

Review of Object Representations

Thomas A. Funkhouser

Object Rep Considerations

- ◆ **Accuracy**
 - How well does the representation approximate the object?
- ◆ **Computational Efficiency**
 - How quickly can we generate images from the representation?
 - How quickly can we compute intersections with the rep?
- ◆ **Storage Efficiency**
 - How much data is required to store the representation?
- ◆ **Construction Efficiency**
 - How easy is it to construct the representation from available input data?

Object Rep Overview

- ◆ **Boundary representations**
 - Polygonal meshes
 - Parametric surfaces
 - Subdivision surfaces
 - Algebraic surfaces
- ◆ **Solid representations**
 - Voxels
 - Octrees
 - BSP trees
 - Constructive solid geometry
- ◆ **Composite representations**
 - Scene graphs

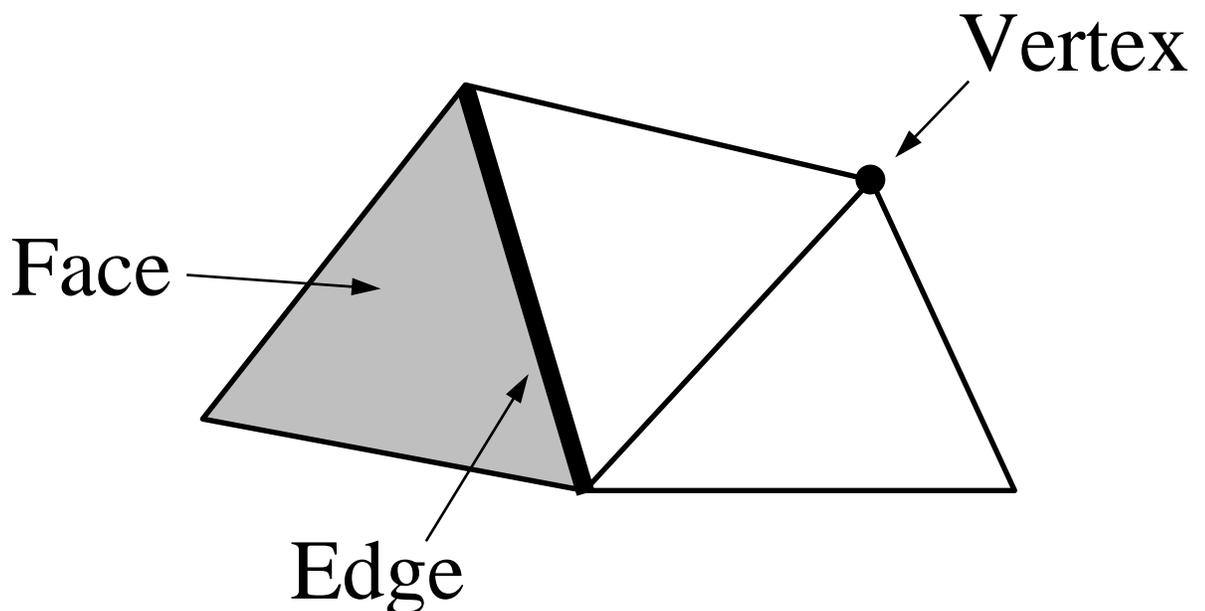
Boundary Representations

◆ Polygonal Meshes:

- + Fast rendering
- Approximate curved surfaces

◆ Mesh Descriptions

- Vertex and Face tables
- Triangle strips
- Adjacency lists
- Winged-edge
- Multiresolution



Boundary Representations

◆ Parametric Surfaces:

