Course 67609:
Computer Graphics

http://www.cs.huji.ac.il/~cg/

Who, When, and Where:

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Exercise: Rony Goldenthal
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Questions should be posted to the newsgroup:
local.course.cg or e-mailed to cg@cs

What is Computer Graphics?

◆ Computer graphics deals with:
  - ◆ Geometric modeling: creating mathematical models of 2D and 3D objects.
  - ◆ Rendering: producing images given these models.
  - ◆ Animation: defining/representing time-dependent behavior of objects.
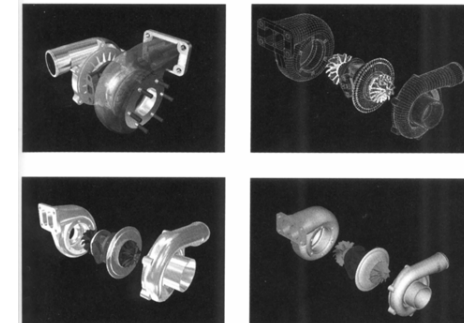

Applications

◆ Simulators (flight, driving)
◆ Mechanical CAD (Computer Aided Design)

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- ◆ Mechanical CAD (Computer Aided Design)
- ◆ Architectural visualization
- ◆ Virtual reality
- ◆ Advertising

Applications

- ◆ Computer games
- ◆ Special effects
- ◆ Computer art
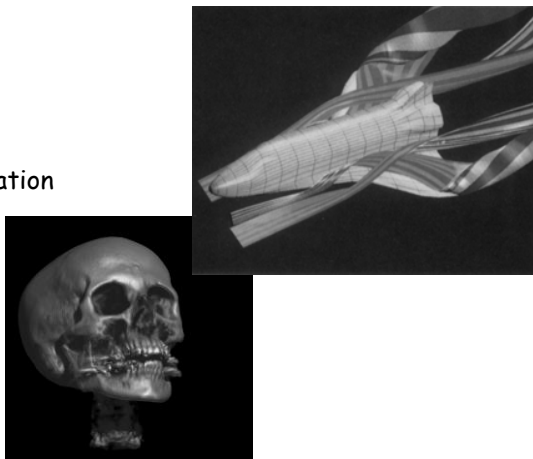
Applications

- ◆ Computer games
- ◆ Special effects
- ◆ Computer art
- ◆ Education
- ◆ Scientific visualization
- ◆ Medical imaging

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Example: Geri's Game

Geometric Modeling

◆ From a concept (or a real object) to a geometric model representable on a computer.

◆ Example: a sphere can be described by four real numbers: (x,y,z,r).

◆ Example: a polygon can be described by listing the coordinates of its vertices.

Geometric Modeling

◆ How to represent more complex shapes?
  - ◆ Polygon meshes: a large collection of polygonal facets, connected with each other.
  - ◆ Free-form surfaces: using low-degree polynomial functions.
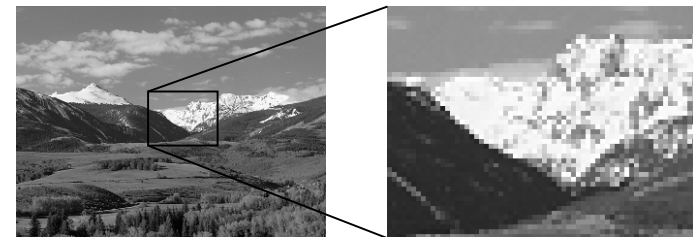 - ◆ CSG: construct a shape by applying boolean operations on primitive shapes.

Rendering

◆ Given a scene and viewing parameters, produce an image = a 2D array of pixels.

Rendering

- ◆ Important sub-tasks:
  - ◆ Scan conversion: Which pixels in the image are covered by each object?
  - ◆ Visible surface algorithms: What is visible at each pixel of the image?
  - ◆ Illumination and shading: What color should be assigned to each pixel?

Animation

- ◆ How to define complex time-dependent behavior of objects?
- ◆ Examples:
  - ◆ Automatic inbetweening (interpolation between key-frames).
  - ◆ Physically-based simulation.

Context

- ◆ Image Processing: from images to images

- ◆ Computer Vision: from images to models

- ◆ Computer Graphics: from models to images

Course Topics

- ◆ Modeling and Viewing Transformations
- ◆ Scan-conversion Algorithms
- ◆ Hidden Surface Removal
- ◆ Color Spaces
- ◆ Illumination and Shading
- ◆ Curves and Surfaces
- ◆ Ray Tracing
- ◆ Radiosity

Bibliography

- *Computer Graphics: principles and practice (2nd edition)*, by Foley, van Dam, Feiner, and Hughes.

- *Advanced Animation and Rendering Techniques*, by Watt and Watt.

- *OpenGL Programming Guide*, by Woo, Neider, and Davis.

Requirements and Grades

- Six programming assignments.
- Final exam: 2.5 hours.

