Discussion of Course Projects

Course Project Goals

Investigate **automatic** methods for creating and fixing 3D models suitable for interactive graphics.

- **Model Generation**
  - Capture from sensors
  - Derivation from other data
  - Procedural methods
- **Model Manipulation**
  - Fixup
  - Simplification
  - Optimization
- **Model Simulation**
  - Lighting
  - Appearance
  - Dynamics

Model Generation

- **Model Capture Tools**
  - Models from images
  - Models from range images
  - Models from sonar, etc.
  - Multi–modal capture
  - Textures from images
  - Image processing for IBR

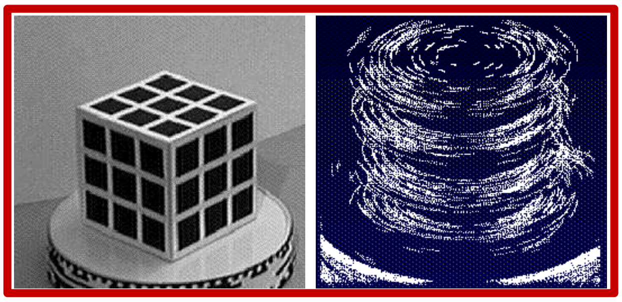
- **Model Derivation Tools**
  - Models from blue prints
  - Models from ???

- **Procedural Modeling Tools**
  - Automated instancing
  - Design rule checking

Model Capture Tools

- **From Images (computer vision) ..**
  - Semi–automatic
  - Guided by constraints

Stereo Matching

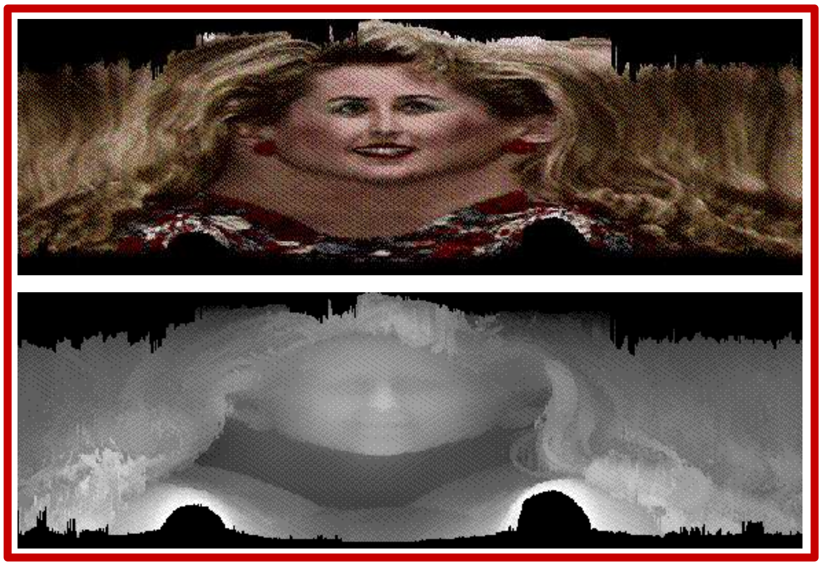


Structure From Motion

User–Driven
Image Analysis

Model Capture Tools

- **From Range Images ...**
  - Large objects
  - Hand–held cameras
- **From Other Sensors ...**
  - Infared
  - Sonar
  - X–ray
  - Others?
- **Multi–modal!**



Active Range Finders

Model Capture Tools

- **For Image–Based Rendering ...**
  - Panoramas
  - Textures
  - Light fields & Lumigraphs

