Welcome
Greg Humphreys
CS445: Intro Graphics
University of Virginia, Fall 2004

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?

What is Computer Graphics?
- Sliced by specialty
  - Imaging = representing 2D images
  - Modeling = representing 3D objects
  - Rendering = building 2D images from 3D models
  - Animation = simulating changes over time
  - Hardware = computer architecture for graphics

What is Computer Graphics?
- Sliced by task
  - Creating pictures on a computer
  - Interacting with those pictures
  - Drawing those pictures faster
  - Displaying those pictures bigger, brighter
  - Simulating physical phenomena
  - Visualizing complex data
  - Acquiring real-world geometry
  - Simulating plants
  - Video games
  - Breaking stuff
  * ...

Why is Graphics Cool?
- Interdisciplinary
  - Biology, Physics, Math, Psychology, CS, Art
- Visual
- Interactive
- Work can be demoed to technically illiterate friends
- Movies
- Games
- Money
  - Video games: $9.4B (2001)
  - Movies: $8.5B (2001)
Entertainment (passive)

- *Final Fantasy* (Square, USA)
- *A Bug’s Life* (Pixar)

Entertainment (Active)

- *Circus Atari* (Atari)
- *Doom III* (ID Software)

Graphical User Interfaces

- Window system and large-screen interaction metaphors ( François Guimbretière)
Computer Aided Design

Los Angeles Airport and Terminals (UCLA)

Gear Shaft Design (Intergraph Corporation)

Computer Aided Design

Boeing 777 Airplane (Boeing Corporation)

Scientific Visualization

Airflow around a Harrier Jet (NASA Ames)

Scientific Visualization

Compressible Turbulence (Lawrence Livermore National Labs)

Visible Human (National Library of Medicine)

Training

Flight Simulator 2002 (Microsoft)
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### Image Processing
- Image Representation
  - Sampling
  - Reconstruction
  - Quantization & Aliasing
- Image Processing
  - Filtering
  - Warping
  - Morphing
  - Composition
- Raster Graphics
  - Display devices
  - Color models

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

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

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

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Coursework

• Exams (25%)
  ▸ In class (Oct 14 and Dec 7)

• Programming Assignments (every two weeks) (50%)
  ▸ Warmup (due Sep 9 - ONE WEEK FROM TODAY)
  ▸ Image Processing (due Sep 23)
  ▸ Ray Tracer (due Oct 7)
  ▸ Virtual Rubik (due Oct 26)
  ▸ NPR (due Nov 9)

• Final Project (25%)
  ▸ Do something cool!
  ▸ Proposals due November 23

Programming Assignments

• When?
  ▸ Every two weeks

• Where?
  ▸ Anywhere you want, e.g. home or Small Hall PC Lab

• How?
  ▸ Portable code, so any OS you like
  ▸ But we have to grade it!
  ▸ Typically C and C++, OpenGL, GLUT

• What?
  ▸ Basic feature lists
  ▸ Extra credit lists
  ▸ Art contest

Art Contest

• Everybody should submit entries for each assignment!
  ▸ 5 points for submitting something non-trivial
  ▸ 20 points for winning (complain to TA about losing)

• Definitely save “accidental art”

Collaboration Policy

• You must write your own 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 (no matter how trivial) with another student
  ▸ Use ideas or code acquired from another sources without attribution
  ▸ Directly debug another student’s program (i.e., by looking at their code)

• Do not test us on this – zero tolerance in effect

Administrative Matters

• http://www.cs.virginia.edu/~gfx/courses/

• Instructor: Greg Humphreys
• Office Hours: TTh 3-5

• TA: Nate Hoobler
• Office Hours: ?

Book

OpenGL Programming Guide

Open GL, the revolution continues!

Open GL Addendum Series
This book was written by learning Open GL, Inc.
Gary Miller, Lead Author

Jade Dragon on Ketchup Stand (Rui Wang, CS447 Spring 2003)
More, more, MORE!

• Sequence of advanced graphics courses at UVA:
  • CS 446: Real Time Rendering (Dave Luebke)
    » Building interactive graphics systems (games!)
    » Spring 2006
  • CS 447: Image Synthesis (Me)
    » Modeling light and materials (Rendering)
    » Spring 2005
  • CS 448: Animation (David Brogan)
    » Modeling movement
    » Fall 2005