- Grade: 50% exercises, 50% exam.

Graphics System Architecture and Display Hardware
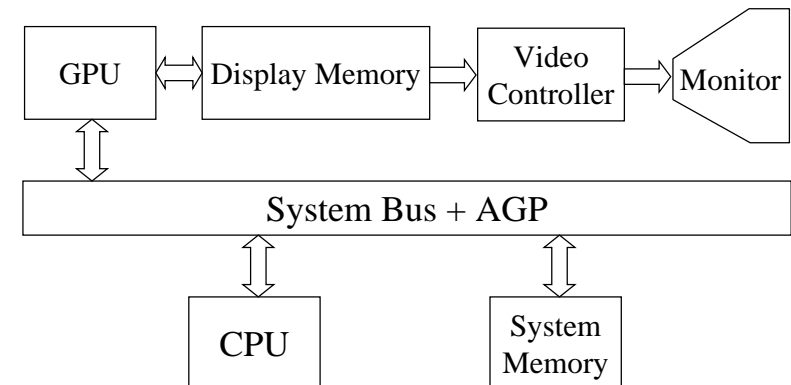
Graphics System Architecture

GPU ⟷ Display Memory → Video Controller → Monitor

System Bus + AGP

CPU   System Memory
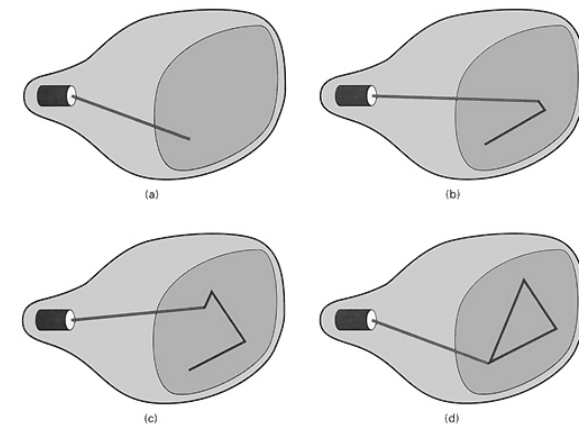
Display Hardware

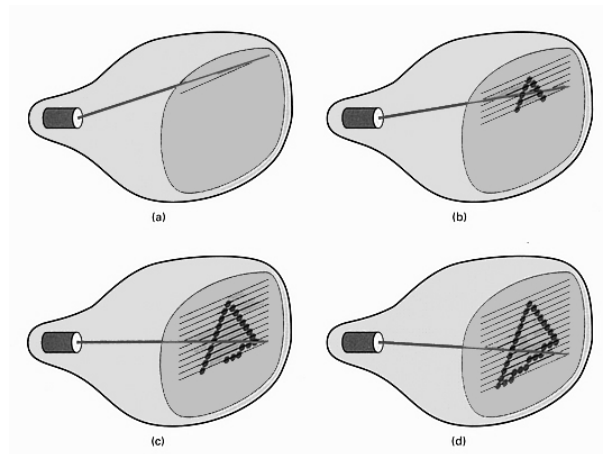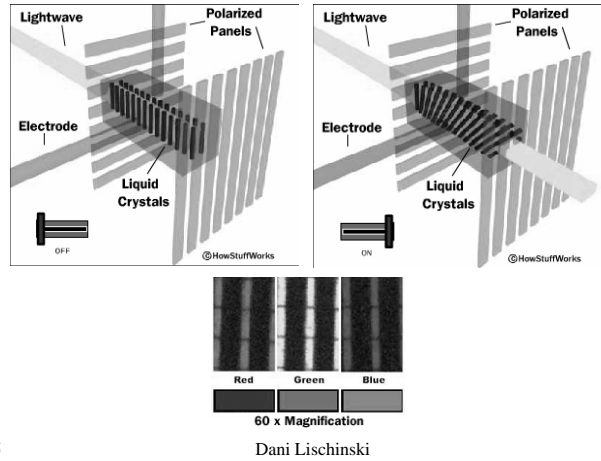◆ Cathode Ray Tube (CRT) Displays:
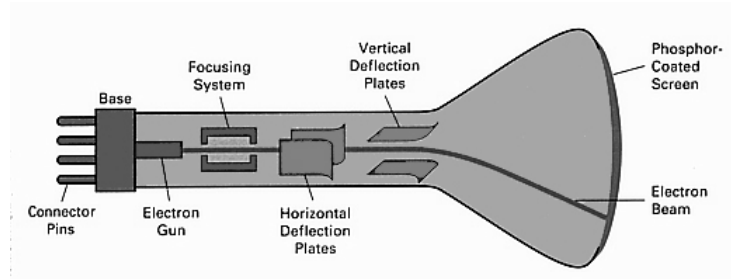
Vector Displays

Raster Displays

The Shadow Mask

LCD Displays

See http://electronics.howstuffworks.com/lcd.htm