



Syllabus

GIST 5050: Basics of Spatial Data Science (3 Credits)

HyFlex In-person & Online Course

Fall 2024

August 26 - December 16 2024

Instructor contact information: [Dr. Shannon Albeke](https://uwyo.instructure.com/courses/594814/pages/about-shannon-albeke) (<https://uwyo.instructure.com/courses/594814/pages/about-shannon-albeke>), salbeke@uwyo.edu, (<mailto:salbeke@uwyo.edu>) Agriculture 323, back office

Permanent Course Zoom Link:

<https://uwyo.zoom.us/j/99242348697?pwd=SENaL0FFZmNVZXRpVjBmVXpaQ3FiZz09> 
<https://uwyo.zoom.us/j/99242348697?pwd=SENaL0FFZmNVZXRpVjBmVXpaQ3FiZz09>

Meeting ID: 992 4234 8697

Passcode: 752513

Office hours and/or open-door policy: Tuesdays 10-12 in AG 323.

Please email me directly or use Canvas Discussions to schedule a meeting with me if you are off campus or cannot meet during office hours....Actually, it is probably ideal to schedule a meeting no matter what. We can use Zoom or other video/screen sharing tools. I will try to be responsive to all requests, but understand that I will not be available 24/7, so you are more likely to get a quicker response during normal business hours (weekdays 8-5) than during other times of the day/week.

Course prerequisites, co-requisites, enrollment restrictions: No prerequisites

Course Description:

This course is using a HyFlex model where we will be recording face to face class-time and posting to the course website for remote students. Remote students are welcome to via the Zoom link listed above. If you are enrolled in Section 01, you are expected to attend class.

(Be AWARE that the first couple of weeks we have a lot of content to cover. This is to support other GIST courses that ask I provide some intro GIS concepts. Sorry for the fire-hose, but there really isn't any other alternative approach at this point in time).

The ability to make information technologies ‘work for you’ is an essential skill set for the 21st century environmental science researcher. This course is designed for new GIST graduate students and/or any graduate student who still uses many separate excel spreadsheets (or separate files) to organize their sample data. Having basic Spatial concepts coupled with good data management (creation of relational databases), attention to data types (text, integer, floating point, etc.) and recording of metadata (e.g. coordinate systems, column descriptions), coupled with the ability to efficiently integrate your data with spatial (ArcGIS; Program R, Python, MS SQL Server, Postgres/PGIS) and statistical (Program R, Python) software, can result in HUGE time savings when it comes to data analysis. Additionally, using a well-designed database to store your information can create a ‘data legacy’ from which others can build from.

I plan on taking you upon a journey through several types of software, beginning with a review of core GIS concepts, data models, coordinate reference systems, and an introduction to ArcPro and simple map-making. Next we move to MS Excel. We will review basic data types and learn some fun and useful functions within Excel so that we can massage data into a usable format. But, since Excel isn't an ideal software, we will jump into using Program R, Python, and code repositories for the remainder of the class. We will use SQLite Database (but will speak about more robust platforms such as MS SQL Server) and new methods such as Graph Databases. We will go over different strategies for storing data in a tabular format and learn what a relational database is and how to build one. From here we will learn how to quickly query and summarize your data using SQL scripting. In addition, having the ability to seamlessly pass data between your database and your statistical analysis software is essential to completing efficient and accurate research. Thus, using Program R (an open-source, command line statistical software package), we will perform several project-based examples for extracting data from a database, perform common statistical analyses, and seamlessly pass results back to commonly used software for easy visualization. Time permitting, we will also look at how to more fully integrate SQL Server with ArcGIS, as well as learn how to write simple scripts to manipulate/create data and program Data Entry Forms.

