The Art Institute of Portland℠

CG Programming III

Syllabus

VGP 353A

Spring 2007, 3 credits
Mondays, 6:00PM – 9:45PM
Room #201

Ian Romanick

Contact Information

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Office Hours

By appointment.

Final Exam

Monday, June 4th, 5:30PM – 7:30PM.

Required Texts

Real-Time Rendering (2nd Ed.) by Tomas Akenine-Möller and Eric Haines. ISBN 1-56881-182-9. The book also has a website, http://www.realtimerendering.com/, that includes lots of additional references and sample code.

OpenGL Shading Language by Randi J. Rost. This book is *optional*, and either the 1st or 2nd edition should be sufficient. This book also has a web site, http://3dshaders.com/, that includes example shaders and some references. There will not be any readings assigned from this book.

OpenGL Programming Guide by Martin Ecker may also be useful. ISBN 0321335732. There will not be any readings assigned from this book. An older version of the book, which should be sufficient for this course, is available for download as a PDF from http://www.opengl.org/documentation/red_book/.

Additional materials will provided on-line at the course website http://people.freedesktop.org/~idr/2007-VGP353/.

Course Description

Programming real-time shadow algorithms using OpenGL and OpenGL Shading Language (GLSL). This includes shadow maps, shadow volumes, and several variations and optimizations of each.

Course Outcomes

By the end of the course, students will be able to:

- Implement various render-to-texture algorithms.
- Implement shadow map based real-time shadow algorithms.

- Implement shadow volume based real-time shadow algorithms.
- Read, understand, and make use of information in academic papers.

Prerequisite

This course is both programming and math intensive. A strong background in C or C++ programming is required. Familiarity with basic graphics programming concepts (e.g., lighting, texturing, transformations, etc.) and OpenGL programming is also required. In addition, familiarity with *basic* matrix math and trigonometry are required.

Required Materials

In addition to paper and writing utensils, each student will need a removable storage device. The storage device will be used to both bring documents and sample code home from class and bring homework completed assignments to class. The storage requirements should be minimal, so a small USB flash-drive (32MB) should be sufficient.

Grading

Each student's grade in this course will be primarily based on a total of five single-week programming assignments and one four-week programming project. The remainder of the student's grade will be based on a mid-term exam, a final exam, and an in-class presentation.

Programming assignments will be graded first and foremost on whether or not correct output is produced. The remaining points are based on the style of the program. This includes, but is not limited to, algorithm selection, code formatting, and naming conventions. A detailed rubric will be provided with each assignment.

Programming Assignments		
In-class presentation		20 pts.
Homework programming assignments		50 pts.
Term project		50 pts.
	Subtotal	120 (64%)
Tests		
In-class quizes		20 pts.
Final Exam		50 pts.
	Subtotal	70 (36%)
	Total	190 (100%)

Some assignments *may* carry extra-credit opportunities, but they will be infrequent.

Grading Scale

A = 93% and above
A- = 90%-92%
B+ = 87%-89%
B = 83%-86%
B- = 80%-82%
C+ = 77%-79%
C = 73%-76%

C- = 70%-72%
D+ = 67%-69%
D = 60-66%

Late Work

I do not accept late work. If you miss a deadline, you will not earn the points for that activity. There are no make-up or extra-credit opportunities. If you are unable to attend class on the due date for a assignment, please submit it by e-mail *before* class.

Attendance and Participation

If you are not in class for an in-class exercise, you cannot earn those points. If you miss an entire class, you are responsible for obtaining copies of handouts and other classroom materials from your classmates.

Lab Policies

Leave food and drink outside the class. Disciplinary action will be taken toward any student found using the equipment in an inappropriate manner, taking cell phone calls or surfing the web. Disruptive, disrespectful or rude behavior will not be tolerated.

Plagiarism

Presenting the writings, images or paraphrased ideas of another as one's own, is strictly prohibited at the Art Institute of Portland. Properly documented excerpts from other's works, when they are limited to an appropriate amount of the total length of a student's paper, are permissible when used to support a researched argument.

Students with Disabilities

It is AiPD policy not to discriminate against qualified students with a documented disability in its educational programs, activities or services. If you have a disability-related need for adjustments or other accommodations in this class, contact the Disability Services Coordinator.

Amber Perrin
Disabilities Services Coordinator
The Art Institute of Portland
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Course Calendar

Week 1 (April 2nd)

- Course road-map
- Render-to-texture techniques
  - Render to framebuffer, copy to texture
  - Framebuffer objects
- Homework assignments:
  - Read:
    - Section 6.12.

