Computer Science 4053/5053 — Computer Graphics
Instructor: Chris Weaver
Spring 2023

Overview

Most interaction with data now happens through computer graphics. Even the display of simple text involves surprisingly advanced graphics processing. As a result, computer graphics is one of the most practical and broadly useful topics in computer science. It is also one of the most fun! Using graphics rendering technologies such as OpenGL, one can create a realistic or abstract virtual world with relatively little code. These worlds can support exploration, entertainment, education, and often a combination of all three. The availability and quality of computer graphics continues to increase rapidly thanks both to increasing hardware performance and ongoing research on rendering techniques.

This course provides a broad introduction to the theory and practice of computer graphics. We will cover both 2-D and 3-D techniques. Our main goals are to build substantial understanding and experience with the fundamentals of 2-D graphical data processing that support applications ranging from games to data visualization and simple, popular mobile games like platformers. Topics include coordinate systems and transformations, drawing, rendering, procedural and object-oriented graphical programming, interactive navigation, and applications to data visualization. You will learn about the popular graphics programming standard OpenGL, as well as some of its more useful extensions that allow for easier development and cross-platform deployment. Individual homework assignments will focus on programming and will be done in Java using the JogAmp JOGL library. You will also complete a semester-long team project, which can involve graphics technologies of your choosing, such as WebGL, JavaFX, Unity, Unreal Engine, etc.

Students enrolled in CS 5053 will develop an extra facet of their team's project, and also individually implement and analyze a graphics technique from a research paper, as the two parts of their additional course workload.

Prerequisites: CS 2413, CS 2813 or MATH 2513, and MATH 3333.

General Information

Place: 130 Devon Energy Hall
Days: Tuesday+Thursday
Time: 4:30pm–5:45pm

Instructor: Chris Weaver
Office: 241 Devon Energy Hall
Email: cweaver@ou.edu
Phone: 405.325.3380 (OU or Canvas email strongly preferred)
Office Hours (Hybrid): Tuesday+Thursday 3:00pm–4:00pm, Friday 11:00am–12:00pm, by appointment.
~~**Booster Sessions (open, group Q&A time):** Friday 1:30pm–2:30pm, in 226 DEH (large team room)~~

Teaching Assistant: Jacob Ross
Email: jacobross@ou.edu
Office Hours: Monday+Wednesday 10:00am–12:00pm, and by appointment.

See announcements in Canvas for details about Zoom meetings for instructor and TA office hours.
TA Office: DEH 210 (large CS Grad Lab); office hours will be held in DEH 115 (first floor Computer Lab)
~~**TA Phone:** 405.325.0811 *(email strongly preferred; this is a shared phone in the CS Grad Lab)*~~

Materials

Class Web Pages:

- Canvas [4053] [5053]
- http://www.cs.ou.edu/~weaver/academic/teaching/2023-A-Spring-CS4053/ (basic information only)

Class Schedule: Refer to the *File/Schedule* folder in Canvas for the current version of the schedule. The schedule may change occasionally due to campus closures or other unforeseen circumstances.

Required Textbooks:

- F. S. Hill, Jr. and Stephen M. Kelley. *Computer Graphics using OpenGL*, 3rd Edition. Pearson/ Prentice-Hall, 2007. ISBN: 0-13-1496790-0 [OU Bookstore]

Software Resources:

- *Coding Tools:* Gradle [7.6], command line on your system, text editor of your choice
- *Coding Environments (optional)*: IntelliJ IDEA [2022.3.1], Eclipse IDE for Java Developers [2022-12 R]
- *Desktop Libraries:* Java [Java SE 8; includes JavaFX 8]
- *Graphics Libraries:* Java Binding for the OpenGL API (JOGL) [2.4.0-rc-20210111], WebGL
- *OpenGL Information:* The OpenGL SDK, The OpenGL "Red" Book
- *Popular Gaming Engines:* Unity, Unreal Engine

