CSE 167:
Introduction to Computer Graphics

Jürgen P. Schulze, Ph.D.
University of California, San Diego
Fall Quarter 2012

Today

- Course organization
- Course overview

Course Staff

Instructor

- Jürgen Schulze, Ph.D.
  Lecturer in CSE, Research Scientist at Calit2

Teaching Assistant

- Sid Vijay, took CSE167 in 2009

Tutors

- Matthew Religioso, took CSE167 in 2010
- Joey Ly, took CSE167 in 2010

Course Organization

Lecture

- Tue/Thu, 2:00pm-3:20pm, WLH 2204

Homework Grading

- Fridays (only on due dates) at 1:30pm, CSE lab 260

Instructor Office Hour

- Tue 3:30pm-4:30pm, Atkinson Hall room 2125

Office Hours in Lab 260

- Sid Vijay: Wed+Thu 3:30-5:30pm
- Matthew Religioso: Thu 4:30-6:30pm
- Joey Ly: Tue 6-8pm

Prerequisites

Familiarity with

- Linear algebra
- C++
- Object oriented programming

In this class

- Rendering 3D models
  - Camera simulation
  - Interactive viewing
  - Lighting
  - Shading
- Modeling
  - Triangle meshes
  - Parametric surfaces
- Applying linear algebra, C++, OpenGL
- Foundation for advanced graphics courses
  - Henrik Wann Jensen's CSE168
  - Wolfgang Engel's CSE 190 on shader programming
  - My CSE 190 on 3D user interfaces

Course Web Site

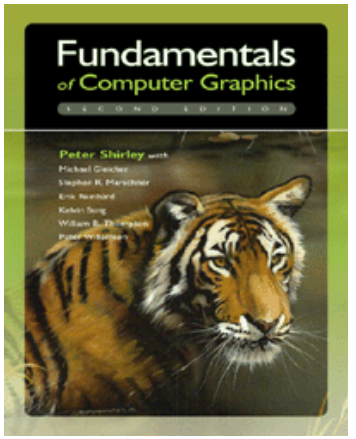
- URL:
  http://ivl.calit2.net/wiki/index.php/CSE_167_Fall_2012
  or
  http://tinyurl.com/cse167f2012
- Class schedule
- Lecture slides
- Textbook recommendations
- Announcements
- Homework assignments
- Grading information (grades on Ted)

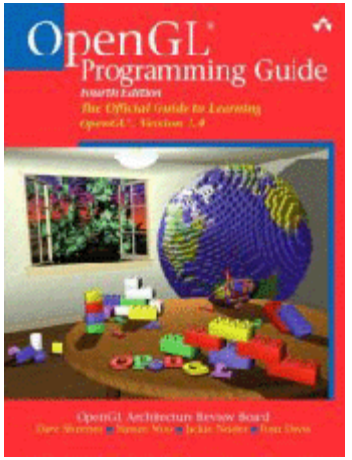
Ted

- Go to
  `http://ted.ucsd.edu`
  and select CSE167
- Log in with your Active Directory account
- Used for discussion board and grades

Textbooks

- Both textbooks are recommended, not required
- Peter Shirley: *Fundamentals of Computer Graphics*, any edition (Google Books has full text version)
- *OpenGL Programming Guide*
  Older versions available on-line





Programming Projects

- 7 programming assignments
- First and last are group projects
- Find assignments and schedule on home page
- Base code (for Windows and Linux) and documentation on home page
- Use EBU3B 2xx labs or your own PC/laptop
- Individual assistance by TA during lab office hours
- Turn in by demonstration to TA, tutors or instructor during homework grading hours on Fridays. Demonstration can be done on lab PC or personal computer.
- Homework projects are due Fridays 1:30pm. Late submissions are possible with 25% point deduction.

Written Examinations

Two in-class written exams.

Closed book, handwritten index card is permitted.

Midterm #1:

- Thu 10/24, 2:00pm-3:20pm, WLH 2204

Midterm #2:

- Thu 11/29, 2:00pm-3:20pm, WLH 2204

Grading

- Homework Projects 1-6: 10% each
- Written exams: 10% each
- Final project: 20%
- Late submission policy for homework projects:

  75% of original grade if you present your project within seven days of the due date

Today

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What is computer graphics?

