CS446/446G Interactive Computer Graphics

Instructor: Qi Li

Course syllabus

- Instructor
  - E-mail: qi.li@cs.wku.edu
  - Office: COHH 4138
  - Office hours
    - MW: 14:00-15:30
    - TR: 14:30-15:30
    - By appointment

Prerequisites

- MATH 307 and a grade of "C" or better in CS 280
- Specifically,
  - Basic concepts in linear algebra (e.g., vectors, matrices, matrix multiplication)

Textbooks and Reference

- **Textbook**
  - **Computer Graphics Using OpenGL (3nd ed.)**, F.S. Hill, Jr., Prentice-Hall, 2007
- **Reference**
  - **OpenGL Programming Guide (2nd ed.)** (the "Red book"), M. Woo, J. Neider, & T. Davis, Addison-Wesley, 1997

Grading

- Exams
  - Test I: 15%
  - Test II: 15%
  - Final: 30%
- Homework: 35%
- Attendance: 5%

Homeworks

- Programming environment
  - C/C++ or Java
  - OpenGL graphics library

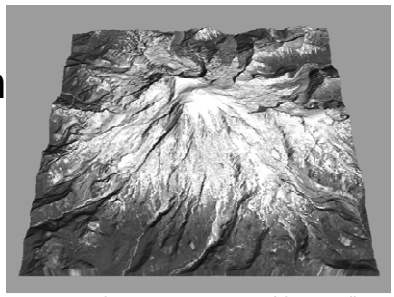
What is Computer Graphics?

- Computer-generated images or sequences of images (i.e., animations, movies)
- The scientific study of techniques and methods for generating such images

from SIGGRAPH 2002 Tech Sketches

Some 3-D Computer Graphics Applications

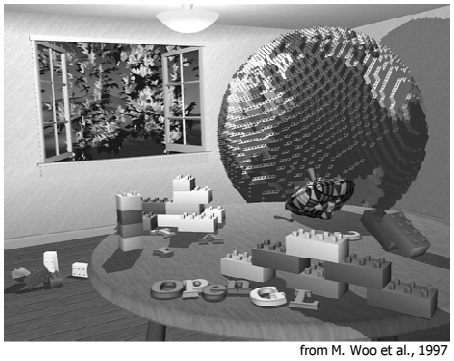
- Manufacturing design (CAD)
- Movies, TV, commercials
  - Animations
- Video games
- Scientific visualization
- Simulation of natural phenomena



3-D view of Mt. Rainier, WA created from satellite data (www.visualizationsoftware.com)

Outline of course

- Geometry
- Rasterization
- Shading
- Hidden surface elimination
- Texture mapping
- Modeling
- Ray tracing



from M. Woo et al., 1997

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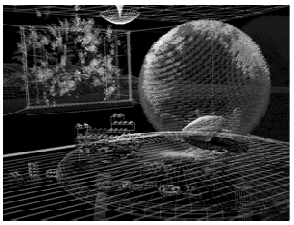
How to specify the 3-D positions of the camera and the scene objects and their various parts, how to project these to 2-D image locations, and how to represent trans-formations of these positions



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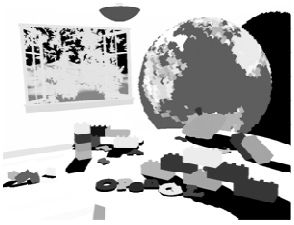
How to set individual image pixels corresponding to projected geometric objects such as points, lines, polygons, and more complicated shapes. Anti-aliasing reduces artifacts ("jaggies") caused by finite image resolution



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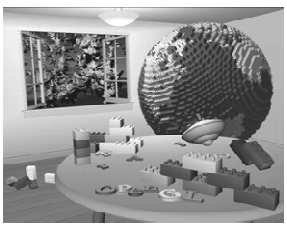
How to model light interaction with 3-D surfaces with varying material properties in order to calculate the proper colors perceived by the eye at different image locations



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How to efficiently rasterize only the visible parts of scene objects

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How to apply "layers" of detail to scene objects to show features, simulate bumps and reflections, or other precomputed shading effects. Procedural texturing is concerned with how some kinds of textures are generated algorithmically

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How to efficiently represent the geometry of scene objects, which may be complex, curved, etc.

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How to realistically simulate the movement of rays from light sources through multiple object reflections and refractions on the way to the eye

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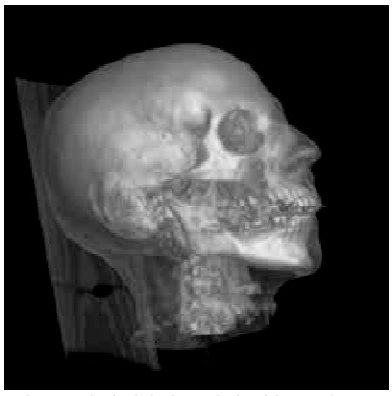
Volume Rendering: Head – Stanford



http://graphics.stanford.edu/software/volpack/movies/vp_movies.html

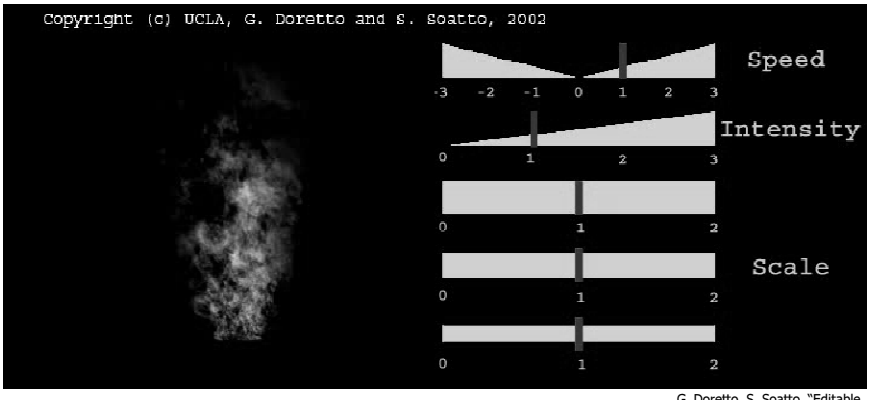
CT scan of a human head. Transparency of different tissue types varies: soft tissues (such as skin) are semi-transparent, and bone is opaque

Rendering with Natural Light

P. Debevec's 1998 SIGGRAPH paper

Note texture-mapped marble, detailed refractions through spheres & reflections of environment

Dynamic Texture: Fire – UCLA



http://vision.ucla.edu/~doretto/projects/dynamic-editing.html

G. Doretto, S. Soatto, "Editable Dynamic Textures", SIGGRAPH 2002

Texture is procedurally generated—editor shows parameters

Take home message

- What makes most realistic-looking images/animations look so good is a lot of expensive software, time spent on detailed modeling, and artistic talent.
- The underlying computer graphics principles are what this course will focus on:
  - Free and often relatively simple