

# CSE 167: Introduction to Computer Graphics

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University of California, San Diego  
Fall Quarter 2010

# Today

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- ▶ **Course overview**
- ▶ Course organization

# What is computer graphics

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## **Applications:**

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

# What is computer graphics?

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- ▶ Rendering
- ▶ Modeling
- ▶ Animation

# Rendering

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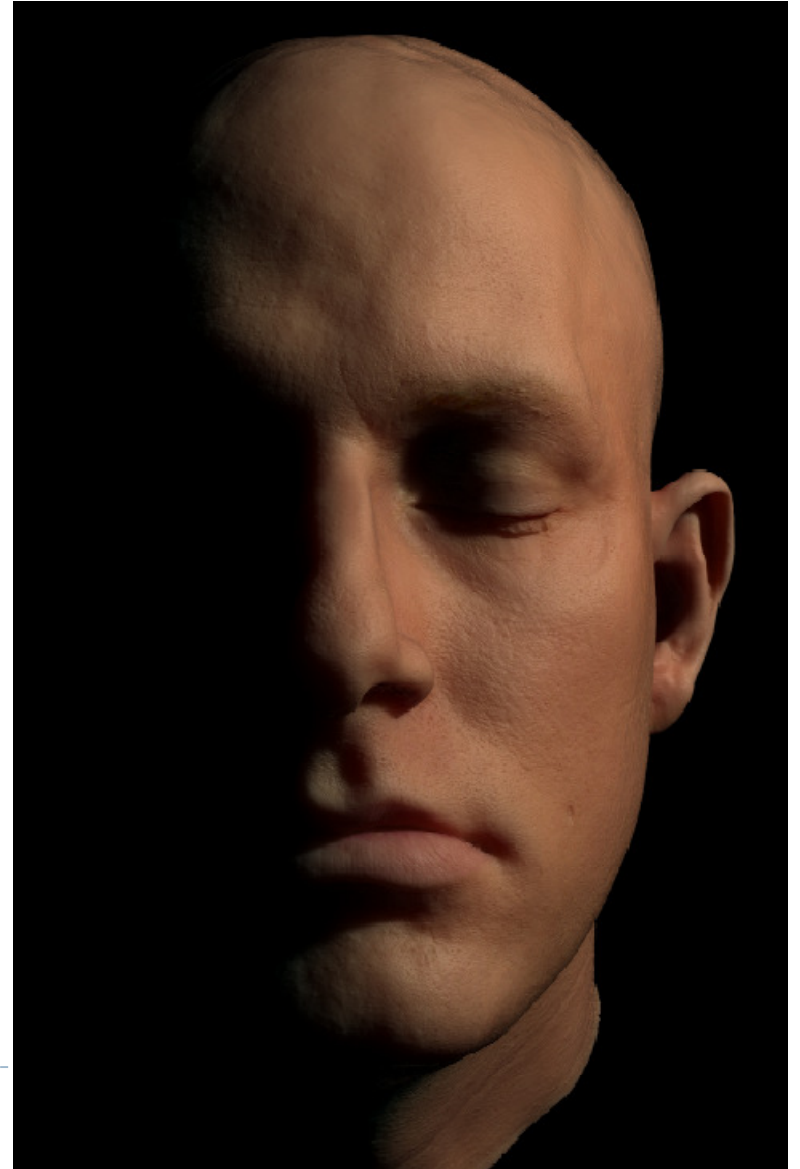
- ▶ **Synthesis of a 2D image from a 3D scene description**
  - ▶ Rendering algorithm interprets data structures that represent the scene in terms of geometric primitives, textures, and lights
- ▶ **2D image is an array of pixels**
  - ▶ Red, green, blue values for each pixel
- ▶ **Different objectives**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

# Photorealistic rendering

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- ▶ Physically-based simulation of light, camera
- ▶ Shadows, realistic illumination, multiple light bounces
- ▶ Slow, minutes to hours per image
- ▶ Special effects, movies
- ▶ CSE I 68: Rendering Algorithms

