15-462 Computer Graphics I
Lecture 1

Course Overview

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January 15, 2002
Frank Pfenning
Carnegie Mellon University

http://www.cs.cmu.edu/~fp/courses/graphics/

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](http://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

- Michael Henson (Wed 6:00-8:00)
- John Ketchpaw (Mon 6:00-8:00)
- Shayan Sarkar (TBA)
- Available in new graphics lab, WeH 5336
- Card reader for access (email me if denied)
- Instructions for account setup on web page soon
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

Postrequisites

- 05-831 Building Virtual Worlds (Pausch, F’02)
- 15-4xx Game Programming (Kuffner, F’02)
- 15-497 Computer Animation (Hodgins, S’03)
- 15-463 Computer Graphics II (Heckbert, S’03)?
Textbook

- **Interactive Computer Graphics**
  A top-down approach with OpenGL
  Edward Angel

- **OpenGL: A Primer**
  Edward Angel

- Available bundled in CMU Bookstore

- Supplementary text:
  **Computer Graphics: Principles and Practice**
  Foley, van Dam, Feiner, Hughes
  On reserve in library (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!
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. 8]

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. 7]
10. Textures and Pixels

- Texture mapping
- OpenGL texture primitives
- Bump maps
- Environment maps
- Opacity and blending
- Image filtering
- [Angel, Ch. 9]

11. Ray Tracing

- Basic ray tracing [Angel, Ch. 6.10]
- Spatial data structures [Angel, Ch. 8.9]
- Motion Blur
- Soft Shadows
12. Physically Based Models

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

13. Scientific Visualization

- Height fields and contours
- Isosurfaces
- Volume rendering
- Texture mapping of volumes
Wildcards & Possible Guest Lectures

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

Hot Application Areas

- Special effects
- Feature animation
- PC graphics boards
- Video games
- Visualization (science, architecture, space)
- The web
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
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