ISTA 450 (undergraduate) / INFO 550 (graduate)
Introduction to Artificial Intelligence
Spring 2022

Course Description:
This course provides a broad technical introduction to the tools, techniques and concepts of artificial intelligence. The course will focus on methods for automating decision making under a variety of conditions, including full and partial information, and dealing with uncertainty. Students will gain practical experience writing programs that use these techniques to solve a variety of problems.

Topics: problem solving (search spaces, uninformed and informed search, games, constraint satisfaction), principles of knowledge representation and reasoning (propositional and first-order logic, logical inference, planning), and representing and reasoning with uncertainty (decision theory, reinforcement learning, probabilistic inference).

Prerequisites:
ISTA 350 or CSC 345 or equivalent or consent of instructor. This course requires programming competency, familiarity with basic discrete mathematics and elementary concepts of algorithm analysis. Familiarity with basic concepts of probability, statistics and logic (propositional and first-order) is helpful.

Units: 3

Course Meeting Times and Location:
M/W 2:00 PM – 3:15 PM; Education, Rm 310

Instructor Information:
Clayton T. Morrison, PhD
Associate Professor, School of Information
Office: Harvill 437A
Office Phone: 520-621-6609
Email: claytonm@email.arizona.edu
Office Hours: Posted on course website; contact by *email* to set up an appointment

Course home page: https://ml4ai-2022-ai.github.io

Course Objectives:
The objective of this course is to introduce the core methods used in modern artificial intelligence and gain experience implementing these methods as algorithms in a programming language (python), using them on data.

By the end of this course, all students will be able to:
• Identify types of problems for which artificial intelligence methods provide problem solving approaches: uninformed and informed search, adversarial search, constraint satisfaction, formal reasoning with propositional or first order representations, decision-making under uncertainty, reinforcement learning, and basic probabilistic modeling (including over time).
• Write programs that make use of these artificial intelligence problem solving techniques.

By the end of this course, graduate students will also be able to:
• Design, write, and evaluate artificial intelligence programs based on the frameworks introduced in the course and apply them to real-world problems.

School of Information Competencies addressed by this course:
• Undergraduates (ISTA)
https://ischool.arizona.edu/undergraduate-student-competencies
F1.2 – Students will demonstrate facility using basic research methods, for example: research design; statistics and analysis; organization, identification, and location of data and information including open- and closed-access sources; and/or presentation of findings in oral, written, and multi-media form, including proper use of and citation of sources.
DAISBS2.2 – Students will establish the ability to exercise the four key techniques of computational thinking (decomposition, pattern recognition, abstraction, and algorithms) in solving information and data challenges.
• Graduates (INFO)
https://ischool.arizona.edu/ms-student-competencies
Students will establish the ability to exercise the four key techniques of computational thinking: decomposition (C1.A), pattern recognition (C1.B), abstraction (C1.C), and algorithms (C1.D) in solving information and data challenges, in addition to analytically. Students will also demonstrate fluency in at least one programming language (C1.E).
C2.A: Students will be able to identify specific types of data for different analytical methods.
C2.C: Students will be able to apply appropriate statistical, machine learning, visual analytics, and other techniques to identify patterns and make sound predictions with given data.

Grade policies:

For *both* undergraduate and graduate students, assignments are broken into the following categories, along with the percentage that the category will contribute to the final grade:
- Written: 30%
- Programming Projects (5 @ 10pts): 50%
- Midterm: 10%
- Final Project: 10%

Within each category, a given assignment will have a clearly specified point scale that represents the difficulty of that item relative to other items in the category. All points on all graded items within a category will be summed and the sum will then be adjusted according to the percentage that category contributes to the final grade, as listed above.

Assignments will have basic components and advanced components. **Undergraduate students** are responsible for the basic components. **Graduate students** are responsible for *both* components. (For example: suppose a written assignment has a basic question worth 10 points and an advanced question worth 5 points; the undergraduate's score will be assessed according to the 10 points for the basic question while the graduate's overall score will be assessed according to the 15 points for both the basic and advanced component.) For most assignments, Graduate students will have approximately 10-20% more work consisting of additional more challenging and in-depth problems than Undergraduate students.

Letter grades are assigned according to the final cumulative grade percentage
    A: 90% ≤ cumulative grade percentage
    B: 80% ≤ cumulative grade percentage < 90%
    C: 70% ≤ cumulative grade percentage < 80%
    D: 60% ≤ cumulative grade percentage < 70%

Late Work Policy:

No examinations may be taken after the examination date.
Assignments are due as specified in the assignment document when released. Programming assignments will be submitted through the course GitHub Classroom and the final submission must be committed and pushed BEFORE the deadline. Written assignments will generally be turned in as PDF documents to the appropriate course D2L Assignment folder.
In case of emergencies affecting turning work in on time, you ***must*** contact the instructor *immediately*, **prior** to the deadline.

