GLY 4930/GLY 6932: Introduction to Simulations and Computational Techniques for Earth Sciences

Time: Monday, Wednesday, Friday, 7th period (1:55 PM - 2:45 PM)
Location: 202 Williamson Hall
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Office Hours: Friday, 3 p.m. - 5 p.m., or by appointment, in 219 Williamson Hall

Welcome to GLY4930/GLY6932, Introduction to Simulations and Computational Techniques for Earth Sciences!

This course gives an introduction to programming in Python, using examples from the Earth Sciences. No previous programming knowledge is required. To learn more about the computational techniques given in the learning objectives below, we will use applications relevant to Earth Sciences such as analyzing earthquake magnitudes, plotting geospatial data or how the orientation of dikes is distributed, computing the discharge of a river, analyzing the grain size distribution of rocks, or modeling the carbon cycle.

Course objectives:

- Learning the basics of Python syntax. This includes the very first program (“Hello World!”), indentation, assigning variables, basic math and logic operations, decision making and loops, and input and output of data.
- Building Python programming skills including the development of stand-alone programs, the usage of existing Python packages/modules, function definitions, and program structure best practices.
- Learning fundamental data analysis techniques including basic statistical analysis, plotting and fitting data.
- Learning the basics of numerical simulations including time and space discretization techniques and how to implement them in Python.

Prerequisites: Some basic calculus will be useful because the course will cover statistics and numerical methods for solving equations. However, the focus of the class is on programming, not on math (and no prior programming knowledge is required).

Materials: Both the in-class exercises and the assignments will require a computer to complete them, so it is important that you bring your computer to class. Lectures will be interactive and you will need your computer to follow along. We will use **Colab (https://colab.research.google.com/)** to run python in the browser, so you will not need to install any software.

Textbooks: No textbooks are required.

Assignments and grading

Your grade in this class will be determined by how you do in the 11 programming assignments. In order to receive an A you need to complete 9 out of the 11 assignments (addressing all of the questions) and demonstrate that you can apply the techniques we discuss in class.

What each of these assignments involves and when it is due will be discussed for each assignment individually. I will upload detailed descriptions of each assignment throughout the semester. The assignments will all be programming exercises and you will find that you will do better if you start working on them early (because debugging code always takes longer than one initially expects). There will be no midterm or final exams.

Information on current UF grading policies for assigning grade points can be found here: **catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/ (http://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/)**.

We expect you to submit the assignments on time. They will be due on Tuesday at midnight every week. The assignments will build on each other and we will try to grade them as quickly as possible so that you can learn from mistakes and incorporate feedback on one assignment while working on the next one.

If you submit fewer than 9 assignments or your submissions are incomplete, we will grade the assignments using the grading scale below. In this case, each of the assignments is worth 10% of the grade and the one with the lowest points will be dropped. We will accept late submissions of assignments up to one week after the original due date, and you will receive 85% of the credit. I know there are other things in life that may come up and may prevent you from submitting an assignment on time. That's okay, and that is why the assignment with the lowest score will be dropped.

Grading scale

Name:	**Range:**	
A	100 %	to 94.0%

Name:	Range:	
A-	< 94.0 %	to 90.0%
B+	< 90.0 %	to 87.0%
B	< 87.0 %	to 84.0%
B-	< 84.0 %	to 80.0%
C+	< 80.0 %	to 77.0%
C	< 77.0 %	to 74.0%
C-	< 74.0 %	to 70.0%
D+	< 70.0 %	to 67.0%
D	< 67.0 %	to 64.0%
D-	< 64.0 %	to 61.0%
F	< 61.0 %	to 0.0%

Schedule

Week 1	Introduction: Python and google Colab
Week 2	Loading and plotting data: The Earth's Topography
Week 3	Plotting data on a map: Earthquake locations
Week 4	Basic programming syntax: Conditionals, Loops and Functions
Week 5	Analyzing data using Pandas Dataframes: Earthquake depth and magnitude
Week 6	Advanced plotting and fitting data: The age of the Universe
Week 7	Using functions in real-world applications: Ice sheets
Week 8	Ordinary differential equations: Heat flux
Week 9	Initial Value Problems and coupled ordinary differential equations: Predator-Prey
Week 10	Numerical Integration: Atmospheric Carbon and Changing Sea Level
Week 11	Space- and Time-dependent problems: Advection, Diffusion, Waves
Week 12	Fourier transform: Volcanic Tremor & Milankovitch Cycles
Week 13	Image Processing: Counting Seamounts
Week 14	Debugging (Thanksgiving week)
Week 15	AI/Machine learning: Classifying Landscapes
Week 16	Bring your own example programming problem!

Attendance and make-up exams

Requirements for class attendance and make-up exams, assignments, and other work in this course are consistent with university policies that can be found at: **catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/ (http://catalog.ufl.edu/UGRD/academic-regulations/attendance-policies/)**

Accommodations for students with disabilities

Students with disabilities who experience learning barriers and would like to request academic accommodations should connect with the disability Resource Center by visiting **https://disability.ufl.edu/students/get-started/ (https://disability.ufl.edu/students/get-started/)** . It is important for students to share their accommodation letter with their instructor and discuss their access needs, as early as possible in the semester.

