

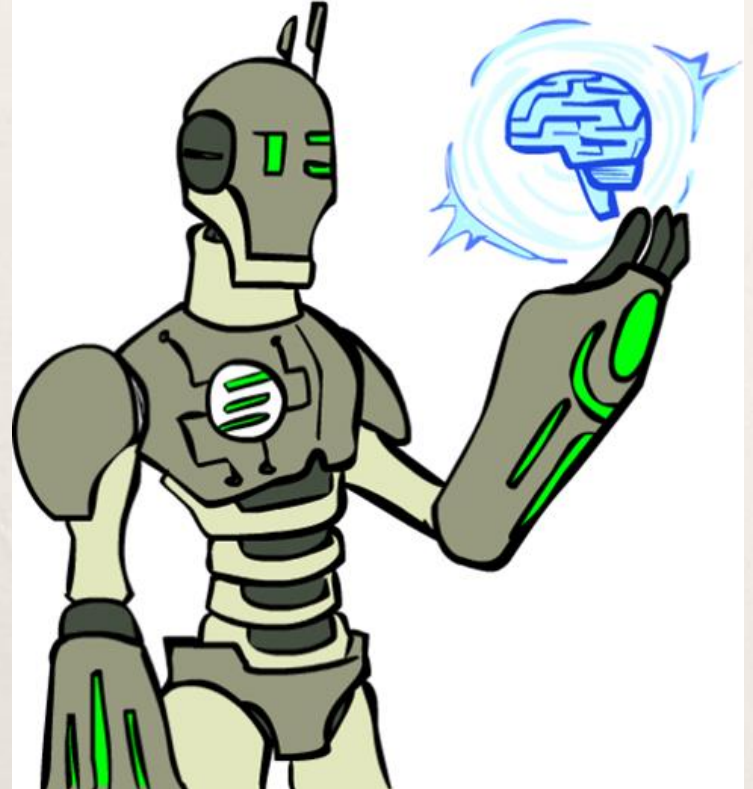
COMPX216/Y05337

Artificial Intelligence

Introduction

What is AI?

- What is artificial intelligence?
- What can AI do?
- What is this course?



Varieties of AI?

- **General AI**
 - “Conscious machines”, “Singularity”, “Super-intelligence”, “Artificial General Intelligence (AGI)”
 - little progress, little serious activity, controversial
- **Narrow AI**
 - Get machines to do things that people can do which machines currently can't ...
 - Most AI research on this topic
 - Seemingly lots of real progress recently

Narrow AI

- Focused on developing systems for
 - narrow, specific problems
 - which currently require (human) brains
- “Superhuman performance” only means superhuman in this specific task.
- No sense of understanding or comprehension of task at hand.
- No ability to transfer capability, generalize, abstract, etc.