Related and Follow-up GIST Courses:

GIST 5200 — Geographic Visualization; GIST 5220 — Spatial Modeling and Data Analysis

GIST Program Learning Outcomes:

GIST courses address broad learning outcomes derived from the AAAS [Vision and Change Initiative](https://live-visionandchange.pantheonsite.io/about-vc-a-call-to-action-2011/)  (<https://live-visionandchange.pantheonsite.io/about-vc-a-call-to-action-2011/>) and more specific objectives outlined in the [UCGIS GIS&T Body of Knowledge](https://gistbok.ucgis.org/)  (<https://gistbok.ucgis.org/>). Achievement of these outcomes will prepare students to use scientific thinking and geospatial information science and technology across disciplines and in their careers. This course and other GIST courses address the following general goals: 1) applying the process of science, 2) using quantitative reasoning, 3) using modeling and simulation,

4) tapping into the interdisciplinary nature of science, 5) communicating and collaborating with other disciplines, and 6) understanding the relationships between science and society.

More specifically, experience shows that students trained in 1) positioning and data acquisition, 2) analysis and modeling, and 3) software and application development will be competitive nationally and internationally. Successful students learn to balance these objectives with knowledge of underlying theory and problem-solving capability in the context of specific disciplines.

Course Learning Outcomes:

The overall objective of the course is for you to gain an appreciation and knowledge of how to manage the spatial data you will collect throughout your graduate and professional careers. A set of applied tools and technology, experienced primarily through software interfaces, coupled with best management practices for organizing data, will be taught. Additionally, scripting languages and syntax will be used to perform complex tasks for creating and manipulating your data.

Once you have completed this course, you will have been introduced to a wide range of concepts and tools related to data storage, manipulation, analysis and visualization. These concepts and/or tools include:

- File types (*.txt, *.csv, *.dbf, *.xlsx, *.sqlite etc.)
- Data types (Text, Numeric, DateTime, etc.)
- MS Excel Functions (too many to list)
- Pivot Tables
- DB Browser for SQLite
 - Table creation/design
 - Query creation/design (using SQL syntax)
- Data Sharing (SQL Server, SQLite, XML, FTP, ODBC)
- Relational Database Design
 - Horizontal vs. Vertical table structure
 - Data Normalization
 - Primary vs. Child keys
- Data/Software Integration and Visualization
 - Excel
 - ArcGIS / ArcPro
 - Program R and R Studio
 - Python and Spyder
 - R Shiny Applications and Notebooks
- Code Repositories like GitLab or GitHub
- Metadata

Understanding these concepts and techniques, coupled with critical thinking and problem solving, should provide you with a solid background on how to apply technology and software to perform data related tasks in an efficient and effective manner throughout your professional career.

Required texts, readings, and special tools or materials:

- Access to **WyoCourses** Canvas course web site and UWYO's email. WyoCourses will be used to manage all aspects of the class, including quizzes, assignments and threaded discussions. For background information,

visit <http://www.uwyo.edu/wyocourses/>.

- Required readings will be provided as pdfs on WyoCourses or links to online resources.
- You do not need to have any of the software installed on your personal computer! We provide you with a Virtual Machine (VM) using the UWYO cloud-based remote system. **HOWEVER, I have found it to be more effective if you actually install the software on your machine so that you can have these tools readily available to you.** I will provide further instructions for installing said software on your own machine. If you choose to use UW Virtual Machines (not recommended):
 - You can access the system here: <https://vdesktop.uwyo.edu/>
 - Choose 'VMware Horizon HTML Access'
 - Login with your UWYO credentials
 - Choose the 'WyGISC' icon and you should then be 'sitting' at a Windows desktop with all of the software and storage space you need to complete this class.
- Be aware that the storage space is specific to this class. All class data will be wiped from the system after the course, so be sure to copy what you want after you complete the course...unless you are using your own machine.

