NORTHWEST
MISSOURI STATE UNIVERSITY
MARYVILLE | KANSAS CITY

School of Computer Science and Information Systems
44-566 Machine Learning (3 hours)
Spring 2023

Instructor: Dr. Charles Hoot **Email:** hoot@nwmissouri.edu
Phone: 660-562-1801 **Office:** Colden Hall 2163

Office Hrs:

MW 3:00-5:00
TTh 9:30-11:00

Section 1 TR 12:30-1:50 CH 3700

GA:

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Prerequisites: No official prerequisites. You should be comfortable with mathematics and programming. We will pick up some threads in the course with Probability, Linear Algebra, and Calculus. We will not go as in depth as we could, but there are some concepts and applications that you should see. If you are interested in looking at the math in depth, I will provide resources that you can use to improve your understanding of the models and learning techniques we will be applying in class. In terms of programming, we will be using Python, but a lot of what we will do is to use Python as the glue between packages that we will use to create our models.

Textbook : ***No textbooks are required; all materials will be provided through the course website.*** Some supplemental material can be found here:

- Stanford CS 229 – There are some good notes here that go into the mathematics behind the techniques. We will frequently reference these notes to get the deeper mathematical picture of what we are doing. (**http://cs229.stanford.edu**)

In addition to the online references, if you want something you can hold in your hands, there are a couple O'Reilly books that are pretty good.

- Data Science From Scratch – Joel Grus - ISBN 9781491901427 - This book starts with the basics giving a gentle introduction to Python, Math and the basic models. While this book is good on the basics, it doesn't match very well once we get to the models. We will be using the Scikit-Learning package and this book implements techniques in Python. If you plan on writing your own models, this could be helpful.

- Hands-On Machine Learning with SciKit-Learn & Tensor Flow – Aurelien Geron – This book spends less time on the basics and heads right into building and using models. It will be closer to the

path we will tread.

Software and resources: Students must have access to the following:

- Their campus-assigned laptop at every class session
- Github account (Free)
- Github classroom (Free)
- JupyterLab with Jupyter note books. (Free)
- Various tools and libraries as directed by the instructors.
- Lockdown browser (for quizzes)

Course description: This course provides an introduction to machine learning.

Student learning outcomes:

Upon completion of this course, each student should be able to:

1. Work with data to determine needed transformations and create training and test sets.
2. Do basic explorations of the data to guide machine learning
3. Identify the Bias vs Variance tradeoff.
4. Pick an appropriate model and train it.
5. Validate their model.
6. Present/Use their model in an interesting way.
7. Understand the difference between classifiers and predictors.
8. Can use and describe the following kinds of models
    a. Linear and Polynomial Regression
    b. Binary classifiers
    c. Decision Trees
    d. Support Vector Machines
    e. Neural Nets
9. Create an ensemble model.
10. Use and describe the advantages of the Tensor Flow package.
11. Use notebooks and markdown to organize and their work on a project.

Assessment methods: Desired Student outcomes will be assessed via programming and homework assignments, quizzes, midterms, and a final exam.

Instructional methods: Instructional methods include lectures, individual work, and quizzes.

Graded course requirements:

Category	Weight
Attendance	5%
Quizzes	5%
Assignments	20%
Midterm Exams (2)	35%
Final Project	15%
Final Exam	20%
Total	100%

Grading scale:

Undergraduate Credit		Graduate Credit	
Percent Range	**Grade**	**Percent Range**	**Grade**
88-100%	A	90-100%	A
>= 78% and < 88%	B	>= 80% and < 90%	B
>= 68% and < 78%	C	>= 70% and < 80%	C
>= 58% and < 68%	D	>= 60% and < 70%	D
below 58%	F	below 60%	F

Course outline/major topics studied:
This is a tentative schedule and is subject to change. For exact information, including important dates, check the course website.

