CS 4710-001 Artificial Intelligence, Fall 2023

Course Description
Welcome! What do autonomous driving, speech recognition, robotic surgery have in common? These are all exciting real-world applications with substantial impact on everyday lives enabled by recent advances in artificial intelligence (AI) technologies. This course will help you to learn foundational AI concepts that apply to a wide variety of real-world problems, which will serve as the foundation for further study in any AI application area you choose to pursue. In addition, we will discuss important ethical and social issues raised by AI technologies. The overall goal of this course is to enable you to learn not only the fundamental knowledge of AI, but also important skills of creative thinking, collaborative working, and continuing learning of new AI techniques after the course is over.

Course Information
Instructor: Lu Feng lu.feng@virginia.edu
TAs:
- Farzana Ahmad fa7sa@virginia.edu
- Shuyang Dong sd3mn@virginia.edu
- MJ Kwon hbt9su@virginia.edu
- Matthew Landers qwp4pk@virginia.edu

Lectures:
- Time: Tue/Thu 3:30-4:45 PM
- Room: Olsson Hall 120
- Zoom: Link (meeting ID: 978 8037 2019, password: 795290)
- The lectures will be in person. However, we also want to offer a flexible learning environment for students who may not be able to attend the class in person due to various reasons (e.g., illness, job interviews). Students who cannot attend the lectures in person may choose to attend the live broadcasting of lectures via zoom or watch the lecture recordings later.

Office Hours:
- Instructor: Olsson Hall 120, Tue/Thu after the lectures
- TAs: Rice Hall 442, Mon 1-3pm, Wed 10am-12pm, Fri 3-5pm

Online course resources:
- Canvas
  Hosting majority of the course materials, including slides and assignments.
- Gradescope (access via Canvas)
  For submitting and auto-grading of programming projects.
- Piazza (access via Canvas)
  You are strongly encouraged to participate in discussion, ask questions, and answer other students' questions through Piazza. The instructor and TAs will also monitor the Piazza site closely to answer questions in time.

Textbook:
- "[Artificial Intelligence: A Modern Approach (Fourth edition)](#)" by Stuart Russell and Peter Norvig. The textbook is recommended as supplementary reading of lecture slides. We do not follow it chapter by chapter.

Prerequisites

You are expected to be familiar with basic concepts of propositional logic and probability theory, because these elements are central to modern AI. The recommended background is the following courses (or equivalent):
- CS 2102 Discrete Mathematics
- APMA 3100 Probability

In addition, you are expected to have some prior computer programming experience. Course programming assignments will be in Python.

Learning Objectives

By the end of the semester, you will be able to
- Explain foundational AI concepts, including various search algorithms, probabilistic inference, and reinforcement learning, etc.
- Analyze and compare the strengths and limitations of different AI techniques, and apply them to solve problems.
- Develop and implement AI agents that efficiently make decisions in fully informed, partially observable and adversarial settings.
- Collaborate in a small group to apply AI techniques to solve a real-world problem of your choice, and communicate your project in writing and presentation.
- Be aware of ethical and social issues raised by AI technologies.

Assessment & Grading

The overall course grade will be determined by the following assessment:
- ***Quizzes (25%):*** There will be 5 quizzes (hosted on Canvas), which are meant to help you reinforce and practice with concepts covered in class. The quizzes will be automatically graded for correctness, and you can submit as many times as you like up to the deadline. You are encouraged to work until you have fully solved the quizzes.
- ***Programming projects (50%):*** There will be 4 programming projects (submitted to Gradescope) that ask you to apply an array of AI techniques learned in class to play Pac-Man, which provides a challenging problem environment that demands creative solutions. These projects allow you to visualize the results of the techniques you implement. *You can work on these programming projects alone or in teams of two.* The programming projects will be automatically graded for correctness, and you can submit as many times as like up to the deadline.
- ***Final course project (25%):*** You will team up in groups of up to 5 students to work on a final course project where you apply AI techniques to solve a real-world problem of your team's choice. The project deliverables include:
  - 1-2 pages proposal (5%)
  - In-class project presentation (10%)
  - 5-10 pages final report (10%)

Grades are on the following fixed scale:

A [90 – 100]%
A- [85 – 90)%
B+ [80 – 85)%
B [75 – 80)%
B- [70 – 75)%
C+ [65 – 70)%
C [60 – 65)%
C- [55 – 60)%
D+ [50 – 55)%
D [45 – 50)%
D- [40 – 45)%
F [0 – 40]%

The instructor may adjust grades upward based on extra bonus credit. The grade of A+ will be awarded at the instructor's discretion based on exceptional performance.

