

CS4620: Introduction to Computer Graphics

Professor: Steve Marschner

Introduction

Computer graphics: The study of creating, manipulating, and using visual images in the computer.

Graphics Applications

- Entertainment
 - film production
 - film effects
 - games
- Science and engineering
 - computer-aided design
 - scientific visualization
- Training & Simulation
- Graphic Arts
- Fine Art



Pixar—Toy Story



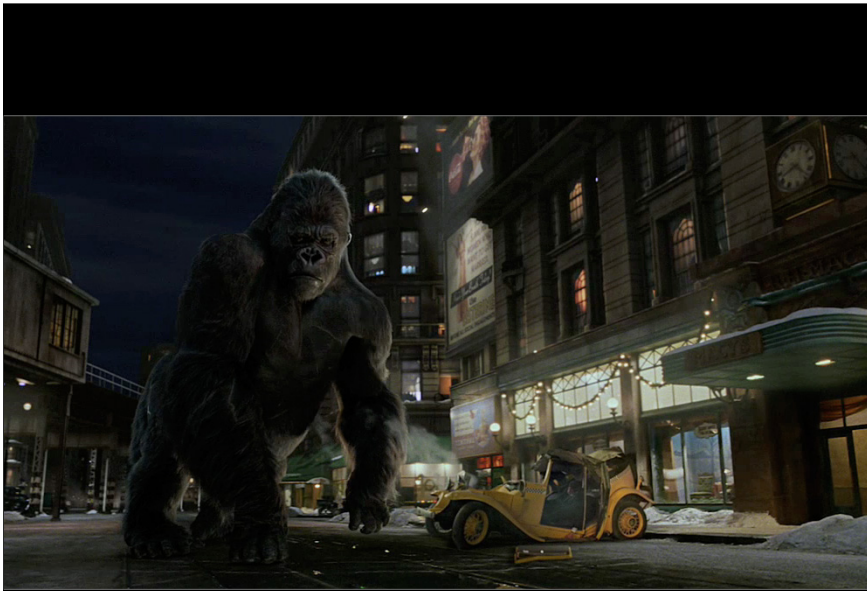
Pixar—Ratatouille (2007)



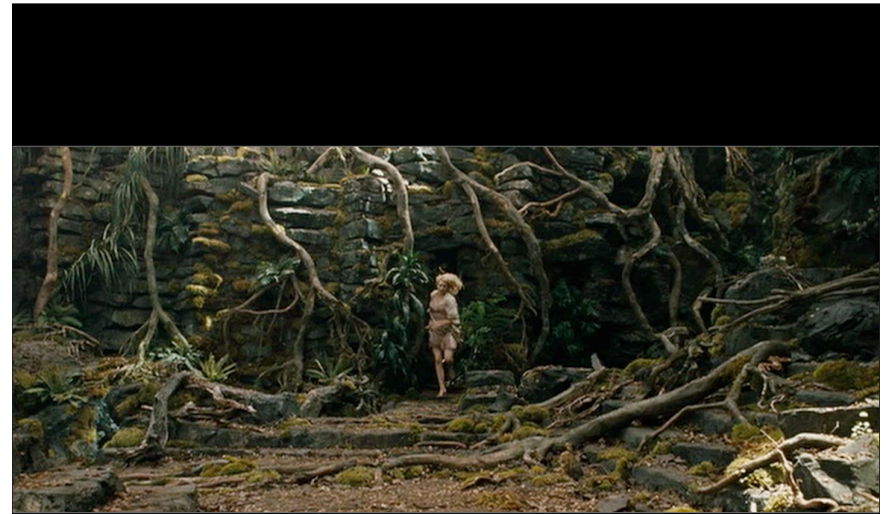
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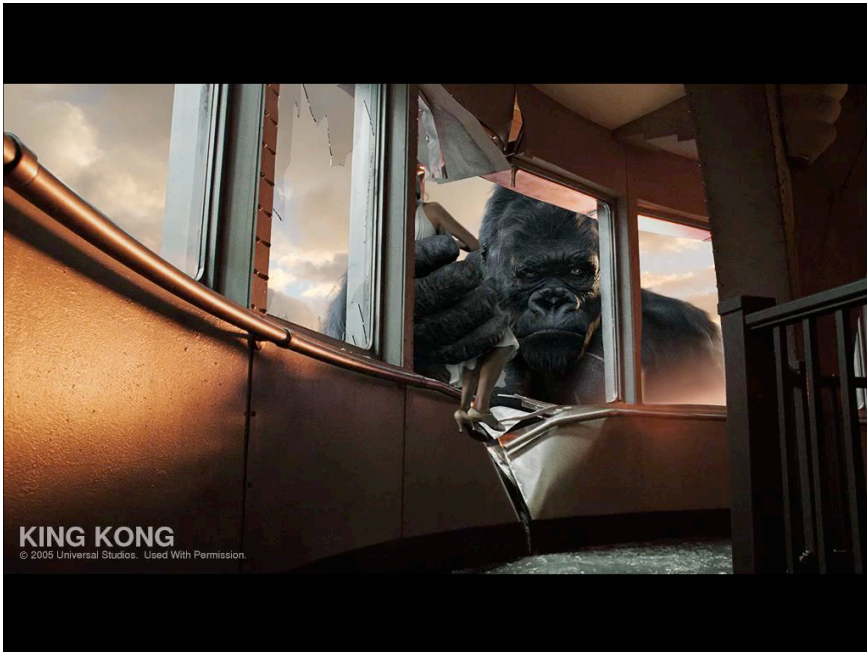
Pixar—Ratatouille (2007)



