

COMP 3501

Contact

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Overview

This is a course about the fundamentals of real-time computer graphics. We will use OpenGL and C++. The course provides both mathematical foundations and implementation practice. You should have some OpenGL knowledge from COMP 2501 and this course will build on that.

Textbooks and Resources

The official textbook is *Computer Graphics Programming in OpenGL with C++* by V. Scott Gordon and John Clevenger. We will be relying more heavily on the textbook than we would in an ordinary year. Morgan McGuire's *Graphics Codex* is an outstanding resource that will reward study; you can find it at www.graphicscodex.com.

You may also find various online tutorials and code fragments useful. You are free to make use of such material provided you credit the source. In particular, models and images found online are fair game. In past years, TurboSquid has been a source of free models for students to incorporate into their assignments and project.

Topics

The course's main topics include the following:

- Mathematical foundations: coordinate systems, vectors, matrices, quaternions
- Review of real-time rendering: the Z-buffer; pixel and vertex shaders
- Texture: texture mapping and texture synthesis
- Camera: translation, rotation, perspective, and camera control
- Illumination: the 3-term lighting model and alternatives
- Physical simulation: use of physics for animation of natural phenomena, particle systems, rigid-body motion
- Screen-space special effects

Additional topics, such as raytracing, shadows, and spline interpolation, will be undertaken as time permits.

Grading Scheme

Assignments: 35%
Midterm and in-class quizzes: 15%
Course project: 20%
Final exam: 30%

Course Project

One of the main components of the course is a large project, to be undertaken in a group of 2 or 3 and (time permitting) to be presented in class. Your final submission will include your implementation, adequately documented, and a written report of approximately 10 pages. The project will involve creating an interactive application in which a player can navigate a detailed 3D environment; optionally, you can add conventional game elements, such as enemies to shoot or treasures to collect. We will discuss the precise requirements in class and on the LMS during the term.

Dates & Deadlines

Sept 7: Classes begin.
Oct 21: Midterm exam.
Oct 24-28: Fall break, no classes.
Nov 3: Project interim report due.
Dec 9: Final day of classes; classes follow a Monday schedule.
Dec 9: Final project due.
Dec ??: Final exam. The exam schedule is not known at the time of writing; exams are centrally scheduled by the University.

Assignments

We will have several assignments throughout the term – approximately weekly, with some gaps. I expect every student to complete every assignment.

Assignment submissions are handled electronically, so assignment deadlines are firm. Do not wait until the last minute; rather, plan to submit at least 30 minutes in advance of the deadline.

For each assignment you will be submitting one or more files that contain source code. These files must be compressed into a “zip” file – never “rar” or other format.

Use good programming practices: thorough comments; good use of whitespace; breakdown into suitable functions; descriptive variable names. Plan your approach before writing any code (e.g., write some pseudocode, make some

drawings). You may be asked to show your pseudocode to the instructor or TA before receiving help.

University Policies

Full academic regulations are found in the University's calendar: calendar.carleton.ca. Some key information is excerpted below.

Requests for Academic Accommodation

You may need special arrangements to meet your academic obligations during the term. For details on the processes for academic accommodation requests, visit the following link:

<https://students.carleton.ca/course-outline/>

Academic Integrity

Academic integrity is central to the University's mission. Allegations of academic dishonesty are taken seriously and in this course will be handled by the Office of the Dean of Science. A finding of academic dishonesty will result in sanctions, ranging from a grade of zero on the affected assignment or exam, to a failing grade in the course, and even suspension or expulsion from the university.

You can read about the policies of the Faculty of Science here:

<https://science.carleton.ca/academic-integrity/>

Additional information about academic integrity can be found here:

<https://carleton.ca/registrar/academic-integrity/>

COVID Statement

The following is the University's pandemic statement for course outlines.

It is important to remember that COVID is still present in Ottawa. The situation can change at any time and the risks of new variants and outbreaks are very real. There are a number of actions you can take to lower your risk and the risk you pose to those around you including being vaccinated, wearing a mask, staying home when you're sick, washing your hands and maintaining proper respiratory and cough etiquette.

Feeling sick? Remaining vigilant and not attending work or school when sick or with symptoms is critically important. If you feel ill or exhibit COVID-19 symptoms do not come to class or campus. If you feel ill or exhibit symptoms while on campus or in class, please leave campus immediately. In all situations, you must follow Carleton's symptom reporting protocols. Masks: Carleton has paused the COVID-19 Mask Policy, but continues to strongly recommend masking when indoors, particularly if physical distancing cannot be maintained. It may become necessary to quickly reinstate the mask requirement if pandemic circumstances were to change.

Vaccines: Further, while proof of vaccination is no longer required as of May 1 to attend campus or in-person activity, it may become necessary for the University to bring back proof of vaccination requirements on short notice if the situation and public health advice changes. Students are strongly encouraged to get a full course of vaccination, including booster doses as soon as they are eligible, and submit their booster dose information in cuScreen as soon as possible. Please note that Carleton cannot guarantee that it will be able to offer virtual or hybrid learning options for those who are unable to attend the campus.

All members of the Carleton community are required to follow requirements and guidelines regarding health and safety which may change from time to time. For the most recent information about Carleton's COVID-19 response and health and safety requirements please see the University's COVID-19 website and review the Frequently Asked Questions (FAQs). Should you have additional questions after reviewing, please contact covidinfo@carleton.ca.