Review of Object Representations

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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 repesentation from available input data?

Object Rep Overview

- **Scene Graphs**

- **Boundary representations**
  - Mesh representations
  - Parametric surfaces
  - Subdivision surfaces

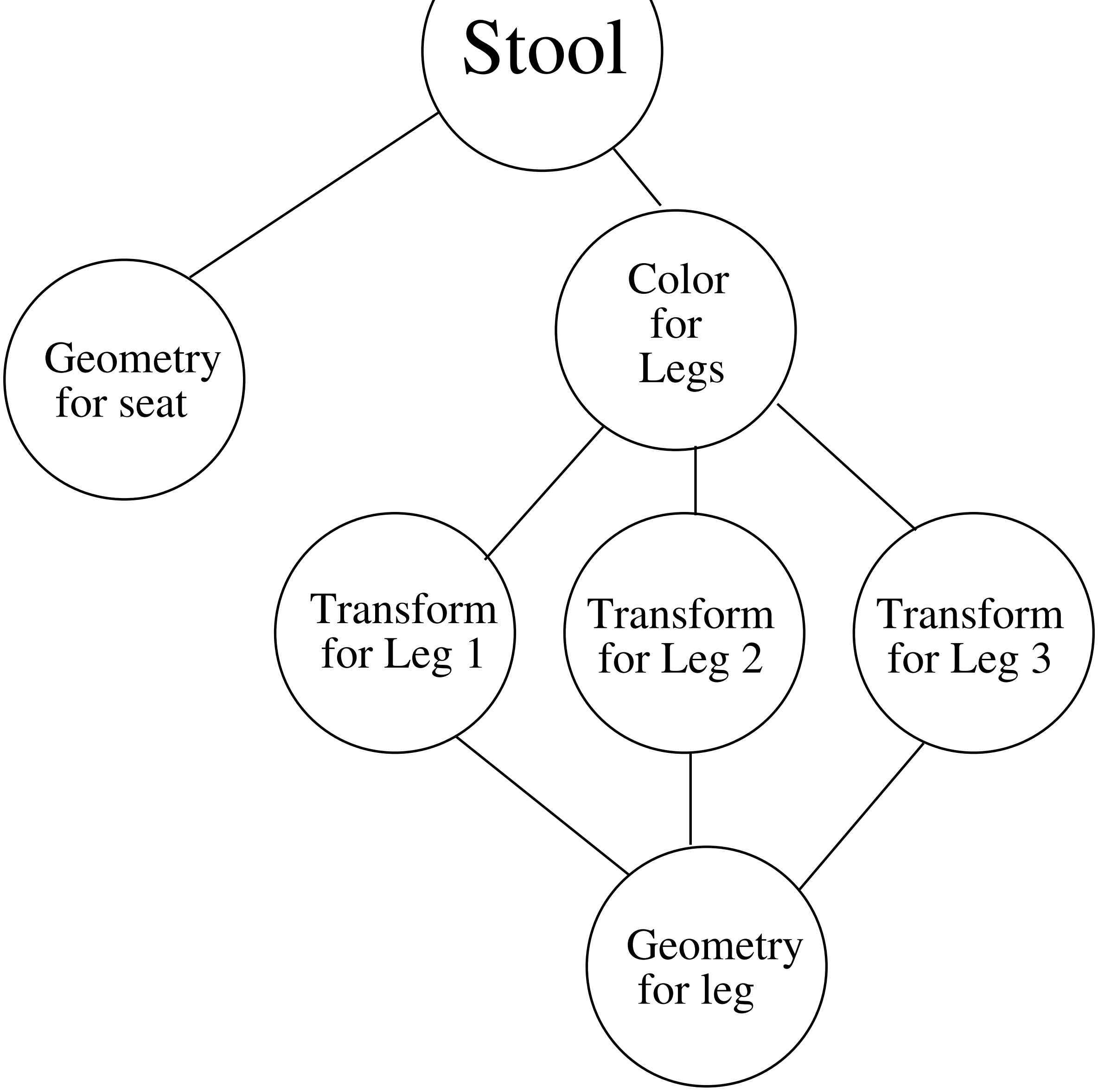
- **Solid representations**
  - Voxels & Octrees
  - BSP trees
  - Constructive solid geometry
  - Algebraic surfaces

