# GGS 664 Spatial Data Structure – Spring 2024

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| Instructor | Dr. Chaowei Yang (Phil) | Classroom | Distance Learning |
| Office | <https://gmu.zoom.us/j/95155436252?pwd=a0QwWkRuVUt3dHgvTUl0YUhXMVBnZz09> | Class time | Thursdays: 4.30 pm – 5.30pm |
| Office Hours | One and half hours according to class progress | 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 course contents.

### 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 Hardware and Software:

There is no special H/W or licensed software recommended, we will introduce many open-source packages for handling spatiotemporal data.

### Course Schedule:

| Weeks/Modules (Wednesday-Sunday) | Materials | ASSIGNMENTS | Due Dates |
| --- | --- | --- | --- |
| Module 1  01/18-01/24 | 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  01/25-01/31 | Database with Postgres/PostGIS I | Module 2 Forum Discussion  Homework 1 | Due by Sunday 11:59PM  Given |
| Module 3  02/01-02/7 | Vector data models and structures | Module 3 Forum Discussion  Homework 2 given, Homework 1 due | Due by Sunday 11:59PM  Due by Wednesday 11:59PM |
| Module 4  02/8-02/14 | Indexing structures and performance I | Module 4 Forum Discussion | Due by Sunday 11:59PM |
| Module 5  02/15-02/21 | Raster data models and structures | Module 5 Forum Discussion  Homework 2 due, Homework 3 given | Due by Sunday 11:59PM  Due by Wednesday 11:59PM |
| Module 6  02/22-02/28 | Indexing structures and performance II | Module 6 Forum Discussion | Due by Sunday 11:59PM |
| Module 7  02/29-03/6 | Spatial database with Postgres/PostGIS II  Project introduction: topic discussion | Module 7 Forum Discussion  Homework 3 due | Due by Sunday 11:59PM  Due by Wednesday 11:59PM |
| 03/7-03/13 | **Spring Break** | | |
| Module 8  03/14-03/20 | Graph data structure and analyses | Module 8 Forum Discussion  Homework 4 given | Due by Sunday 11:59PM |
| Module 9  03/21-03/27 | Spatiotemporal Data Analytics | Module 9 Forum Discussion | Due by Sunday 11:59PM |
| Module 10  03/28-04/03 | Research example I: COVID-19 & Social media | Module 10 Forum Discussion  Homework 4 due | Due by Sunday 11:59PM  Due by Wednesday 11:59PM |
| Module 11  04/04-04/10 | Research example II: COVID-19 & Environment | Module 11 Forum Discussion  Project proposal due (online in project module) | Due by Sunday 11:59PM  Due by Wednesday 11:59Pm |
| Module 12  04/11-04/17 | Research example III: COVID-19 & Policy | Module 12 Forum Discussion | Due by Sunday 11:59PM |
| Module 13  04/18-04/24 | Research example IV: COVID-19 Data & Analytics | Module 13 Forum Discussion | Due by Sunday 11:59PM |
| Module 14  05/02 | Project presentation I | Project Module Forum Discussion  Project report due | Both due by 11:59pm |

**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.