Foundations of Computer Graphics (Spring 2010)
CS 184, Lecture 1: Overview and History
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http://inst.eecs.berkeley.edu/~cs184

Goals

- **Systems**: Write complex 3D graphics programs (real-time in OpenGL, offline raytracer, animation)
- **Theory**: Mathematical aspects and algorithms underlying modern 3D graphics systems

This course is *not* about the specifics of 3D graphics programs and APIs like Maya, Alias, DirectX but about the concepts underlying them.

Demo: Surreal and Crazy World (HW 3)

Course Outline

- **3D Graphics Pipeline**
  - Modeling
  - Animation
  - Rendering

Unit 1: Transformations
- Resizing and placing objects in the world; Creating perspective images.
- Weeks 1 and 2
- Ass 1 due Feb 11 (Demo)

Unit 2: Spline Curves
- Modeling geometric objects
- Weeks 3,4
- Ass 2 due Feb 25 (Demo)
Course Outline

- **3D Graphics Pipeline**
  - **Unit 1:** Transformations
    - Weeks 1,2
    - Ass 1 due Feb 11
  - **Unit 2:** Spline Curves
    - Weeks 3,4
    - Ass 2 due Feb 25
  - **Unit 3:** OpenGL
    - Weeks 5-7
    - Ass 3 due Mar 18
  - **Unit 4:** Animation
    - Week 8
    - Ass 4 due Apr 8
  - **Unit 5:** Shading, Ray Tracing
    - Weeks 9-12
    - Ass 5 due Apr 29

Image Synthesis Examples

Logistics

- Website http://inst.eecs.berkeley.edu/~cs184 has most of the information (look at it)
- Office hours: before or after class (or send me e-mail)
- TA: Fu-Chung Huang, Daniel Ritchie, Rm 545, 537?
- Course bulletin board, cs184@imail.eecs.berkeley.edu
- Many optional textbooks of interest on reserve
- Website for late, collaboration policy, etc
- Questions?

Workload

- Lots of fun, rewarding but may involve significant work
- 5 programming projects; latter three are time-consuming (but you have 3 weeks, groups of two, intermediate milestones). START EARLY !!
- Course will involve understanding of mathematical, geometrical concepts taught (tested on midterm, final)
- Prerequisites: Solid C/C++/Java programming background. Linear algebra (review on Mon) and general math skills
- Should be a difficult, but fun and rewarding course
To Do

- Look at website
- Various policies etc. for course. Send e-mail if confused.
- Skim assignments if you want. First two are ready
  - Rest will be up soon
  - Submission instructions for assignments 1,2 soon
- Assignment 0, Due Jan 28 Thu (see website). Set up your account and tell us about yourself, providing a digital photo (so we can put names to faces).
- Any questions?

History

- Brief history of significant developments in field
- Couple of animated shorts for fun
- Towards end of course: movie, history of CG

What is Computer Graphics?

- Anything to do with visual representations on a computer
- Includes much of 2D graphics we take for granted
- And 3D graphics modeling and rendering (focus of course)
- Computer animation (both 2D and 3D)
- Auxiliary problems: Display devices, physics and math for computational problems

The term Computer Graphics was coined by William Fetter of Boeing in 1960. First graphic system in mid 1950s USAF SAGE radar data (developed MIT)

2D Graphics

Many of the standard operations you’re used to:

- Text
- Graphical User Interfaces (Windows, MacOS, …)
- Image processing and paint programs (Photoshop, …)
- Drawing and presentation (Powerpoint, …)

How far we’ve come: TEXT

From Text to GUIs

- Invented at PARC circa 1975. Used in the Apple Macintosh, and now prevalent everywhere.
**Drawing: Sketchpad (1963)**
- Sketchpad (Sutherland, MIT 1963)
- First interactive graphics system (VIDEO)
- Many of concepts for drawing in current systems
  - Pop up menus
  - Constraint-based drawing
  - Hierarchical Modeling

**Paint Systems**
- Nowadays, image processing programs like Photoshop can draw, paint, edit, etc.

**Image Processing**
- Digitally alter images, crop, scale, composite
- Add or remove objects
- Sports broadcasts for TV (combine 2D and 3D processing)

**3D Graphics**
- 3D Graphics Pipeline
  - Modeling → Animation → Rendering

**Applications**
- Entertainment (Movies), Art
- Design (CAD)
- Video games
- Education, simulators, augmented reality
- Image processing and photography

**Modeling**
- Spline curves, surfaces: 70s – 80s
- Utah teapot: Famous 3D model
- More recently: Triangle meshes often acquired from real objects
Rendering: 1960s (visibility)
- Roberts (1963), Appel (1967) - hidden-line algorithms
- Sutherland (1974) - visibility = sorting

Images from FvDFH, Pixar’s Shutterbug
Slide ideas for history of Rendering courtesy Marc Levoy

Rendering: 1970s (lighting)
- 1970s - raster graphics
  - Blinn (1974) - curved surfaces, texture
  - Catmull (1974) - 2-buffer hidden-surface algorithm

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Rendering (1980s, 90s: Global Illumination)
early 1980s - global illumination
- Whitted (1980) - ray tracing
- Goral, Torrance et al. (1984) radiosity
- Kajiya (1986) - the rendering equation

History of Computer Animation
- 10 min clip from video on history of animation
- Covers sketchpad, animation, basic modeling, rendering
- A synopsis of what this course is about

Related courses
- CS 283 (taught as 294), graduate class taught for first time in the fall this year
- Many CS 294 and similar courses, e.g. visualization, physical simulation, geometric modeling, …
- Other related courses: Computer Vision, Robotics, User Interfaces Computational Geometry, Photography, …

Short Videos
- 10 min clip from video on history of animation
- Covers sketchpad, animation, basic modeling, rendering
- A synopsis of what this course is about