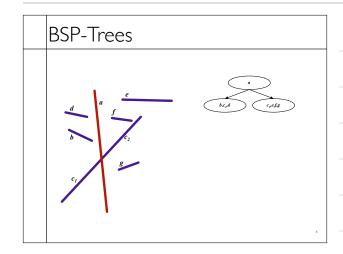
Prof. James O'Brien University of California, Berkeley

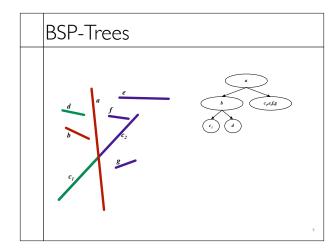
BSP-Trees

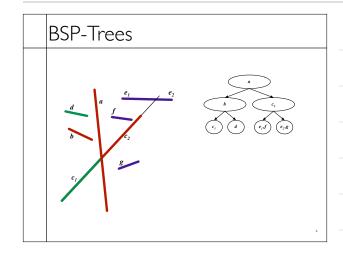
- Binary Space Partition Trees
- Split space along planes
- · Allows fast queries of some spatial relations
- Simple construction algorithm
- Select a plane as sub-tree root
- · Everything on one side to one child
- Everything on the other side to other child
- Use random polygon for splitting plane

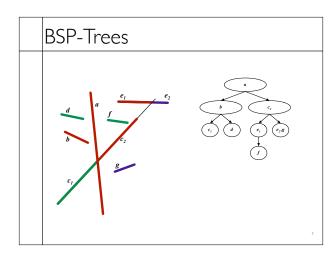
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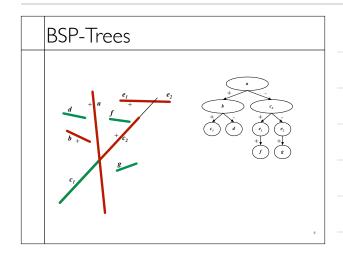








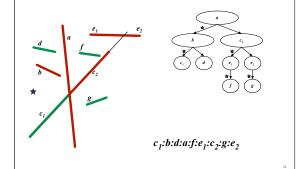




BSP-Trees

- Visibility Traversal
- · Variation of in-order-traversal
- Child one
- Sub-tree root
- Child two
- · Select "child one" based on location of viewpoint
- · Child one on same side of sub-tree root as viewpoint

