University of Massachusetts Amherst

GEOGRAPH 491P/691P
GIS Programming

Course Information

Term:	Fall 2024
Credits:	3.0
Days & Times:	TuTh 8:30AM – 9:45AM
Location:	Amherst Holdsworth 302 or MIC School of Design Rm 6 or Zoom: https://umass-amherst.zoom.us/j/98140128932

Instructor

Name:	Hongyu Zhang
Email:	honzhang@umass.edu
Virtual Office:	Zoom: https://umass-amherst.zoom.us/my/hzhang
Office Hours:	TuTh 11:30AM – 12:00PM or by appointment at https://cal.com/hzhang

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Teaching Assistant

Name:	Joshua Driscoll	**Email:**	jmdriscoll@umass.edu
Virtual Office:	https://umass-amherst.zoom.us/j/99467681429	**Office Hours:**	W 2:30 – 3:30PM

Course Websites

Canvas:	https://umamherst.instructure.com/courses/23959
Piazza:	https://piazza.com/umass/fall2024/geograph491p691p/info

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Course Description

This course will cover a number of programming methods and applications in GIS. Beginning in the (familiar) ArcGIS environment, this course will explore fundamentals of programming in Python while learning the Model Builder interface. By exploring basic automation methods of repetitive or complex tasks, this course will also introduce foundations of computer science and computational thinking. While gaining proficiency in Model Builder, this course will expand to other python scripting applications, both within ArcGIS and on other platforms. By exploring many applications of programming to advance GIS analysis and improve workflows, students will build a strong base of knowledge and capacity for future learning and flexibility with programming in GIS.

Course Objectives

In this course, students will:

- Learn fundamentals of computer programming;
- Consider how GIS applications interface with programming functions;
- Practice writing scripts in many forms, primarily using Python;
- Examine and practice foundations of computational thinking; and
- Create novel GIS programming solutions through independent skill building.

Required Textbook

Zandbergen, P. A. (2024). *Python scripting for ArcGIS Pro (3rd ed.)*. Redlands, CA: ESRI Press.

Additional Readings

- The National Center for Geographic Information & Analysis (NCGIA) Core Curriculum in GIScience, a guide to key GIS topics: http://www.ncgia.ucsb.edu/giscc/
- The ESRI Virtual Campus, a guide to all things ArcGIS: http://campus.esri.com/
- The Geographers Craft web site developed by Peter Dana and Ken Foote: https://foote.geography.uconn.edu/gcraft/contents.html
- Texas A&M's award-winning Maps and GIS library has some good tutorials on common GIS tasks: http://guides.library.tamu.edu/MapGIS_tutorials
- The UMass Library has a new GIS page worth visiting as well: https://gis.library.umass.edu/

Tentative Course Schedule

Week	*Topic(s)*	*Assignments*
1	Introductions	
2	The basics of ModelBuilder	
3	Geoprocessing I	Lab 1
4	Python fundamentals	
5	Loop, thinking computationally, and geoprocessing II	Lab 2
6	Python geoprocessing in ArcGIS Pro	
7	Managing spatial data	Project proposal
8	Cursors I & SDSS 2024	Take home exam
9	Cursors II and notebooks I	Lab 3
10	Notebooks II	Project report
11	Raster data I	Lab 4
12	Raster data II	

13	*Thanksgiving recess*
14	Hot topics in GIS programming
15	Project presentation

Course Assessments

Your grade in this course will be based on performance on lab assignments, a take home exam concerning fundamentals of programming, completion of GIS programming exercises and certificates, a final GIS project in an area of your interest, and symposium participation.

1. **Lab Assignments** **40%**
   The lab assignments will require you to engage in a variety of hands-on tasks, including solving complex programming problems, developing custom scripts, and constructing detailed models. Each assignment is designed to challenge your technical skills and deepen your understanding of the course material through practical application.

2. **Exercises** **10%**
   Each class period, we'll have little exercises to work on together (or, on your own if you're following asynchronously). These, combined with tutorials and other materials will help guide and support our learning throughout the term.

3. **Certificates** **8%**
   To supplement lab activities, various trainings and certificate-earning activities will also be a component of this course. Sponsored by ESRI and others, these will provide credentials for your future use as a resume builder, while also providing additional recognition of your GIS Programming skill base.

4. **Symposium Participation** **2%**
   The 5th Spatial Data Science Symposium (SDSS 2024, Oct. 23-24) explore how incorporating spatial-temporal thinking into data science enhances research across various disciplines. Attending and reflecting on the symposium will help you explore trending topics in GIS that are not necessarily covered in this course.

5. **Take Home Exam** **10%**
   The take home exam will cover concepts and topics related to programming and python fundamentals. It will be primarily of a multiple choice and short answer format, intended to see how you understand some of the computer science fundamentals of the course.

