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?

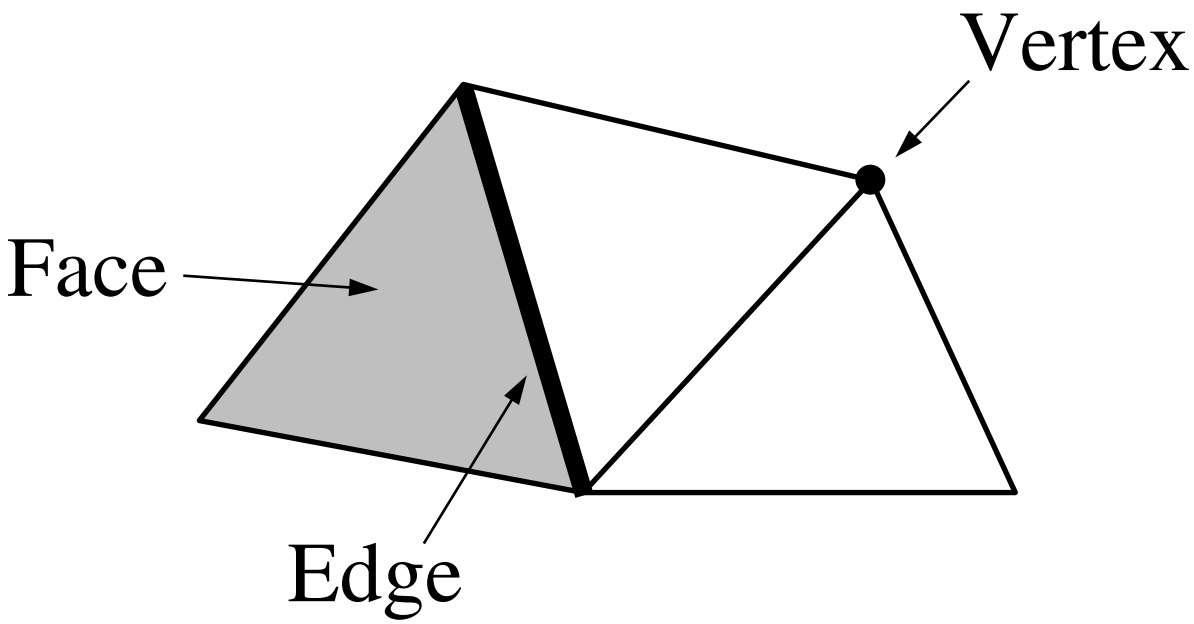
Object Rep Overview

- **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



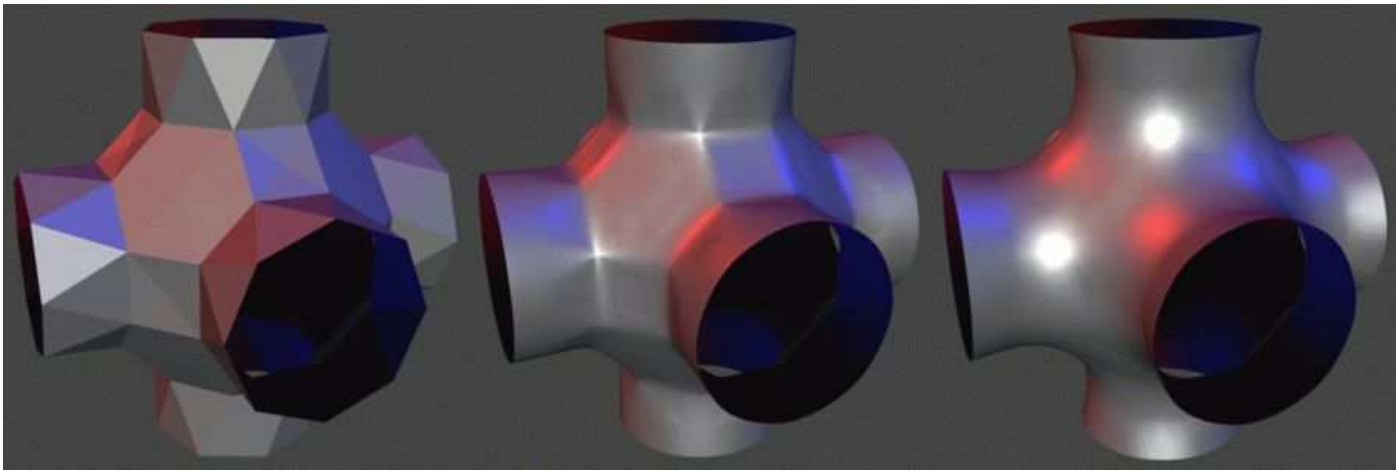
Boundary Representations

- **Parametric Surfaces:**
  - + More accurate for curved surfaces
