CS559: Computer Graphics

Lecture 1 Introduction
Li Zhang
University of Wisconsin, Madison
Today

• Introduction to Computer Graphics
• Course Overview
What is Computer Graphics

• Using computers to generate and display images

• Core areas
  – Modeling
    • lighting, shape, reflectance …
  – Rendering
    • math models -> images

The Digital Michelangelo Project
Stanford University
What is Computer Graphics

• Using computers to generate and display images

• Core areas
  – Modeling
    • lighting, shape, reflectance ...
  – Rendering
    • math models -> images
  – Animation
    • how things change

Park and Hodgins, SIGGRAPH 2006
What is Computer Graphics

• Using computers to generate and display images
• Related areas
  – Image processing

Image Analogies, Hertzmann et al, SIGGRAPH 2001
What is Computer Graphics

• Using computers to generate and display images
• Related areas
  – Image processing

Motion Deblurring, Shan et al, SIGGRAPH 2008
What is Computer Graphics

• Using computers to generate and display images
• Related areas
  – Image processing

Image Analogies, Hertzmann et al, SIGGRAPH 2001
What is Computer Graphics

• Using computers to generate and display images

• Related areas
  – Image processing
  – 3D photography
What is Computer Graphics

• Using computers to generate and display images
• Related areas
  – Image processing
  – 3D photography

Motion Capture
What is Computer Graphics

• Using computers to generate and display images
• Related areas
  – Image processing
  – 3D photography
  – Visualization

PV-Wave, Visual Numerics
What is Computer Graphics

• Using computers to generate and display images

• Related areas
  – Image processing
  – 3D photography
  – Visualization
  – Virtual reality

[Image: U.S. Navy personnel using a VR parachute trainer
http://en.wikipedia.org/wiki/Virtual_reality]
What is Computer Graphics

• Using computers to generate and display images
• Related areas
  – Image processing
  – 3D photography
  – Visualization
  – Virtual reality
  – User interaction

Freeform from Sensible Technologies
J. Hodgins, Computer Graphics, Fall 2007
Why do we care?

- Applications are cool
  - Create Fantasy World

Graphique3d.republika.pl
Why do we care?

- Applications are cool
  - Create Fantasy World
  - Making Movies

Avatar
Why do we care?

• Applications are cool
  – Create Fantasy World
  – Making Movies

Pirates of the Caribbean
Why do we care?

• Applications are cool
  – Create Fantasy World
  – Making Movies

Finding Nemo
Why do we care?

• Applications are cool
  – Create Fantasy World
  – Making Movies

Star War, Episode I, Lucas Film
Why do we care?

- Applications are cool
  - Create Fantasy World
  - Making Movies
  - Industry Design
Why do we care?

• Applications are cool
  – Create Fantasy World
  – Making Movies
  – Industry Design
  – Architecture

Jingyi Yu, Graphics, U Delaware
Why do we care?

• Applications are cool
  – Create Fantasy World
  – Making Movies
  – Industry Design
  – Architecture
  – Games

America’s army, released by US Government

US Game Sales:
• $4.82 billion in December
• $\sim$18 billion for all of 2007
market research firm NPD, Jan 17

Wii Sales:
• $2.14 million in December 2008
• $3 million in Dec 2009
http://www.dailyfinance.com/
Why do we care?

• Applications are cool
  – Create Fantasy World
  – Making Movies
  – Industry Design
  – Architecture
  – Games
  – Training

Image from Defense News, 31 Jan 07
Why do we care?

• Applications are cool
  – Create Fantasy World
  – Making Movies
  – Industry Design
  – Architecture
  – Games
  – Training
  – Virtual World
Why do we care?

• Applications are cool
  – Create Fantasy World
  – Making Movies
  – Industry Design
  – Architecture
  – Games
  – Training
  – Virtual World
  – Surgery

Jingyi Yu, Graphics, U Delaware
Why do we care?

• Applications are cool
  – Create Fantasy World
  – Making Movies
  – Industry Design
  – Architecture
  – Games
  – Training
  – Virtual World
  – Surgery
  – Visualization

Jingyi Yu, Graphics, U Delaware
Why do we care?

• Research is fun
  – Deformation Transfer
    • http://www.mit.edu/~ibaran/sdt/
Why do we care?

• Research is fun
  – Deformation Transfer
  – Fluid Simulation
    • http://graphics.cs.cmu.edu/projects/modular_bases/
Why do we care?

• Research is fun
  – Deformation Transfer
  – Fluid Simulation
  – Morphing
Why do we care?

