

CS4620/5620

Introduction to Computer Graphics

Professor: Kavita Bala

Computer graphics

The study of
creating,
manipulating, and
using visual images
in the computer

Or, to paraphrase Ken Perlin...

Computer graphics: What you need to show other people your dreams.

Graphics Applications

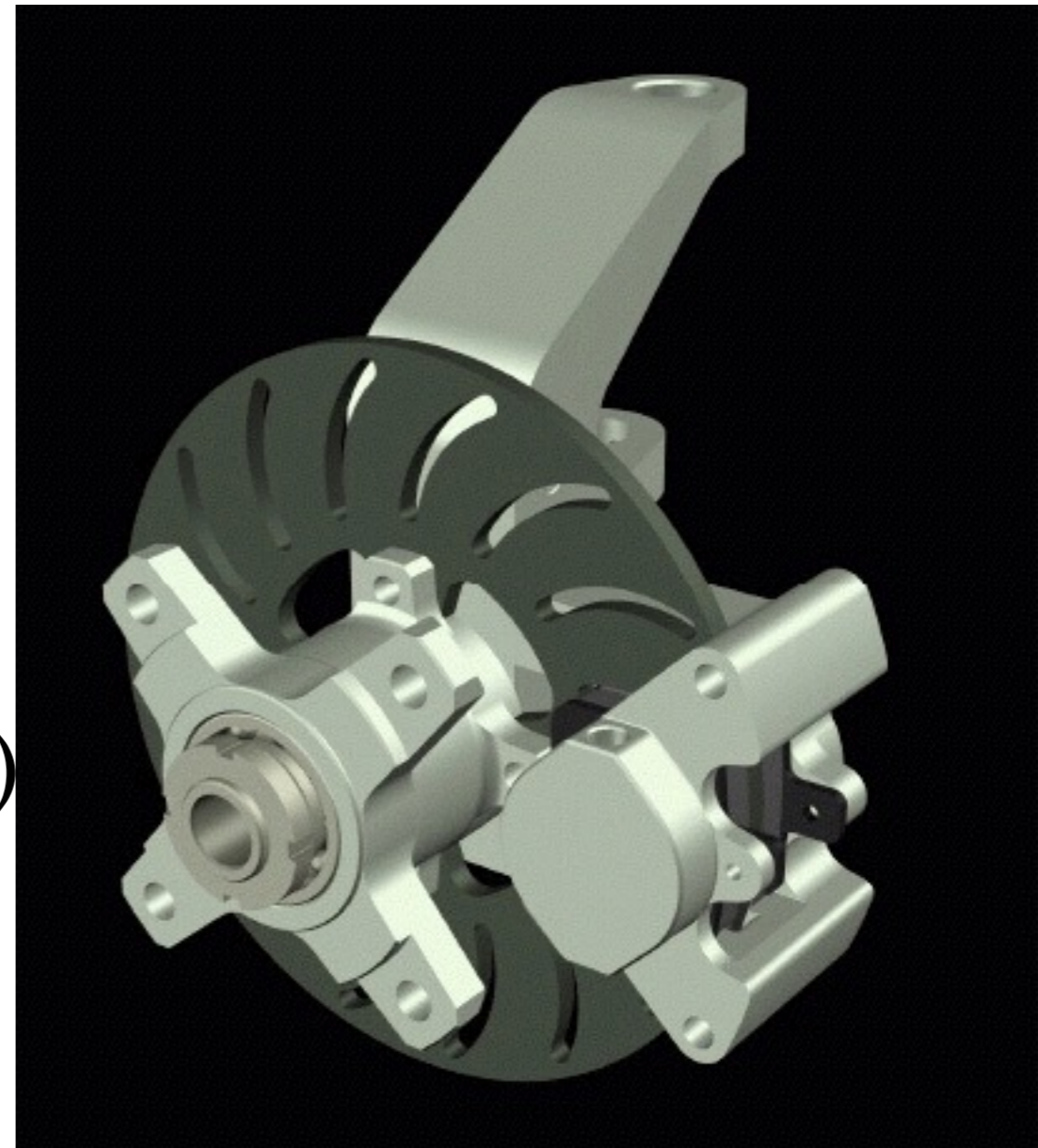
- Entertainment
 - film production
 - film effects
 - games
- Science and engineering
 - computer-aided design
 - visualization (scientific, information)
- Virtual Prototyping
- Cultural Heritage
- Training & Simulation
- Graphic Arts, Fine Art