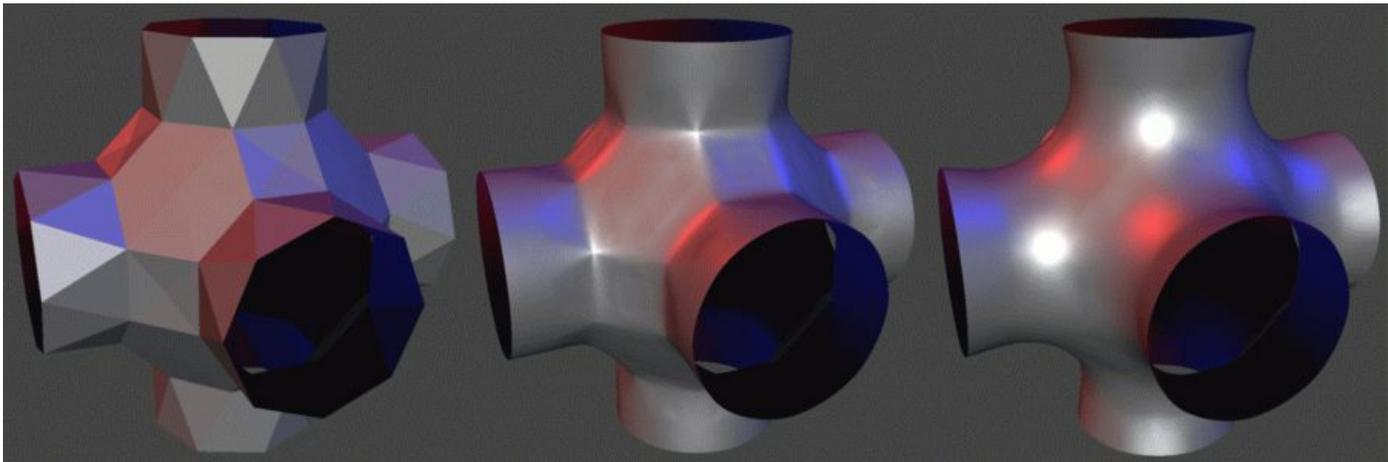
- + More accurate for curved surfaces
- + More concise
- Tessellate for rendering
- Expensive intersections

