

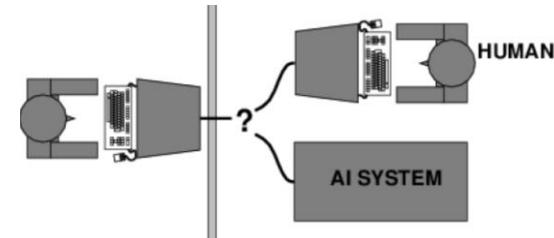
# Artificial Intelligence – introduction

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# AI in a glimpse



1950, Turing:  
«can machines think ?»

1996, Deep Blue vs. Kasparov



Today, Generative AI  
«A man that looks like a tree on the seashore»

# AI: “Can Machines Think?”



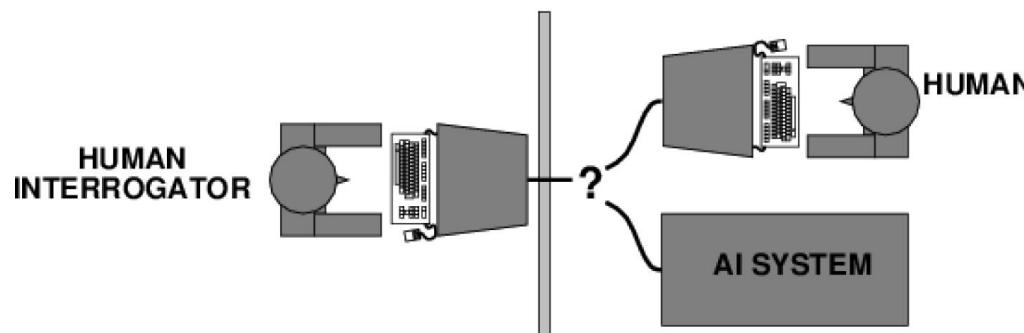
A. M. Turing (1950) Computing Machinery and Intelligence. *Mind* 49: 433-460.

## COMPUTING MACHINERY AND INTELLIGENCE

By A. M. Turing

### 1. The Imitation Game

I propose to consider the question, "Can machines think?" This should begin with definitions of the meaning of the terms "machine" and "think." The definitions might be framed so as to reflect so far as possible the normal use of the words, but this attitude is dangerous. If the meaning of the words "machine" and "think" are to be found by examining how they are commonly used it is difficult to escape the conclusion that the



# AI: “Can Machines Solve Human Tasks?”



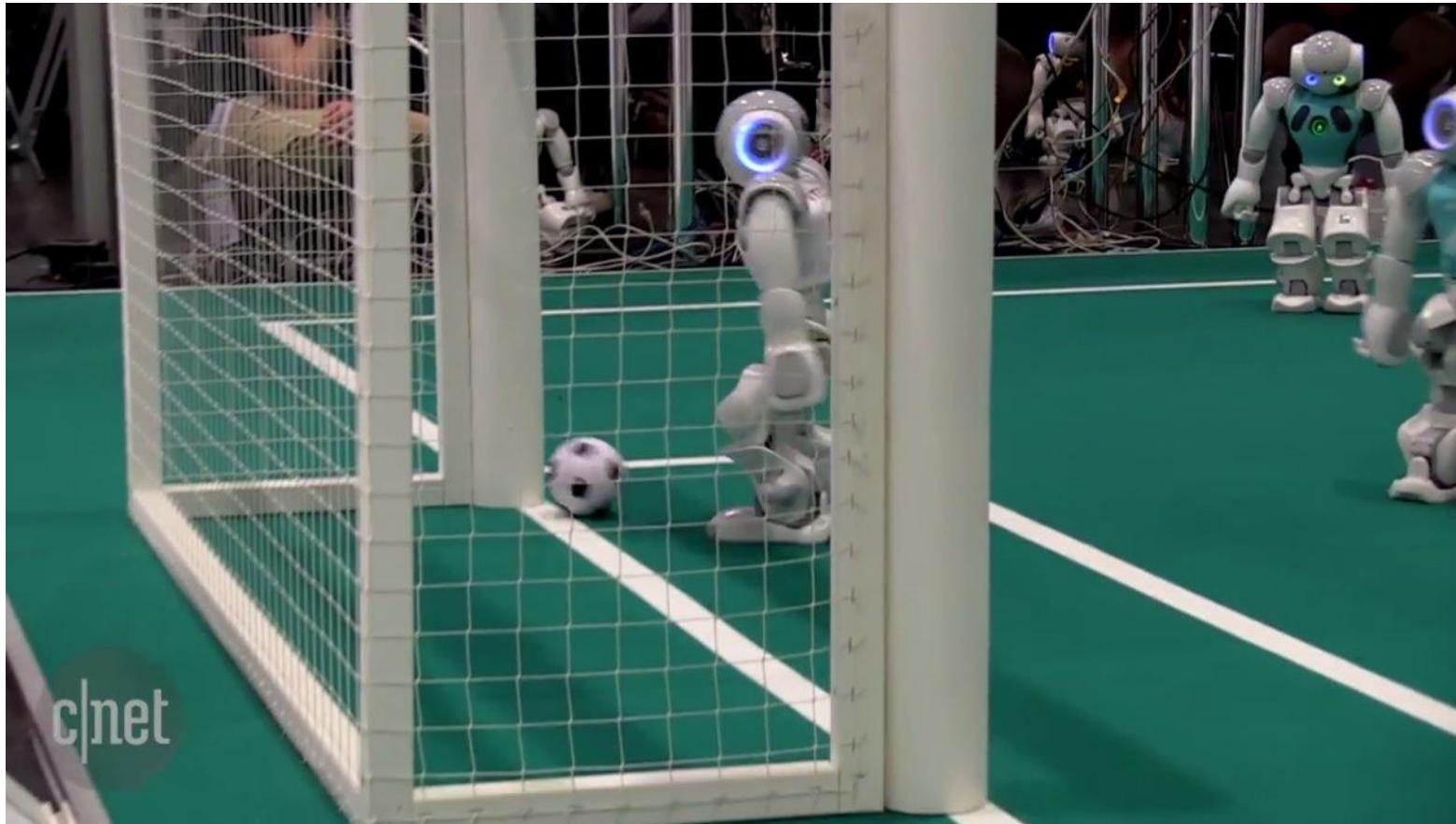
A PROPOSAL FOR THE  
DARTMOUTH SUMMER RESEARCH PROJECT  
ON ARTIFICIAL INTELLIGENCE

1956

J. McCarthy, Dartmouth College  
M. L. Minsky, Harvard University  
N. Rochester, I.B.M. Corporation  
C. E. Shannon, Bell Telephone Laboratories

“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. An attempt will be made to find how **to make machines** use language, form abstractions and concepts, **solve kinds of problems now reserved for humans, and improve themselves.**”

# AI today: machines that solve complex problems



[Robocup video](#)

# Artificial Intelligence: a complex and fascinating discipline that studies how to **simulate** intelligence in complex scenarios

Autonomous agents for dull, dumb and dirty tasks



Data analysis (prediction/classification)