Classroom Behavior:

Please be considerate: Please disable your cellphone/pager ringer. If you get an urgent call, please quietly leave the lecture hall to conduct it.   Screens are distracting! If you want to use a laptop or tablet for taking notes, please sit toward the side of the class in order to not disrupt other students.
Asking Questions: During class, feel free to interrupt with questions whenever they occur to you. The instructor may ask you to hold off on your question for a few moments.
Answering Questions: We frequently ask questions of the class during lectures to judge the level of understanding (and to break up the monotony). Some students really like answering questions, sometimes to the point of discouraging anyone else from answering. If you are an eager answerer, pace yourself; let someone else answer an easy one once in a while and save the hard ones for yourself.

Textbooks:

The primary book, required, will be:
• Stuart Russell and Peter Norvig (2010). Artificial Intelligence: A Modern Approach
   (3rd Edition). Prentice Hall. http://aima.cs.berkeley.edu/

We will also read portions of the following:
• Richard S. Sutton and Andrew G. Barto (1998). Reinforcement Learning: An
   Introduction. The MIT Press
   This book is available free from the author's website:
   http://incompleteideas.net/book/the-book-2nd.html

Additional readings in the form of research articles (electronic pdfs) will be provide (generally through D2L) during the course.

Course Outline:
• *Module 1: Tools for Problem Solving*
Uninformed search, informed (heuristic) search, local search and optimization, adversarial search and games, constraint satisfaction.
• *Module 2: Knowledge, Reasoning and Planning*
Propositional and First-Order logic, logical inference, classical planning, planning and acting in the real world, knowledge representation.
• *Module 3: Decision-making with Uncertain Knowledge*
Basic probability theory and probabilistic reasoning, decision theory, probabilistic reasoning over time, reinforcement learning.

Course Meeting Information for Spring 2022 during the Pandemic

Instruction Mode: In Person

Statement on compliance with COVID-19 mitigation guidelines: As we enter the Spring semester, the health and wellbeing of everyone in this class is highest priority. Accordingly, we are all required to follow the university guidelines on COVID-19 mitigation. Please visit www.covid19.arizona.edu for the latest guidance.

University Face Coverings Requirement:

- Surgical or higher-grade face masks are required in all indoor spaces where it is not possible to adequately and continuously maintain social distance (in accordance with posted signage), and in:
    - Any building/facility that is operated by or affiliated with the University of Arizona where patients or human research subjects participating in clinical research are seen in person.
    - In locations where personal protective equipment (including face masks) has always been required to maintain safety protocols for situations with high hazards, such as areas where regulated chemicals are used or stored and other laboratory settings.
- Surgical masks are three-ply disposable masks. Higher-grade face masks include KN95 and KF94 masks. N95/N99 masks are acceptable for those who are authorized to wear them by the University's Respiratory Protection Program: https://research.arizona.edu/compliance/RLSS/respiratory-protection-program
- The University will provide surgical masks in building lobbies, classrooms, and large sites. KN95 masks will be provided by building managers upon request.
- Cloth masks alone will not be allowed, although they may be worn over a surgical mask to enhance fit.
- Per CDC guidance, masks of any grade with exhalation valves are not allowed.

Classroom attendance:

- If you feel sick, or may have been in contact with someone who is infectious, stay home. Except for seeking medical care, avoid contact with others and do not travel.
- Notify your instructors if you will be missing a course meeting or an assignment deadline.
- Non-attendance for any reason does **not** guarantee an automatic extension of due date or rescheduling of examinations/assessments.
    - Please communicate and coordinate any request directly with your instructor.
- If you must miss the equivalent of more than one week of class, you should contact the Dean of Students Office DOS-deanofstudents@email.arizona.edu to share documentation about the challenges you are facing.
- Voluntary, free, and convenient COVID-19 testing (https://covid19.arizona.edu/test-trace-treat) is available for students on Main Campus.
- If you test positive for COVID-19 and you are participating in on-campus activities, you must report your results to Campus Health. To learn more about the process for

reporting a positive test, visit the Case Notification Protocol page:
https://covid19.arizona.edu/test-trace-treat/positive-case-protocol .
o COVID-19 vaccine is available for all students at Campus Health:
https://health.arizona.edu/covidvaccine .
o Visit the UArizona COVID-19 page (https://covid19.arizona.edu/) for regular updates.

