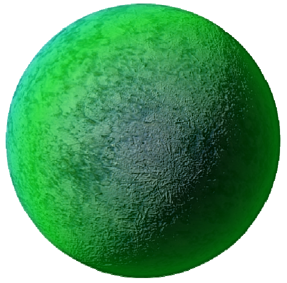
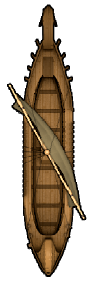
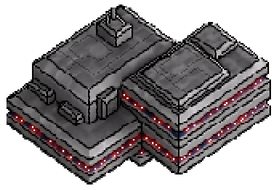
Representing Objects

Sprites

- Image or animation of object

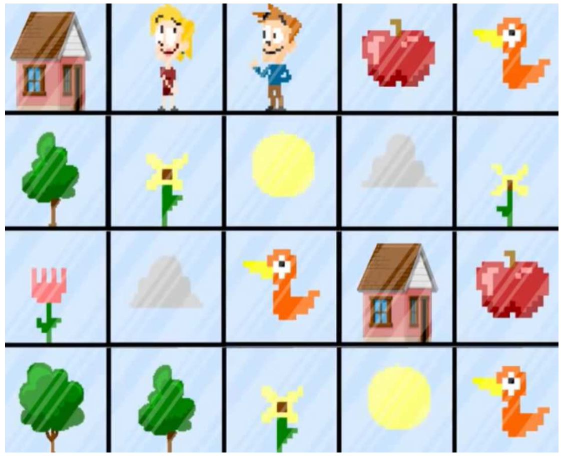






Sprites

- Layer many to generate scene



3D Objects

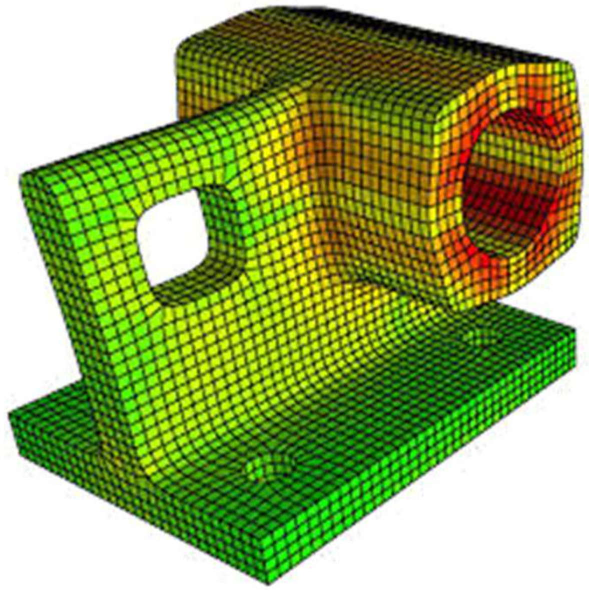
- Graphics scenes contain
  - Solid geometric objects
  - Trees, flowers, clouds, rocks, water
- Creation of models
  - Surface $\leftrightarrow$ interior models
  - Explicit $\leftrightarrow$ procedural models
  - Heuristically $\leftrightarrow$ physically based models

Polygon Surfaces

- set of surface polygons enclose object interior

= ***Boundary Representation***

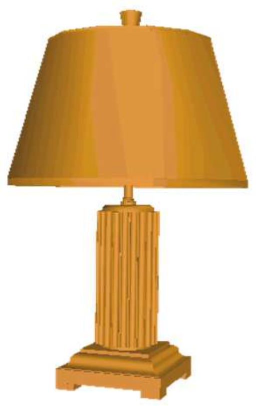
("B-Rep")

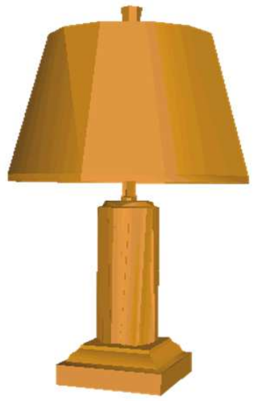


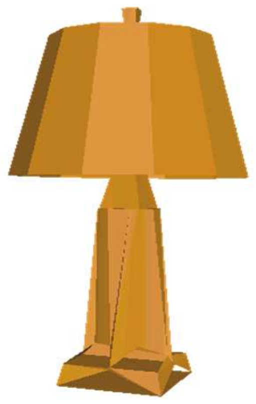
example:
machine part surface
represented by quadrilaterals

