

GEOGRAPHY 333 · FALL 2022

Introduction to Programming for the Spatial Sciences

INSTRUCTOR

Professor Grant McKenzie
Office: Burnside Hall 613A
grant.mckenzie@mcgill.ca

Office Hour:
*Tuesdays 10:30-11:30am
and by appointment*

TEACHING ASSISTANT

Sichen Wan
sichen.wan@mail.mcgill.ca

Yiyi Zhang
yiyi.zhang2@mail.mcgill.ca

Office Hours TBA

GENERAL INFORMATION

This course introduces students to conceptual and practical aspects of programming for the spatial sciences. The primary focus of this course is on developing a solid understanding of programming concepts and techniques irrespective of the specific programming language, framework, or software. Topics will include spatial data structures, flow control, classes & objects, and basics of geospatial data modeling and analysis. Students in this course will develop a proficiency in applying these programming principles to real-world geospatial problems. Supplemental to a conceptual and practical understanding of programming, students will be introduced to a number of leading commercial frameworks and cutting-edge open source tool-kits.

This course is open to any and all students with an interest in the spatial sciences and related disciplines. The prerequisite for this course is GEOG 201 or permission from the instructor. Students taking the course are expected to be familiar with geographic data formats and demonstrate a basic understanding of core geospatial concepts. No previous programming experience is expected.

LEARNING OUTCOMES FOR THE COURSE

Upon successful completion of the course students will be able to:

- Demonstrate an understanding of the complexity involved in developing computational models as abstractions of the real world.
- Demonstrate an understanding of the class-object model employed in object-oriented programming.
- Present a basic understanding of how geospatial (GIS & RS) software works 'under-the-hood.'
- Automate geospatial processing tasks using the Python programming language.
- Organize, communicate, and solve theoretical and practical geospatial problems both individually and in a team environment.

COURSE SCHEDULE

- **Lecture:** Tuesdays, 11:35am – 12:55pm (BH 306)
- **Tutorial:** Thursdays, 2:35pm – 3:55pm (BH 306)
- **Lab Section:** Fridays, 2:35pm – 4:25pm (BH 511)

COURSE MATERIALS

- Required textbooks:
 - Tagliaferri, Lisa (2018). [How to Code in Python](#). Digital Ocean, New York, USA [FREE].
<https://www.digitalocean.com/community/tutorials/digitalocean-ebook-how-to-code-in-python>
 - Smith, M., Goodchild, M., Longley, P. (2018) [Geospatial Analysis](#), 6th Edition, [FREE].
<http://www.spatialanalysisonline.com/HTML/index.html>
- Optional (physical) textbooks:
 - Shaw, Z. (2017) Learn Python 3 the Hard Way
 - Toms, S., van Rees, E., Crickard, P. (2018) Mastering Geospatial Analysis with Python
- Online resources:
 - [Online Python documentation](#): (Python version 3.x)
 - Specific module document will be announced in class

COURSE COMMUNICATION

The main course communication will be carried out through the course portal within the McGill University course management system (MyCourses). All students enrolled in the course have access to this system. In addition to communication, MyCourses will be used by the instructor and the TA to post lecture slides, problem sets, assignments and grades, and by students to submit their assignments. Lab Sections, Tutorials, and Office Hours will be held in person.

CLASS STRUCTURE

Lecture Component

The lecture sessions will introduce concepts, techniques, analytic methods, and theoretical problems that are fundamental to understanding geographic data types, formats, and programming for the spatial sciences. Students are expected to attend lecture, take notes, and participate through questions and discussions. PDF versions of lecture slides will be uploaded to MyCourses immediately prior to each lecture.

Tutorial Component

While new concepts will be introduced in lectures, Tutorials will involve *live* problem solving, demonstrations, writing code, and opportunities to ask the instructor lots of question. A weekly problem set will be posted to MyCourses at the beginning of each week. Students should attempt the problem set themselves before the Thursday Tutorial session. During the Tutorial, the instructor will work through the problem set questions live and students are encouraged to follow along on their own computers and ask questions. Previous students have found these sessions immensely useful for the assignments, exams, and their future careers.

Lab Component

This course includes a Lab component, which is of equal importance to the Lectures and Tutorials. During the allocated lab time students will work individually or in small groups on assignments. The teaching assistant will spend 10 minutes at the beginning of the session to introduce each assignment. During the remainder of the scheduled lab time, the teaching assistant will be available for one-on-one or small group meetings to answer any assignment-related questions. Students are encouraged to work together on assignments, however, all submissions must reflect their own work. Plagiarism will not be tolerated and result in a grade of zero.

All deliverables, as described in each lab assignment, should be submitted to MyCourses before posted deadlines (typically one week after assignment). **All students have a grace period for lab assignments of 9 days *total* to use how they see fit. For instance, each assignment could be one day late, or one assignment could be 9 days late without penalty (weekend days are counted as days). How you use these 9 days is up to you. My suggestion is to bank these days for when you truly need them (e.g., if you are sick, attending wedding, etc.).** After this grace period, late assignments will be given a 10% per day penalty up to a maximum of 5 days (including weekends). Assignment submitted more than 5 days late will be given a grade of zero. Please note that attendance during the lab section is not mandatory though *highly* encouraged since this is the time that the teaching assistant is scheduled to answer your questions. Those students who attend lab can seek additional help during the TA office hours if necessary.

