CS143: Artificial Intelligence

Syllabus
Logistics
AI overview: goals, history, progress, challenges

Introduction

- Md Alimoor **Reza**
  - Assistant Professor of Computer Science, Dept. of Mathematics and Computer Science, Drake University
  - **Office:** 323 Collier-Scripps
  - **Email:** md.reza@drake.edu
  - **Phone:** 515-271-1972
  - **Office hours:** Tues/Thurs: 1:00-3:30pm CDT
    additionally by appointment
    Zoom link

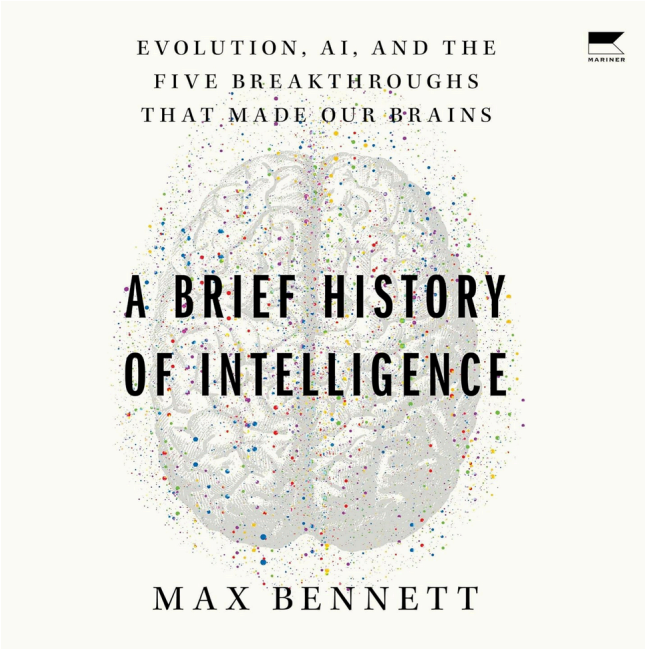
What is Intelligence?

- **Roger Penrose** (physicist/Nobel laureate)
  - Intelligence needs “awareness” and “awareness” needs “understanding”. These are connected.
  - He thinks we’re way off in how we understand these concepts such as ‘awareness’ and ‘understanding’.
  - Our current understanding of Intelligence or understanding of consciousness is at the “tentative” level

- **David Chalmers** (cognitive scientist)
  - Intelligence is “the extended mind”

What is Intelligence?

- **Definition of Intelligence is vague**
  - Some people define intelligence with achieving a goal.



What is Machine Intelligence?

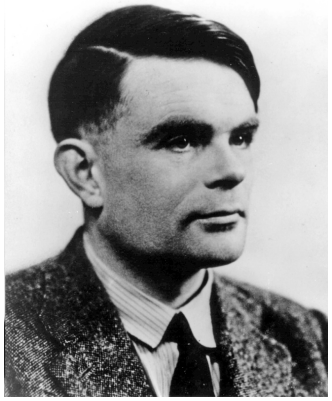
- **Rene Descartes** (1598-1650AD)

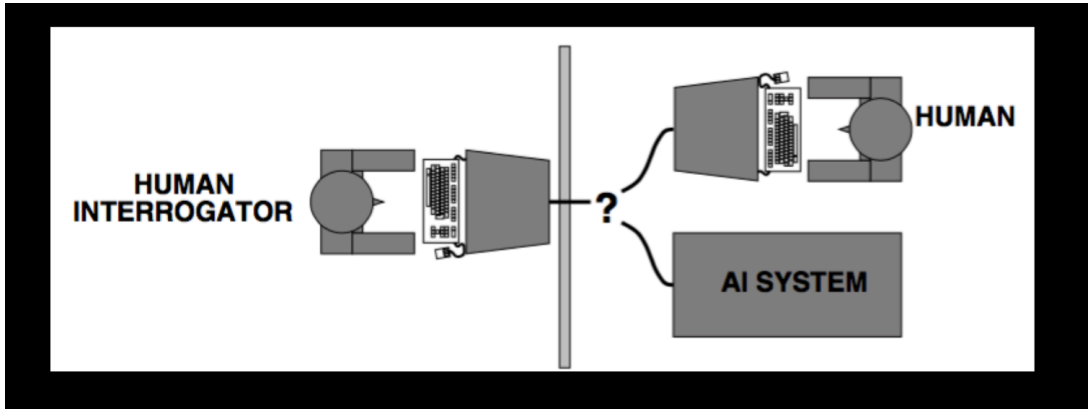
  "If there were machines which bore a resemblance to our bodies and imitated our actions as closely as possible for all practical purposes, we should still have two very certain means of recognizing that they were not real men. The first is that they could never use words, or put together signs, as we do in order to declare our thoughts to others… Secondly, even though some machines might do some things as well as we do them, or perhaps even better, they would inevitably fail in others, which would reveal that they are acting not from understanding, …"

  - Discourse on the Method - Descartes

What is Machine Intelligence?

- **Alan Turing** (1950AD)
  - Alan Turing proposed the so-called Turing test for machine intelligence: The basic idea is that a human poses written questions to both a human and a computer, unaware of which is which.
  - If the human interrogator cannot determine which conversant is the human and which is the computer, then the computer should be counted as intelligent
  - He explored the the concept of "thinking machine"





An Application of the Turing Test

- CAPTCHA: Completely Automatic Public Turing tests to tell Computers and Humans Apart

Group Activity: What is Artificial Intelligence or AI?

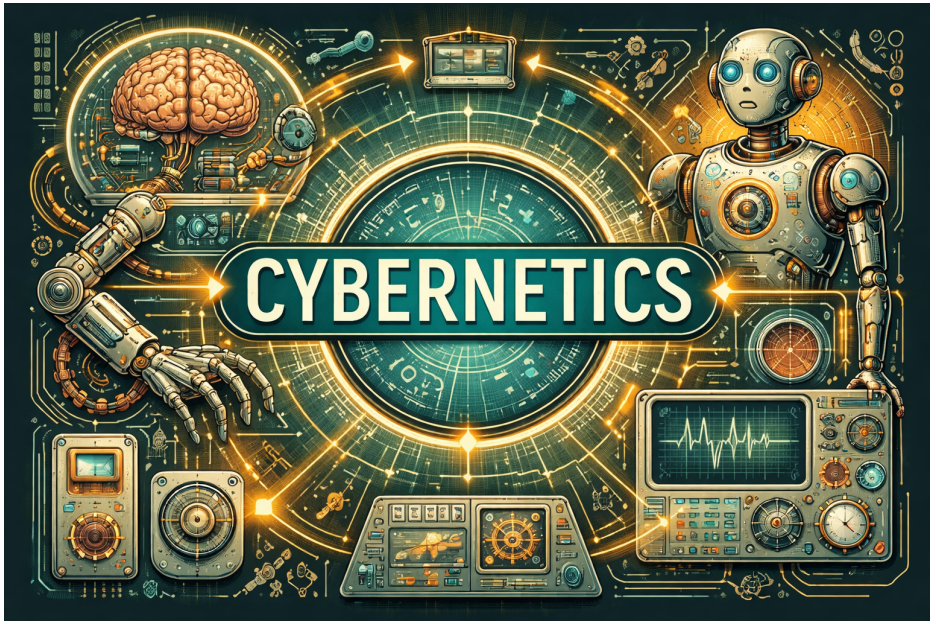
Click here

The Term “Artificial Intelligence” (AI)

- **Artificial Intelligence (1950ADs-present)**
  - John McCarthy coined the term “Artificial Intelligence” which he defined to be “the science and engineering of making intelligent machines”
  - The philosophy was “intelligence” can be replicated or simulated in machines