Michael Wooldridge, 2018

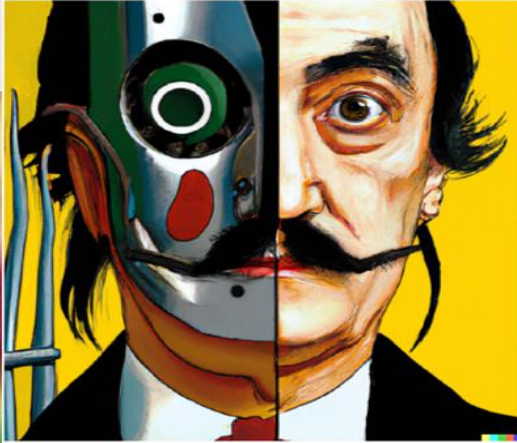
AI having is having real-world impact

- Public imagination
 - Text assistants



AI having is having real-world impact

- Public imagination
 - Text assistants
 - Image generation



vibrant portrait painting of Salvador Dalí with a robotic half face



a shiba inu wearing a beret and black turtleneck



a close up of a handpalm with leaves growing from it



an espresso machine that makes coffee from human souls, artstation



panda mad scientist mixing sparkling chemicals, artstation



a corgi's head depicted as an explosion of a nebula

AI having is having real-world impact

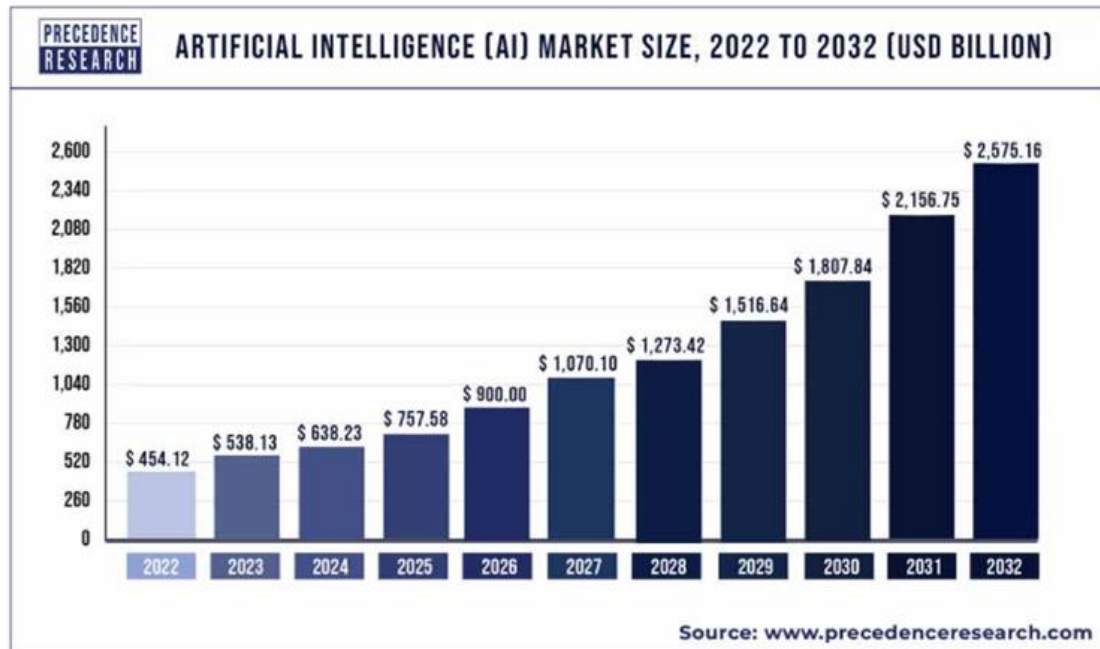
- Public imagination
 - Text assistants
 - Image generation



AI having is having real-world impact

- Public imagination
- Economy
 - 454 billion USD globally

The global artificial intelligence (AI) market size was valued at USD 454.12 billion in 2022 and is expected to hit around USD 2,575.16 billion by 2032, progressing with a CAGR of 19% from 2023 to 2032. The North America artificial intelligence market was valued at USD 167.30 billion in 2022.



<https://www.precedenceresearch.com/artificial-intelligence-market>

AI having is having real-world impact

- Public imagination
- Economy
- Politics



<https://english.cctv.com/2025/02/20/ARTIijoT7A6bnljVg5A9UJtq250220.shtml>

AI having is having real-world impact

- Public imagination
- Economy
- Politics



<https://thehill.com/blogs/in-the-know/5097935-jon-stewart-trump-inauguration-tech-moguls/>

AI having is having real-world impact

- Public imagination
- Economy
- Politics
- Law

Aug. 18, 2023, 12:18 PM; Updated: Aug. 18, 2023, 12:48 PM

AI-Generated Art Lacks Copyright Protection, D.C. Court Says (1)



Riddhi Setty
Reporter



Isaiah Poritz
Legal Reporter



Bloomberg Law, 2023

AI having is having real-world impact

- Public imagination
- Economy
- Politics
- Law
- Labor

Finance & economics | Free exchange

New research shows the robots are coming for jobs—but stealthily

Look beneath the aggregate economic numbers, and change is afoot

The Economist, 2021

The Optimist's Guide to Artificial Intelligence and Work

The focus of much discussion is on how it will replace jobs, but nothing is inevitable.

New York Times, 2023

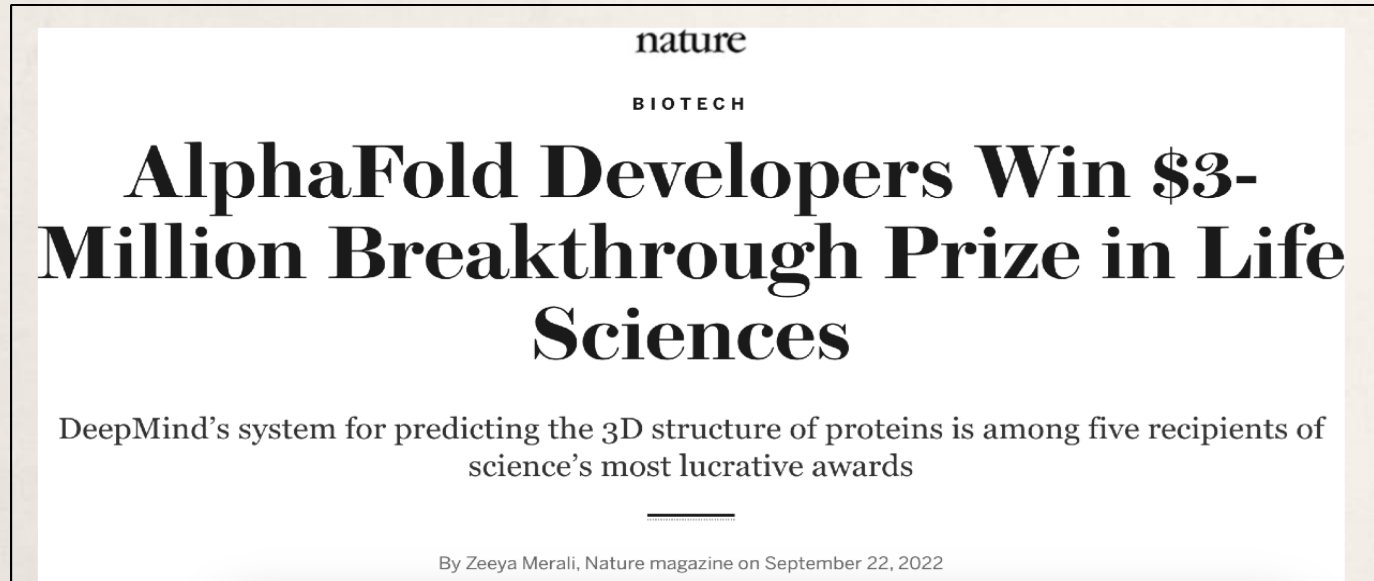
The human labor behind AI chatbots and other smart tools