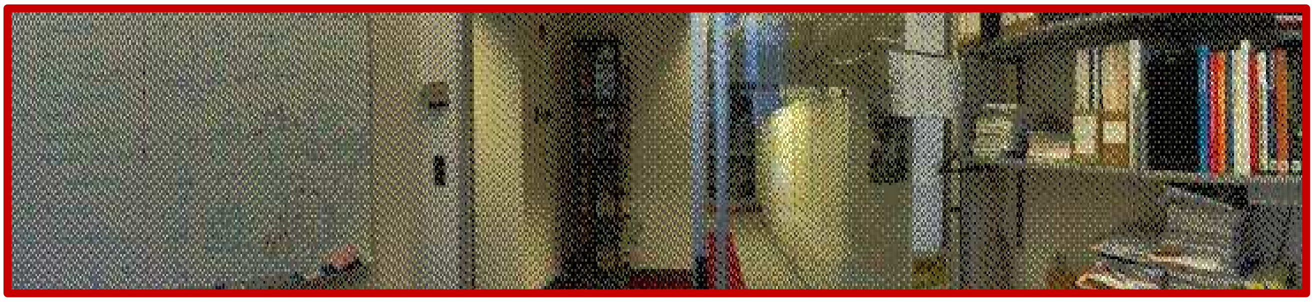


Image Processing for Panoramic Images

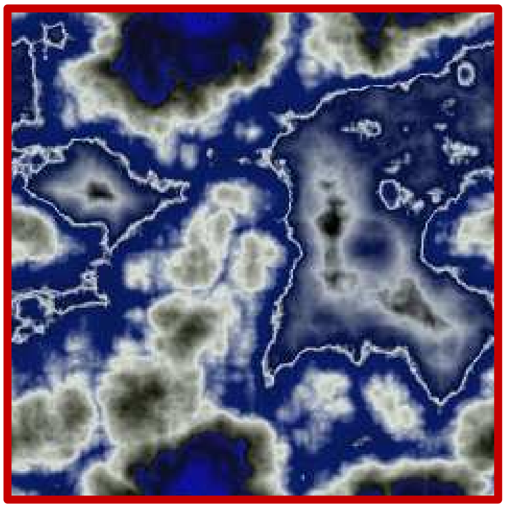
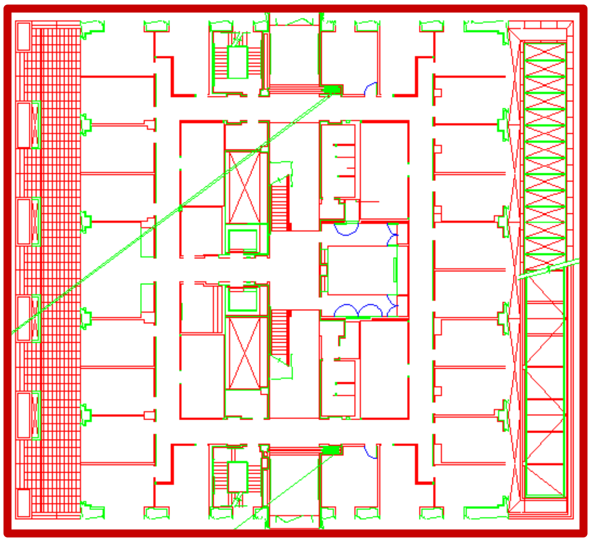


