PPOL 6805 / DSAN 6750

Geographic Information Systems (GIS) for Spatial Data Science

Wednesdays 6:30-9pm, Car Barn 204

Prof. Jeff Jacobs

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Fall 2024, Georgetown University

Welcome to the Fall 2024 version of **Geographic Information Systems (GIS) for Spatial Data Science** at Georgetown University! Please note that the most up-to-date version of this syllabus will always be available at jjacobs.me/ppol6805

> **i** Course Numbering
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> - For *Public Policy* students (McCourt): the course number is **PPOL 6805**
> - For *Data Science and Analytics* students: the course number is **DSAN 6750**

Course Staff and Office Hours

- **Prof. Jeff Jacobs**, jj1088@georgetown.edu: *Schedule office hour slots at jjacobs.me/meet*
  - Mondays 4:30-6:30pm
  - Tuesdays 3-5:30pm
  - *(Please try to schedule at least 8 hours in advance, and let me know briefly what you'd like to discuss, so I have time to prepare)*
- **TA Billy McGloin**, wtm30@georgetown.edu
  - By appointment (Email)

Course Description

This course provides students with an overview of Geographic Information Systems (GIS), encompassing both general principles of geospatial data analysis and their applications for studying important issues of climate change, international conflict, economic development, and urban planning, among other areas of application.

The beginning of the course emphasizes fundamentals of GIS design and use, such as projection systems, raster and vector data, and efficient representation and storage of geospatial data. As students become more comfortable with these foundations, the course will shift to a greater emphasis on applications during the second half of the semester. Particular emphasis will be placed on effective visualization of spatial data, through creation of static publication-quality maps as well as interactive maps for web applications and data dashboards.

The course will utilize libraries from R, Python, and JavaScript as needed, so experience using any of these languages will be helpful, but is not required. Pre-requisites *(for PPOL students)*: PPOL 564 or PPOL 670.

Assignment Structure

On the basis of the guidelines we've developed for courses offered through DSAN, this course will have one in-class midterm but **no** final exam! Instead, you will work on a final project throughout the second half of the course. Each of the four units will involve a homework assignment, and final grades will be determined using the following weighting scheme:

Category	Percent of Final Grade
In-Class Midterm (Nov 6)	30%
Final Project	30%
Homeworks	40%
HW1: GIS Concepts	10%
HW2: Unary Operations	10%
HW3: Binary Operations and Spatial Joins	10%
HW4: Autocorrelation, Clustering, and Point Processes	10%

The course does not have any "official" prerequisites, but a general comfort with **R** and/or **Python** is strongly recommended. If you have never used Python before, however (or if you haven't used it in a while and feel like your skills are rusty), you can browse the materials on the Resources page!

Course Topics / Calendar

The following is a rough map of what we will work through together throughout the semester; given that **everyone learns at a different pace**, my aim is to leave us with a good amount of **flexibility** in terms of how much time we spend on each topic.

If I find that it takes me longer than a week to convey a certain topic in sufficient depth, for example, then I view it as a strength rather than a weakness of the course that we

can then rearrange the calendar below by adding an extra week on that particular topic! Similarly, if it seems like I am spending too much time on a topic, to the point that students seem bored or impatient to move onto the next topic, we can move a topic intended for the next week to the current week!

If you find any discrepancies between this schedule and Georgetown's official calendar, please let me know.

Unit	Week	Date	Topic
Unit 1: GIS Concepts	1	Aug 28	Introduction to GIS
	2	Sep 4	How Do Maps Work? *HW1 Release*
Unit 2: Geospatial Operations	3	Sep 11	Unary Operations *[Deliverable] HW1: GIS Concepts*
		Sep 13 (Fri)	*HW2 Release*
	4	Sep 18	Binary Operations
		Sep 20 (Fri), 5:59pm	*[Deliverable] HW2: Unary Operations*
Unit 3: Spatial Data Science I: Foundations	5	Sep 25	Spatial Data Science! *HW3 Release*
	6	Oct 2	Random Fields and Spatial Autocorrelation *HW4 Release*
		Oct 4 (Fri), 5:59pm	*[Deliverable] HW3: Binary Operations and Spatial Joins*
Unit 4: Spatial Data Science II: Methods	7	Oct 9	Point Processes, Clustering, and Regularity
	8	Oct 16	Null Models and Marked Point Processes
	9	Oct 23	Evaluating Spatial Hypotheses I: Point Data
	10	Oct 30	Evaluating Spatial Hypotheses II: Areal Data *[Deliverable, 11:59pm] HW4: Autocorrelation, Clustering, and Point Processes*
		Nov 1 (Fri)	*Midterm Practice Problems Release*
	11	Nov 6	In-Class Midterm
Unit 5: Mapping and Applications	12	Nov 13	Static and Interactive Mapping
	13	Nov 20	Applications: Urban Planning

