

**Carleton University**  
**School of Computer Science**  
**COMP 5115F: Geometry processing**  
**Fall 2022**  
**Course Outline**

**Instructor Contact**

Instructor: Oliver van Kaick  
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Office: HP 5348

**Class Details**

Classroom: RB 3201 (Richcraft Hall)  
Class Times: Mondays and Wednesdays, 10:05am-11:25pm

**Resources**

Course Website: [http://people.scs.carleton.ca/~olivervankaick/geomproc\\_fall\\_2022.html](http://people.scs.carleton.ca/~olivervankaick/geomproc_fall_2022.html)  
Notes, references, and assignments in Brightspace: <https://brightspace.carleton.ca/d2l/home/143837>

**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 is still the subject of much active work and presents opportunities for future research.

**Topics Covered**

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

## **Prerequisites**

Experience with computer programming, familiarity with basic calculus and linear algebra (vectors, matrices, etc.), and eagerness to study mathematical concepts and algorithms. Familiarity with computer graphics and/or computer vision and/or image processing are a plus but not required.

## **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.

## **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.

## **Evaluation**

The grade will be based on the presentation of a paper, assignments, a take-home exam, and a final course project. The idea is that the paper presentation and assignments will all converge to the same goal: the chosen paper will be ideally on the same topic as the project, while the assignments will set up the programming environment for working with 3D geometry. The project will consist in the implementation and evaluation of a geometry processing technique, followed by the submission of a report, code, and an analysis of the results. The take-home exam is open book.

## **Late assignments 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

## **University Policies**

### **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. Some examples of offences are: plagiarism and unauthorized co-operation or collaboration. Information on this policy may be found in the Undergraduate Calendar.

### **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.

### **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.

### **Requests for Academic Accommodation**

You may need special arrangements to meet your academic obligations during the term. For an accommodation request, the processes are as follows:

#### **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 the Equity Services website: [carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf](http://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf)

#### **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 the Equity Services website: [carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf](http://carleton.ca/equity/wp-content/uploads/Student-Guide-to-Academic-Accommodation.pdf)

### **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](mailto: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. [carleton.ca/pmc](https://carleton.ca/pmc)

### **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 is 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](https://carleton.ca/sexual-violence-support)

### **Accommodation for Student Activities**

Carleton University recognizes the substantial benefits, both to the individual student and for the university, that 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. <https://carleton.ca/senate/wp-content/uploads/Accommodation-for-Student-Activities-1.pdf>

For more information on academic accommodation, please contact the departmental administrator or visit: [students.carleton.ca/course-outline](https://students.carleton.ca/course-outline)

Preliminary course outline subject to change; last updated on Tue Jul 19 2022.