# GGS 664 Spatial Data Structure – Spring 2025 (3 credits)

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| Instructor | Dr. Chaowei Yang (Phil) | Classroom | Distance Hybrid Learning |
| Office | Zoom for Q&A (Expl.2211) | Class time | Mondays: 5.66 pm – 7.10pm |
| Office Hours | TBD | E-mail | cyang3@gmu.edu |

### Course Description:

This course explores spatial/spatiotemporal data models and structures used to effectively represent, store and index geospatial data. Emphasis is on core data models, structures and tools. Specific topics include database theory, spatial indexing, and geospatial data examples including shapefiles, social media, earth observation, climate, land use, and big data. The class will be project/practice-centered and will involve significant programming effort to complete the course project.

### Prerequisite:

GGS 650 or a working knowledge of any programming language. This is a high-level graduate course introducing research examples; therefore, first-year graduate students are not encouraged to take this course.

### References:

There is no required text for this course. At least ***one external source*** (e.g. journal articles, news articles, blogs, etc.) will be given to enhance the understanding of each course module.

### Grading:

The components of the final grade are as follows:1

Class Participation: 10%

4 Homework: 60% (15% each)

Individual Project: 30%

Class Participation

All students are expected to keep up with assigned readings, complete exercises and participate in class forum discussion. You may be asked to demonstrate data models, structures and algorithms during class.

Homework Assignments

Four homework assignments will entail creation or handling of specific spatial/spatiotemporal data models, structures or related algorithms. Pseudocode may be used for the assignments. All assignments should be submitted before class on the due date, and each one is due two weeks after assignment.

Late assignment credit will be reduced on a basis of 10% (3 day), 30% (1 week).

You are encouraged to discuss assignments with other students, but all work must be your own. Violation of this rule will result in both students receiving zero credit.

You may use any programming language for your assignment and final project. No programming assistance will be given.

Project

Each student must complete an original research project that involves a spatial or spatiotemporal data structure or modeling technique. Past projects have addressed issues such as climate, spatial indexing and spatial search, social media, uncertainty and interoperability. You are encouraged to explore existing software libraries and their component object models for your final project. All use of such libraries must be properly documented.

Two types of projects are acceptable:

1. Research oriented: Ph.D. students are encouraged to propose a research project and document the project results in the format of a research article. The objective is to publish the article (either in conference proceedings or peer-reviewed articles) with the help of the instructor.
2. Technique oriented: M.S. students are encouraged to propose a technique-based project and document the manipulation of data structure, analysis, and visualization in the format of a project report. The objective is to utilize the understanding and exploration of spatial/spatiotemporal data structure, model, and algorithms to assist your work or thesis.

### Computer Software:

There is no special licensed software recommended; we will introduce many open-source packages for handling spatiotemporal data. Please make sure you have access to a Windows machine and can install software as detailed later in this document.

### Course Schedule:

| Weeks/Modules (Monday-Sunday) | Materials | ASSIGNMENTS | Due Dates |
| --- | --- | --- | --- |
| Module 1  01/27-02/2 | Course introduction  Spatial data structures: aspatial, raster, vector, graph | Module 1 Forum Discussion (1+by yourself and responding to 1+, or responding to 3+, applies to all forum assignments) | Due by Sunday 11:59PM |
| Module 2  02/3-02/9 | Database with Postgres/PostGIS I | Module 2 Forum Discussion  Homework 1 | Due by Sunday 11:59PM  Given |
| Module 3  02/10-02/16 | Vector data models and structures | Module 3 Forum Discussion  Homework 2 given, Homework 1 due | Due by Friday 11:59PM  Due by Sunday 11:59PM |
| Module 4  02/17-02/23 | Indexing structures and performance I | Module 4 Forum Discussion | Due by Sunday 11:59PM |
| Module 5  02/24-03/2 | Raster data models and structures | Module 5 Forum Discussion  Homework 2 due, Homework 3 given | Due by Friday 11:59PM  Due by Sunday 11:59PM |
| Module 6  03/3-03/09 | Social Media analytics | Module 6 Forum Discussion | Due by Sunday 11:59PM |
| 03/10-03/16 | **Spring Break** | | |
| Module 7  03/17-03/23 | Social Media and spatiotemporal DB | Module 7 Forum Discussion  Homework 3 due | Due by Friday 11:59PM  Due by Sudnay 11:59PM |
| Module 8  03/24-03/30 | Numerical Modeling and Dust Storm | Module 8 Forum Discussion  Homework 4 given | Due by Sunday 11:59PM |
| Module 9  03/31-04/6 | Spatiotemporal Data Analytics | Module 9 Forum Discussion | Due by Sunday 11:59PM |
| Module 10  04/07-04/13 | Research example I: COVID-19 & its impact | Module 10 Forum Discussion  Homework 4 due | Due by Friday 11:59PM  Due by Sunday 11:59PM |
| Module 11  04/14-04/20 | Research example II: COVID-19 data collection, process, and analytics | Module 11 Forum Discussion  Project proposal due (online in project module) | Due by Sunday 11:59PM  Due by Sunday 11:59Pm |
| Module 12  04/21-04/27 | Research example III: COVID-19 environmental impact analyses | Module 12 Forum Discussion | Due by Sunday 11:59PM |
| Module 13  04/28-05/4 | Research example IV: COVID-19 policy analyses | Module 13 Forum Discussion | Due by Sunday 11:59PM |
| Module 14  05/05 | Project presentation I | Project Module Forum Discussion  Project report due | Both due by 11:59pm |

