History of Artificial Intelligence: Minds and Machines

Fall 2023: HIST 30701
Tuesdays and Thursdays 4:30-5:45 PM
WALC 2127

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Office: University Hall 120
Office Hours: Tuesday and Thursday, 2 -3 pm

This course examines the long history of efforts in automating human cognition. Historically, the attempts to automate human cognitive functions – from the mere reckoning of numbers to complex decision-making have been entangled with heated debates about what counts as good, proper, and desirable thinking; whose thinking machines should emulate; and whether the thinking of some humans is inferior to that of machines. In this course, we will examine how the invention of calculating machines – analogue and then digital – has developed in tandem with philosophical and scientific theories of human thinking and intelligence. In their turn, the latter developed as a response to changing social, political, and economic currents.

The course is divided into four modules. We will begin with seventeenth-century calculating machines, Enlightenment projects of automating logarithmic calculations, and the nineteenth-century's first mechanical computers. In the first module, we will be paying special attention to how the Enlightenment theories of knowledge and the changing socio-economic landscape of the era of industrialization helped scientists and engineers imagine human cognition as something that could be described in discrete sequential steps and modeled with number reckoning machines. The remaining three modules will focus on the twentieth century. In them, we will explore how the growth of state bureaucracies, the formation of the discipline of psychology, new developments in twentieth-century engineering, and theories of human rational thinking have strengthened the assumption that computers could be treated as models of human minds and that computer systems could fully replace human minds. In these modules, we will consider first digital computers, information theory, cybernetics, artificial intelligence, and expert systems programs, and machine learning.

Learning Outcomes:

By the end of the course, students will be able to:

1) Critique the epistemological foundations and ethical implications of past and present approaches to the automation of human cognition by writing three reflection papers;
2) Use primary sources to make arguments about the role of social, political, economic, and cultural currents that have historically provided the impulses for research and development in the automation of human cognition;
3) Assess historical scholarly arguments about social, economic, and political power asymmetries surrounding computing, psychology, and artificial intelligence by taking part in group discussions;

4) Create websites to use text, imagery, and video content and effectively communicate how social factors have historically shaped the development of artificial intelligence.

Requirements:

Participation: 100 points

Class participation and weekly responses posted to Brightspace.

Midterm: 150 points

Primary Source Analysis: 150 points

Choose a primary source from a list of suggested sources. Drawing on two secondary sources from this syllabus, discuss the primary source of your choice in a 700-1000 words essay.

Reflection on Experiential Exercise 1: 100 points

Write 300-500 words discussing what you've learned about computation in the age of Enlightenment while doing exercise 1. Was completing log tables easy for you? Did de Prony succeed in breaking down the process of logarithms calculation into algorithms that could be followed mindlessly? Or did you actually feel like you needed some prior mathematical knowledge to complete this task?

Reflection on Experiential Exercise 2: 100 points

Write 300-500 words discussing what you have learned about the Cold War artificial intelligence system EWAMS while completing exercise 2. The point of the Crisis Early Warning and Monitoring System (EWAMS) was to remove the irrational, subjective human judgment from international crisis prediction. The system was based on a system of numerical codes of geopolitical events that grad students would ascribe to articles in the *New York Times*. Based on these codes, a computing system would pattern and predict crises. You will play the role of the grad students, responsible for assigning codes to this week's *New York Times* global coverage. In your reflection paper, discuss how did your subjective judgment enter how you assigned the codes.

Reflection on Experiential Exercise 3: 100 points

Write 300-500 words discussing what you have learned about knowledge engineering, which was the dominant 20th century approach to artificial intelligence, while completing this exercise. Much

of early AI research was predicated on the belief that what experts know and what human minds do can be made visible through introspection and interview. Knowledge engineers were those tasked to "elicit" what experts know by interviewing them. If you played the role of a knowledge engineer, discuss what challenges you faced while making the knowledge of your classmate visible. Was it hard to find the right questions? Do you think the "expert" gave you all the information you needed? If you played the role of an expert, discuss whether the questions asked by "knowledge engineers" allowed you to describe the activity you are good at. Which questions, in your opinion, were successful? And which were not?

Final Group Project – Online Exhibit: 300 points

Working in groups of three to five people, you will need to create an online exhibit of five different primary sources (texts, images, or video) on the history of computing, automation, and/or artificial intelligence. Your exhibition should have one central theme; that is to say, your primary sources should be related to each other. Your theme should respond to one or several questions raised in this class (i.e., how do social, political, cultural contexts help mathematicians and engineers *imagine* an intelligent machine? How do social inequalities play into computational innovation? Explain the central theme of your exhibit in a brief statement (500-700 words). Each primary source should be accompanied by a 300-500 words explanation of the historical significance of each source.