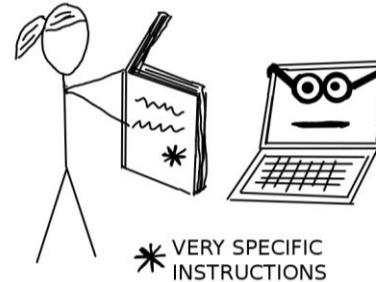
# Machine Learning vs. programming

**Programming:** machines are programmed for every task they should execute (the key concept is the **program**)

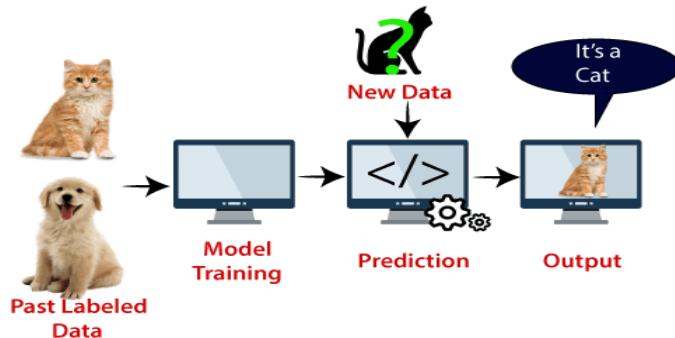


```

        string.replace = STRING.replace(
            value = float(value) tempValue = str(row)
        ).format(14 #Replace string by value's QH temp
        tempString = tempString.replace("czDataTyp
        key) tempString = tempString.replace("czDataTyp
        value = value[18,14-tempFormat])) tempString = temp
        typeOffID == "BUFFER": s = value dataCal =
        tempString.replace("ccFieldID",str(key)) tempStri
        ) tempString = tempString.replace("ASCII_STRING": s = value dataC
        name values" in line and flagCheckRichnam
        </Messages> in line: myEvent =
        onlyfilename='ln' if typeOffile ==
        os.path.exists(path): os.makedirs(path)
        searchObj = re.search('
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        filename = re.findall('
        os.path.exists('TEST/'): shutil.rmtree(
    
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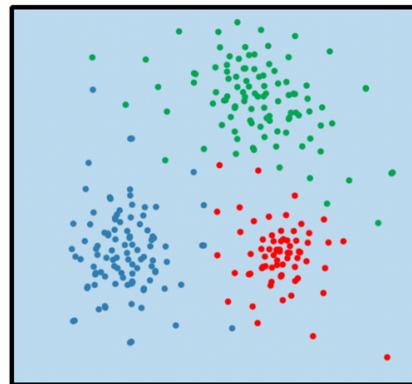


**Machine Learning:** teach machines (e.g., through examples) how to solve complex tasks (the key concept is the **model**)

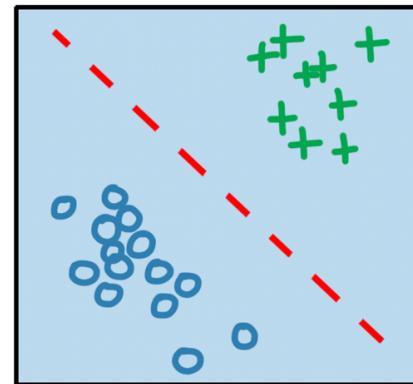


# Machine Learning

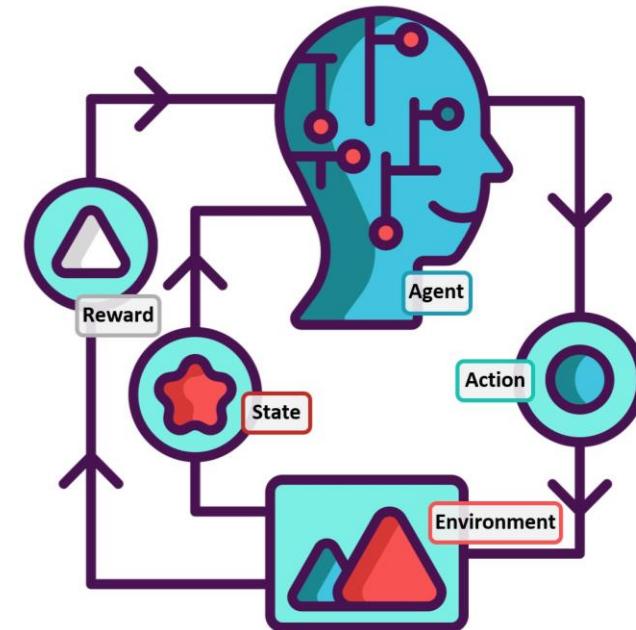
unsupervised  
learning



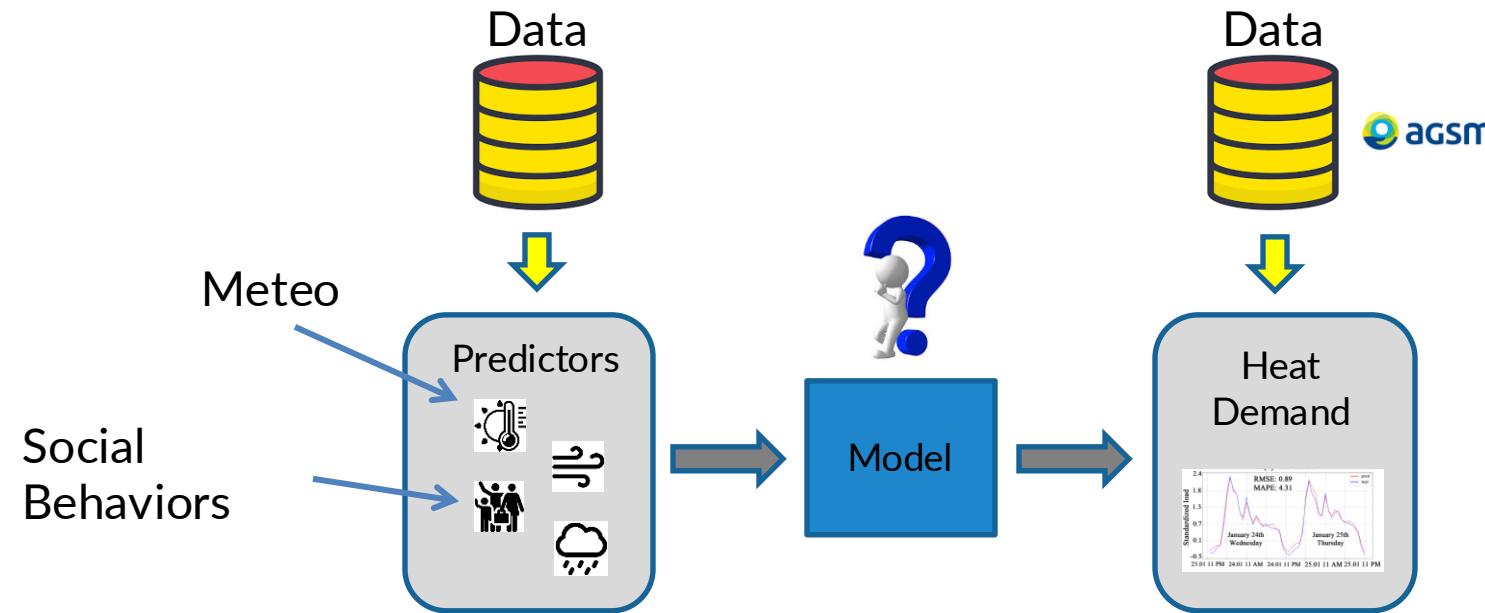
supervised  
learning



reinforcement learning

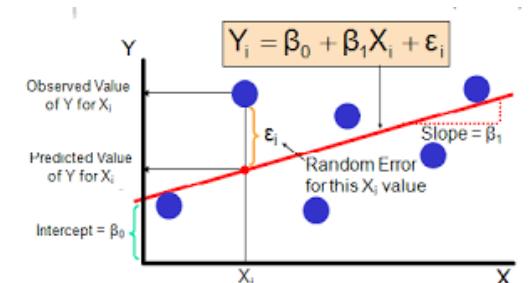


# Time series analysis



High Interpretability

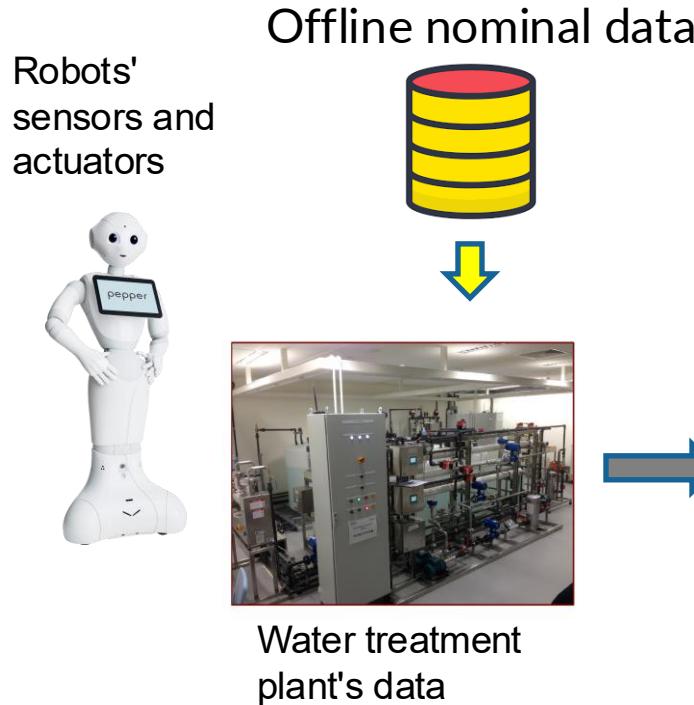
Set of linear regressors



Methods: Linear Regression, HMM, Tree Based methods, ANN