Course Schedule

Date	Lecture Topic	Readings	Assignments
8/22	Introduction	Ch 1-2	
8/24	Search 1	Ch 3	
8/29	Search 2	Ch 3	Quiz 1 (due 9/5)
8/31	Games 1	Ch 5	Project 1 (due 9/14)
9/5	Games 2	Ch 5	
9/7	Constraint Satisfaction Problems 1	Ch 6	
9/12	Constraint Satisfaction Problems 2	Ch 6	Quiz 2 (due 9/19)
9/14	Markov Decision Processes 1	Ch 17	Project 2 (due 9/28)
9/19	Markov Decision Processes 2	Ch 17	
9/21	Reinforcement Learning 1	Ch 22	
9/26	Reinforcement Learning 2	Ch 22	Quiz 3 (due 10/3)
9/28	Inverse Reinforcement Learning	Ch 22	Project 3 (due 10/12)
10/3	No Class (Fall Reading Days)		
10/5	Quantifying Uncertainty	Ch 12	
10/10	Bayesian Networks 1	Ch 13	
10/12	Bayesian Networks 2	Ch 13	
10/17	Bayesian Networks 3	Ch 13	
10/19	Decision Networks	Ch 16	Project proposal due date
10/24	Hidden Markov Models	Ch 14	Quiz 4 (due 10/31)
10/26	Deep Learning 1	Ch 21	Project 4 (due 11/9)
10/31	Deep Learning 2	Ch 21	
11/2	Guest Lecture		
11/7	No Class (Election Day)		
11/9	Deep Learning 3	Ch 21	
11/14	Deep Learning 4	Ch 21	Quiz 5 (due 11/21)
11/16	Autonomous Driving		
11/21	AI Safety and Ethics	Ch 27	
11/23	No Class (Thanksgiving)		
11/28	Final Project Presentations		
11/30	Final Project Presentations		
12/5	Final Project Presentations		
12/10	-		Project report due date

Slip Days and Extensions

You will have a total of 5 slip days for late submission of assignments, and may use up to 2 days for each assignment (including group submissions). *There is no penalty for using the slip days and you do not need to seek the instructor's prior approval.* However, if more than 2 slip days are used for an assignment or more than 5 slip days are used in total, the grading would be discounted 5% for each extra slip day. Note that this policy is meant to deal with cases like internet issues while submitting, forgetting about the deadline, joining the class late, etc.

In addition to slip days, extensions for assignments are generally granted if you have a medical or family-related emergency, or job interviews. The default extension is 3 days, and you can request more if necessary. *Please email the instructor before the assignment deadline for any extension request.*

Honor Code

We trust every student in this course to fully comply with all of the provisions of the University's Honor Code. By enrolling in this course, you have agreed to abide by and uphold the Honor System of the University of Virginia, as well as the following policies specific to this course.

- All graded assignments must be pledged.
- **Collaboration**: Quizzes must be completed on your own. The programming projects can be completed alone or in teams of two. The final course project is encouraged to be completed in groups of up to five students.
- **Ethics**: Submissions should acknowledge all collaborators and sources consulted. All code and written responses should be original. We trust you to submit your own work, but to protect the integrity of the course from anyone who doesn't play by the rules, we will actively be checking for code plagiarism.

All suspected violations will be forwarded to the Honor Committee, and you may, at the instructor's discretion, receive an immediate zero on that assignment regardless of any action taken by the Honor Committee.

Please let the instructor know if you have any questions regarding the course Honor policy. If you believe you may have committed an Honor Offense, you may wish to file a Conscientious Retraction by calling the Honor Offices at (434) 924-7602. For your retraction to be considered valid, it must, among other things, be filed with the Honor Committee before you are aware that the act in question has come under suspicion by anyone. More information can be found at http://honor.virginia.edu. Your Honor representatives can be found at: http://honor.virginia.edu/representatives.

About the Use of Generative AI Tools

Generative artificial intelligence tools—software that creates new text, images, computer code, audio, video, and other content—have become widely available. Well-known examples include ChatGPT for text and DALL•E for images. This policy governs all such tools, including those released during our semester together. You may use generative AI tools for work in this course however you see fit. If you do use generative AI tools on assignments in this class, you must properly document and credit the tools themselves. Cite the tool you used, following the pattern for computer software given in the specified style guide.

Additionally, please include a brief description of how you used the tool. If you choose to use generative AI tools, please remember that they are typically trained on limited datasets that may be out of date. Additionally, generative AI datasets are trained on pre-existing material, including copyrighted material; therefore, relying on a generative AI tool may result in plagiarism or copyright violations. Finally, keep in mind that the goal of generative AI tools is to produce content that seems to have been produced by a human, not to produce accurate or reliable content; therefore, relying on a generative AI tool may result in your submission of inaccurate content. It is your responsibility—not the tool's—to assure the quality, integrity, and accuracy of work you submit in any college course. Although you have wide latitude to determine how you use generative AI tools in this course, you must be wary of unintentional plagiarism or fabrication of data. Depending on the specific circumstances, a first offense academic integrity violation related to misuse of generative AI could range anywhere from Level 1 to Level 3 under the Code of Academic Integrity. Repeated offenses could raise the violation to Level 4. Please act with integrity, for the sake of both your personal character and your academic record.