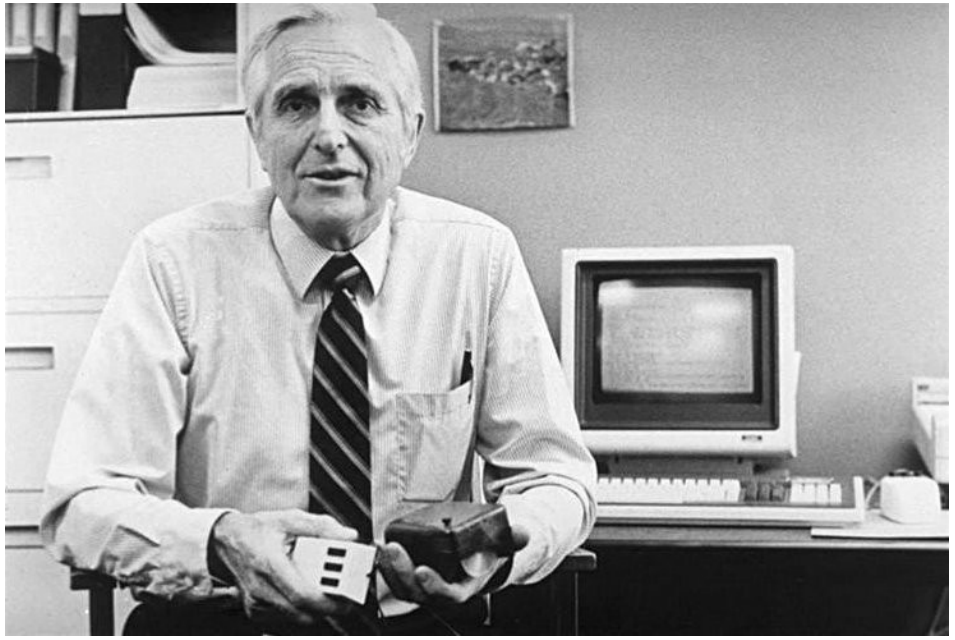
Other less-favored term competing with AI

- **Cybernetics (1940s-1960ADs)**
  - Mathematician Norbert Wiener coined the term "cybernetics" in the late 1940s to define the study of control and communication in both animals and machines.
  - Focus was how do systems regulate themselves using feedback.
    - Eg systems: thermostats, autopilots, etc



Other less-favored term competing with AI

- **Intelligence Augmentation (1960ADs-present)**
  - Douglas Engelbert coined the term “Intelligence Augmentation”. He thought computer should be aiding human in solving problems.
  - The core idea is to enhance human intelligence, not replace it with the goal of making better humans, not smarter machines.
    - Eg systems: search engine, decision support systems, CAD tools, etc



History of AI

1943	McCulloch & Pitts: Boolean circuit model of brain
1950	Turing's "Computing Machinery and Intelligence"
1952–69	Look, Ma, no hands!
1950s	Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
1956	Dartmouth meeting: "Artificial Intelligence" adopted
1965	Robinson's complete algorithm for logical reasoning
1966–74	AI discovers computational complexity Neural network research almost disappears
1969–79	Early development of knowledge-based systems
1980–88	Expert systems industry booms
1988–93	Expert systems industry busts: "AI Winter"
1985–95	Neural networks return to popularity
1995–	Agents, agents, everywhere . . . (search engines, recommender systems,etc.)
2003–	Human-level AI back on the agenda

Going back to the question: What is AI?

- AI is the reproduction of **human reasoning and intelligent behavior** by computational methods

What is AI?

- AI is *an attempt at* reproduction of **human reasoning and intelligent behavior** by computational methods

What is AI?

- It's a discipline that automates reasoning processes to create machines that:

Think like humans	Think rationally
Act like humans	Act rationally

Think like humans	Think rationally
Act like humans	Act rationally

- The goal of AI is: to build machines that operate in the same way that humans think
- But how do humans think?
  - Cognitive Science: Build machines according to theory, test how behavior matches mind's behavior
- Is this even possible?
  - Different hardware: digital computers, analog minds

Think like humans	Think rationally
Act like humans	Act rationally

- The goal of AI is: to build machines that ~~operate~~ perform tasks ~~in the same way that humans think~~ in a way similar to an intelligent human

- Take a hard task that people do well, and build a computer system to do it automatically

- But do we want to duplicate human imperfections?

Think like humans	Think rationally
Act like humans	Act rationally

- The goal of AI is: to build machines that ~~perform tasks in a way similar to an intelligent human~~ make the "best" decisions given current knowledge and resources

- "Best" decision based on some **utility function**
  - Based on some model and assumptions of the world

- As we objectified our "best" decision, this definition of AI ignores self-consciousness, hopes, fears, etc. that can impact intelligence.

So, are machines intelligent yet?

Big milestone: Chess (1997)

Deep Blue beats Garry Kasparov, 1997

Milestone: DARPA Grand Challenge

- Autonomous car travels 132 miles through challenging desert (2005)

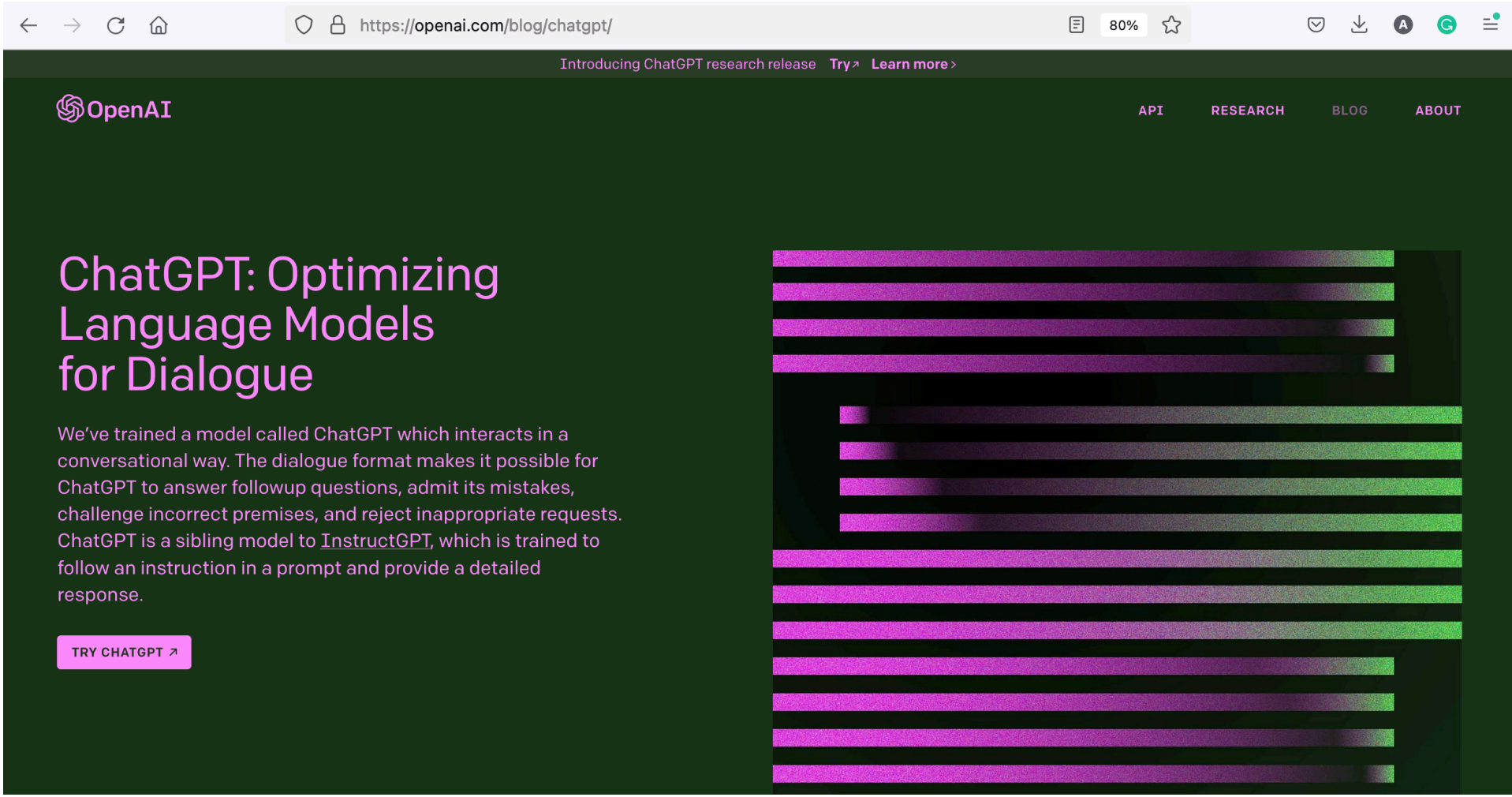
Milestone: Jeopardy (2010)

