
Class meeting: None (Asynchronous)

Class location: mymason.gmu.edu

Sect/Credits: DL1 / 3 credit hours

Teaching assistant: Mengfei Xin

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Instructor: Nathan Burtch

Email: nburtch@gmu.edu

Instructor office: EXPL 2413

Office hours: T 10:00 – 11:00 AM (via Zoom)

MW 12:00 – 1:00 PM in person

General Information

Classmate contact information:

Name	Email	Phone

Catalog description: Sources of digital geospatial data; and methods of input, storage, display, and processing of spatial data for geographic analysis using GIS. Lectures, hands-on exercises familiarize students with current technology.

Course overview: Geographic Information Systems (GIS) are computerized systems designed for the storage, retrieval and analysis of geographically referenced data. GIS uses advanced analytical tools to explore at a scientific level the spatial relationships, patterns, and processes of cultural, biological, demographic, economic, geographic, and physical phenomena. This is done through modeling the infinite complexity of the Earth to finite computer systems. By the end of the course, students will have sufficient background to identify spatial characteristics of diverse application areas enabling them to integrate spatial thinking and GIS analysis into their academic research and careers.

In this graduate level course, students will learn GIS history, theory, and methods through readings and lectures. Through lab assignments and a term project, students will apply these principles in ‘hands-on’ experience with real world datasets, using the software package ArcGIS Pro.

Online course: GGS 553 is presented as an asynchronous online course. “Asynchronous” means that there are no specific timed gatherings for this course (E.G.: we don’t meet for lectures at specific times like in-classroom courses). Still, there will be specific due dates for graded work in the course that you are expected to meet. It is incumbent upon each student to organize their time and work through materials in a timely and efficient manner.

The course has been designed in weekly segments (see the schedule at the end of the syllabus). Segments will be released in order in a prescribed manner. Students will not have access to the entirety of the course materials from the start; you will get the materials necessary for each week as the week approaches. This is done to ease logistical problems of students being at significantly different sections of the course. Please do not ask for advanced access to materials.

Target audience: This course is required for those pursuing the Geographic and Cartographic Sciences MS, the Geoinformatics and Geospatial Intelligence MS, the Accelerated MS degrees offered by GGS, and both the Geospatial Intelligence and the Geographic Information Science graduate certificates. It is an optional core class for those pursuing the Earth Systems and Geoinformation Sciences PhD, the Earth Systems Science MS, or the Environmental GIS and Biodiversity Conservation graduate certificate. Beyond those programs, this course is also targeted for students within other graduate programs who want to learn the fundamentals of GIS and develop geoinformation analysis.

Applicable learning outcomes: Successful completion of this course will enable students to:

1. Define key concepts and principles related to the fundamental scientific theories and techniques of GIS.
2. Demonstrate skills of data creation, management, and analysis using commercial GIS software.
3. Develop graduate-level independent research in spatial analysis by acquiring and processing GIS data.
4. Effectively communicate by coupling analysis with visual outputs in the form of maps and other graphics produced with GIS, designed according to best professional cartographic practices and aesthetic principles.
5. Develop skills involved in problem solving with spatial data and methods.

Prerequisites: It is recommended that students take GGS 550 or equivalent, or receive permission of the instructor.

Enrollment and repeat policy: GGS 553 may not be repeated for credit. Enrollment is limited to students with a class of Advanced to Candidacy, Graduate, Non-Degree, or Senior Plus. Students in a Non-Degree Undergraduate classification may not enroll.

Course Materials

Required texts:

Textbook:

Bolstad, P. and S. Manson. 2022. *GIS fundamentals: A first text on geographic information systems*. 7th ed. White Bear Lake, MN: Eider Press.

The 7th edition is the newest edition of this text. This text has been chosen because it is affordable and comprehensive. You may also purchase older editions of the text; there will be some differences but overall covers the same topics. The 7th edition can be purchased as either a physical book or an eBook. The text is available in the campus bookstore.

Lab manual:

Gorr, W. L. and K.S. Kurland. 2021. *GIS Tutorial for ArcGIS Pro 2.8*. 4th ed. ESRI Press.