Image Processing for
Repeating Textures

Model Derivation Tools

- **From 2.5D Floorplans ...**
  - Feature detection
  - Extrusion



2.5D Floorplan

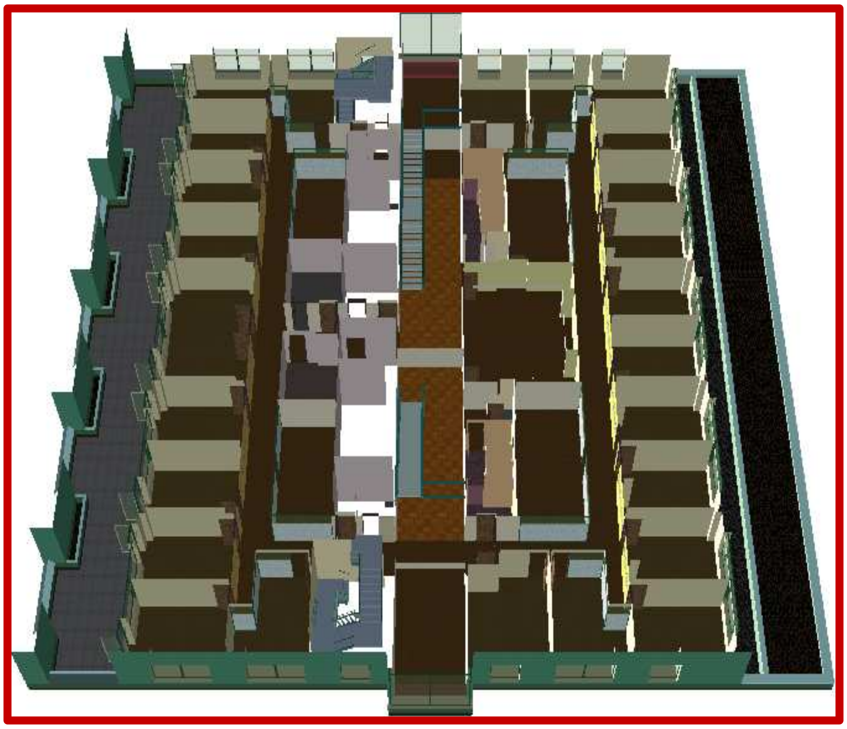
3D Model

Procedural Modeling Tools

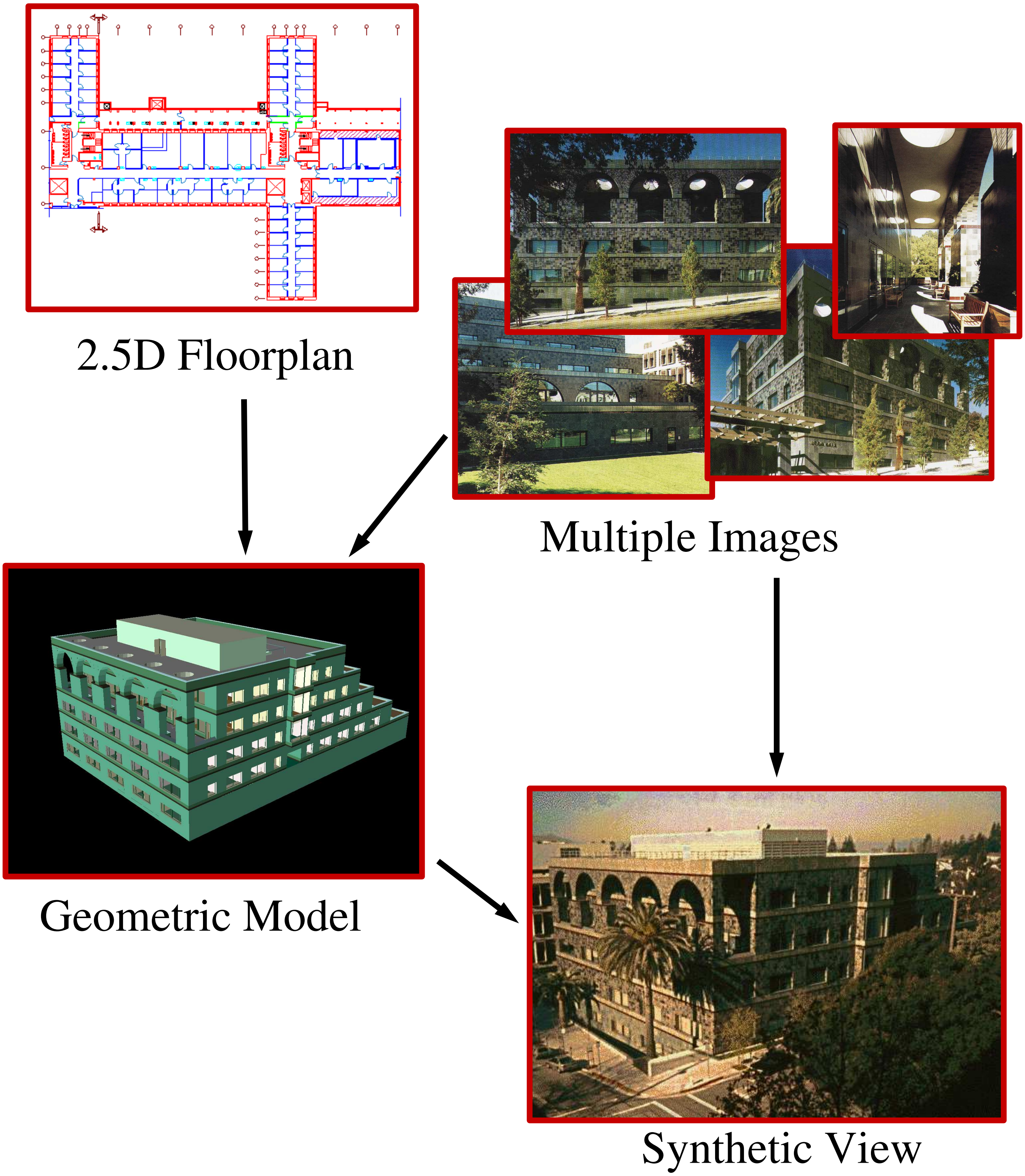
- **Generation**
  - Sweeps
  - Fractals
  - Grammars