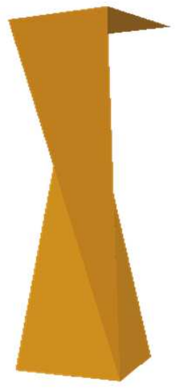
Polygon Surfaces

- More polys = better approximation

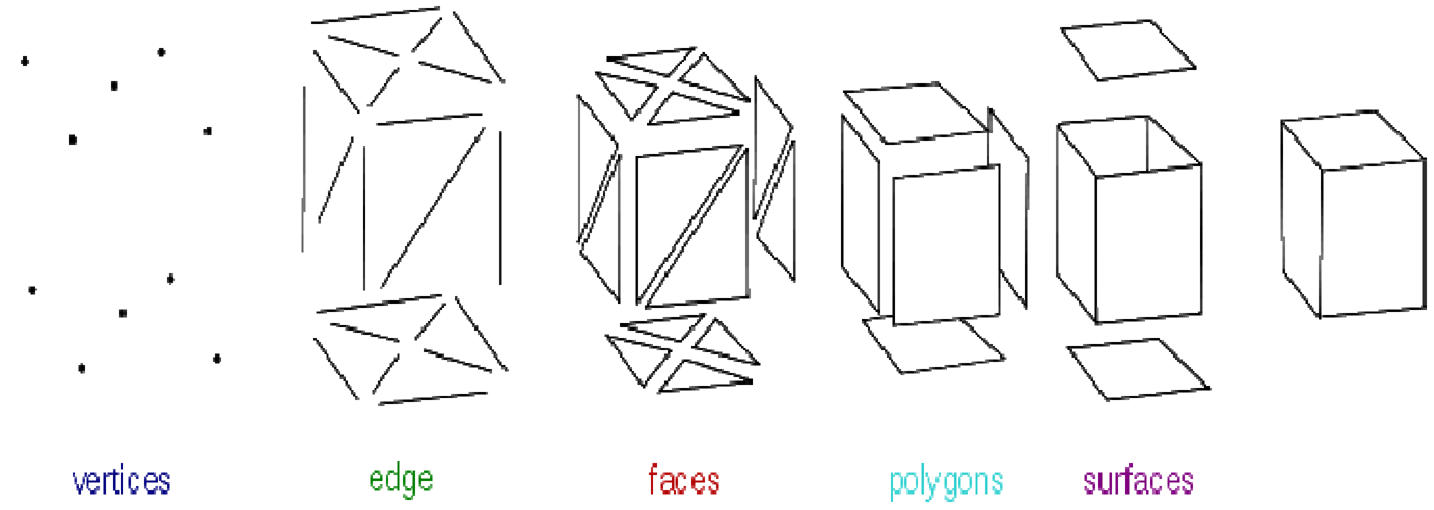

10,108 polys


1,383 polys

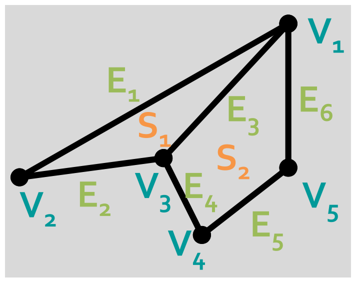

474 polys

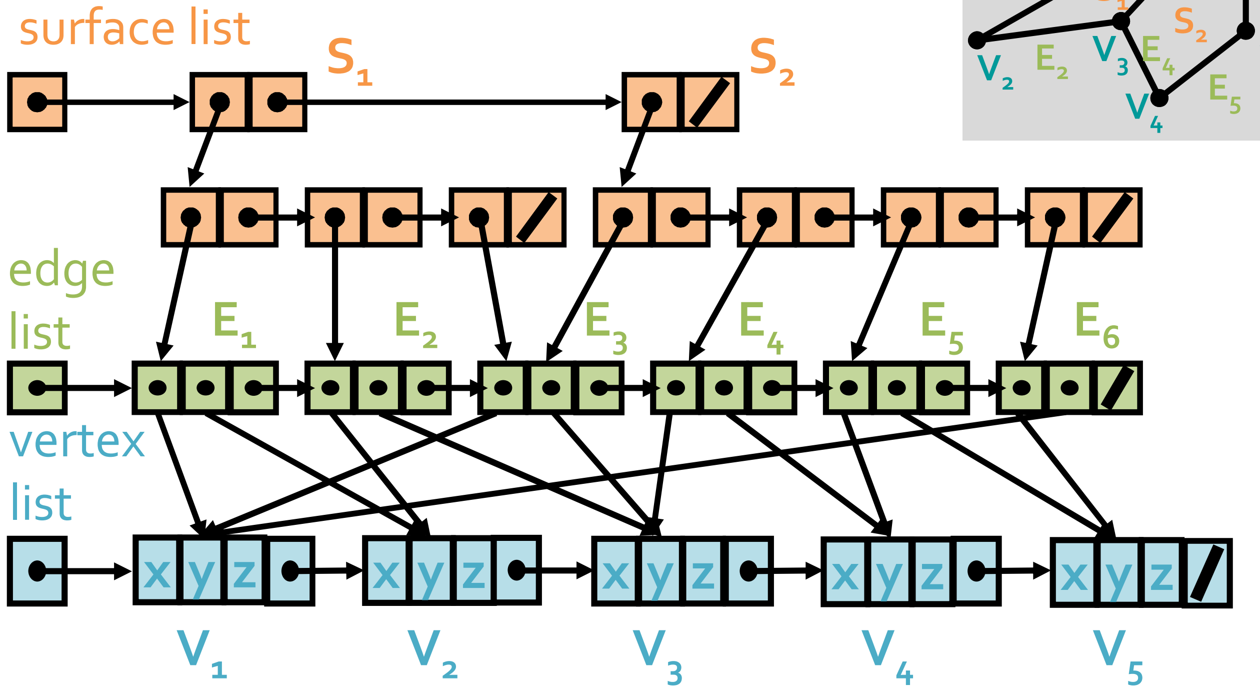

6 polys

B-Rep (Boundary Representation)

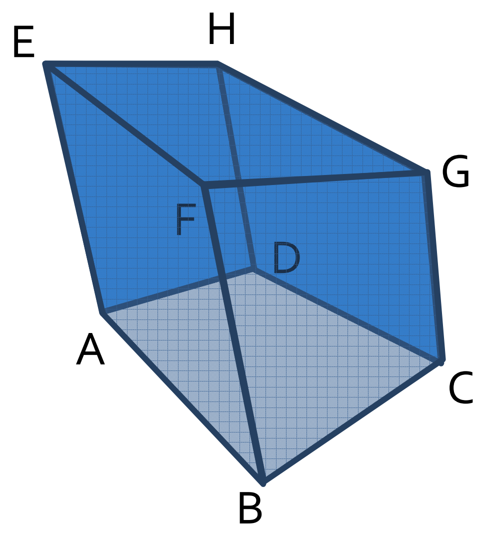


Lists for B-Reps





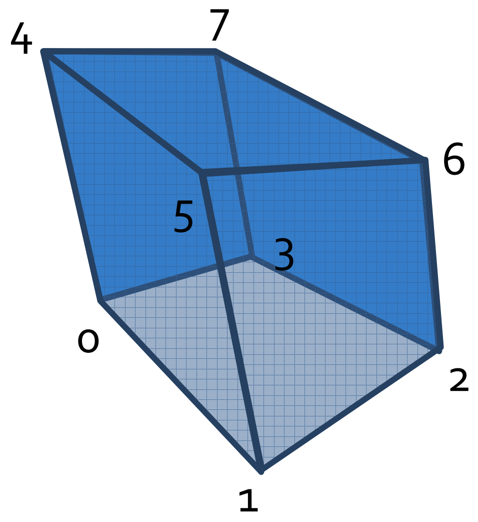
