Introduction to Machine Learning

CPSC 483 -02, -01

Fall 2021

Description & Objectives

Design, implement and analyze machine learning algorithms, including supervised learning and unsupervised learning algorithms. Methods to address uncertainty. Projects with real-world data.

Prerequisites

CPSC 335, MATH 338; Computer Science or Computer Engineering major or minor; or Computer Science or Computer engineering graduate standing.

G.E. Requirements

This class does not meet any CSU General Education requirements.

Instructor

Professor Kenytt Avery

Email: kavery@fullerton.edu
Office: Zoom meetings accessed through Canvas
Office Hours:

- After course Zoom meetings - Monday-Thursday 21:45-22:00,

  Office hours will end when students have left the Zoom meeting. If class ends early, I will begin office hours then rather than waiting for the scheduled time slot.

- Friday 14:00-15:00 - Walk-in consultation

Use the link labeled “Office Hours” in Canvas.

- Friday 15:00-16:00 - Scheduled Appointments

    1. Sign up using the Canvas calendar.
    2. Use the link labeled “Office Hours” in Canvas to enter the Waiting Room.

See Scheduling private appointments for Office Hours for more information.

Meeting Information

Room: Use the link labeled “Zoom” in Canvas.

Time:	Section 02 - Monday	19:00-21:15
	Section 01 - Thursday	19:00-21:15

Learning Goals

1. Understand the basic concepts and methods of supervised machine learning.
2. Recognize the relative strengths and weaknesses of common supervised machine learning algorithms.
3. Explore unsupervised algorithms for clustering and dimensionality reduction.
4. Evaluate methods of training, testing, and validating machine learning models.
5. Apply machine learning methods to solve real-world problems in varying complexity.
6. Understand ethical issues in applying machine learning and critically evaluate potential applications.

Course Outline

1. Introduction. Linear models.
2. The method of least squares.
3. Vectorization.
4. Polynomial regression. Training and testing.
5. Regularization.
6. Random variables and discrete probability.
7. Continuous probability.
8. The method of maximum likelihood.
9. Logistic regression.

10. Bayesian classifiers and performance.
11. The curse of dimensionality. Ethics.
12. Ensemble methods.
13. Support vector machines
14. Fall recess.
15. Principal components analysis.
16. Clustering.
17. Final Exam

Important Dates

CSUF's Academic Calendar is posted online at «http://apps.fullerton.edu/AcademicCalendar/». The Academic Calendar contains all the campus closures and holidays you should be aware of.

CSUF's Registration Calendar is posted online at «http://admissions.fullerton.edu/apps/calendars.aspx». The Admissions Calendar contains all the major dates with respect to adding, dropping, and withdrawing from your classes.

Section 02	**Section 01**	
September 6		Labor Day - No class
September 17		Project 1 due
October 15		Project 2 due
October 18	October 21	Midterm Exam
	November 11	Veterans Day - No class
November 19		Project 3 due
November 22	November 25	Fall Recess - No class
December 10		Project 4 due
December 13	December 16	Final Exam

Textbooks

Required

A First Course in Machine Learning, 2nd Ed., Rogers and Girolami, Chapman & Hall/CRC Press, ISBN: 9781498738484

> Note that the Second Edition of the textbook contains the same content as the First Edition and additional material that will not be covered in class. You may use either edition. Since there is a slight change in section numbering between the editions, all chapter and section references in the assigned reading will include both the number

from the Second Edition and the chapter or section names so that they can be located in either edition.

An Introduction to Statistical Learning, Second Edition, James, Witten, et al., Springer, ISBN: 9781071614174, available from «https://www.statlearning.com/»

Recommended

A Whirlwind Tour of Python, Jake VanderPlas, O'Reilly Media, ISBN: 9781491964651, available from «https://jakevdp.github.io/WhirlwindTourOfPython/»

Mathematics for Machine Learning, Deisenroth, Faisal, et al., Cambridge University Press, ISBN: 9781108455145, available from «https://mml-book.com/»

Additional Reference Material

Many popular technical books may be read online through the campus's subscription to Safari Books Online. From outside of the campus network, the campus library's WWW proxy will grant you access, «https://learning-oreilly-com.lib-proxy.fullerton.edu/home/». The Safari Books Online service can be accessed directly from any computer on the campus network, «https://learning.oreilly.com/home/».

