

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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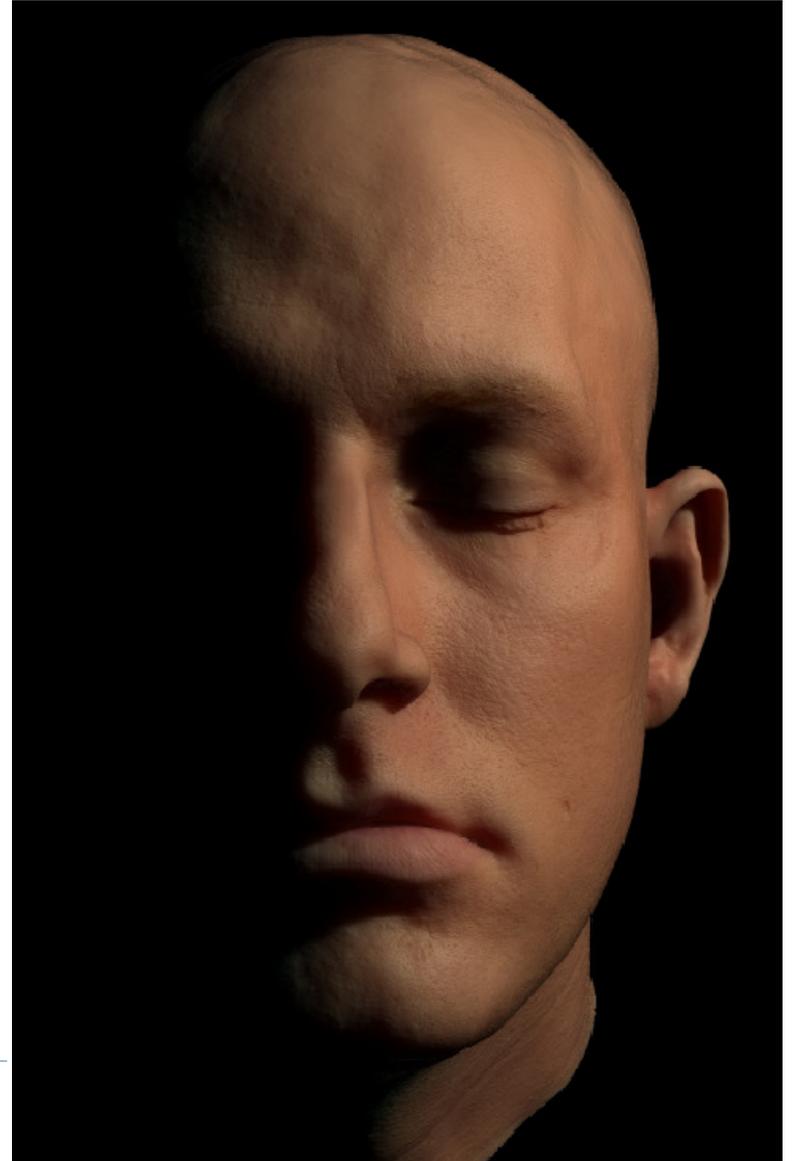
- ▶ **Synthesis of a 2D image from a 3D scene description**
  - ▶ Rendering algorithm interprets data structures that represent the scene in terms of geometric primitives, textures, and lights
- ▶ **2D image is an array of pixels**
  - ▶ Red, green, blue values for each pixel
- ▶ **Different objectives**
  - ▶ 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
- ▶ CSE167

