**Programming for Remote Sensing and GIS**

**GIS 4090/5090 — Fall 2020**

**Class Time: Wednesday 4:10 PM - 7:00 PM**

**Location: Des Peres Hall 204**

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| Instructor: Gregory Brunner  Office Hours: Monday before class and scheduled upon request  Phone: 636-222-3818  E-mail: [gregory.brunner@slu.edu](mailto:gregory.brunner@slu.edu) |

**Course Description (Modified from what is listed in the Course Catalog):**

This course will introduce students to Python programming and its applications to remote sensing and GIS. Through completing this course, students will be able to use Python to perform common GIS and remote sensing analysis tasks, automate workflows, and develop custom Python tools. Topics will include describing data, manipulating data, automating spatial analysis tasks, creating Python scripts and tools, and using Python for imagery analysis. We will also introduce students to WebGIS and how Python can be used to interface with data that is shared online.

**Course Objectives:**

* Students will learn Python and understand how to use it to solve problems in GIS and Remote Sensing and will demonstrate their knowledge by completing multiple homework assignments and projects.
* Students will be encouraged to use Python through relevant examples and assignments.
* Students will begin implementing it in their own research projects such as theses and capstones.

**Materials:**

Course Materials will be shared using Blackboard. Slides, labs, and homework are in the folders that correspond to the specific units covered in class.

**Texts:**

(Primary Textbook) Paul A Zandenbergen. [Python Scripting for ArcGIS Pro](https://esripress.esri.com/display/index.cfm?fuseaction=display&websiteID=384&moduleID=12). ISBN: 9781589484993. $79.99

(Recommended) Paul A Zandenbergen. [Advanced Python Scripting for ArcGIS Pro](https://esripress.esri.com/display/index.cfm?fuseaction=display&websiteID=393&moduleID=0). ISBN: 9781589486188. $79.99

(Optional) Laura Tateosian. Python for ArcGIS. ISBN 978-3-319-18398-5. $99.00

**Grading:**

1. 15% - Lab Work & Programming Exercises
2. 15% - Homework Assignments
3. 20% - Project 1
4. 20% - Project 2
5. 30% - Final Project

**Feedback and Assessment**

In order to ensure that students are on track to achieve the course objectives, students will have weekly coding assignments. The coding assignments will be graded and returned before the next online lecture, where the solutions will be reviewed, and questions will be addressed. Feedback on respective assignments will also be given to each student through Blackboard. Weekly assignment will become the foundation for student projects which will serve as the benchmarks for whether students understand how to use programming to solve GIS and remote sensing problems. There will be 3 projects over the course of the semester. Two will be defined by the professor. The third and final project will be defined by the student in consultation with me. For the final project, the student will define the questions he or she wants to answer, find the data to answer it, code up a solution to the question(s), and put together a presentation on the project and solution that will be presented during our final class. For the final project, discussion with classmates and me is encouraged as each student will define his or her own project and goals. The instructor will make himself available for virtual office hours weekly on Mondays from 4 to 5 PM using Zoom. If you have questions or concerns, don’t hesitate to meet with me during office hours, send me an email, or schedule an ad-hoc meeting with me outside of our regular meetings or office hours. For week 1 of class, please post your name, discipline of study, and academic interests in the Introductions discussion channel in Blackboard. If you ever need to talk, do not hesitate to reach out to me.

[**Github**](https://github.com/)

Almost all developers use Github for versioning and sharing their code and if they are not using Github, they are using SVN, GitLab, or something similar. In order to familiarize yourselves with Github, I would like every student to create an account on Github and to use it for submitting and sharing Project1, Project 2, and their final project. I will walk you through checking in Project 1 prior to its due date. You are not expected to become experts with Github, but it is a skill that I want to make sure everyone is familiar with before the end of the semester.

**Grading Scale:**

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| --- | --- | --- |
| **Grade** | **Points** | **0-100% scale** |
| A | 4.0 | 93-100% |
| A- | 3.7 | 90-92.9% |
| B+ | 3.3 | 87-89.9% |
| B | 3.0 | 83-86.9% |
| B- | 2.7 | 80-82.9% |
| C+ | 2.3 | 77-79.9% |
| C | 2.0 | 73-76.9% |
| C- | 1.7 | 70-72.9% |
| D | 1.0 | 60-69.9% |
| F | 0.0 | 0-59.9% |

