Course ID and Title: NACME Artificial Intelligence & Machine Learning

Units: 0

Term—Day—Time: Summer 24—MTWRF—9:10AM-5:10PM

Location: RTH 105

Instructor:

Office: EEB 342
Office Hours: In-class
Contact Info: coreybak@usc.edu

Teaching Assistant:

Office: EEB 342
Office Hours: In-class
Contact Info: rbl_023@usc.edu, aguilarb@usc.edu, jm_635@usc.edu

IT Help: N/A

Hours of Service: N/A
Contact Info: N/A

Course Description

As machine learning (ML) becomes a powerful tool across industries — from healthcare and retail to investment banking and insurance — there is a growing need for a workforce that understands how to apply ML strategically and use ML models to collaborate with data scientists and engineers for maximum business impact.

In this course, students will learn the fundamentals of machine learning (ML) to prepare for a role at the intersection of data science, computer science, and the individual student's field of study or interest. Students will become familiar with different ML tools and models, develop skills to assess when ML is the right solution to a given problem, learn how to prepare and identify issues with data, and hone their coding skills in Python. In addition, students will dive into deep learning, clustering, k-Means, and other models and algorithms. Students will then work on group based projects and integrate their learning from the course to solve a particular problem or meet a specific need. Students integrate technical concepts, project management, organizational skills, and ethical considerations to create a meaningful final product. Culminating the gathered knowledge is beneficial as data science employers look to see projects applicants have undertaken, the skills they built while working on them, and what they learned from the experience. The final project provides students with a meaningful work-like experience to discuss in interviews.

Learning Objectives

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

1. Describe the fundamental concepts of machine learning
2. Use and develop software to investigate, clean, and visualize data
3. Understand and frame a problem as a supervised machine learning problem including whether it is a regression or classification problem and to incorporate the application requirements.

4. Identify the potential for bias in ML models and explain its implications along with techniques for mitigating it.
5. Apply and tune common machine learning models (for regression and classification) in Python by making use of multiple ML toolkits
6. Demonstrate the ability to qualitatively and quantitatively evaluate the quality of trained regression and classification models
7. Use and develop efficient software for loading and manipulating datasets
8. Develop a machine learning system for real-world data. This includes identifying appropriate training data, determining the correct problem statement, developing feature extraction methods, testing learning algorithms and documenting the complete system
9. Communicate technical concepts (both orally and in writing) for an audience who may have a limited technical background

Prerequisite(s): Students should have a strong programming ability, knowledge of basic probability and statistics. Students who have not completed the pre-requisites should contact the professor immediately in order to receive clearance to take the course or else the student will be removed from the course.

Pre semester knowledge and material

- Mathematical Concepts
  - Logs
  - Scientific Notation
  - Functions
- Linear Algebra
  - Straight Line Equations
  - Matrix Algebra
- Statistical Distributions
  - Normal Distribution
  - Binomial Distribution
- Statistical Concepts
  - Hypothesis Testing
  - P-Values for Data Scientists

Co-Requisite(s): N/A
Concurrent Enrollment: N/A
Recommended Preparation: See prerequisite material.

Course Notes

N/A

Technological Proficiency and Hardware/Software Required

Computer (Required)

Students are required to have access to a Mac laptop computer capable of running Mac OS Sonoma, Xcode 15.x, and Python 3.x. We will use Xcode, Swift, CreateML/CoreML, and Jupyter Notebooks. In-class notebooks are IPython notebooks targeted at the Jupyter environment and compatible with most Jupyter environments. Other toolkits can be used as long as they are easy to install in Jupyter.

If you do not have a computer that meets the requirements, please look into the USC Computing Center Laptop Loaner Program. Link information USC Technology Support: Zoom information for students, Brightspace help for students, Software available to USC Campus.

Required Readings and Supplementary Materials

This course does not follow any specific textbook. Course material will be provided during the semester on Github Classrooms and Slack.

Optional Readings and Supplementary Materials

Additional material found online.

