University of British Columbia
CPSC 314 Computer Graphics
Jan 2016

Tamara Munzner

Intro

Week 1, Mon Jan 4

http://www.ugrad.cs.ubc.ca/~cs314

Outline

- course content overview
- structure/logistics
- discuss: CG or photo?
  - (if time permits)

Course Content Overview

What is Computer Graphics?

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

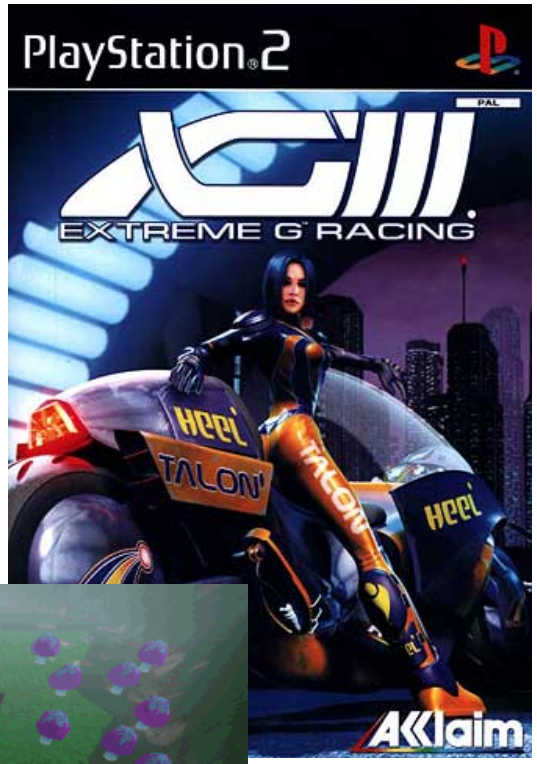
What is CG used for?

- movies
  - animation
  - special effects

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

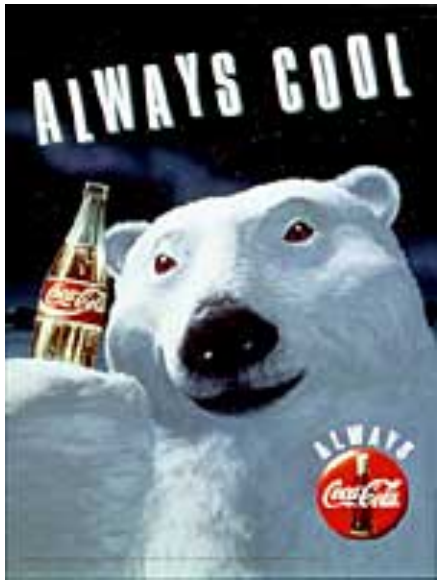
What is CG used for?

- computer games



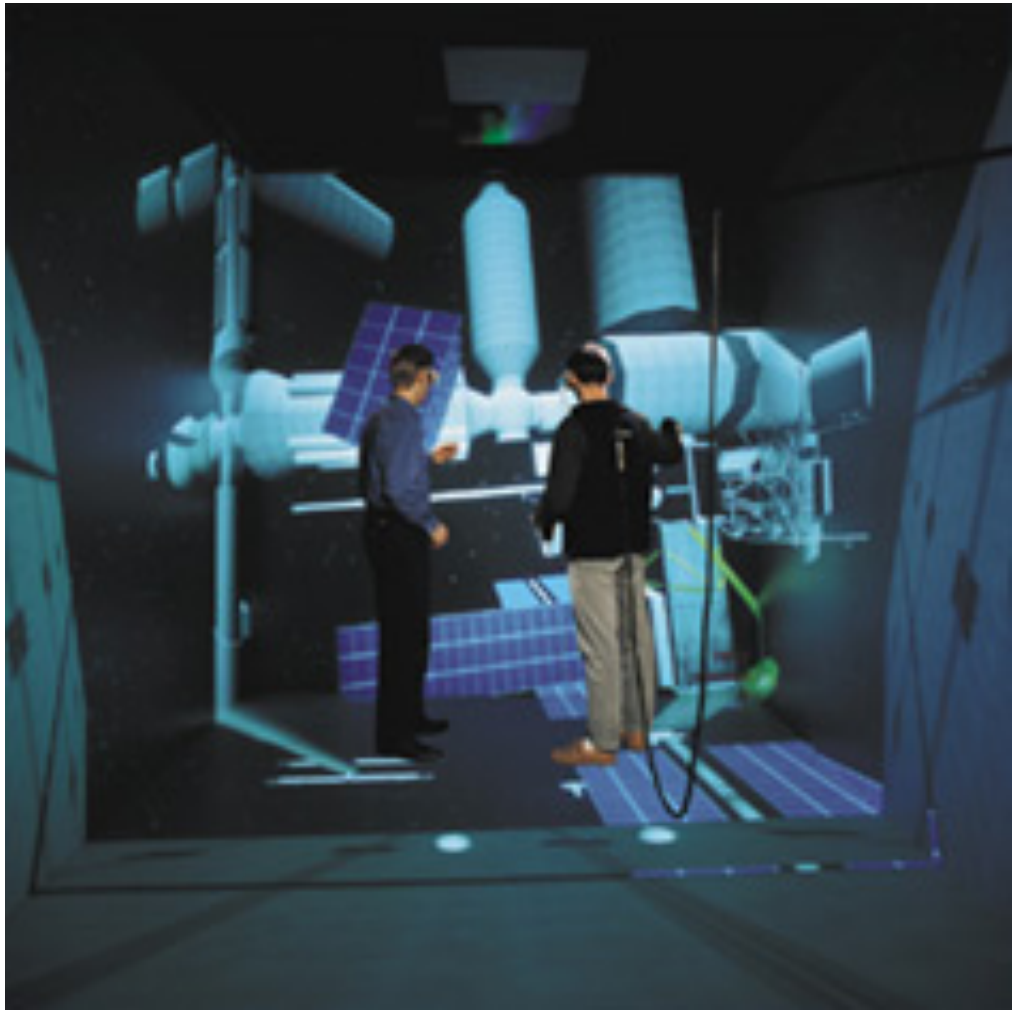
What is CG used for?

- images
  - design
  - advertising
  - art



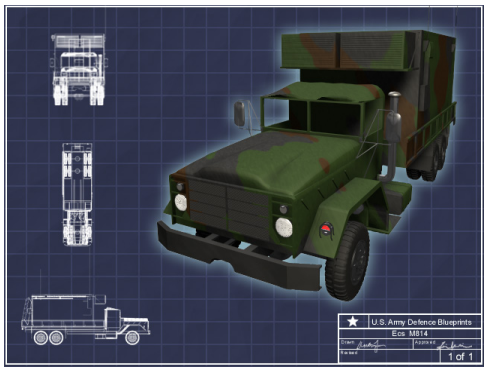
What is CG used for?

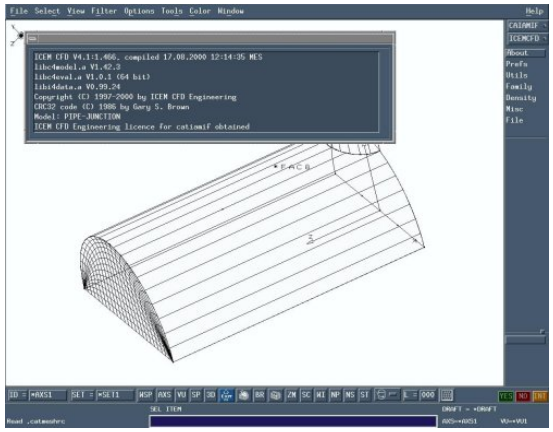
- virtual reality / immersive displays

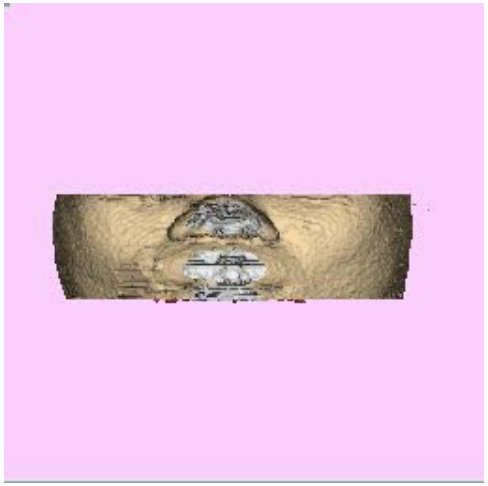


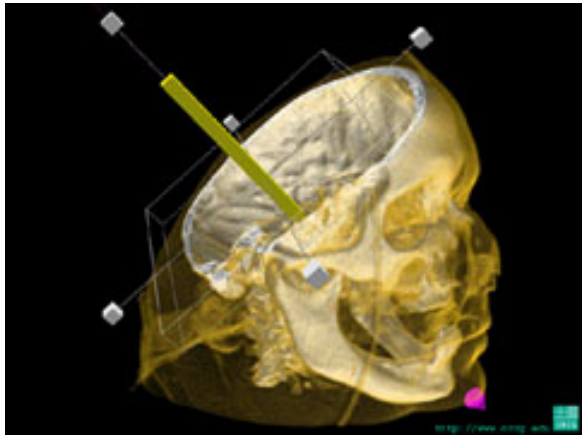
What is CG used for?

