

# 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



10:27 🏠 ⏱ 0.00 KB/S VOLTE 86 %

X



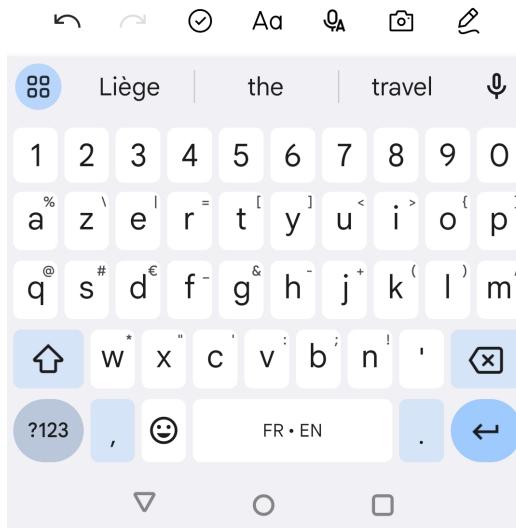
⋮

08/09, 10:26 | 45

So tell me, what would you recommend for a  
1-day trip to |

One simple idea:

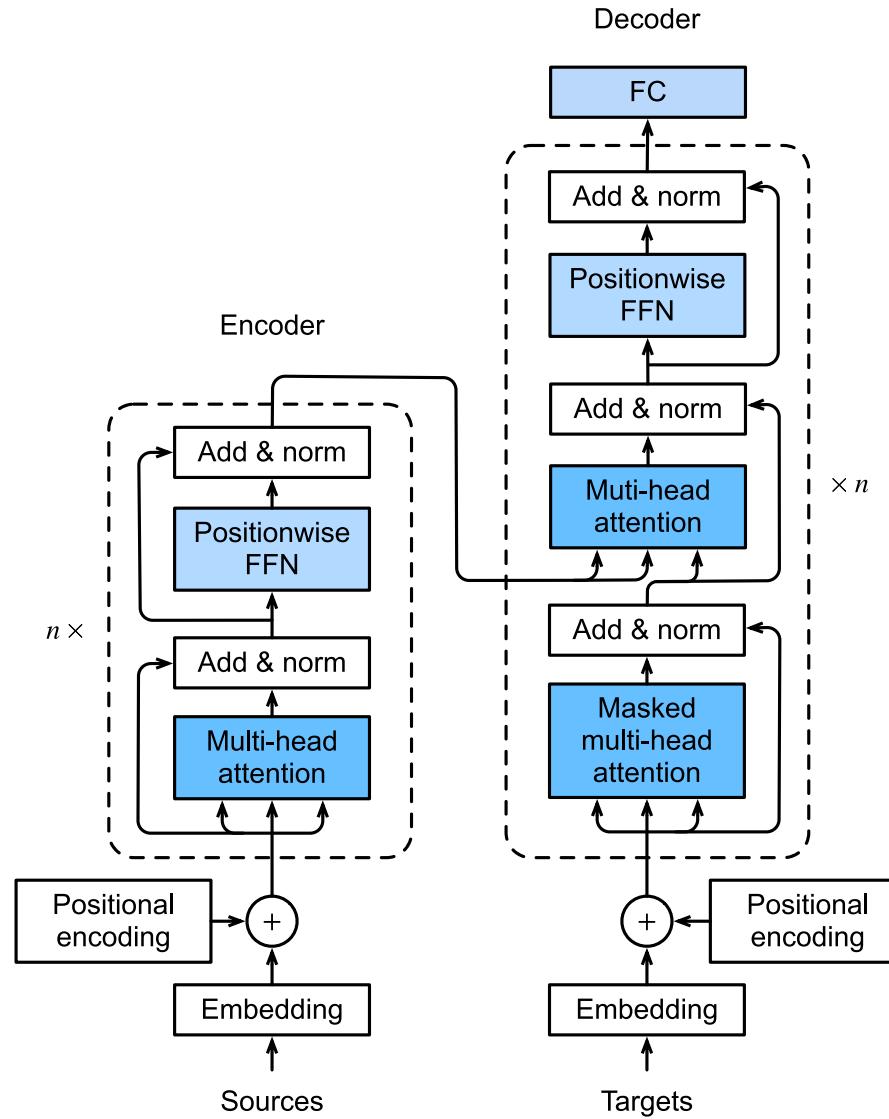
## Guess the next word

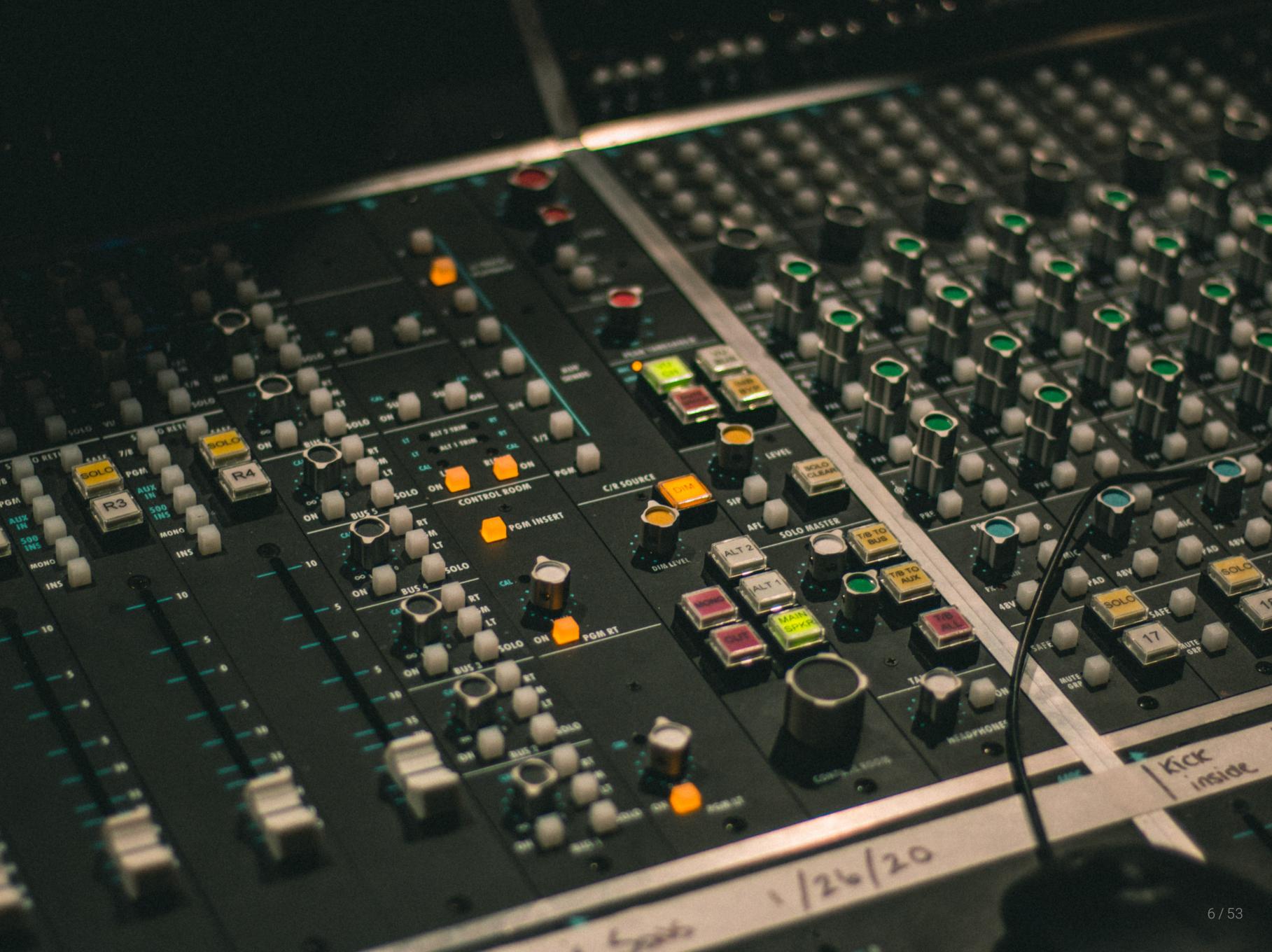


John plays the \_\_\_\_

John plays the piano and Mary plays the \_\_\_\_\_

