



University of British Columbia  
 CPSC 314 Computer Graphics  
 Jan 2013

Tamara Munzner

## Intro

**Week 1, Fri Jan 4**

<http://www.ugrad.cs.ubc.ca/~cs314/Vjan2013>

## Outline

- defining computer graphics
- course structure
- course content overview

## What is Computer Graphics?

- create or manipulate images with computer
  - this course: algorithms for image generation

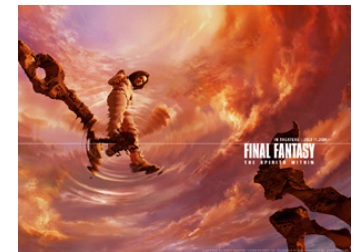


## What is CG used for?

- movies
  - animation
  - special effects

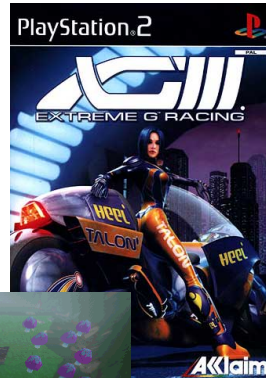
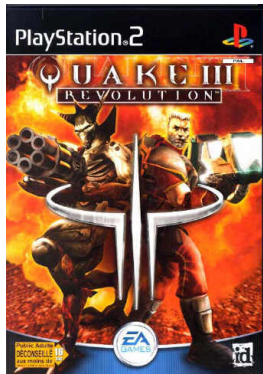


Inspector Gadget © 1999 Walt Disney Pictures  
 Visual Effects by Dream Quest Images



## What is CG used for?

- computer games



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## What is CG used for?

- images
  - design
  - advertising
  - art



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## What is CG used for?

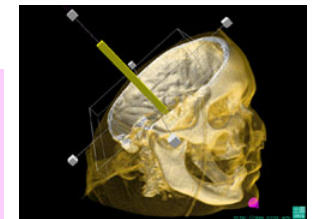
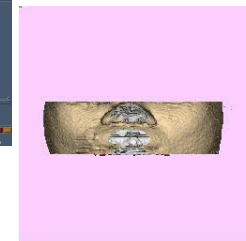
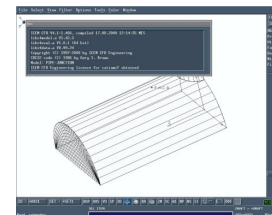
- virtual reality / immersive displays



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## What is CG used for?

- graphical user interfaces
  - modeling systems
  - applications
- simulation & visualization

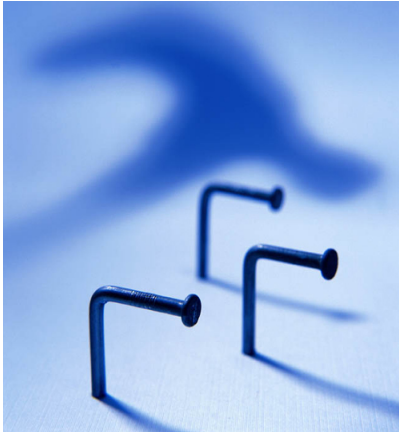


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## Real or CG?

<http://www.alias.com/eng/etc/fakeorfoto/quiz.html>

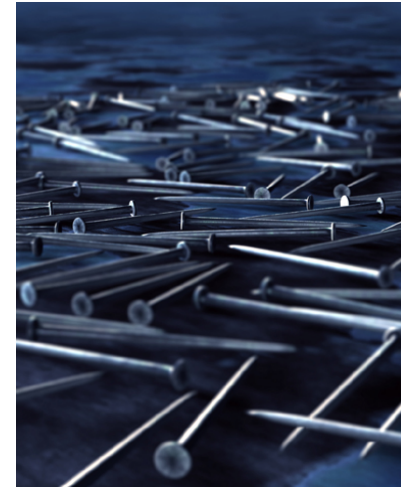
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## Real or CG?

