

# Computer Graphics

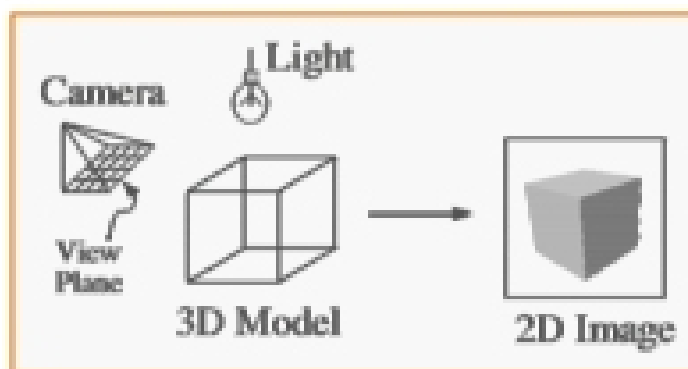
Adam Finkelstein  
Princeton University  
COS 426, Spring 2003

## Overview

- Introduction
  - What is computer graphics?
- Applications
  - What is it good for?
- Syllabus
  - What will I learn in this course?
- Coursework
  - How much work will there be?

## Introduction

- What is computer graphics?
  - Imaging = *representing 2D images*
  - Modeling = *representing 3D objects*
  - Rendering = *constructing 2D images from 3D models*
  - Animation = *simulating changes over time*



## Overview

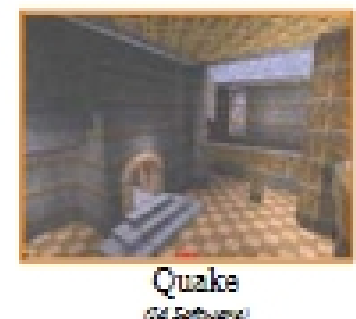
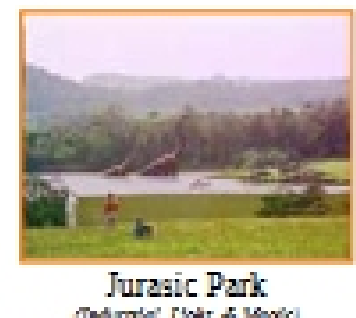
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## Applications

- Entertainment
- Computer-aided design
- Scientific visualization
- Training
- Education
- E-commerce
- Computer art

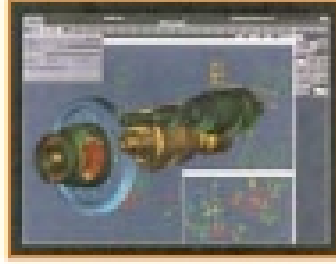
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## Applications

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Gear Shaft Design  
(Geograph Corporation)



Los Angeles Airport  
(Bill Jagan, UCLA)



Boeing 777 Airplane  
(Boeing Corporation)

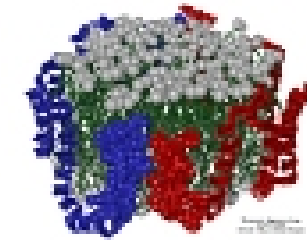


## Applications

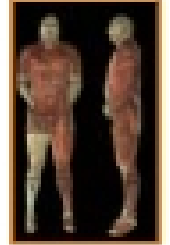
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Airflow Inside a Thunderstorm  
(Gabi Mikalson  
University of Illinois at Urbana-Champaign)



Apo A-1  
(Theoretical Biophysics Group  
University of Illinois at Urbana-Champaign)

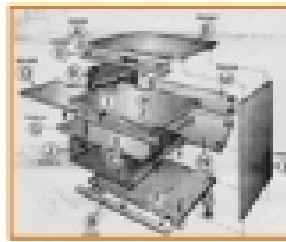


Visible Human  
(National Library of Medicine)

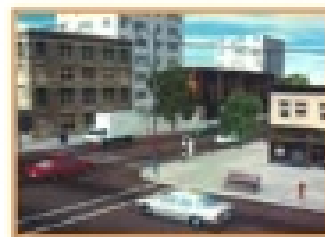


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Desk Assembly  
(Silicon Graphics, Inc.)



Driving Simulation  
(Gunter & Switzerland)



Flight Simulation  
(NASA)

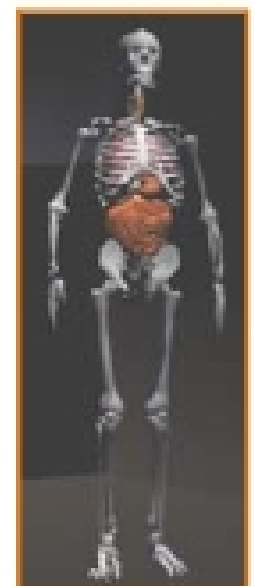


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Forum of Trajan  
(Bill Jagan, UCLA)

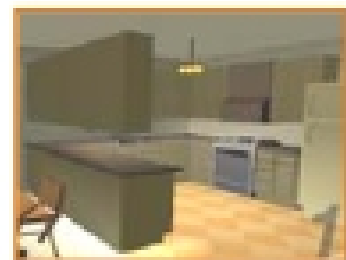


Human Skeleton  
(GSI)

