Artificial Intelligence for Sciences and Humanities

Syllabus

DO NOT POLLUTE! AVOID PRINTING, OR PRINT 2-SIDED MULTIPAGE.

Course Description

Artificial Intelligence (AI) is transforming every corner of society — from healthcare and education to the social sciences and the arts. This course invites students from *all* backgrounds, whether in the sciences or the humanities, to explore *what* is AI, *how* it works, and *how* it can be tailored to apply it meaningfully in their own disciplines.

No math or programming experience is required. Instead, the course is designed to make AI accessible through two complementary components:

- **How AI works:** A big-picture overview of the inner workings of AI, explained intuitively rather than mathematically.
- **AI in Action:** Hands-on projects that let you experiment with AI tools in real-world, domain-specific applications—no coding skills needed. Running examples will draw from healthcare, environmental studies, social sciences, and the arts, showing how AI can both empower discovery and challenge the way we think.

Logistics

Lectures: Monday/Wednesday, 2:30pm-3:45pm. 2532 Morgridge Hall.

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Prerequisites

- **Basic Computer Literacy:** Students should be comfortable using a computer, including basic file management (saving, copying, renaming files) and navigating the internet.
- **Logical Thinking Skills:** A general ability to think logically. If you can solve the following puzzle, you should be fine: *Five people were eating apples, A finished before B, but behind C. D finished before E, but behind B. What was the finishing order?*

- **Middle School Mathematics:** Familiarity with basic algebra and mathematical concepts like variables and equations. If you can solve for x in the equation $3x + 8 = 5$, you should be fine.
- **Willingness to Learn:** A positive attitude toward learning new concepts, tools, and problem-solving methods is emphasized over specific technical knowledge.

Grading (curved)

- 20% Attendance
- 60% Homework
- 20% Quizzes

Topics

1. **Foundations of AI**
   - What is Artificial Intelligence? Main ingredients and definitions.
   - Everyday examples of AI: recommendation systems, chatbots, medical diagnostics, art generation.
2. **How AI Works (without the math)**
   - How AI *sees* data, and how AI *learns* from data.
   - Supervised, unsupervised, and reinforcement learning.
   - Neural networks explained visually (layers, connections, activation).
   - Black box vs. interpretable models.
3. **Hands-On AI Tools (No Coding Required)**
   - Image recognition demos (e.g., classifying objects, medical scans, artworks).
   - Text analysis (chatbots, sentiment analysis, translation).
   - Generative AI (text-to-image, text-to-music, creative writing).
   - Create your own AI and apply it (e.g., in science, education, policy, or art)
4. **AI Across Disciplines**
   - Healthcare: diagnosis, drug discovery, public health.
   - Social sciences: surveys, behavior prediction, bias detection.
   - Humanities and arts: creative AI, music, visual art, literature.
   - Environmental and agricultural sciences: climate models, biodiversity monitoring, precision farming.
5. **Broader Issues and Critical Perspectives**
   - Ethics: fairness, bias, privacy, and discrimination in AI.
   - Interpretability: can we understand AI decisions?
   - Impact on jobs, creativity, environment, and society.
   - Regulation and policy debates.
   - Consciousness.

Materials

All materials, such as sample code, lecture notes, and homework will be posted at:

`https://danielpimentel.github.io/teaching.html`

Additional Resources

- *Statistics for the Humanities*, by John Canning, 2014.
- *Humanities Data Analysis. Case Studies with Python*, by Folgert Karsdorp, Mike Kestemont, and Allen Riddell; Princeton University Press, 2021.
- *An Introduction to Statistical Learning*, by G. James, D. Witten, T. Hastie, and R. Tibshirani; Springer 2017.
- *Machine Learning*, by T. Mitchell; McGraw Hill, 1997.
- *Pattern Recognition and Machine Learning*, by C. Bishop; Springer, 2011.