Watson beats Jeopardy champions, 2010

Milestone: Go (2016)

Google's AlphaGo beats Lee Sodol (9-dan player), March 2016

Milestone: ChatGPT (2023)



OpenAI's ChatGPT, large language model, 2022

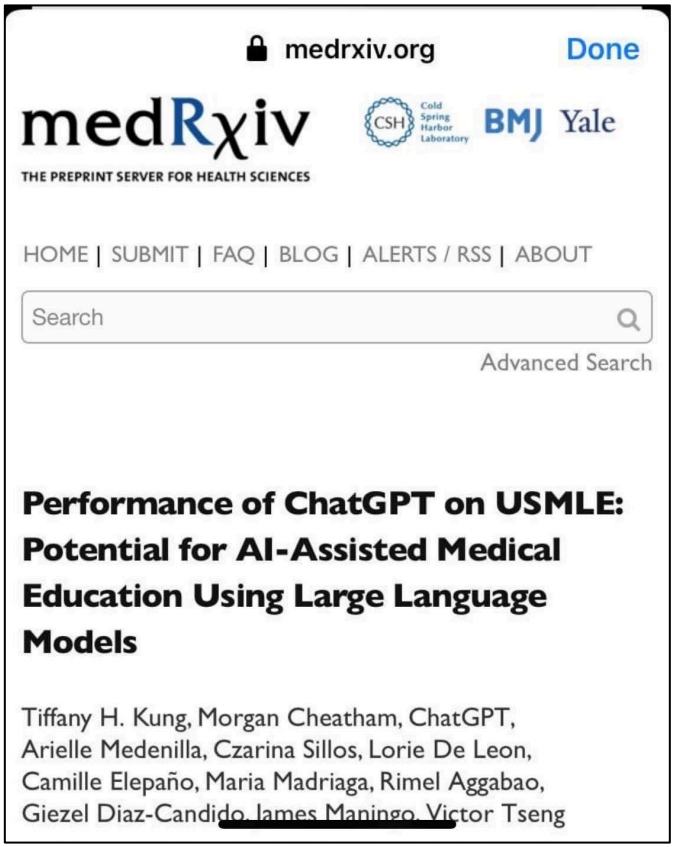
Milestone: ChatGPT (2023)

ChatGPT has passed the United States Medical Licensing Examination (USMLE).

Today, it takes 4 years of med school and 2+ years of clinical rotations to pass. It tests ambiguous scenarios & closely-related differential diagnoses.

This is still just a pre-print though.

https://www.medrxiv.org/content/10.1101/2022.12.19.22283643v2.full



OpenAI's ChatGPT can potentially pass USMLE, December 2022

Open Philosophical Question: Are Machines Intelligent?

- **A1:** Yes, if intelligence is narrowly defined as "information processing"
  - Many tasks initially assumed to require intelligence can be automated.
  - Each success of AI seems to push further the limits of what we consider "intelligence"

Open Philosophical Question: Are Machines Intelligent?