John plays the piano and Paul plays the \_\_\_\_\_



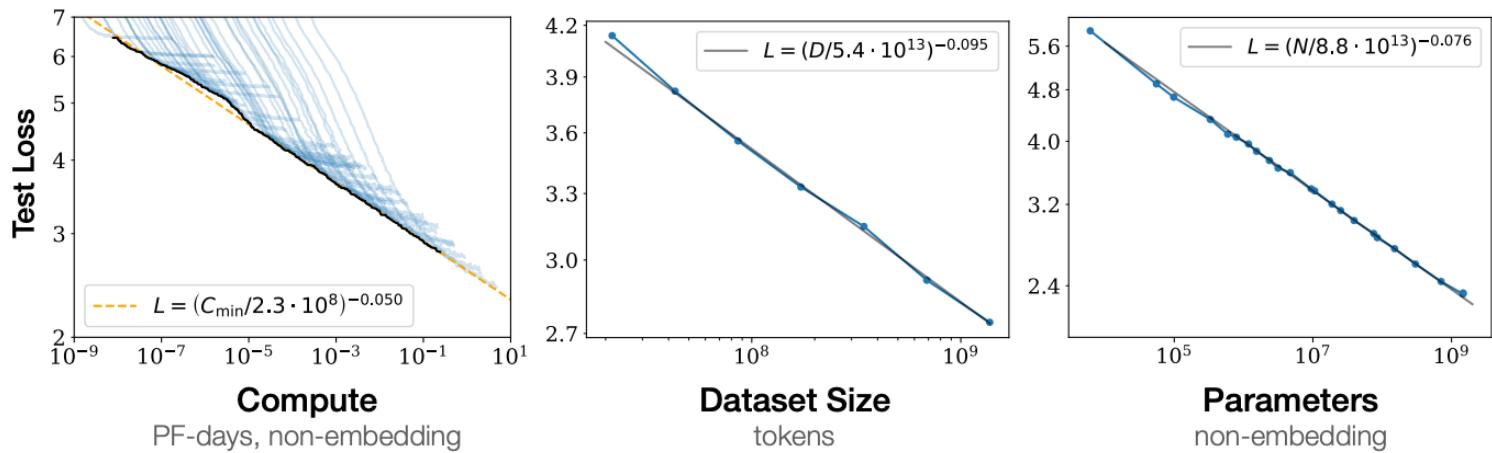


John plays the piano and Paul plays the

TEXT

TOKEN IDS

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



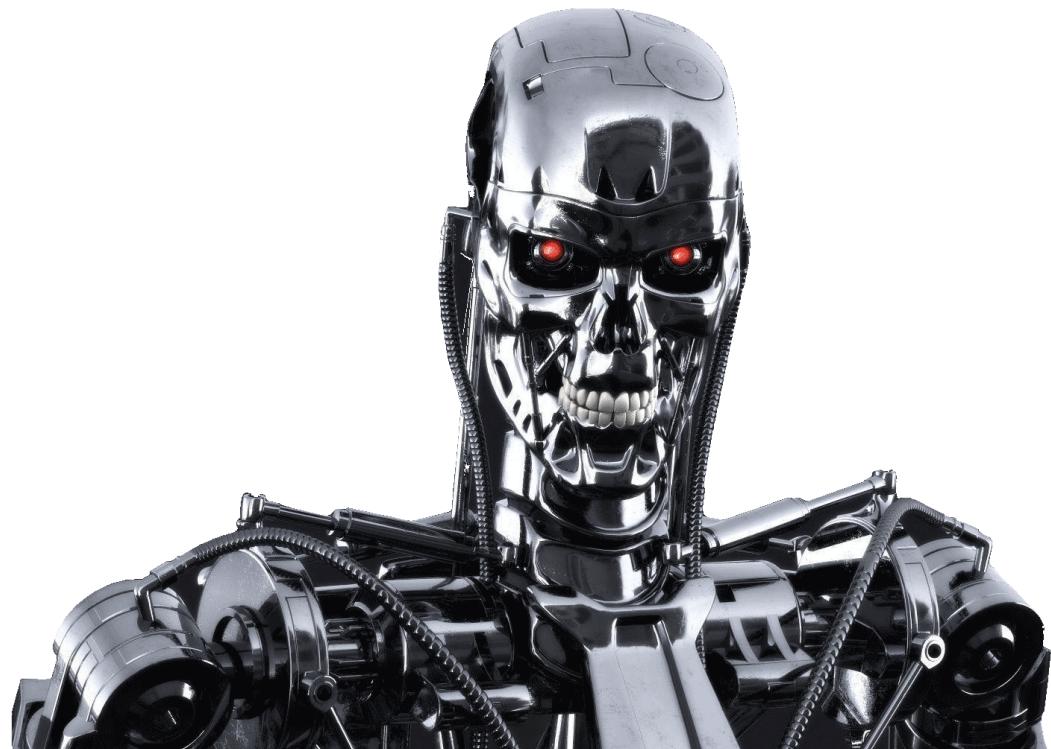
A brutal simplicity:

- 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 '\_\_\_'?

# **Artificial Intelligence**



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



AI 'godfather' quits Google over dangers of ...



Later bekij...  
...



Delen

BBC is een Britse publieke omroep. >

# 'AI could be smarter than us'

BBC NEWS



Geoffrey Hinton



"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



2:39

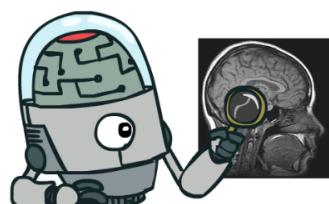
**Les gens ont des peurs,  
des fantasmes.**

Yann LeCun

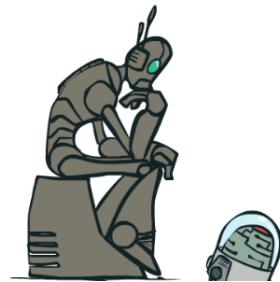
# A definition?

