**Programming for Remote Sensing and GIS**

**GIS 5090-01 — Spring 2017**

**Class Time: Tuesday 4:20 AM - 6:50 PM**

**Location: Des Peres Hall 204**

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| Instructor: Gregory Brunner (Center for Sustainability)  Office Hours: Tuesday before class and scheduled upon request  Phone: 636-222-3818  E-mail: brunnergj@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.

**Course Objectives:**

* Learn Python and understand how to use it to solve problems in GIS and Remote Sensing
* Encourage the use of Python through relevant examples and assignments
* Get graduate level students implementing it in their own research projects.

**Materials:**

Course Materials are hosted at <https://github.com/gbrunner/Python_for_GIS_and_RS>. Slides, labs, and homework are in the folders that correspond to the specific week in class.

**Texts:**

(Required) Silas Toms. ArcPy and ArcGIS – Geospatial Analysis with Python. ISBN978-1-78398-866-2. $44.99

(Optional) Paul A Zandenbergen. Python Scripting for ArcGIS. ISBN 978-1-58948-282-1. $79.99

(Optional) David W. Allen. GIS Tutorial for Python Scripting. ISBN  978-1589483712. $52.14

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

**Assessment & Grading:**

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

[**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** |
| Intro | | |
| 1 | 1/17 | **Intro to Python**  **Python Basics**  **Python Fundamentals** |
| More Python Fundamentals | | |
| 2 | 1/24 | **Geoprocessing and Arcpy**  **Intro to Arcpy** |
| Working with Data | | |
| 3 | 1/31 | **Creating Your First Python Script (Chapter 3 of Toms)**  **CSVs and Text Files – Text to Feature Class** |
| Manipulating Data | | |
| 4 | 2/7 | **Describing GIS Data**  **Functions Overview**  **Classes and Functions (Chapter 4 of Toms)**  **\*Project 1 Assigned\*** |
| Manipulating Spatial Data | | |
| 5 | 2/14 | **Cursors – Search, Insert, Update (Chapter 5 of Toms)**  **JSON – JavaScript Object Notation** |
| Geometries | | |
| 6 | 2/21 | **Working with Geometries (Chapter 6 of Toms)**  **Advanced Geometry Methods (Chapter 10 of Toms)**  **\*Project 1 Due\*** |
| Creating Script Tools | | |
| 7 | 2/28 | **Creating and Running Python Script Tools (Chapter 7 of Toms)**  **Python Toolboxes (Chapter 4 of Allen)** |
| Network and Spatial Analysis | | |
| 8 | 3/7 | **Network and Spatial Analysis with Python (Chapter 11 of Toms)** |
| Working with Rasters | | |
| 9 | 3/21 | **Working with Rasters (**[**Chapter 9 of Zandbergen**](http://esripress.esri.com/bookResources/index.cfm?event=catalog.book&id=9)**)**  **Raster Analysis with Numpy (Custom Exercise)**  **\*Project 2 Assigned\*** |
| Managing Collections of Rasters | | |
| 10 | 3/28 | **Mosaic Datasets (**[**Mosaic Dataset in ArcMap Excercise**](http://desktop.arcgis.com/en/arcmap/10.3/manage-data/raster-and-images/ex-1-creating-a-mosaic-dataset.htm)**,** [**Landsat Mosaic Excercise**](http://desktop.arcgis.com/en/arcmap/10.3/manage-data/raster-and-images/ex-8-creating-a-mosaic-dataset-to-contain-landsat-imagery.htm)**)**  **Using Python to Create Mosaic Datasets (Custom Exercise)** |
| Field Calculator and DataTime | | |
| 11 | 4/4 | **[Using Python in the ArcGIS Field Calculator (Allen 1-3 and 1-4)](http://esripress.esri.com/bookResources/index.cfm?event=catalog.book&id=8)**  **[Python DateTime (Allen 1-5)](http://esripress.esri.com/bookResources/index.cfm?event=catalog.book&id=8)**  **\*Project 2 Due\*** |
| Map Scripting | | |
| 12 | 4/11 | **Arcpy.Mapping (Chapter 8 of Toms)**  **Map Automation and Other Arcpy.Mapping Techniques (Chapter 9 of Toms)** |
| Hipster Python | | |
| 13 | 4/18 | **Intro to ArcGIS Python Web API and Jupyter** |
| Potpourri – I’ll Take Suggestions! | | |
| 14 | 4/25 | **List Comprehension**  **More Pandas?**  **Scipy?**  **Multiprocessing?** |
| Final Projects Presented | | |
| 15 | 5/2 | **\*Final Projects Due\***  Each student will give a presentation on their final project. |
| Grades | | |
| 16 | 5/9 |  |

**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.