• Research is fun
  – Deformation Transfer
  – Fluid Simulation
  – Morphing
  – 3D Video Conference
    • http://gl.ict.usc.edu/Research/3DTeleconferencing/
A broader view

• Computer Graphics is
  – The technology for communicating and interacting with information *in a visual way*

• Visual information is
  – Intuitive
  – Parallel
  – Correlated
What’s covered in this class

• Not!
  – Paint and Imaging packages (Photoshop)
  – CAD packages (AutoCAD)
  – Rendering packages (Maya)
  – Modeling packages (3D Max)
  – Graphics Modeling and Languages (RenderMan)

• We will cover...
  – Graphics programming languages (OpenGL)
  – Graphics algorithms
  – Graphics data structures
  – Graphical User Interface (GLUT)
  – Applied geometry and modeling
  – Shape and motion capture
What’s covered in this class

• Image related topics
  – Image formation in eye, and cameras,
  – Digital images, sampling and re-sampling
  – Filtering, Warping, Morphing, Compositing
What’s covered in this class

• Project 1: A picture processing system
  – Implement basic image processing operations like filtering, re-sampling, warping,
  – Image compositing, impressionist painting

Image Analogies, Hertzmann et al, SIGGRAPH 2001
What’s covered in this class

• Geometric Modeling
  – coordinate systems, transformation
  – 2D/3D primitives, projection,
  – OpenGL, graphics pipeline, 3D UI issues
  – Shape concepts, parametric forms, splines
  – Meshes, subdivision surfaces

Jingyi Yu, Graphics, U Delaware

Eck and Hoppe, SIGGRAPH 96
What is this class about?

• Project 2: Roller coaster train

Rob Iverson's A+ assignment from 1999
What is this class about?

- Project 2: Roller coaster train

Rob Iverson's A+ assignment from 1999
What’s covered in this class

• Basic Rendering techniques
  – Visibility, scan-conversion,
  – Lighting, Texture mapping,
  – Ray tracing, global illumination,
What’s covered in this class

• Project 3: A graphics town

Brandon Smith
What’s covered in this class

- Project 3: A graphics town
What’s covered in this class

• Project 3: A graphics town
What’s covered in this class

• Project 3: A graphics town

Marc Lenz
What’s covered in this class

• Project 3: A graphics town

Xiang Ji and Yuxiang Yang
Staff

• Instructor: Li Zhang
  – lizhang@cs.wisc.edu
  – Office hours: Monday Wednesday 3.50-4.50pm
  – Office location: 6387 Comp S&ST

• TA: Sajika Gallege
  – sgallege@cs.wisc.edu
  – Office hours: Thursday Friday 1-2pm
  – Office location: 1306 Comp S&ST
Course info

• Mailing list: compsci559-1-s10@lists.wisc.edu
• Course web: www.cs.wisc.edu/~cs559-1
• Computers: Windows XP 32 bit
  – 1358: 8
  – 1366: 30
  – 1368: 29
• Language: C++
• Compiler: MS Visual Studio 2008
  – Your code must be able to compile and run on department windows PC.
Books (required)

• Peter Shirley. *Fundamentals of Computer Graphics, 3ed*
Books (required)

  - An older edition (available online) would be OK. It’s an important reference.
Books (recommended)

• *Real–time rendering*. 3\textsuperscript{rd} edition
Prerequisites

• CS367 (Data Structures)
• Math 320, 340 or CS416 (some familiarity with linear algebra)
• I will skip
  – Chapter 2 Miscellaneous Math
  – Chapter 5 Linear Algebra
• C/C++
  – You can learn it as you do project, but you need to work very hard.
Exams

• Midterm
  – Monday, March 17\textsuperscript{th}, in class

• Final
  – In the final week
Grading

• Projects: 20%, 25%, 25%
• Midterm: 10%
• Final: 20%
• Late policy
  – 80% 1\textsuperscript{st} day, 60% 2\textsuperscript{nd} day, ... 0% 5\textsuperscript{th} day,
    • Prorated hourly
  – Can be late ONCE without penalty in the semester,
    • But can’t be later than demo date
  – Penalty Recovery
Group

• For each project
  – Two students form a group to do the project
  – Doing it individually is fine, if you are brave.
  – Three students in a group is subject to my approval
      • For example, we have odd number of students in the class
  – Each group member will receive the same grade for each project (except the written assignment).
  – Group partners should be different for each project
  – Doing it alone doesn’t mean double your credit.
Previous comments

• “assignments and exams are too difficult especially the assingments”
• “the projects were very large scale and time intensive, fairly difficult”
• “the projects involved too much hours of coding, can be made a little less in magnitude”
• “the projects are very time consuming”
• ......
Questions?