

Computer Graphics

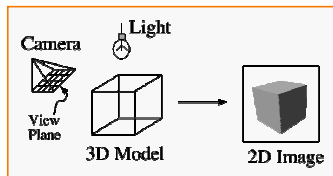
Adam Finkelstein
Princeton University
COS 426, Fall 2001

Overview

- Introduction
 - What is computer graphics?
- Applications
 - What is it good for?
- Syllabus
 - What will I learn in this course?
- Coursework
 - How much work will there be?

Introduction

- What is computer graphics?
 - Imaging = *representing 2D images*
 - Modeling = *representing 3D objects*
 - Rendering = *constructing 2D images from 3D models*
 - Animation = *simulating changes over time*



Overview

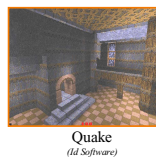
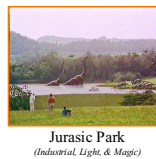
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Applications

- Entertainment
- Computer-aided design
- Scientific visualization
- Training
- Education
- E-commerce
- Computer art

Applications


- **Entertainment**
- Computer-aided design
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Applications


- Entertainment
- ➔ **Computer-aided design**
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Gear Shaft Design
(Intergraph Corporation)



Los Angeles Airport
(Bill Jepsen, UCLA)

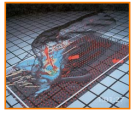


Boeing 777 Airplane
(Boeing Corporation)

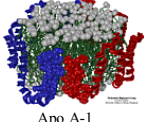
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Applications


- Entertainment
- Computer-aided design
- ➔ **Scientific visualization**
- Training
- Education
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Airflow Inside a Thunderstorm
(Bob Wilhelmson, University of Illinois at Urbana-Champaign)



Apo A-1
(Theoretical Biophysics Group, University of Illinois at Urbana-Champaign)




Visible Human
(National Library of Medicine)


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Applications

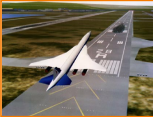
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Desk Assembly
(Silicon Graphics, Inc.)



Driving Simulation
(Evans & Sutherland)




Flight Simulation
(NASA)

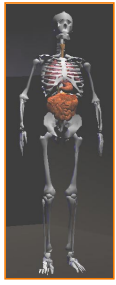
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Applications

- Entertainment
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Forum of Trajan
(Bill Jepsen, UCLA)




Human Skeleton
(SGI)


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Applications

- Entertainment
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- Education
- ➔ **E-commerce**
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Interactive Kitchen Planner
(Matsushita)




Virtual Phone Store
(Lucent Technologies)

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Applications

- Entertainment
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- Scientific visualization
- Training
- Education
- E-commerce
- ➔ **Computer art**



Blair Arch
(Mariano Range '98)

Overview 13

- Introduction
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- » **Syllabus**
 - **What will I learn in this course?**
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Syllabus 14

- I. Image processing
- II. Rendering
- III. Modeling
- IV. Animation


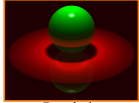




Image Processing
(Rusty Coleman, CS426, Fall99)



Rendering
(Michael Bostock, CS426, Fall99)



Modeling
(Dennis Zorin, CalTech)



Animation
(Angel, Plate 1)

Part I: Image Processing 15

- Image Representation
 - Sampling
 - Reconstruction
 - Quantization & Aliasing
- Image Processing
 - Filtering
 - Warping
 - Morphing
 - Composition
- Raster Graphics
 - Display devices
 - Color models




Image Composition
(Michael Bostock, CS426, Fall99)






Image Morphing
(All students in CS 426, Fall98)

Part II: Rendering 16

- 3D Rendering Pipeline
 - Modeling transformations
 - Viewing transformations
 - Hidden surface removal
 - Illumination, shading, and textures
 - Scan conversion, clipping
 - Hierarchical scene graphics
 - OpenGL
- Global illumination
 - Ray tracing
 - Radiosity




OpenGL
(Chi Zhang, CS 426, Fall99)



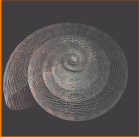
Ray Tracing
(James Percy, CS 426, Fall99)

Part III: Modeling 17

- Representations of geometry
 - Curves: splines
 - Surfaces: meshes, splines, subdivision
 - Solids: voxels, CSG, BSP
- Procedural modeling
 - Sweeps
 - Fractals
 - Grammars



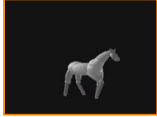
Scenery Designer
(Dirk Bajanz, Igor Guskov, Sangee Kumar, & Rindra Samantia, CS426, Fall95)




Shell
(Douglas Turnbull, CS 426, Fall99)

Part IV: Animation 18

- Keyframing
 - Kinematics
 - Articulated figures
- Motion capture
 - Capture
 - Warping
- Dynamics
 - Physically-based simulations
 - Particle systems
- Behaviors
 - Planning, learning, etc.



Mr. Ed
(Casey McTaggart, CS426, Fall99)



Ice Queen
(Mao Chen, Zaijin Guan, Zheyuan Liu, & Xiaohu Qi, CS426, Fall98)

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Coursework

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- Exams (30%)
 - In class (on 10/25 and 12/11)
- Programming Assignments (50%)
 - Assignment #1: Image Processing (due 9/27)
 - Assignment #2: Ray Tracing (due 10/18)
 - Assignment #3: Modeling (due 11/20)
 - Assignment #4: Animation (due 12/6)
- Final Project (15%)
 - Do something cool! (due Jan 2002)
- Class Participation (5%)

Programming Assignments

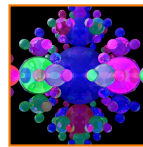
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- When?
 - Roughly every two weeks
- Where?
 - Anywhere you want, e.g. home or MECA lab
- How?
 - Windows 2000 (E417) or Unix (E423)
 - C and C++, OpenGL, GLUT
- What?
 - Basic feature lists
 - Extra credit lists
 - Art contest

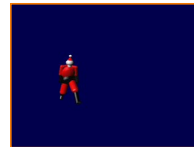
Art Contest

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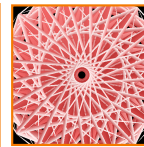
- Everybody should submit entries!
 - 1 point for submitting
 - 2 points for winning



Cool Images
(James Percy, CS 426, Fall99)



Videos
(Terrance Liu, CS 426, Fall99)



Bloopers
(Kathleen Minkabeay, CS 426, Fall99)

Collaboration Policy

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- Overview:
 - You must write your own code (no credit for other code)
 - You must reference your sources of any ideas/code
- It's OK to ...
 - Talk with other students about ideas, approaches, etc.
 - Get ideas from information in books, web sites, etc.
 - Get "support" code from example programs
 - » **But, you must reference your sources**
- It's NOT OK to ...
 - Share code with another student
 - Use ideas or code acquired from another sources without attribution

Distinguished Lecture Series

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See some visionaries in computer graphics!

Some Wednesdays, 4-5pm, Small Auditorium (room 105)

- 10/10 Hugues Hoppe, Microsoft Research
- 10/17 Turner Whitted, Microsoft Research
- 11/14 John Hughes, Brown University
- 11/28 Henry Fuchs, UNC
- 12/5 Pat Hanrahan, Stanford University
- 12/12 Jessica Hodgins, CMU