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

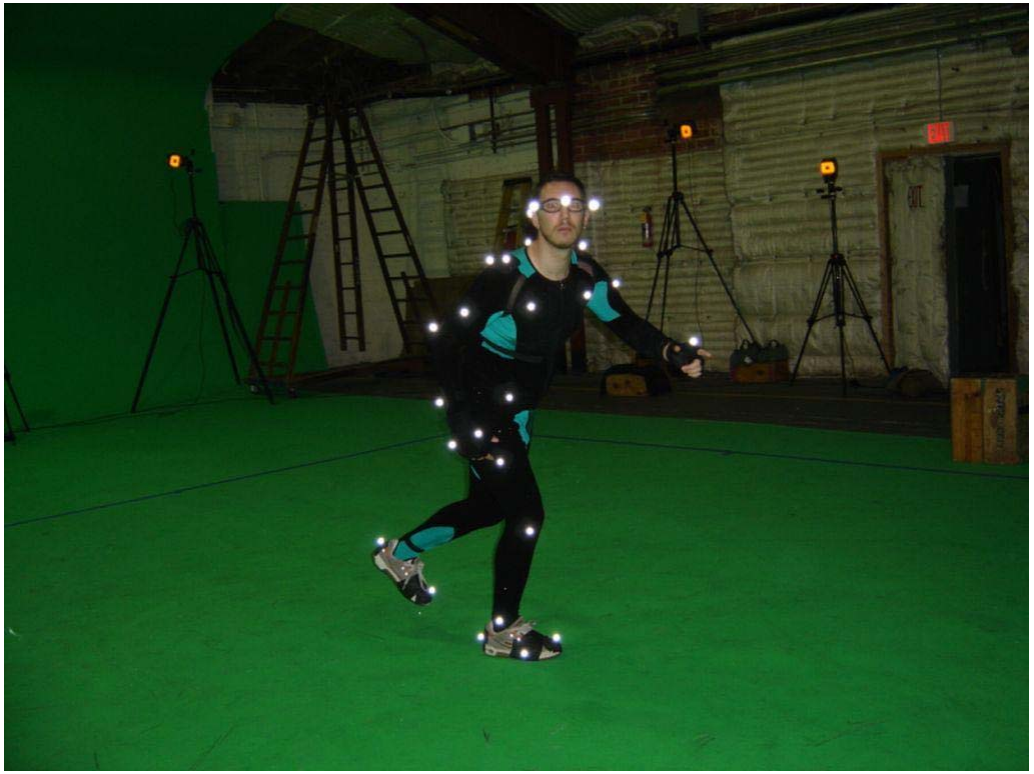
What is Computer Graphics

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

Cyberware

What is Computer Graphics

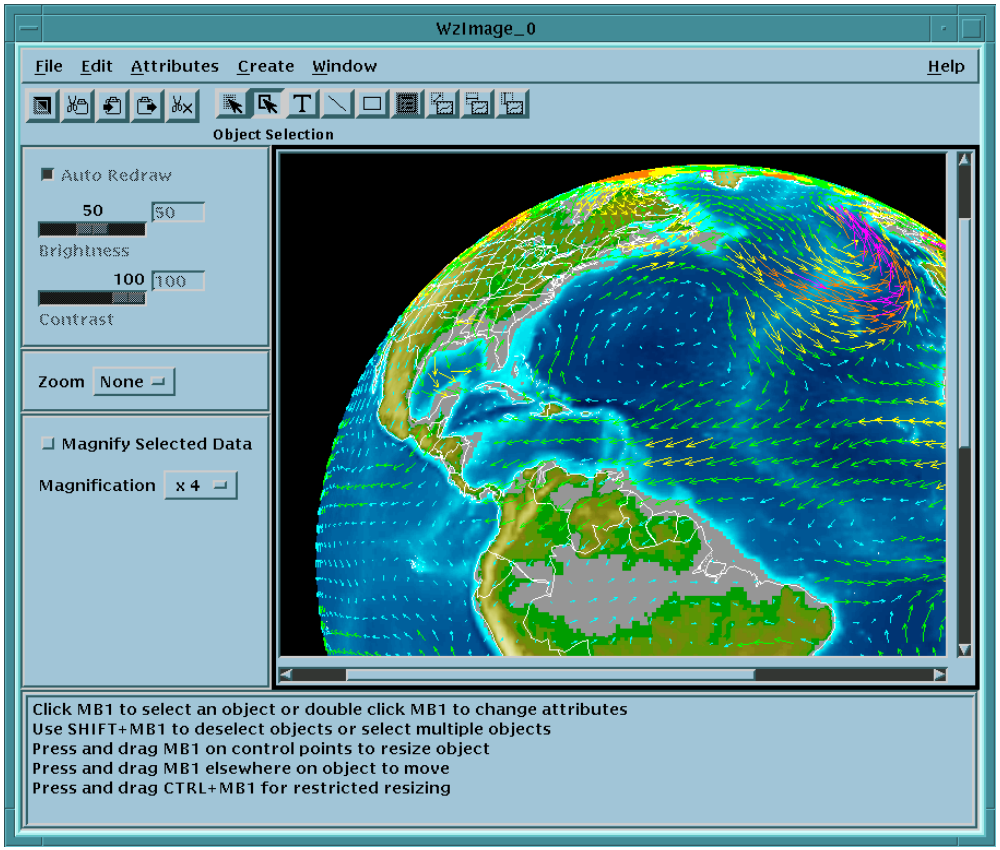
- Using computers to generate and display images
- Related areas
  - Image processing
  - 3D photography



