**Programming for Remote Sensing and GIS**

**GIS 4090/5090 — Fall 2020**

**Class Time: Wednesday 4:15 AM - 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 7 to 8 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 via which SLU embodies 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 governing University-level Academic Integrity Policy was adopted in Spring 2015, and can be accessed on the Provost's Office website at: <http://www.slu.edu/Documents/provost/academic_affairs/University-wide%20Academic%20Integrity%20Policy%20FINAL%20%206-26-15.pdf>.

Additionally, each SLU College, School, and Center may have adopted its own academic integrity policies, available on their respective websites. All SLU students are expected to know and abide by these policies, which detail definitions of violations, processes for reporting violations, sanctions, and appeals. Please direct questions about any facet of academic integrity to your faculty, the chair of the department of your academic program, or the Dean/Director of the College, School or Center in which your program is housed.

**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 misconduct (e.g. sexual assault, sexual harassment, stalking, domestic or dating violence), we encourage you to report this to the University. If you speak with a faculty member about an incident of misconduct, that faculty member must notify SLU’s Title IX coordinator, Anna R. Kratky (DuBourg Hall, room 36; akratky@slu.edu; 314-977-3886) and share the basic fact of your experience with her. 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.

If you wish to speak with a confidential source, you may contact the counselors at the University Counseling Center at 314-977-TALK. To view SLU’s sexual misconduct policy and for resources, please visit the following web address: <http://www.slu.edu/general-counsel-home/office-of-institutional-equity-and-diversity/sexual-misconduct-policy> [www.slu.edu/here4you](http://www.slu.edu/here4you) .

**Student Success Center**

In recognition that people learn in a variety of ways and that learning is influenced by multiple factors (e.g., prior experience, study skills, learning disability), resources to support student success are available on campus. The Student Success Center, a one-stop shop, which assists students with academic and career related services, is located in the Busch Student Center (Suite, 331) and the School of Nursing (Suite, 114). Students who think they might benefit from these resources can find out more about:

* Course-level support (e.g., faculty member, departmental resources, etc.) by asking your course instructor.
* University-level support (e.g., tutoring services, university writing services, disability services, academic coaching, career services, and/or facets of curriculum planning) by visiting the Student Success Center or by going to www.slu.edu/success.

**Disability Services Academic Accommodations**

Students with a documented disability who wish to request academic accommodations are encouraged to contact Disability Services to discuss accommodation requests and eligibility requirements. Please contact Disability Services, located within the Student Success Center, at Disability\_services@slu.edu or 314.977.3484 to schedule an appointment. Confidentiality will be observed in all inquiries. Once approved, information about academic accommodations will be shared with course instructors via email from Disability Services and viewed within Banner via the instructor’s course roster.