CIS 736: Computer Graphics
Spring 2011

Hours: 3 hours; 3 hour extended course project option (CIS 598, 690, 798, 890) available
Prerequisite: CIS 300 and knowledge of C/C++ programming. Background in **precalculus (trigonometry and analytic geometry) and basic matrix algebra (Math 551)** recommended. A first course in computer graphics is *not* required for CIS 636, but is recommended for CIS 736.
Textbook: Eberly, D. H. (2006). *3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics, 2nd edition.* San Francisco, CA: Morgan Kaufmann. ISBN: 0122290631
Venue: MWF 10:30 – 11:20, Room 127 Nichols Hall (Lecture) and Room 128 Nichols Hall (Lab)
Instructor: William H. Hsu, Department of Computing and Information Sciences
    Office: 213 Nichols Hall   URL: http://www.cis.ksu.edu/~bhsu E-mail: bhsu@ksu.edu
    Phone (Google Voice: office/home/cell): +1 785 236 8247   TA: Ming Yang, 218 Nichols Hall
    Instructional e-mail alias (use for instructor and TA): CIS736TA-L@listserv.ksu.edu
Office hours: 12:30 – 13:30 Monday, Friday; 09:00 – 10:00 Wednesday; 09:30 – 10:30 Tuesday; by appointment
K-State Online (KSOL) page: http://bit.ly/eVizrE
Course web page: http://www.kddresearch.org/Courses/CIS736/
Camtasia lectures: Linked from course web page (http://bit.ly/eILaFl) and KSOL

Course Description

This course provides intermediate background in computer graphics for graduate and advanced undergraduate students. After a brief review of basic principles of graphics display systems (clipping, view normalization, 3D graphics data structures), the course will cover fundamental topics in realistic rendering: shading and illumination, texture and bump mapping, visible surface determination, multipass rendering, particle systems, physically-based modeling, and basics of animation. The last part of the course will focus on a small number of advanced topics of interest, such as fractals, scientific and information visualization, curve and surface modeling, ray tracing, radiosity (photon maps), or character modeling.

Course Requirements

Homework: 8 of 10 programming and written assignments – 5 written, 5 programming (**16**%)
Paper reviews: 2 written reviews (1-2 pages) of short (10-15 page) research papers (**4%**)
Labs and class participation: attendance (**2**%), in-class discussion (**4**%), peer review (**2**%), labs (**7%**)
Examinations: two hour exams (10% each, **20%** total), 1 final exam (**25%**)
Computer language(s): C/C++, C#, and Java (any of these permitted for term programming project); *OpenGL*, other graphics libraries and packages (e.g., *Ogre3D*, *Maya 9 aka Maya 2011*) to be taught and used
Project: term programming project for all students (**20**%); additional term paper or project extension option for graduate students and advanced undergraduates

References (to be placed on reserve in K-State CIS Library)

- Orange Book 3^e (ISBN: 032163`7631), SuperBible *aka* Blue Book 5^e (ISBN: 0321712617), formerly Cyan Book
- OpenGL Architecture Review Board, Shreiner, D. & The Khronos OpenGL ARB Working Group (2009). *OpenGL® Programming Guide: The Official Guide to Learning OpenGL®, Versions 3.0 and 3.1, 7th edition.* Reading, MA: Addison-Wesley. ISBN: 0321552628
- Angel, E. (2008). *Interactive Computer Graphics: A Top-Down Approach with OpenGL, 5th edition.* Reading, MA: Addison-Wesley. ISBN: 0321535863 (with *OpenGL: A Primer, 3rd edition*, 2007, ISBN: 0321398114)
- Hearn, D. O. & Baker, M. P. (2003). *Computer Graphics with OpenGL, 3rd edition.* Englewood Cliffs, NJ: Prentice-Hall. ISBN: 0130153907.
- Foley, J. D., VanDam, A., Feiner, S. K., & Hughes, J. F. (1991). *Computer Graphics: Principles and Practice, 2nd Edition in C .* Reading, MA: Addison-Wesley. ISBN: 0201848406

Additional bibliography (excerpted in course notes and handouts)

- Tufte, E. R. (2006). *Beautiful Evidence.* Cheshire, CT: Graphics Press.
- Tufte, E. R. (1997). *Visual Explanations: Images and Quantities, Evidence and Narrative.* Cheshire, CT: Graphics Press.
- Card, S. K., MacKinlay, J. D., & Schneiderman, B. (1999). *Readings in Information Visualization: Using Vision to Think.* San Francisco, CA: Morgan Kaufmann.
- Barnsley, M. F. (1993). *Fractals Everywhere, 2nd Edition.* Burlington, MA: Academic Press.
- Books on Flash, Maya, and Ogre 3D – to be announced