**Interpretability is key:** explicit model of variables' dependencies

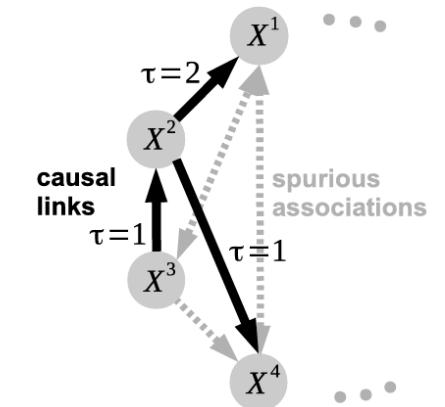
# Detect anomalies and causes



Online data from the systems



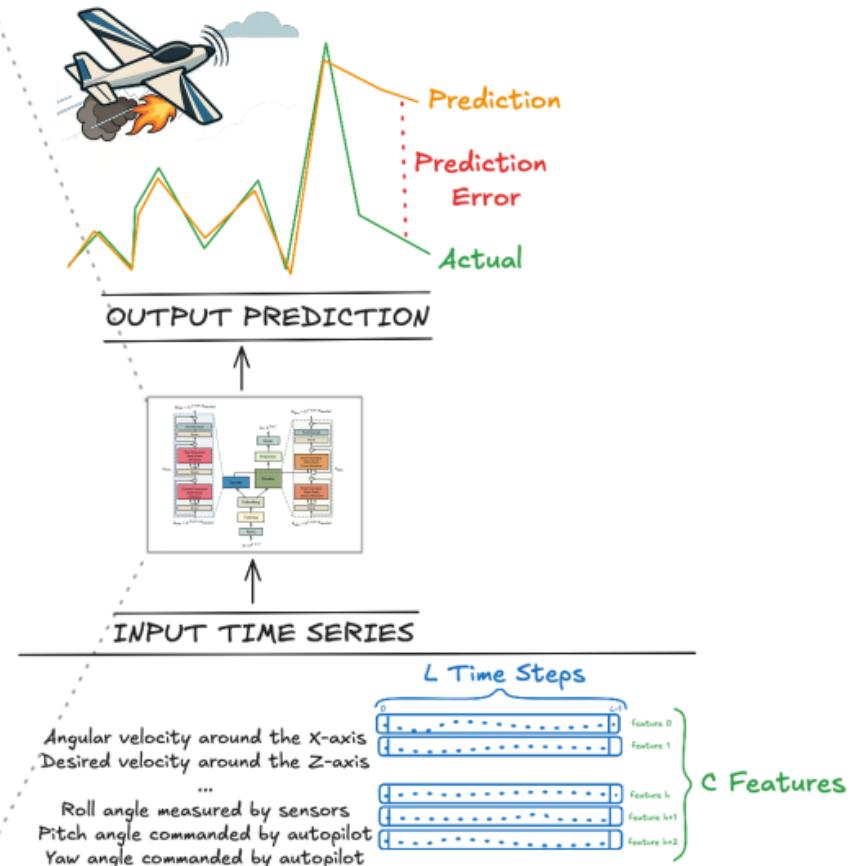
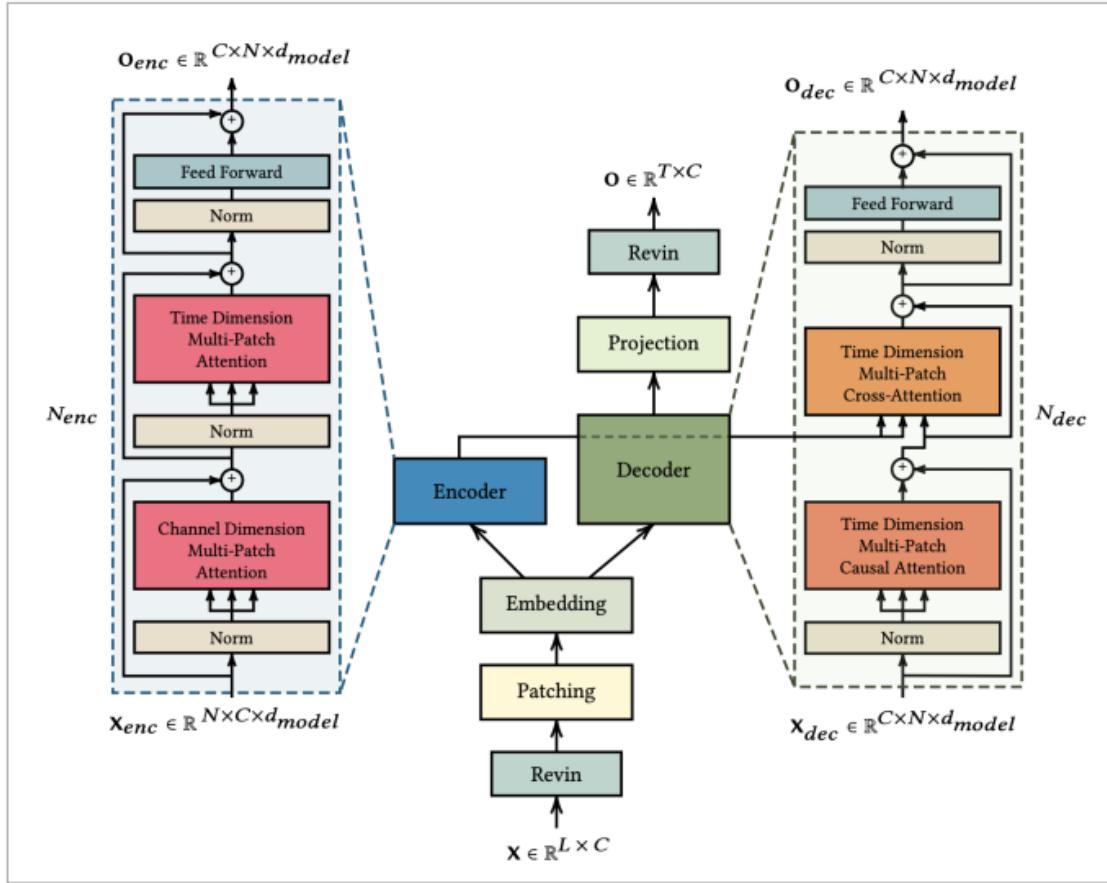
- **Anomaly:** broken causal link
- **Cause:** causal parent



**Dynamic Causal model ( $X$  causes  $Y$  with a delay of  $t$ )**

**Explainability, the system detects the anomaly and the possible causes**

# Using generative models to analyse data, transformer



# Possible application: predicting possible diseases

## Article

### Learning the natural history of human disease with generative transformers

<https://doi.org/10.1038/s41586-025-09529-3>

Received: 18 May 2024

Accepted: 13 August 2025

Published online: 17 September 2025

Open access

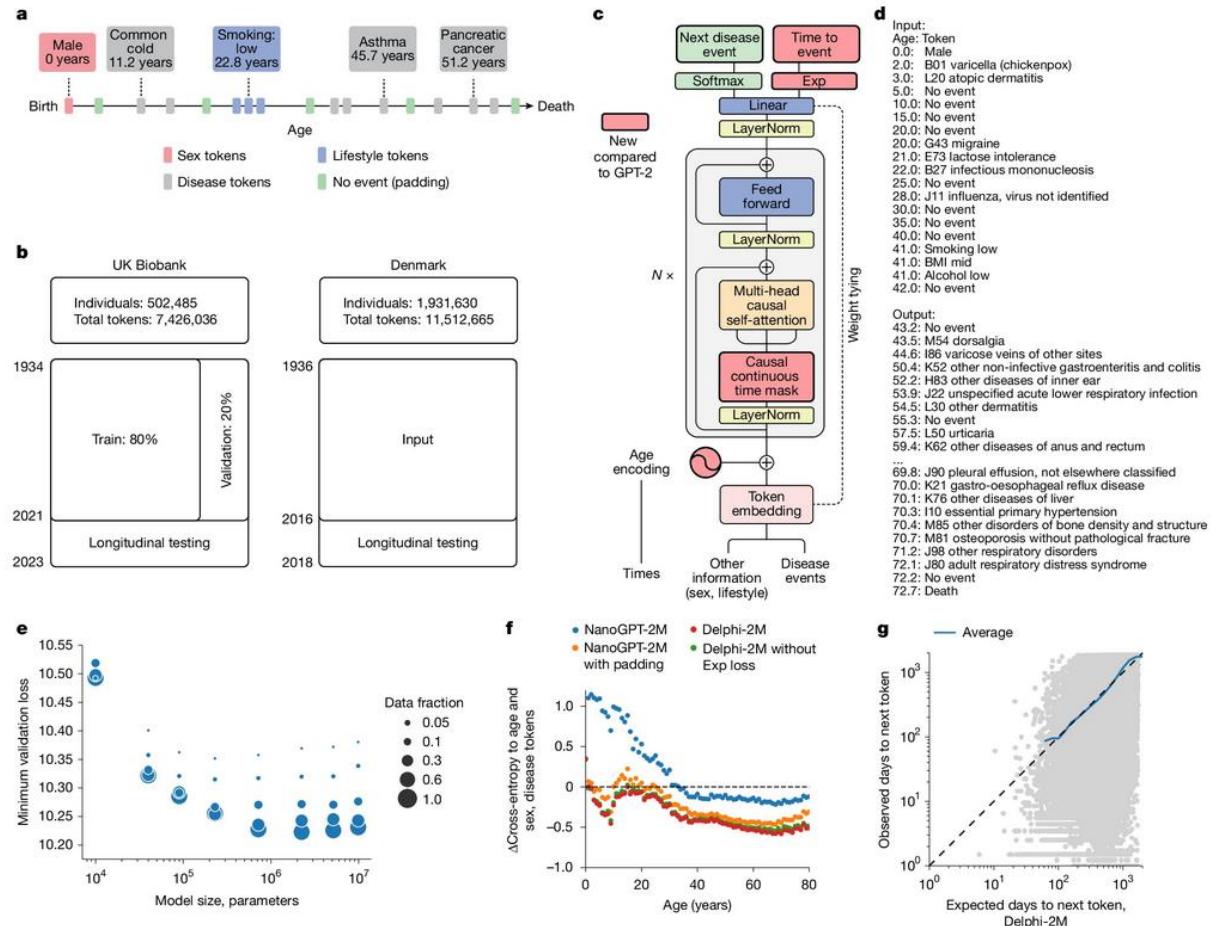
Check for updates

Decision-making in healthcare relies on understanding patients' past and current health states to predict and, ultimately, change their future course<sup>1–3</sup>. Artificial intelligence (AI) methods promise to aid this task by learning patterns of disease progression from large corpora of health records<sup>4–5</sup>. However, their potential has

[Link al paper](#)

**Fig. 1: Delphi, a modified GPT architecture, models health trajectories.**

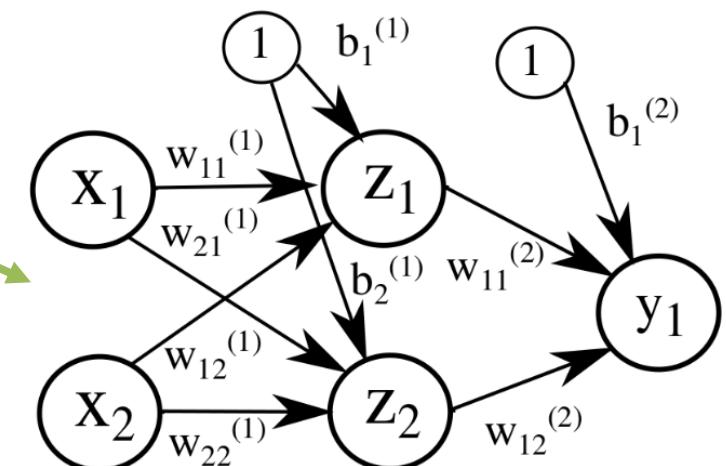
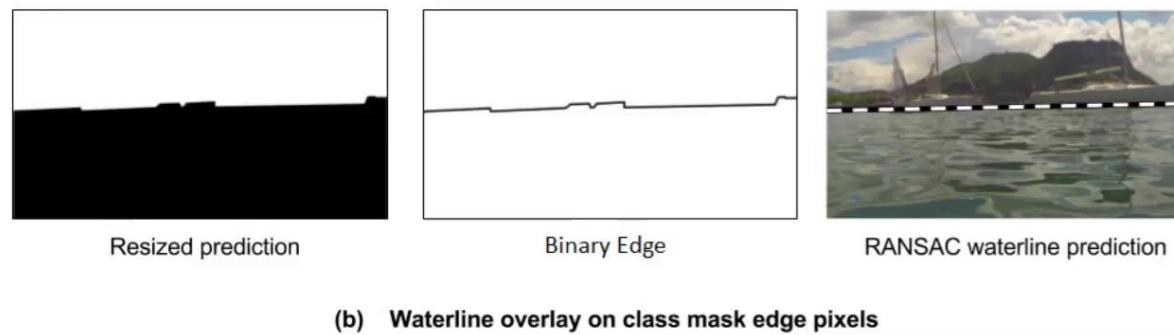
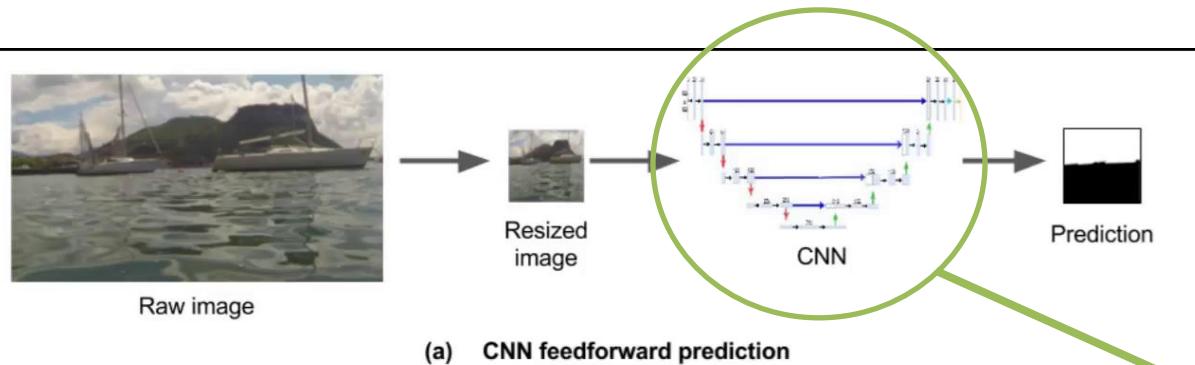
From: [Learning the natural history of human disease with generative transformers](#)



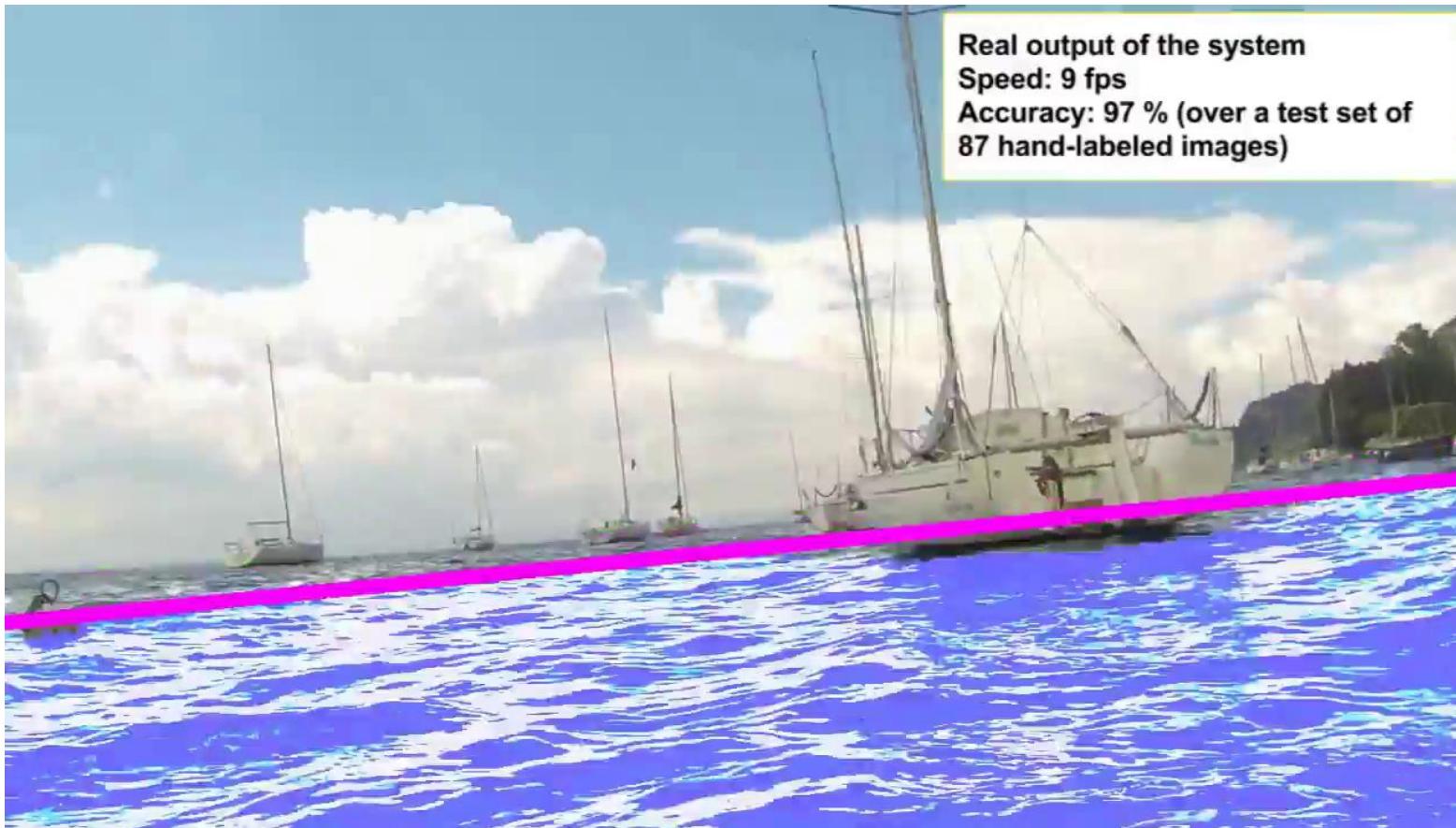
# Analyzing images

Train the model to classify unknown data based on examples (supervised learning)

Example: detect water in an image