$$P(u,v) = \sum_{j=0}^m \sum_{k=0}^n p_{i,k} B_{j,m}(v) B_{k,n}(u)$$

Boundary Representations

◆ Subdivision Surfaces

- + Very concise
- Tessellate for rendering
- Expensive intersections

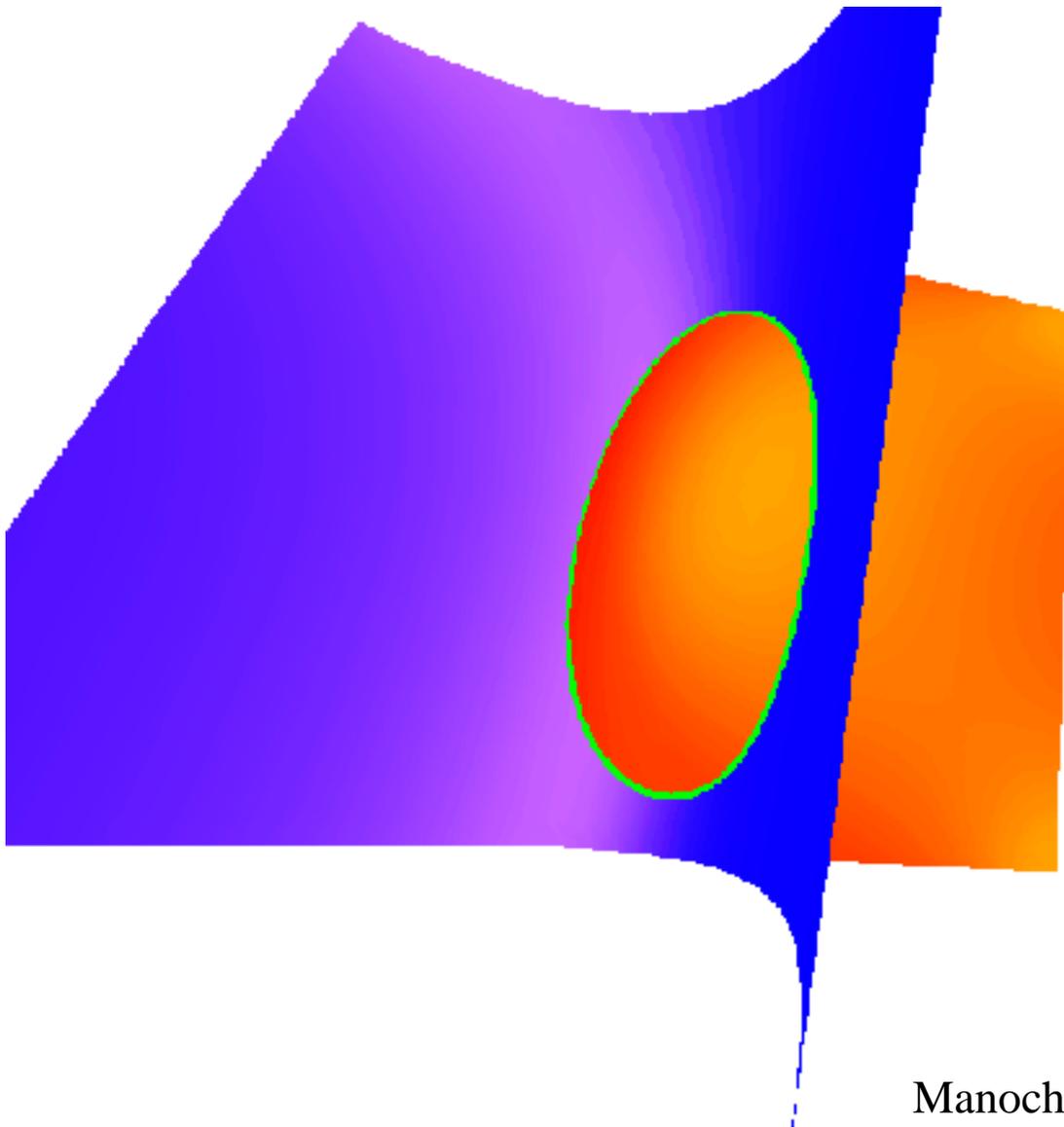


Zorin et al.

Boundary Representations

◆ Algebraic Surfaces

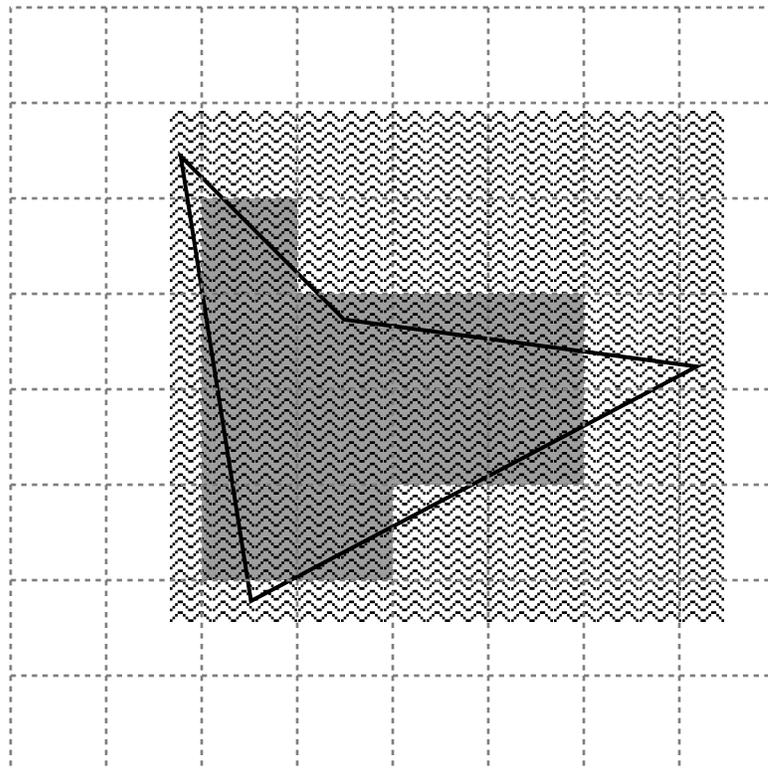
- Functional
 - + Difficult for arbitrary surfaces
 - + High accuracy
 - + Very concise
 - Implicit representation



