Course Information On-Line

• [http://www.cs.cmu.edu/~fp/courses/graphics/](http://www.cs.cmu.edu/~fp/courses/graphics/)
  – Schedule (slides, readings)
  – Assignments (details, due dates)
  – Software (libraries, hints)
  – Resources (books, tutorials, links)

• [news:cmu.cs.class.cs462](mailto:news:cmu.cs.class.cs462)
About Me

• **Research**: Programming Languages & Logic
• **Teaching**: Anything
• [http://www.cs.cmu.edu/~fp/](http://www.cs.cmu.edu/~fp/)
• **Office Hours**
  – Wed 2:30-3:30, WeH 8117
  – Right after class
  – By appointment
Teaching Assistants

- Chris Twigg (Thu 3:00-5:00)
- Ian Graham (Wed, Fri 10:30-11:30)
- Sriram Vaidhyanathan (Mon 6:00-8:00)
- David Kitchin (O’Caml wizard)
- TAs available in graphics lab, WeH 5336
- Card reader for access (email me if denied)
- Instructions for account setup on web page
Prerequisites

• 15-213 Intro to Computer Systems
• 21-241 Matrix Algebra
• 21-259 Calculus in 3D
• See me if you are missing any and we haven’t discussed it
Some Follow-On Courses

- 53-831 Building Virtual Worlds (Pausch, F’03)
- 15-493 Game Programming (Kuffner, F’03)?
- ? (James, F’03)
- 15-497 Computer Animation (Hodgins, S’04)
- 53-609 Game Design (Schell, S’04, F’03?)
- Also: research opportunities in graphics group!
Textbook

• Interactive Computer Graphics
  A top-down approach with OpenGL, 3rd edition
  Edward Angel, Addison-Wesley, 2002

• Supplementary texts:
  OpenGL Programming Guide (“Red Book”)
  Also available on-line (see Resources)
  Real-Time Rendering
  Tomas Akenine-Möller and Eric Haines
  2nd edition, AK Peters, 2002
  On reserve soon
Grading

- 45% Programming Assignments (4)
- 20% Written Assignments (4)
- 10% Midterm (one sheet of notes only, in class)
- 25% Final (open book)
- Alternating assignments
  - Programming (2 weeks)
  - Written (1 week)
- No collaboration!
Assignment Policies

• Programming assignments
  – Hand in via AFS by end of due date
  – Functionality and features
  – Style and documentation
  – Artistic impression

• Written assignments
  – Hand in on paper before lecture
  – Correctness is central
  – Show your reasoning

• 3 late days, usable any time during semester
• Academic integrity policy applied rigorously
Course Overview

• The computer graphics trinity
  – **Modeling**: how to represent objects
  – **Animation**: how to control and represent motion
  – **Rendering**: how to create images

• OpenGL graphics library

• **Not** in this course:
  – Human-computer interaction
  – Graphic design
  – Graphics hardware
  – DirectX API
Computer Graphics Goals I

- Synthetic images indistinguishable from reality
- Practical, scientifically sound, in real time
Example: Ray Tracing

- 2001 Internet ray tracing competition, N. Kern
Example: Radiosity

- Lightscape by Autodesk
Computer Graphics Goals II

- Creating a new reality
- Practical, aesthetically pleasing, in real time
Example: Illustrating Smooth Surfaces

- SIGGRAPH 2000 Conference, A. Hertzmann, D. Zorin
Example: Image Analogies

1. Course Overview

- Administrative Issues
- Topics Outline (next)
2. OpenGL Basics

- Primitives and attributes
- Color
- Viewing
- Control functions
- [Angel, Ch. 2]
3. Input and Interaction

- Clients and servers
- Event driven programming
- Text and fonts
- [Angel, Ch. 3]
4. Objects & Transformations

• Linear algebra review
• Coordinate systems and frames
• Rotation, translation, scaling
• Homogeneous coordinates
• OpenGL transformation matrices
• [Angel, Ch. 4]
5. Viewing and Projection

- Orthographic projection
- Perspective projection
- Camera positioning
- Projections in OpenGL
- Hidden surface removal
- [Angel, Ch. 5]
6. Hierarchical Models

- Graphical objects
- Animations
- OpenGL routines
- Parameters and transformations
- [Angel, Ch. 9]
7. Light and Shading

• Light sources
• Ambient, diffuse, and specular reflection
• Normal vectors
• Material properties in OpenGL
• Radiosity
• [Angel, Ch. 6]
8. Curves and Surfaces

- Review of 3D-calculus
- Explicit representations
- Implicit representations
- Parametric curves and surfaces
- Hermite curves and surfaces
- Bezier curves and surfaces
- Splines
- Curves and surfaces in OpenGL
- [Angel, Ch. 10]
9. Rendering

- Clipping
- Bounding boxes
- Hidden-surface removal
- Line drawing
- Scan conversion
- Antialiasing
- [Angel, Ch. 8]
10. Textures and Pixels

- Texture mapping
- OpenGL texture primitives
- Bump maps
- Environment maps
- Opacity and blending
- Image filtering
- [Angel, Ch. 7]
11. Ray Tracing

• Basic ray tracing [Angel, Ch. 13.2]
• Spatial data structures [Angel, Ch. 9.10]
• Motion Blur
• Soft Shadows
12. Radiosity

• Local vs global illumination model
• Interreflection between surfaces
• Radiosity equation
• Solution methods
• [Angel Ch. 13.5]
13. Physically Based Models

- Particle systems
- Spring forces
- Cloth
- Collisions
- Constraints
- Fractals
- [Angel, Ch. 11]
14. Scientific Visualization

- Height fields and contours
- Isosurfaces
- Volume rendering
- Texture mapping of volumes
- [Angel Ch. 12]
Wildcards & Possible Guest Lectures

- Graphics hardware
- More on animation
- Motion capture
- Virtual reality and interaction
- Special effects in movies
- Video game programming
- Non-photo-realistic rendering

(last year’s additional lectures highlighted)
Hot Application Areas

- Special effects
- Feature animation
- PC graphics boards
- Video games
- Visualization (science, architecture, space)
Hot Research Topics

• Modeling
  – getting models from the real world
  – multi-resolution

• Animation
  – physically based simulation
  – motion capture

• Rendering:
  – more realistic: image-based modeling
  – less realistic: impressionist, pen & ink
Acknowledgments

- Jessica Hodgins
- Paul Heckbert
- Joel Welling
- Students and TAs in Spring’02 Version Movies!