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

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

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

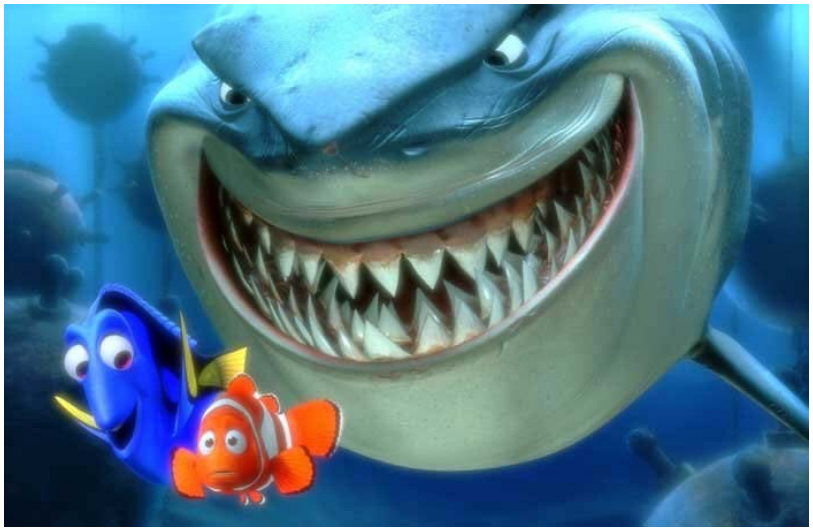
Why do we care?

- 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

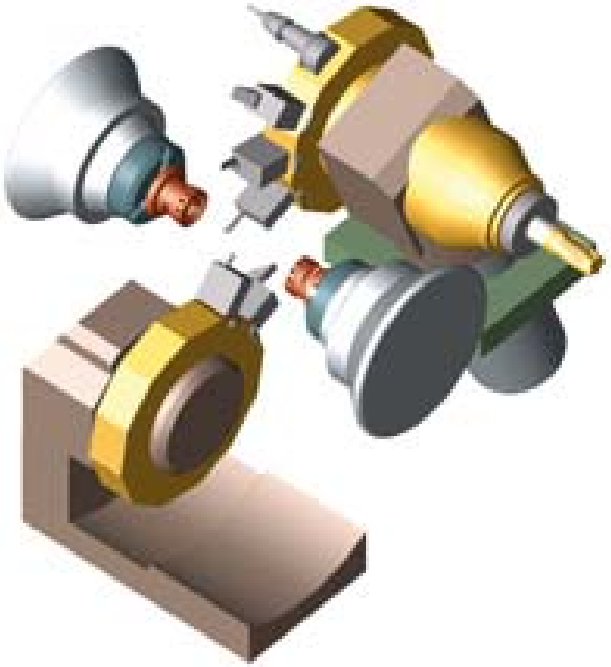
Why do we care?

