



History of computer graphics

CS 248 - Introduction to Computer Graphics

Autumn quarter, 2003

Slides for September 25 lecture

Ivan Sutherland (1963) - SKETCHPAD



pop-up menus

constraint-based drawing

hierarchical modeling

Display hardware

vector displays

- 1963 – modified oscilloscope
- 1974 – Evans and Sutherland Picture System

raster displays

- 1975 – Evans and Sutherland frame buffer
- 1980s – cheap frame buffers → bit-mapped personal computers
- 1990s – liquid-crystal displays → laptops
- 2000s – micro-mirror projectors → digital cinema

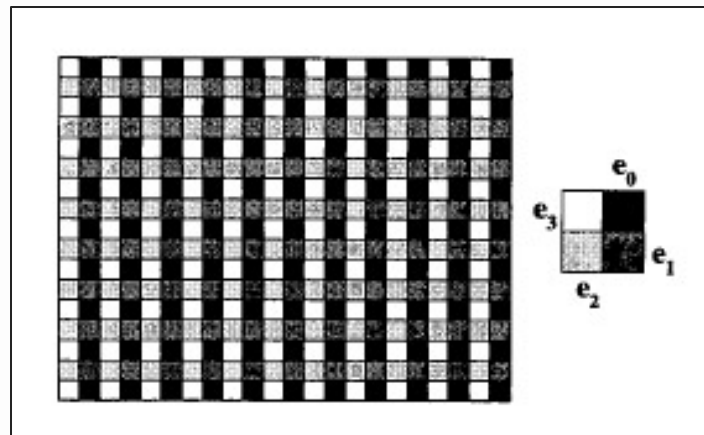
other

- stereo, head-mounted displays
- autostereoscopic displays
- tactile, haptic, sound

Input hardware

2D

- light pen, tablet, mouse, joystick, track ball, touch panel, etc.
- 1970s & 80s - CCD analog image sensor + frame grabber
- 1990s & 2000's - CMOS digital sensor + in-camera processing
 - high-X imaging (dynamic range, resolution, depth of field,...)

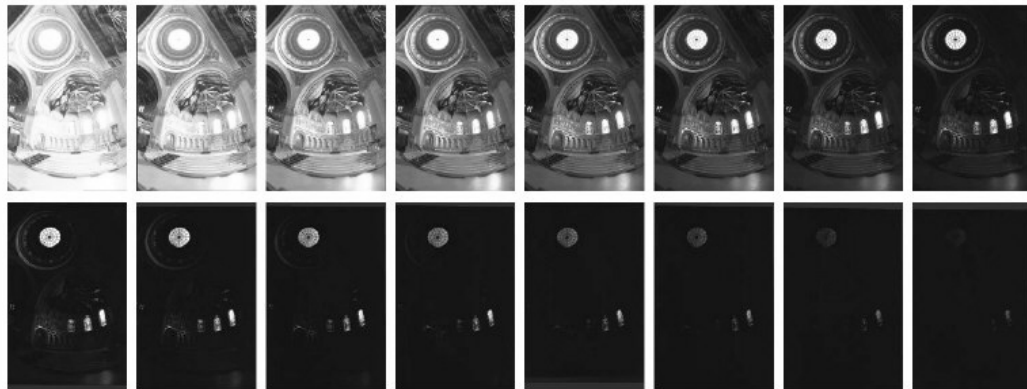


[Nayar00]

negative film = 130:1 (7 stops)

paper prints = 46:1

[Debevec97] = 250,000:1 (18 stops)



Input hardware

2D

- light pen, tablet, mouse, joystick, track ball, touch panel, etc.
- 1970s & 80s - CCD analog image sensor + frame grabber
- 1990s & 2000's - CMOS digital sensor + in-camera processing
→ high-X imaging (dynamic range, resolution, depth of field,...)

