



## Lecture 0 of 41: Part A – Course Organization

### Introduction to Computer Graphics: Course Organization and Survey

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**KSOL course page:** <http://bit.ly/hGvXIH>

**Course web site:** <http://www.kddresearch.org/Courses/CIS636>

**Instructor home page:** <http://www.cis.ksu.edu/~bhsu>

#### Reading for Next Class:

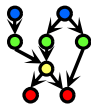
Syllabus and Introductory Handouts

CIS 536 & CIS 636 students: CG Basics 1 slides

Chapter 1, Eberly (2006) 3D Game Engine Design, 2<sup>e</sup>



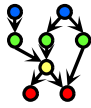
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## Course Administration

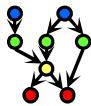
- **Course Pages (KSOL):** <http://bit.ly/hGvXIH> / <http://bit.ly/eVizrE>
- **Class Web Page:** [www.kddresearch.org/Courses/CIS636](http://www.kddresearch.org/Courses/CIS636)
- **Instructional E-Mail Addresses – Best Way to Reach Instructor**
  - \* [CIS736TA-L@listserv.ksu.edu](mailto:CIS736TA-L@listserv.ksu.edu) (always use this to reach instructor and TA)
  - \* [CIS636-L@listserv.ksu.edu](mailto:CIS636-L@listserv.ksu.edu) (everyone; substitute “736” for Advanced CG)
- **Instructor: William Hsu, Nichols 324C**
  - \* **Google Voice** (cell/office/home): +1 785 236 8247; office: +1 785 532 7905
  - \* **IM:** AIM/MSN/YIM [hsuw/h](#)/[rizanabsith](#), ICQ [28651394](#)/[191317559](#), Google [banazir](#)
  - \* **Office hours:** after class Mon/Wed/Fri; Tue AM; other times by appointment
- **Graduate Teaching Assistant: To Be Announced**
  - \* **Office location:** Nichols 124 (CIS Visualization Lab) & Nichols 218
  - \* **Office hours:** to be announced on class web board
- **Grading Policy: Overview**
  - \* **Exams:** 45%
  - \* **Homework:** 23% (5 written, 5 programming, drop lowest 2; 7 labs)
  - \* **Term project:** 20%
  - \* **Paper/peer reviews and class participation:** 12% (Q&A)





## Course Policies

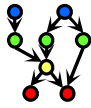
- **Letter Grades**
  - \* 15% graduations (85+%: A, 70+%: B, etc.)
  - \* Cutoffs may be more lenient, but a) never higher and b) seldom much lower
- **Grading Policy**
  - \* Hour exams: 10% each (in-class, with notes); final (open-book): 25%
  - \* Machine problems, problem sets (8 of 10): 16%; labs: 7%; term project: 20%
  - \* Reviews: paper critiques (2): 4%; peer review: 2%
  - \* Class participation: 6% (HW, Q&A)
- **Late Homework Policy**
  - \* Allowed only in case of medical excusal
  - \* All other late homework: see drop policy
- **Attendance Policy**
  - \* Absence due to travel or personal reasons: e-mail CIS736TA-L in advance
  - \* See instructor, Office of the Dean of Student Life as needed
- **Honor System Policy: <http://www.ksu.edu/honor/>**
  - \* On plagiarism: cite sources, use quotes if verbatim, includes textbooks
  - \* OK to discuss work, but turn in your own work only
  - \* When in doubt, ask instructor



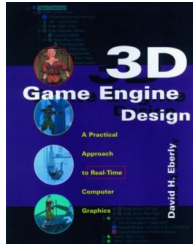
## Class Resources

- **Course Content Management System (CMS): K-State Online (KSOL)**
  - \* Official course page: <http://bit.ly/hGvXIH>
  - \* Mirror: <http://www.kddresearch.org/Courses/CIS636>
  - \* Lecture notes (MS PowerPoint 97-2010, PDF)
  - \* Homeworks (MS Word 97-2010, PDF)
  - \* Exam and homework solutions (MS PowerPoint 97-2010, PDF)
  - \* Class announcements (students' responsibility) and grade postings
- **Course Notes On KSOL and Public Mirror**
- **Mailing List (Automatic): [CIS636-L@listserv.ksu.edu](mailto:CIS636-L@listserv.ksu.edu)**
  - \* Homework/exams (before uploading to CMS, KSOL), sample data, solutions
  - \* Use KSOL "File Dropbox"
  - \* Class participation
  - \* Project info, course calendar reminders
  - \* Dated research announcements (seminars, conferences, calls for papers)
- **LISTSERV Web Archive**
  - \* <http://listserv.ksu.edu/archives/cis636-l.html>
  - \* Stores e-mails to class mailing list as browsable/searchable posts