- 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

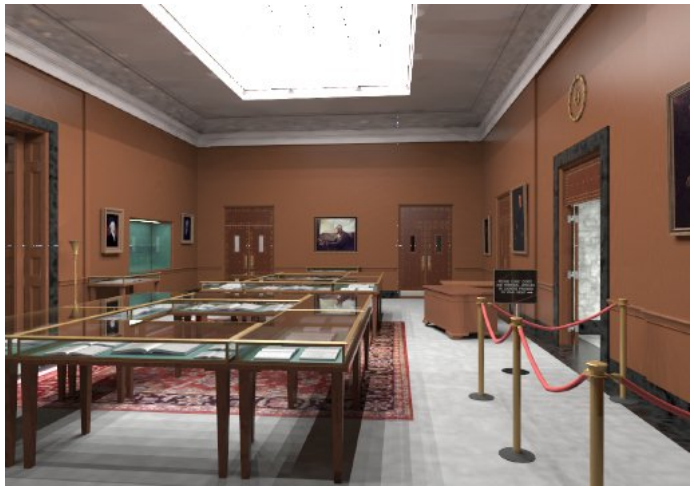


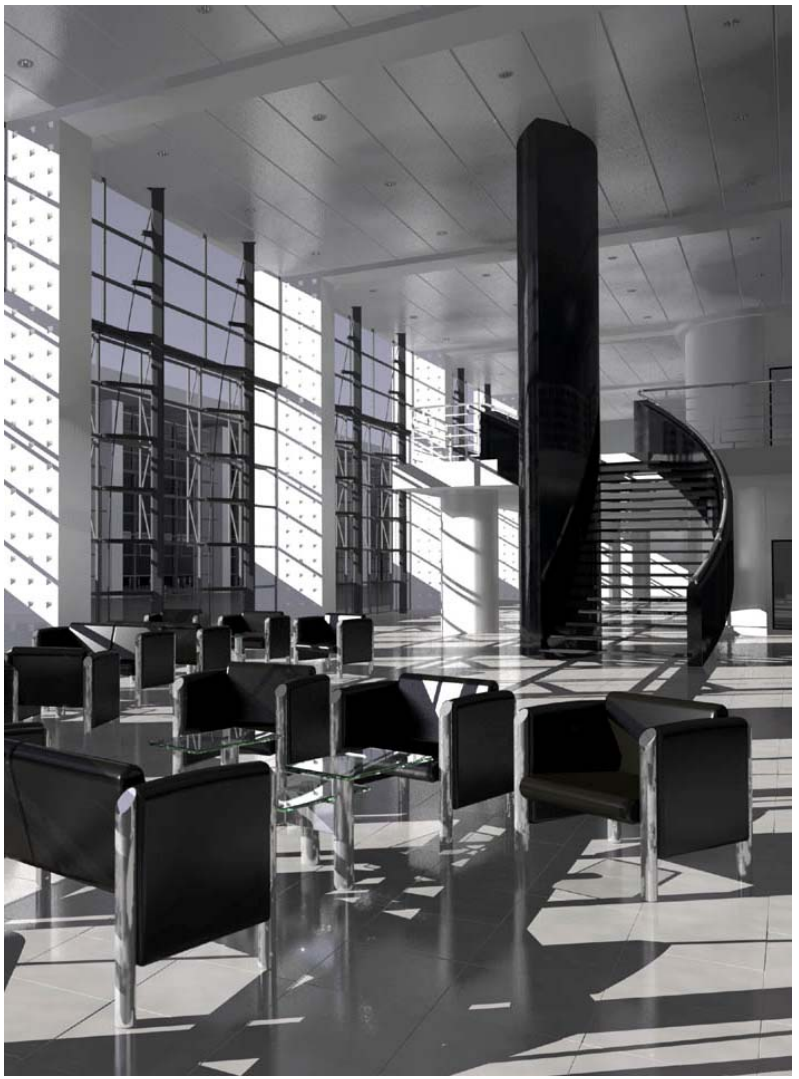
Missler Software

Icadsolutions.com

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 Goverment

PSP, SONY

US Game Sales:
•$4.82 billion in December
•$~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

Second Life

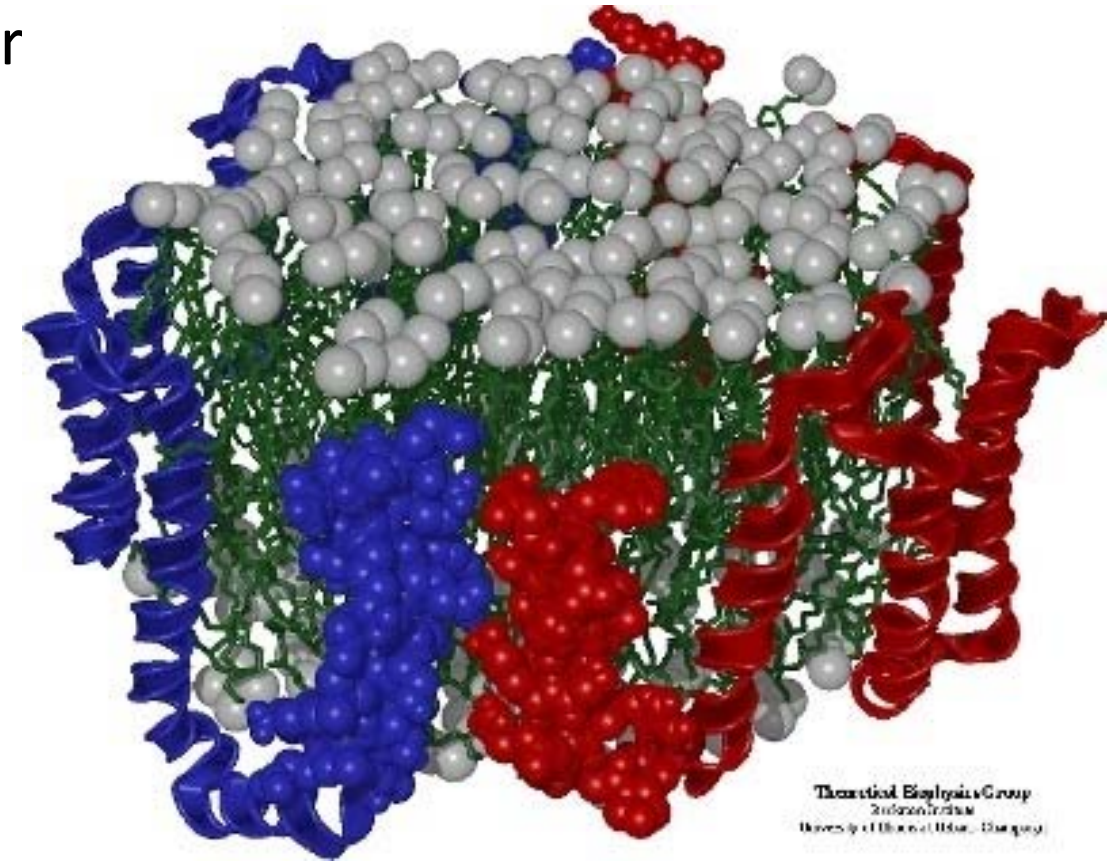
Why do we care?