- Website Proposal - 100 points;
- Final Website Project (should be accompanied with a memo describing each student's contribution to the project): 200 points.

ATTENDANCE POLICY. There is a strong correlation between students' attendance and their performance. That said, please stay home if you are sick. The main thing is that if you miss a class (or a week), you need to check Brightspace and remain in contact with the instructor. Please do not wait until the last week of class or after class ends to inform the instructor of a substantial reason for your absence in class.

According to Purdue, it is the "University's expectation that students should be present for every meeting of a lass/laboratory for which they are registered." The following is the language of the university.
Students are expected to be present for every meeting of the classes in which they are enrolled. Only the instructor can excuse a student from a course requirement or responsibility. When conflicts or absences can be anticipated, such as for many University sponsored activities and religious observations, the student should inform the instructor of the situation as far in advance as possible...For unanticipated or emergency absences when advance notification to an instructor is not possible, the student should contact the instructor as soon as possible by email, or by contacting the main office that offers the course. When the student is unable to make direct contact with the instructor and is unable to leave word with the instructor's department because of circumstances beyond the student's control, and in cases of bereavement, the student or the student's representative should contact the Office of the Dean of Students, (http://www.purdue.edu/studentregulations/regulations_procedures/classes.html)

ABSENCES
The Office of the Dean of Students provides students with the right to be excused from classes for the following reasons: grief these refer to the need to process the loss of loved ones and attend funerals); jury duty, serious medical (physical and mental) situations, active military serving, and parental leave. Please contact the Office of the Dean of Students for official absence permission. For more information, see https://www.purdue.edu/advocacy/students/absences.html

CHEATING PLAGIARISM
Plagiarism refers to the reproduction of another's words or ideas without proper attribution. University Regulations contains further information on dishonesty. Plagiarism and other forms of academic dishonesty are serious offenses, and will be treated as such in this class. You are expected to produce your own work and to accurately cite all necessary materials. Cheating, plagiarism, and other dishonest practices will be punished as harshly as Purdue University policies allow. Any instances of academic dishonesty will likely result in a grade of F for the course and notification of the Dean of Students Office. Please make sure that you are familiar with Purdue's academic integrity policies:
http://www.purdue.edu/odos/aboutodos/academicintegrity.php

STUDENTS WITH DISABILITIES
Purdue University is committed to providing equal access and equal opportunity to university courses, activities, and programs for students with disabilities. Students with documented disabilities that substantially limit a major life activity, such as learning, walking, or seeing, may qualify for academic adjustments and/or services. If you have a disability that requires special academic accommodation, please make an appointment to speak with me within the first three weeks of the semester in order to discuss any adjustments. It is the student's responsibility to notify the Disability Resource Center of any impairment/condition that may require accommodations and/or classroom modifications. To request information about academic adjustments, auxiliary aids, or services, please contact the Disability Resource Center in the Office of the Dean of Students, 830 Young Hall, (765) 494-1247 (V/TTY), drc@purdue.edu.

NONDISCRIMINATION POLICY STATEMENT
Purdue University is committed to maintaining a community which recognizes and values the inherent worth and dignity of every person; fosters tolerance, sensitivity, understanding, and mutual respect among its members; and encourages each individual to strive to reach his or her own potential. In pursuit of its goal of academic excellence, the University seeks to develop and nurture diversity. The University believes that diversity among its many members strengthens the institution, stimulates creativity, promotes the exchange of ideas, and enriches campus life.

Purdue University prohibits discrimination against any member of the University community on the basis of race, religion, color, sex, age, national origin or ancestry, marital status, parental status, sexual orientation, disability, or status as a veteran. The University will conduct its programs, services and activities consistent with applicable federal, state and local laws, regulations and orders and in conformance with the procedures and limitations as set forth in Executive Memorandum No. D-1, which provides specific contractual rights and remedies.

VIOLENT BEHAVIOR POLICY
Purdue University is committed to providing a safe and secure campus environment. Purdue strives to create an educational environment for students and work environment for employees that promote educational and career goals. Violent behavior impedes such goals. Therefore, violent behavior is prohibited in or on any university facility or while participating in any university activity.