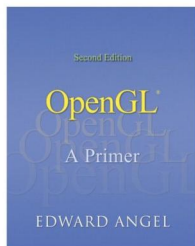




## Textbook and Recommended References



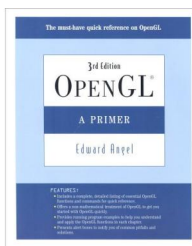
1<sup>st</sup> edition (outdated)



2<sup>nd</sup> edition (OK to use)



2<sup>nd</sup> edition



3<sup>rd</sup> edition

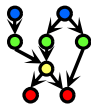
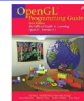
### Required Textbook

Eberly, D. H. (2006). *3D Game Engine Design: A Practical Approach to Real-Time Computer Graphics*, second edition. San Francisco, CA: Morgan Kaufman.

### Recommended References

Angel, E. O. (2007). *OpenGL: A Primer*, third edition. Reading, MA: Addison-Wesley. [2<sup>nd</sup> edition on reserve]

Shreiner, D., Woo, M., Neider, J., & Davis, T. (2009). *OpenGL® Programming Guide: The Official Guide to Learning OpenGL®, Versions 3.0 and 3.1*, seventh edition. ["The Red Book": use 7<sup>th</sup> ed. or later]



## Background Expected

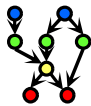
- **Both Courses**
  - \* Proficiency in C/C++ or *strong* proficiency in Java and ability to learn
  - \* Strongly recommended: matrix theory or linear algebra (e.g., Math 551)
  - \* At least 120 hours for semester (up to 150 depending on term project)
  - \* Textbook: *3D Game Engine Design, Second Edition* (2006), Eberly
  - \* Angel's *OpenGL: A Primer* recommended
- **CIS 636 Introduction to Computer Graphics**
  - \* Fresh background in precalculus: Algebra 1-2, Analytic Geometry
  - \* Linear algebra basics: matrices, linear bases, vector spaces
  - \* Watch background lectures
- **CIS 736 Computer Graphics**
  - \* Recommended: first course in graphics (background lectures as needed)
  - \* OpenGL experience helps
  - \* Read up on shaders and shading languages
  - \* Watch advanced topics lectures; see list before choosing project topic





## Online Recorded Lectures for CIS 536/636 (Intro to CG)

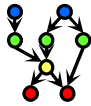
- **Project Topics for CIS 536/636**
- **Computer Graphics Basics (10)**
  - \* [1. Mathematical Foundations – Week 1 - 2](#)
  - \* [2. OpenGL Primer 1 of 3: Basic Primitives and 3-D – Weeks 2-3](#)
  - \* [3. Detailed Introduction to Projections and 3-D Viewing – Week 3](#)
  - \* [4. Fixed-Function Graphics Pipeline – Weeks 3-4](#)
  - \* [5. Rasterizing \(Lines, Polygons, Circles, Ellipses\) and Clipping – Week 4](#)
  - \* [6. Lighting and Shading – Week 5](#)
  - \* [7. OpenGL Primer 2 of 3: Boundaries \(Meshes\), Transformations – Weeks 5-6](#)
  - \* [8. Texture Mapping – Week 6](#)
  - \* [9. OpenGL Primer 3 of 3: Shading and Texturing, VBOs – Weeks 6-7](#)
  - \* [10. Visible Surface Determination – Week 8](#)
- **Recommended Background Reading for CIS 636**
- **Shared Lectures with CIS 736 (*Computer Graphics*)**
  - \* [Regular in-class lectures \(30\) and labs \(7\)](#)
  - \* [Guidelines for paper reviews – Week 6](#)
  - \* [Preparing term project presentations, CG demos – Weeks 11-12](#)



