GEOG 384: Principles of the Geospatial Web

Fall 2022, Tuesdays and Thursdays, 13:05-14:25, Burnside 511

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Introduction

Most often when students think of geographic information systems (GIS), it is a mapmaking tool, a complete yet expensive, desktop-bound software package or client instance requiring considerable computational power. We now work in a "stack" of interoperable and "mashed up" geospatial web 2.0 applications and statistical packages, many of which are "freemium" and require no more processing power than being able to run a basic web browser. The learning curve has changed as well. Where once a GIS technician entered, managed and visualized data with a specific learning curve; these functions are being replaced by smarter software and the skillset is shifting to coding by neogeographers.

The nature of locational data has changed as well. Large and streaming datasets, called big data and are derived from sources such as social media and mobile sensors, are commonplace. This includes navigation from autonomous vehicles and facial pattern recognition from CCTV cameras. Entire industries have sprung up to harness the power of interpreting patterns revealed by alphanumeric and image data. These industries also have the capability to influence policy and society as they monetize what has been termed the "ambient awareness" of pervasive space-time data collection. The sheer amount of data with spatial attributes, produced in a single day, could not have been created a mere ten years ago. Whereas the underlying technology has rapidly evolved, our understanding of the information we generate has not kept pace. This calls to question issues of accuracy, rights, privacy and the potential for harm. Should we be able to scrape any data on the web and should we trust in its validity? Should we uncritically utilize crowdsourced asserted data (i.e., location-based sentiments and observations from non-experts called volunteered geographic information {VGI})? The data is far more unstructured and is sourced to a myriad of multimedia (e.g., videos, graphs and tables, social media posts, phone pings and tagged photos). This geospatial data constitutes a departure from traditional authoritative datasets of latitude, longitude, projection and attributes, and introduces varied data structures and potentially disputed sources. The user is simultaneously the producer of new forms of spatial data, as well as user and commodity.

In this course we will cover the principles of this paradigm, called the Geospatial Web or Geoweb. Like GIS, the Geoweb has broad applicability that extends well beyond the

traditional discipline of geography. Numerous examples can be seen in health provision (e.g., fitness tracking), wildlife and natural resources (e.g., feature identification), criminology (e.g., predictive policing of likely offenders; conversely stalking apps), and transportation (e.g., Uber, Lyft, as well as docked/dockless vehicles). The Geoweb can be used in retail marketing, political mobilization, tourism development, journalism and the humanities. The Geoweb also can be fully linked to social networking platforms. Perhaps the most lucrative use of the Geoweb, however, has been location-enabled apps that we use every day. Have you ever used a physical map to navigate space or do you always seek directions to a new location via Google? Does Alexa know the layout of your apartment because you gave your robot vacuum cleaner a map? And what are these firms actually doing with your information?

The course will offer a combination of theory and practice of the Geoweb. In terms of theory, we will cover subjects like VGI and big data and how it changes our ideas about spatial data accuracy. In practical lab sessions students will build Geoweb apps. An additional goal is not to be taught specific skills, but to 'learn how to learn'. Geoweb software changes monthly so students learn of resources and strategies to effectively use emerging technologies and anticipate innovations in geospatial technologies. The course will cover the following topics:

- Examining the underlying methods of digital earth architectures, including georeferent systems. These architectures underlie most digital earth platforms like Google Maps/ Earth, OpenStreetMap, OpenLayers, and Mapbox
- Exploring political, sociological, economic and legal issues in using locational data (e.g., tracking of Amazon warehouse workers, relying on ghost work)
- Critically analyzing the concept of VGI, for example, spatial data accuracy and uncertainty of heterogeneous data sources (spatial data quality)
- Understanding the infrastructure of the Geoweb, including the geospatial software stack, Application Program Interfaces (APIs), and the Document Object Model (DOM)
- Comparing and contrasting GIS and the Geoweb
- Repurposing geographic digital content (secondary data), for example via web scraping
- Learning underlying concepts of server/cloud geospatial applications
- Understanding issues related to real time streaming data (e.g., changes in sampling and geostatistics)
- Working with location-based services and mobile platforms
- Gently introducing Web 3.0
- Identifying basic problem-solving requirements for geospatial apps. For proposed solutions, critically evaluating and justifying various existing and emergent geospatial technologies and enabling software stacks.