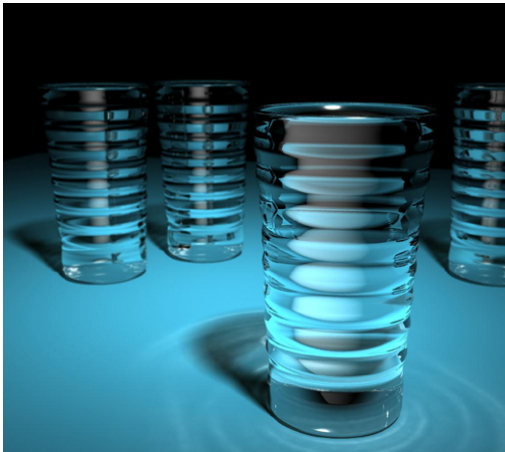
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## Real or CG?

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## Real or CG?

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## Expectations

- hard course!
  - heavy programming and heavy math
- fun course!
  - graphics programming addictive, create great demos
- programming prereq
  - CPSC 221 (Program Design and Data Structures)
  - course language is C++/C
- math prereq
  - MATH 200 (Calculus III)
  - MATH 221/223 (Matrix Algebra/Linear Algebra)

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## Course Structure

- 39% programming projects
  - 8% project 1 (building beasts with cubes and math)
  - 8% project 2
  - 8% project 3
  - 15% project 4 (create your own graphics game)
- 25% final
- 20% midterm (week 9 Fri 3/8)
- 16% written assignments
  - 4% each HW 1/2/3/4
- programming projects and homeworks synchronized

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## Programming Projects

- structure
  - C++, Linux
    - OK to cross-platform develop on Windows, Mac
  - OpenGL graphics library
  - GLUT for platform-independent windows/UI
  - face to face grading in lab
- Hall of Fame
  - first project: building beasts
    - previous years: bison, spiders, armadillos, giraffes, frogs, elephants, birds, poodles, dinos, cats...
  - last project: create your own graphics game

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## Late Work

- 3 grace days
    - for unforeseen circumstances
    - strong recommendation: don't use early in term
    - handing in late uses up automatically unless you tell us
  - otherwise: 50% if one day (24 hrs) late, 0% afterwards
  - **only** exception: severe illness or crisis
    - as per UBC rules
    - must let me know ASAP (in person or email)
      - at latest, 7 days after return to school
    - **must** also turn in form
      - with documentation (doctor note)
- <http://www.ugrad.cs.ubc.ca/~cs314/Vjan2013/illness.html>

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## Regrading

- to request assignment or exam regrade
  - give me paper to be regraded, and also **in writing**
    - what problem you're disputing
    - detailed explanation why you think grader was wrong
  - I will not accept until next class after solutions handed out
    - exception: simple arithmetic errors
- I may regrade entire assignment
  - thus even if I agree with your original request, your score may nevertheless end up higher or lower

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## Course Information

- course web page is main resource
  - <http://www.ugrad.cs.ubc.ca/~cs314/Vjan2013>
  - updated often, reload frequently
- discussion group: Piazza
  - signup: <https://piazza.com/ubc.ca/spring2013/cpsc314>
  - standard: <https://piazza.com/class#spring2013/cpsc314>
  - use Piazza, not direct email, for all questions
    - make posts private if you need to post your code

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## Teaching Staff

- instructor: Tamara Munzner
  - call me Tamara or Prof. Munzner, your choice
  - [tmm@cs.ubc.ca](mailto:tmm@cs.ubc.ca)
  - office hrs in ICICS/CS 005 (our lab)
    - Fridays right after class, 2-3
  - or by appointment in X661
- TAs: Peter Beshai, James Gregson, Yufeng Zhu
  - [pbeshai@cs](mailto:pbeshai@cs), [jgregson@cs](mailto:jgregson@cs), [mike323zyf@gmail](mailto:mike323zyf@gmail)

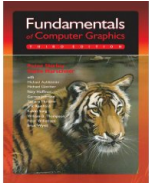
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## Labs