- **A1:** Yes, if intelligence is narrowly defined as "information processing"
  - Many tasks initially assumed to require intelligence can be automated.
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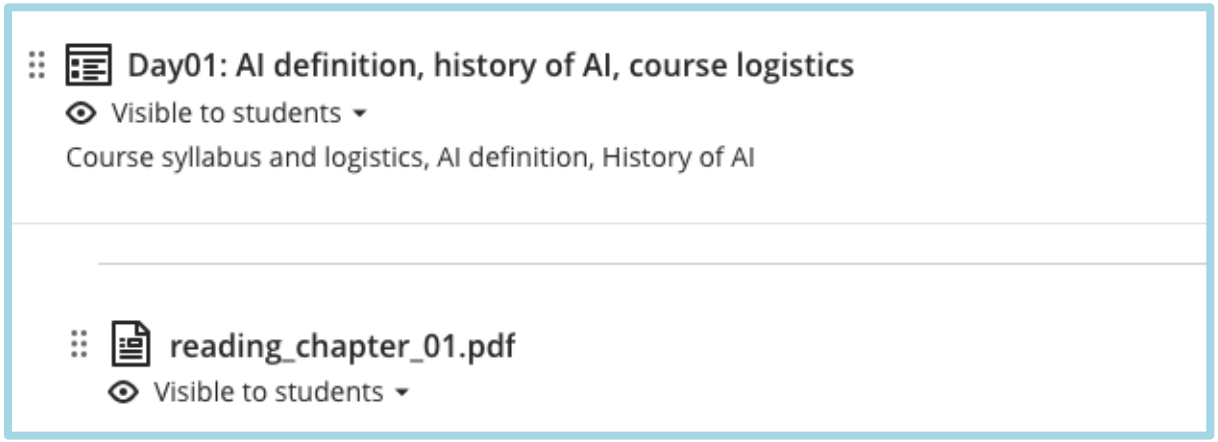
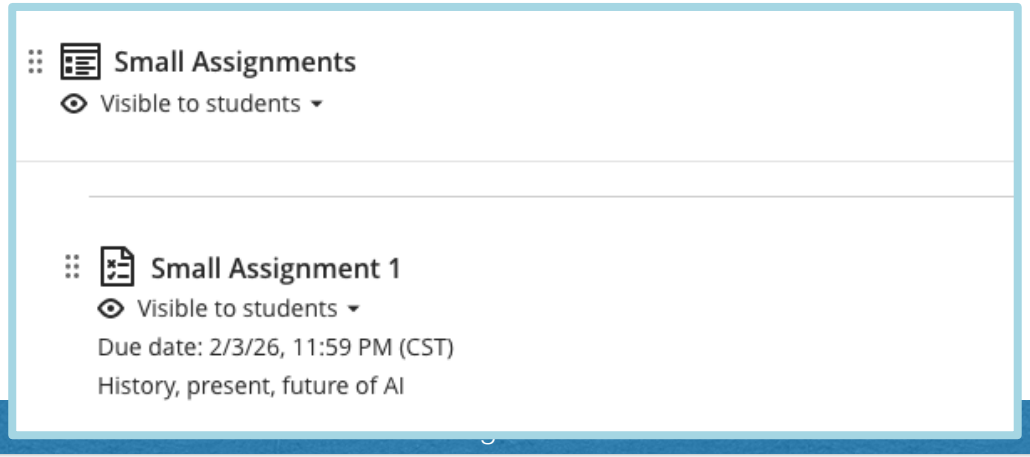
- **A2:** Maybe yes, maybe not, if intelligence cannot be separated from consciousness
  - Is the machine *experiencing* thought?
  - Strong vs. Weak AI

First Assignment

- Read the “reading chapter 01.pdf” posted in the Day01 folder on our course Blackboard page, which covers the historical development in a bit more detail.



- See the Blackboard page for a short learning reflection due Tuesday next week



Course Logistics

Contacting

- I am here to help! To get a reply as quickly as possible:
  - For questions about the class, assignments, personal matters, etc: email md.reza@drake.edu

Course mechanics

- Syllabus, schedule, assignments, announcements, etc. on Drake Blackboard
  - https://drake.blackboard.com

- Meetings:
  - Tuesday and Thursday, 3:30 pm - 4:45 pm
  - Science Connector Building#101

- Textbook:

Norvig & Russell, *Artificial Intelligence: A Modern Approach*, 2010.

Prerequisites

- CS 66: Introduction to Computer Science II
- Practically, this means:
  - Proficiency in a general-purpose programming language
  - Some level of mathematical maturity will be helpful, esp. with calculus, linear algebra, statistics
  - Willingness to learn some programming and/or math on your own if necessary

Grading

- 40% Assignments (5-6)
  - Mostly programming, require Python
  - Discussion and small write up
- 15% Small assignments (10-12)
  - Short learning reflections, pen-and-paper illustrations of algorithm execution, small programming labs, etc.
- 20% Midterm exam
- 20% Final exam
- 05% Attendance

Course overview (tentative)

- AI goals, history, background
- Heuristic search and applications
  - A*, local search, …
- Adversarial search
  - game playing, alpha-beta pruning, …
- Learning
  - Reinforcement learning
- Applications
  - Computer vision, natural language processing, robotics