THE OHIO STATE UNIVERSITY

College of Engineering
Department of Electrical and Computer Engineering

SYLLABUS
ECE-5307

Introduction to Machine Learning for ECE
Spring 2023 – In Person

COURSE OVERVIEW

Instructional team

Instructor: Prof. Philip Schniter (schniter.1@osu.edu)

TA: Ms. Kaiying Xie (xie.916@buckeyemail.osu.edu) … will grade labs and homework

Lecture:

- MWF 4:10-5:05pm in Journalism 251
- If necessary, the lecture will take place via zoom at

  https://osu.zoom.us/j/93008711267?pwd=MjRnTU9DSkVyUUl4ZzBueFNjTUtxZz09

Office hours:

- Prof. Schniter: Dreese 616 and zoom: Th 12-2pm
  https://osu.zoom.us/j/98240951978?pwd=amppRERpR0F5aE52TjdaUUFjb2g1QT09
- Kaiying: Dreese 331 only: We 6:30-8:00pm, Th 4-8pm
- Kaiying: zoom only: Fr 11am-1pm
  https://osu.zoom.us/j/97389076148?pwd=RzMrQnp3QmdTWnBnZ0VYWFJibFN5dz09

Course description

Introduction to Machine Learning. Coverage includes linear regression, linear classification, model and feature selection, neural networks, ensemble methods, clustering, and principal components analysis. Python will be used for implementation examples.

Course learning outcomes

By the end of this course, students should successfully be able to:

- Formulate and solve linear regression problems.
- Formulate and solve classification problems using logistic regression and SVM.
- Solve regression and classification problems using neural networks, decision trees, and ensemble methods.
- Formulate and solve clustering problems using k-means, EM-GMM, NMF.
- Understand under/over-fitting, cross-validation, model-order selection, feature selection, maximum-likelihood estimation, gradient descent, and PCA.
- Gain experience with probabilistic modeling and optimization.
- Implement basic machine-learning tasks using Python/NumPy/Scikit-Learn/PyTorch.

HOW THIS COURSE WORKS

Mode of delivery: This course has “in-person” lectures (see above for time & location)

Pace of activities: This course has weekly homeworks, labs, and quizzes. Students are expected to keep pace with these deadlines.

Credit hours and work expectations: This is a **4-credit-hour course**. According to Ohio State policy, students should expect around 3 hours per week of time spent on direct instruction (lectures, for example) in addition to 6 hours of independent work (assignment preparation, for example) plus 3 hours of lab work to receive a grade of “average” (C).

Attendance and participation requirements: The following is a summary of everyone's expected participation:

- **Lecture**: **REQUIRED**
  You are expected to attend the lectures, although no attendance will be taken.
- **Office hours**: **OPTIONAL**
  Office hours are optional. They will be held in-person.

COURSE MATERIALS AND TECHNOLOGIES

Textbooks

REQUIRED

- None. We will be following the instructor’s course notes.

RECOMMENDED / OPTIONAL

- G. James, D. Witten, T. Hastie, and R. Tibshirani, *An Introduction to Statistical Learning*, Springer, 2013. (Free at https://hastie.su.domains/ISLR2/ISLRv2_website.pdf)
- C. Albon, *Machine Learning with Python Cookbook*, O'Reilly, 2018.
- A. Géron, *Hands-On Machine Learning with Scikit-Learn, Keras & TensorFlow*, O'Reilly, 2019.
- E. Stevens and L. Antiga, *Deep Learning with PyTorch*, Manning, 2020.

Course technology

For help with your password, university email, CarmenCanvas, or any other technology issues, questions, or requests, contact the Ohio State IT Service Desk. Standard support hours are available at ocio.osu.edu/help/hours, and support for urgent issues is available 24/7.

- **Self-Service and Chat support:** ocio.osu.edu/help
- **Phone:** 614-688-4357(HELP)
- **Email:** servicedesk@osu.edu
- **TDD:** 614-688-8743

BASIC TECHNICAL SKILLS

- Basic computer and web-browsing skills
- Navigating CarmenCanvas: for questions about specific functionality, see the Canvas Student Guide.

REQUIRED TECHNOLOGY SKILLS SPECIFIC TO THIS COURSE

- CarmenZoom virtual meetings (in case the pandemic forces us to switch to remote)
- Scanning to a pdf with a smartphone (in case of absence/illness)
- Basic scientific programming (prior expertise in Python coding is not required)

REQUIRED EQUIPMENT

- Computer: current Mac (OS X) or PC (Windows 7+) or Linux, with high-speed internet connection
- Webcam: built-in or external webcam, fully installed and tested
- Microphone: built-in laptop or tablet mic or external microphone

- Other: a mobile device (smartphone or tablet) or landline to use for BuckeyePass authentication and pdf scanning

REQUIRED SOFTWARE

- Anaconda software distribution (providing Python, NumPy, Scikit-Learn, and PyTorch). This software is free.
- Github account and a local git client. These are both free.
- Kaggle account. This is free.