# Interactive rendering



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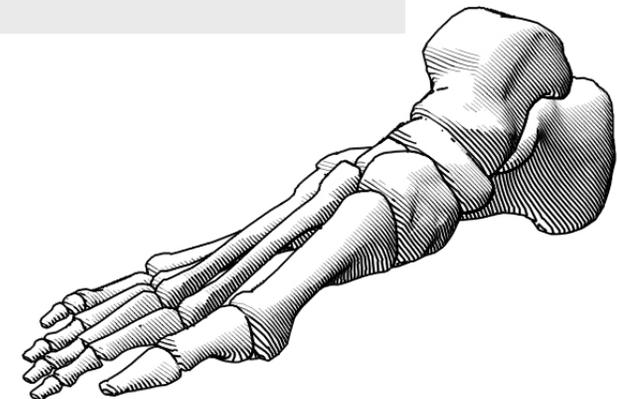
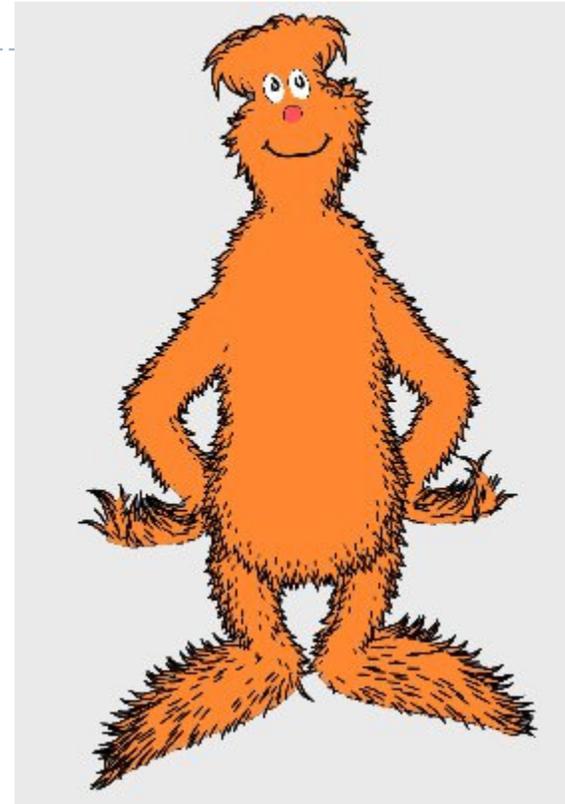
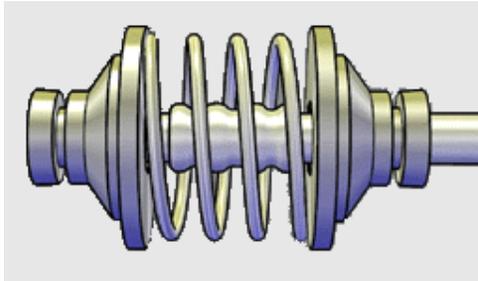
# Artistic rendering

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- ▶ Stylized
- ▶ Artwork, illustrations, data visualization

# Artistic rendering

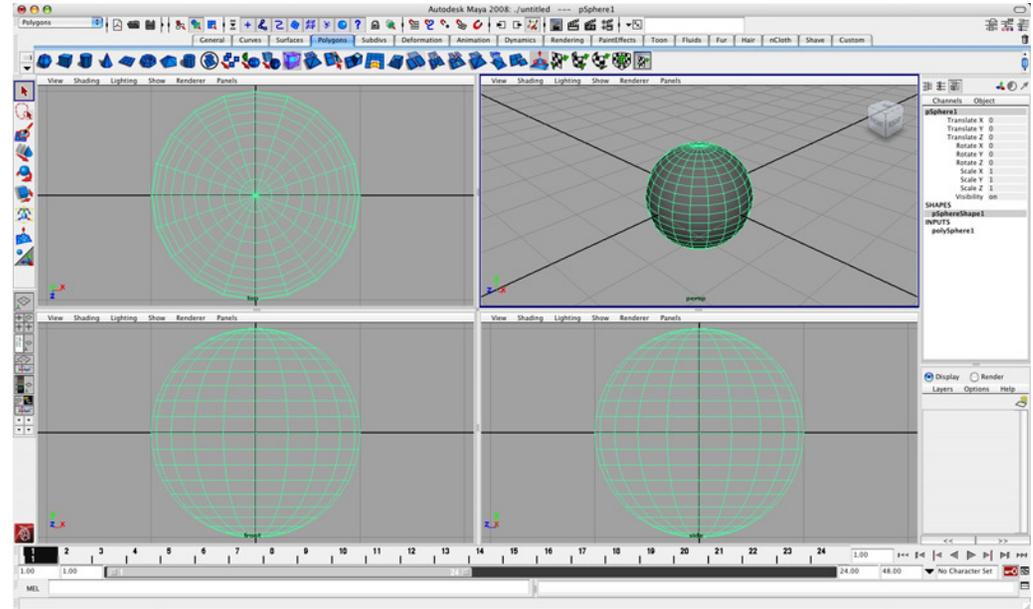
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# Modeling