Instructor-Student Communication: I will respond to your emails within 24 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:

* Syllabus
* Contact your instructor
* On-demand Blackboard videos on how to use Blackboard features, and Technical Requirements.

Feel free to respond to other students in the forums if you know the answer.

Feedback: Throughout the semester you will have plenty of opportunities to give feedback on the topics covered in the class and what you would like covered/changed through the class blackboard forum and email me.

# Blackboard Login Instructions

Access to [MyMason](http://mymason.gmu.edu) 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](http://itservices.gmu.edu/) website. Navigate to [the Student Support page](https://coursessupport.gmu.edu/Students/) 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.

# University Policies and Resources

1. Academic Honesty: You are expected to be familiar with and abide by the University’s Honor Code. The Code can be found [here](https://oai.gmu.edu/mason-honor-code/). 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:*

1. Students must follow the university policy for [Responsible Use of Computing](http://universitypolicy.gmu.edu/policies/responsible-use-of-computing/)
2. 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).
3. 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.
4. Other [student rights and responsibilities](https://catalog.gmu.edu/policies/student-rights-responsibilities/) can be found online.
5. [The George Mason University Counseling and Psychological Services (CAPS)](http://caps.gmu.edu/) 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.
6. Students with disabilities who seek accommodations in a course must be registered with the [George Mason University Office of Disability Services (ODS)](http://ods.gmu.edu/) 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.
7. Students must follow the university policy stating that all sound emitting devices shall be turned off during class unless otherwise authorized by the instructor.
8. [The George Mason University Writing Center](http://writingcenter.gmu.edu/) 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.
9. [Diversity](http://ctfe.gmu.edu/professional-development/mason-diversity-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.
10. [Religious Holiday Calendar](https://ulife.gmu.edu/religious-holiday-calendar/): George Mason University recognizes major religious holidays that Mason students may recognize.

# Technology Requirements

**Technology**. You will need a reliable computer and internet access to view course materials in Blackboard. You will need to video record your two role-plays and you can do that with a smartphone or other video camera, such as Kaltura CaptureSpace in Blackboard.

**Hardware:** You will need access to a Windows computer with at least 16 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:

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

**Software:** You will need a browser and Windows that are listed compatible or certified with the Blackboard version available on the [myMason Portal](http://mymason.gmu.edu). See [supported browsers and operating systems](https://help.blackboard.com/en-us/Learn/9.1_SP_10_and_SP_11/Student/002_Browser_Support_SP_11). Log in to [myMason](http://mymasonportal.gmu.edu/) 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](http://get.adobe.com/reader/), [Flash](http://get.adobe.com/flashplayer/), [Java](http://www.java.com/en/download/), and [Windows Media Player](http://windows.microsoft.com/en-US/windows/products/windows-media-player), [QuickTime](http://support.apple.com/downloads/#quicktime) and/or [Real Media Player](http://www.real.com/realplayer/search). 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](http://antivirus.gmu.edu/).

We will use zoom for synchronous online instruction part. Please test your computer to make sure it supports Zoom.

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.