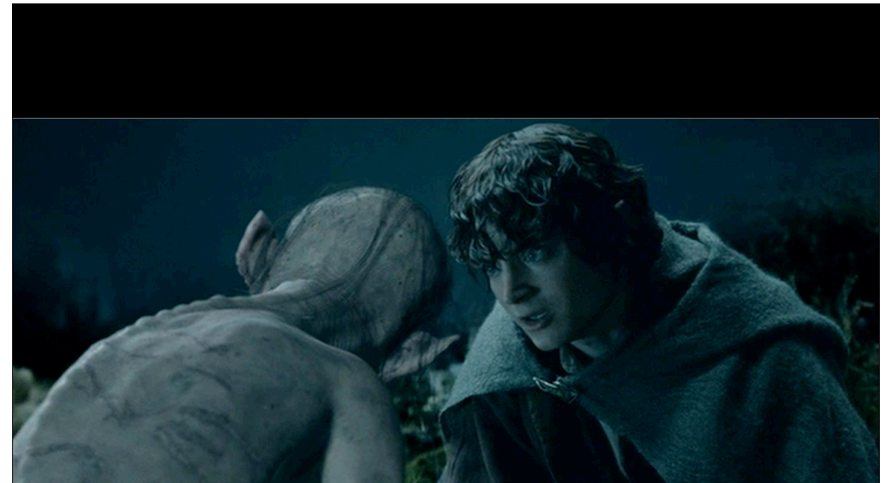
King Kong (Universal Pictures, 2005)—visual effects:WETA Digital



King Kong (Universal Pictures, 2005)—visual effects:WETA Digital



KING KONG
© 2005 Universal Studios. Used With Permission.