I. FROM CALCULATORS TO HUMAN COMPUTERS (17th-19th centuries)

WEEK 1:

T, Aug 22: Introduction and Course Overview

Th, Aug 24: Reckoning with Matter

Secondary: Jones, Matthew, "Chapter 1. Carrying Tens: Pascal, Morland, and the Challenge of Machine Calculation." In *Reckoning with Matter: Calculating Machines, Innovation, and Thinking about Thinking from Pascal to Babbage*, 13-43. University of Chicago Press, 2016.

WEEK 2:

T, Aug 29: Reasoning in the Age of Enlightenment

Primary: Condorcet

Th, Aug 31: **EXPERIENTIAL EXERCISE 1: Human Computers**

After discussing Daston's article, you will play the role of mathematician De Prony's human computers. You will complete log tables from 1-10 to six decimal places. The point of this exercise is not to test your mathematical reasoning, but to experience what being a human computer in the 18th century was like.

Secondary: Daston, Lorraine. "Enlightenment Calculations." *Critical Inquiry* 21, no. 1 (1994): 182–202.

Saturday, September 2 – a 300-500 words reflection on experiential exercise 1 is due

WEEK 3:

T, Sep 5: Factories as Sites of Intelligence

Primary: Babbage, Charles, "In Contriving Machinery" and "On the Division of Human Labor" in *On the Economy of Machinery and Manufacture*, 1832.

Th, Sep 7: The Bureaucratic Machine

Secondary: Agar, Jon. "Chapter 2: The Parent of a Totally Different Order of Things": Charles Trevelyan and the Civil Service as Machine" In *The Government Machine: A Revolutionary History of the Computer*, 45-75. MIT Press, 2003

II. ROBOTS, QUNATIFIABLE INTELLIGENCE, AND ITS TECHNOLOGICAL EXTENSION: FISRT HALF OF THE 20TH CENTURY

WEEK 4

T, Sep 12: Testing Human Intelligence

Secondary: Gould, Stephen Jay. "Lewis M. Therman and the mass marketing of innate IQ" in *The Mismeasure of Man*, 204 - W. W. Norton & Company, 1996.

T, Sep 14: From Laborers to Robots

Primary: Karel Čapek, *"R.U.R. Rossum's Universal Robots,"* 1920 (a science-fiction play)

WEEK 5

T, Sep 19: Testing Machine Intelligence

Primary: Turing, A. M. "Computing Machinery and Intelligence." *Mind*, no. 236 (October 1, 1950): 433–60.

Th, Sep 21: Computing in WWII

Primary: University of Pennsylvania, Moore School of Engineering, *Report on the ENIAC (Electronical Numerical Integrator and Computer)*, 1946.

Friday, September 22 – Primary Source Analysis Due

WEEK 6

T, Sep 26: Cybernetics

Secondary: Galison, Peter. 1994. "The Ontology of the Enemy: Norbert Wiener and the Cybernetic Vision." *Critical Inquiry* 21 (1): 228–66.

Th, Sep 28: Programmers and Their Minds

Primary: a selection of 1960s-1970s newspaper ads advertising programming classes and excerpts from 1960s computer science textbooks.

WEEK 7

T, Oct 3: The Dawn of Cognitive Psychology: the Mind as a Computer

Secondary: Edwards, Paul. "The Machine in the Middle: Cybernetic Psychology and World War II," in *The Closed World: Computers and the Politics of Discourse in Cold War America*, 175-207

Th, Oct 5: The Dawn of the Internet: Mind's Technological Extension

Primary: Licklider, J. C. R. "Man-Computer Symbiosis," *IRE Transactions on Human Factors in Electronics,* March 1960.

III. VISIONS OF ARTIFICIAL INTELLIGENCE

WEEK 8

T, Oct 10: October Break – No Class.

Th, Oct 12: Bounded Rationality

Primary: Allen Newell, Herbert Simon, "Elements of the Theory of Human Problem Solving," in *Psychological Review,* Vol. 65, No. 3 (1958).

WEEK 9

T, Oct 17: Making up for Human Lack of Reason in the Cold War

Secondary: Joy Rohde, "Pax Technologica: Computers, International Affairs, and Human Reason in the Cold War," *Isis* 108, no. 4 (December 2, 2017): 792–813, https://doi.org/10.1086/695679

Th, Oct 19: **EXPERIENTIAL EXERCISE 2: BUILD YOUR EWAMS**

Joy Rohde has given us a history of attempts to automate the prediction of geopolitical crisis during the Cold War. The Crisis Early Warning and Monitoring System (EWAMS) was based on a system of numerical codes of geopolitical events that grad students would ascribe to articles in the New York Times. Based on these codes, a computing system would pattern and predict crises. You will play the role of the grad students, responsible for assigning codes to this week's New York Times global coverage.