DO NOT get any older editions of the lab manual; it may not have instructions that are fully compatible with our labs and assignments. This text is available in the campus bookstore. You can purchase the lab manual from a variety of online retailers. If you purchase a new copy, you will receive a code for an evaluation (EVA) code for of our course software, ArcGIS Pro. Chances are

used books will not have a valid code. That said, your Mason netID allows you access to the software as well.

GG5 computer lab and virtual computing: The lab in EXPL 2102 is open 24 hours for you to use. Registration in a GG5 class should automatically grant you access. Please contact ggsit@gmu.edu to report issues.

Mason provides access to Mason Labs virtual computing through your web browser. In order to access it, you will need to install both a Mason VPN (<https://its.gmu.edu/service/virtual-private-network-vpn/>) and the Citrix Workspace app (<https://www.citrix.com/products/receiver.html>). After logging into the VPN, you can then access <https://mymasonapps.gmu.edu/> using your Mason directory ID. Once inside, you will be able to access Mason Labs and have a virtual connection to a Mason lab computer with some specialized software. You can connect to the Microsoft One Drive cloud storage that each Mason student has or connect to local storage drives.

Software, hardware, and data: We will use Esri ArcGIS Pro for lab work this semester. You have access to download ArcGIS Pro with your Mason account. Details are provided on Blackboard. **This software is NOT compatible with the Macintosh operating system (Apple computers).** **You must have Microsoft Windows installed.** For Mac users, you can install Windows concurrently with your existing operating system. See here: <http://support.apple.com/kb/HT1461>.

You are encouraged to have viable storage for your data and projects. This may be your local machine hard drive, a USB flash drive/portable hard drive, or cloud storage (like Microsoft One Drive). GIS data files are often large, so you will need multiple gigabytes of storage space for this course. Think about backing up data periodically through the semester!

It is recommended that students have the technological bandwidth to stream data; students should have regular, reliable access to a computer with an updated operating system and a stable broadband Internet connection (consistent 1.5 Mbps or higher download and upload speed; you can use <https://www.speedtest.net/> to check the speed of your connection).

Online materials and email: This course will make extensive use of Blackboard at Mason. Course materials such as assignments will be available only in electronic version on Blackboard. Students are expected to submit assignments online through Blackboard. **Only Word document (.docx or .doc) or Adobe PDF (.pdf) file formats will be accepted**, with some exceptions. Grades will be posted on Blackboard as well. Make sure you are familiar and comfortable with the Blackboard interface.

Students are required to have a MasonLive/Email account, which will allow you access to Blackboard and lab computers. Please use this university email account when contacting the professor regarding this class; your professor will not respond to messages sent from a non-Mason email address. Students may also contact the professor through Microsoft Teams, although students should not expect instant responses from these direct chats; in other words, Teams is not a 24/7 direct support line for the class.

Grading

Lab assignments (30%): Most weeks will have a lab assignment, generally connected to chapters in the Gorr and Kurland lab manual. Students are expected to complete exercises in the Gorr and Kurland text, but (generally) will not turn those results in. Rather, an assignment building upon the skills shown in the lab manual will be posted to Blackboard and completed for assessment.

Assignments will be due Sundays at 11:59 PM. Please view the calendar at the end of the syllabus to see the schedule of assignments. There will be nine (9) lab assignments overall.

Midterm exam (10%): There will be one midterm exam for this course. The midterm will (most probably) be a mix of multiple choice, fill-in-the-blank, calculations/operations, and short answer questions covering topics from lecture and readings. You will be given 60 minutes to complete the midterm exam.

Final exam (20%): The final will be roughly the same format as the midterms but with the addition of longer essay questions. The final is cumulative, though the last topics of the course, not covered on the prior midterm, will have priority.

Term project (30%): Each student is expected to complete a research project using GIS methods learned and practiced in the course. Students will choose a topic of interest and will develop a research question that will utilize GIS methods to answer. Students will submit a written report, containing the research question, literature review, methodology, discussion of results, and visual outputs such as a map. More details will be discussed during the semester.

