



Syllabus

Class Schedule: Lecture: T R: 9:30 PM – 10:50 PM (Section 01)

Lecture: T R: 2:00 PM – 3:20 PM (Section 02)

Instructor: Daniel Vasiliu
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Office Hours: T W R 4 – 5 pm, and by appointment.

Course Description: Machine learning is the science of automating decisions and inferences based on data. It uses interdisciplinary concepts and techniques such as statistics, linear algebra, optimization, and computer science to create systems that can parse large amounts of data at high speeds and make automated predictions and decisions with or without human supervision. Machine learning is remarkably pervasive, with applications ranging from business intelligence to homeland security, medical analytics to biochemical engineering, environmental science to astrophysics, etc. This course will introduce students to a broad set of machine-learning ideas, models, and algorithms.

Course Objectives:

1. Provide students with a critical understanding of the essential aspects and techniques in machine learning and the use of data.
2. Develop students' ability to apply different machine learning methods and interpret the results.
3. Expose students to real-world problems that are being engaged with by contemporary problem-solvers and decision-makers.

Evaluation:	Class Participation	10%
	Homework	60%
	Midterm	15%
	Final	15%

Letter Grades	93 – 100 %	A	73 – 76.99%	C
	90 – 92.99%	A-	70 – 72.99%	C-
	87 – 89.99%	B+	67 – 69.99%	D+
	83 – 86.99%	B	63 – 66.99%	D
	80 – 82.99%	B-	60 – 62.99%	D-
	77 – 79.99%	C+	0.0 – 59.99%	F

Resources: For programming, you need access to reliable cloud computing, such as Google COLAB Pro. We use Piazza for discussions and class participation. Consider getting access to capable cloud computing hardware for applications with neural networks and deep learning. I aim to deliver the study material in a self-contained and efficient manner, so no expensive textbook is necessary. In this course, you will engage with fundamental, conceptual ideas and applications.

Class Participation: You will receive the credit for participation ONLY if you actively engage in class discussions, contribute to coding sessions, and provide feedback to your peers, including Piazza posts.

Homework:

The homework assignments (labs & projects) will be posted on Blackboard at least five days before the due date. The expectation is that you will work on the assignment as the material is covered, so do not be surprised if the due dates are relatively close to when we finish covering the material. If you have any questions, please actively engage in Q/As on Piazza. Labs will involve a lot of short answer or multiple-choice questions and developing code to determine the answer, whereas the projects require that you design more ample programming approaches. For projects, you will write your code to solve a machine-learning problem and get feedback on improving it. The grading of projects also involves partial credit. The lowest homework score will be dropped to accommodate an unexpected short-term illness or class absence.

Midterm and Final:

A midterm (March 20th) and final (May 6th) will have both in-class closed-book conceptual questions and take-home coding parts. They assess your knowledge of the foundational concepts and machine-learning algorithms presented during the course.

Important Dates:

Please read the important dates and plan accordingly.

- The add-and-drop deadline is January 31st.
- Spring Break (no classes) March 8th – 16th.
- Midterm Exam - March 20th.
- The withdrawal deadline is March 24th.
- The last day of classes is May 2nd.
- Final Exam - May 6th.

Learning Modules:

Module 1	Preliminaries, Probability, Monte Carlo Simulations
Module 2	Reinforcement Learning, Association Rules
Module 3	Regression/Classification Problems, Support Vector Machines
Module 4	Grid Search Optimization Algorithms
Module 5	Neural Networks (with PyTorch) and Deep Learning
Module 6	Natural Language Processing

Weekly Schedule:

	What we will discuss/do in class	What to read (before class)
Week 1	Probability, Monte Carlo Simulations	Experimental probability, Bayesian Rule, Probability Distributions
Week 2	Reinforcement Learning	Confidence Intervals, Markov Decision Processes
Week 3	Association Rules	Operations with Pandas Data Frames (including pivoting)
Week 4	Regression Problems and Regularization	Vectors, Gradients, Matrix Equations, Orthogonal Projections
Week 5	Support Vector Machines and Classification Problems	Stratified K-Fold Cross-validations, Precision, Recall, Cross-Entropy
Week 6	Q/A and Review	
Week 7	Spring Break (March 8 – 16)	
Week 8	Grid Search Algorithms	Iterators, Python Dictionaries
Week 9	Intro to Neural Networks	Multilayer Perceptron in PyTorch Library, Backpropagation
Week 10	Convolutional Neural Networks	Image Convolutions, Convolution Arithmetic for Deep Learning
Week 11	Natural Language Processing	Bag of Words, Tokenization

Due Dates:

HW 0	January 29
HW 1	February 5
HW 2	February 12
HW 3	February 19
HW 4	February 26
HW 5	March 5
Midterm	March 20
HW 6	April 2
HW 7	April 9
HW 8	April 16
Final	May 6

Class Participation: Every class will have reserved about 20 minutes, on average, for group discussions and code development. You can work in small groups to understand and debate the class materials, exercises, and code applications; the instructor mediates all the class discussions. Drafts of the code for solving the problems are shared and discussed in class in a round table format; the instructor and all participants in the debate provide feedback.

Textbooks: *The Hundred-page Machine Learning Book* – Andriy Burkov
Data Science from Scratch: First Principles with Python - Joel Grus
Machine Learning, A Probabilistic Perspective – Kevin P. Murphy

Collaboration: Collaboration is both allowed and encouraged. Most of the time, we do not work in isolation, and using the resources available is both wise and efficient. You are welcome to work collaboratively with classmates – that means you can work together to solve problems together...not that one person does the work and others copy it. You are also welcome to use the internet as a resource to refresh your memory, clarify concepts, and help with short code snippets. You must cite your sources, and you should not be copying anything wholesale from any source: internet, human, artificial intelligence, or otherwise.