We also have the opportunity to hear from experts in the field. We often have guest lectures from representatives of Geoweb firms like Mapbox and Stamen Design as well as representatives of traditional GIS firms like ESRI, coordinators of VGI sites like OpenStreetMap, and researchers working in the Geospatial Web (e.g., researching copyright laws for geospatial data).

Finally, and time willing, we will host some workshops outside class time to assist in learning. Among possible topics are HTML and CSS, the Document Object Model, GIT and Scalable Vector Graphics. Stay tuned for times and locations.

Course Prerequisites

GEOG 201 and COMP 202/GEOG 333 are required (COMP 202 can be taken in parallel). OR permission of the instructor.

Books and Other Reading Material

During the course, students are required to read a variety of articles, working papers and other material. These will be posted on the course website (neogeoweb.ca). Students have to learn Javascript. At the moment, this will be done via W3Schools (https://www.w3schools.com/js/). We will specify which modules are relevant to the course content and thus must be completed as part of your learning. If you require additional help in learning material such as JSON, web scraping, or JQuery, you may wish to purchase books (e.g., Eloquent JavaScript: A Modern Introduction to Programming). There are other excellent online resources as well such as stackoverflow for questions or youtube for tutorials. This course assumes you will pick up HTML and CSS; W3Schools serves as an excellent resource for those as well.

Evaluation

In-class and online participation – 10% (5% in-class and 5% online)
In class quizzes – 20%
Assignments – 40%
Final Exam – 30%

In-class and online participation: Student preparation and participation as well as performance during class will be assessed for half (5%) of the participation grade. We are looking for quality of contributions over the quantity of contributions. Class participation will be evaluated based on verbal evidence that students have read assigned readings, done exercises and otherwise prepared for class. Students also will be assessed in their ability to thoughtfully and reflectively build on other students' contributions. The other five percent of the participation grade will be based on online contributions on Twitter, using the hashtag #neogeoweb. Like above, quality of contributions in tweets is preferred over sheer number of tweets, although we normally expect 3 tweets per week.

Assignments: Assignments allow the student to apply lecture material and/or programming to real world cases of geospatial representation on the web. There are five assignments in the course. All assignments are completed in groups of approximately three students. The goal is to balance levels of computational experience so every group possesses a similar level. All assignments are graded as a group regardless of individual contribution.

Note: The temptation in all assignments is to let the experts or intermediates in the team handle the hard technical details. RESIST THIS TEMPTATION because it will hurt you in the final lab exam, which is individual-based. As you know from working with GIS or RS, knowing the tech ONLY comes from doing (and occasionally, creatively failing) the tech.

Quizzes: Approximately half of the assignments require the use of the coding language of web development, which is Javascript. Quizzes will be announced in the class prior to the day the quiz is held. You will be expected to complete the assigned W3Schools 'My Learning' modules up to that point (JS instruction and W3Schools schedule TBA). You must email your completion (https://my-learning.w3schools.com/tutorial/js) to the instructor by the beginning of Week 6. This file will demonstrate that you have completed the required W3Schools modules.

It is possible to waive out of the coding requirement if you know JS. Contact the instructor for details.

Final Exam: The final exam is comprehensive of all material in the course. It is divided into two equally weighted components—a written exam and a lab practical exam. The final exam is *four* hours long with a one-half hour break in between.

Obligatory Statements

In accord with McGill University's Charter of Student Rights, students in this course have the right to submit in English or in French written work that is to be graded. This does not apply to courses in which acquiring proficiency in a language is one of the objectives." (Approved by Senate on 21 January 2009)

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. » (Énoncé approuvé par le Sénat le 21 janvier 2009)

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." (Approved by Senate on 29 January 2003) (See McGill's guide to academic honesty for more information.)