# Photorealistic rendering



# Interactive rendering

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- ▶ 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
- ▶ CSEI67



# Interactive rendering

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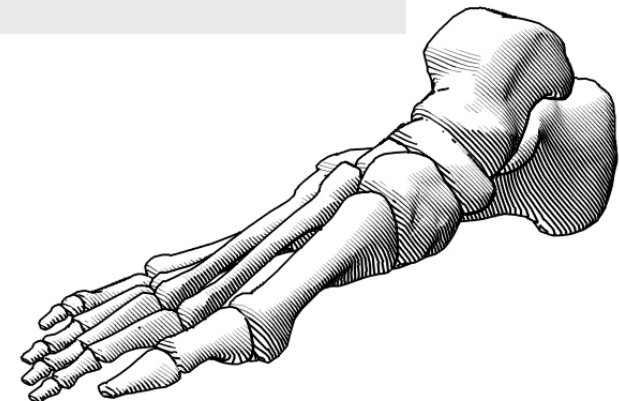
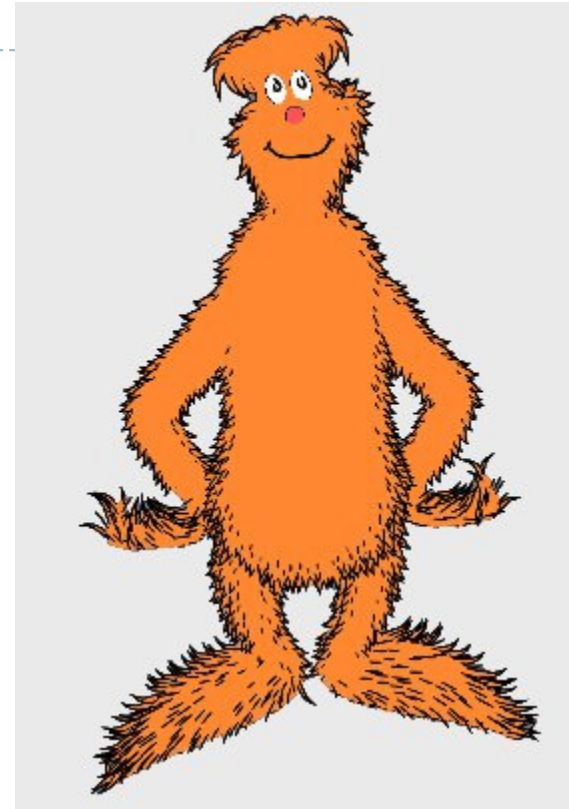
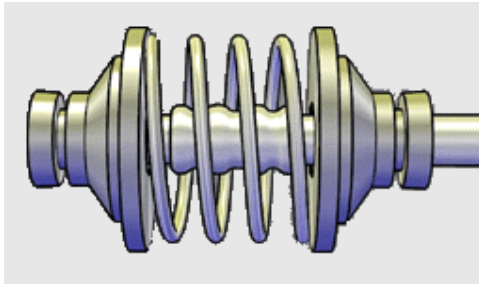
# Artistic rendering

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- ▶ Stylized
- ▶ Artwork, illustrations, data visualization