- **Image–based representations**
  - Images & panoramas
  - Light field & lumigraph

- **Composite representations**

Scene Graphs

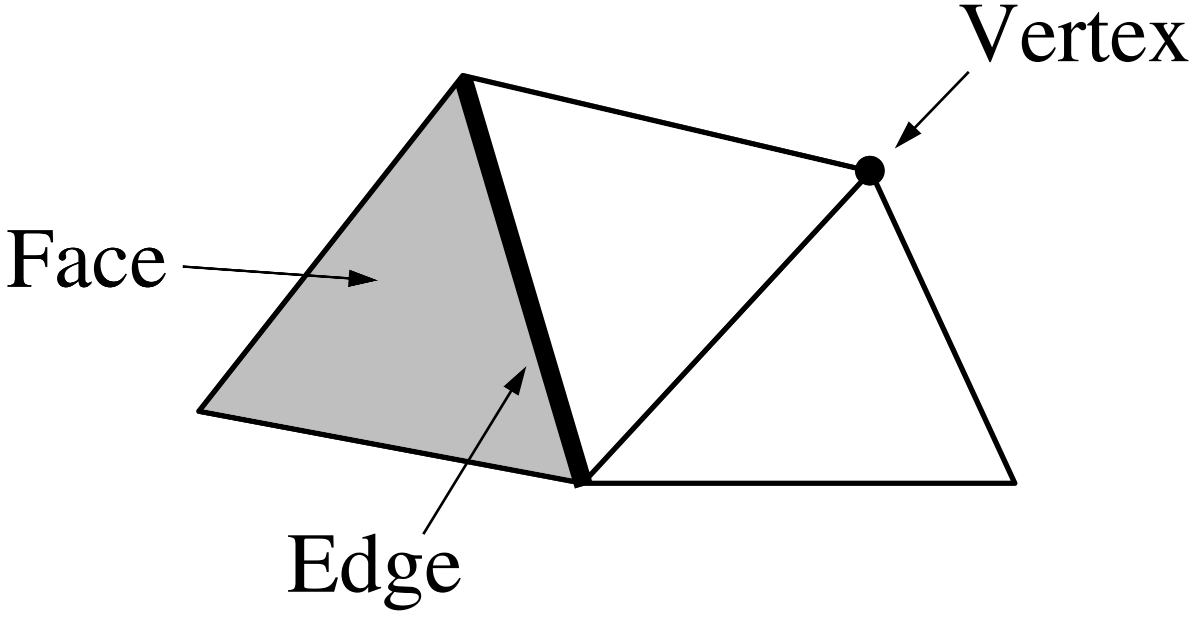
+ Combine multiple reps
+ Hierarchical attribute specification



Mesh Representations

- **Properties:**
  - Boundary representation, so solids not explicitly represented
  - Piecewise linear, so approximate curved surfaces

- **Mesh Descriptions**
  - Vertex and Face tables
  - Triangle strips
  - Adjacency lists
  - Winged–edge
  - Multiresolution