Face-Vertex List



Vertex List	
A	(0,0,0)
B	(0,0,1)
C	(1,0,1)
D	(1,0,0)
E	(0,1,0)
F	(0,1,1)
G	(1,1,1)
H	(1,1,0)

Index List
(A,B,C,D)
(A,B,F,E)
(B,C,G,F)
(E,F,G,H)
(A,D,H,E)
(D,C,G,H)

Face-Vertex List

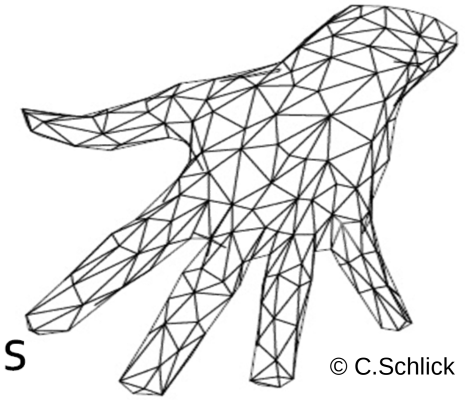


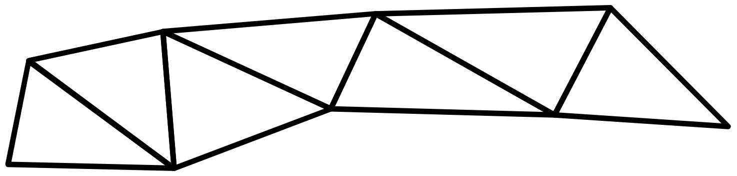
Vertex List	
0	(0,0,0)
1	(0,0,1)
2	(1,0,1)
3	(1,0,0)
4	(0,1,0)
5	(0,1,1)
6	(1,1,1)
7	(1,1,0)