**Course Schedule**

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| --- | --- | --- |
| **Week** | **Class**  **Date** | **Discussion & Readings** |
| Introduction to Python and Notebooks | | |
| 1 | 8/19 | **Welcome!**  **Introduction to Python**  **Introduction to ArcGIS Notebooks** |
| More Python Fundamentals | | |
| 2 | 8/26 | **ArcPy and Geoprocessing with Python in both ArcGIS Pro and ArcGIS Notebooks** |
| Working with Data | | |
| 3 | 9/2 | **Setting up Jupyter Notebooks Locally with ArcGIS Pro**  **Exploring Spatial Data**  **Describing Spatial Data**  **Text files and CSVs** |
| Manipulating Data | | |
| 4 | 9/9 | **Cursors – Search, Insert, Update (Chapter 7 of Zandbergen)**  **JSON – JavaScript Object Notation**  **\*\*Project 1 Assigned\*\*** |
| Geometries | | |
| 5 | 9/16 | **Working with Geometries (Chapter 8 of Zandbergen)**  **Advanced Geometry Methods (Chapter 10 of Toms)** |
| Rasters and Numpy | | |
| 6 | 9/23 | **\*Project 1 Due\***  **Arcpy Raster Objects**  **Manipulating Rasters with Numpy** |
| Creating Python Script Tools | | |
| 7 | 9/30 | **Creating Python Script Tools in ArcGIS Pro** |
| Requests, Try-Except, Functions | | |
| 8 | 10/7 | **Try-Except**  **Functions**  **Requests**  **\*\*Project 2 Assigned\*\*** |
| Python for WebGIS | | |
| 9 | 10/14 | **WebGIS**  **ArcGIS API for Python** |
| Data Visualization, Analysis, and Portal Management | | |
| 10 | 10/21 | **\*\*Project 2 Due\*\***  **Data visualization (renderers)**  **Analysis (geoprocessing for ArcGIS Online)**  **Portal Management** |
| REST Services and Publishing GIS Content | | |
| 11 | 10/28 | **REST Services**  **Publishing Content**  **Automating Publishing Content** |
| Data Science | | |
| 12 | 11/4 | **\*\*Final Project Proposal Due\*\***  **Matplotlib**  **Pandas**  **Dataframes and Spatial Dataframes**  **Plotly** |
| Image Services and Multidimensional Data | | |
| 13 | 11/11 | **Imagery**  **Image Service**  **Multidimensional, Scientific Data**  **Slideshows in ArcGIS Notebooks!** |
| Javascript and web Development | | |
| 14 | 11/18 | **Intro to Javascript and Web Development** |
| Final Projects Presented | | |
| 15 | 12/2 | **\*Final Projects Due and Presented via Zoom meeting\*** |

**Homework**

The purpose of the homework is twofold: to keep you thinking about Python outside of the lab and to prepare you for the next class. I do not want to overwhelm you with homework. I do want to ensure that you are learning how to use Python to solve GIS and remote sensing problems. Please do not hesitate to ask me or your classmates questions on homework if you are encountering difficulties. Furthermore, I would like your feedback as to whether assignments get too difficult or too easy so that I can adjust the assignments and in-class materials accordingly. Homework is to be submitted via blackboard before class on the day that it is due.

**In Class Exercises**

The easiest way to learn to code is by writing code! Lectures are designed to be interactive. If I am typing code, you should be too! Lectures will be followed by in-class exercises that are designed to get you writing code on your own. The exercises that I have written as Python notebooks (.ipynb files) have questions throughout them. Please answer these questions and submit them via Blackboard before the beginning of the following week of class.

**Project 1**

Project 1 will likely consist of working with tabular data (CSV or text file) or generating some report based on GIS data using Python. I will give the assignment by week 4. It is due before class on week 6.

**Project 2**

Project 2 will likely consist of using Python to do some sort of spatial analysis or raster analysis. It will be assigned by week 9. It is due before class on week 11.

**Final Project**

In my experience, all students and professionals need at least one demo or presentation that they can be prepared to give for a job interview, conference presentation, or other type of meeting. Through this class, I’d like each student to develop that demo or presentation, with the foundation of that presentation being some sort of spatial analysis, imagery analysis, or GIS analysis with Python. Each student will be responsible for a short 10 minute presentation to be given during either Week 14 or 15 of class on a project of their own choosing that will leverage Python. Before Spring Break (i.e. by Week 8), please submit to me a short write up (no more than 1 page) of what your project will be, what problem you will solve, how you will use Python to solve the problem. On week 14 or 15, please be prepared to give a 10 minute presentation explaining your problem, solution, how you got there, and hopefully some cool maps and results.

**Academic Integrity**

*Academic integrity is honest, truthful and responsible conduct in all academic endeavors.* The mission of Saint Louis University is “the pursuit of truth for the greater glory of God and for the service of humanity.” Accordingly, all acts of falsehood demean and compromise the corporate endeavors of teaching, research, health care, and community service through which SLU fulfills its mission. The University strives to prepare students for lives of personal and professional integrity, and therefore regards all breaches of academic integrity as matters of serious concern. The full University-level Academic Integrity Policy can be found on the Provost's Office website at:<https://www.slu.edu/provost/policies/academic-and-course/policy_academic-integrity_6-26-2015.pdf>.