Data labeling is an important step in developing artificial intelligence but also exposes the people doing the work to harmful content.

MarketWatch, 2023

AI having is having real-world impact

- Public imagination
- Economy
- Politics
- Law
- Labor
- Sciences



Nobel Prize *World / Europe*

Nobel Prize for chemistry awarded to Baker, Hassabis, Jumper for protein structure work

Winners of this year's Nobel will receive a cash prize and medal on December 10, followed by a lavish banquet in Stockholm city hall

AI having is having real-world impact

- Public imagination
- Economy
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- Sciences



Wired, 2022

AI having is having real-world impact

- Public imagination
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- Sciences
- Education

BREAKING

ChatGPT In Schools: Here's Where It's Banned—And How It Could Potentially Help Students

Arianna Johnson Forbes Staff
I cover the latest trends in science, tech and healthcare.

Follow

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Jan 18, 2023, 02:31pm EST

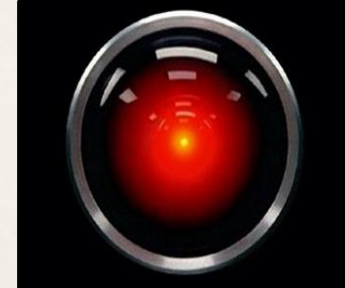
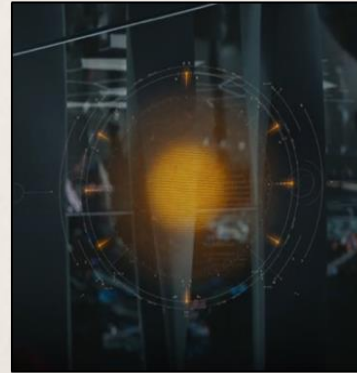
Forbes, 2023

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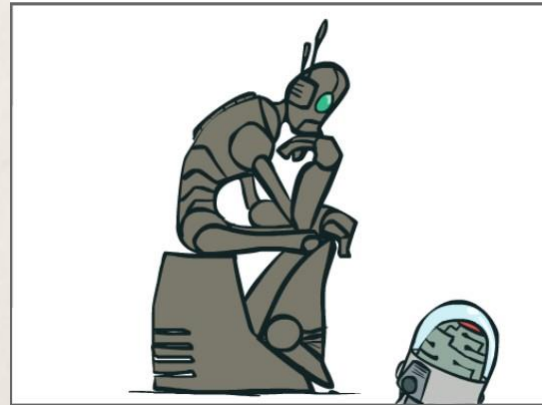
Ok, but what does *AI do*???

Science fiction AI?



What is AI?

The science of making machines that:



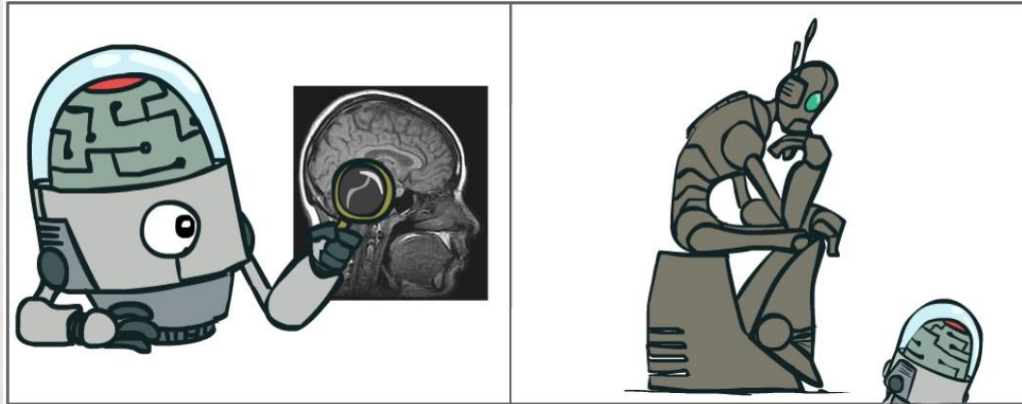
Think rationally

What is AI?

