Advanced GIS for Natural Resource Management

ENVB 530

Winter 2023

Tuesdays 10:35 - 2:25 Macdonald-Stewart Building 02-028, Macdonald Campus McGill University	**Professor:** **Dr. Jeffrey A. Cardille** MS2-078 jeffrey.cardille@mcgill.ca Equally: jeffcardille@gmail.com https://calendly.com/jeffcardille/ http://cardillelab.com/	**TA:** **Flavie Pelletier** flavie.pelletier@mail.mcgill.ca flavie.c.pelletier@gmail.com

Google Site for the course	Speed Learning in ArcGIS
Index of Student Work	Group Resources (created by students in previous years) • GIS and Programming • GIS Tutorials

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1. Course Description

The goal of this course is to study and to use GIS as a tool that can aid the resolution of spatial problems in the domain of natural resource management. In the course, you will enlarge your repertoire of GIS knowledge as well as your ability to define and execute an independent study project using GIS for the resolution of practical problems.

2. Course Objectives

- Gain technical knowledge to resolve spatial problems
- Improve your capacities to
    - organize and present your ideas,
    - learn the state of the art and find solutions to questions;
    - collaborate with others and constructively evaluate and improve the work of colleagues.
- Develop a permanent dossier of your work: of presentations, proposals, lab reports, and Project effort that can be accessed for the long term.

3. Tools

- ArcGIS: Spatial Analyst, ArcMap, ArcCatalog. 3D Analyst, Network Analyst, Geodatabases
- Google Earth Engine
- Google: Docs, Presentations, Sites
- Others: Depending on the specific interests and needs of members of the class, this could include: KML, Grass, QGIS, Google Earth, R (spatial package), PCI, Excel, and more

4. Approach

In the world of GIS, my philosophy is that learning is shared, incomplete, and continually in need of updating. Given the ever-increasing amount of information on the internet, it is an incredibly useful resource-- but good use of GIS help, blog entries, user forums, etc is a difficult skill that takes plenty of practice.

Part of the intention of this course is to help you to either get a job using GIS, to do your project for a graduate degree, or to quickly understand the work of others that was produced with GIS. To do this convincingly, the following skills are critical:

- Understanding existing GIS capacity in varied domains;
- The ability to work both individually and with others;
- Comfort in describing your ideas, both orally and in writing;
- Comfort with being "stuck" on a problem, with no idea how to resolve it.

The course is divided into two parts: (1) the expansion of your knowledge of GIS as rapidly and efficiently as possible, and (2) the application of this knowledge to projects that you conceive, develop, and execute yourself. All work will be stored on the web for the long term. This is for two benefits: (1) as a work dossier that you can use to demonstrate to future employers about your skills in GIS development and presentation; and (2) as a growing database of knowledge for yourself, future students, and visitors to the web sites.

Learning, particularly in GIS, is not easy to do at the last minute. True learning requires continual expansion of your knowledge, and frequent reinforcement of what you have recently learned. Thus, you will notice that there is something due nearly every week in this course. My experience is that by requiring a steady effort, the large effort required for a successful research project, when you arrive at that part of the semester, is much less intimidating.

5. Labs

We will do several labs, moving from ones based on what you have already seen in introductory GIS, moving toward programming and a lab you choose yourself, and doing labs on cutting-edge technologies.

Below is part of the list:

- ArcGIS Spatial Analyst Tutorial
- Rectification in ArcGIS
- Programming and Python
- Take your pick from a set
- QGIS
- Google Earth Engine
- Take your pick (for an optional lab)

6. Calendar

Week	Date	Subject

1	10 jan	• Overview of the course. General principles.
		• Verify that you can connect using our common google account, envb530w23@gmail.com. This is the account for the submission of work on the group file "Index of Work" and for the Google Site that you will create. To connect, go to drive.google.com.
		• To do this next step correctly, copy the link and open it in an Incognito window. Fill out this survey about your skills as you begin the course.
		• Create your Google Site and data space for the course.
		• Add your name to the Index of Work and include the link to your site. To be able to edit that page, change your account to the common user first.
		• We'll view the evaluations students have given of labs in this course in past years.
		• Icebreaker. Collaboration and commiserating are a big part of life. Here, you'll break into groups of 2 and discuss:
		  ○ One thing you're good at in GIS
		  ○ Worst thing that happened to you with GIS so far
		  ○ What are you hoping to know how to do?
		  ○ (We'll ask you to introduce your partner briefly after you've met.)
		• Earth Engine:
		  ○ Requisition an Earth Engine account using a Google Account at signup.earthengine.google.com. Check your spam folder if you don't see an email. You'll know you have that account if you can go to the Google Earth Engine Code Editor and see your account name in the upper right.
		  ○ First, I'll introduce you to Earth Engine and tell you about our lab's work with it.
		  ○ Then, you will do F1.0 and F1.1 in the Earth Engine Fundamentals and Applications book.
		• Use this lab report and this lab report as indications of what is expected in the lab reports. Here is a more detailed version that got the same grade.