Course Calendar and Syllabus

Lecture	Date	Topic	Primary Source(s)
0	Wed 19 Jan 2011	Course Overview	Chapter 1, Eberly 2e
1	**Fri 21 Jan 2011**	**CG Refresher: Transformations; Lab 0**	**Sections (§) 2.1, 2.2**
2	Mon 24 Jan 2011	Viewing 1; Linear and Affine Transformations	§ 2.2.3 – 2.2.4, 2.8
3	Wed 26 Jan 2011	Viewing 2; Parametric Equations	§ 2.3 esp. 2.3.4; FVFH slides
4	Fri 28 Jan 2011	Lab 1a: 3-D Refresher; Flash, GL, Direct3D	Chapters 2, 16[1], Angel *Primer*
5	Mon 31 Jan 2011	Viewing 3: Scene Graphs: State, MVT	§ 2.3; 2.6, 2.7; 4.1 – 4.3
6	Wed 02 Feb 2011	Scan Conversion 1: Lines & Antialiasing	§ 2.5.1, 3.1; FVFH slides
7	**Fri 04 Feb 2011**	**Viewing 4: Clipping, Culling, OBBs; Lab 1b**	**§ 2.3.5, 2.4, 3.1.3**
8	Mon 07 Feb 2011	Scan Conversion 2: Polygons, Clipping Intro	§ 2.4, 2.5 esp. 2.5.4, 3.1.6
9	Wed 09 Feb 2011	Surface Detail 1: Phong Illumination	§ 2.5, 2.6.1 – 2.6.2, 4.3.2, 20.2
10	**Fri 11 Feb 2011**	**Lab 2a: Direct3D / DirectX Intro**	**§ 2.7, Direct3D handout**
11	Mon 14 Feb 2011	Surface Detail 2: OGLSL; Many Mappings	§ 2.6.3, 20.3 – 20.4, *Primer*
12	Wed 16 Feb 2011	Surface Detail 3: Advanced Texture Mapping	§ 20.5 – 20.13
13	**Fri 18 Feb 2011**	**Surface Detail 4: Pixel/Vertex Shad.; Lab 2b**	**§ 3.1**
14	Mon 21 Feb 2011	Surface Detail 5: Writing Shaders; RenderMan	§ 3.2 – 3.4, Direct3D handout
15	Wed 23 Feb 2011	Demos 1: CGA; Scene Graphs: Traversal	§ 4.4 – 4.7, CGA handout
16	**Fri 25 Feb 2011**	**Lab 3a: Alpha in Flash *vs.* GL, Direct3D**	**§ 2.6, 20.1, *Primer***
17	**Mon 28 Feb 2011**	**Animation 1: Keyframes, Interpolation**	**§ 5.1 – 5.2, OGLSL handout**
	Wed 02 Mar 2011	**Exam 1 review; Hour Exam 1 (evening)**	**Chapters 1 – 4, 16, 20**
18	Fri 04 Mar 2011	**Scene Graphs: Rendering; Lab 3b: OGLSL**	§ 11.1, **mesh handout**
19	**Mon 07 Mar 2011**	**Demos 2: SFX; Inverse Kinematics**	**§ 5.3 – 5.5, CGA handout**
20	Wed 09 Mar 2011	Demos 3: Bézier, NURBS; CSG, Solid Models	§ 10.4, 11.3, 11.8, 12.2, 12.7
21	**Fri 11 Mar 2011**	**Lab 4a: Animation Basics; Maya Modeling**	**Flash animation handout**
22	Mon 21 Mar 2011	Animation 2: Euler Angles *vs.* Quaternions	Chapter 17, esp. §17.1 – 17.2
23	Wed 23 Mar 2011	Demos 4: Modeling & Simulation; Smoothness	Chapter 10[1], 13[2], §17.3 – 17.5
24	**Fri 25 Mar 2011**	**Collisions 1: capsules/lozenges, Lab 4b**	**§2.4.3, 8.1, GL handout**
25	Mon 28 Mar 2011	Spatial Sorting: BSP and Portals	Chapter 6, esp. §6.1
26	**Wed 30 Mar 2011**	**Demos 5: More CGA; Picking Modes**	**Chapter 7[2]; § 8.4**
27	**Fri 01 Apr 2011**	**Lab 5a: Picking in OpenGL, Flash**	**§ 8.3 – 8.4; 4.2, 5.0, 5.6, 9.1**
28	Mon 04 Apr 2011	Collisions 2: Dynamic, Particle Systems	§ 9.1, particle system handout
	Wed 06 Apr 2011	**Exam 2 review; Hour Exam 2 (evening)**	**Chapters 5 – 6, 7[2] – 8, 12, 17**
29	**Fri 08 Apr 2011**	**Lab 5b: Advanced Particle Systems**	**Particle system handout**
30	**Mon 11 Apr 2011**	**Animation 3: Control & IK, PBM**	**§ 5.3, CGA handout**
31	Wed 13 Apr 2011	Ray Tracing 1: intersections, recursion, trees	Chapter 14
32	Fri 15 Apr 2011	Lab 6a: Ray Tracing w/POV-Ray	RT handout
33	Mon 18 Apr 2011	Ray Tracing 2: refraction, supersampling	Chapter 15, RT handout
34	Wed 20 Apr 2011	Visualization 1: Graphical Integrity, Data-Ink	Tufte handout (1)
35	**Fri 22 Apr 2011**	**Lab 6b: More Ray Tracing**	**RT handout**
36	Mon 25 Apr 2011	Visualization 2: Small Multiples, Macro/Micro	Tufte handout (2 & 4)
37	Wed 27 Apr 2011	Fractals & fBm; Term Project Prep	**Color handout**
38	Fri 29 Apr 2011	Lab 7: Fractals & Terrain Generation	**Fractals/Terrain handout**
39	**Mon 02 May 2011**	**Visualization 3: Confections, HCI; Review 1**	Tufte handout (3)
40	**Wed 04 May 2011**	**Term project presentations 1; Review 2**	**–**
41	Fri 06 May 2011	Term project presentations 2	–
	Final Exam 11:50 Tue 10 May 2011		**Ch. 1 – 8, 10 – 15, 17, 20**

Lightly-shaded entries denote the due date of a written problem set; heavily-shaded entries, that of a machine problem (programming assignment); blue-shaded entries, that of a paper review; and the green-shaded entry, that of the term project.

Lab exercises are always due on the day before the next lab.

Green, **blue** and **red** letters denote **exam review**, **exam**, and **exam solution review** dates.

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[1] Required for CIS 636 students; optional (refresher as needed) for CIS 736 students.
[2] Required only for CIS 736 students.