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Graphics Applications

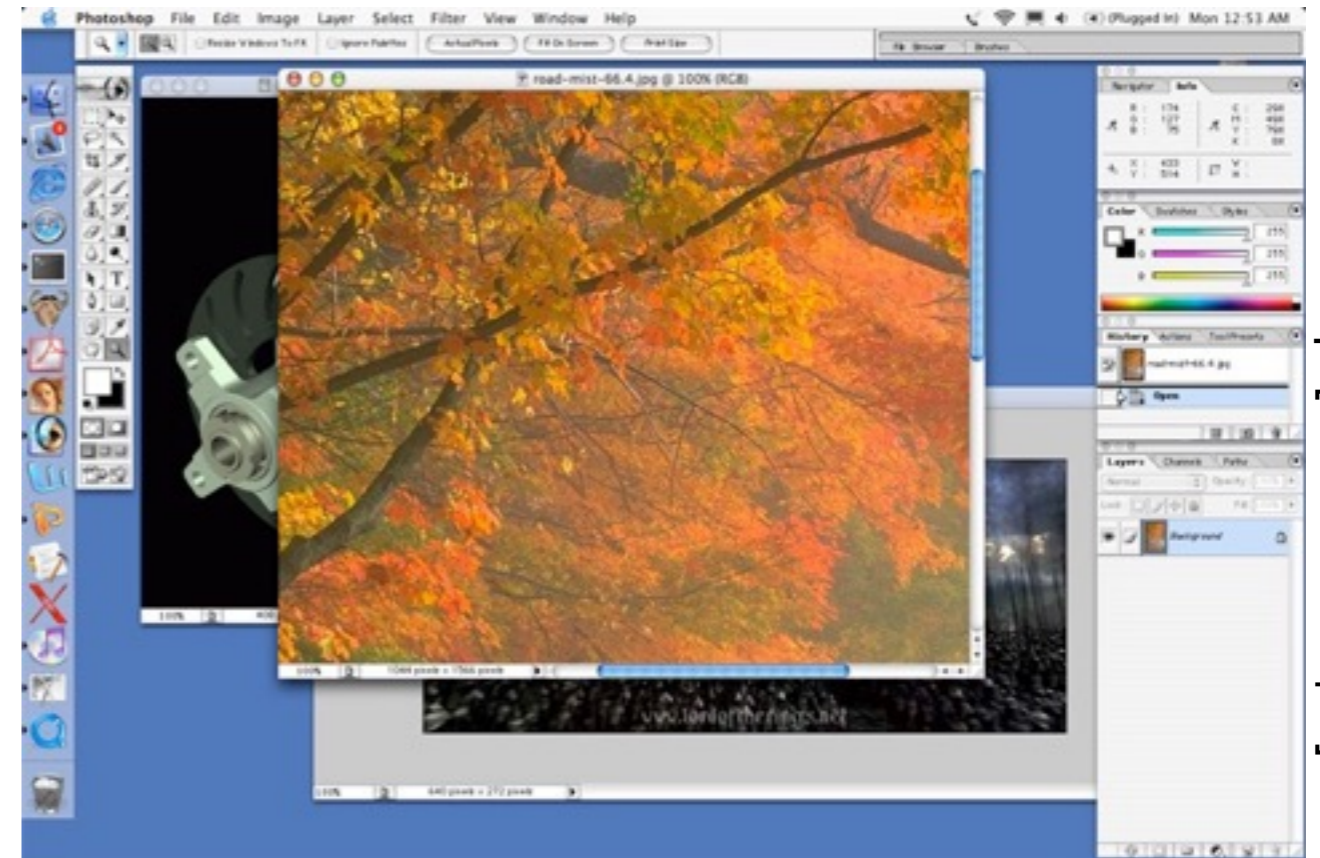
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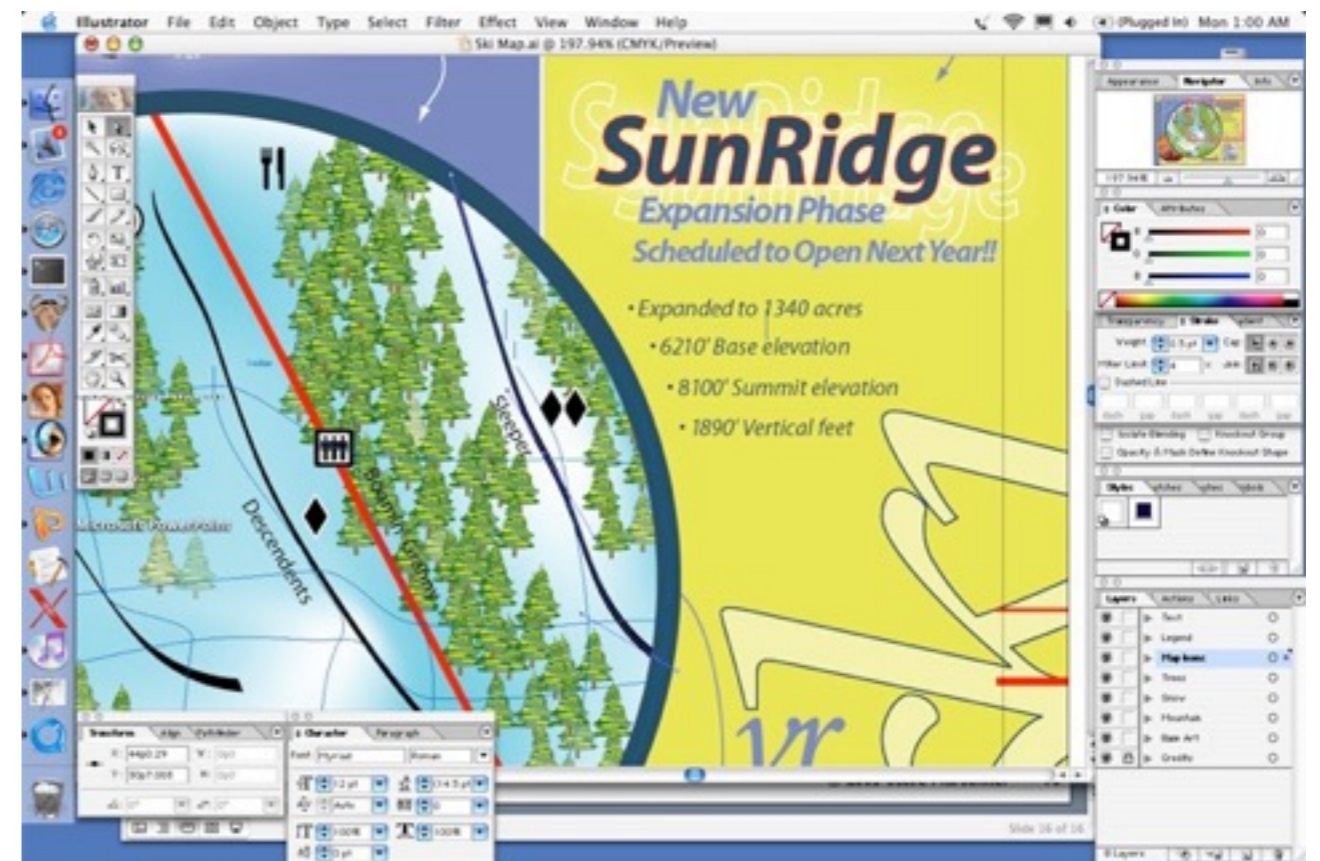
U. of Utah—Alpha I

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 - scientific visualization
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- **Graphic Arts, Fine Arts**



Adobe Photoshop [Photo: P. Greenspun]

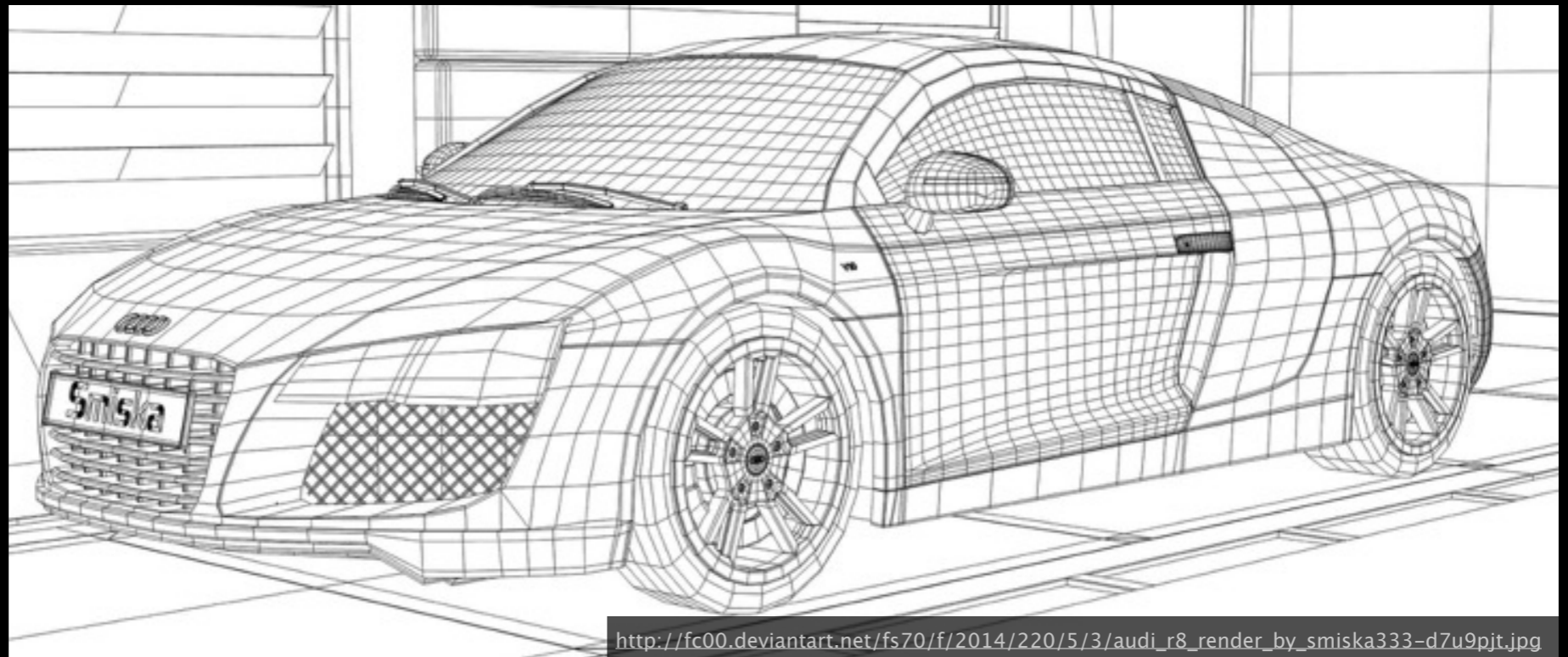


Adobe Illustrator

What is graphics about?

