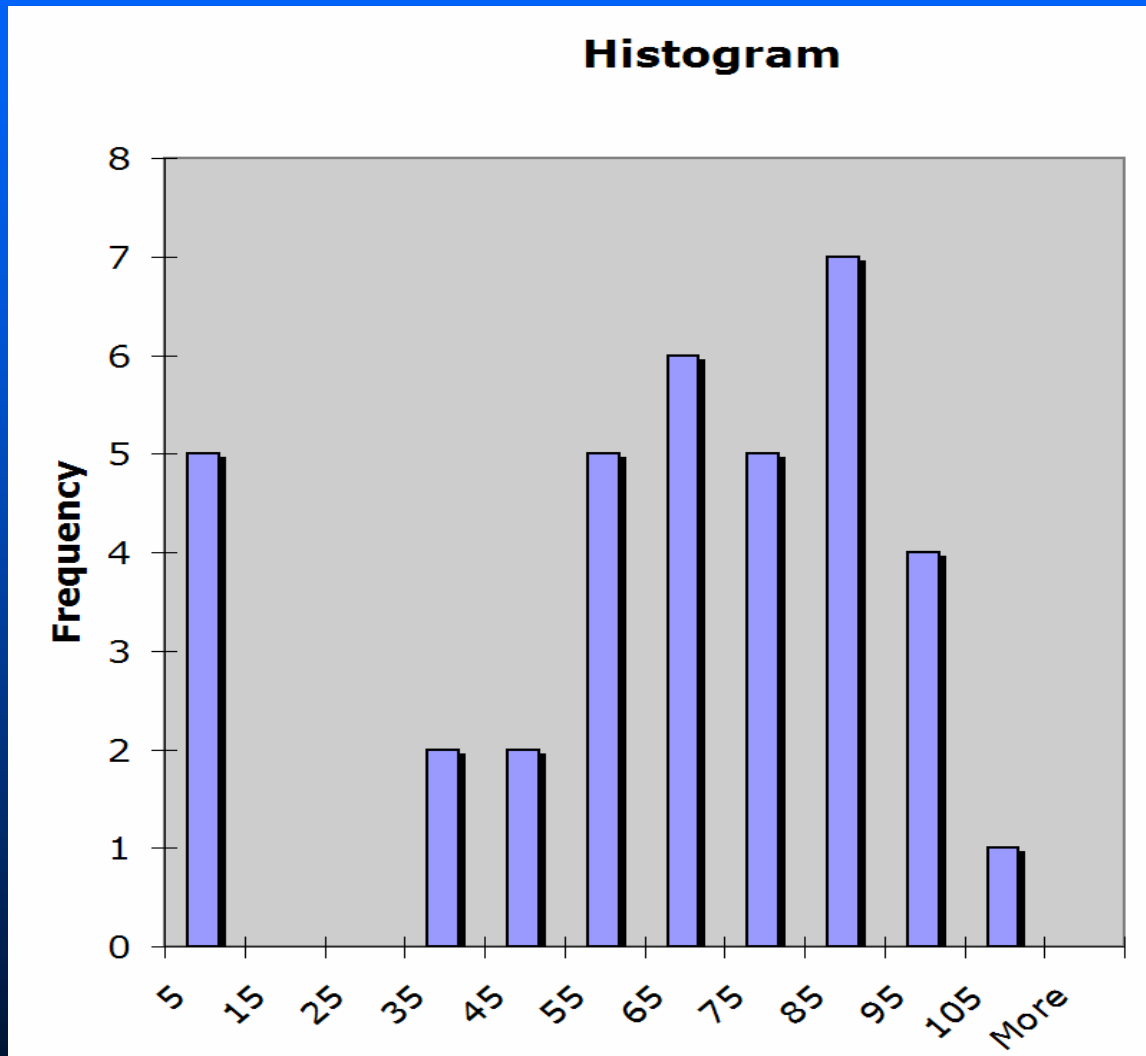


# Spatial Data Structures and Bounding Volume Hierarchies (BVHs)

15-462 : Graphics I  
*Fall 2006*

James Kuffner  
Carnegie Mellon University

# Midterm Exam



$N = 37$

*raw scores:*

range = [0, 90]