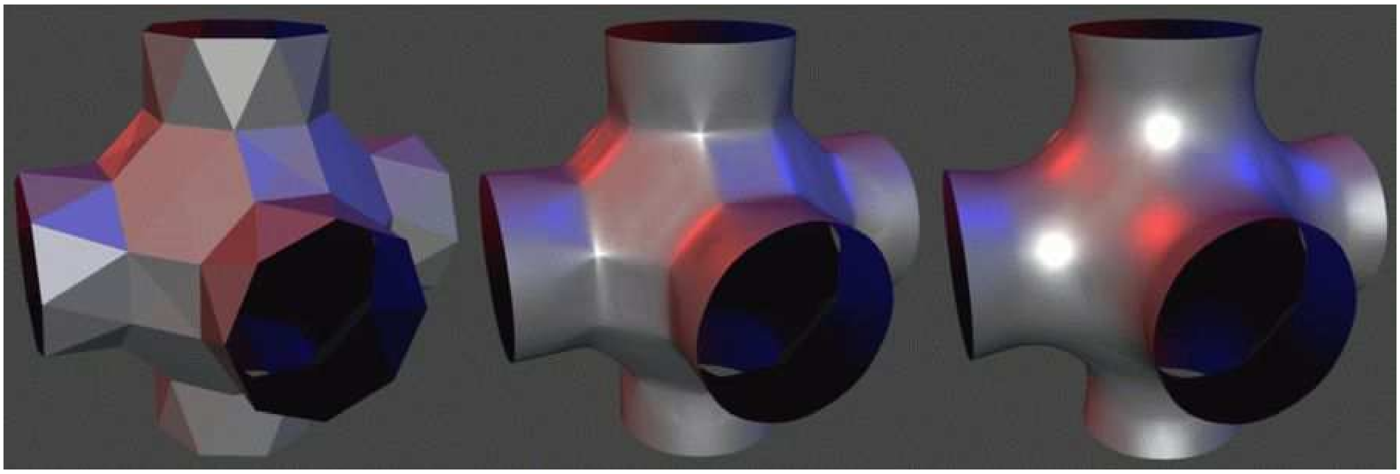
Parametric Surfaces

- **Tensor Product Splines:**
  - + More accurate for curved surfaces
  - + More concise
  - – Tesselate for rendering
  - – Expensive intersections

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

Subdivision Surfaces

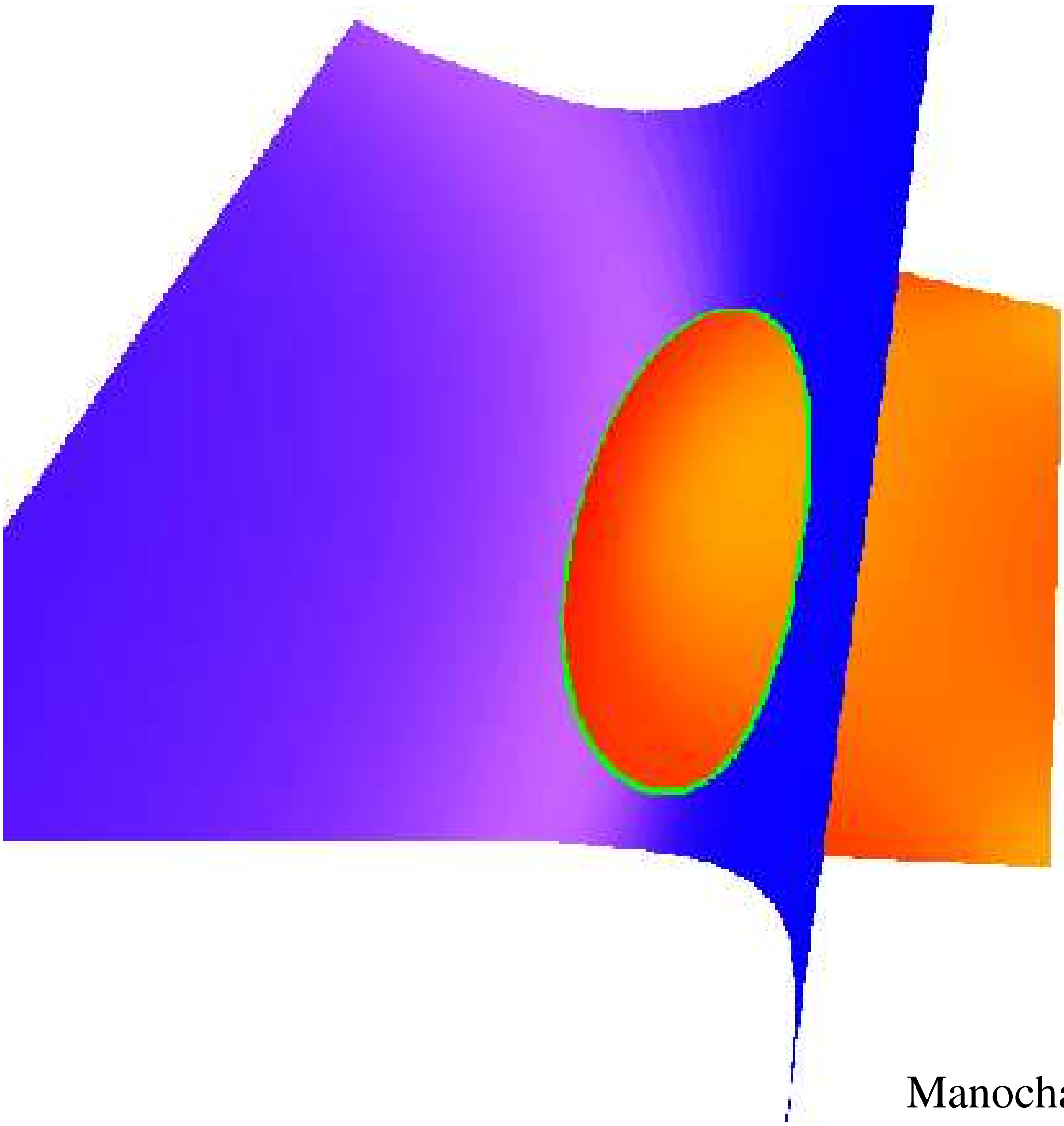
- **Subdivision Surfaces**
  - \+ Very concise
  - – Tesselate for rendering
  - – Expensive intersections