Description and Assessment of Assignments

Assignments, Submissions, and Additional Material
Brightspace: TBD
Slack: TBD
GitHub Organization: https://github.com/NACME-AIML-2024
GitHub Classroom: https://classroom.github.com/classrooms/171599853-nacme-aiml-bootcamp-2024

Projects

Students will complete prescribed projects using the tools and knowledge they have learned during the course.

Final Project

The final project is meant to be completed in a group collaboration with the following learning objectives:

- Apply technical ML concepts and data skills from the first half of the course on a sizeable dataset and challenging problem
- Demonstrate professional development skills, such as working in a group with different personalities, giving and receiving feedback, communicating results, and project management
- Create and facilitate a recorded demo or presentation of capstone project work

Deliverables: Students will complete each of the following deliverables for their total capstone. The percent value next to each item reflects how much effort and time are likely to be spent on that particular assignment and can therefore inform assessment.

- Design doc - 8%
    - Goal(s) for the project - ideally long term, and realistic for the project Duration
    - Who will play what roles (program manager, note taker) during each project phase
    - Describe the dataset(s), data acquisition, and data preparation
    - Explain problem space and motivated questions
    - Approach and list of tasks
- Ethical consideration worksheet - 2%
- Notebook - 20%
    - The notebook should read like a formal report and follow a linear flow from start to finish with both narrative and code blocks.
    - The notebook should be internally complete in the sense that a “reader” should understand the motivating question, goals, dataset, model, and ethical considerations.
    - Markdown cells with narrative should precede and follow each code block.
    - For each piece of code, describe the purpose, an overview of how it works, and how to interpret results.
    - Discuss current limitations and future improvements.
- Project demo or presentation - 10%
    - Overview of the project and the problem it seeks to solve
    - Conclusions and findings

- Things that went well, things that did not go well, and lessons learned
- Next steps

Participation

Please post all questions in the Brightspace/Slack discussion board first as other students may have a similar question. Posting in Brightspace/Slack allows all questions/answers to be centralized and easily viewed by all classmates. Other students enrolled in the course are encouraged to answer questions and provide suggestions.

With regard to questions directly related to code, provide inline comments and post the repo on the course GitHub. The question should still be posted in the Brightspace/Slack with links to your repo in GitHub. These type of questions should point out the problem, the line number where the problem occurs, and different steps taken to attempt to remedy the problem.

If your question is not answered in Brightspace/Slack, please contact the instructor via email or office hours. Note that private questions to the TA's or the professor can be posted in Brightspace/Slack if needed.

Note: Most questions should be asked in Brightspace/Slack discussions (can ask direct questions to the professor or TAs within Brightspace/Slack). If for some reason you need to email the professor or TAs **always include "USC AIML: " in the subject line**.

Grading Breakdown

Table 1 Grading Breakdown

Assessment Tool (assignments)	**Points**	**% of Grade**
In-class labs		30%
Participation		10%
Projects (5)		20%
Final Project		40%
TOTAL		100%

Grading Scale

Course final grades will be determined using the following scale:

Table 2 Course Grading Scale

Letter grade	Corresponding numerical point range
A	95-100
A-	90-94
B+	87-89
B	83-86
B-	80-82

Letter grade	Corresponding numerical point range
A	95-100
A-	90-94
B+	87-89
B	83-86
C+	77-79
C	73-76
C-	70-72
D+	67-69
D	63-66
D-	60-62
F	59 and below

Assignment Submission Policy

All assignments and project submissions will be submitted via email by 11:59 pm (or a designated time by the Professor) of the deadline through Github Classroom. Late homework will not be accepted under any conditions.

Grading Timeline

[Announce a timeline for when students can expect grading and feedback from the instructor.]

Course Specific Policies

N/A

Attendance & Quizzes

Students are responsible for knowing the material provided in the lectures as well as being able to apply the concepts to develop the project. Students are expected to attend class everyday and notify the instructor about excused absences.

Classroom norms

Active class participation will count towards a student's participation grade. Discussion sessions will be used to assist students with understanding key concepts. Attending discussions is mandatory.