Solid Representations

◆ Voxels

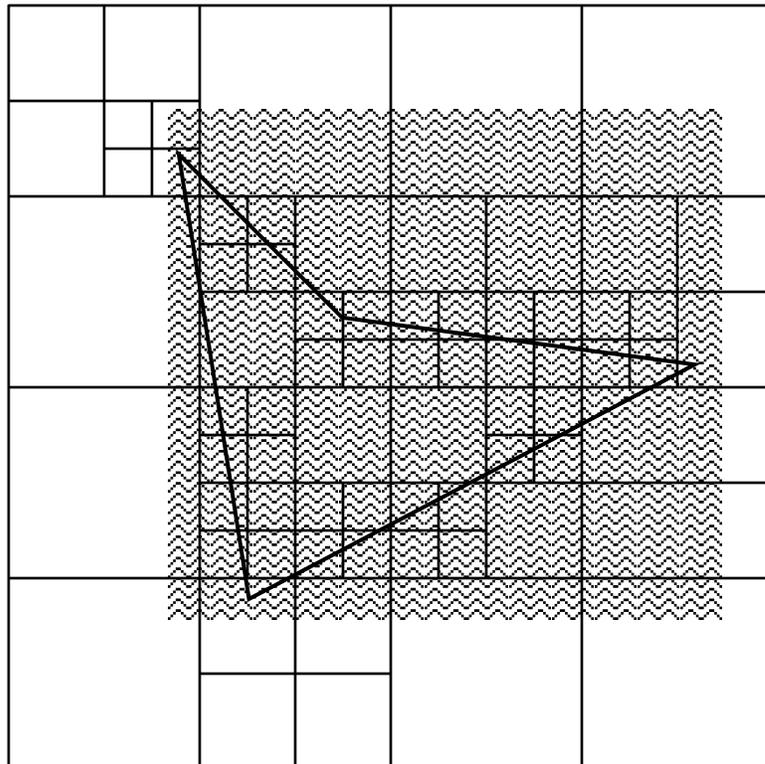
- + Simple
- + Construction from sensor data
- + Fast intersections
- + Depth sorting
- Not real-time rendering?
- Less accuracy
- Lots of storage



Solid Representations

◆ Octrees

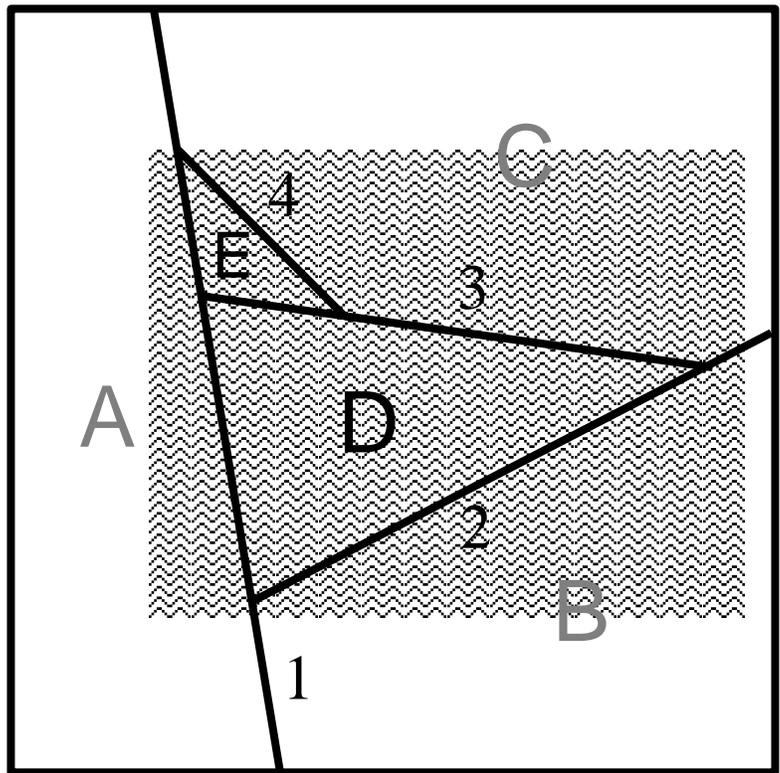
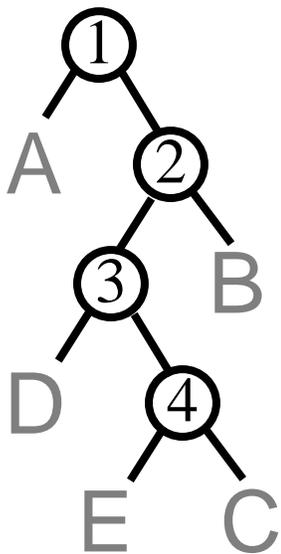
- Similar to voxels, but
 - + Multiresolution
 - + More efficient rendering & isects
 - + More accuracy
 - + Less storage
 - More complex than voxels



