

## GG5 563: Advanced Geographic Information Systems (3 credits)

\*\*Syllabus is subject to change

Spring 2023

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Course type: Hybrid (synchronous + asynchronous)

Synchronous meeting hours: Thursdays 4:30-5:45pm (EXPL 2310)

Office hours: Thursdays 1-2pm (Blackboard Collaborate Ultra)

Course website: Blackboard

**Safe Return to Campus Notice:** All students taking courses with a face-to-face component are required to take Safe Return to Campus Training prior to visiting campus. The Safe Return to Campus Training is currently available in Blackboard. More instructions can be found [here](#). Students are required to follow the university's public health and safety precautions and procedures outlined on the university Safe Return to Campus [webpage](#). Similarly, all students in face to face and hybrid courses must also complete the Mason COVID Health Check daily, seven days a week. The COVID Health Check system uses a color code system and students will receive either a Green, Yellow, or Red email response. Only students who receive a "green" notification are permitted to attend courses with a face-to-face component. If you suspect that you are sick or have been directed to self-isolate, please quarantine or get testing. Faculty are allowed to ask you to show them that you have received a Green email and are thereby permitted to be in class.

### Course Description

Big spatial data is used to describe large (petabytes or exabytes) georeferenced datasets that exceed the capabilities of even the most state-of-the-art data management technologies. Examples include GPS technologies carried by individuals (citizens as sensors), vehicles, and embedded in infrastructure as well as smart card public transportation ticketing, volunteer geographic information (VGI), remote sensors carried by airborne and satellite platforms, radiofrequency identification (RFID) tags attached to objects, and georeferenced social media data. As the volume, velocity, variety and veracity of spatial data increases, GIScientists are prompted to explore new means for data storage, processing, analysis, and visualization in order to transform data into useful information. Therefore, the objective of this course is to enable students in developing a well-rounded theoretical understanding of the modern spatial data and database landscape as well as provide the opportunity for practical hands-on experience with a variety

of cutting-edge spatial database management systems (SDBMS) that have emerged from the big data paradigm. Specifically, this course offers a conceptual and practical dive into advanced relational SDBMS including PostgreSQL and PostGIS and NoSQL databases like MongoDB and Neo4J. Students will work with a range of traditional and non-conventional data including crowdsourced and user contributed data, network, and social media generated data.

### **Blackboard Login Instructions**

Access to [MyMason](#) and GMU email are required to participate successfully in this course. Please make sure to update your computer and prepare yourself to begin using the online format BEFORE the first day of class. Check [the IT Support Center](#) website. Navigate to [the Student Support page](#) for help and information about Blackboard. In the menu bar to the left you will find all the tools you need to become familiar with for this course. Take time to learn each. Make sure you run a system check a few days before class. Become familiar with the attributes of Blackboard and online learning.

### **Textbooks**

The following texts are RECCOMENDED:

1. **Barlow, Max, Tietze, Wolf, Claval, Paul, Gradus, Yehuda, Park, Sam Ock, Wusten, Herman van Der, . . . Hall, G. Brent. (2007). Spatial Database Systems: Design, Implementation and Project Management (Volume 87). The GeoJournal Library. Dordrecht: Springer Netherlands.**  
The above text is available online through the Mason Libraries with a valid Mason Net ID. Please use the following link for more information: <https://library.gmu.edu/catalogs>
2. **Perkins, L., Redmond, E., & Wilson, J. (2018). Seven databases in seven weeks: a guide to modern databases and the NoSQL movement (Second Edition). Pragmatic Bookshelf.**  
The above text (first edition) is available online through the George Mason University Libraries with a valid Mason Net ID. Please use the following link for more information: <https://library.gmu.edu/catalogs>  
The above text (second edition) is available online and can be purchased for \$25.95 from the Pragmatic Bookshelf. Please use the following link for more information: <https://pragprog.com/book/pwrdata/seven-databases-in-seven-weeks-second-edition>

### **Course Learning Outcomes**

Upon completion of this course, students will be able to:

1. Identify the role and challenges faced by spatial database management technologies in the era of big data
2. Explain the fundamental concepts for relational databases and NoSQL databases
3. Build experience working with query languages including SQL, JSON/Javascript, and Cypher
4. Demonstrate practical experience with a variety of novel spatial data structures and spatial database management systems for spatial data storage, processing, and analysis

## Technology Requirements

**Hardware:** You will need access to a Windows or Macintosh computer with at least 2 GB of RAM and access to a fast and reliable broadband internet connection (e.g., cable, DSL). A larger screen is recommended for better visibility of course material. You will need speakers or headphones to hear recorded content and a headset with a microphone is recommended for the best experience. For the amount of Hard Disk Space required taking a distance education course, consider and allow for:

1. the storage amount needed to install any additional software and
2. space to store work that you will do for the course.

If you consider the purchase of a new computer, please go to [Patriot Tech](#) to see recommendations.

**Software:** Many courses use Blackboard as the learning management system. You will need a browser and operating system that are listed compatible or certified with the Blackboard version available on the [myMason Portal](#). See [supported browsers and operating systems](#). Log in to [myMason](#) to access your registered courses. Some courses may use other learning management systems. Check the syllabus or contact the instructor for details. Online courses typically use [Acrobat Reader](#), [Flash](#), [Java](#), and [Windows Media Player](#), [QuickTime](#) and/or [Real Media Player](#). Your computer should be capable of running current versions of those applications. Also, make sure your computer is protected from viruses by downloading the latest version of Symantec Endpoint Protection/Anti-Virus software for free [here](#).

Students owning Macs or Linux should be aware that some courses may use software that only runs on Windows. You can set up a Mac computer with Boot Camp or virtualization software so Windows will also run on it. Watch [this video](#) about using Windows on a Mac. Computers running Linux can also be configured with virtualization software or configured to dual boot with Windows.

Note: If you are using an employer-provided computer or corporate office for class attendance, please verify with your systems administrators that you will be able to install the necessary applications and that system or corporate firewalls do not block access to any sites or media types.

**Course-specific Hardware/Software:** This course uses a range of open source software including QGIS, PostgreSQL, PostGIS, pgAdmin, and MongoDB. This course also uses a browser-based sandbox to work with Neo4J. **We do not use ArcGIS in this course.**

**Course Schedule** \*\*Full details can be found on Blackboard and is subject to change

WEEK	MEETING (THURSDAYS @4:30)	TOPICS	ASSIGNMENTS (DUE SUNDAYS @11:59pm)
<b>Section 1: Introduction to Spatial Databases</b>			
1	Jan 23-29	Jan 26	Database Fundamentals
2	Jan 30-Feb 5	Feb 2	Relational Databases
3	Feb 6-12	Feb 9	Working with GIS Databases
			<b>ASSIGNMENT 1 DUE</b>
<b>Section 2: Working with Relational Databases</b>			
4	Feb 13-19	Feb 16	PostgreSQL
5	Feb 20-26	Feb 23	PostgreSQL
6	Feb 27-Mar 5	Mar 2	PostGIS
			<b>ASSIGNMENT 2 DUE</b>
<b>Section 3: Working with Document Databases</b>			
7	Mar 7-13	Mar 9	NoSQL and MongoDB
	Mar 13-19	March Break	
8	Mar 20-26	Mar 23	MongoDB
9	Mar 27-Apr 2	Mar 30	MongoDB Spatial
			<b>ASSIGNMENT 3 DUE</b>
<b>Section 4: Working with Network Databases</b>			
10	Apr 3-9	Apr 6	Network Databases and Neo4J
11	Apr 10-16	Apr 13	Neo4J
12	Apr 17-23	Apr 20	Neo4J Spatial
			<b>ASSIGNMENT 4 DUE</b>
<b>Section 5: Database Modeling</b>			
13	Apr 24-30	Apr 28	Future Trends and Review
14	May 1-May 7	May 5	Mini-Project Work
			<b>MINI-PROJECT DUE</b>

### Assignments Description

DELIVERABLE	% OF FINAL GRADE
Assignments	60
Participation	15
Mini Project	25

## Exercises

Throughout the course of the semester, you will be required to independently complete 4 assignments (each worth 15% of your final grade). It should be noted that each assignment takes a **significant** amount of time to complete and should be worked on gradually throughout each module. Take care in giving yourself enough time to complete them. Answers for each assignment are to be submitted to Blackboard on the last Sunday of each module at 11:59pm. They must be neatly organized and professional.