Evaluation

In this course you will be learning and applying computer graphics theory and practice. **Learning these topics involves progressive layers of practical knowledge and experience. This makes it essential that you attend class consistently and participate actively.** What you get out of this course will depend on what you put into it. The contributions to your grade are as follows:

- Team project: 40%, consisting of the following components ([1.00] total)
  - [0.05] Group Proposal *(~300 words, format TBA)*
  - [0.15] Group Plan *(~2100 words, format TBA)*
  - [0.10] Group Progress Report *(~1200 words, format TBA, plus peer evaluation forms)*
  - [0.20] Group Presentation *(around N minutes + N/2 minutes Q&A, N depending on the # of teams)*
  - [0.30] Group Final Report *(~2100 words, format TBA, plus attachments and peer evaluation forms)*
  - [0.20] Individual participation *(based on input from your teammates on peer evaluation forms)*
- Individual homework: 45% (35% for CS 5053), consisting of the following components ([1.00] total)
  - [0.16̄]x6 Graphics Implementations *(6 assignments)*
- Individual research & development mini-project: 10% (CS 5053 only)
- Final exam: 15% *(see below for details)*

The additional workload for students enrolled in CS 5053 has two components. The first component is an additional individual development thread within the team project. Each CS 5053 student will pursue a significant extra facet of discovery, design, implementation, and/or evaluation as an extension of their team's project. The length of each group assignment (written and oral) will increase by ~10% for each CS 5053 team member to document their extra work. The second component is an individual mini-project, which consists of: reading the student's choice of several classic research papers on non-photorealistic rendering, implementing code to reproduce a graphics technique, analyzing the utility and usability of the result, and writing a short paper (~3 pages) in the style of peer-reviewed conference proceedings.

Due Dates: Unless otherwise specified in writing, all assignments are due at the **exact** beginning of class regardless of whether you hand them in electronically in Canvas, physically on paper, or otherwise. The grade of any late assignment will be lowered by 10% per day late. No assignment will be accepted more than 72 hours after the original due date and time.

Grade Summary: I will store all of your grades in the Canvas online grade book. It is your responsibility to verify that the grades on Canvas are correct. If an error is found, bring the graded item to me and I will correct the online entry.

Grade Questions: To maintain fairness in grading, I prefer that any disagreement be brought to me within a week of the item being returned.

Presentations: The director of the School of Computer Science has granted permission to hold student presentations on Thursday of pre-finals week. Refer to the OU Final Exam Policies for more information.

Final Exam: The final exam is Friday, May 12, 2023 from 10:30am–12:30pm. No final exams can be given early, except as required by University policy. Refer to the OU Final Exam Policies for more information.

Borderline Grades: Borderline final grades will be decided by your in-class participation. This means that being an active participant in class can push you over a grade boundary.

Course Policies

The following set of rules will help keep us all on the same page all semester and help to ensure fair treatment for all students.

Course Web Page: Access the Canvas website using your 4+4 (first four letters of your last name followed by the last four digits of your student number) and your standard OU password. If you have general difficulty with Canvas, please read the online OU IT documentation or call them at 325-HELP. All handouts and assignments will be made available in Canvas. You should check the site regularly. When I update the site with something important, I will post an announcement telling you what has been added and where it is located. You are responsible for things posted on the site after a 24 hour delay or the end of the first following class meeting, whichever occurs first.

Course Announcements: Announcements will be posted in Canvas. It is your responsibility to:

- Set up Canvas to receive notification of course announcements, class and group forum messages, and updates to course content including posting of assignments.
- Make sure that your contact info in Canvas includes an email address that you read regularly. I'll send out at least one class-wide message during the first week of class. If you do not receive this message, it is your responsibility to get the problem resolved immediately.
- Have your email program set up properly so that replying to your email will work correctly the first time. You can send email to yourself and reply to yourself to test this.

If you need assistance in accomplishing any of these tasks, contact OU IT.

Course Communications: The *General Discussion* in Canvas should be the primary method of communication outside of class. This allows everyone in the class to benefit from the answer to your question. If you email me a question of general interest, I may post your question and my answer to the discussion. Matters of personal interest should be directed to email instead of to the discussion, e.g. informing me of an extended personal illness.