Applications:

- Movie, TV special effects
- Video games
- Scientific visualization
- GIS (Geographic Information Systems)
- Medical visualization
- Industrial design
- Simulation
- Communication
- Etc.

What is computer graphics?

- Rendering
- Modeling
- Animation

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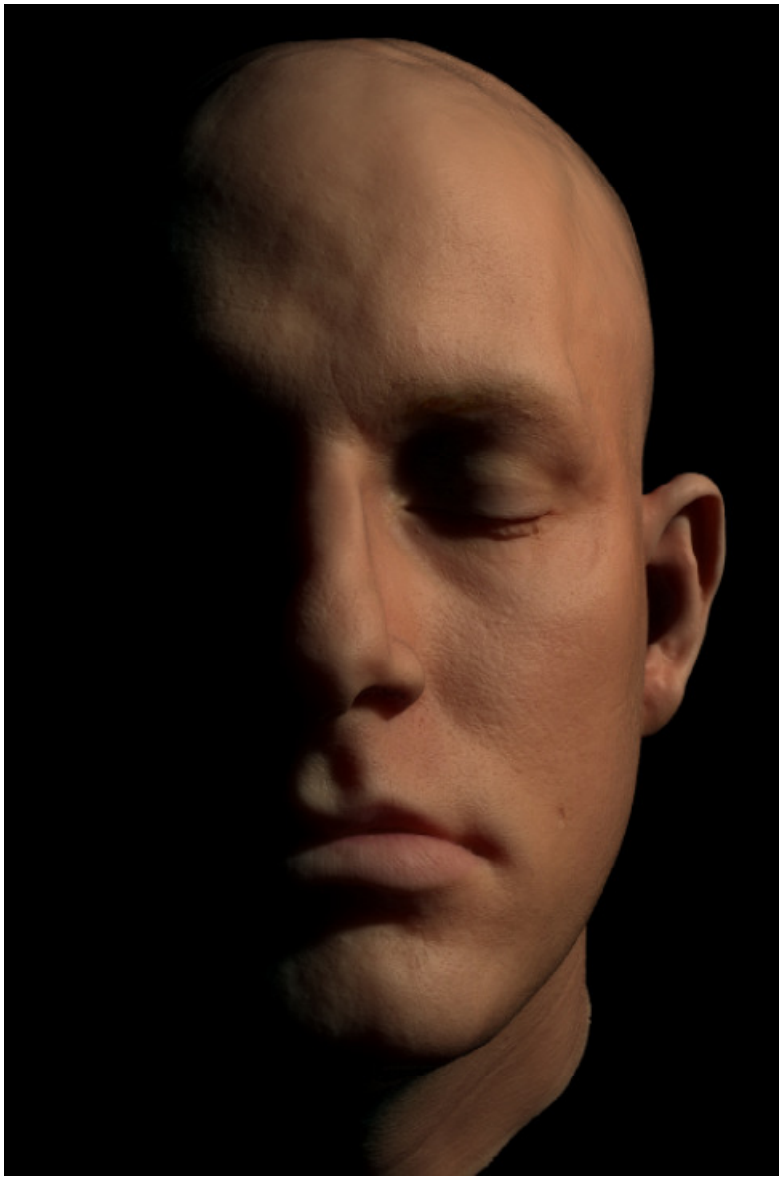
Rendering

- Synthesis of a 2D image from a 3D scene description
  - Rendering algorithm interprets data structures that represent the scene in terms of geometric primitives, textures, and lights
- 2D image is an array of pixels
  - Red, green, blue values for each pixel
- Different objectives
  - Photorealistic
  - Interactive
  - Artistic

Photorealistic rendering

- Physically-based simulation of light, camera
- Shadows, realistic illumination, multiple light bounces
- Slow, minutes to hours per image
- Special effects, movies
- CSE168: Rendering Algorithms