I also recommend readings from these two online books:

- *Machine Learning: A Probabilistic Perspective*, by K. Murphy; MIT Press, 2012.
- *Understanding Machine Learning: From Theory to Algorithms*, by S. Shalev-Shwartz and S. Ben-David; Cambridge University Press, 2014.
- *Linear Algebra*, by Stephen Friedberg, Arnold Insel, and Lawrence Spence, Pearson, 2019.
- *Probability and Random Processes for Electrical and Computer Engineers*, by John Gubner, Cambridge University Press, 2006.
- *Convex Optimization*, by Stephen Boyd and Lieven Vandenberghe, Cambridge University Press, 2009.
- *Numerical Optimization*, by Jorge Nocedal and Stephen Wright, Springer, 2006.
- *Neural Networks and Deep Learning*, by Michael Nielsen, 2019, available at `http://neuralnetworksanddeeplearning.com/index.html`
- *Deep Learning*, by Ian Goodfellow, Yoshua Bengio, and Aaron Courville, MIT Press, 2016, available at `http://www.deeplearningbook.org`

Academic Policies

- The course syllabus provides a general plan for the course; deviations may be necessary.
- **Recordings.** Lecture materials and recordings of this course are protected intellectual property at UW-Madison. Students in this course may use the materials and recordings for their personal use related to participation in this class. Students may also take notes solely for their personal use. If a lecture is not already recorded, you are not authorized to record lectures without permission unless you are considered by the university to be a qualified student with a disability requiring accommodation.

[Regent Policy Document 4-1] Students may not copy or have lecture materials and recordings outside of class, including posting on internet sites or selling to commercial entities. Students are also prohibited from providing or selling their personal notes to anyone else or being paid for taking notes by any person or commercial firm without the instructor's express written permission. Unauthorized use of these copyrighted lecture materials and recordings constitutes copyright infringement and may be addressed under the university's policies, UWS Chapters 14 and 17, governing student academic and non-academic misconduct.

- **Evaluations.** Your constructive assessment of this course plays an indispensable role in shaping education at UW-Madison. Upon completing the course, please take the time to fill out the online course evaluation.

- **Academic Integrity.** By enrolling in this course, each student assumes the responsibilities of an active participant in UW-Madison's community of scholars in which everyone's academic work and behavior are held to the highest academic integrity standards. Academic misconduct compromises the integrity of the university. Cheating, fabrication, plagiarism, unauthorized collaboration, and helping others commit these acts are examples of academic misconduct, which can result in disciplinary action. This includes but is not limited to failure on the assignment/course, disciplinary probation, or suspension. Substantial or repeated cases of misconduct will be forwarded to the Office of Student Conduct & Community Standards for additional review.

- **Accommodations for Students with Disabilities.** McBurney Disability Resource Center syllabus statement: The University of Wisconsin-Madison supports the right of all enrolled students to a full and equal educational opportunity. The Americans with Disabilities Act (ADA), Wisconsin State Statute (36.12), andUW-Madison policy (Faculty Document 1071) require that students with disabilities be reasonably accommodated in instruction and campus life. Reasonable accommodations for students with disabilities is a shared faculty and student responsibility. Students are expected to inform faculty of their need for instructional accommodations by the end of the third week of the semester, or as soon as possible after a disability has been incurred or recognized. Faculty will work either directly with the student or in coordination with the McBurney Center to identify and provide reasonable instructional accommodations. Disability information, including instructional accommodations as part of a student's educational record, is confidential and protected under FERPA.

- **Diversity and Inclusion.** Institutional Statement on Diversity: Diversity is a source of strength, creativity, and innovation for UW-Madison. We value the contributions of each person and respect the profound ways their identity, culture, background, experience, status, abilities, and opinion enrich the university community. We commit ourselves to the pursuit of excellence in teaching, research, outreach, and diversity as inextricably linked goals. The University of Wisconsin-Madison fulfills its public mission by creating a welcoming and inclusive community for people from everybackground – people who as students, faculty, and staff serve Wisconsin and the world.

- **Religious Observances.** UW faculty policy states that mandatory academic requirements should not be scheduled on days when religious observances may cause substantial numbers of students to be absent. Refer to the university's Academic Calendar for specific information.