CS-184: Computer Graphics

Lecture #1: Introduction, Overview,
and Image Basics

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University of California, Berkeley

V2006S-01-1.0

Today

- Introduction and Course Overview
- Homeworks #0 and #1

- 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...

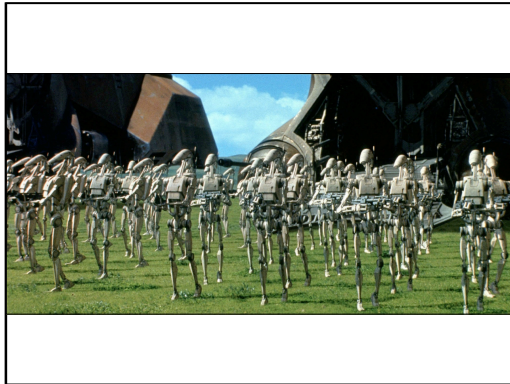## Computer Graphics

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

Computer Graphics

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  - Movies
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  - Others...

From *Star Wars Episode 1*, Lucasfilm Ltd.

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Computer Graphics

- Applications (in other words, why we care)
  - Movies
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  - Design
  - Others...

From *Finding Nemo*, Pixar Animation Studios

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Computer Graphics

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

From Halo 2, by Bungie Entertainment

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Computer Graphics

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

From America's Army

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Computer Graphics

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

Image from CAE Inc.

Computer Graphics

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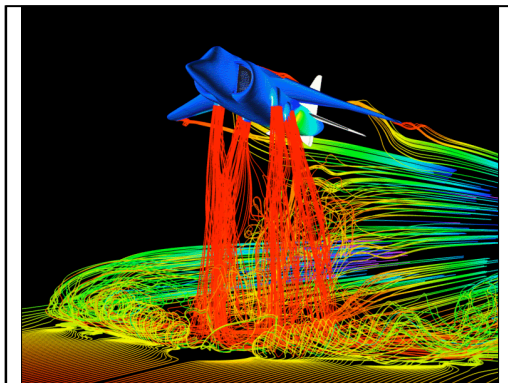 ○ Simulation
  ○ Analysis
  ○ Design
  ○ Others...

Carlo Sequin

Computer Graphics

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

Fluid simulation w/ NASA FAST

Course Topics

○ Image representation and manipulation

○ 2D and 3D drawing algorithms

○ Object representations

○ Rendering

○ Animation

○ Interaction techniques

People

Prof. James O'Brien

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Adam Kirk

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Office hours location: 751 Soda Hall

? TBA

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

Contact Information

○ Class web site:
   ○ http://inst.eecs.berkeley.edu/~cs184
   ○ Handouts assignments, *etc.* will beposted 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 out next week

○ New lab with Power Mac G5s

○ Can also use other labs (Linux or Windows)

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: 30%
  - Mix of written and programing
  - Average 1 or 2 weeks to do them
- Final Project: 30%
- Midterm: 20%
- Final: 20%

- Dates in course handout
  - Check *now* for conflicts!

Prerequisites

- You must know how to program C or C++
  - Big final project, several programing assignments
  - No hand holding
- Data structures (CS60C)
- Math: linear algebra, calc, trig

Waitlist

- Relax for now...

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

Homeworks #0 and #1

- Homework #0
  - Setup CS184 account and let us know who you are
  - Do this ASAP (after you get the account sheet)
- Homework #1
  - Due (see handout)
  - 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
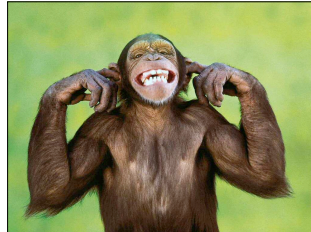 - Getting reported to the University
  - No exceptions.

Questions?

Images

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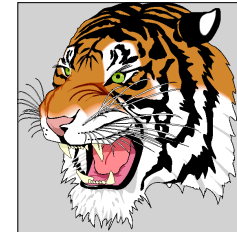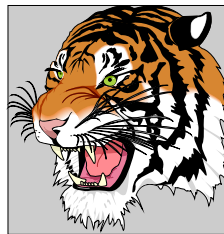 - Object based
  - Functional

Images

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

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

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Images

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

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  - Functional

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Images

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- Computer representations
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  - Object based
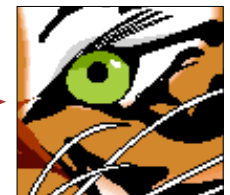 - Functional

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Images

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

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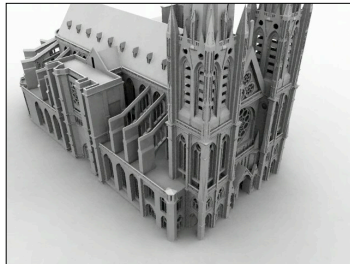 - Object based →
  - Functional

PS Type 1 font →

Vector- or stroke-based

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Images

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

- Computer representations

  - Sampled (pixel based)

  - | Object based |

  - Functional

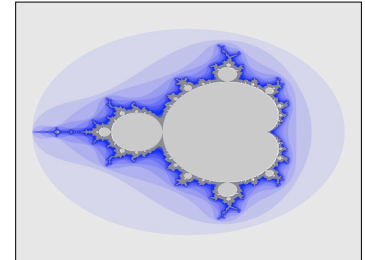Well, this *used* to be in an object based representation...