Photorealistic rendering



Interactive rendering

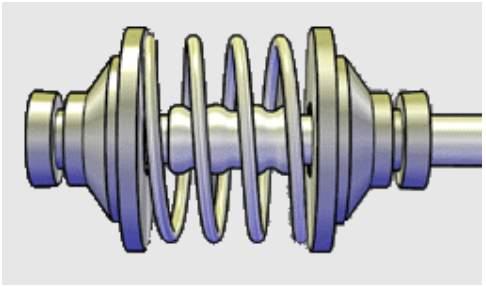
- Produce images within milliseconds
- Using specialized hardware, graphics processing units (GPUs)
- Standardized APIs (OpenGL, DirectX)
- Often "as photorealistic as possible"
- Hard shadows, fake soft shadows, only single bounce of light
- Games
- CSE167

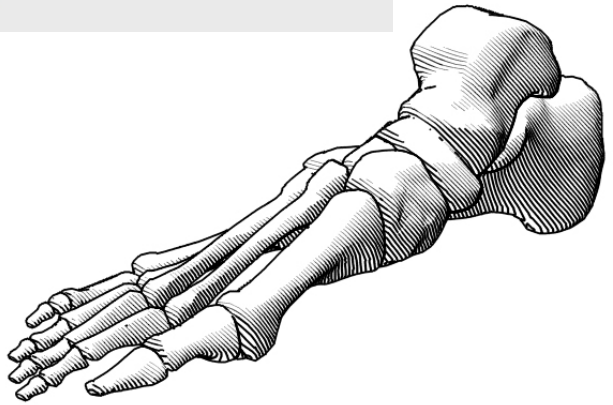
Interactive rendering

Artistic rendering

- Stylized
- Artwork, illustrations, data visualization

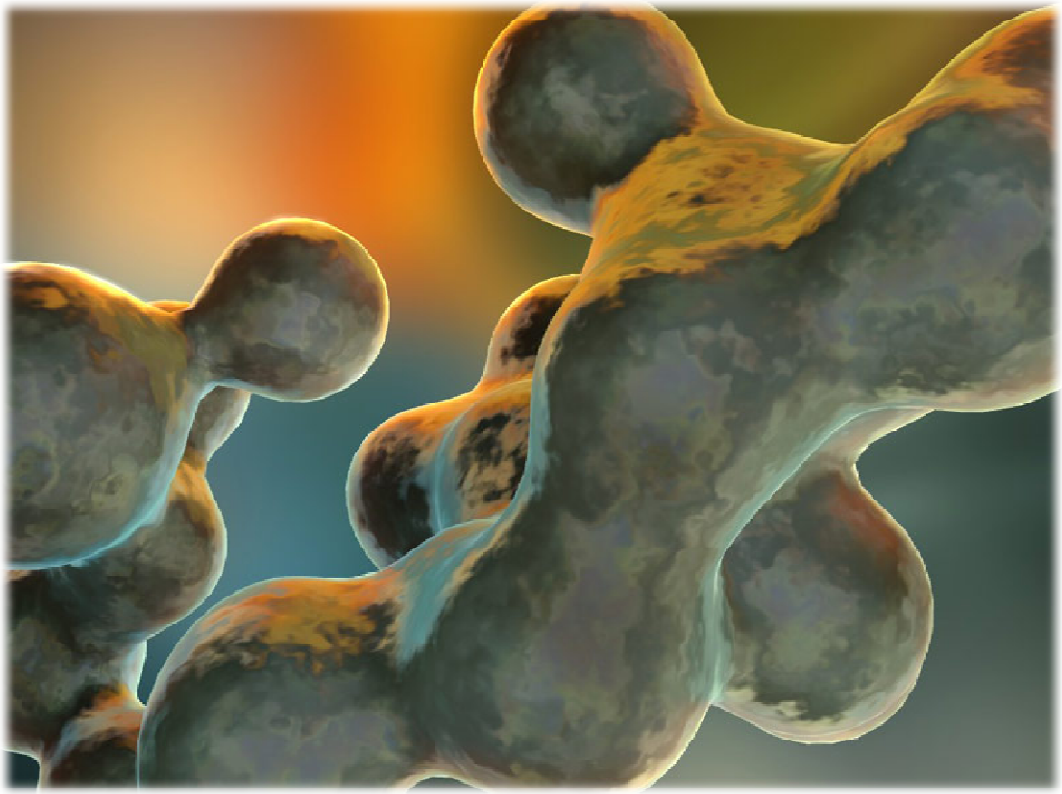
Artistic rendering





Live Demo

- NVIDIA Geoforms: Real-Time Rendering
  http://www.nvidia.com/coolstuff/demos#!/geoforms