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









This Course

- we cover
  - basic **algorithms** for
    - rendering – displaying models [focus]
    - modeling – generating models [tidbits]
    - animation – generating motion [tidbits]
  - programming in WebGL/Javascript
- we do not cover
  - art/design issues
  - commercial software packages

Other Graphics Courses

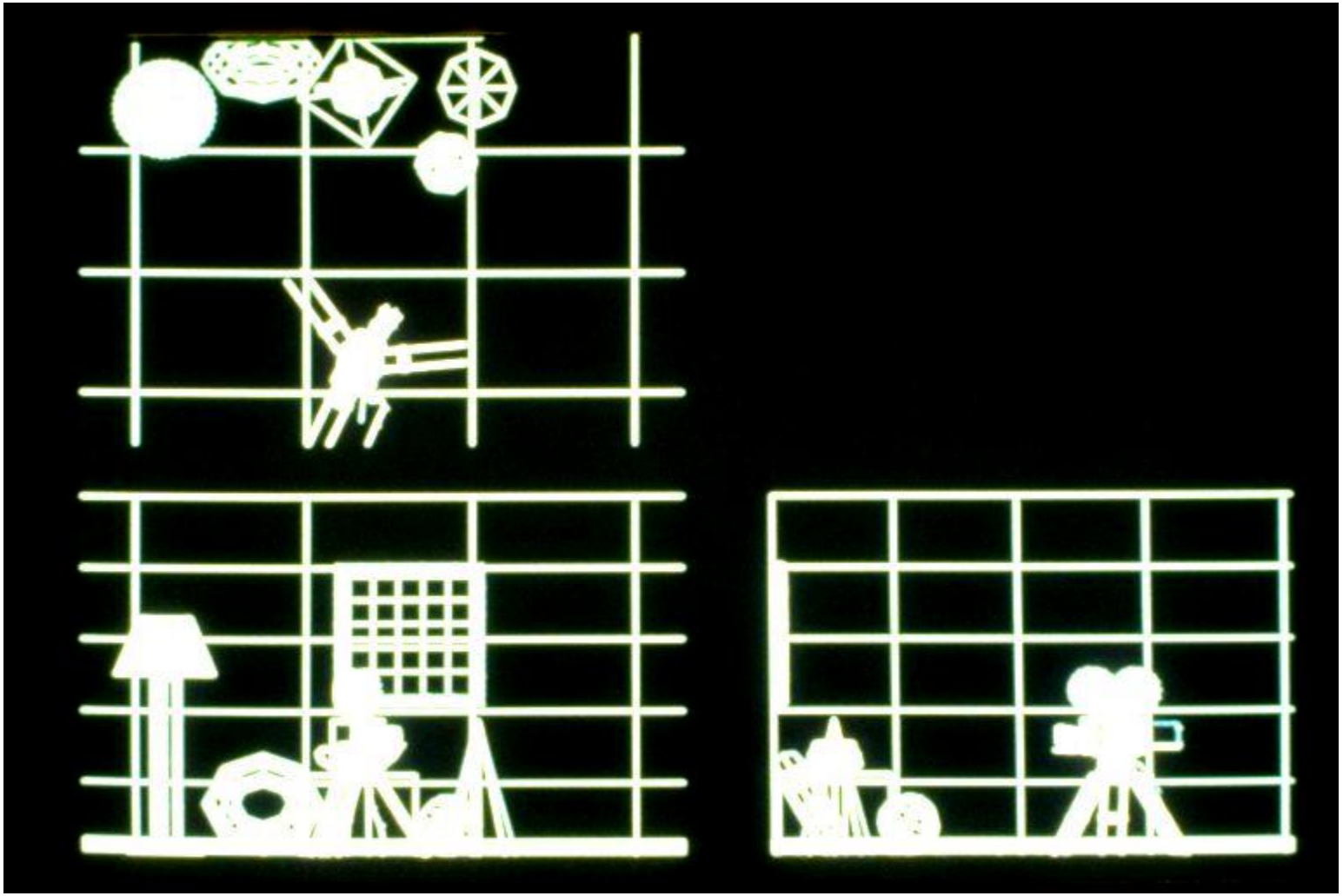
- CPSC 426: Computer Animation
  - offered next year (2016-2017)
- CPSC 424: Geometric Modeling
  - offered 2017-2018

- CPSC 526: Computer Animation
- CPSC 533A: Digital Geometry
- CPSC 533B: Animation Physics
- CPSC 547: Information Visualization
- CPSC 530P: Sensorimotor Computation

