School of Computing
UNIVERSITY OF GEORGIA

Course Information Sheet
CSCI 4810
Computer Graphics

Brief Course Description (50-words or less)	Introduction to the principles and techniques of computer graphics. Topics include 2D and 3D modeling, rendering techniques, and shading, with a discussion on the GPU's role, lighting, texture mapping, and animation—emphasis on practical applications and implementation of graphics algorithms.
Extended Course Description / Comments	This course is designed for students interested in the conceptual and practical aspects of computer graphics. It is suitable for those who plan to engage in research within the field of graphics or visualization, as well as students from computer science, engineering, and related disciplines looking to incorporate graphic elements into their projects. The coursework emphasizes both the understanding and application of core graphic principles, from the manipulation of 2D/3D models to the complexities of rendering and animation. Discussions will extend to the operational role of GPUs in shading and rendering processes, highlighting their impact on performance and visual outcomes. Through a combination of theoretical knowledge and hands-on projects, students will learn to implement various graphics algorithms, enabling the creation of sophisticated visual representations and simulations. By the end of the course, students will be equipped with the skills to develop practical graphics applications that leverage modern hardware and software tools.
Pre-Requisites and/or Co-Requisites	Prerequisite: CSCI 1302; corequisite: CSCI 2720 or CSCI 2725
Required, Elective or Selected Elective	Selected Elective Course
Approved Textbook	• Fundamentals of Computer Graphics 5th edition by Steve Marschner and Peter Shirley. • Introduction to Computer Graphics by David J. Eck • A collection of peer-reviewed journal articles, industry reports, case studies, and curated online content will be utilized. Students will receive a list of readings and materials that will vary as relevant new information becomes available, ensuring that course content remains current with the latest industry and academic developments.
Specific Learning Outcomes. (Performance Indicators)	1. Demonstrate proficiency in 2D and 3D graphics systems, including understanding of mathematical foundations, modeling, viewing, and rendering techniques. 2. Apply geometric transformations, interpolation, and scene graph management to manipulate and organize graphical objects effectively. 3. Develop and implement algorithms for texture mapping, shading, and lighting to achieve realistic rendering in 3D scenes. 4. Utilize GPU shader programming for custom visual effects and accelerated graphics processing. 5. Understand and implement techniques for anti-aliasing to improve the visual quality of rendered images.

6. Explore advanced topics in computer graphics, such as volumetric rendering, and discuss their applications and implications.
7. Understand and apply sampling techniques in graphics processing, including the use of Fourier transforms for analyzing and manipulating frequency components of images.

ABET Learning Outcomes

A. Analyze a complex computing problem and apply computing principles and other relevant disciplines to identify solutions.
B. Design, implement, and evaluate a computing-based solution to meet a given set of computing requirements in the context of the program's discipline.
C. Communicate effectively in a variety of professional contexts.
D. **Recognize** professional responsibilities and make informed judgments based on **legal** and ethical principles in computing practice.
E. Function effectively as a member or leader of a team engaged in activities appropriate to the program's discipline.
F. Apply computer science theory and software development fundamentals to produce computing-based solutions.

Relationship Between Student Outcomes and Learning Outcomes

		ABET Learning Outcomes					
Specific Learning Outcomes		1 A	2 B	3 C	4 D	5 E	6 F
	1	●					●
	2	●	●				●
	3	●	●	●			●
	4	●	●				●
	5	●	●	●			●
	6	●		●			●
	7	●					●

Major Topics Covered

1. Overview of 2D and 3D Graphics Systems: Applications and history (Familiarity).
2. Mathematical Foundations: Linear algebra, vectors, matrices, and transformations in graphics (Assessment).
3. Modeling, Viewing, and Clipping: Techniques for representing and viewing 2D and 3D objects (Usage).
4. Graphics Pipeline: Understanding the process from modeling to image display (Usage).
5. Rendering: Techniques and algorithms for generating images from models (Assessment).
6. Scene Graphs: Organizing and managing graphical objects in a scene (Usage).
7. Transformations and Interpolation: Geometric transformations and interpolation techniques in graphics (Usage).
8. Curves and Surfaces: Mathematical representation of curves and surfaces, including Bezier curves and B-splines (Usage).
9. Texture Mapping: Techniques for applying textures to surfaces (Usage).

10. Color Models: Understanding different color models and their applications in graphics (Familiarity).
11. Shading and Lighting: Principles of shading and lighting models for realistic rendering (Usage).
12. Advanced Shading Techniques: Exploration of advanced shading methods (Familiarity).
13. GPU Shader Programming: Programming GPUs for custom visual effects and accelerated graphics processing (Assessment).
14. Animation: Principles of animation techniques (Usage).
15. Ray Tracing: Techniques for realistic image synthesis (Assessment)
16. Global Illumination Models: Understanding complex lighting interactions in scenes (Usage).
17. Graphics Hardware: Role of graphics hardware, especially GPUs, in graphics processing (Familiarity).
18. Selected Advanced Topics: Exploration of advanced topics such as virtual reality, augmented reality, volumetric rendering, or computational photography (Familiarity).

Knowledge Levels

The following is the ACM's categorization of different levels of mastery: Assessment, Usage, and Familiarity. Note that Assessment encompasses both Usage and Familiarity, and Usage encompasses Familiarity.

Familiarity: The student understands what a concept is or what it means. This level of mastery concerns a basic awareness of a concept as opposed to expecting real facility with its application. It provides an answer to the question "What do you know about this?"

Usage: The student is able to use or apply a concept in a concrete way. Using a concept may include, for example, appropriately using a specific concept in a program, using a particular proof technique, or performing a particular analysis. It provides an answer to the question "What do you know how to do?"

Assessment: The student is able to consider a concept from multiple viewpoints and/or justify the selection of a particular approach to solve a problem. This level of mastery implies more than using a concept; it involves the ability to select an appropriate approach from understood alternatives. It provides an answer to the question "Why would you do that?"

Modified

4/08/2024 by Ingrid Maria Hybinette

Approved

Yes