Zorin et al.

Algebraic Surfaces

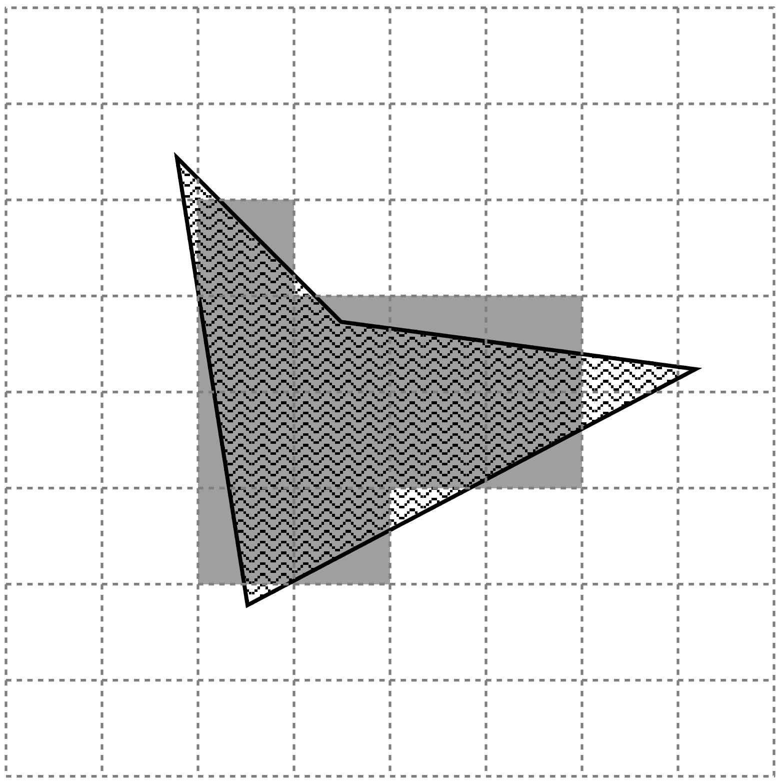
- **Algebraic Surfaces**
  - • Functional
  - + Difficult for arbitrary surfaces
  - + High accuracy
  - + Very concise
  - – Implicit representation



Manocha et al.

