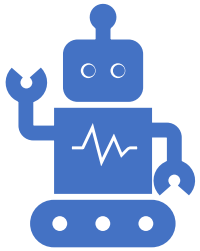
UiO : University of Oslo

institutt for informatikk



IN3050/IN4050 - Introduction to Artificial Intelligence and Machine Learning

Lecture 1 – 2025

Course Introduction

Pooya Zakeri and Ali Ramezani-Kebrya



Motivation/State-of-the-art

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What can we achieve with State-of-the-art AI / ML?

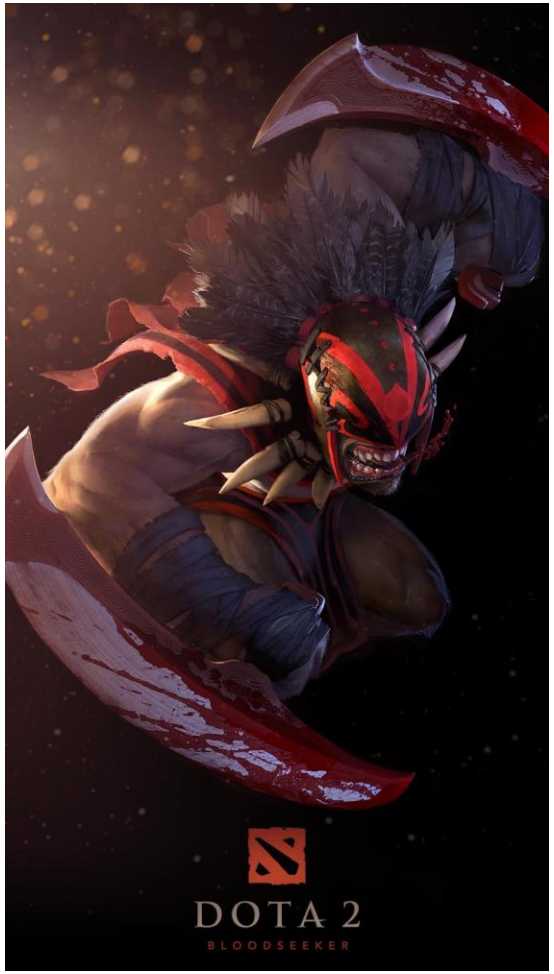
- **Teach a robot to interact with complex objects**



What can we achieve with State-of-the-art AI / ML?

- Teach a robot to interact with complex objects
- **Teach a computer to play complex games**







What can we achieve with State-of-the-art AI / ML?

- Teach a robot to interact with complex objects
- Teach a computer to play complex games
- **Teach a computer to describe images**