- **Verification**
  - Design rule checking

- **Population**
  - Populate models automatically



Hybrid Methods

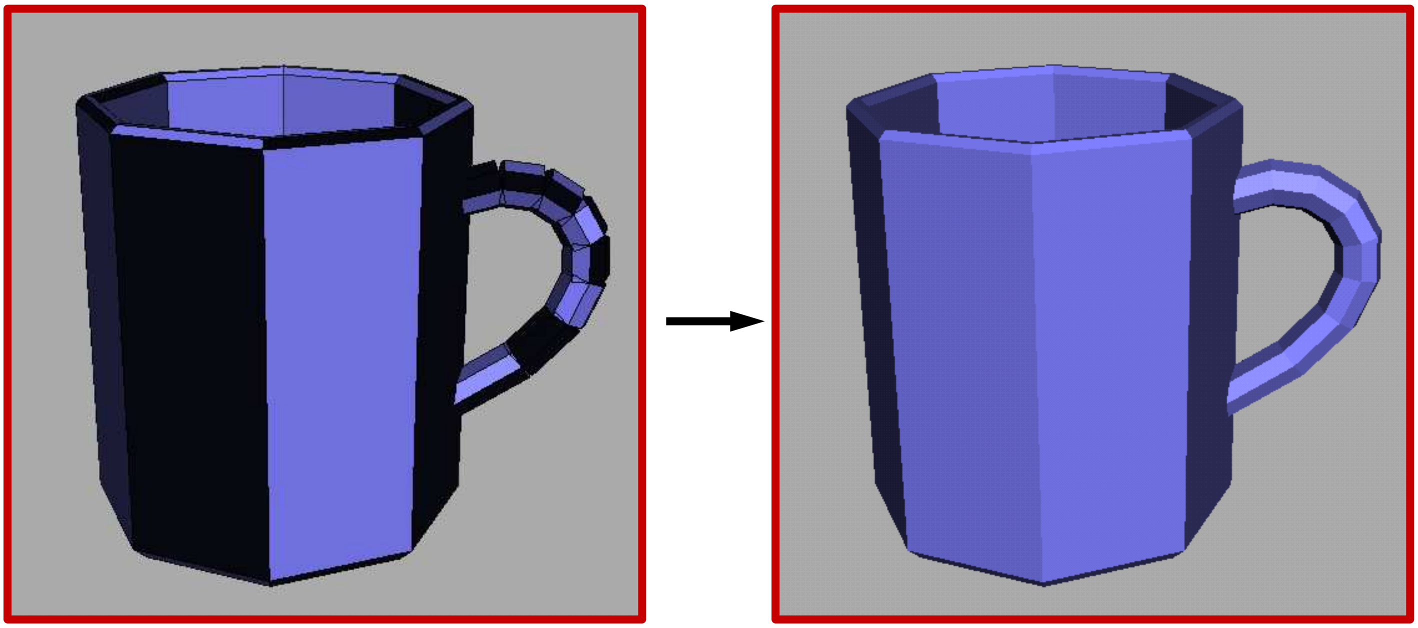


Model Manipulation

- **Model Manipulation Tools**
  - Model fixup (orient polys, etc.)
  - Convert between representations
  - Mesh parameterization
  - Mesh watermarking
- **Model Optimization Tools**
  - Scene graph optimization
  - Mesh simplification
  - Triangle strip generation
- **Model Analysis Tools**
  - BSP construction
  - Spatial subdivision methods
  - CSG from polygons