CARMEN ACCESS

You will need to use BuckeyePass multi-factor authentication to access your courses in CarmenCanvas. To ensure that you are able to connect to CarmenCanvas at all times, it is recommended that you take the following steps:

- Register multiple devices in case something happens to your primary device. Visit the BuckeyePass - Adding a Device help article for step-by-step instructions.
- Request passcodes to keep as a backup authentication option. When you see the Duo login screen on your computer, click **Enter a Passcode** and then click the **Text me new codes** button that appears. This will text you ten passcodes good for 365 days that can each be used once.
- Download the Duo Mobile application to all of your registered devices for the ability to generate one-time codes in the event that you lose cell, data, or Wi-Fi service.

If none of these options will meet the needs of your situation, you can contact the IT Service Desk at 614-688-4357 (HELP) and IT support staff will work out a solution with you.

Health and Safety Requirements

All students, faculty and staff are required to comply with and stay up to date on all university safety and health guidance (https://safeandhealthy.osu.edu), which includes wearing a face mask in any indoor space and maintaining a safe physical distance at all times. Non-compliance will be warned first and disciplinary actions will be taken for repeated offenses.

GRADING AND FACULTY RESPONSE

How your grade is calculated

ASSIGNMENT CATEGORY	POINTS
Weekly homework assignments	20
Weekly labs	20
Weekly quizzes	20
Midterm exams	20
Final project)	20
Total	**100**

See course schedule below for additional dates.

Late assignments

Late submissions will not be accepted without prior approval. Please refer to CarmenCanvas for due dates.

Grading scale

Your cumulative score will be curved to yield your final letter grade. Undergrads will be curved differently than grad students.

Instructor feedback and response time

I am providing the following list to give you an idea of my intended availability throughout the course. (Remember that you can call **614-688-HELP** at any time if you have a technical problem.)

- **Grading and feedback:** For weekly assignments and exams, you can generally expect feedback within **7 days**.
- **Email:** I will reply to emails within **24 hours on days when class is in session at the university**.

OTHER COURSE POLICIES

Discussion and communication guidelines

The following are my expectations for how we should communicate as a class. Above all, please remember to be respectful and thoughtful.

- **Tone and civility**: Let's maintain a supportive learning community where everyone feels safe and willing to ask questions. Remember that sarcasm doesn't always come across online.

Academic integrity policy

POLICIES FOR THIS ONLINE COURSE

- **Homework and lab assignments**: Because the purpose of homework and labs is to improve your understanding of course material, peer discussions about homeworks, labs, and lecture material are permitted. However, all *submitted* homework and lab materials *must reflect your own work*.
- **Quizzes and exams**: You must complete the quizzes and exams yourself, *without any help from other people or chatbots*. If you have questions about a quiz or exam question, please contact the instructor.
- **Group project**: The final project is group-based. Group members bear a responsibility to fairly share the workload and to respond to group communications promptly. The final project report must identify which tasks where accomplished by which group members. Also, all content that is not student-authored must be properly cited, and the use of chatbots is not allowed. Plagiarism checking software will be employed.

OHIO STATE'S ACADEMIC INTEGRITY POLICY

Academic integrity is essential to maintaining an environment that fosters excellence in teaching, research, and other educational and scholarly activities. Thus, The Ohio State University and the Committee on Academic Misconduct (COAM) expect that all students have read and understand the university's *Code of Student Conduct*, and that all students will complete all academic and scholarly assignments with fairness and honesty. Students must recognize that failure to follow the rules and guidelines established in the university's *Code of Student Conduct* and this syllabus may constitute "Academic Misconduct."

The Ohio State University's *Code of Student Conduct* (Section 3335-23-04) defines academic misconduct as: "Any activity that tends to compromise the academic integrity of the university or subvert the educational process." Examples of academic misconduct include (but are not limited to) plagiarism, collusion (unauthorized collaboration), copying the work of another

student, and possession of unauthorized materials during an examination. Ignorance of the university's *Code of Student Conduct* is never considered an excuse for academic misconduct, so I recommend that you review the *Code of Student Conduct* and, specifically, the sections dealing with academic misconduct.

If I suspect that a student has committed academic misconduct in this course, I am obligated by university rules to report my suspicions to the Committee on Academic Misconduct. If COAM determines that you have violated the university's *Code of Student Conduct* (i.e., committed academic misconduct), the sanctions for the misconduct could include a failing grade in this course and suspension or dismissal from the university.

If you have any questions about the above policy or what constitutes academic misconduct in this course, please contact me.

Other sources of information on academic misconduct (integrity) to which you can refer include:

- The Committee on Academic Misconduct web pages (COAM Home)
- *Ten Suggestions for Preserving Academic Integrity (Ten Suggestions)*
- *Eight Cardinal Rules of Academic Integrity* (www.northwestern.edu/uacc/8cards.htm)

Copyright disclaimer

The materials used in connection with this course may be subject to copyright protection and are only for the use of students officially enrolled in the course for the educational purposes associated with the course. Copyright law must be considered before copying, retaining, or disseminating materials outside of the course.

Statement on Title IX

All students and employees at Ohio State have the right to work and learn in an environment free from harassment and discrimination based on sex or gender, and the university can arrange interim measures, provide support resources, and explain investigation options, including referral to confidential resources.

