COMPUTER GRAPHICS

15-462 / 15-662

Nancy Pollard

T-R: 10:30 am – 11:50am

DH 1212

Introduction

- What is computer graphics?
- Who am I?
- Administrivia.
- Topics

Introduction

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Goals of Computer Graphics

- Faking reality – convincingly.
- Creating alternative reality.

FAKING REALITY

FAKING REALITY

FAKING REALITY

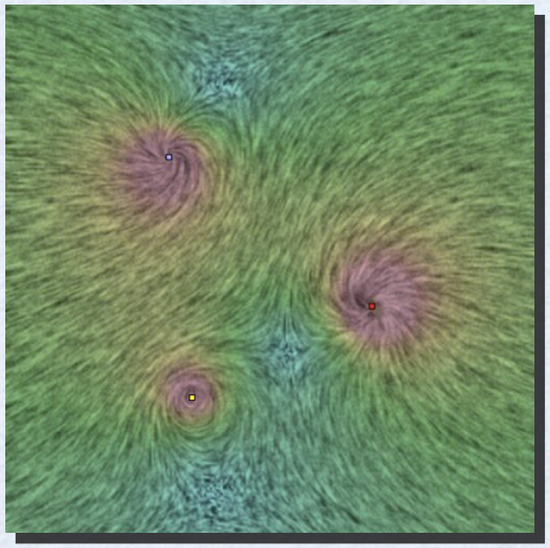
ALTERNATIVE REALITY

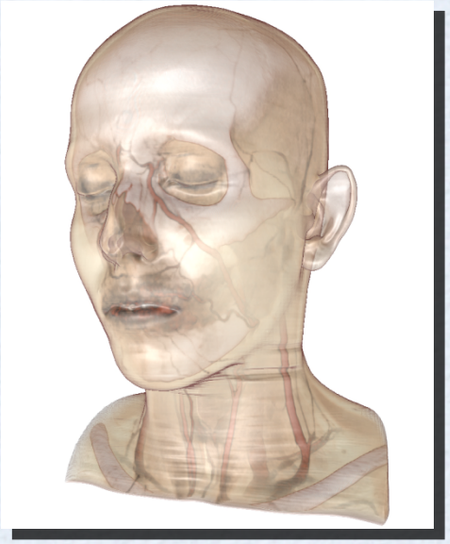
Making of the Gatorade Commercial

What is Computer Graphics?

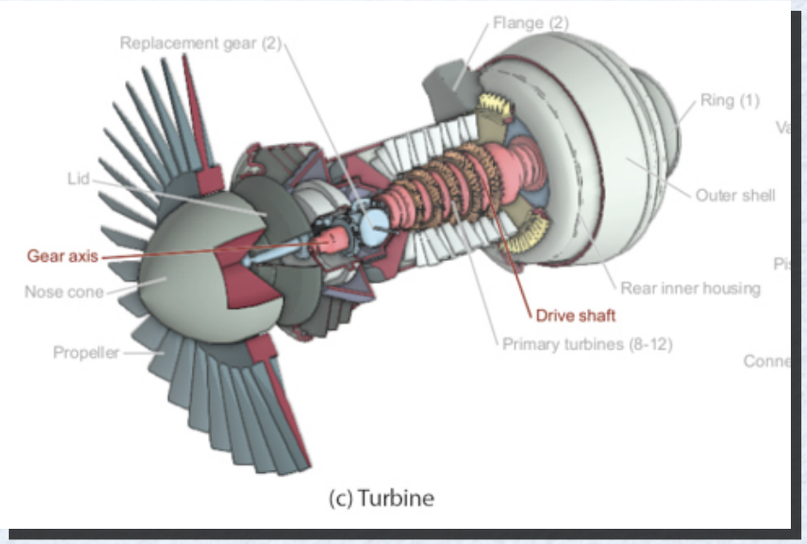
- 3D Modeling / Geometry
- Simulation / Animation / Character Animation
- Lighting / Light Transfer
- Textures and Color
- Post-Processing: Image Processing
- Camera tricks / Optics

WHAT ELSE IS COMPUTER GRAPHICS

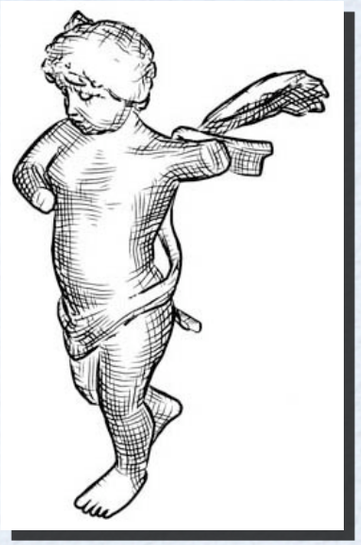




Scientific Visualization

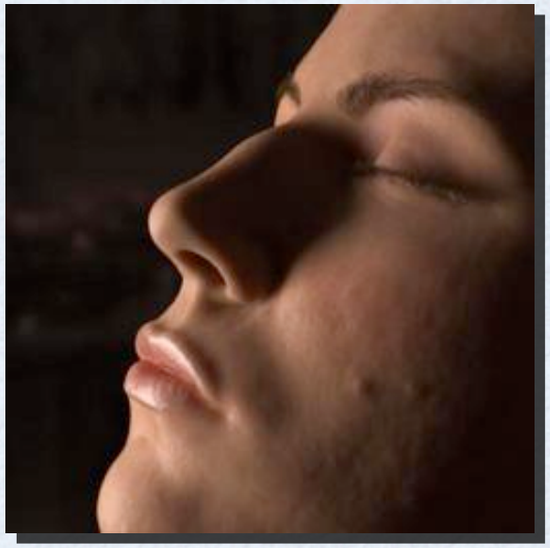


Illustration



NPR / Art

Computational Photography



Virtual Life

and much more....

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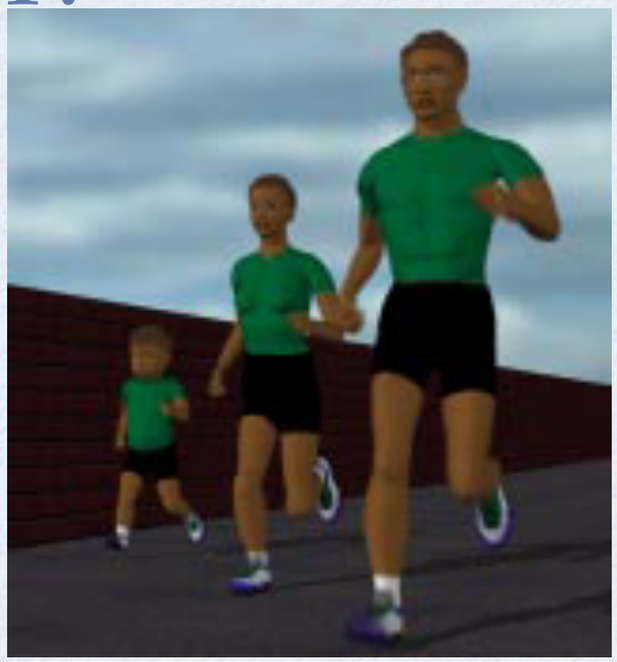
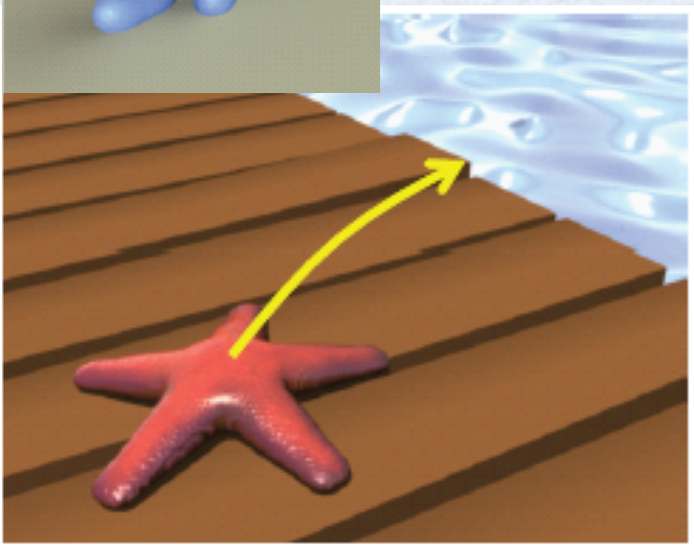
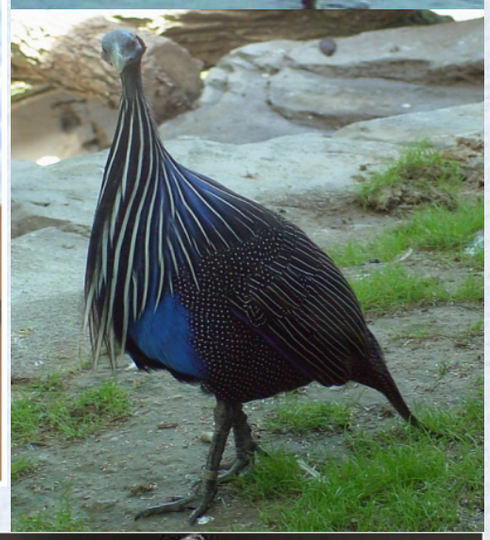
Who Am I

