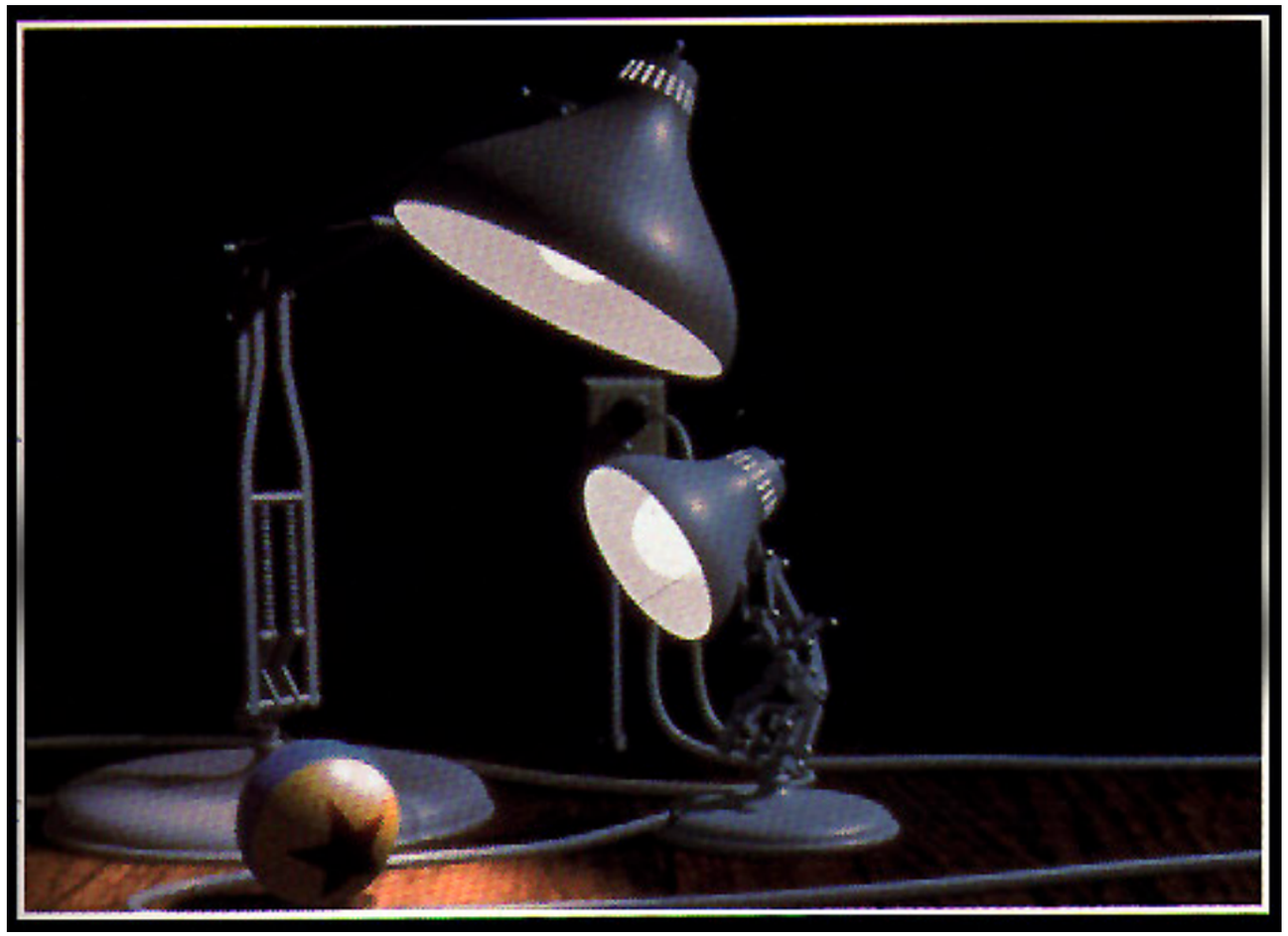

Monash University • Clayton's School of Information Technology

CSE3313 Computer Graphics

Lecture 1: Introduction to Computer Graphics

What is Computer Graphics?

- The synthesis of images and graphic objects by computer
- Creating pictures that get displayed in 2-dimensions or 3-dimensions.
- Examples:
  - Computer Games
  - Film Special Effects (SFX)
  - Visualization
  - Simulation
  - Design & Manufacture
  - Prototyping

Star Wars: Episode II, Attack of the Clones © 2002 Lucasfilm Ltd & TM. All rights reserved.
Photo Credit: Industrial Light & Magic.

The Mummy © 1999 Universal Studios. All rights reserved.
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MIB II © 2002 Columbia Pictures. All rights reserved.
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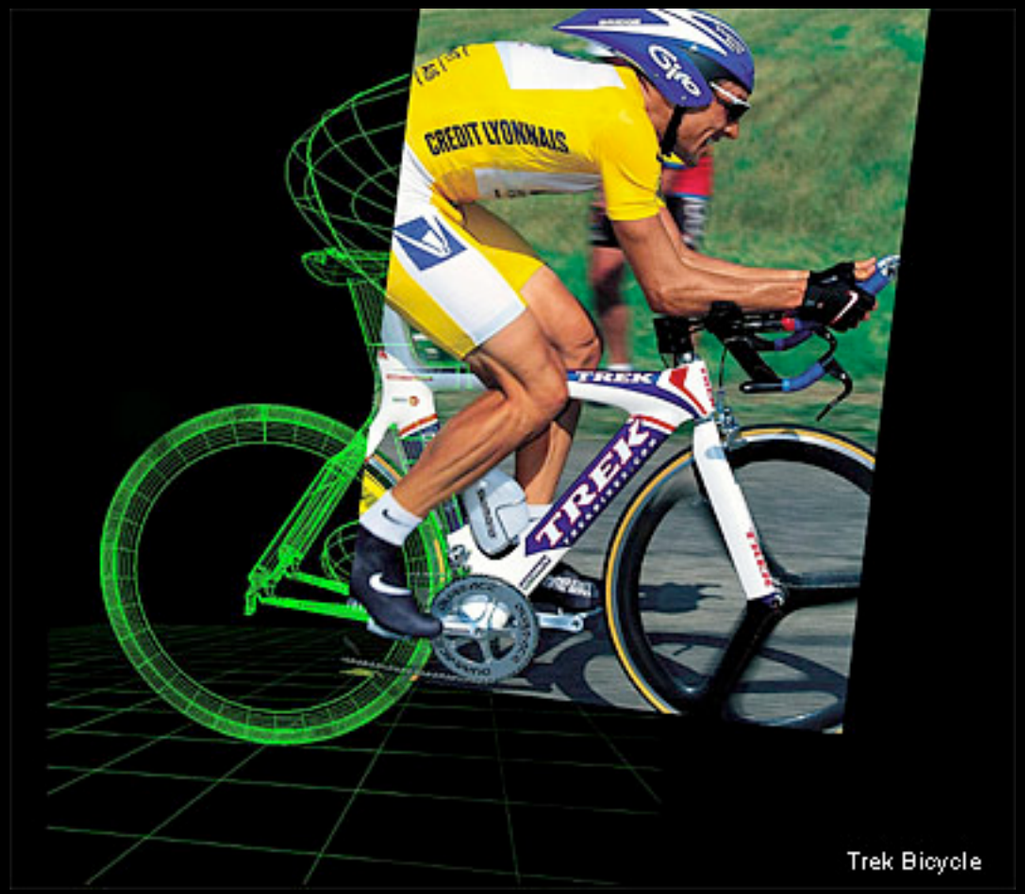
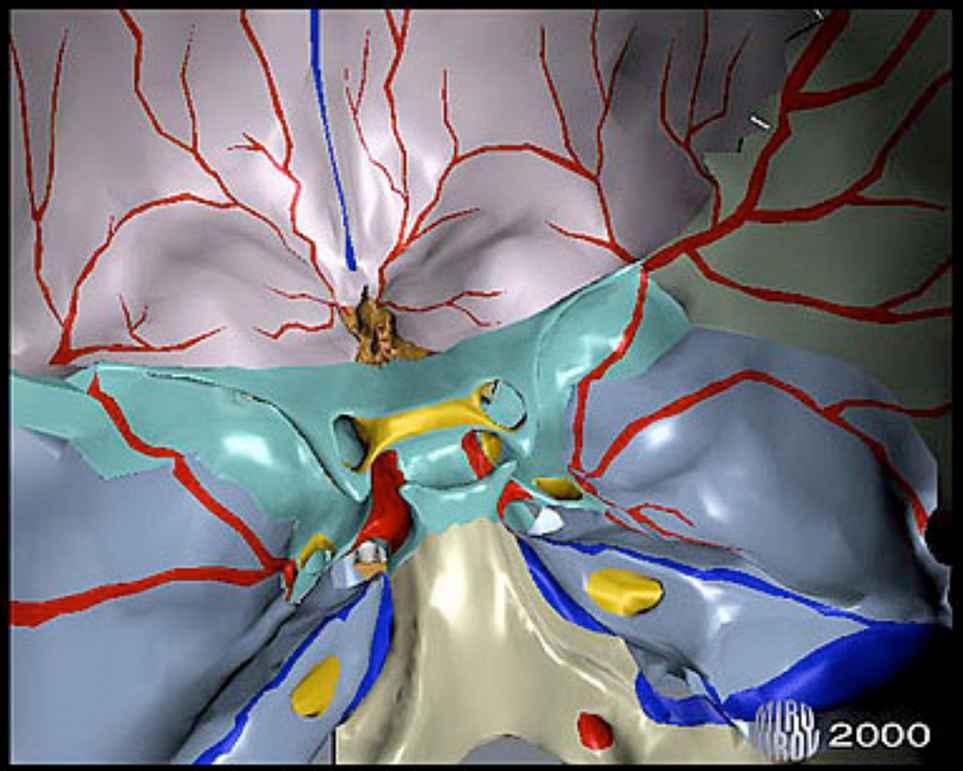
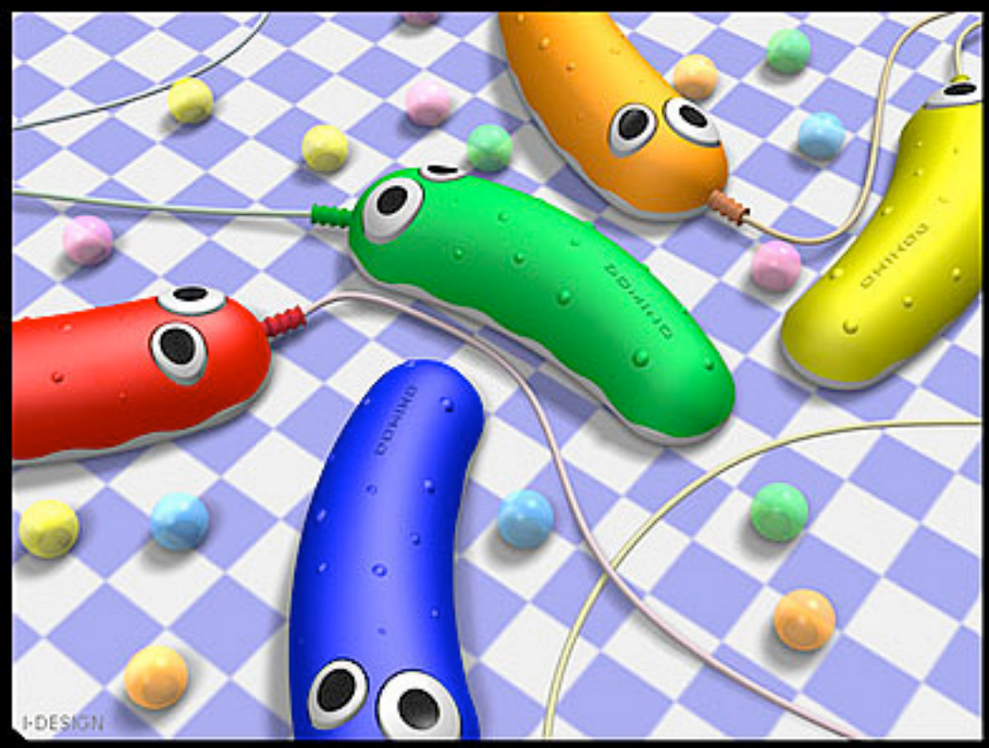


Trek Bicycle



© NYU School of Medicine. Design by Miro Kirov, 2000



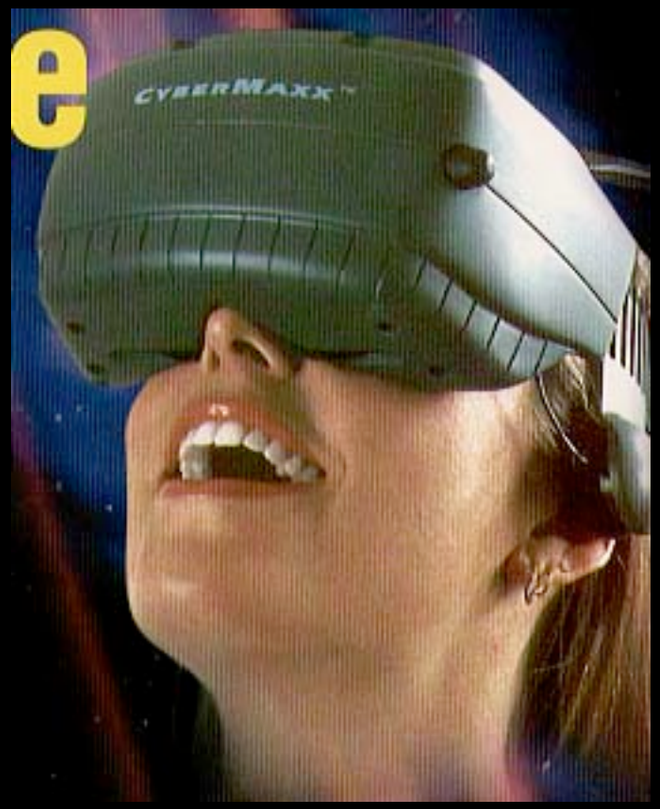
© I-DESIGN

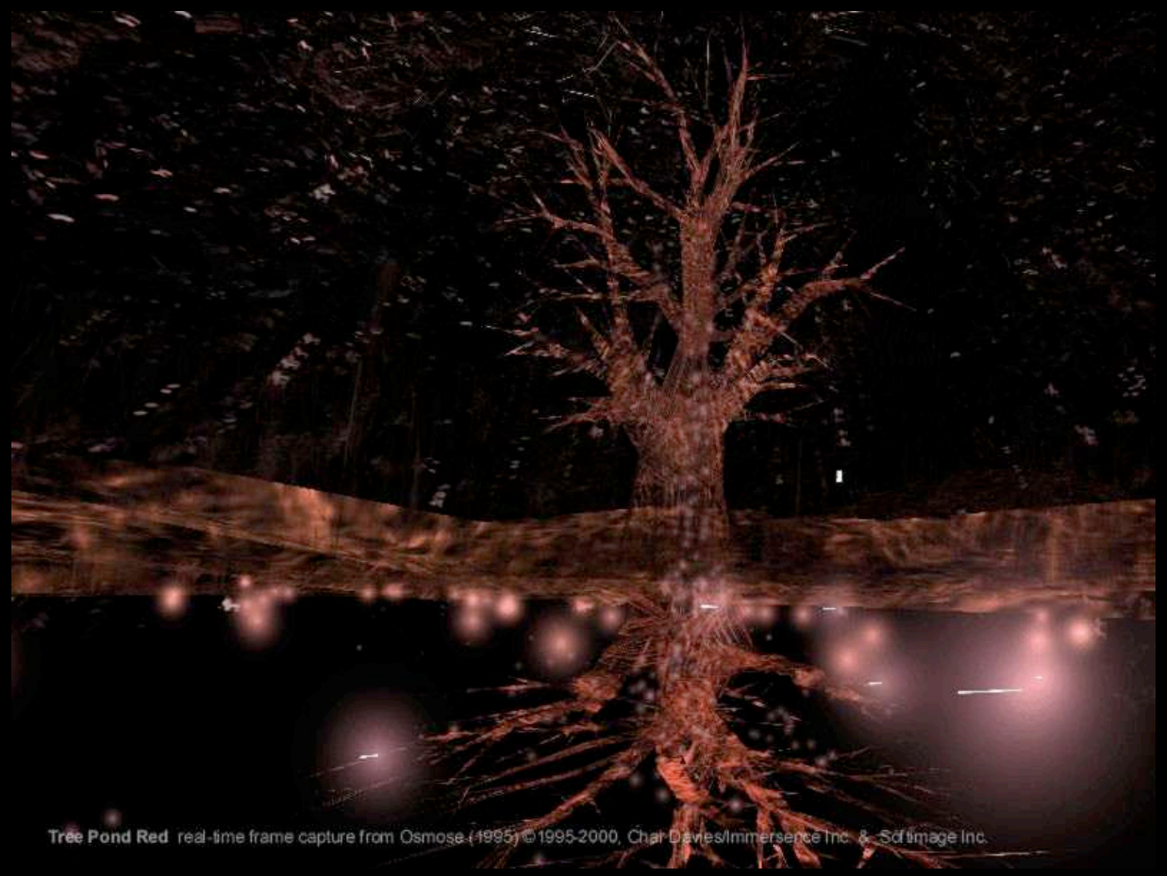
Image Processing / Computer Graphics

- There is a distinction between Computer Graphics and Image Processing. Both deal with images.
  - Image Processing — image analysis
  - Computer Graphics — image synthesis
- Images are rectangular arrays of *pixels*
  (pixels = picture elements)
- Data comes from digitized pictures
  - scanning, satellite data, digital cameras, airborne camera
  - pictures might not be in visible light
- Image correction (colour balence, density, framing)
- *Segmentation* — divide image into areas of interest and background
- Robotic or machine vision (low and high level)

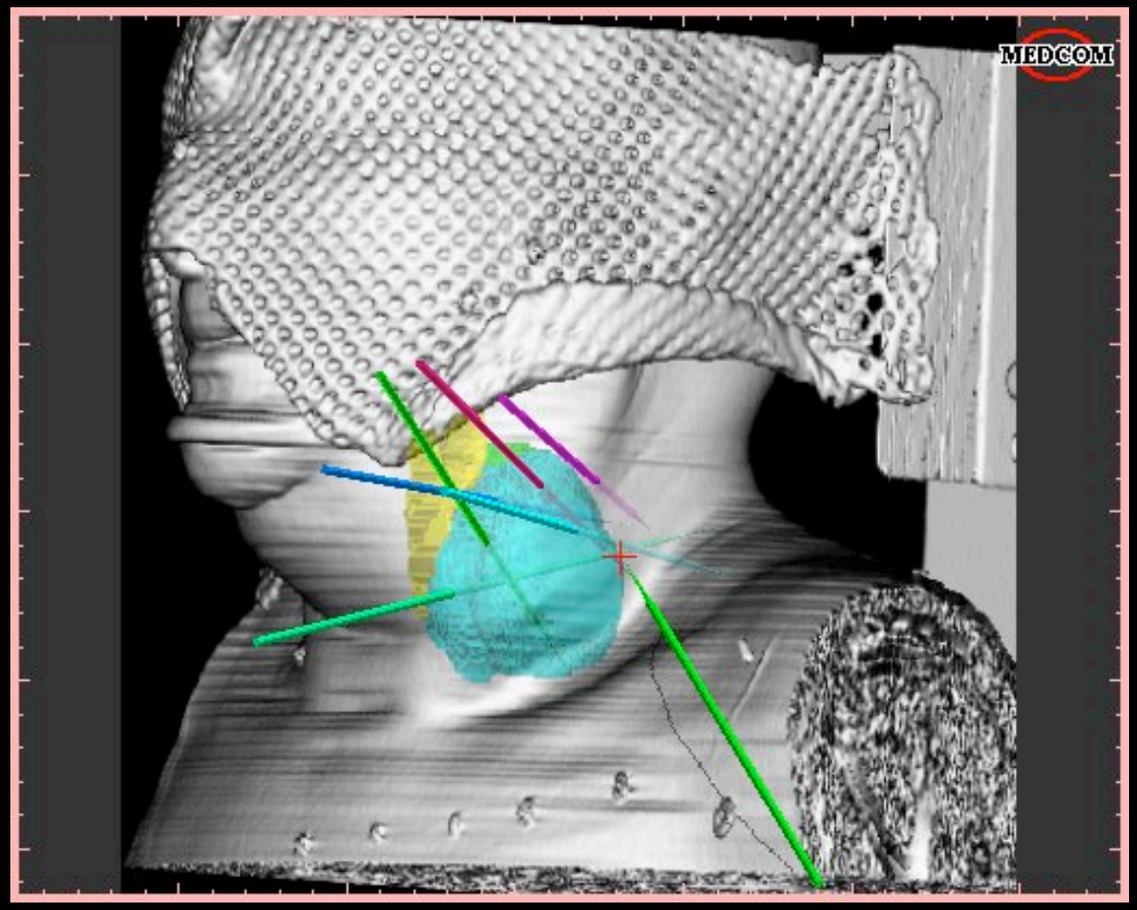
Computer Graphics

- CAD/CAM (Computer Aided Design / Manufacture)
  - design new products within the computer.
  - visualize their appearance, simulate their performance.
- Computer Animation
  - The successive display of still images in rapid succession can give the illusion of motion.
  - Generally a *frame rate* of at least 12 frames per second (fps) is required for interactive applications.
- Interactive Graphics / Virtual Reality
  - Real time simulation of 2D/3D worlds that the user may navigate and possibly interact with.
  - Applications: architectural visualization, virtual medical precedures, complex design and engineering prototyping.





Tree Pond Red real-time frame capture from Osmose (1995) ©1995-2000, Char Davies/Immersence Inc. & Softimage Inc.