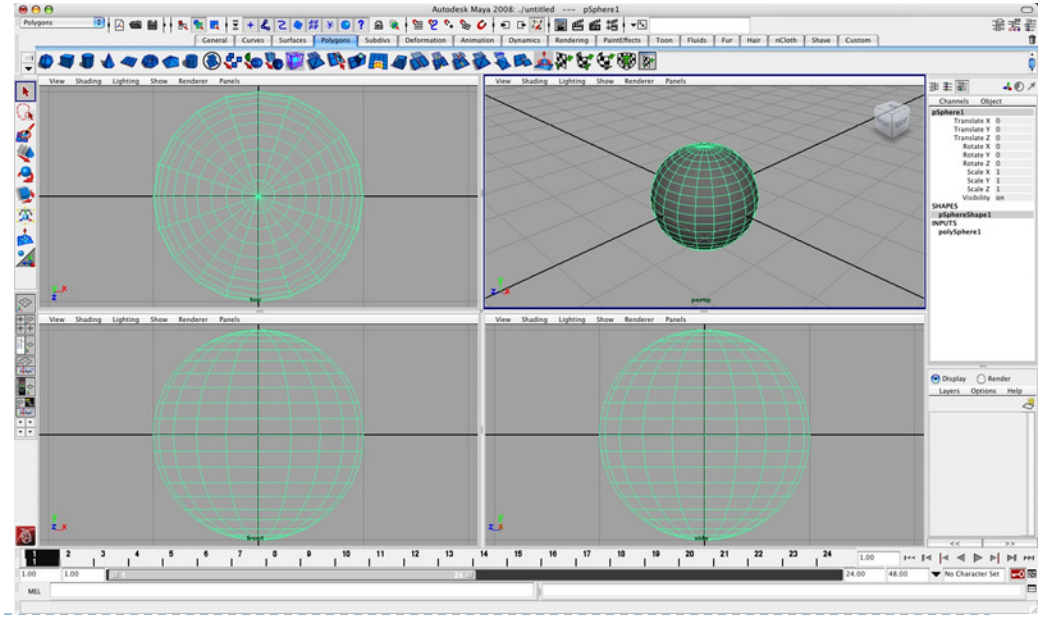


What is computer graphics?