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

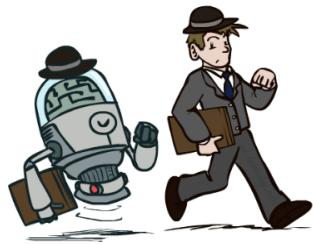
*Think like people*



*Think rationally*



*Act like people*

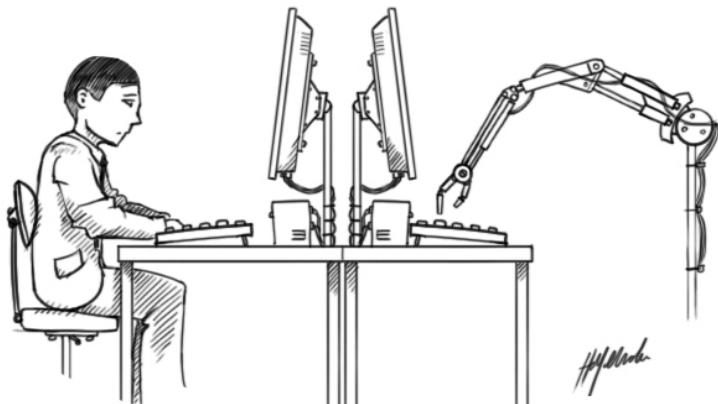


*Act rationally*



## 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.

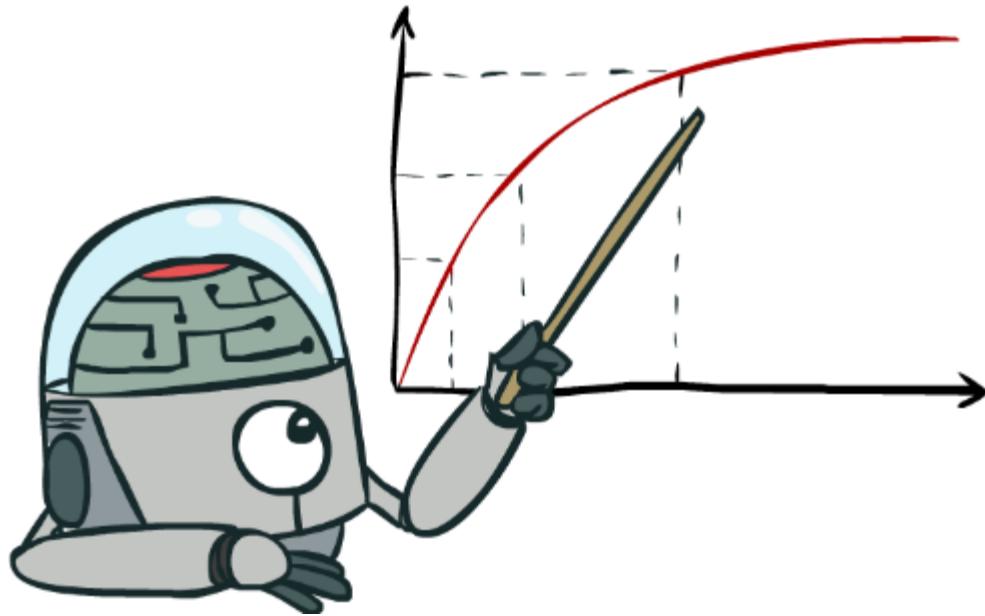
However, it seems more important to study the **principles** underlying intelligence than to replicate an exemplar.



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**

# 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 Dartmouth 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...



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## **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.
- 2000-: Availability of very large datasets.
- 2010-: Availability of fast commodity hardware (GPUs).
- 2012-: Resurgence of neural networks with deep learning approaches.
- 2017: Attention is all you need (transformers).
- 2022: ChatGPT released to the public.

# What can an AI do today?

- Translate spoken Chinese to spoken English, live?
- Answer multiple 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?
- 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 Van Gogh? Compose music?
- Show common sense?



Speech translation and synthesis (2012)



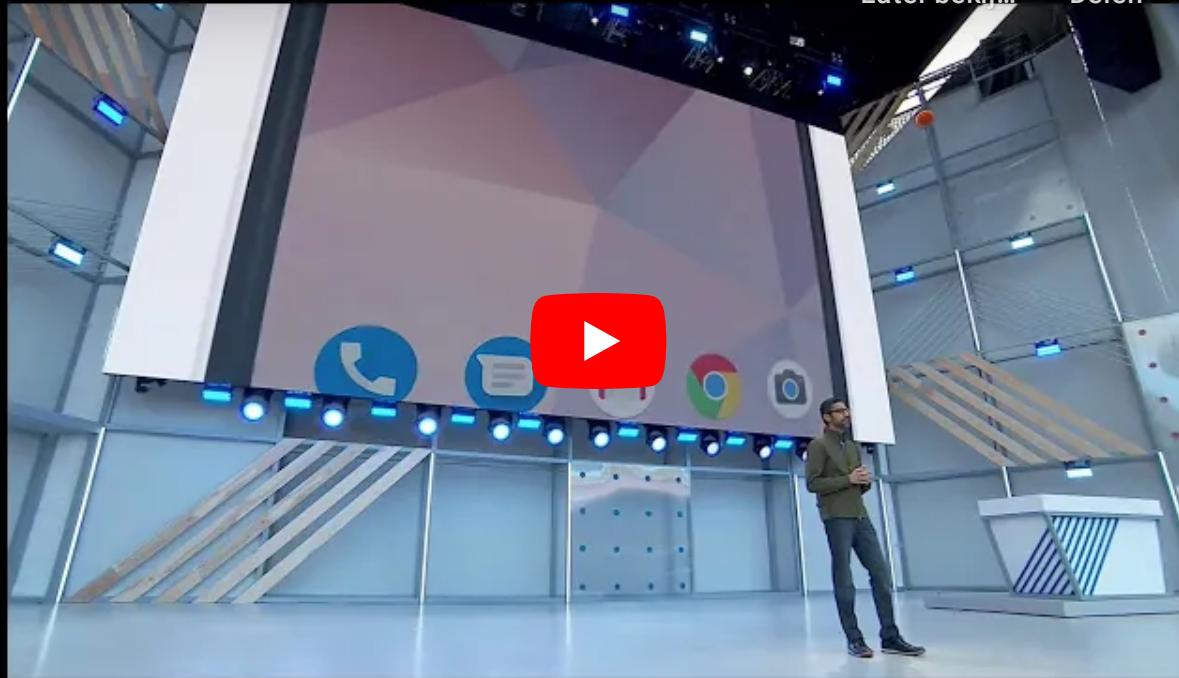
Google Assistant will soon be able to call re...



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Speech synthesis and question answering (Google, 2018)



Google DeepMind's Deep Q-learning playing...



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Playing Atari games (2013)



The computer that mastered Go



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Beat the best human Go players (2016)



Google's DeepMind AI Just Taught Itself To ...



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Later bekijken



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Learning to walk (2017)



RoboCup 2018 Humanoid AdultSize Final: ...