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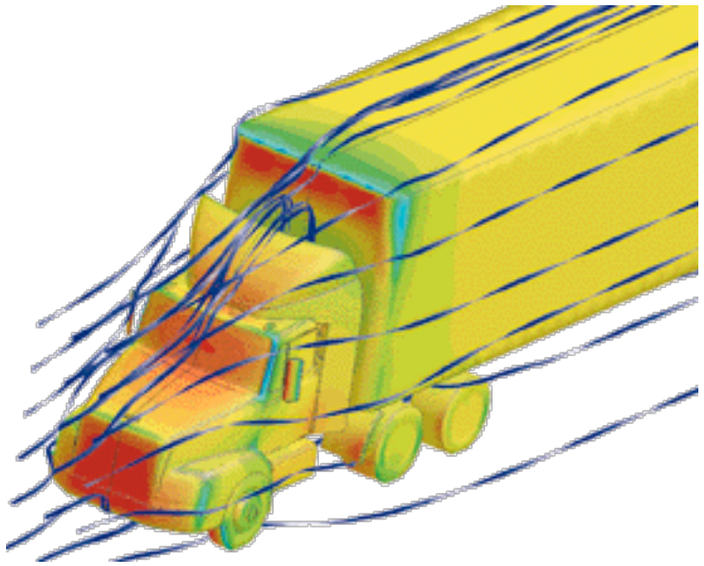
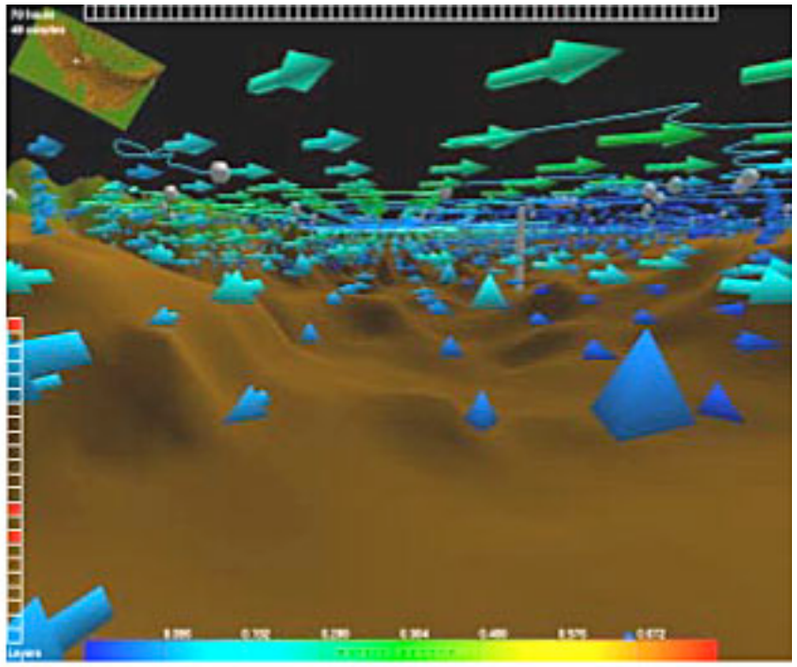
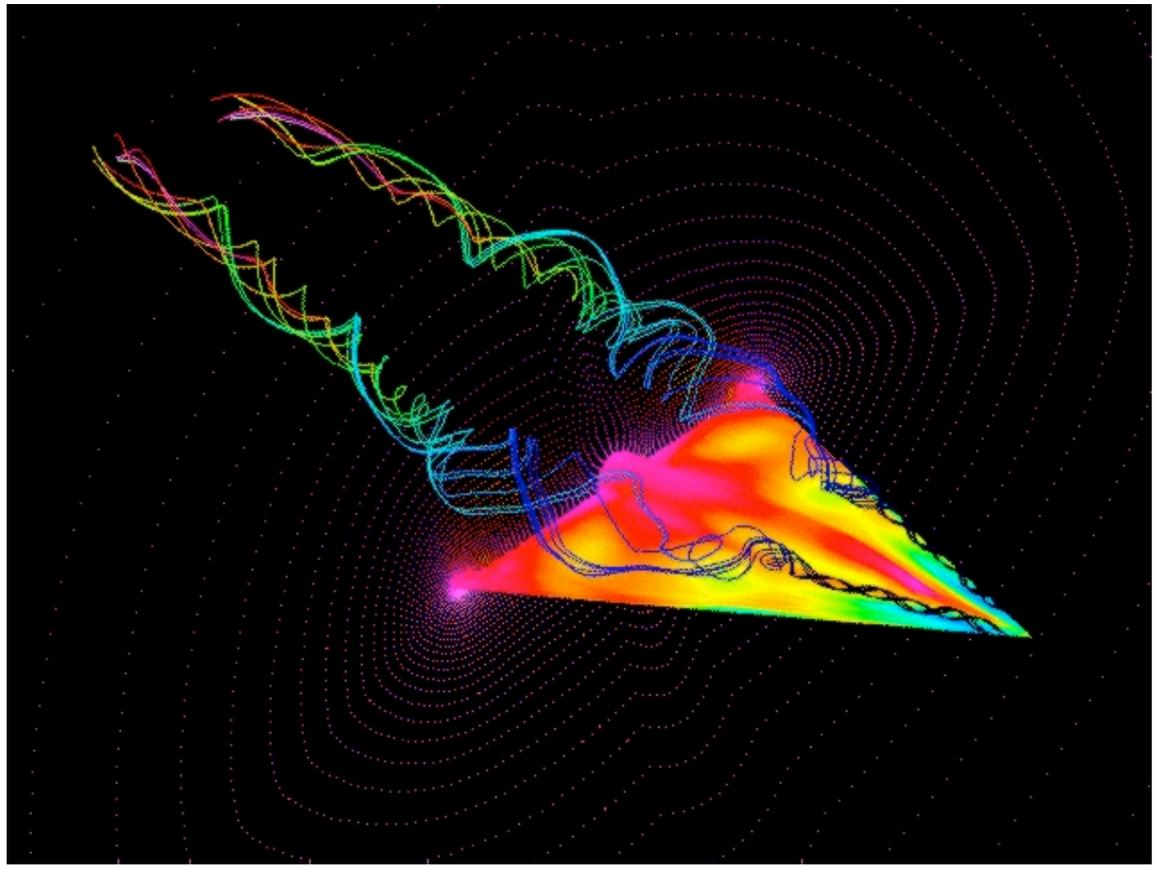
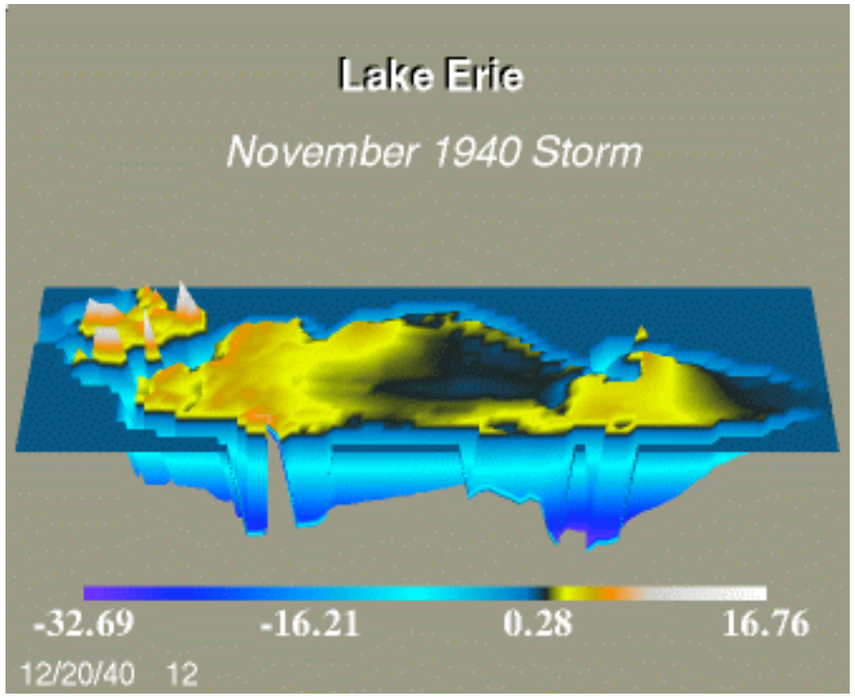
Computer Graphics

- WIMPS — Windows, Icons, Mouse, Pointing
- GUI — Graphical User Interface
- Computer Visualization
  - Present large amounts of information (e.g. simulation run)
  - Images can make understanding complex data sets easier
  - Scientific Visualization
- Computer Art and Animation
  - Simulation of (non) traditional artist's materials and techniques
  - complex characters and sets for films
  - compositing — merging many different layers, possibly from different sources (e.g. live action and CG) to form a composite
  - Morphing