- Rendering
- Modeling
- Animation

Modeling

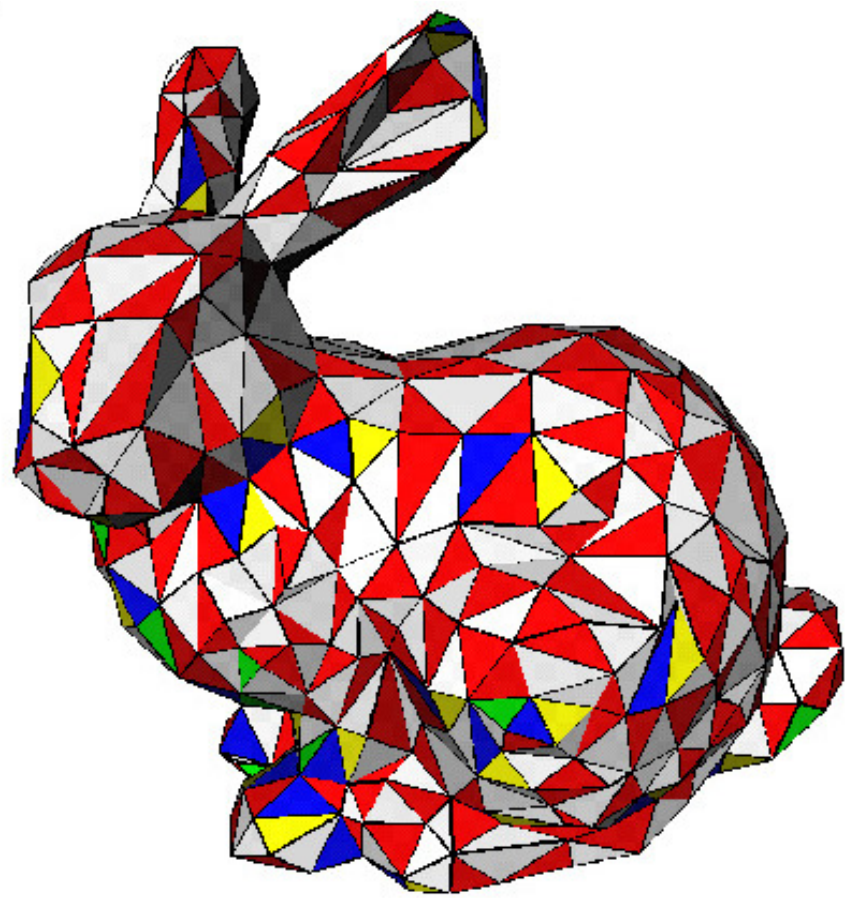
- Creating 3D geometric data
  - The "model" or the "scene"
- By hand
  - Autodesk (Maya, AutoCAD), LightWave 3D, …
- Free software
  - Blender
- Not as easy to use as Notepad…



Maya Screenshot

Modeling

- Basic 3D models consist of array of triangles
- Each triangle stores 3 vertices
- Each vertex contains
  - xyz position
  - Color
  - Etc.