  - + More concise
  - – Tesselate for rendering
  - – Expensive intersections

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

Boundary Representations

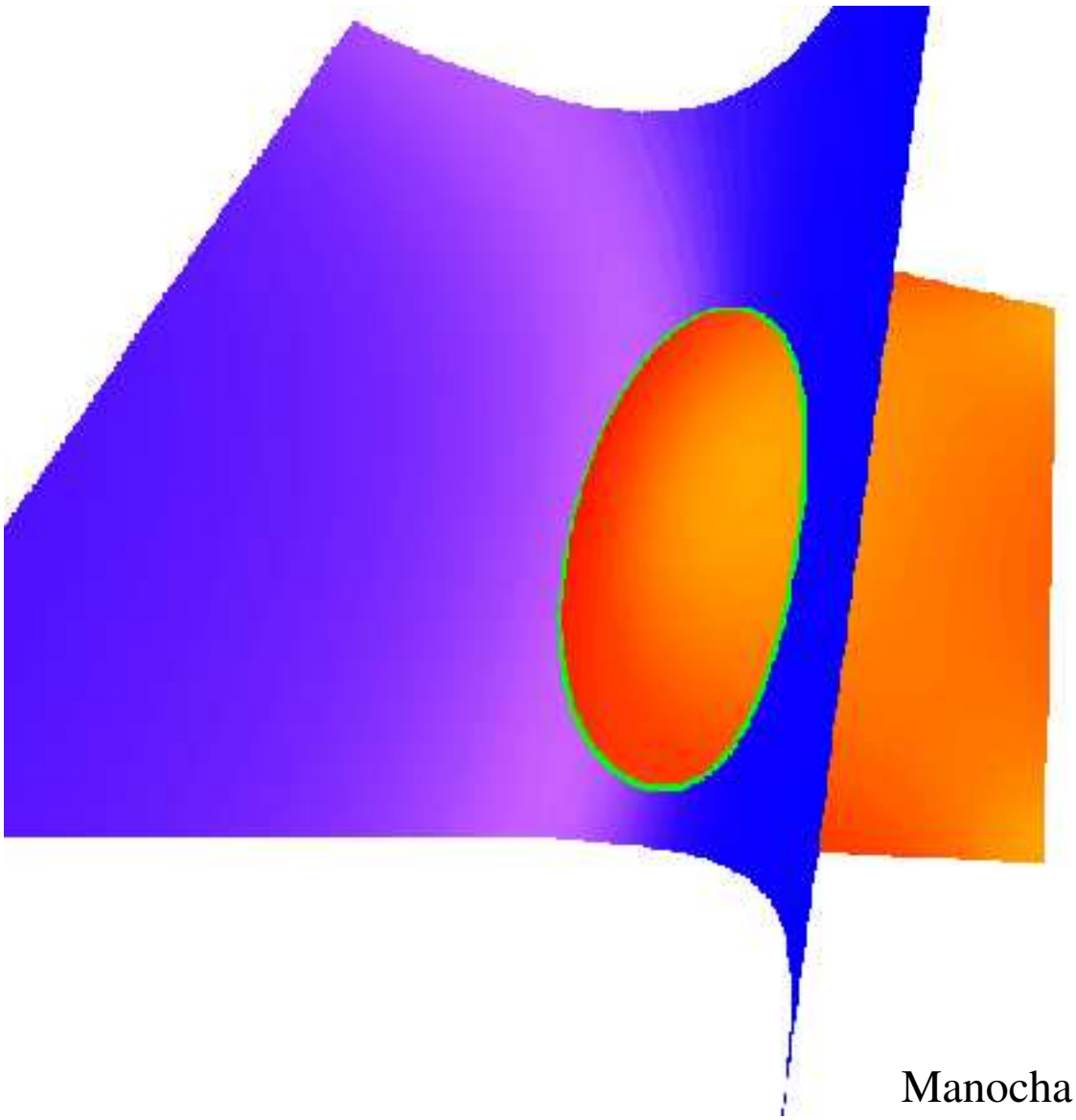
- **Subdivision Surfaces**
  - \+ Very concise
  - – Tesselate for rendering
  - – Expensive intersections