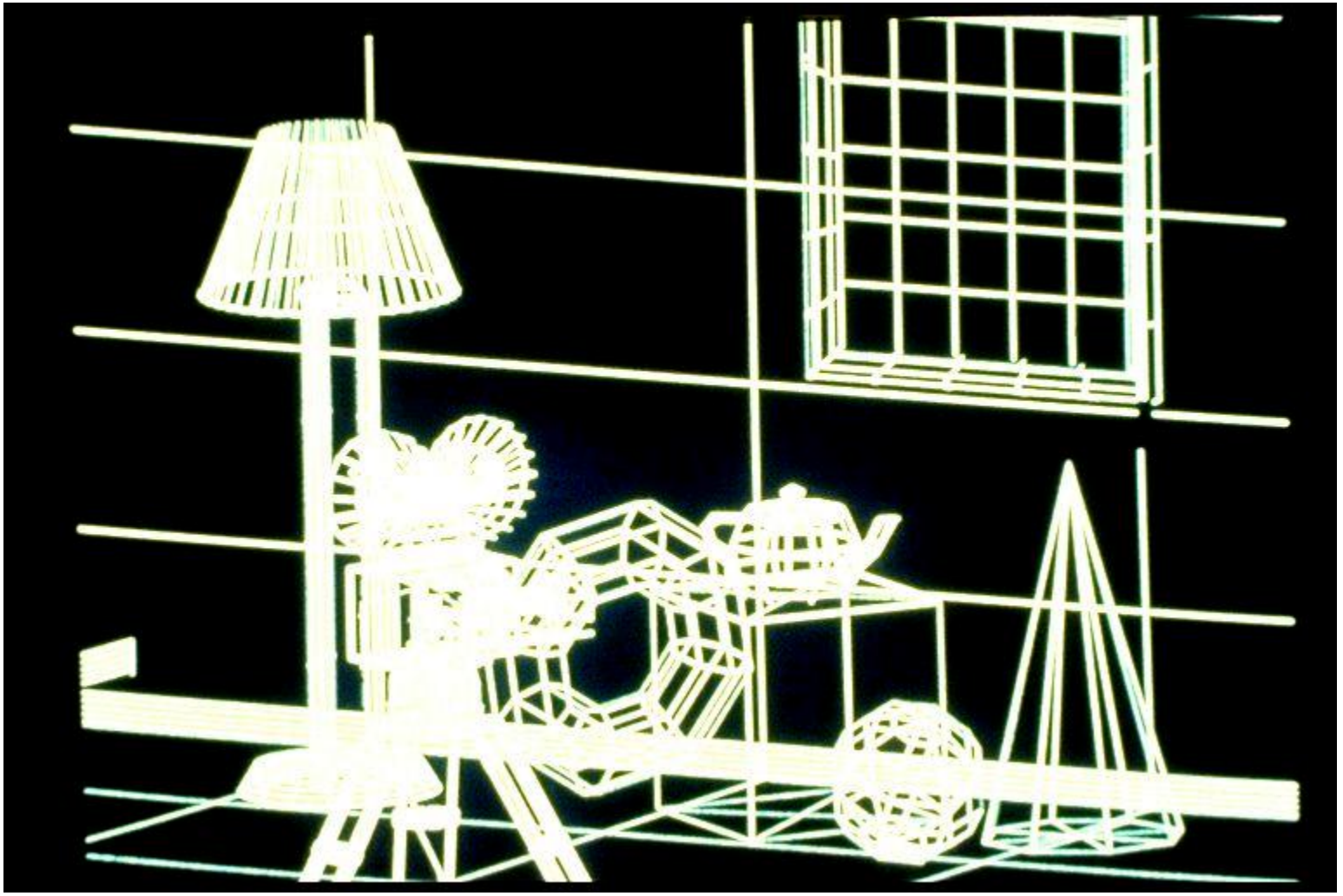
Rendering

- 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

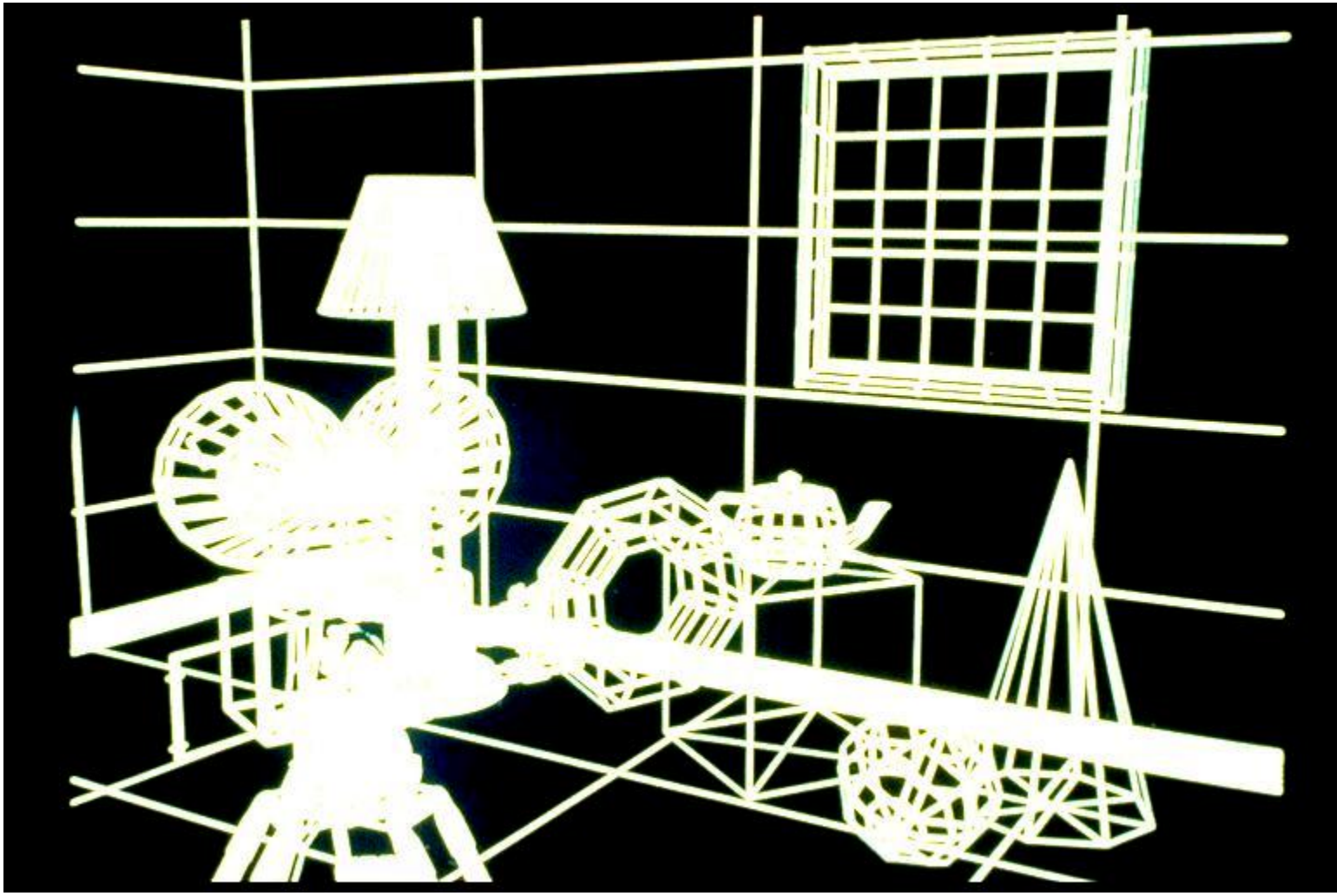
Modelling Transformation: Object Placement



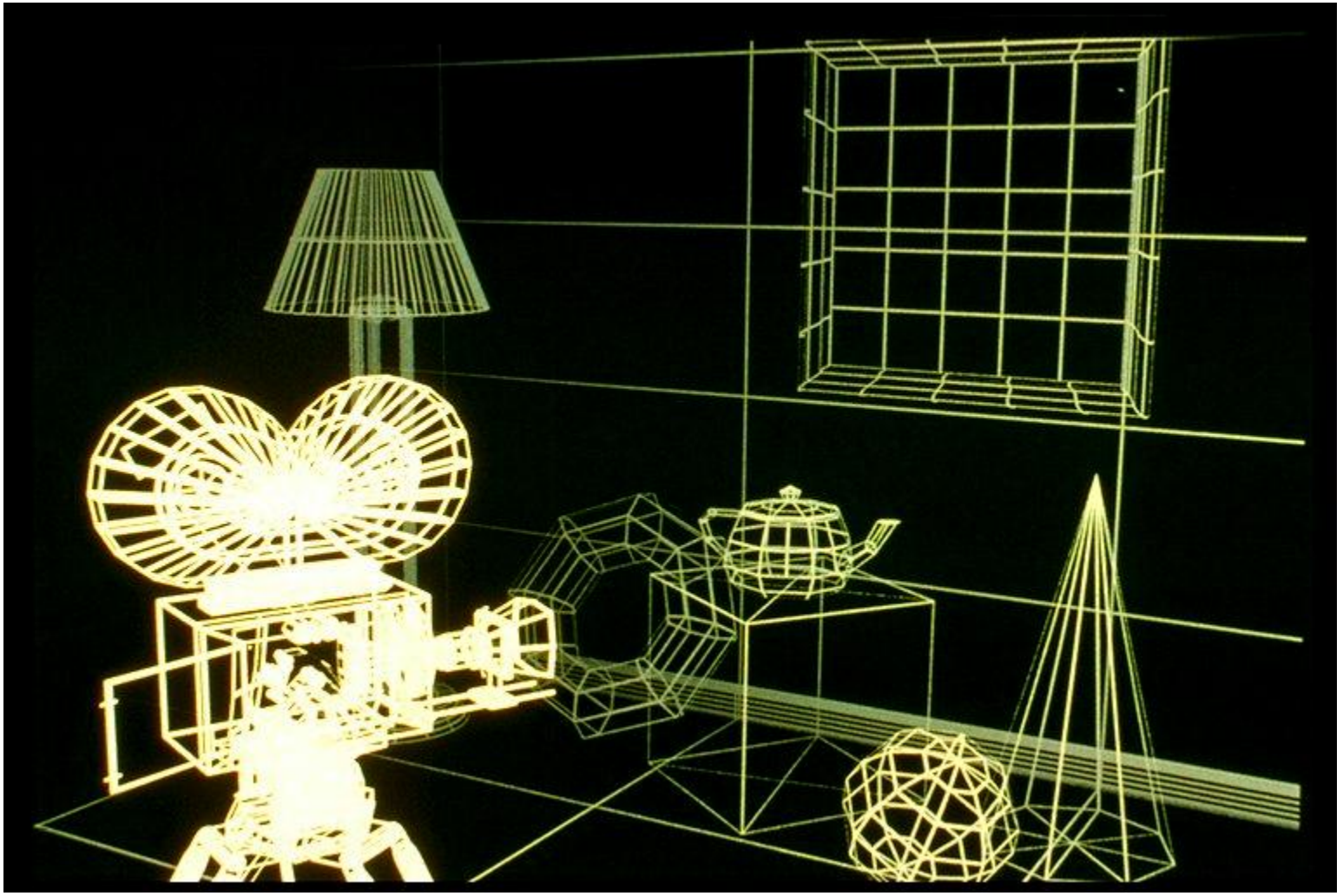
Viewing Transformation: Camera Placement



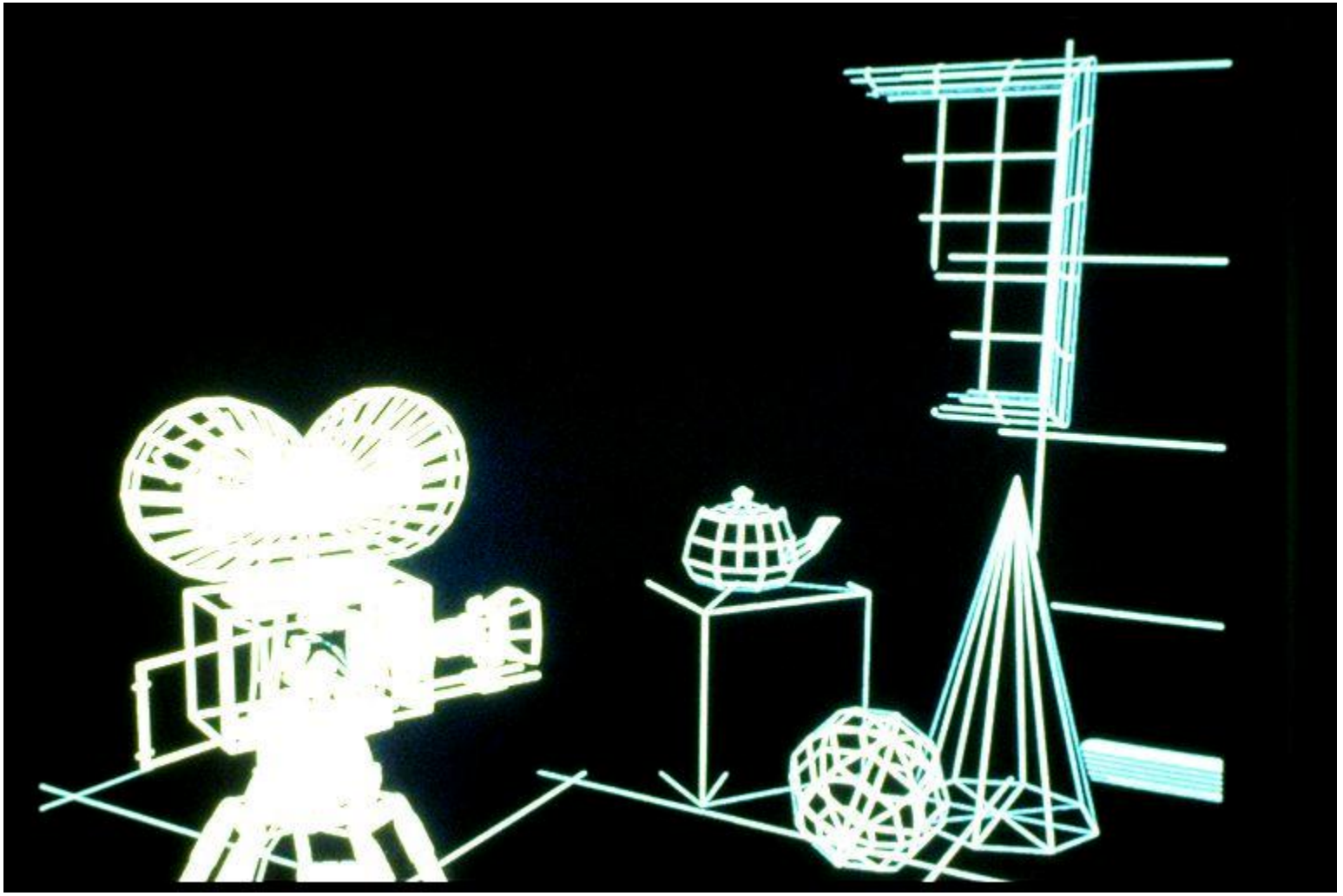
Perspective Projection



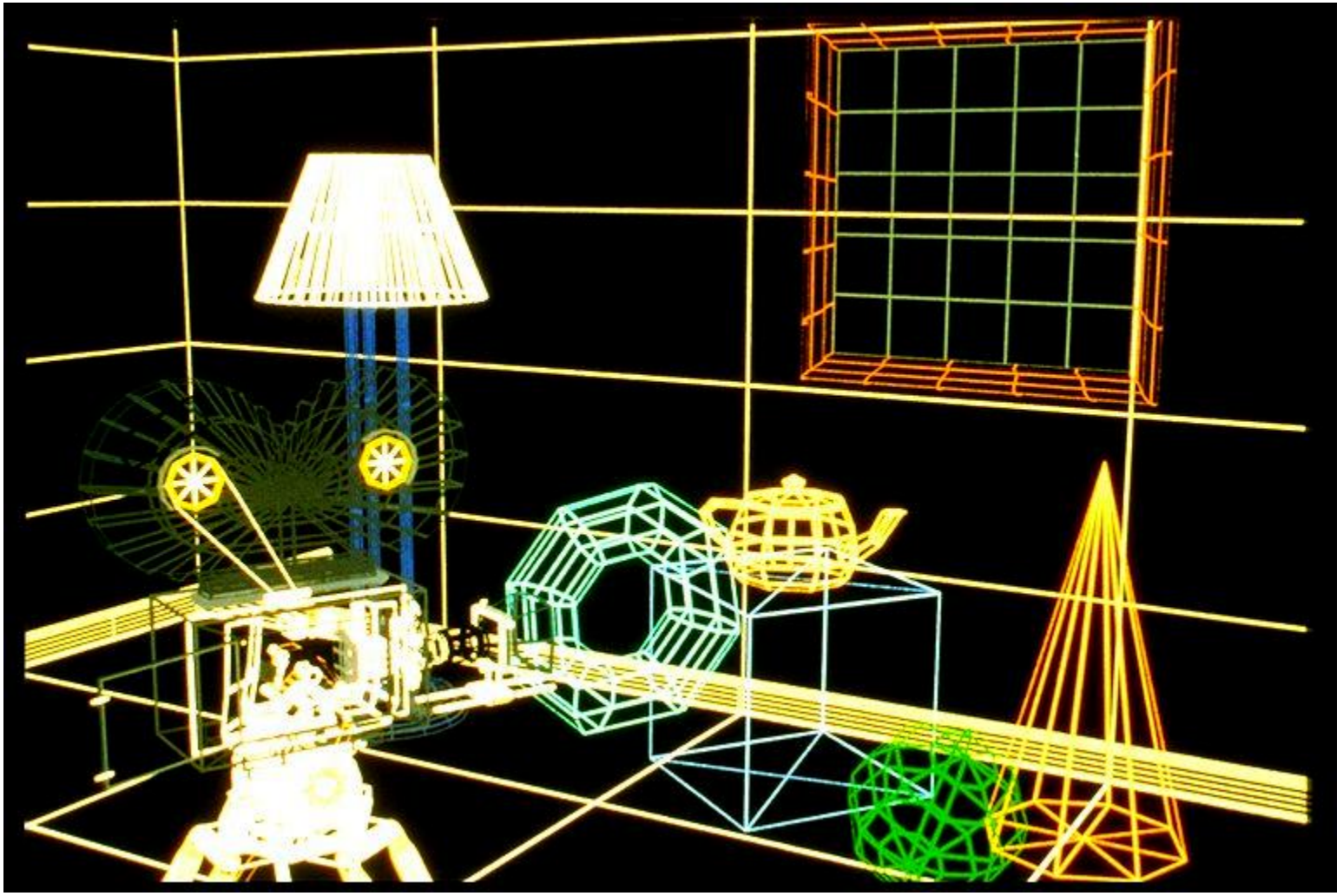
Depth Cueing



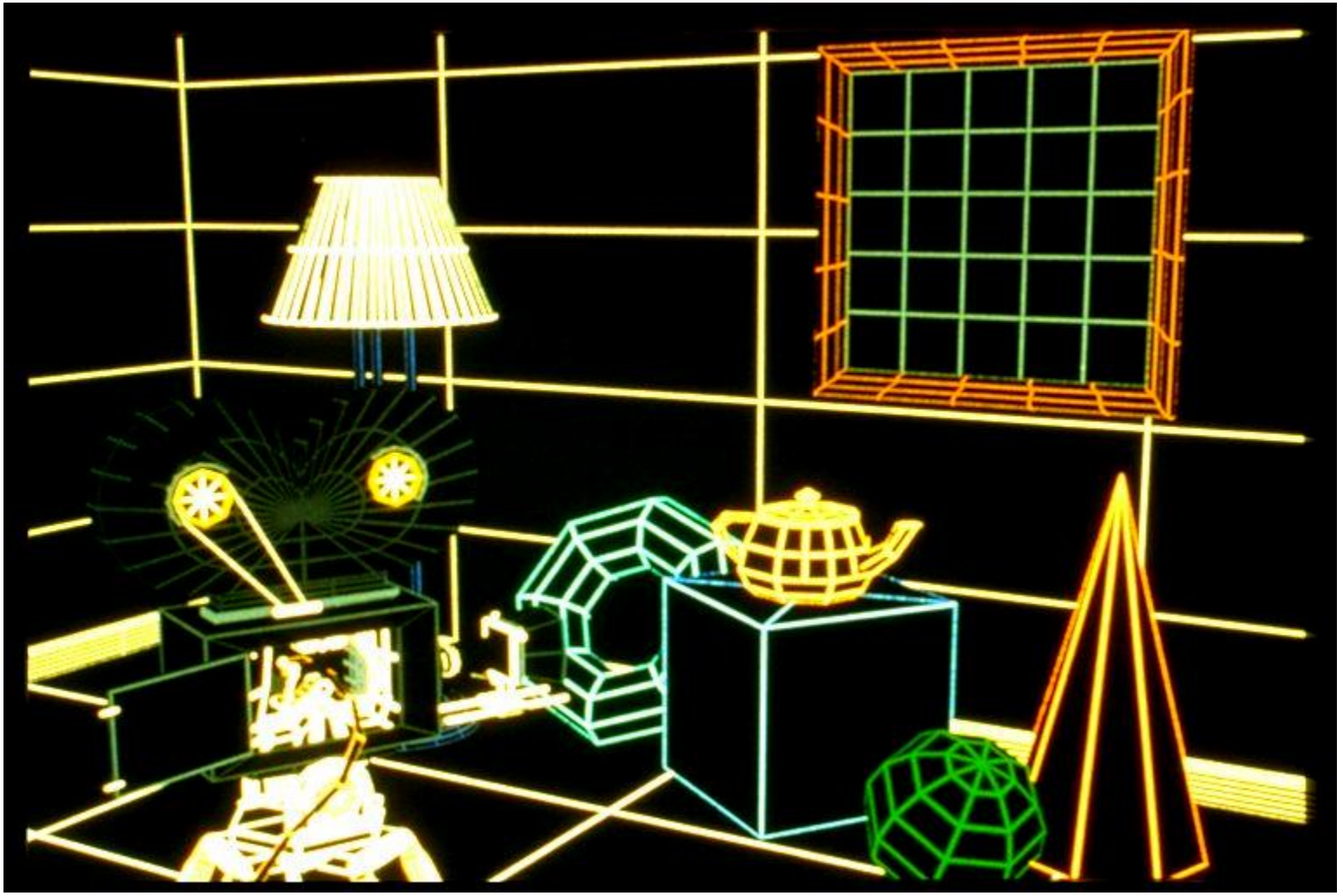
Depth Clipping



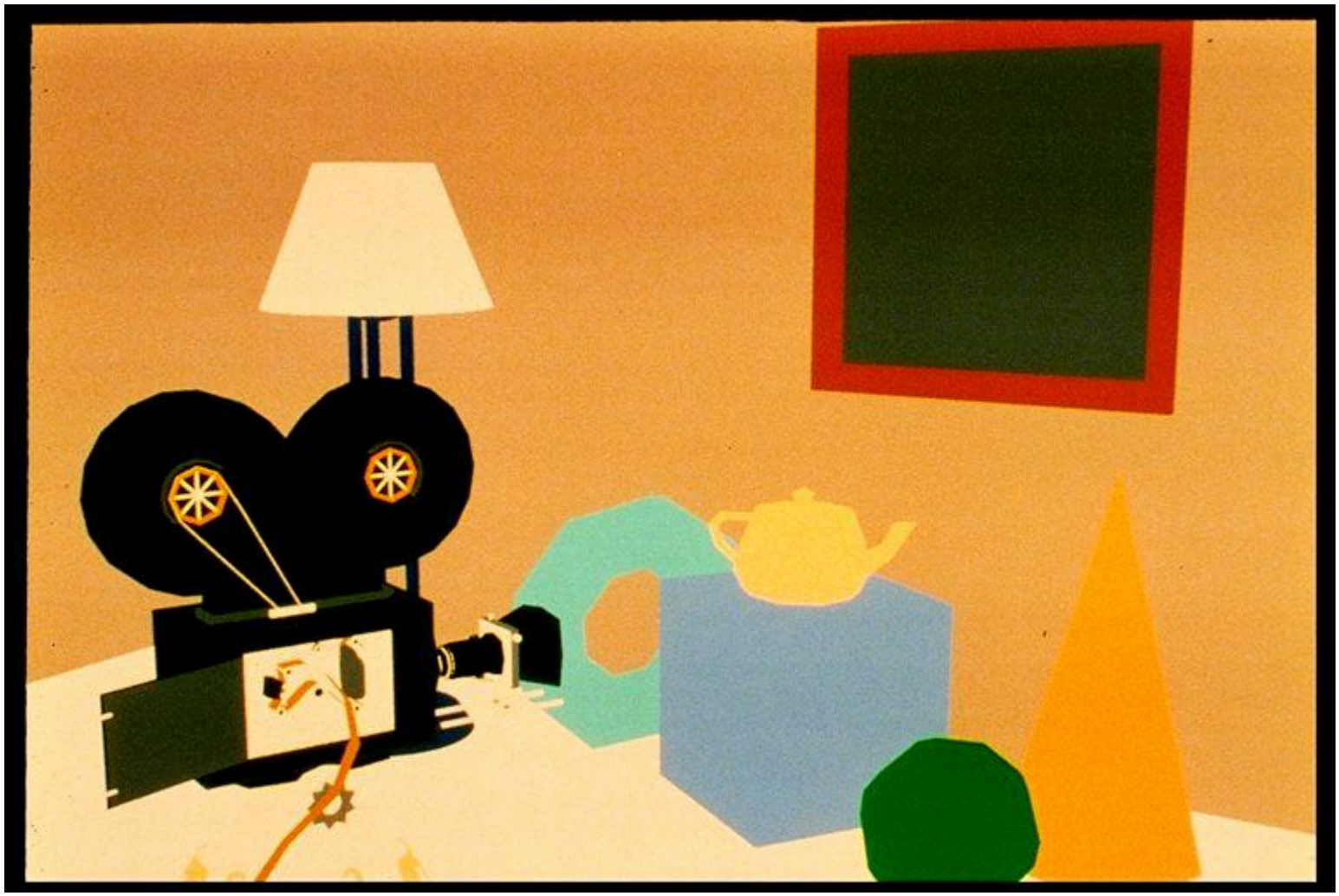
Colored Wireframes



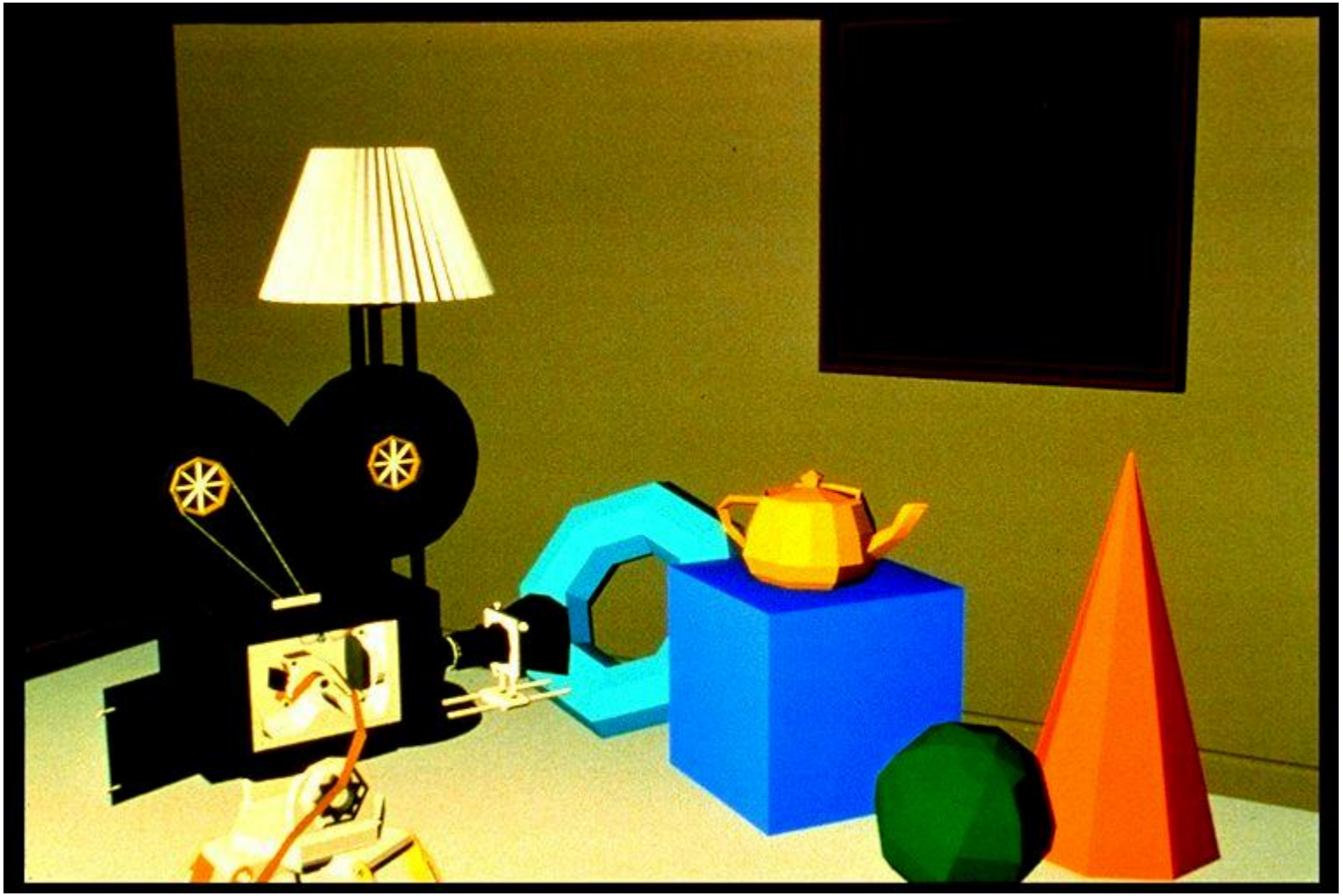
Hidden Line Removal



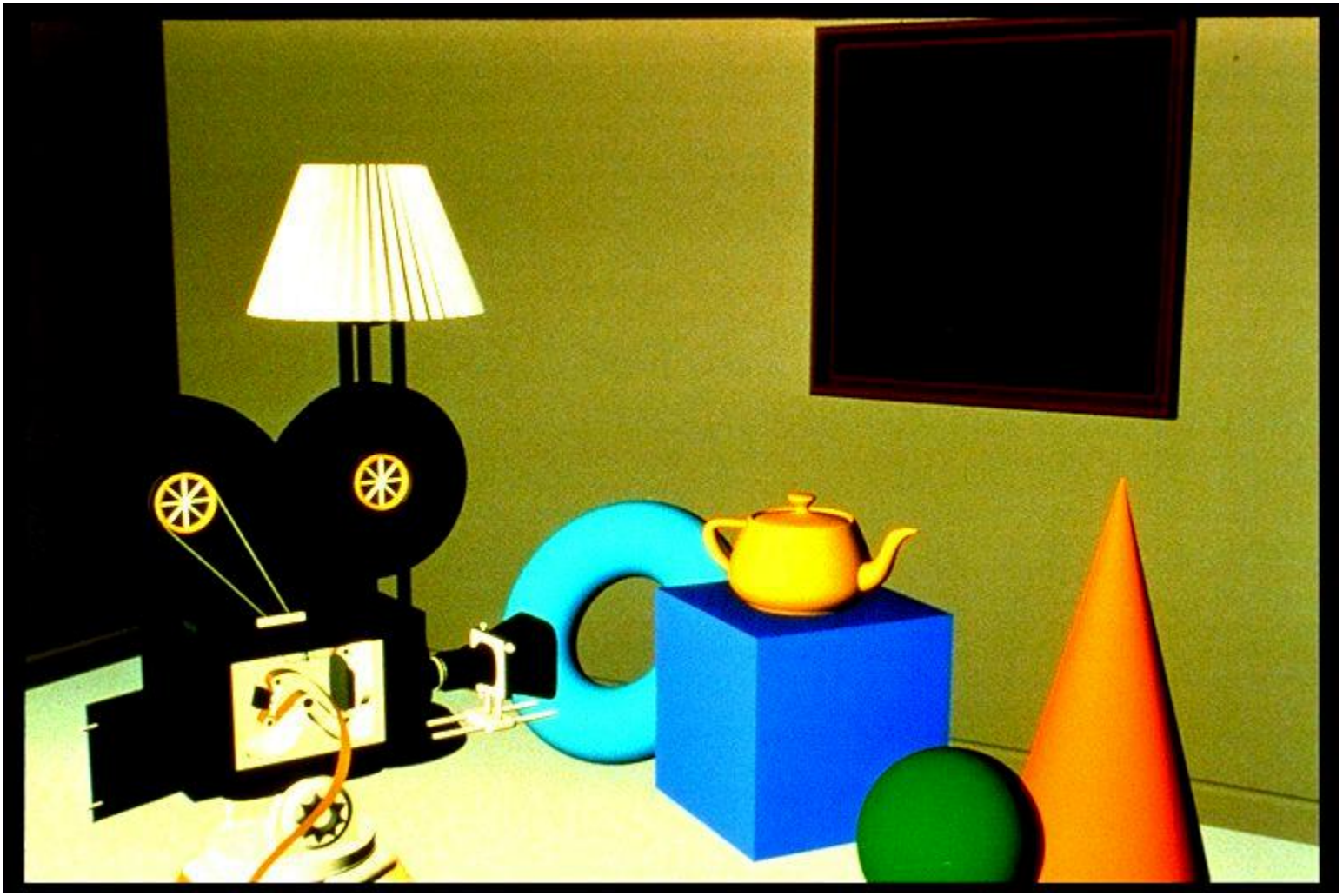
Hidden Surface Removal



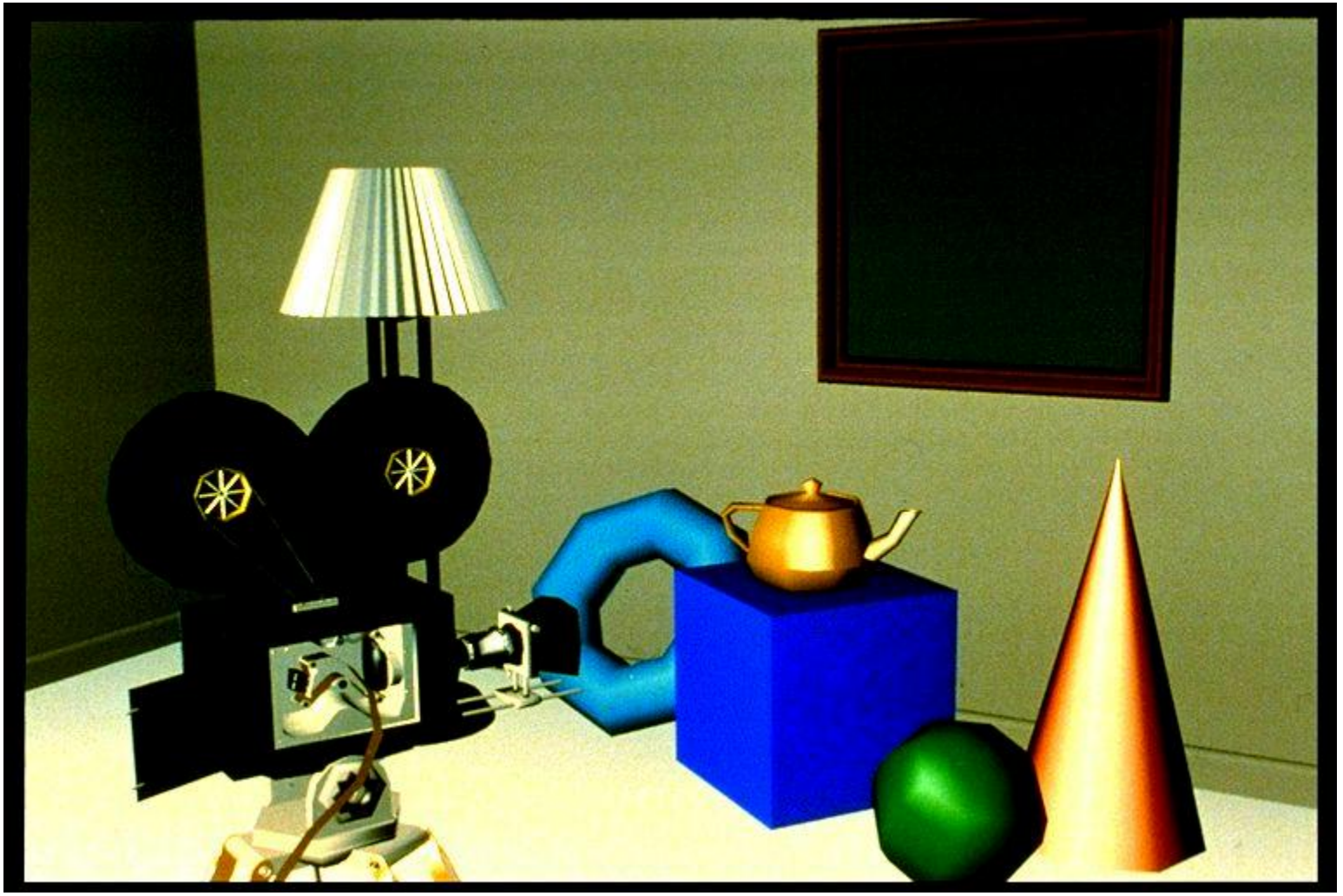
Per-Polygon Shading



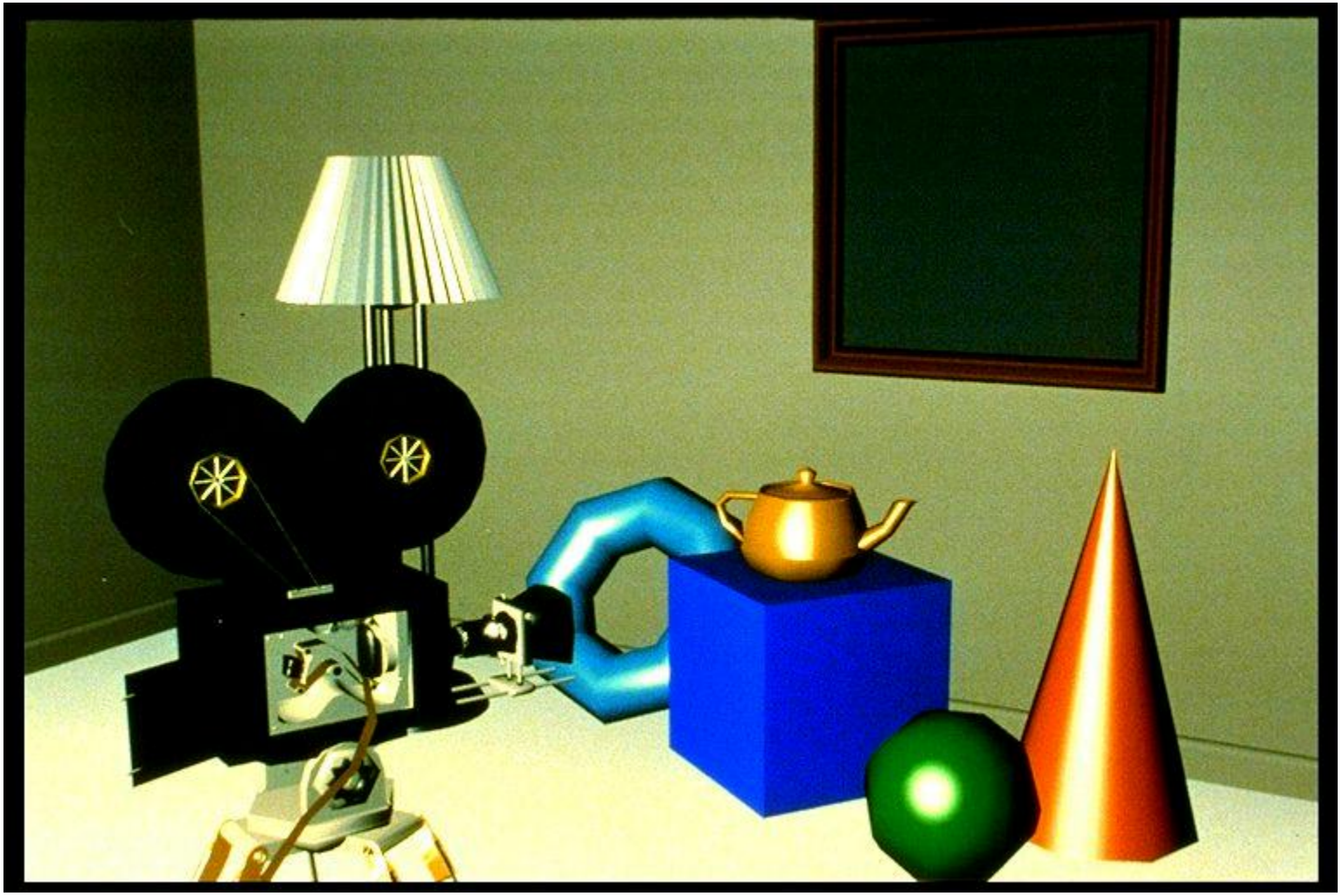
Gouraud Shading



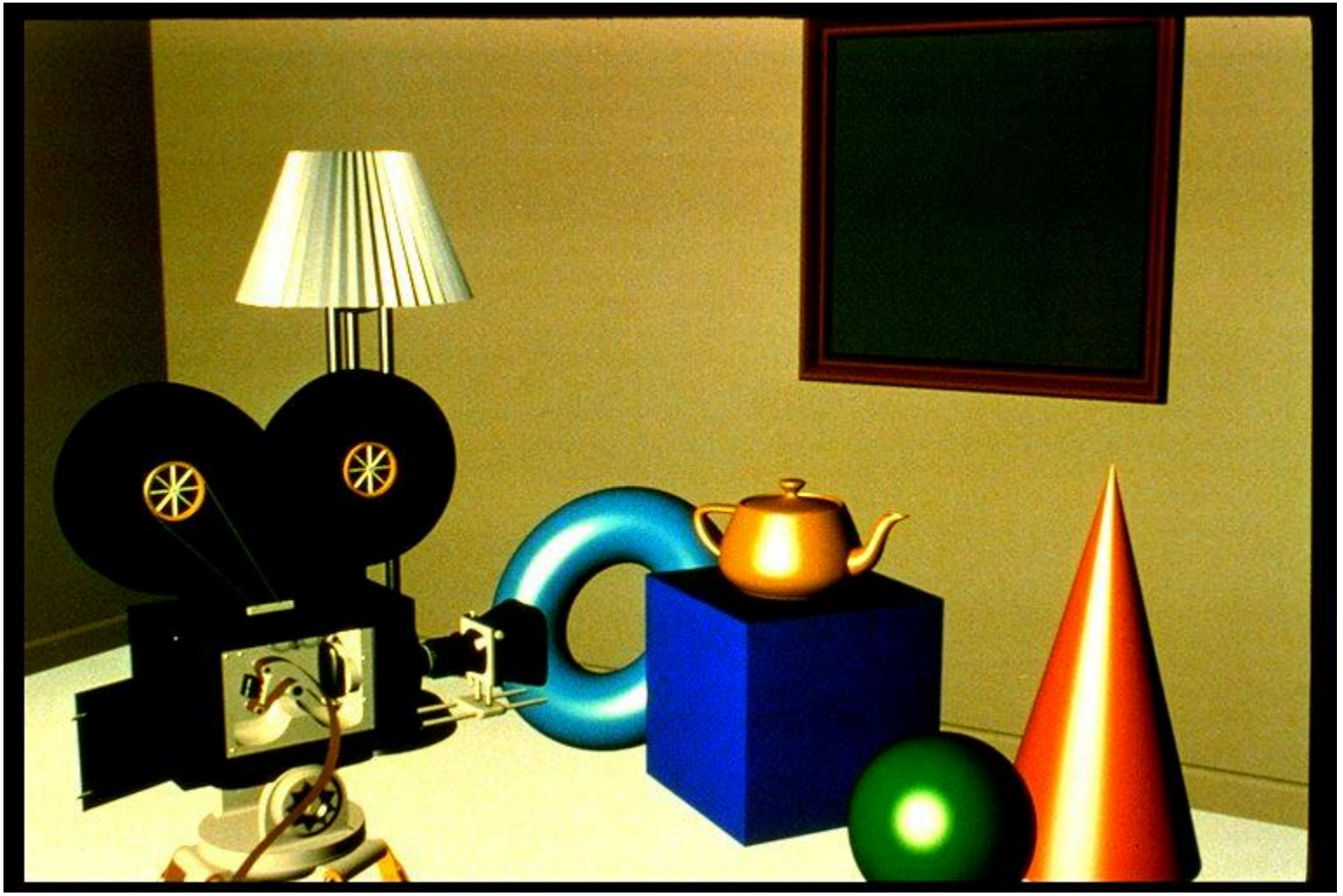
Specular Reflection



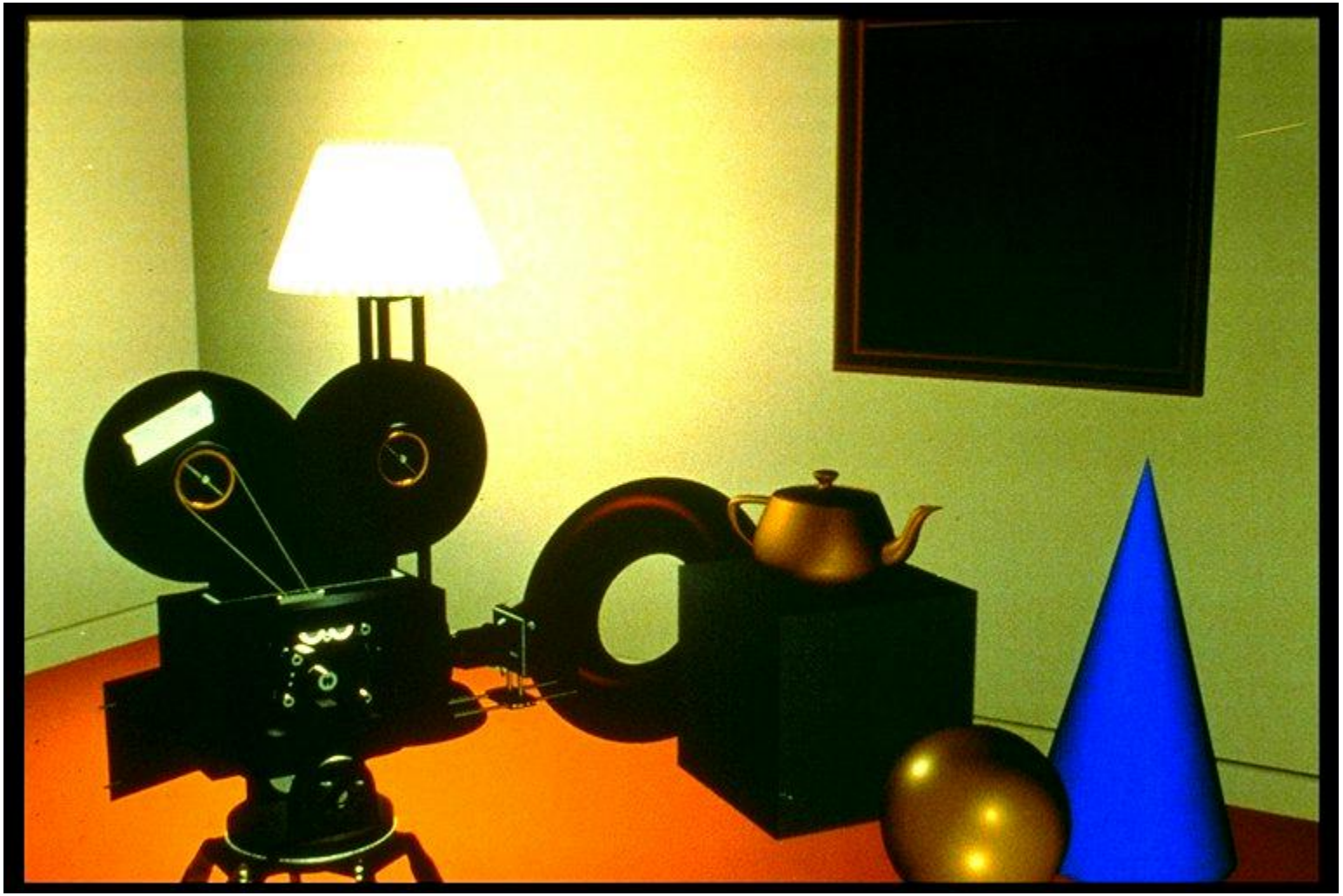
Phong Shading



Curved Surfaces



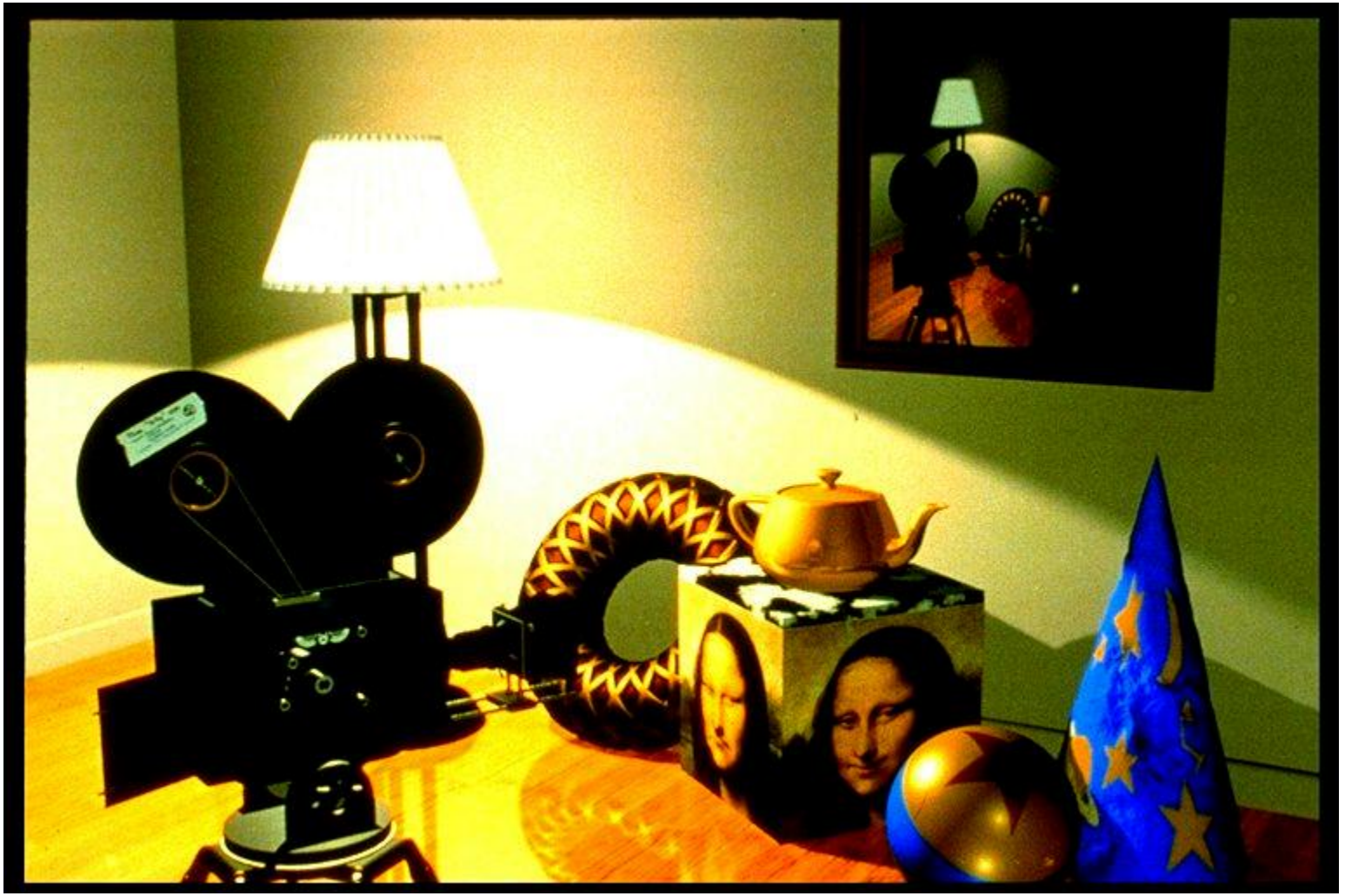
Complex Lighting and Shading



Texture Mapping

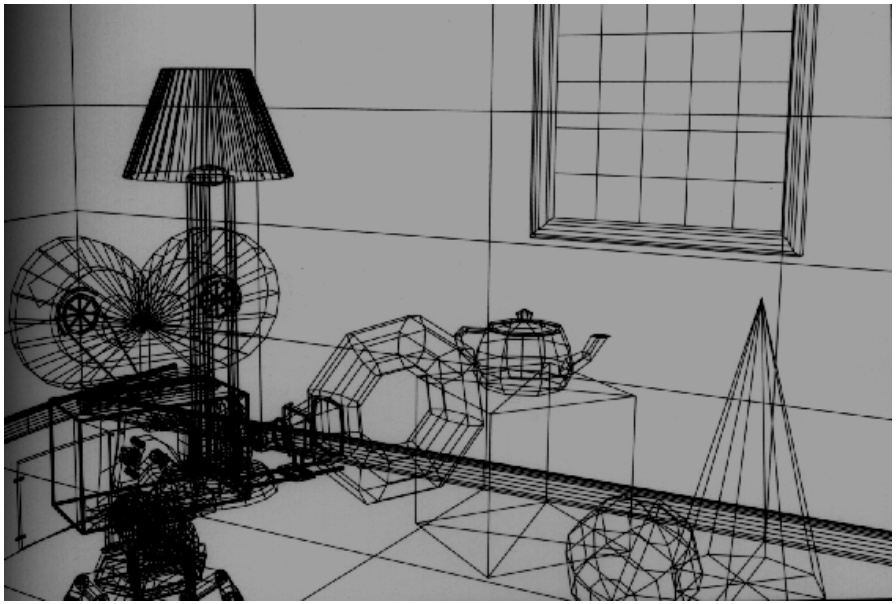
Displacement Mapping

Reflection Mapping



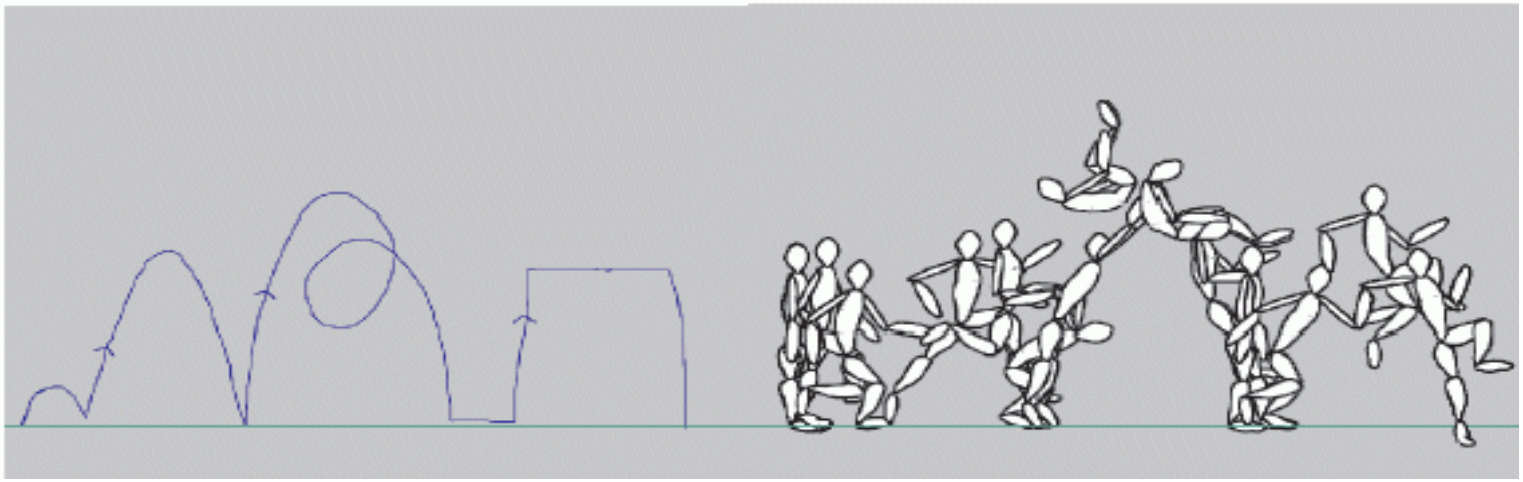
Modelling

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



Animation

- generating motion
  - interpolating between frames, states



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

