Course Title

Artificial Intelligence

Course Number
CSCI-UA 9472

Instruction Mode: Blended

Fall 2021

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 marion.aller@nyu.edu if you have trouble accessing the Brightspace site.

Syllabus last updated on: 24-08-2021

Lecturer Contact Information
Augustin Cosse

Prerequisites
CSCI-UA 201: Computer Systems Org and CSCI-UA 310: Basic Algorithms

Units earned
4 pts

Course Details

- Meeting on Monday, Wednesday 3:30pm-4:45pm CET (lecture) + Wednesday 5:00pm-6:25pm CET (recitation)
- All times are CET (Daylight Saving Time ends on October 21).
- 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 or email.
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
There are many cognitive tasks that people can do easily and almost unconsciously but that have proven extremely difficult to program on a computer. Artificial intelligence is the problem of developing computer systems that can carry out these tasks. We will focus on five central sections in AI: Problem solving (and search methods), Logical reasoning, reasoning in uncertainty, learning with neural networks and reinforcement learning, learning by mimicking nature. Finally, we will also spend some time discussing some of the main challenges in computer vision and natural language understanding/processing. For each of the sections above, we will study how they can improve the behavior of an intelligent agent. We will study the set of skills associated with each section and the methods that can be designed for our agent to demonstrate or at least mimic those skills. The course will essentially consist in building an intelligent agent by gradually endowing this agent with more and more tools as we go through each of the sections above. The course will also discuss some of the philosophical questions related to AI such as the Frame Problem of McCarthy and Hayes, The Mind Body problem, Searle's "Chinese room" thought experiment, The Turing Test,…

Course Objective

Students who complete this course successfully will be able to:
- Understand the main paradigms in the field (logicism vs connectionism, Strong AI vs Weak AI, ...)
- List the major events which shaped the development of Artificial Intelligence
- Understand and implement the various forms of Knowledge Based (KB) agents (including reflex based, Goal based, Utility based,...) as well as the constitutive elements of artificial environments and their descriptions.
- Implement and describe the most important search algorithms (Informed, uninformed, A*) as an aspect of artificial intelligence within agents, to achieve specific objectives or maximize a given utility.
• Understand the notion of formal language and its use in the reasoning of intelligent agents. In particular, understand how the use of a formal language together with a way to carry out reasoning in such a language can be used to define a logic.
• Understand and implement simple representational languages such as propositional logic and first order logic.
• Understand the notions of syntax and semantics
• Understand and implement neural networks.
• Train neural networks through backpropagation.
• List the main events that led to the development of neural networks and deep learning
• Use efficient python libraries for the training of neural networks (scikit-learn) and deep networks (TensorFlow/keras)
• Understand the main paradigms of reinforcement learning
• Solve some simple problems (e.g. Instances from openAI Gym) through reinforcement learning and deep reinforcement learning/deep Q-learning
• Understand the frame, qualification and ramification problems and their use as a motivation for the use of probabilistic reasoning and inference mechanisms.
• Understand and implement the notions of belief networks and Bayesian networks
• Understand and implement the most important Biology inspired/Evolutionary algorithms (including Genetic algorithms, Ant Colonies and Particle Swarm Optimization Methods)
• Understand the main paradigms, approaches and open problems in Computer Vision and Language Processing.
• Code some of the algorithms used in Computer Vision and Natural Language Processing
• Use Python (including classes, inheritance, functions) to implement an intelligent agent and provide this agent with all the aspects discussed throughout the course.

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.

Required Text(s)
Electronic Resources (via Brightspace / NYU Library Course Reserves)

• All the information will be contained in the slides which can be downloaded from the website http://www.augustincosse.com/ai-fall2020
• Examples of assignments and programming sessions can be found on GitHub: http://www.augustincosse.com/ai-fall2020
• Relevant papers and/or book chapters available free of charge on the internet might also be assigned throughout the semester
Supplemental Text(s) (not required to purchase)
The books listed below are not required for the class but are listed as additional resources for those who are interested in getting additional details/clarifications with respect to the material covered during the lectures. PDF versions can be found online for most of those books. Versions of those books will be available at the library.