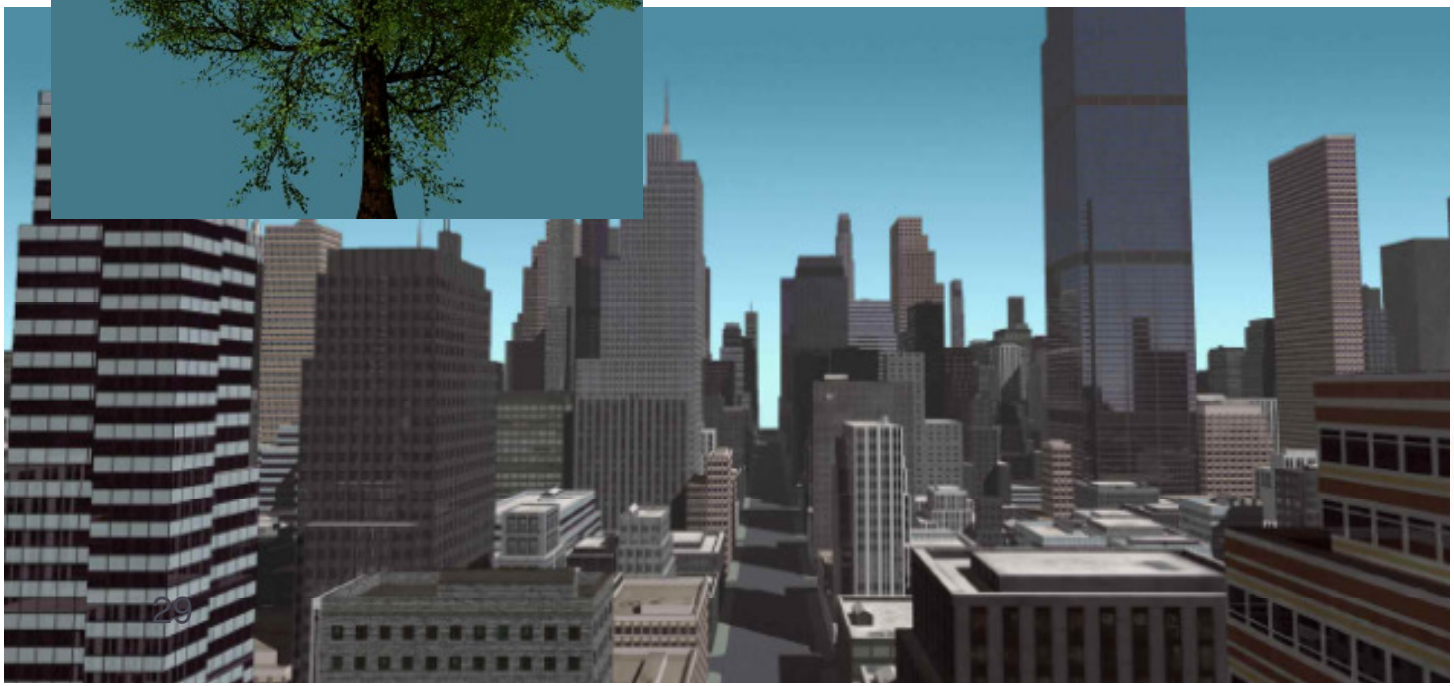
Modeling

- Procedural: by writing programs
- Scanning real-world objects

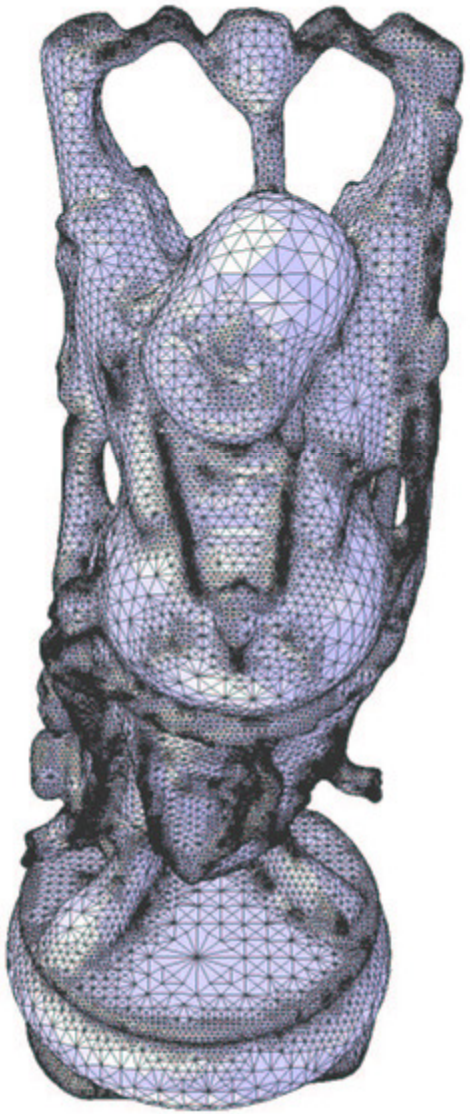
Modeling

Procedural tree

Procedural city



Scanned statue



What is computer graphics?

