**Binghamton University**

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**State University of New York**

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School of Engineering
and Applied Science

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**WARNING**



**CS 560**

**Computer Graphics**

**Professor Richard Eckert**

**Lecture # 1**

**January 22, 2001**

# CS-460/560: Computer Graphics

Richard R. Eckert

M,W, 8:30-9:50 A.M.

EB-J23/J15

Lecture 1 - 1/22/01

## Contacting Me

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- My web page: www.cs.binghamton.edu/~reckert/
  - See link to: CS-460/560 (Computer Graphics)
- EngiNet CS-560 course web page: http://www.enginet.binghamton.edu/cs560

## Course Materials

- Text book: D. Hearn and M.P. Baker, "Computer Graphics, C Version," 2nd Edition., Prentice Hall, 1997
- Online notes: CS-460 link on my home page
- Class presentations (slides and audio): EngiNet CS-560 web page

## Prerequisites

- Data Structures (CS-240)
- Basic Knowledge of Linear Algebra
  - Matrix/Vector Manipulation
- C or C++ Programming
  - Visual C++ Ideal
- Some Knowledge of Computer Organization
  - e.g., CS-220

## Evaluation

- CS-460:
  - 2 Term Exams (20% each)
  - Programming Assignments (40%)
  - Final Exam (20%)
- CS-560:
  - 2 Term Exams (15% each)
  - Programming Assignments (40%)
  - Research Paper or Project (10%)
  - Final Exam (20%)

## Course Schedule (by weeks)

- 1. Introduction/Applications/History, Introduction to Win32 API Programming
- 2. Computer Graphics Hardware and Software,
- 3. Graphics Output Primitives: lines, polygons, circles, curves, text
- 4. Display Attributes and Area Fill Algorithms
- 5. 2-Dimensional Geometric Transformations
- 6. 2-D Windows, Viewports, and Clipping
  - *** Term Examination # 1 ***

## Course Schedule (by weeks)

- 7. Interactive 2-D Graphics: Input Devices, GUI Techniques
- 8. Segmentation, Hierarchical Modeling; PHIGS, OpenGL, VRML
- 9. Curved lines and surfaces, parametric equations, Bezier and B-spline curves
- 10. Animation, Sprites, Game Development, DirectX
- 11. 3-D Graphics: Transformations
- 12. 3-D Graphics: Viewing and Projections

## Course Schedule (by weeks)

- 13. Hidden Surface Removal
  - *** Term Examination # 2 ***
- 14. Illumination, Reflection, Shading, Texturing, Ray Tracing, Radiosity
- 15. Fractals, Iterated Function Systems, L-Systems, Particle Systems, Escape-time algorithms, Chaos

## Lecture 1: Computer Graphics

See:

Week 1-A: An Introduction to Computer Graphics

URL:

http://www.cs.binghamton.edu/~reckert/460/wk1a.htm

## Computer Graphics

- Using a computer to generate visual images
- Definition:
  - Creation, storage, manipulation, and display of models of scenes (real or imagined) using the computer
- Interactive Computer Graphics:
  - User dynamically controls displayed image attributes by means of interactive input devices

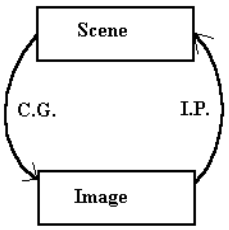
## Motivation

- Human visual channel highly developed
- Efficient for communicating complex ideas

## Related Field--Image Processing

- Reconstruction of objects from images
- Computer Graphics--Synthesis of images
- Image Processing--Analysis of images
- Image Processing subfields:
  - image enhancement
  - computer vision
  - pattern recognition (AI important)

## Computer Graphics & Image Processing




## Two Phases of Computer Graphics

- Modeling
  - Mathematical representations of objects/scenes
- Rendering
  - Production of an image from a model

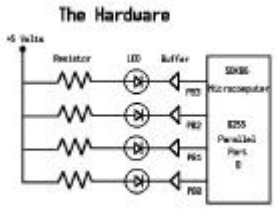
## Features of Computer Graphics Models

- Output primitives:
  - building blocks
- Data structures:
  - how primitives relate to each other

## Levels of Complexity of CG

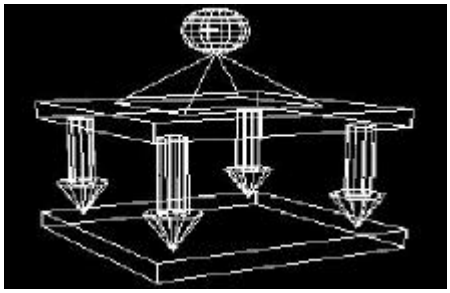
- 2-D line Drawings: Primitives
- 2-D colored images: Area fill
- 3-D line drawings: 3-D to 2-D projection
- 3-D colored images: Hidden surface removal, color, shading
- 3-D photorealistic images: materials properties, lighting, reflection, transparency, shadows (physics), complex object models
- Animation at all levels: Movement