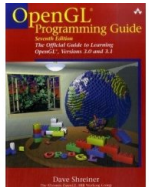
- labs start next week, no labs this week
- attend one (or more) labs per week
  - Mon 2-3, Tue 1-2, Fri 12-1
    - TA coverage TBA
  - mix of activities
    - example problems in spirit of written assignments and exams
    - help with programming projects
    - tutorials
  - no deliverables (unlike intro classes)
  - strongly recommend that you attend
  - if you can't attend your regular one, ok to drop by another if there's space

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## Textbooks



- Fundamentals of Computer Graphics
  - Peter Shirley, AK Peters, 3rd edition



- OpenGL Programming Guide, v 3.1
  - OpenGL Architecture Review Board
  - v 1.1 **available for free online**
  - aka “The Red Book”
- readings posted on schedule page
  - strongly encouraged but not mandatory

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## Learning OpenGL

- this is a graphics course using OpenGL
  - not a course \*on\* OpenGL
- upper-level class: learning APIs mostly on your own
  - only minimal lecture coverage
    - basics, some of the tricky bits
  - OpenGL Red Book
  - many tutorial sites on the web
    - [nehe.gamedev.net](http://nehe.gamedev.net)

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## Citation

- cite all sources of information
  - what to cite
    - study group members, books, web sites
  - where to cite it
    - README for programming projects
    - end of writeup for written assignments
  - <http://www.ugrad.cs.ubc.ca/~cs314/Vjan2013/cheat.html>

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## Plagiarism and Cheating

- don't cheat, I will prosecute
  - insult to your fellow students and to me
- programming and homework writeups must be individual work
  - can discuss ideas, browse Web
  - cannot just copy code or answers
  - cannot do team coding
  - exception: final project can be team of two
- you must be able to explain algorithms during face-to-face demo
  - or no credit for that part of assignment
  - and possibly prosecution

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## Plagiarism and Cheating

- submit statement that you've read and understood before we'll mark your work
  - <http://www.ugrad.cs.ubc.ca/~cs314/Vjan2013/cheat.html>

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## Course Content Overview

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## This Course

- we cover
  - basic **algorithms** for
    - rendering – displaying models
    - (modeling – generating models)
    - (animation – generating motion)
  - programming in OpenGL, C++
- we do not cover
  - art/design issues
  - commercial software packages

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## Other Graphics Courses

- CPSC 424: Geometric Modeling
  - offered now
- CPSC 426: Computer Animation
  - offered next year
- CPSC 514: Image-based Modeling and Rendering
- CPSC 526: Computer Animation
- CPSC 533A: Digital Geometry
- CPSC 533B: Animation Physics
- CPSC 547: Information Visualization
- CPSC 530P: Sensorimotor Computation

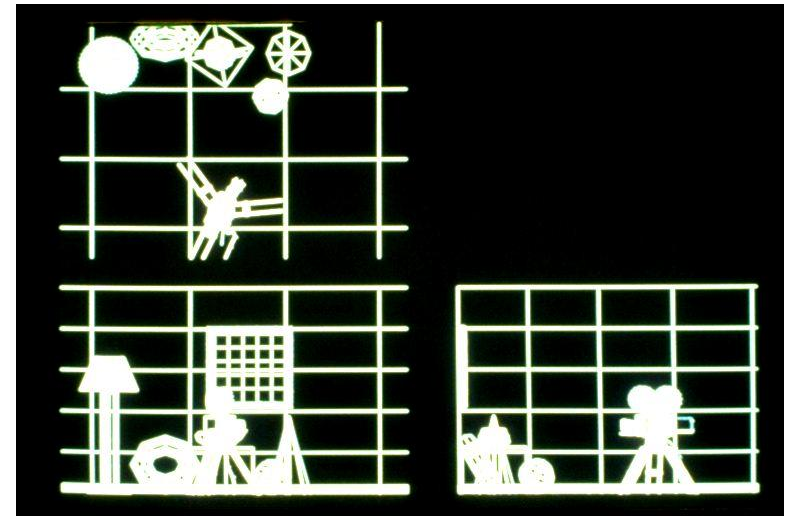
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## Rendering