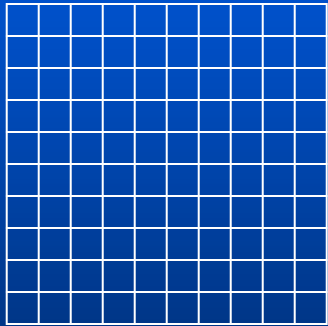
mean = 67.0

*percent:*

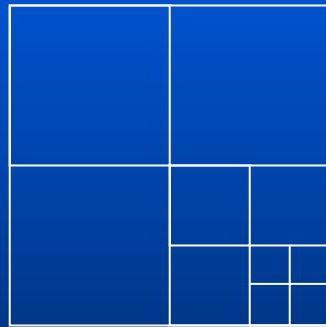
range = [0, 100]

mean = 74.4

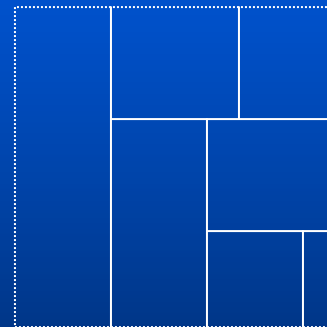
# Spatial Data Structures & Subdivision



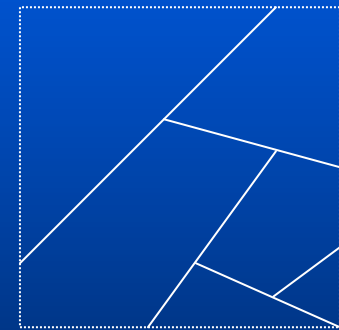
Uniform Spatial Sub



Quadtree/Octree

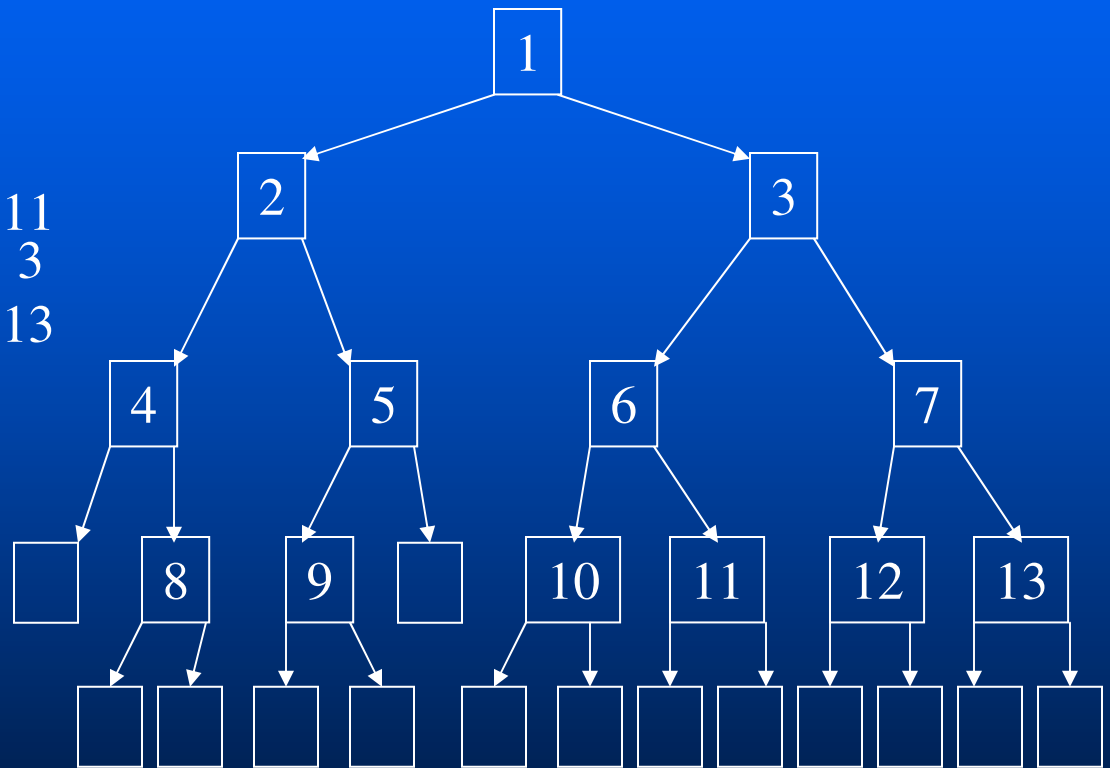
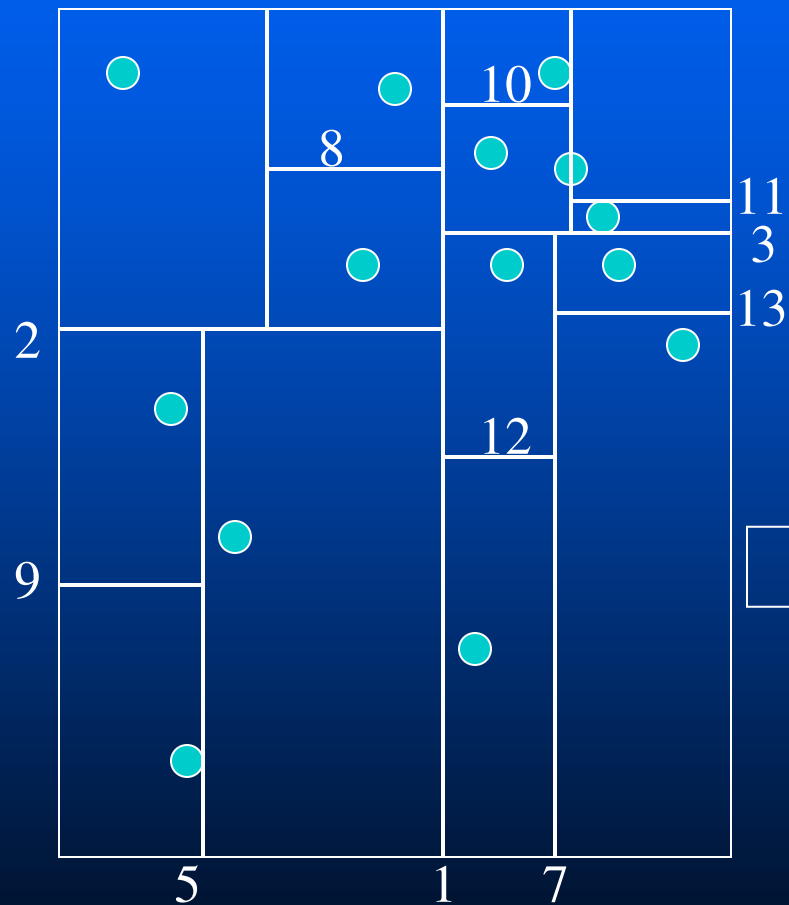