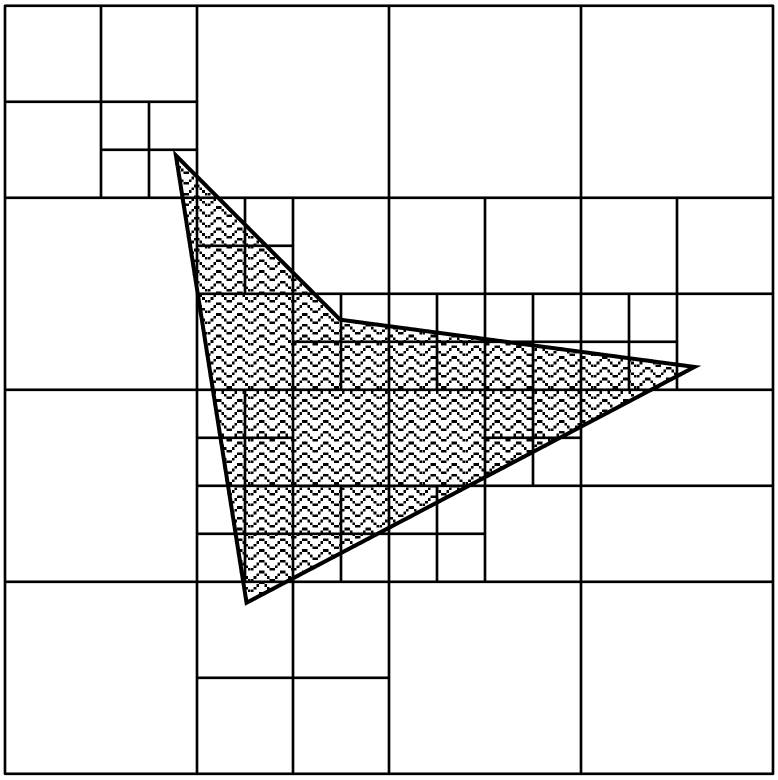
Volumetric Reps

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



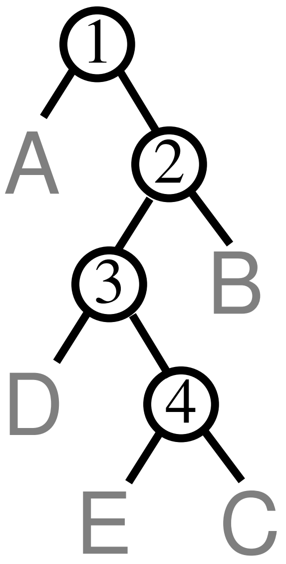
Volumetric Reps

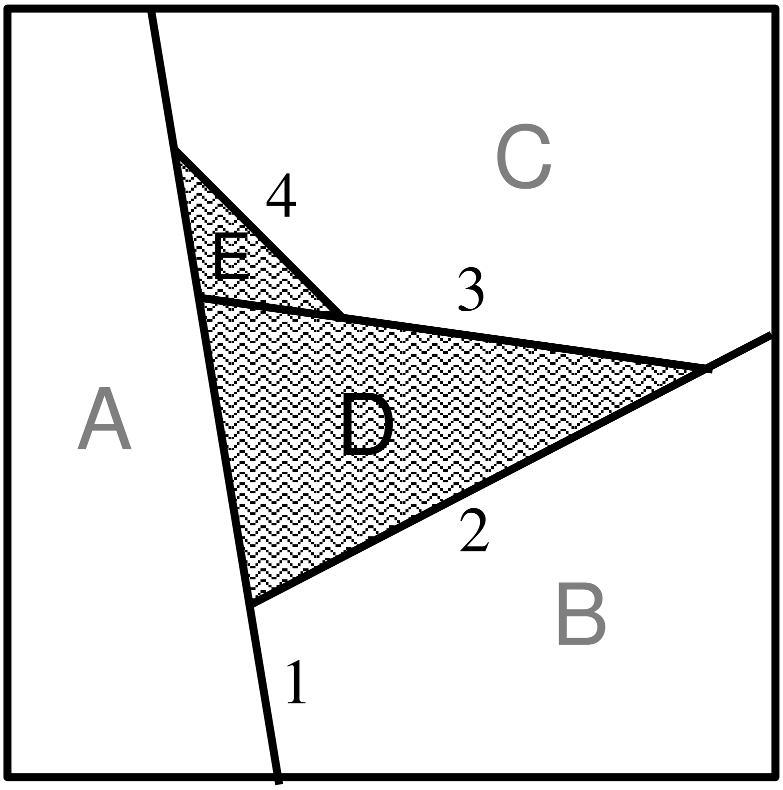
- **Octrees**
  - Similar to voxels, but
  - + Multiresolution
  - + More efficient rendering & isects
  - + More accuracy
  - + Less storage
  - – More complex than voxels