- creating images from models
  - geometric objects
    - lines, polygons, curves, curved surfaces
  - camera
    - pinhole camera, lens systems, orthogonal
  - shading
    - light interacting with material
- illustration of rendering capabilities
  - Shutterbug series by Williams and Siegel using Pixar's Renderman
    - [www.siggraph.org/education/materials/HyperGraph/shutbug.htm](http://www.siggraph.org/education/materials/HyperGraph/shutbug.htm)

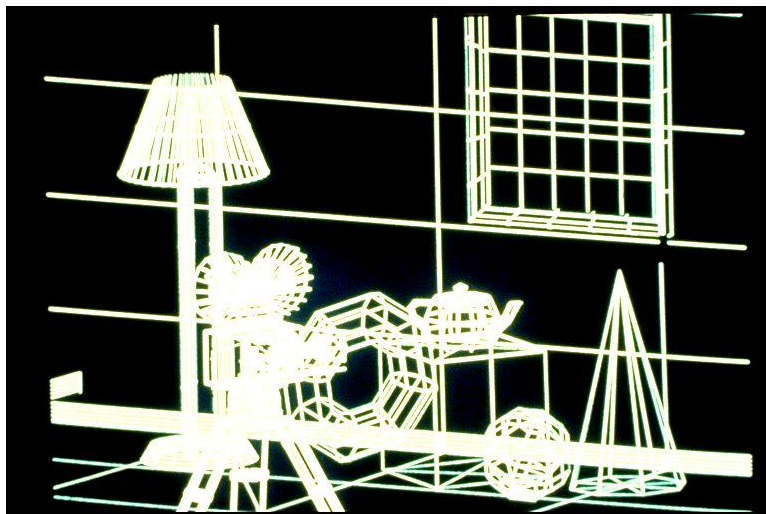
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## Modelling Transformation: Object Placement



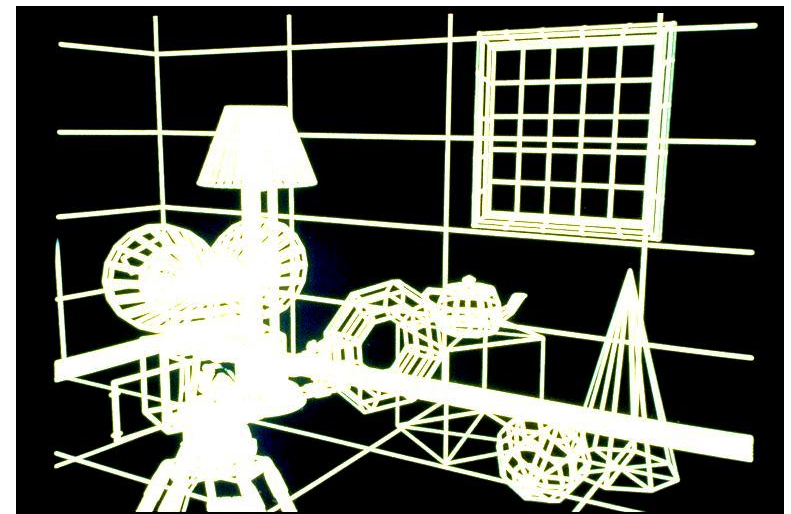
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## Viewing Transformation: Camera Placement



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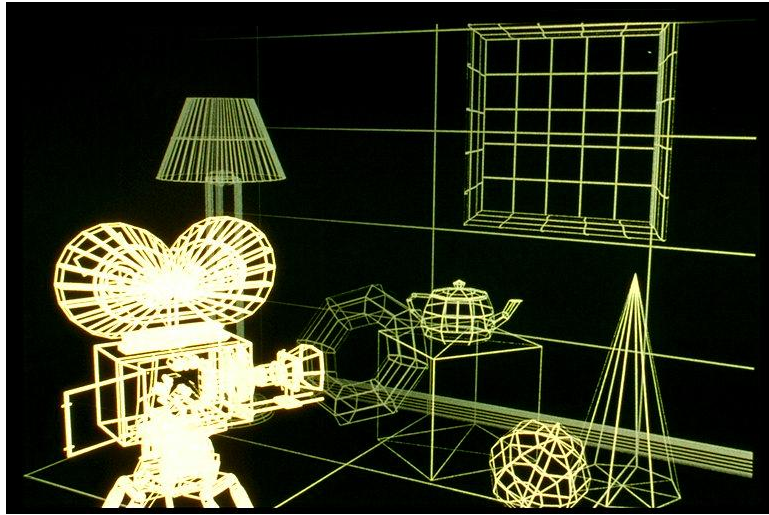
## Perspective Projection



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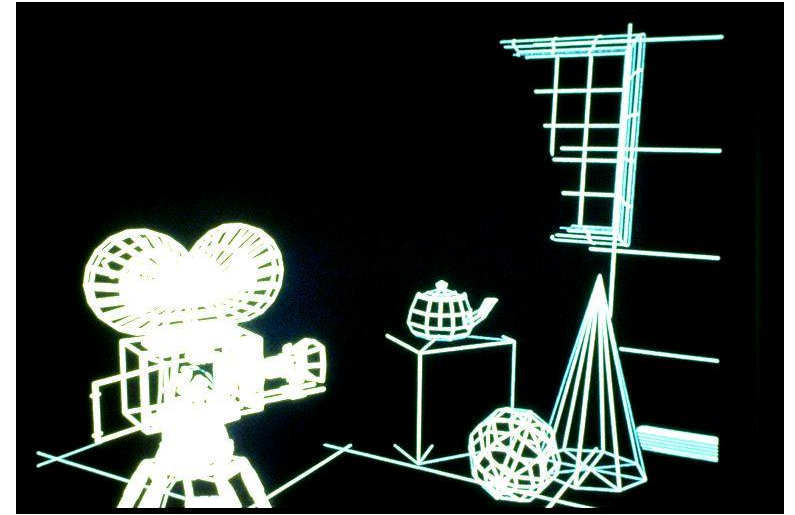


## Depth Cueing



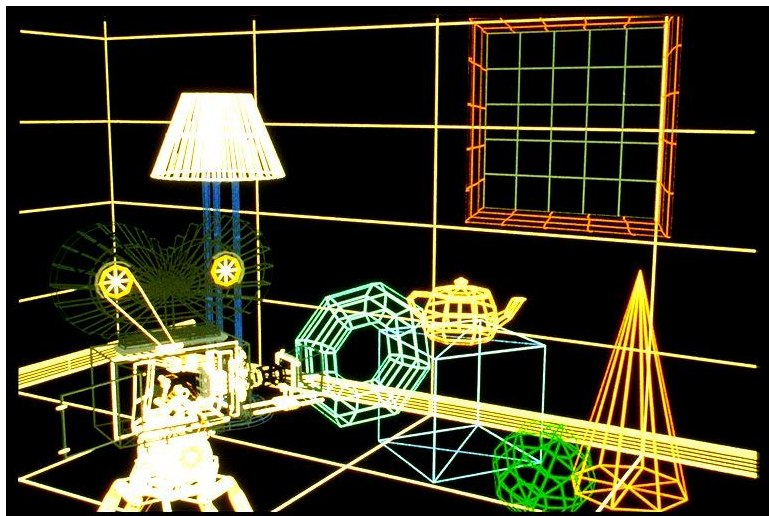
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## Depth Clipping