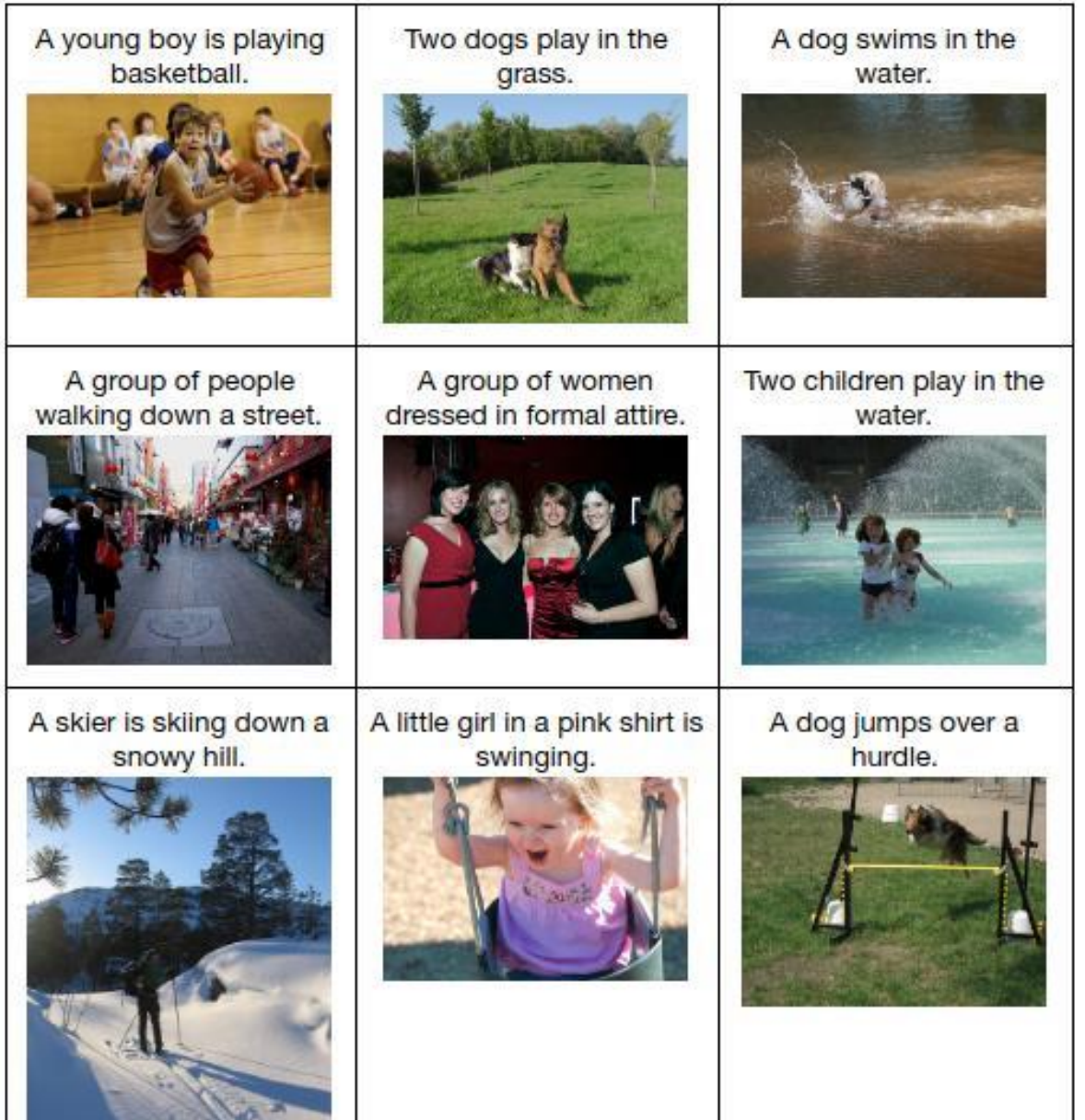


Image from:https://github.com/danieljl/keras-image-captioning

What can we achieve with State-of-the-art AI / ML?

- Teach a robot to interact with complex objects
- Teach a computer to play complex games
- Teach a computer to describe images
- **Robots that adapt**