- 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 Wor
  - 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
    - http://grail.cs.washington.edu/projects/animal-morphology/s2009/

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

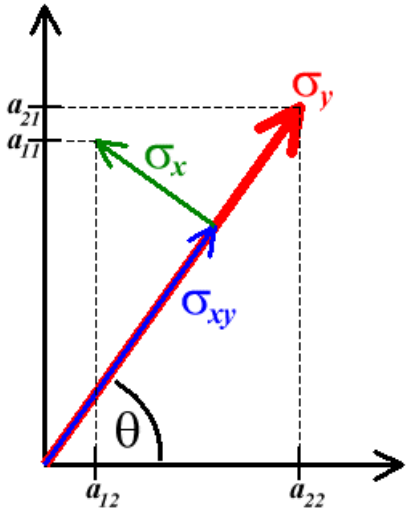
What's covered in this class

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

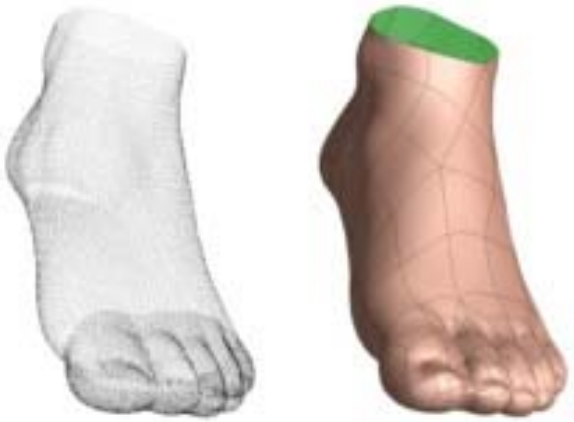
Image Analogies, Hertzmann et al, SIGGRAPH 2001

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



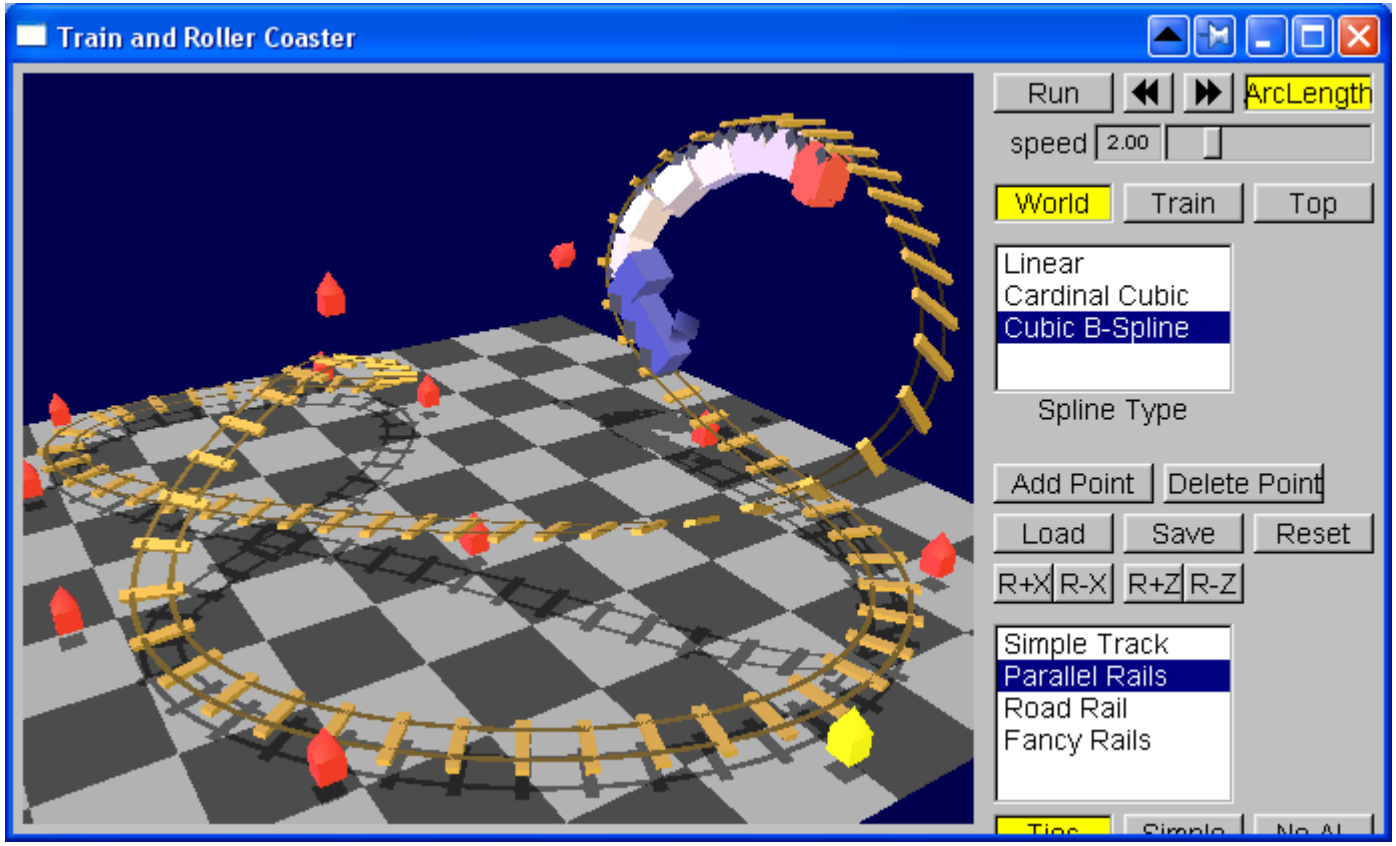
Jingyi Yu, Graphics, U Delaware



Eck and Hoppe, SIGGRAPH 96

What is this class about?

