Binghamton University
EngiNet™
State University of New York

Thomas J. Watson
School of Engineering and Applied Science

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

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

Course Materials
- 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)

- 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
- 13. Hidden Surface Removal
- 14. Illumination, Reflection, Shading, Texturing, Ray Tracing, Radiosity

Lecture 1: Computer Graphics

See:

Week 1-A: An Introduction to Computer Graphics

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

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)
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

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**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
  - Inexpensive
  - Primitive graphics capability
- Late 70s--First graphics software standard
  - (CORE--1977)
  - First attempt at portable graphic software

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**History of CG (continued)**
- 1980s
  - Micros with extensive graphics capabilities
  - Introduction of first Work Stations (graphics engines)
  - Graphics standards with increased capabilities
  - Microcomputer GUIs (Macintosh, Windows)

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**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:**