Zorin et al.

Boundary Represenations

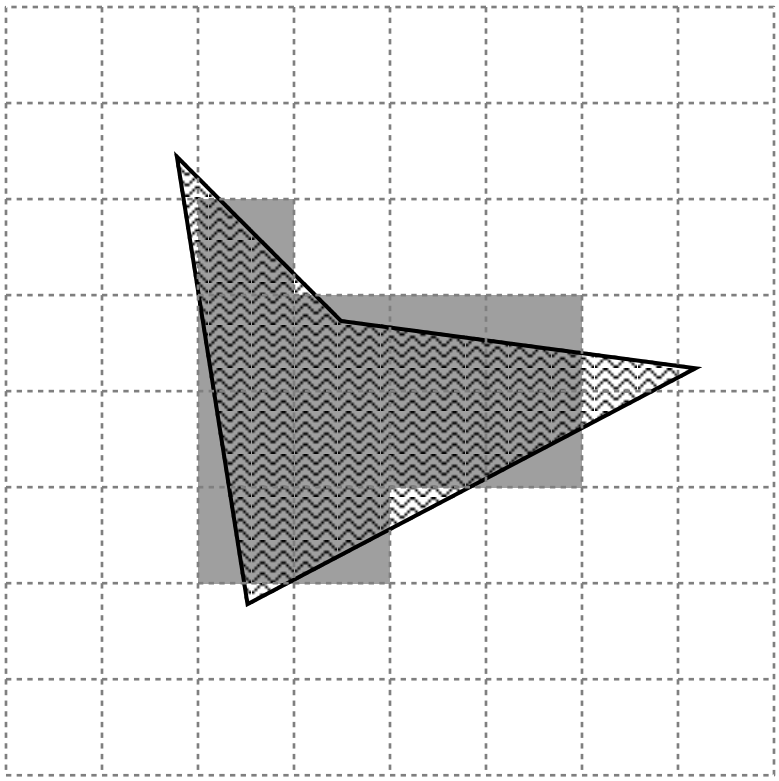
- **Algebraic Surfaces**
  - • Functional
  - + Difficult for arbitrary surfaces
  - + High accuracy
  - + Very concise
  - – Implicit representation



Manocha et al.