The science of making machines that:



Think like people



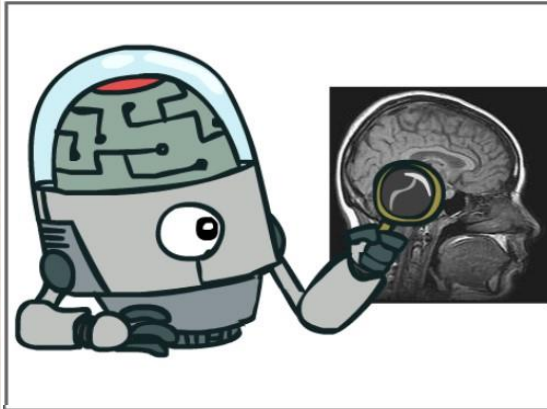
Think rationally

What is AI?

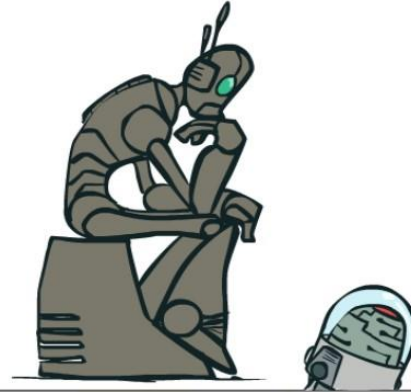
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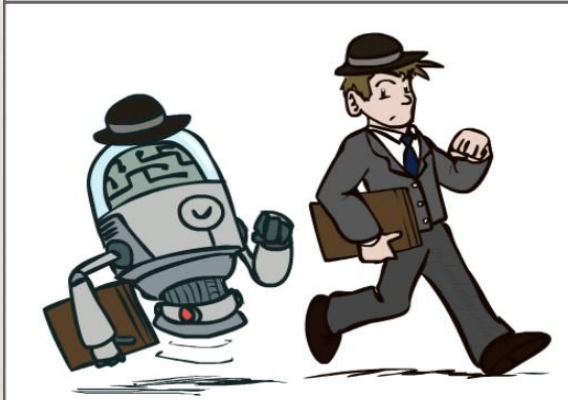
Think like people



Think rationally



Act like people

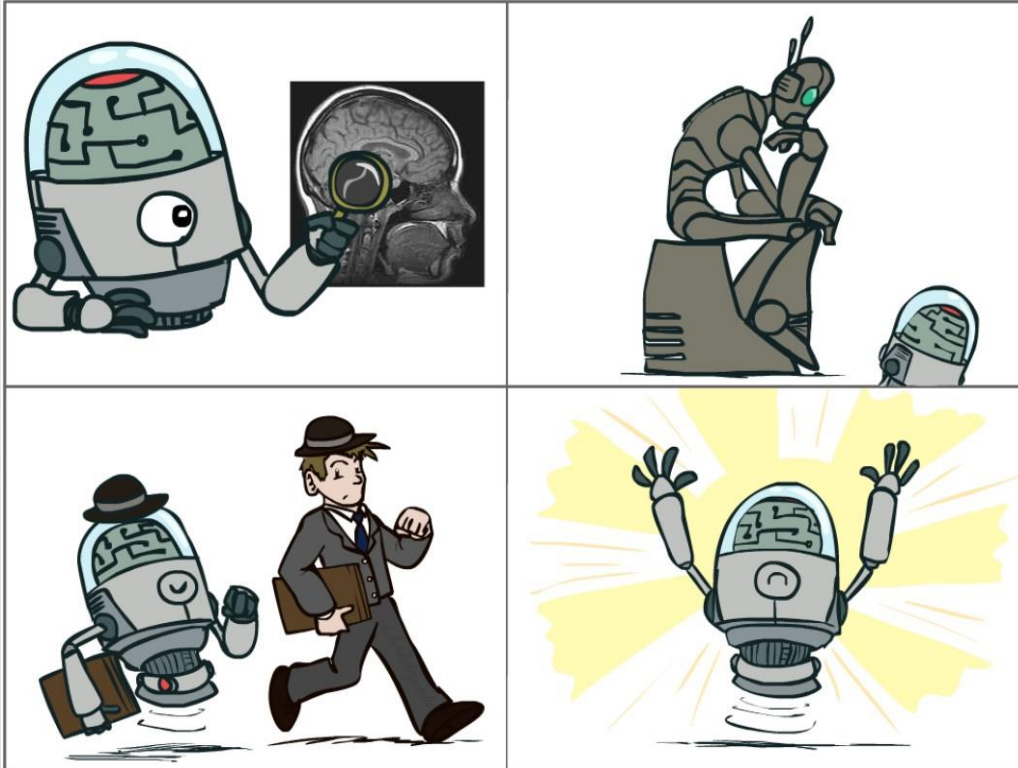


What is AI?

