CS4620/5620: Introduction to Computer Graphics

Professor: Kavita Bala

Computer graphics: The study of creating, manipulating, and using visual images in the computer.

Graphics Applications

- Entertainment
  - film production
  - film effects
  - games
- Science and engineering
  - computer-aided design
  - visualization (scientific, information)
- Training & Simulation
- Graphic Arts
- Fine Art

Or, to paraphrase Ken Perlin...

Computer graphics: What you need to show other people your dreams.

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What is graphics about?

Problems in graphics CONT'D

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

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

• Animation
  – keyframe animation
  – physical simulation
Problems in graphics

- 2D imaging
  - compositing and layering
  - digital filtering
  - color transformations
- 2D drawing
  - illustration, drafting
  - text, GUIs

Problems in graphics CONT’D

- User Interaction
  - 2D graphical user interfaces
  - 3D modeling interfaces
  - virtual reality

Course mechanics

Web  http://www.cs.cornell.edu/Courses/cs4620

Teaching Assistants (3 Ph.D. TAs, 1 MEng, 3 ugrad TAs)
  * Ivaylo Boyadzhiev
  * Pramook Khungurn
  * Shuang Zhao
  * Yunfeng Bei
  * Mark, Mohamed, Asher

Mailing lists, ... (TBA)

CS4620/5620

- You will:
  - explore fundamental ideas
  - learn math essential to graphics
  - implement key algorithms
  - write cool programs
  - learn a little about OpenGL (http://www.opengl.org)
- You will not:
  - write big programs

Topics

- Graphics pipeline
- Rendering 3D scenes
  - ray tracing
  - GPU
- Images and image processing
  (featuring sampling and reconstruction)
- Geometric transformations
- Modeling in 2D and 3D
- Animation
- Color science
**Graphics pipeline**
- rasterization
- interpolation
- z-buffer
- vertex and fragment ops

**Rendering**
- ray tracing
- shading & shadows
- transparency
- texture mapping

**Geometric transformations**
- affine transforms
- perspective transforms
- viewing

**Modeling**
- splines
- parametric surfaces
- triangle meshes

**Animation**
- key frame animation
- subdivision surfaces
- physics-based animation
- particle systems

**Images**
- What is an image?
- Compositing
- Resampling
CS4620 Prerequisites

- Programming
  - ability to read, write, and debug small Java 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 CS4621

- You will also:
  - implement a modeling, rendering, animation system
    - in groups
  - learn a lot about
    - architecting good-sized interactive programs
    - OpenGL
    - subdivision surfaces
    - mesh data structures
    - scene data structures

Workload

- CS 4620/5620
  - 4-5 Homeworks
  - 2-3 programming assignments
  - No penalty for 1 late homework, then 10% per day
- CS 4621/5621
  - 4-3 programming assignments

Academic Integrity

Textbooks

Required Text:
Shirley & Marschner
Fundamentals of Computer Graphics
third edition

Optional:
Open GL Programming Guide
(a.k.a. the "Red Book")
Older version available online:
http://www.opengl.org/documentation/red_book/

GLSL Shading Language
(a.k.a. the "Orange Book")

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Practicum
- Have to reschedule to Friday 3:30. Is that a problem?
  (Will also send email)