Geography 5223: Design and Implementation of GIS

Spring 2026

Location: Online
Date and time: Asynchronous
Course URL: http://carmen.osu.edu

Instructors
Prof. Ningchuan Xiao | xiao.37@osu.edu

Office hours

Monday and Wednesday 11 AM - 12 PM, or by appointment

This course covers a wide range of topics in developing GIS software tools. There are two main themes of this course. First, we introduce techniques that will help students build custom tools to automate spatial data handling processes, including topics of programming skills, software testing, and verification. The second theme of this course is about project management for GIS software development. More specifically, we discuss how agile methods can be applied for software development projects. The course is organized around a set of coding tutorials, lectures, projects, and discussions. It is mostly a project-oriented course, where each major coding topic will end with finishing a project using the concepts covered, and there is also a final project. Upon completion of this course students will be able to

- Write code to implement tools in GIS platforms,
- Understand the tasks of GIS customization,
- Understand the fundamentals of software design patterns, and
- Put together and manage a project to automate GIS tasks.

How this course works

This course is divided into weekly modules and each module is released at the beginning of the week. A module is organized around a specific topic and may consist of coding tutorials, readings, and other activities. The final project is a long-term process that starts at the beginning of the semester and continues through a set of major steps during the semester.

Texts

There are no required textbooks for this class. We will provide tutorials to cover topics of tool development in QGIS and ArcGIS Pro. The following two textbooks are optional:

- *Python Scripting for ArcGIS Pro, 3rd Ed.*, by Paul A. Zandbergen, ESRI Press, 2024
- *Advanced Python Scripting for ArcGIS Pro, 2nd Ed.*, by Paul A. Zandbergen, ESRI Press, 2024

Technology

In addition to the commonly used software, each student should install the following software packages on their own computer:

- ArcGIS Pro. The university has site license. Detailed information about how to download, install, and set up ArcGIS Pro can be found at this page: https://guides.osu.edu/esri/arcgis-pro. You will need an updated Windows Operating System to run ArcGIS Pro.
- QGIS. This is an open-source system. Please visit https://qgis.org/en/site/ for details about how to download and install it.
- The Department may have a limited number of Windows remote desktops. If you need to use it, please contact me in the first week of class. Please note there is no guarantee that everyone will have access to it. This service is a web-based application and the performance may not be optimal.

Prerequisites

Geography 5222 or consent of instructor.

Credit Hours

This class is for 3 credits.

Schedule

The detailed course schedule is presented on the front page of the Carmen site. In general, the course is roughly divided into the following topics:

Weeks 1-2: Introduction Week 3: Getting started
Week 4: Layers and query
Week 5: Geometry
Weeks 6-7: Geoprocessing
Weeks 8-9: Tools
Week 10: Spring break (no class)
Week 11: Mapping
Week 12-15: Design
Week 16: Final projects

Grading

Assignment category	Weights
Module exercises	25

Assignment category	Weights
Analysis tool of market share	25
Final projects	25
Quizzes	20
Participation	5
Total	100

Course organization and assignment information

- **Module exercises.** Each module includes some questions that reflect what is covered in that module. These exercises are typically due in a week.
- **Analysis tool of market share (ATOMS).** This is a project that every student will work starting from the beginning of the semester. The ultimate goal here is to build a GIS tool to conduct market share analysis, using the public libraries in Franklin County as an example. We will start from the manual process in these systems and then eventually built the complete tools. Manual calculation will be introduced in the first two weeks, and the final submission of the tools will be due in week 14.
- **Final projects.** Students form teams, each working on a GIS development project. A typical team has no more than 4 students. Conducting the final project is a semester long process, where formal deliverables such as a video presentation and/or document are required at each of the steps. Some of these videos and documents will also be peer reviewed. There are two stages of the final projects in this class. The first stage is called icebreakers where students are randomly put in small groups to explore GIS tools and to discuss improvement and new possibilities. The groups will be finalized after these activities and we enter the stage of project management where each group focuses on a project idea and finish it at the end of the semester. Each project should be concluded by (a) delivering the final product including the full set of documents, software, and necessary data, and (b) making professional presentations about the project to the class. Teams that do not deliver the complete package on time will not receive any credit for the project.
- **Participation.** Each student will peer review different presentation videos and other final project through the semester. Participation in these peer reviews are counted toward the participation.
- **Auto Quizzes.** There will be three online quizzes, at weeks 2, 6 and 9, respectively. These are timed, open-book quizzes that will be automatically graded and students can take them anytime during the week the quiz is scheduled. All questions in the first auto quiz must be answered in one attempt. For the other two auto quizzes, questions will be randomly drawn from a pool; students have two attempts and the higher score will be used as the final score of each quiz.
- **Quizzes.** There will be two open-book, timed coding quizzes for this semester.

