

UNIVERSITY OF WYOMING

MATH 5490 40

Machine Learning for Fluid Dynamics (3 credit hours)

Spring 2024

Online-Asynchronous

Instructor contact information:

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

Office hours:

In person: MW 2:30 – 4:00 pm after email notification at least one hour before
Zoom <https://uwyo.zoom.us/j/95503109939>: 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)

Course Description:

Machine learning techniques are used for the design of models, relationships, data analysis. Emphasis is placed on fluid flow problems that are relevant to real-world engineering and atmospheric science problems.

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 2 office visits, 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 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 relevance to fluid dynamics (engineering and atmospheric science problems). 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 writing.
- 5) The research talk related talks will probably take place on Tuesdays and Thursdays, April 9, 11. The plan is to have zoom presentations or talks in person, up to 20 minutes including questions and answers. We should set up these presentations by the end of January, see specific due dates below. Please let me know the sooner the better about your availability in the afternoons of these dates. Everybody should see these talks except there is a valid excuse. There will be no video postings during this week.

Specific Due Dates:

| Action | Deadline/Dates | Week |
|---|-----------------|------|
| Availability for research paper talks April 9, 11 | R, Feb. 1 | 3 |
| Placeholder research paper idea (can be changed) | R, Feb. 29 | 7 |
| Research paper first version | R, March 28 | 11 |
| Research paper talks | TR, April 9, 11 | 13 |
| S. Heinz: research paper revision recommendations | R, April 18 | 14 |
| Research paper final version | R, May 9 | 17 |

Grading Scale and Grading Policies:

Grading Scheme

| | |
|-----|---|
| 10% | At least two office visits (one before Feb. 1 th) |
| 30% | Homework (evidence of video watching) |
| 40% | written research report |
| 20% | talk related to research report |

Grade Requirements

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

Classroom Statement on Diversity:

The University of Wyoming values an educational environment that is diverse, equitable, and inclusive. The diversity that students and faculty bring to class, including age, country of origin, culture, disability, economic class, ethnicity, gender identity, immigration status, linguistic, political affiliation, race, religion, sexual orientation, veteran status, worldview, and other social and cultural diversity is valued, respected, and considered a resource for learning.

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.

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.

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

COVID-19 Policies – during this pandemic, you must abide by all UW policies and public health rules put forward by the City of Laramie (or by Natrona County if at UW-Casper), the University of Wyoming and the State of Wyoming to promote the health and well-being of fellow students and your own personal self-care. In particular, you need to follow UW's mask policy. If required, I will inform you about more restrictive mask requirements in my class.