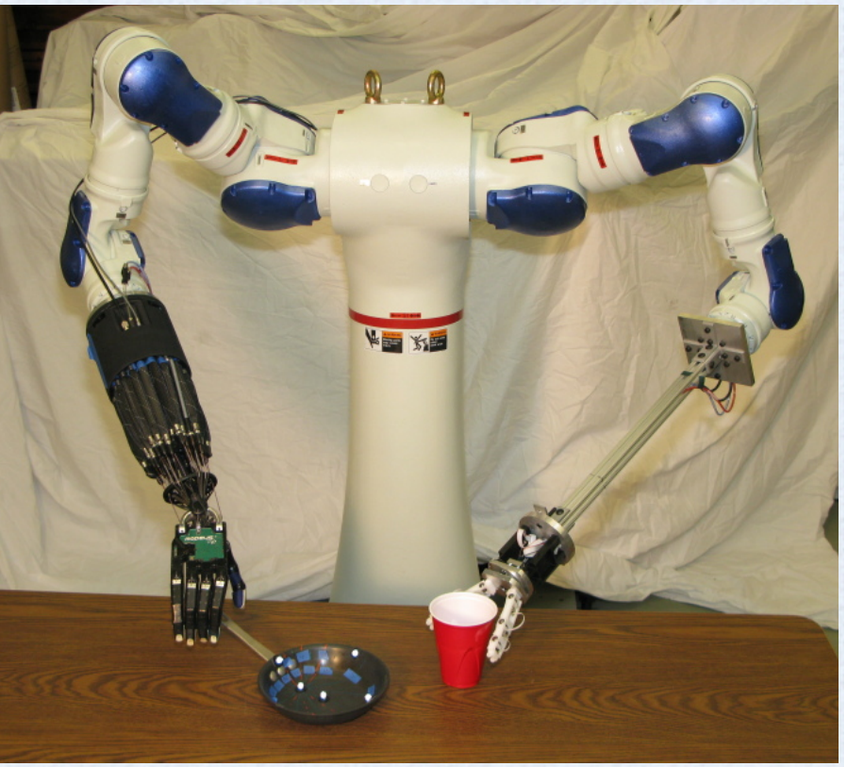
- I'm a graphics/robotics researcher.
- I've been at SCS (RI and CSD) for 12 yrs.
- Before that, I was at Brown University for 5 yrs.
- PhD 1994 MIT.

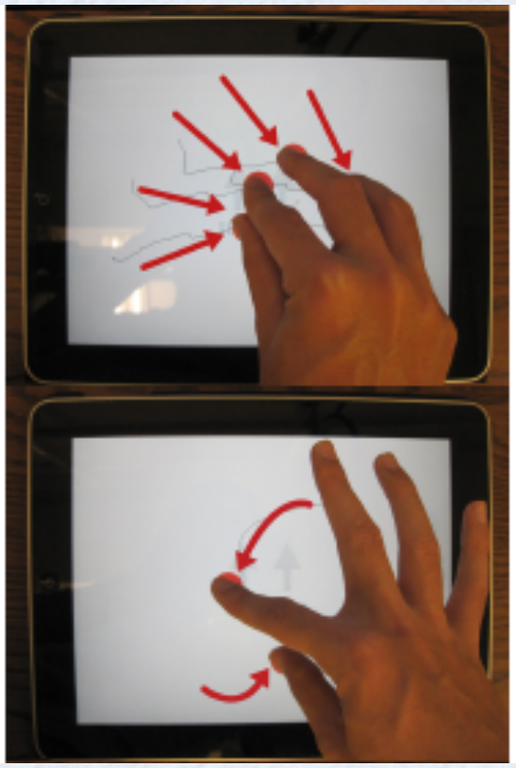


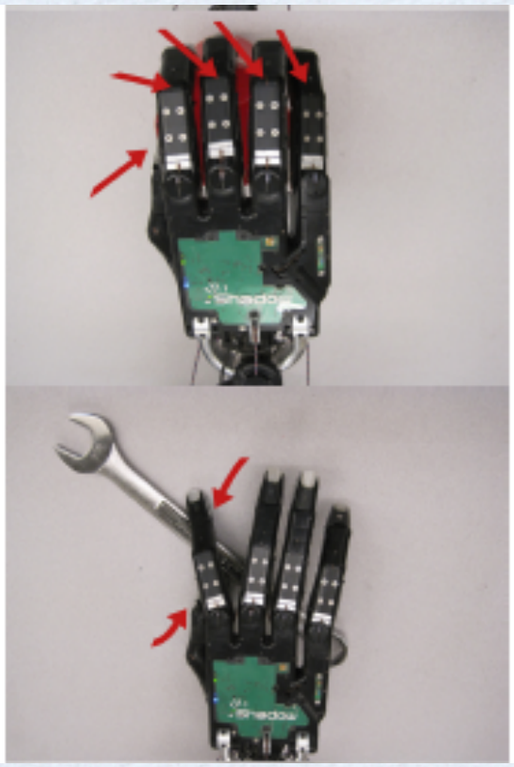
WHAT I DO











DEXTERITY

"Dexterity is the ability to find a motor solution for any external situation, that is, to adequately solve any emerging motor problem

correctly (i.e., adequately and accurately)

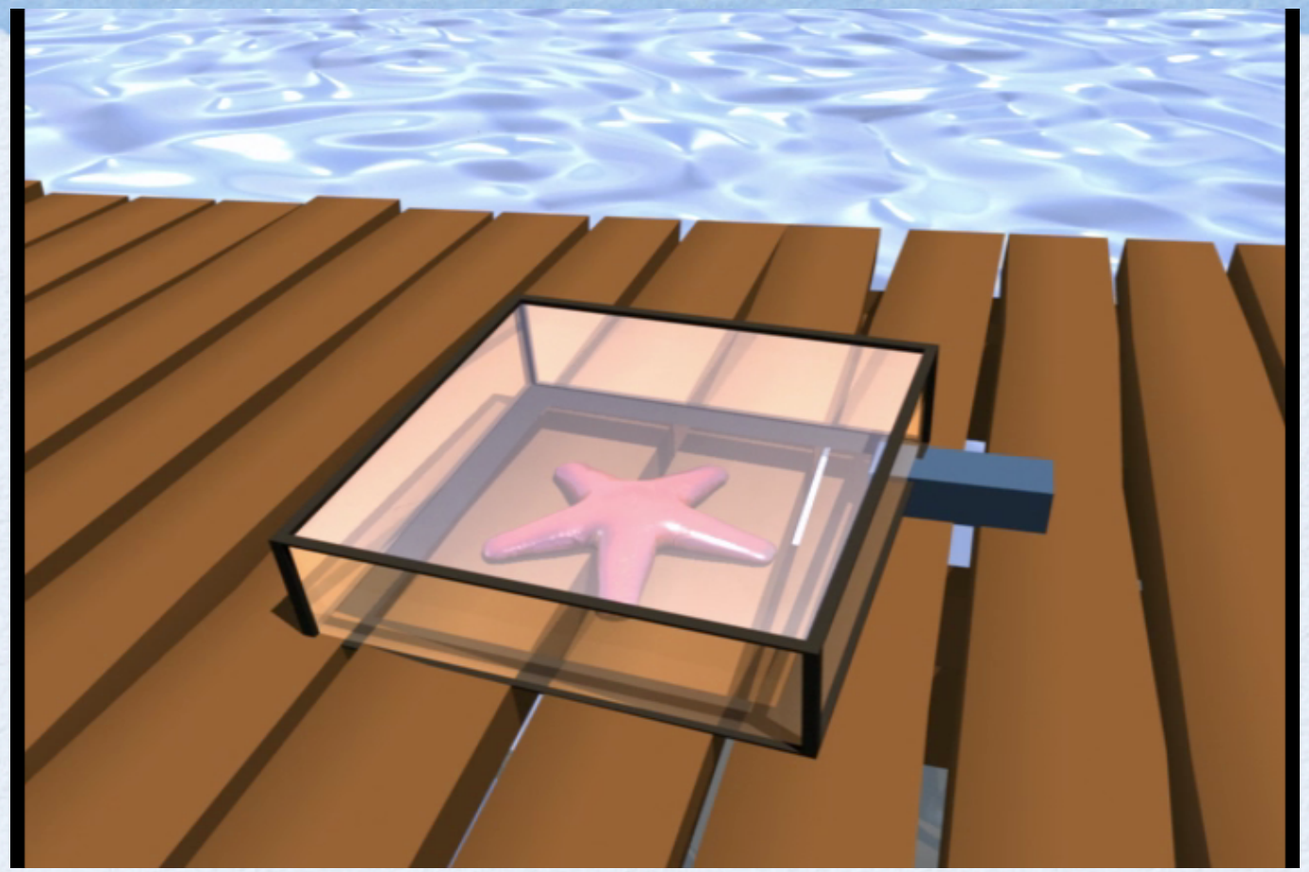
quickly (with respect to both decision making and achieving a correct result)

rationally (i.e., expediently and economically), and

resourcefully (i.e., quick-wittedly and initiatively).

