



Course Title

Fundamentals of Machine Learning

Course Number

CSCI-UA 9473

[Instructors: Please fill in/delete all square brackets, and check your syllabus for digital accessibility]

Instruction Mode: In-person

Spring 2024

Lecturer Contact Information

Monday : 9:55 - 10:25

Wednesday : 16:20 - 16:50

Prerequisites: MATH-UA 140: Linear Algebra (or equivalent) AND MATH-UA 235: Probability and Statistics (or equivalent) And grade of C or better in CSCI-UA 102: Data Structures (or equivalent)

Units earned

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Course Details

- Monday 01-22-2024 10:25 to 12:55
- Location: Rooms will be posted in Albert before your first class.

Course Description

Machine Learning is getting more and more important these days with applications ranging from autonomous driving to computer assisted medicine, including weather or financial forecasting. In the first part of the course, we will study the mathematical foundations of the current machine learning algorithms. This includes the main models from supervised learning, such as linear regression, logistic regression, support vector machines, ensemble methods and neural networks. This also includes several themes in unsupervised learning, such as dimensionality reduction, clustering and anomaly detection. In the second part, we will explore a certain number of specific applications, such as recommender systems,

reinforcement learning, and natural language processing. The class will alternate between lectures and Lab sessions. Two entire sessions will be devoted to graded projects.

Course Objective

After the course, the students will be able to:

- ☐ Build a machine learning pipeline using Python/Sklearn
- ☐ Handle raw data using Pandas, including missing data, categorical variables and high dimensional datasets
- ☐ Handle structured data such as text and image
- ☐ Train a neural network using Keras
- ☐ Understand the statistical framework behind most machine learning algorithms
- ☐ Understand the main optimization algorithms under the hood of machine learning
- ☐ Use reinforcement learning in Open AI Gym, to play games
- ☐ Know and profile customers to recommend products

Assessment Components

You are expected to attend class in person. Failure to submit or fulfill any required component may result in failure of the class, regardless of grades achieved in other assignments.

Teaching & Learning Philosophy

Required Text(s)

Electronic Resources (via Brightspace / NYU Library Course Reserves)

Supplemental Text(s) (not required to purchase)

C. M. Bishop, Pattern Recognition and Machine Learning, Springer 2006.
Suvrit Sra, Sebastian Nowozin, Stephen J. Wright, Optimization for Machine Learning, MIT Press, 2012
M. J. Kearns, M. Vazirani, An introduction to Computational Learning Theory, MIT press, 1994
M. Vidyasagar, Learning and Generalization, with applications to Neural Networks, Springer, 2003
T. Hastie, R. Tibshirani, J Friedman, The elements of statistical Learning, Springer Series in Statistics, 2017
K. P . Murphy, Machine Learning, A probabilistic perspective, MIT Press 2012.
I. GoodFellow, Y. Bengio, A. Courville, Deep Learning, MIT Press, 2016
<http://www.deeplearningbook.org>

Program (subject to possible modifications)

Date	Program	Lecturer*
22/01 M	Course introduction	GS
24/01 W	Tutorial: Mathematical background	GS
29/01 M	Linear regression, confidence intervals	PB
31/01 W	Lab: Sale's prediction	GS
05/02 M	Likelihood, logistic regression	PB
07/02 W	Tutorial: Bayes classifier - Multiclass classification	IC
12/02 M	Support Vector Machines	PB
14/02 W	Tutorial: Optimization	IC
16/02 F (W mkpday)	Lab: Titanic survival analysis	PB
19/02 M	Neural networks	GS
21/02 W	Lab: Convolutional Neural Networks	GS
26/02 M	Decision Trees – Ensemble methods	PB
28/02 W	Lab: Car accidents in France	IC
04/03 M	Clustering	GS
06/03 W	Lab: Clustering	GS
11/03 M	Principal component analysis	GS
	Midterm (written exam, 1h30, no documents)	
13/03 W	Project: Machine Learning	IC
20/03 W	Project: Machine Learning	IC

25/03 M	Anomaly Detection	GS
27/03 W	Lab: Anomaly Detection	GS
03/04 W	Tutorial: Bandits	IC
05/04 F (M makeup day)	Reinforcement learning	PB
08/04 M	Reinforcement learning project	EK
10/04 W	Reinforcement learning project	EK
15/04 M	Large language models	ML
17/04 W	Lab: Large language models	ML
22/04 M	Recommender systems	PB
24/04 W	Lab: Recommender systems	IC
29/04 M	Final exam (written, 1h30, no documents)	PB

* PB: Pascal BIANCHI, IC: Igor Colin, ML: Matthieu LABEAU, EK: Elie KADOUCHE

Grades: 25%: Final exam, 25%: Midterm exam, 25%: Projects, 25%: Assignments

Grading policy:

- Four labs will eventually be graded, each on 10 points. Graded labs will be selected at random. Lab 1, 2, 3, 4 are graded on 10 points each.
- Midterm and final exams are graded on 40 points each.
- ML project and RL project are graded on 20 points each.