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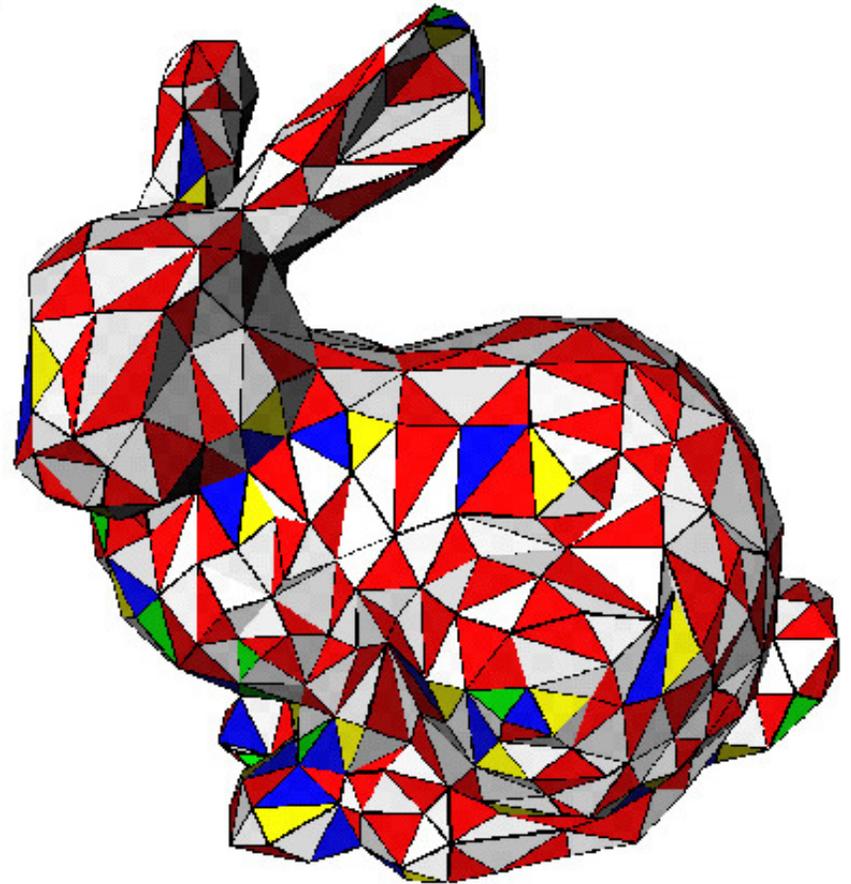
- ▶ Creating 3D geometric data
  - ▶ The “model” or the “scene”
- ▶ By hand
  - ▶ Autodesk (Maya, AutoCAD), LightWave 3D, ...
- ▶ Free software
  - ▶ Blender
- ▶ Not as easy to use as Notepad...



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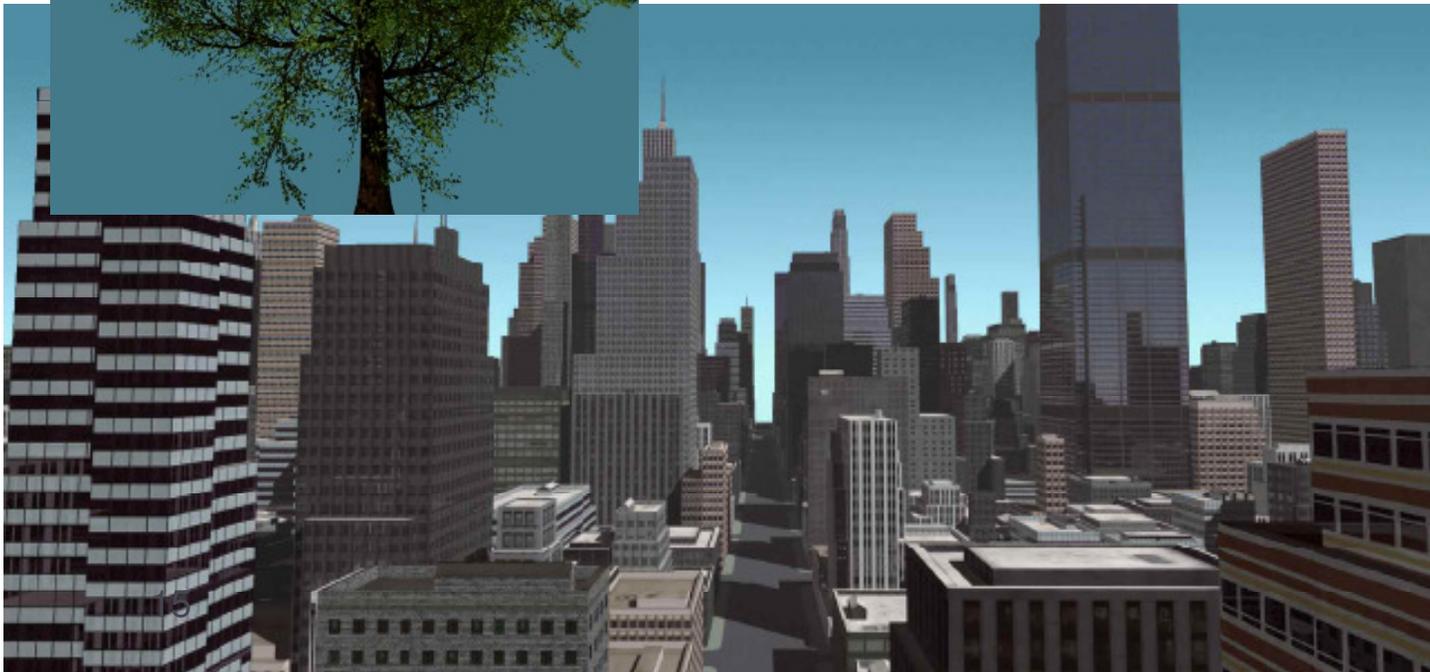
- ▶ Procedural: by writing programs
- ▶ Scanning real-world objects