Structure and Logistics

Course Information

- course web page is main resource
  - http://www.ugrad.cs.ubc.ca/~cs314/
    http://www.ugrad.cs.ubc.ca/~cs314/Vjan2016
  - updated often, reload frequently

- discussion group: Piazza
  - signup: https://piazza.com/ubc.ca/winterterm22015/cpsc314
  - standard: https://piazza.com/class/iixq3j3lemq4br
  - use Piazza, not direct email, for all questions
    - make posts private if you need to post your code
    - bonus marks for significant Piazza contributions

Teaching Staff

- instructor: Tamara Munzner
  - call me Tamara or Prof. Munzner, your choice
  - tmm@cs.ubc.ca
  - office hrs in ICICS/CS 005 (our lab)
    - Fridays right after class, 2-3
  - or by appointment in X661

- TAs: Glen Berseth, Silver Burla, Joao Cardoso, Qian Zhou
  - gberseth@cs, suisse_silver@hotmail, jaliborc@cs, qzhou@ece

Expectations

- substantial course!
  - heavy programming and heavy math
- fun course!
  - graphics programming is addictive, make great demos
- programming prereq
  - CPSC 221 (Program Design and Data Structures)
  - or both of CPSC 260 and EECE 320
- math prereq
  - one of MATH 200 (Calc III) or MATH 253 (Multivar Calc)
  - one of MATH 152 (Linear Systems) or MATH 221 (Matrix Algebra) or MATH 223 (Linear Algebra)

Course Structure

- 39% projects (programming)
  - 8% project 1: building beasties with shapes and math
  - 8% project 2
  - 8% project 3
  - 15% project 4: create your own graphics game
- 25% final (date TBA)
- 20% midterm (date TBA)
- 16% theory (written assignments/homeworks)
  - 4% each HW 1/2/3/4
- theory and programming projects interleaved

Programming Projects

- structure
  - WebGL / JavaScript
    - cross-platform, works on any modern browser
  - template code will be provided for projects 1-3
  - face to face grading in lab
- 4 projects
  - P1: building beasties
    - previous years: bison, spiders, armadillos, giraffes, frogs, elephants, birds, poodles, dinos, cats…
  - P2, P3: TBA
  - P4: create your own graphics game
- online Hall of Fame for P1 and P4
  - I'll also show off best of project 1 in class

Face to Face Grading