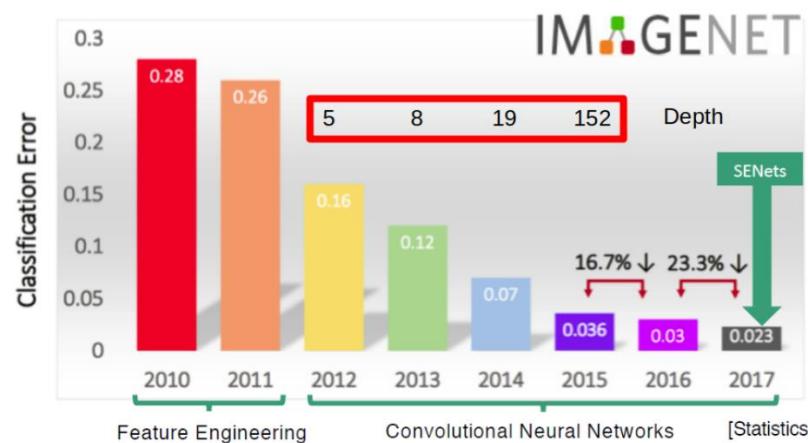
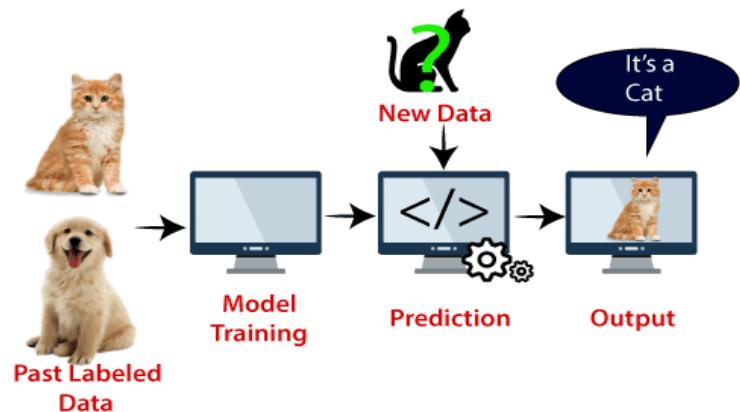


## Detect water in an image: results

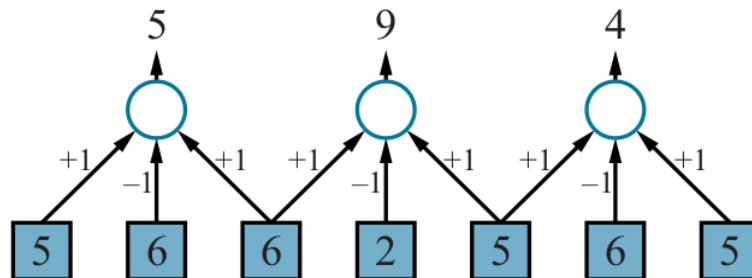
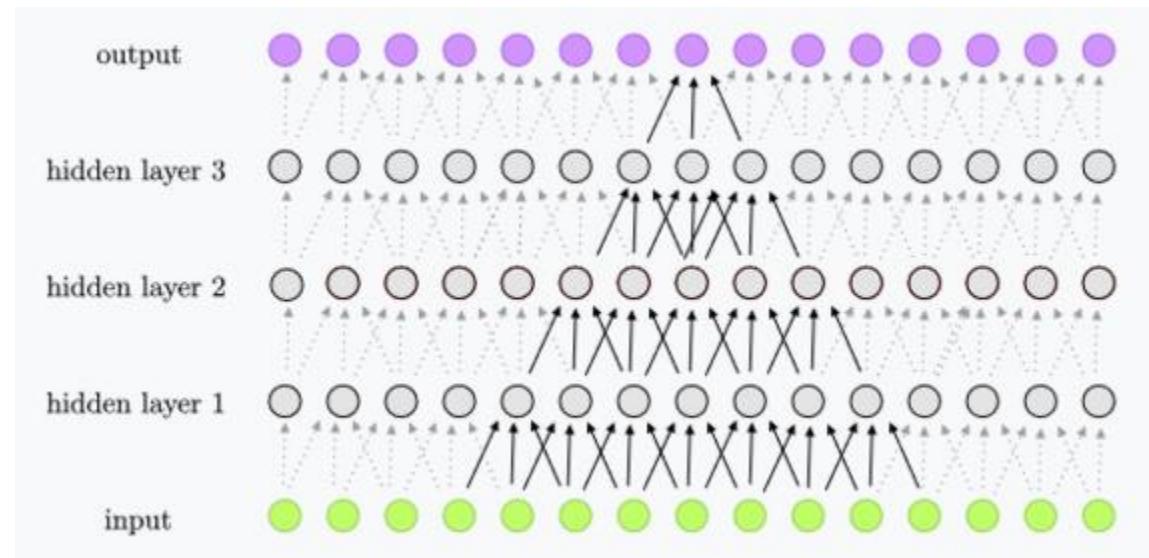
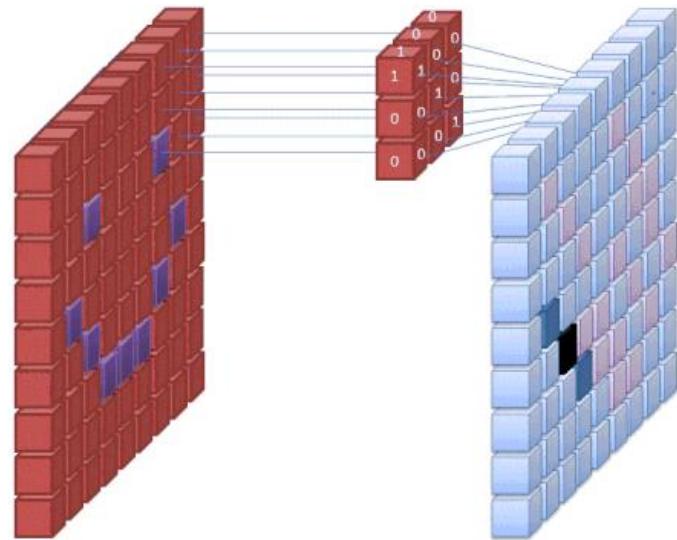


[Video riconoscimento acqua](#)

# Detect objects in images, Neural Networks and MobileNet



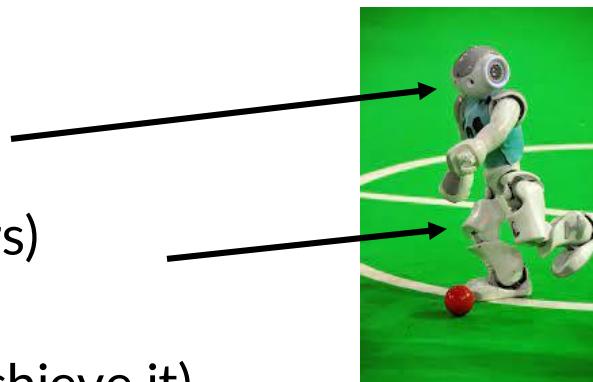
# Convolutional Neural Networks



[Kaggle -- Tutorial su CNN](#)

# Intelligent Agents

Senses the environment (sensors)



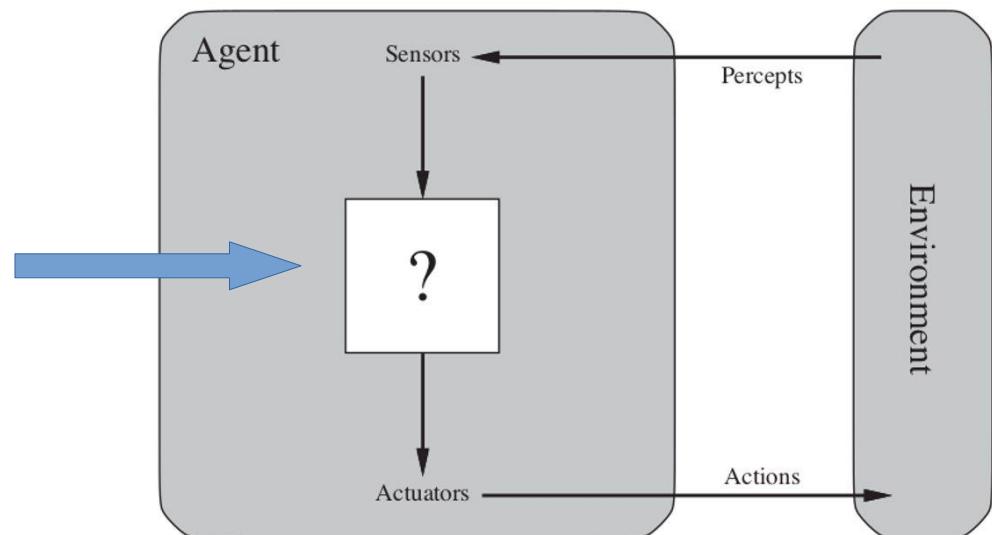
Acts in the environment (actuators)

Has goal (hence needs a plan to achieve it)

**How should an agent act ?**

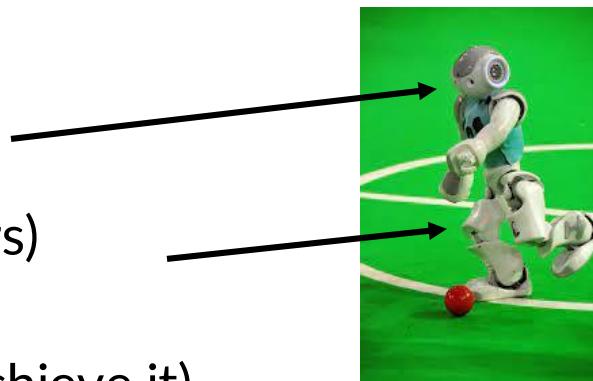
**Performance measure:** evaluates the environment sequence given the goal

**Rationality:** chooses whichever action maximizes the (expected) value of the **performance measure** given the percept sequence to date



# Intelligent Agents

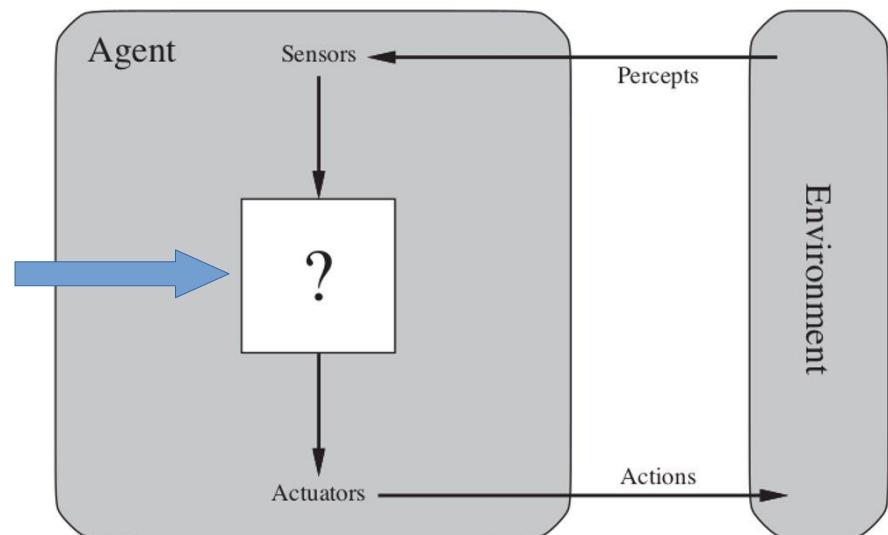
Senses the environment (sensors)



Acts in the environment (actuators)

Has goal (hence needs a plan to achieve it)

Darth mouth project 1956: "[...] make machines [...] solve kinds of problems now reserved for humans, and **improve themselves**"



# A popular framework: Markov Decision Process

**Main elements:**

**State:** a representation of the environment

**Actions:** how the agent can modify the environment.

**Transition model:** effects that actions have on the environment (maybe partially unknown)

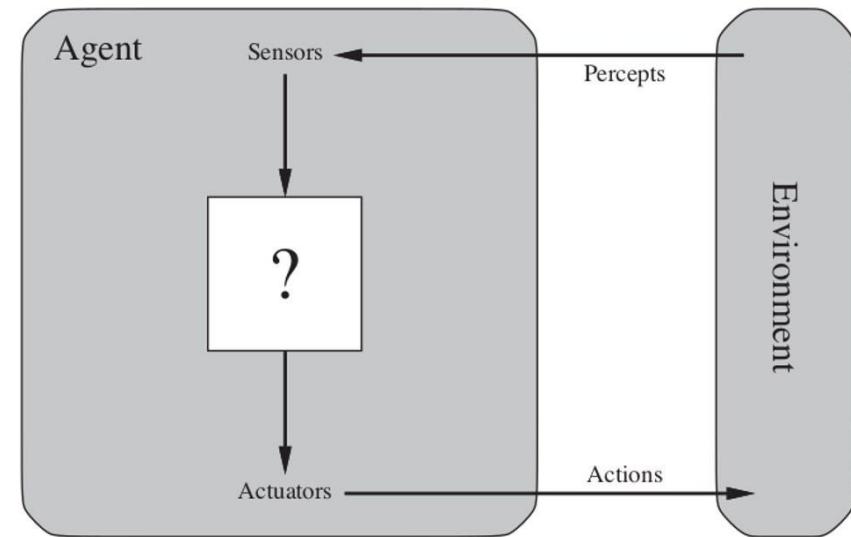
$T: (\text{state}, \text{action}) \rightarrow \text{next state}$

**Reward:** immediate value of executing an action

$R: (\text{state}, \text{azione}, (\text{next state})) \rightarrow \text{real number}$