3D

- 3D trackers
- multiple cameras
- active rangefinders

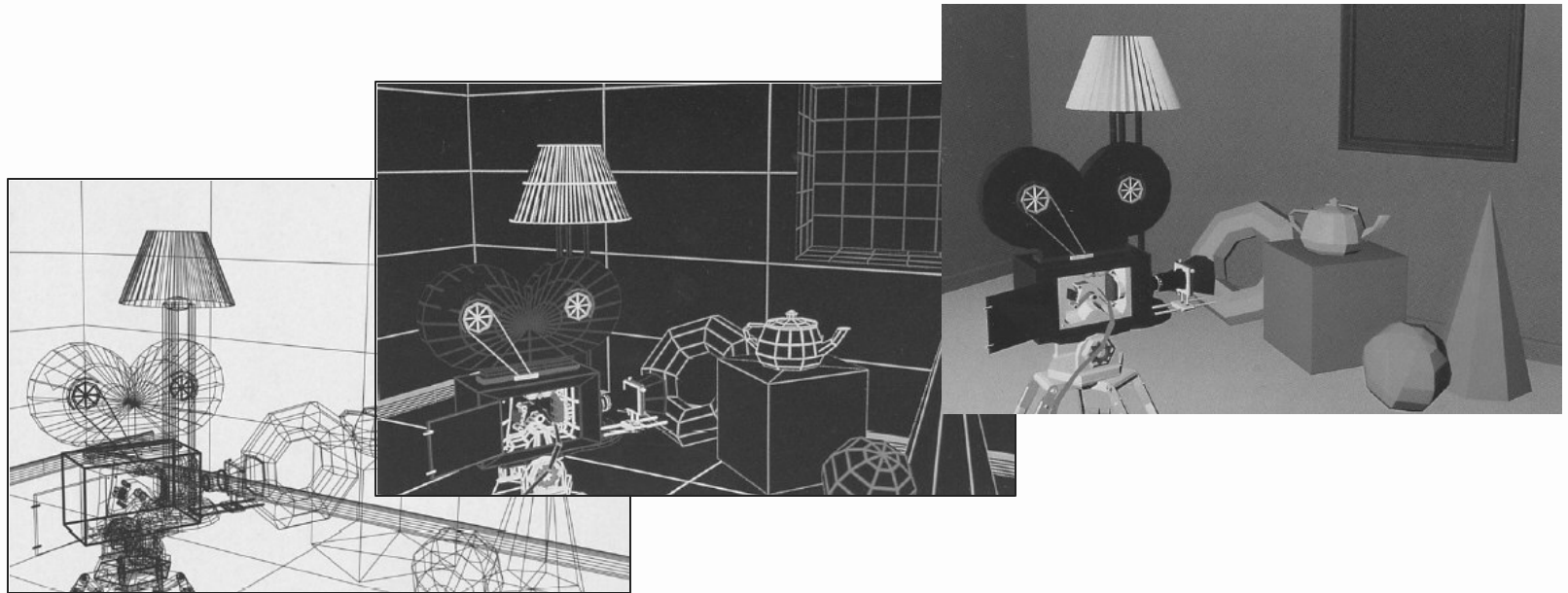
other

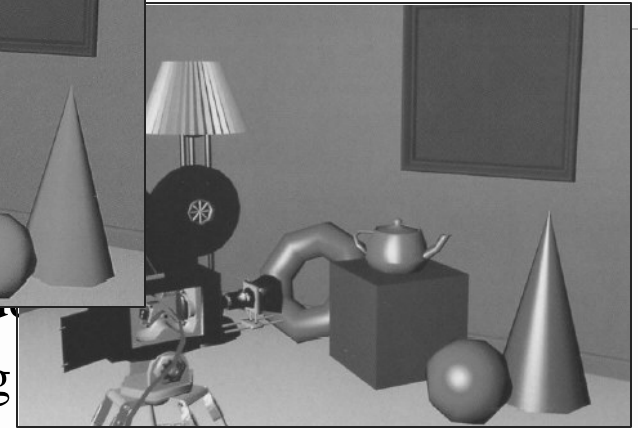
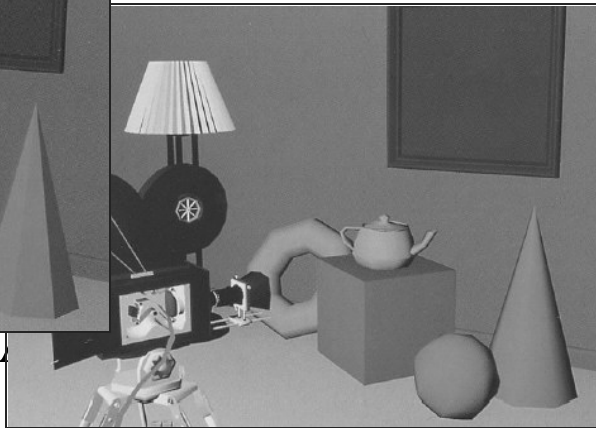
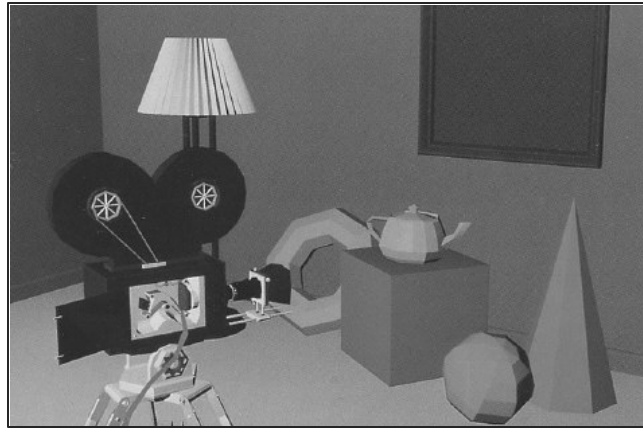
- data gloves
- voice

Rendering

1960s - the visibility problem

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





