Lecture 0

A Brief Summary of Topics in Computer Graphics

Friday, January 14, 2000

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Readings:
Class Introduction (Handout)
Appendix: Mathematics for Computer Graphics, Foley *et al*

Lecture Outline

- Course Information: Format, Exams, Resources, Assignments, Grading
- Overview
  - Topics covered
  - What is computer graphics?
  - Applications
- Brief Tour of Computer Graphics
  - A case study and some demos
  - Survey of rendering and animation systems
  - Applications to computer-aided design (CAD), manufacturing (CAM), and engineering (CAE)
- Brief Tour of Visualization Systems
  - Information, data, and scientific visualization
  - Focus on informational graphics

Course Information and Administrivia

- Instructor: William H. Hsu
  - E-mail: bhsu@cis.ksu.edu
  - Phone: (785) 532-6350 (office), (785) 539-7180 (home)
  - Office hours: after class; 1-2pm Wednesday, Friday; by appointment
- Grading
  - Assignments (6): 25%, reviews (4): 15%, midterm: 15%, final: 20%, project: 25%
  - Lowest homework score and lowest paper review score dropped
- Homework
  - Six (6) assignments: programming (2), written (2), application (2)
  - Late policy: due on Fridays; free extension to following Monday (*if needed by due date*); -10% credit per day after 5:00 PM (1700) Monday
  - Cheating: don't do it; see introductory handout for policy
- Project Option
  - 1-hour project option for graduate students (CIS 798)
  - Term paper or semester research project
  - Sign up by February 14, 2000 if interested (see class web page)

Class Resources

- Web Page (Required)
  - http://ringil.cis.ksu.edu/Courses/Spring-2000/CIS736
  - Lecture notes (MS PowerPoint 97, PostScript)
  - Homeworks (MS Word 97, PostScript)
  - Exam and homework solutions (MS Word 97, PostScript)
  - Class announcements (students responsibility to follow) and grade postings
- Course Notes at Copy Center (Required)
- Class Web Board (Required)
  - http://ringil.cis.ksu.edu/Courses/Spring-2000/CIS736/Board
  - Login: Students; password: announced in class
  - Research announcements (seminars, conferences, calls for papers)
  - Discussions (instructor and other students)
- Mailing List (Recommended)
  - CIS736WHH-L@cis.ksu.edu
  - Sign-up sheet (if interested)
  - Reminders, related research, job announcements

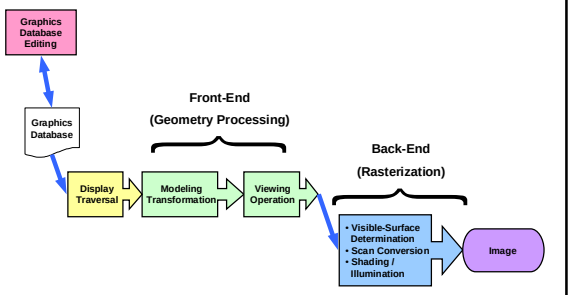
Course Overview

- Graphics Systems and Techniques
  - 2-D, 3-D models: curves, surfaces, visible surface identification, illumination
  - Photorealistic rendering and animation: shading models, ray tracing, radiosity
  - Special topics: fractals, information visualization
- Operations
  - Surface modeling, mapping
  - Pipelines for display, transformation, illumination, animation
- Computer Graphics (CG): Duality with Computer Vision
- Visualization and User Interfaces
  - Display optimization: hardware, libraries, GUI design
  - Techniques for quantitative information, objects, processes
  - Survey of statistical, data, information, and scientific visualization
- Applications
  - CAD/CAM/CAE: object transformations, surface/solid modeling, animation
  - Entertainment: 3-D games, photorealistic animation, etc.
  - Analysis: info visualization, decision support systems, intelligent displays

Why Computer Graphics?

- Developing Computational Capability
  - Rendering: synthesizing realistic-looking, useful, or interesting images
  - Animation: creating visual impression of motion
  - Image processing: analyzing, transforming, displaying images efficiently
- Better Understanding of Data, Objects, Processes through Visualization
  - Visual summarization, description, manipulation
  - Virtual environments (VR), visual monitoring, interactivity
  - Human-computer intelligent interaction (HCII): training, tutoring, analysis, control systems
- Time is Right
  - Recent progress in algorithms and theory
  - Rapidly emergence of new I/O (display and data acquisition) technologies
  - Available computational power, improving price-performance-ratio of hardware
  - Growth and interest of graphics industries (e.g., information visualization, entertainment CAD)

Image Synthesis Pipeline



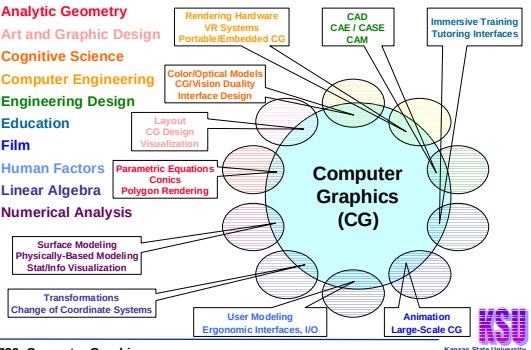
Hypermedia User Interfaces

NCSA *D2K*:
http://chili.ncsa.uiuc.edu
Visual programming system for high-performance knowledge discovery in databases (KDD)