# Modeling

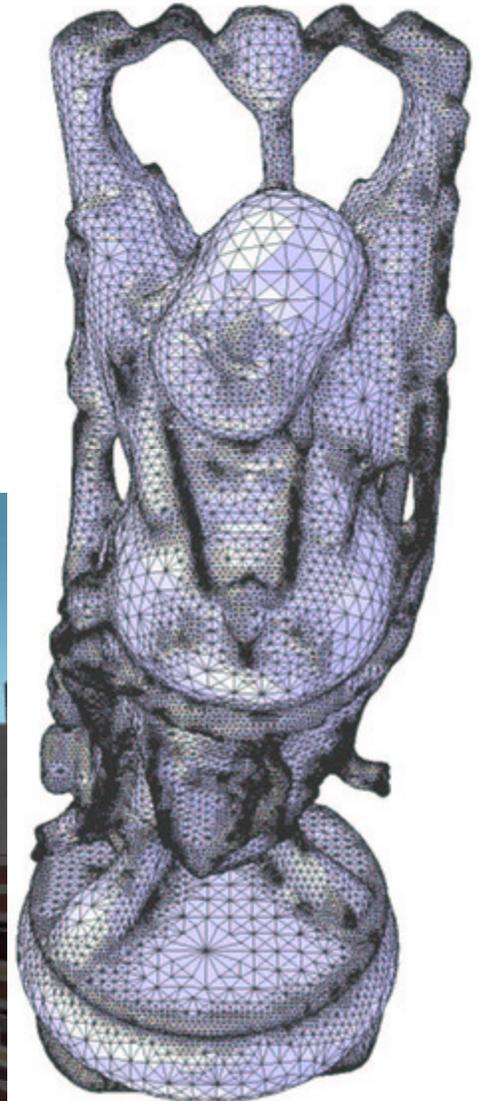
Procedural tree



Procedural city



Scanned statue



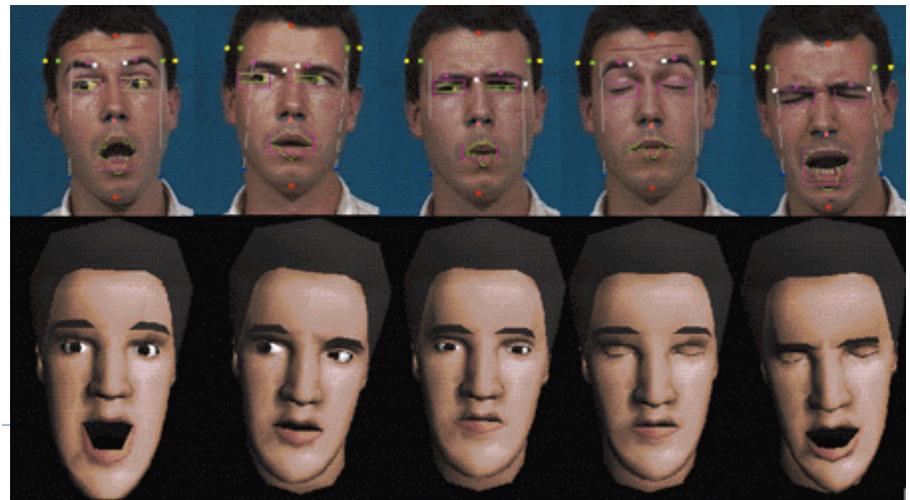
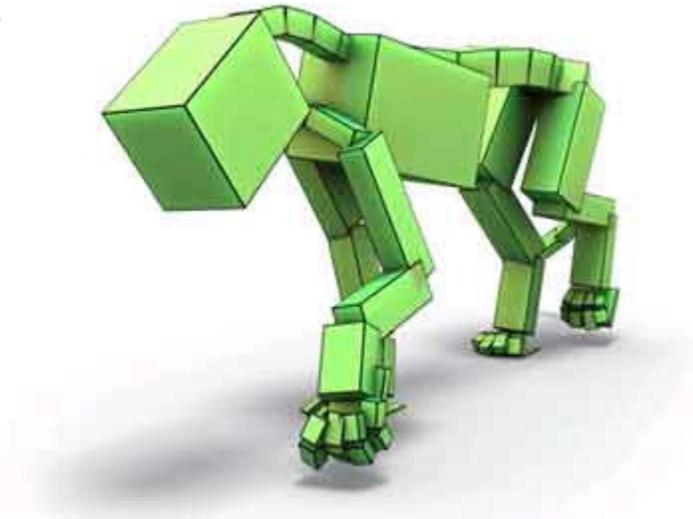
# Animation

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

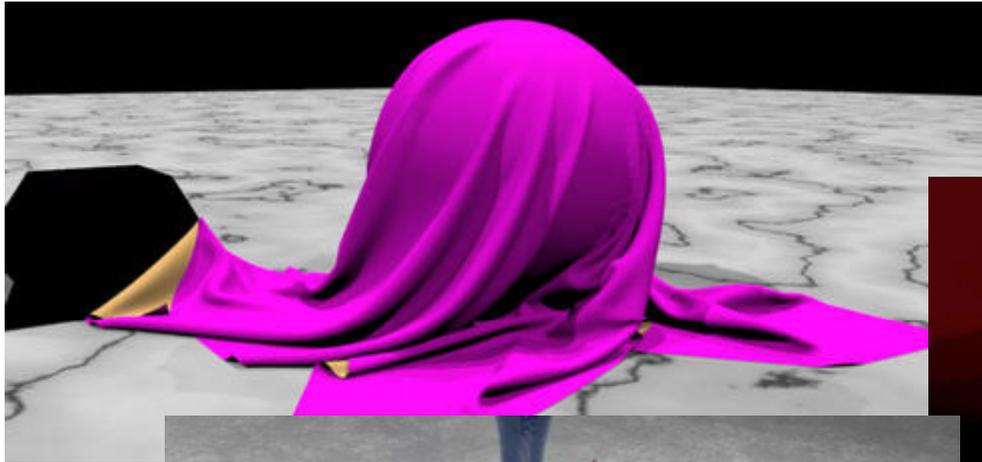
# Animation

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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, WLH 