Office Hours During the Pandemic:
Our goal is to be able to hold office hours in person. However, with the uncertain pandemic conditions, especially at the beginning of the semester, we will start by holding office hours by zoom. The zoom link(s) will be provided in class and through D2L. Once we feel that it is safe to hold in-person office hours, we will announce in class and on D2L our change in office hours mode.

Obtaining Help

- **Academic advising:** If you have questions about your academic progress this semester, please reach out to your academic advisor (https://advising.arizona.edu/advisors/major). Contact the Advising Resource Center (https://advising.arizona.edu/) for all general advising questions and referral assistance. Call 520-626-8667 or email to advising@.arizona.edu

- **Life challenges:** If you are experiencing unexpected barriers to your success in your courses, please note the Dean of Students Office is a central support resource for all students and may be helpful. The Dean of Students Office can be reached at (520) 621-2057 or DOS-deanofstudents@email.arizona.edu.

- **Physical and mental-health challenges**: If you are facing physical or mental health challenges this semester, please note that Campus Health provides quality medical and mental health care. For medical appointments, call (520) 621-9202. For After Hours care, call (520) 570-7898. For the Counseling & Psych Services (CAPS) 24/7 hotline, call (520) 621-3334.

University Policies

Class Recordings:
We will be recording some of the classes (at the discretion of the instructor).
o   Students must access content in D2L only. Students may not modify content or re-use content for any purpose other than personal educational reasons. All recordings are subject to government and university regulations. Therefore, students accessing unauthorized recordings or using them in a manner inconsistent with UArizona values (https://www.arizona.edu/purpose-mission-values) and educational policies (Code of Academic Integrity, https://deanofstudents.arizona.edu/student-rights-responsibilities/academic-integrity, and the Student Code of Conduct, https://deanofstudents.arizona.edu/student-rights-responsibilities/student-code-conduct) are also subject to civil action.

Honors Credit:
Students wishing to contract this course for Honors Credit should email me to set up an appointment to discuss the terms of the contact and to sign the Honors Course Contract Request Form.
The Honors College website: https://www.honors.arizona.edu/

Missed Classes (Absence):
The UA's policy concerning Class Attendance and Administrative Drops is available at: http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop

All holidays or special events observed by organized religions will be honored for those students who show affiliation with such religions. Absences pre-approved by the UA Dean of Students office will be honored. See: http://policy.arizona.edu/human-resources/religious-accommodation-policy

No matter the reason for missing class, the student is <u>always</u> responsible for any missed material.

Final Exams:
Final Exam Regulations and Information:
https://www.registrar.arizona.edu/courses/final-examination-regulations-and-information Final Exam Schedule:
http://www.registrar.arizona.edu/students/courses/final-exams

Audit Policy:
http://catalog.arizona.edu/policy/audit-policy

Accessibility and Accommodations:
At the University of Arizona, we strive to make learning experiences as accessible as possible. If you anticipate or experience barriers based on disability or pregnancy, please contact the Disability Resource Center (520-621-3268, https://drc.arizona.edu) to establish reasonable accommodations.

UA SALT Center: http://www.salt.arizona.edu

Please be aware that the accessible table and chairs in this room should remain available for students for whom standard classroom seating is not usable.

Student Code of Academic Integrity (a.k.a., Cheating):
Students are encouraged to share intellectual views and discuss freely the principles and applications of course materials. However, graded work/exercises must be the product of independent effort unless otherwise instructed. Students are expected to adhere to the UA Code of Academic Integrity as described in the UA General Catalog. See:
http://deanofstudents.arizona.edu/policies-and-codes/code-academic-integrity

The University Libraries have some excellent tips for avoiding plagiarism available at: http://new.library.arizona.edu/research/citing/plagiarism

Selling class notes and/or other course materials to other students or to a third party for resale is **not permitted** *without the instructor's express written consent.* Violations to this and other course rules are subject to the Code of Academic Integrity and may result in course sanctions. Additionally, students who use D2L or UA email to sell or buy these copyrighted materials are subject to Code of Conduct Violations for misuse of student email addresses. This conduct may also constitute copyright infringement.

Additional Information on conduct:
        The Arizona Board of Regents list of Prohibited Conduct (pdf):
                https://public.azregents.edu/Policy%20Manual/5-303-
                Prohibited%20Conduct.pdf
        The Arizona Board of Regents Student Code of Conduct (pdf):
                https://public.azregents.edu/Policy%20Manual/5-308-
                Student%20Code%20of%20Conduct.pdf

Policies Against Threatening Behavior:
The Student Code of Conduct (5-308.F.11) dictates that no person or organization may interfere with or threaten University-sponsored classroom activities. The

following link provides details about the policy:
http://policy.arizona.edu/education-and-student-affairs/threatening-behavior-students
http://policy.arizona.edu/education-and-student-affairs/disruptive-behavior-instructional-setting

Non-Discrimination and Anti-Harassment Policy:
http://policy.arizona.edu/human-resources/nondiscrimination-and-anti-harassment-policy

Statements of Inclusion:
Elective name and pronoun usage: This course supports elective gender pronoun use and self-identification; rosters indicating such choices will be updated throughout the semester, upon student request. As the course includes in-class discussion, it is vitally important for us to create an educational environment of inclusion and mutual respect.