If you or someone you know has been harassed or discriminated against based on your sex or gender, including sexual harassment, sexual assault, relationship violence, stalking, or sexual exploitation, you may find information about your rights and options at titleix.osu.edu or by contacting the Ohio State Title IX Coordinator at titleix@osu.edu. Title IX is part of the Office of Institutional Equity (OIE) at Ohio State, which responds to all bias-motivated incidents of

harassment and discrimination, such as race, religion, national origin and disability. For more information on OIE, visit equity.osu.edu or email equity@osu.edu.

ECE diversity and antiracism statement

Success in engineering requires multiple perspectives, a wide range of expertise, and diverse backgrounds to solve societal problems and advance science. To be a student, faculty, or staff member in the Department of Electrical and Computer Engineering means being innately tied to a rich tapestry of diverse cultures, ethnicities, and backgrounds through people from all over the world. ECE faculty and staff aspire to hear the voices of those disenfranchised by racism. As educators and mentors within ECE, we will promote a culture of care. We are working to become better allies to create a safer society for everyone, and to invite all of our students, staff, and faculty to be courageous, take a stand against racism, and condemn any form of racial injustice. Not only do we help cultivate diversity in ECE, we celebrate it. The Office of Institutional Equity (OIE) at Ohio State responds to all bias-motivated incidents of harassment and discrimination, such as race, religion, national origin and disability. For more information on OIE, visit equity.osu.edu or email equity@osu.edu.

Outdated/non-inclusive language

ECE is committed to working to make everyone feel valued and welcome in our courses. If you find that some language used by anyone on an instruction team, or in a textbook or other resource materials, is offensive, please bring it to our attention immediately. For example, we recently spoke to the publisher of a textbook used in a required course, a book that uses industry standard terminology that is nevertheless offensive, and they have assured us that they have worked to change this and will be printing a revised version as soon as possible. If you identify any similar issues, You may email Prof. Anderson (.67) in ECE or Bryanna Stigger (.8) in the College of Engineering Diversity, Outreach, and Inclusion office. Or, if you wish to remain anonymous, you may report it through the University Office of Diversity and Inclusion (odi@osu.edu).

Your mental health

As a student you may experience a range of issues that can cause barriers to learning, such as strained relationships, increased anxiety, alcohol/drug problems, feeling down, difficulty concentrating and/or lack of motivation. These mental health concerns or stressful events may lead to diminished academic performance or reduce a student's ability to participate in daily activities. The Ohio State University offers services to assist you with addressing these and other concerns you may be experiencing. If you or someone you know are suffering from any of the aforementioned conditions, you can learn more about the broad range of confidential

mental health services available on campus via the Office of Student Life's Counseling and Consultation Service (CCS) by visiting ccs.osu.edu or calling **614-292-5766**. CCS is located on the 4th Floor of the Younkin Success Center and 10th Floor of Lincoln Tower. You can reach an on-call counselor when CCS is closed at **614-292-5766** and 24-hour emergency help is also available through the 24/7 National Suicide Prevention Hotline at **1-800-273-TALK** or at suicidepreventionlifeline.org. The ECE website also offers a listing of student wellness and support services available at Ohio State. The Ohio State Wellness app is also a great resource available at go.osu.edu/wellnessapp.

ACCESSIBILITY ACCOMMODATIONS FOR STUDENTS WITH DISABILITIES

Requesting accommodations

The university strives to make all learning experiences as accessible as possible. If you anticipate or experience academic barriers based on your disability including mental health, chronic or temporary medical conditions, please let me know immediately so that we can privately discuss options. To establish reasonable accommodations, I may request that you register with Student Life Disability Services. After registration, make arrangements with me as soon as possible to discuss your accommodations so that they may be implemented in a timely fashion. **SLDS contact information:** slds@osu.edu; 614-292-3307; 098 Baker Hall, 113 W. 12th Avenue.

Accessibility of course technology

This online course requires use of CarmenCanvas (Ohio State's learning management system) and other online communication and multimedia tools. If you need additional services to use these technologies, please request accommodations with your instructor.

- CarmenCanvas accessibility
- CarmenZoom accessibility

TENTATIVE COURSE SCHEDULE

Unit	Dates	Topics, Readings, Assignments, Deadlines
0	1/9	Introduction
1	1/11-1/13	Simple linear regression
2	1/16-1/20	Multiple linear regression
3	1/23-1/27	Model selection, bias-variance tradeoff
4	1/30-2/3	Feature selection, maximum likelihood
5	2/6-2/10	Classification, logistic regression
	2/17	Midterm exam #1 covering units 1-4
6	2/13-2/20	Optimization
7	2/22-3/1	Support vector machine
8	3/3-3/10	Neural networks
9	3/20-4/3	Deep convolutional neural networks
	3/31	Midterm exam #2 covering units 5-8
10	4/5-4/10	Ensemble methods, decision trees, random forests, boosting
11	4/12-4/14	Principal components analysis, nonnegative matrix factorization
12	4/17-4/21	Clustering, Gaussian-mixture modeling, EM, text mining
	4/25	Final project due