Recording of Classroom Activities
I intend to record our Zoom lecture meeting sessions for the sake of students who are unable to attend. Recordings will be available in the Zoom cloud. Recordings will be set to "view only" so that they cannot be shared or moved, they will be deleted when the course is completed, and will always be password protected. Please be aware that per university policy and out of respect to our class community, recordings may not be downloaded, reproduced, shared outside our course, or uploaded to other online environments. Pre-arranged permission from me is required for any recordings made by students. My default setting is to record only the shared screen, and during class I may pause recording at times to allow for everyone to feel comfortable discussing sensitive topics. I encourage you to contact me directly if you prefer to participate via audio only or to use an alias during class, or with any additional concerns or considerations you think the class community should consider about recording.

Students with disabilities or learning needs
It is my goal to create a learning experience that is as accessible as possible. If you anticipate any issues related to the format, materials, or requirements of this course, please meet with me outside of class so we can explore potential options. Students with disabilities may also wish to work with the Student Disability Access Center (SDAC) to discuss a range of options to removing barriers in this course, including official accommodations. We are fortunate to have an SDAC advisor, Courtney MacMasters, physically located in Engineering. You may email her at cmacmasters@virginia.edu to schedule an appointment. For general questions please visit the SDAC website: sdac.studenthealth.virginia.edu. If you have already been approved for accommodations through SDAC, please send me your accommodation letter and meet with me so we can develop an implementation plan together.

Religious accommodations
It is the University's long-standing policy and practice to reasonably accommodate students so that they do not experience an adverse academic consequence when sincerely held religious beliefs or observances conflict with academic requirements.

Students who wish to request academic accommodation for a religious observance should submit their request to me by email as far in advance as possible. Students who have questions or concerns about academic accommodations for religious observance or religious beliefs may contact the University's Office for Equal Opportunity and Civil Rights (EOCR) at UVAEOCR@virginia.edu or 434-924-3200.

Harassment, Discrimination, and Interpersonal Violence
The University of Virginia is dedicated to providing a safe and equitable learning environment for all students. If you or someone you know has been affected by power-based personal violence, more information can be found on the UVA Sexual Violence website that describes reporting options and resources available - www.virginia.edu/sexualviolence.

The same resources and options for individuals who experience sexual misconduct are available for discrimination, harassment, and retaliation. UVA prohibits discrimination and harassment based on age, color, disability, family medical or genetic information, gender identity or expression, marital status, military status, national or ethnic origin, political affiliation, pregnancy (including childbirth and related conditions), race, religion, sex, sexual orientation, or veteran status. UVA policy also prohibits retaliation for reporting such behavior.

If you witness or are aware of someone who has experienced prohibited conduct, you are encouraged to submit a report to Just Report It (justreportit.virginia.edu) or contact EOCR, the office of Equal Opportunity and Civil Rights.

If you would prefer to disclose such conduct to a confidential resource where what you share is not reported to the University, you can turn to Counseling & Psychological Services ("CAPS") and Women's Center Counseling Staff and Confidential Advocates (for students of all genders).

As your professor and as a person, know that I care about you and your well-being and stand ready to provide support and resources as I can. As a faculty member, I am a responsible employee, which means that I am required by University policy and by federal law to report certain kinds of conduct that you report to me to the University's Title IX Coordinator. The Title IX Coordinator's job is to ensure that the reporting student receives the resources and support that they need, while also determining whether further action is necessary to ensure survivor safety and the safety of the University community.

Support for your career development
Engaging in your career development is an important part of your student experience. For example, presenting at a research conference, attending an interview for a job or internship, or participating in an extern/shadowing experience are not only necessary steps on your path but are also invaluable lessons in and of themselves. I wish to encourage and support you in activities related to your career development. To that end, please notify me by email as far in advance as possible to arrange for appropriate accommodations.

Student support team
You have many resources available to you when you experience academic or personal stresses. In addition to your professor, the School of Engineering and Applied Science has

staff members located in Thornton Hall who you can contact to help manage academic or personal challenges. Please do not wait until the end of the semester to ask for help!

Learning
Lisa Lampe, Assistant Dean for Undergraduate Affairs
Director of Student Success (search underway)
Courtney MacMasters, Accessibility Specialist
Free tutoring is available for most classes.

Health and Wellbeing
Kelly Garrett, Assistant Dean of Students, Student Safety and Support
Elizabeth Ramirez-Weaver, CAPS counselor*
Katie Fowler, CAPS counselor*

*You may schedule time with the CAPS counselors through Student Health (https://www.studenthealth.virginia.edu/getting-started-caps). When scheduling, be sure to specify that you are an Engineering student. You are also urged to use TimelyCare for either scheduled or on-demand 24/7 mental health care.

Community and Identity
The Center for Diversity in Engineering (CDE) is a student space dedicated to advocating for underrepresented groups in STEM. It exists to connect students with the academic, financial, health, and community resources they need to thrive both at UVA and in the world. The CDE includes an open study area, event space, and staff members on site. Through this space, we affirm and empower equitable participation toward intercultural fluency and provide the resources necessary for students to be successful during their academic journey and future careers.