The science of making machines that:



Think like people



Think rationally



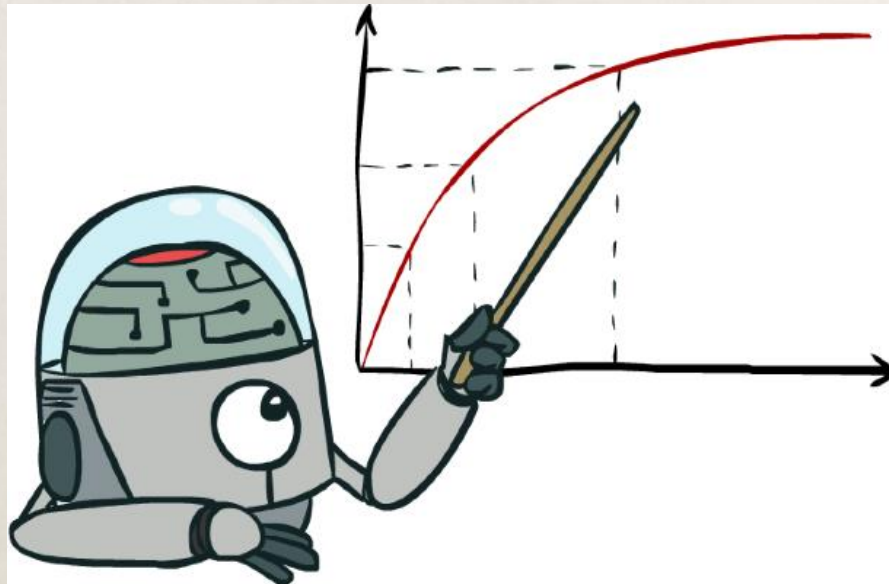
Act like people



Act rationally

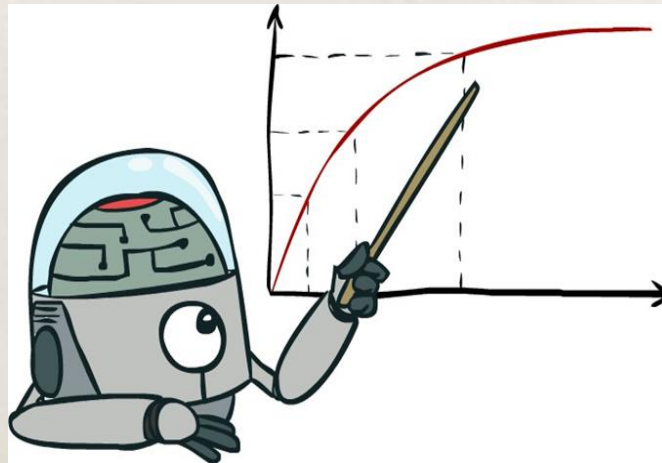
What does "rational" mean?

- We'll use the term **rational** in a very specific, technical way:
 - Rational: *maximally achieving pre-defined goals*
 - Goals are expressed in terms of the **utility** of outcomes
 - World is uncertain, so we'll use **expected** utility
 - Being rational means acting to **maximize your expected utility**