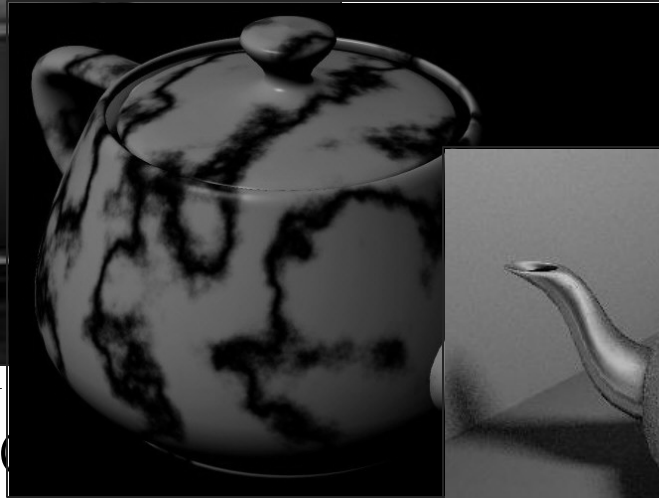
- Roberts (1963),
- Warnock (1969),
- Sutherland (1974) - visibility = sorting

1970s - raster graphics

- Gouraud (1971) - diffuse lighting
- Phong (1974) - specular lighting
- Blinn (1974) - curved surfaces, texture
- Crow (1977) - anti-aliasing



- Warnock (1970)
- Sutherland (1973)