The librarians at the CSUF Pollack Library have developed a number of research guides to support students studying computer science. The LibGuides are online at «http://libraryguides.fullerton.edu/sb.php?subject_id=17830».

Required Material

- A writing instrument
- A notebook
- A personal computer with the requisite development tools
- An electronic device (laptop, desktop or tablet) with a camera and built-in microphone (this may be the same as the personal computer used for development)
- Reliable access to the Internet
- One of the following:
    - a document scanner,
    - a mobile phone with a scanning app capable of flattening a camera image and exporting to PDF, or
    - a digital drawing tablet

CSUF students can submit device requests to borrow PC laptops, mi-fi's, webcams, and headsets by submitting the Device Request form at «https://apps.fullerton.edu/coviddevicerequest».

If you require a device for your classes, please inform me as soon as possible so that in addition to your Device Request form submission, I can sponsor your request by sending a request on your behalf to «devicerequest@fullerton.edu».

Students are responsible for ensuring that they have reliable Internet access during exams. If you are unable to have reliable Internet access, you must inform the instructor as soon as possible (or at the latest one week before the test date) to determine an alternative.

You are encouraged to turn on your camera in order to participate in Zoom meetings, but this is only a requirement during exams. If you choose not to turn on your camera during lecture or in-class exercises, you must still actively participate via voice or chat.

Announcements & Communication

Announcements of ordinary priority will be made in class and generally result in an update being posted to the course website.

Urgent announcements (i.e. regarding events before the next regular class meeting) will be made via Canvas. The default settings in Canvas will forward announcements to your student @csu.fullerton.edu email address.

Please check, read, and understand all the messages sent to your @csu.fullerton.edu address and posted to the learning management system.

Email Communication

All email to the instructor **must** include your name, class, and section number, and should come from your @csu.fullerton.edu email account. You do not need to include your CWID. Note that the sections are cross-listed in Canvas, so the title of the course may not match the section in which you are enrolled. Please **double-check** your enrollment in Titan Online before sending email.

The email account provided by CSUF is the only way the instructor may reach the student outside of class meeting times. Additionally, it is the only way the instructor knows that he is corresponding with a student enrolled in the class. Please refrain from using your personal email address and use your @csu.fullerton.edu email.

Typically, the instructor shall respond to your emails within 2 business days (i.e. Monday through Friday). In general, if you have not received a response, it is because the instructor believes that your concern has already been addressed (e.g., verbally, or as part of class discussion). If you

are expecting a response and do not receive one within this timeframe, please double-check that you have included your name, class, and section number, then re-send your request.

Grading

Plus and minus grading is used when determining final grades.

Graduate students that use this course on a graduate study plan must perform additional work and will be evaluated on a separate grading scale vis-à-vis their undergraduate counterparts.

Final grades are computed by first finding the average score in each category described in the second table below. All scores are normalized to a scale of 0 to 100 before being averaged. The average score for each category is then used to compute the weighted average according to the weights in the second table below.

Grade	% of Total Points
A	93–100%
A-	90–92%
B+	87–89%
B	83–86%
B-	80–82%
C+	77–79%
C	73–76%
C-	70–72%
D+	67–69%
D	63–66%
D-	60–62%
F	Below 60%

Category	% of Final Grade
Projects	30%
Midterm Exam	30%
Final Exam	35%
Attendance	5%

Note that while individual scores will be shown in Canvas correctly, its grade calculations may not map directly to the grading scheme shown above.

Assignments

There are approximately:

- 4 group programming projects
- 15 weeks of reading assignments

Programming projects will be discussed in class and posted to the course website in advance of their due dates. Each assignment description will include the assignment's grading rubric. Reading assignments are outlined in the syllabus and it is the responsibility of the student to stay up to date with the reading.

There will be approximately 4 projects posted. Except in cases of academic dishonesty, the lowest project score will be dropped automatically.

Information in Markdown format must be included in the Jupyter Notebook submission for each project summarizing and documenting the work submitted. Issues with presentation, spelling and grammar can all negatively impact an assignment's grade.

If your work does not meet the requirements specified for the project, your submission must document which portions are currently working and which are not.