Central theme of the course

Maximization of Expected Utility

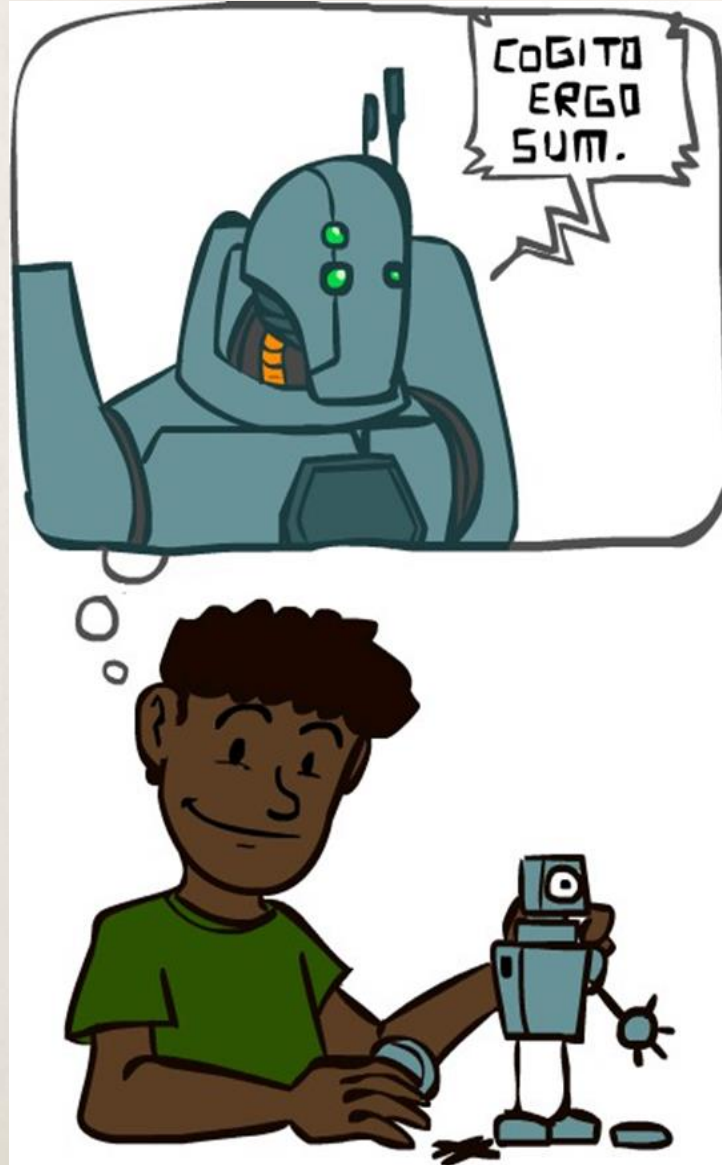


What about the brain?

- Brains (human minds) are very good at making rational decisions, but not perfect
- Brains aren't as modular as software, so hard to reverse engineer!
- AI may be better than brains at some tasks
- *"Brains are to intelligence as wings are to flight"*
- We can't yet build AI on the scale of the brain
 - ~100T synapses in the human brain vs ~1.8T weights in ChatGPT4
- Still, the brain can be a great inspiration for AI!



A short history of AI



A short history of AI

- 1940-1950: Early days: neural and computer science meet
 - 1943: McCulloch & Pitts: Boolean circuit model of brain
 - 1950: Turing's "Computing Machinery and Intelligence"
- 1950 – 70: Excitement! Logic-driven
 - 1950s: Early AI programs, including Samuel's checkers program, Newell & Simon's Logic Theorist, Gelernter's Geometry Engine
 - 1956: Dartmouth meeting: "Artificial Intelligence" adopted
 - 1957: Newell, Shaw, Simon GPS, General Problem Solver
 - 1965: Robinson's complete algorithm for logical reasoning

A short history of AI

1970 – 90: Knowledge-based approaches

1969 – 79: Early development of knowledge-based systems

1980 – 88: Expert systems industry booms

1988 – 93: Expert systems industry busts: “AI Winter”

1990 – 2010: Statistical approaches

- Resurgence of probability, focus on uncertainty
- Agents and learning systems... “AI Spring”?
- 1992: TD-Gammon attains human-level performance
- 1996: Kasparov defeats Deep Blue at chess
- 1997: Deep Blue defeats Kasparov at chess
- 2002: Embodied AI; Roomba vacuum invented

A short history of AI

2010 — 2017: Big Data, GPUs, Deep Learning

2011: Apple releases Siri

2012: AlexNet (neural net) wins ImageNet (image recognition) competition

2015: DeepMind achieves human-level control in Atari games

2016: DeepMind's AlphaGo beat Go Master, Lee Sedol

2016: Google Translate migrates to neural networks

2017 — : Scaling up, Large Language Models

2017: Google invents Transformer architecture

2017: DeepStack and Libratus defeat humans at poker

2018-2020: AlphaFold predicts protein structure from amino acids

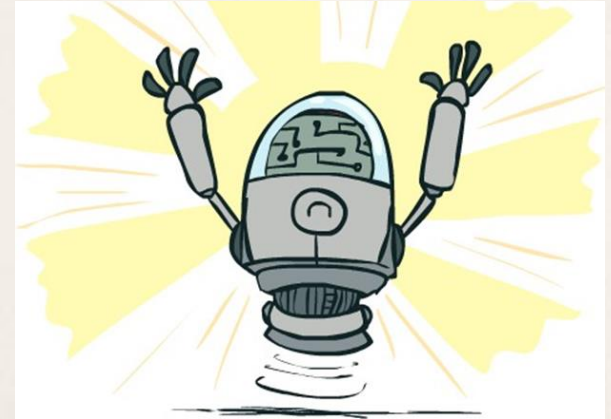
2021-2022: Modern text-to-image generation

2022: OpenAI release ChatGPT

What can AI do?

Quiz: Which of the following can be done at present?

- ✓ Win against any human at chess?
- ✓ Win against the best humans at Go?
- Play a decent game of tennis?
- Unload any dishwasher in any home?
- Drive safely along the highway?
- Drive safely along streets of Haikou?
- Buy a week's worth of groceries on the web?
- Discover and prove a new mathematical theorem?
- Perform a surgical operation?
- Translate spoken Chinese into spoken English in real time?
- Win an art competition?
- Write an intentionally funny story?
- Construct a building?