Things that are off limits:


- Soliciting (hey, what did you get for question X? Can you send me your code?) and copying code and answers from another person
- Copying code/answers directly from internet sources
- Using sources appropriately but failing to cite them
- Getting generative AI to do your work for you

Think about it: do you want to do all of the work and then give the answers to someone? Is that fair to you? Do you wholeheartedly trust that the answers you get from sources (ahem, ChatGPT) will be 100% correct? Do you want to attend a job interview and explain that you don't understand the material? Do you know answers you are deriving from external sources well enough that you could explain them when asked?

You should always be ready and able to defend every answer you submit confidently. This means that if I ask you to meet with me to explain any answer you submit, you should be able to do so in detail yourself.

Possible Changes: Any changes to the following course schedule or due dates will be announced in class and on Blackboard ahead of time.

Guidance: Students performing at a C level or below must schedule a meeting with the instructor to discuss class performance.

- Class Absences:** If you miss a class or two, check the material covered in class posted on Blackboard. For additional help, you can make an appointment with the TA or the instructor. Long-term absences need to be documented via the Dean of Students Office.
- Honor Code:** Academic integrity is at the heart of the university, and we all are responsible for upholding the ideals of honor and integrity. The student-led honor system is responsible for resolving any suspected violations of the Honor Code, and I will report all suspected instances of academic dishonesty to the honor system. The Student Handbook (www.wm.edu/studenthandbook) includes your responsibilities as a student. Your full participation and observance of the Honor Code are expected. To read the Honor Code, see www.wm.edu/honor.
- Artificial Intelligence:** The use or incorporation of ANY AI-generated content (from ChatGPT, Gemini, Co-Pilot, etc.) in graded assignments or exams is strictly prohibited.
- Student Accessibility:** William & Mary accommodates students with disabilities by federal laws and university policy. Any student who feels they may need an accommodation based on the impact of a learning, psychiatric, physical, or chronic health diagnosis should contact Student Accessibility Services staff at 757-221-2512 or sas@wm.edu to determine if accommodations are warranted and to obtain an official letter of accommodation. For more information, please see www.wm.edu/sas.
- Student Success:** Student Success supports students' personal growth, development, engagement, and belonging by providing holistic guidance as they navigate their own W&M journey. It encompasses the offices of Academic Wellbeing, Care Support Services, and Student Accessibility Services.
- For academic support such as tutoring, time management, study skills, and educational coaching, please contact Academic Wellbeing at wm.edu/academicwellbeing (academicwellbeing@wm.edu)
 - For concerns about the well-being of a member of the William & Mary community or to seek assistance for interpersonal, academic, and wellness challenges, please contact Care Support Services at wm.edu/care (care@wm.edu)
 - For accommodation needs or questions, please contact Student Accessibility Services at wm.edu/sas (sas@wm.edu)
- Student Health:** William & Mary recognizes that students juggle different responsibilities and can face challenges that make learning difficult. There are many resources available at W&M to help students navigate emotional/psychological, physical/medical, material/accessibility concerns, including:
- The W&M Counseling Center at (757) 221-3620. Services are free and confidential.
 - The W&M Health Center at (757) 221-4386.
 - To seek assistance for interpersonal, academic, and wellness challenges, please contact Care Support Services at wm.edu/care (care@wm.edu).
- For a list of other [resources](#) available to students, see [here](#) or: 

Students who experience COVID-19 symptoms during the semester must make an appointment with the Student Health Center for a clinical assessment and testing if necessary. Students who test positive after the start of the semester and need to be quarantined must be cleared by the Student Health Center or a physician before returning to their residence hall and classes.

Living off campus? Visit the [Off-Campus Isolation Guide](#).

The CDC recommends isolating any COVID-19-positive person for at least five days. For more information, visit the Quarantine & Isolation Guide and Calculator.

If feasible, students who test positive should complete their five-day isolation at home or off campus. W&M does not coordinate dedicated COVID-19 quarantine or isolation housing.

In extenuating circumstances, residential students who cannot return home must be isolated in their room for five days, attending class remotely if possible and if they feel well enough. Otherwise, they should partner with professors to arrange to be out sick for their isolation period. Visit [Academic Resources & Support](#).

For more information, visit:

https://www.wm.edu/about/administration/emergency/current_issues/coronavirus/index.php

For psychological/emotional stress, contact the Counseling Center by [email](#) or 757-221-3620.

For physical/medical concerns, contact the Health Center by [email](#) or at 757-221-4386.

Both are located at 240 Gooch Drive. Services are free and confidential.

If you or someone you know needs additional support or resources, please contact the Dean of Students by submitting a care report [online](#), by phone at 757-221-2510, or by [email](#).

Expectations:

All students are strongly encouraged to bring their laptops or notebook computers to class since we plan on doing a significant amount of active coding.

This semester, the world continues to confront COVID-19 infections. As we experience a surge of the pandemic with the highly transmissible omicron variant, it is reasonable to expect significant levels of infection at W&M. As an academic community based on faculty and students *convening*, fall 2023 courses will primarily consist of in-person instruction. All of us will follow W&M requirements. For those who have tested positive, W&M's requirements must be fulfilled before class can be attended in person, and, out of an abundance of caution, anyone with symptoms consistent with COVID-19 -even if they don't have a positive test- should not come to class.

Please note that testing positive for COVID-19 or any other temporary illness is not considered a disability defined by ADA guidelines nor under the purview of W&M's Student Accessibility Services (SAS). Thus, any questions should be addressed to the instructor via email.

For this course in the fall, we will address justified student absences by dropping everyone's lowest lab/project score.

We will address instructor absence/illness by scheduling remote (online) classes for no more than a week. In extreme cases, a substitute instructor will be arranged.