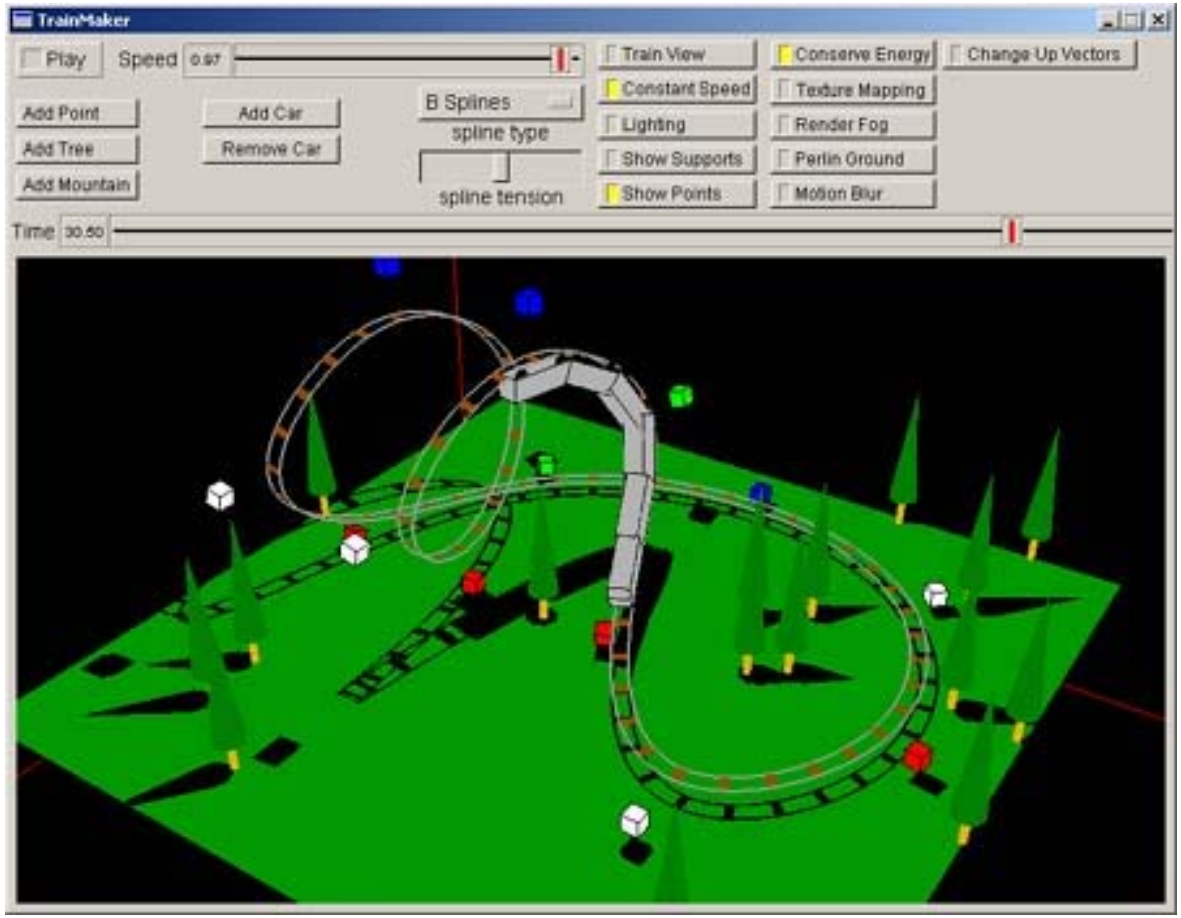
- Project 2: Roller coaster train



Rob Iverson's A+ assignment from 1999

What is this class about?