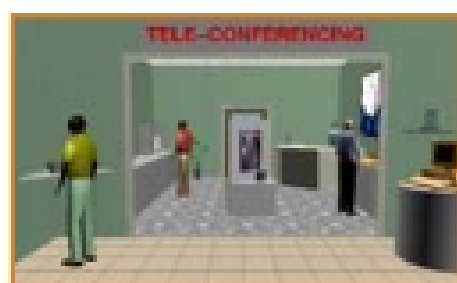


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Interactive Kitchen Planner  
(Microsoft)

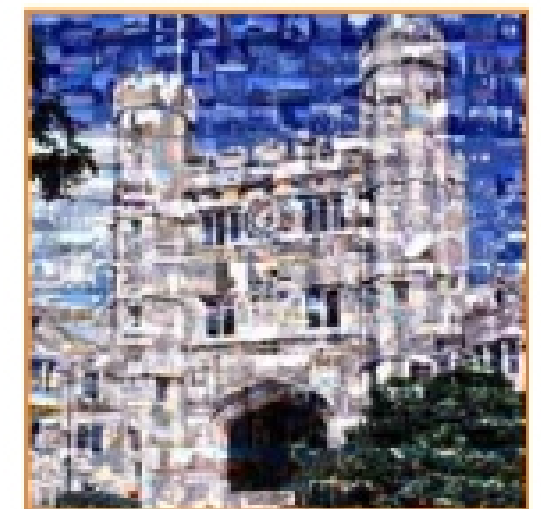


Virtual Phone Store  
(Lucient Technologies)



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Blair Arch  
(Marina Range '98)



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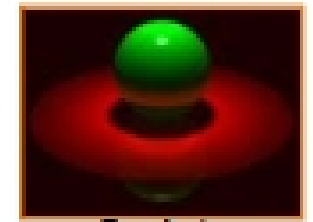


## Syllabus

- I. Image processing
- II. Rendering
- III. Modeling
- IV. Animation



Image Processing  
(Ravi, Coleman, CS438, Fall98)



Rendering  
(Michael Beetz, CS438, Fall98)



Modeling  
(Dimit Zark, CalTrack)



Animation  
(Angel, Pixar 1)

## Part I: Image Processing

- Image Representation
  - Sampling
  - Reconstruction
  - Quantization & Aliasing
- Image Processing
  - Filtering
  - Warping
  - Morphing
  - Composition
- Raster Graphics
  - Display devices
  - Color models



Image Composition  
(Michael Beetz, CS438, Fall98)

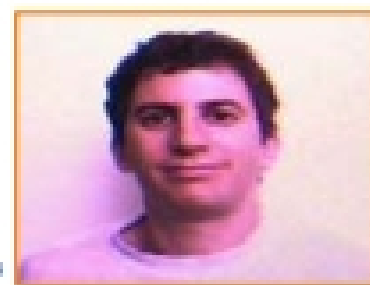
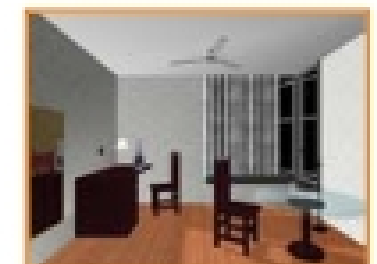


Image Morphing  
(All students in CS 438, Fall98)

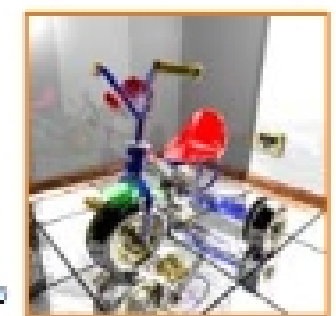


## Part II: Rendering

- 3D Rendering Pipeline
  - Modeling transformations
  - Viewing transformations
  - Hidden surface removal
  - Illumination, shading, and textures
  - Scan conversion, clipping
  - Hierarchical scene graphics
  - OpenGL
- Global illumination
  - Ray tracing
  - Radiosity



OpenGL  
(Chi Zhang, CS 438, Fall98)

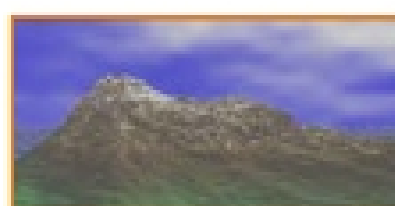


Ray Tracing  
(Gleno Peng, CS 438, Fall98)



## Part III: Modeling

- Representations of geometry
  - Curves: splines
  - Surfaces: meshes, splines, subdivision
  - Solids: voxels, CSG, BSP
- Procedural modeling
  - Sweeps
  - Fractals
  - Grammars



Scenery Designer  
(Dink Bejlic, Igor Gustov, Sanjiv Kumar, & Rade Semencic, CS438, Fall98)



Shell  
(Douglas Tombut, CS 438, Fall98)



## Part IV: Animation

- Keyframing
  - Kinematics
  - Articulated figures
- Motion capture
  - Capture
  - Warping
- Dynamics
  - Physically-based simulations
  - Particle systems
- Behaviors
  - Planning, learning, etc.



Mr. Ed  
(Carey, McTaggart, CS438, Fall98)



Ice Queen  
(Xiao Chen, Zefu Guo, Ziyun Liu, & Marko Jia, CS438, Fall98)