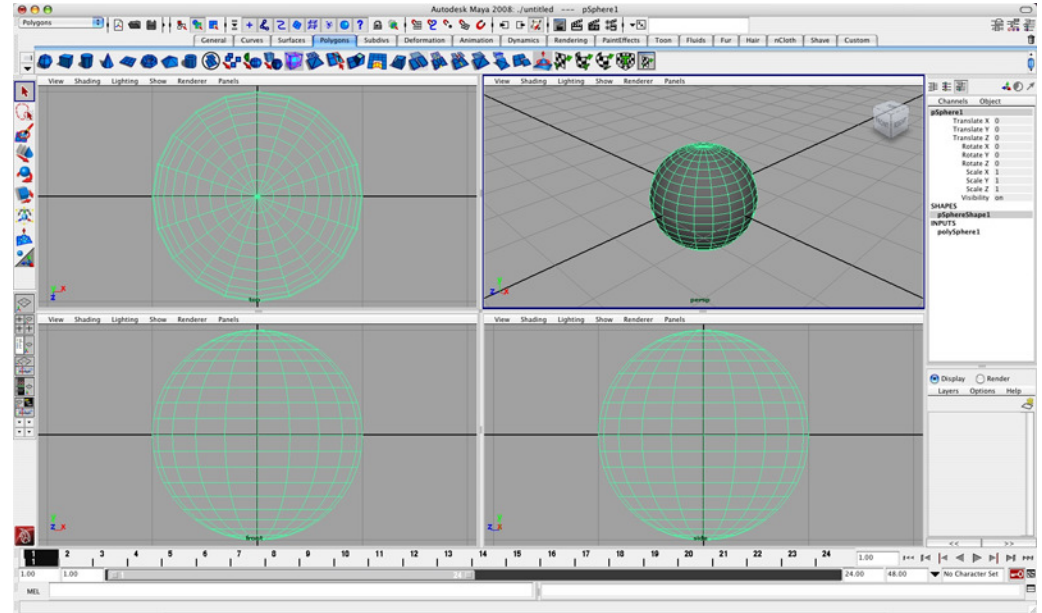
# Artistic rendering

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# 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...

