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UNIVERSITY OF WISCONSIN–MADISON

Course Syllabus-F&W ECOL 458, Spring 2026

General Course Information

Course Number and Title
F&W ECOL 458: Environmental Data Science

Number of Credits
3

Course Designations and Attributes
LAS – Intermediate, 50% Graduate Coursework

Course Description
Introduces fundamental machine learning techniques for numerical modeling and data analysis and modern computer programming tools used to analyze, prepare, and visualize data from common formats of datasets in the field of Earth and environmental sciences. Emphasizes opportunities to consider real-world applications for concepts in environmental data science.

Requisites
STAT 240, 301,324, 371 or Graduate/Professional Standing

Meeting Time and Location
WF 2:30-3:45 pm @ 228 Russell Labs

Instructional Modality
In-person

How Credit Hours Are Met by the Course
This class meets for two, 75-minute class periods each week over the spring semester (3 hours per week, 42 hours in total). The students are expected to work on course learning, reading course materials, completing homework tasks, and practicing activities for about 6-7 hours outside the classroom every week, 93 hours in total.

Regular and Substantive Student-Instructor Interaction

A qualified instructor will interact regularly and substantively with students through direct instruction during face-to-face class meetings twice a week and through personalized feedback on the weekly homework assignments. Students can ask questions anytime during class and after class by appointment.

Other Course Information

Instructor and Teaching Assistants

Instructor: Min Chen, Assistant Professor
Instructor Availability: by appointment
Instructor Email: min.chen@wisc.edu
Teaching Assistant: N/A

Course Learning Outcomes

1. Demonstrate introductory skills in using collaboration technology (e.g., Jupyter Notebooks) to write, edit, and run programs in a scientific programming language (e.g., Python);
2. Recognize, read, write, and use common environmental dataset formats;
3. Use a scientific programming language (e.g,. Python) to read and process environmental data;
4. Produce visualizations of environmental data, including basic scientific charts, statistics, and maps;
5. Understandthe fundamentals of modern machine learning algorithms and gain experience with their practical use;
6. Solve real-world data science problems individually and in teams;
7. Identify the frontiers in real-world environmental science challenges and how data science can help;
8. Identify a problem in environmental science that may be solved or better understood through data science, and provide a basic visualization or analysis of a data set associated with that problem; (Undergraduate-only)
9. Develop in-depth spatial and temporal analyses using advanced data science tools such as machine learning, visualize datasets related to your research or anticipated area of research that meet the standards of scientific journals, critically evaluate your findings, and situate them within the larger context of current research literature; (Graduate-only)

Grading

- Homework + Random Quizzes: 60%
- Final project: 40%
- Grade cutoffs may be adjusted downward based on the performance of the entire

class; they will not be adjusted upward:

- A: 90-100%
- AB: 85-89%
- B: 80-84%
- BC: 75-79%
- C: 70-74%
- D: 60-69%
- F: 0-59%

Course Website

N/A

Discussion Sessions

None

Laboratory Sessions

None

Class Schedule

Meeting Dates	Topic
Jan 21, 23	Course overview; Introduction to the programming environment; Markdown
Jan 28, 30	git/GitHub
Feb 4, 6	Fundamentals of Python
Feb 11, 13	Python Scientific packages; Statistics with Python; Introduction to optimization
Feb 18, 20	Data visualization
Feb 25, 27	Analyzing time series data; Analyzing spatial data 1
Mar 4, 6	Analyzing spatial data 2 and 3
Mar 11, 13	Fundamentals of Machine learning; Linear regression and logistic regression
Mar 18, 20	ML topics 1-2 (e.g., Supporting Vector Machine; Naive Bayes Classification)
Mar 25, 27	ML topics 3-4 (e.g., KNN; K-Means)

Apr 1, 3	Spring recess; No class
Apr 8, 10	ML topics 5-6 (e.g., Decision trees and random forests)
Apr 15, 17	ML topics 7-8 (e.g., Artificial Neural Networks and Deep Learning)
Apr 22, 24	Other things you need to know; Guest lecture
Apr 29, May 1	AI tools; Questions and Answer session; Final project presentations
May 6, 8	Final project presentations; Final project paper due

Required Textbook, Software & Other Course Materials

The students will need to bring their laptops to the classes.
No Textbook is required and the course materials will be published on the course website before the classes. The instructor will provide the data to be used as examples in the classes.

Readings

Burkov, A. (2019). The Hundred-page Machine Learning Book.

Python Data Science Handbook by Jake VanderPlas, available at https://jakevdp.github.io/PythonDataScienceHandbook/

Homework & Other Assignments

Students must do weekly coding-based homework. There will be no homework assignments due during the first or last couple of weeks of the semester or the guest lecture week, for a total of ~11 homework assignments. Homework writings that demonstrate the results should be uploaded through a personal private Github repository shared with the instructor, and the associated codes should be updated on their Github workspace. Homework is due before the class after the week of the assignment release.

Late homework will not be accepted unless it is discussed with the instructor beforehand and permission is granted.

Exams, Quizzes, Papers & Other Major Graded Work

No exam.

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Quizzes:
There may be a few random quizzes (possibly none) covering basic course content. Each quiz will be announced at least one week in advance.