----- Nicholai Bernstein, "On Dexterity and its Development" 1949/91/96

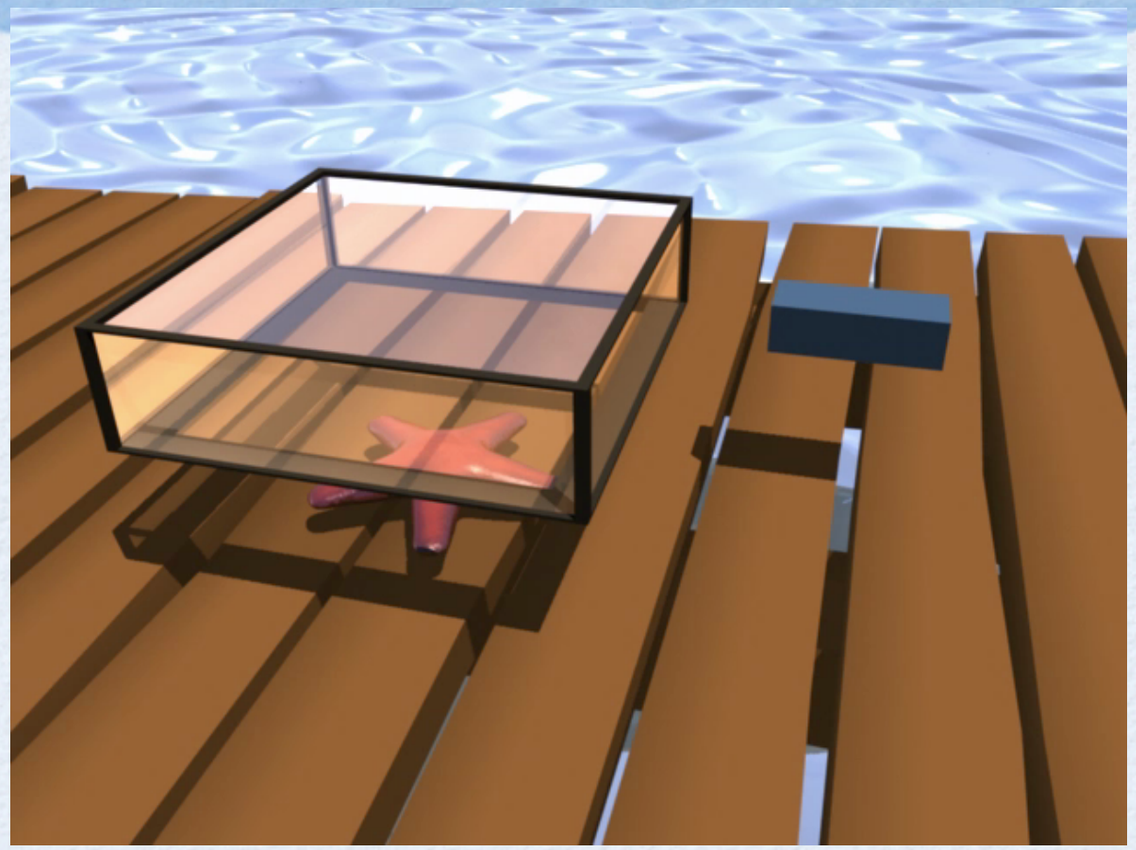
Animating Dexterous Motions

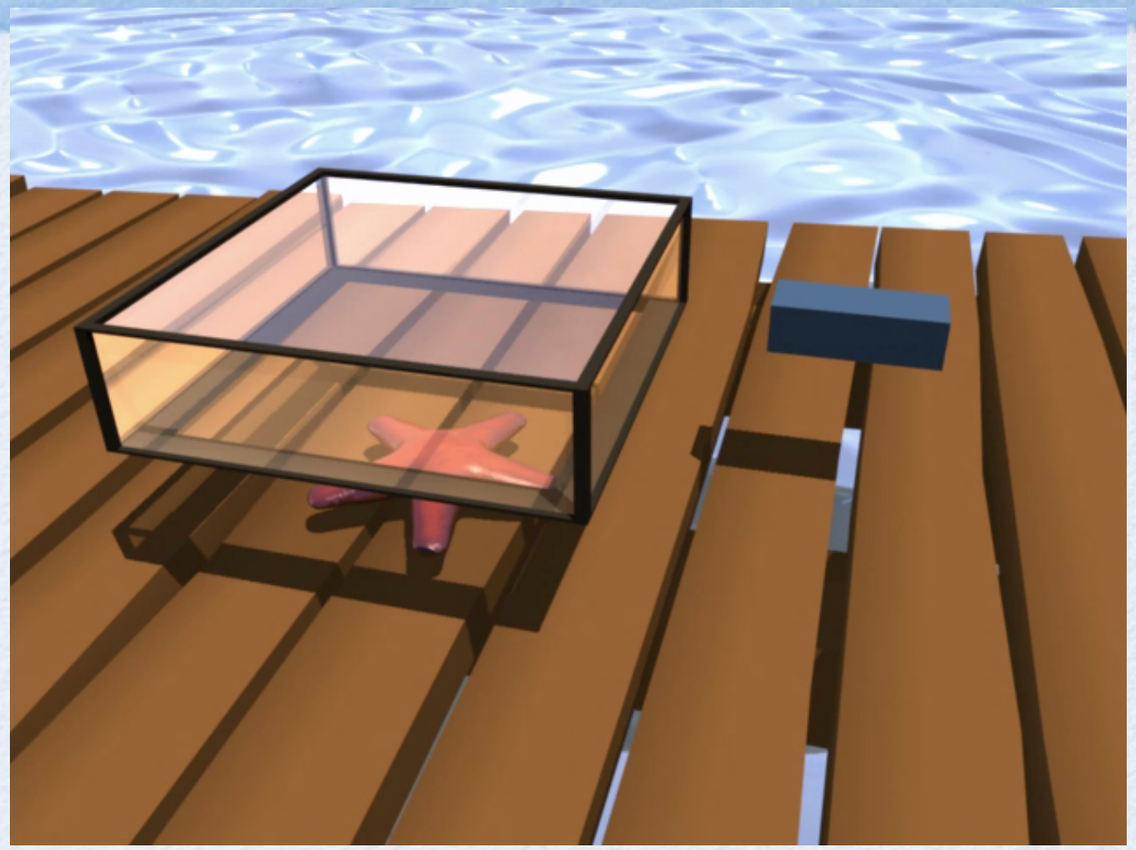


How can we easily animate the starfish's escape?

- Appearance of intelligent motion
- Believable physical interaction with the glass box
- Dynamic, fun actions
- Animation tools accessible to anyone

Animating Dexterous Motions





Videos created by two novice users using our system.