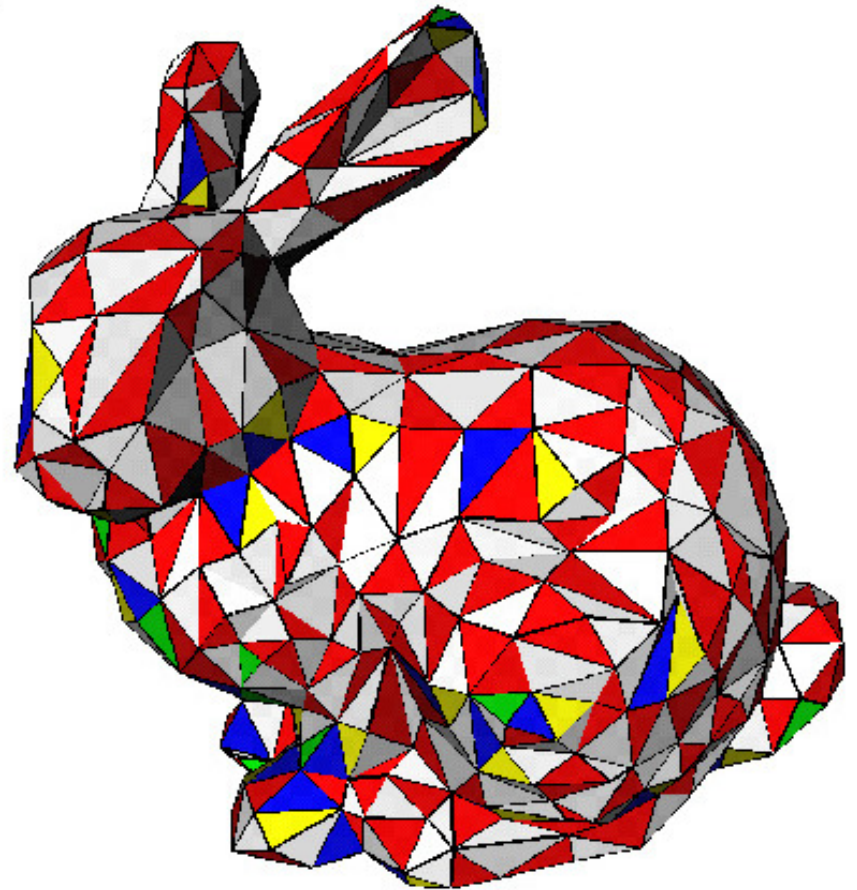




# Modeling

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



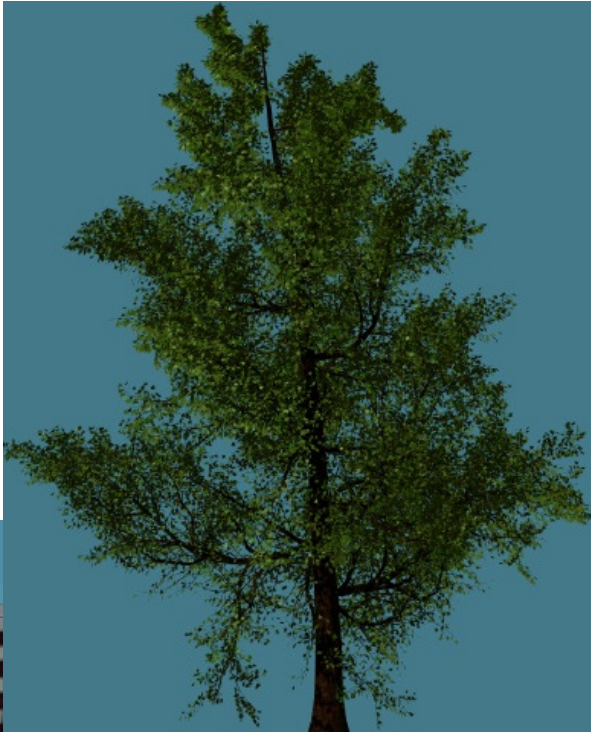
# Modeling

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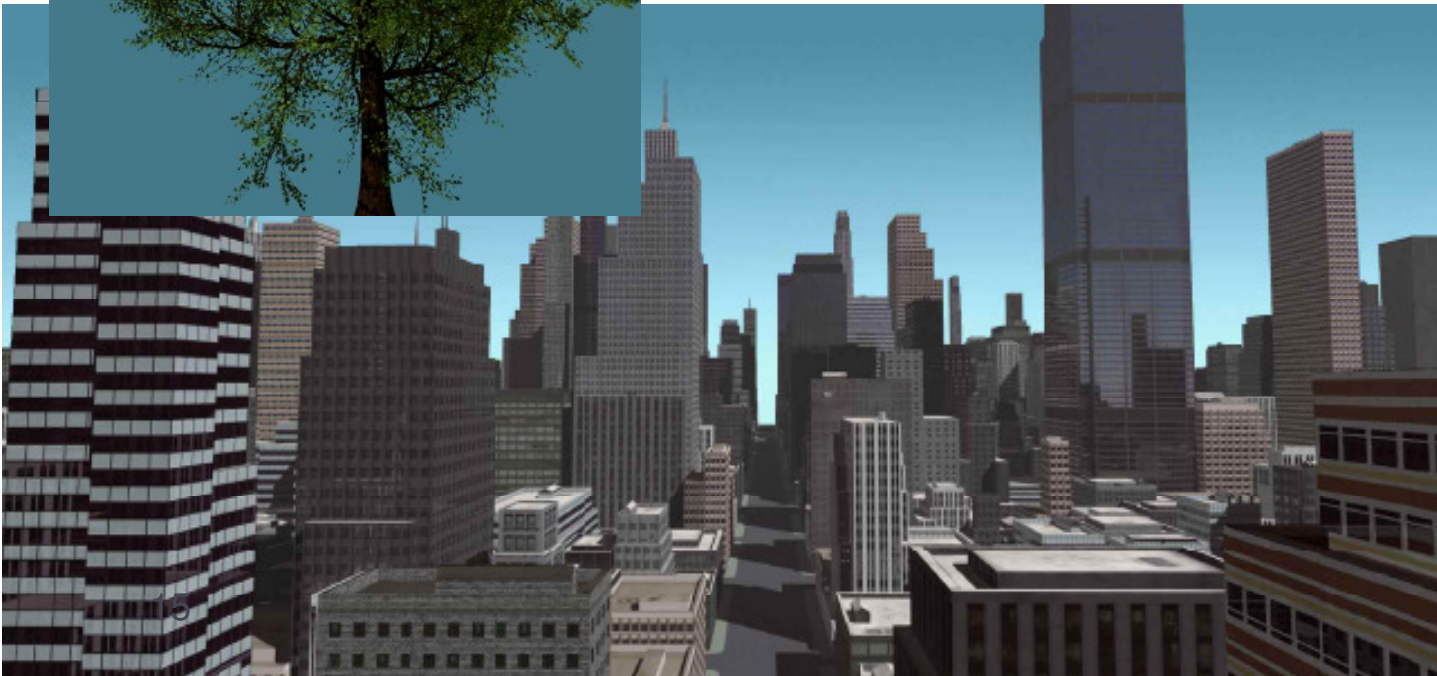
- ▶ Procedural: by writing programs
- ▶ Scanning real-world objects