The units within the tracks are arranged so new information is presented via brief lectures and reinforced through learning activities like labs and mini projects. A lecture and either a lab or other learning activity make up a single unit within a track. To mimic work flows students are likely to experience in the industry, a mix of individual and group-based work is utilized within each track.

Zoom etiquette

N/A

Academic Integrity

The University of Southern California is foremost a learning community committed to fostering successful scholars and researchers dedicated to the pursuit of knowledge and the transmission of ideas. Academic misconduct is in contrast to the university's mission to educate students through a broad array of first-rank

academic, professional, and extracurricular programs and includes any act of dishonesty in the submission of academic work (either in draft or final form).

This course will follow the expectations for academic integrity as stated in the USC Student Handbook. All students are expected to submit assignments that are original work and prepared specifically for the course/ section in this academic term. You may not submit work written by others or "recycle" work prepared for other courses without obtaining written permission from the instructor(s). Students suspected of engaging in academic misconduct will be reported to the Office of Academic Integrity.

Other violations of academic misconduct include, but are not limited to, cheating, plagiarism, fabrication (e.g., falsifying data), knowingly assisting others in acts of academic dishonesty, and any act that gains or is intended to gain an unfair academic advantage.

Academic dishonesty has a far-reaching impact and is considered a serious offense against the university. Violations will result in a grade penalty, such as a failing grade on the assignment or in the course, and disciplinary action from the university itself, such as suspension or even expulsion.

For more information about academic integrity see the student handbook or the Office of Academic Integrity's website, and university policies on Research and Scholarship Misconduct.

Please ask your instructor if you are unsure what constitutes unauthorized assistance on an exam or assignment or what information requires citation and/or attribution.

Creating a policy for the use of AI Generators in your course
This course aims to develop creative, analytical, and critical thinking skills. Therefore, all assignments should be prepared by the student working individually or in groups. Students may not have another person or entity complete any substantive portion of the assignment. Developing strong competencies in these areas will prepare you for a competitive workplace. Therefore, using AI-generated text, code, or other content is prohibited in this course, will be identified as plagiarism, and will be reported to the Office of Academic Integrity.

Course Content Distribution and Synchronous Session Recordings Policies

USC has policies that prohibit recording and distribution of any synchronous and asynchronous course content outside of the learning environment.

Recording a university class without the express permission of the instructor and announcement to the class, or unless conducted pursuant to an Office of Student Accessibility Services (OSAS) accommodation. Recording can inhibit free discussion in the future, and thus infringe on the academic freedom of other students as well as the instructor. (Living our Unifying Values: The USC Student Handbook, page 13).

Distribution or use of notes, recordings, exams, or other intellectual property, based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study. This includes but is not limited to providing materials for distribution by services publishing course materials. This restriction on unauthorized use also applies to all information, which had been distributed to students or in any way had been displayed for use in relation to the class, whether obtained in class, via email, on the internet, or via any other media. Distributing course material without the instructor's permission will be presumed to be an intentional act to facilitate or enable academic dishonestly and is strictly prohibited. (Living our Unifying Values: The USC Student Handbook, page 13).

Course Evaluations

Course evaluation occurs at the end of the semester university-wide. It is an important review of students' experience in the class. The process and intent of the end-of-semester evaluation should be provided. In addition, a mid-semester evaluation is recommended practice for early course correction. Contact CET for support in creating a mid-semester evaluation.

Course Schedule

Table 3 Course schedule

Week	Topic
1	Introduction to Swift/Python Intermediate Swift/Python Intro to Machine Learning Intro to ML Models ML Fairness
2	Introduction to Jupyter Introduction to Pandas Intermediate Pandas Visualizing and Acquiring Data Exploratory Data Analysis
3	Introduction to Regression Introduction to scikit-learn Regression Quality Polynomial Regression Introduction to Tensorflow/PyTorch Linear Regression Neural Networks
4	Introduction to Classification Classification with Tensorflow/PyTorch Image Classification Image-Video Classification Saving and Loading Models
5	Convolutional Neural Networks Recurrent Neural Network Natural Language Processing Transfer Learning Image Classification Introduction to Final Project

