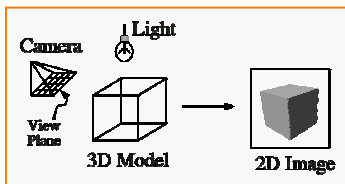# Computer Graphics

Adam Finkelstein
Princeton University

COS 426, Spring 2003

Overview

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

Introduction

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

Overview

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

Applications

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

Applications

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

Jurasic Park
(Industrial, Light, & Magic)

Geri's Game
(Pixar Animation Studios)

Quake
(Id Software)

Applications

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

Los Angeles Airport
(Bill Jepson, UCLA)

Gear Shaft Design
(Intergraph Corporation)
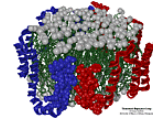
Boeing 777 Airplane
(Boeing Corporation)

Applications

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

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)

Applications

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

Driving Simulation
(Evans & Sutherland)

Desk Assembly
(Silicon Graphics, Inc.)

Flight Simulation
(NASA)

Applications

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

Forum of Trajan
(Bill Jepson, UCLA)

Human Skeleton
(SGI)

Applications

- Entertainment
- Computer-aided design
- Scientific visualization
- Training
- Education
→ **E-commerce**
- Computer art
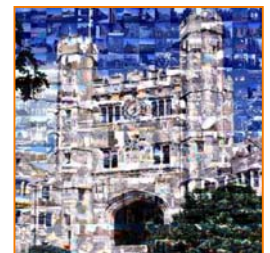
Interactive Kitchen Planner
(Matsushita)

Virtual Phone Store
(Lucent Technologies)

Applications

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

Blair Arch
(Marissa Range '98)

Overview

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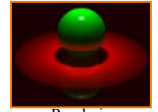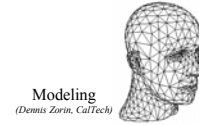 - How much work will there be?

Syllabus

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

- 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

- 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

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

Shell
(Douglas Turnbull, CS 426, Fall99)

Scenery Designer
(Dirk Balfanz, Igor Guskov, Sanjeev Kumar, & Rudro Samanta, CS426, Fall95)
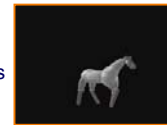
Part IV: Animation

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

Mr. Ed
(Casey McTaggert, CS426, Fall99)

Ice Queen
(Mao Chen, Zaijin Guan, Zhiyan Liu, & Xiaohu Qie, CS426, Fall98)

Overview

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

Coursework

- Exams (30%)
  - o In class (Mar 4 and Apr 29)
- Programming Assignments (50%)
  - o Assignment #1: Image Processing (due Feb 24)
  - o Assignment #2: Ray Tracing (due Mar 24)
  - o Assignment #3: Modeling (due Apr 7)
  - o Assignment #4: Animation (due Apr 21)
- Final Project (15%)
  - o Do something cool! (end of semester due date TBA)
- Class Participation (5%)

Programming Assignments

- When?
  - o Roughly every two weeks
- Where?
  - o Anywhere you want, e.g. home or Friend 017 lab
- How?
  - o Windows (017) or Unix/Linux ("hats")
  - o C and C++, OpenGL, GLUT
- What?
  - o Basic feature lists
  - o Extra credit lists
  - o Art contest

Art Contest

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

Cool Images
(James Percy, CS 426, Fall99)

Videos
(Terrance Liu, CS 426, Fall99)

Bloopers
(Kathleen Mulcahey, CS 426, Fall99)

Collaboration Policy

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

Administrative Matters

- Course web page:
  - o *http://www.cs.princeton.edu/courses/cs426/*
- Scheduling:
  - o Office hours…
  - o Final project presentations…