## 2-D Line Drawing

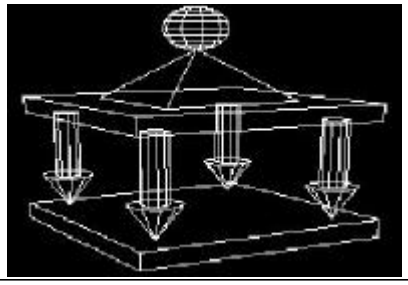



## 2-D Colored Image

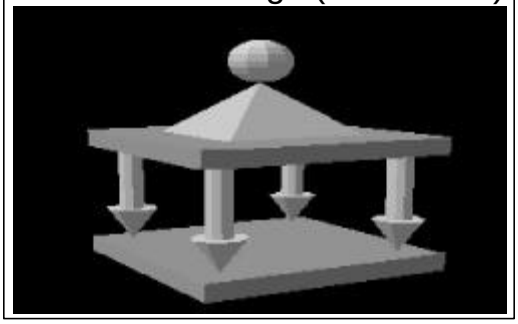
3-D Line Drawing



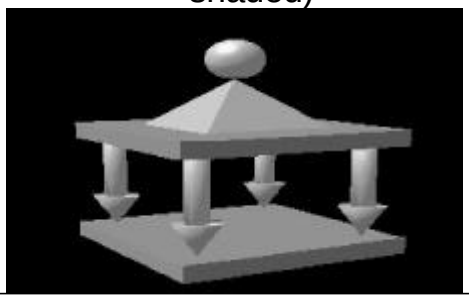
3-D Line Drawing (hidden lines removed)



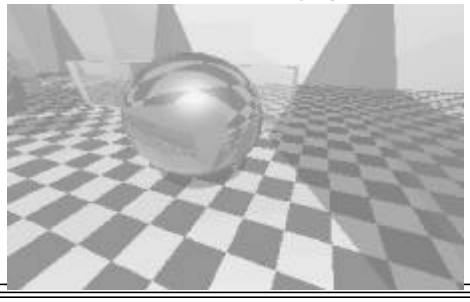
3-D Colored Image (flat shaded)



3-D Colored Image (smooth shaded)



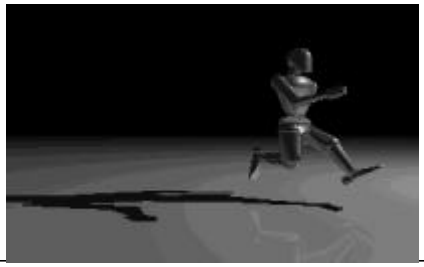
3-D Photorealistic Image (ray traced image)



3-D Photorealistic Image (fractal mountains, L-system plants)

## An Animation of a 3D Scene

- Frames generated by ray tracing



## Brief History of Computer Graphics

- Early 50s--MIT Whirlwind Computer
  - First computer-driven CRT
- Middle 50s--SAGE Air Defense System
  - Selection of targets with light pen
  - First interactive graphics
- Early 60s--Ivan Sutherland's PhD thesis
  - Proposed 1st model for interactive graphics
  - Identified basic data structures
  - Discovered important algorithms

## History of CG (continued)

- Middle 60s--GM's Digigraphic Design System
  - Beginning of CAD
  - Costly hardware
  - Hard-to-write programs
  - Non-portable software
- Late 60s--Tektronix Direct View Storage Tube
  - First inexpensive graphics display device

## History of CG (continued)

- Early 70s--First microprocessors
  - first microcomputers
  - inexpensive
  - primitive graphics capability
- Late 70s--First graphics software standard
  - (CORE--1977)
  - first attempt at portable graphic software

## History of CG (continued)

- 1980s
  - Micros with extensive graphics capabilities
  - Introduction of first Work Stations (graphics engines)
  - Graphics standards with increased capabilities
    GKS (1984), GKS-3D (1988), PHIGS (1988)
  - Microcomputer GUIs (Macintosh, Windows)

## History of CG (continued)

- 1990s
  - Graphics engines
  - many algorithms implemented in hardware
  - Fast, powerful, cheap
  - Multimedia systems
  - Windows-95/98/NT
  - X Windows with PEX
  - GL, OpenGL industry standard graphics libraries
  - Microsoft Direct-X

## Some Applications of CG

- Data Presentation (statistics, business, scientific, demographics...)
- CAD, CAM, CIM
- Painting/Drawing systems
- TV Commercials
- Entertainment; Video Games
- Cartography
- Computer Art

## More CG Applications

- Motion Picture Industry (animation, special effects, etc.)
- Desktop Publishing
- Architectural Design
- Simulation of Reality
  - Flight simulators
  - Ground vehicle simulators
  - Arcade games
  - Virtual reality devices

## More CG Applications

- Scientific Simulation/Visualization
  - Use graphics to make sense of vast amounts of scientific data
  - Use when too dangerous to do real experiments
- Hypermedia
  - Integration of broadcasting, computing, publishing
- Education
- Process Control
- CASE

## More CG Applications

- Image Processing/Enhancement
- Medicine
  - Computed Tomography (CT Scan)
  - X-ray, ultrasound, NMR, PET:
  - All can give 3-D images of human anatomy
- GUIs
- World Wide Web Development
- VRML
- New Stuff--can't even be imagined

## Computer Graphics--

- A huge, fast-moving, exciting field that integrates the best of art and science
- Needs new Renaissance men & women
  - Bright and analytic enough to understand the science & math
  - Sensitive and creative enough to do the art
- Both left and right sides of the brain required!

## A VIDEO SHOWING SOME COMPUTER GRAPHICS APPLICATIONS: