Introduction to Artificial Intelligence

Lecture 0: Artificial Intelligence

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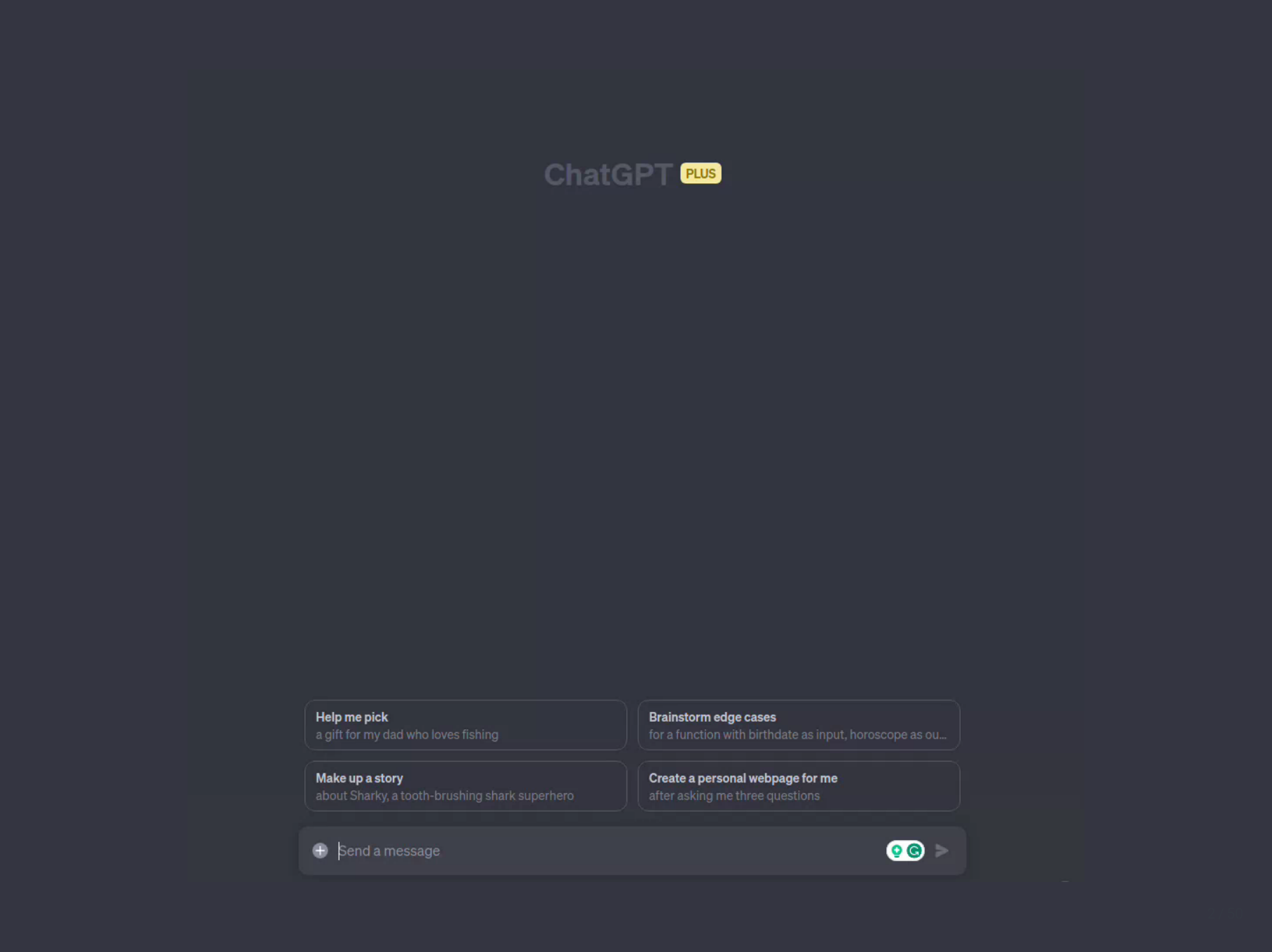
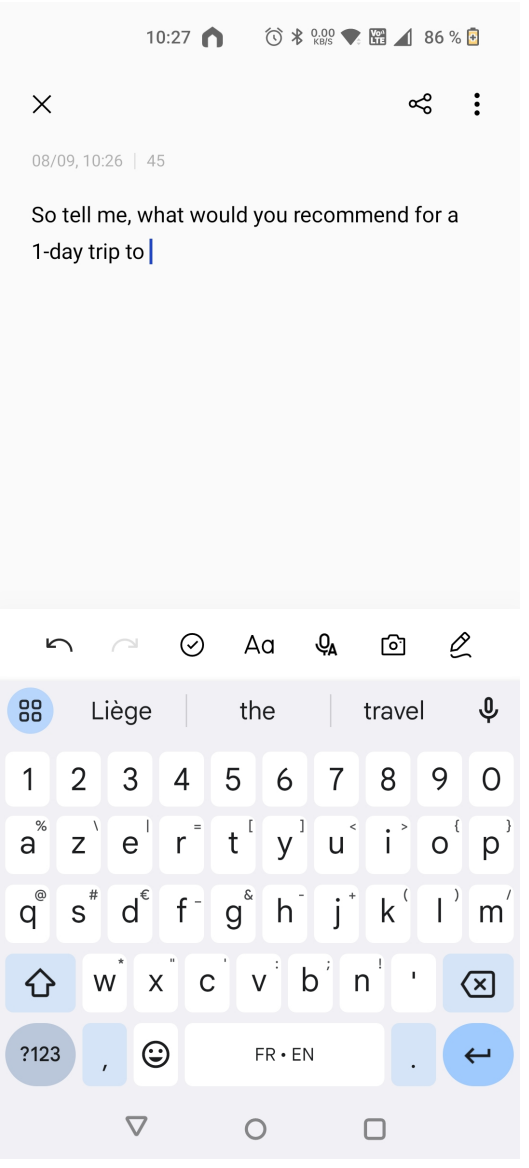

ChatGPT
PLUS
Help me pick
a gift for my dad who loves fishing
Brainstorm edge cases
for a function with birthdate as input, horoscope as ou...
Make up a story
about Sharky, a tooth-brushing shark superhero
Create a personal webpage for me
after asking me three questions
Send a message

One simple idea:

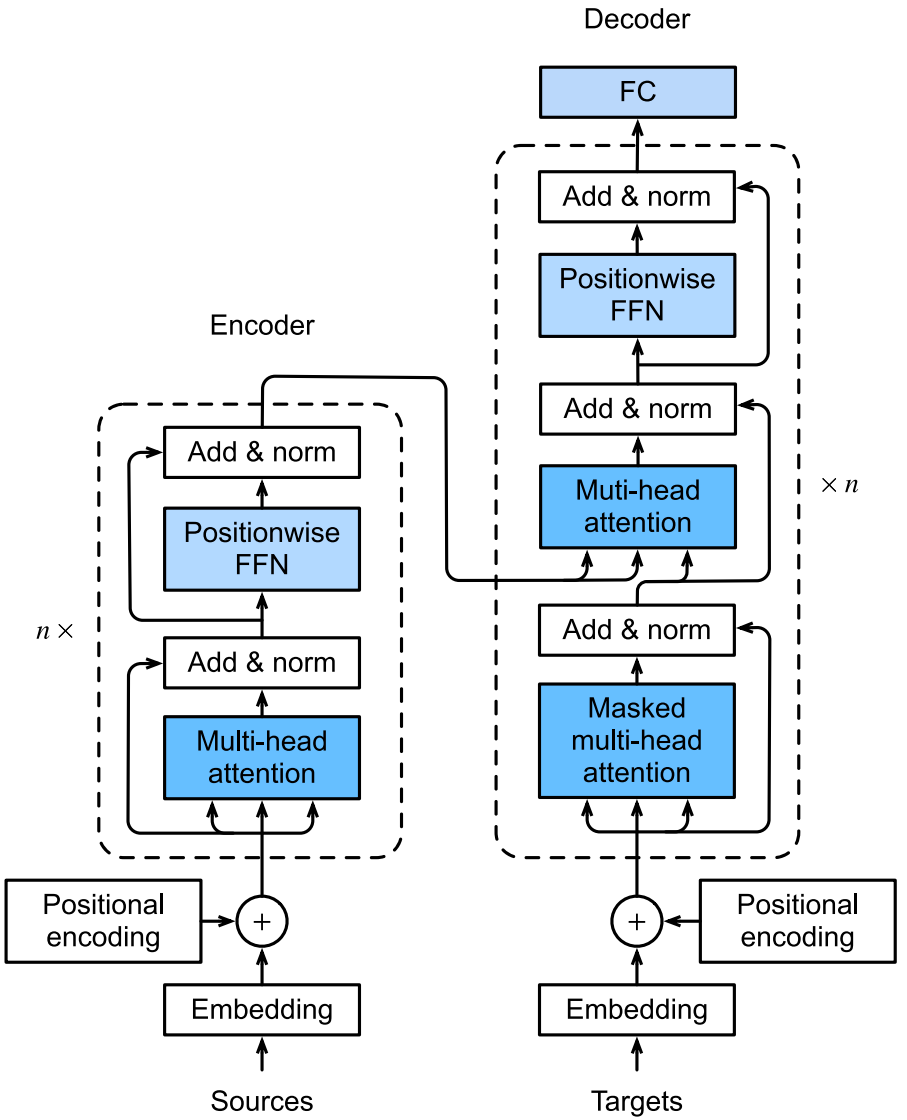
Guess the next word



John plays the ___

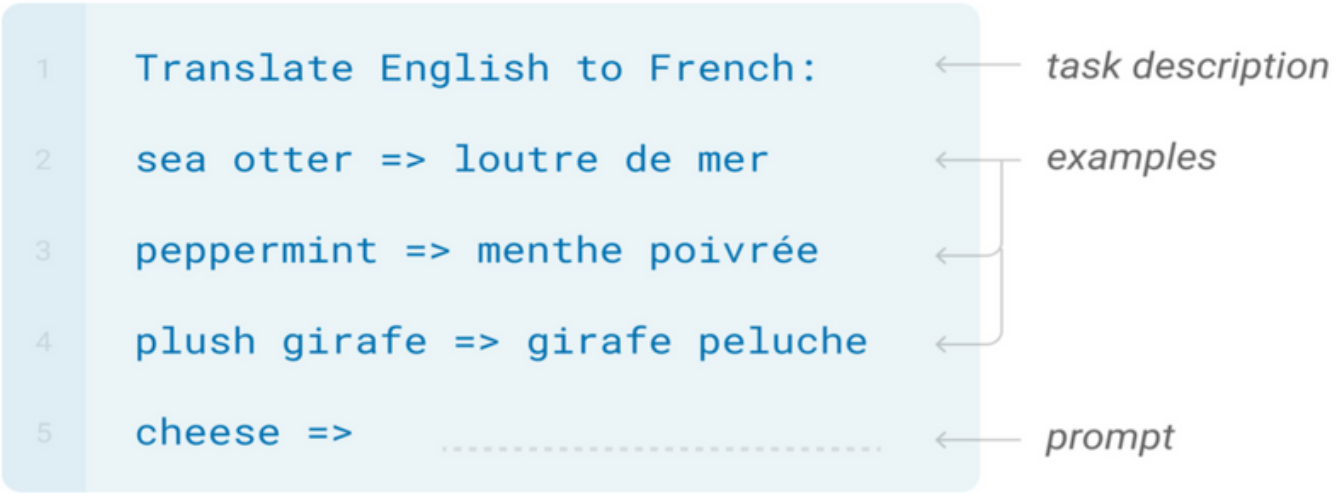
John plays the piano and Mary plays the _____

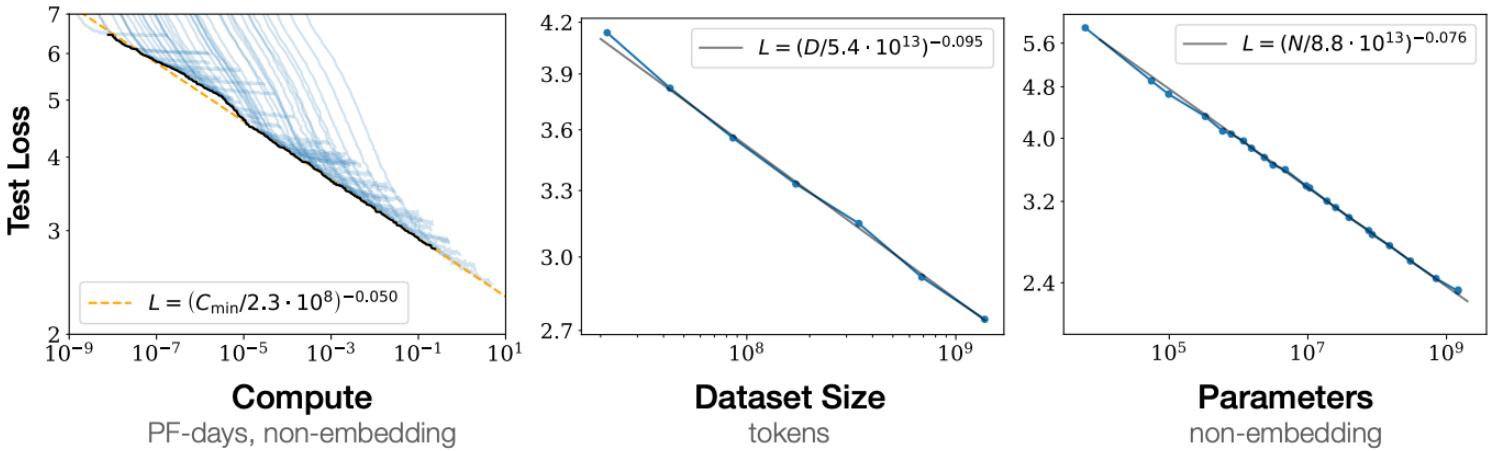
John plays the piano and Paul plays the _____


Decoder
FC
Add & norm
Positionwise FFN
Add & norm
Muti-head attention
Add & norm
Masked multi-head attention
× n
Encoder
n ×
Add & norm
Positionwise FFN
Add & norm
Multi-head attention
Positional encoding
Positional encoding
Embedding
Embedding
Sources
Targets

John plays the piano and Paul plays the

TEXT TOKEN IDS


1 Translate English to French:
2 sea otter => loutre de mer
3 peppermint => menthe poivrée
4 plush girafe => girafe peluche
5 cheese =>
task description
examples
prompt

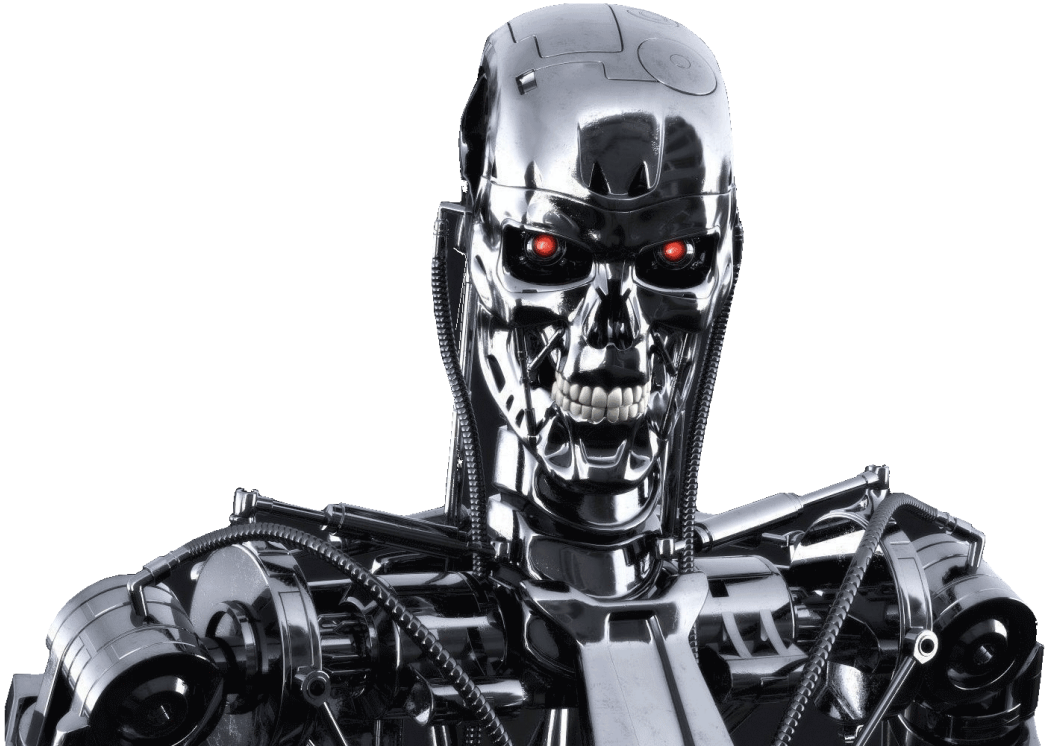


A brutal simplicity:

- The more data, the better the model.
- The more parameters, the better the model.
- The more compute, the better the model.


Why does it work? How does complexity arise from
the simplicity of guessing the next `____`?

Before ChatGPT



"With artificial intelligence we are summoning the demon" -- Elon Musk

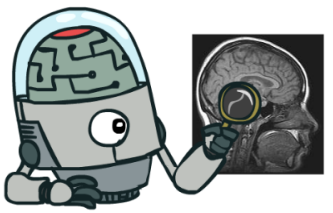
"We're really closer to a smart washing machine than Terminator" -- Fei-Fei Li, Director of Stanford AI Lab.


Rencontre avec Yann Le Cun, directeur de la recherche en AI chez F...
powered by Dailymotion
Konbini techno
2:39
Les gens ont des peurs,
des fantasmes.

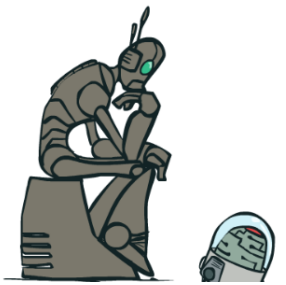
A definition?

Artificial intelligence is the science of making machines or programs that:

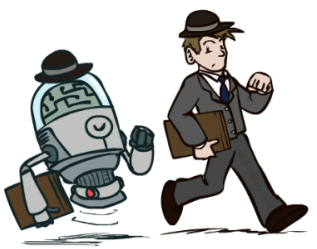
Think like people



Think rationally



Act like people



Act rationally

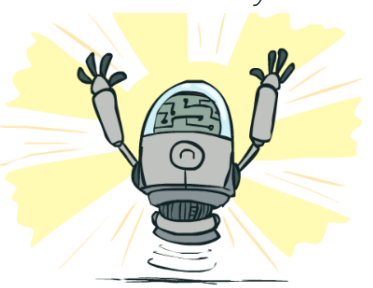


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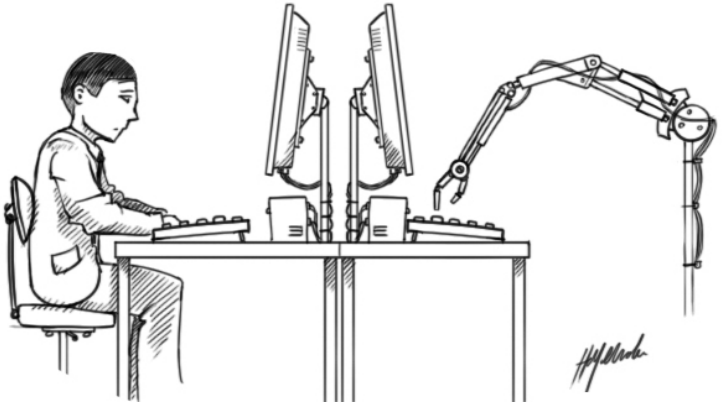
Image credits: CS188, UC Berkeley.

The Turing test

A computer passes the Turing test (aka the Imitation Game) if a human operator, after posing some written questions, cannot tell whether the written responses come from a person or from a computer.



Can machines think?
(Alan Turing, 1950)

An agent would not pass the Turing test without the following requirements:

- natural language processing
- knowledge representation
- automated reasoning
- machine learning
- computer vision (total Turing test)
- robotics (total Turing test)

Despite being proposed almost 70 years ago, the Turing test is still relevant today.

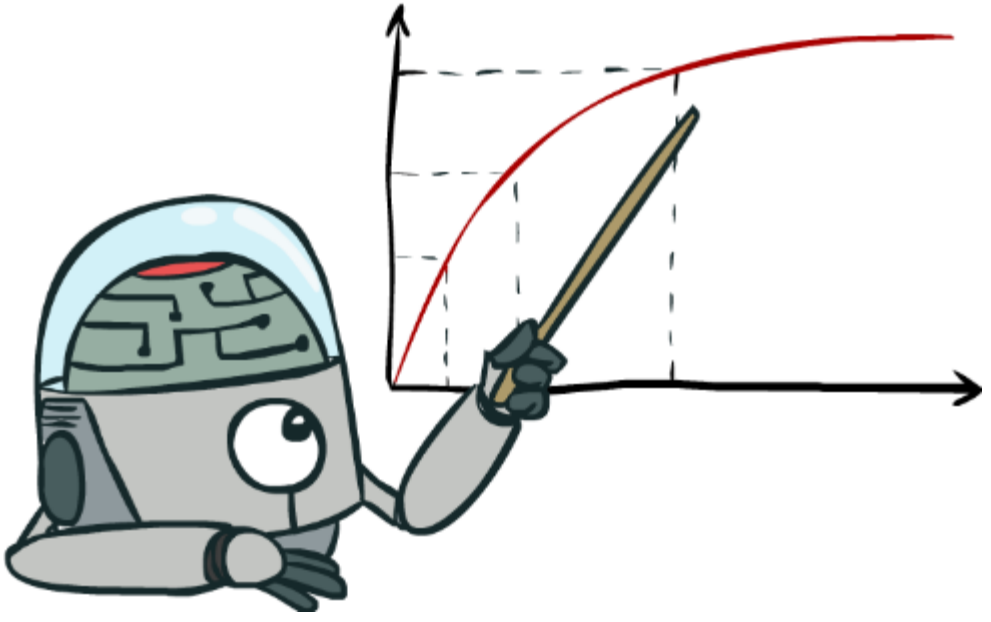
The Turing test tends to focus on human-like errors, linguistic tricks, etc.

However, it seems more important to study the principles underlying intelligence than to replicate an exemplar.

Aeronautics is not defined as the field of making machines
that fly so exactly like pigeons that they can fool even other pigeons.

Rational agents

- A rational agent acts so as to achieve the best expected outcome.
- Rationality only concerns what decisions are made (not the thought process behind them, human-like or not).
- Goals are expressed in terms of the performance or utility of outcomes. Being rational means maximizing its expected performance.
- The standard of rationality is general and mathematically well defined.



In this course, Artificial intelligence = Maximizing expected performance

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Image credits: CS188, UC Berkeley.

A short history of AI

1940-1950: Early days

- 1943: McCulloch and Pitts: Boolean circuit model of the brain.
- 1950: Turing's "Computing machinery and intelligence".

1950-1970: Excitement and expectations

- 1950s: Early AI programs, including Samuel's checkers program, Newell and Simon's Logic Theorist and Gelernter's Geometry Engine.
- 1956: Dartmouth meeting: "Aritificial Intelligence" adopted.
- 1958: Rosenblatt invents the perceptron.
- 1965: Robinson's complete algorithm for logical reasoning.
- 1966-1974: AI discovers computational complexity.

The Darthmouth workshop (1956)

The study is to proceed on the basis of the conjecture that every aspect of learning or any other feature of intelligence can in principle be so precisely described *that a machine can be made to simulate it.*


The Thinking Machine (Artificial Intelligenc...
Later bekij...
Delen

1970-1990: Knowledge-based approaches

- 1969: Neural network research almost disappears after Minsky and Papert's book (1st AI winter).
- 1969-1979: Early development of knowledge-based systems.
- 1980-1988: Expert systems industrial boom.
- 1988-1993: Expert systems industry busts (2nd AI winter).

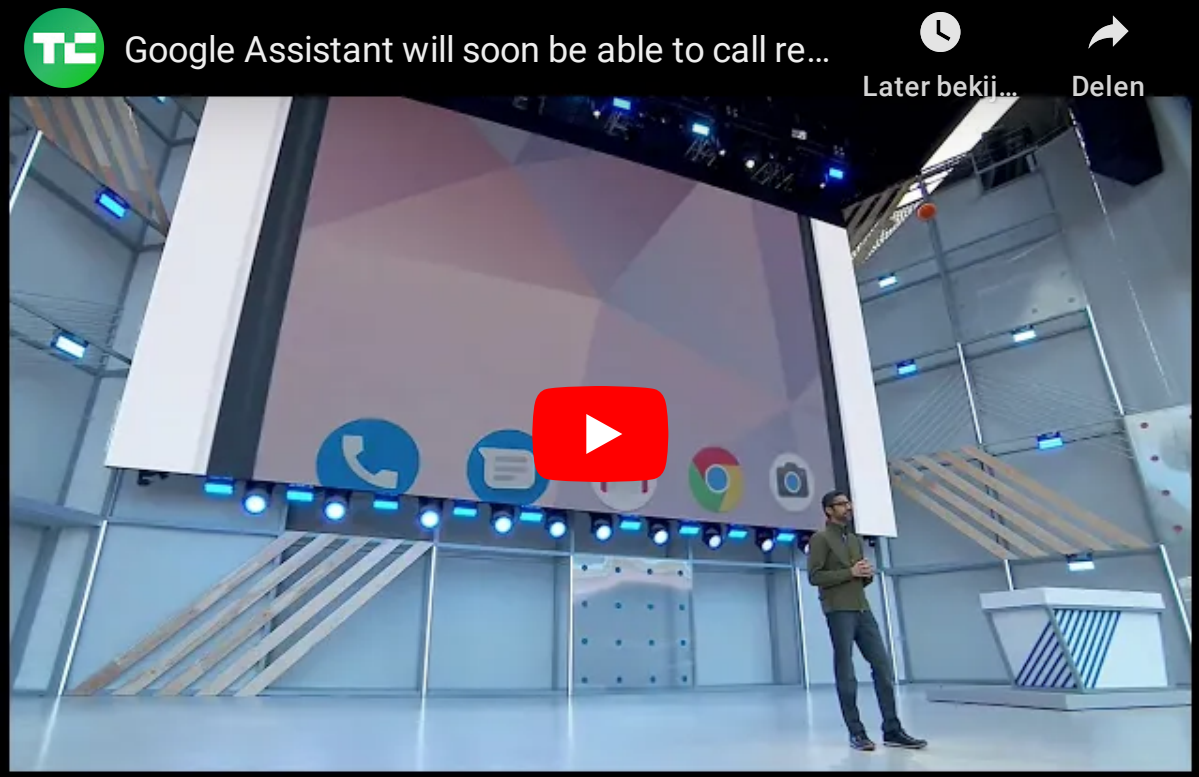
1990-Present: Statistical approaches

- 1985-1995: The return of neural networks.
- 1988-: Resurgence of probability, focus on uncertainty, general increase in technical depth.
- 1995-2010: New fade of neural networks.
- 1995-: Complete intelligent agents and learning systems.
- 2000-: Availability of very large datasets.
- 2010-: Availability of fast commodity hardware (GPUs).
- 2012-: Resurgence of neural networks with deep learning approaches.

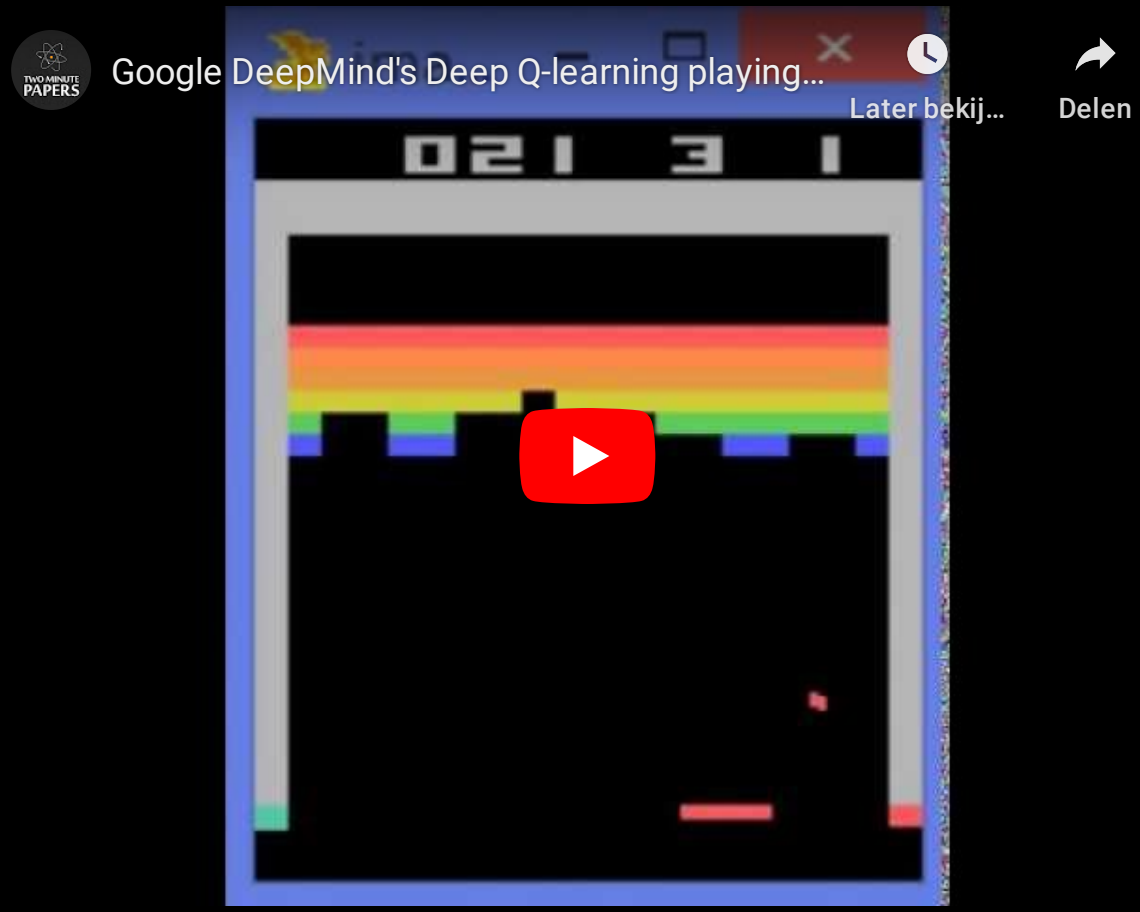
What can an AI do today?

- Translate spoken Chinese to spoken English, live?
- Answer multi choice questions, as good as an 8th grader?
- Solve university math problems?
- Prove mathematical theorems?
- Converse with a person for an hour?
- Play decently at Chess? Go? Poker? Soccer?
- Buy groceries on the web? in a supermarket?
- Drive a car safely on a parking lot? in New York? in Germany?
- Identify skin cancer better than a dermatologist?
- Write computer code?
- Tell a funny story?
- Paint like Vangogh? Compose music?
- Show common sense?

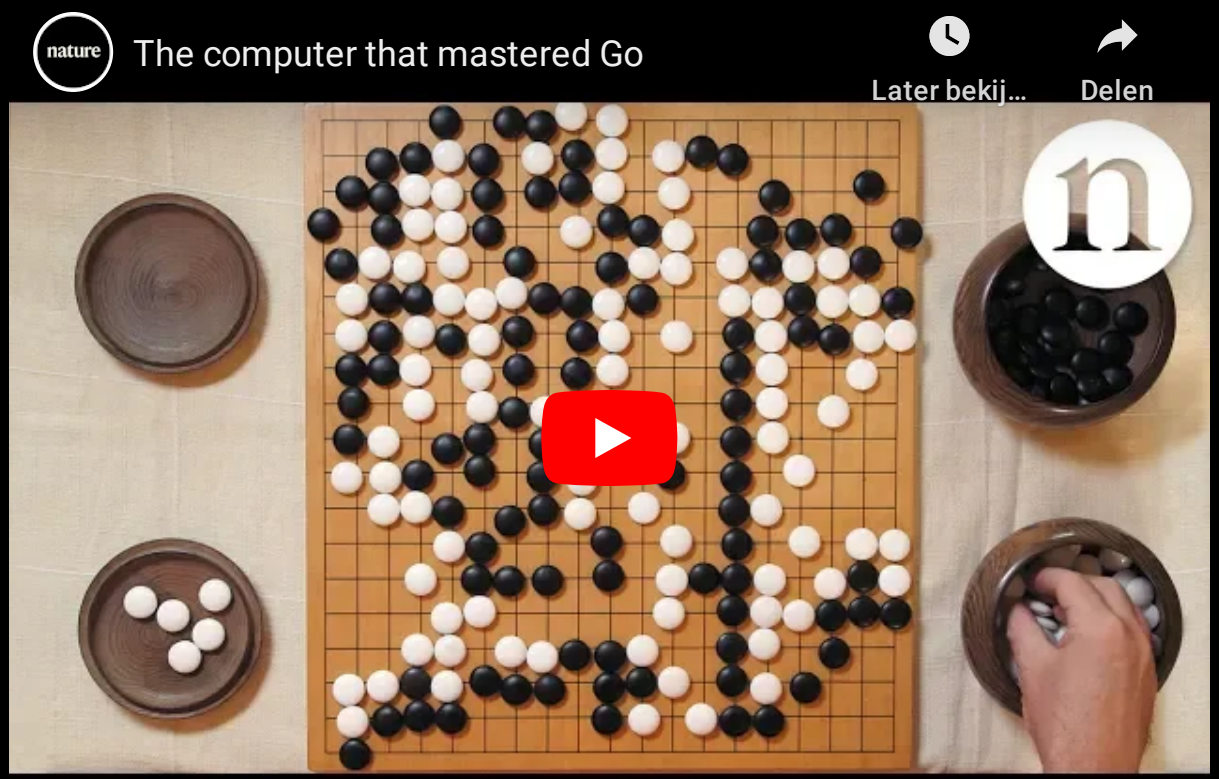
Speech translation and synthesis (2012)



Speech synthesis and question answering (Google, 2018)