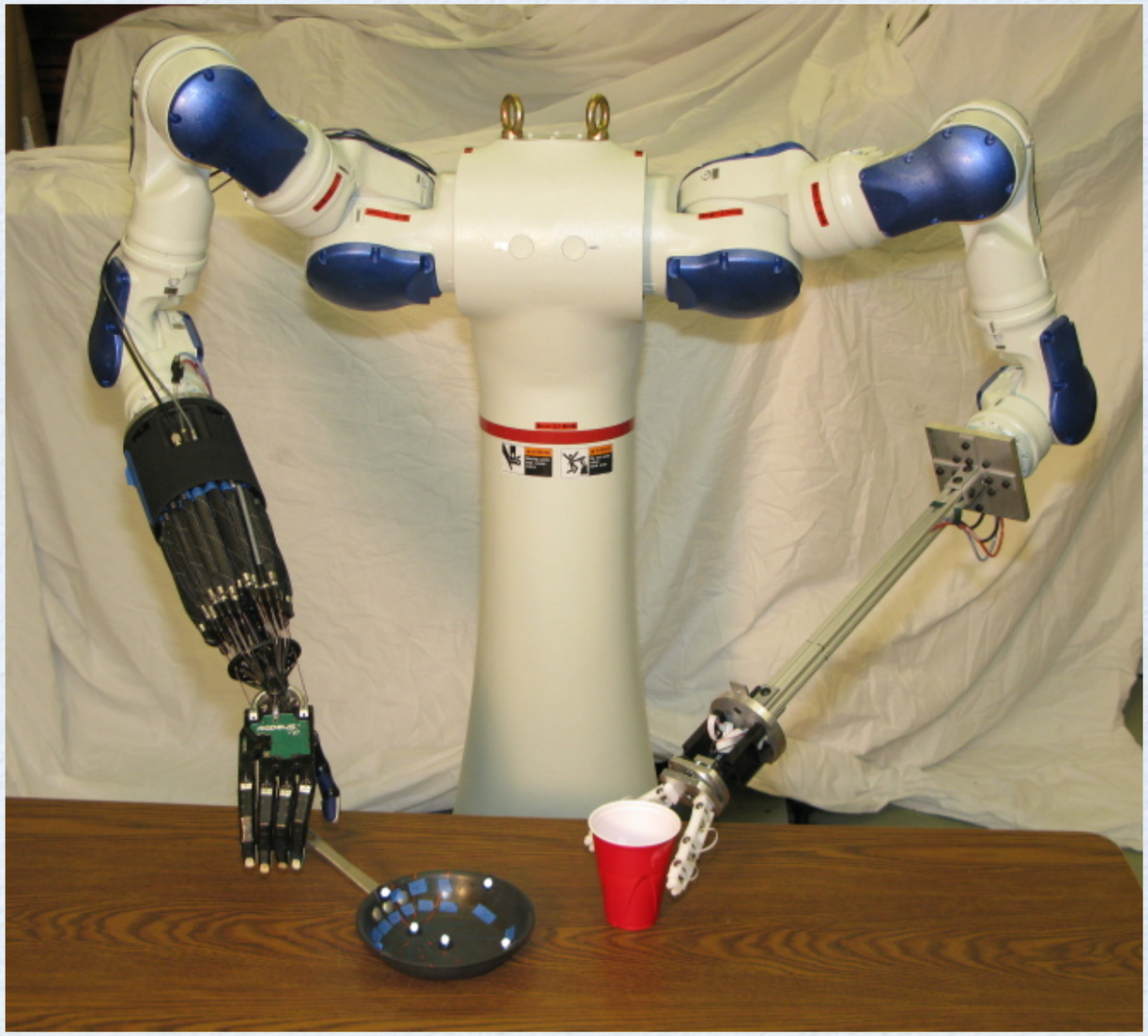
DEMOS


Direct Control of
Simulated Non-human Characters
Results
(animations)
(No audio)

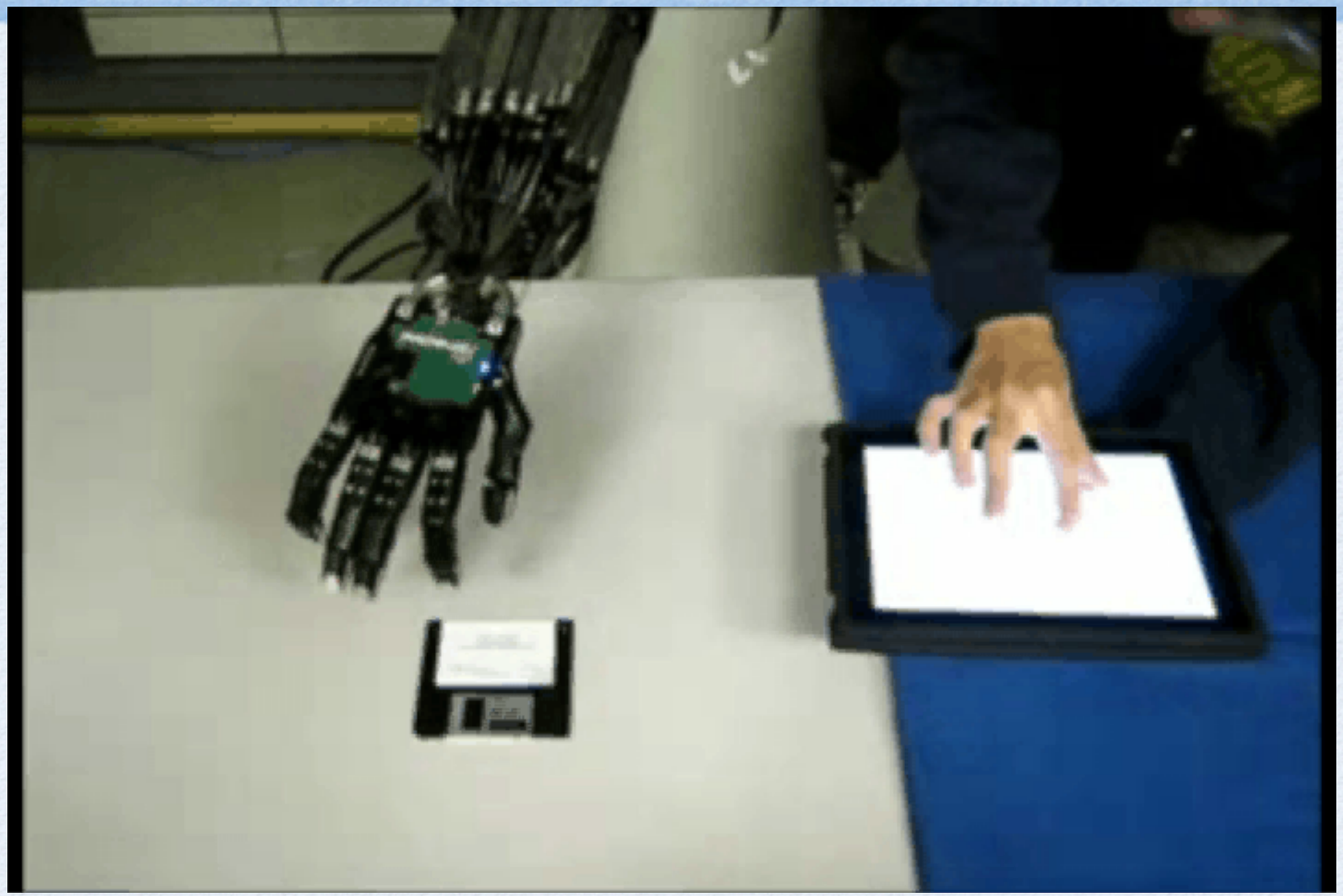
Robotic Telemanipulation

Goal: intuitive interactive control of dexterous manipulation for a robot arm / hand system

- Remote dexterous manipulation
- Scripting new behaviors
- Learning from demonstration



DEMO! (3X SPEED)



HUMAN MANIPULATION

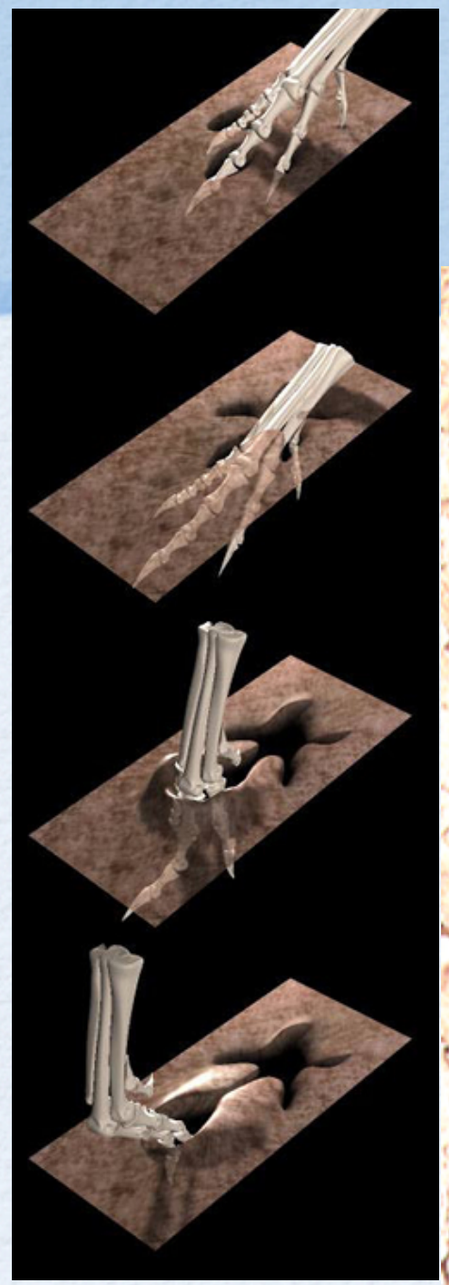
http://www.cs.cmu.edu/~jialiu1/database.html

How can we compare motions of different species?

Motivation for Evolutionary Biology:

- Trace evolution of locomotor movements through the tree of life, using comparative methods
- Clarify relationships between species
- Deduce likely movement patterns of common ancestors
- Answer questions such as “How did T-Rex run?”