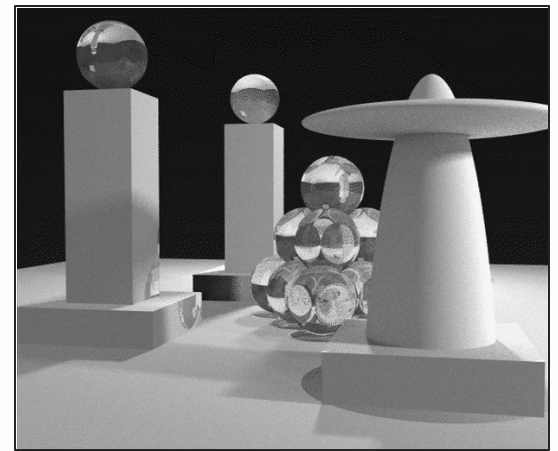
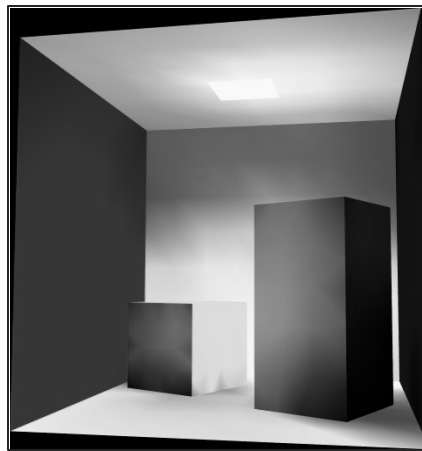
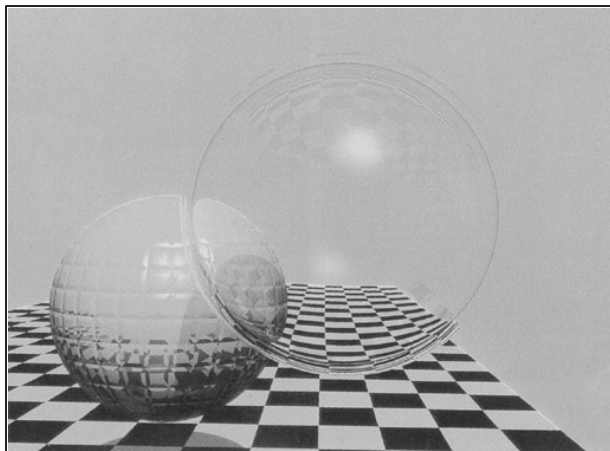


1970s - raster graphics

- Gouraud (1971) - diffuse lighting
- Phong (1974) - specular lighting
- Blinn (1974) - curved surfaces, texture
- Catmull (1974) - Z-buffer hidden-surface algorithm
- Crow (1977) - anti-aliasing

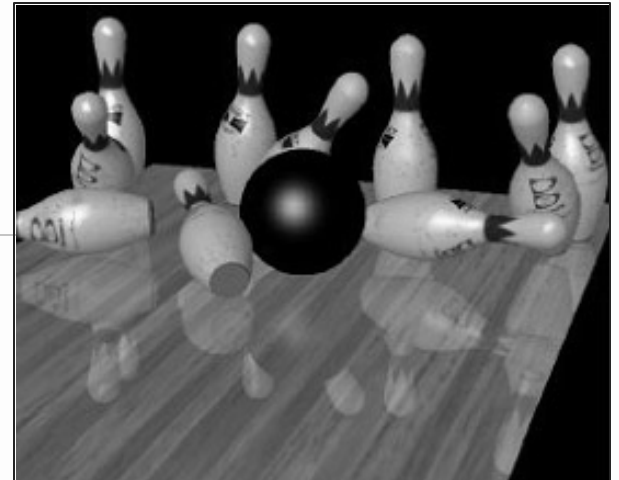
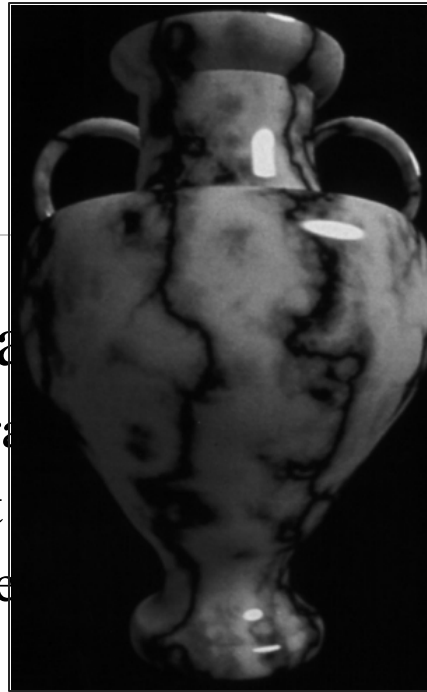
early 1980s - global illumination