Programming Language and Platform

All programming assignments must be written in the Python programming language, unless specified otherwise. Coding style must conform to professional norms. At a minimum, code must be commented, have descriptive names for identifiers, and contain a comment at the top of each file with pertinent information such as the student's name, email address, and assignment name. For students unfamiliar with coding style, consult PEP 8 -- Style Guide for Python code.

The instructor shall use the latest version of the Anaconda Individual Edition with Python 3 to evaluate all programs. The instructor will detail any additional libraries or tools required for each programming assignment. It is the student's responsibility to ensure that the assignments execute to his or her satisfaction on the instructor's grading platform.

Technical Proficiency

Technical proficiency in programming and software engineering should correspond to the prerequisite(s) of the course. Students are expected to be intimately familiar with their development platform of choice and be able to write and debug code in C++ at a level of proficiency that corresponds to the prerequisites of the course.

Note that while projects in this course are written in Python, CPSC 223P is not a prerequisite and the course does not assume that you already know how to program in Python. Reading assignments on Python will be assigned in the first few weeks of the course, and a programmer comfortable with C++ can pick up the rudiments of Python syntax in a few hours and begin writing useful applications in a few days.

Technical proficiency with information technology, such as, but not limited to, the use of web-based online services, sending and receiving electronic mail, and desktop computer file systems, is assumed.

Development Tool Resources

Students enrolled in CPSC 120, CPSC 121, and CPSC 131 are recommended to use the Computer Science Department's official GNU/Linux development environment, Tuffix. Tuffix is Tuffy the Titan's Linux distribution. The Tuffix home page is «https://github.com/kevinwortman/tuffix».

Students enrolled in courses other than CPSC 120, 121, and 131 are strongly recommended to use Tuffix.

Professor Shafae has made a series of captioned videos available at «https://youtube.com/playlist?list=PL3LtnHvH0mFEUtiLHYAKEowJcqnZ4fZwP» to guide a student through the process of installing and using Tuffix.

Students using Tuffix should join the CSUF TUFFIX Slack workspace at «https://csuf-tuffix.slack.com/». Please use the `#general` channel to ask about troubleshooting, installing, and using Tuffix.

You can use your own computer, or borrow a computer from CSUF for free through the Long-Term Laptop Checkout process at «https://www.fullerton.edu/it/students/equipment/longtermlaptop.php».

A student who needs immediate access to computer resources may do so through the Virtual Computing Lab. Professor Shafae has recorded a video available at «https://youtu.be/1EuNyBvmfXY» demonstrating how to access and use the service.

A student who needs immediate access to computer resources may do so through the Virtual Computing Lab. An online video demonstrates how to access and use the service.

A general purpose CentOS (Linux) shell server is available through secure shell (ssh) and secure file transfer protocol (sftp). The hostname is ecs.fullerton.edu.

Three specialized GPU servers are available. The systems are named aries.ecs.fullerton.edu, prudence.ecs.fullerton.edu and turing.ecs.fullerton.edu. Access to these systems may be limited to the campus network; you may use a VPN to access them off campus. Each system has at

least one Nvidia Titan X GPU. Please use Docker to create containers for your project. This is the only mechanism for GPU users to install software for their projects. These GPU shell servers are not available off campus. To log into them from outside CSUF's network, first login to ecs.fullerton.edu and then log into the GPU shell server of your choice.

To login to any of the shell servers, all you need is your CSUF Portal login and password. If your email address is taylor@csu.fullerton.edu, then your username is taylor. If you are using a command-line ssh client, then your command to connect to ecs.fullerton.edu will be `ssh taylor@ecs.fullerton.edu`; replace ecs.fullerton.edu with the appropriate target hostname. Your password is the same password as your CSUF Portal password. (Faculty members can login in as well if you specify your Active Directory domain. For example, if your email address is kai@fullerton.edu, then your username is 'AD\kai'; thus the command will be `ssh 'AD\kai'@ecs.fullerton.edu`; note the use of single quotes to escape the username..)

Attendance Policy

Attending class is mandatory. Missing class is not allowed unless it is excused by the instructor. Missing class as part of a documented accommodation is guaranteed to be excused. The ADA accommodated student must make a reasonable effort to coordinate any absences with the instructor.