## Online Recorded Lectures for CIS 736 (Computer Graphics)

- **Project Topics for CIS 736**
- **Advanced Topics in Computer Graphics (10)**
  - \* [1. Filters for Texturing – Week 2](#)
  - \* [2. Level-of-Detail Algorithms and Terrain – Week 3](#)
  - \* [3. More Mappings – Week 6](#)
  - \* [4. More on Animation – Week 8](#)
  - \* [5. Character Modeling and IK – Week 9](#)
  - \* [6. Global Illumination: Photon Maps \(Radiosity\) – Week 10](#)
  - \* [7. Advanced Lighting Models – Week 11](#)
  - \* [8. Advanced Ray-Tracing – Week 12](#)
  - \* [9. More on Scientific, Data, Info Visualization – Week 13](#)
  - \* [10. Fractals and L-Systems – Week 14](#)
- **Recommended Background Reading for CIS 736**
- **Shared Lectures with CIS 536/636 (*Introduction to Computer Graphics*)**
  - \* [Regular in-class lectures \(30\) and labs \(7\)](#)
  - \* [Guidelines for paper reviews – Week 6](#)
  - \* [Preparing term project presentations, CG demos – Weeks 11-12](#)





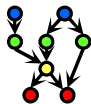
## Syllabus [1]: First Half of Course

Lecture	Topic	Primary Source(s)
0	Course Overview	Chapter 1, Eberly 2*
1	<b>CG Basics: Transformation Matrices; Lab 0</b>	<b>Sections (§) 2.1, 2.2</b>
2	Viewing 1: Overview, Projections	§ 2.2.3 – 2.2.4, 2.8
3	Viewing 2: Viewing Transformation	§ 2.3 esp. 2.3.4; <a href="#">FVFH slides</a>
4	<b>Lab 1a: Flash &amp; OpenGL Basics</b>	<b>Ch. 2, 16<sup>†</sup>, <a href="#">Angel Primer</a></b>
5	Viewing 3: Graphics Pipeline	§ 2.3 esp. 2.3.7; 2.6, 2.7
6	Scan Conversion 1: Lines, Midpoint Algorithm	§ 2.5.1, 3.1; <a href="#">FVFH slides</a>
7	<b>Viewing 4: Clipping &amp; Culling; Lab 1b</b>	<b>§ 2.3.5, 2.4, 3.1.3</b>
8	Scan Conversion 2: Polygons, Clipping Intro	§ 2.4, 2.5 esp. 2.5.4, 3.1.6
9	Surface Detail 1: Illumination & Shading	§ 2.5, 2.6.1 – 2.6.2, 4.3.2, 20.2
10	<b>Lab 2a: Direct3D / DirectX Intro</b>	<b>§ 2.7, <a href="#">Direct3D handout</a></b>
11	Surface Detail 2: Textures; OpenGL Shading	§ 2.6.3, 20.3 – 20.4, <a href="#">Primer</a>
12	Surface Detail 3: Mappings; OpenGL Textures	§ 20.5 – 20.13
13	<b>Surface Detail 4: Pixel/Vertex Shad.; Lab 2b</b>	<b>§ 3.1</b>
14	Surface Detail 5: Direct3D Shading; OGLSL	§ 3.2 – 3.4, <a href="#">Direct3D handout</a>
15	Demos 1: CGA, Fun; Scene Graphs: State	§ 4.1 – 4.3, <a href="#">CGA handout</a>
16	<b>Lab 3a: Shading &amp; Transparency</b>	<b>§ 2.6, 20.1, <a href="#">Primer</a></b>
17	<b>Animation 1: Basics, Keyframes; HW/Exam</b>	<b>§ 5.1 – 5.2</b>
	<b>Exam 1 review: Hour Exam 1 (evening)</b>	<b>Chapters 1 – 4, 20</b>
18	<b>Scene Graphs: Rendering; Lab 3b: Shader</b>	<b>§ 4.4 – 4.7</b>
19	<b>Demos 2: SFX; Skinning, Morphing</b>	<b>§ 5.3 – 5.5, <a href="#">CGA handout</a></b>
20	Demos 3: Surfaces; B-reps/Volume Graphics	§ 10.4, 12.7, <a href="#">Mesh handout</a>

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.