Discussions (10%): There will be group discussions most weeks in this course. While some discussions will occur among the entire class, others will be in smaller, randomly sorted groups. Most discussions will require two parts: posting and commenting. Topics will be provided for each discussion. Topics will generally revolve around finding/using online resources.

Grading scale:

<i>Grade</i>	<i>Percent Required</i>			<i>Assignment</i>	<i>Percentage of Total Grade</i>
A+	96 to 100	B	83 to 85.9	Assignments (9)	30%
A	93 to 95.9	B-	80 to 82.9	Midterm exam	10%
A-	90 to 92.9	C	70 to 79.9	Final exam	20%
B+	86 to 89.9	F	<70	Term Project	30%
				Discussions	10%

Make-up and late assignment policies: Due dates are explicitly stated. All assessed/graded items in this course (listed above) will be accepted past the ascribed due date until **Tuesday, May 9th**. Late penalties are assigned in a two-tiered system. Items turned in **within seven (7) days will result in a 10% deduction** for the item. Items **later than seven (7) days will result in a 30% deduction** for the item. This penalty begins 1 minute after the due date. Technical excuses ("computer system error", "didn't submit correctly on Blackboard", etc.) will not be accepted as reasons for late work. You are expected to start the work early. **Never underestimate the time you will spend on the assignments.** If you cannot complete the assignment on time, it may be better to turn in partially completed work than nothing at all.

If you are ill or physically indisposed and cannot submit work on time, you must notify the instructor beforehand for you to have a chance to make up the work without late penalty. **Special dispensation is available for students with difficulties due to COVID-19 illness or quarantine**; please contact the instructor to make any special accommodations in this regard.

This policy may seem strict, but it is in your best interest to turn in everything on time to avoid falling irrecoverably behind. Please contact the instructor if you are struggling and you will receive aid as best as the instructor can provide.

Incomplete policy: Students may request an incomplete for this course if they (a) currently have a passing grade based on submitted coursework; (b) have completed at least 50% of coursework materials; (c) cannot complete scheduled coursework for a cause beyond reasonable control; and (d) submit an Incomplete Grade Contract with the professor. In general, students have until the 9th week of the following full semester to complete their work (unless it is the student's final semester). Keep in mind that if the incomplete grade is not updated by the deadline, it defaults to a grade of F.

Administrative

Academic integrity: *The following statement is adapted from the Stearns Center for Teaching and Learning.* No grade is important enough to justify academic misconduct. The integrity of the University community is affected by the individual choices made by each of us. Mason has an Honor Code, which you can read fully at the Office for Academic Integrity (<https://oai.gmu.edu/mason-honor-code/>). The Honor Code Pledge reads as follows:

To promote a stronger sense of mutual responsibility, respect, trust, and fairness among all members of the George Mason University Community and with the desire for greater academic and personal achievement, we, the student members of the university community, have set for this Honor Code: Student Members of the George Mason University community pledge not to cheat, plagiarize, steal, or lie in matters related to academic work.

The Mason Honor Code defines cheating, plagiarism, stealing, and lying. It is expected that you understand these definitions. If you have any doubts about what constitutes cheating, plagiarism, stealing, or lying in the academic context, please see your professor. **Acts of academic dishonesty in this course may be penalized with failure of either the work in question or the entire course.**

While collaboration and group learning is encouraged in this course, each student **absolutely must** turn in their own work, from their own computer, and any discussion must be theirs alone, and not attributable to another person or group, *except where noted* (for example, quoting authors as a small portion of your scholarly work). This also applies to online sources; you cannot copy the words of anyone else for any graded part of this course. It is not enough to exchange a few synonyms within a sentence! You must write, summarize, and analyze with your own words and ideas.