# Modeling

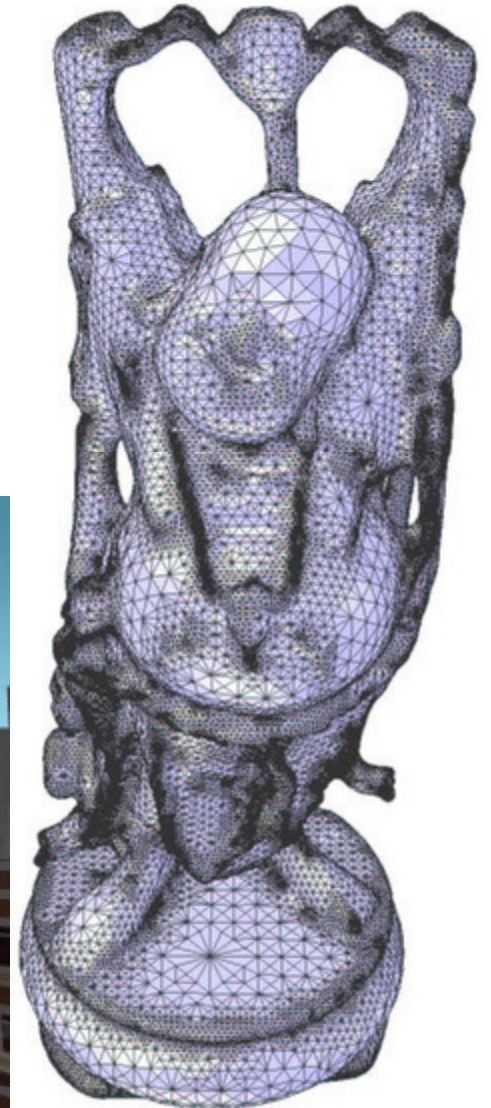
Procedural tree



Procedural city



Scanned statue



# Animation

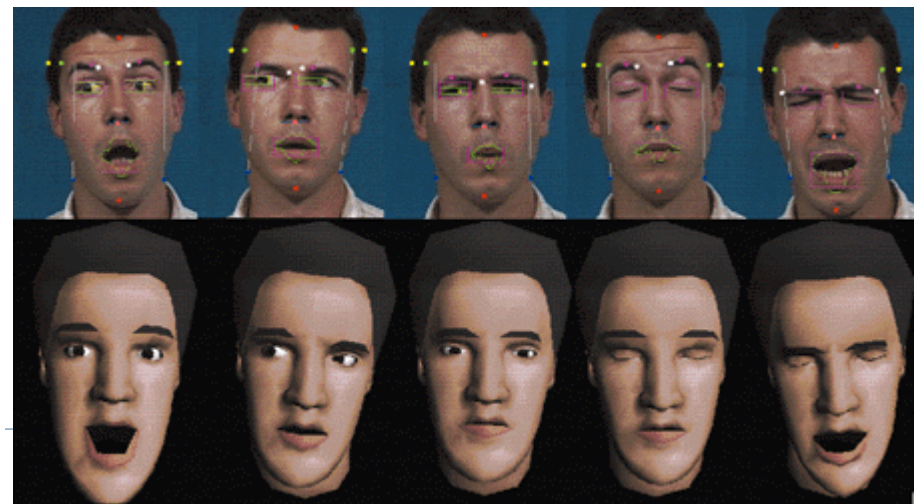
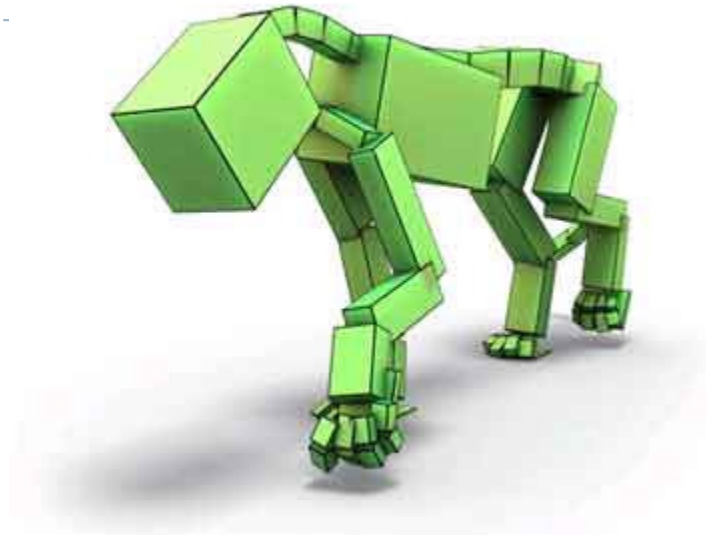
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- ▶ Deforming or editing the geometry
- ▶ Change over time
- ▶ Faces, articulated characters, ...
- ▶ CSEI 69: Computer Animation (not offered this year)



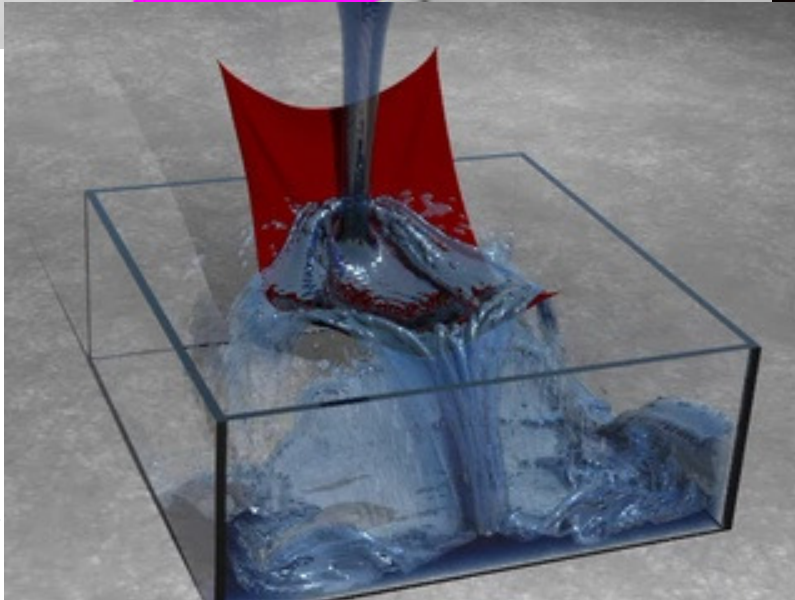
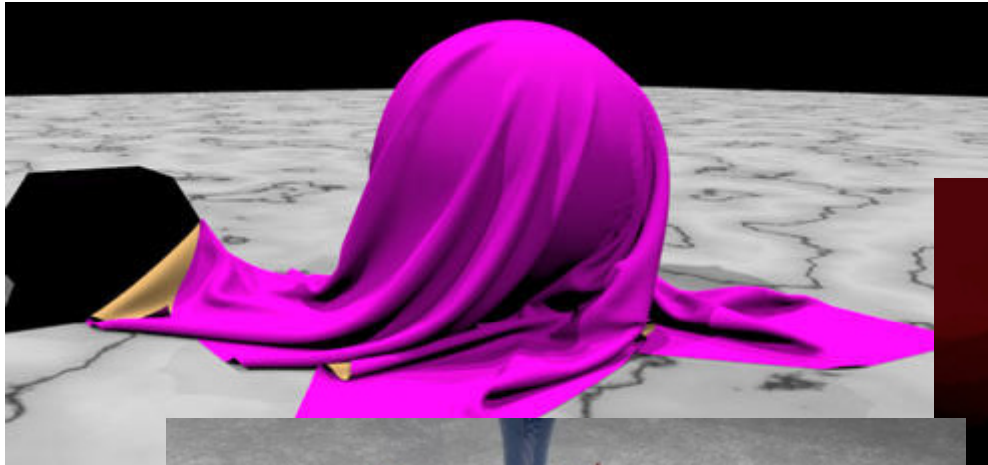
# Animation