Solid Representations

◆ BSP Trees

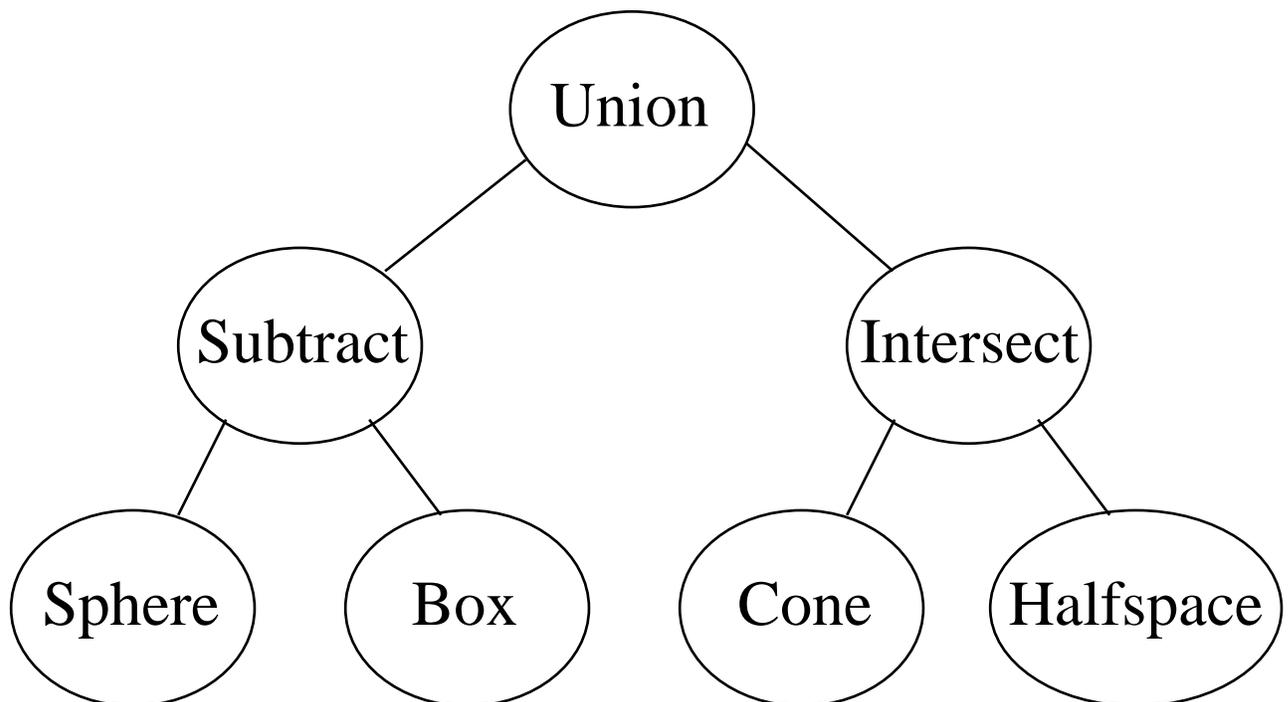
- Binary partition of space
- + Multiresolution
- + Object space
- Implicit representation
- Irregularly shaped cells



Solid Representations

◆ CSG

- Boolean solid operators
- + Easy specification
- + High accuracy
- + Very concise
- Implicit representation



Composite Representations

◆ Scene Graphs

+ Combine multiple reps

+ Hierarchical attribute specification

