

GLY4930/GLY6932 Course Syllabus

Data Science and Machine Learning Methods in the Geosciences

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Location: Williamson 218

Time: Fridays 10:40-11:30 AM

Office hours: Wednesdays 4-5 PM and by appointment

Welcome to GLY4930/GLY6932, Data Science and Machine Learning Methods in the Geosciences!

This course provides an introduction to data science and machine learning methods in Python using examples in the Earth Sciences. This course will introduce students to both the theory as well as implementation considerations when conducting data science analysis in geoscience topics. It is taught in a hybrid format, where the majority of the lectures will be pre-recorded and posted on Canvas. We will meet in person once per week to discuss applications.

Course objectives:

By the end of this course, students should be able to:

- Use and apply common analytical and machine learning tools in Python including data transformations, supervised learning, unsupervised learning, Bayesian statistics, and interpolation.
- Identify the tools and techniques that are best suited for a given geological problem or objective.
- Interpret outputs from machine learning algorithms and recognize any pitfalls.
- Discuss and critically evaluate machine learning analyses.

Prerequisites: Calculus and programming proficiency in MATLAB, R, Python, or C/C++ are required. Linear algebra and programming experience in Python are recommended. The first two weeks will be devoted to refreshing Python and linear algebra skills.

Materials: The assignments will require a computer for completion.

Textbooks: No textbooks are required.

Assignments and grading: Your grade in this course will be determined by how you do in 10 programming assignments, 15 weekly quizzes, and a final project. The homework assignments and deadlines will be discussed individually throughout the semester. The lowest homework score will be dropped. There will be a short (~3 questions) multiple choice online quiz each week based on the online video lectures. For students enrolled in GLY4930, the final project will be a written proposal to do research involving machine learning in the geosciences. Students enrolled in GLY6932 will conduct a research project involving the application of a machine

learning method to a geological problem. This will culminate in a final report and oral presentation for both GLY4930 and GLY6932 students. There will be no exams.

Homeworks are worth 60% of the grade, the final project is 30%, and the online quizzes are 10%. The homework with the lowest grade will be dropped. Homeworks will be marked down 10% for every day they are late until they reach 50%. They will be accepted up to a week late. I understand that things happen that may prevent you from turning in an assignment. That is why the lowest score is dropped. Homeworks can be resubmitted to gain back up to 50% of missed answers. Resubmitted assignments must be submitted within one month of the original due date.

Online quizzes are due before class each week with no exceptions.

Grading scale:

A	94-100%
A-	90-94%
B+	87-90%
B	84-87%
B-	80-84%
C+	77-80%
C	74-77%
C-	70-74%
D+	67-70%
D	64-67%
D-	61-64%
F	<61%

UF grading policy: <https://catalog.ufl.edu/UGRD/academic-regulations/grades-grading-policies/>

Schedule:

Week 1	Introduction to AI/ML. Python review
Week 2	Linear algebra, data transformations, principal component analysis, and dimension reduction
Week 3	Regression analysis, and overfitting
Week 4	Unsupervised learning, clustering, compositional analysis
Week 5	Intro to probability theory. Proposal writing. Project milestone for GLY4930: a brief statement on final project topic selection Project milestone for GLY69320: final project

	proposal
Week 6	Bayes theorem
Week 7	Markov Chain Monte Carlo and uncertainty quantification
Week 8	Decision trees, K-NN, and classification
Week 9	Geostatistics and variogram modeling
Week 10	Deterministic interpolation
Week 11	Geostatistical simulation
Week 12	Extreme value theory
Week 13	Neural network and computer vision basics
Week 14	Special topics in ML/AI Final presentations
Week 15	Special topics in ML/AI Final presentations, continued

Honor code:

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 specifies a number of behaviors that are in violation of this code and the possible sanctions. Click [here](#) to read the Conduct Code. If you have any questions or concerns, please consult with the instructor or TAs in this class.

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 guest 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.

Campus Resources:

- *U Matter, We Care:* If you or someone you know is in distress, please contact umatter@ufl.edu, 352-392-1575, or visit [U Matter, We Care](#).
- 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](#).
- 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](#).
- *University Police Department:* Visit [UF Police Department website](#).
- 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](#).
- *GatorWell Health Promotion Services:* For prevention services focused on optimal wellbeing, including Wellness Coaching for Academic Success, visit the [GatorWell website](#).
- or call 352-273-4450.

Academic Resources

- *E-learning technical support:* Contact the [UF Computing Help Desk](#).
- at 352-392-4357 or via e-mail at helpdesk@ufl.edu.
- [Career Connections Center](#).
- : Reitz Union Suite 1300, 352-392-1601. Career assistance and counseling services.
- [Library Support](#).

- : Various ways to receive assistance with respect to using the libraries or finding resources.
- Teaching Center.
- : Broward Hall, 352-392-2010 or to make an appointment 352-392-6420. General study skills and tutoring.
- 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 for more information.