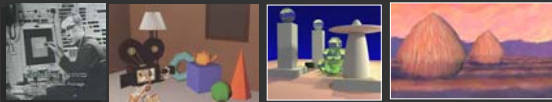


Computer Graphics (Fall 2005)

COMS 4160, Lecture 25: Summary and Preview

<http://www.cs.columbia.edu/~cs4160>

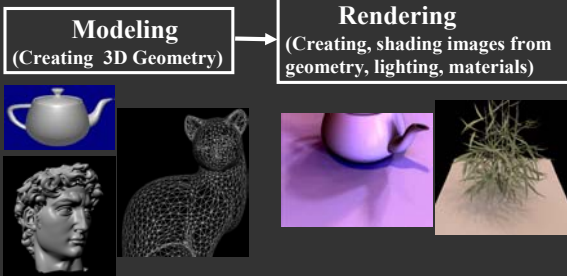


Goals

- **Systems:** Be able to write fairly complex interactive 3D graphics programs (in OpenGL)
 - Homework 3: OpenGL programming
 - Homework 4: Game assignment
- **Theory:** Understand mathematical aspects and algorithms underlying modern 3D graphics systems
 - Unit 1 Transformations: Basic concept in graphics
 - Unit 2 Curves: Basic modeling tools
 - Units 4, 5 Rendering, Global Illumination: Basic theory of image synthesis

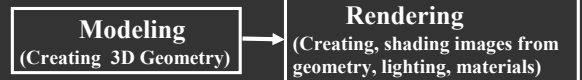
Course Outline

- 3D Graphics Pipeline



Course Outline

- 3D Graphics Pipeline



Unit 1: Transformations

Unit 4: Lighting, Shading

Unit 3: OpenGL

Unit 2: Spline Curves

Unit 5: Advanced Render

Midterm on units 1-3: Oct 26

Ass 4: Interactive 3D Video Game (final project) due Dec 11

Related courses

- *COMS 4162, follow on to 4160 taught by me in the spring. I hope many of you will enroll in that.*
- COMS 4167, Computer Animation and Simulation, taught by Prof. Grinspun spring next year.
- Many 6000-level courses (e.g. COMS 6160 High Quality Real-Time Rendering taught by me last year, simulation by Prof. Grinspun this year)

History

- Brief summary of course in context of history of field
- Story of Computer Graphics: Video on history



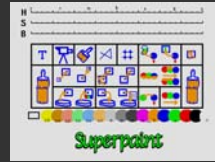
2D Graphics

Many of the standard operations you're used to:

- Text
- Graphical User Interfaces (Windows, MacOS, ..)
- Image processing and paint programs (Photoshop, ...)
- Drawing and presentation (Powerpoint, ...)

Paint Systems

- SuperPaint system: Richard Shoup, Alvy Ray Smith (PARC, 1973-79)



- Nowadays, image processing programs like Photoshop can draw, paint, edit, etc.

Image Processing

- Digitally alter images, crop, scale, composite
- Add or remove objects
- Sports broadcasts for TV (combine 2D and 3D processing)

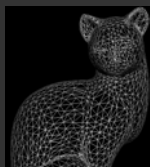


Relevance to Course

- In 4160, didn't cover 2D at all
- But relevant broadly (not just for 2D), since ultimately 3D scene displayed as 2D image
- In 4162, we cover image processing and many photoshop functions [assignment to write a mini-version]

Modeling

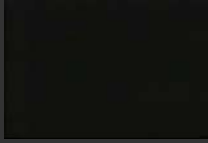
- Spline curves, surfaces: 70s – 80s
- Utah teapot: Famous 3D model
- More recently: Triangle meshes often acquired from real objects



Relevance to Course

- Covered Bezier, B-spline curves for modeling
Will talk briefly about NURBS, surfaces in 4162
- Main idea is to talk about mesh processing algs.
- Will learn to represent, work with meshes
- Do mesh simplification, progressive meshes

Progressive Mesh Movie



Rendering: 1960s (visibility)

- Roberts (1963), Appel (1967) - hidden-line algorithms
- Warnock (1969), Watkins (1970) - hidden-surface
- Sutherland (1974) - visibility = sorting



Images from FvDEH, Pixar's Shatterbox
Slide ideas for history of Rendering courtesy Marc Levoy

Rendering: 1970s (lighting)

1970s - raster graphics

- Gouraud (1971) - diffuse lighting, Phong (1974) - specular lighting
- Blinn (1974) - curved surfaces, texture
- Catmull (1974) - Z-buffer hidden-surface algorithm



Rendering (1980s, 90s: Global Illumination)

early 1980s - global illumination

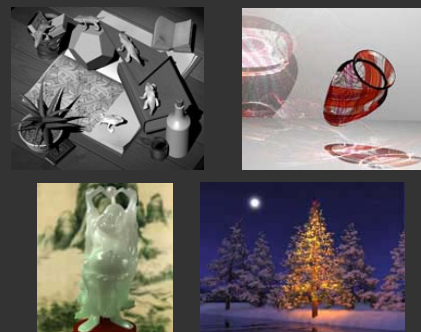
- Whitted (1980) - ray tracing
- Goral, Torrance et al. (1984) radiosity
- Kajiya (1986) - the rendering equation



Relevance to Course

- We didn't talk about visibility algorithms
 - Nowadays, simple Z-buffer used OpenGL
- Discussed illumination and shading models
 - And theory (but not practice) of global illumination
- In 4162, we will cover practical global illum.
- First, build a simple ray tracer
- Extensions/final project related to rendering

Image Synthesis Examples



Summary

- COMS 4160 covered basics of computer graphics
 - Theory of transformations, curves, illumination
 - Building complex interactive graphics programs
- COMS 4162 covers more advanced topics and fills in the gaps in 4160. Essential for full graphics intro
 - 2D Image and Signal Processing
 - Mesh algorithms
 - Ray Tracing
 - Advanced Rendering and other topics
- I hope you enjoyed the course (and do well on HW 4)
- Hope to see you all in 4162 next semester...