

## Course Overview

From eerily accurate movie recommendations to the selection of inspection-worthy soil and rock samples on Mars, it is increasingly commonplace to discover machines using data to make critically important decisions. This course introduces the interdisciplinary field of machine learning which is at the intersection of computer science, statistics, and business. In this course, students will learn to use Python to acquire, parse and model data. A significant portion of the course will be a hands-on approach to the fundamental modeling techniques and machine learning algorithms that enable students to build robust predictive models of real-world data and test their validity.

## Learning Objectives

This course seeks to:

- provide students a deeper understanding - conceptually and contextually - of both the modern machine learning landscape and the engineering problem solving process as a whole.
- prepare students for real-world application of skills related to machine learning models, including data wrangling, model training, and results analysis.

## Measurable Outcomes

After completing this course, students will be able to:

- Perform exploratory data analysis.
- Transform raw data into the appropriate format for machine learning processing.
- Build and refine machine learning models.
- Use machine learning models to predict patterns from data.
- Communicate data-driven insight.

## Prerequisite(s)

ITP-115 or ITP-116 or equivalent

## Course Notes

This course will make use of several tools for delivery of content and assignments, and for general communication. edstem (<https://edstem.org>) will serve as the entry-point for everything related to this course. Lecture slides and any supplemental course content will be posted to edstem for use by all students. All assignments will be posted to edstem and will be submitted through edstem. General assignment help and communication will be done through edstem.

You will receive an invite email to the edstem course at the beginning of the semester. Please familiarize yourself with edstem before the course begins.

## Attendance and Etiquette

Attendance is not part of the grading breakdown, although attending scheduled meetings will help you learn the material and succeed in this class. The instructor expects you to pay attention during scheduled meetings and be an active learner. Chatting while the instructor is talking, texting on your mobile device, and participating on social media sites during class is disrespectful to the instructor and your classmates. If you are not able to attend lectures, then you should watch the recorded lectures and complete the in-class labs.

## Adding the course after the first week

Per university policy, students are allowed to add the course until the end of week three. Any students wishing to add the course should plan on attending the course from the beginning of the semester. If the student needs to add the course after week 1, they will need to apply for D-Clearance. Upon getting D Clearance, students will need to reach out to advising to add the class, and should email the instructor immediately to make sure there is a plan for completion of work and learning missed materials. Any missed work is required to be completed and submitted according to the schedule provided by the instructor.

## Technological Proficiency and Hardware/Software Required

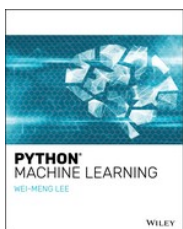
Students will need a computer (laptop or desktop) and access to the internet. If you do not have access to a computer, please contact your instructor.

Students should have basic technical knowledge of their computer, including the ability to install software, download course material, and properly submit their assignments online. All software needed for the course is available for free.

# Required Readings and Supplementary Materials

Required materials: None

Supplementary Materials:



Wei-Meng Lee. *Python Machine Learning*. Wiley, 2019.

<https://learning.oreilly.com/library/view/python-machine-learning/9781119545637/>

Additional reference material will be provided as needed.

# Coursework

## General information

1. **Unless otherwise noted, students must complete all coursework individually.**
2. Extensions will gladly be given for circumstances out of the student's control, e.g. sickness.
3. Extensions will **not** be given for anything under the student's control, e.g. extracurricular events overlapping with due dates.

## Assignments

There are two types of assignment in this course:

1. **Homework:** week-long assignments which pertain to the material from the current week as well as to previous weeks. Typically, these are due one week after being assigned.
2. **Check-in:** end-of week summary with several questions to allow for reflection regarding the material covered, as well as an opportunity to ask any clarifying questions. For full credit, typically you will only have to complete around half of these across the entire semester.

Generally, each week there will be one Homework and one Check-in assigned; they will relate to the topic covered that particular week. Each assignment will include instructions, a due date, and a link for electronic submission. Assignments must be submitted using this link; they will not be accepted through any other method.

## Assignment Submission Policy

All assignments must be submitted through edstem. They will not be accepted through any other method.

## Late Assignment Policy

It is the student's responsibility to submit assignments on or before the due date. Assignments may be submitted within two days with a late penalty. Homeworks turned in one day (24 hours) late will have 25% of the total points deducted from the graded score. Homeworks turned in over one day and up to two days (>24 hours and ≤ 48hours) late will have 50% of the total points deducted from the graded score. After two days, submissions will not be accepted, and the score for the assignment will be a 0.