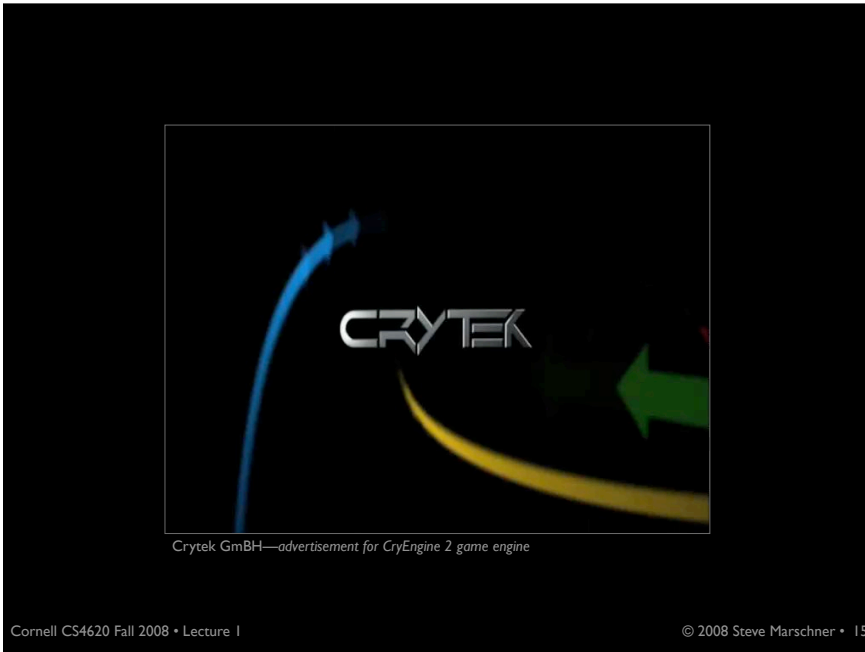
The Two Towers (New Line Cinema, 2002)—visual effects:WETA Digital



id Software—*Quake 4* (screenshot: Planet Quake)



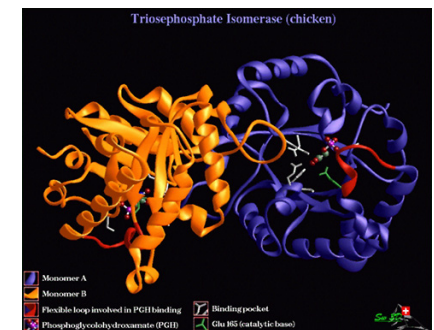
Electronic Arts—*NBA Live 07* (screenshot: gamespy.com)



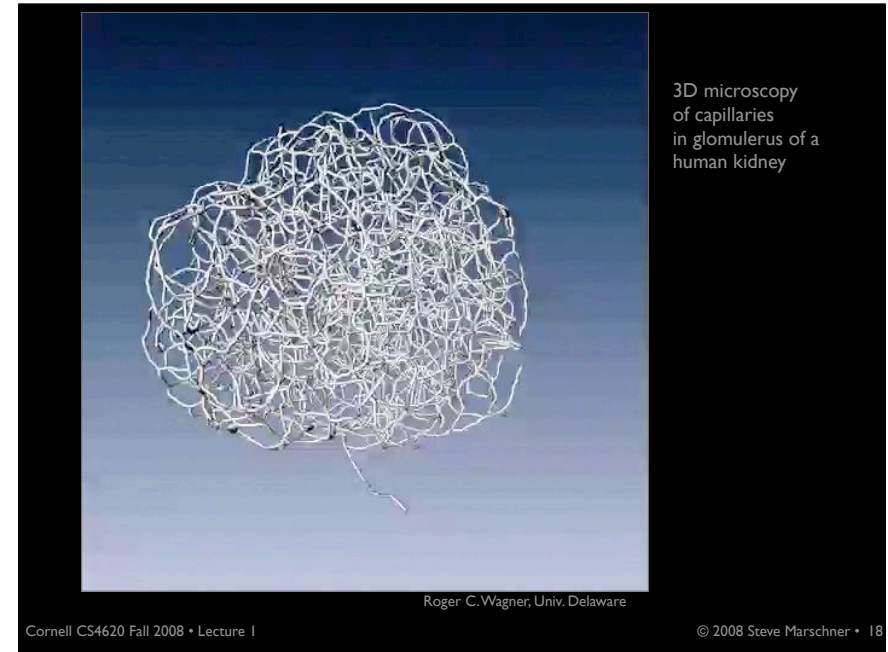
Crytek GmbH—advertisement for *CryEngine 2* game engine