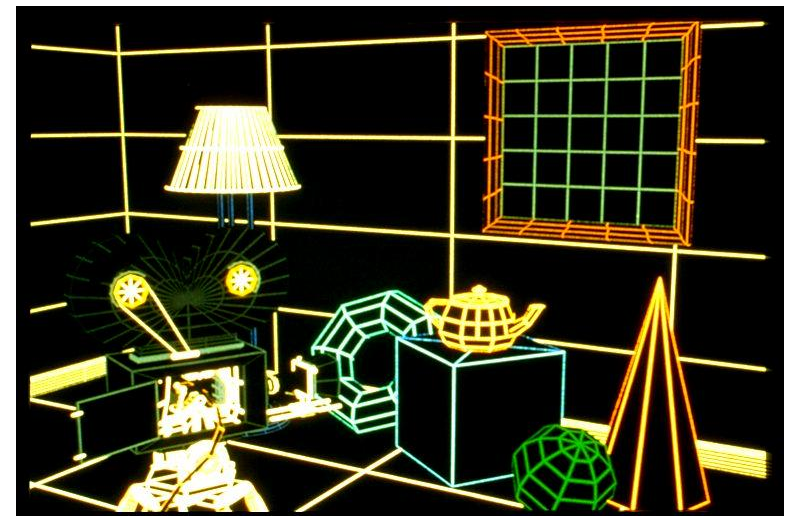
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## Colored Wireframes



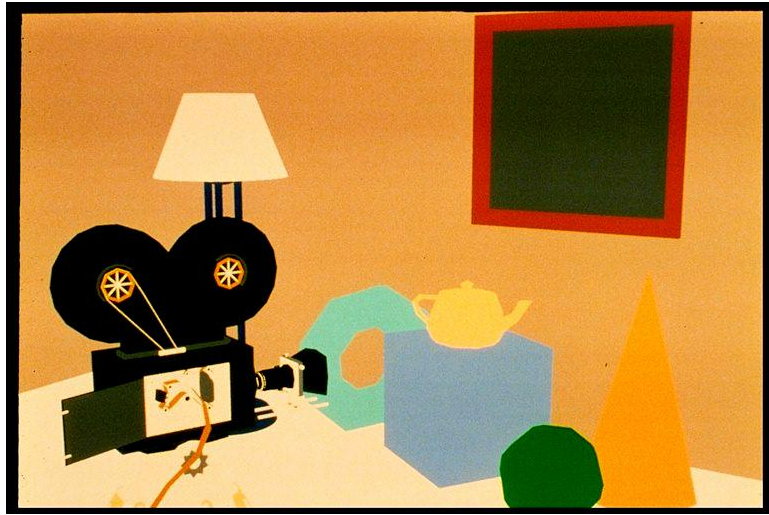
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## Hidden Line Removal



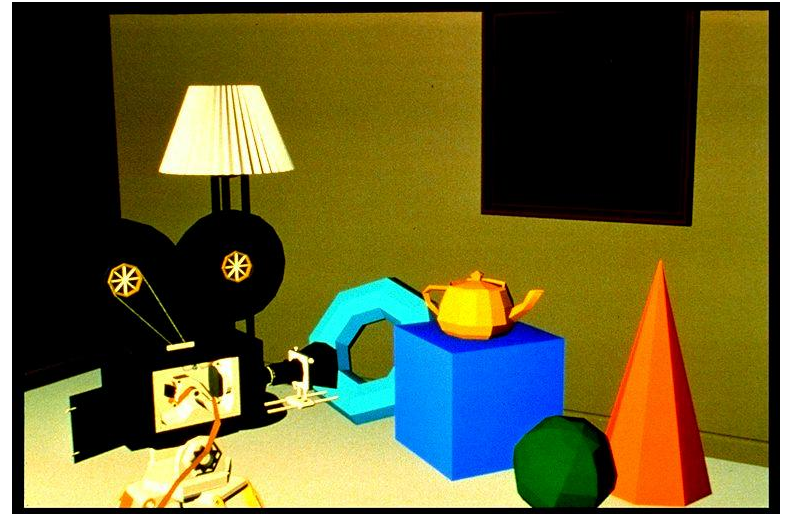
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## Hidden Surface Removal