Course materials and student privacy: All course materials posted to Blackboard or other course sites are private; by federal law, any materials that identify specific students (via their name, voice, or image) **must not be shared** with anyone not enrolled in this class. Video recordings of class

meetings that include audio or visual information from other students are private and must not be shared. Live video conference meetings (e.g. Collaborate or Zoom) that include audio or visual information from other students must be viewed privately and not shared with others in your household. Recordings will be stored on Blackboard and will only be accessible to students taking this course during this semester. **Sharing of instructor-created materials** (lectures, notes, videos, assignments, exams, etc.) to others not currently enrolled in this specific section of this class, **including to public or private online “study” sites, is considered a violation of Mason’s Honor Code.**

Disability statement: This course complies with Mason policies for students with disabilities. Students with disabilities are encouraged to register with Disability Services (DS). DS can be contacted by phone at (703) 993-2474, or in person at SUB I Suite 2500, or online by the link at the end of this section. Students who suspect that they have a disability, temporary or permanent, but do not have documentation are encouraged to contact DS for advice on how to obtain appropriate evaluation. A memo from DS authorizing your accommodation is needed before any accommodation can be made. The memo should be furnished to the professor preferably within the first two weeks of class or as soon as an accommodation is made. Please visit <https://ds.gmu.edu/> for more information.

Diversity, non-discrimination, and anti-racism: Mason President Gregory Washington has created the President’s Task Force on Anti-Racism and Inclusive Excellence. Through a broad focus, the task force will help Mason become “a local, regional, and national beacon for the advancement of anti-racism, reconciliation, and healing.” For President Washington’s full statement, visit <https://www2.gmu.edu/news/587381>. Members of this classroom community must uphold Mason’s core values of diversity and inclusion, and help maintain a learning environment of respect across identity, status, origin, and ability. Being inclusive and anti-racist is an active, conscious practice involving self-reflection.

Mason’s non-discrimination policy can be read at <https://universitypolicy.gmu.edu/policies/non-discrimination-policy/>. Please utilize the office of Compliance, Diversity, and Ethics (<https://diversity.gmu.edu/>) for training, resources, and to submit grievances. The following is a short portion of the Mason Diversity Statement; visit <https://stearnscenter.gmu.edu/knowledge-center/general-teaching-resources/mason-diversity-statement/> to read the full statement:

George Mason University promotes a living and learning environment for outstanding growth and productivity among its students, faculty and staff. Through its curriculum, programs, policies, procedures, services and resources, Mason strives to maintain a quality environment for work, study and personal growth.

An emphasis upon diversity and inclusion throughout the campus community is essential to achieve these goals. Diversity is broadly defined to include such characteristics as, but not limited to, race, ethnicity, gender, religion, age, disability, and sexual orientation. Diversity also entails different viewpoints, philosophies, and perspectives. Attention to these aspects of diversity will help promote a culture of inclusion and belonging, and an environment where diverse opinions, backgrounds and practices have the opportunity to be voiced, heard and respected.

Gender identity, pronoun use, and proper address: Students are welcome to share their chosen name and gender pronouns with the instructor and discuss how the instructor can best address you in class and via email. As well, students should be aware that they can use Mason-provided tools to

update their chosen name and pronouns; these changes will appear in Blackboard class sites among other places. See <https://registrar.gmu.edu/updating-chosen-name-pronouns/> for more information. Your instructor uses *he/him/his* pronouns. When addressing your instructor in writing or verbally, please use “Dr. Burtch” or “Prof. Burtch.” The surname ‘Burtch’ is pronounced the same as ‘birch.’

Instructor availability: Please do not hesitate to contact your instructor if you have questions about course topics or assignments. Your instructor will do his best to answer all weekday emails within 24 hours, and weekend emails within 48 hours. Should you not receive a response within that time frame, you may send a gentle reminder via email. Do try to avoid last-minute emails, as your instructor may not have email accessible immediately before deadlines. It is generally a good practice to avoid sending an email at the first sign of trouble with an assignment; often you will find the proper solution by giving yourself an hour or two to problem solve! Please make use of the office hours listed at the top of this document. Generally, issues can be clarified quickly in person or in a live online chat.

Safe return to campus: The COVID-19 pandemic has disrupted our lives. Administration at Mason has developed protocols outlined in the university Safe Return to Campus website (<https://www2.gmu.edu/safe-return-campus>). Please familiarize yourself with Safe Return to Campus protocols. This course will follow official Mason administration guidance on public health as those policies shift.