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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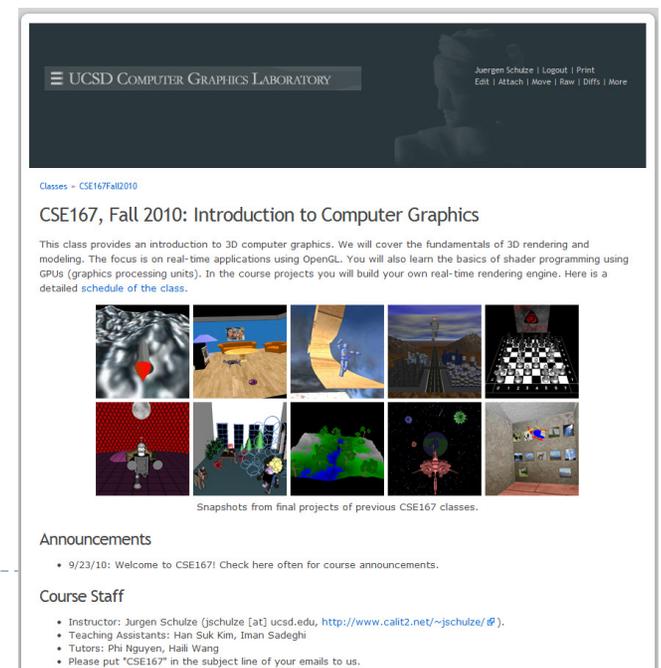
- ▶ **Rendering 3D models**
  - ▶ Camera simulation
  - ▶ Interactive viewing
  - ▶ Lighting
  - ▶ Shading
- ▶ **Modeling**
  - ▶ Triangle meshes
  - ▶ Parametric surfaces
- ▶ **Applying linear algebra, C++, OpenGL**
- ▶ **Foundation for advanced graphics courses (CSE168, CSE169, CSE 190 on shader programming)**