What is the CG problem?

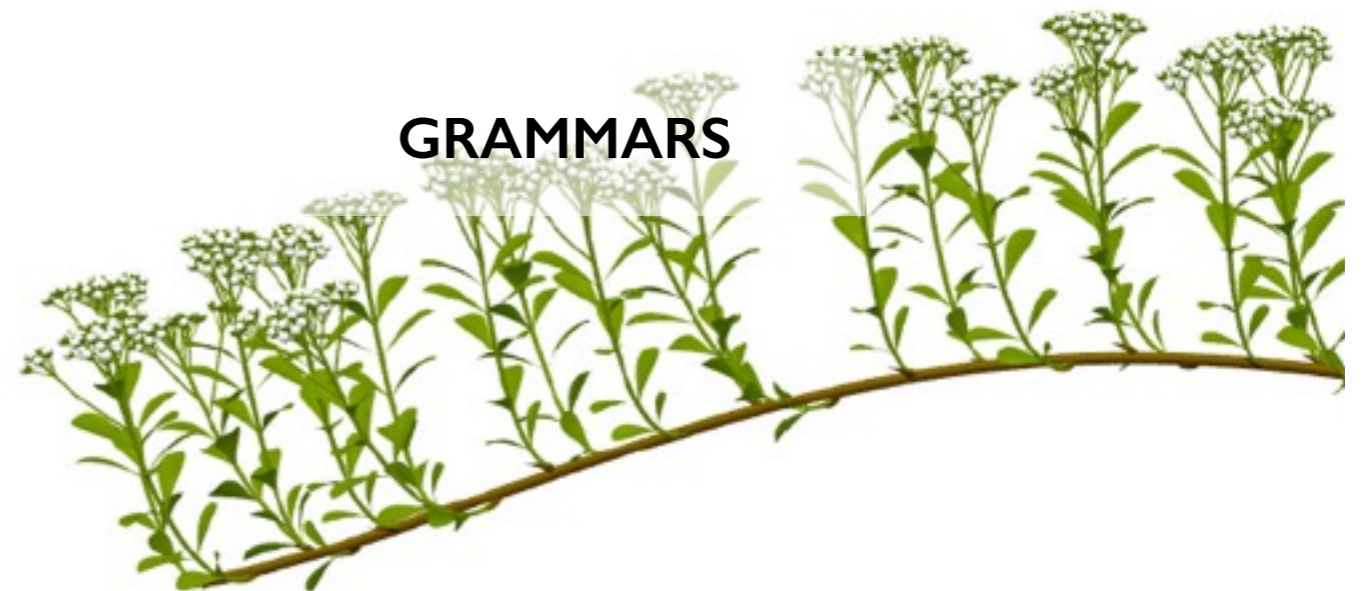
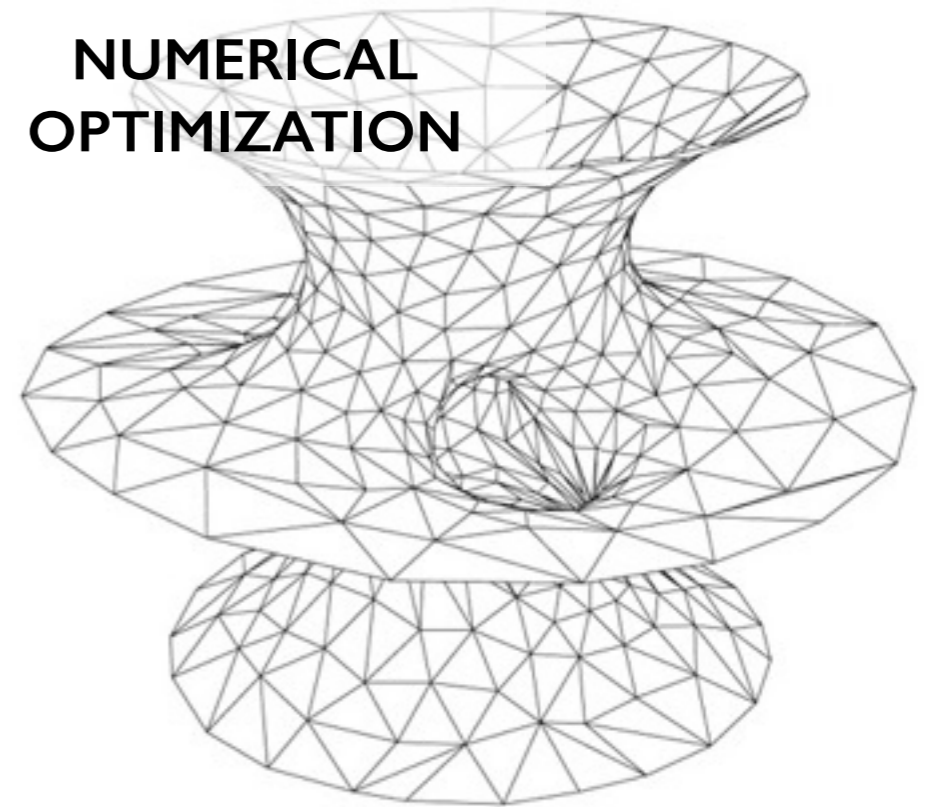
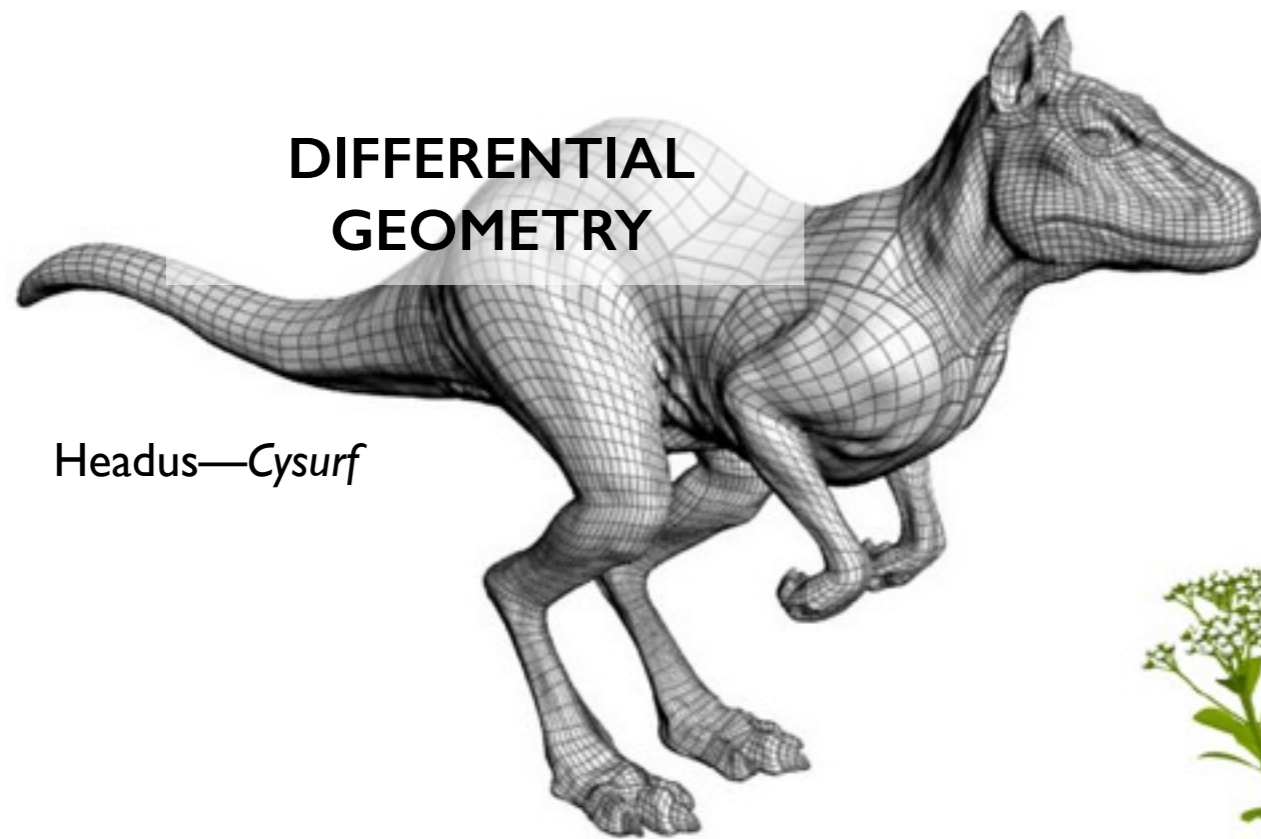
Shape