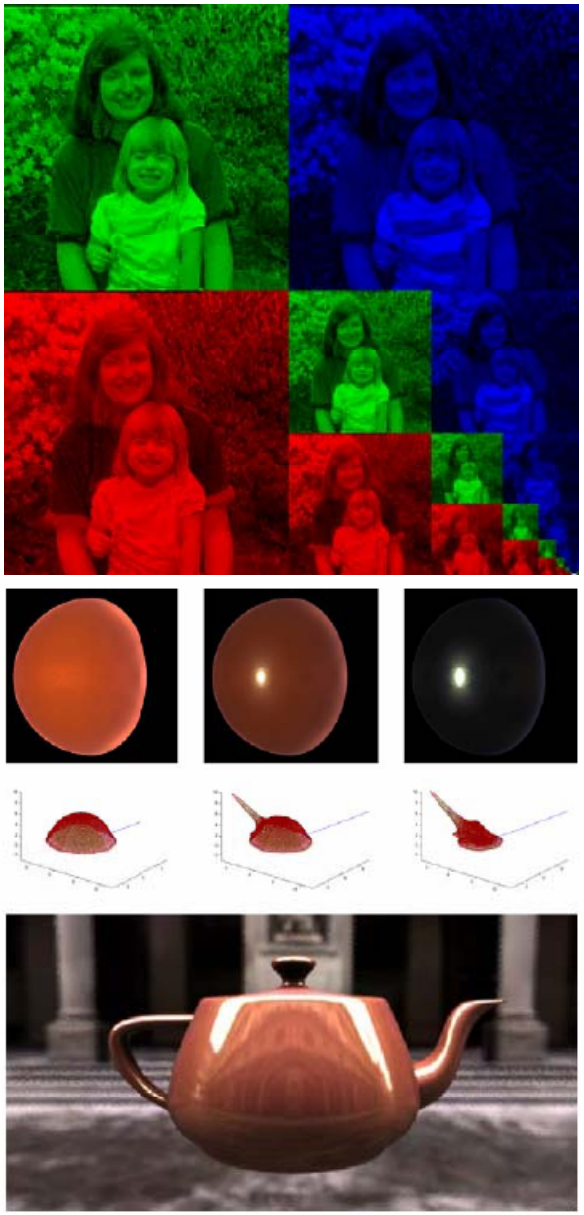
- Project 2: Roller coaster train

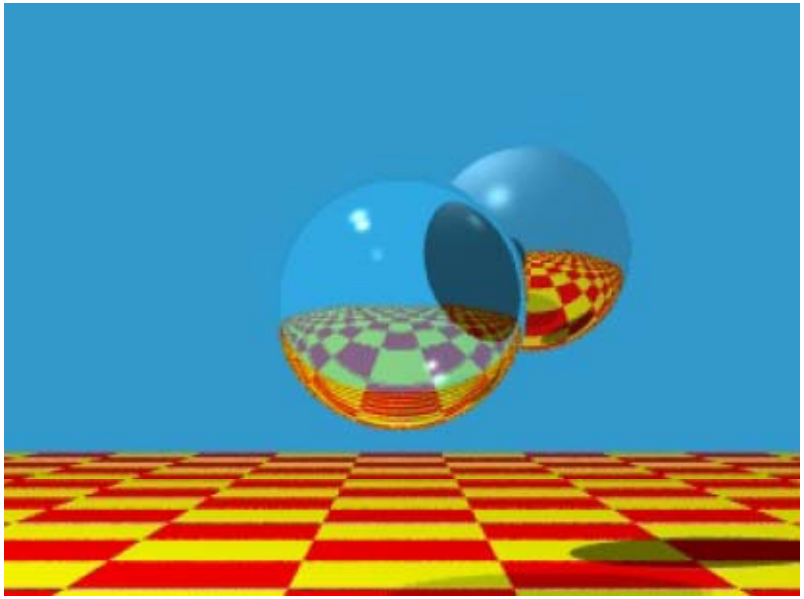


Rob Iverson's A+ assignment from 1999

What's covered in this class

- Basic Rendering techniques
  - Visibility, scan-conversion,
  - Lighting, Texture mapping,
  - Ray tracing, global illumination,

