JOHNS HOPKINS
WHITING SCHOOL
of ENGINEERING

Computer Science 601.464/664
Artificial Intelligence
Fall, 2018 (3 credits, EQ)

Description
The class is recommended for all scientists and engineers with a genuine curiosity about the fundamental obstacles to getting machines to perform tasks such as deduction, learning, planning and prediction, and how to overcome those obstacles. Strong programming skills are expected, as well as basic familiarity with probability. For students intending to also take courses in Machine Learning (e.g., 601.475/675, 601.476/676), they may find it beneficial to take this course first, or concurrently.

Prerequisites
601.226 Data Structures
Recommended: Linear Algebra, Probability, Statistics

Instructors
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The readings, unless otherwise noted, come from *Artificial Intelligence: A Modern Approach*, 3rd ed., known as the (Stuart) Russell (of Berkeley) and (Peter) Norvig (of Google) book, or just (R&N). Other texts include *Reinforcement Learning: An Introduction*, 2nd ed., by Sutton and Barto (S&B) `http://www.incompleteideas.net/book/bookdraft2018jan1.pdf`

Unless otherwise noted, lecture materials and assignments come from the popular Berkeley AI course (`http://ai.berkeley.edu/course_schedule.html`) following the same lecture title. These were developed in the same department as the textbook, and have become a community standard across many of the top CS departments across the country. Philipp Koehn's AI (`http://www.cs.jhu.edu/~phi/ai/`) materials are noted via (Koehn).

Assignments may be completed in teams of 1 or 2 people, and should be submitted via Gradescope. All assignments are due by noon on the day due. Late policy: each interval of 24hrs late will result in an additional 20% penalty (1 second late = 20% penalty; 23hrs 59mins 59secs = 20% penalty; 24hrs = 40% penalty; and so on).

Date	Topic	Assignments	Due	Readings
Sept 4	Introduction to AI	P0: Coding Skills	9/11	Ch. 1 (Tim lect.)
Sept 6	AI in the Public Imagination			(Koehn slides)
Sept 11	Philosophy of Mind			(Koehn slides) Ch. 26.1-2
Sept 13	Uninformed Search	P1: Search	9/27	Ch. 3.1-4
Sept 18	A* Search and Heuristics			Ch. 3.5-6
Sept 20	Game Trees: Minimax			Ch. 5.2-5
Sept 25	Game Trees: Expectimax; Utilities			Ch. 5.2-5
Sept 27	Markov Decision Processes	P2: Multi-Agent Pacman	10/16	Ch. 17.1-3 (Rachel lect.)
Oct 2	Markov Decision Processes II			Ch. 17.1-3 (R&N), Ch. 3 (S&B)
Oct 4	Reinforcement Learning			Ch. 21 (R&N), Ch. 6.1,2,5 (S&B)
Oct 9	Reinforcement Learning II			Ch. 21
Oct 11	**EXAM 1**: in-class			
Oct 16	Probability	P3: Reinforcement Learning	10/30	Ch. 13.1-5
Oct 18	Markov Models			Ch. 15.2,5
Oct 23	Hidden Markov Models			Ch. 15.2,5
Oct 25	Applications of HMMs			Ch. 15.2,6
Oct 30	Bayes' Nets: Representation	P4: Ghostbusters	11/15	Ch. 14.1-2,4
Nov 1	Bayes' Nets: Independence			Ch. 14.1-2,4 (Huda lect.)
Nov 6	Bayes' Nets: Inference			Ch. 14.4
Nov 8	Bayes' Nets: Sampling			Ch. 14.4-5
Nov 13	**EXAM 2**: in-class			
Nov 15	ML: Naive Bayes	P5: Classification	12/6	Ch. 20.1-20.2.2
Nov 20	*Thanksgiving*			
Nov 22	*Thanksgiving*			
Nov 27	ML: Perceptrons			Ch. 18.6.3
Nov 29	ML: DNNs			(local slides) (Tim lect.)
Dec 4	Fairness and Ethics			(local slides) (Rachel lect.)
Dec 6	Common Sense, and Wrapup			(local slides)
	EXAM 3: ???			

Readings

There will be a set of required readings, which will be covered in the exams via basic reading comprehension questions, such as multiple choice or fill in the blank. Those questions on exams are meant to ensure you have read the assigned materials, they will not be long-form analytic essays.