## Regrade requests

Students have one week to contest a grade once it has been posted. After this one week, the grade will not be changed. To contest a grade, create a private post on edstem and select the grades folder. In the post, include your name, the assignment name, and your reasons. Tag your instructor and your grader. This will allow the grader and instructor to view your submission and make a decision.

## Exams

No make-up tests (except for documented medical or family emergencies) will be offered. If you will not be able to attend a test due to an athletic game or other valid reason, then you must coordinate with the instructor before the test is given. You may arrange to take the test before you leave with an approved university personnel during the time you are gone, or within the week the test is given. If you do not take a test, then you will receive a 0 for the test. If you need

accommodations authorized by the Office of Student Accessibility (OSAS), notify the instructor at least two weeks before the test. This will allow time for arrangements to be made.

# Final Project

## Description

There will be a final project in this course which aims to solve real-world challenges using Machine Learning. Students will need to incorporate skills learned over the entire course of the semester in order to complete the project.

The final project will be graded on how it fulfills the requirements and the quality and completion of the challenge. **The Final Project must represent the student's sole effort.**

## Schedule

Week (Fall/Spring)	Week (Summer)	Event
12	5	Project assigned
13 through 16	5 through 6	Work on Final Projects
16 (Final exam period)	6 (Final exam period)	Due: Final Project

## Final Project Grade Breakdown

Item	% of grade
Question 1	50
Question 2	50
<b>TOTAL</b>	<b>100</b>

## Final Grade breakdown

The coursework is comprised of a mixture of Homeworks, Exams, Check-ins, and the Final Project, with the following grade breakdown:

Item	% of grade
Homeworks	45
Check-ins	5
Exams	30
Final Project	20
<b>TOTAL</b>	<b>100</b>

# Course Schedule: Topic Breakdown

Topic	Topics	Supplementary Reading	Assigned work	Due
1	<b>Introduction</b> <b>Python Core 01</b>	See edstem	H01	See edstem
2	<b>Python Core 02</b>		H02	
3	<b>Data Manipulation</b> <ul style="list-style-type: none"> <li>- numpy</li> <li>- pandas</li> </ul>			
4	<b>Data Visualization</b> <ul style="list-style-type: none"> <li>- matplotlib</li> </ul>		H04	
5	<b>Data Wrangling 01</b> <ul style="list-style-type: none"> <li>- cross-sectional data</li> <li>- panel data</li> </ul>			
6	<b>Data Wrangling 02</b> <ul style="list-style-type: none"> <li>- time series</li> </ul>		H06	
7	<b>Exam 01</b>			
8	<b>ML: Linear Regression</b> <ul style="list-style-type: none"> <li>- regressors</li> <li>- analysis: <math>R^2</math></li> </ul>		H08	
9	<b>ML: Logistic Regression</b> <ul style="list-style-type: none"> <li>- classifiers</li> <li>- analysis: accuracy, precision, recall, f1</li> </ul> <b>ML: K-Nearest Neighbors</b> <ul style="list-style-type: none"> <li>- underfitting, fitting, and overfitting</li> </ul>			
10	<b>ML: Methods of Analysis</b> <ul style="list-style-type: none"> <li>- Pre-ML: correlation</li> <li>- During-ML: Cross Validation</li> <li>- Post-ML: regressors and classifiers</li> </ul>		H10	
11	<b>ML: Decision Trees</b> <ul style="list-style-type: none"> <li>- homogeneity</li> <li>- growing and pruning</li> </ul>			
12	<b>ML: Clustering</b> <ul style="list-style-type: none"> <li>- Hierarchical</li> <li>- K-Means</li> <li>- silhouette score, inertia</li> </ul>		H12, Final Project	
13	<b>ML: Support Vector Machines</b> <ul style="list-style-type: none"> <li>- hyperplanes</li> <li>- kernels</li> </ul> <b>ML: Naive Bayes</b> <ul style="list-style-type: none"> <li>- collinearity</li> </ul>			

<b>14</b>	<b>ML: Fairness</b> - fairness assessment - harms mitigation			
	<b>Exam 02</b>			
<b>FINALS</b>	FINAL PROJECT DUE	<b>Date:</b> see edstem		

## Academic Integrity

Assignments in computer programming courses are different from those in some other types of courses. Students may NOT collaborate, work together, share code, or in any way exchange solutions for assignments. Assignments may be analyzed by software that looks for similarity. Any sharing of ideas or code will be considered a violation of academic integrity (cheating); an OAI report will be filed with the recommended penalty of an F in the course. Do not share your code with anyone else in this or a future section of the course, as allowing someone else to copy your code carries the same penalty as copying the code yourself.