Model Manipulation Tools

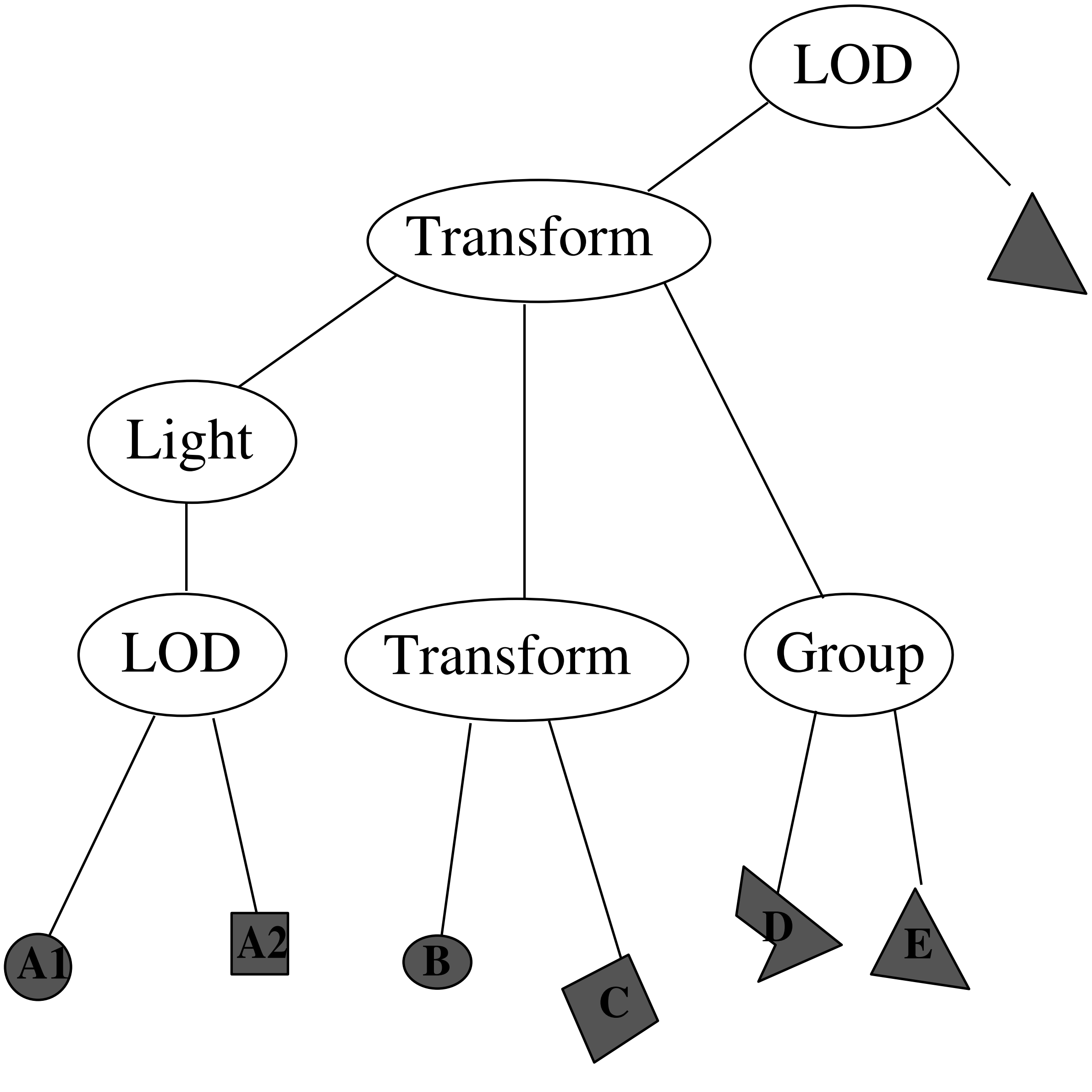
- **Model Fixup**
  - Topological methods
  - Solid reconstruction