- Hypermedia
  - Database format (similar to *hypertext*) that provides display-based access to (internetworked) *multimedia* (text, image, audio, video, *etc.*) documents
  - *Chimera*: http://www.ics.uci.edu/pub/chimera/
- Virtual Environments
  - Immersion: interactive training, tutoring systems
  - Entertainment hypermedia
- Visualization and Computer-Aided Design and Engineering (CAD/CAE)
  - Visualization: scientific, data/information, statistics
  - User interfaces for CAD/CAE/CAM/CASE: http://www.isii.com

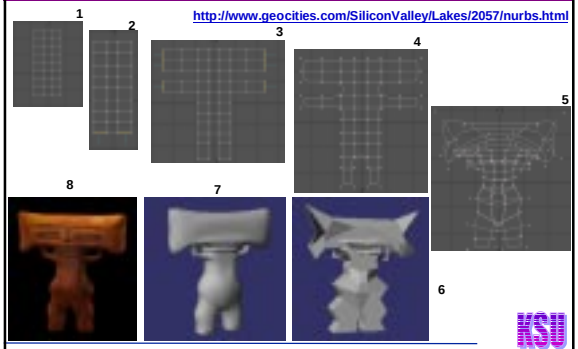
Relevant Disciplines

- Analytic Geometry
- Art and Graphic Design
- Cognitive Science
- Computer Engineering
- Engineering Design
- Education
- Film
- Human Factors
- Linear Algebra
- Numerical Analysis



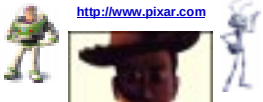
Curve and Surface Modeling in Computer-Aided Design (CAD)

http://www.geocities.com/SiliconValley/Lakes/2057/nurbs.html



Photorealistic Illumination Models

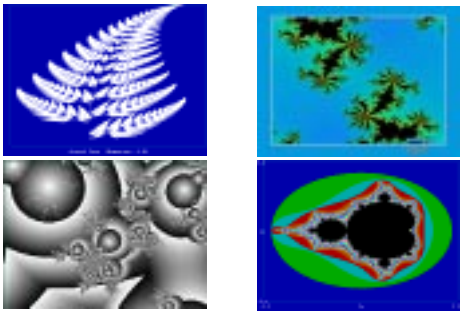
http://www.pixar.com



http://www.ktx.com/3dsmaxr3/

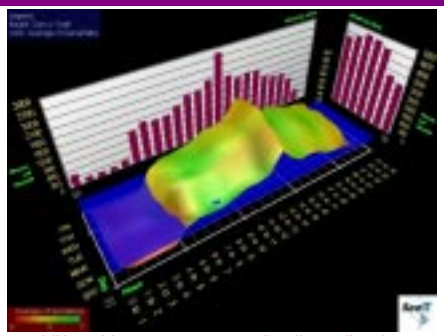
http://www.aliaswavefront.com

Fractal Systems



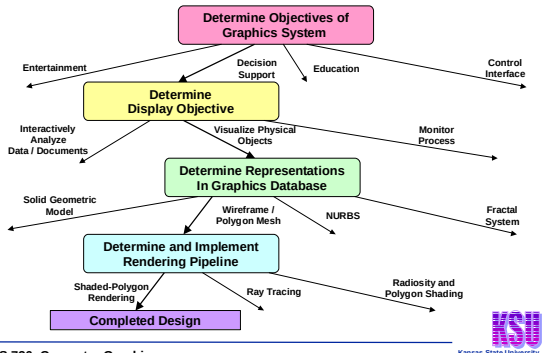
http://sprott.physics.wisc.edu/fractals.htm

Information Visualization



Visible Decisions *SeeIT* (http://www.vdi.com)

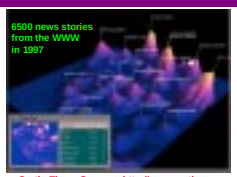
Design Choices and Issues in Computer Graphics



Math Review

- **Overview: First Two Weeks**
  - Review of mathematical foundations of CG: analytic geometry, linear algebra
  - Line and polygon rendering
  - Matrix transformations
  - Graphical interfaces
- **Line and Polygon Rendering**
  - Basic line drawing and 2-D clipping
  - Bresenham's algorithm
  - Follow-up: 3-D clipping, z-buffering (painter's algorithm)
- **Matrix Transformations**
  - Application of linear transformations to rendering
  - Basic operations: translation, rotation, scaling, shearing
  - Follow-up: review of standard graphics libraries (e.g., *OpenGL*)
- **Graphical Interfaces**
  - Brief overview
  - Survey of windowing environments (MFC, Java AWT)

Interesting Industrial Applications



iWing – http://www.geocities.com/CapeCanaveral/3925/

Entertainment CGA

Cartia *ThemeScapes* – http://www.cartia.com

Hypermedia and Statistical Visualization

DC-ARM – http://www-kbs.ai.uiuc.edu

Virtual Environments for Immersive Training