What is Computer Graphics?

- Generation of static/dynamic (realistic) images on computer

What is CG used for?

- GUI
  - Modeling systems
  - Applications
  - Simulations & Visualization

- Movies
  - Animation
  - Special Effects

- Computer Games

- Images
  - Design
  - Advertising
  - Art
Computer Graphics

Introduction

What is CG used for?
- Virtual reality

What This Course Is About
- Basic algorithms for
  - Modeling – generating models
  - Rendering – displaying models
  - (Animation – generating motion)
- Programming in OpenGL, C++

What This Course is NOT About
- NOT covered:
  - Artistic and design issues
  - Usage of commercial software packages

Expectations
- Hard course!
  - heavy math
  - heavy programming
- Fun course!
  - graphics programming addictive, create great demos
- Programming prereq
  - CPSC 216 (Program Design and Data Structures)
  - Good knowledge of C++
- Math prereq
  - MATH 200 (Calculus III)
  - MATH 221/223 (Matrix Algebra/Linear Algebra)

Other graphics courses
- CPSC 424: Geometric Modeling
  - Not given this year
- CPSC 426: Computer Animation
  - Given in the fall
- CPSC 514: Image-based Modeling and Rendering
- CPSC 526: Computer Animation
- CPSC 533A: Digital Geometry
- CPSC 533B: Animation Physics
- CPSC 533C: Information Visualization

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**Introduction**

**Teaching Staff**
- Instructor: Alla Sheffer
  - Office hrs: ClCSR 011/X651, Tue 4-5pm
  - Contact info: sheffa@cs.ubc.ca
  - do NOT use for assignment related questions
    - anything else which might be relevant to other students
- Temporary instructor (Sep 13-23): Dan Julius djulius@cs.ubc.ca
- TA: Stephen Ingram sfingram@cs.ubc.ca

**Course Information**
- Up-to-date information:
  - [http://www.ugrad.cs.ubc.ca/~cs314](http://www.ugrad.cs.ubc.ca/~cs314)
    - updated often, reload frequently
  - WebCT (follow link from course home page)
    - Bulletin board
    - REQUIRES INTERCHANGE ACCOUNT!
  - I assume that once information is posted on WebCT or web-page students know it
    - within 2 workdays

**Labs**
- Will have **only 2 labs** (cutbacks + low student registration)
  - Option 1: Mon 13-14, Thu 15:30-16:30
  - Option 2: Mon 13-14, Wed 12-13
  - Option 3: Wed 12-13, Thu 15:30-16:30
  - Vote
  - Example problems in spirit of written assignments and exams + help with programming assignments
  - Strongly recommend that you attend

**Grading**
- Assignments (programming + theory): 45%
  - OpenGL+Math 101 (3%)
  - 3D Transformations (13%)
  - Rendering pipeline (13%)
  - OpenGL Extravaganza (16%)
- Two Quizzes: (30%)
  - 15% each
- Final Exam: (25%)

**Important Dates**
- Assignment 0 due: Sep 23
- Assignment 1 due: Oct 14
- Assignment 2 due: Nov 4
- Assignment 3 due:
  - Theory: Nov 25
  - Programming: Nov 28
- Quiz 1: Oct 20
- Quiz 2: Nov 10

**Course Organization**
- Programming assignments:
  - C++, Windows or Linux
  - OpenGL graphics library / GLUT for user interface
- **Face to face grading in lab**
  - Opportunity to show all the “cool” extra stuff
  - Test that you do know what every piece of your code does
- Hall of fame – coolest projects from 2002 on
Late Work
- 3 grace days
  - for unforeseen circumstances
  - strong recommendation: don’t use early in term
  - handing in late uses up automatically unless you tell us
- Otherwise: 25% per 24 hours
  - no work accepted after solutions handed out
- Exception: severe illness or crisis, as per UBC rules
  - MUST
    - Get approval from me ASAP (in person or email)
    - Turn in form with documentation
http://www.ugrad.cs.ubc.ca/~cs314/Vsep2005/policies.html#illness

Regrading
- To request assignment or exam regrade:
  - Submit detailed written explanation - why you think the grader was incorrect for the particular problem that you are disputing
- I will regrade entire assignment:
  - thus even if I agree with your original request, your score may end up higher or lower

Literature (optional)
- Fundamentals of Computer Graphics
  - Second edition
  - Peter Shirley, A.K. Peters
- OpenGL Programming Guide
  - J. Neider, T. Davis and W. Mason, Addison-Wesley

Learning OpenGL
- This is a graphics course using OpenGL
  - not a course ON OpenGL
- Upper-level class: learning APIs mostly on your own
  - only minimal lecture coverage
    - basics, some of the tricky bits
- OpenGL Red Book
- many tutorial sites on the web
  - nehe.gamedev.net

Plagiarism and Cheating
- Don’t cheat, I will prosecute
  - insult to your fellow students and to me
- Theoretical assignments are individual work
- Programming assignments (when specified) can be done in pairs
- Can discuss ideas, browse Web
- But cannot copy code or answers
- Must be able to explain algorithms during face-to-face demo
  - or no credit for that assignment, possible prosecution

Citation
- Cite all sources of information in assignment’s README
  - web sites, study group members, books
http://www.ugrad.cs.ubc.ca/~cs314/Vsep2005/policies.html#plag
Computer Graphics

Introduction

Rendering in 2D
- Raster display - discrete grid of elements
- Terminology
  - **Pixel**: basic element on device
- **Resolution**: number of rows & columns in device
  - Measured in
    - Absolute values (1K x 1K)
    - Density values (300 dots per inch)
- **Screen Space**: Discrete 2D Cartesian coordinate system of the screen pixels

Basics

Basic Rendering – 2D
- Algorithms for:
  - Scan Conversion
    - Draw (lines)
      - Anti-Aliasing
    - Fill (polygons)
    - Clipping
    - Color

3D Graphics Components
- Geometric Modeling
  - polygons,
  - smooth surfaces,
  - etc...
- Rendering

Modeling Transformation: Object Placement

Viewing Transformation: Camera Placement

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Curved Surfaces

Complex Lighting and Shading

Texture Mapping

Shadows (+Displacement Mapping)

Reflection Mapping

Animation
- Generating motion
  - Frame/State interpolation
  - Physical simulation
  - Motion capture

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Lecture Syllabus

- Introduction + Math
- Review + OpenGL + Rendering Pipeline (week 1)
- Transformations (week 2/3)
- Rasterization (week 4/5)
- Clipping (week 5)
- Hidden Surface Removal (week 6)
- Review & Quiz (week 7)
- Quiz: Oct 20

- Lighting Models (week 8)
- Texture mapping (week 9)
- Review & Quiz (week 10)
  - Quiz: Nov 10
- Shadows (week 11)
- Ray Tracing (week 11/12)
- Geometric Modeling (week 12/13)
- Review (last lecture)