http://fc00.deviantart.net/fs70/f/2014/220/5/3/audi_r8_render_by_smiska333-d7u9pjt.jpg

3D Modeling

- representing 3D shapes
- polygons, curved surfaces, ...
- procedural modeling



[Hoppe et al. 1993]

[Prusinkiewicz et al. 2001]

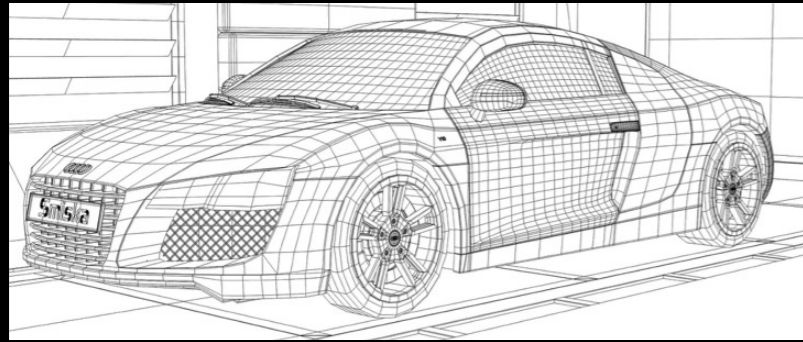
Material



Light

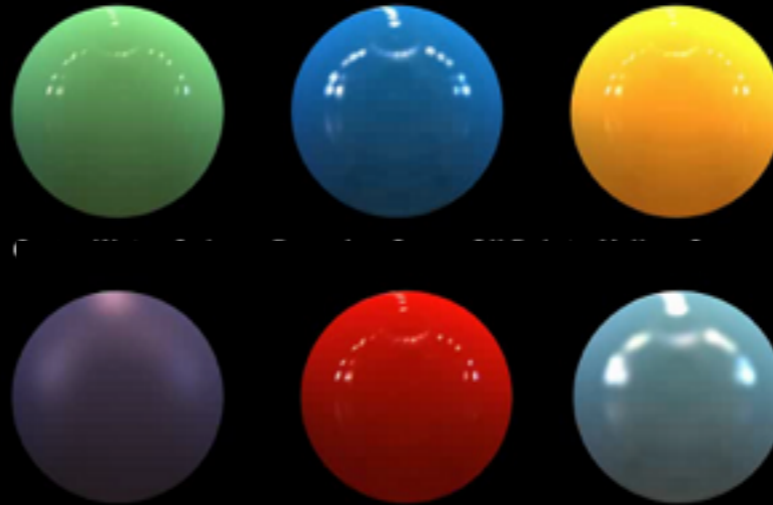


Computer Graphics



shape

+

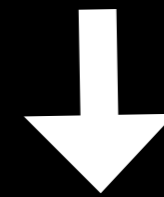


material

+



light



Virtual?
Real?