Saturday, October 21 – a 300-500 words reflection on experiential exercise 2 is due

WEEK 10

T, Oct 24: Computing Across the Iron Curtain

Secondary: Peters, Benjamin, "Staging the OGAS: 1962 to 1969" in *How Not to Network a Nation: The Uneasy History of the Soviet Internet*, 107-158, The MIT Press, 2016.

Th, Oct 26: No Class, Instructor at a Conference (SHOT)

IV: EXPERT THINKING VS MACHINE LEARNING (1950s-2000s)

WEEK 11

T, Oct. 31: The Expert Systems Approach

Secondary: Collins, Harry, "Chapter 6, What We Can Say about What We Know" in *Artificial Experts: Social Knowledge and Intelligent Machines*. Cambridge, Mass: The MIT Press, 1990.

Th, Nov 2: **EXPERIENTIAL EXRECISE 3**

Much of early AI research was predicated on the belief that what experts know and what human minds do can be made visible through introspection and interview. Knowledge engineers were those tasked to "elicit" what experts know by interviewing them. Working in groups of four and using a guide from the 1960s, you will perform interviews on one another to see what this kind of intelligence gathering was like. In each group, three members should take up the roles of knowledge engineers, while the fourth member of the group will be an expert. They task is to interview an expert on how they approach a certain assignment (a group project, preparing for an exam, etc.). Then write a set of verbal rules to codify their experience.

Primary: Feigenbaum, Edward, "Knowledge Engineering: The Applied Side of Artificial Intelligence," 1980.

Saturday, November 4 – a 300-500 words reflection on experiential exercise 3 is due

WEEK 12

T, Nov 7: The Socialist AI

Primary: Primary: Lem, Stanislaw, "How the World Was Saved" (pp. 3-8) and "The First Sally, or the Trap of Gargantius" (pp. 35-46) in *The Cyberiad: Fables for the Cybernetic Age,* The Seabury Press, 1974

AND

Primary: Pushkin, V. N. "Heuristic Aspects of the 'Man-Large System' Problem." *IFAC Proceedings Volumes* 2, no. 4 (September 1968): 715–21.

Th, Nov 9: instructor at a conference (HSS); use this time to work on step 1 of the final project assignment.

WEEK 13

T, Nov 14: The History of Black Boxes

Secondary: Jones, Matthew, "Decision trees, random forests, and the genealogy of the black box," in *Algorithmic Modernity: Mechanizing Thought and Action, 1500-2000*, Massimo Mazzotti and Morgan Ames, ed. (Oxford, 2022)

Th, Nov 16: Work on your proposals with your groupmates. All groups MUST met during this time to work on their website proposals. You have two options here: a) I will reserve a quiet working space for your group on campus; b) your group will be working in our regular classroom. I will be there to answer questions and give feedback on your ideas. If you settle for the first option, I will be available on Zoom or chat on Brightspace during the class-time.

Friday, Nov 17 – Website Proposals Due

WEEK 14

T, Nov 21: ML and Its Discontents

Secondary: Rudin, Cynthia, and Joanna Radin. "Why Are We Using Black Box Models in AI When We Don't Need To? A Lesson From an Explainable AI Competition." *Harvard Data Science Review* 1, no. 2 (November 22, 2019).

Th, Nov 23: no class, Thanksgiving break

WEEK 15

T, Nov 28: Conclusions: What's *Intelligence?*

Secondary: Joseph Weizenbaum, "Chapter 8. Artificial Intelligence," pages 202-227 in *Computer Power and Human Reason, From Judgment to Calculation.* San Francisco, Cal.: W.H. Freeman, 1976

Th, Nov 30: Work on your websites and website presentations with your groupmates. All groups MUST meet during this time. Just like previously, I can reserve a quiet working space for your group on campus, or your group should work in our regular classroom. If you opt for the latter, I will be in the classroom to answer your questions and give feedback on your ideas. For those groups who decide to work in a separate study space: I will be available on Zoom and Brightspace during the class time.

WEEK 16

T, Dec 5: Group Presentations I

Th, Dec 7: Group Presentations II