History of computer graphics

CS 248 - Introduction to Computer Graphics
Autumn quarter, 2006
Slides for September 26 lecture

Ivan Sutherland (1963) - SKETCHPAD

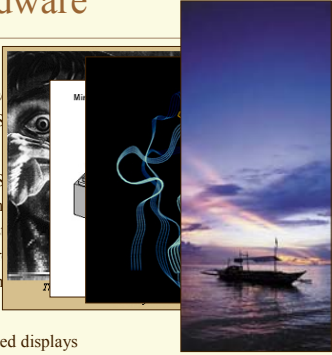pop-up menus
constraint-based drawing
hierarchical modeling

Display hardware

vector displays
- 1963 – modified os
- 1974 – Evans and S

raster displays
- 1975 – Evans and S
- 1980s – cheap fram
- 1990s – liquid-crys
- 2000s – micro-mirr
- 2010s – high dynan

other
- stereo, head-mounted displays
- autostereoscopic displays

Input hardware

2D
- light pen, tablet, mouse, joystick, track ball, touch panel, etc.
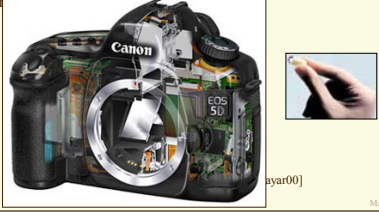- 1970s & 80s - CCD analog image sensor + frame grabber

Input hardware

2D

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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

[ayar00]

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negative film = 130:1 (7 stops)
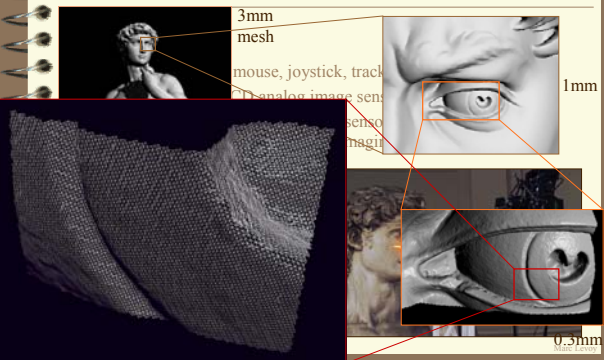paper prints   = 46:1
[Debevec97] = 250,000:1 (18 stops)

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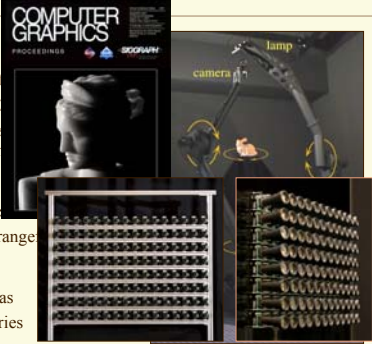## Input hardware

3mm
mesh

mouse, joystick, track

D analog image sens

senso

1mm

0.3mm

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Input hardware

2D
- light pen, table
- 1970s & 80s - C
- 1990s & 2000's
  high-dynam

3D
- 1980s - 3D trac
- 1990s - active range

4D and higher
- multiple cameras
- multi-arm gantries

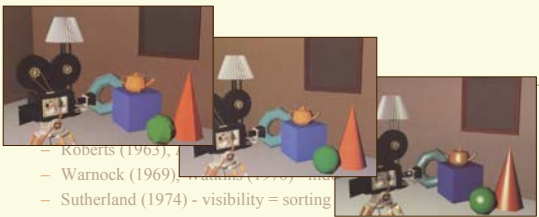
Rendering

1960s - the visibility problem
- Roberts (1963), Appel (1967) - hidden-line algorithms
- Warnock (1969), Watkins (1970) - hidden-surface algorithms
- Sutherland (1974) - visibility = sorting
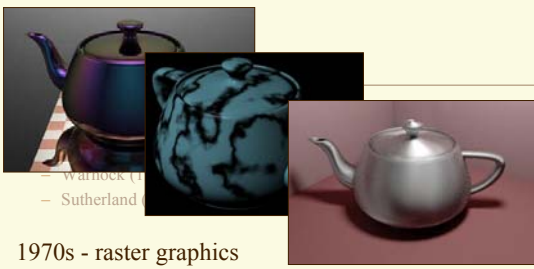
- Roberts (1963),
- Warnock (1969), Watkins (1970) - hid
- Sutherland (1974) - visibility = sorting

1970s - raster graphics
- Gouraud (1971) - diffuse lighting
- Phong (1974) - specular lighting
- Blinn (1974) - curved surfaces, texture
- Crow (1977) - anti-aliasing

- Warnock (1
- Sutherland

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

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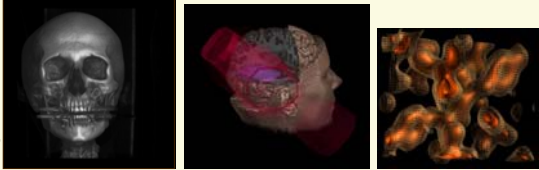– Kajiya (1986) - the rendering equation

late 1980s - photorealism
– Cook (1984) - shade trees
– Perlin (1985) - shading languages
– Hanrahan and Lawson (1990) - RenderMan
→ shaders

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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
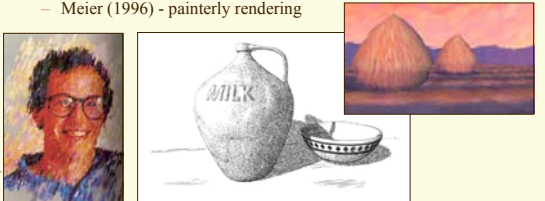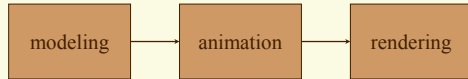
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The graphics pipeline

```
┌──────────┐     ┌───────────┐     ┌───────────┐
│ modeling │ ──> │ animation │ ──> │ rendering │
└──────────┘     └───────────┘     └───────────┘
```

Modeling

polygons
constructive solid geometry
parametric surfaces
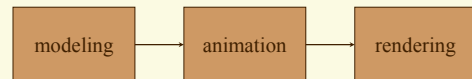implicit surfaces
subdivision surfaces
particle systems
volumes

Animation

scripted
key-frame interpolation
inverse kinematics
dynamics

The graphics pipeline
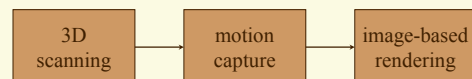
the traditional pipeline

```
┌──────────┐     ┌───────────┐     ┌───────────┐
│ modeling │ ──> │ animation │ ──> │ rendering │
└──────────┘     └───────────┘     └───────────┘
```

the new pipeline

```
┌──────────┐     ┌───────────┐     ┌──────────────┐
│    3D    │ ──> │  motion   │ ──> │ image-based  │
│ scanning │     │  capture  │     │  rendering   │
└──────────┘     └───────────┘     └──────────────┘
```

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– 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

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