Online course evaluation

Students are expected to provide professional and respectful feedback on the quality of instruction in this course by completing course evaluations online via GatorEvals. Guidance on how to give feedback in a professional and respectful manner is available at **gatorevals.aa.ufl.edu/students/ (http://gatorevals.aa.ufl.edu/students/)** . Students will be notified when the evaluation period opens, and can complete evaluations through the email they receive from GatorEvals, in their Canvas course menu under GatorEvals, or via **ufl.bluera.com/ufl/**

(http://ufl.bluera.com/ufl/). Summaries of course evaluation results are available to students at gatorevals.aa.ufl.edu/public-results/ (http://gatorevals.aa.ufl.edu/public-results/).

The university's honesty policy

UF students are bound by The Honor Pledge which states, "We, the members of the University of Florida community, pledge to hold ourselves and our peers to the highest standards of honor and integrity by abiding by the Honor Code. On all work submitted for credit by students at the University of Florida, the following pledge is either required or implied: "On my honor, I have neither given nor received unauthorized aid in doing this assignment." The **Conduct Code** (https://sccr.dso.ufl.edu/process/student-conduct-code/) specifies a number of behaviors that are in violation of this code and the possible sanctions. If you have any questions or concerns, please talk to us about them.

Campus Resources: Health and Wellness

- *U Matter, We Care*: If you or someone you know is in distress, please contact **umatter@ufl.edu** (mailto:umatter@ufl.edu), 352-392-1575, or visit **U Matter, We Care** (https://umatter.ufl.edu/) website to refer or report a concern and a team member will reach out to the student in distress.
- *Counseling and Wellness Center*: Visit the **Counseling and Wellness Center website** (https://counseling.ufl.edu/) or call 352-392-1575 for information on crisis services as well as non-crisis services.
- *Student Health Care Center*: Call 352-392-1161 for 24/7 information to help you find the care you need, or visit the **Student Health Care Center website** (https://shcc.ufl.edu/).
- *University Police Department*: Visit **UF Police Department website** (https://police.ufl.edu/) or call 352-392-1111 (or 9-1-1 for emergencies).
- *UF Health Shands Emergency Room / Trauma Center*: For immediate medical care call 352-733-0111 or go to the emergency room at 1515 SW Archer Road, Gainesville, FL 32608; Visit the **UF Health Emergency Room and Trauma Center website** (https://ufhealth.org/emergency-room-trauma-center).
- *GatorWell Health Promotion Services*: For prevention services focused on optimal wellbeing, including Wellness Coaching for Academic Success, visit the **GatorWell website** (https://gatorwell.ufsa.ufl.edu/) or call 352-273-4450.

Academic Resources

- *E-learning technical support*: Contact the **UF Computing Help Desk** (http://helpdesk.ufl.edu/) at 352-392-4357 or via e-mail at **helpdesk@ufl.edu.** (mailto:helpdesk@ufl.edu.)
- ***Career Connections Center*** (https://career.ufl.edu/): Reitz Union Suite 1300, 352-392-1601. Career assistance and counseling services.
- ***Library Support*** (https://cms.uflib.ufl.edu/ask): Various ways to receive assistance with respect to using the libraries or finding resources.
- ***Teaching Center*** (https://teachingcenter.ufl.edu/): Broward Hall, 352-392-2010 or to make an appointment 352-392-6420. General study skills and tutoring.
- ***Writing Studio*** (https://writing.ufl.edu/writing-studio/): 2215 Turlington Hall, 352-846-1138. Help brainstorming, formatting, and writing papers.
- *Student Complaints On-Campus*: Visit the **Student Honor Code and Student Conduct Code webpage** (https://sccr.dso.ufl.edu/policies/student-honor-%20code-student-conduct-code/) for more information.

In-Class Recording

Students are allowed to record video or audio of class lectures. However, the purposes for which these recordings may be used are strictly controlled. The only allowable purposes are (1) for personal educational use, (2) in connection with a complaint to the university, or (3) as evidence in, or in preparation for, a criminal or civil proceeding. All other purposes are prohibited. Specifically, students may not publish recorded lectures without the written consent of the instructor.

A "class lecture" is an educational presentation intended to inform or teach enrolled students about a particular subject, including any instructor-led discussions that form part of the presentation, and delivered by any instructor hired or appointed by the University, or by a guest instructor, as part of a University of Florida course. A class lecture does not include lab sessions, student presentations, clinical presentations such as patient history, academic exercises involving solely student participation, assessments (quizzes, tests, exams), field trips, private conversations between students in the class or between a student and the faculty or lecturer during a class session.

Publication without permission of the instructor is prohibited. To "publish" means to share, transmit, circulate, distribute, or provide access to a recording, regardless of format or medium, to another person (or persons), including but not limited to another student within the same class section. Additionally, a recording, or transcript of a recording, is considered published if it is posted on or uploaded to, in whole or in part, any media platform, including but not limited to social media, book, magazine, newspaper, leaflet, or third party note/tutoring services. A student who publishes a recording without written consent may be subject to a civil cause of action instituted by a person injured by the publication and/or discipline under UF Regulation 4.040 Student Honor Code and Student Conduct Code.