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Playing soccer (2018)



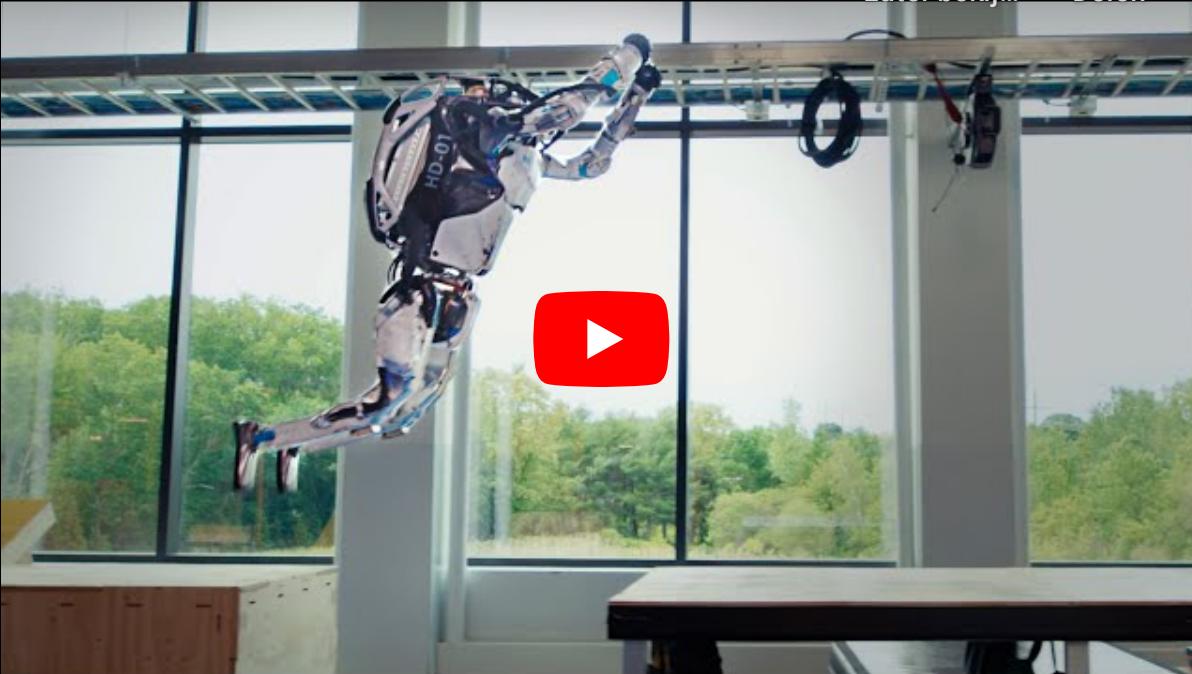
Atlas | Partners in Parkour



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



NVIDIA Autonomous Car



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Driving a car (NVIDIA, 2016)



Sense, Solve, and Go: The Magic of the Wa...



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Autonomous cars (Waymo, 2022)

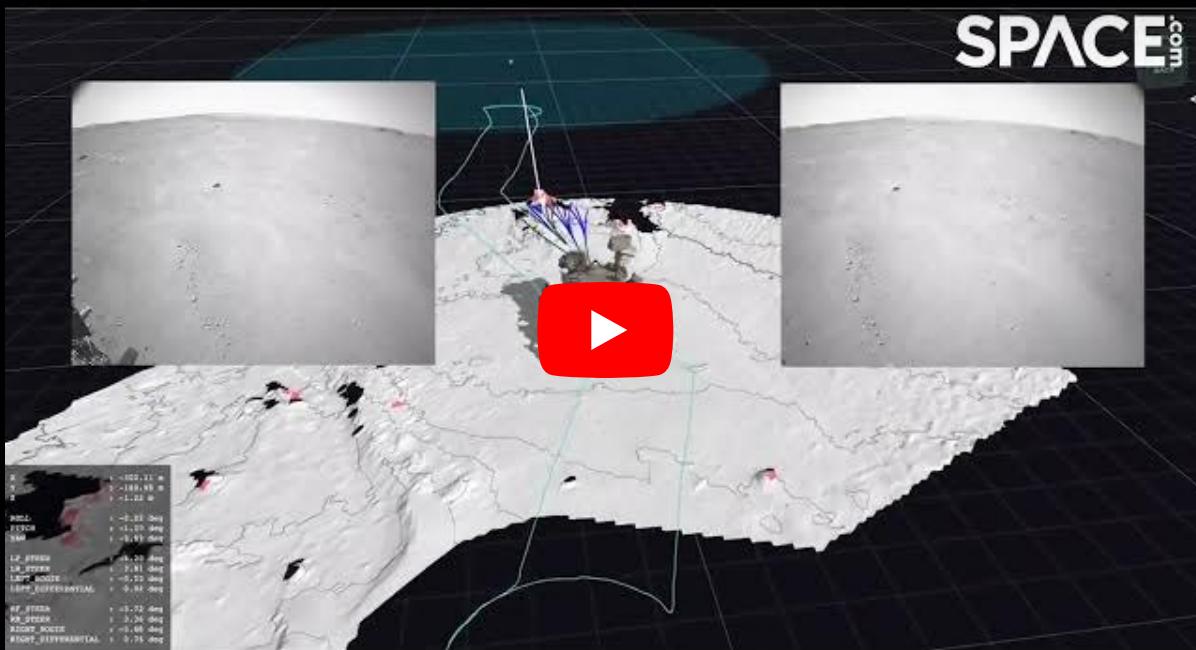
SPACE Watch Perseverance drive itself on Mars in '...'