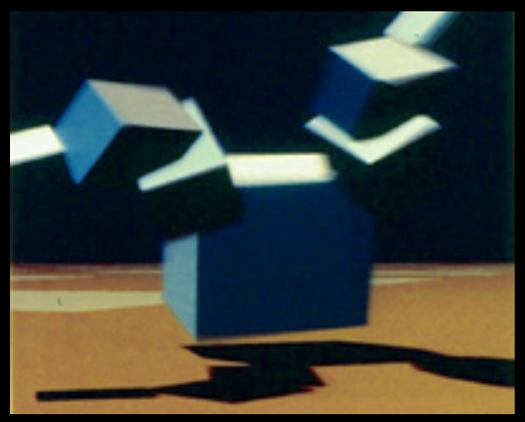


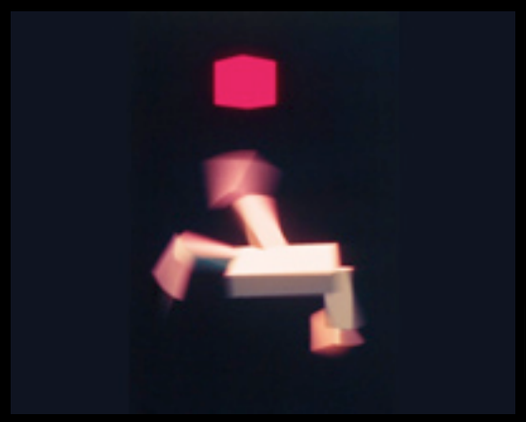


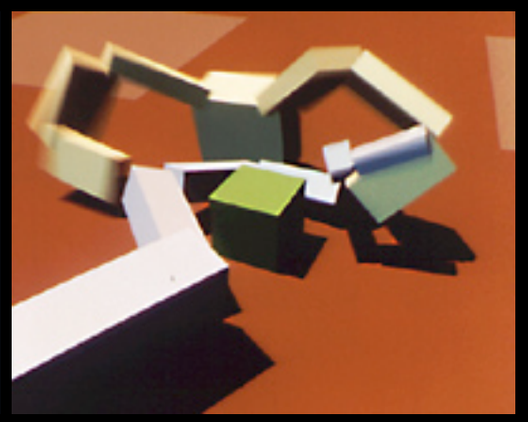


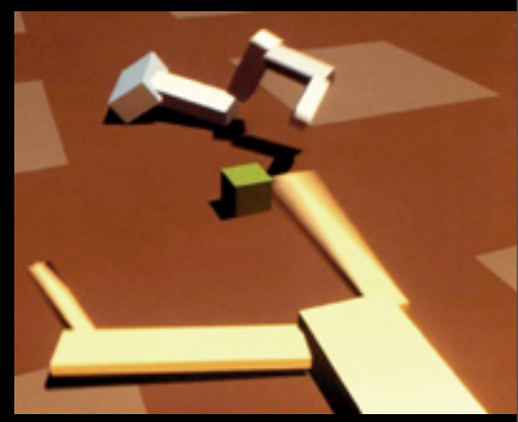

Lake Erie
November 1940 Storm
-32.69
-16.21
0.28
16.76
12/20/40 12

Turbulence: Jon McCormack







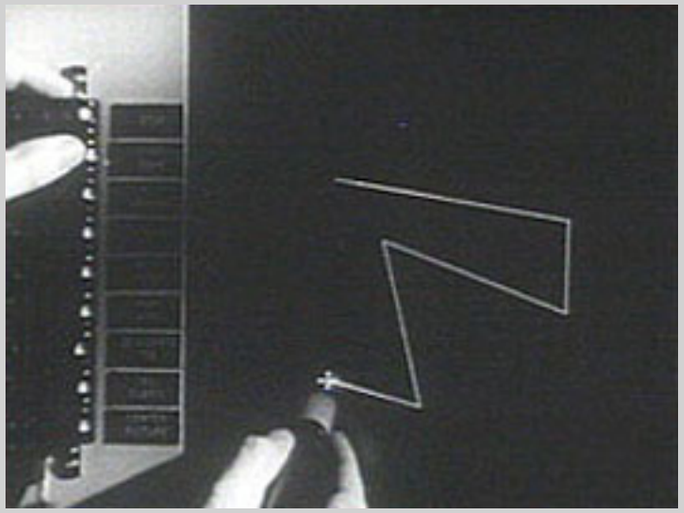


Evolved Virtual Creatures: Karl Sims

Brief History of Computer Graphics

- 1950
  - First computer driven display, MIT's Whirlwind 1 computer used to generate simple pictures.
- SAGE
  - Air defense system— command and control CRT system
  - Identified 'targets' by pointing at them with a light pen
- 1962
  - *Sketchpad: A Man-machine Graphical Communication System,* Ivan E. Sutherland, Ph.D. thesis, MIT
  - Modular, hierarchical approach to data-structures;
  - pioneered interaction techniques using keyboard, light pen for choice making, pointing and drawing.