Sexual harassment, sexual misconduct, and interpersonal violence: *The following statement is adapted from the Stearns Center for Teaching and Learning.* As a faculty member and designated “Responsible Employee,” I am required to report all disclosures of sexual assault, interpersonal violence, stalking, sexual exploitation, and retaliation to Mason’s Title IX Coordinator per [university policy 1412](#). If you wish to speak with someone confidentially, please contact one of Mason’s confidential resources, such as the [Student Support and Advocacy Center](#) at 703-380-1434, [Counseling and Psychological Services](#) at 703-993-2380, [Student Health Services](#), or [Mason’s Title IX Coordinator](#) at 703-993-8730 or via email at titleix@gmu.edu).

University-wide closures and class cancellations/delays: There may be times during the semester in which George Mason University announces university-wide closures or delays. As an asynchronous online course, in general these cancellations should not delay our course. However, there may be times in which university-wide closures or delays will affect Blackboard availability or the ability to submit coursework. In these situations, your professor will make an announcement via Blackboard and/or email. Check the Mason website and our own Blackboard site for updates. Other cancellations or delays to class will be announced via Blackboard by your professor. In the event that this course is in some way interrupted, the course schedule, assignment deadlines, and other course alterations will be decided upon and announced via Blackboard and email by the professor. You are expected to stay abreast of any changes.

GGG 553 Course Schedule

Under readings, BM is for the Bolstad & Manson text and GK for Gorr and Kurland. The number(s) refer to the assigned chapter. In some cases, only specific pages of a chapter are noted in parentheses.

Week	Lecture/Lab Topic	Coursework Due
Unit 1: Spatial data, maps, and location		
Week 1 Jan 23 – Jan 29	Course overview, GIS history, ArcGIS, and file types	Read BM 1
Week 2 Jan 30 – Feb 5	Spatial data representation Lab 1: Exploring spatial data	Read BM 2 (39-73); GK 1 Lab 1
Week 3 Feb 6 – Feb 12	Mapping and cartography Lab 2: Cartographic principles	Read BM 4 (147-153, 168-175); GK 2 Lab 2
Week 4 Feb 13 – Feb 19	Geodesy, datums, and projections Lab 3: Projections	Read BM 2 (25-38) & 3; GK 3 & 5 Lab 3
Unit 2: Tables and data creation		
Week 5 Feb 20 – Feb 26	Digital data and tables Lab 4: Joining tables	Read BM 7 & 8; GK 4 Lab 4
Week 6 Feb 27 – Mar 5	Digitizing and coordinate transformation Lab 5: Digitizing and editing data	Read BM 4 (154-167, 176-183); GK 7 Lab 5
Week 7 Mar 6 – Mar 12	GPS and remote sensing Midterm Exam	Read BM 5 & 6 Project proposal
Mar 13 – Mar 19	<i>Spring Recess – No class</i>	
Unit 3: Spatial data analysis		
Week 8 Mar 20 – Mar 26	Vector spatial analysis Lab 6: Geoprocessing	Read BM 9 (363-409); GK 6 Lab 6
Week 9 Mar 27 – Apr 2	Networks and geocoding Lab 7: Geocoding	Read BM 9 (410-418); GK 8 & 9 Lab 7
Week 10 Apr 3 – Apr 9	Raster spatial analysis Lab 8: Analyzing rasters	Read BM 10 & 13; GK 10 Lab 8
Week 11 Apr 10 – Apr 16	Spatial estimation and terrain analysis Lab 9: Spatial estimation and terrain	Read BM 11 & 12; GK 11 Lab 9
Unit 4: Data standards and final project		
Week 12 Apr 17 – Apr 23	Data standards and data quality Working on term project	Read BM 14
Week 13 Apr 24 – Apr 30	New developments in GIS Working on term project	Read BM 15 Project check in meeting
Week 14 May 1 – May 7	Final Exam Working on term project	
Finals Week	Course presentations	Project presentation Project report

Note: The GGS 553 course schedule is tentative and is subject to revision by the instructor.