Attendance will be taken using the Zoom reporting feature.

In order to receive credit for attendance:

1. Make certain that your full name is displayed in the Participants list.

   See «https://www.google.com/search?q=change+zoom+display+name» for instructions.

2. You must attend the section in which you are enrolled.

   If you miss class, you may attend the other section's lecture and participate in the in-class exercise, but you will not receive credit for attendance.

3. You must attend the entire class session.

Late Submissions and Make Up Work

Do not submit projects via email under any circumstances. If you miss the submission deadline, contact the instructor as soon as possible. If the late project is accepted, the assignment will be re-opened for submission via Canvas.

Exams cannot be taken after the deadline on Canvas has passed and answers have been discussed in class. If you miss an exam and are excused by the instructor, its score will be imputed as the score from the other exam.

Participation

In the context of this course, participation is defined as the following:

- Arriving to class prepared and on time.
- Taking notes.
- Actively listening to the lecture and asking questions when appropriate.
- Annotating code listings and handouts.
- Bringing any required materials to class.
- When needed/desired, seeking assistance to complete assignments.
- Barring an emergency, not leaving the class session early unless the instructor consents.
- Not distracting oneself or others with smartphones, games, online diversions, etc.
- Respecting and treating the instructor and the student's peers civilly.

You are encouraged to turn on your camera in order to participate in Zoom meetings, but this is not a requirement except for exams. If you choose not to turn on your camera, you must still actively participate via voice or chat.

Academic Integrity

Students are encouraged to assist one another and discuss the course materials with your peers. It is your responsibility to be aware of and follow the spirit of CSU Fullerton's academic honesty policy which can be found at «http://www.fullerton.edu/senate/publications_policies_resolutions/ups/UPS%20300/UPS%20300.021.pdf». Academic dishonesty will not be tolerated. The University Catalog and the Class Schedule provide a detailed description of Academic Dishonesty under *University Regulations*.

By submitting work for evaluation, you acknowledge that you have adhered to the spirit of the university's academic honesty policy and that your submission is an original work by you unless otherwise directed to work in groups.

Failure to follow the spirit of the academic honesty policy shall result in the following consequences:

- A zero grade for the assignment at a minimum, a failing grade ('F') for the course in most cases. Zero grades assigned for academic dishonesty cannot be dropped.
- Your name, your actions, and the evidence collected submitted to Student Affairs.
- Student Affairs shall contact the department chair and levy their own disciplinary action.

Students with Special Needs

Please inform the instructor during the first week of classes about any disability or special needs that you may have that may require specific arrangements related to attending class sessions, carrying out class assignments, or writing papers or examinations. According to California State University policy, students with disabilities must document their disabilities at the Disability Support Services (DSS) Office in order to be accommodated in their courses. Additional information can be found at «http://www.fullerton.edu/DSS/», by calling 657-278-3112 or email «dsservices@fullerton.edu».

Student Resources

Any student who wishes to discuss any concern may contact the assistant deans of the college. Assistant deans are student advocates who will help you navigate the university's policies and procedures and assist with resolving any conflict.

Assistant Dean for Student Affairs Shannen Allado

CS-206A (657) 278-4407 «shallado@fullerton.edu»

College International Advisor Karen Lau

CS-206A (657) 278-3813 «karenlau@fullerton.edu»

Emergency Procedures

For your own safety and the safety of others, each student is expected to read and understand the guidelines published at «http://prepare.fullerton.edu/campuspreparedness/». Should an emergency occur, follow the instructions given to you by faculty, staff, and public safety officials. An emergency information recording is available by calling the Campus Operation and Emergency Closure line at 657-278-4444.

Instructional Continuity

Due to an event such as an epidemic or a natural disaster that disrupts normal campus operations, students must monitor the course website and their campus email address for any instructions and assignments that the instructor announces.

Laboratory Safety

Safety is no accident. Learning and following the appropriate safety practices and protocols is an integral part to all laboratory courses. Following the appropriate safety practices and protocols minimizes the chances of repetitive stress injuries, mishandling hazardous materials, and injury to self and others. Additional campus laboratory safety information regarding hazardous materials is online at «http://riskmanagement.fullerton.edu/laboratorysafety/».