2	17 jan	• To remit (*before* class, online at your Google Site): Report for previous lab.
		• Do Lab: *ArcGIS Spatial Analyst Tutorial*
		  ○ First, read these notes made by students about running this lab.
		  ○ The data can be found here.
		• Optional: complete this longer survey about the Earth Engine labs.

3	24 jan	• To remit (*before* class, online at your Google Site): Report for previous lab. • (Don't forget to update the Index of Work) • Please complete this survey about the last lab. • Endure Jeff's heartfelt advice about data organization ○ Get a free folder structure here • Lab: *Rectification in ArcGIS*. See these notes made by students about running this lab.
4	31 jan	• To remit (*before* class, online at your Google Site): Report for previous lab. • Please complete this survey about the last lab. • Learn the Ten Commandments of GIS • Lab: Programming and Python. ○ See these notes made by students about the lab.
5	7 feb	• To remit (*before* class, online at your Google Site): Report for previous lab. • Please complete this survey about the last lab. • Lab: Do one or more of these lab exercises. To choose, you might view the evaluations of some of these labs from students in previous years.
6	14 feb	• To remit (*before* class, online at your Google Site): Report for previous lab. • Please complete this survey about the last lab. • Informal presentations possible: Be prepared to show your report of the lab exercise(s) you did.

		• We'll view the evaluations you have given of labs in this course so far. • Introduction of the ***Python / Model Builder Mini-Project*** • Please do this Lab: QGIS Check out or contribute to any comments from previous students here.
7	21 feb	• To remit (*before* class, online at your Google Site): Report for previous lab. • Work on Python / Model Builder Project
*	break	**Feb 27-March 3 Winter Break**
8	7 mar	• Introduction to the Final Project • Preview of Speed Learning • *Student Presentations*: Present the result of your Python / Model Builder project. After: feedback sessions (as needed) for proposal planning. • Mid-course survey

9	14 March	• To complete (before class): your written proposal, presenting your initial ideas for your project. Click here for guidelines for the proposal.
		• One-on-one with Prof and TA (8 min). If we're still online, we'll do something structured like this: One-on-one schedule
		• Mid-course survey
		• Reviews/discussions with other members of your consulting team
		• Lab (optional, no writeup required): Do one or more lab exercises. These might include:
		  ○ One of these lab exercises
		  ○ Citizen Science in Landscape Ecology- happy to get your feedback. From the book Learning Landscape Ecology, the practical manual for the field
		  ○ F4.8 in the Earth Engine book - happy to get your feedback on that or any other chapter!
		  ○ Metric Finder and Metaland lab from the same book
		  ○ Other lab by your suggestion

10	21 March	• **Student Presentations:** Proposal presentations for the final project ○ Present your project proposal. • Introduce the Speed Learning Presentation • Due (by *end* of the class): Written critiques of project proposals • Please fill out our first-ever chatGPT survey • Continue projects work
11	28 March	• Show and tell of your secret skill (?) • **Student Presentations:** *Speed Learning* • Continue projects work
12	4 April	• Please complete this survey about the optional lab (if you did one) • Continue projects work
13 *Last day*	11 April	• **Student Presentations:** Final Presentations of Projects. • Please review this course on Minerva today. We want your feedback to improve the course, and to compare future iterations of the course. • Please fill out this deeper end-of-course survey (optional). It will help us to improve the course. • Looking back on the course- see what you've done
X	18 April	**Report due**
		End of the course!

7. Evaluation

Evaluation is composed of the following items, including presentations to other students, reports on your ideas and your results, help to other students, and your own projects.