Self-driving cars



Source: Wikipedia

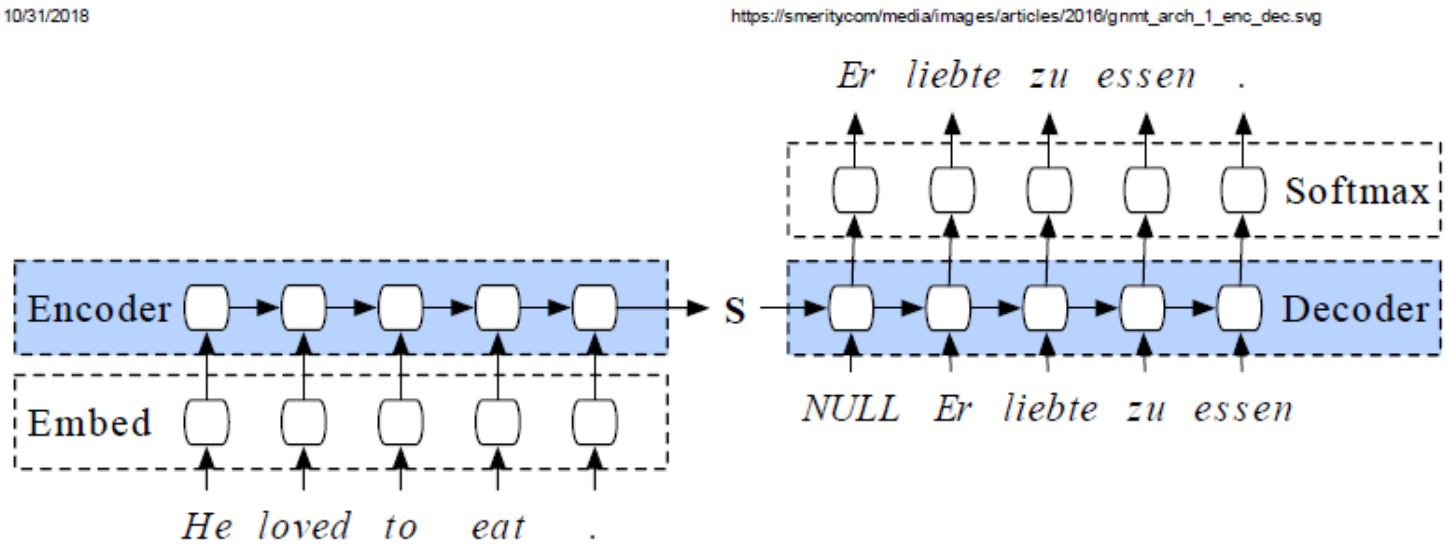
Speech ⟷ text

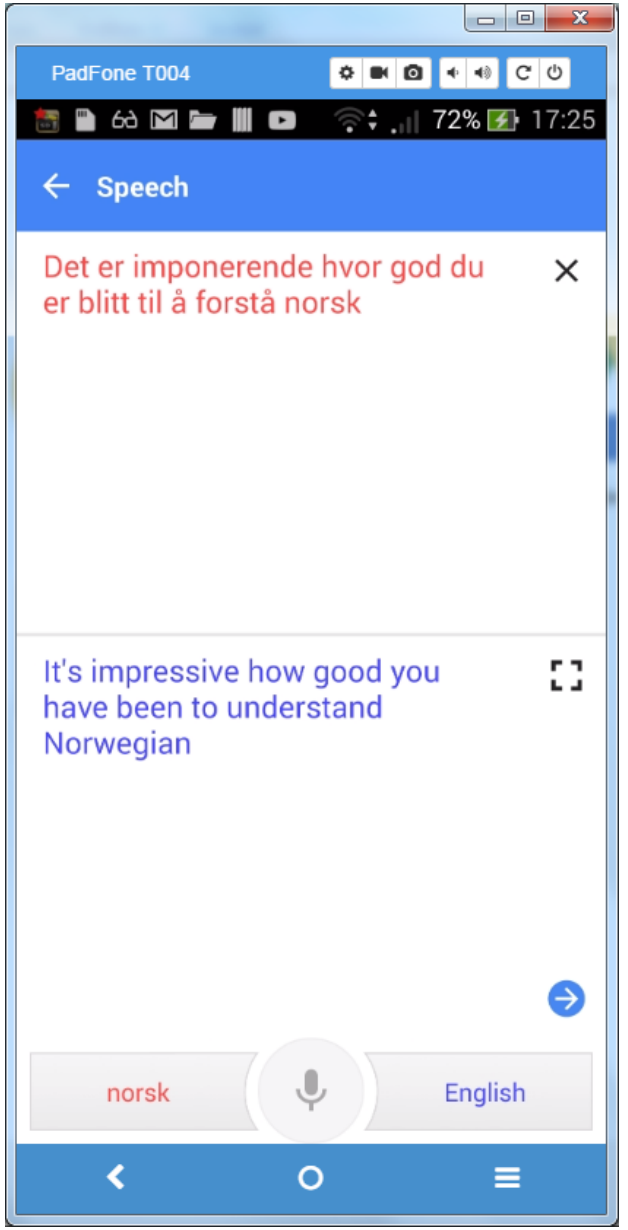




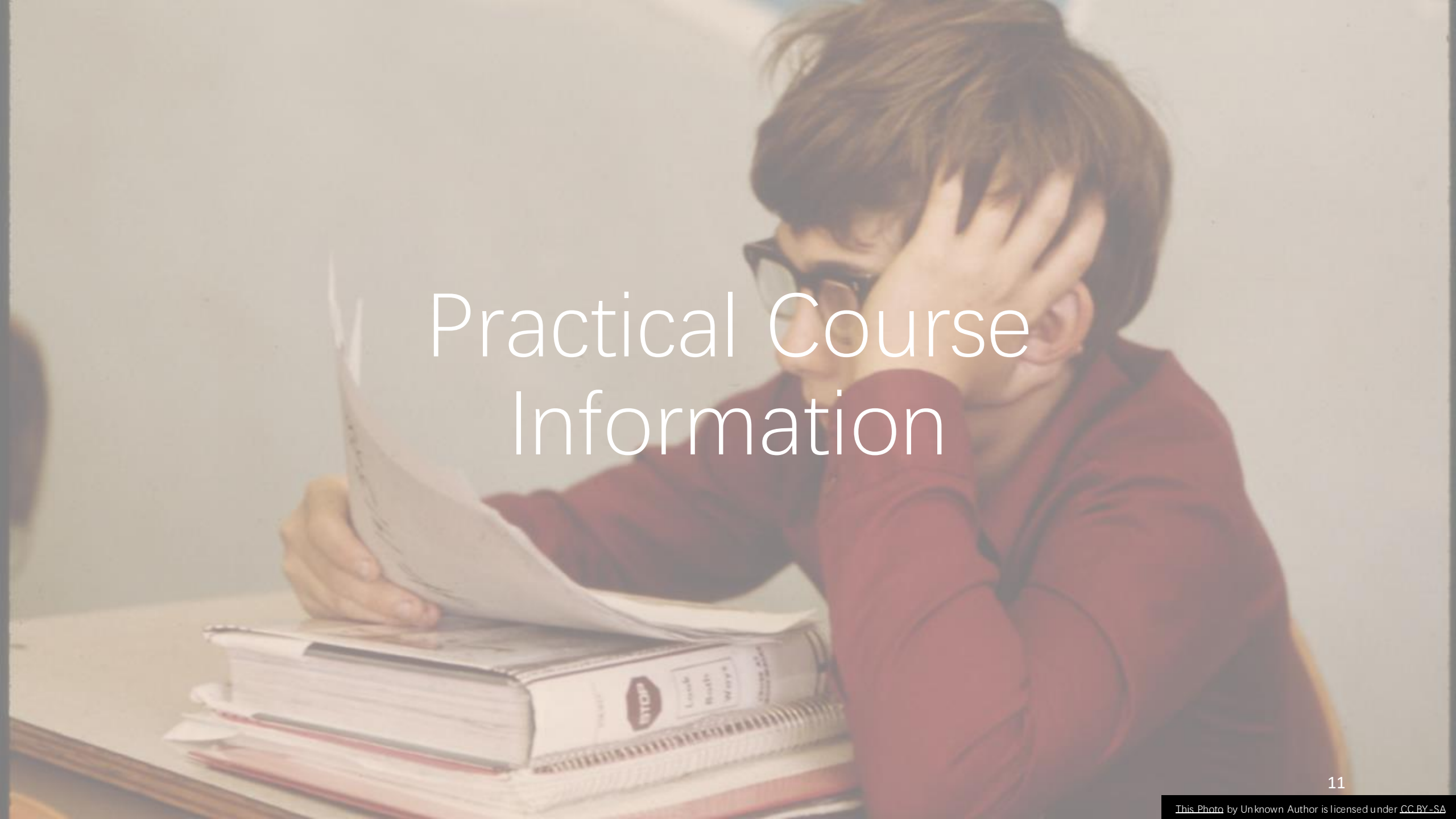
und Polarisation des Lichtes in den sogenannten kolloidalen Metallösungen. Zieht man die Folgerungen aus der elektromagnetischen Lichttheorie auf das Verhalten der trüben Medien, so kommt man zu verschiedenen Resultaten, je nachdem die trübenden Teilchen Isolatoren oder Leiter der Elektrizität sind. Die bezüglichen Rechnungen sind durchgeführt worden von Lord Rayleigh[1]) für Isolatoren und von J. J. Thomson[2]) für Leiter der Elektrizität. Dabei machen beide die Annahme, daß die kleinen Teilchen Kugeln mit gegen die Lichtwellenlänge kleinem Durchmesser sind. Beide Autoren behandeln das Problem der Zerstreuung des Lichtes durch eine solche kleine Kugel, wenn diese von einer Welle natürlichen Lichtes getroffen wird. Während nun die Rechnung ergab, daß das von einer isolierenden Kugel in einer Ebene senkrecht zum einfallenden Strahl zerstreute Licht vollkommen linear polarisiert ist, und zwar in der durch die betrachtete Zerstreuungsrichtung