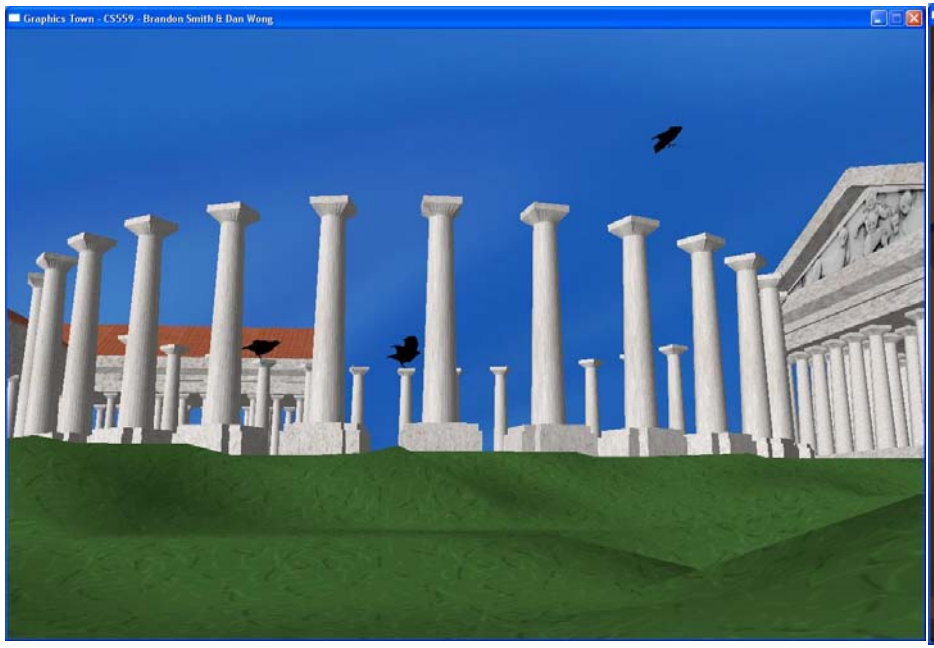




Jingyi Yu, Graphics, U Delaware

What's covered in this class

- Project 3: A graphics town



Brandon Smith

What's covered in this class

- Project 3: A graphics town

Jacob Felder

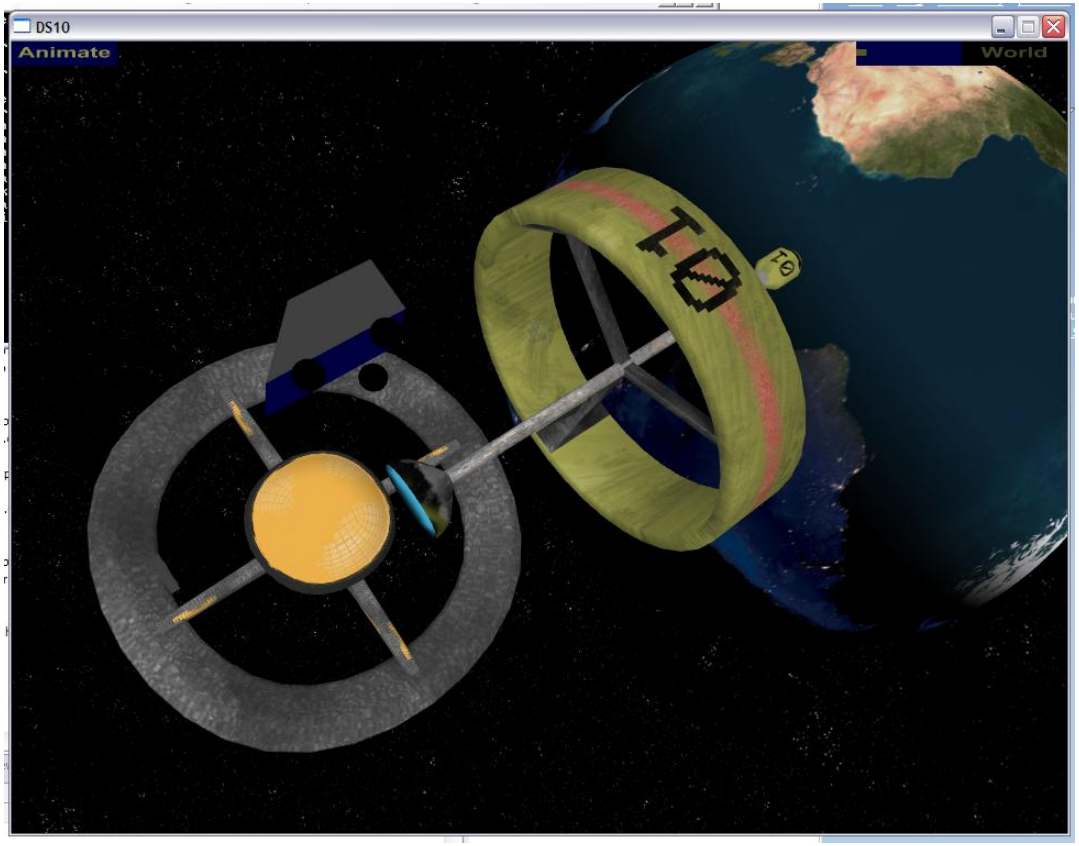
What's covered in this class

- Project 3: A graphics town

Daniel Geil

What's covered in this class

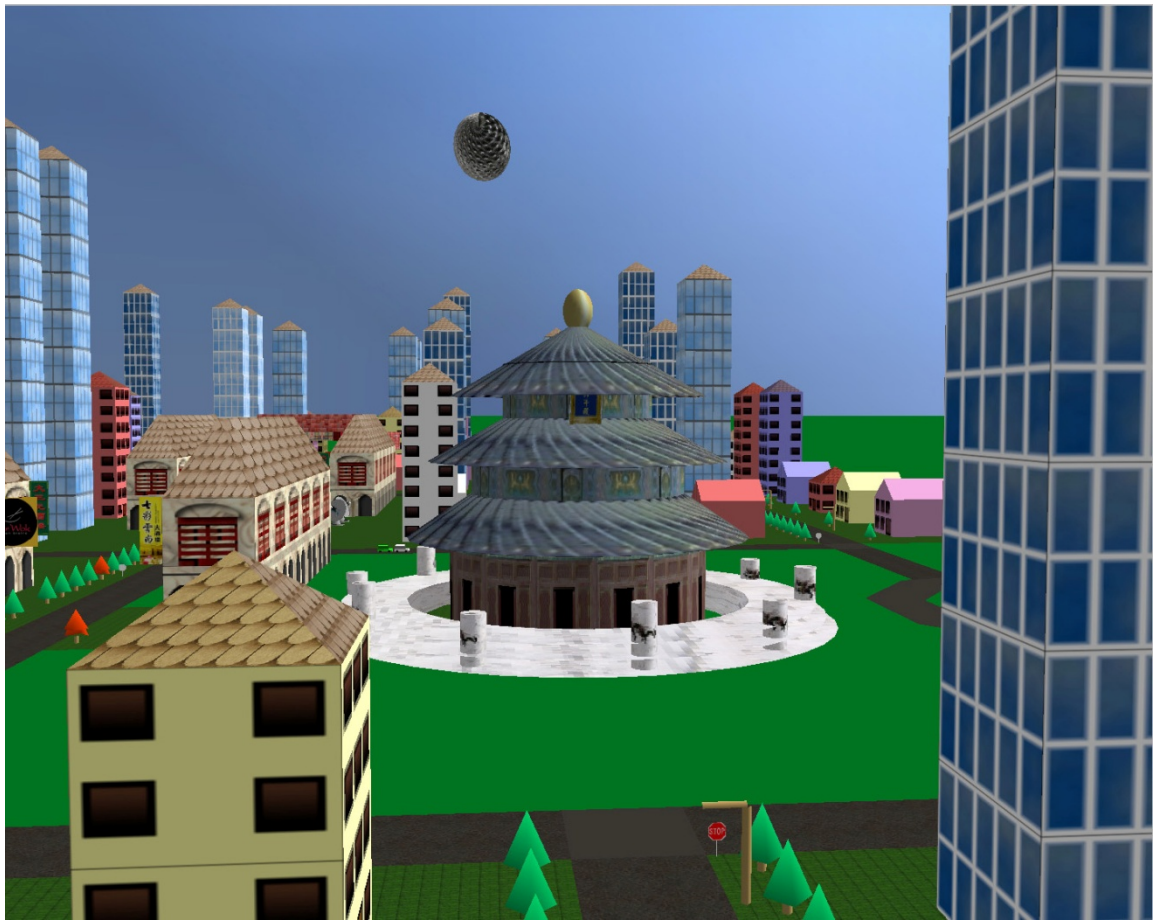
- Project 3: A graphics town



Marc Lenz

What's covered in this class

- Project 3: A graphics town



Xiang Ji and Yuxiang Yang

Staff

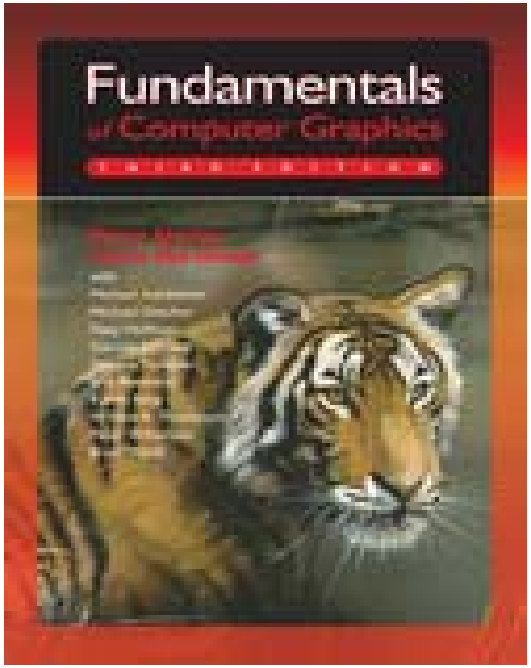
- Instructor: Li Zhang
  - lizhang@cs.wisc.edu
  - Office hours: Monday Wednesday 3.50-4.50pm
  - Office location: 6387 Comp S&ST
- TA: Sajika Gallege
  - sgallege@cs.wisc.edu
  - Office hours: Thursday Friday 1-2pm