More information on updating your preferred name and pronouns is available on the Office of the Registrar site at https://www.registrar.arizona.edu/.

Inclusive Excellence is a fundamental part of the University of Arizona's strategic plan and culture. As part of this initiative, the institution embraces and practices diversity and inclusiveness. These values are expected, respected and welcomed in this course.

Confidentiality of Student Records:
http://registrar.arizona.edu/personal-information/family-educational-rights-and-privacy-act-1974-ferpa

Required or Special Materials: None.

Notice of Potentially Offensive Material: None.

Miscellaneous University Policies:

(1) On Dropping Classes:

See the official University of Arizona Registrar fall 2021 Dates and Deadlines: https://registrar.arizona.edu/dates-and-deadlines

If you find yourself thinking about dropping this (or any other) class, first make sure that that's what you really want to do. Chatting with the instructor or your academic advisor may help.

University of Arizona Class Attendance and Administrative Drop Policy:
http://catalog.arizona.edu/policy/class-attendance-participation-and-administrative-drop

(2) Grades of 'Incomplete':
      Office of Curriculum and Registration Grading Policy Manual:
            https://www.registrar.arizona.edu/grades/incomplete-i-grade
      UA General Catalog's Grades and the Grading System:
            http://catalog.arizona.edu/policy/grades-and-grading-system
The university's course catalog contains all of the details about incompletes, but here's the key sentence: "The grade of I may be awarded only at the end of a term, when all but a minor portion of the course work has been satisfactorily completed."

To qualify for an incomplete, a student must have maintained a passing grade for the class until the term is nearly complete, and then, due to an unusual and substantiated cause beyond the student's control, the student is unable to complete the class work. In short, you can't get an "I" just because you aren't happy with your grade.

Additional Resources for Students:
- UA Acadmic policies and procedures are available at http://catalog.arizona.edu/policies.

- **Campus Health:** http://www.health.arizona.edu/ . Campus Health provides quality medical and mental health care services through virtual and in-person care. Voluntary, free and convenient COVID-19 testing is available for students on Main Campus. COVID-19 vaccine is available for all students at Camps Health. Phone: 520-621-9202.

- **Counseling and Psychological Services (CAPS):** https://health.arizona.edu/counseling-psych-services . CAPS provides mental health care, including short-term counseling services. Phone: 520-621-3334.

- **Office of Diversity:** http://diversity.arizona.edu/

- **The Dean of Students Office's Student Assistance Program** http://deanofstudents.arizona.edu/student-assistance/students/student-assistance

Student Assistance helps students manage crises, life traumas, and other barriers that impede success. The staff addresses the needs of students who experience issues related to social adjustment, academic challenges, psychological health, physical health, victimization, and relationship issues, through a variety of interventions, referrals, and follow up services. Email: DOS-deanofstudents@email.arizona.edu
Phone: 520-621-7057

- **Survivor Advocacy Program**
https://survivoradvocacy.arizona.edu/
The Survivor Advocacy Program provides confidential support and advocacy services to student survivors of sexual and gender-based violence. The Program can also advise students about relevant non-UA resources available within the local community for support.
Email: survivoradvocacy@email.arizona.edu
Phone: 520-621-5767

- **Campus Pantry**
Any student who has difficulty affording groceries or accessing sufficient food to eat every day, or who lacks a safe and stable place to live and believes this may affect their performance in the course, is urged to contact the Dean of Students for support. In addition, the University of Arizona Campus Pantry is open for students to receive supplemental groceries at no cost. Please see their website at: https://campuspantry.arizona.edu/ for open times.

"Subject to Change" Statement:
The instructor reserves the right to change with advance notice where appropriate the content of the course. This right does not apply to the grade, absence or University policies.

Land Acknowledgement Statement
We respectfully acknowledge the University of Arizona is on the land and territories of Indigenous peoples. Today, Arizona is home to 22 federally recognized tribes, with Tucson being home to the O'odham and the Yaqui. Committed to diversity and inclusion, the University strives to build sustainable relationships with sovereign Native Nations and Indigenous communities through education offerings, partnerships, and community service.