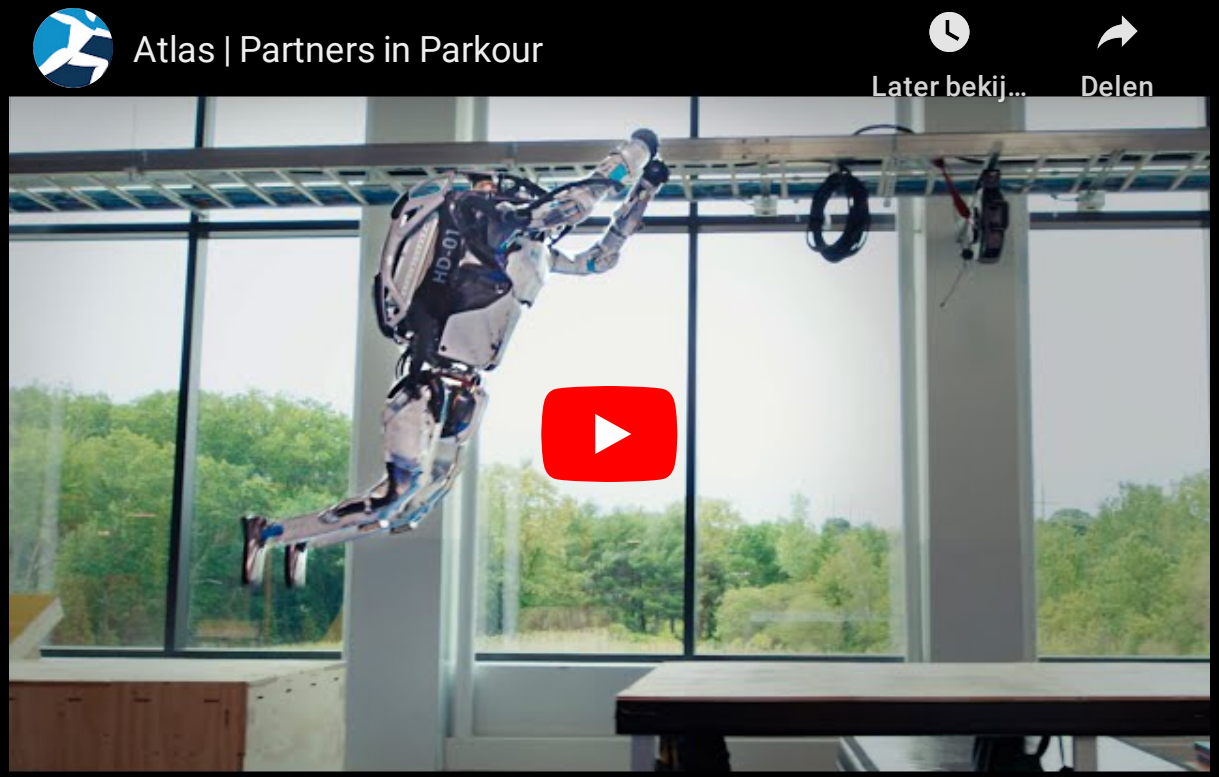


Playing Atari games

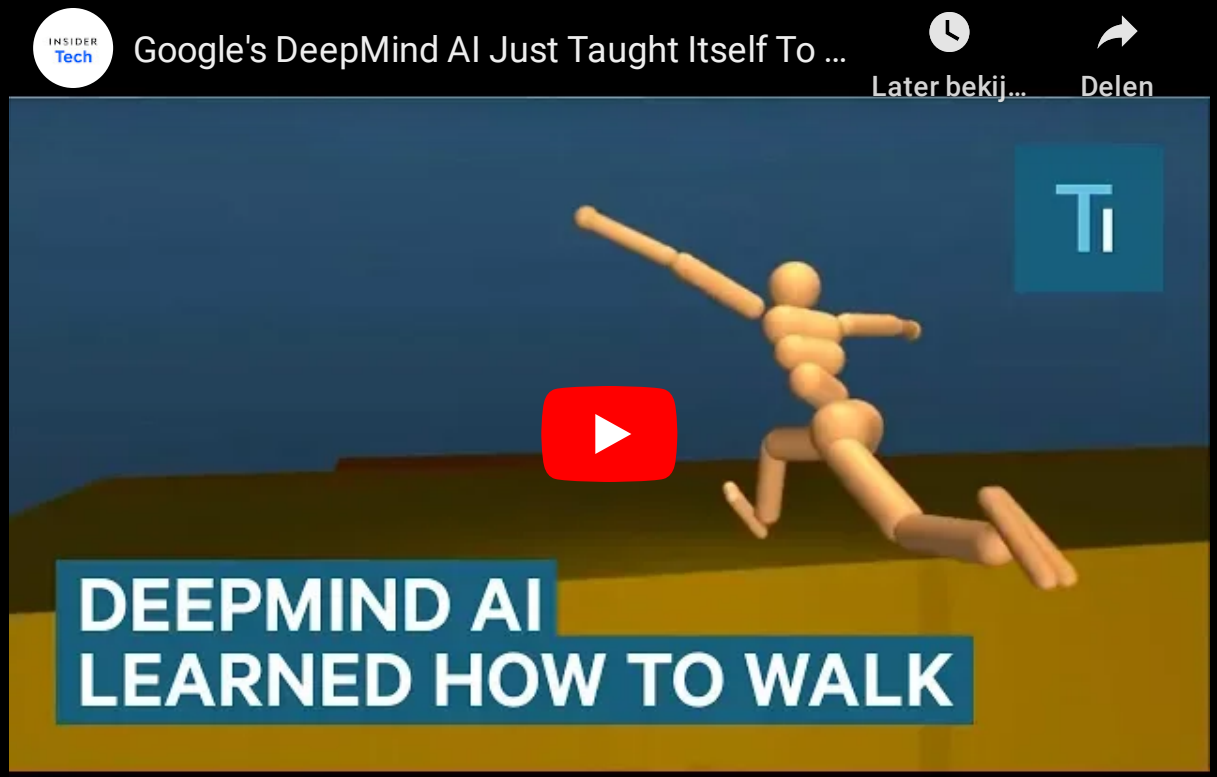


Beat the best human Go players (2016)

Playing soccer (2018)

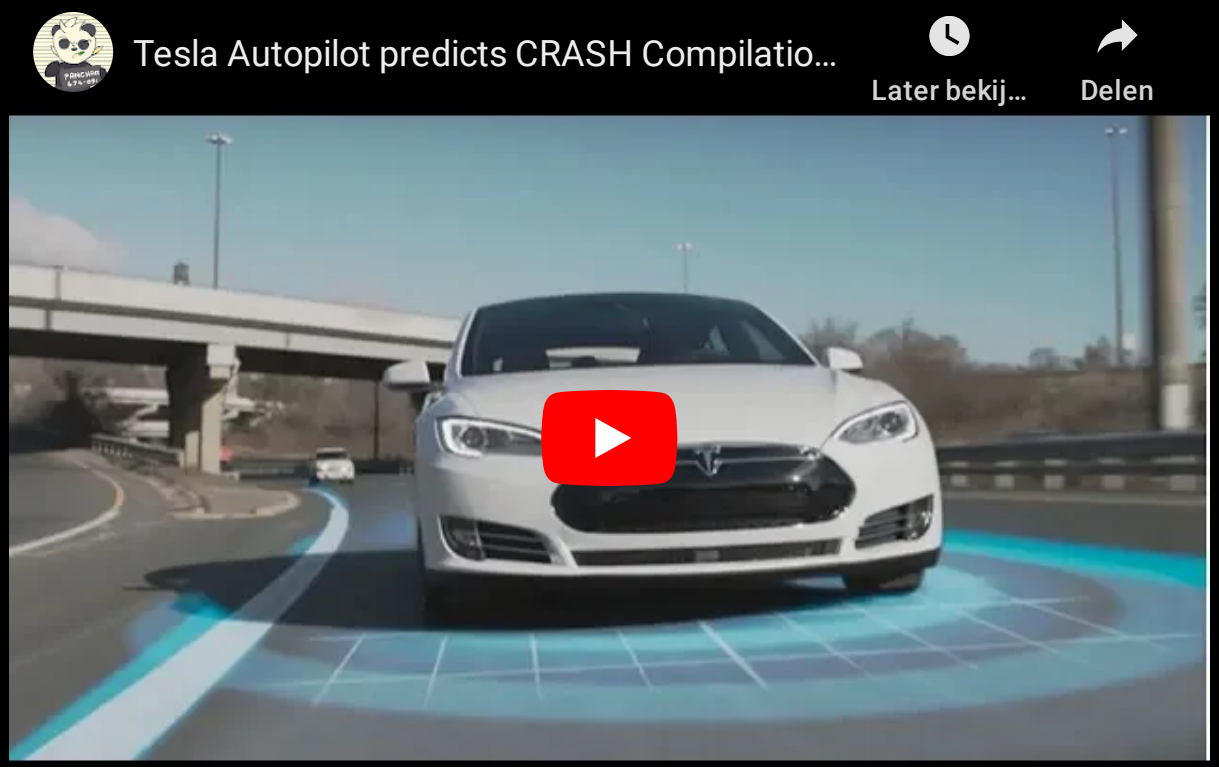


... although some robots might now do better (2021).