Classroom Conduct: Disruptions of class are not permitted. No electronic devices may be used during class except to take notes or as a direct part of class exercises. Examples of disruptive behavior include:

- Allowing a cell phone or other device to make audible sound.
- Browsing, listening to music, or playing computer games, regardless of whether they are visible or audible to other class members. (Such activities disrupt YOUR ability to pay attention and participate.)
- Exhibiting erratic or irrational behavior.
- Behavior that distracts the class from the subject matter or discussion.
- Making physical or verbal threats to a faculty member, teaching assistant, or class member.
- Refusal to comply with faculty direction.

In the case of disruptive behavior, I may ask that you leave the classroom and may charge you with a violation of the Student Rights and Responsibilities Code.

Project Code: Your project code and write ups must be written exclusively by you or your group. *Use of any downloaded code or code taken from a book (whether documented or undocumented) is considered academic misconduct and will be treated as such.* Exceptions to this policy (such as a course project that builds on an existing open-source project) may be granted but you **MUST** obtain approval from me first.

Generated Materials: All materials submitted or presented as a part of an assignment must be human generated exclusively by you or your group, except for materials either included with or explicitly required by the assignment instructions. *Use of any automatically generated text, images, code, or other materials (such as from GPT-3 or DALL-E) is considered academic misconduct and will be treated as such.* Exceptions to this policy (such as a course project that builds on an artificial intelligence image generation algorithm) may be granted but you **MUST** obtain approval from me first.

Evaluating the Course: The College of Engineering utilizes student ratings as one of the bases for evaluating the teaching effectiveness of each of its faculty members. The results of these forms are important data used in the process of awarding tenure, making promotions, and giving salary increases. In addition, the faculty uses these forms to improve their own teaching effectiveness. The original request for the use of these forms came from students, and it is students who eventually benefit most from their use. Please take this task seriously and respond as honestly and precisely as possible, both to the machine-scored items and to the open-ended questions.

Incompletes: The grade of *I* is intended for the rare circumstance when a student who has been successful in a course has an unexpected event occur shortly before the end of the course. I will not consider giving a student a grade of *I* unless all three of the following conditions have been met: (1) it is within two weeks of the end of the semester; (2) the student has a grade of *C* or better in the class; (3) the reason that the student cannot complete the class is properly documented and compelling.

University Policies

Reasonable Accommodation Policy: Students requiring academic accommodation should contact the Accessibility and Disability Resource Center (https://www.ou.edu/adrc, 405/325-3852, TDD: 405/325-4173). Any student in this course who has a disability that may prevent the full demonstration of his or her abilities should contact me personally as soon as possible so we can discuss accommodations necessary to ensure full participation and facilitate your educational opportunities.

Masking Protocols: The university welcomes masking on campus. See https://www.ou.edu/together/university-masking-policy for more information.

Copyright Syllabus Statement for In-Person or Online Courses: Sessions of this course may be recorded or live-streamed. These recordings are the intellectual property of the individual faculty member

and may not be shared or reproduced without the explicit, written consent of the faculty member. In addition, privacy rights of others such as students, guest lecturers, and providers of copyrighted material displayed in the recording may be of concern. Students may not share any course recordings with individuals not enrolled in the class, or upload them to any other online environment.

Academic Integrity: Cheating is strictly prohibited at OU because it devalues the degree you are working hard to get. As a member of the OU community it is your responsibility to protect your educational investment by knowing and following the rules. For specific definitions on what constitutes cheating, review the *Student's Guide to Academic Integrity* at http://integrity.ou.edu/students_guide.html.