If the instructor, a grader, or a teaching assistant suspects you of academic dishonesty, it has to be reported to OAI. Do not share assignments with another person. Do not submit another person's work as your own. Do not look at other students' papers during tests. Do not leave the room during a test without permission. Do not cheat! As Trojans, we are faithful, scholarly, skillful, courageous, and ambitious.

## Academic Conduct

Plagiarism – presenting someone else's ideas as your own, either verbatim or recast in your own words – is a serious academic offense with serious consequences. Please familiarize yourself with the discussion of plagiarism in SCampus in Part B, Section 11, "Behavior Violating University Standards" [policy.usc.edu/scampus-part-b](http://policy.usc.edu/scampus-part-b). Other forms of academic dishonesty are equally unacceptable. See additional information in SCampus and university policies on scientific misconduct, [policy.usc.edu/scientific-misconduct](http://policy.usc.edu/scientific-misconduct).

## Sharing of course materials outside of the learning environment

As per SCampus Section 11.12(B):

Distribution or use of notes or recordings based on university classes or lectures without the express permission of the instructor for purposes other than individual or group study is a violation of the USC Student Conduct Code. This includes, but is not limited to, providing materials for distribution by services publishing class notes. 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 relationship to the class, whether obtained in class, via email, on the Internet or via any other media. (See Section C.1 Class Notes Policy.)

## Support Systems

*Counseling and Mental Health - (213) 740-9355 – 24/7 on call*  
[studenthealth.usc.edu/counseling](http://studenthealth.usc.edu/counseling)

Free and confidential mental health treatment for students, including short-term psychotherapy, group counseling, stress fitness workshops, and crisis intervention.

*National Suicide Prevention Lifeline - 1 (800) 273-8255 – 24/7 on call*

[suicidepreventionlifeline.org](https://suicidepreventionlifeline.org)

Free and confidential emotional support to people in suicidal crisis or emotional distress 24 hours a day, 7 days a week.

*Relationship and Sexual Violence Prevention Services (RSVP) - (213) 740-9355(WELL), press “0” after hours – 24/7 on call*

[studenthealth.usc.edu/sexual-assault](https://studenthealth.usc.edu/sexual-assault)

Free and confidential therapy services, workshops, and training for situations related to gender-based harm.

*Office of Equity and Diversity (OED) - (213) 740-5086 | Title IX – (213) 821-8298*

[equity.usc.edu](https://equity.usc.edu), [titleix.usc.edu](https://titleix.usc.edu)

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) 740-5086 or (213) 821-8298*

[usc-advocate.symplicity.com/care\\_report](https://usc-advocate.symplicity.com/care_report)

Avenue to report incidents of bias, hate crimes, and microaggressions to the Office of Equity and Diversity | Title IX for appropriate investigation, supportive measures, and response.

*The Office of Student Accessibility Services - (213) 740-0776*

<https://osas.usc.edu/>

Support and accommodations for students with disabilities. Services include assistance in providing readers/notetakers/interpreters, special accommodations for test taking needs, assistance with architectural barriers, assistive technology, and support for individual needs.

*USC Campus Support and Intervention - (213) 821-4710*

[campussupport.usc.edu](https://campussupport.usc.edu)

Assists students and families in resolving complex personal, financial, and academic issues adversely affecting their success as a student.

*Diversity at USC - (213) 740-2101*

[diversity.usc.edu](https://diversity.usc.edu)

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*

[dps.usc.edu](https://dps.usc.edu), [emergency.usc.edu](https://emergency.usc.edu)

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) 442-120 – 24/7 on call*

[dps.usc.edu](https://dps.usc.edu)

Non-emergency assistance or information.

*Office of the Ombuds - (213) 821-9556 (UPC) / (323-442-0382 (HSC)*

[ombuds.usc.edu](https://ombuds.usc.edu)

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.