



## Course Title

# Machine Learning

## Course Number

CSCI-UA 9473

**Instruction Mode: In-person**

## SEMESTER & YEAR

If you are enrolled in this course 100% remotely and are not a Go Local/Study Away student for NYU Paris, please make sure that you've completed the online academic orientation via Brightspace so you are aware of site specific support structure, policies and procedures. Please contact [be16@nyu.edu](mailto:be16@nyu.edu) if you have trouble accessing the Brightspace site.

**Syllabus last updated on: 24-01-2023**

## Lecturer Contact Information

### Prerequisites

MATH-UA 121: Calculus I (or equivalent)

MATH-UA 140: Linear Algebra (or equivalent)

Recommended: MATH-UA 235: Probability and Statistics (or equivalent), CSCI-UA 102: Data Structures (or equivalent)

### Units earned

4

## Course Details

- All times are Central European Time
- Location: Rooms will be posted in Albert before your first class.
- Remote Participants: Your instructor will provide you with the Zoom link via NYU Classes.

- COVID-related details: In the interest of protecting the NYU Paris community, we are closely following CDC guidance around COVID-19 and adjusting our recommendations and policies accordingly. Your health and well-being is our top priority.
  - If you are attending in person, you will be assigned a seat on the first day and are expected to use that seat for the entire semester due to NYU COVID-19 safety protocol. Please note that you are expected to attend every class meeting in-person; however, this may change during the drop/add period if in-person student registration increases significantly or at any point during the semester if local COVID-19 regulations require additional physical distancing.
  - Additionally, in-person students will be split into cohorts who will attend sessions.

### **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 or remote synchronously. Failure to submit or fulfill any required component may result in failure of the class, regardless of grades achieved in other assignments.

### **Session 1 – 27/01 (Wednesday make up day)**

Lecture: Course introduction

Tutorial: Probability theory (reminder)

### **Session 2 – 30/01, 01/02**

Lecture: Linear regression  
Recitation: A sale's prediction problem

**Session 3** – 06/02, 08/02

Lecture: Likelihood, Logistic regression, Multi-class classification

Recitation: Titanic survival analysis

**Session 4** – 13/02, 15/02

Lecture: Optimization theory, Support Vector Machines

Tutorial: Stochastic gradient descent

**Session 5** – 20/02, 22/02

Lecture: Neural networks

Recitation: Image classification

**Session 6** – 27/02, 01/03, **03/03 (Monday make up day)**

Lecture: Decision trees and ensemble methods

Recitation: Geolocation in IoT networks

Conference: Machine learning in action (Guest lecturer)

**Session 7** – 06/03, 08/03

Lecture: Dimensionality reduction

Recitation: Source separation in EEG signals

**Session 8** – **20/03 (Midterm exam)**, 22/03

Lecture: Anomaly detection

On Monday 20/03, the class is devoted to the midterm exam (1 hour: 9:00 – 10:00)

**Session 9** – 27/03, 29/03

Machine learning project: large scale machine learning for click prediction

**Session 10** – 03/04, 05/04

Lecture: Clustering

Recitation: TBA

**Session 11** – 12/04, **14/04 (Monday make up day)** – no class on Monday 01/04

Lecture: Recommender systems

Recitation: Movie rating prediction

**Session 12** – 17/04, 19/04

Lecture: Reinforcement learning

Recitation: Tutorial on the policy gradient theorem

**Session 13** – 24/04, 26/04

Reinforcement learning project

**Session 14** – 03/05, **05/05 (Monday make up day)** – no class on Monday 01/05

Lecture: Natural language processing

Recitation: Opinion analysis

**Final exam** – 17/05

**Grades:** 40%: Final exam, 20%: Midterm exam, 20%: Projects , 20%: Assignments

**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>

**Classroom Etiquette**

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

- Please be mindful of your microphone and video display during synchronous class meetings. Ambient noise and some visual images may disrupt class time for you and your peers.
- 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 centers, 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](mailto: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. Your professor is entitled to deduct points if you frequently join 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 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 approved by Academic Affairs ([nyu.paris.academics@nyu.edu](mailto:nyu.paris.academics@nyu.edu)).
- (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.

### **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 offences against academic integrity.

The presentation of another person's words, ideas, judgment, images, or data as though they were your own, whether intentionally or unintentionally, constitutes an act of

plagiarism. It is also an offense to submit work for assignments from two different courses that is substantially the same (be it oral presentations or written work). If there is an 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, 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](mailto: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 Paris.

### **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, please contact one of the following:

- Online using the [Web Form \(link\)](#)
- Email: [bias.response@nyu.edu](mailto:bias.response@nyu.edu)
- Phone (NY): +1 (212) 998-2277
- Office of the Director, NYU Paris: +33 1 53 92 50 80