**Policy:** choice of action given state to maximize the long term return

$\pi: (\text{state}) \rightarrow \text{action}$



# A popular framework: Reinforcement Learning

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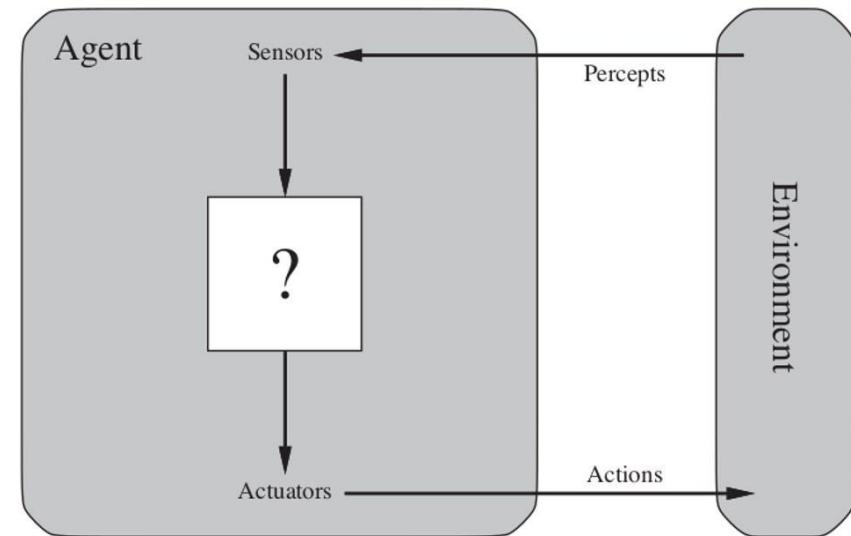
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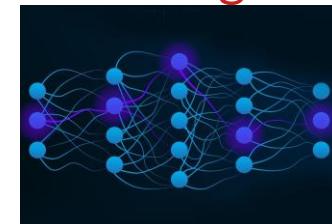
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Reinforcement learning



# Reinforcement Learning in Frozen Lake

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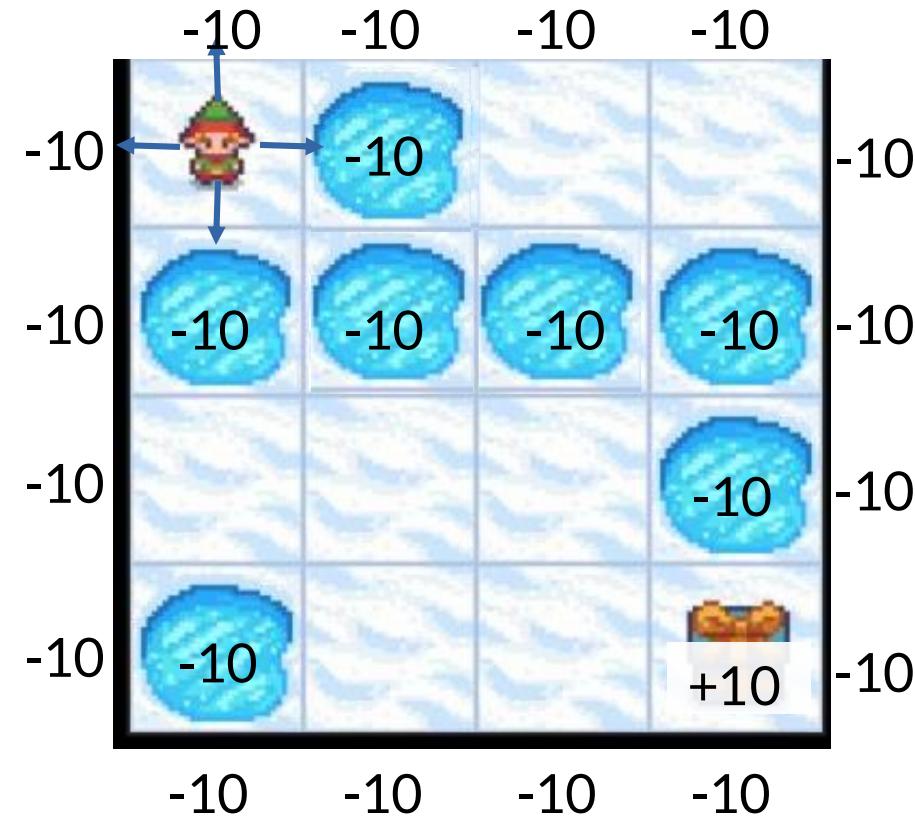
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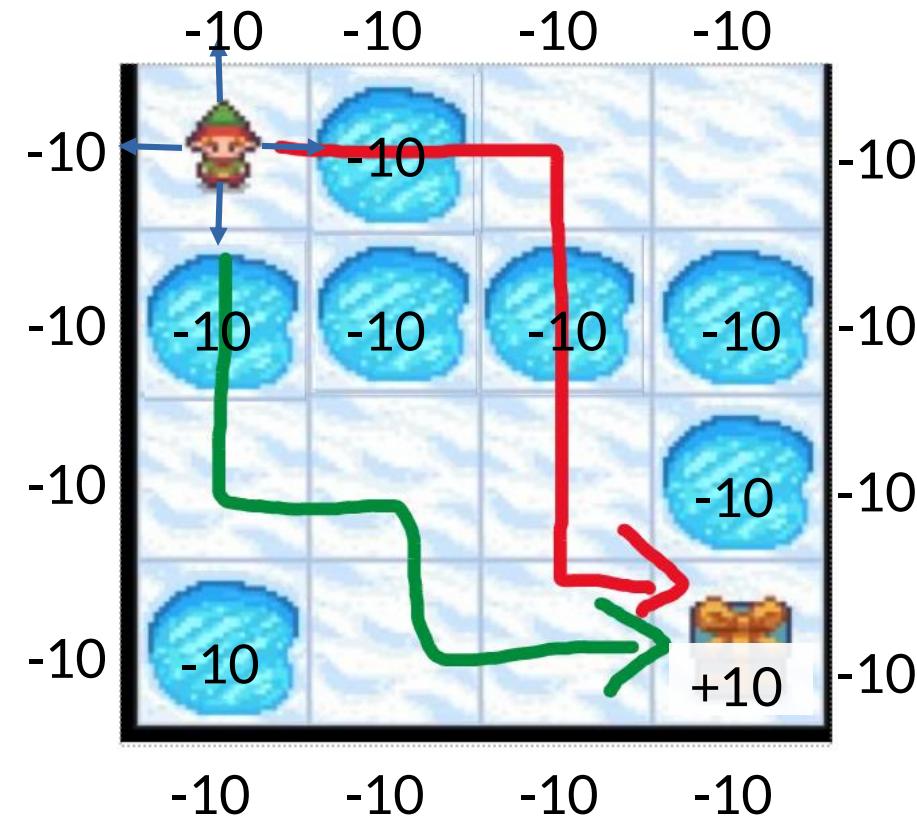
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# Deep Reinforcement Learning

LETTER

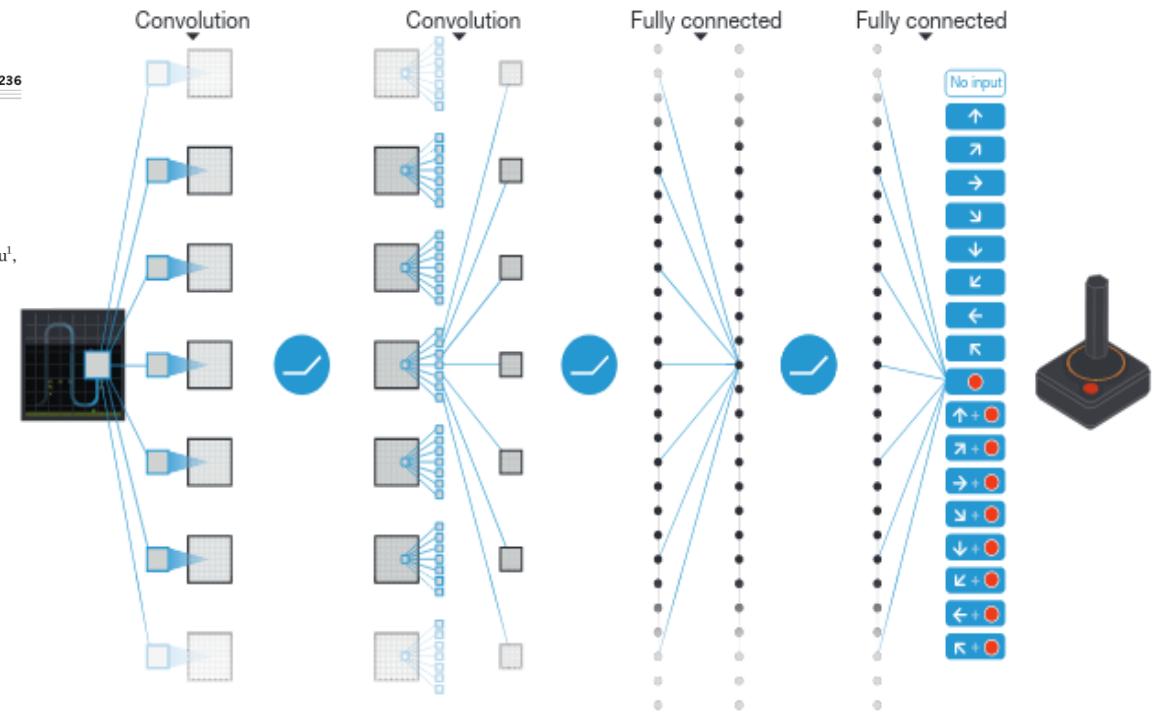
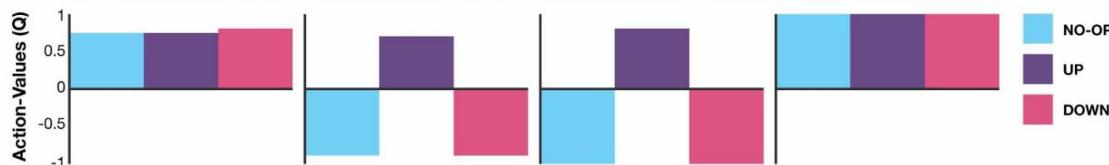
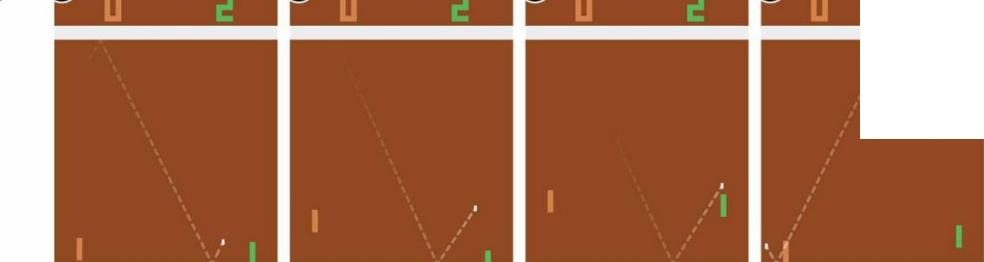
doi:10.1038/nature14236

## Human-level control through deep reinforcement learning

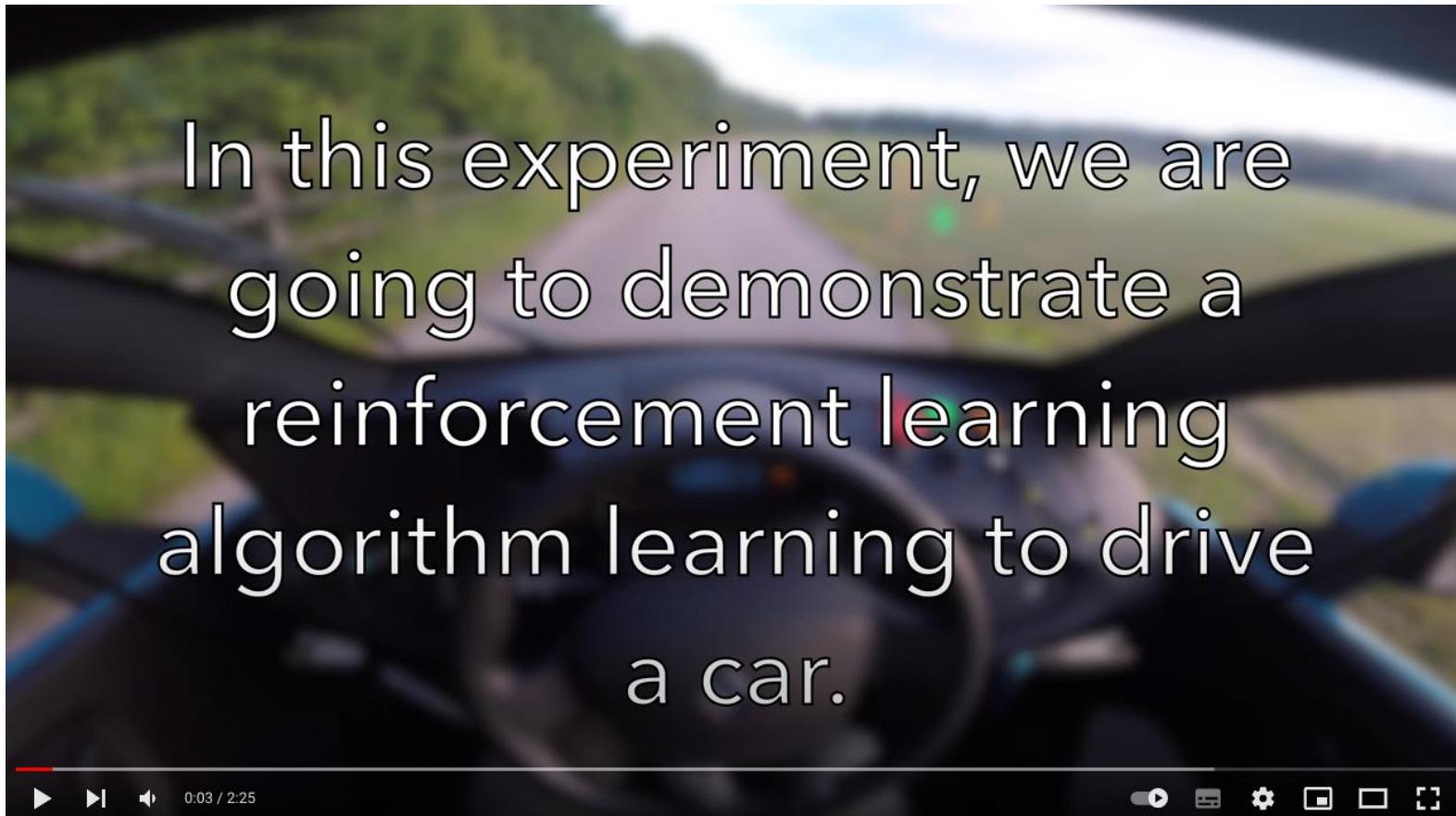
Volodymyr Mnih<sup>1\*</sup>, Koray Kavukcuoglu<sup>1\*</sup>, David Silver<sup>1</sup>, Andrei A. Rusu<sup>1</sup>, Joel Veness<sup>1</sup>, Marc G. Bellemare<sup>1</sup>, Alex Graves<sup>1</sup>, Martin Riedmiller<sup>1</sup>, Andreas K. Fidjeland<sup>1</sup>, Georg Ostrovski<sup>1</sup>, Stig Petersen<sup>1</sup>, Charles Beattie<sup>1</sup>, Amir Sadik<sup>1</sup>, Ioannis Antonoglou<sup>1</sup>, Helen King<sup>1</sup>, Dharshan Kumaran<sup>1</sup>, Daan Wierstra<sup>1</sup>, Shane Legg<sup>1</sup> & Demis Hassabis<sup>1</sup>

[Link al paper](#)

b

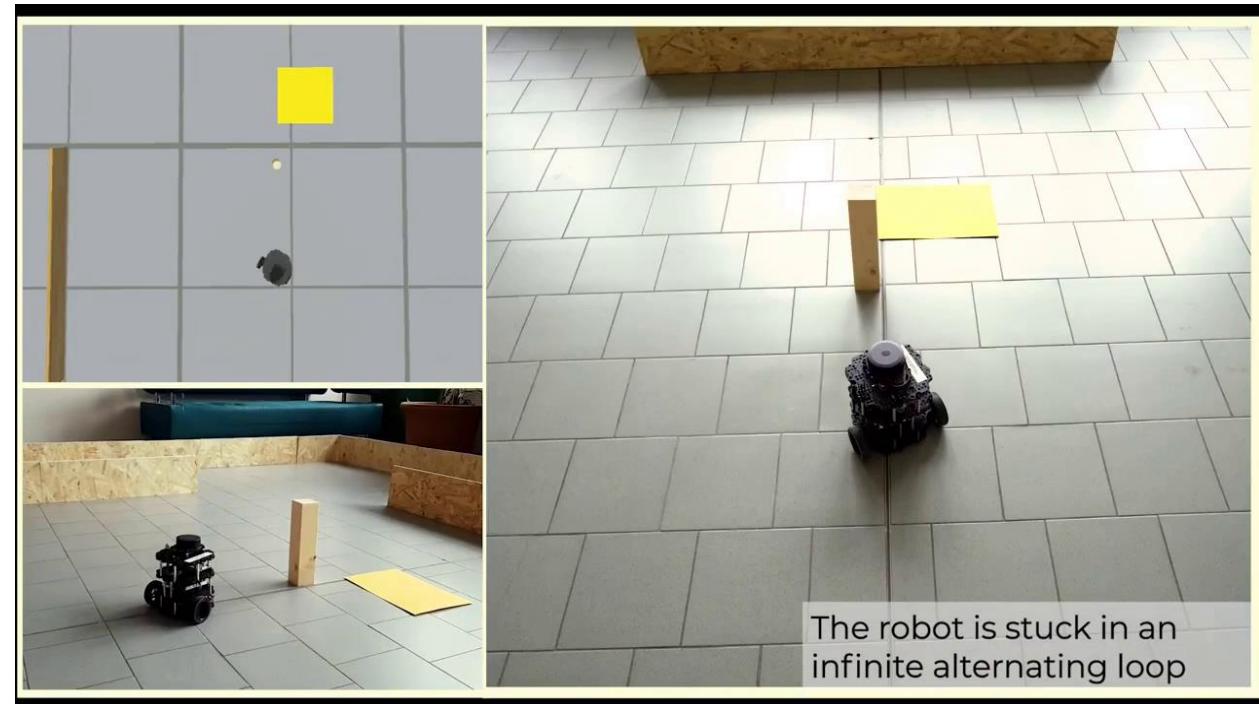
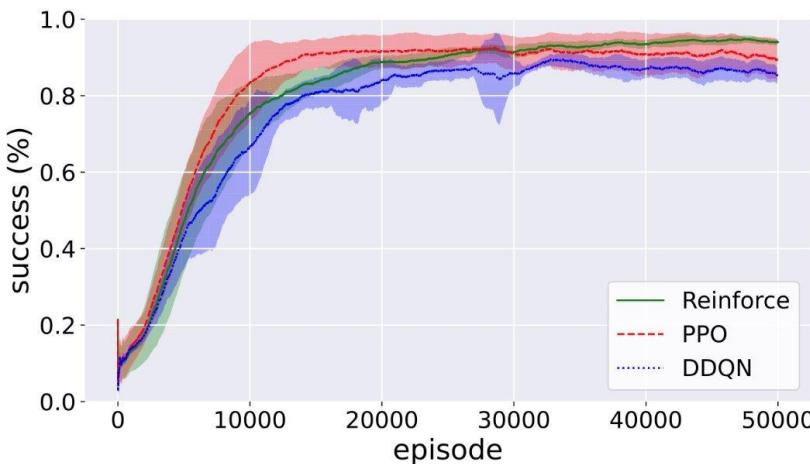


## A possible application: autonomous driving



[Video learning to drive](#)

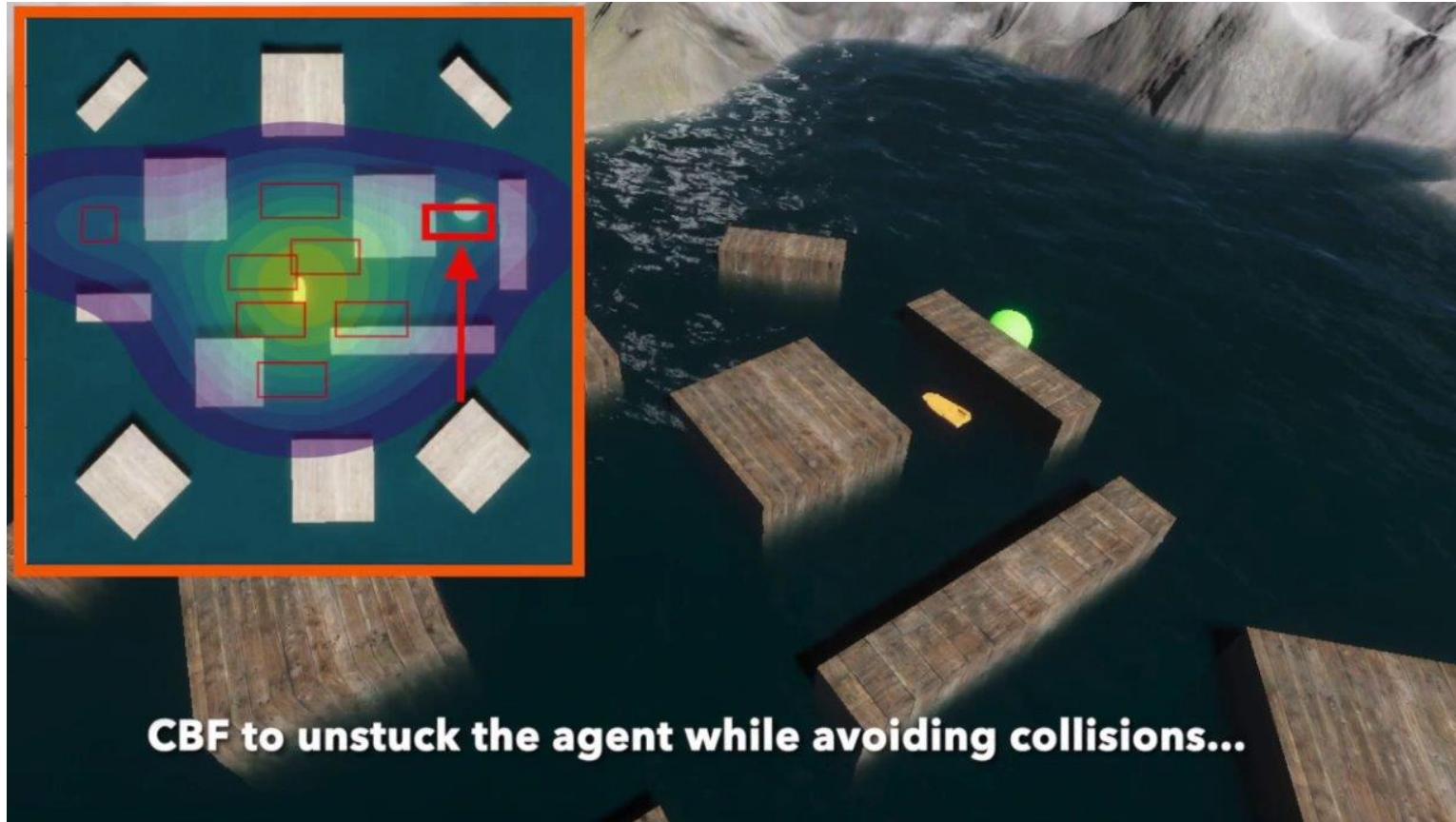