Machine translation





Who are we?



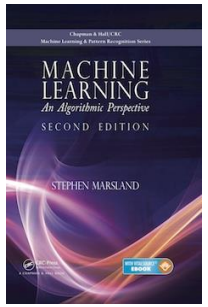
Practical Course Information

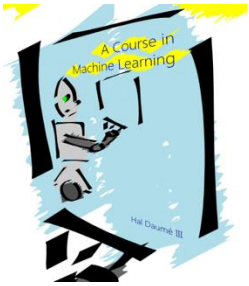
This Photo by Unknown Author is licensed under CC BY-SA

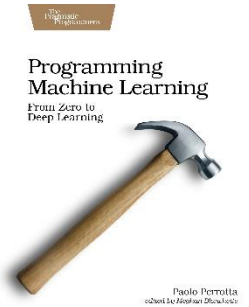
IN3050/4050 – Fall 2025

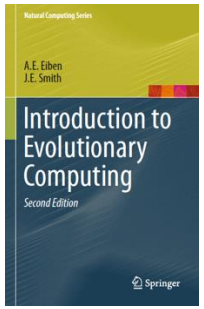
- **Lecturers:**
  - Pooya Zakeri (zakeri@ifi.uio.no)
  - Ali Ramezani-Kebrya (ali@ifi.uio.no)
- **Lecture time:** Thursday 10.15-12.00
- **Course web page:**
  https://www.uio.no/studier/emner/matnat/ifi/IN3050/h25/index.html

Syllabus









Syllabus:

- Selected parts of the following books (details on course web page):
  - S. Marsland: Machine learning: An Algorithmic Perspective, Second Edition, ISBN: 978-1466583283
  - + smaller selections from several other books available online or through O'Reilly
  - A.E. Eiben and J.E. Smith: Introduction to Evolutionary Computing, Second Edition (ISBN 978-3-662-44873-1). Springer.
  - On-line material (on the course web page).
- The lecture notes.
- Books are available online through O'Reilly

Exercises

Mandatory Exercises:

- Two exercises
  - Deadlines: See course webpage
- Published on the course web page (Messages) at least two weeks before the deadline.
- Supervision: Group lectures

Non-Mandatory Exercises:

- Weekly, extra material for learning the topics in the course
- Suggested solutions posted later
- Stuck? Get help in group lectures!

Mandatory Exercises - Regulations

- https://www.uio.no/english/studies/examinations/compulsory-activities/mn-ifi-mandatory.html
- Important: Exercises should reflect your own individual efforts. If you use code parts from other sources, you should inform us where it came from
- Discussing problems and solutions with others is great – but you should not share your code / use other students' code.

Staying up to date

- Website: https://www.uio.no/studier/emner/matnat/ifi/IN3050/

- Mattermost

A course for third year students in informatics

- Focus on algorithms
- Assumed background:
  - 3 programming courses
    - recursion
- Use Python
  - Packages:
    - Jupyter notebooks
    - …

- Machine learning uses mathematics:
  - Vectors, matrices
  - Derivatives
  - Probabilities
- Goal:
  - Not more maths than necessary
  - Try to adapt to your background
- But:
  - You must be willing to learn



WHAT IS A.I.?

Source: Wikipedia

What is Intelligence?

