What is Computer Graphics?

Producing pictures and animations on computers and for movies

Survey of some application areas

Courtesy Mike Carson UAB/CMC
Graphs & Charts

- Visual display of data
- Complex data relationships
- Reports: summarize results
Graphs & Charts

- 3D graphs
- Mathematical function plots
Computer-Aided Design (CAD)

- Engineering & Architecture Software
- Buildings, aircraft, computers, appliances, etc.
- Interactive design (mesh editing, wire-frame display, etc.)
- Standard shape database
- Testing: real-time animations
- Requires algorithm efficiency for speed

Courtesy of Lana Rushing, Engineering Animation, Inc.
Computer-Aided Design (CAD)

- Architecture, Engineering, Construction
- Final product appearance: surface rendering, realistic lighting
- Construction planning: Architects, clients can study appearance before actual construction

Courtesy of Craig Mosher & Ron Burdock, Peripheral Vision Animations
Computer-Aided Design (CAD)

- Crash Dummy
CAM

- Computer-Aided Manufacturing
- A rendering of machined investment casting of scanner housing
- The part was redesigned from machined part original to reduce fabrication time

Courtesy of Benny S. Chi, BSC Engineering
- User interacts with objects in a 3D scene
- Special devices (input, output)
- Virtual walkthroughs
- Equipment training (pilots, surgeons, construction workers)
- Social Media
Virtual Reality: Training

- Education using computer-generated system & process models
- Visual simulation: external environment
  - aircraft simulator
  - spacecraft simulator
  - naval craft simulator
  - automobile simulator: study traffic conditions
  - heavy machinery simulator
  - surgery simulator
- Special hardware required
Virtual Reality

- Virtual Tour of Ancient Olympia

Image courtesy SGI
Virtual Reality: Medical Imaging

- Virtual Colonoscopy
  - Developed at SUNY Stony Brook, Visualization Lab
Visual Simulation

- VISUAL SIMULATION
- Database generated for train simulation application.
Scientific Visualization

- Scientific data representation
- Large data size, highly complex processes
- Picture vs. stream of numbers
- Techniques: contour plots, color coding, constant-value surface rendering, custom shapes

Display of a 2D slice through the total electron density of C-60; Created by Cary Sandvig of SGI
Scientific Visualization

- Electromagnetic potential field
- Fluid flow in a bronchial tube
Protein on DNA

Created by Dr. Edward H. Egelman, Univ. of Minnesota, Dept. of Cell Biology.
Scientific Visualization/Simulation

- COMPUTATIONAL FLUID DYNAMICS
- Strong winds around a high-rise building are very harmful
- Builders predict the flow field around the new building and determine suitable counter-measures which decrease wind speed around the building
Computer Art

- Fine art, commercial art
- Artistic tools for digital art:
  - Commercial software (StudioMAX, Cinema4D)
  - Mathematics software (Matlab, Mathematica)
  - CAD software
- Graphical user interfaces (GUIs)
- Painting programs
- Special input devices (pressure-sensitive stylus, graphics tablet)
- Texture mapping
- Mathematical patterns
  - Frequency variations, functions, fractals
Computer Art

- Digital Sculpting
Computer Art

- Special effects: Digital art
  - Movies, games, advertising
  - Computer-generated characters
  - Realistic scenes and action
  - Modeling and Rendering
Image Processing

- Computer graphics vs. Image processing
- Editing/modification/analysis of existing images/photos
- Improve picture quality
- Recognize visual patterns
- Create commercial art, analyze satellite photos/recordings
  - e.g.: EARTH RESOURCES MGMT. & GEOSCIENCES