6. **Final Project** **30%**
   In the latter part of the course, you will undertake an independent project in an area of your interest. This project should involve substantial model development, data manipulation, and geoprocessing using Python and related tools. You will have the opportunity to present your project to the class in a brief presentation.

a.	Project Proposal	5%
b.	Project Presentation	10%
c.	Project Report	15%

Grading Scale

Letter Grade	*Grade Point*	*Percentage*	*Grad Only*
A	4.0	93-100	93-100
A-	3.7	90-92	90-92
B+	3.3	87-89	87-89
B	3.0	83-86	83-86
B-	2.7	80-82	80-82
C+	2.3	77-79	77-79
C	2.0	73-76	73-76
C-*	1.7	70-72	-
D+*	1.3	67-69	-
D*	1.0	63-66	-
F	0.0	0-62	0-72

Please note that a grade of D- is *not* valid.
**Graduate students may not receive a grade of C-, D+, or D*

Class Attendance

Students are required to attend all regularly scheduled classes at the university for which they are registered. If you are unable to attend a class, you must inform the instructor in advance or, if that is not possible, immediately after the absence. This notification is mandatory to be considered for make-up work.

Late Policy

Assignments are due by the posted date on Canvas, and adherence to deadlines is mandatory. A late penalty of 10% per 24-hour period will be applied, up to 96 hours after the due date. After this 96-hour period, missed work may be submitted for partial credit, with a maximum of 60%, until the end of classes (**Dec. 10, 2024 at 11:59 PM**). Failure to submit an assignment will result in a grade of 0.

How to avoid late penalties: If you anticipate being unable to complete an assignment by the deadline, you must notify me via email at least one week in advance to arrange an alternative plan. Should an unforeseen circumstance arise, you are required to request an extension no later than 24 hours before the assignment is due.

Email Policy

Students are required to use their university-associated email accounts when contacting the instructor or teaching assistants. Emails from personal accounts (such as @yahoo or @gmail) that lack proper forwarding information will *not* be acknowledged. You will receive regular emails from the course listserv regarding scheduling and important events, and it is your responsibility to monitor your university email account regularly. Additionally, be aware that federal privacy law (FERPA) prohibits the discussion of grades via email.

Tips for Successful Learning

Plan ahead by marking assessment due dates on your personal calendar and setting aside dedicated time to work on them. For a 3-credit graduate course, you should allocate 6-9 hours per week outside of class for reading and assessments. Begin working on assignments early to allow time for breaks, giving your brain a chance to process the material—a technique known as "distributed learning," which is proven to be more effective than cramming. Take short physical breaks every half hour to stay focused.

When tackling problems, refer back to the textbook for similar concepts, especially if the assignment includes exercises from the book.

Engage with your classmates and avoid isolation by using the course Piazza workspace: https://piazza.com/umass/fall2024/geograph491p691p/info.

Finally, address any technical issues promptly. While the instructor may assist with some problems, you may need to contact IT or seek external computer repair services for others.

Academic Honesty Policy

Since the integrity of the academic enterprise of any institution of higher education requires honesty in scholarship and research, academic honesty is required of all students at the University of Massachusetts Amherst. Academic dishonesty is prohibited in all programs of the University. Academic dishonesty includes but is not limited to: cheating, fabrication, plagiarism, and facilitating dishonesty. Appropriate sanctions may be imposed on any student who has committed an act of academic dishonesty. Instructors should take reasonable steps to address academic misconduct. Any person who has reason to believe that a student has committed academic dishonesty should bring such information to the attention of the appropriate course instructor as soon as possible. Instances of academic dishonesty not related to a specific course should be brought to the attention of the appropriate department Head or Chair. Since students are expected to be familiar with this policy and the commonly accepted standards of academic integrity, ignorance of such standards is not normally sufficient evidence of lack of intent (http://www.umass.edu/dean_students/codeofconduct/acadhonesty/).

Accommodations Statement

The University of Massachusetts Amherst is committed to providing an equal educational opportunity for all students. If you have a documented physical, psychological, or learning disability on file with Disability Services (DS), you may be eligible for reasonable academic accommodations to help you succeed in this course. If you have a documented disability that requires an accommodation, please notify me within the first two weeks of the semester so that we may make appropriate arrangements. For further information, please visit Disability Services (https://www.umass.edu/disability/).

Title IX Statement

In accordance with Title IX of the Education Amendments of 1972 that prohibits gender-based discrimination in educational settings that receive federal funds, the University of Massachusetts Amherst is committed to providing a safe learning environment for all students, free from all forms of discrimination, including sexual assault, sexual harassment, domestic violence, dating violence, stalking, and retaliation. This includes interactions in person or online through digital platforms and social media. Title IX also protects against discrimination on the basis of pregnancy, childbirth, false pregnancy, miscarriage, abortion, or related conditions, including recovery. There are resources here on campus to support you. A summary of the available Title IX resources (confidential and non-confidential) can be found at the following link: https://www.umass.edu/titleix/resources. You do not need to make a formal report to access them. If you need immediate support, you are not alone. Free and confidential support is available 24 hours a day / 7 days a week / 365 days a year at the SASA Hotline 413-545-0800.