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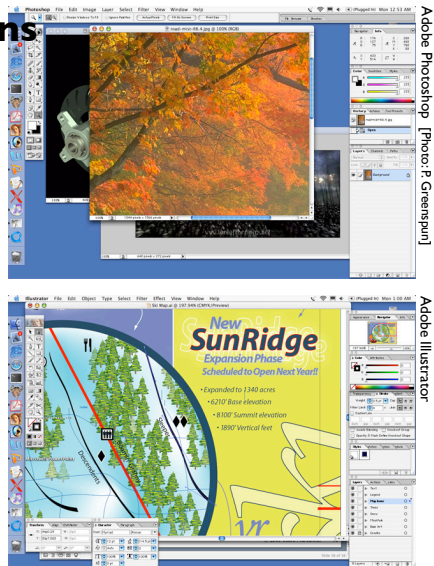


RIT Biochem. 502—Paul Craig



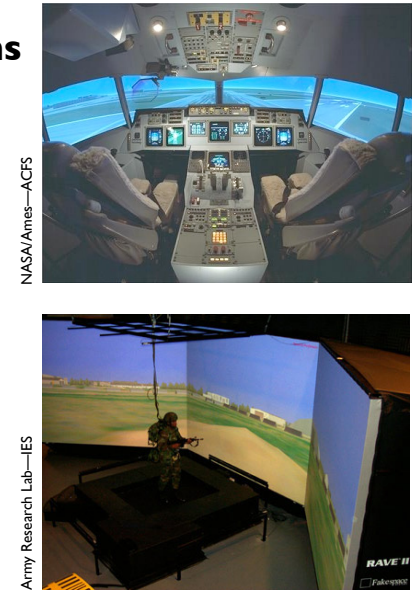
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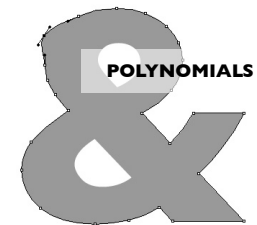
Computer aided sculptures
Ergun Akleman



Problems in graphics

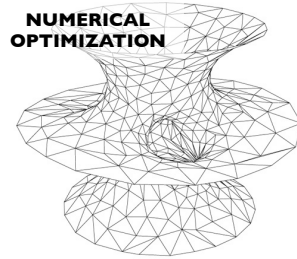
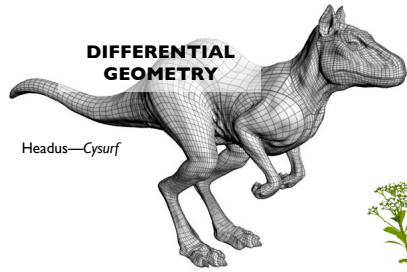
Problems in graphics

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

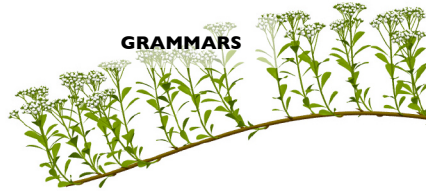


Problems in graphics CONT'D

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



[Hoppe et al. 1993]



[Prusinkewicz et al. 2001]

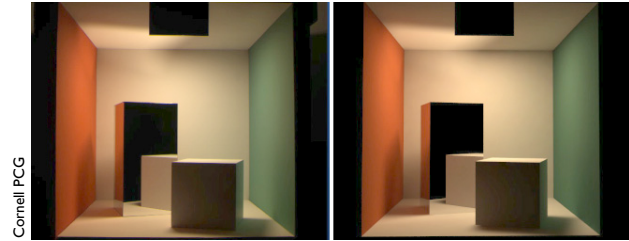
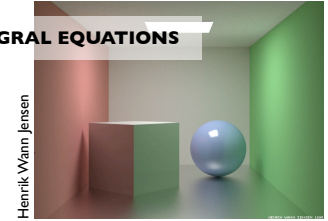
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Problems in graphics CONT'D