Extra Credit

There are no opportunities for extra credit. In particular, completing more than the number of projects required to receive full credit for the Projects category will not result in a higher grade.

Recording & Transcription of Class Content

This course or portions of this course (i.e., lectures, discussions, student presentations) may be recorded for instructional or educational purposes. The recordings will only be shared with students enrolled in the class through Canvas. The recordings will be deleted at the end of the semester. If, however, you would prefer to remain anonymous during these recordings, then please speak with the instructor about possible accommodations (e.g., temporarily turning off identifying information from the Zoom session, including student name and picture, prior to recording).

Recordings will not be made available to students except in exceptional cases. Currently the only class recordings that are anticipated to be made available to all class members are of Section 01 on September 6 and Section 02 on November 11 for the Labor Day and Veterans Day holidays.

Students are prohibited from recording class activities (including class lectures, office hours, advising sessions, etc.), distributing class recordings, or posting class recordings. This university policy (330.230 «http://www.fullerton.edu/senate/publications_policies_resolutions/ups/UPS%20300/UPS%20330.230.pdf») is in place to protect the privacy of students in the course, as well as to maintain

academic integrity through reducing the instances of cheating. Students who record, distribute, or post these materials may be referred to the Office of Student Conduct.

Each instructor must permit class content to be recorded or transcribed by students when mandated to do so by the Americans with Disabilities Act or by other federal or state laws. Any recording of class content is for private use and study and shall not be made publicly accessible without the written consent of the instructor and students in the class. It is the responsibility of students that require special accommodations or assistive technology due to a disability to notify the instructor.

Taking Notes

As Computer Science students, this probably runs counter to your intuition, but it's true: the best way to take notes is to write them by hand on paper. For details, see Note-taking by hand: A powerful tool to support memory by Hetty Roessingh of the University of Calgary.

In order to encourage you to take notes by hand, the instructor does **not** provide copies of slides, class notes, or boardwork. If you wish to have a permanent record of anything that is said in class or appears on the board, you are expected to take notes.

If you require reasonable accommodation for notetaking through Disability Support Services, you may submit a request through the TITANable Notetaking Services website. See «https://www.fullerton.edu/dss/titanable/tutorials/notetaking.php» for details.

Course Rules & Classroom Management

Unless an agreement or accommodation is reached between the student and the instructor, these rules must be followed.

- Attendance at all regularly scheduled lecture and discussion sections is mandatory.
- Do not eat during lecture.
- If it makes noise, silence it.
- Computer use is not allowed in lecture except for taking notes.
- The student is responsible to be aware of any course announcements including changes to due dates and requirements.
- Homework, programming assignments, etc. may not be submitted late.

- Third party work (code, artwork, etc.) may not be used in student work without prior instructor consent. Failure to gain and document instructor consent will be construed as willful academic dishonesty.
- When a third party's work is incorporated into student work after gaining instructor consent, failure to wholly document the work's origin, copyright and license will be construed as willful academic dishonesty.

Code of Conduct

We shall endeavor to question, discuss, disagree, and debate without resorting to tactics of intimidation, harassment, or personal attack. Insensitive language, harassment, or disruptive behavior shall not be tolerated. The University expects students to know the rules specified at «http://www.fullerton.edu/integrity/student/LetterToStudents.php» and abide by them.

Zoom Classroom Etiquette

Mute Your Microphone: To help keep background noise to a minimum, make sure you mute your microphone when you are not speaking.

Be Mindful of Background Noise and Distractions: Find a quiet place to "attend" class, to the greatest extent possible.

- Avoid video setups where people may be walking behind you, people talking/making noise, etc.
- Avoid activities that could create additional noise, such as shuffling papers, listening to music in the background, etc.

Position Your Camera Properly: Be sure your webcam is in a stable position and focused at eye level.

Limit Your Distractions/Avoid Multitasking: You can make it easier to focus on the meeting by turning off notifications, closing or minimizing running apps, and putting your smartphone away (unless you are using it to access Zoom or participate in a course activity).

Use Appropriate Virtual Backgrounds: If using a virtual background, it should be appropriate and professional and should NOT suggest or include content that is objectively offensive or demeaning.

Acknowledgments

Portions of this syllabus are drawn from syllabi authored by Professor Shafae.