- Whitted (1980) - ray tracing
- Goral, Torrance et al. (1984), Cohen (1985) - radiosity
- Kajiya (1986) - the rendering equation





- Whitted (1980) - rainbow
- Goral, Torrance et al. (1985) - radiosity
- Kajiya (1986) - the

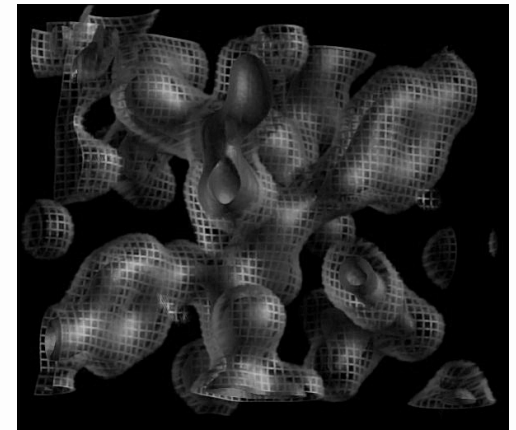
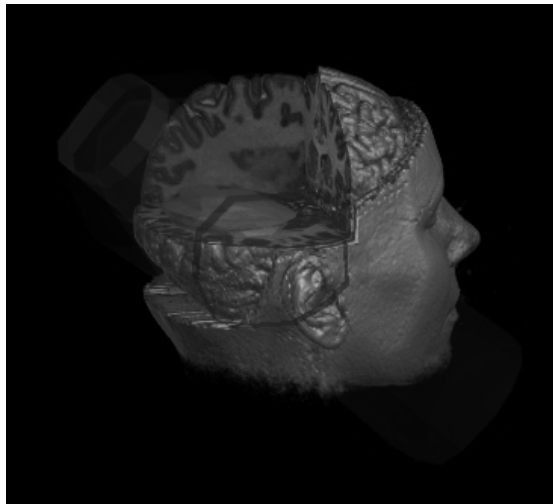
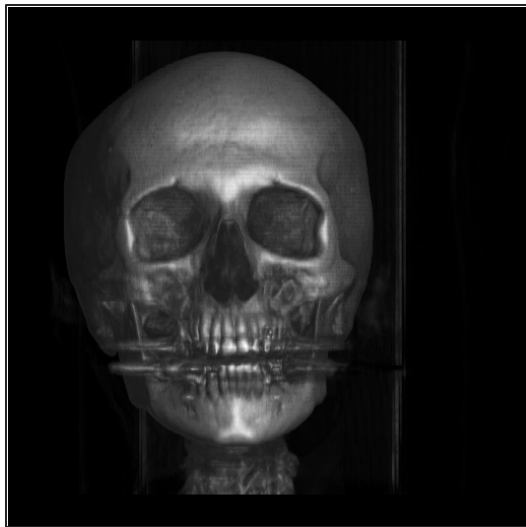


late 1980s - photorealism

- Cook (1984) - shade trees
- Perlin (1985) - shading languages
- Hanrahan and Lawson (1990) - RenderMan

