COMP 5115F – Geometry Processing
Fall 2024

Carleton University
School of Computer Science
Course Outline
Last update: August 22, 2024

Course Information

Instructor: Oliver van Kaick
Contact: Oliver.vanKaick at carleton.ca
Classroom: The room location is posted in Brightspace
Lectures: Wednesdays and Fridays, 11:35am – 12:55pm
Student hours: Information on student hours can be found in Brightspace
Course Website: https://brightspace.carleton.ca/d2l/home/292795

Brightspace access for University of Ottawa Students: please see information at https://gradstudents.carleton.ca/faculty-of-graduate-and-postdoctoral-affairs-access-to-brightspace/

For information about Carleton's academic year, including registration and withdrawal dates, see Carleton's Academic Calendar.

Teaching Assistants

A list of teaching assistants and their contact/office hours information will be posted to Brightspace once the course starts.

Course Description

The course covers concepts, representations, and algorithms for analyzing and processing 3D geometric datasets. We will discuss the geometry processing pipeline that starts with the acquisition of geometric models (e.g., with laser scanning or stereo imaging) and goes all the way to the fabrication (3D printing) of the models. More specifically, we will discuss the tasks of acquisition, reconstruction, analysis, manipulation, editing, and fabrication of complex 3D models, and representations such as triangle meshes and implicit functions. The techniques covered have applications in computer graphics, engineering, medical imaging, and many other areas, while the field presents opportunities for research contributions.

Includes: Experiential Learning Activity
Prerequisite(s): None.
Lectures three hours a week.

Resources

Recommended book: M. Botsch, L. Kobbelt, M. Pauly, P. Alliez, and B. Levy, "Polygon Mesh Processing", A K Peters/CRC Press, 2010.
We will follow this book closely in the first part of the course. Each topic may also have additional references and suggested readings. The second part of the course will use papers from journals/conferences as references.

Topics Covered

- Surface representations and mesh data structures
- Registration and surface reconstruction
- Mesh smoothing and fairing
- Mesh simplification
- Mesh parameterization
- Mesh editing and deformation
- Shape analysis (including learning-based methods)
- 3D printing and fabrication

Learning Outcomes

At the end of this course, students will be able to:

- Summarize the main problems and solution methods in the field of geometry processing.
- Identify the most suitable techniques to address specific problems in geometry processing.
- Implement algorithms for processing of polygonal meshes and apply them to specific datasets.

Assessment Scheme

The grade will be based on the following items:

- Presentation of a paper: 15%
- Two programming assignments: 25% (split as 10% + 15%)
- Project (including a presentation and report): 40%
- Take-home exam: 20%

The project will consist in the implementation and evaluation of a geometry processing technique, followed by a presentation and the submission of a report and the code. The idea is that the paper presentation and assignments will help you to get started with the project: the chosen paper will be ideally on the same topic as the project and will provide you with background about a specific research problem in geometry processing, while the assignments will give you some familiarity with the programming environment for working with 3D geometry. The take-home exam is open book and consists of a review of all the course content.

Late Assignment Policy

Assignment deadlines are strict. The following scheme is applied to late submissions (which includes assignments and the final course project):

- 3 hours late: no penalty
- 3 to 12 hours late: -10%
- 12 to 24 hours late: -20%
- More than one day late: assignment receives a grade of zero.

Assignment submissions are handled electronically (i.e., through Brightspace). Technical problems do not exempt you from submitting on time. So, if you wait until the last minute and then have issues with your connection, you will receive a deduction according to the scheme above. Consequently, you are advised to:

- Periodically upload you progress (e.g., upload your progress to Brightspace after each major change; we will only grade your last submission).
- Submit your final work at least one hour in advance of the due date and time.
- Store backups of your assignments in the cloud, e.g., OneDrive, Dropbox, or a private GitHub repository. However, your assignment has to be submitted to Brightspace so that we have a formal, timestamped submission for the assignment. Urls to the cloud will not be accepted as assignment submission.

Some of the assignments consist of programming tasks. You are expected to demonstrate good programming practices such as adding comments and your code may be penalized if it is poorly written. You are also expected to do the necessary preparatory work (i.e., devising an algorithm) before you start coding.

Academic Integrity

We will discuss the expectations regarding academic integrity in the first lecture of the course. If you are still unsure about the expectations after that (how to use and cite references or existing code, if collaboration with classmates is permitted), then you must ask your instructor. Sharing assignment or quiz specifications or posting them online (to sites like Chegg, CourseHero, OneClass, etc.) is always considered academic misconduct. You are never permitted to post, share, or upload course materials without explicit permission from your instructor. Please check the section below on university policies for more information on the expectations of the university regarding academic integrity.

Use of tools based on artificial intelligence

All of the assessed activities in this course were designed to be completed by an individual working alone. The use of artificial intelligence tools such as ChatGPT, Copilot, etc., is allowed. However, if you use any of these tools, you have to disclose this in a radme.txt file or report when submitting the activity, just as you would do when reusing code from other sources. Explain what portions of the assignment were created solely by you and what portions were created with the aid of the tool. The use of any of these tools without disclosure will be

considered academic misconduct. An exception to this rule is made for automated grammar and punctuation checking tools (such as Grammarly). In addition, do not fully trust these tools and double check any generated code, as AI tools are known to produce incorrect outputs.

Undergraduate Academic Advisors

The Undergraduate Advisors for the School of Computer Science are available in Room 5302HP; 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.

Graduate Academic Advisors

The Graduate Advisors for the School of Computer Science are available in Room 5302 HP; or by email at grad.scs@carleton.ca. The graduate advisors can assist with understanding your academic audit and the remaining courses required to meet graduation requirements.

SCS Computer Laboratory

Students taking a COMP course can access the SCS computer labs. The lab schedule and location 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/tech-support/. Technical support staff may be contacted in-person or virtually, see this page for details: https://carleton.ca/scs/tech-support/contact-it-support/.

University Policies:

- **Academic Accommodations**

Carleton is committed to providing academic accessibility for all individuals. Please review the academic accommodation available to students here: https://students.carleton.ca/course-outline/.

- **Academic Integrity**

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 sanctioned with penalties which range from a reprimand to receiving a grade of F in the course, or even being suspended or expelled from the University. Examples of punishable offences include plagiarism and unauthorized collaboration. Any such reported offences will be reviewed by the office of the Dean of Science. More information on this policy may be found on the ODS Academic Integrity page: Academic Integrity | Faculty of Science (carleton.ca).

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. More information and standard sanction guidelines can be found here: https://science.carleton.ca/students/academic-integrity/. Please note that content generated by an unauthorized A.I.-based tool *is* considered plagiarized material.

Unauthorized 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".