

Syllabus – Spring 2021

PHYS F472Z: Special Topics – Machine Learning

Course Information

Credits	: 1 credit
Meeting Times	: MWF – 10:30 ~ 11:30am, 14 lectures from Mar 26 to Apr 26
Meeting Locations	: Zoom meeting
Course Homepage	: Google Classroom

Instructor Information

Instructor	: Dr. Hyunju Connor
Office	: Elvey 706B
Email	: hkconnor@alaska.edu
Phone	: (907) 474-5421
Website	: https://sites.google.com/a/alaska.edu/hkconnor/
Office Hours	: MW – 3:30 ~ 5:00pm (Zoom meeting) or by appointment (Zoom meeting)

Prerequisites

PHYS 220 and 310, or permission of instructor

Textbook

The notes, workbooks, and reading materials will be made available online.

Supplementary materials:

- Introduction Machine Learning, 4th Edition, Ethem Alpaydin, The MIT Press, 2020.
- Introduction to Machine Learning with Python, Andreas C. Müller, Sarah Guido, O'Reilly Media, Inc, 2016.

Course Description

Introduction to machine learning and applications. 14-lecture, one-credit courses. Python knowledge is required for taking this class.

Course Goals

The main goal of this course is to introduce the basics of machine learning, and help students develop computational tools to explore machine learning principles. The course will build upon beginner level Python knowledge. The course will equip students with the tools to further explore advanced machine learning applications and algorithms. The emphasis will be on the applications rather than rigorous mathematical derivations.

Student Learning Outcomes

- Be able to clean and prepare data sets for machine learning applications.
- Be able to identify feature and target parameters for machine learning models.
- Train different machine learning models using Python Sklearn Toolbox.
- Validate and compare the performance of different machine learning models.
- Use the tools developed in the course for different applications.

Instructional Methods

Three 1-hr online lectures per week for 5 weeks, a total of 14 lectures per semester.

- Synchronous lectures will be held on MWF from 10:30am – 11:30 am via [Zoom meeting](#). Students are expected to attend the virtual lectures at the scheduled time.
- Every Zoom class will be recorded and provided to students via [Google classroom](#) in case that their internet connection is not ideal.

Tentative Course Schedule

The class will only cover most fundamental machine learning principles because of the time limitation. However, the students will be able to further explore introduced Python toolboxes to advance their knowledge on machine learning.

Class	Dates	Topics
1	Mar 26, Friday	Introduction
2	Mar 29, Monday	Python Basics: Numpy
3	Mar 31, Wednesday	Python Basics: Pandas and Sklearn
4	Apr 02, Friday	Regression Analysis: Linear Regression
5	Apr 05, Monday	Regression Analysis: Polynomial Regression
6	Apr 07, Wednesday	Decision Trees
7	Apr 09, Friday	Ensemble Methods
8	Apr 12, Monday	Classification Algorithms
9	Apr 14, Wednesday	Clustering Algorithms
10	Apr 16, Friday	Data Cleaning
11	Apr 19, Monday	Feature and Target Selection
12	Apr 21, Wednesday	Model Training
13	Apr 23, Friday	Error Analysis
14	Apr 26, Monday	Ethical Machine Learning
15	Apr 30, Friday	Project Deadline

Grading:

Quizzes (Best 3 out of 5)	15%
4 Homework Assignments (5% for 1, 10% for 3)	35%
Project (Due by 11:59pm on Apr 30)	50%
Total	100%

The final project will be available from the beginning of the class. The instructor will provide various data sets describing space weather for the students to pick from. The students can also work with a data set of their preference after it's approved by the instructor. The project will include data cleaning, exploratory analysis, feature and target selection, training machine learning models, performance evaluation, and fundamental visualization. The tools developed for homework tasks will be relevant to the final project. Students will submit the codes and project report for the final project. The project report will detail the steps described above as well as a discussion of gained physical understanding and good practices employed during the development of the tasks.

Final grades will be returned as letter grades with plus/minus modifiers. These will be derived from the overall percentage grade. The approximate conversions for each letter grade will be as follows: A+ (>97.5), A(>87.5), A-(>85), B+(>82.5), B(>72.5), B-(>70), C+(>67.5), C(>57.5), C-(>55), D+(>52.5), D(>42.5), D-(>40), F (<40)

Course Policies:

- (a) Quizzes will be given each week at a random date and used as a way of checking and enforcing attendance.
- (b) This introduction-level course covers basics of the machine learning principles. Due to time limitations, there won't be enough time to go through all the algorithms and derivations. Students are highly recommended to read and study the designated supplementary materials by themselves before each class and ask questions during a class, office hours, or by setting up an appointment.
- (c) Homework will be posted and collected through the [Google classroom](#). Please submit your homework on the due date stated in the homework. Late homework will not be accepted without evidence of illness or genuine emergency.
- (d) Students are encouraged to work together on the homework problems. However, the final materials must be their own answers.
- (e) Plagiarism and cheating are not accepted with no exception.

Covid-19 Information

Students should keep up-to-date on the university's policies, practices, and mandates related to COVID-19 by regularly checking this website:

<https://sites.google.com/alaska.edu/coronavirus/uaf/uaf-students?authuser=0>.

Further, students are expected to adhere to the university's policies, practices, and mandates and are subject to disciplinary actions if they do not comply.

Academic Honesty

UAF expects and requires academic honesty from all members of the University community, and takes any act of plagiarism and cheating seriously. It is expected that all assignments, including homework and reports, that are turned in for this course must be the original work of the individual student. Failure to comply with this policy will result in penalty as stipulated under UAF regulations.

Student Protections and Services

Every qualified student is welcome in my classroom. As needed, I am happy to work with you, disability services, veterans' services, rural student services, etc. to find reasonable accommodations. Students at this university are protected against sexual harassment and discrimination (Title IX), and minors have additional protections. As required, if I notice or am informed of certain types of misconduct, then I am required to report it to the appropriate authorities. For more information on your rights as a student and the resources available to you to resolve problems, please go the following site: www.uaf.edu/handbook/.

UA is an AA/EO employer and educational institution and prohibits illegal discrimination against any individual: <https://alaska.edu/nondiscrimination/>.

Your instructor follows the University of Alaska Fairbanks Incomplete Grade Policy: “The letter “I” (Incomplete) is a temporary grade used to indicate that the student has satisfactorily completed (C or better) the majority of work in a course but for personal reasons beyond the student’s control, such as sickness, has not been able to complete the course during the regular semester. Negligence or indifference are not acceptable reasons for an “I” grade.”

Disabilities Services

The UAF Office of Disability Services implements the Americans with Disabilities Act (ADA), and insures that UAF students have equal access to the campus and course materials. Any student who may need assistance with disabilities, should feel free to contact the instructor or directly to the Office of Disabilities Services (208 WHIT) by calling 907- 474-5655, or through email: uaf-disability-service@alaska.edu.

Effective Communication

Students who have difficulties with oral presentations and/or writing are strongly encouraged to get help from the UAF Department of Communication’s Speaking Center (907-474-5470, speak@uaf.edu) and the UAF English’s Department’s Writing Center (907-474-5314, Gruening 8th floor), and/or CTC’s Learning Center (604 Barnette Street, 907-455- 2860).