Unit	Week	Date	Topic
		Nov 27	*No Class (Fall Break)*
	14	Dec 4	Applications: Climate Change and Ecological Data
	15	Dec 11	Final Presentations
		Dec 13 (Friday), 5:59pm	*[Deliverable] Final Project*

Assignment Distribution, Submission, and Grading

The programming assignments for the course will be managed through Posit.Cloud This means that, to work on and submit the assignments, you will use the following workflow:

1. Click the "Start" button for the assignment within the Posit.Cloud interface, which should immediately create and display a new in-browser RStudio workspace for you.
2. Work on the problems within the project's `.qmd` file, saving your progress early and often! You can **try things out** or **create drafts** of your solutions locally if you'd like (for example, in VSCode or JupyterLab or any other IDE), but the `.qmd` file within your RStudio project will be considered your "official" submission for each assignment.

Late Policy

After the due date, for each **homework** assignment, you will have a grace period of 24 hours to submit the assignment without a lateness penalty. After this 24 hour grace period, late penalties will be applied up until 66 hours after the due date. Specifically, late penalties will be applied based on the following scale (unless you obtain an excused lateness from one of the instructional staff!):

- **0 to 24 hours** after due date: no penalty
- **24 to 30 hours** after due date: 2.5% penalty
- **30 to 42 hours** after due date: 5% penalty
- **42 to 54 hours** after due date: 10% penalty
- **54 to 66 hours** after due date: 20% penalty
- **More than 66 hours** after due date: Assignment submissions no longer accepted (without instructor approval)

Final Letter Grade Determination

Once all assignments have been graded, we will compute your final **numeric grade** according to the above weighting, rounded to two decimal places. The **letter grade** that we report to Georgetown on the basis of this numeric grade will then follow the DSAN letter grade policy as follows, where the start and end points for each range are **inclusive**:

Range Start	Range End	Letter Grade
92.50	100.00	A
89.50	92.49	A-
87.99	89.49	B+
81.50	87.98	B
79.50	81.49	B-
69.50	79.49	C
59.50	69.49	D
0.00	59.49	F

Title IX/Sexual Misconduct Statement

Georgetown University and its faculty are committed to supporting survivors and those impacted by sexual misconduct, which includes sexual assault, sexual harassment, relationship violence, and stalking. Georgetown requires faculty members, unless otherwise designated as confidential, to report all disclosures of sexual misconduct to the University Title IX Coordinator or a Deputy Title IX Coordinator.

If you disclose an incident of sexual misconduct to a professor in or outside of the classroom (with the exception of disclosures in papers), that faculty member must report the incident to the Title IX Coordinator, or Deputy Title IX Coordinator. The coordinator will, in turn, reach out to the student to provide support, resources, and the option to meet. [Please note that the student is not required to meet with the Title IX coordinator.]. More information about reporting options and resources can be found in the Sexual Misconduct Resource Center.

If you would prefer to speak to someone confidentially, Georgetown has a number of fully confidential professional resources that can provide support and assistance. These resources include:

- *Health Education Services for Sexual Assault Response and Prevention*: Confidential email `sarp@georgetown.edu`
- *Counseling and Psychiatric Services (CAPS)*: 202-687-6985
  - After hours you can call 833-960-3006 to reach Fonemed, a telehealth service, and ask for the on-call CAPS clinician

GSAS and McCourt Resources and Policies

You can find a collection of relevant resources and policies for students on the GSAS website, and the Provost's policy on accommodating students' religious observances on the Campus Ministry website.

You can also make use of the Student Academic Resource Center. In particular, within the Resource Center there is a link to Georgetown's Disability Support page. If you believe you have a disability, you can contact the Academic Resource Center (`arc@georgetown.edu`) for further information. The ARC is located in the Leavey Center, Suite 335 (202-687-8354), and it is the campus office responsible for reviewing documentation provided by students with disabilities and for determining reasonable accommodations in accordance with the Americans with Disabilities Act (ADA) and University policies.

McCourt Academic Integrity Policy

McCourt School students are expected to uphold the academic policies set forth by Georgetown University and the Graduate School of Arts and Sciences. Students should therefore familiarize themselves with all the rules, regulations, and procedures relevant to their pursuit of a Graduate School degree. The relevant policies are listed at this link.