BSP-Trees



Your Ray Tracer

```
RayTrace(image)
  For ray in camera
    image[pixel] = Trace(ray)

Trace(ray)

  t_hit = infinity
  For object in scene
    t_hit = min(object.intersect(ray), t_hit)
  shade at t_hit
  possible calls to Trace(new_ray)
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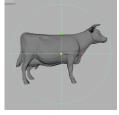
Your Ray Tracer

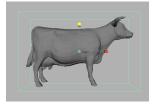
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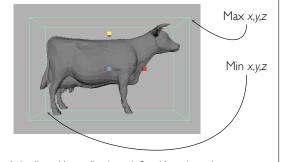
Bounding Shapes



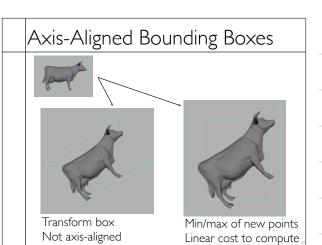


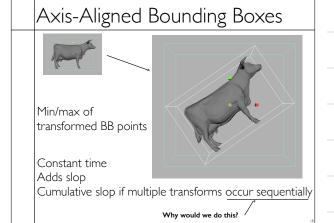
- Bounding shape completely encloses associated object
- Rays cannot hit object w/o intersecting bounding shape
- Two objects cannot collide if shapes don't overlap
- Simplicity -vs- tightness

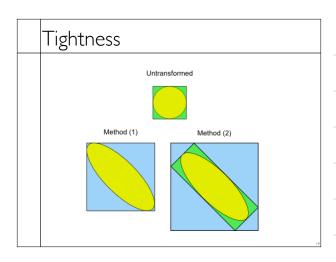
Axis-Aligned Bounding Boxes

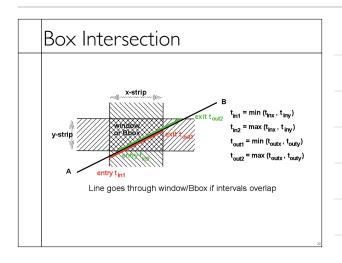


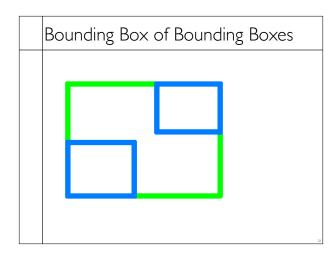
• Axis-aligned bounding box defined by min and max x,y,z

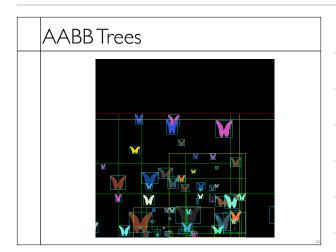


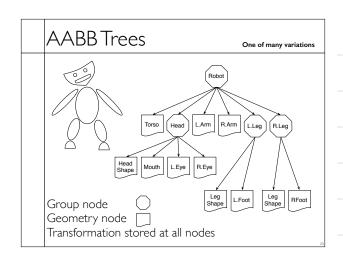


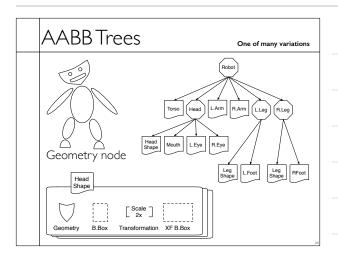


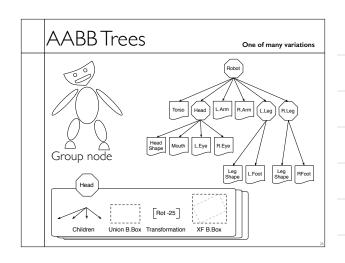


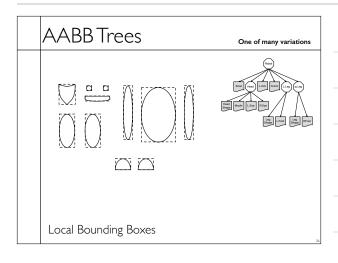


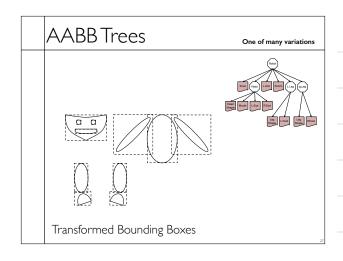


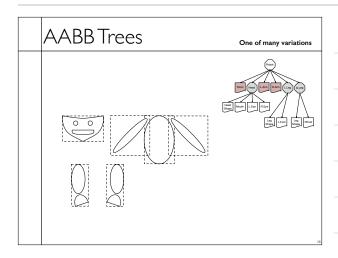


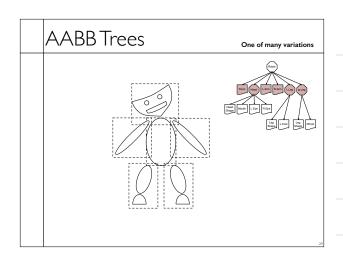


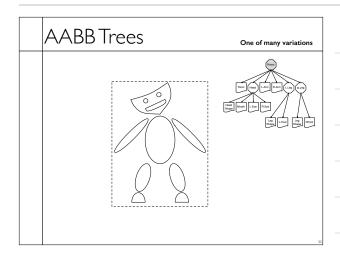












AABB Trees	One of many variations

Ray Test Against Bound Tree

- RayHitSubTree(&ray, node)
- If RayHitsBB(ray, node.xfBB)
- * ixfRay = Inverse(node.xf)*ray
- If RayHitsBB(ixfRay, node.BB)
- * If node is group
- · Foreach child in node.children
- RayHitSubTree(ixfRay,child)
- ·else // node not group
- RayHitGeometry(ixfRay, node.geom)
- ray.collisionInfo.update(ixfRay)

Building the tree • Sort (or QuickSelect) and split on one axis • Repeat for the other axis x,y,z Other Schemes • Uniform Grid/Octrees • Spatial Hierarchies • Etc

