Fall GEOG 473/673: Open-sourced Environmental Computing

Virtual – MW 9:00-10:00

Phase 1: Environmental Computing with R - 9/1/2020 to 10/1/2020 – 1cr

Phase 2: Spatial Computing with Python – 10/2/2020 to 12/10/2020 – 2cr

Prof: James Simkins (simkins@udel.edu) Website: https://github.com/jsimkins2/geog473-673

Office Hours: By Appointment

Objective

The objective of GEOG 473/673 Open-sourced Environmental Computing is for advanced undergraduate and graduate students to gain practical experience with R & Python, two industry-leading open-sourced programming languages. Both of these languages are used to assemble, read, and manage large geospatial and environmental datasets by academics, government scientists, and private industry. Each of these programming languages offer a plethora of free packages that allow a user to work with big spatial data in an analytical manner without paying a dime. The demand for students knowledgeable in R & Python is continuing to grow. It's important to note that this is an Introduction to R (or Python), NOT an introduction to programming. This challenging, fast-paced course is intended for students that already have at least basic programming experience. *ArcGIS does NOT count towards the required experience*.

Outcomes

By the end of this course, students will have 1) proficiency in the basic R & Python data management and capabilities, 2) experience with quality control and quality assurance of remote sensing datasets using these languages, 3) experience plotting and representation of geospatial datasets, 4) improved teamwork skills by participating in hands-on, collaborative code development, 5) ability to apply common data analysis and hypothesis testing tools for spatial datasets. The overarching goal of this course is for students to gain confidence in using R or Python to solve geospatial data related problems in other research endeavors and acquire experience that provides them with an advantage in the working world.

Structure

This course will be a series of brief lectures followed by a real-world geospatial data problem or task that will be solved using R & Python. It is designed to be very hands-on and involved as coding in this manner is a skill that needs to be practiced, rather than a theory that needs to be learned. Collaborative coding and team-based problem solving will be a large feature of this course as this is how R & Python scientific programmers perform at a high level.

Prerequisites

Graduate Students: Some form of computer programming experience from your undergraduate university and/or prior research experience involving programming.
Undergraduate Students: CISC 106/108, CISC 210, CISC 220, and GEOG/MAST 481/681 or research experience involving programming.

Exceptions to these prerequisites will be permitted on a case by base basis.

Assessment

Coding Assignments (60%) – Each week we will begin a collaborative coding exercise where mimic real-world issues and practice our coding skills. The completion of these coding exercises with deliverables in-hand will be necessary for successful completion of this course. For the Python section, a final project will be given which represents 33% of this portion.

**I encourage collaboration amongst your classmates as solving some coding issues can require an unnecessary amount of time to solve and often these are simple fixes. Analyzing another's code is a useful tool for growing as a programmer. Ultimately, however, what you get out of this course is dependent on the practice you put in.*

Weekly Quizzes (30%) – Each week will begin with a short, timed quiz intended to examine how well students are retaining information. These will all be relative to the previous week's material. The quiz will be posed online and should a student miss the class they will have the opportunity to make it up online within 48 hours of the class.

Participation (10%) – This course is designed in a discussion based, open-lab environment. We're trying to solve environmental problems as a team and participation is necessary for that to be achieved.

Textbook

There will be **no** required textbook for this class. Myself, your colleagues, Stackoverflow & google will be your guides on the quest to learn R & Python. Texts that might be useful (but are NOT required) are

1) Python Programming and Visualization for Scientists by Alex J. Decaria
2) https://geocompr.robinlovelace.net/index.html - Geocomputing in R - FREE
3) https://www.r-spatial.org/ - Spatial Computing in R - FREE
4) http://faculty.marshall.usc.edu/gareth-james/ISL/index.html - Intro to Stats in R - FREE

Additional Notes

- I encourage notes to be taken within Rstudio or a Python IDE so they are easy to reference when you're coding in the future. This also promotes over-zealous commenting which is a highly recommended habit
-This is the first implementation of this course so please be prepared for adjustments to be made during the semester. Everything will be communicated should changes be made.
-Programming is all about trial and error, so if you don't succeed at first, stick with it! Mistakes are necessary during this journey.
- I cannot debug code outside of the course assignments. I don't have time for this & this is beyond the scope of my position here at UD.

Course Outline

Phase 1: Environmental Computing with R - 9/1/2020 to 10/1/2020 – 1cr

9/2: Introduction to Environmental Computing with R, machine set up & RStudio Basics

9/7: R Packages, Syntax, Classes, and Datatypes
9/9: R Packages, Syntax, Classes, and Datatypes

9/14: Time Series Analysis with DEOS Data
9/16: Time Series Analysis with DEOS Data

9/21: Oceanographic Mapping with GOES-16 SST
9/23: Oceanographic Mapping with GOES-16 SST

9/28: Reprojecting & Resampling in R
9/30: Reprojecting & Resampling in R

Phase 2: Spatial Computing with Python – 10/2/2020 to 12/10/2020 – 2cr

10/5: Introduction to spatial computing with Python, Python vs. R, the IDE
10/7: Python Modules, Syntax, Classes, and Datatypes and Environments

10/12: Inroduction to Numpy
10/14: Introduction to Matplotlib

10/19: Xarray Tutorial
10/21: Xarray Tutorial

10/26: Pandas Tutorial
10/28: Pandas Tutorial

11/2: Cartopy Tutorial
11/3: ELECTION DAY GET OUT AND VOTE
11/4: Cartopy Tutorial

11/9: MetPy Tutorial
11/11: MetPy Tutorial

11/16: SciPy Tutorail / Oceanography with Python
11/18: SciPy Tutorial / Oceanography with Python

11/30: Final Project
12/2: Final Project

12/7: Final Project
12/9: **Final Class, Final Project due 12/10 at midnight**