**Syllabus – Fall 2023**

**PHYS F471M: Machine Learning and Applications**

(14 lectures)

**Course Information**

Credits : 1 credits

Meeting Times : MWF – 13:00 ~ 14:00, 14 lectures from Aug 28 to Sep 29

Meeting Locations : Reichardt Building, Room 138

Course Homepage : Canvas – [Canvas Link](https://canvas.alaska.edu/courses/16521)

**Instructor Information**

Instructor : Dr. Dogacan Su Ozturk

Office : 706 A, Elvey Building

Email : dsozturk@alaska.edu

Office Hours : Wednesdays – 14:30 ~ 15:30, or by appointment

In-person at 706 A, Elvey Building or via Zoom ([Zoom Link](https://alaska.zoom.us/j/87284127251?pwd=RGFKUnNmcU5WOVpvMFBQb1dFOFVXdz09))

**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.

* Students are expected to attend the lectures at the scheduled time.
* The classes will be recorded and provided to students via Canvas or UAF Google Drive.

**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.

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| Class | Dates | Topics |
| 1 | 28 August, Monday | Introduction to Machine Learning |
| 2 | 30 August, Wednesday | Python Basics: Numpy, Matplotlib |
| 3 | 01 September, Friday | Python Basics: Pandas, Seaborn |
| 4 | 04 September, Monday | No Class due to Labor Day Holiday |
| 5 | 06 September, Wednesday | Python Basics: Sklearn |
| 6 | 08 September, Friday | Regression Analysis: Regression [HW1 Due] |
| 7 | 11 September, Monday | Decision Trees, Ensemble Methods |
| 8 | 13 September, Wednesday | Classification Algorithms |
| 9 | 15 September, Friday | Clustering Algorithms [HW2 Due] |
| 10 | 18 September, Monday | Neural Networks |
| 11 | 20 September, Wednesday | Ethical ML |
| 12 | 22 September, Friday | Data Preparation [HW3 Due] |
| 13 | 25 September, Monday | Model Training |
| 14 | 27 September, Wednesday | Error Analysis |
| 15 | 29 September, Friday | Closing Remarks |
|  | 02 October, Monday | Final Project Deadline |

**Grading:**

Quizzes (Best 3 out of 5) 15%

3 Homework Assignments (10% for 1, 15% for 2) 45%

Project (**End of Finals**) 40%

Total 100%

The final project will be available from the beginning of the class. The instructor will provide various data sets 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:**

1. Quizzes will be given each week at a random date and used as a way of checking and enforcing attendance.
2. 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.
3. Homework will be posted and collected through Canvas. 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.
4. Students are encouraged to work together on the homework problems. However, the final materials must be their own answers.
5. 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 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 Americas 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).