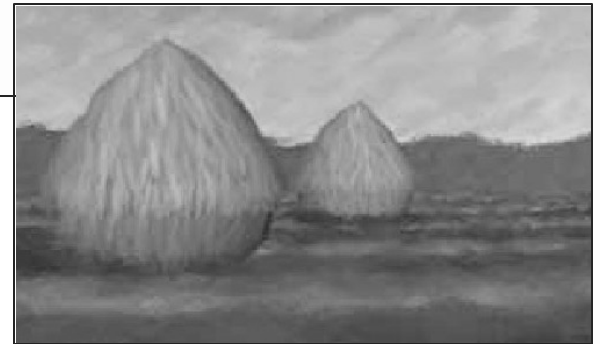
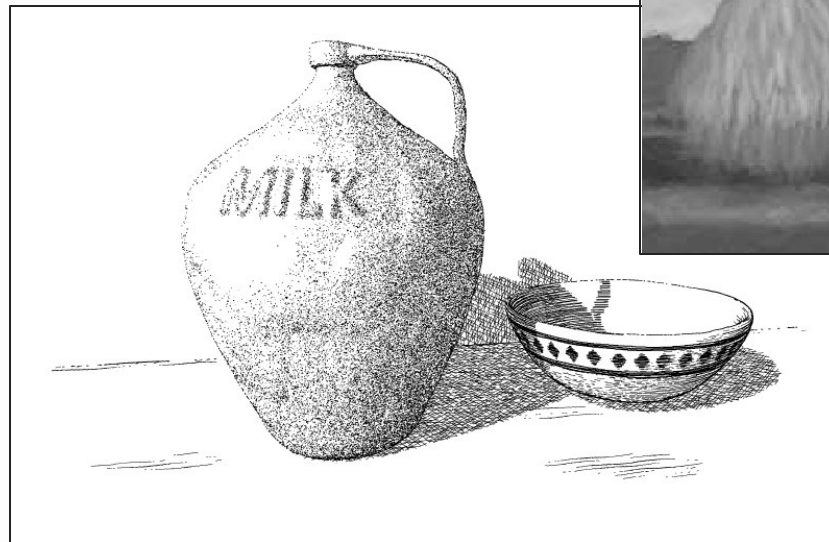
early 1990s - non-photorealistic rendering

- Drebin et al. (1988), Levoy (1988) - volume rendering
- Haeberli (1990) - impressionistic paint programs
- Salesin et al. (1994-) - automatic pen-and-ink illustration
- Meier (1996) - painterly rendering



early 1990s - non-photorealistic rendering

- Drebin et al. (1988), Levoy (1988) - volume rendering
- Haeberli (1990) - impressionistic paint programs
- Salesin et al. (1994-) - automatic pen-and-ink illustration
- Meier (1996) - painterly rendering



The graphics pipeline



Modeling

polygons

constructive solid geometry

parametric surfaces

implicit surfaces

subdivision surfaces

particle systems

volumes

Animation

scripted

key-frame interpolation

inverse kinematics

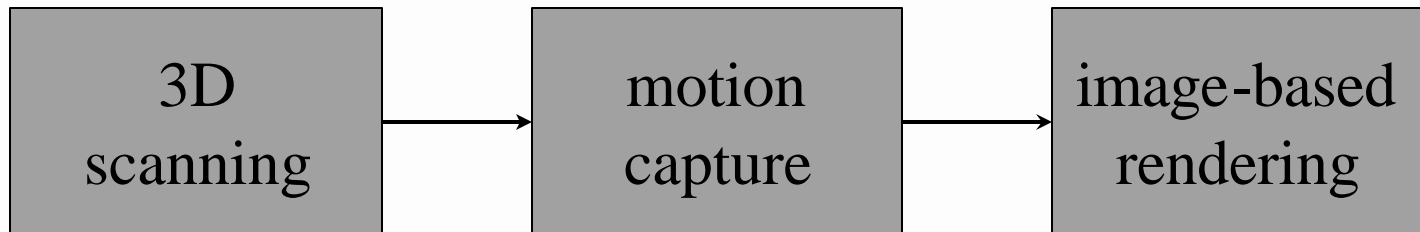
dynamics

The graphics pipeline

the traditional pipeline



the new pipeline?



early 1990s - non-photorealistic rendering

- Drebin et al. (1988), Levoy (1988) - volume rendering
- Haeberli (1990) - impressionistic paint programs
- Salesin et al. (1994-) - automatic pen-and-ink illustration
- Meier (1996) - painterly rendering

late 1990s - image-based rendering

- Chen and Williams (1993) - view interpolation
- McMillan and Bishop (1995) - plenoptic modeling
- Levoy and Hanrahan (1996) - light field rendering