        - Rob Jones, OpenGL Framebuffer Object 101, 2006. http://www.gamedev.net/reference/programming/features/fbo1/
        - Simon Green, The OpenGL Framebuffer Object Extension, Game Developer's Conference '05, 2005. http://developer.nvidia.com/object/gdc_2005_presentations.html
    - Render-to-texture wave simulation. Due 4/9. (10 points)

Week 2 (April 9th)

- Continue render-to-texture
    - Wrap-up framebuffer objects
- Introduce shadows
    - Importance of shadows
    - Planar shadows
    - Soft shadows
- Homework assignments:
    - Read:
        - Sections 6.12.1 and 6.12.2.
        - Eric Haines, Soft Planar Shadows Using Plateaus, journal of graphics tools, vol. 6, no. 1, pp. 19-27, 2001. http://jgt.akpeters.com/papers/Haines01/ and http://www.acm.org/tog/editors/erich/plateaus.pdf.
        - Bruce Gooch, Peter-Pike J. Sloan, Amy Gooch, Peter Shirley, and Richard Riesenfeld, Interactive Technical Illustration, In *Proceedings 1999 Symposium on Interactive 3D Graphics*, pp. 31-38, April 1999. http://www.cs.utah.edu/npr/utah_papers.html.
    - Soft, planar shadows. Due 4/23. (10 points)

Week 3 (April 16th)

- Introduce shadow maps
- Homework assignments:
    - Read:
        - Section 6.12.4. *We'll come back to 6.12.3 later.*

Week 4 (April 23rd)

- Advanced shadow map techniques
    - Percentage closer filtering
    - Depth range optimizations
- Homework assignments:
    - Read:
        - R. Fernando, Percentage-Closer Soft Shadows, In *Proceedings of SIGGRAPH 2005*. 2005. http://developer.nvidia.com/object/siggraph_2005_presentations.html
        - W. Reeves, D. Salesin, and R. Cook, Rendering Antialiased Shadows with Depth Maps, In *Proceedings of SIGGRAPH '87.* 1987. http://graphics.pixar.com/ShadowMaps/
    - Replace planar shadows with shadow maps. Due 5/7. (10 points)

Week 5 (April 30th)

- Wrap up shadow map techniques
- Introduce the stencil buffer
- Homework assignments:
    - Read:

        - S. Brabec, T. Annen, and H.-P. Seidel, Practical Shadow Mapping, Journal of Graphics Tools, Vol. 7, Number 4, 2003. http://www.mpi-sb.mpg.de/~tannen/

Week 6 (May 7th)

- Introduction to shadow volumes.
  - Z-pass
  - Z-fail
- Homework assignments:
  - Read:
    - Sections 6.12.3.
    - C. Evertt and M. Kilgard, Practical and Robust Stenciled Shadow Volumes for Hardware-Accelerated Rendering, NVIDIA White Paper, May 2001. http://developer.nvidia.com/object/robust_shadow_volumes.html
  - Stencils using the stencil buffer. Due 5/14. (10 points)

Week 7 (May 14th)

- Shadow volumes on the GPU.
- Homework assignments:
  - Read:
    - Chris Brennan, Shadow Volume Extrusion Using a Vertex Shader, in Engel, Wolfgang, ed., *ShaderX,* Wordware, May 2002. http://ati.amd.com/developer/shaderx/ShaderX_ShadowExtrusion.pdf.
    - Samuel Hornus, Jared Hoberock, Sylvain Lefebvre, John C. Hart, ZP+: Correct Z-Pass Stencil Shadows, In *Proceedings of ACM Symposium on Interactive 3D Graphics and Games*. April 2005. http://artis.imag.fr/Publications/2005/HHLH05/.
  - Hard shadows using shadow volumes and the stencil buffer. Due 5/21. (10 points)

Week 8 (May 21st)

- Hardware extensions that optimize shadow volumes:
  - Two-sided stencil
  - Depth clamping
  - Depth bounds testing
- Homework assignments:
  - Begin work on term project. Due 6/11. (50 points)

Week 9 (May 28th)

- No class today – Memorial Day holiday.

Week 10 (June 4th)

- TBD.
- Homework assignments:
  - Prepare for final.

Week 11 (June 11th)

- Final exam. 5:30PM – 7:30PM. *Do not be late today!*