Classroom Etiquette

To optimize the experience in a blended learning environment, please consider the following:

- Please do not eat during class and minimize any other distracting noises (e.g. rustling of papers and leaving the classroom before the break, unless absolutely necessary).
- If you are not using your cell phone to follow the lesson, cell phones should be turned off or in silent mode during class time.
- Make sure to let your classmates finish speaking before you do.
- If deemed necessary by the study away site (ie COVID related need), synchronous

class sessions may be recorded and archived for other students to view. This will be announced at the beginning of class time.

- Students should be respectful and courteous at all times to all participants in class.

Academic Policies

Grade Conversion

Your lecturer may use one of the following scales of numerical equivalents to letter grades:

US Letter Grade	US numerical	French numerical	
A	94-100 or 4.0	15-20	Excellent
A-	90-93 or 3.7	14	Very Good
B+	87-89 or 3.3	13	Good
B	84-83 or 2.7	12	Good
B-	80-83 or 2.7	11	Satisfactory
C+	77-79 or 2.3	10	Sufficient
C	74-76 or 2.0	9	Sufficient
C-	70-73 or 1.7	8	Sufficient
D	65-66 or 1.0	5-7	Poor
F	below 65 or 0	1-4	Fail

Attendance Policy

Studying at Global Academic Centers is an academically intensive and immersive experience, in which students from a wide range of backgrounds exchange ideas in discussion-based seminars. Learning in such an environment depends on the active participation of all students. And since classes typically meet once or twice a week, even a single absence can cause a student to miss a significant portion of a course. To ensure the integrity of this academic

experience, class attendance at the Academic Center, or online through NYU Brightspaces if the course is remote synchronous/blended, is expected promptly when class begins. Attendance will be checked at each class meeting. If you have scheduled a remote course immediately preceding/following an in-person class, you may want to write to nyu.paris.academics@nyu.edu to see if you can take your remote class at the Academic Center.

As soon as it becomes clear that you cannot attend a class, you must inform your professor and/or the Academics team by e-mail immediately (i.e. before the start of your class). Absences are only excused if they are due to illness, Moses Center accommodations, religious observance or emergencies. Your professor or site staff may ask you to present a doctor's note or an exceptional permission from an NYU Staff member as proof. Emergencies or other exceptional circumstances that you wish to be treated confidentially must be presented to staff. Doctor's notes must be submitted in person or by e-mail to the Academics team, who will inform your professors.

Unexcused absences may be penalized with a two percent deduction from the student's final course grade for every week's worth of classes missed, and may negatively affect your class participation grade. Four unexcused absences in one course may lead to a Fail in that course. Being more than 15 minutes late counts as an unexcused absence. Furthermore, your professor is entitled to deduct points for frequently joining the class late.

Exams, tests and quizzes, deadlines, and oral presentations that are missed due to illness always require a doctor's note as documentation. It is the student's responsibility to produce this doctor's note and submit it to site staff; until this doctor's note is produced the missed assessment is graded with an F and no make-up assessment is scheduled. In content classes, an F in one assignment may lead to failure of the entire class.

Regardless of whether an absence is excused or not, it is the student's responsibility to catch up with the work that was missed.

Final exams

Final exams need to be scheduled for exam week and must be taken at their designated times. Should there be a conflict between your final exams, please bring this to the attention of the Academics team. Final exams may not be taken early, and students should not plan to leave the site before the end of the finals period.

Late Submission of Work

- (1) Work submitted late receives a penalty of 2 points on the 100 point scale for each day it is late (including weekends and public holidays), unless an extension has been approved (with a doctor's note or by approval of NYU SITE Staff), in which case the 2 points per day deductions start counting from the day the extended deadline has passed.
- (2) Without an approved extension, written work submitted more than 5 days (including weekends and public holidays) following the submission date receives an F.
- (3) Assignments due during finals week that are submitted more than 3 days late (including weekends and public holidays) without previously arranged extensions will not be accepted and will receive a zero. Any exceptions or extensions for work during finals week must be discussed with Dr. Alfred Galichon, Director of NYU Paris, or Dr. Beth Epstein, Academic Director.

