CS 457/557 – Computer Graphics Shaders

Catalog Description: Theoretical and practical treatment of computer graphics shaders, including both RenderMan and GPU shaders. Programming in both RenderMan and OpenGL shading languages.

Credits: 4

Prerequisites: Previous graphics pipeline programming experience. At OSU, any of our CS computer graphics courses are acceptable.

Courses that require this as a prerequisite: None

Structure: Three 50-minute lectures per week

Instructor: Mike Bailey

Course Content:

- A more advanced look at the graphics pipeline
- RenderMan
- The RenderMan Interface Bytestream
- RenderMan Surface and Displacement shaders
- Light interaction
- Color interaction
- Opacity interaction
- Step boundaries
- Smooth step boundaries
- Positional and gradient noise
- Fractional Brownian Motion (FBM, 1/f, octave) noise
- The OpenGL Shading Language (GLSL)
- GLSL Vertex shaders
- GLSL Fragment shaders
- GLSL Geometry shaders
- GLSL Tessellation shaders
- GLSL Compute shaders
- Hiding data in textures for visualization

Learning Resources:
Bailey and Cunningham, *Graphics Shaders: Theory and Practice*, CRC Press, 2012. ISBN: 978-1-56881-434-6.

Course Learning Outcomes:
On completion of the course, students will have demonstrated the ability to:

1. **Explain** the difference between Model Coordinates, World Coordinates, Eye Coordinates, Clip Coordinates, Normalized Device Coordinates, and Screen Coordinates (ABET Outcomes: A, J)

2. **Explain** the ModelView and Projection matrices, and what operations belong in each, and why (ABET Outcomes: A, J)
3. **Describe** where surface, displacement, vertex, fragment, geometry, tessellation, and compute shaders fit into the graphics pipeline (ABET Outcomes: A, I)
4. **Explain** the difference between uniform, varying, and attribute variables (ABET Outcomes: A, I)
5. **Demonstrate** the application of octave noise to shader effects (ABET Outcomes: A, J)
6. **Demonstrate** how shaders can be used to simulate various optics effects (ABET Outcomes: A, J)
7. **Demonstrate** the difference between bump-mapping and displacement-mapping (ABET Outcomes: A, J)
8. **Demonstrate** how to use cube mapping to achieve a good approximation to reflection and refraction. **Explain** what is different about reflection and refraction done this way and real reflection and refraction (ABET Outcomes: A, J)
9. **Apply** shaders to visualization problems (ABET Outcomes: A, B, C, J, K)
10. **Demonstrate** how to use textures in shaders (ABET Outcomes: A, J)
11. **Demonstrate** the use of a smooth step to avoid the aliasing effects of sharp transitions (ABET Outcomes: A, J)

Additional Course Learning Outcome for CS 557 Students:

12. **Read** a current research paper on the use of shaders and write a 5-page paper **Analyzing** it. (ABET Outcomes: A, B, C, F, G, I, J)

Students with Disabilities:
Accommodations are collaborative efforts between students, faculty and Disability Access Services (DAS). Students with accommodations approved through DAS are responsible for contacting the faculty member in charge of the course prior to or during the first week of the term to discuss accommodations. Students who believe they are eligible for accommodations but who have not yet obtained approval through DAS should contact DAS immediately at 737-4098.

Link to Statement of Expectations for Student Conduct, i.e., cheating policies
http://oregonstate.edu/studentconduct/http:/%252Foregonstate.edu/studentconduct/code/index.php