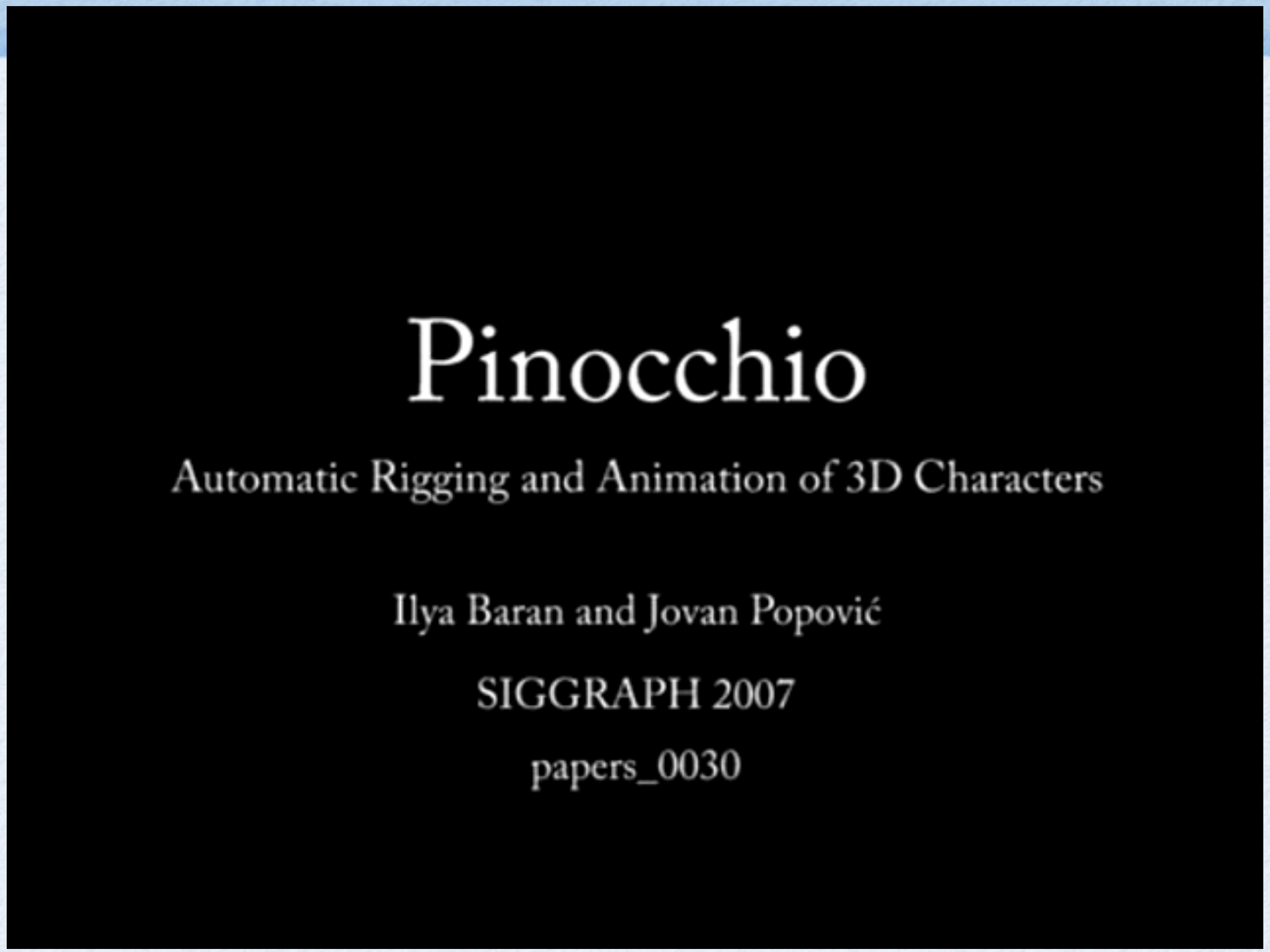
REFERENCE



Steve Gatesy
Dept. of Evolutionary Biology, Brown Univ.

Stephen M. Gatesy and Nancy S. Pollard, "Apples, oranges, and angles: Comparative kinematic analysis of disparate limbs," Journal of Theoretical Biology 2011

Are these motions the same?



Baran and Popovic

Introduction

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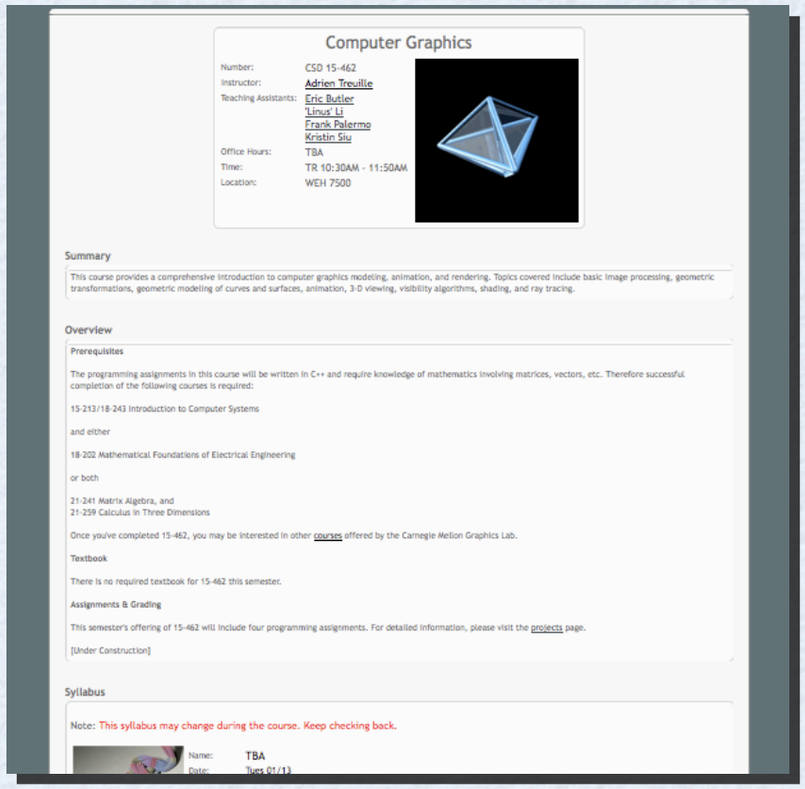
ADMINISTRIVIA

- Web Page is up!
  - http://www.cs.cmu.edu/~15462/
  - It will also be linked from my web page
- Use Piazza for announcements / discussion
  - https://piazza.com/class#spring2015/15462



Computer Graphics

Number: CSD 15-462
Instructor: Adrien Treuille
Teaching Assistants: Eric Butler, 'Linus' Li, Frank Palermo, Kristin Siu
Office Hours: TBA
Time: TR 10:30AM - 11:50AM
Location: WEH 7500

Summary

This course provides a comprehensive introduction to computer graphics modeling, animation, and rendering. Topics covered include basic image processing, geometric transformations, geometric modeling of curves and surfaces, animation, 3-D viewing, visibility algorithms, shading, and ray tracing.

Overview

Prerequisites

The programming assignments in this course will be written in C++ and require knowledge of mathematics involving matrices, vectors, etc. Therefore successful completion of the following courses is required:

15-213/18-243 Introduction to Computer Systems

and either

18-202 Mathematical Foundations of Electrical Engineering

or both

21-241 Matrix Algebra, and
21-259 Calculus in Three Dimensions

Once you've completed 15-462, you may be interested in other courses offered by the Carnegie Mellon Graphics Lab.

Textbook

There is no required textbook for 15-462 this semester.

Assignments & Grading

This semester's offering of 15-462 will include four programming assignments. For detailed information, please visit the projects page.

[Under Construction]

Syllabus

Note: This syllabus may change during the course. Keep checking back.

Name: TBA
Date: Tues 01/13

TA Office Hours

- TAs:
  - Felipe Gomez-Frittelli (fgomezfr@andrew.cmu.edu)
  - Nathan Dobson (ndobson@andrew.cmu.edu)
  - Anna Etzel (aetzel@andrew.cmu.edu)

- Office hours will be announced on Thursday

TEXTBOOK

- Shirley, 3rd Edition (with the red cover)
- OpenGL Red Book
  - http://www.glprogramming.com/red/
- For Thursday:
  - Red Book Chapters 1 and 2

Pre-Requisites

- Talk to us if you're missing these!
  - 15-213/18-213: Introduction to Computer Systems

And either

  - 18-202: Mathematical Foundations of Electrical Engineering

Or both of

  - 21-241: Matrix Algebra (matrix & vector algebra)
  - 21-259: Calculus in Three Dimensions

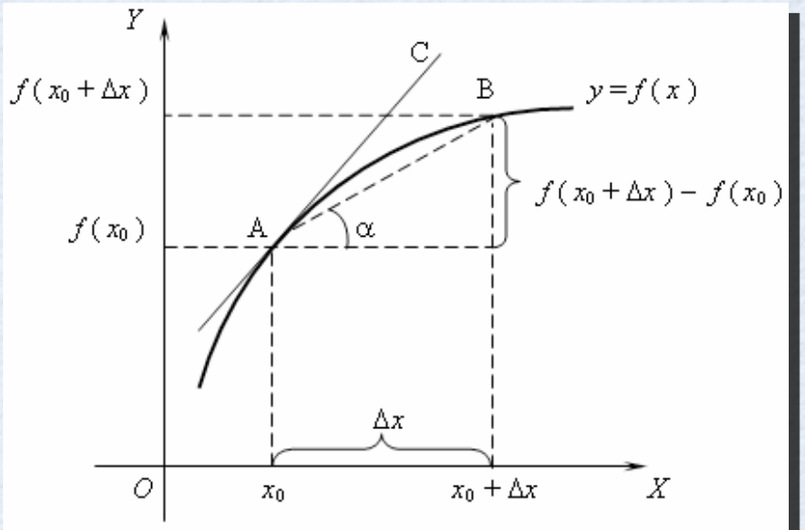


Fig. 1

- Basic 3-D geometry / C++

GRADING

- Project 1 (10%)
- Project 2 (15%)
- Project 3 (15%)
- Project 4 (15%)
- Project 5 (15%)

- Midterm (15%)
- Final Exam (15%)

Late Policy

- 3 late days for projects.
- No further extensions without explicit permission 2 days before deadline.

