Carleton University School of Computer Science
COMP 3009 - Computer graphics
Winter 2024

Class Schedule

Classroom: Southam Hall 502
Class Times: Monday and Wednesday 16:00 – 15:30
Tutorials:

- Tuesday 08:30 – 09:30 (HP 4155)

Instructor

Name: Dr. Doron Nussbaum (nussbaum@scs.carleton.ca).

Instructor Office Hours: Wednesday 13:00 - 14:00 (HP 5378) or by appointment.

Course Website:

Brightspace

Teaching Assistants:

TA	E-mail	Office hours
Bahareh Abolhasanzade	BaharehAbolhasanzade@cmail.carleton.ca	TBA
Kareem Tantawy	kareemtantawy@cmail.carleton.ca	TBA

Course Description

An overview of computer graphics including rendering, modeling, and animation. Topics include geometric primitives and modeling; image formation algorithms such as ray tracing and the Z-buffer; lighting, shading, and texture; and introduction to physics-based animation and character animation.

SCS Laptop Requirement (only applies to on campus courses)

Everyone enrolled in a 1st year COMP course after the 2020/21 school year is required to have a laptop. This applies to students enrolled in a 1st year COMP course, which includes COMP1001, 1005 and 1006. For more information, please visit SCS Laptop Requirement - School of Computer Science (carleton.ca).

Course Objectives

a. Understand basic concepts of computer graphics.
b. Study computer graphics techniques used in generating graphics images.

c. Use mathematical concepts and formulas used in computer graphics.
d. Gain insight to interactive computer graphics
e. Learn graphics programming using C++ and OpenGL

Learning Outcomes:
At the end of the course students should be able to
- Describe and explain the graphics pipeline.
- Create interactive computer graphics in C/C++ using OpenGL.
- Create computer graphics models.
- Use matrices and vector geometry to manipulate graphics entities.
- Analyse a computer-generated image and determine computer graphics concepts that were used in generating it.
- Use and explain lighting models.
- Explain the different coordinate system used in computer graphics (model, view, projection, and screen).

Course Topics
The following topics will be covered in this course:
Computer graphic hardware
Graphics Pipeline
Transformation
Projections
Graphics primitives
Lighting models (Gouraud and Phong)
Shaders
Collision detection
Colour
Modelling (Object representation, hierarchical scenes/object)
Textures
Ray tracing
OpenGL

Other topics such as curve modelling (Bezier curves), clipping, visibility, raster scan, line drawing and polygon fill may be included.

The environment is Visual C++ and OpenGL

Prerequisites
COMP 2401 (C-), COMP 2402, Math 1104, Math 1007

Course Notes
Note that all course material created or provided in this course remains the intellectual property of the instructor (see next sentence regarding the course material). The course material includes, but not limited to, course notes, examples, code examples, assignment,

marking schemes, solutions, exams, tests, quizzes, tutorials, and tutorials' code. You can use the material for personal use while taking the course and is non-transferrable to other students or people, it cannot be published either electronically or as a hard copy and it cannot be loaded to any website other than Brightspace course website.

Reproducing, redistributing, or publishing the course material in any shape or form without a written consent of the instructor is a copyright violation and is strictly prohibited.

Course Software

In this course you will use the OpenGL graphics library and visual C++

Textbook (s)

I will refer to a number of books
1. Joey de Vries, Learn OpenGL: Learn modern OpenGL graphics programming in a step-by step https://learnopengl.com/book/book_pdf.pdf
2. Hearn Baker Carithers, Computer Graphics with Open GL, edition, Pearson

The book should be available on archive.org. See
https://archive.org/details/DonaldD.HearnPaulineBakerWarrenCarithersBookZZ.org

However, there are many computer graphics books that are available at the library (online) as well as on the web. I will provide reference to other books.