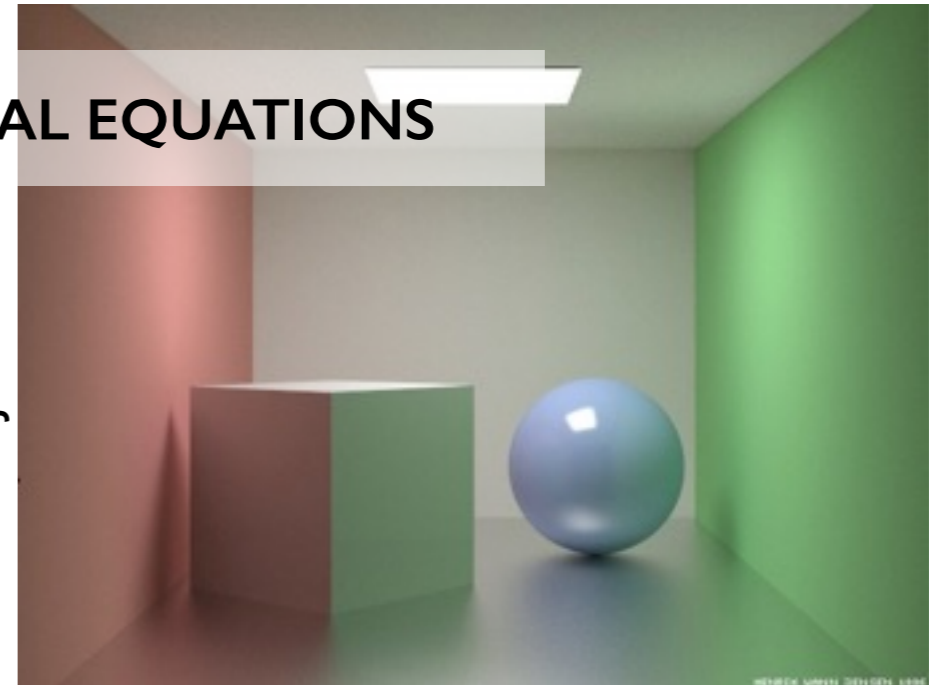


3D Rendering

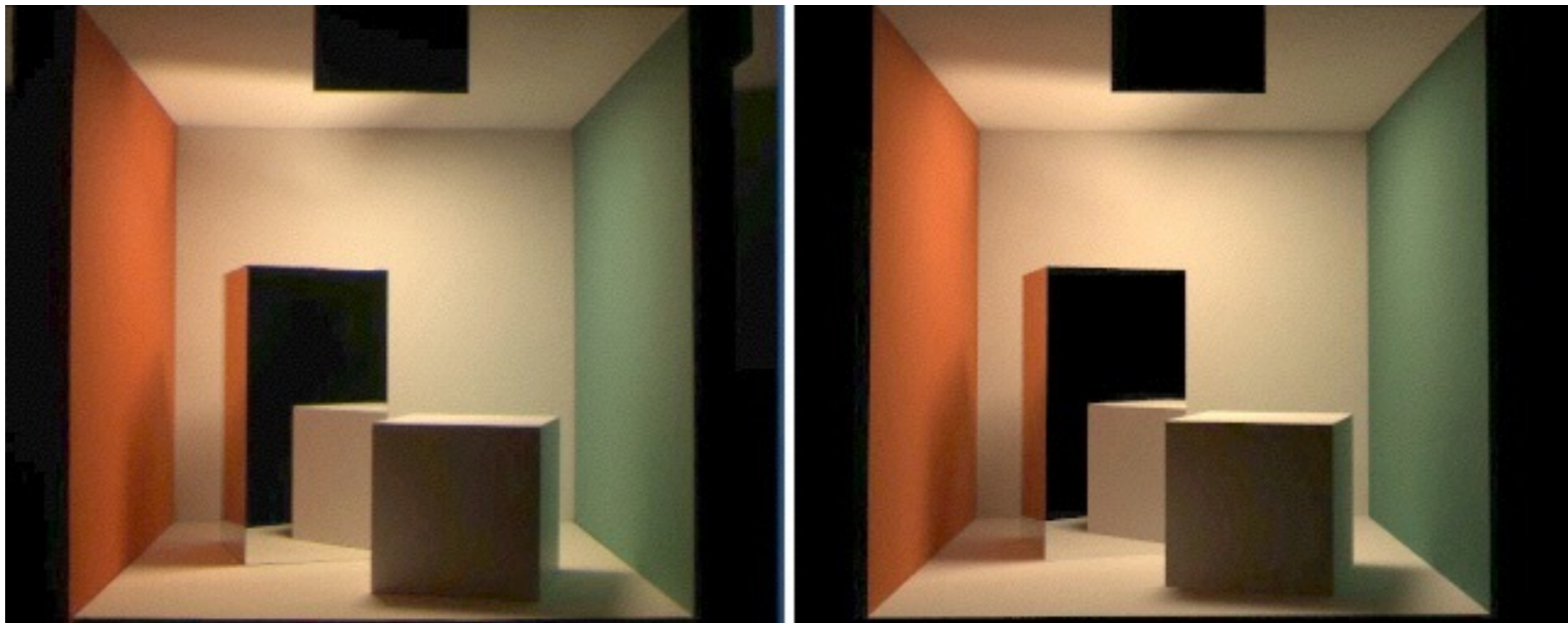
- 2D views of 3D geometry
- projection and perspective
- removing hidden surfaces
- lighting simulation