6	Clustering k-Means Embeddings Decision Tree & Random Forest K Nearest Neighbors Support Vector Machines Bayesian Modeling XG Boost Work on Final Project
7	Big O Dimensionality Reduction Loss Function History of Machine Learning Probability and Statistics Regular Expressions Work on Final Project
8	Passing a ML Industry Interview Tailoring Your Resume for ML Complete and Present Final Project

Statement on University Academic and Support Systems

Students and Disability Accommodations:
USC welcomes students with disabilities into all of the University's educational programs. The Office of Student Accessibility Services (OSAS) is responsible for the determination of appropriate accommodations for students who encounter disability-related barriers. Once a student has completed the OSAS process (registration, initial appointment, and submitted documentation) and accommodations are determined to be reasonable and appropriate, a Letter of Accommodation (LOA) will be available to generate for each course. The LOA must be given to each course instructor by the student and followed up with a discussion. This should be done as early in the semester as possible as accommodations are not retroactive. More information can be found at osas.usc.edu. You may contact OSAS at (213) 740-0776 or via email at osasfrontdesk@usc.edu.

Student Financial Aid and Satisfactory Academic Progress:
To be eligible for certain kinds of financial aid, students are required to maintain Satisfactory Academic Progress (SAP) toward their degree objectives. Visit the Financial Aid Office webpage for undergraduate- and graduate-level SAP eligibility requirements and the appeals process.

Support Systems:
Counseling and Mental Health - (213) 740-9355 – 24/7 on call
Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

988 Suicide and Crisis Lifeline - 988 for both calls and text messages – 24/7 on call
The 988 Suicide and Crisis Lifeline (formerly known as the National Suicide Prevention Lifeline) provides free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week, across the United States. The Lifeline consists of a national network of over 200 local crisis centers, combining custom local care and resources with national standards and best practices. The new, shorter

phone number makes it easier for people to remember and access mental health crisis services (though the previous 1 (800) 273-8255 number will continue to function indefinitely) and represents a continued commitment to those in crisis.

Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL) – 24/7 on call
Free and confidential therapy services, workshops, and training for situations related to gender- and power-based harm (including sexual assault, intimate partner violence, and stalking).

Office for Equity, Equal Opportunity, and Title IX (EEO-TIX) - (213) 740-5086
Information about how to get help or help someone affected by harassment or discrimination, rights of protected classes, reporting options, and additional resources for students, faculty, staff, visitors, and applicants.

Reporting Incidents of Bias or Harassment - (213) 740-2500
Avenue to report incidents of bias, hate crimes, and microaggressions to the Office for Equity, Equal Opportunity, and Title for appropriate investigation, supportive measures, and response.

The Office of Student Accessibility Services (OSAS) - (213) 740-0776
OSAS ensures equal access for students with disabilities through providing academic accommodations and auxiliary aids in accordance with federal laws and university policy.

USC Campus Support and Intervention - (213) 740-0411
Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

Diversity, Equity and Inclusion - (213) 740-2101
Information on events, programs and training, the Provost's Diversity and Inclusion Council, Diversity Liaisons for each academic school, chronology, participation, and various resources for students.

USC Emergency - UPC: (213) 740-4321, HSC: (323) 442-1000 – 24/7 on call
Emergency assistance and avenue to report a crime. Latest updates regarding safety, including ways in which instruction will be continued if an officially declared emergency makes travel to campus infeasible.

USC Department of Public Safety - UPC: (213) 740-6000, HSC: (323) 442-1200 – 24/7 on call
Non-emergency assistance or information.

Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)
A safe and confidential place to share your USC-related issues with a University Ombuds who will work with you to explore options or paths to manage your concern.

Occupational Therapy Faculty Practice - (323) 442-2850 or otfp@med.usc.edu
Confidential Lifestyle Redesign services for USC students to support health promoting habits and routines that enhance quality of life and academic performance.