GRADE DETERMINATION

- Lab Assignments: 45% (9 x 5%)
- Midterm Exam: 27%
- Final Lab Exam: 28%

PROVISIONAL SCHEDULE

Please note that modifications may be introduced to the schedule as the semester progresses. Updated schedules will be made available to all students via MyCourses as soon as possible.

WEEK	TUESDAY	THURSDAY	FRIDAY
Aug 30		Introduction	<i>Lab 0*</i>
Sept 6	Data types, Variables & Operators**	Tutorial**	Lab 1
Sept 13	Conditionals, Logic & Control	Tutorial	Lab 2
Sept 20	Lists, Tuples, Sets & Dictionaries	Tutorial	Lab 3
Sept 27	Loops, Input & Output	Tutorial	Lab 4
Oct 4	Functions, Scope & Modules	Tutorial	Lab 5
Oct 11	No Class or Lab (Thanksgiving break)		<i>Seminar (Optional)</i>
Oct 18	<i>Midterm Review</i>	Midterm Exam	No Lab
Oct 25	Classes & Objects	Tutorial	Lab 6
Nov 1	Spatial Data Structures	Tutorial	Lab 7
Nov 8	Spatial Data Analysis I	Tutorial	Lab 8
Nov 15	Spatial Data Analysis II	Tutorial	Lab 9
Nov 22	Future of Spatial Data Science	No Class	No Lab
Nov 29	<i>Lab Exam Review</i>	No Class	Final Lab Exam

* *Lab 0 will not be graded. It is an introductory lab to get you familiar with the JupyterHub Integrated Development Environment (IDE). There is nothing to submit on myCourses.*

** *The lecture and tutorial this week will be pre-recorded and posted to myCourses, as I will be attending a conference. There will be no in-person lecture (Tuesday), tutorial (Thursday), or Office Hour this week.*

MIDTERM EXAM

There is one written midterm exam in this course that will be administered on Thursday, October 20th. The reason for this exam is that there are both theoretical and practical concepts that must be well understood early in the course as they are the foundation on which more complex concepts are built. The written midterm contains a combination of pseudo-code, concept explanation, and code completion questions. This exam will be written in person during scheduled class time and is worth 27% of the overall course grade.

FINAL LAB EXAM

There is one final lab exam for this course. It is a practical, applied-coding exam that will take place in Burnside Hall 511 during scheduled lab time. As a complement to the midterm exam, this exam will test students' knowledge of python programming applied to geospatial problems. Students will be given a set of problems and asked to write code to solve the problem within the allotted lab time. The final lab exam is worth 28% of the overall course grade. Further details on this exam will be introduced after the midterm exam.

STATEMENT ON EQUITY, DIVERSITY, AND INCLUSION

It is my intent that students from all diverse backgrounds and perspectives be well served by this course, that students' learning needs be addressed both in and out of class, and that the diversity that students bring to this class be viewed as a resource, strength and benefit. It is my intent to present materials and activities that are respectful of diversity: gender, sexuality, ability, age, socioeconomic status, ethnicity, race, and culture. Your suggestions are encouraged and appreciated. Please let me know ways to improve the effectiveness of the course for you personally or for other students or student groups.

EXPECTATIONS OF STUDENTS IN THIS COURSE

Students should be aware that the material presented during lectures, tutorials, and labs are complementary, meaning each serves a different purpose and all are essential to successfully completing this course. Students are encouraged to do the readings (suggested in each lecture) and take notes during lectures, tutorials, and lab sections as not all material will be presented on the slides.

Students are expected to complete their lab assignments, attend lectures and tutorials, and actively participate in lab sessions. All lab assignments are to be submitted via McGill's myCourses by the specified due date and time.

Students are expected to treat each other with respect. Disruptive behavior of any kind will not be tolerated. Students who are unable to demonstrate civility with one another, the teaching assistants, or the instructors will be subject to referral to the Office of Student Conduct or to the McGill Campus Security. You are expected to adhere to the [Code of Student Conduct](#).

OTHER MATTERS

McGill University values academic integrity. Therefore, all students must understand the meaning and consequences of cheating, plagiarism and other academic offences under the [Code of Student Conduct and Disciplinary Procedures](#).

For information on university and department policies for student assessment, please go to <http://www.mcgill.ca/geography/studentassessment>.

In accord with McGill University's Charter of Students' Rights, students in this course have the right to submit in English or in French any written work that is to be graded. *Conformément à [la Charte des droits de l'étudiant](#) de l'Université McGill, chaque étudiant a le droit de soumettre en français ou en anglais tout travail écrit devant être noté, sauf dans le cas des cours dont l'un des objets est la maîtrise d'une langue*

In the event of extraordinary circumstances beyond the University's control, the content and/or evaluation scheme in this course is subject to change.

If you have a disability for which you need special accommodations, please contact the instructor to arrange a time to discuss your situation. It would be helpful if you contact the [Office for Students with Disabilities](#) prior to meeting with the instructor.

Additional policies governing academic issues which affect students can be found in the [McGill Charter of Students' Rights](#).

McGill University shall strive to be recognized as an environmentally safe and responsible institution, and as a model of environmentally responsible living (see https://www.mcgill.ca/sustainability/files/sustainability/enviro_policy.pdf).

The COVID-19 pandemic is not over. If you test positive or show symptoms of COVID-19, please do not attend class or lab. The 9 day no-late-penalty policy is there in case of illnesses and all lecture slides are posted to myCourses.