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Google's AlphaGo beats Lee Sedol at Go in 2016



But ... a plot twist in 2023!

DEEP BLUE WAS JUST THE START —

Man beats machine at Go in human victory over AI

Amateur exploited weakness in systems that have otherwise dominated grandmasters.

RICHARD WATERS, FINANCIAL TIMES - 2/19/2023, 4:51 AM

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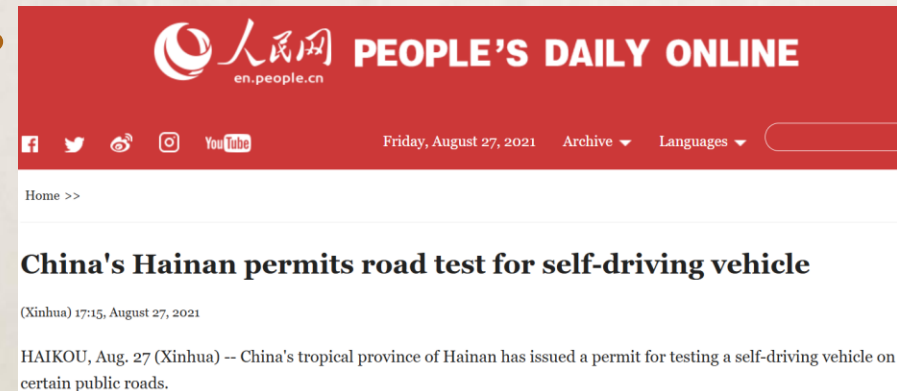
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- Construct a building?

SMART NEWS

Art Made With A.I. Won a State Fair Last Year. Now, the Rules Are Changing

Artists who submit to the competition will need to disclose whether they used A.I. tools like Midjourney



Sarah Kuta
Daily Correspondent
September 8, 2023



What can AI do?

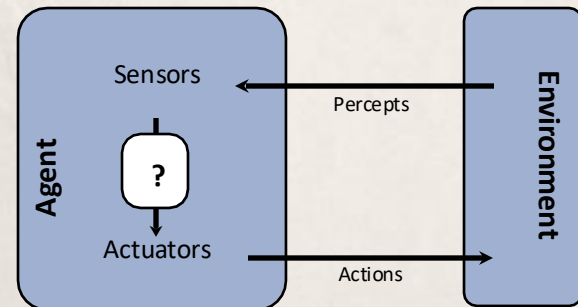
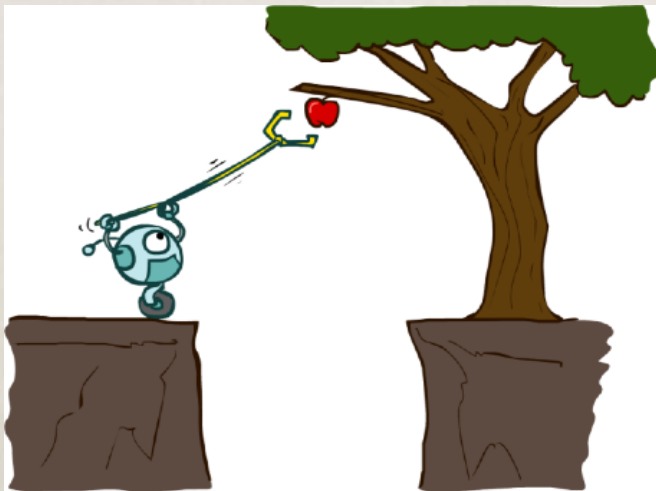
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This Course: Designing Rational Agents

- An **agent** is an entity that perceives and acts.
- A **rational agent** selects actions that maximize its (expected) **utility**.
- Characteristics of the **percepts**, **environment**, and **action space** dictate techniques for selecting rational actions
- This course is about:
 - General AI techniques for a variety of problem types
 - Learning to recognize when and how a new problem can be solved with an existing technique



Course Topics

Core Components of Rational Agents:

Search &
Planning

Reinforcement
Learning

Probability &
Inference

Supervised
Learning

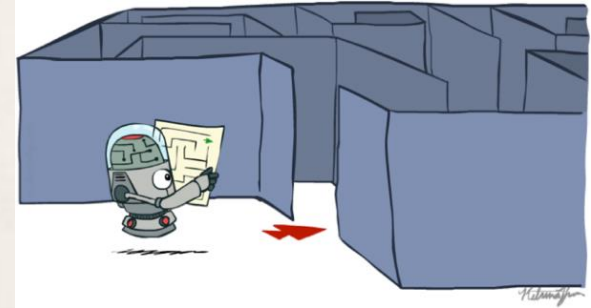
Course Topics

Search &
Planning

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How can I find a *sequence of best decisions* for a *particular* situation?