All work submitted for an individual grade (or group grade), such as a homework or project assignment, should be the work of that single individual (or group), not their friends, a tutor, or other form of outside help. On examinations and quizzes you will never be permitted to use your notes, textbooks, calculators, or any other study aids. Should you see someone else engaging in this behavior, I encourage you to report it to myself or directly to the Office of Academic Integrity Programs. That student is devaluing not only their degree, but yours, too. Be aware that it is my professional obligation to report academic misconduct, which I will not hesitate to do. Sanctions for academic misconduct can include expulsion from the University and an F in this course, so don't cheat. It's simply not worth it.

Religious Observance: It is the policy of the University to excuse the absences of students that result from religious observances and to reschedule examinations and additional required classwork that may fall on religious holidays, without penalty.

Title IX Resources: For any concerns regarding gender-based discrimination, sexual harassment, sexual misconduct, stalking, or intimate partner violence, the University offers a variety of resources, including advocates on-call 24.7, counseling services, mutual no contact orders, scheduling adjustments and disciplinary sanctions against the perpetrator. Please contact the Sexual Misconduct Office 405-325-2215 (8-5, M-F) or OU Advocates 405-615-0013 (24.7) to learn more or to report an incident.

Adjustments for Pregnancy/Childbirth Related Issues: Should you need modifications or adjustments to your course requirements because of documented pregnancy-related or childbirth-related issues, please contact me as soon as possible to discuss. Generally, modifications will be made where medically necessary and similar in scope to accommodations based on temporary disability. Please see http://www.ou.edu/eoo/faqs/pregnancy-faqs.html for answers to commonly asked questions.

Mental Health Support Services: If you are experiencing any mental health issues that are impacting your academic performance, counseling is available at the University Counseling Center (UCC). The Center is located on the second floor of the Goddard Health Center, at 620 Elm Rm. 201, Norman, OK 73019. To schedule an appointment call 405/325-2911. For more information visit http://www.ou.edu/ucc.

Emergency Protocol: During an emergency, there are official university procedures that will maximize your safety:

> ***Severe Weather:*** If you receive an OU Alert to seek refuge or hear a tornado siren that signals severe weather 1. LOOK for severe weather refuge location maps located inside most OU buildings near the entrances 2. SEEK refuge inside a building. Do not leave one building to seek shelter in another building that you deem safer. If outside, get into the nearest building. 3. GO to the building's severe weather refuge location. If you do not know where that is, go to the lowest level possible and seek refuge in an innermost room. Avoid outside doors and windows. 4. GET IN, GET DOWN, COVER UP. 5. WAIT for official notice to resume normal activities. [Severe Weather Refuge Areas - Spreadsheet] [Severe Weather Preparedness - Video]
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> ***Armed Subject/Campus Intruder:*** If you receive an OU Alert to shelter-in-place due to an active shooter or armed intruder situation or you hear what you perceive to be gunshots: (1) GET OUT: If

you believe you can get out of the area WITHOUT encountering the armed individual, move quickly towards the nearest building exit, move away from the building, and call 911. (2) HIDE OUT: If you cannot flee, move to an area that can be locked or barricaded, turn off lights, silence devices, spread out, and formulate a plan of attack if the shooter enters the room. (3) TAKE OUT: As a last resort fight to defend yourself. For more information, visit OU Emergency Preparedness. [Shots Fired on Campus Procedure - Video]

Fire Alarm/General Emergency: If you receive an OU Alert that there is danger inside or near the building, or the fire alarm inside the building activates: (1) LEAVE the building. Do not use the elevators. (2) KNOW at least two building exits. (3) ASSIST those that may need help. (4) PROCEED to the emergency assembly area. (5) ONCE safely outside, NOTIFY first responders of anyone that may still be inside building due to mobility issues. (6) WAIT for official notice before attempting to re-enter the building. [OU Fire Safety on Campus - Video]

Final Exam Preparation Period: Pre-finals week will be defined as the seven calendar days before the first day of finals. Faculty may cover new course material throughout this week. For specific provisions of the policy please refer to the OU Final Exam Policies. Note the provision that states "All University laboratory classes and graduate courses are exempt from this policy."

I reserve the right to add, remove, or change any element or policy of this course, including evaluation percentages, at any time and for any reason, within the limits of University policy.