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SPACE.com



Driving on Mars (NASA/JPL, 2021)



NVIDIA

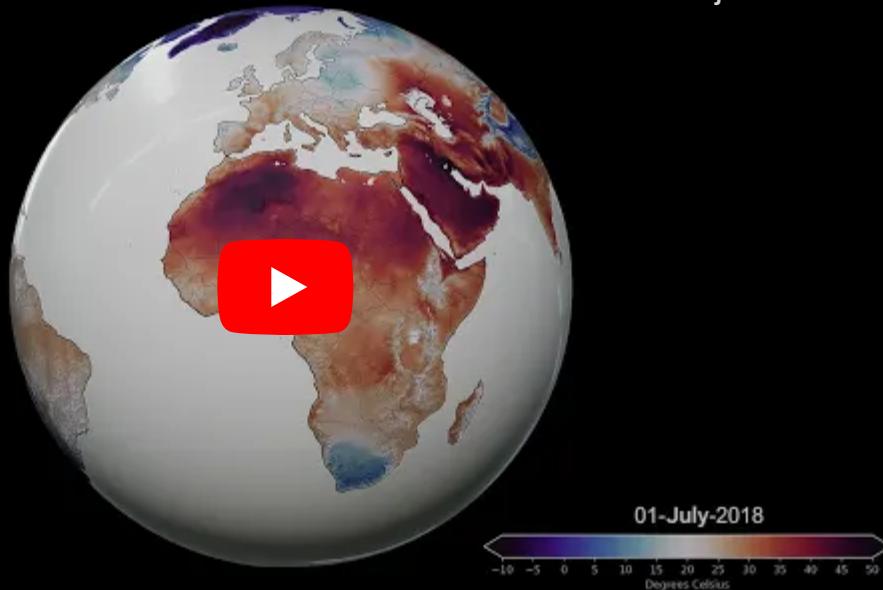
Predicting Extreme Weather Risk Three Weeks i...



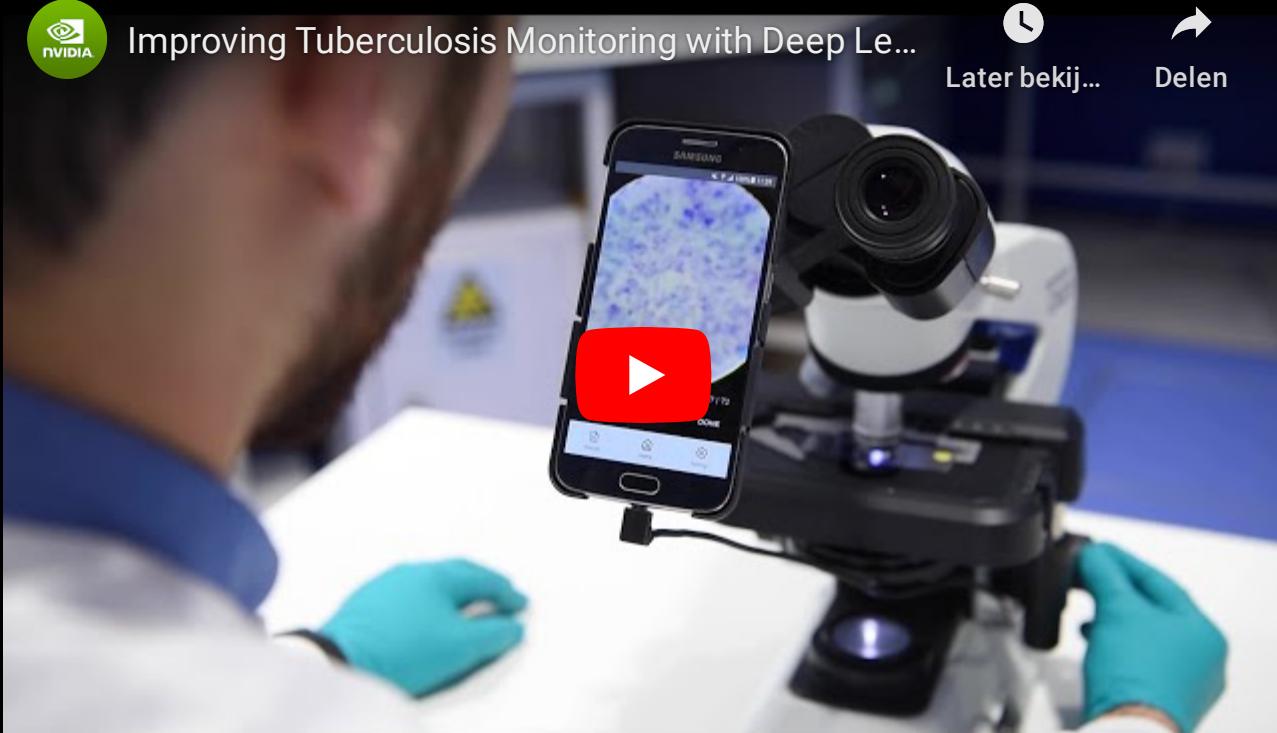
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Predicting extreme weather events (NVIDIA, 2023)



Improving Tuberculosis Monitoring with Deep Learning (NVIDIA, 2020)



