Teaching Team

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• Teaching Assistant
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Introduction
Computer graphics: The study of creating, manipulating, and using visual images/information in the computer.
Why should I learn computer graphics?

• Interested in games, movies, scientific applications, computer-aided, etc.
  • Can get me a nice paying job.

• Am interested in winning a (technical) Oscar
  “Technical Achievement Award from The Academy of Motion Picture Arts & Science”
Why should I learn computer graphics?

• We are living in a visual era
  – Displays of computers, cell phones and mobile devices
  – Computing interfaces are becoming more visual (iOS, Windows 8)
  – More information is communicated visually
    – A picture is worth a thousand words: images, videos…

Visual representations of abstract data
Graphics Applications

• Entertainment
  – film production
  – film effects
  – games

• Science and engineering
  – computer-aided design
  – scientific visualization

• Training & Simulation

• Graphic Arts

• Fine Art
Special Effects in Movies

- History
Pixar—Ratatouille (2007)
Pixar—*Ratatouille* (2007)
*King Kong* (Universal Pictures, 2005)—visual effects: WETA Digital
*King Kong* (Universal Pictures, 2005)—visual effects: WETA Digital
The Two Towers (New Line Cinema, 2002)—visual effects: WETA Digital
The Two Towers (New Line Cinema, 2002)—visual effects: WETA Digital
http://www.youtube.com/watch?v=5HghLB7Gcqc

Visual Effects in Avatar


Visual Effects in “Life of Pi”
Electronic Arts—*NBA Live 07* (screenshot: gamespy.com)
Crytek GmBH—advertisement for CryEngine 2 game engine
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RIT Biochem. 502—Paul Craig
Simulated deformation of citrate synthase during substrate binding

Kalju Kahn, UCSB
3D microscopy of capillaries in glomulerus of a human kidney

Roger C. Wagner, Univ. Delaware
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Computer aided sculptures
Ergun Akleman
Problems in graphics
Problems in graphics

- 2D imaging
  - compositing and layering
  - digital filtering
  - color transformations
- 2D drawing
  - illustration, drafting
  - text, GUIs
Problems in graphics CONT’D

• 3D modeling
  – representing 3D shapes
  – polygons, curved surfaces, …
  – procedural modeling
Problems in graphics

• 3D rendering
  – 2D views of 3D geometry
  – projection and perspective
  – removing hidden surfaces
  – lighting simulation
Problems in graphics

PROJECTIVE GEOMETRY

SPHERICAL GEOMETRY
Problems in graphics

- Animation
  - keyframe animation
  - physical simulation

Pixar

Enright et al. SIGGRAPH 2003
Problems in graphics

Enright et al. SIGGRAPH 2003

Pixar
Graphics hardware is becoming widespread

Desktop and Laptop GPUs

PowerVR GPU
Graphics hardware is becoming widespread

Desktop and Laptop GPUs

PowerVR GPU
Virtual Reality


Lets try some VR demos!
WHAT YOU WILL (or WILL NOT) LEARN

• You will:
  – explore fundamental ideas
  – learn math essential to graphics
  – implement key algorithms
  – write cool programs

• You will not:
  – learn a lot about OpenGL or DirectX
    (though you will use some OpenGL)
  – write very big programs
  – Advanced topics (global illumination, VR, simulation, etc.)
Topics

• Rendering 3D scenes
  (ray tracing as the basic model)
• Images and image processing
  (featuring sampling and reconstruction)
• Geometric transformations
• The graphics pipeline
  (with a slant toward understanding graphics hardware)
• Modeling in 2D and 3D
Images

- What is an image?
- Compositing
- Resampling
Rendering

• ray tracing
• shading & shadows
• transparency
• texture mapping

[Glassner 89]
Geometric transformations

• affine transforms
• perspective transforms
• viewing

rotate, then translate  translate, then rotate
Graphics pipeline

- rasterization
- interpolation
- z-buffer
- vertex and fragment ops
Modeling

- splines
- parametric surfaces
- triangle meshes
Course Prerequisites

- **Programming & Data Structures**
  - ability to read, write, and debug small Java or C++ programs (10s of classes)
  - understanding of very basic data structures
  - no serious software design required

- **Mathematics**
  - vector geometry (dot/cross products, etc.)
  - linear algebra (just basic matrices in 2-4D)
  - basic calculus (simple derivatives)
  - graphics is a good place to pick up some, but not all, of this
In this course

• You will also:
  – Work on 4-5 major programming assignments
  – Some programming assignments are time consuming
  – Work on 4 problem sets (HW)
  – learn a lot about
    • surfaces
    • mesh data structures
    • scene data structures
    • architecting good-sized interactive programs
    • using OpenGL
Course Project

• Required for COMP770 (20% of your grade)
• Optional for COMP575 (extra credit)

– Work on any topic related to computer graphics
– Can combine with your research
– Can work in teams of 2-3 students
– Talk to the instructor about the specific project topic
Grading Policies

- **Grading Breakdown (575)**: HW & Prog. Assignments 50%, Midterm 20%, Final 20%, Class Attendance & Participation 10%

- **Grading Breakdown (770)**: HW & Prog. Assignments 50%, Midterm 20%, Project 20%, Class Attendance & Participation 10%

More details at:

http://gamma.cs.unc.edu/graphicscourse