Cheating – Zero Tolerance

- Please don't cheat! Using code from the web is ok as long as it is a SMALL percentage of the code for written the assignment and you acknowledge your sources.
- Do projects and homeworks individually.

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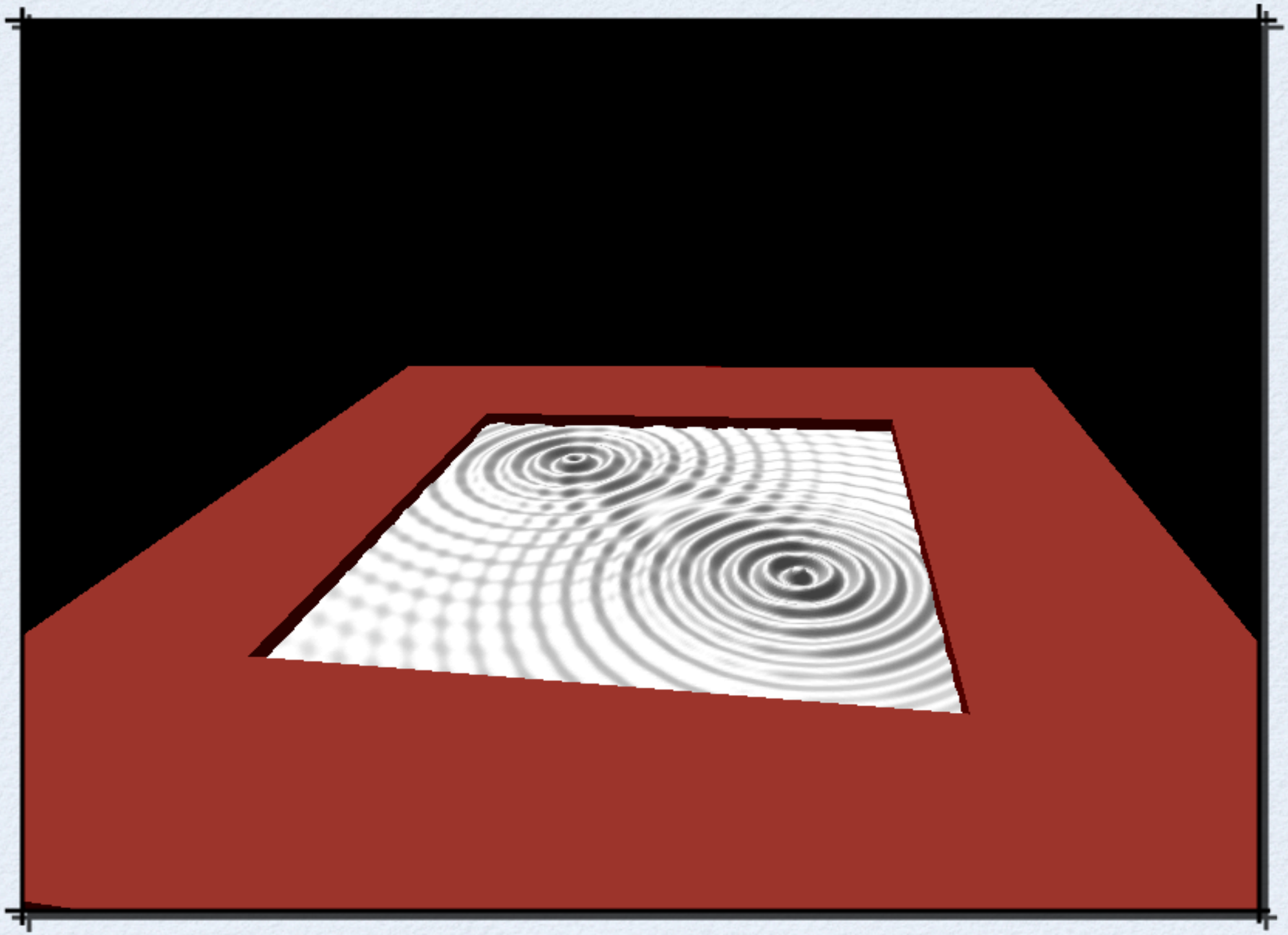
Syllabus and Schedule