BSP Trees

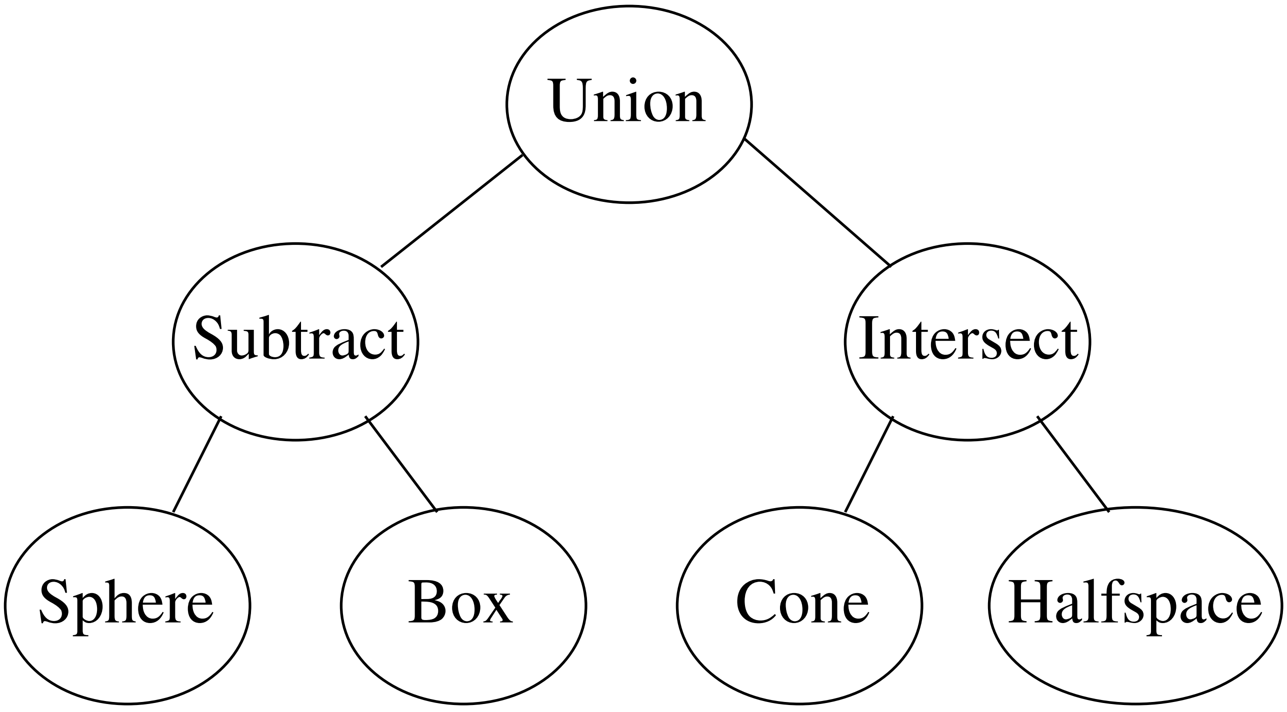
- **BSP Trees**
  - Binary partition of space
  - \+ Multiresolution
  - \+ Object space
  - – Implicit representation
  - – Irregularly shaped cells