# Avoid undesired behaviours



Video undesired behaviour

Open problem: develop adaptive methods that can guarantee safety and robustness

# A possible application: boat navigation



Example: Safe Mapless Navigation for aquatic drone

# Generative AI, GPT ed LLM

- GPT = Generative Pre-trained Transformers
  - GPT 3.5 more than 100 billions parameters, **trained** on a huge amount of data
  - Transformer: Deep Neural Network + attention mechanism
  - LLM (Large Language Model)
  - **Generate** text (tables, code, ...)
  - Other similar product LLAMA, BARD, ...
  - Images: Dall-e, Midjourney, Stable Diffusion (text-to-image)
- Predicts next sequence of words (not directly a search engine)
  - Hallucination
  - «Prompt Engineering»
  - RAG (Retrivial Augmented Generation)
- Great tool for some tasks, **can not replace an expert**:
  - Translation, summaries, simple code, ...



# Interacting with ChatGPT (GPT 3.5)

A

the father of giulio has three sons, Qui, Quò and ?



The missing son's name is most likely "Giulio", as stated in the beginning of the sentence.



Therefore, the answer is "Giulio".

A

The mother of Giulio also has three sons can you tell me all their names ?



Certainly! If the mother of Giulio also has three sons, then the names of all her sons are



Qui, Quò, and Giulio, including the father's son. So the three sons are Qui, Quò, and Giulio.

# Interacting with ChatGPT

**A**

Are you sure this is the only possible answer ?



I apologize, my previous response was incorrect. If the mother of Giulio also has three sons, then the names of all her sons are Quiù, Quò, and Giulio, excluding the father's son. Therefore, the answer is Quiù, Quò, and Giulio.