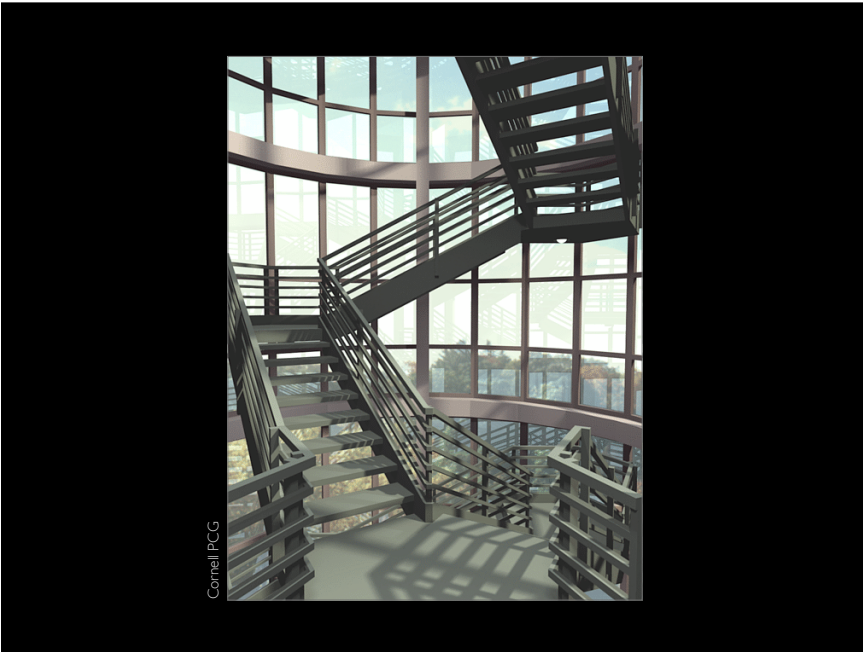
- 3D rendering
 - 2D views of 3D geometry
 - projection and perspective
 - removing hidden surfaces
 - lighting simulation

INTEGRAL EQUATIONS



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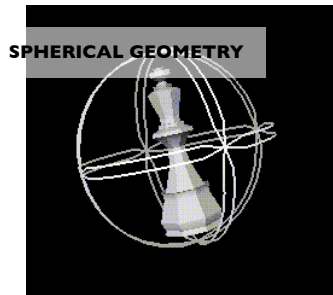
Problems in graphics CONT'D

- User Interaction
 - 2D graphical user interfaces
 - 3D modeling interfaces
 - virtual reality



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SCI - OpenInventor

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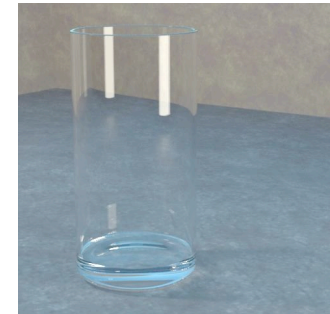
Problems in graphics CONT'D

- Animation
 - keyframe animation
 - physical simulation



Pixar

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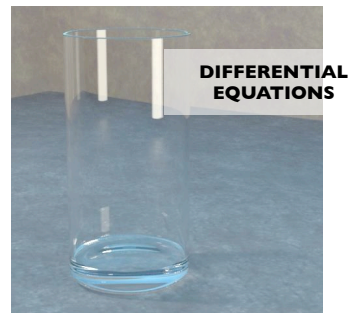
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Pixar

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Enright et al. SIGGRAPH 2003

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Computer graphics:
Mathematics made visible.