Images

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  - | Functional |

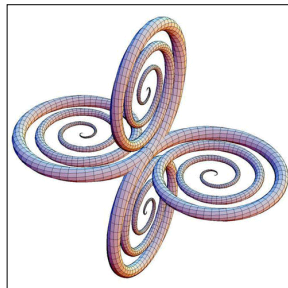
Images

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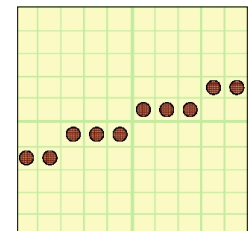Function→Polygons→Pixels

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
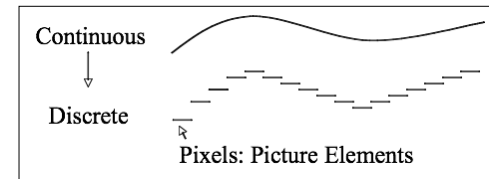   ○ Others...

  ○ May be mapped to special HW

0.25	0.5	0.25	0.5	0.25
1	0.25	0	0.25	1
0.25	0.5	0.25	0.5	0.25

Stephen Chenney

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Discretization

○ Real world and "object" representations are continuous.

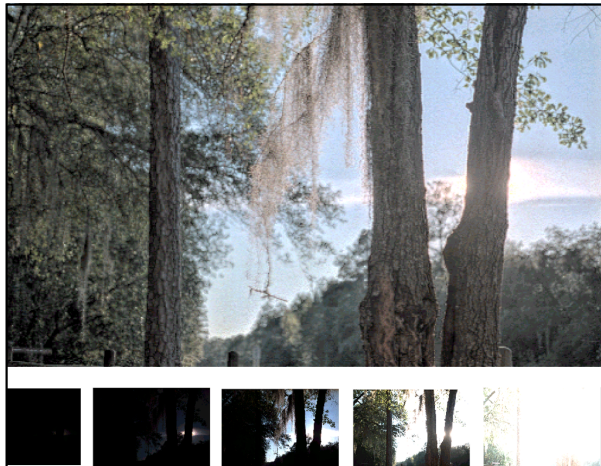○ Raster images have discrete pixel *locations* and discrete pixel *values*

Continuous

Discrete

Pixels: Picture Elements

Stephen Chenney

○ We will see problems from this soon...

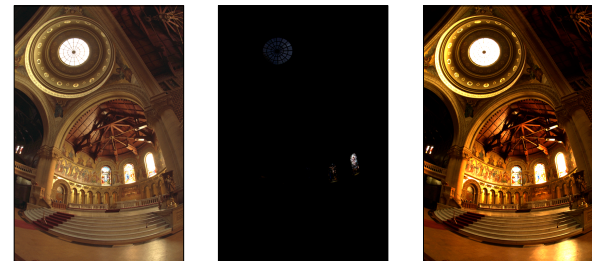34

High Dynamic Range Images

Jack Tumblin

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High Dynamic Range Images

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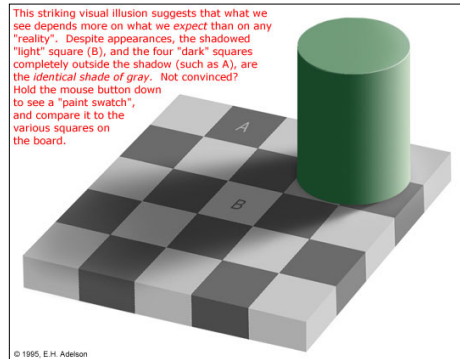
○ Eye adjusts as we look around

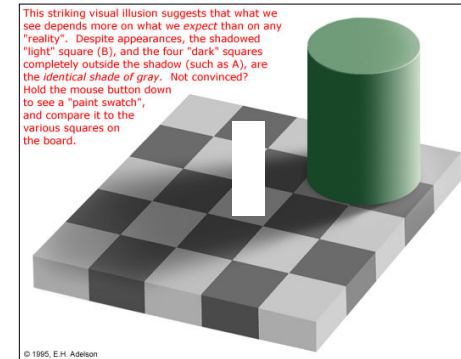

Paul Debevec and Jitenrda Malik

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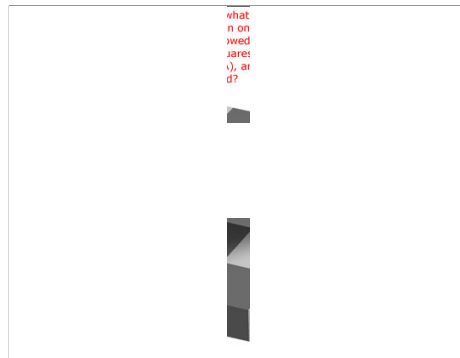# Perception

- 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 shadowed "light" square (B), and the four "dark" squares completely outside the shadow (such as A), are the *identical shade of gray*. Not convinced? Hold the mouse button down to see a "paint swatch", and compare it to the various squares on the board.

© 1995, E.H. Adelson

Perception

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© 1995, E.H. Adelson

Perception

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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