Additionally, each SLU College, School, and Center has its own academic integrity policies, available on their respective websites.

## **Disability Accommodations**

Students with a documented disability who wish to request academic accommodations must formally register their disability with the University. Once successfully registered, students also must notify their course instructor that they wish to use their approved accommodations in the course.

Please contact Disability Services to schedule an appointment to discuss accommodation requests and eligibility requirements. Most students on the St. Louis campus will contact Disability Services, located in the Student Success Center and available by email at [Disability\_services@slu.edu](mailto:Disability_services@slu.edu) or by phone at 314.977.3484. Once approved, information about a student’s eligibility for academic accommodations will be shared with course instructors by email from Disability Services and within the instructor’s official course roster. Students who do not have a documented disability but who think they may have one also are encouraged to contact to Disability Services. Confidentiality will be observed in all inquiries.

*Note: due to accreditation requirements, regulatory differences, and/or location-specific resources, the School of Law, the School of Medicine, and SLU Madrid have their own standard language for syllabus statements related to disability accommodations. Faculty in those units should seek guidance for syllabus requirements from their dean’s office.*

**Title IX**

Saint Louis University and its faculty are committed to supporting our students and seeking an environment that is free of bias, discrimination, and harassment. If you have encountered any form of sexual harassment, including sexual assault, stalking, domestic or dating violence, we encourage you to report this to the University. If you speak with a faculty member about an incident that involves a Title IX matter, **that faculty member must notify SLU’s Title IX Coordinator and share the basic facts of your experience**. This is true even if you ask the faculty member not to disclose the incident. The Title IX Coordinator will then be available to assist you in understanding all of your options and in connecting you with all possible resources on and off campus.

Anna Kratky is the Title IX Coordinator at Saint Louis University (DuBourg Hall, room 36; [anna.kratky@slu.edu](mailto:anna.kratky@slu.edu); 314-977-3886). If you wish to speak with a confidential source, you may contact the counselors at the University Counseling Center at 314-977-TALK or make an anonymous report through SLU’s Integrity Hotline by calling 1-877-525-5669 or online at <https://www.lighthouse-services.com/_StandardCustomURL/LHILandingPage.asp>. To view SLU’s policies, and for resources, please visit the following web addresses: <https://www.slu.edu/here4you> and <https://www.slu.edu/general-counsel>.

IMPORTANT UPDATE: SLU’s Title IX Policy (formerly called the Sexual Misconduct Policy) has been significantly revised to adhere to a new federal law governing Title IX that was released on May 6, 2020. Please take a moment to review the new policy and information on the following web address: <https://www.slu.edu/here4you>. Please contact the Anna Kratky, the Title IX Coordinator, with any questions or concerns.

*Note: due to accreditation requirements, regulatory differences, and/or location-specific resources, the School of Law, the School of Medicine, and SLU Madrid have their own standard language for syllabus statements related to Title IX. Faculty in those units should seek guidance for syllabus requirements from their dean’s office.*

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## **Mandatory Statement on Face Masks (Fall 2020)**

The University’s [*Interim Policy on Face Masks*](https://slu.policystat.com/policy/token_access/2e1e7d4c-49c9-42ba-8055-ca833711bea4/) governs all students, faculty, staff, and campus visitors in all University-owned, leased, or operated facilities. All persons physically present in any such University facility associated with this course shall comply fully with this policy at all times. Masks must be worn before entry to all such University facilities (as well as outdoors on all University property when six feet of distance is unpredictable or cannot be maintained).

Saint Louis University is committed to maintaining an inclusive and accessible environment. Individuals who are unable to wear a face mask due to medical reasons should contact the Office of Disability Services or Human Resources to initiate the accommodation process identified in the University’s [ADA Policy](https://www.slu.edu/human-resources/pdfs/policies/americans-disabilities-act-policy.pdf). Inquires or concerns may also be directed to the [Office of Institutional Equity and Diversity](https://www.slu.edu/general-counsel/institutional-equity-diversity/index.php). Notification to instructors of SLU-approved ADA accommodations should be made in writing prior to the first class session in any term (or as soon thereafter as possible).

As the instructor of this course, I shall comply fully with SLU’s policy and all related ADA regulations.

Students who attempt to enter a classroom without wearing masks will be asked by the instructor to wear masks prior to entry. Students who remove their masks at any time during a class session will be asked by the instructor to resume wearing their masks.

***Note: Accordingly, no consumption of any food will be allowed in class.***

Students who do not comply with a request by a SLU instructor to wear a mask in accordance with the University’s *Interim Policy on Face Masks* may be subject to disciplinary actions per the rules, regulations, and policies of Saint Louis University, including but not limited to the *Student Handbook*. Non-compliance with this policy may result in disciplinary action, up to and including any of the following:

* dismissal from the course(s)
* removal from campus housing (if applicable)
* dismissal from the University

To immediately protect the health and well-being of all students, instructors, and staff, instructors reserve the right to cancel or terminate any class session at which any student fails to comply with faculty or staff request to wear a mask in accordance with University policy.