- (4) Students who are late for a written exam have no automatic right to take extra time or to write the exam on another day.
- (5) Please remember that university computers do not keep your essays - you must save them elsewhere. Having lost parts of your essay on the university computer is no excuse for a late submission. Also consider saving your work on a cloud or a drive to avoid any technical issues or loss on a computer

Academic Honesty/Plagiarism

As the University's policy on "[Academic Integrity for Students at NYU](#)" states: "At NYU, a commitment to excellence, fairness, honesty, and respect within and outside the classroom is essential to maintaining the integrity of our community. By accepting membership in this community, students take responsibility for demonstrating these values in their own conduct and for recognizing and supporting these values in others." Students at Global Academic Centers must follow the University and school policies.

NYU takes plagiarism very seriously; penalties follow and may exceed those set out by your home school. Your lecturer may ask you to sign a declaration of authorship form, and may check your assignments by using TurnItIn or another software designed to detect offenses against academic integrity.

The presentation of any improperly cited work other than your own, as though it is your own, including words, ideas, judgment, images, data, or AI-generated work (like ChatGPT or Google Bard), whether intentionally or unintentionally, constitutes a breach of academic integrity. It is important that all work submitted for this course is your own. It is also an offense to submit your own work for assignments from two different courses that are substantially the same (be they oral presentations or written work). If there is overlap of the subject of your assignment with one that you produced for another course (either in the current or any previous semester), you must inform your professor.

For guidelines on academic honesty, clarification of the definition of plagiarism, examples of procedures and sanctions, and resources to support proper citation, please see:

[NYU Academic Integrity Policies and Guidelines](#)

[NYU Library Guides](#)

Inclusivity Policies and Priorities

NYU's Office of Global Programs and NYU's global sites are committed to equity, diversity, and inclusion. In order to nurture a more inclusive global university, NYU affirms the value of sharing differing perspectives and encourages open dialogue through a variety of pedagogical approaches. Our goal is to make all students feel included and welcome in all aspects of academic life, including our syllabi, classrooms, and educational activities/spaces.

Attendance Rules on Religious Holidays

Members of any religious group may, without penalty, excuse themselves from classes when required in compliance with their religious obligations. Students who anticipate being absent due to religious observance should notify their lecturer AND NYU SITE's Academics Office in writing via e-mail one week in advance. If examinations or assignment deadlines are scheduled on the day the student will be absent, the Academics Office will schedule a make-up

examination or extend the deadline for assignments. Please note that an absence is only excused for the holiday but not for any days of travel that may come before and/or after the holiday. See also [University Calendar Policy on Religious Holidays](#)

Pronouns and Name Pronunciation (Albert and Zoom)

Students, staff, and faculty have the opportunity to add their pronouns, as well as the pronunciation of their names, into Albert. Students can have this information displayed to faculty, advisors, and administrators in Albert, NYU Brightspace, the NYU Home internal directory, as well as other NYU systems. Students can also opt out of having their pronouns viewed by their instructors, in case they feel more comfortable sharing their pronouns outside of the classroom. For more information on how to change this information for your Albert account, please see the [Pronouns and Name Pronunciation website](#).

Students, staff, and faculty are also encouraged, though not required, to list their pronouns, and update their names in the name display for Zoom. For more information on how to make this change, please see the [Personalizing Zoom Display Names website](#).

Moses Accommodations Statement

Academic accommodations are available for students with documented and registered disabilities. Please contact the Moses Center for Student Accessibility (+1 212-998-4980 or mosescsd@nyu.edu) for further information. Students who are requesting academic accommodations are advised to reach out to the Moses Center as early as possible in the semester for assistance. Accommodations for this course are managed through NYU [SITE].

Bias Response

The New York University Bias Response Line provides a mechanism through which members of our community can share or report experiences and concerns of bias, discrimination, or harassing behavior that may occur within our community.

Experienced administrators in the Office of Equal Opportunity (OEO) receive and assess reports, and then help facilitate responses, which may include referral to another University school or unit, or investigation if warranted according to the University's existing Non-Discrimination and Anti-Harassment Policy.

The Bias Response Line is designed to enable the University to provide an open forum that helps to ensure that our community is equitable and inclusive.

To report an incident, you may do so in one of three ways:

- Online using the [Web Form \(link\)](#)
- Email: bias.response@nyu.edu
- Phone: 212-998-2277
- Local Phone: 0033 (0)1 53 73 29 77

Wellness and Counseling Resources

Mental health resources are available to students studying at NYU Paris through NYU's Wellness Exchange. Students can speak to a counselor about a variety of topics, including, day-to-day challenges, stress, health concerns and medical issues. Students may call the 24 hotline at +33 6 83 75 16 10, chat through the Wellness Exchange app for iPhone or Android; call (212) 443-9999 to arrange a same-day Urgent Counseling session; or email wellness.exchange@nyu.edu during business hours. Alternatively, students can also make an appointment with NYU Paris's onsite Global Wellness Counselor at paris.counseling@nyu.edu