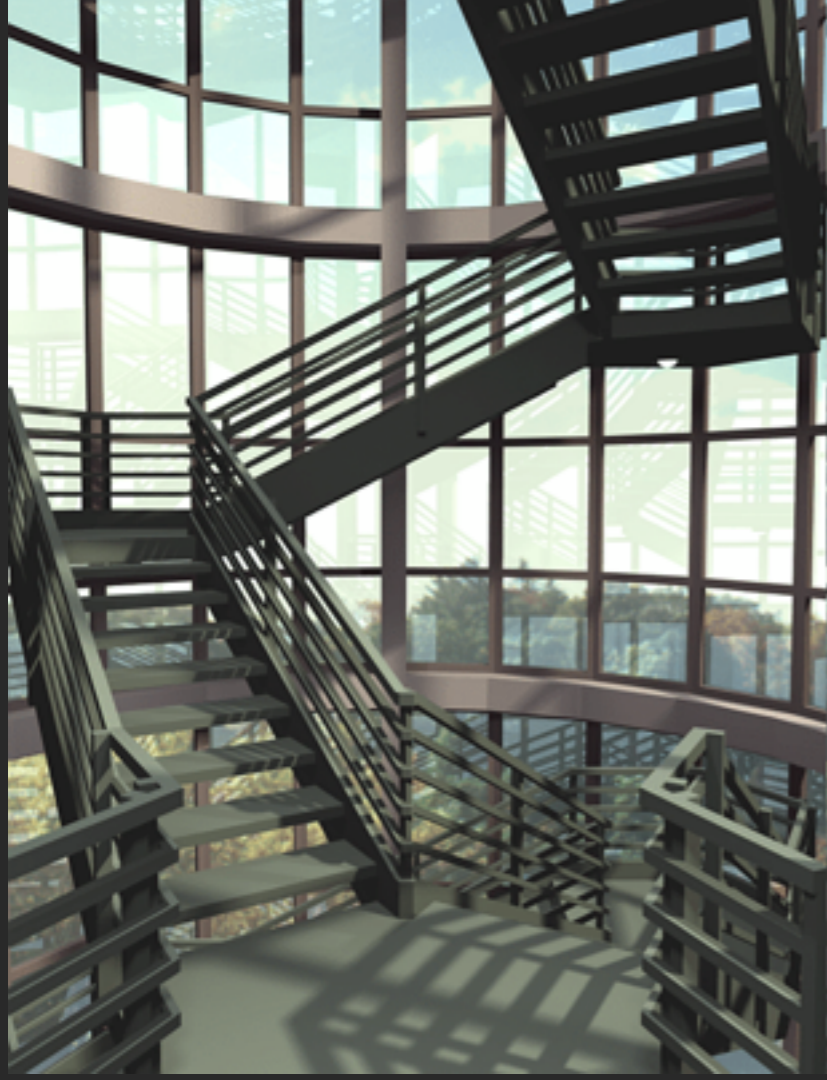
INTEGRAL EQUATIONS

Henrik Wann Jensen



Cornell PCG





Kavita Bala, Bruce Wlaler

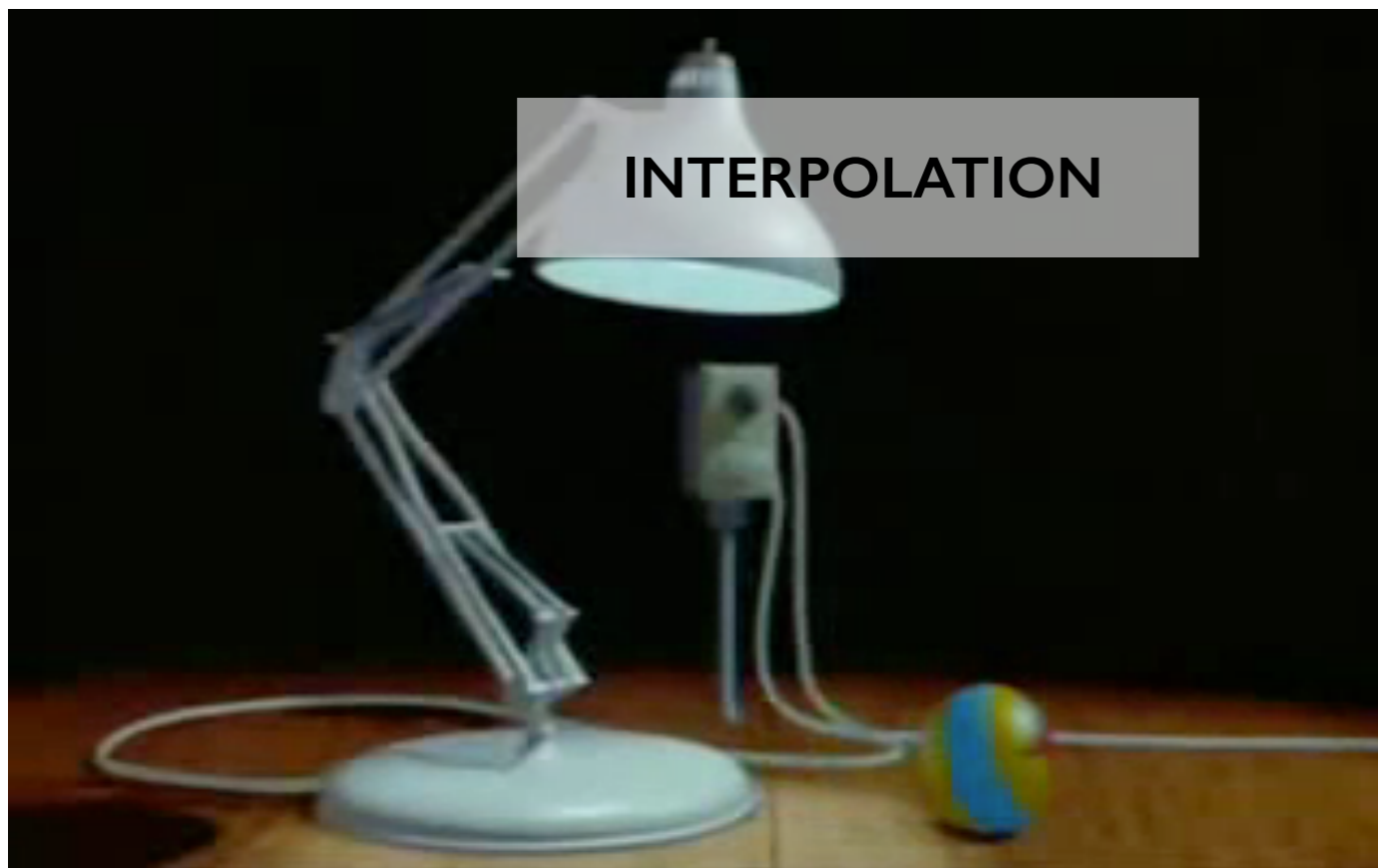


Animation

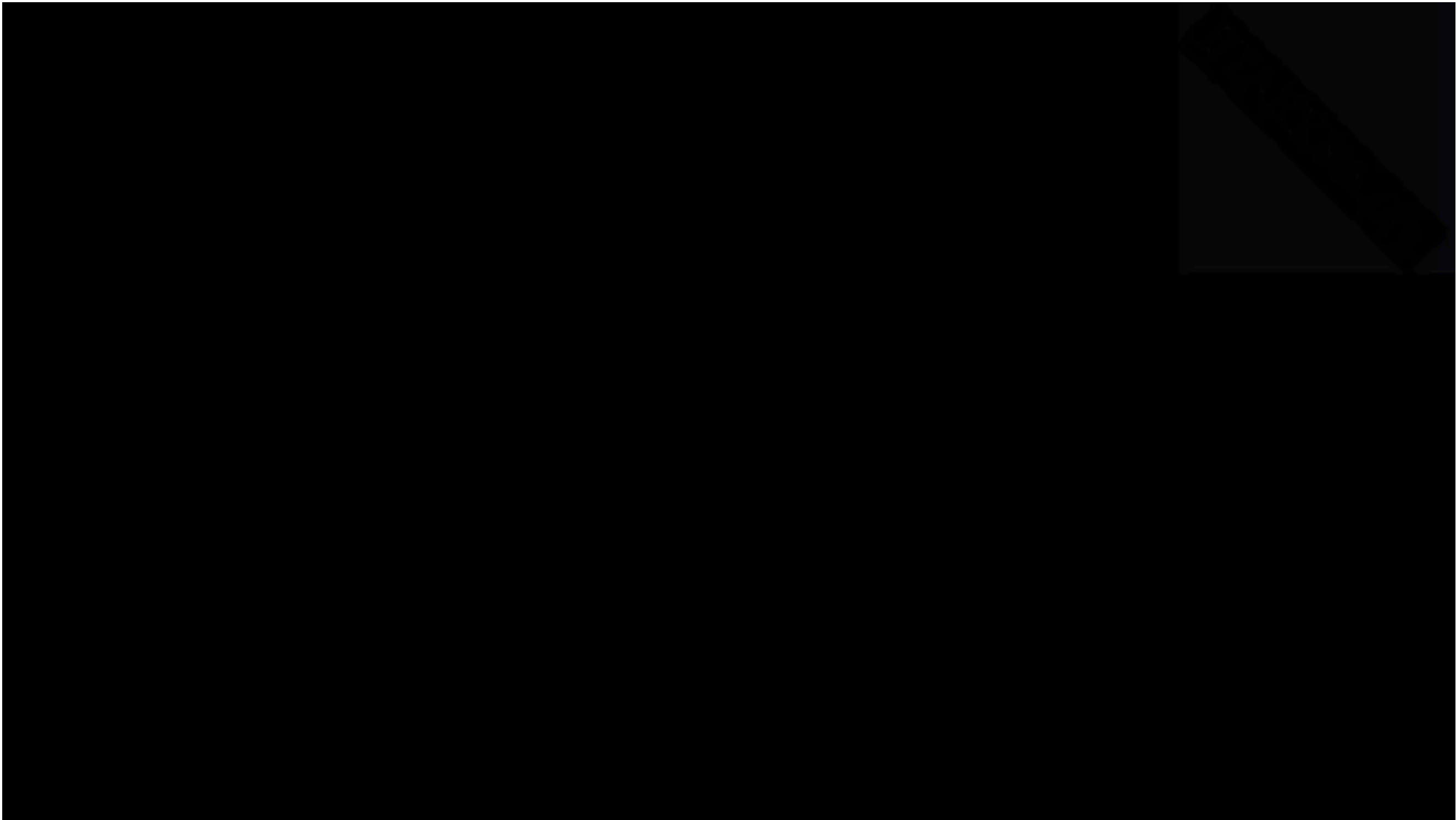
- keyframe animation
- physical simulation



Avengers (2012)

