

COMP 4900F/5900F – Winter 2024

Surgical Data Science

Course Information

Classroom: In-person (room location is posted on Carleton Central)

Lectures: Wednesdays & Fridays, 8:30am – 10:00am

Course Website: <https://brightspace.carleton.ca/d2l/home/258837>

(University of Ottawa students, please see information here to access the course website: <https://gradstudents.carleton.ca/faculty-of-graduate-and-postdoctoral-affairs-access-to-brightspace/>)

Instructor

Matthew Holden

Contact: matthew.holden@carleton.ca

Office Hours: Wednesdays & Fridays 10:00am – 11:00am (or by appointment)

Office Location: Herzberg Laboratories 5435

Course Calendar Description

Core concepts for modelling and analyzing data from image-guided surgeries and interventions. Emphasis on the underlying methods in surgical navigation, sensorization of the operating environment, modelling of surgical processes, and machine learning on surgical time series data.

Prerequisites

Graduate students in COMP 5900F:

Prior coursework in machine learning or artificial intelligence.

Undergraduate students in COMP 4900F:

COMP 3105 or COMP 3106

Topics Covered

- Computer-assisted interventions
- Coordinate transformations and surgical navigation
- Introduction to medical imaging
- Representations for time series
- Alignment and comparison of time series
- Neural networks for time series
- Validation strategies for machine learning on surgical data

Learning Objectives

By the end of this course, students should be able to:

- Understand how to develop a system for surgical navigation and/or data collection
- Select appropriate methods to analyze medical imaging and surgical time series data
- Implement methods and validate their performance

Course Format

This course will be in-person. During class, we will have interactive activities such as: discussions, tutorials, demonstrations, examples, exercises, etc. Class attendance is very important as students will be responsible for all items discussed in class.

Communication

All announcements for the course will be made in class or through Brightspace. You are responsible for regularly monitoring these announcements.

Students are requested to ask questions or have discussions about the course or course material during the live classes, during instructor office hours, or on Brightspace. This way, other students may benefit from the discussion. You may not, however, post solutions to the assessments during the live classes or on Brightspace. Questions or discussion about your individual situation may be asked by email.

Required Textbook(s) and Other Resources

There is no required textbook for this course. The course will use resources (e.g. journal articles, book chapters, conference proceedings) available through the Carleton Library. Information on accessing these resources will be provided in class or posted on Brightspace.

This course may use Poll Everywhere, Carleton University's tool for in-class polling. See here for details: <https://carleton.ca/edc/pollev/>.

Assessment Scheme

Students will be evaluated in this course according to the following scheme. Details, due dates, and submission procedures for each component will be posted on Brightspace.

<i>Component</i>	<i>Weight</i>
Article summary presentations (2)	10%
Assignments (2)	20%
Participation	5%
Project (proposal + presentation + report)	50%
Student-led discussion	15%

Article Summary Presentations

Students will make two short presentations on an interesting problem in surgical data science, based on one or more articles in the literature. All students must complete the article summary presentations individually.

Assignments

There will be two assignments in this course, each weighted equally. Each assignment will contain a theoretical part and an implementation part. Implementations may be written in Matlab or Python 3. Graduate students in COMP 5900F must complete the assignments individually; undergraduate students in COMP 4900F may complete the assignments in small groups of two students.

Participation

Students may participate through either in-class discussion or through posting on Brightspace. To receive full participation marks, students must make at least ten contributions throughout the course (maximum one contribution per week will count). All students must complete the participation individually.

Project

Students will complete a project where they address a research question in surgical data science. They may address the question by providing a practical solution, developing a theoretical solution, comparing/analyzing pre-existing solutions, or other related topics. Students must first submit a project proposal for approval by the instructor. Students will make a presentation on their project and write a report on their project. Graduate students in COMP 5900F must complete the project individually; undergraduate students in COMP 4900F may complete the project in small groups of two students.

Student-Led Discussion

Students will lead a class discussion on a topic in surgical data science. Students are encouraged to consult with the course instructor about their discussion beforehand. Graduate students in COMP 5900F must complete the student-led discussion individually; undergraduate students in COMP 4900F may complete the student-led discussion in small groups of two students.

Important Considerations

If you are unsure of the expectations regarding academic integrity (e.g. how to use and cite references, how much collaboration with classmates is appropriate), ask your instructor beforehand. Academic integrity offences are reported to the office of the Dean.

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.

References to any material you use but did not originate must be appropriately cited. This includes the use of chatbots (e.g., ChatGPT, Google Bard, Bing Chat), research assistants (e.g., Elicit), and image generators (e.g., Stable Diffusion, Dall-E), etc. Such tools must also be appropriately cited. Failure to reference materials or tools is considered academic misconduct.

For each assignment, the project proposal, and the project report, students may request a 48-

hour extension with no questions asked. Submissions within this 48-hour extension period will be accepted without penalty. Late submissions beyond this will not be accepted. This will be strictly enforced. Exceptions to these rules will not be granted except for accommodations provided by university policy. Technical problems do not exempt you from this requirement. Consequently, you are advised to: (1) periodically upload your progress (e.g. upload your progress at least daily) and (2) attempt to submit your final submission well in advance of the due date and time. It is your responsibility to ensure you have submitted the correct materials.

For each assignment, you may be submitting one or more files that contain source code. These files must be written in Matlab or Python 3, be given the correct filename, and be provided in the specified format. Assignments that are incorrectly named or in the incorrect format will be penalized and may receive a mark of zero. If any of the source code files you submit does not run, it may receive a mark of zero. Furthermore, you are expected to demonstrate good programming practices, 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. You may be asked to present either pseudocode or a flowchart before you will receive any assistance from the instructor.

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.

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.

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

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

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/>.

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

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/>.

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".