ARTIFICIAL INTELLIGENCE

Course Number
CSCI-UA 9472

Instruction Mode: Blended

Semester

Syllabus last updated on:

Lecturer Contact Information

Prerequisites
V22.0201 (Computer Systems Design I) and V22.0301 (Basic Algorithms)

Units earned
[Enter credits earned - 3, 4 or 6]

Course Details
The course is composed of two components.

Lectures
The purpose of the lectures is to convey essential concepts in AI, explain problems and methods, and describe use cases. These theory classes include interaction between the students and the instructors.

Lab classes
Understanding the notions presented during lectures will be greatly facilitated by laboratory courses.
● Location:

● Remote Participants: Your instructor will provide you with the Zoom link via NYU Classes.

● COVID-related details: In the interest of protecting the NYU [SITE] 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 [AS INDICATED HERE].

Course Description

There are many tasks that humans can do easily and almost unconsciously but that have proven extremely difficult to program on a computer. Artificial Intelligence (AI) aims at developing computer systems that can carry out some of these tasks. This body of knowledge and techniques at the interface between mathematics and computer science has made constant progress in recent decades and will be at the origin of many technological innovations with a strong scientific, societal or economic impact. Computer vision or the automatic recognition of speech or handwriting are successful applications that are the most frequently mentioned to illustrate the efficiency of AI solutions. These successes are being presented as harbingers of a revolution that will spare no field of human activity. Expectations are high. AI is supposed to allow for the development of a personalized medicine that will adapt a treatment to the patient's genetic traits. It is to be used to design systems of predictive maintenance for complex infrastructures, such as electricity grids. It would help make aircraft with systems for the early detection of "weak" signals that announce breakdowns, and would thus serve to plan the replacement of components before their probable failure. The vehicles using AI would be safer and fully autonomous, and be in service longer. This is even more so with machine learning, the branch of AI that seeks to develop techniques for automatically analyzing masses of data, usually for predictive purposes. Motivated at the origin by problems related to the recognition of shapes and stimulated by the cognitive sciences, machine learning does not serve just to process data and adjust the parameters of a more or less rigid, predefined model. It is used to design algorithms that "learn" automatically, from examples, which model in an immense catalog of models will be the most efficient. The efficiency of learning algorithms (e.g., "neural networks", "support vector machines" or "random forests") and the development of optimized software for implementing them have popularized the use of AI over the past two decades. Machine learning draws from several fields of applied mathematics: in particular and of course, from Probability, since it provides the right language for describing data variability and formulating predictive problems, Statistics, Optimization and Image/Signal Processing among others. AI is a very vast interdisciplinary domain and the problems it can be used to tackle are extremely diverse. Undeniably, they cannot be covered through a single course... The main purpose of this class is to familiarize you with some of the fundamental mathematical and algorithmic concepts used to develop intelligent systems. We will focus on several aspects of AI: machine learning, the main paradigm of AI research now, including
reinforcement learning (i.e. situations where the machine/agent interacts with its environment) and some of its popular applications such as computer vision, biometrics, recommending systems and natural language processing (NLP), certain crucial notions of symbolic AI as well (e.g. search, logic and automated reasoning) to design knowledge-based systems. We will underline the importance of representations (of data/knowledge) in AI approaches and will explain that the level of “delegation” to be granted to “smart systems” in the near future will heavily depend on how research in AI methodology will reply to questions of ethics (the processing of personal data while respecting privacy, fairness) and reliability/robustness.

Course Objective

The purpose of this class is to familiarize you with certain crucial notions of AI through the presentation of some major problems (e.g. Pattern recognition, Q-learning, unsupervised learning, collaborative filtering) and popular use cases (e.g. facial recognition, automated medical diagnosis, fraud detection, recommender systems, virtual assistants, the analytics of opinions or feelings). Although focus will be on practice definitely, a certain amount of formalism cannot be avoided however, in particular to gain insight into concepts such as complexity, model under/overfitting, generalization capacity and to describe the problems and the methods in AI. The knowledge of basics in Probability/Statistics, Linear Algebra and Mathematical Analysis is advisable but not mandatory. Regarding the implementation of AI methods, the Python language will be used. However, this is not a coding class and softwares such as https://scikit-learn.org will be used extensively.