General requirements and expectations for the course:

- Read all of the syllabus content prior to embarking on any course content!!
- Watch all the videos and take notes. Since there isn't a required textbook, the videos are the main source of content.
- Watch all the videos in the assignments and press the pause button a lot. These videos show you step by step how to use the software, so watch the first step, pause the video, then do the step yourself. If you hit the wrong button and get off track, go back a step or two.
- Don't wait to the last minute to do the assignments. If you get stuck and need help, I'm pretty quick at returning emails and aim to be responsive on the discussion board, and there's even a way we can share screens for trouble shooting, but none of this is much help to you if it's 11:30pm and the assignment is due at 11:59pm.
- Do the assignments, and redo parts of them if you didn't hit at least 80%. You don't have to redo the entire thing – just pick one part that you had difficulty with, read the feedback I gave you, make the necessary adjustments and resubmit (email them to me is probably best).
- Ask me questions. Post to the discussion board or email or visit my office if you're on campus (by appointment only). There is no such thing as a dumb question. Here's a good one: "Hey I don't understand what you mean or what you are looking for in this part of the assignment." I've been doing this stuff for more than 20 years, so it's hard for me to imagine what it's like to hear about it for the first time and how to explain it in the right wording or with the right examples. But I'm eager to work on getting your questions answered and concerns addressed.
- As with all software and scripting languages, you WILL MAKE MISTAKES!!! Do your best to not get discouraged. Data Science is a constant battle of trying to make things work. Things often don't work the first try, especially when you are just beginning. Each 'failure' is a lesson. Use that lesson to gain the experience needed to become an 'expert', or as I often say, "...become a Ninja or Jedi". Persistence is your best friend! Be persistent, if after 3-5 tries at solving the problem (opportunity?) and not succeeding, then ask for help from others. Learning to solve your own issues are hugely rewarding in the end, I promise!

Attendance policy

For this course, my approach is to have the information available for you to be self-paced, at least for the current assignment/topic period. Thus I will not be taking attendance nor expecting you to participate in required discussion

groups. However, I will expect students to use discussion boards for asking advice or clarification of a topic, and with that I would expect students to help other students solve a problem. Helping others helps you better understand a topic.

Late work policy

- **Late assignments:** To avoid a glut of assignments piling into my inbox at the end of the semester, I will have deadlines for assignments throughout the semester. I will deduct 5% off your total score for the assignment for each day it is late.
- **Incompletes:** Assigning a course grade of X (incomplete) will be considered only in extreme cases when conditions beyond the student's control require an extended period of absence.

Course Workload:

For this course I would anticipate approximately 4-6 hours per week needed to complete all of the course material and assignments. Some modules may take longer and require more effort, others will be short and relatively easy.

Required examinations, assignments, activities, and projects:

This is a three credit course, but given the technology and software, there will probably be a steeper learning curve, thus a higher course workload than a typical 3 credit course. But since this is a graduate level course, you all are aware that was a strong possibility. **Please do not hesitate to contact me** if you have concerns about any aspects of the course, including course requirements or your individual progress (email is the best way of reaching me).

The activities/assignments are described below:

- Each lecture will combine a prerecorded video lecture introducing a topic and coupled with integrated videos of using Program R, Python or other software to accomplish the analysis (students can directly follow along with the examples). A quiz/assignment will be provided on WyoCourses covering the topic. Some topics may also have required reading, but this will be minimal.
- This course is 'hands-on' and each student will gain the most knowledge by following along with the software demonstrations, then applying the new skill to their own data. Class participation and interaction is highly encouraged through the use of discussion boards.
- The quiz/assignment is due before you can move onto a different topic. This gives the instructor time to assess the results and responses and adjust the topics accordingly. Again, there will be deadlines for assignments, yet still be self-paced.
- [Data Management Assignments](#): There will be a total of at least five homework assignments, possibly more. Please refer to the [Syllabus](https://uwyo.instructure.com/courses/594814/assignments/syllabus) (<https://uwyo.instructure.com/courses/594814/assignments/syllabus>) for details on each assignment and the due dates. All assignments will consist of demonstrating your ability to write code to integrate data and software.
- [Class Participation](#): Class participation is important for you to be successful in this class. This means keeping up with assignments in a timely manner and helping your fellow student colleagues via the [Discussion Topics](https://uwyo.instructure.com/courses/594814/discussion_topics) (https://uwyo.instructure.com/courses/594814/discussion_topics).
- [Final Project](#): The final project is meant to assess if you have obtained the skills to apply the ideas and concepts to create a workable/usable data workflow/pipeline and associated data management skills. If you have your own data, great, otherwise I will provide you with a sample dataset. Your responsibility will be to solve a data problem. This can be pretty broadly defined. My main goal is to have you use class time to make progress on your thesis by using either databases, creating workflows to automate, or using web APIs to grab