Index List
(0,1,2,3)
(0,1,5,4)
(1,2,6,5)
(4,5,6,7)
(0,3,7,4)
(3,2,6,7)

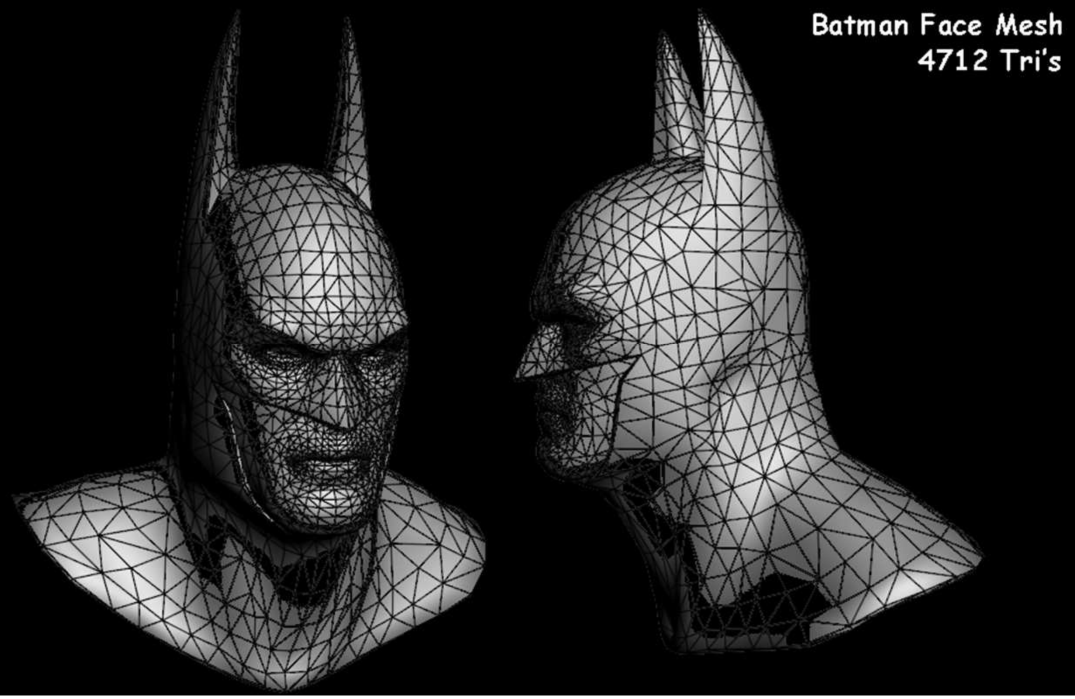
Triangle Meshes

- Most often used (directly rendered by hardware)
- Why triangles?
  - Simplest polygon
  - Always on a plane
- ***Triangle mesh*** = connected triangles

