Computer Graphics
CS 371 - Fall 2023

Instructor: George Thomas **Office:** Halsey 218
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Office Hours:	MW	9:30-10:30	
	Tu	12:30-1:30	
	Th	11:30-12:30	
		Or by appointment	
Lectures:	MW	11:30-12:30 PM	Halsey 309
Lab:	F	11:30-12:30 PM	Halsey 101C

Prerequisites: CS 262, and Math-171 or Math 206, each with a grade of C or better

Reference books and resources:

- *Interactive Computer Graphics: A Top-Down Approach with WebGL,* 8th Edition, by Edward Angel, Dave Shreiner (Online version only)
- *WebGL Programming Guide: Interactive 3D Graphics Programming with WebGL,* by Kouichi Matsuda, Rodger Lea
- *WebGL API*
  - https://developer.mozilla.org/en-US/docs/Web/API/WebGL_API
- *WebGL fundamentals* – online reference
  - https://webgl2fundamentals.org/webgl/lessons/webgl-fundamentals.html

Course Website: UWO Canvas

Current Catalog Course Description: An introduction to the mathematics, data structures, and algorithms used to create graphical output in the programmable pipeline. Topics include graphics hardware, shaders, transformations in two and three dimensions, three-dimensional viewing, modeling three-dimensional shapes with polygon meshes, hierarchical modeling of three-dimensional objects, lighting and shading techniques, raster algorithms.

Course Outcomes:

1. Identify and define the purpose of each component in the graphics pipeline that transforms a vertex in world coordinates to a pixel location with a particular color.
2. To perform in manual fashion the transformation carried out by the graphics pipeline on points in two-dimensional and three-dimensional world coordinate space.
3. Discuss the relationship between the aspect ratio of a scene and the viewport in which it is rendered.
4. Define and discuss the role of double buffering in real-time animations.
5. Apply linear affine transformations such as scaling, translation, and rotation to points in two- and three-dimensional space and analyze the effects of such transformations on the points in a rendered scene.
6. Define and compare the perspective and orthographic projections on points and scenes in three-dimensional space.
7. Plan and design scenes animated by an underlying hierarchical model.

8. Identify the role of the model-view transformation and its matrix representation in rendering hierarchical models.
9. Define the roles of the eye point, look point, and up vector parameters in the synthetic camera's view of a three-dimensional scene and to perform the computations necessary to illustrate how these parameters affect the model-view transformation matrix.
10. Trace the depth-buffer (Z-buffer) algorithm as it is used to determine hidden points and surfaces in a rendered scene.
11. Define and compare the variety of transformations used in texture, bump, and reflection mapping that associate a coordinate on a model with a color or normal vector determined by the corresponding map.
12. To discuss the mathematics underlying two- and three-dimensional interpolating curves and surfaces (for example, Bezier curves and surfaces).
13. Discuss the roles played by color, lighting, and material parameters in the progression of increasingly sophisticated shading models such as flat, smooth, Gouraud, Phong, ray-tracing, radiosity, and photon-mapping.
14. Using visual clues, differentiate between scenes rendered by a variety of shading models such as flat, smooth, Gouraud, Phong, ray-tracing, radiosity, and photon-mapping.
15. Analyze the relationship between computational rendering algorithms for increasingly sophisticated shading models - flat, smooth, Gouraud, Phong, ray-tracing, radiosity, and photon-mapping - and the time required to render the scene using that algorithm.
16. Using a graphics library such as WebGL in conjunction with the GLSL shading language, implement three-dimensional animations rendered in real-time using an appropriate lighting model built into the programmable pipeline.

Course Grading Policy:
Your final grade for this course will be based on three components, namely exams, programming projects and homework. Your overall numerical grade for the course will be computed as the weighted sum of the component grades using the following weights:

Component	Weight
Exams (3)	50%
Projects (2)	20%
Labs (10)	20%
Homework	10%

Tentative exam dates are as follows:

- **Exam 1 –-Friday, 10/06**
- **Exam 2 – Friday, 11/10**
- **Exam 3 – Friday, 12/15**

Your letter grade for the course will be computed as follows:

Numerical Score	Grade	Numerical Score	Grade
>=92	A	72-78	C
90-92	A-	70-72	C-
88-90	B+	68-70	D+
82-88	B	62-68	D
80-82	B-	60-62	D-
78-80	C+	<60	F

While this overall grading scheme is fixed, I will be happy to discuss any issue you may have with individual grades. If you notice a mistake or have a question regarding a specific grade, please come and talk to me *as soon as possible*. Please do not wait until the end of the semester to bring up grading issues.

Project, Lab, and Homework Deadlines:
Each project, lab and homework will come with a deadline (day and time) by which it must be submitted. **Late project, lab and homework submissions will NOT be accepted.**

Attendance Policy:
I do not require attendance for this course, but I do encourage you to attend and hope it will be beneficial to you. When attending class, please do come prepared for, and participate actively, in it. *Topics and material may be covered during the lectures and labs that are not presented on Canvas. If you miss lecture or lab, it is your responsibility to make sure you catch up on anything you may have missed!*

Extensions and Makeups:
Extensions on deadlines may be granted at the discretion of the instructor if you provide a valid justification (in the form of a written excuse from a medical doctor or the Dean of Students Office) **before** the due date.

If you miss a scheduled exam (tentative dates are provided), you **may** be able to take a make-up exam provided you give the instructor a valid justification (see above) ahead of time if possible. Only one make-up exam will be given. It will be a comprehensive exam scheduled at the end of the semester.

Academic Misconduct Policy:
Clearly, all exams and homework must be entirely your own work.
Unless otherwise stated in a project, all submissions here must also be entirely your own work. While it is acceptable to discuss assignments at a high level (for example, at the design level) with others, you must submit your own work. **You may not "borrow" any piece of code or design of any length from someone else, the internet, or any other source, unless you can live with a zero and the other potential academic sanctions of cheating** (see UWO Student Discipline Code 2007, Chapter UWS 14).

Use of AI tools in this class:
As stated in the above section, I expect you to generate your own work in this class. When you submit any kind of work, you assert that you have generated any code and text yourself. Submitting content that has been generated by someone other than you or was created or assisted by a computer application or tool, including Artificial Intelligence (AI) will be considered cheating and will be subject to the Academic Misconduct policy.

Accessibility and Accommodations:
The University of Wisconsin Oshkosh supports the right of all enrolled students to a full and equal educational opportunity. It is the University's policy to provide reasonable accommodations to students who have documented disabilities that may affect their ability to participate in course activities or to meet course requirements. Students are expected to inform instructors of the need for accommodations as soon as possible by presenting an Accommodation Plan from either the Accessibility Center, Project Success, or both. Reasonable accommodations for students with disabilities is a shared instructor and student responsibility. The Accessibility Center is part of the

Dean of Students Office and is located in 125 Dempsey Hall. For more information, email accessibilitycenter@uwosh.edu, call 920-424-3100, or visit the Accessibility Center Website.

Equity & Inclusion:
At the University of Wisconsin Oshkosh, the culture, identities, life experiences, unique abilities, and talents of every individual contribute to the foundation of our success. Creating and maintaining an inclusive and equitable environment is of paramount importance to us. This pursuit prepares all of us to be global citizens who will contribute to the betterment of the world. We are committed to a university culture that provides everyone with the opportunity to thrive.

Disclosure Statement:
Students are advised to see the following URL for disclosures about essential consumer protection items required by the Students Right to Know Act of 1990:
https://uwosh.edu/financialaid/consumer-information/