Faculty feedback and response time

I am providing the following list to give you an idea of my intended availability throughout the course. (Remember that you can call 614-688-HELP at any time if you have a technical problem.)

- **Grading and feedback:** For large weekly assignments, you can generally expect feedback within 7 days.
- **Email:** I will reply to emails within 24 hours on school days.
- **Discussion board:** The discussion board called Class Cafe is meant for students to ask questions and share experiences. I will check and reply to messages each week. I also encourage everyone to respond to questions whenever you can. Please do not use this place to ask questions that you need quick responses. In that case, email is the most efficient way.

Important Class Policies

- **Lab computers**. The computers in the classroom as well as the remote desktops will have all the software installed for this class. Every student should be able to log in any computer with their OSU credentials. Please note that WE ARE NOT RESPONSIBLE FOR FILES LEFT ON LAB MACHINES. Files on the computer hard drive may be deleted at any time if needed. Students should use USB devices or Cloud storage to save their work. It is important to LOG OUT when you are done with the work so other people can use the computer.

- **Submissions**. All submissions must be done on Carmen (unless otherwise specified). There will be **absolutely no email submissions**. Email submissions of work for this class will not be acknowledged and will not be accepted.

- **Late submissions**. Late submissions may be accepted, with a penalty, up to a week past the due date. One day late will incur a 10% penalty. Two days late will incur 20% penalty. Three days will incur a 30% penalty. Four days late will incur a 40% penalty. Five to seven days late will only receive 50% credit of the grade you would have received if it was submitted on time. If you contact me **prior to the due date** for deadline adjustments you will not incur any penalty. Please note this may not apply to every assignment. The final project, for example, has a firm deadline that cannot be changed.

- **Do your own work**. Collaboration is healthy and often necessary, but each student should definitely finish the work individually. Please see below for more information about academic misconduct.

- **Communication**. The only official way to communicate with me and the TA is through our OSU email address as listed on the top of the syllabus. We cannot guarantee that we will reply messages through any other methods. We normally will reply emails in a day (except weekends or holidays).

- **Alternative course delivery**. Should in-person classes be canceled due to weather or other short-term closing, we will meet virtually via CarmenZoom during our regularly scheduled time. I

will share any updates via CarmenCanvas announcement.

Students with Disabilities. I would like to hear from anyone who has a disability that may require some modification of seating, testing, or other class requirements so that appropriate arrangements may be made. Please talk with me after class or during my office hours. If you need more information about disabilities and accommodations, contact the Office of Disability Services.

Policy on Plagiarism and Academic Misconduct. If I suspect that a student has committed academic misconduct in this course, I am obligated by University Rules to report my suspicions to the Committee on Academic Misconduct. In the Code of Student Conduct, academic misconduct is defined as "any activity that tends to compromise the academic integrity of the university, or subvert the educational process"; plagiarism is defined as "the representation of another's work or ideas as one's own; it includes the unacknowledged word-for-word use and/or paraphrasing of another person's work, and/or the inappropriate unacknowledged use of another person's ideas."

Plagiarism is wrong and should be prohibited. The University has a policy on academic misconduct and plagiarism, as provided in the Code of Student Conduct. To further understand this, it is worthwhile to read and understand the Eight Cardinal Rules of Academic Integrity at here and guidelines to avoid plagiarism at here.

Religious accommodations. It is Ohio State's policy to reasonably accommodate the sincerely held religious beliefs and practices of all students. The policy permits a student to be absent for up to three days each academic semester for reasons of faith or religious or spiritual belief. Students planning to use religious beliefs or practices accommodations for course requirements must inform the instructor in writing no later than 14 days after the course begins. The instructor is then responsible for scheduling an alternative time and date for the course requirement, which may be before or after the original time and date of the course requirement. These alternative accommodations will remain confidential. It is the student's responsibility to ensure that all course assignments are completed.