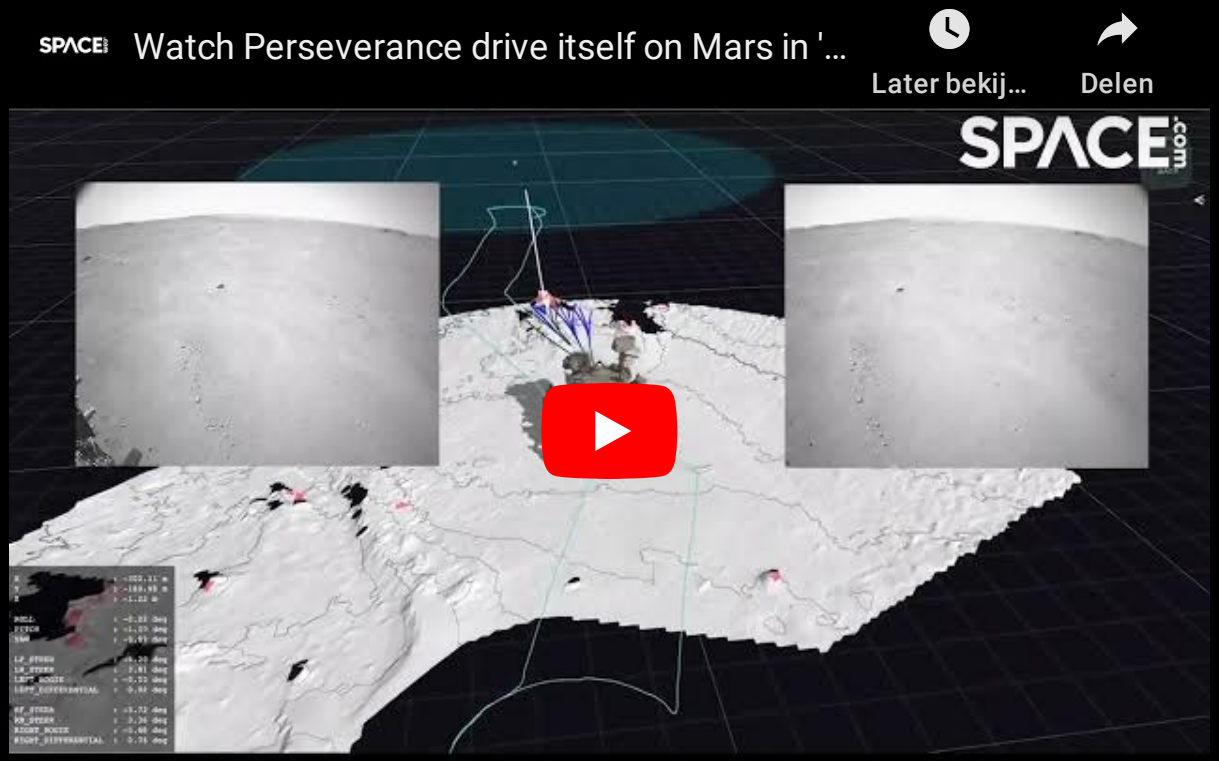


Learning to walk (2017)

Driving a car (NVIDIA, 2016)



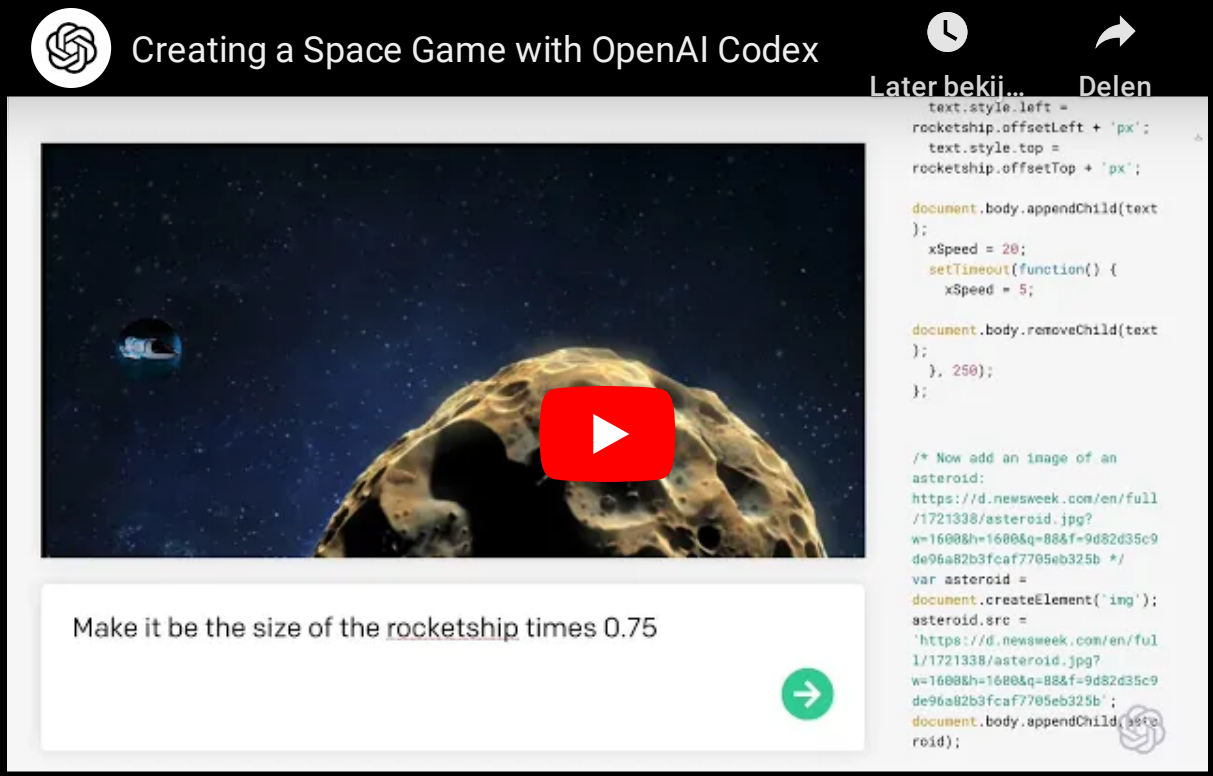
... and preventing accidents.



Driving on Mars.

Detecting skin cancer (2017)

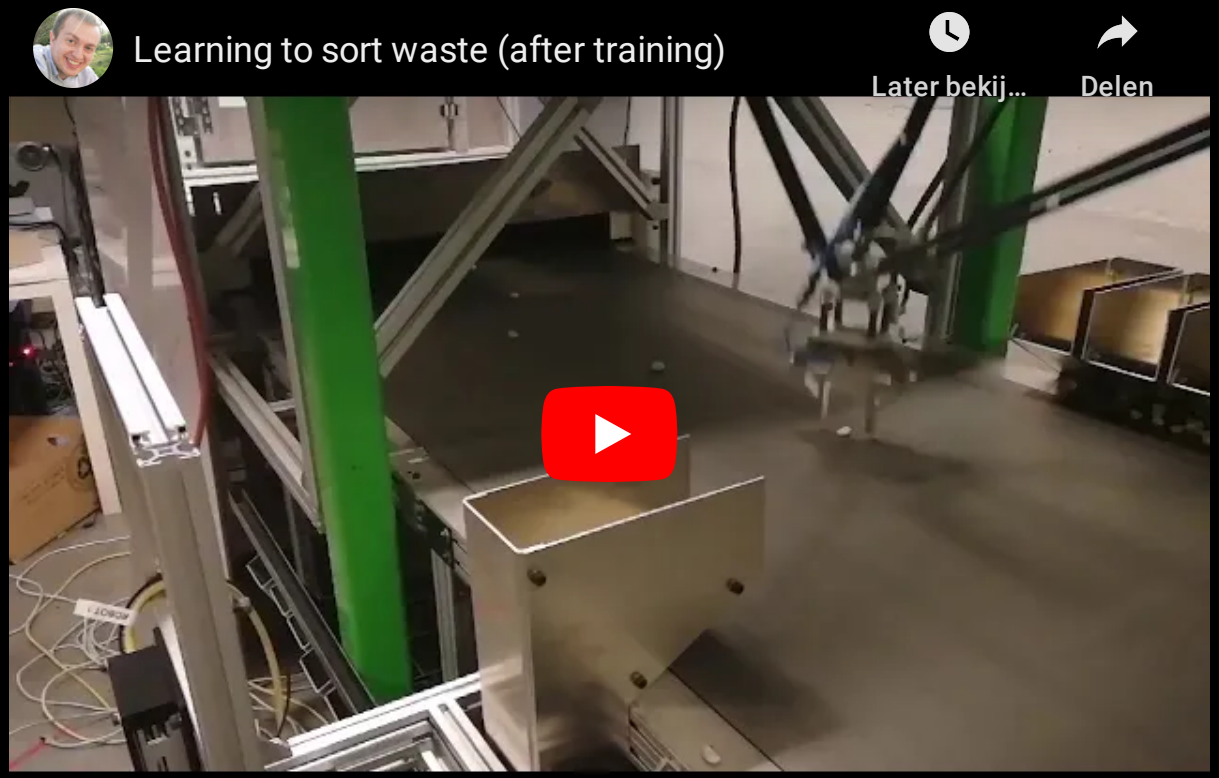
Advance Science (Deepmind, AlphaFold, 2020)



