GeoComputation I
GTECH 73100
Spring 2022 Syllabus
Version 1 – 1-28-2022

Hours and Location: Thursdays, 5:35 – 9:25pm. Hunter College North Building, 1090B-1.
Instructor: Anthony (Tony) Albanese, anthony.albanese08@myhunter.cuny.edu
Office Hours: Mondays 3-5pm, also by appointment.
Office Location: CARSI LAB – Ring the doorbell to get in
Hunter College North Building
10th Floor, Suite #1023-N

Prerequisites: GTECH 709

Required materials: None

Suggested materials:

This class is taught using the Python programming language. If you are not familiar with Python, there are an incredible array of free resources to learn Python available online, a well-organized list is available at: https://docs.python-guide.org/intro/learning/. Almost every programming concept utilized in class is covered by sections 1-9 of the official Python tutorial: https://docs.python.org/3/tutorial/index.html.

Students are free to choose their preferred development environment and operating system. Outside of the week in which we will be using ArcPy, the entire class can be completed using a text editor and a command line Python interpreter, though this approach is not recommended. PyCharm and VS Code are two popular (and recommended) options for Python development, and for students who would prefer to work online Google Collab supports all the libraries utilized in class – though its current debugging capabilities leave much to be desired. PyCharm is available on computers in the geography lab.

Course Description:

This is a practical, lab and project-based course to introduce the student to computational methods in geography. We will focus on the fundamentals of reading, writing, and debugging code in Python 3 and how to utilize those skills to facilitate geocomputational analysis, modelling, and visualization.

Students will begin the course by learning the basics of Python for geocomputation, starting by setting up a practical development environment and then learning the basics of flow control and objected-oriented programming. Once all students are up to speed with programming, we will move onto covering geospatial specific topics, including working with projections, polygon and raster data, spatial indexing, common software packages (ArcPy, GDAL, Rasterio, Geopandas, etc...), convolution, and, time allowing, advanced techniques such as working with geospatial data in neural networks.

The class will be structured with weekly or semi-weekly lab assignments on which students are encouraged to collaborate and assist each other. The final weeks of the class will consist of the final project, in which students create and present an original project that utilizes the skills learned in class to pursue their own geographic interests. Past final projects have included: Spatial correlation of cancer rates in NYC, urban heat index analysis, traffic incident analysis, dynamic flood mapping with machine learning, and an interactive road quality map for NYC.

Course Objective:

The goal of this course is to make students comfortable reading, writing, and debugging Python code when working with geospatial data. Students should also be familiar with common geospatial libraries and techniques. It is impossible to cover the entire breadth of geocomputation in a single course, so there will be a strong emphasis on reading code and documentation in order to facilitate future autodidactic instruction. This course will also provide the basis for more advanced geographic problem solving in GTECH 73300- GeoComputation II. Students should be able to take the skills learned in this class and apply them both academically and professionally.

Learning Outcome:

By the end of this course, each student is expected to be able to take an idea for a geospatial analysis, model, or other means of answering a geospatial question and develop it into functioning and readable code with reproducible results. This capacity will be demonstrated with the final project.

Course Calendar:

Course calendar is subject to change based on student progress and interests. Please feel free to email me if you have any concerns about the calendar or would like a particular topic covered.

Week	**Topic**	**Homework (Assigned)**
2/4/22	Introduction/Python Basics	Test Development Environment
2/11/22	Python Basics: Flow Control and Functions	Lab #1: Python Basics
2/18/22	Python Basics: Objects and Debugging	Lab #2: Further Python Basics
2/25/22	Projections and GIS Geometry	Lab #3: GIS Geometry
3/3/22	Reading data and intro to geographic data	Lab #4: Working with GeoJSONs
3/10/22	Spatial Library: GeoPandas	Lab #5: Spatial Analysis
3/17/22	Spatial Library: ArcPy	Lab #6: Environmental Inequities
3/24/22	Spatial Library: NumPy and Rasterio	Lab #7: Rasters
3/31/22	Convolution and Image Filtering	Lab #8: Convolution (Two Weeks)
4/7/22	Geospatial Machine Learning and Neural networks	Final Project Proposal
4/14/22	Final Project Discussion – Final project proposals due	Work on Final Project
4/28/22	Advanced Techniques: Agent Based Modeling and Object Oriented Design	Work on Final Project

5/5/22	Advanced Techniques: Simulations	Work on Final Project
5/12/22	Advanced Techniques: Neural Networks/ML cont'd	Work on Final Project
5/19/22	Final Project Presentations	

Course Policies and Recommendations:

Grades:

Lab Assignments: 70% - Each lab will be assessed on whether it produces the correct output, is well commented, and readable. Code provided should be runnable either in a cloud environment or a local machine.

Final Project: 25% - The final project will consist of code which addresses a geospatial problem, a presentation to the class of the outcomes, and a short formal write up of the process. A rubric for the final project will be provided.

Class Engagement: 5% - Professional programming is almost never a solo effort, and students are expected to participate in class and engage with each other. If you would prefer not to engage with the rest of the class, challenging bonus assignments will be provided to fulfill the class engagement requirement (get ready to do some math).

Attendance: Students are expected to attend class in person each week. If you know that you will be unable to attend class, please let me know as soon as possible so that I can prepare materials for what you will be missing. If you have missed class, I will do what I can to get you up to date but in-person lectures will generally not be recorded.

Late Assignments: Assignment due dates will be provided with each assignment and may be flexible depending on class progress. If you know that you will not be able to submit an assignment on time, please let me know. Assignments not submitted by the final class session will not receive credit. Late assignments submitted without warning will be held to a higher grading standard than on-time assignments.

Collaboration: I encourage students but do not require to work together on assignments, though each student should only submit code that they themselves have written.

Questions: Students will have many questions as they work through assignments and gain arcane geocomputational knowledge. There will be mysterious bugs, undocumented behaviors, baffling projection transformations, and other untold problems that come up. Feel free to ask your fellow students for help with these problems or look them up on stackoverflow/stackexchange. If you are uncertain, please email me with any questions. I am happy to assist.

Frustrating Assignments: Students, especially those new to programming, may find some of the assignments frustratingly difficult. The goal of this class is not to frustrate you. If you are stuck on an assignment, my first recommendation would be to take a break – the solution often becomes apparent after walking away for a few minutes or hours. If you would like further guidance on an assignment, please email me. I may be able to help or point you towards learning resources that will help you understand the problem better than my explanations.