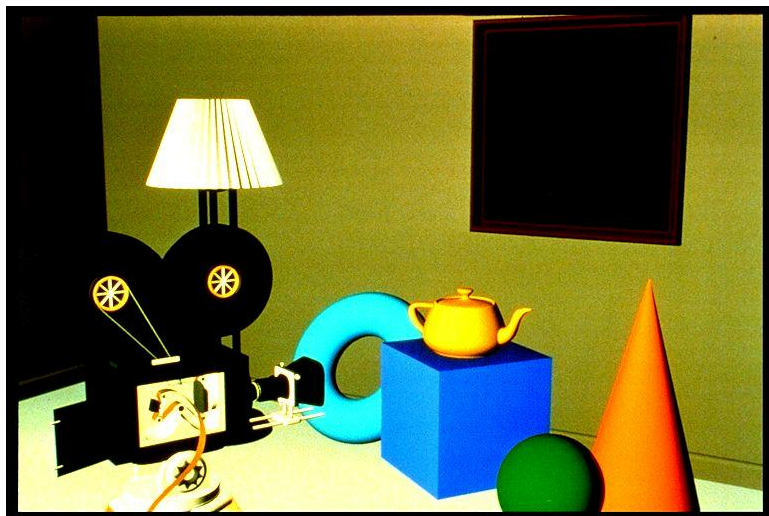
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## Per-Polygon Shading



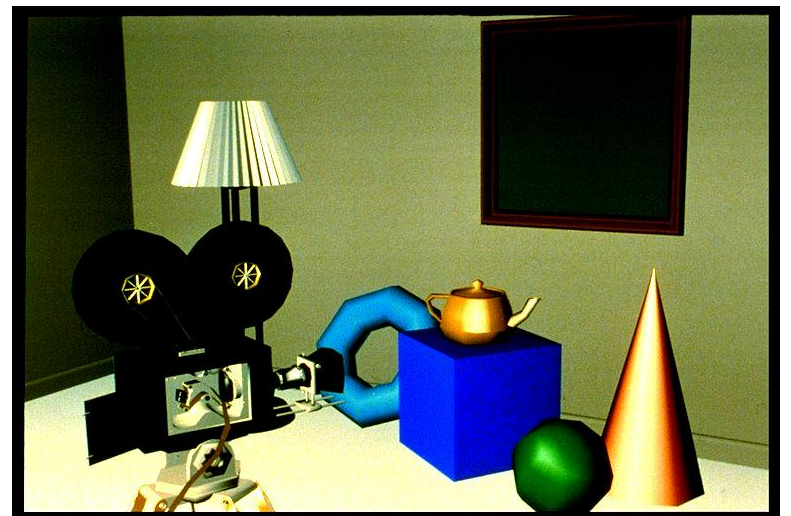
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## Gouraud Shading



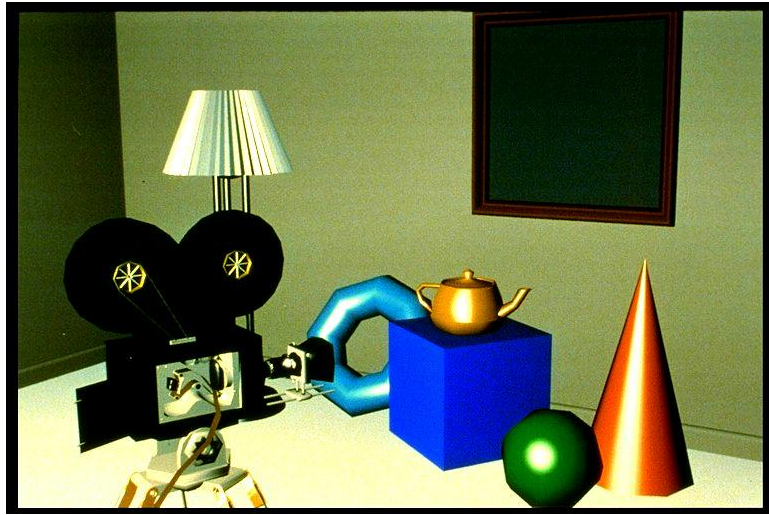
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## Specular Reflection