## Syllabus [2]: Second Half of Course

21	<b>Lab 4a: Animation Basics</b>	<b>Flash animation handout</b>
22	Animation 2: Rotations; Dynamics, Kinematics	Chapter 17, esp. §17.1 – 17.2
23	Demos 4: Modeling & Simulation; Rotations	Chapter 10 <sup>†</sup> , 13 <sup>†</sup> , §17.3 – 17.5
24	<b>Collisions 1: axes, OBBs, Lab 4b</b>	<b>§2.4.3, 8.1, <a href="#">GL handout</a></b>
25	Spatial Sorting: Binary Space Partitioning	Chapter 6, esp. §6.1
26	<b>Demos 5: More CGA; Picking; HW/Exam</b>	<b>Chapter 7<sup>†</sup>; § 8.4</b>
27	<b>Lab 5a: Interaction Handling</b>	<b>§ 8.3 – 8.4; 4.2, 5.0, 5.6, 9.1</b>
28	Collisions 2: Dynamic, Particle Systems	§ 9.1, <a href="#">particle system handout</a>
	<b>Exam 2 review: Hour Exam 2 (evening)</b>	<b>Chapters 5 – 6, 7<sup>†</sup> – 8, 12, 17</b>
29	<b>Lab 5b: Particle Systems</b>	<b>Particle system handout</b>
30	<b>Animation 3: Control &amp; IK</b>	<b>§ 5.3, <a href="#">CGA handout</a></b>
31	Ray Tracing 1: intersections, ray trees	Chapter 14
32	Lab 6a: Ray Tracing Basics with POV-Ray	<a href="#">RT handout</a>
33	Ray Tracing 2: advanced topic survey	Chapter 15, <a href="#">RT handout</a>
34	Visualization 1: Data (Quantities & Evidence)	<a href="#">Tufte handout (1)</a>
35	<b>Lab 6b: More Ray Tracing</b>	<b><a href="#">RT handout</a></b>
36	Visualization 2: Objects	<a href="#">Tufte handout (2 &amp; 4)</a>
37	Color Basics; Term Project Prep	<a href="#">Color handout</a>
38	Lab 7: Fractals & Terrain Generation	<a href="#">Fractals/Terrain handout</a>
39	<b>Visualization 3: Processes; Final Review 1</b>	<b><a href="#">Tufte handout (3)</a></b>
40	<b>Project presentations 1; Final Review 2</b>	<b>–</b>
41	<b>Project presentations 2</b>	<b>–</b>
	<b>Final Exam</b>	<b>Ch. 1 – 8, 10 – 15, 17, 20</b>

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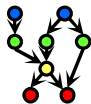






## Math Review for CIS 536 / 636

- **Overview: First Month (Weeks 2-5 of Course)**
  - \* [Review of mathematical foundations of CG: analytic geometry, linear algebra](#)
  - \* [Line and polygon rendering](#)
  - \* [Matrix transformations](#)
  - \* [Graphical interfaces](#)
- **Line and Polygon Rendering (Week 3)**
  - \* [Basic line drawing and 2-D clipping](#)
  - \* [Bresenham's algorithm](#)
  - \* [Follow-up: 3-D clipping, z-buffering \(painter's algorithm\)](#)
- **Matrix Transformations (Week 4)**
  - \* [Application of linear transformations to rendering](#)
  - \* [Basic operations: translation, rotation, scaling, shearing](#)
  - \* [Follow-up: review of standard graphics libraries \(starting with OpenGL\)](#)
- **Weeks 5 – 6: More OpenGL and Direct3D**
- **Graphical Interfaces**
  - \* [Brief overview](#)
  - \* [Survey of windowing environments \(SDL in OpenGL, DirectX\)](#)



## References and Outside Reading

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

- 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, 7<sup>th</sup> edition*. Reading, MA: Addison-Wesley. ISBN: 0321552628
- Angel, E. (2008). *Interactive Computer Graphics: A Top-Down Approach with OpenGL, 5<sup>th</sup> edition*. Reading, MA: Addison-Wesley. ISBN: 0321535863 (with *OpenGL: A Primer, 3<sup>rd</sup> edition*, 2007, ISBN: 0321398114)
- Hearn, D. O. & Baker, M. P. (2003). *Computer Graphics with OpenGL, 3<sup>rd</sup> 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, 2<sup>nd</sup> Edition in C*. Reading, MA: Addison-Wesley. ISBN: 0201848406
- *Orange Book 3<sup>e</sup>* (ISBN: 0321637631), *SuperBible aka Blue Book 5<sup>e</sup>* (ISBN: 0321712617), formerly *Cyan Book*

### 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, 2<sup>nd</sup> Edition*. Burlington, MA: Academic Press.
- Books on Maya and Ogre 3D – to be announced

- **OpenGL Tutorials (GameDev aka Nehe):** <http://nehe.gamedev.net>
- **Andy vanDam's Lectures @ Brown:** <http://bit.ly/cWUxBz>