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- Modeling
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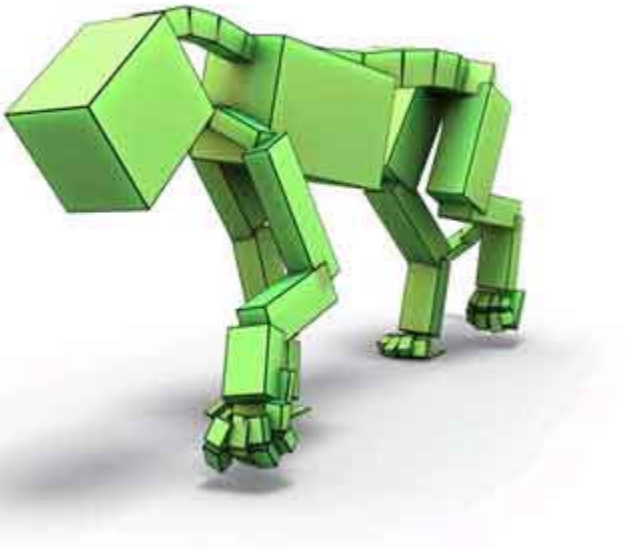
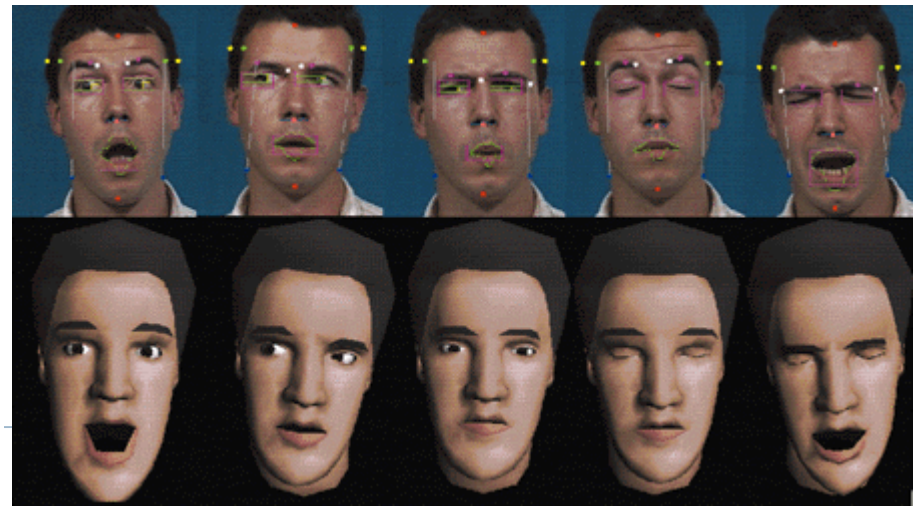
Animation

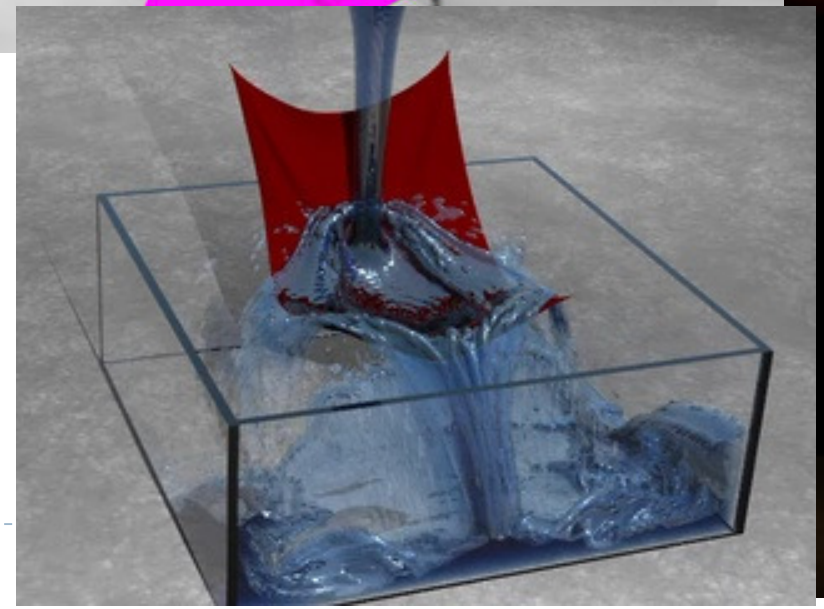
- Deforming or editing the geometry
- Change over time
- Faces, articulated characters, …
- CSE169: Computer Animation (not offered this year)

Animation





Physics Based Animation



Video

- SIGGRAPH 2012 Technical Papers:
  http://www.youtube.com/watch?v=cKrng7ztpog
- Blender Demo Reel 2012:
  http://www.youtube.com/watch?v=P2xzn6bEN_U

Announcements

- Next Lecture
  - Tue 10/2 at 2pm
  - Topic: Homogeneous Coordinates
  - Preparation:
    Review three dimensional vector/matrix calculations

- Homework Introduction (optional):
  Introduction to base code and homework assignment #1:
  Sid Vijay, CSE lab 260, Monday Oct 1st, 2:30-4:30pm

- Homework assignment #1 due Friday, Oct 5th