Final Project:
The final project is a team-based research project focused on addressing an environmental science challenge using data science approaches. Teams (3-5 students/team) may be self-formed or assigned by the instructor once course enrollment stabilizes and will remain fixed for the remainder of the semester.
The instructor will provide a set of predefined research questions, each designed with a different level of complexity and technical challenge. Student teams will select one project based on their interests and academic background. Evaluation criteria and scoring strategies will be aligned with the selected project's level of challenge to ensure fair assessment. Predefined project options will be released around mid-March, with team selections due by early April. Teams may also propose self-defined project ideas; such proposals must be approved by the instructor and are likewise due by early April.

Final deliverables include a technical project paper and an accompanying Colab Notebook, written in the format of a peer-reviewed scientific article with sections for Introduction, Methods, Results, Discussion, and References. All analyses must be clearly documented, reproducible, and professionally presented. Teams will also give a final presentation summarizing their work.

This course includes both undergraduate and graduate students. While all students will follow the same project structure, evaluation expectations differ by academic level. Undergraduate students will be evaluated on correct application of course concepts, completeness of analysis, and clarity of communication. Graduate students are expected to demonstrate greater depth and rigor, including the use of advanced data science methods, stronger synthesis with primary literature, and more critical evaluation of methods and results.

Final projects will be evaluated based on level of challenge, completeness and technical rigor (relative to project complexity), quality of the final paper, quality of the presentation, and professionalism in teamwork. Detailed scoring guidelines will be released with the predefined research questions.

Policy on AI Tool Usage
Philosophy AI tools like ChatGPT, Claude, Gemini, and similar systems are transforming how scientists write code and analyze data. Learning to use these tools effectively is a genuine professional skill. However, AI tools amplify your capabilities; they don't replace them. A scientist who doesn't understand array indexing cannot effectively debug an AI-generated spatial analysis

script. A researcher who doesn't grasp the assumptions behind a random forest model cannot critically evaluate whether it is appropriate for their environmental question.
This course, therefore, permits and encourages AI tool usage, with requirements designed to ensure you build a genuine understanding alongside AI proficiency.

Permitted Uses

- Debugging code you have written or attempted to write
- Explaining error messages or unexpected behavior
- Learning syntax for unfamiliar libraries (e.g., How do I read a NetCDF file with xarray?)
- Generating boilerplate code that you then customize (e.g., basic plotting templates)
- Exploring alternative approaches to problems you've already attempted
- Improving code clarity, documentation, or efficiency after you have a working solution

Requirements for AI-Assisted Work

Maintain an AI_LOG.md file in your GitHub repository. For each assignment where you use AI tools, document:

- The prompt(s) you used
- A summary of the AI's response
- What you kept, modified, or rejected, and why
- What you learned from the interaction

Prohibited Uses

- Submitting AI-generated code that you cannot explain line-by-line
- Using AI during in-class coding challenges or quizzes
- Having AI write your final project narrative sections without substantial revision in your own voice
- Claiming AI-generated work as entirely your own by omitting AI_LOG documentation

Verification Methods

The instructor may ask you to explain your code during brief oral check-ins (5-10 minutes, scheduled or random). Think of them as practice for research lab meetings where you will present your analytical approaches to colleagues.

Privacy of Student Records & the Use of Audio Recorded Lectures Statement

Lecture materials and recordings for this course are protected intellectual property at UW-Madison. Students in this course may use the materials and recordings for their personal use related to participation in this class. Students may also take notes solely for their personal use. If a lecture is not already recorded, you are not authorized to record my lectures without my permission unless you are considered by the university to be a qualified student with a disability requiring accommodation. [Regent Policy Document 4-1] Students may not copy or have lecture materials and recordings outside of class, including posting on internet sites or selling to commercial entities. Students are also prohibited from providing or selling their personal notes to anyone else or being paid for taking notes by any person or commercial firm without the instructor's express written permission. Unauthorized use of these copyrighted lecture materials and recordings constitutes copyright infringement and may be addressed under the university's policies, UWS Chapters 14 and 17, governing student academic and non-academic misconduct.

Course Evaluations

Students will be provided with an opportunity to evaluate this course and your learning experience. Student participation is an integral component of this course, and your confidential feedback is important to me. I strongly encourage you to participate in the course evaluation.

Digital Course Evaluation (AEFIS)

UW-Madison uses a digital course evaluation survey tool called AEFIS. For this course, you will receive an official email two weeks prior to the end of the semester, notifying you that your course evaluation is available. In the email you will receive a link to log into the course evaluation with your NetID. Evaluations are anonymous. Your participation is an integral component of this course, and your feedback is important to me. I strongly encourage you to participate in the course evaluation.

Diversity & Inclusion Statement

Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals. The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from every background – people who as students, faculty, and staff serve Wisconsin and the world.

Academic Integrity Statement

By virtue of enrollment, each student agrees to uphold the high academic standards of the University of Wisconsin-Madison; academic misconduct is behavior that negatively impacts the integrity of the institution. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these previously listed acts are examples of misconduct that may result in disciplinary action. Examples of disciplinary action include, but is not limited to, failure on the assignment/course, written reprimand, disciplinary probation, suspension, or expulsion.

Accommodations for Students with Disabilities Statement

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The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), and UW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform faculty [me] of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Faculty [I], will work either directly with the student [you] or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA. (See: McBurney Disability Resource Center)