Students are strongly encouraged to identify to their instructor any student or instructor not in compliance. Non-compliance may be anonymously reported via the SLU Integrity Hotline at 1-877-525-5669 (or confidentially via the Integrity Hotline's website at<http://www.lighthouse-services.com/slu>.

## **Attendance**

The health and well-being of SLU’s students, staff, and faculty are critical concerns. Accordingly, the following University policy statements on in-person class attendance are designed to preserve and advance the collective health and well-being of our institutional constituencies.

1. Students who exhibit any [potential COVID symptoms](https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html) (those that cannot be attributed to some other medical condition the students are known to have, such as allergies, asthma, etc.) shall absent themselves from any in-person class attendance or in-person participation in any class-related activity until they have been evaluated by a qualified medical official. Students should contact the [University Student Health Center](https://www.slu.edu/life-at-slu/student-health/index.php) for immediate assistance.

2. Students who exhibit any [potential COVID symptoms](https://www.cdc.gov/coronavirus/2019-ncov/symptoms-testing/symptoms.html) (those that cannot be attributed to some other medical condition the students are known to have, such as allergies, asthma, etc.) but who feel well enough to a) attend the course synchronously in an online class session or b) participate in asynchronous online class activities, are expected to do so. Those who do not feel well enough to do so should absent themselves accordingly.

3. Students (whether exhibiting any of potential COVID symptoms or not, and regardless of how they feel) who are under either an isolation or quarantine directive issued by a qualified health official must absent themselves from all in-person course activity per the stipulations of the isolation or quarantine directive. They are expected to participate in synchronous or asynchronous online class activities as they feel able to do so, or absent themselves accordingly.

4. Students are responsible for notifying each instructor of an absence as far in advance as possible; when advance notification is not possible, students are responsible for notifying each instructor as soon after the absence as possible.

5. As a temporary amendment to the current [University Attendance Policy](https://catalog.slu.edu/academic-policies/academic-policies-procedures/attendance/), all absences due to illness or an isolation/quarantine directive issued by a qualified health official shall be considered “Authorized” absences (effective August 2020 through May 2021).

## **Distance Education Etiquette**

Your actions in distance education contexts are just as important as in on-ground, face-to-face educational contexts – and sometimes require additional attention and commitment, as some distance education technologies might be less familiar to us. Accordingly, all students are expected to follow the guidelines below:

**Synchronous Video Contexts (Zoom, etc.)**

1. Mute your microphone when you are not speaking. Remember to “un-mute” yourself just prior to speaking. Identify yourself when you begin speaking.

2. Expect a few seconds of delay in getting a response from the instructor or another class member to a question; wait before repeating your question or assuming it was not heard.

3. If possible, position your camera such that your video feed does not capture too much of your surroundings or other activity/sound from your home/location. Be conscious of posters, art, or other surroundings that others might find offensive or inappropriate for an educational context.

4. Use the “Raise Hand” and “Chat” (or similar) features of your video-conferencing tool. This limits verbal interruptions and the confusion generated when multiple people try to speak at once.

5. Just as in an on-ground, face-to-face class, limit side conversations, multi-tasking (on your computer or otherwise), and use of your cellphone.

6. Temporarily turn off your video feed and mute your microphone when engaged in any non-class conversation or activity.

7. Respect and be attentive to the diversity of your classmates and instructor. Before communicating, consider your message in the context of the class’ diversity in race, ethnicity, religion, disabilities, gender, sexual orientation, age, social class, marital status, geography, etc. Consider the diversity you can see or know – as well as that you cannot.

8. Remember that video-based class sessions (including chat transcripts) may be recorded and retrieved for later viewing.

**Non-Video & Asynchronous Contexts (Blackboard, Canvas, Online Chats, Discussion Boards, etc.)**

1. When using the “Chat” or “Discussion Board” (or similar) features of your course management system, remember that your course-related communications to the instructor or other students should be considered “professional” (they are not like texts to your friends). Remember that course context and all related written work – including chat and discussion board transcripts – can be recorded and retrieved.

2. Be cautious when using humor or sarcasm; without the context of facial expressions or other body language, your tone or intent could be missed or misunderstood by others.

3. Respect and be attentive to the diversity of your classmates and instructor. Before communicating, consider your message in the context of the class’ diversity in race, ethnicity, religion, disabilities, gender, sexual orientation, age, social class, marital status, geography, etc. Consider the diversity you can see or know – as well as that you cannot.

4. Respect others’ time and life circumstances, which often don’t allow for an immediate response to a question or comment.