Input Model Output Model

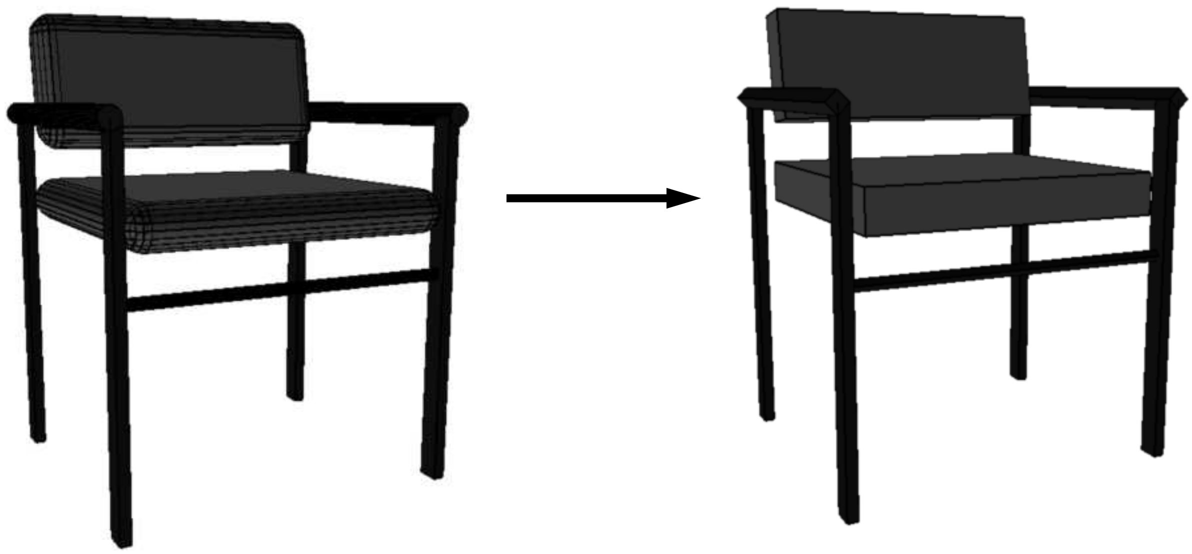
Model Optimization Tools

- **Scene Graph Optimization**
  - Bounding volume hierarchies
  - Bounding volume leaf granularity
  - LOD nodes & ranges
  - Light scoping
  - Multi–threaded scene graphs?