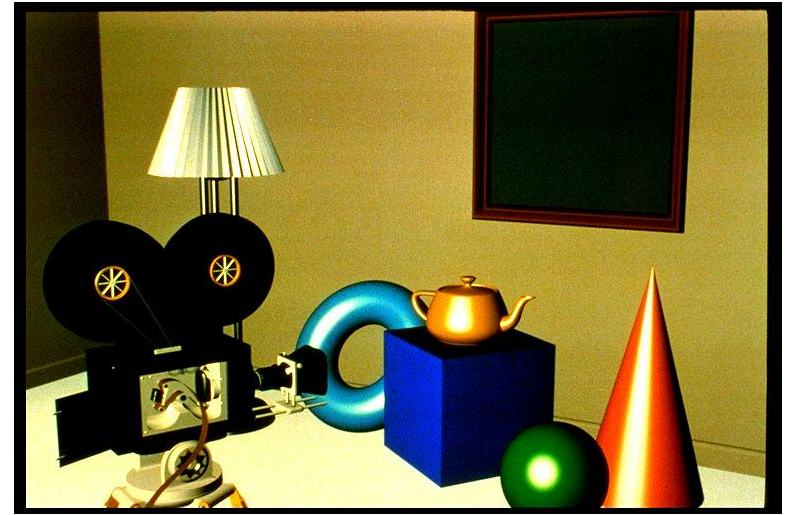
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## Phong Shading



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## Curved Surfaces



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## Complex Lighting and Shading



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## Texture Mapping



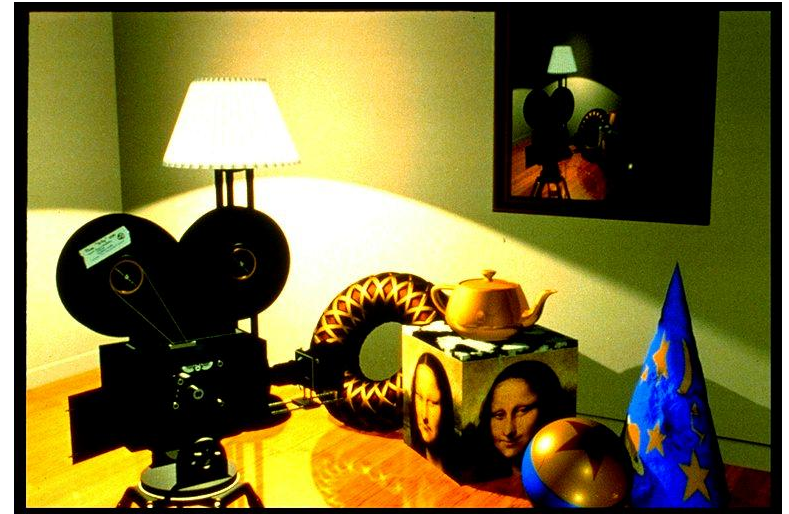
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## Displacement Mapping



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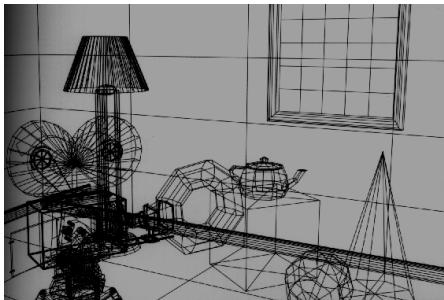
## Reflection Mapping



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## Modelling

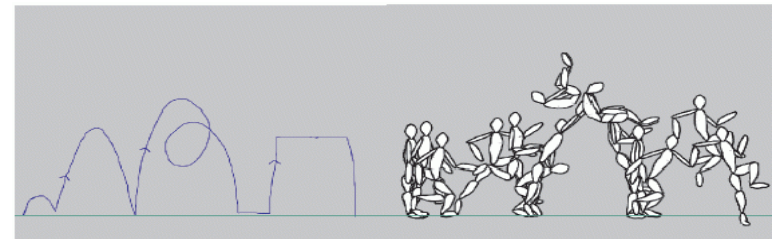
- generating models
  - lines, curves, polygons, smooth surfaces
  - digital geometry



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## Animation

- generating motion
  - interpolating between frames, states



<http://www.cs.ubc.ca/~van/papers/doodle.html>

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## Readings

- today
  - FCG Chap 1
- Wed (last time)
  - FCG Chap 2
    - except 2.7 (covered later)
  - FCG Chap 5
    - except 5.4