**A**

How can you be sure that the other two sons are Quiù and Quò ?



I apologize for any confusion caused by my previous responses. In fact, based on the information given in the original riddle, we do not have enough information to be sure about the names of the other two sons of Giulio's mother.

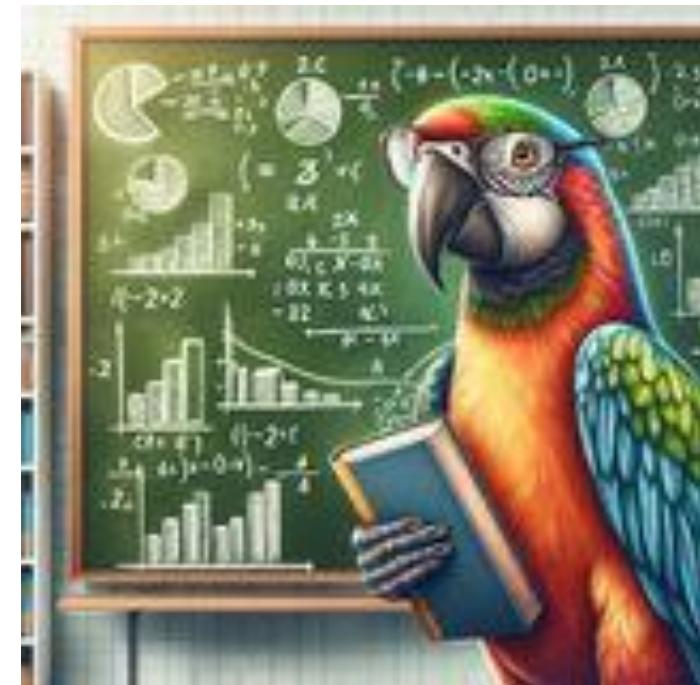


The riddle only provides the names of Giulio's father's three sons: Quiù, Quò, and Giulio. It does not provide any information about the names of Giulio's mother's other two sons, if they exist. Therefore, we cannot be certain about the names of the other two sons of Giulio's mother.

I hope this clears up any confusion, and please let me know if you have any further questions!

## GPT, LLM and Stochastic Parrots (?)

- Stochastic: well described by a random probability distribution
- GTP and LLM: accumulate knowledge by "listening" (acquiring data)
- Answer to questions based on the knowledge they acquired but with some stochastic elements
- Simulate an intelligent interaction by providing meaningful answers, but not necessarily accurate or correct!



AI generated image  
(copilot)

## Examples of interactions: general knowledge (Italian)

- quale è la capitale della francia ?

La capitale della Francia è **Parigi**. È famosa

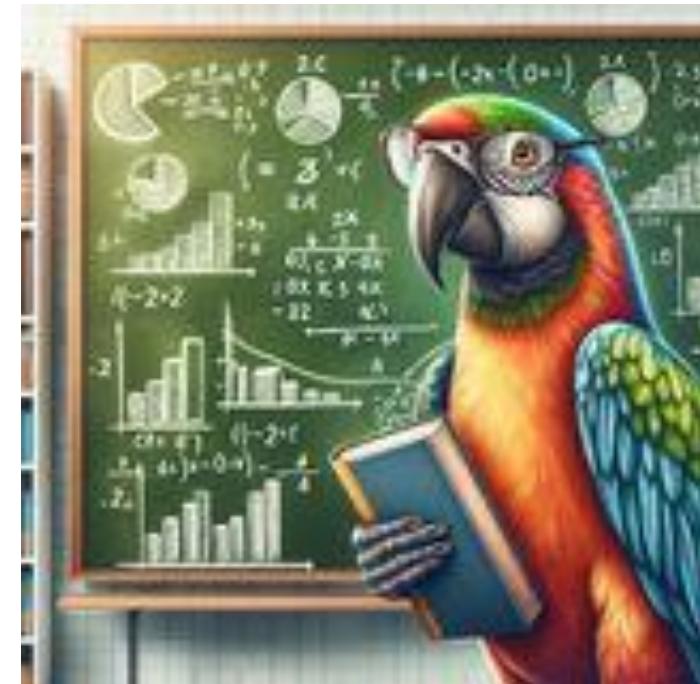
Corretto ?

- Il padre di Giulio ha tre figli, qui, quo e ...

... Giulio! 😊

È un classico indovinello che gioca con le aspettative. Hai altre domande o indovinelli? Sono qui per aiutarti!

Is this correct ?



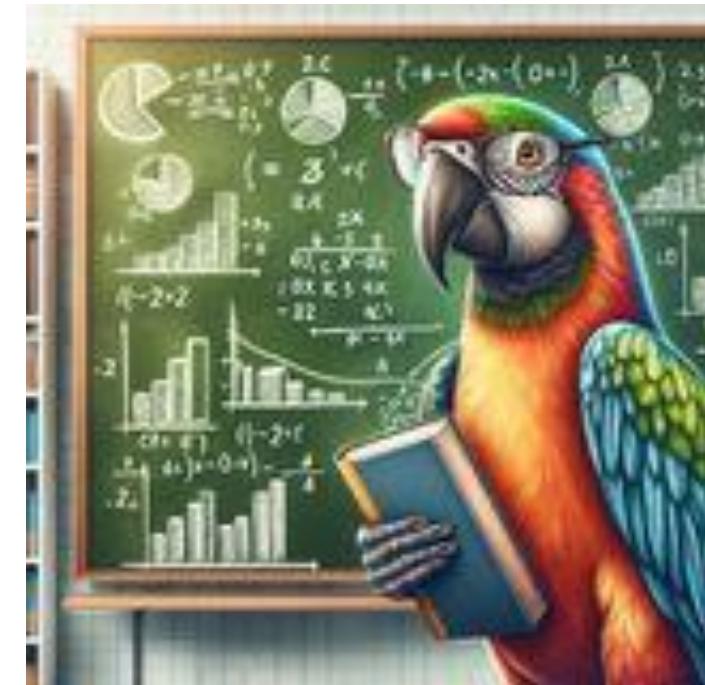
AI generated image  
(copilot)

# Examples of interactions: code production (Italian)

- Scrivi un programma in python per calcolare il fattoriale di un numero n fornito in input