  - Office location: 1306 Comp S&ST

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.

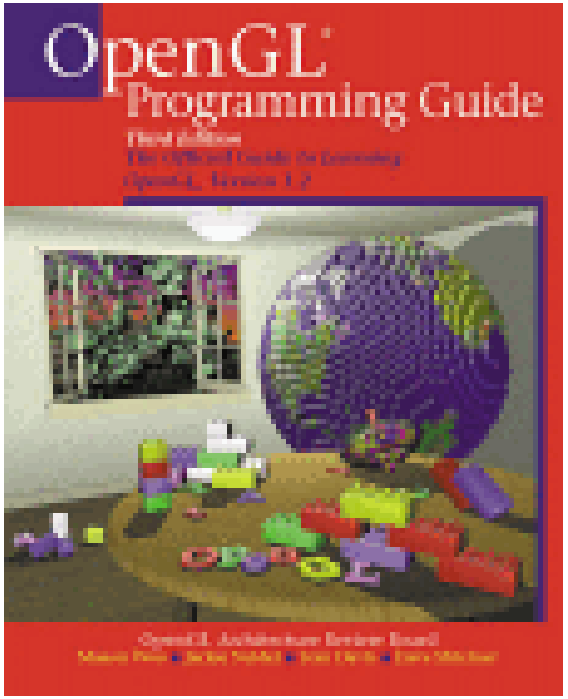
Books (required)

- Peter Shirley. *Fundamentals of Computer Graphics, 3ed*



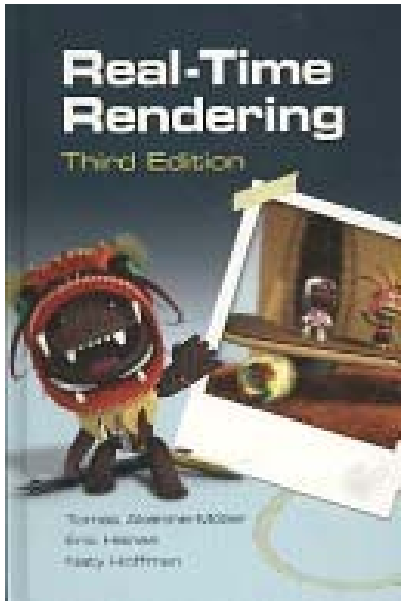
Books (required)

- *The OpenGL Programmer's Guide.* (“red book”) 7th edition
  - An older edition (available online) would be OK. It’s an important reference.



Books (recommended)

- *Real –time rendering.* 3th edition
  - Tomas Akenine-Möller, Eric Haines, Naty Hoffman - A.K. Peters (2008)



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 17th, in class
- Final
  - In the final week

Grading

- Projects: 20%, 25%, 25%
- Midterm: 10%
- Final: 20%
- Late policy
  - 80% 1st day, 60% 2nd day, … 0% 5th 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?