

Brief Course Description

(50-words or less)

Fundamentals of two-dimensional and three-dimensional computer graphics, techniques for image processing and rendering, study of graphic rendering components, algorithms and data structures for image analysis and representation, modelling two-dimensional and three-dimensional transformations and viewing, methods for rasterization, anti-aliasing and basic animations.

**Extended Course Description /
Comments**

This course emphasizes on fundamental principles of computer graphics. The coursework begins with introduction of hardware and software systems which are crucial for generating graphics. Students are encouraged to discuss how computer graphic systems generally works. The next part focuses on the representation of basic geometrical components including lines, curves and basic shapes. Students will work on modelling these components by analysing their attributes. The subsequent phase begins with an emphasis on two-dimensional transformation modelling which involves translation, rotation, scaling and matrix operations. It describes the graphic pipeline procedures that involve viewing, normalization and clipping algorithms. Students will be given programming tasks to modify previous algorithms to generate a specific graphic output. Following two-dimensional modelling, the coursework continues with the basic transformation operations in three-dimensional and the working of the coordinate system in different phases of the image rendering process. Concepts of three-dimensional viewing and different projections are discussed with practical illustrations about boundary representations. After familiarizing with the fundamentals of computer graphics, the final phase focuses on key concepts of animation, shading and illumination models, visible surface detection methods, different color models, ray tracing methods, and information visualization.

This course is also cross-listed with CSCI 6810, the graduate version of this course.

Pre-Requisites and/or Co-Requisites

CSCI 2720
Data Structures

CSCI 2670
Introduction to Theory of Computing

Approved Textbooks

(if more than one listed, the textbook used during a semester is at the discretion of the instructor)

Author(s): Hearn, Baker, Carithers
Title: Computer Graphics with Open GL
Edition: 4th
ISBN: 0-13-605358-0

**Specific Learning Outcomes
(Performance Indicators)**

This course provides an introduction to theoretical as well as practical knowledge of modern computer graphics domain which can be useful for

students who are interested in animation, imaging technology and/or fundamental computer graphics. At the end of the semester, all students will be able to do the following:

1. Describe the general hardware and software architecture systems involved in graphics pipeline.
2. Understand the data structure of pixel, colour and intensity for graphics pipeline.
3. Design two-dimensional and three-dimensional line drawing algorithms and perform basic graphical operations on them.
4. Implement window to viewport transformation and line clipping methods.
5. Create two-dimensional graphics of lines, curves, simple shapes, fill areas and polygons.
6. Implement scan fill, flood fill algorithms and anti-aliasing methods.
7. Understand and apply techniques of perspective projection, clipping, and windowing.
8. Apply the principles of 2D geometric transformation.
9. Discuss high performance computing for graphics.
10. Understand the fundamentals of image development.
11. Develop Steganography.
12. Apply 3D perspective projection, hidden-line surface removals and shading.
13. Understand and explain fractals, Koch curve with usability and mathematics behind mapping algorithms.

Relationship Between Student Outcomes and Learning Outcomes

	<i>Student Outcomes</i>										
	a	b	c	d	e	f	g	h	i	j	k
1	•								•		
2									•		
3			•						•	•	
4	•		•						•	•	
5	•		•						•	•	
6	•		•						•	•	
7	•	•							•	•	•
8	•		•						•	•	
9	•								•		•
10	•										•
11	•	•	•							•	
12	•		•							•	
13	•	•								•	

Program Outcomes
(These are ABET-specified and should not be changed)

- a. An ability to apply knowledge of computing and mathematics appropriate to the discipline.

- b. An ability to analyse a problem, and identify and define the computing requirements appropriate to its solution.
- c. An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs.
- d. An ability to function effectively on teams to accomplish a common goal.
- e. An understanding of professional, ethical, legal, security and social issues and responsibilities.
- f. An ability to communicate effectively with a range of audiences.
- g. An ability to analyse the local and global impact of computing on individuals, organizations, and society.
- h. Recognition of the need for and an ability to engage in continuing professional development.
- i. An ability to use current techniques, skills, and tools necessary for computing practice.
- j. An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices.
- k. An ability to apply design and development principles in the construction of software systems of varying complexity.

Major Topics Covered
(Approximate Course Hours)

3 credit hours = 37.5 contact hours
4 credit hours = 50 contact hours

Note: Exams count as a major topic covered

Computer graphics Hardware & Software	10.5 hours
Video Display Devices	
3D Viewing Devices	
Graphical Input & Output Devices	
General Graphic Libraries & its Components	
Graphics Output Primitives	7 hours
Line Drawing Algorithms	
Anti-aliasing Lines	
Circle & Eclipse Generating Algorithms	
Scan Fill, Flood Fill	
Two-dimensional transformations	5 hours
Windowing & Viewing Pipeline	
Clipping Algorithm	
Window to Viewport Transformations	
Three-dimensional Transformation & Viewing Pipeline	8.5hours
Perspective Projection	
Parallel Projection	
Visible Surface Detection Methods	
Illumination Models	7.5 hours
Texture Patterns	
Color Models	
Color Display techniques	
Ray Tracing	
Information Visualization	3 hours

Assessment Plan for this Course

Each time this course is offered, the class is initially informed of the Course Outcomes listed in this document, and they are included in the syllabus. At the end of the semester, an anonymous survey is administered to the class where each student is asked to rate how well the outcome was achieved. The choices provided use a 5-point Likert scale containing the following options: Strongly agree, Agree, Neither agree or disagree, Disagree, and Strongly Disagree. The results of the anonymous survey are tabulated and results returned to the instructor of the course.

The course instructor takes the results of the survey, combined with sample student responses to homework and final exam questions corresponding to course outcomes, and reports these results to the ABET committee. If necessary, the instructor also writes a recommendation to the ABET committee for better achieving the course outcomes the next time the course is offered.

How Data is Used to Assess Program Outcomes

Each course Learning Outcome, listed above, directly supports one or more of the Student Outcomes, as is listed in "Relationships between Learning Outcomes and Student Outcomes". For CSCI 4810, Student Outcomes

Course Master

Dr. Hamid Arabnia

Course History