CS-184: Computer Graphics

Lecture #1: Introduction, Overview, and Image Basics

Prof. James O'Brien
University of California, Berkeley

Today

- Introduction and Course Overview
- Assignments #1 and #2
- Digital Images
The Subject: Computer Graphics

- **Computer Graphics:**
  Using computers to generate and display images

- **Issues that arise:**
  - Modeling
  - Rendering
  - Animation
  - Perception
  - Lots of details...

Computer Graphics

- **Applications (in other words, why we care)**
  - Movies
  - Video Games
  - Simulation
  - Analysis
  - Design
  - Others...
Computer Graphics

Applications (in other words, why we care)

- Movies
- Video Games
- Simulation
- Analysis
- Design
- Others...

From Star Wars Episode / Lucasfilm Ltd.

Computer Graphics

Applications (in other words, why we care)

- Movies
- Video Games
- Simulation
- Analysis
- Design
- Others...

From Finding Nemo, Pixar Animation Studios
Computer Graphics

- Applications (in other words, why we care)
  - Movies
  - Video Games
  - Simulation
  - Analysis
  - Design
  - Others...

From Halo 2 by Bungie Entertainment

From America's Army
Computer Graphics

- Applications (in other words, why we care)
  - Movies
  - Video Games
  - Simulation
  - Analysis
  - Design
  - Others...

Image from CAE Inc.

Carlo Sequin
Computer Graphics

- Applications (in other words, why we care)
  - Movies
  - Video Games
  - Simulation
  - Analysis
  - Design
  - Others...

Course Topics

- Image representation and manipulation
- 2D and 3D drawing algorithms
- Object representations
- Rendering
- Animation
- Interaction techniques
People

Prof. James O'Brien
Email: job@eecs.berkeley.edu
Office hours: Fridays 2:00-4:00pm
Office location: 633 Soda Hall

T.A. Niels Joubert
Email: niels@berkeley.edu
Office hours: TBA
Office hours location: TBA

T.A. James Andrews
Email: jima@eecs.berkeley.edu
Office hours: TBA
Office hours location: TBA

Send class related email to cs184@mail.eecs.berkeley.edu

Contact Information

- Class web site:
  - http://inst.eecs.berkeley.edu/~cs184
  - Handouts assignments, etc. will be posted there
  - Lecture notes posted there (hopefully) before classes

- News group:
  - ucb.class.cs184
  - Not reading newsgroup... bad idea

- Email addresses on previous page...
Computing Resources

- Class accounts handed shortly
- Can also use CS Labs
  - Linux
  - Windows
  - Mac

Text Book

- *Fundamentals of Computer Graphics*
  by Peter Shirley
  *Get the current version!*
- Also handouts and other supplemental material will be provided
- See other books listed in course information handout
Grading

- Assignments: 40%
  - Mix of written and programming
  - Average 1 or 2 weeks to do them
- Final Project: 20%
  - Presentation: Dec 10, 2:30-6:00pm
- Midterm: 20%
  - Wednesday, October 13, In class
- Final: 20%
  - Thursday, December 18 5:00-8:00pm

- Check now for conflicts!

Prerequisites

- You must know how to program C or C++
  - Big final project, several programming assignments
  - No hand holding
- Data structures (CS60B)
- Math: linear algebra, calc, trig
Waitlist

- Relax for now... there is lots of space.

Class Participation

- Reasons to participate
  - More fun for me and you
  - You learn more
  - I won’t give stupid little annoying quizzes in class

- How to participate
  - Ask questions
  - Make comments

- Stupid questions/comments
  - That’s okay
Assignments #1 and #2

- Assignment #1
  - Setup CS184 account and let us know who you are
  - Get very simple OpenGL program working
- Assignment #2
  - Tests math prerequisites

Academic Honesty

- If you use an external resource cite it clearly!
- Don’t do things that would be considered dishonest... if in doubt ask.
- Cheating earns you:
  - An ‘F’ in the class and
  - Getting reported to the University
  - No exceptions.
Images

- Something that represents a *pattern of light* that will be *perceived* by something
- Computer representations
  - Sampled (pixel based)
  - Object based
  - Functional
Images

- Something that represents a pattern of light that will be perceived by something

- Computer representations
  - Sampled (pixel based)
  - Object based
  - Functional

Images

- Something that represents a pattern of light that will be perceived by something

- Computer representations
  - Sampled (pixel based)
  - Object based
  - Functional
Images

- Something that represents a *pattern of light* that will be *perceived* by something
- Computer representations
  - Sampled (pixel based)
    - Object based
  - Functional
Images

- Something that represents a *pattern of light* that will be *perceived* by something
- Computer representations
  - Sampled (pixel based)
  - Object based
  - Functional

Images

- Something that represents a *pattern of light* that will be *perceived* by something
- Computer representations
  - Sampled (pixel based)
  - Object based
  - Functional
Images

• Something that represents a *pattern of light* that will be *perceived* by something

• Computer representations
  • Sampled (pixel based)
  • Object based
  • Functional

Well, this *used* to be in an object based representation...

Images

• Something that represents a *pattern of light* that will be *perceived* by something

• Computer representations
  • Sampled (pixel based)
  • Object based
  • Functional
Images

- Something that represents a *pattern of light* that will be *perceived* by something
- Computer representations
  - Sampled (pixel based)
  - Object based
    - Functional
  Function → Polygons → Pixels
  Think about making edits...

Storing Images

- Object and Function representations basically arbitrary ...later...
- Raster Images
  - 2D array of memory
  - Pixels store different things
    - Intensity
    - RGB color
    - Depth
    - Others...
  - May be mapped to special HW
Storing Images

- Object and Function representations basically arbitrary ...later...

- Raster Images
  - 2D array of memory
  - Pixels store different things
    - Intensity (scalar value, e.g. float, int)
    - RGB color (vector value)
    - Depth
    - Others...
  - May be mapped to special HW

Discretization

- Real world and “object” representations are continuous.
- Raster images have discrete pixel locations and discrete pixel values

- We will see problems from this soon...
High Dynamic Range Images

- Dynamic range of the human eye >> range of standard monitors
- Eye adjusts as we look around
Perception

- The eye does not see intensity values...

This striking visual illusion suggests that what we see depends more on what we expect than on any "reality". Despite appearances, the shaded "light" square (3), and the four "dark" squares surrounding it, are identical in brightness (light intensity). Holding the mouse button down to see a "fant switch" and compare it to the various squares on the board.
Perception

- The eye does not see intensity values...
Storing Images

- Digital file formats
  - TIFF, JPEG, PNG, GIF, BMP, PPM, etc. ...
  - Compression (lossless and lossy)
  - Interlaced (e.g. NTSC television)
  - Tend to be complex... use libraries

- Mapping to memory