Spring GEOG 473/673: Advanced Programming for Spatial Analysis and Visualization

Pearson 203 – MW 8:40 – 9:55

Phase 1: Spaital Analysis & Visualization in R – 2/10/2020 to 4/17/2020 – 2cr

Phase 2: Investigative Spatial Programming – 4/20/2020 to 5/18/2020 – 1cr

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

Office Hours: By Appointment

Objective

The objective of the spring installment of GEOG 473/673 is to expand on the topics covered in the fall version of GEOG 473/673 – open source environmental computing. The course will be split into 2 phases. The first phase is a 2-credit course focused on using advanced tools within the R programming language. The goal of this phase is for students to gain practical experience with challenging R topics that can be used for generating publication quality material. The second phase is a 1-credit course focused on investigating scientific publications and attempting to replicate research data methods using either R or Python. Through examining and duplicating data-analysis procedures found in research, students will apply R or Python knowledge and gain confidence in using these programming languages via meaningful research applications. This challenging, fast-paced course is intended for students that already have programming experience with R or Python.

Outcomes

By the end of this course, students will have 1) advanced proficiency in R data management and capabilities, 2) experience with quality control and quality assurance statistical methods, 3) understanding of publication level plotting and representation of geospatial datasets, 4) improved teamwork skills by participating in hands-on, collaborative code development, 5) ability to apply advanced data analysis and hypothesis testing tools for spatial datasets. The overarching goal of this course is for students to gain knowledge and experience in employing the use of R or Python to solve geospatial data related research questions.

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. 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 scientific programmers perform at a high level.

Prerequisites

Graduate Students: Exeperience using R or Python.

Undergraduate Students: Strong experience using R or Python.

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 advanced 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: Spaital Analysis & Visualization R - 2/10/2020 to 4/17/2020 – 2cr

2/10: Welcome to advanced R - Tutorial

2/12: Welcome to advanced R - Tutorial

2/17: Basic Statistics with R Tutorial

2/19: Basic Statistics with R Tutorial

2/24: ggplot2 Tutorial

2/26: ggplot2 Tutorial

3/2: Spatial ggplot2 Tutorial

3/4: Spatial ggplot2 Tutorial

3/9: Shapefiles in R

3/11: Shapefiles in R

3/16

3/18

3/23

3/25

3/30: SPRING BREAK

4/1: SPRING BREAK

4/6: R final project

4/8: R final project

4/13: R final project

4/15: R final project

<u>Phase 2: Investigative Spatial Programming - 4/20/2020 to 5/18/2020 – 1cr</u>

4/20: Introduction to Investigative Spatial Programming – A group discussion

4/22: Create Outline

4/27: Project
4/29: Project

5/4: Project
5/6: Project

5/11: Project
5/13: Project & Final Evaluation