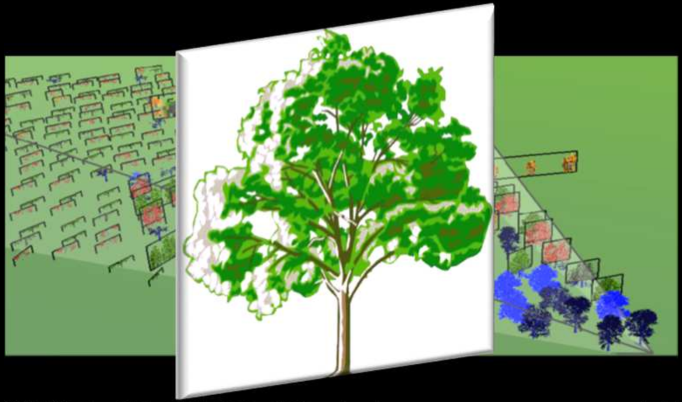


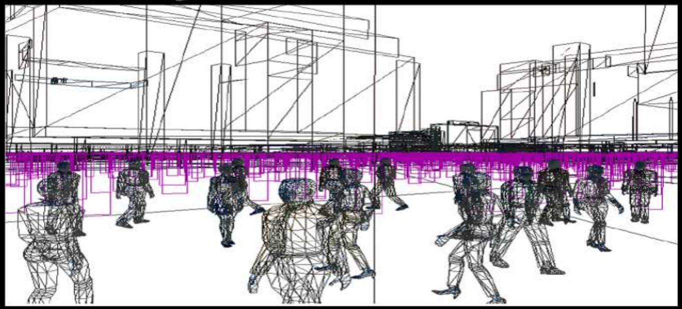


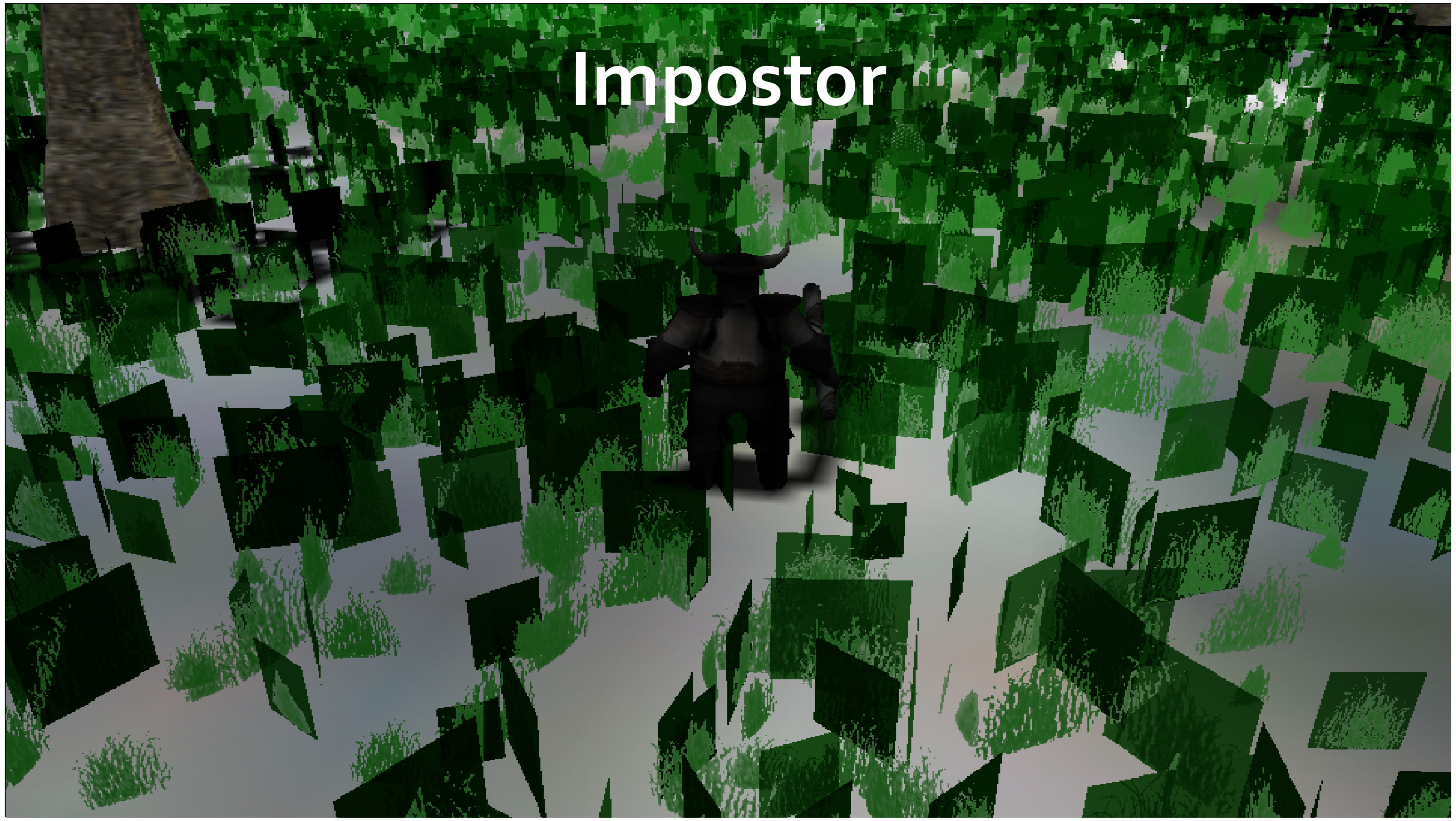
Triangle Meshes



Impostor



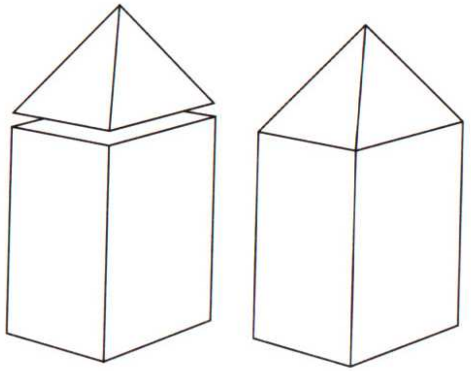



Impostor

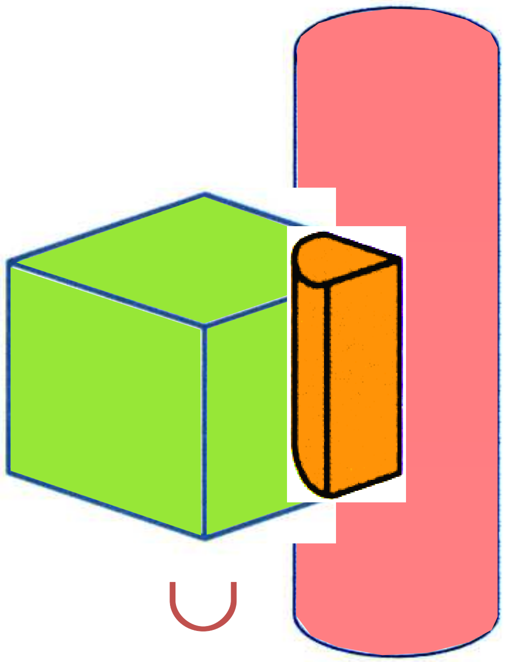
Impostor

Constructive Solid Geometry

- Constructive Solid Geometry (CSG)
  - boolean set operations on 3D objects
  - union, intersection, difference operation