information from the web to help solve a problem. So you get it, very broad, but the expectations will be somewhat high :-) But since everyone's projects are unique, the types of work and expectations will vary by individual student.

The Final Project will be comprised of four separate components:

1. *Final Project Proposal (15% of the final project grade)*- I need to vet your idea and provide feedback to set expectations of what I think you can/should accomplish. The proposal will be the beginning of 'negotiations' between the instructor and student.
2. *Final Project Abstract (20% of the final project grade)* - I would like a 250 word Abstract describing your final project. I anticipate that this abstract will follow common peer-reviewed format with some background, methods, results and discussion.
3. *Final Project Presentation (50% of the final project grade)* - A recorded PowerPoint presentation of the research to the class covering the objectives, methods/analysis, results, and significance of the project (15 minute limit please). Since this is a graduate level course, it is important to be able to communicate science, thus the presentations will be posted as a video for the class to see.
4. *Review and Discuss Other Presentations (15% of the final project grade)* - As an additional assignment, students must watch a minimum of 5 other presentations and provide submitted feedback to demonstrate viewing and understanding of the research.

Final Examination or Final Project Date:

The final project due date is subject to change, but for the time being let's aim for **December 11, 2024**

Required Participation Outside of Class Meetings:

There will be no required meetings outside of class. However, participation in Discussion boards is highly encouraged. You will also be required to view 5 other Final Presentations beyond your own and make comments or ask questions of the presenter in the discussion board.

Assessment Standards and Expectations:

Data Management Assignments: 45%

Class Participation: 10%

Final Project: 45%

Grading Scale and Grading Policies:

The final course grade will be a weighted average of the final project, assignments, and participation grades using the percentages above. Grades will be assigned as follows: 90-100 = A, 80-89 = B, 70-79 = C, 60-69 = D, < 60 = F. Grades are rounded to the nearest whole number (89.5 rounds up to 90 for an A, 89.4 rounds down to 89 for a B).

Attendance and Absence policies.

For this course, my approach is to have the information available for you to be self-paced, at least for the current assignment/topic period. Thus I will not be taking attendance nor expecting you to participate in required discussion

groups. However, I will expect students to use discussion boards for asking advice or clarification of a topic, and with that I would expect students to help other students solve a problem. Helping others helps you better understand a topic.

AI Technology:

Students are permitted to use advanced automated artificial intelligence or machine learning tools on assignments in this course; no special documentation or citation is required. However, I encourage you to avoid doing so as becoming overly reliant on AI to think for you as you write code is actually a hindrance to you becoming proficient in coding...oftentimes one can spot AI code as the logic isn't actually correct or functional or feels obviously out of place.

