


Lecture 0

**A Brief Summary of Topics in
Computer Graphics**

Friday, January 14, 2000

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<http://www.cis.ksu.edu/~bhsu>


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



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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



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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)



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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



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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



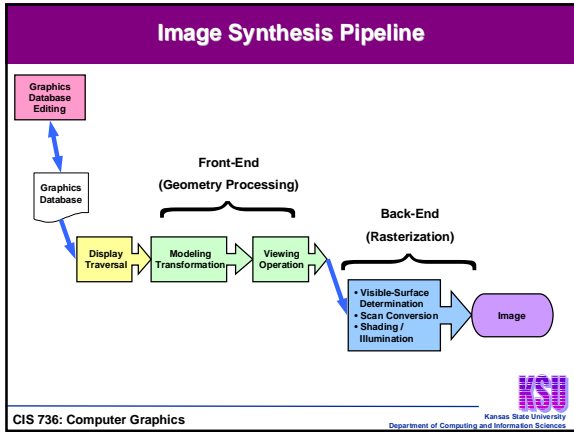
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Why Computer Graphics?

- **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)



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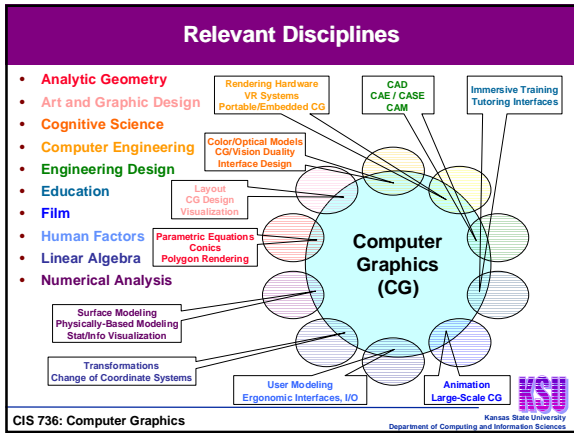


Hypermedia User Interfaces

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>

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

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

The sequence shows the progression from a grid of control points to a smooth, shaded 3D object.

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Photorealistic Illumination Models

Examples of photorealistic lighting effects:

- <http://www.pixar.com>
- <http://www.ktx.com/3dsmxr3/>
- <http://www.aliaswavefront.com>

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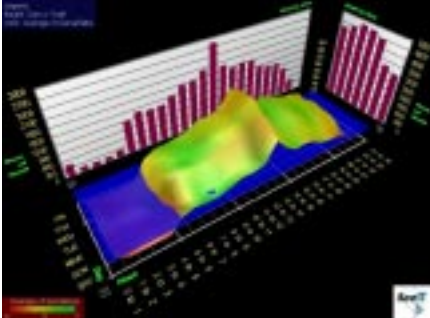
Fractal Systems

Examples of fractal systems:

- <http://sprott.physics.wisc.edu/fractals.htm>

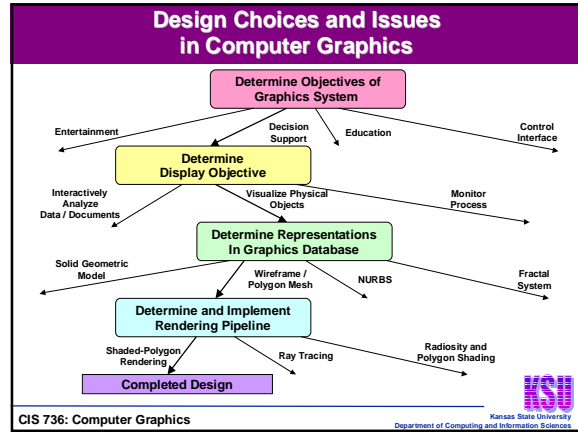
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Information Visualization



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

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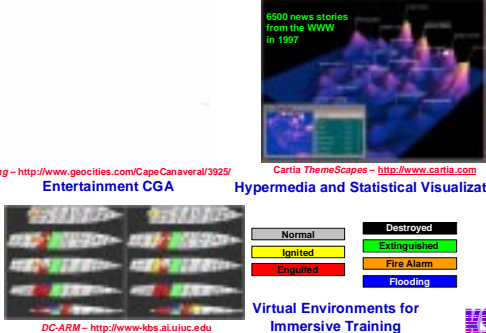


Math Review

- **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)

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Interesting Industrial Applications



<http://www.geocities.com/CapeCanaveral/3925/> <http://www.cartia.com/>
Entertainment CGA **Hypermedia and Statistical Visualization**

Virtual Environments for Immersive Training
<http://www.kbs.ai.uiuc.edu/>

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