CSG: Different Set Operations



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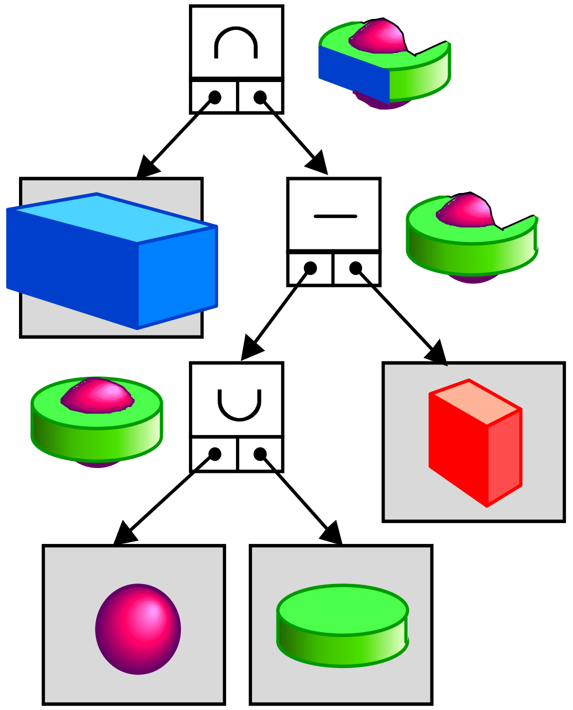
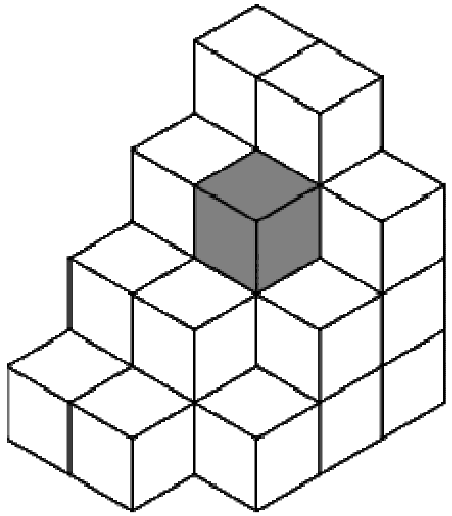
CSG Data Structure

- Object assembled from simple solids with **set operations**
- data structure **binary tree**
- recursive evaluation



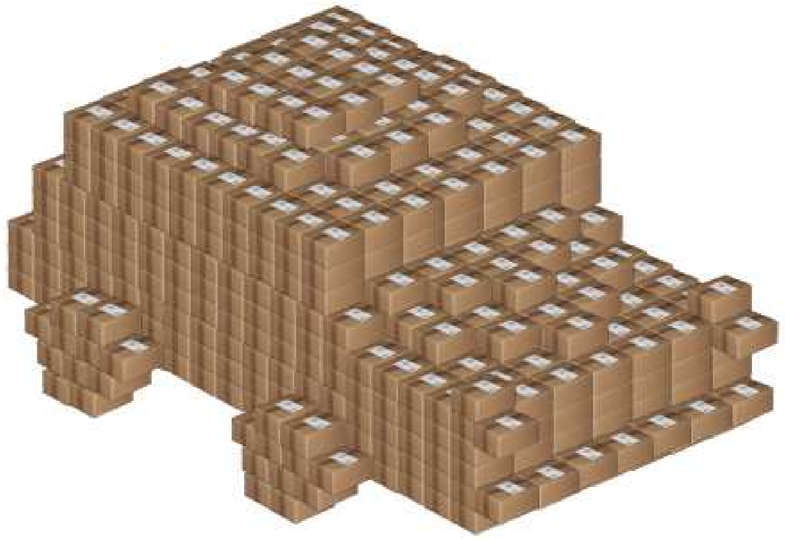
Voxels

- Name is a combination of “volume” and “pixel”