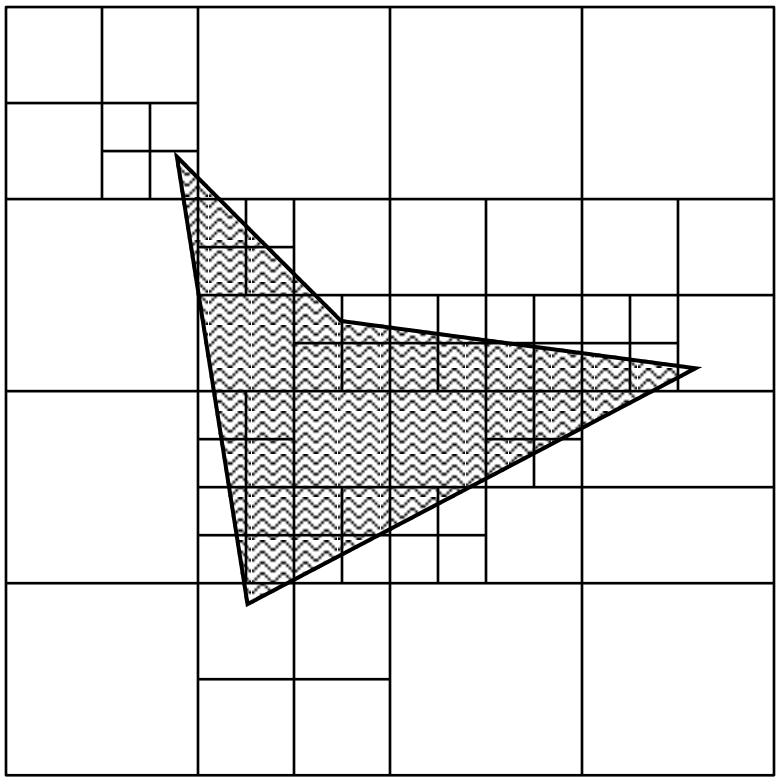
Solid Representations

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



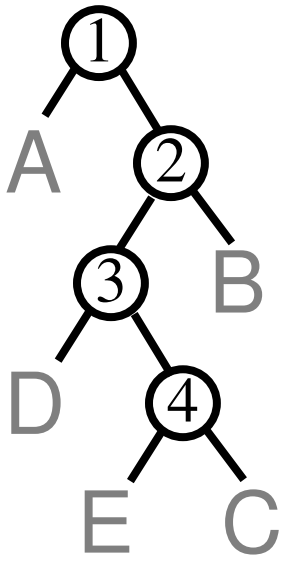
Solid Representations

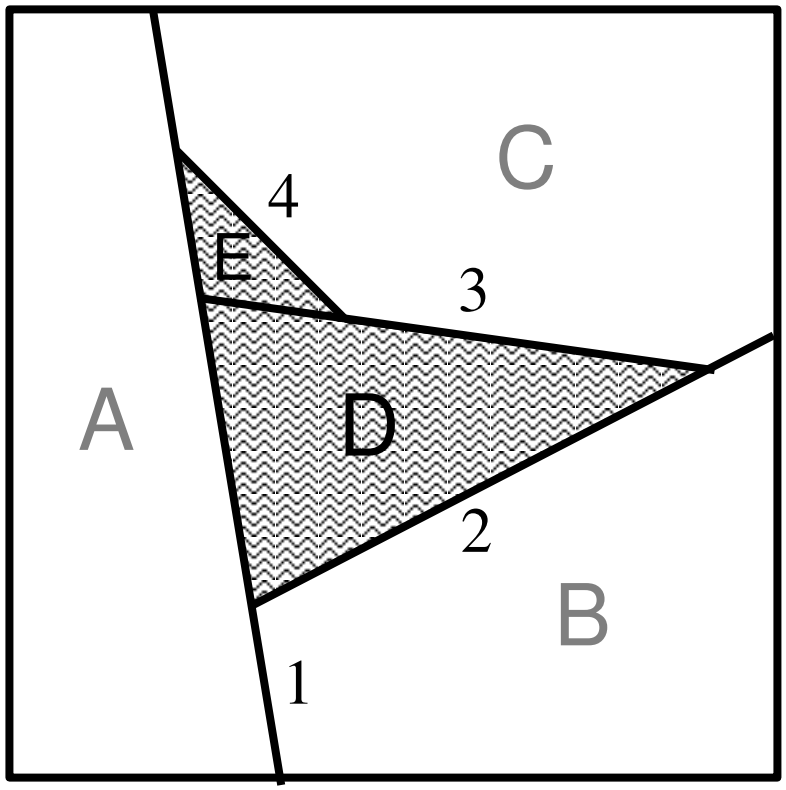
- **Octrees**
  - Similar to voxels, but
  + Multiresolution
  + More efficient rendering & isects
  + More accuracy
  + Less storage
  – More complex than voxels