The final grade is calculated from the following components:

Percentage		Activity

30		Lab reports
20		Development of a ModelBuilder-based model enhanced by supplementary Python work, using provided data
5		Presentation and slides for Speed Learning
5		Written Counsels for other students and overall participation
40		Project * grading details to be given in class before Winter break

Documents, presentations, and technical projects are due before the class, not during the class. It is tempting to try to catch up on a lab report during the next class, but you may soon find that the requirements of that session gets you further behind. If the modification date of a document is after the start of the course, then the work is late. Note well that presentations are stored online and made visible by you before the course begins. The file must be viewable by someone who is not logged into the user account before you start your presentation.

8. Readings

Readings for this course can be pursued as needed for your work.
Online Resources:

- Penn State Geog 485: GIS Programming and Automation. An online course, potentially for credit.
- NC State's Master of GIS Programming course is available for free online.

Optional: during the semester, we may consult the following volumes for additional detail on the subjects covered.

- ***Geospatial Analysis*** (3e Edition)
  - Michael J de Smith (Author), Michael F Goodchild (Author), Paul A Longley (Author). Of this book, you might be most likely to consult: 5.3 Grid Stats, 5.6 Geographically Weighted Regression, 6.1 Test datasets, 6.3 Visibility, 6.4 Watersheds, 6.6 Interpolation, 7 Networks.

  - The book is available in varied formats:
    - online, free: at www.spatialanalysisonline.com
    - *Please note that there is a special, student ordering page, for those students who would like their own copy in special PDF or printed form:* http://www.spatialanalysisonline.com/GAOrderpageStudent.html

- ***Geographic patterns & relationships***. Mitchell, A., and Environmental Systems Research Institute (1999), ESRI press.

9. Prepare yourself

Despite the (very good) urge to work together, much work with GIS is done alone, and it is important to be able to work independently, yet without feeling isolated. When I say this, I mean that in this course and later, in your career, you will often be either

- alone in a room, trying to get un-stuck
- working on a problem that is so detailed that you are on your own
- the only person in your organization who has any idea what to do
- working with new software without a useful manual at hand
- perceived as the expert, who is the only person who can solve a given problem with GIS.

Despite this challenge, the internet allows you to be only one or two clicks away from:

- the right answer
- information about how to do what you want, in a different way than you had anticipated
- an answer that is correct in concept, but which was for an earlier version of software

as well as being only a few clicks away from:

- an answer that seemed relevant but is not;
- distracting forums that are outdated and highly specific;
- infinite distractions like facebook and Instagram.

Early in my own college career in computer science, I was lamenting to one of my friends how frustrating it was to be stuck on a certain problem, and how I always felt that I was stuck. His reply: "But-- *most of our time* is spent being stuck. If you are humming along, you can move really quickly and it's not long until you are stuck again. When it is easy to get unstuck, you get unstuck quickly and hum along to the next stuck point. And when we're not stuck, there's no problems to solve and it can get really boring."

With this in mind, I encourage you to think of GIS and your projects as giant puzzles that are continually unfolding in front of you. These puzzles are intermittently very exciting and tremendously frustrating. But this is the mark of a good puzzle-- not too easy, especially at first, but not impossibly hard, either. When you begin a puzzle, progress is very slow and you are very often stuck. Yet-- if you were never stuck, your puzzle would quickly become busy work with no creative aspect to it. So-- from time to time, I encourage you to embrace your inevitable confusion, because it really is a confirmation that **you are one of the few people who are both talented enough and lucky enough to get to work on something that is not easy.** Then ask somebody- talking it through will almost always get you a little bit further, or at least help you remember that you're not alone.

11. Collegiality during the course

- Do not intentionally (or unintentionally) destroy the work of others. To ensure that you do this, be careful and proceed with caution, particularly in the initial weeks of the course. If you make a problem, you can either hit control-Z to go back a few clicks, or File ⇒ Revision History to go back a few minutes.
- Don't use the Google Site or Google Documents for a reason other than the course (for example, for commercial or personal purposes).
- Although collaboration and sharing knowledge is extremely important, copying the work of others is prohibited. This is particularly important for the lab reports.

12. Prerequisite courses or knowledge

Prerequisite :

- ENVB/BREE 529 or equivalent, or graduate student status

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 (see www.mcgill.ca/students/srr/honest/ for more information).

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.

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

Sickness/illness during the term: Please visit Student Services (CC1-124) at Macdonald Campus if you are suffering from any mental or physical health-related issues during the term. If you need to seek accommodation for in-course assignments, for medical or other emergencies, please bring medical documentation to the Student Affairs Office (106 Laird Hall).

#End of Syllabus