Tentative Spring 2023 Schedule

Week 1 – Jan 9	Introduction to the course. Jupyter, Python and Notebooks.
Week 2 – Jan 16	Introduction to Python
Week 3 – Jan 23	Getting data, Pandas, Data Frames
Week 4 – Jan 30	**Project Proposal, Friday Feb 3** Exploring the space Classification, Model Evaluation
Week 5 – Feb 6	Model Parameters, Hyper-parameters, Regression, Minimization
Week 6 – Feb 13	Bias vs. Variance Polynomial Regression, Cross validation **Midterm 1, Thursday Feb 16 in class**
Week 7 – Feb 20	Gradient Descent Decision Trees
Week 8 – Feb 27	Regularization, Data selection, PCA **Project Milestone 1, Friday Mar 3**
Week 9 – Mar 6	**Spring Break – No Class**
Week 10 – Mar 13	K-means clustering
Week 11 – Mar 20	SVM and Kernals **Project Milestone 2, Friday Mar 24**
Week 12 – Mar 27	Neural Nets, Perceptrons **Midterm 2, Thursday March 30 in class**
Week 13 – Apr 3	Neural Nets, back propagation, deep learning, activation functions
Week 14 – Apr 10	**Project Milestone 3, Friday Apr 14** Convolutional Neural Nets **Ensemble learning**
Week 15 – Apr 19	Tensor Flow
Week 16 – Apr 26	**Project presentations** **Final Project Submission, Thursday Apr 27**
Week 17 – May 3 Finals Week	**Final Exam** Tuesday, May. 2 at 4:10 pm - 6:10 pm

Note: Course schedule is subject to change with instructor notification and students will be responsible for abiding by these changes.

Academic Calendar: *http://www.nwmissouri.edu/academics/calendar.htm*

Final Exam Schedule: *http://www.nwmissouri.edu/registrar/finals.htm*

Programming Assignments
All programming assignment are to be submitted electronically on GitHub classroom by 11:59pm of the due date. Work can be submitted late up to 24 hours, but will be assessed a penalty of 10% of the maximum possible score on the assignment. Any work submitted after the late period will receive **NO** credit. The number of points for an assignment may vary depending on the difficulty of the assignment.

Homework Assignments
There will be some written homework assignments that will be assigned as needed. Those assignments will be due at the beginning of the class period and will be scanned electronically and then returned immediately. A solution will be posted and students are expected to review them and be ready for a quiz over that material in the next class period. Late submissions will not be accepted and will receive **NO** credit.

Paper Quizzes
Once a written assignment has been submitted, there will be a 10 minute written quiz during the next class period. After a set of material has been covered, there may be an unannounced quiz over that material.

Exams
The midterms and final will be held on the dates specified. If you must miss an exam, it is your responsibility to notify the instructor in person prior to the exam and to provide the instructor with written verification of the reason for your absence. Failure to follow these instructions may result in a grade of zero on the exam.

All quizzes/exams are closed book and no resources are allowed.

No calculators, cell phones, or other electronic devices can be used during exams or quizzes unless explicitly allowed by the instructor.

Final Project

- All students must complete a final project
- The final project will be individual.
- Students will be required to provide a **final project proposal, three milestones, and present a poster for their final project**. (See schedule for dates.0

Grade verification:
Your score on each component will be posted on Canvas as soon as that component has been graded. You are responsible for checking Canvas at least once a week to ensure that your grades are properly posted. ***If there is an error in grading, you must bring that to the attention of the class assistant or instructor within one week of the time the grade is posted. Grades cannot be changed after the one-week period.***

Attendance
You are expected to attend class each day AND BE ON TIME. Attendance will be a factor in your grade. If you must miss class due to a university sponsored event (documented with an excuse signed by the university sponsor prior to the event) or by circumstances considered extenuating by the course instructor, it is your responsibility to inform the instructor class time via email. If the instructor was not notified before class time, the absence will be unexcused. Please refer to the general university policy on attendance at https://www.nwmissouri.edu/policies/academics/Attendance.pdf

Classroom Decorum
Students are required to come to class prepared for the day's activities. That means be in your seat before the class starts, with the textbook, notepaper or notebook and writing instrument. We will start class promptly at the designated time.

Cell phones and pagers must be turned off during class time and are not allowed during exams. Laptop computers and handhelds may be used during class time if they are being used for a class activity, such as taking notes. Students are not to read or send e-mails, text messages, or surf the web during class time. Anyone using an electronic device to give or receive assistance during exams will be in violation of the "Academic Integrity" section of the catalog.

Northwest Online Tools
Course materials are distributed through the course website at Northwest Online. To access the site, go to http://www.nwmissouri.edu/online/. Click the link for Technical Support to see the basic technical requirements your computer system must satisfy. Use the links to configure and test your devices.

Accessing Course Materials

To access course materials go to the Northwest Online site and log in. Your login ID is your Northwest Student Number (S------). Your password is your social security number, or your 919 number, without dashes. If you are a returning online student, your password will be the same as last trimester. During the first week of classes, *all* students are required to visit the site, check that their computer system meets the technical requirements, and complete the Student Orientation Course, which shows how Northwest Online operates.