(in humans:)

- No consensus definition, but
- "Mental abilities"
  - Aptitude – not acquired knowledge
  - More than one dimension
- Various lists of what to include
- Emphasis on differences



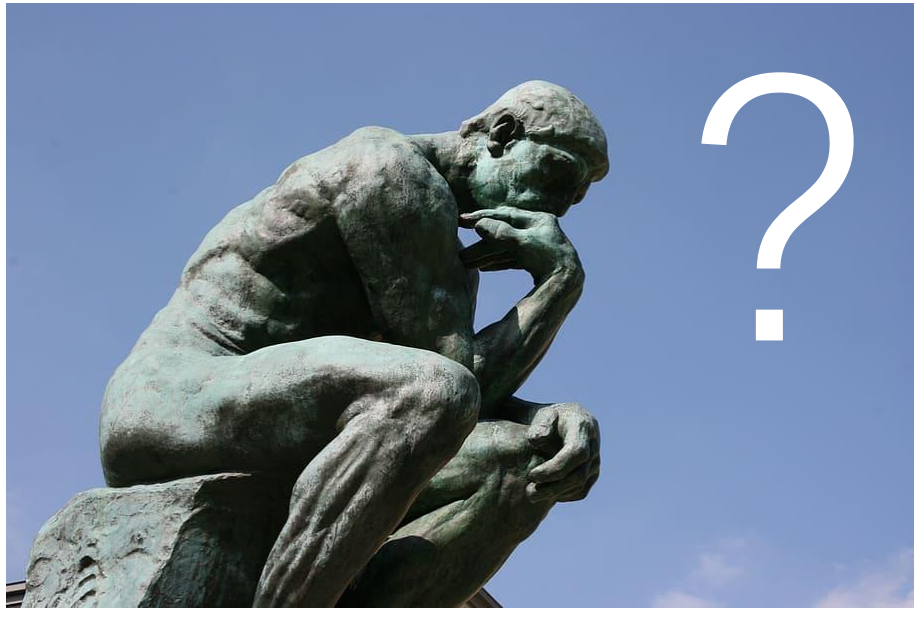
- Are animals intelligent?
- Can machines be intelligent?

What is Artificial Intelligence?

Definition?

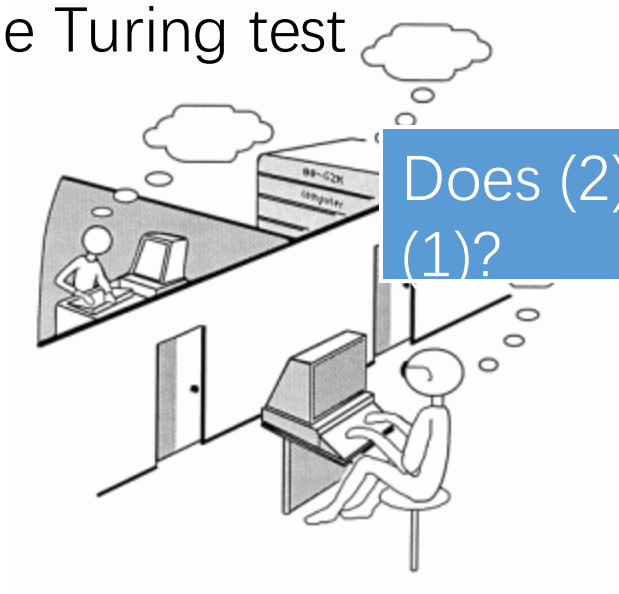
"A machine is considered intelligent if it can perform tasks which are considered intelligent when carried out by a human being."

But, one necessary condition for considering a task intelligent is that it is genuinely human – and cannot be carried out by an animal and even less a machine



Goals of AI

1. Theoretical:
   - Build models of how humans think and act
   - Understand ourselves
   - The Turing test



Does (2) have to build on (1)?