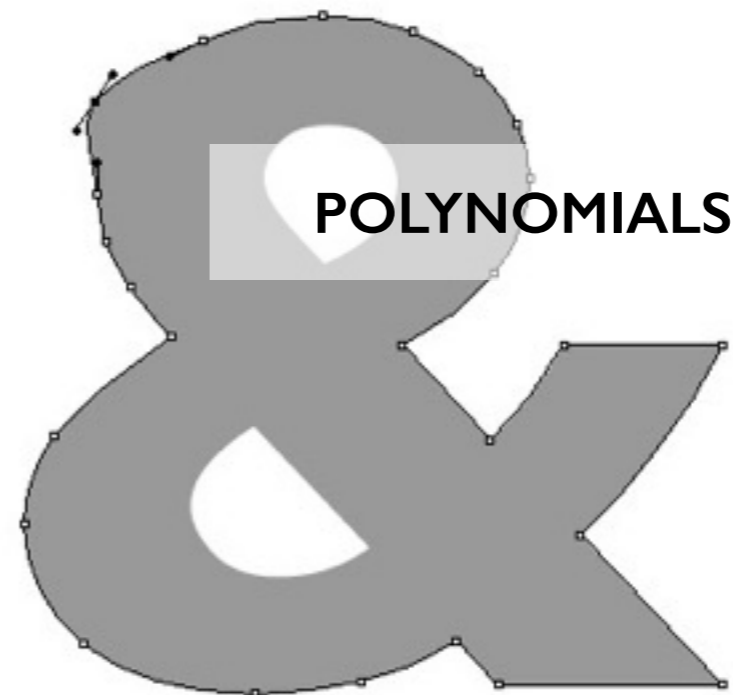
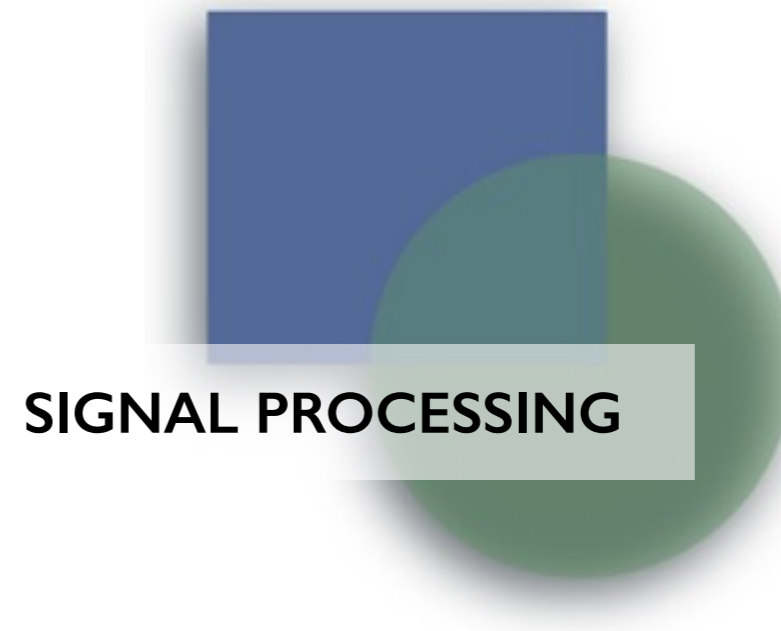


Pixar



Images

- 2D imaging
 - compositing and layering
 - digital filtering
 - color transformations
- 2D drawing
 - illustration, drafting
 - text, GUIs

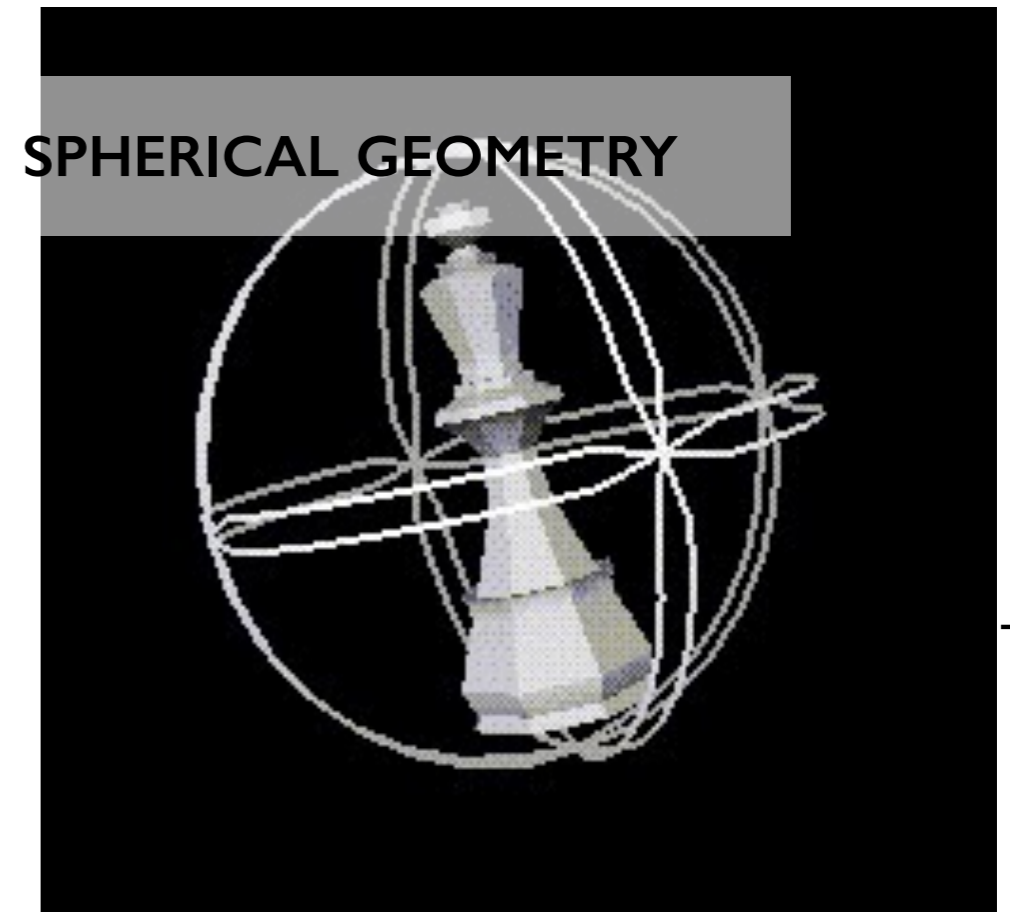


User Interaction

- 2D graphical user interfaces
- 3D modeling interfaces
- virtual reality, augmented reality



TU Berlin



SGI—OpenInventor

Computer graphics: Mathematics made visible.

Introductions...

Course Overview

Course mechanics

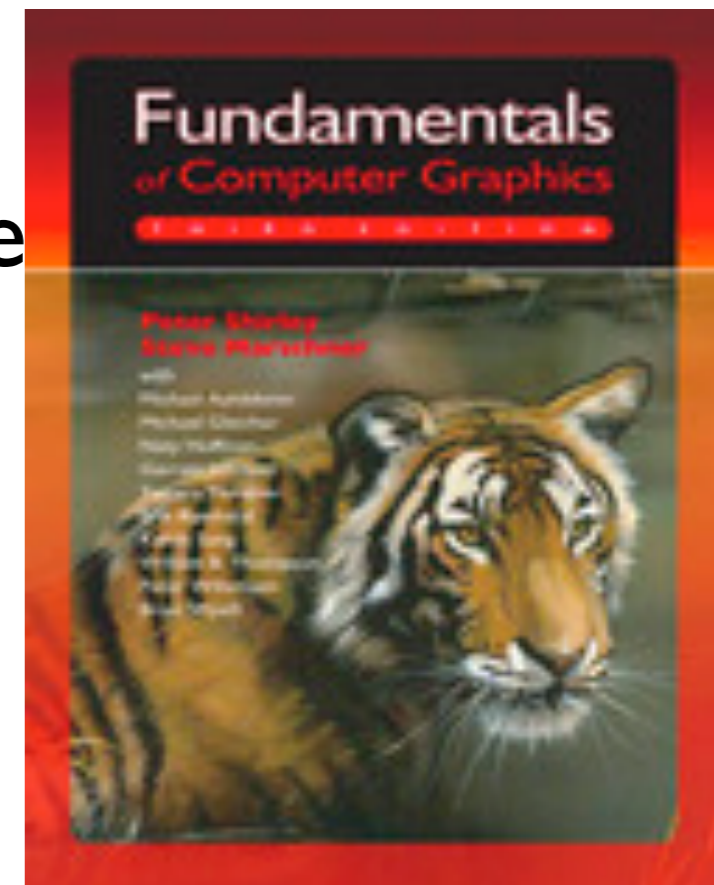
Web <http://www.cs.cornell.edu/Courses/cs4620>

Teaching Assistants (7 PhD/MS/MEng, ≥ 6 ugrad)

Eston Schweickart, Nicolas Savva,
Brandon Benton, Bryce Evans, Eric Gao, Fujun Luan,
Zegiang Zhao

Jimmy Briggs, Kristen Crasto,
Kyle Genova, Tongcheng Li, Andrew Mullen
Kate Salesin, Ning Wang, Kelly Yu
Cristian Zaloz, software architect

Piazza: Please sign up!



