CS562: Advanced Real-time Rendering Techniques

General Information:

Prerequisite:	CS 300 or CS 541
Professor:	Dr. Gary Herron
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Course Description:

This course attempts to bring the student up to the current state-of-the-art in computer graphics. The course consists of a number of instructor chosen projects and one student chosen project, all taken from recently published research papers. Current topics include: Deferred Shading (2 and 3 pass variants), enhancements of the basic shadow-map algorithm (exponential and variance pre-filtering), modern BRDF (micro-facet) lighting calculations, image-based (and other physically based) lighting algorithms, and multiple variations of ambient occlusion.

Course Objectives and Learning Outcomes:

Upon successful completion of this course students will have an understanding of (and implementation of) a full-featured high-multi-pass graphics pipeline including many modern advanced algorithms in graphics. The student will have also gained some experience in reading, understanding, and implementing modern research papers as well as some experience in presenting such to peers.

Textbook (optional but recommended):

Real-Time Rendering, third edition, Akenine-Möller, Haines, Hoffman, ISBN: 978-1-56881-424-7

Outline and Tentative Dates:

Week 1:	Introduction
Week 2:	Deferred Shading,
	Project 1: Deferred Shading
Week 3:	Shadow intro, PCF and Exponential Shadow Map
Week 4:	Shadow-map filtering and Compute shaders
	Project 2: Exponential Shadow Map
Week 5:	BRDF, lighting equation, linear color space, global tone-mapping
Week 6:	Monte-Carlo integration, irradiance map
	Project 3a: PBL, IBL, linear color space, tone mapping
Week 7:	Spherical Harmonics and Irradiance maps
Week 8:	Irradiance map
	Project 3b: Irradiance maps
Week 9:	Ambient Occlusion (Alchemy algorithm and hash function)
Week 10:	Bilateral filter
	Project 4: Ambient occlusion and bilateral filter
Week 11:	Alternate topics: 3-pass deferred shading, more shadows, global illumination, tone mapping
Week 12:	...
Week 13:	...
Week 14:	Project 5 presentations
Week 15:	(Finals week) Project 5 demos

Graphics Framework

You should start the course with a graphics project/framework:

- from a previous course, or
- a minimal one supplied by the instructor, or
- your current or past game project.

This framework, at a minimum, should allow you to easily display and interactively view a small scene. It should be able to use textures (and perhaps normal maps), and perform lighting (Phong or better). It must use shader programming, and would be very beneficial if it has an shadow maps implementation.

Grading Policy:
The course grade will be computed from an equal weighting of four instructor assigned projects and one student chosen project:
1. Deferred Shading
2. Exponential shadow map
3. Image based lighting (part a:85%, part b:15%)
4. Ambient occlusion
5. Student choice paper (with presentation, implementation, and demo)

All 5 projects will be turned in with code, but the grading will be based almost entirely on a project report.
- For the four **instructor chosen** projects, the report should consist of a description of the algorithm and its implementation (inclining pseudo-code) and enough screen captured images to demonstrate the correctness.
- For the one **student chosen** project, the grade will be based on an a detailed presentation to the class, and a final demo of the working implementation.

Homework/Project submission policy:
Projects are to be handed in via Moodle, as a single ZIP file, by midnight of the specified date. A written document, the project report, must be included.

Late Policy:
Late projects will be assessed a 10% penalty per week.

Academic Integrity Policy:
Academic dishonesty in any form will not be tolerated in this course. Cheating, copying, plagiarizing, or any other form of academic dishonesty (including doing someone else's individual assignments) will result in, at the extreme minimum, a zero on the assignment in question, and could result in a failing grade in the course or even expulsion from DigiPen.

Disabled Student Services:
If students have disabilities and will need formal accommodations in order to fully participate or effectively demonstration learning in this class, they should contact the Disability Support Services Office at (425)629- 015 or dss@digipen.edu. The DSS Office welcomes the opportunity to meet with students to discuss how the accommodations will be implemented. Also, if you may need assistance in the event of an evacuation, please let the instructor know.