Solid Representations

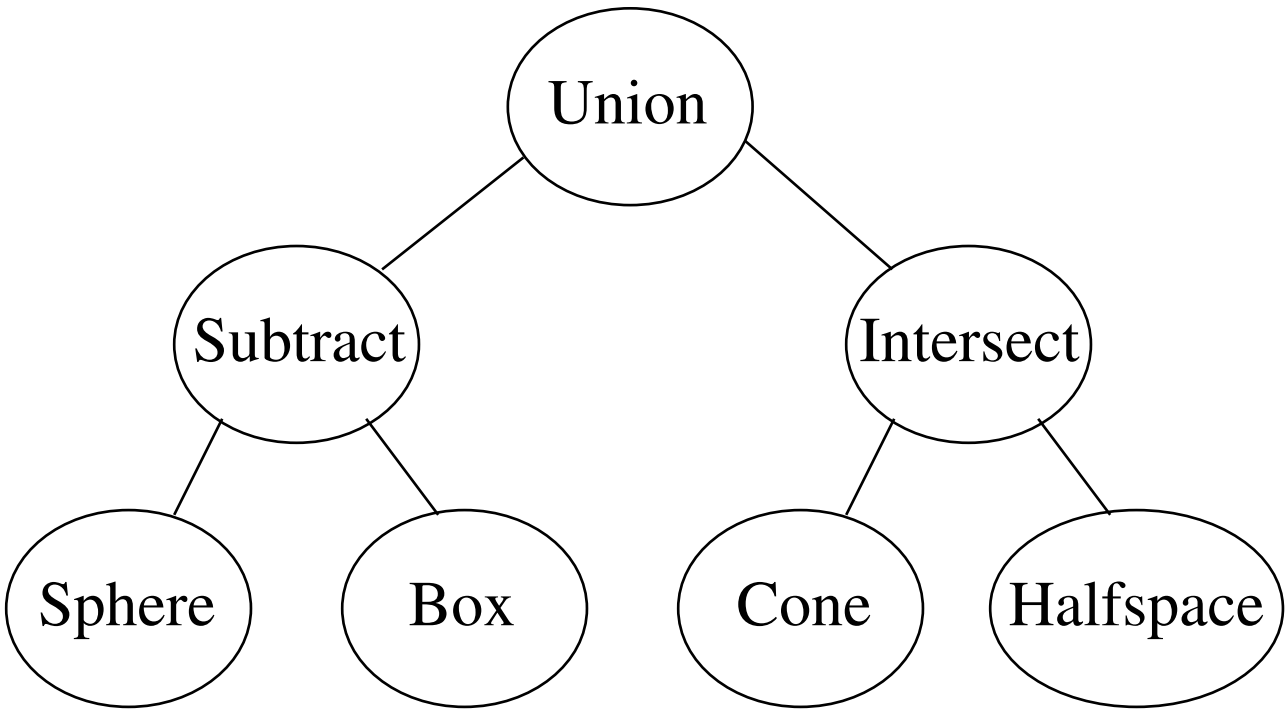
- **BSP Trees**
  - • Binary partition of space
  - \+ Multiresolution
  - \+ Object space
  - – Implicit representation
  - – Irregularly shaped cells