Write computer code (OpenAI, 2021)

Compose music (NVIDIA, 2017)

Cow behaviour recognition (Francois Lievens, ULiège, 2022)



Learning to sort waste
(Norman Marlier, ULiège, 2018)

What is missing?

Intelligence is not just about pattern recognition, which is something most of these works are based on.

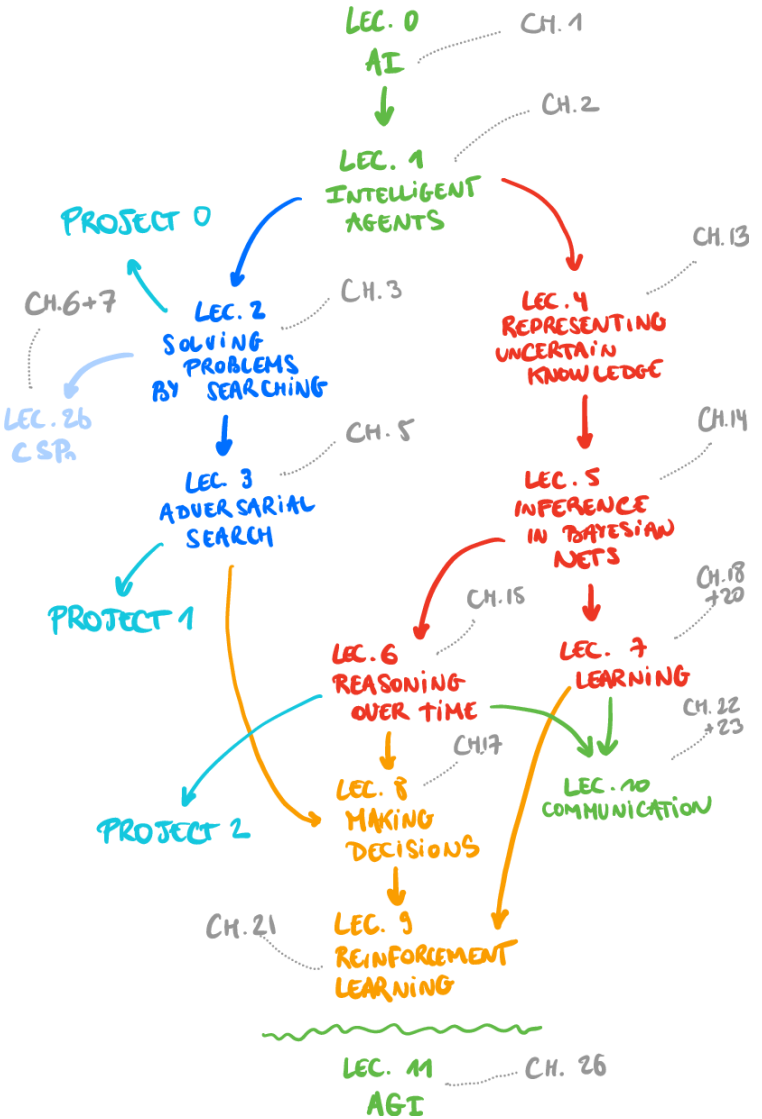
It is about modeling the world:

- explaining and understanding what we see;
- imagining things we could see but haven't yet;
- problem solving and planning actions to make these things real;
- building new models as we learn more about the world.

INFO8006 Introduction to AI

Course outline

- Lecture 0: Artificial intelligence
- Lecture 1: Intelligent agents
- Lecture 2: Solving problems by searching
- Lecture 3: Adversarial search
- Lecture 4: Representing uncertain knowledge
- Lecture 5: Inference in Bayesian networks
- Lecture 6: Reasoning over time
- Lecture 7: Machine learning and neural networks
- Lecture 8: Making decisions
- Lecture 9: Reinforcement learning


LEC. 0
AI
CH. 1
CH. 2
LEC. 1
INTELLIGENT AGENTS
PROJECT 0
CH. 13
CH. 6+7
LEC. 2
SOLVING PROBLEMS BY SEARCHING
CH. 3
LEC. 4
REPRESENTING UNCERTAIN KNOWLEDGE
LEC. 26
CSP
CH. 5
CH. 14
LEC. 3
ADVERSARIAL SEARCH
LEC. 5
INFERENCE IN BAYESIAN NETS
PROJECT 1
CH. 15
CH. 18 +20
LEC. 6
REASONING OVER TIME
LEC. 7
LEARNING
CH. 22 +23
CH. 17
LEC. 8
MAKING DECISIONS
LEC. 10
COMMUNICATION
PROJECT 2
CH. 21
LEC. 9
REINFORCEMENT LEARNING
LEC. 11
AGI
CH. 26

My mission

By the end of this course, you will have built autonomous agents that efficiently make decisions in fully informed, partially observable and adversarial settings. Your agents will draw inferences in uncertain and unknown environments and optimize actions for arbitrary reward structures.

The models and algorithms you will learn in this course apply to a wide variety of artificial intelligence problems and will serve as the foundation for further study in any application area (from engineering and science, to business and medicine) you choose to pursue.

Goals and philosophy

General

- Understand the landscape of artificial intelligence.
- Be able to write from scratch, debug and run (some) AI algorithms.

Well-established and state-of-the-art algorithms

- Good old-fashioned AI: well-established algorithms for intelligent agents and their mathematical foundations.
- Introduction to materials new from research ($\leq$ 5 years old).
- Understand some of the open questions and challenges in the field.

Practical

- Fun and challenging course projects.

Going further

This course is designed as an introduction to the many other courses available at ULiège and (broadly) related to AI, including:

- INFO8006: Introduction to Artificial Intelligence ← you are there
- DATS0001: Foundations of Data Science
- ELEN0062: Introduction to Machine Learning
- INFO8010: Deep Learning
- INFO8004: Advanced Machine Learning
- INFO9023: Machine Learning Systems Design
- INFO8003: Optimal decision making for complex problems
- INFO0948: Introduction to Intelligent Robotics
- INFO9014: Knowledge representation and reasoning
- ELEN0016: Computer vision

The end.