Constructive Solid Geometry

- ♦ **CSG**
  - • Boolean solid operators
  - + Easy specification
  - + High accuracy
  - + Very concise
  - – Implicit representation



Image–Based Representations

- **Images & Panaramas**
  - 2D Illumination

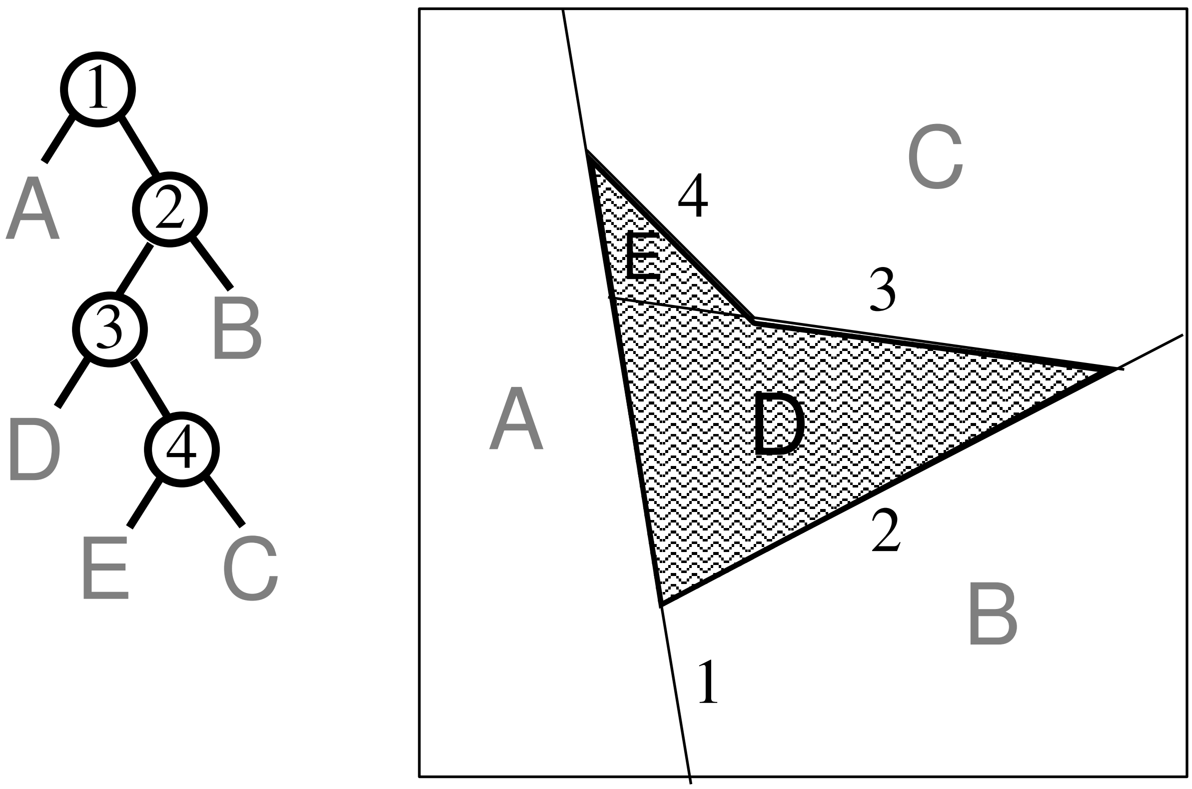
  + Capture from cameras
  + Photo–realistic
  – Limited viewpoints
  – Lots of storage
  – No geometry

Image–Based Representations

- ♦ **Light Field & Lumigraph**
  - • 4D Illumination
  - + Capture from cameras
  - + Photo–realistic
  - – Lots of storage
  - – No geometry

Composite Representations

- **BSP & Polygons**
  - Index polygons with BSP
  - \+ Benefits of both representations
  - – More storage



Composite Representations

- Others?