kd-tree



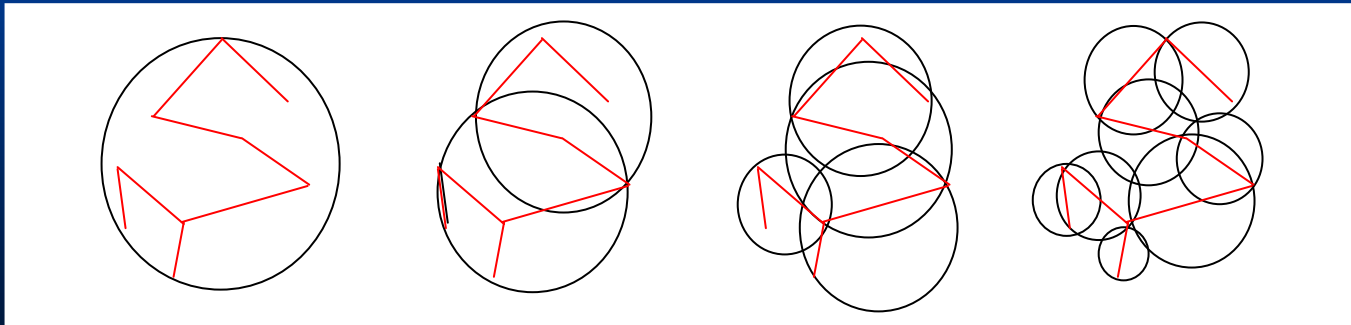
BSP-tree

# kd-tree example



# Bounding Volume Hierarchies

- Model Hierarchy:
  - Simple volume that bounds a set of triangles
  - Nodes bound a subset of the parent's triangles
  - Leaves contain individual triangles
- Sample Binary BVH:



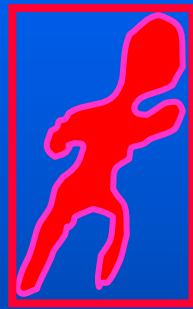
# Example Bounding Volumes

- Spheres
- Ellipsoids
- Axis-Aligned Bounding Boxes (AABB)
- Oriented Bounding Boxes (OBBs)
- Convex Hulls
- $k$ -Discrete Orientation Polytopes ( $k$ -dop)
- Spherical Shells
- Swept-Sphere Volumes (SSVs)

# Trade-off in Choosing BV's



Sphere



AABB



OBB



6-dop



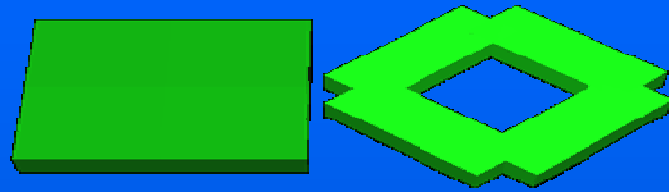
Convex Hull



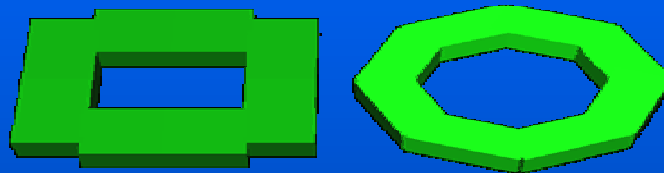
Increasing:

- Complexity
- Tightness of Fit
- Cost of overlap test

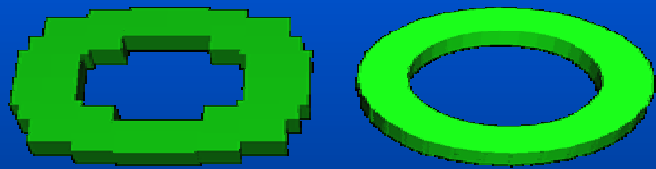
# Example: AABB's vs. OBB's



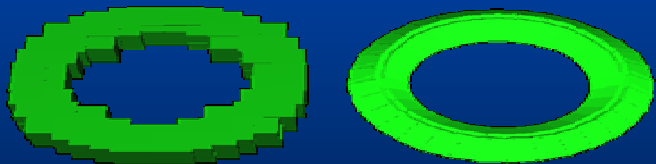
Level-2



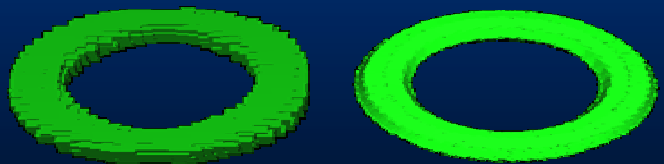
Level-3



Level-5



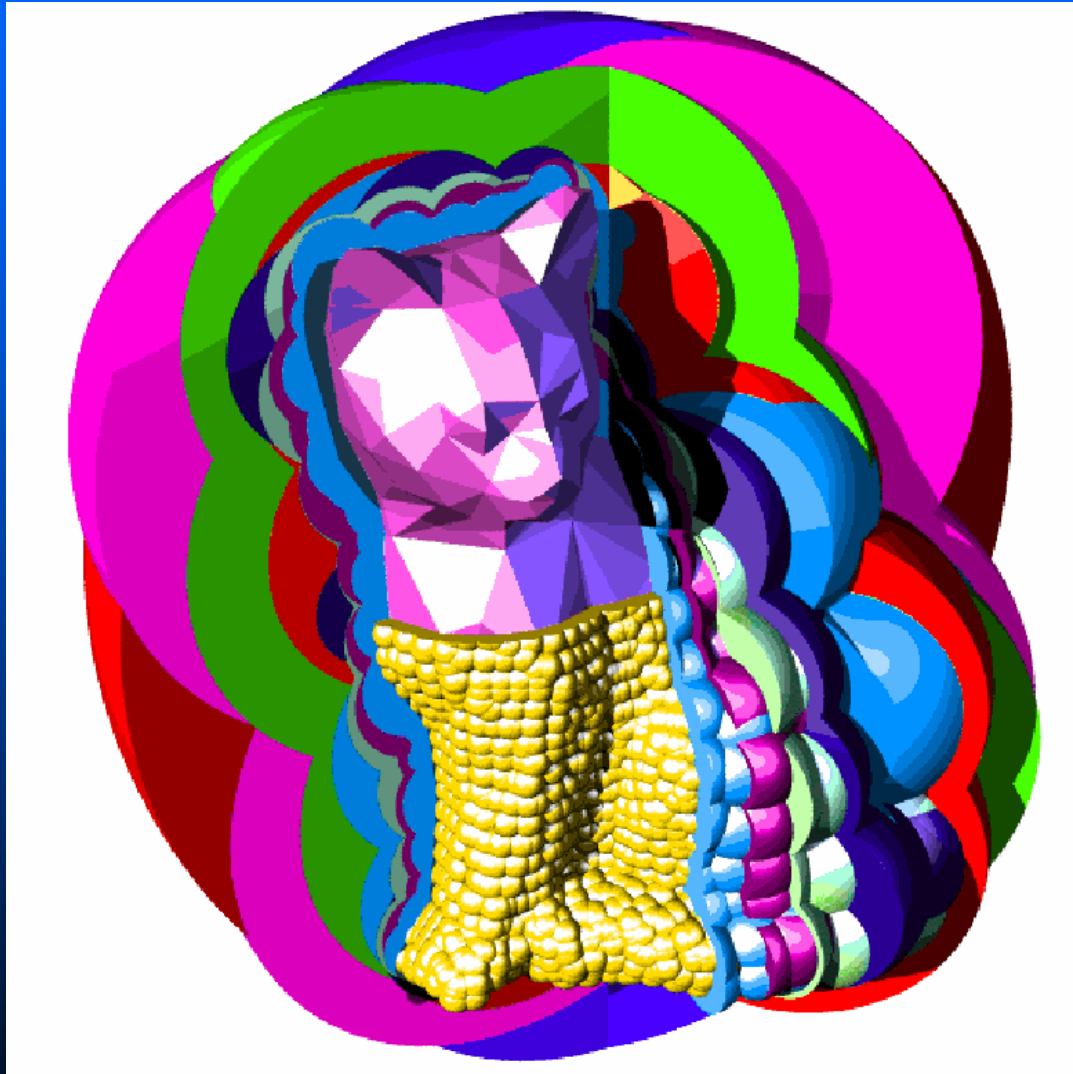
Level-7



Level-9

Approximation  
of a Torus

# Sphere Tree Hierarchy



D. Ruspini

# Some Links and Resources

- University of North Carolina (UNC) at Chapel Hill

<http://gamma.cs.unc.edu/>

<http://www.cs.unc.edu/~geom/collide/>

- Other Collision Detection Resources

<http://www.gamedev.net/>

<http://www.gamasutra.com/>