- S. Russel and P. Norvig (RN), *Artificial Intelligence: A Modern approach*
- P.H. Winston (W), *Artificial Intelligence*, 3rd ed. Addison-Wesley
- R. E. Neapolitan, X. Jiang (NJ), *Artificial Intelligence, With an Introduction to Machine Learning*
- M. Flasinski, *Introduction to artificial intelligence*
- P. Marquis, O. Papini, H. Prade, *Panorama de l’intelligence artificielle*

Additional Required Equipment
NA

When mentioning book chapters in the overall course schedule below, we use the codes indicated in the Supplementary material section (i.e. RN = Russel and Norvig, ...).

**Session 1 – 30/08/2021, 01/09/2021**
General Intro. Critical and Philosophical perspectives, History, (RN 1-2)

**Session 2 – 06/09/2021, 08/09/2021**
Intelligent Agent, Search Methods (including informed/uninformed, A*,..) Part I (W 4-6) (RN 3-4)
HW 1

**Session 3 – 13/09/2021, 15/09/2021**
Intelligent Agents, Search Methods (including informed/uninformed, A*,..) Part II (W 4-6) (RN 3-4)

**Session 4 – 20/09/2021, 22/09/2021**
Logical reasoning, Planning and acting (including first order and propositional Logic) (Part I) (W 13) (NJ 2-4) (RN 6,7,9,11)
HW1 due date, HW2

**Session 5 – 27/09/2021, 29/09/2021**
Logical reasoning, Planning and acting (including first order and propositional Logic) (Part II),
(W 13) (NJ 2-4) (RN 6,7,9,11)

Session 6 – 4/10/2021, 6/10/2021
Neural Networks and Deep Learning (Part I)
(W 22, 23, 24) (RN 19)(NJ 15)
HW2 due date

Session 7 – 11/10/2021, 13/10/2021
MidTerm Exam
Project Final choice
Neural Networks and Deep Learning (Part II)
(RN 20)

Session 8 – 18/10/2021, 20/10/2021
Unsupervised and Reinforcement Learning (Part I)
(RN 17, 20)(NJ 12)
HW3

Session 9 – 25/10/2021, 27/10/2021
Unsupervised and Reinforcement Learning (Part II)
(RN 17, 20)(NJ 12)

Session 10 – 01/11/2021, 03/11/2021
Learning in multiagent systems + Guest lecture manifold learning (part II)
HW3 due date. HW4

Session 11 – 08/11/2021, 10/11/2021
Learning under uncertainty, Bayesian Nets, Backward chaining
(RN 14, 15, 19) (NJ 6-11)

Session 12 – 15/11/2021, 17/11/2021
Biology inspired computing (Evolutionary Algs, Particle Swarm, Ant Col.) (Part I)
HW4 due date. HW5
(W 25)(NJ 13-14) (RN 20.8)

Session 13 – 22/11/2021, 24/11/2021
Biology inspired computing (Evolutionary Algs, Particle Swarm, Ant Col.) (Part II)
(W 25)(NJ 13-14) (RN 20.8)
Session 14 – 29/11/2021, 1/12/2021
Computer Vision and Language Processing (Part I),
(W 26-29)(RN 22-24)(NJ 16)
Posters deadlines
HW5 due date, HW6

Session 15 – 6/12/2021, 8/12/2021
Computer Vision and Language Processing (Part II)
(W 26-29)(RN 22-24)(NJ 16)

Session 16 – 13/12/2021, 15/12/2021
Revisions + advanced topics, Poster/papers presentations

Session 17 – 20/12/2021, 22/12/2021
Final Exams

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.

Suggested Co-Curricular Activities
NA

Your Lecturer
Augustin Cosse received the BS, MS and PhD in Engineering and applied mathematics at the University of Louvain (Belgium) in 2009, 2011 and 2016. He was a visiting student at MIT between 2013 and 2014, a visiting fellow at Harvard (IACS) between 2014 and 2015 and
visited the University of Chicago, Department of Statistics, between 2015 and 2016. Between 2016 and 2020, he was a postdoctoral researcher at NYU CIMS and Ecole Normale Superieure (Paris).

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

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 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).

(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) 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