Other books
- Foley, van Dam, Feiner, Hughes, Computer Graphics Principles and Practice, Addison Wesley
- Angel, Shreiner, Interactive Computer Graphics A Top Down Approach with Shader Based OpenGL, 6th Edition, Pearson
- Shreiner, Sellers, Kessenich, Licea-Kane, OpenGL Programming Guide: The Official Guide to Learning OpenGL, Version 4.3, Addison Wesley

Online and Other Resources

Numerous resources are available online for OpenGL
- Opengl.org – OpenGL main page (contains numerous links to OpenGL related websites).
- https://learnopengl.com

Library Reserves

There are no library reserves

Course Evaluation

Component	Weight	Details	Due date
Assignments	25%	4-6 assignments	TBA
Tutorials	0%	10-11 tutorials	Weekly
Quizzes*	10%*		In class or online
Midterm exam*	20%*		
Project	25%		TBA

| Final Exam | 30% | Formal scheduled exam | TBA |
| Participation | 5% | | TBA |

* - There may be several short quizzes during the term. Each quiz is worth 1% of the final grade. The total weight of the quizzes and the midterm exam is 25% of the final grade. Therefore, each quiz will reduce the weight of the midterm by 1%.

Assignments

There will be 4-6 assignments in this course. Assignments will be announced in class and will be available on Brightspace. Assignments are to be submitted electronically before the due date and time on Brightspace. Make sure that you submit your assignment ahead of the deadline in case there is a problem with Brightspace. Once you submitted an assigned download it to a new directory and test the code. This will ensure that you uploaded the correct solution to the assignment.

Late Assignments.
You can submit an assignment up to one day late. In this case the grade will be reduced by 20% of the assignment maximum grade (e.g., if the assignment maximum grade is 100 then the grade will be reduced by 20 points). Assignments submitted later than 24 hours after the due day and time will receive a grade of 0.

A late assignment is an assignment that was submitted past the due date and time.

You must submit at least three assignments in order to pass the course. An assignment is considered submitted if you uploaded the required file (even if the file has not content, e.g., an empty tar file).

Tutorials

Tutorials will start on January 16. There will be 10-11 tutorials. The tutorials provide you with a hands on experience with the material learned in class (ask questions if you do not understand the material).

In-class Test (midterm test)

There will be one midterm test during the semester. The test will be 80 minutes long. If you miss the test then the weight of the midterm test will be added to the final exam weight (e.g., if the midterm test weight is 20%, due to quizzes, then the final exam weight will be 60%).

The test will take place during class time.

Students must retain all assignments and exams (including grades) in case there is a discrepancy between the grades in Brightspace. The marks will be posted on-line. The students should ensure that the posted marks are correct. All questions or clarifications regarding marking (assignments or tests) should be first discussed with the T.A. who marked it. In cases that the TA did not address the problem then you can bring the matter to the instructor). This should be

done no later than one week after the assignment has been marked. After this time, no remarking will be done.

Quizzes

There may be quizzes during the term. The quizzes will be online quizzes on Brightspace. Quizzes may be conducted during class time or be completed outside of class time. Quizzes duration will be 15-60 minutes long. If the quiz will be conducted online at home then students will be given a time range to start the quiz (e.g., from 12:00-24:00).

The weight for each quiz is 1% that will be subtracted from the in-class tests weigh. For example, if there will be only one quiz then the quiz weight will be 1% and in-class exams weight as 24%.

Project

The project is an implementation of a computer graphics feature, algorithm, comparison etc. It can be an individual work or a group project. The project work will be carried out throughout the term and the evaluation includes a project presentation, a project report, and a project meeting.

Final Exam

The time and place as well as the format of the final exam will be announced later in the term. Do not make travel plans until the dates are known as no special arrangements for earlier exam will be made. The final exam for this course will most likely be graded using the Scantron automatic grading system and where applicable by the instructor or course TAs.

One must obtain a passing grade in the final exam in order to pass the course.

Attendance

Class attendance is important because students will be responsible for all topics discussed in class. There is a strong correlation between attendance (class lectures and tutorials) and the final grade and between assignment completion and the final grade

Course notes will be provided. However, the course notes will cover only the main topics. In class tests and final exam will include all material that is covered during class time, tutorials, and assignments. Note that annotated notes during class time will not be posted.

Meeting course requirements

In order to pass the course, you must meet the following:

1. Assignments – you must submit at least three assignments. Note that the grades of all the assignments will be used when calculating the final course grade. Namely, if you submit only three assignments then a grade of 0 will be assigned to the unsubmitted assignments.
2. Obtain a passing grade in the final exam.

Course Schedule

Date	Task
Jan. 8	First class
Jan. 16	First tutorial
Jan. 31	Project proposal
Feb. 19-23	Winter break
Feb. 28	Midterm exam
Feb. 27-Mar. 3	Project – midterm demo/review
Apr. 1-8	Project presentations in class (may be cancelled)
April 8	Last class (April 10 is on Friday schedule)
Apr. 12	Project is due
TBD	Final exam

Assignments will be released throughout the term. Assignments due date will be published on each assignment.