Model Optimization Tools

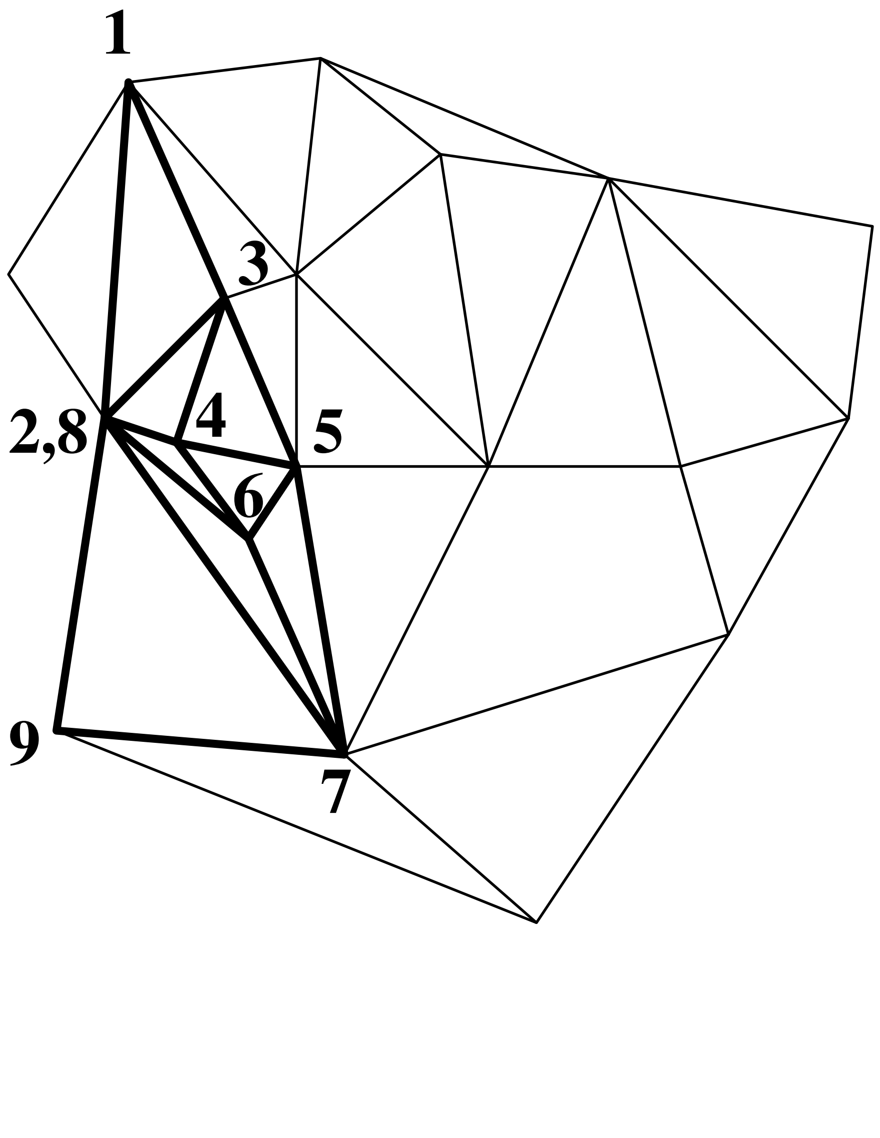
- **Mesh Simplification**
  - Attributes
  - Search
  - Semantics



