Computer Graphics
CS 371 - Fall 2020

Instructor: George Thomas **Office:** Halsey 218
Email: thomasg@uwosh.edu **Phone:** 424-2069

Virtual Office Hours: MWF 1:30-2:30 PM
Or by appointment
Collaborate Ultra link on Canvas

Lectures: MWF 9:10-10:10 Halsey 106
All lectures are offered in **Hyflex** mode

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

Recommended Textbooks:

- *Interactive Computer Graphics : a top-down approach with WebGL,* 8th edition (eText only) or 7th edition (hardcover), Edward Angel and Dave Shreiner.
- *Introduction to Computer Graphics,* David Eck, chapters 6, 7 and Appendix A, section 3. Available at: *http://math.hws.edu/graphicsbook/*

Course Website: UWO Canvas

Note: If you have special needs, please do talk to me at the end of the first class.

Statement Regarding Classroom Mask Requirements:

- All students are required to wear an appropriate face mask that covers their mouth and nose when they are in the classroom.
- Students must maintain appropriate physical distance from classmates and adhere to any additional expectations communicated by the instructor or posted in the classroom.
- UWO procedure dictates that, during the COVID-19 pandemic, an instructor cannot begin class until all students are wearing a mask properly. If a student is non-compliant with the masking policy and also refuses to leave the classroom promptly when requested, the instructor is required to cancel class. Students responsible for class cancellation for these reasons will be referred to the Dean of Students office, and the student will be unable to attend class until they meet with the Dean of Students. The student may be dropped from the class by the Dean of Students.

Statement Regarding Disinfecting Workspaces in Classrooms:

- Students will disinfect their workspace prior to the start of each class. Upon entering the classroom, students will go to get a disinfectant wipe from the canister in the room. They will use the wipe to clean the arms of the chair and the work surface being used. If the chair is not fabric, student may choose to wipe the seats and backs of the chairs as well. Wipes should be tossed into the garbage receptacle in the room.
- Eating and drinking is prohibited in classrooms during the Fall 2020 semester.

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)	45%
Projects	35%
Homework	20%

Tentative exam dates are as follows:

- **Exam 1 – Friday, 10/2**
- **Exam 2 – Friday, 11/6**
- **Exam 3 – Wednesday, 12/9**

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 and Homework Deadlines:
Each homework will come with a deadline (day and time) by which it must be submitted. <u>Late homework submissions will NOT be accepted</u>.

Each project will also come with a deadline (day and time) by which it must be submitted. You are allotted *three* project credit days you can use through the semester. A credit day is exactly 24 hours or less. You can use unused credit days to submit a project after its deadline, without penalty. <u>Any project submitted after the deadline, plus any credit days you have unused, will receive a zero.</u>

For example, if you have 2 unused credit days available and a project is due on Tuesday at 5:00PM, you can submit it anytime by exactly Thursday at 5:00PM without penalty. Do note that if you submit your project on Thursday at 5:01PM, you will be penalized 100% of the score of the project and thus receive a zero! Note also that if you submit your project on Wednesday at 5:01PM, you will be charged two credit days (but no penalty, obviously).

Attendance Policy:
Since this class is offered in Hyflex mode, you may attend in-person, online in synchronous mode, or online asynchronously. I do not require attendance for this course, but I do encourage you to attend

and hope it will be beneficial to you. Lectures will also be recorded and available for asynchronous viewing later. All homework, projects and exams will be submitted electronically.

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.

Collaborating versus Cheating:

Unless otherwise stated in the assignment or project, all submissions must be entirely your own work. While it is acceptable to discuss the 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).

Statement Regarding Diversity, Equity & Inclusion:

Diversity drives innovation, creativity, and progress. 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.

Required 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/