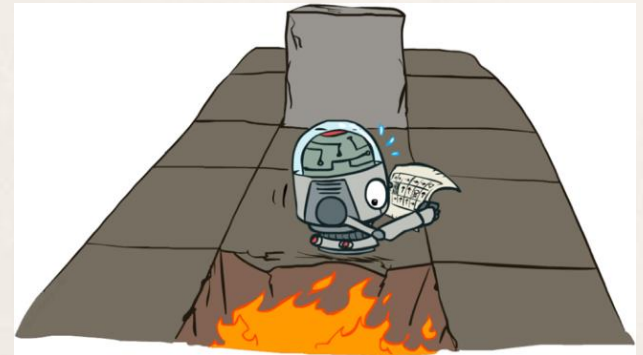
Course Topics

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How can I find *rules (policy)* to make best decisions for *any* situation?

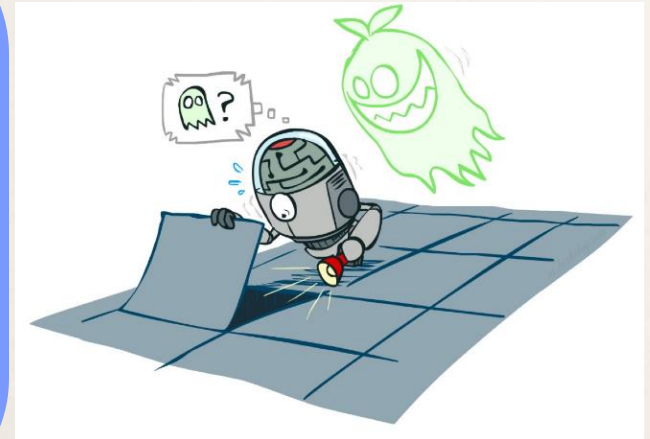
Course Topics

Search &
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How can I make sense of *uncertainty* in
the world?

Course Topics

Search &
Planning

Reinforcement
Learning

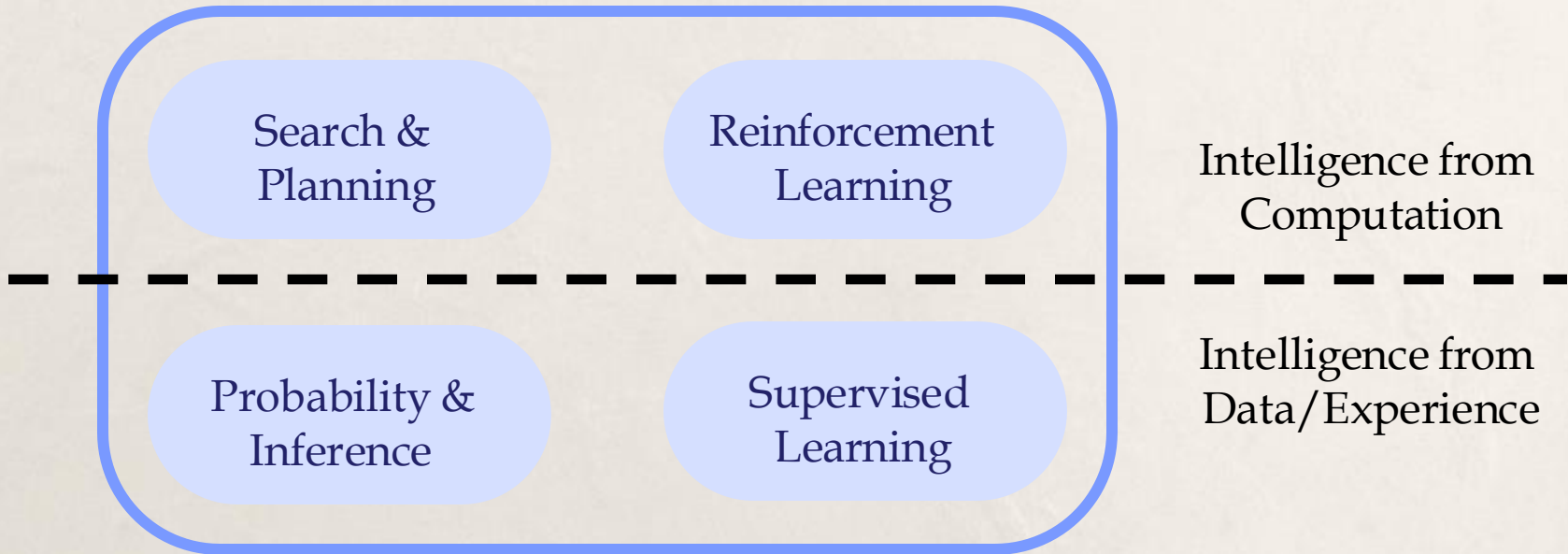
Probability &
Inference

Supervised
Learning



How can I learn a *model* of the world from *data*?

Course Topics



Course Topics