Announcements and email

Announcements are communicated via the **Announcements** page on the course website and your Northwest Missouri State University email account. It is your responsibility to check each of these sources daily. Note that you must use your Northwest e-mail account on the Northwest Online site. For security reasons, emails without an appropriate subject may not be opened. Emails *must* include a useful signature; unsigned emails may not receive a reply.

Northwest Online Helpdesk. for Canvas and eConferencing Software
Hours: 24/7/365 helpdesk@northwestonline.org ☎ 877.740.2213

NWMSU Helpdesk. for General Questions on Campus Computer, Software, and Networking
Hours: Monday-Thursday 8-9; Friday 8-5 helpdesk@nwmissouri.edu ☎ 660.562.1634

Final exams: If an emergency occurs that prevents the administration of a course scheduled final examination, the final course grades will be calculated based on the work in the course completed to that point in time and

the faculty member's considered judgment. Final exams will not be rescheduled, and a grade of "I" will not be given as a result of an institutional cancellation of a final examination. This final exam policy does not apply to online courses.

Wellness: Northwest focuses on student success—every student, every day.
The Wellness Center, 660.562.1348, offers free counseling for students coping with depression, anxiety, alcohol or drug misuse, relationships, and other emotional, social, and academic stressors. In addition, faculty, staff, and students who are concerned with student wellbeing can report their concerns, including anonymously, to the Behavioral Intervention Team, so that the student can be offered relevant support, at this link: Concerning Behavior Reporting Form. If you are concerned about the immediate safety of a student, please call the University Police, who have specialized training in intervention, at 660.562.1254.

The wellness center website has links to a lot of resources (both human and on-line) that you might find of use. Check it out at: https://www.nwmissouri.edu/wellness/index.htm

Academic Administrative withdrawal: When it is in the best interest of Northwest Missouri State University for a student to withdraw, a student will be given a W, put on administrative hold, and given notice that they are about to be withdrawn. This action will result in removal of all credits associated with courses that have yet to be completed in the semester in question and the student will be administratively withdrawn from the University. An Administrative Withdrawal does not affect the student's grade point average. Please refer to Northwest Missouri State University's Academic Administrative Withdrawal Policy at: https://www.nwmissouri.edu/policies/academics/Adding-Dropping-Withdrawals.pdf

University communications: Students are expected to use their Northwest student email account for any electronic correspondence within the university. Students are also strongly advised to check their email and CatPAWS accounts on a regular basis.

Academic integrity policy: The students, faculty, and staff at Northwest endeavor to sustain an environment that values honesty in academic work, that acknowledges the authorized aid provided by and intellectual contributions of others, and that enables equitable student evaluation. Please refer to Northwest Missouri State University's Academic Integrity Policy at http://www.nwmissouri.edu/policies/academics/Academic-Integrity.pdf

Learning or Living Accommodations Request Process: Northwest Missouri State University complies with Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act of 1990 [ADA] and the ADA Amendments Act of 2008 [ADAAA]. If a student has a documented disability that qualifies under the ADA/ADAAA and requests accommodations, they should review the Accessibility and Accommodations webpage at https://www.nwmissouri.edu/titleixequity/accessibility/index.htm for guidance, including the accommodations application and supporting documentation requirements. Contact ada@nwmissouri.edu or 660.562.1873 for further assistance. For the university policy on disability accommodation refer to http://www.nwmissouri.edu/policies/student/Disability-Accommodation.pdf

Non-discrimination and anti-harassment policy: Northwest Missouri State University is committed to maintaining an environment for all faculty, staff, students, and third parties that is free of illegal discrimination and harassment. Please refer to the Non-Discrimination and Anti-Harassment Policy at http://www.nwmissouri.edu/diversity/titlevi.htm

Family Education Rights and Privacy Act (FERPA) policy: Family Educational Rights and Privacy Act of 1974, as amended (commonly known as the Buckley Amendment), is a federal law which provides that colleges and

universities will maintain the confidentiality of student education records. Please refer to the Family Educational Rights and Privacy Act (FERPA) Policy at http://www.nwmissouri.edu/policies/academics/Family-Educational-Rights-and-Privacy-Act.pdf

Disclaimer: Course schedule is subject to change and you will be responsible for abiding by any such changes. Your instructor will notify you of an