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# CS541: Advanced Computer Graphics

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## General Information

Professor:	Dr. Gary Herron
Email	gherron@digipen.edu (Specify CS541 in subject field.)
My web page:	<a href="http://faculty.digipen.edu/~gherron">http://faculty.digipen.edu/~gherron</a>
Office Hours:	Via Teams; See <a href="http://faculty.digipen.edu/~gherron">http://faculty.digipen.edu/~gherron</a> for schedule

## Description

In this course, students will study algorithms, and the underlying mathematics, that are designed to increase the realism of 3D graphics. Topics include homogeneous coordinates, 3D transformations, modern BRDF lighting and shading, shadow generation algorithms, reflections and the generation of reflection maps, bump/normal maps and more.

## Learning Outcomes

Upon successful completion of this course, students will have implemented (via shader programming) a number of basic graphics algorithms, as well as demonstrated an understanding of the mathematics involved.

## Course Materials

No textbook is required. A good (but optional) textbook is:

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

## Grading:

6 equally weighted programming projects:	72%
4 equally weighted written homework assignments:	28%

## Mechanisms and Procedures

Projects are to be handed in via Moodle, as a single ZIP file, by midnight on the specified date. Projects which cannot be graded, or are graded down for any reason, may be resubmitted within two weeks of grading for a partial return of credit.

## Late Policy

Late projects and assignments will be assessed a 2% penalty per day.

# Course Outline and Tentative Dates

Week 1 Intro, graphics pipeline, transformations and homogeneous coordinates.

Week 2 Perspective, transformations for viewing and navigation

Week 3 Project 1: 3D and perspective transformations for viewing and navigation

Week 4 Phong lighting, problems, and the Bidirectional Reflection Distribution Function (BRDF)

Week 5: GLSL shader programming; The texture pipeline  
Project 2: Lighting/Shading (microfacet BRDFs)

Week 6: Texture data flow on the GPU; Bump/normal maps

Week 7 Environment map (sky dome),  
Project 3: Texture map, Bump/normal mapping, environment map, ...

Week 8 Multi-pass algorithms, shadow map intro

Week 9 Complete shadow-map algorithm; review of point/vector/normal transformations  
Project 4: Shadow map

Week 10 Reflection maps

Week 11 Spherical maps (cube-map, dual-paraboloid, longitude-latitude, ...)  
Project 5: Reflection map algorithm

Week 12 Image Based Lighting

Week 13 Irradiance maps  
Project 6: IBL

Week 14 Miscellaneous

# 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.

# Disability Support Services

If students have disabilities and will need formal accommodations in order to fully participate or effectively demonstrate learning in this class, they should contact the Disability Support Services Office at (425)629-5015 or [dss@digipen.edu](mailto: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.

# Religious Accommodation

DigiPen Institute of Technology provides reasonable accommodations to students who may be absent from activities or incur significant hardship due to religious holidays or observances. These holidays or observances must be part of a religious denomination, church, or religious organization, and the course instructor must be notified in writing during the first two weeks of the course. The institute's policy for grievances is published in the course catalog.

# Academic Support Center

The Academic Support Center, located at The Wing, offers free tutoring sessions for select 100 and 200 level courses. Tutors are trained to enhance the understanding of core course concepts, answer questions, and assist with exam preparation. Drop-in tutoring is available throughout the day or students can schedule a drop-in appointment. For any additional questions regarding Tutoring Services, please contact [tutors@digipen.edu](mailto:tutors@digipen.edu).

# Title IX

Title IX is a law that protects against gender discrimination and provides for equal opportunity for students to pursue education and have equal and safe access to all of a school's programs and facilities and protects these environments from becoming hostile environments. To report a Title IX concern, email [titleix@digipen.edu](mailto:titleix@digipen.edu), or fill out the Title IX incident report on the DigiPen website.

# AI policy:

This is all very new. The policy is still evolving, and may be negotiated.

**Permitted AI Usage:** Students may use AI tools to assist in understanding course materials. However, All work submitted must be the student's own original effort.

**Prohibited AI Usage:** The use of AI tools to generate content (in particular source code) is prohibited.

**Proper Citation:** If AI tools are used to assist with any aspect of your work, you must: 1) Clearly cite the specific AI tool used. 2) Provide a brief explanation of how it contributed to your work.

**Consequences of Violation:** Any violation of this policy will be addressed under the Academic Integrity guidelines.

**Extra Note:** If you are uncertain about the appropriate use of AI for a specific task, consult with the instructor before proceeding.