Classroom Behavior Policy:

At all times, treat your presence in the web conferences and your enrollment in this course as you would a job. Act professionally, arrive on time, pay attention, complete your work in a timely and professional manner, and treat all deadlines seriously. Spirited debate and disagreement are to be expected in any classroom and all views will be heard fully, but at all times we will behave civilly and with respect towards one another. As the instructor, I have the right to dismiss you from the discussion groups and other areas where disruptive behavior occurs. **The following behaviors are disruptive to the learning environment and will not be tolerated.**

- **Flaming:** Flaming is the term used for behaving disrespectfully toward others. This behavior includes, but is not limited to, mocking, shouting, cursing, humiliating, and discriminating against someone.
- **Disrespect:** Impolite and impertinent behavior, such as putting down or cursing your instructor or any student. Tone and presentation of your thoughts are very important. If you disagree with a posting or find one to be personally insulting, please find a way to respond politely or contact your instructor.
- **Offensiveness:** The class is not the place for graphic terminology, sexual discussions, swearing, or any pornographic resources or other inappropriate language/materials.
- **Discrimination:** Derogatory statements about race, color, national or ethnic origin, religion, sex, age, disability, sexual orientation, and veterans will not be tolerated.

Effective communication: I will sometimes send course-related emails. You are expected to check the institution's email account (your @uwyo.edu account) at least once per day, though response by email is only required if stated in emails. Please use professional email etiquette (for example: <https://www.thebalance.com/emailetiquette-525535> (<https://www.thebalance.com/emailetiquette-525535>)). This is good practice for all courses, as well as for professional life beyond UW. This etiquette also applies to appropriate posts and responses on class discussion boards.

Classroom Statement on Diversity: The University of Wyoming values an educational environment that is diverse, equitable, and inclusive. The diversity that students and faculty bring to class, including age, country of origin, culture, disability, economic class, ethnicity, gender identity, immigration status, linguistic, political affiliation, race, religion, sexual orientation, veteran status, worldview, and other social and cultural diversity is valued, respected, and considered a resource for learning.

Disability Support:

The University of Wyoming is committed to providing equitable access to learning opportunities for all students. If you have a disability, including but not limited to physical, learning, sensory or psychological disabilities, and would like to request accommodations in this course due to your disability, please register with and provide documentation of your disability as soon as possible to Disability Support Services (DSS), Room 128 Knight Hall. You may also contact DSS at (307) 766-3073 or udss@uwyo.edu. It is in the student's best interest to request accommodations within the first week of classes, understanding that accommodations are not retroactive. Visit the DSS website for more information at: www.uwyo.edu/udss (<http://www.uwyo.edu/udss>)

Academic Dishonesty Policies:

The University of Wyoming is built upon a strong foundation of integrity, respect and trust. All members of the university community have a responsibility to be honest and the right to expect honesty from others. Any form of academic dishonesty is unacceptable to our community and will not be tolerated. Teachers and students should report suspected violations of standards of academic honesty to the instructor, department head, or dean. Other University regulations can be found at: <http://www.uwyo.edu/as/student-appeals/academic-dishonesty.html> (<http://www.uwyo.edu/as/student-appeals/academic-dishonesty.html>)

AI Technology:

Use is freely permitted with no acknowledgement. Students are permitted to use advanced automated artificial intelligence or machine learning tools on assignments in this course; no special documentation or citation is required.

Duty to Report:

UW faculty are committed to supporting students and upholding the University's non-discrimination policy. Under Title IX, discrimination based upon sex and gender is prohibited. If you experience an incident of sex- or gender-based discrimination, we encourage you to report it. While you may talk to a faculty member, understand that as a "Responsible Employee" of the University, the faculty member MUST report information you share about the incident to the university's Title IX Coordinator (you may choose whether you or anyone involved is identified by name). If you would like to speak with someone who may be able to afford you privacy or confidentiality, there are people who can meet with you. Faculty can help direct you or you may find info about UW policy and resources at <http://www.uwyo.edu/reportit> (<http://www.uwyo.edu/reportit>) (<http://www.uwyo.edu/reportit>)

(<http://www.uwyo.edu/reportit>) You do not have to go through the experience alone. Assistance and resources are available, and you are not required to make a formal complaint or participate in an investigation to access them.