899 Polygons 40 Polygons

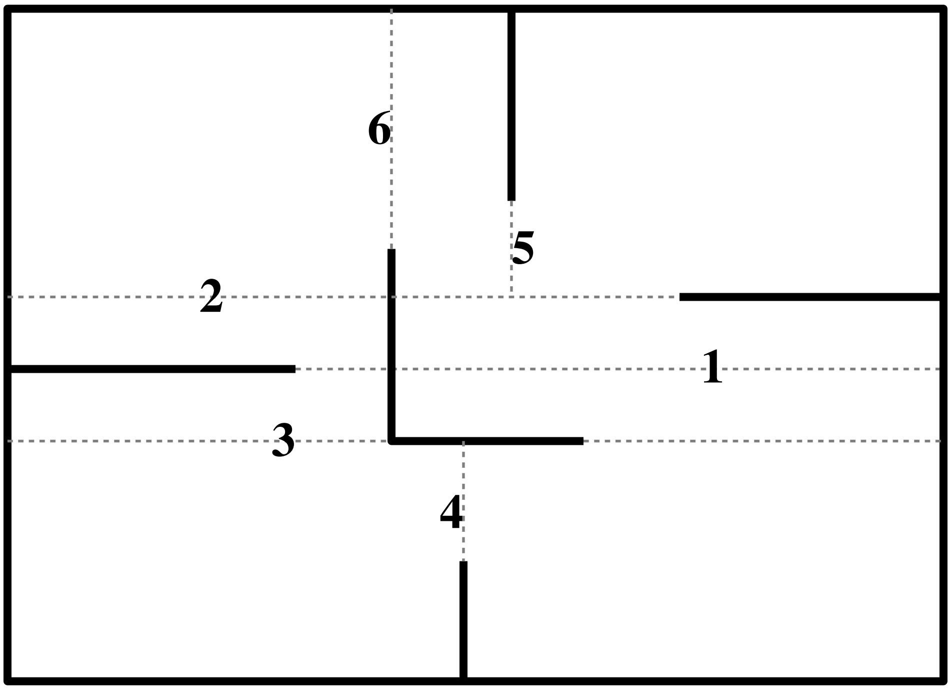
Model Optimization Tools

- **Triangle Strip Generation**
  - From mesh
  - From high–level reps



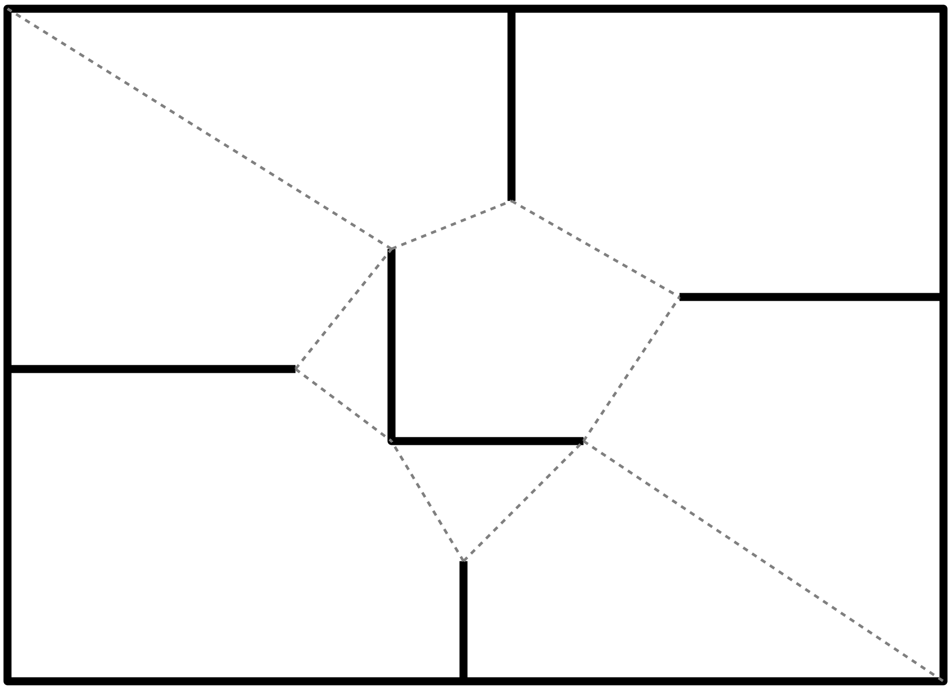
Model Analysis Tools

- **BSP Construction**
  - Plane selection algorithms



Model Analysis Tools

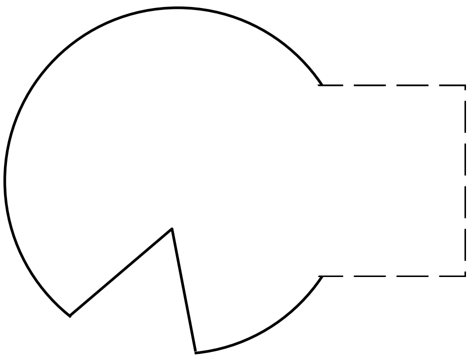
- **Spatial Subdivision**
  - Decomposition into convex cells
  - Sweep plane algorithm



Model Analysis Tools

- **Low−level Representation**
  - Point set
  - Voxels
  - Mesh

- **High−level Representation**
  - Constructive Solid Geometry
  - Procedural (e.g., sweep)



Model Simulation

- **Lighting Simulation**
  - Shadows
- **Appearance Simulation**
  - Water flow
  - Scuff marks
- **Behavior Simulation**
  - Motion capture
  - Contact forces
  - Traffic analysis

Model Simulation

- **Lighting Simulation**
  - Shadows
  - Radiosity

Model Simulation

- **Appearance Simulation**
  - Water flow
  - Scuff marks

Model Simulation

- **Behavior Simulation**
  - Motion capture
  - Contact forces
  - Traffic analysis

Summary

- ♦ **Model Generation**
  - **Model Capture Tools**
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    - CSG from polygons
- ♦ **Model Simulation**
  - **Lighting Simulation**
    - Shadows
  - **Appearance Simulation**
    - Water flow
    - Scuff marks
  - **Dynamics Simulation**
    - Motion capture
    - Contact forces
    - Traffic analysis