## Participation

Each week, you will have an opportunity to engage in active learning activities **(ALA) in the synchronous meetings.**

## Mini Project

You will model and implement a spatial database of your choosing. You will draw on the knowledge you have built over the term.

## Course Policies

### Late Assignments:

One Extension Policy: Any student may propose a reasonable deadline extension for any course deliverable, subject to my approval, once during the semester. Students must justify in writing why they need this extension and provide a plan for how they will complete the work.

One Revision Policy: Any student may revise and resubmit one major project deliverable within two weeks, after it is graded, either for a new grade or for up to a 15% increase on their prior grade provided the revisions are significant (not just error corrections).

Late Assignment Deduction Policy: Any late deliverable will earn a flat 10% grade deduction as long as the deliverable is completed within 7 days of the deadline.

**Instructor-Student Communication:** I will respond to your emails within 48 hours. If I will be away from email for more than one day, I will post an announcement in the Blackboard course folder. Before sending an email, please check the following (available on your Blackboard course menu) unless the email is of a personal nature:

1. Syllabus
2. Ask the Instructor Blackboard Discussion
3. On-demand Blackboard videos on how to use Blackboard features, and Technical Requirements.

Feel free to respond to other students in the Ask Professor forum if you know the answer.

**Campus Closure:** If the campus closes or class is canceled due to weather or other concern, students should check Blackboard for announcements.

### Grading Scale

GRADE	PERCENTAGE
A+	> 99
A	93 – 98.9
A-	90 – 92.9
B+	87 – 89.9
B	83 – 86.9
B-	76 – 82.9
C	70 – 75.9
D	60 – 69.9
F	0 – 59.9

### University Policies and Resources

- a. Academic Honesty: You are expected to be familiar with and abide by the University’s Honor Code. The Code can be found [here](#). It is your responsibility to see me if you have questions about these policies. George Mason University has an honor code that states the following:  
*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 forth this:*
- b. Course materials and student privacy: All course materials posted to Blackboard or other course site 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. Videorecordings 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. Some/All of our synchronous meetings in this class will be recorded to provide necessary information for students in this class. Recordings will be stored on Blackboard [or other secure site] and will only be accessible to students taking this course during this semester.

- c. Students must follow the university policy for [Responsible Use of Computing](#)
- d. Student services: The University provides range of services to help you succeed academically and you should make use of these if you think they could benefit you. I also invite you to speak to me (the earlier the better).
- e. Students are responsible for the content of university communications sent to their George Mason University email account and are required to activate their account and check it regularly. All communication from the university, college, school, and program will be sent to students solely through their Mason email account.
- f. [The George Mason University Counseling and Psychological Services \(CAPS\)](#) staff consists of professional counseling and clinical psychologists, social workers, and counselors who offer a wide range of services (e.g., individual and group counseling, workshops and outreach programs) to enhance students' personal experience and academic performance. Counseling Center: Student Union I, Room 364, 703-993-2380.
- g. Students with disabilities who seek accommodations in a course must be registered with the [George Mason University Office of Disability Services \(ODS\)](#) and inform their instructor, in writing, at the beginning of the semester. All academic accommodations must be arranged through that office. Please note that accommodations MUST BE MADE BEFORE assignments or exams are due. I cannot adjust your grade after the fact.
- h. Students must follow the university policy stating that all sound emitting devices shall be turned off during class unless otherwise authorized by the instructor.
- i. [The George Mason University Writing Center](#) staff provides a variety of resources and services (e.g., tutoring, workshops, writing guides, handbooks) intended to support students as they work to construct and share knowledge through writing. University Writing Center: Robinson Hall Room A114, 703-993-1200. The writing center includes assistance for students for whom English is a second language.
- j. Diversity: 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.