Substantive changes to syllabus:

All deadlines, requirements, and course structure is subject to change if deemed necessary by the instructor. Students will be notified on our WyoCourses page announcement, and via email of these changes.

Campus Resources:

DISABILITY SUPPORT SERVICES: udss@uwyo.edu (<mailto:udss@uwyo.edu>), 766-3073, 128 Knight Hall, www.uwyo.edu/udss (<http://www.uwyo.edu/udss>)

COUNSELING CENTER: uccstaff@uwyo.edu (mailto:uccstaff@uwyo.edu), 766-2187, 766-8989 (After hours),
341 Knight Hall, www.uwyo.edu/ucc (<http://www.uwyo.edu/ucc>)

ACADEMIC AFFAIRS: 766-4286, 312 Old Main, www.uwyo.edu/acadaffairs (<http://www.uwyo.edu/acadaffairs>)

DEAN OF STUDENTS OFFICE: dos@uwyo.edu (mailto:dos@uwyo.edu), 766-3296, 128 Knight Hall, www.uwyo.edu/dos (<http://www.uwyo.edu/dos>)

UW POLICE DEPARTMENT: uwpd@uwyo.edu (mailto:uwpd@uwyo.edu), 766-5179, 1426 E Flint St, www.uwyo.edu/uwpd (<http://www.uwyo.edu/uwpd>)

STUDENT CODE OF CONDUCT WEBSITE: www.uwyo.edu/dos/conduct (<http://www.uwyo.edu/dos/conduct>)

Course Summary:

Date	Details	Due
Wed Sep 11, 2024	 Quiz 3: Projections and Datums (https://uwyo.instructure.com/courses/594814/assignments/5237493)	due by 11:59pm
	 Assignment 2: Distorted Distance (https://uwyo.instructure.com/courses/594814/assignments/5237495)	due by 11:59pm
	 Quiz 1: What is GIS / Map Making (classic) (https://uwyo.instructure.com/courses/594814/assignments/5237492)	due by 11:59pm
Fri Sep 13, 2024	 Quiz 2: Spatial Thinking, Data Models and Scale/Uncertainty (https://uwyo.instructure.com/courses/594814/assignments/5237491)	due by 11:59pm
	 Assignment 1 : Making your first map! (https://uwyo.instructure.com/courses/594814/assignments/5237494)	due by 11:59pm
	 Assignment 3: Use Excel (https://uwyo.instructure.com/courses/594814/assignments/5237496)	due by 11:59pm
Fri Sep 27, 2024	 Quiz 4: Version Control and Base R (https://uwyo.instructure.com/courses/594814/assignments/5237490)	due by 11:59pm
	 Assignment 4: Use R! (https://uwyo.instructure.com/courses/594814/assignments/5237497)	due by 11:59pm
Fri Oct 11, 2024	 Quiz 5: Relational Databases (https://uwyo.instructure.com/courses/594814/assignments/5237489)	due by 11:59pm

Date	Details	Due
Fri Nov 8, 2024	 <u>Final Project Proposal</u> (<https: 5237502="" 594814="" assignments="" courses="" uwyo.instructure.com="">)</https:>	due by 11:59pm
Wed Nov 27, 2024	 <u>Assignment 5: Query a Database</u> (<https: 5237498="" 594814="" assignments="" courses="" uwyo.instructure.com="">)</https:>	due by 11:59pm
	 <u>Final Project Abstract</u> (<https: 5237499="" 594814="" assignments="" courses="" uwyo.instructure.com="">)</https:>	due by 11:59pm
Fri Dec 13, 2024	 <u>Final Project Presentation Video</u> (<https: 5237501="" 594814="" assignments="" courses="" uwyo.instructure.com="">)</https:>	due by 11:59pm
Mon Dec 16, 2024	 <u>Final Project Presentation</u> <u>Discussion of Others</u> (<https: 5237500="" 594814="" assignments="" courses="" uwyo.instructure.com="">)</https:>	due by 11:59pm