Additional Statements

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

We endeavor to provide an inclusive learning environment in this course. If you are experiencing barriers to learning in this course, do not hesitate to discuss them with a member of the teaching team and/or the Office for Students with Disabilities, 514-398-6009.

We value intellectual freedom and we also value creating a safe and respectful classroom environment. If you do not feel safe in the classroom by virtue of comments related to your race, gender, sexual orientation, physical ability or for any other reason, please come speak with the course instructors.

Student well-being is a priority for the University. All of our health and wellness resources have been integrated into a single Student Wellness Hub, your one-stop shop for everything related to your physical and mental health. If you need to access services or get more information, visit the Virtual Hub at mcgill.ca/wellness-hub or drop by the Brown Student Services Building (downtown) or Centennial Centre (Macdonald Campus). Within your faculty, you can also connect with your Local Wellness Advisor (to make an appointment, visit mcgill.ca/lwa).

McGill has policies on sustainability, paper use and other initiatives to promote a culture of sustainability at McGill. (See the Office of Sustainability.)

Syllabus

Introduction
Overview of Geoweb and goals of the course.

In-class exercise: Work with existing Geoweb platform, Mapbox GL JS.

Set up Twitter account for online participation
Answer a few questions about your comfort level with various concepts
Learn about the course website
Sign up for W3Schools 'My Learning'
Sign up for Mapbox account

Module 1: Digital Earths, the prime mapping platform in the Geoweb.
Definitions and types of digital earths. Georeferent systems, tiling, and projections. Differences between data structuration in GIS compared to the Geoweb. First introduction to web hosting. Introduction to concepts of markup languages (XML, HTML, KML) and list-based ways of storing data.

In-class exercise: Create your first dataset in geojson, with one point, line, polygon, extrusion, photo using https://geojson.io

Assignment 1: Create a storymap with Mapbox storytelling and geojson.io .

Module 2: Everything You See in Cloud is a Data Source

Introduction to web architectures, DOM and software stacks. Principles of web harvesting/scraping. Legal issues in "repurposing" data, for example, intellectual property and liability. Example from tourism and facial recognition technology. Structured and unstructured data.

In-class exercise: Conduct web scraping. Tag content with XML. Create a web page.

Assignment 2: Use Google Sheets and XPath to automatically scrape and then map a popular classified advertising site.

Module 3: Democratization of Data: Volunteered Geographic Information (VGI), the crowd and Beyond

Concepts in VGI (e.g., citizen sensors, crowdsourcing, ghost work, and neogeography). Motivations for volunteers to contribute. Common methods to assessing accuracy of VGI. Legal issues underlying VGI (e.g., copyright, intellectual property of using citizen-generated content, place-based discrimination). Emergence of citizen science, crisis mapping and open data.

In class exercise: Explore the location enabled data you have on your smartphone. Then take a selfie and email it to yourself.

Assignment 3: Create tracker app with the Mapbox on the browser with Javascript and your cell phone

Module 4: Streaming, real time BIG Geospatial Data

Introduction to concepts of big data and data-intensive science. Brief discussion of geosensors, which are a prime source of geolocated data. Challenges to working with big data, like sampling.

Assignment 4: Create a localized information app, contents of which include streaming weather and transportation data.

Module 5: Geo- and Data Visualization

Principles of cartographic/ geo-visualization and the emergence of data visualization. Exploratory data visualization vs explanatory data visualization. Visualization as storytelling.

In-class exercise: Explore the "maps" of D3JS. Tell a story with a Geoweb platform.

Assignment 5: Conduct data journalism using D3JS.

Module 6: Geoweb on Mobile Devices (if time permits)

Concepts of geospatial awareness on devices--location based services (LBS), including location intelligence, vehicle tracking, and RFIDs. Examples from mobile commerce. Social issues in LBS (privacy, data brokers, surveillance)

In-class exercise: Map geographic data from mobile messaging

TBD: Final exams