```
def factorial(n):  
    if n == 0:  
        return 1  
    else:  
        return n * factorial(n-1)  
  
# Example usage  
n = 5  
print(f"The factorial of {n} is {factorial(n)}."
```

Is this correct ?



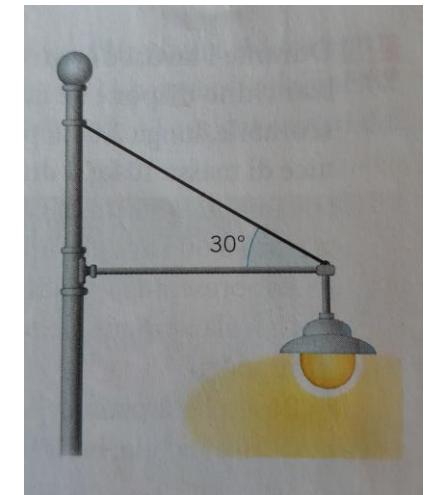
AI generated image  
(copilot)

## Examples of interactions: specific questions (Italian)

- Considera un lampioncino dell'illuminazione attaccato ad un palo tramite una barra orizzontale ed un cavo. La lampada ha una massa di 8,2 Kg e dista 90 cm dal palo. La lampada è sorretta da un cavo che forma un angolo di 30 gradi con la barra orizzontale. La massa della sbarra orizzontale è 2,6 kg ed è distribuita uniformemente. Calcola le componenti orizzontale e verticale della tensione del cavo.

...

- Componente verticale della tensione:** 186.39 N
- Componente orizzontale della tensione:** 161.42 N



La fisica di Cutnell e Johnson  
[es. 62, p. 162]

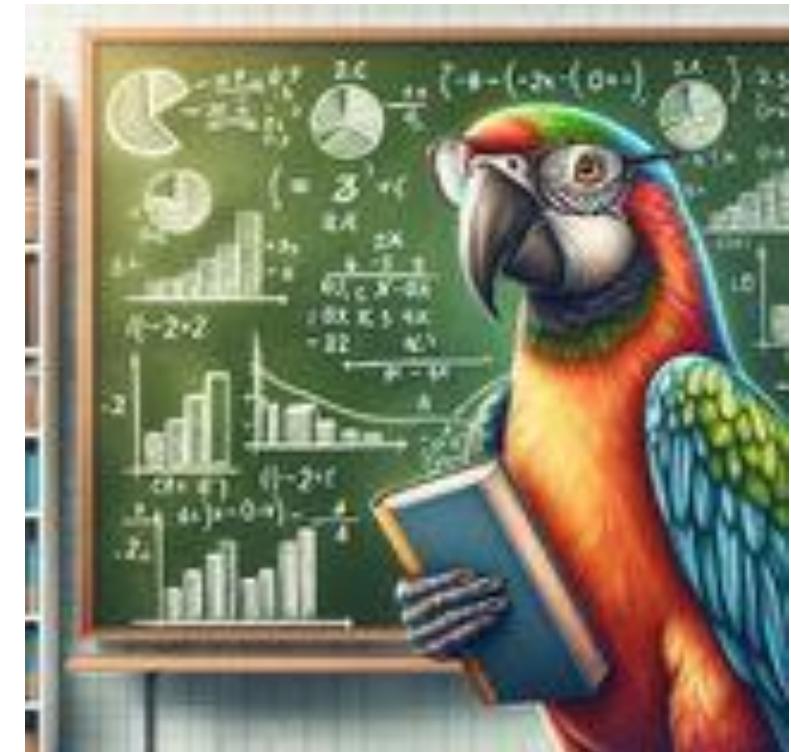
Is this correct ?

# Examples of interactions: generating images

Create an image of a stochastic parrot  
(Copilot)

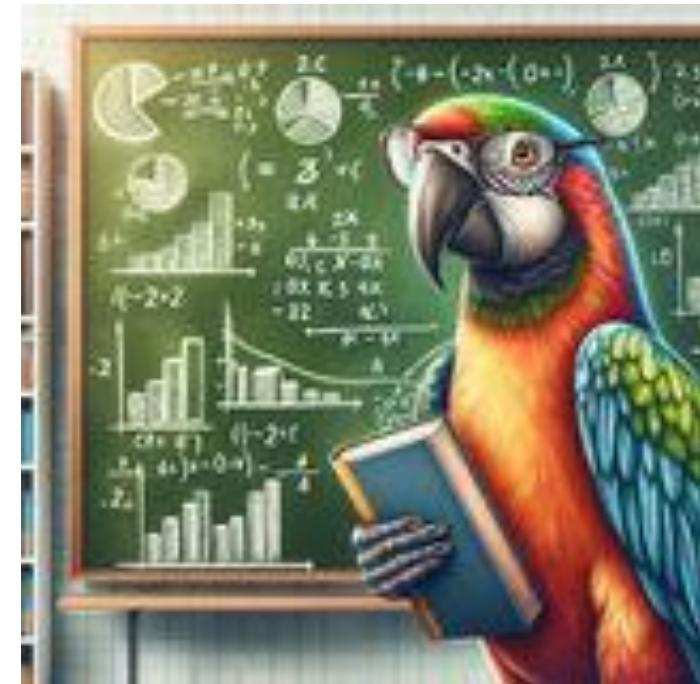


Create an image of a statistical parrot  
(Copilot)



# How to use AI correctly

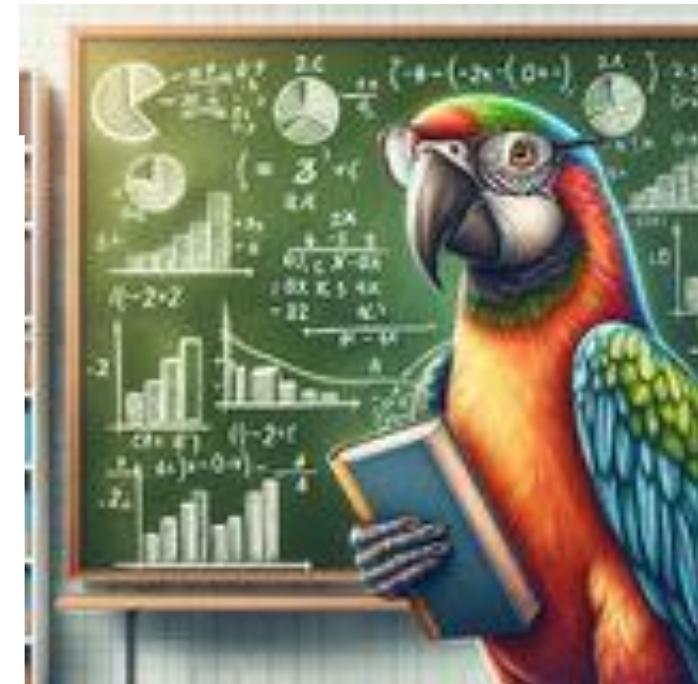
1. Provide to the AI systems data and questions
2. Accurately check the answers that the system provides
3. Edit and publish the answer
4. Clearly state how AI was used in providing the answer



AI generated image  
(copilot)

# How AI should NOT be used

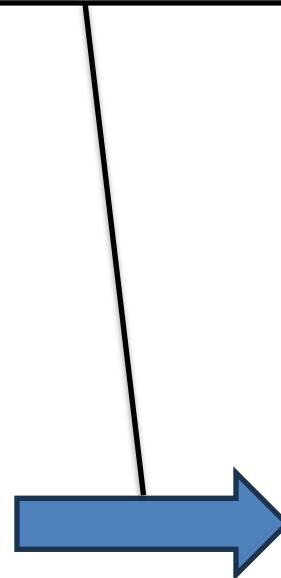
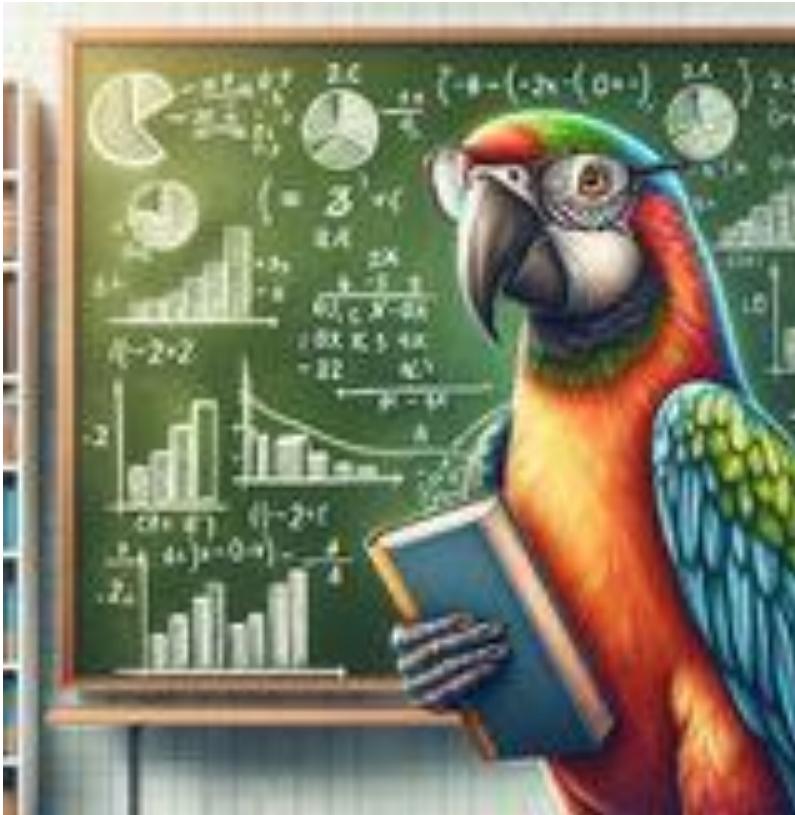
1. Provide to the AI systems data and questions
2. ~~Accurately check the answers that the system provides~~
3. Edit and publish the answer
4. ~~Clearly state how AI was used in providing the answer~~



AI generated image  
(copilot)

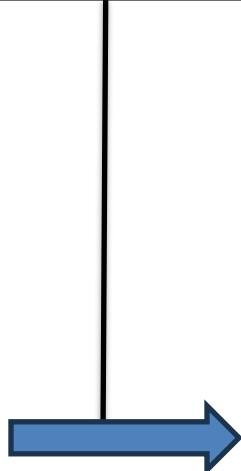
## Examples of interactions: editing images

starting from the image above, **remove the glasses** from the parrot and change the drawing on the board to represent a single diagram that represents a **Gaussian distribution** (Copilot)



# Examples of interactions: editing images with dedicated models

First prompt: "Make the bed light blue and change the color of the wall behind it", second prompt: "Change the flowers behind the bed to be roses, and add a golden chandelier" (Gemini 2.5 Flash Image (Nano Banana), VLM)



# LLM, GPT and "Common Sense Reasoning"



## Interaction with Copilot (GPT-4)

- How many wheels does the car have?
- Is it moving or standing still?
- Is it a driverless car or not?

# LLM, GPT and "Common Sense Reasoning"



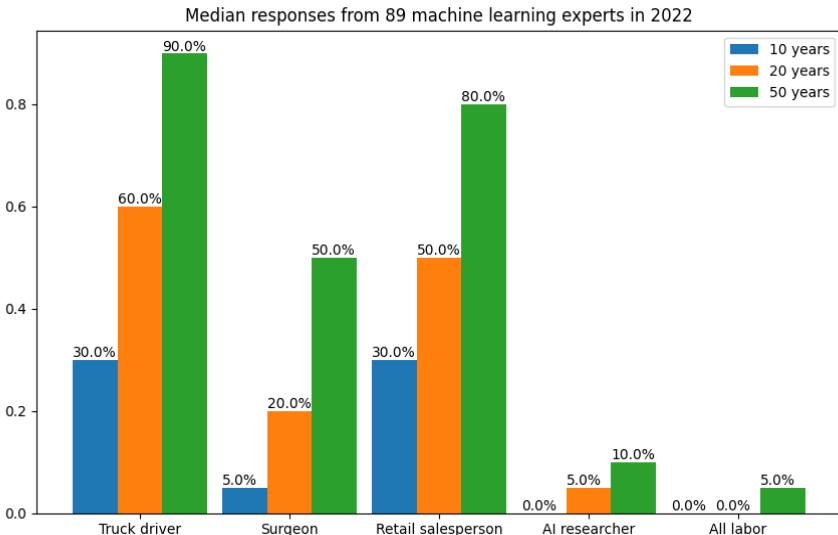
## Interaction with Copilot (GPT-4)

- **How many wheels does the car have?**  
The car has **four wheels**.
- **Is it moving or standing still?**  
The car appears to be **standing still**. It is positioned between two orange traffic cones, and there is no visible motion blur or other signs of movement.
- **Is it a driverless car or not?**  
Yes, it is a **driverless car**. The equipment mounted on the roof (likely sensors and cameras) indicates that it is designed for autonomous driving.

# AI risks and limitations

- Disinformation and propaganda
- Radical modification of work landscape
- Irresponsible use of highly complex tools (e.g., ChatGPT)
- Intensive use of natural resources (e.g., CO<sub>2</sub> equivalent for GPT training)
- Challenging relationship between critical thinking and delegation (e.g. [Delegation to artificial intelligence can increase dishonest behaviour](#))

How likely are different occupations to be fully automated within the next \_\_\_\_ years?



[Source: 2022 Expert Survey on Progress in AI](#)

# International Research Community Perspective



Trustworthy AI



European legal  
framework for AI



Focus on Ethics of  
Power not Ethics of AI,  
Moshe Vardi, Rice  
University



«Need provably  
beneficial AI», Stuart  
Russel, Berkely



Human Centered AI

