GEOG 407: ISSUES IN GEOGRAPHY (FALL 2020)

Introduction to Programming for the Spatial Sciences

Instructor
Professor Grant McKenzie
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Office Hours: Tuesdays 10:05-11:25am

Teaching Assistants
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

- **Lectures** - Videos/Slides will be posted on Monday mornings (No "live" Tuesday lectures)
- **Hands-on Session** – Thursdays, 10:05a – 11:25a – Zoom
- **Lab Section** (TAs available) – Fridays, 2:35p – 4:25p – Zoom

COURSE REMOTE DELIVERY

All interaction will take place through "remote delivery." There will be no in-person meetings, lectures, or labs. All lecture videos will be uploaded. Hands-on session, lab session, office hours (instructor) will take place at:
https://mcgill.zoom.us/j/91023637477?pwd=VVZBVzNDbm9leldkRVhTVFFBQU9jdz09

COURSE MATERIALS

- Required textbook:
  - 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)
  - ESRI's ArcPy Documentation: (Python version 2.x)
  - GeoPandas

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 the system. In addition to communications, this portal will be used by the instructor and the TA to post lecture videos, slides, assignments and grades, and by the students to submit their assignments. All Hands-On sessions, Lab sessions, and office hours will use the Zoom Video Conferencing platform. A link to each session will be posted on myCourses.

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 geographical sciences. All lectures will be pre-recorded and uploaded onto myCourses along with the lecture slides. Students will not 'attend' video lectures. During the scheduled lecture time (Tuesdays 10:05-11:25am), the instructor will hold office hours and students are encourage to sign into zoom (Zoom Link) and ask questions then.

HANDS-ON SESSION

While new concepts will be introduced in the video lectures, the hands-on session 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 the week. Students are encouraged to try and complete the problem set themselves before the "hands-on" session. During the "hands-on" session, the instructor will work through the problem set questions live (Zoom Link) 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 SECTION

This course includes a lab component, which is of equal importance to the lecture and hands-on session. During the allocated lab section 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 via Zoom video conference (Zoom Link). During the remainder of the scheduled lab time, the teaching assistant will be available via Zoom for one-on-one or small group video conference to answer any assignment-related questions.

All deliverables, as described in each lab assignment, should be submitted to myCourses before posted deadlines. **Late assignments will be given a 0.42% penalty per hour (roughly 10% per day) up to a maximum of 5 days (including weekends).** Assignment submitted more than 5 days late will be given a grade of 0. Please note that video attendance during the lab section is not mandatory though highly encouraged since this is the time that the TA is scheduled to answer your questions.

GRADE DETERMINATION

- Lab Assignments: 50% (5 x 10%)
- Midterm: 25%
- Final Exam: 25%

MID-TERM EXAM

There is one written midterm exam in this course that will be administered in Week 9 of the semester. 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 short answer, long answer, and pseudo-code questions.

FINAL (TAKE-HOME) EXAM

A take home exam is one of the best ways to assess the knowledge gained by students taking a programming and conceptual modeling course. This exam mirrors the type of work that students may be presented with after graduating and places students in a 'project-deliverable' type situation with access to all available real-world resources. The final exam deliverables consist of:

a) A report (40%)
b) Functioning code with relevant documentation (60%)

The final exam is an individual assignment (not a group assignment). More details on the final exam (including a detailed grading break-down) will be introduced after the midterm exam.

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.

WK	HANDS-ON	TOPIC	LAB
1	Sep 3	Course Logistics	*No Lab*
2	Sep 10	Introduction to Spatial Programming	Lab 0: Intro to JupyterHub *(not graded)*
3	Sep 17	Data types, Variables, & Operators	Lab 1: Surveying Urban Populations
4	Sep 24	Conditionals, Logic & Control	
5	Oct 1	Lists, Tuples, Sets & Dictionaries	Lab 2: City Info Dictionaries
6	Oct 8	Loops, Input & Output	
7	Oct 15	Functions, Scope & Modules	Lab 3: Soil Sampling
8	Oct 22	Classes & Objects	
9	Oct 29	MIDTERM (No Lecture)	
10	Nov 5	Geospatial Data Structures	Lab 4: Global Land/Water Ratio
11	Nov 12	Spatial Data Analysis 1	
12	Nov 19	Spatial Data Analysis 2	Lab 5: POI & Metro Stations
13	Nov 26	Automation & Tool Creation	
14	Dec 3	Geo-semantics & Artificial Intelligence	
	TBD	Take-home exam due (myCourses)	

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EXPECTATIONS OF STUDENTS IN THIS COURSE

- Students should be aware that most of the material covered in the class is not available in the course eBook and will be presented in lectures, through hands-on discussions, and in lab sections only. Students are strongly encouraged to take notes during video lectures, and hands-on sessions as not all material will be presented on the slides.

- Students are expected to complete their lab assignments, watch video lectures, participate in hands-on sessions, and attend scheduled 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 instructor 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.