# Web Site

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## Course web site:

- ▶ <http://graphics.ucsd.edu/twiki/bin/view.pl/Classes/CSE167Fall12010>
- ▶ Contains:
  - ▶ Schedule
  - ▶ Slides
  - ▶ Recommended reading
  - ▶ Homework assignments
  - ▶ Grading
  - ▶ Exam information



The screenshot shows the UCSD Computer Graphics Laboratory website. The header includes the logo and navigation links for Jaergen Schulze. The main content area is titled "CSE167, Fall 2010: Introduction to Computer Graphics" and provides a brief description of the course. Below the text is a grid of 10 small images showing various 3D renderings and projects from previous classes. The footer contains an "Announcements" section with a date and a "Course Staff" section listing the instructor and teaching assistants.

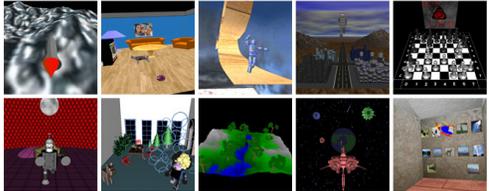
UCSD COMPUTER GRAPHICS LABORATORY

Jaergen Schulze | Logout | Print  
Edit | Attach | Move | Raw | Diff | More

Classes - CSE167Fall2010

### CSE167, Fall 2010: Introduction to Computer Graphics

This class provides an introduction to 3D computer graphics. We will cover the fundamentals of 3D rendering and modeling. The focus is on real-time applications using OpenGL. You will also learn the basics of shader programming using GPUs (graphics processing units). In the course projects you will build your own real-time rendering engine. Here is a detailed [schedule of the class](#).



Snapshots from final projects of previous CSE167 classes.

#### Announcements

- 9/23/10: Welcome to CSE167! Check here often for course announcements.

#### Course Staff

- Instructor: Jurgen Schulze (jschulze [at] ucsd.edu, <http://www.calit2.net/~jschulze/>).
- Teaching Assistants: Han Suk Kim, Iman Sadeghi
- Tutors: Phi Nguyen, Haili Wang
- Please put "CSE167" in the subject line of your emails to us.

# WebCT

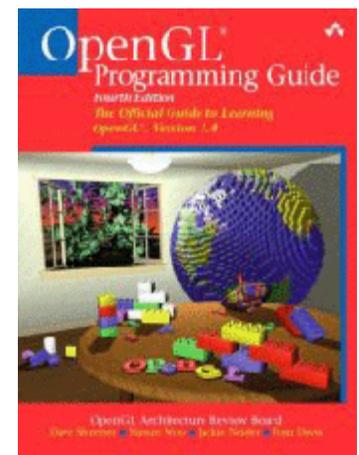
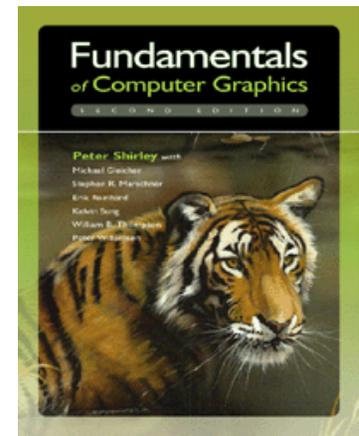
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- ▶ Go to **`http://webct.ucsd.edu`** and select CSE167
- ▶ Log in with your Active Directory account
- ▶ Find discussion board, chat, etc.

# 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