

UNIVERSITY OF WYOMING**MATH 5490 40****Machine Learning in Applied Sciences (3 credit hours)****Spring 2026****Online-Asynchronous****Instructor contact information:**

Dr. Stefan Heinz, Ross Hall 214, 766-4203, heinz@uwyo.edu

Office hours:

In person: TW 2:30 – 4:00 pm after email notification at least one hour before
Zoom <https://uwyo.zoom.us/j/94458377115>: by appointment

Course prerequisites, co-requisites, enrollment restrictions:

Grade of C or better in MATH 2205, MATH 2250 or 2310, basic programming skills
(ability to program basic machine learning algorithms; data reading, writing, plotting)

Preliminary Course Description:

- a) **Basic methods:** regression, artificial neural networks, genetic-expression programming, random forest, decision trees, cluster analysis, support vector machine methods, Gaussian mixture models
- b) **Applications:** spectrum of applications covering daily-life problems, atmospheric science, engineering, geology & geophysics, economics, health, life sciences
- c) **Physics-informed machine learning (ML):** focus on physics-informed neural network applications to fluid dynamics type problems (including e.g. sparse and incomplete data, causality questions)
- d) **Predictive ML in applied sciences:** ML methods suffer from their rather limited ability to provide reliable predictions if used outside of training. We will discuss the design of predictive ML: requirements and promising developments will be presented.

Student Learning Outcomes:

Understanding of how real-world problems can be analyzed and explained on the basis of machine learning (ML) methods. Ability to actively use ML methods for model design and data analysis.

Recommended texts, readings, and special tools or materials:

No specific textbook is used. Course materials will be provided by PDF lecture notes and related videos.

General requirements and expectations for the course:

- 1) Course materials will be provided by PDF files and related videos, which will be usually posted on Tuesdays and Thursdays.
- 2) The grading is based on at least one office visit, homework, a written research report, and a talk given on the research report.
- 3) There will be homework posted usually once a week. You should submit your responses as a PDF file after one week via WyoCourses.
- 4) The main course requirement is the writing of a research report. After double checking with me, you may pick a topic of your choice (not only simple regression applications). The task is to demonstrate the use of machine learning (ML) methods to address questions of practical relevance. This includes your implementation of ML methods and applications. Consider the writing of about 10 pages of text followed by an appropriate amount of plots, references, and a copy of your program. I'll provide more details regarding the research report requirement in my first lecture. Please note that your development of a project report idea is a part of the research report presentation.
- 5) The research paper related talks will probably take place on Tuesdays and Thursdays, April 2, 7, 9. The plan is to have zoom presentations or talks in person, up to 15 minutes including questions and answers. We should set up these presentations by beginning of February, see the dates below. Please let me know the sooner the better about your availability in the afternoons of these dates. Everybody should see at least 8 talks. There will be no video postings during this time.

Preliminary Due Dates:

Action	Deadline/Dates	Week
Availability for research paper talks in April	R, Feb. 5	3
Placeholder research paper idea (can be changed)	R, Feb. 26	6
Spring break		9
Research paper first version	R, March 26	10
Research paper talks	RTR, April 2, 7, 9	11-12
S. Heinz: research paper revision recommendations	R, April 16	13
Research paper final version	R, May 7	16

Grading Scale and Grading Policies:

Grading Scheme

5%	at least one office visit to prepare research
30%	homework (evidence of video watching)
45%	written research report
20%	talk related to research report

Grade Requirements

A	> 90%
B	> 80%
C	> 70%
D	< 60%

Academic Freedom and Institutional Discrimination:

UW Regulation 2-15 on Academic Freedom states, "Academic freedom in teaching protects the rights of Academic Personnel to teach according to their expertise. Academic Personnel are entitled to freedom in discussing their subject. Academic Personnel have a responsibility to ensure that their teaching is effective and consistent with the standards of the discipline, understanding that disciplines may have diverse points of view on any given subject. Teaching may involve controversial material; however, with academic freedom in the classroom, Academic Personnel also have the responsibility to respect others' freedom to express disagreement and alternate opinions." Additionally, "Academic freedom does not negate the rights of students and the public to disagree with Academic Personnel's work, although students are expected to learn material with which they may disagree." Also adopted by UW in its Academic Freedom policy, "Students should be free to take reasoned exception to the data or views offered in any course of study and to reserve judgment about matters of opinion, but they are responsible for learning the content of any course of study for which they are enrolled."