Sketchpad: 1968



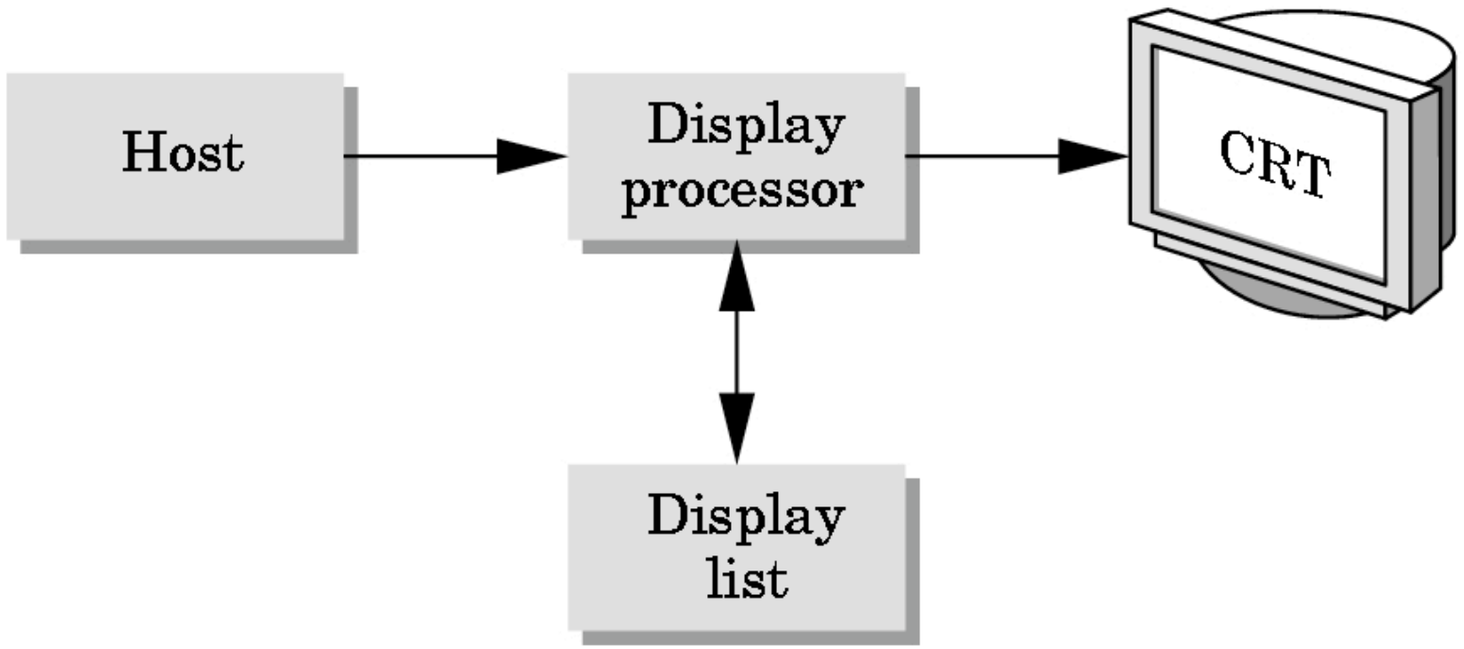
History of Computer Graphics (cont.)

- mid 1960's
  - Graphics research at MIT, General Motors, Bell Telephone Labs, Lockheed Aircraft
  - Large corporations interested in CAD/CAM

- Obstacles to quicker progress:
  - Cost of hardware;
  - Amount of computing resources required;
  - difficulty of writing large, interactive programs when programmers used to batch environments;
  - non-portable software written for specific hardware.

Display Processor

- Rather than have the host computer try to refresh display use a special purpose computer called a display processor (DPU)



- Graphics stored in display list (display file) on display processor
- Host compiles display list and sends to DPU

History of Computer Graphics (cont.)

- 1970's — early 1980's
  - Development of the first integrated graphics workstations — CPU, graphics display and interactive devices share single bus (Evans and Sutherland).
  - Colour displays become more widespread
  - Much work is done on rendering algorithms for realistic image synthesis.
  - First Silicon Graphics Workstations.
  - IBM introduces standards for PC monitors:
    - EGA (Enhanced Graphics Adapter)
    - VGA (Video Graphics Array)

History of Computer Graphics (cont.)

- late 1980's — 1990's
  - 1994: first 3D graphics boards for high end workstations.
  - 1997–98: production of new PCs containing graphics chips grows from 20% to 80%.
  - Computer Games production rivals Hollywood in sales $.
- Present:
  - Colour graphics, 3D acceleration, high resolution raster displays built in to standard PCs at relatively low cost.
  - Graphics is an essential part of most modern software.
  - Graphics cards can handle 10^6 — 10^9 *shaded, texture-mapped* polygons/second.
  - High-end chips can render up to 1.2 billion *texels*/sec., low-cost chips about 50 million *texels*/sec.

Future of Computer Graphics

- Several graphics standards and APIs — suited to many applications.
- Games hardware sets new price/performance benchmarks.
- Hardware now does procedural shading (OGSL, CG, etc.)
- The future:
  - Graphics in PDAs, mobile phones, consumer electronics devices.
  - Screens are everywhere — bigger and thinner each year.
  - Low-cost hardware, mobility, GPS...
  - Augmented reality / Virtual reality.
  - Photorealism on a single chip