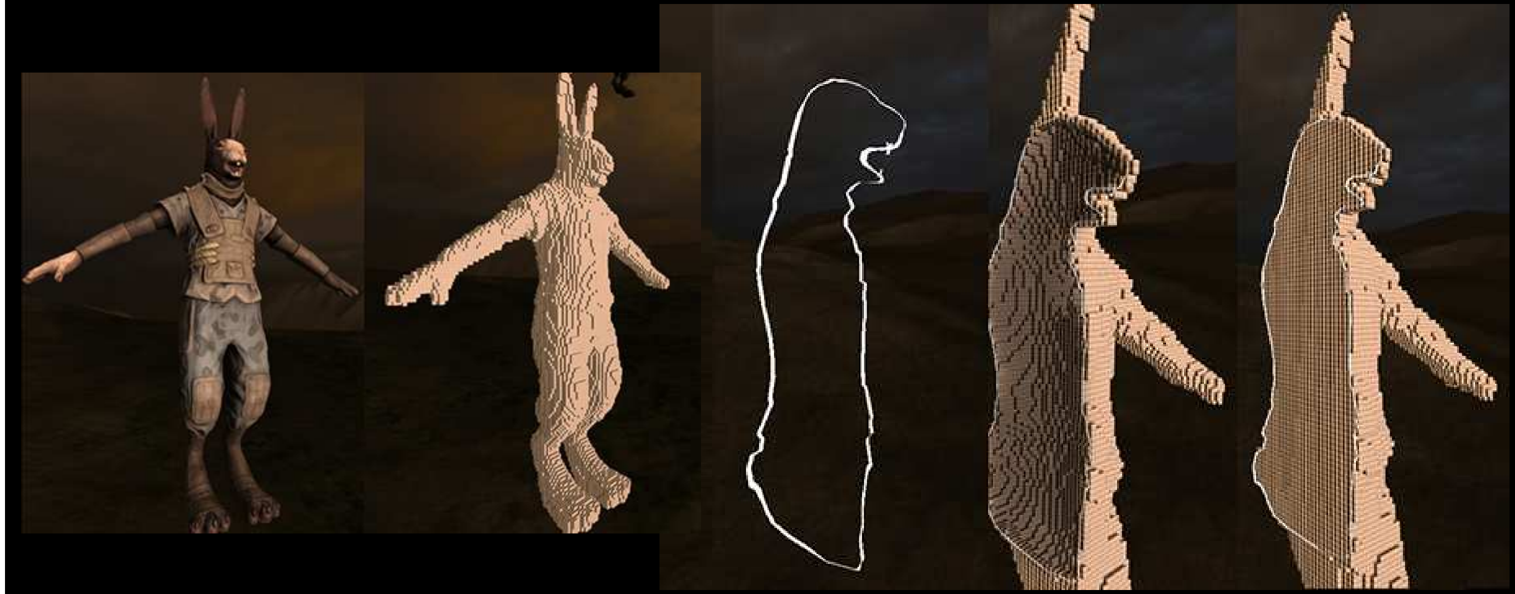


Real World

Real World



Surface vs Solid Voxelization

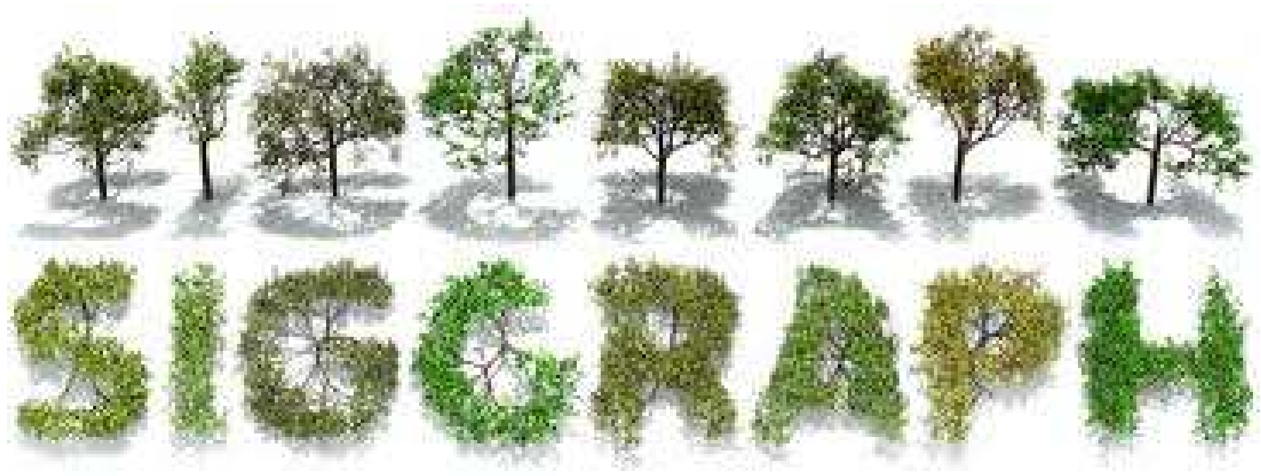


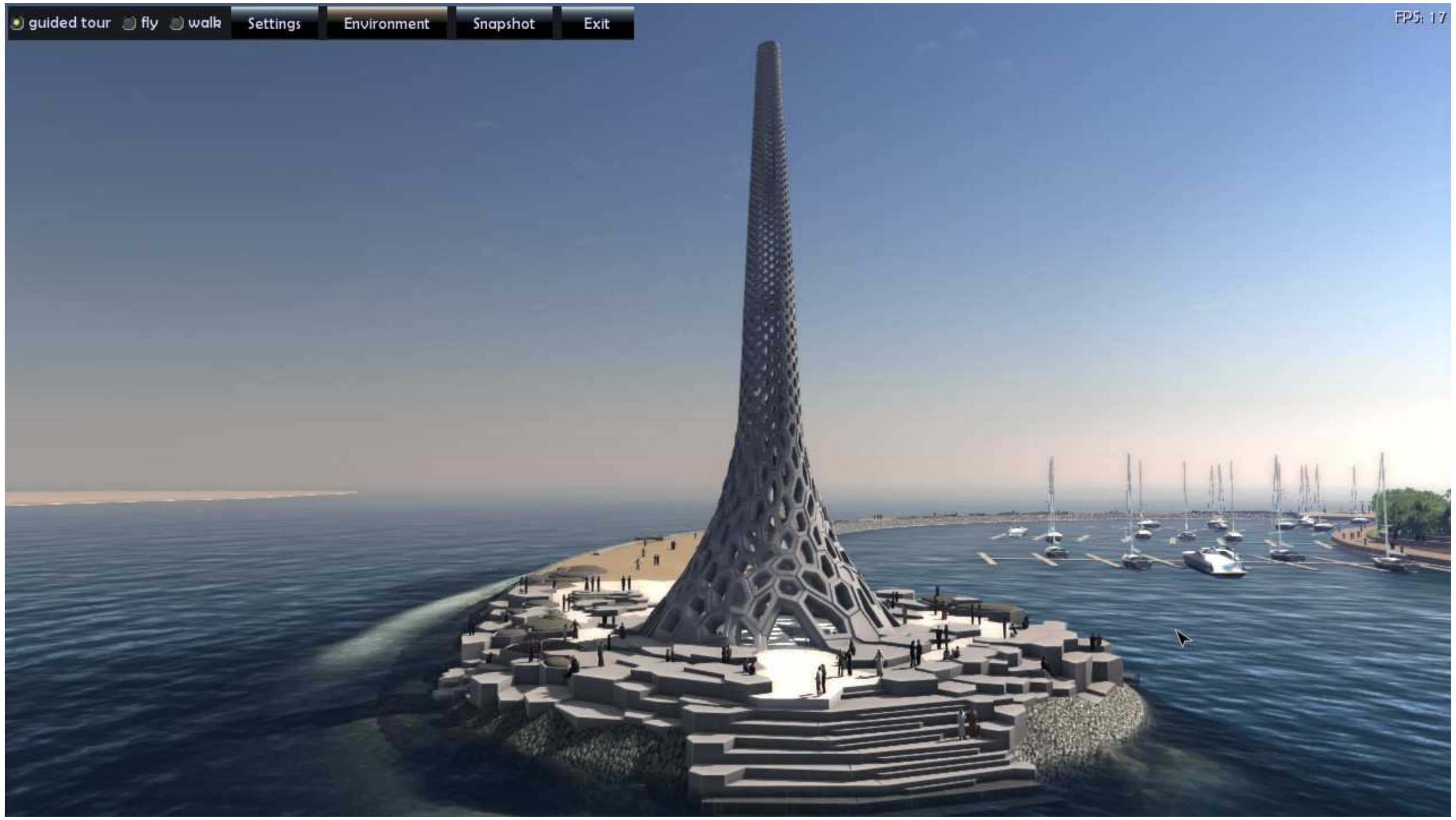
Voxels

- Not directly renderable by hardware
- Bad if lots of free space (memory!)
- But “fast” algorithms exists
  - Volume rendering
  - Ray casting
  - Marching cubes

Procedural Modeling

- Use algorithm/rule to produce models




guided tour
fly
walk
Settings
Environment
Snapshot
Exit
FPS: 17

Physically Based Modelling

- Procedural modeling with physically based rules