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# Physics simulation

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# Questions?

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# Today

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- ▶ Course overview
- ▶ Course organization

# Course Staff

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## **Instructor**

- ▶ Jürgen Schulze, Ph.D.  
Research Scientist at Calit2

## **Teaching Assistants**

- ▶ Han Suk Kim, CSE graduate student
- ▶ Iman Sadeghi, CSE graduate student

## **Tutors**

- ▶ Phi Nguyen, CSE senior
- ▶ Haili Wang, CSE senior

# Course Organization

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## **Lecture**

- ▶ Tue/Thu, 2:00pm-3:20pm, VLH 2005

## **Homework Grading**

- ▶ Fridays (only on due dates) 2pm-5pm, CSE lab 260

## **Instructor Office Hour**

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

## **Office Hours in Lab**

- ▶ Han Suk Kim: Mon/Thu 9:30am-11:30am
- ▶ Phi Nguyen: Tue/Thu 11:30am-12:30pm
- ▶ Haili Wang: Tue/Thu 3:30pm-4:30pm
- ▶ Iman Sadeghi: TBD
- ▶ For updates see the course web site

# Prerequisites

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## **Familiarity with**

- ▶ Linear algebra
- ▶ C++
- ▶ Object oriented programming

# In this class

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- ▶ **Rendering 3D models**
  - ▶ Camera simulation
  - ▶ Interactive viewing
  - ▶ Lighting
  - ▶ Shading
- ▶ **Modeling**
  - ▶ Triangle meshes
  - ▶ Parametric surfaces
- ▶ Applying linear algebra, C++, OpenGL
- ▶ Foundation for advanced graphics courses (CSEI 68, CSEI 69, CSE 190 on shader programming)

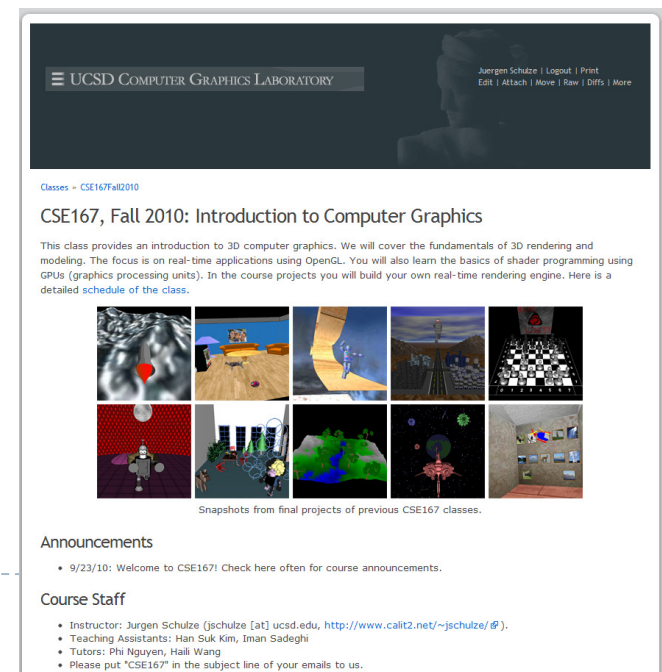


# Web Site

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## Course web site:

- ▶ <http://graphics.ucsd.edu/twiki/bin/view.pl/Classes/CSE167Fall2010>
- ▶ Contains:
  - ▶ Schedule
  - ▶ Slides
  - ▶ Recommended reading
  - ▶ Homework assignments
  - ▶ Grading
  - ▶ Exam information



# WebCT

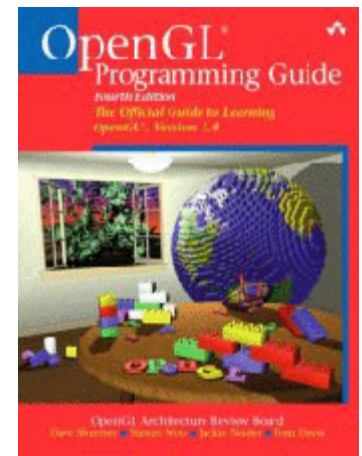
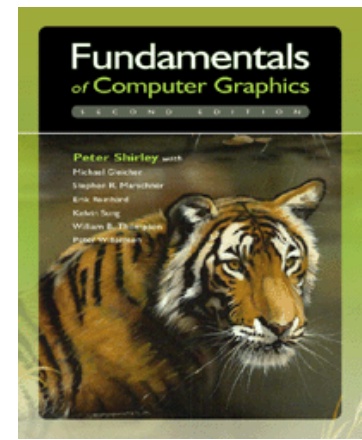
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- ▶ Go to  
**`http://webct.ucsd.edu`**  
and select CSE167
- ▶ Log in with your Active Directory account
- ▶ Find discussion board, chat, etc.

# Textbooks

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- ▶ Required:  
Peter Shirley: *Fundamentals of Computer Graphics*, any edition (Google Books has full text version)
- ▶ Recommended (available on-line):  
*OpenGL Programming Guide*



# Programming Projects

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- ▶ Find assignments and schedule on class web site
- ▶ Base code (for Windows and Linux) and documentation on class web site
- ▶ Use EBU3B 2xx labs or your own PC
- ▶ Individual assistance by TAs and tutors during lab hours
- ▶ Turn in by demonstration to TA or tutor during lab hours or homework grading hours. Demonstration can be done on lab PC or personal laptop computer.

# Programming Projects

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- ▶ **Project 1:** Matrices, Vectors, and Coordinate Transformations
- ▶ **Project 2:** Interactive Viewing
- ▶ **Project 3:** Rasterization
- ▶ **Project 4:** Lighting and Texturing
- ▶ **Project 5:** Scene Graphs
- ▶ **Project 6:** Shader Programming
- ▶ **Final Project**

# Tests

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Two in-class written tests.

Closed book, handwritten index card is permitted.

## **First exam:**

- ▶ Thu 10/21, 2:00pm-3:20pm, WLH 2005

## **Second exam:**

- ▶ Tue 11/23, 2:00pm-3:20pm, WLH 2005

# Grading

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- ▶ 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

# Questions?

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# Next Lecture

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- ▶ Tue 9/28 at 2pm
- ▶ Topic: Homogeneous Coordinates
- ▶ Preparation:  
Refresh three dimensional vector/matrix calculations
- ▶ Lab session (optional):  
Introduction to base code and homework assignment #1:  
Han Suk Kim, CSE lab 260, Monday Sept 27, 9:30am