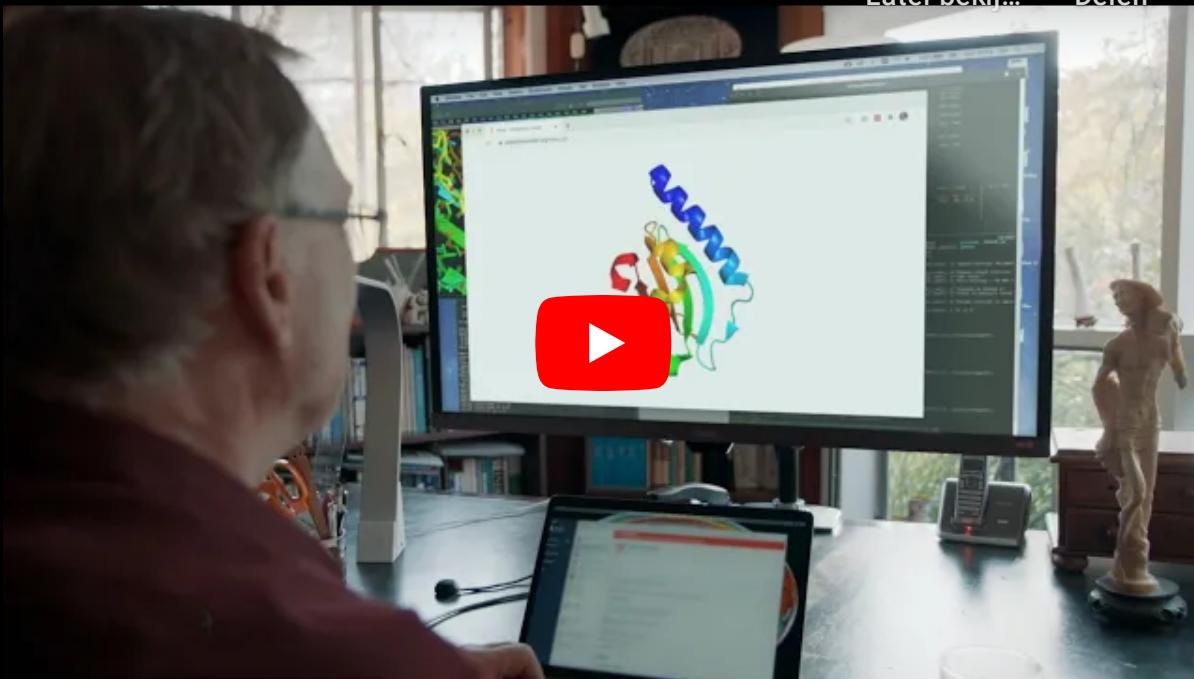
AlphaFold: The making of a scientific break...



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Solving protein folding (Deepmind, AlphaFold, 2020)



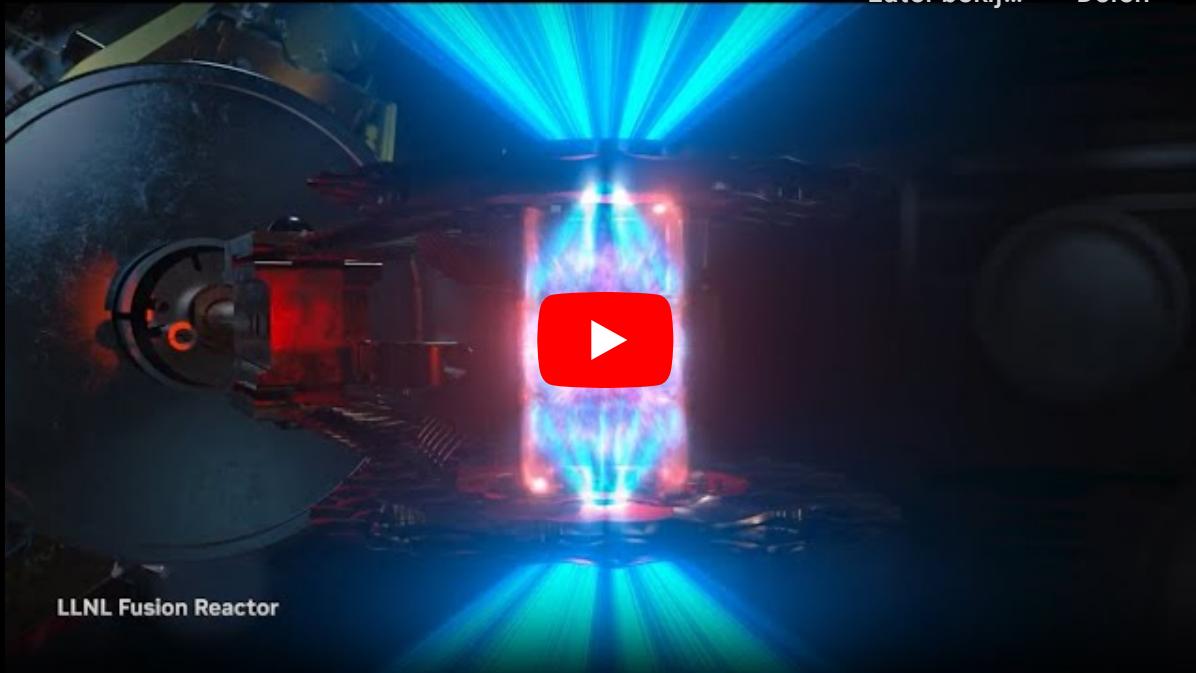
Powering the Future of Clean Energy | I AM ...



