CS4620/5620

Introduction to Computer Graphics

Professor: Kavita Bala
Computer graphics

The study of creating, manipulating, and using visual images in the computer
Or, to paraphrase Ken Perlin...

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

• Entertainment
  – film production
  – film effects
  – games

• Science and engineering
  – computer-aided design
  – visualization (scientific, information)

• Virtual Prototyping

• Cultural Heritage

• Training & Simulation

• Graphic Arts, Fine Art
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What is graphics about?
What is the CG problem?
Shape
3D Modeling

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

[Hoppe et al. 1993]

[Prusinkiewicz et al. 2001]
Light
Computer Graphics

shape + material + light

Virtual?
Real?
3D Rendering

- 2D views of 3D geometry
- projection and perspective
- removing hidden surfaces
- lighting simulation
Animation

• keyframe animation
• physical simulation

Avengers (2012)
Images

• 2D imaging
  – compositing and layering
  – digital filtering
  – color transformations

• 2D drawing
  – illustration, drafting
  – text, GUIs
User Interaction

- 2D graphical user interfaces
- 3D modeling interfaces
- virtual reality, augmented reality
Computer graphics:
Mathematics made visible.
Introductions…
Course Overview
Course mechanics

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

Teaching Assistants (7 PhD/MS/MEng, ≥6 ugrad)
Eston Schweickart, Nicolas Savva,
Brandon Benton, Bryce Evans, Eric Gao, Fujun Luan,
Zegiang Zhao

Jimmy Briggs, Kristen Crasto,
Kyle Genova, Tongcheng Li, Andrew Mulle
Kate Salesin, Ning Wang, Kelly Yu
Cristian Zaloj, software architect

Piazza: Please sign up!
In CS4620/5620

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

• You will not:
  – write very big programs
Topics

• Modeling in 2D and 3D
• Geometric transformations
• The graphics pipeline
• Rendering 3D scenes  
  (using ray tracing and using the GPU)
• Animation
• Images, image processing, color science
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
    • programmable shaders, textures, animation
Workload

• CS 4620/5620
  – 7 assignments (written + programming)
  – 1 free late assignment (up to 1 week), else 10% per day
  – 2 exams (midterm + final)
  – Written (individual), programming (pairs)

• CS 4621/5621
  – Classes on Fridays
    • First class this friday. No class for 2 fridays after.
  – 4 small assignments
  – one open-ended project
  – In pairs
Textbook

Shirley & Marschner
Fundamentals of Computer Graphics
third edition
More books

Steven Gortler
Foundations of Computer Graphics
first edition

OpenGL 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")
Academic Integrity

- Written homework
  - On your own
- Programming
  - With partner

- We will test and follow up
Course mechanics

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Schedule, handouts, etc. all on the web page

Practicum (4621)

• See schedule on website
• Mixer this Friday
• First planned meeting on website