http://www.cs.cmu.edu/~15462/

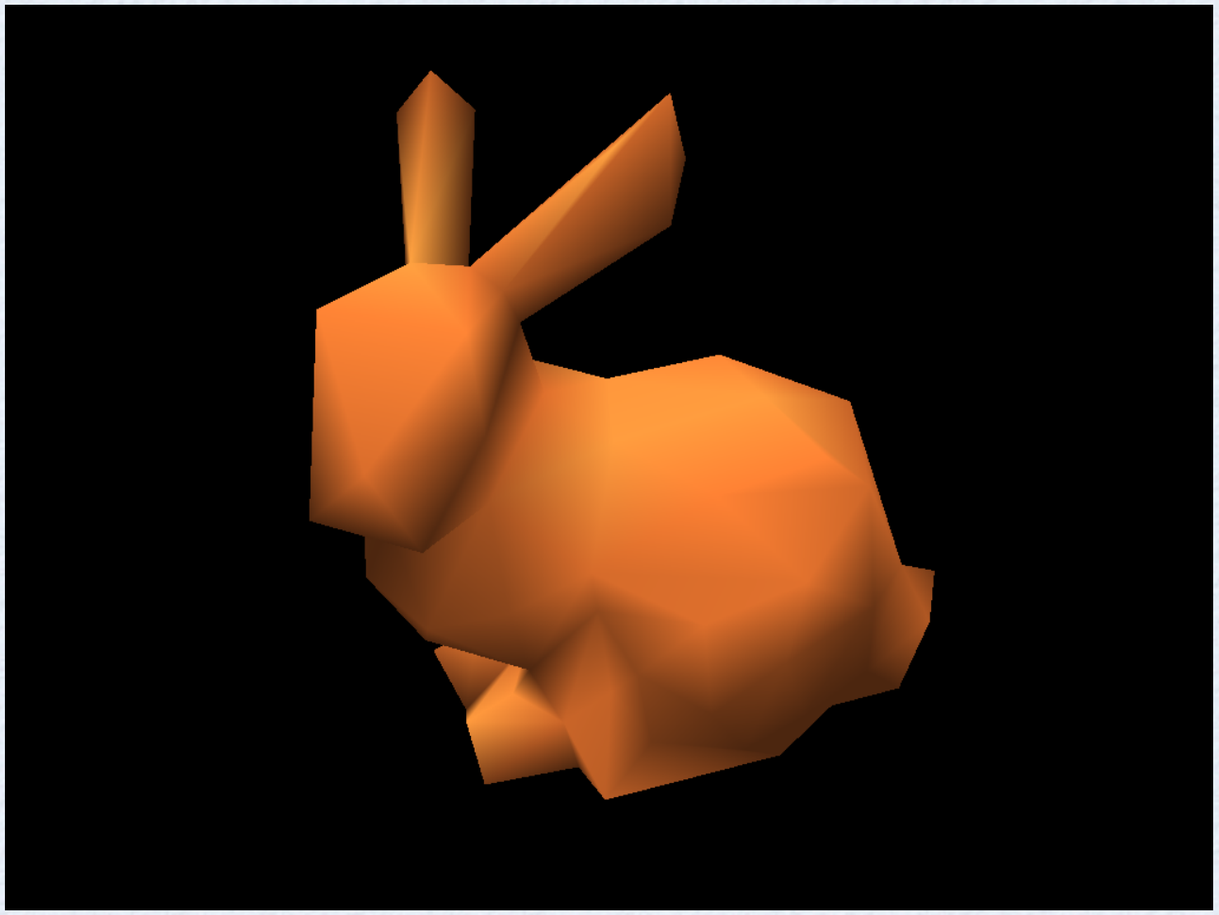
Projects

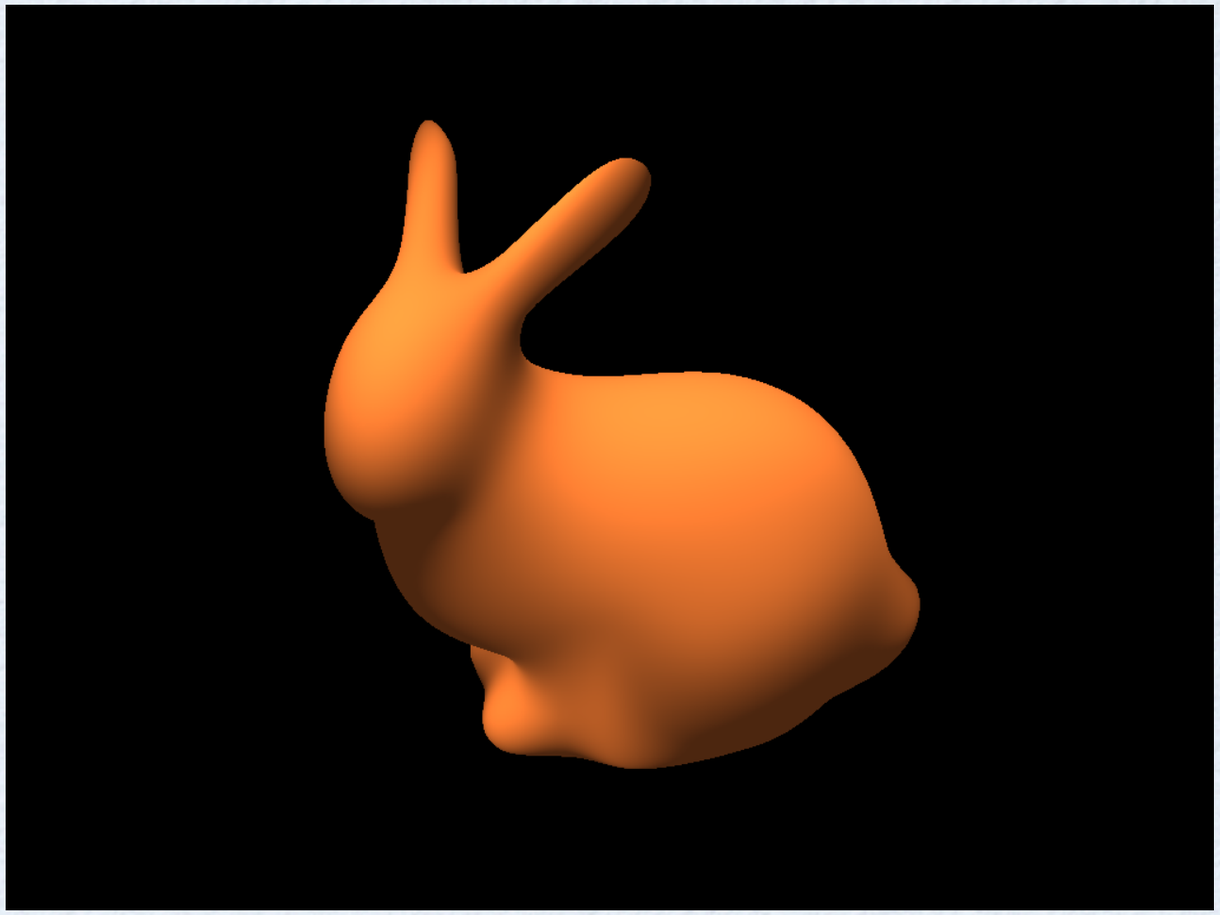
- Five Projects:
  - Starter project - OpenGL
  - Geometry and Meshes
  - Ray Tracing
  - Global Illumination
  - Physics Engine