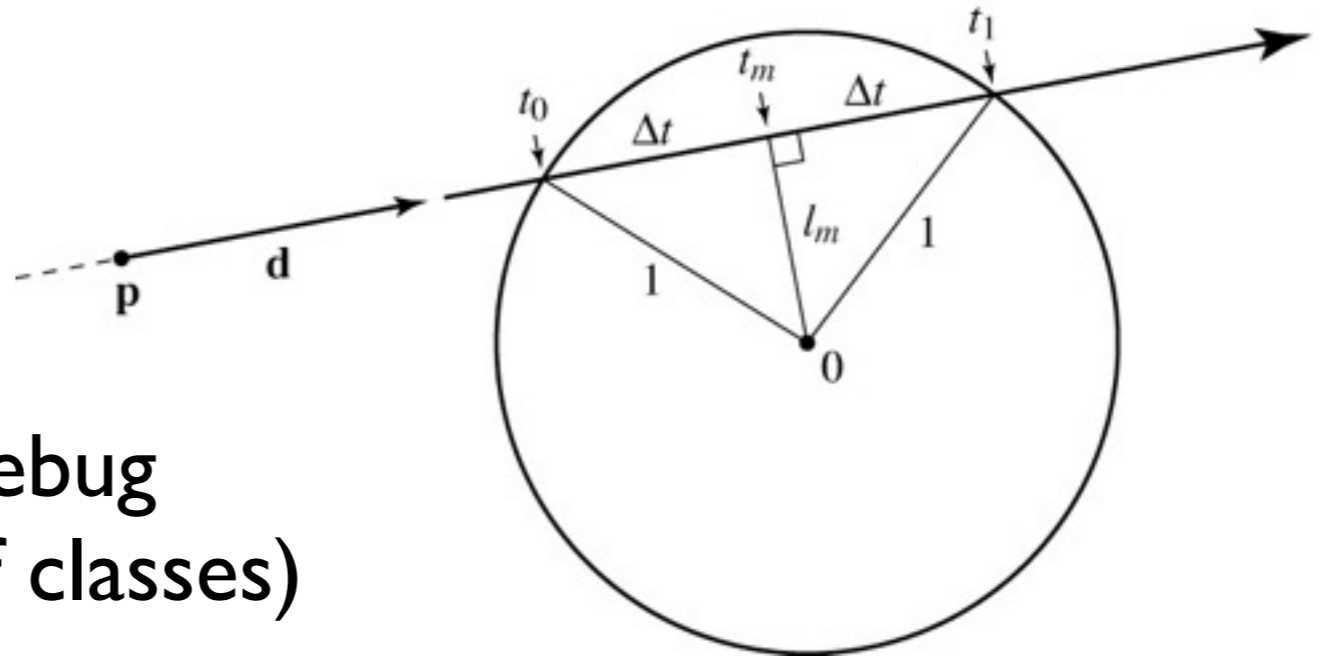
In CS4620/5620

- You will:
 - explore fundamental ideas
 - learn math essential to graphics
 - implement key algorithms
 - write cool programs
 - learn the basics of OpenGL
- You will not:
 - write very big programs

Topics

- Modeling in 2D and 3D
- Geometric transformations
- The graphics pipeline
- Rendering 3D scenes
(using ray tracing and using the GPU)
- Animation
- Images, image processing, color science

CS4620 Prerequisites



- Programming

- ability to read, write, and debug small Java programs (10s of classes)
- understanding of very basic data structures
- no serious software design required

- Mathematics

- vector geometry (dot/cross products, etc.)
- linear algebra (just basic matrices in 2-4D)
- basic calculus (simple derivatives)
- graphics is a good place to pick up some, but not all, of this

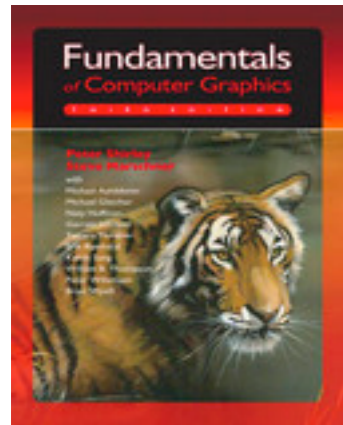
In CS462 I

- You will also:
 - implement a modeling, rendering, animation system
 - in groups
 - learn a lot about
 - architecting good-sized interactive programs
 - OpenGL
 - programmable shaders, textures, animation

Workload

- CS 4620/5620
 - 7 assignments (written + programming)
 - 1 free late assignment (up to 1 week), else 10% per day
 - 2 exams (midterm + final)
 - Written (individual), programming (pairs)
- CS 4621/5621
 - Classes on Fridays
 - First class this friday. No class for 2 fridays after.
 - 4 small assignments
 - one open-ended project
 - In pairs

Textbook

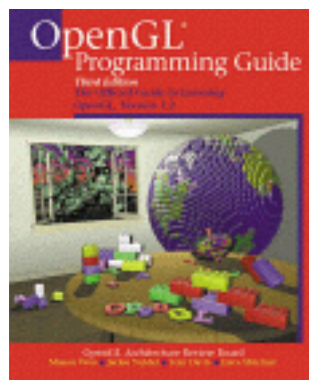


Shirley & Marschner **Fundamentals of Computer Graphics** third edition

More books



Steven Gortler
Foundations of Computer Graphics
first edition

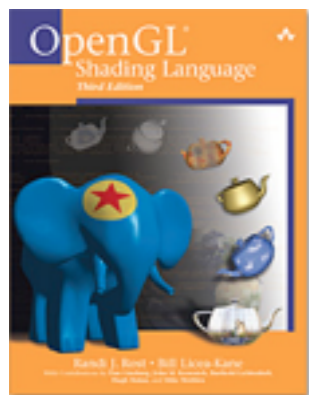


OpenGL Programming Guide

(a.k.a. the "Red Book")

Older version available online:

http://www.opengl.org/documentation/red_book/



GLSL Shading Language

(a.k.a. the "Orange Book")

Academic Integrity

- Written homework
 - On your own
 - Programming
 - With partner
-
- We will test and follow up

Course mechanics

Web <http://www.cs.cornell.edu/Courses/cs4620>

Schedule, handouts, etc. all on the web page

Practicum (4621)

- See schedule on website
- Mixer this Friday
- First planned meeting on website