COMP 4490: Computer Graphics II

Time: M/W/F 10:30-11:20
Place: ALLEN 330
Course web page: `www.cs.umanitoba.ca/~bruce/COMP4490/`

Instructor: Neil Bruce
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Prerequisites: COMP 3490

Calendar Description: Methods in computer graphics including topics such as representation of curves and surfaces, viewing in three dimensions, and colour models.

Topics covered: The following is a list of more specific topics that will make up the course curriculum and span the more general topics appearing in the course calendar.

- Introduction: Introduction to the course, review of important concepts and mathematics from COMP 3490
- Lighting Models and Ray Tracing: Ray casting, intersection testing, lighting/shading models
- Acceleration Data Structures: Accelerated intersection testing, Octrees, k-d trees, binary space partitioning
- "Modern" OpenGL: A look at the evolution of OpenGL from versions 1.x through 4.x and critical differences
- Curves, Splines, Surfaces and Mesh Data Structures: Curves, Splines and Surfaces (Bezier, Hermite, Catmull-Rom), Implicit surfaces, NURBS, Mesh Simplification and Decimation
- Image Processing and Sampling: Textures, sampling, blending, antialiasing, convolution, edge detection, discrete fourier transform and the frequency domain
- Computational Photography: Image based lighting, environment maps, BRDFs, BSSRDFs, the rendering equation, High Dynamic-Range compression
- Motion Capture and 3D reconstruction: Motion capture, depth cameras and 3D reconstruction, augmented reality, 3D printing
- Color and Perception: Overview of visual perception relevant to graphics, computational overview of human vision
- Stereoscopic 3D: Rendering 3-dimensional images, depth cues, motion parallax, perceptual issues
- Stochastics: Procedural terrain, textures, physical simulation
- Future Graphics: Photorealism, emerging technology and the future of computer graphics

Grading:
Three assignments (10% each)
Course Project (40%)
Term-Test (30%)

Note on Textbooks: There are many decent textbooks, but the course matter doesn't follow any single textbook closely. A selection of decent textbooks for both theory and implementation are listed in what follows:

Theory

- Computer Graphics: Principles and Practice (3rd Edition) John F. Hughes, Andries van Dam, Morgan McGuire, David F. Sklar, James D. Foley, Steven K. Feiner, Kurt Akeley
- Fundamentals of Computer Graphics, by Peter Shirley, Steve Marschner, et alia, A.K. Peters, July 2009. (A very accessible theory book widely used)
- Interactive Computer Graphics: A Top-Down Approach with Shader-Based OpenGL, Sixth Edition. (Good theory/shader reference)
- OpenGL SuperBible, Fifth Edition, by Richard S. Wright Jr., Benjamin Lipchak, Addison-Wesley, August 2010. (API/Programming Guide)
- OpenGL Programming Guide: The Official Guide to Learning OpenGL, Versions 4.1, Eighth Edition, Dave Shreiner, Bill Licea-Kane, Graham Sellers, Addison-Wesley, April 1 2013. (The Red Book - OpenGL API/Programming Guide)
- OpenGL Shading Language, Third Edition, by Randi J. Rost, Bill Licea-Kane, and others, Addison-Wesley, July 2009. (The Orange Book - GLSL API/Programming Guide)
- Also check out the free books here: `http://www.realtimerendering.com/`

Important Dates: Please see the Important Dates section of the U of M Calendar.

Late Policy: (0-12] hours: -5%, (12-24] hours: -10%, (24-48] hours: -20%, (48-72] hours: -50%. No assignments will be accepted beyond 72 hours past the deadline barring extenuating circumstances. (e.g. a valid reason, medical, personal or otherwise subject to University policy)

Academic Honesty: Any academic dishonesty will be dealt with according to the University's discipline bylaw. Assignments and projects should be exclusively based of your own work, and providing work to another student or students is prohibited. While the depth of problems tackled by the course is challenging and building on prior knowledge and/or progress made on problems assigned is permitted, any external resources that provide partial solutions to problems should be credited, prior approval from the course instructor should be granted, and special effort made to disambiguate contributions to the overall body of work that are those of the student versus existing publicly available resources. A single blanket honesty declaration must be submitted prior to your first assignment and this will be treated as a contract applied to any and all materials submitted in satisfying the requirements of the course.