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.

- Problem sets and programming assignments, prolongating three of the labs (60% of the grade: 20% each)
- Final exam/quizz (40% of the grade)

Required Text(s)

Electronic Resources (via Brightspace / NYU Library Course Reserves)

None

Supplemental Text(s) (not required to purchase)

**Additional Required Equipment**

Personal laptop

**Sessions**

**Week 1 (Sept. 6 & 8)** General introduction: scope, basic definitions, historical perspectives, agenda, organization, evaluation - Getting started with scikit-learn – The (monolayer) Perceptron.

**Weeks 2 and 3 (Sept. 13, 15, 20 & 22)** – Pattern recognition: formulation, use cases (e.g. handwritten character recognition, medical diagnosis), first algorithms (linear discriminant analysis, decision trees, linear SVM, nearest neighbours, neural nets), concepts of statistical learning (training/test, complexity, model selection)

**Weeks 4 and 5 (Sept 27 & 29, Oct. 4 & 6)** – Towards more predictive approaches: advanced learning algorithms (ensemble learning, deep nets, kernel methods) – applications to biometrics

**Week 6 (Oct. 11 & 13)** – Recommending systems – Preference learning – Collaborative Filtering

**Week 7, 8 (Oct. 18 & 20)** - Unsupervised learning, 'learning without a teacher': clustering, blind source separation, novelty/anomaly detection, autoencoders

**Weeks 9 (Oct. 25 & 27)** Reliable/trustworthy AI: bias, fairness, explainability/interpretability, robustness

**Weeks 10, 11 (Oct. 28, Nov. 3, 8, 10 & 18)** Sequential Learning – Stochastic Bandits – Q learning

**Weeks 12, 13 (Nov. 15, 17, 22 & 29, Dec. 1)** – Natural Language Processing

**Week 14 (Dec. 6 and 8)** - Symbolic AI: knowledge-based systems (systems of experts), logic reasoning

**Weeks 15** - Exam (Quizz)

**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.

[Enter further classroom etiquette if applicable; if, for example, it is not permitted to use laptops for note taking, please add the following clause: “Exceptions will be made for students with academic accommodations from the Moses Center.” You may also want to tell your students if and how they should signal to you that they would like to speak.]
Suggested Co-Curricular Activities
[Enter suggested voluntary co-curricular activities]

Academic Policies

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

<table>
<thead>
<tr>
<th>US Letter Grade</th>
<th>US numerical</th>
<th>French numerical</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>94-100 or 4.0</td>
<td>15-20</td>
</tr>
<tr>
<td>A-</td>
<td>90-93 or 3.7</td>
<td>14</td>
</tr>
<tr>
<td>B+</td>
<td>87-89 or 3.3</td>
<td>13</td>
</tr>
<tr>
<td>B</td>
<td>84-83 or 2.7</td>
<td>12</td>
</tr>
<tr>
<td>B-</td>
<td>80-83 or 2.7</td>
<td>11</td>
</tr>
<tr>
<td>C+</td>
<td>77-79 or 2.3</td>
<td>10</td>
</tr>
<tr>
<td>C</td>
<td>74-76 or 2.0</td>
<td>9</td>
</tr>
<tr>
<td>C-</td>
<td>70-73 or 1.7</td>
<td>8</td>
</tr>
<tr>
<td>D</td>
<td>65-66 or 1.0</td>
<td>5-7</td>
</tr>
<tr>
<td>F</td>
<td>below 65 or 0</td>
<td>1-4</td>
</tr>
</tbody>
</table>

Excellent
Very Good
Good
Satisfactory
Sufficient
Sufficient
Poor
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 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
toled 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.

(1) 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).
(2) Students who are late for a written exam have no automatic right to take extra time or to write the exam on another day.

(3) 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](https://www.globalacademic.columbia.edu/policies/academic-integrity)" 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](https://www.globalacademic.columbia.edu/policies/academic-integrity)
- [NYU Library Guides](https://www.library.columbia.edu/)

**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) 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
- Phone (NY): +1 (212) 998-2277
- Office of the Director, NYU Paris: +33 1 53 92 50 80