Project 1: Basics of OpenGL

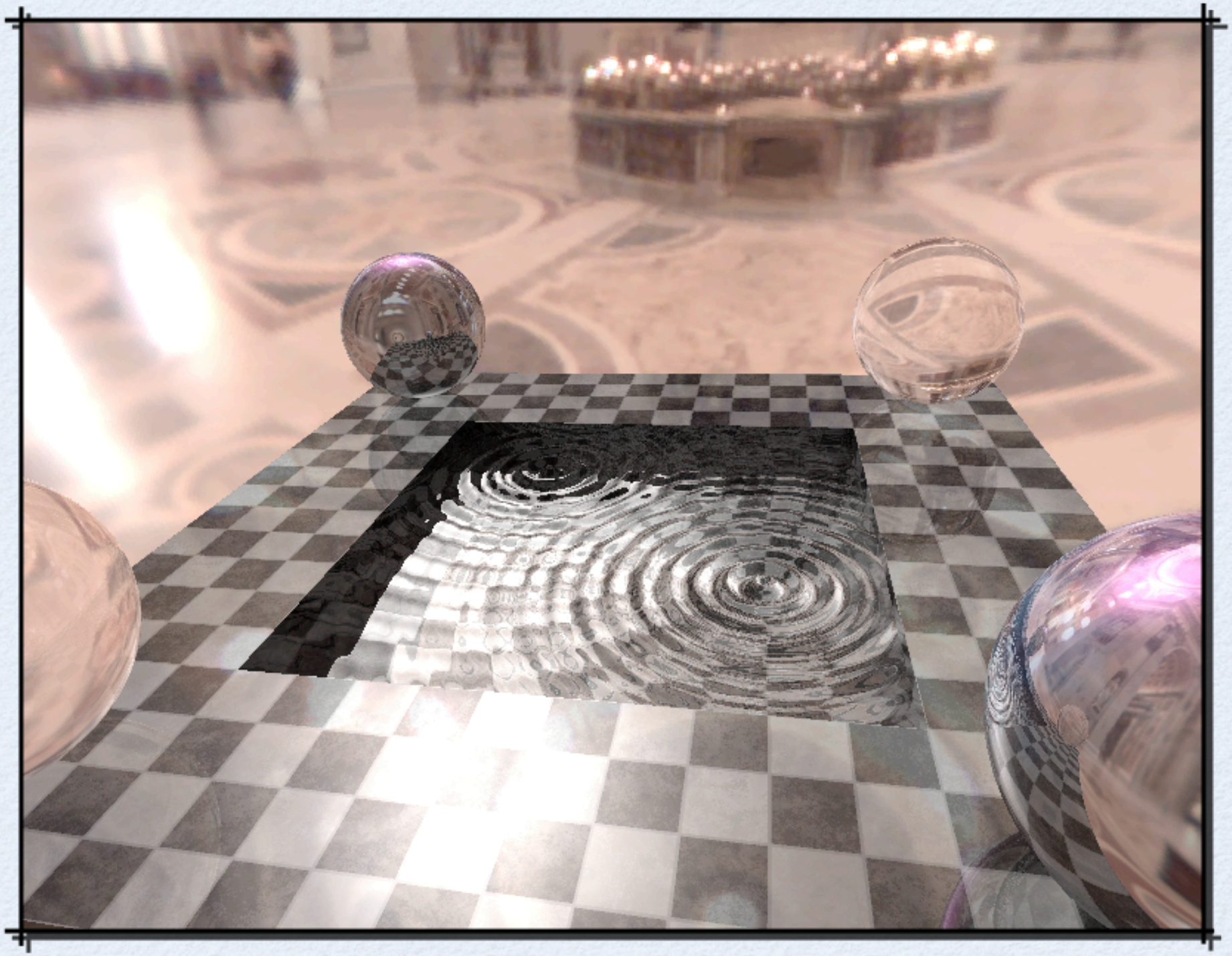


Project 2: Geometry and Meshes and Shaders





PROJECT 3: RAY TRACING



Project 4: Global Illumination

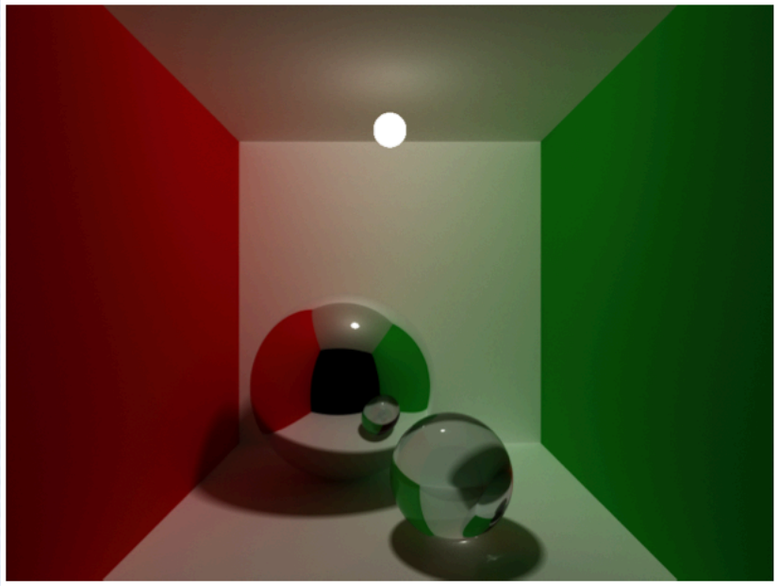


Figure 3: Cornell Box scene

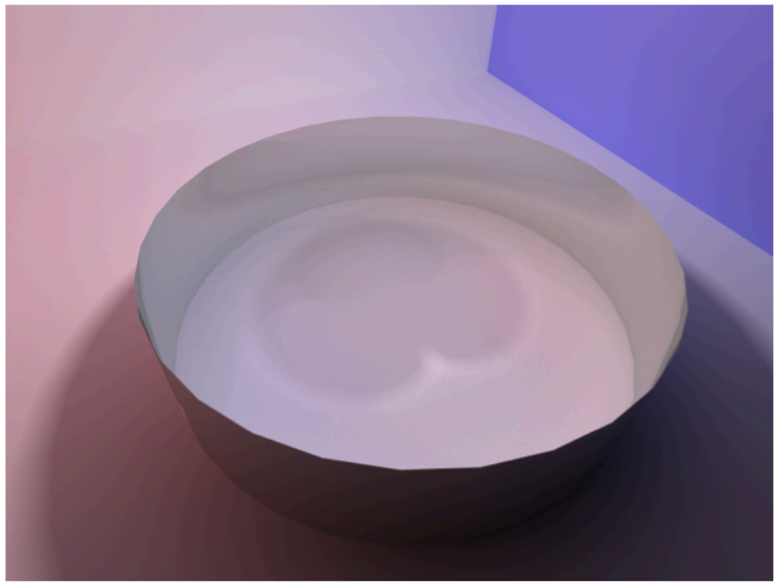


Figure 4: Ring scene

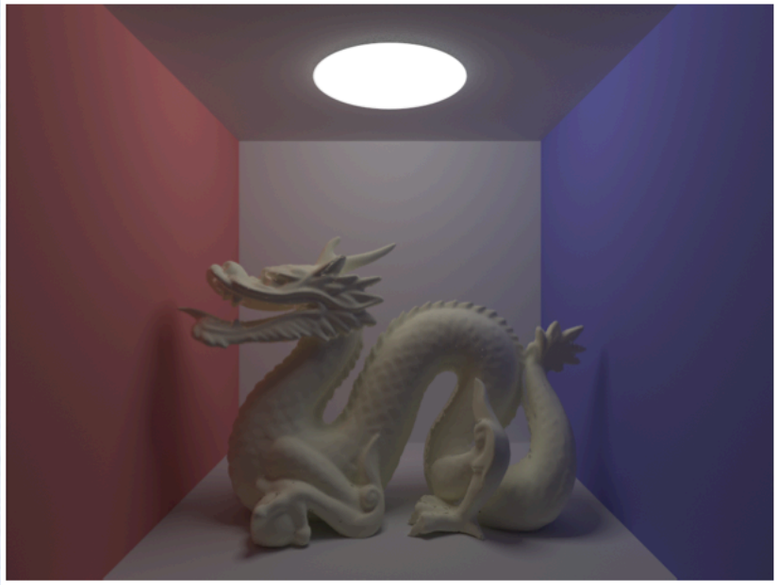


Figure 5: Dragon scene

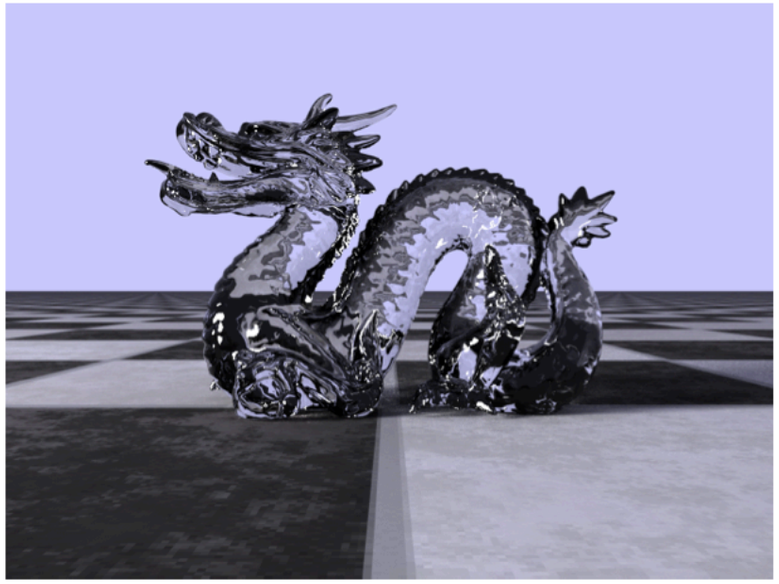
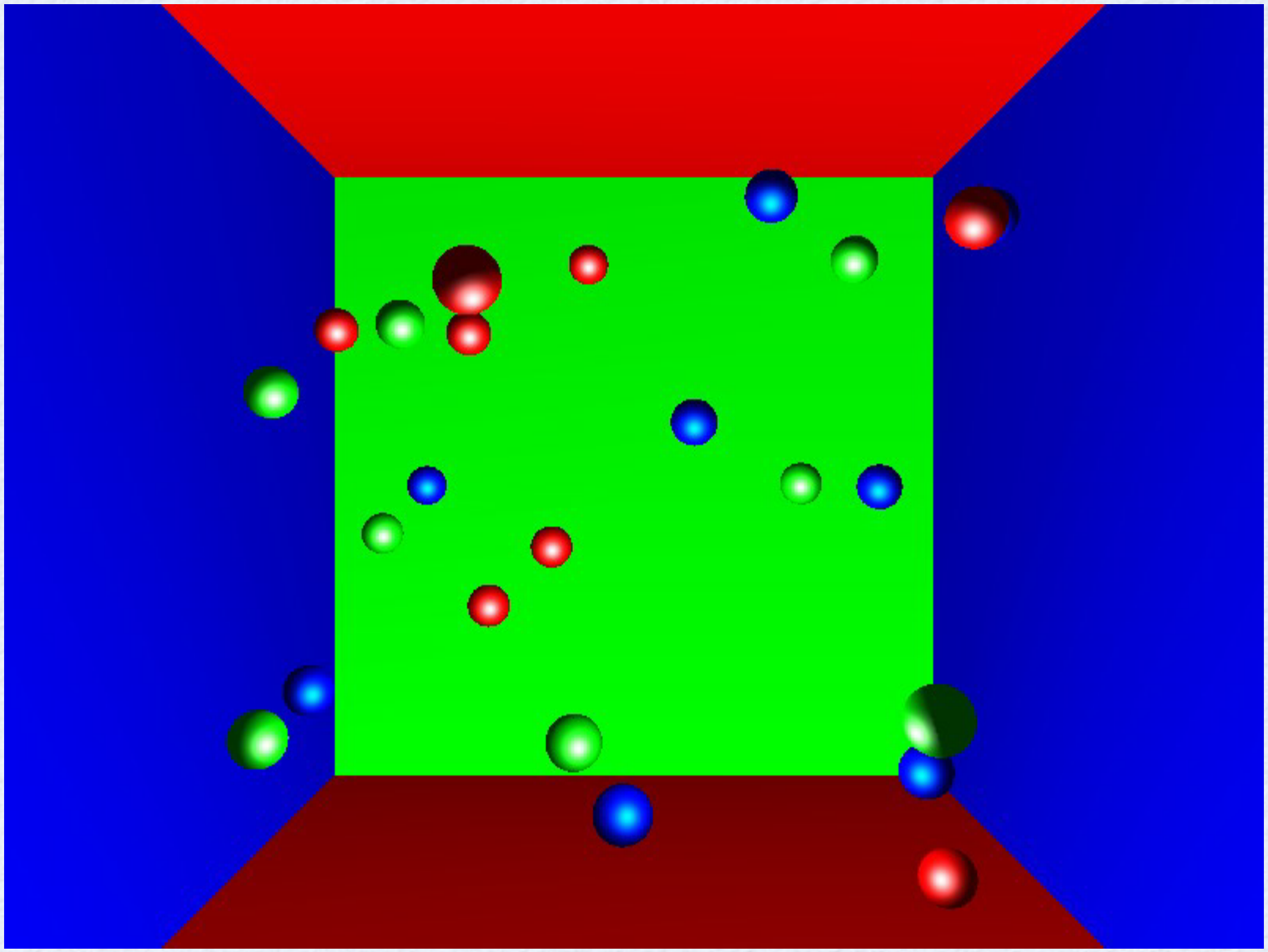


Figure 6: Glass dragon

Project 5: Physics Engine



Next Lecture

- Basics of OpenGL
- How to access CMU machines and start programming
- Project 1 assigned

LET'S HAVE FUN