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Powering the future of clean energy (NVIDIA, 2023)



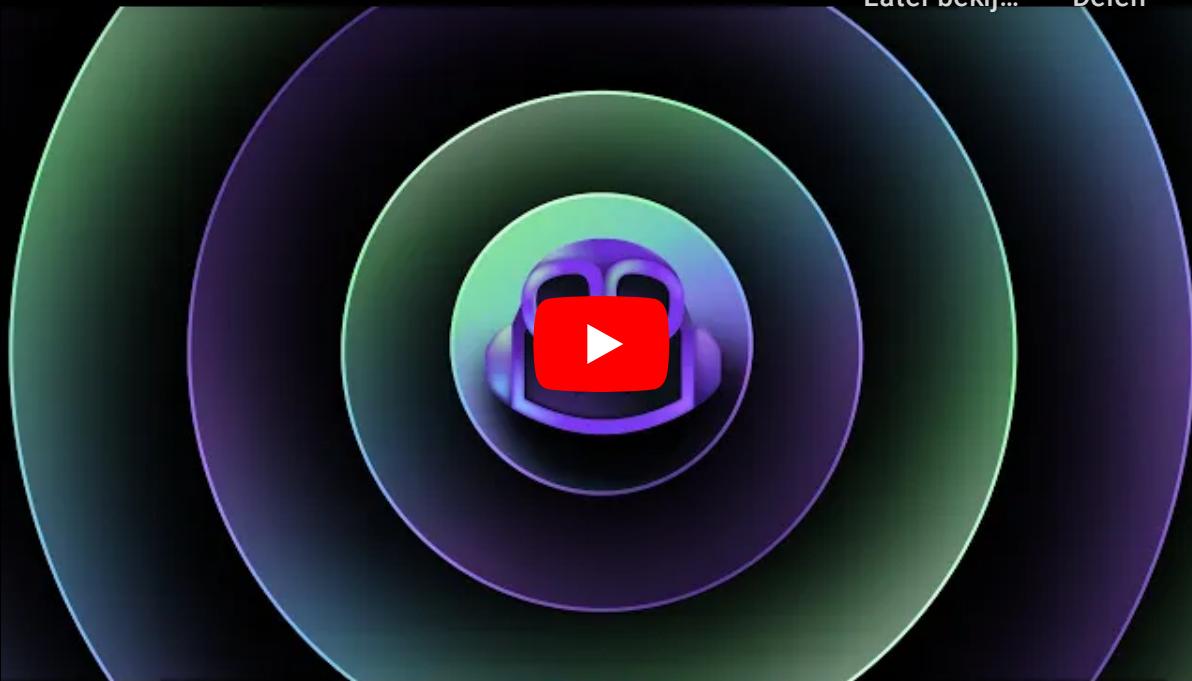
GitHub Copilot X



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Write computer code (Github Copilot X, 2023)



PICK IT : mieux trier pour mieux recycler



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Learning to sort waste  
(ULiège, 2021)



TFE\_DEMO\_DEF



Link kopië...  
[Link](#)



AI4ERD

# Real-Time Behaviour Recognition

Cow behaviour recognition (Francois Lievens, ULiège, 2022)

# What is missing?

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

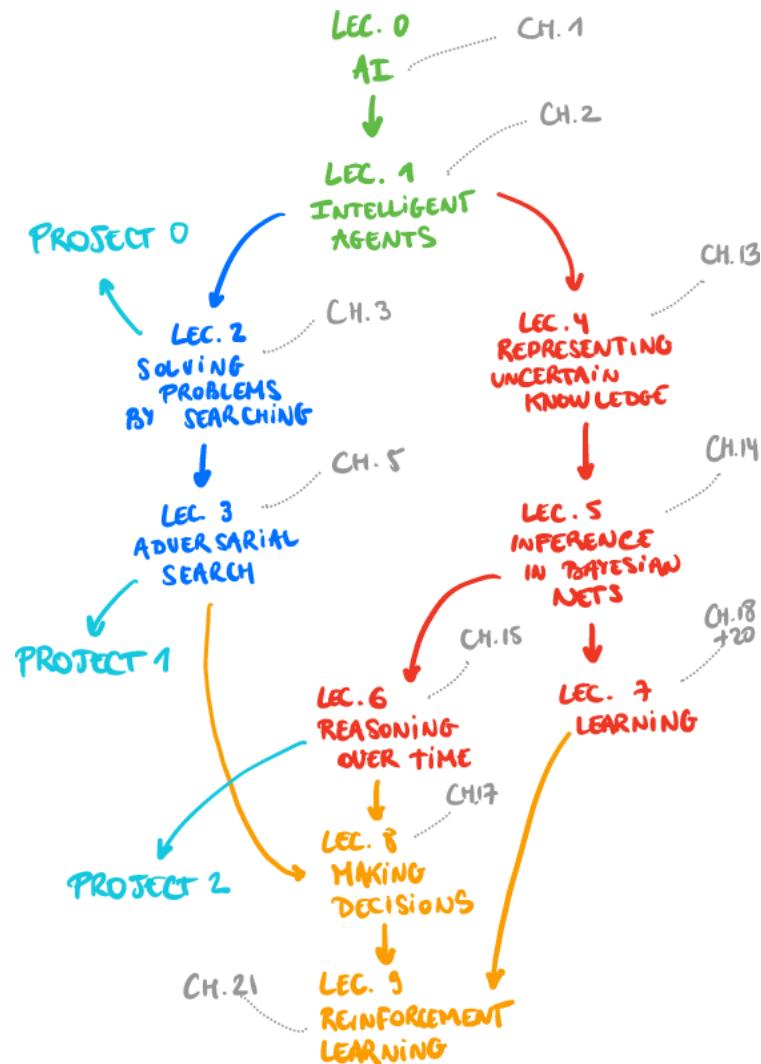
It is about **modeling the world**:

- 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



## 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
- INFO948: Introduction to Intelligent Robotics
- INFO9014: Knowledge representation and reasoning
- ELEN0016: Computer vision