- all programming projects marked this way
  - TAs mark projects 1/2/3, I mark project 4 myself
- 10 min sessions in lab, signups posted before due date
  - arrive at least 5 min before your timeslot to set up
  - show timestamps on files (terminal window or file browser)
    - do **not** edit code after handin! if you discover problem, copy to fresh directory and edit there
  - run code to give brief demo of required/extra functionality
  - brief walkthrough of your code with marker in editor
  - marker asks you questions about both high-level algorithms and low-level code

Late Work

- 3 grace days
  - for unforeseen circumstances
    - no explanations needed/wanted
  - strong recommendation: don't use early in term
  - handing in late uses up automatically
    - unless you tell us otherwise
- 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 (eg doctor note)

http://www.ugrad.cs.ubc.ca/~cs314/Vjan2016/illness.html

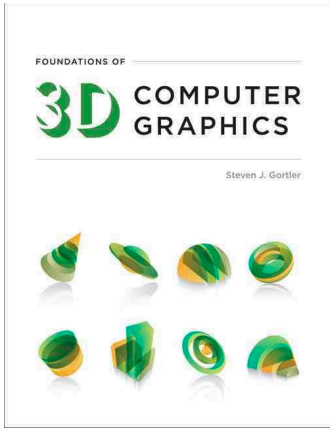
Regrading

- 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

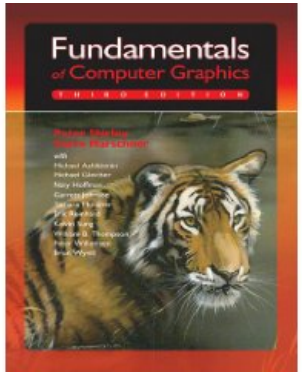
Labs

- labs start next week, no labs this week
- attend one (or more) labs per week (in CS 005)
  - Wed 3-4, Thu 1-2, Fri 1-2
    - TA coverage TBA
  - mix of activities
    - help with programming projects (office hours)
    - walking through example theory questions
    - tutorials on tools/languages
  - no deliverables (unlike intro classes)
  - strongly recommend that you attend
  - if you can't attend your regular one and/or want more help, drop by another (if there's space)
- there will also be extra TA office hours tied to deadlines
  - times TBA

Textbooks: Recommended Resources



- Foundations of 3D Computer Graphics
  - Steven Gortler, MIT Press
  - free online through UBC
    http://resolve.library.ubc.ca/cgi-bin/catsearch?bid=7005713



- Fundamentals of Computer Graphics
  - Peter Shirley, AK Peters
  - free online through UBC (2nd ed)
    http://resolve.library.ubc.ca/cgi-bin/catsearch?bid=7755681

- readings will be posted on schedule page
  - encouraged but not mandatory
  - pick whichever book suits your style