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Course Overview

In CS4620

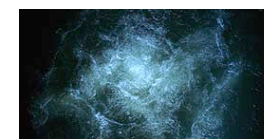
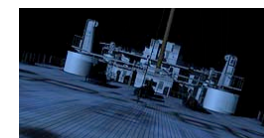
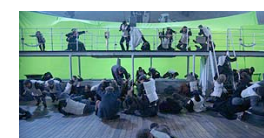
- You will:
 - explore fundamental ideas
 - learn math essential to graphics
 - implement key algorithms
 - write cool programs
- You will not:
 - learn a lot about OpenGL or DirectX
(though you will use some OpenGL)
 - write big programs

Topics

- Rendering 3D scenes
(ray tracing as the basic model)
- Images and image processing
(featuring sampling and reconstruction)
- Geometric transformations
- The graphics pipeline
(with a slant toward understanding graphics hardware)
- Modeling in 2D and 3D
- Color science

Images

- What is an image?
- Compositing
- Resampling



Rendering

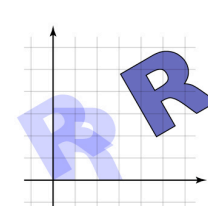
- ray tracing
- shading & shadows
- transparency
- texture mapping



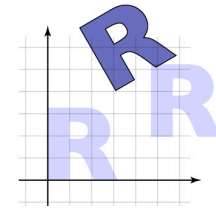
[Glasner 89]

Geometric transformations

- affine transforms
- perspective transforms
- viewing



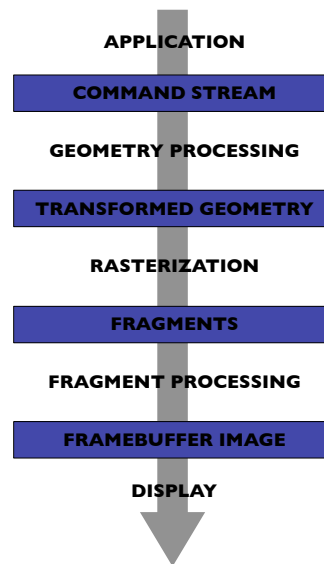
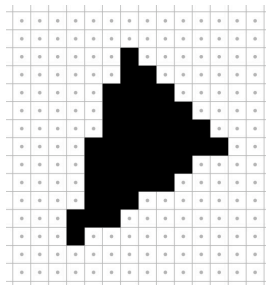
rotate, then translate



translate, then rotate

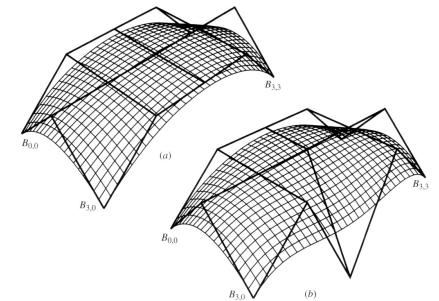
Graphics pipeline

- rasterization
- interpolation
- z-buffer
- vertex and fragment ops

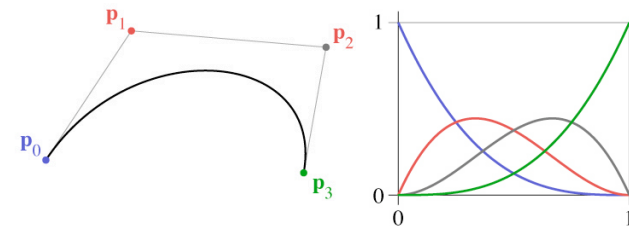


Modeling

- splines
- parametric surfaces
- triangle meshes

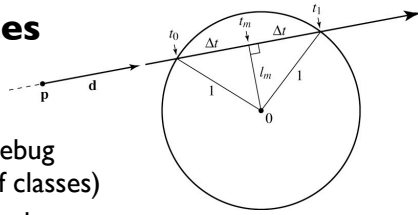


[Rogers]



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 CS4621

- You will also:
 - implement a modeling and animation system, in groups of ~4
 - learn a lot about
 - subdivision surfaces
 - mesh data structures
 - scene data structures
 - architecting good-sized interactive programs
 - using OpenGL



Pixar—Geri's Game (2006)

Course mechanics

see web site:
<http://www.cs.cornell.edu/Courses/cs4620>