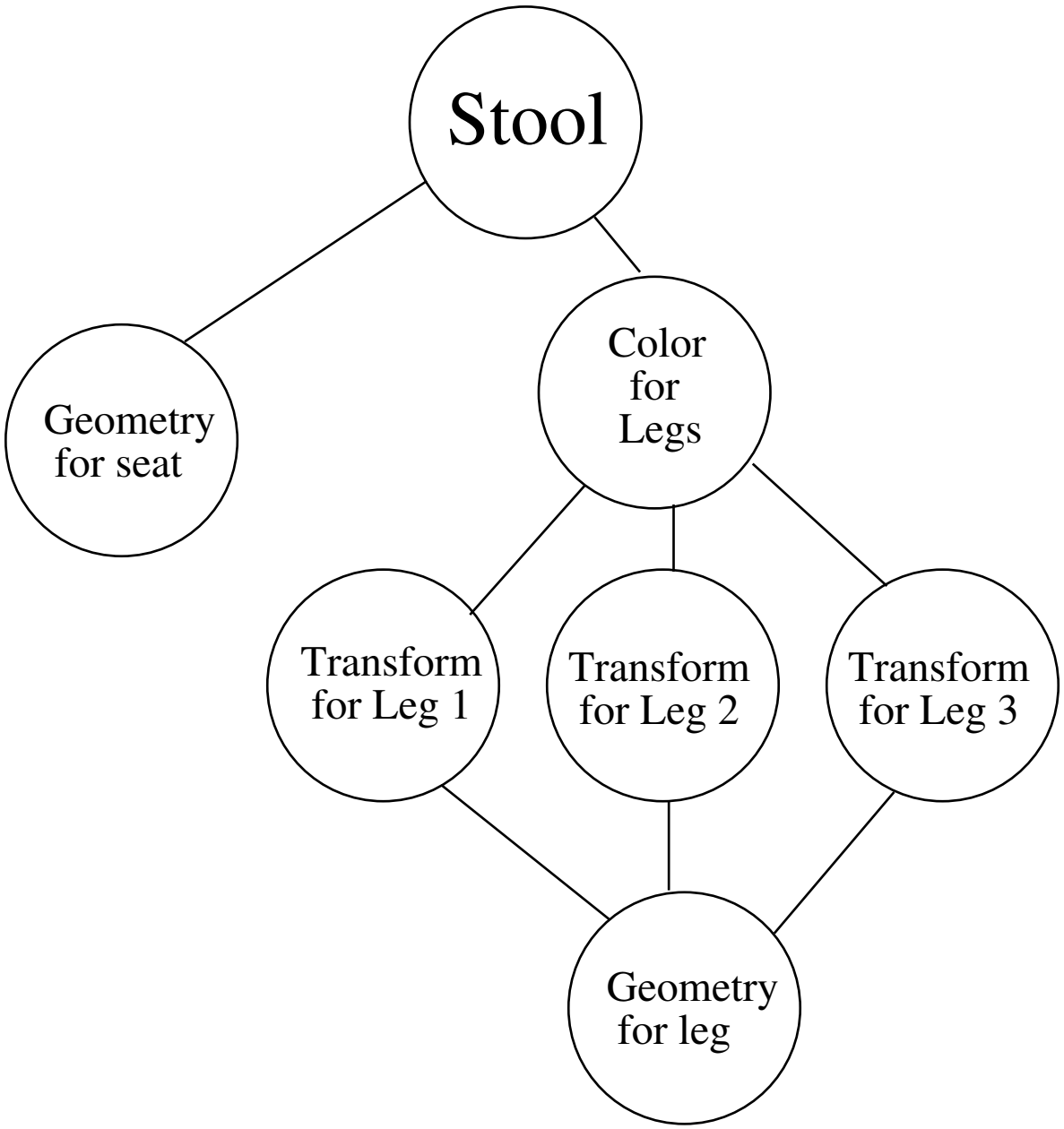




Solid Representations

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



Composite Represenations

- **Scene Graphs**
  + Combine multiple reps
  + Hierarchical attribute specification