The readings to be covered per exam are:

Exam 1	A. M. Turing (1950) Computing Machinery and Intelligence. Mind 49: 433-460. original https://academic.oup.com/mind/article/LIX/236/433/986238 or with modern typsetting https://www.csee.umbc.edu/courses/471/papers/turing.pdf
Exam 1	Artificial Intelligence and Life in 2030: One Hundred Year Study on Artificial Intelligence https://ai100.stanford.edu/sites/default/files/ai100report10032016fnl_singles.pdf
Exam 1	"Why Zuckerberg and Musk Are Fighting About the Robot Future," The Atlantic. https://www.theatlantic.com/technology/archive/2017/07/musk-vs-zuck/535077/
Exam 2	"I, Robot", by Isaac Assimov
Exam 3	Kate Crawford and Ryan Calo. "There is a blind spot in AI research." Nature. October, 2016. https://www.nature.com/news/there-is-a-blind-spot-in-ai-research-1.20805
Exam 3	Hanna Wallach. "Big Data, Machine Learning, and the Social Sciences: Fairness, Accountability, and Transparency." https://medium.com/@hannawallach/big-data-machine-learning-and-the-social-sciences-927a8e20460d
Exam 3	Julia Angwin, Jeff Larson, Surya Mattu, and Lauren Kirchner. "Machine Bias." ProPublica. https://www.propublica.org/article/machine-bias-risk-assessments-in-criminal-sentencing

Online Resources

https://piazza.com/class/jckvqr80bhp33u

Students are encouraged to make use of Piazza for posting questions to the instructors and to other students in the class, but recall that assignments are restricted to teams of 1 or 2. Please do *not* use Piazza for sharing code snippets for the assignments!

Outcomes

This course will address the following Student Outcomes:

- An ability to apply knowledge of computing and mathematics appropriate to the discipline (a)
- An ability to analyze a problem, and identify and define the computing requirements appropriate to its solution (b)
- An ability to design, implement, and evaluate a computer-based system, process, component, or program to meet desired needs (c)
- An ability to apply mathematical foundations, algorithmic principles, and computer science theory in the modeling and design of computer-based systems in a way that demonstrates comprehension of the tradeoffs involved in design choices (j)
- Students will learn about the broader context of artificial intelligence.
- Students will learn core concepts in artificial intelligence, such as heuristic search, game playing, reinforcement learning, Bayesian networks, and machine learning.

Course Expectations & Grading

Grades in this course will be determined as follows: 20% Exam 1, 20% Exam 2, 30% Exam 3, 30% Assignments.

Exam 3 takes place during the final exam period: it will include both a focus on material in the course since Exam 2, and then also material from the rest of the semester as a comprehensive final.

Exams will be closed book, no electronics, on your own (no teammate!). Students are allowed to each bring a single sheet of standard 8"x11" paper with them to exams, covered on one or both sides in whatever writing you feel will be most helpful. Printed notes are fine, at whatever font size you choose; e.g., AT&T's Bell Gothic font, designed for legibility at small sizes (phonebooks).

Ethics

The strength of the university depends on academic and personal integrity. In this course, you must be honest and truthful, abiding by the *Computer Science Academic Integrity Policy*:

> Cheating is wrong. Cheating hurts our community by undermining academic integrity, creating mistrust, and fostering unfair competition. The university will punish cheaters with failure on an assignment, failure in a

course, permanent transcript notation, suspension, and/or expulsion. Offenses may be reported to medical, law or other professional or graduate schools when a cheater applies.

Violations can include cheating on exams, plagiarism, reuse of assignments without permission, improper use of the Internet and electronic devices, unauthorized collaboration, alteration of graded assignments, forgery and falsification, lying, facilitating academic dishonesty, and unfair competition. Ignorance of these rules is not an excuse.

Academic honesty is required in all work you submit to be graded. Except where the instructor specifies group work, you must solve all homework and programming assignments without the help of others. For example, you must not look at anyone else's solutions (including program code) to your homework problems. However, you may discuss assignment specifications (not solutions) with others to be sure you understand what is required by the assignment.

If your instructor permits using fragments of source code from outside sources, such as your textbook or on-line resources, you must properly cite the source. Not citing it constitutes plagiarism. Similarly, your group projects must list everyone who participated.

Falsifying program output or results is prohibited.

Your instructor is free to override parts of this policy for particular assignments. To protect yourself: (1) Ask the instructor if you are not sure what is permissible. (2) Seek help from the instructor, TA or CAs, as you are always encouraged to do, rather than from other students. (3) Cite any questionable sources of help you may have received.

On every exam, you will sign the following pledge: "I agree to complete this exam without unauthorized assistance from any person, materials or device. [Signed and dated]". Your course instructors will let you know where to find copies of old exams, if they are available.

Report any violations you witness to the instructor.
You can find more information about university misconduct policies on the web at these sites:

- Undergraduates: `e-catalog.jhu.edu/undergrad-students/student-life-policies/`
- Graduate students: `e-catalog.jhu.edu/grad-students/graduate-specific-policies/`

Students with Disabilities
Any student with a disability who may need accommodations in this class must obtain an accommodation letter from Student Disability Services, 385 Garland, (410) 516–4720, `studentdisabilityservices@jhu.edu`.