Collaboration and Academic Integrity

Collaborating on assignments or exams are strictly disallowed. You must complete the work by yourself. If you need help, please see a TA or your instructor. Posting assignment solutions on discussion boards or on the internet before or after the due date and time is also prohibited. See university policy regarding Academic Integrity and Plagiarism:
http://carleton.ca/registrar/academic-integrity/
 Also, see the faculty of science academic integrity process:
https://science.carleton.ca/academic-integrity/

Unauthorized Co-operation or Collaboration
"If you are unsure of the expectations regarding academic integrity (how to use and cite references, how much collaboration with lab- or classmates is appropriate), ASK your instructor. Sharing assignment or quiz specifications or posting them online (to sites like Chegg, CourseHero, OneClass, etc.) is considered academic misconduct. You are never permitted to post, share, or upload course materials without explicit permission from your instructor.

Academic integrity offences are reported to the office of the Dean of Science. Penalties for such offences can be found on the ODS webpage: https://science.carleton.ca/academic-integrity/.*"*

Undergraduate Academic Advisor

The Undergraduate Advisor for the School of Computer Science is available in Room 5302C HP; or by email at scs.ug.advisor@cunet.carleton.ca. The undergraduate advisors can assist with information about prerequisites and preclusions, course substitutions/equivalencies, understanding your academic audit and the remaining requirements for graduation. The undergraduate advisors will also refer students to appropriate resources such as the Science Student Success Centre, Learning Support Services and Writing Tutorial Services.

SCS Computer Laboratory

SCS students can access one of the designated labs for your course. The lab schedule can be found at: https://carleton.ca/scs/tech-support/computer-laboratories/. All SCS computer lab and technical support information can be found at: https://carleton.ca/scs/technical-support/. Technical support is available in room HP5161 Monday to Friday from 9:00 until 17:00 or by emailing [SCS.Tech.Support@cunet.carleton.ca.](mailto:SCS.Tech.Support@cunet.carleton.ca)

University Policies

For information about Carleton's academic year, including registration and withdrawal dates, see [Carleton's Academic Calendar](#).

Pregnancy Obligation. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, visit [Equity Services](#).

Religious Obligation. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, visit https://carleton.ca/equity/focus/discrimination-harassment/religious-spiritual-observances/.

Academic Accommodations for Students with Disabilities If you have a documented disability requiring academic accommodations in this course, please contact the Paul Menton Centre for Students with Disabilities (PMC) at 613-520-6608 or pmc@carleton.ca for a formal evaluation or contact your PMC coordinator to send your instructor your Letter of Accommodation at the beginning of the term. You must also contact the PMC no later than two weeks before the first in-class scheduled test or exam requiring accommodation (if applicable). After requesting accommodation from PMC, meet with your instructor as soon as possible to ensure

accommodation arrangements are made. For more details, visit the Paul Menton Centre website.

Survivors of Sexual Violence. As a community, Carleton University is committed to maintaining a positive learning, working, and living environment where sexual violence will not be tolerated, and survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit: carleton.ca/sexual-violence-support

Accommodation for Student Activities. Carleton University recognizes the substantial benefits, both to the individual student and for the university, which result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see the policy.

Student Academic Integrity Policy. Every student should be familiar with the Carleton University student academic integrity policy. A student found in violation of academic integrity standards may be awarded penalties which range from a reprimand to receiving a grade of *F* in the course or even being expelled from the program or University. Examples of punishable offences include: plagiarism and unauthorized co-operation or collaboration. Information on this policy may be found here.

Plagiarism. As defined by Senate, "plagiarism is presenting, whether intentional or not, the ideas, expression of ideas or work of others as one's own". Such reported offences will be reviewed by the office of the Dean of Science. Standard penalty guidelines can be found here.

Unauthorized Co-operation or Collaboration. Senate policy states that "to ensure fairness and equity in assessment of term work, students shall not co-operate or collaborate in the completion of an academic assignment, in whole or in part, when the instructor has indicated that the assignment is to be completed on an individual basis". Please refer to the course outline statement or the instructor concerning this issue.

Special Information
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 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 are 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.