GEOG 5222: GIS Programming and Algorithms

The Ohio State University
Spring 2019

Time: Monday and Wednesday, 9:35 AM - 10:55 AM
Location: 0135 Derby Hall
Course URL: http://carmen.osu.edu

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This class is about coding. More specifically we develop skills to program a computer to do spatial data handling. It is obvious, one may argue, that today's software are often quite easy to use and they are quite powerful too. So why should we code? Coding is fun. Frederick P. Brooks, Jr, in his book *The Mythical Man-month*, talked about the reward of coding as the sheer joy of making things. Other agree. In a 1984 New York Times article, Erik Sandberg-Diment gave three reasons of programming: "First, it allows you to develop software that is not available commercially, and in some cases it lets you customize purchased software to serve your specific needs better. Second, programming can be fun. If you enjoy working on puzzles, programming may well turn out to be more pleasurable than solving The Times crossword puzzle or Dr. Crypton's mind-bending puzzle page in Science Digest. Third, there is the intellectual exercise, the honing of logic skills and learning to learn, stressed by pedagogues as a perfect reason to have computers available in schools for pupils from kindergarten age on up." In a blog at Invent with Python, Al Sweigart pointed out that "Programming transforms your computer from a home appliance to a power tool." It is apparent that writing computer code is becoming an essential part of life. As Steve Jobs once put it, "everybody in this country should learn to program a computer...because it teaches you how to think."

In this class, we aim to help students gain freedom in dealing with spatial data. To put it more plainly, it is my hope that students will understand how spatial data works and how to write their own code to handle the data, instead of relying on existing (especially commercial) software packages. We use the powerful and (most) popular Python programming language in this class. We start from scratch by learning the basics of Python. Before the mid-semester, we should have developed sufficient knowledge about programming with Python and we will start to use Python to handle spatial data. Most of the materials do not rely on existing software packages (in other words, we use pure Python), which will provide an intuitive way of understanding spatial data and spatial data processing. By the end of the semester, students should understand the fundamental considerations of computational issues in spatial data processing and should be able to write Python code to complete various tasks of using spatial data.

Textbooks

The following two textbooks are required for this class:

Allen B. Downey. 2016. **Think Python**. 2nd Edition. O'Reilly Media.
Ningchuan Xiao. 2016. **GIS Algorithms**. SAGE Publications.

Also, a Github site called gisalgs will be used intensively for most part of the class. Lecture notes will be made available through the course schedule page.

Additionally, there are numerous useful online sources for learning Python. For example, The Hitchhiker's Guide to Python! has information that can be extremely practical for many beginners. The official Python Tutorial is a good place to find the details of most of the topics in Python coding (make sure to choose the right version on top of the page).

Credit Hours

This is a 3 credit hour class.

Schedule

The overall course contents are divided into a few major topics:

Weeks 1-5: Python programming language
Weeks 6-9: Geometric algorithms
Weeks 10-13: Spatial indexing
Weeks 15-16: Applications

The detailed schedule can be found on the home course page on Carmen. Students should check this page frequently as it will be updated whenever new materials are made available. Important notes regarding the course will also be posted on the home page.

Activities

Students are expected to work on the following activities throughout the course.

1. **Exercises**. At the end of each lecture, there will be some review exercises that typically require students to finish by the end of the next day. These exercises may be only handed out to students who attend the class. In additional to these after-class exercises, pop quizzes will be occasionally given during class.
2. **Homework**. For each major topic on the course schedule, there will be a homework assignment that includes some more in-depth questions for students to finish. These assignments are generally due in one or two weeks.
3. **Quizzes**. A quiz will be given after we finish a major topic. Three quizzes are scheduled for this course. These are open-book quizzes that will require students use the computer to answer. All the quizzes are equally weighted.
4. **Final exam**. This is a closed book exam that covers all the topics of this course.
5. **Final project**. I will provide a list of guided questions and each student will choose to answer one of these questions. The questions will be based on the topics covered in the semester. Only sufficient information will be provided, which means I will not provide all the implementation details for the questions and students must find solutions by themselves. There will also be open questions that give students a lot of freedom to choose their own project. The open questions will require a short proposal from the students.

Grading

The final project will only receive whole letter grades. Each of the other categories will be graded based on the percent of the total points received using the following scheme:

Category grade	Percent (%)
A	90 or higher

B	80 to 90
C	70 to 80
D	60 to 70
E	Lower than 60

A definitional grading system as listed below will be used to determine the course grade of each student. The number of letters in the "Best grades" column is the minimum number of grades that the student meets or exceeds among all categories. The course grade is the highest level the student can reach for ALL the three columns in the table. For example, assuming the first letter grade is for the project, BABBC will be a B+, CABBB will be a B, BAABC will be an A-, CAAAB will be a B, BAAAC will be an A, and AAABB (or BAAAB) will be an A.

Course grade	Best grades	Project	Minimum grade
A	AAA	B	C
A-	AA	B	C
B+	A	B	C
B	BBB	C	C
B-	BB	C	D
C+	B	C	D
C	CCC	C	D
C-	CC	C	E
D+	C	D	E
D		D	E
E			E

Important Class Policies

- **Lab computers**. The computers in the classroom will have all the software installed for this class. Every student should be able to log in any computer with their OSU name.# 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 their work.
- **Late submissions**. I will not give makeup quizzes or accept late submissions unless a good and acceptable reason is presented **prior to the due date** (in the case of a quiz, it will be before the quiz starts). Submissions after due date will no longer be accepted, unless otherwise permitted.
- **Deliverables**. All deliverables must be submitted as specified in the homework/project instructions. There will be **absolutely no email submissions**. Email submissions of work for this class will not be acknowledged and will not be accepted.
- **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 accounts 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).

Student with Disabilities

The University strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability (including mental health, chronic or temporary medical conditions), please let me know immediately so that we can privately discuss options. You are also welcome to register with Student Life Disability Services to establish reasonable accommodations. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. The web site of SLDS is slds.osu.edu, and its contact information is slds@osu.edu, 614-292-3307, 098 Baker Hall, 113 W. 12th Avenue.

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. The term "academic misconduct" includes all forms of student academic misconduct wherever committed, illustrated by, but not limited to, cases of plagiarism and dishonest practices in connection with examinations. It is the responsibility of the Committee on Academic Misconduct to investigate or establish procedures for the investigation of all reported cases of student academic misconduct. Instructors shall report all instances of alleged academic misconduct to the committee (Faculty Rule 3335-5-487). For additional information, see the Code of Student Conduct at http://studentlife.osu.edu/csc/.

The following is a list of other useful sources of information on academic misconduct and academic integrity:

- The Committee on Academic Misconduct web pages: COAM Home
- Ten Suggestions for Preserving Academic Integrity
- Eight Cardinal Rules of Academic Integrity