Classroom Behavior Policy:

At all times, treat your presence in the classroom and your enrollment in this course as you would a job. Act professionally, arrive on time, pay attention, complete your work in a timely and professional manner, and treat all deadlines seriously. You will be respectful towards your classmates and instructor. Spirited debate and disagreement are to be expected in any classroom and all views will be heard fully, but at all times we will behave civilly and with respect towards one another. Personal attacks, offensive language, name-calling, and dismissive gestures are not warranted in a learning atmosphere. As the instructor, I have the right to dismiss you from the classroom and other areas where disruptive behavior occurs. Electronic devices such as mobile phones should be set to silent.

Classroom Statement on Diversity:

The University of Wyoming values an educational environment that supports students of all backgrounds and viewpoints. Diversity of viewpoints is considered a resource for learning. Topics may be difficult, not only intellectually but emotionally; however, discussions are essential to meeting the course's student learning outcomes and assisting students in developing problem-solving and critical-thinking skills. During all conversations, respect and civility are of utmost importance.

Disability Support:

The University of Wyoming is committed to providing equitable access to learning opportunities for all students. If you have a disability, including but not limited to physical, learning, sensory or psychological disabilities, and would like to request accommodations in this course due to your disability, please register with and provide documentation of your disability as soon as possible to Disability Support Services (DSS), Room 128 Knight Hall. You may also contact DSS at (307) 766-3073 or udss@uwyo.edu. It is in the student's best interest to request accommodations within the first week of classes, understanding that accommodations are not retroactive. Visit the DSS website for more information at: www.uwyo.edu/udss.

Academic Dishonesty Policies:

Academic dishonesty will not be tolerated in this class. Cases of academic dishonesty will be treated in accordance with UW Regulation 2-114. The penalties for academic dishonesty can include, at my discretion, an "F" on an exam, an "F" on the class component exercise, and/or an "F" in the entire course. Academic dishonesty means anything that represents someone else's ideas as your own without attribution. It is intellectual theft - stealing - and includes (but is not limited to) unapproved assistance on examinations, plagiarism (use of any amount of another person's writings, blog posts, publications, and other materials without attributing that material to that person with citations), or fabrication of referenced information. Facilitation of another person's academic dishonesty is also considered academic dishonesty and will be treated identically.

AI Technology:

Students are not permitted to use advanced automated artificial intelligence on assignments in this course. Each student is expected to complete each assignment without substantive assistance from others, including automated tools.

Duty to Report:

UW faculty are committed to supporting students and upholding the University's non-discrimination policy. Under Title IX, discrimination based upon sex and gender is prohibited. If you experience an incident of sex- or gender-based discrimination, we encourage you to report it. While you may talk to a faculty member, understand that as a "Responsible Employee" of the University, the faculty member MUST report information you share about the incident to the university's Title IX Coordinator (you may choose whether you or anyone involved is identified by name). If you would like to speak with someone who may be able to afford you privacy or confidentiality, there are people who can meet with you. Faculty can help direct you or you may find info about UW policy and resources at <http://www.uwyo.edu/reportit>. You do not have to go through the experience alone. Assistance and resources are available, and you are not required to make a formal complaint or participate in an investigation to access them.

Green Dot Program at UW:

Here at The University of Wyoming, we are committed to reducing and preventing power-based personal violence such as sexual assault, relationship violence, and stalking. Green Dot is a bystander intervention program to reduce these forms of violence with one thought; If everyone does one thing, no one will have to do everything. A Green Dot is your choice at any moment to make campus safer by promoting safety for everyone and letting others know that you will not tolerate violence. A Green Dot is any behavior, choice, word or attitude that sends a clear message that: 1. Violence is not okay with you, and 2. Everyone is expected to do their part. Additional information on Green DOT training and resources are available at: <http://www.uwyo.edu/greendot/>

Substantive changes to syllabus:

All deadlines, requirements, and course structure is subject to change if deemed necessary by the instructor. Students will be notified verbally in class, on our WyoCourses page announcement, and via email of these changes."

Student Resources:

DISABILITY SUPPORT SERVICES:

udss@uwyo.edu, 766-3073, 128 Knight Hall, www.uwyo.edu/udss

COUNSELING CENTER:

uccstaff@uwyo.edu, 766-2187, 766-8989 (After hours), 341 Knight Hall, www.uwyo.edu/ucc

ACADEMIC AFFAIRS:

766-4286, 312 Old Main, www.uwyo.edu/acadaffairs

DEAN OF STUDENTS OFFICE:

dos@uwyo.edu, 766-3296, 128 Knight Hall, www.uwyo.edu/dos

UW POLICE DEPARTMENT:

uwpd@uwyo.edu, 766-5179, 1426 E Flint St, www.uwyo.edu/uwpd

STUDENT CODE OF CONDUCT WEBSITE:

www.uwyo.edu/dos/conduct