2. Practical:
   - Replace human activities that demand intelligence
   - Assist us



Main approaches to AI

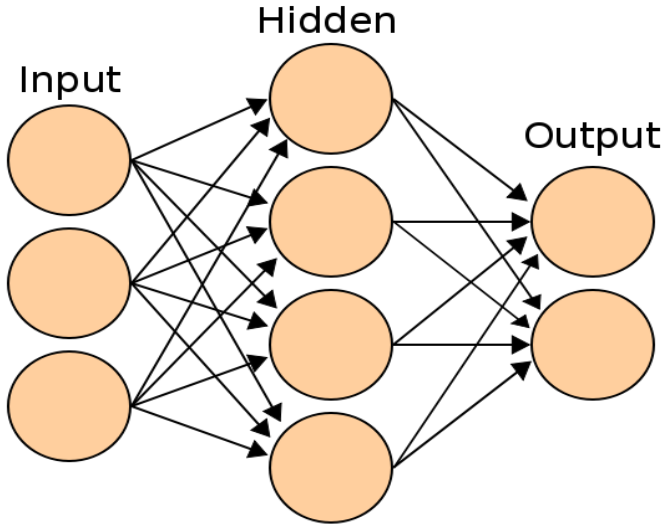
Rule-based

- Logic, deduction
- Explicit coding of knowledge as formulas or rules
- Expert systems
- Dominated AI-books until the end of the last century

$\forall x(human(x) \rightarrow \exists y(mother_of(y,x)))$

Machine learning

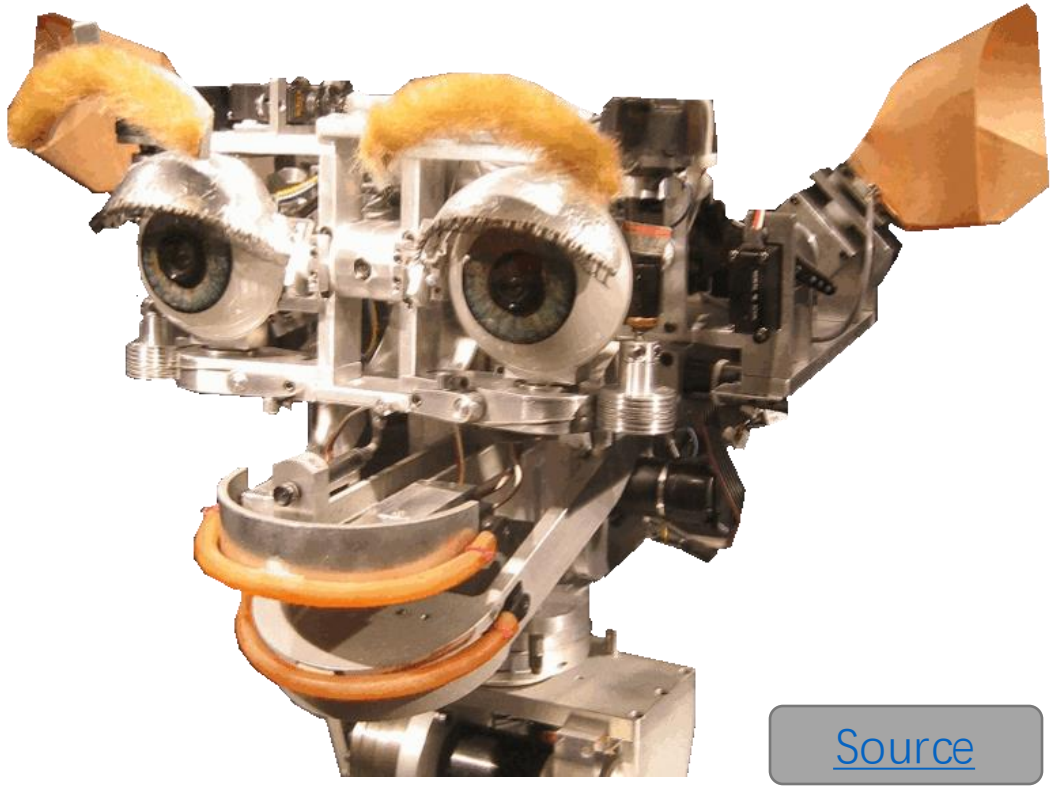
- Induction rather than deduction
- Adapt to the environment
- Main-focus in this course



Source

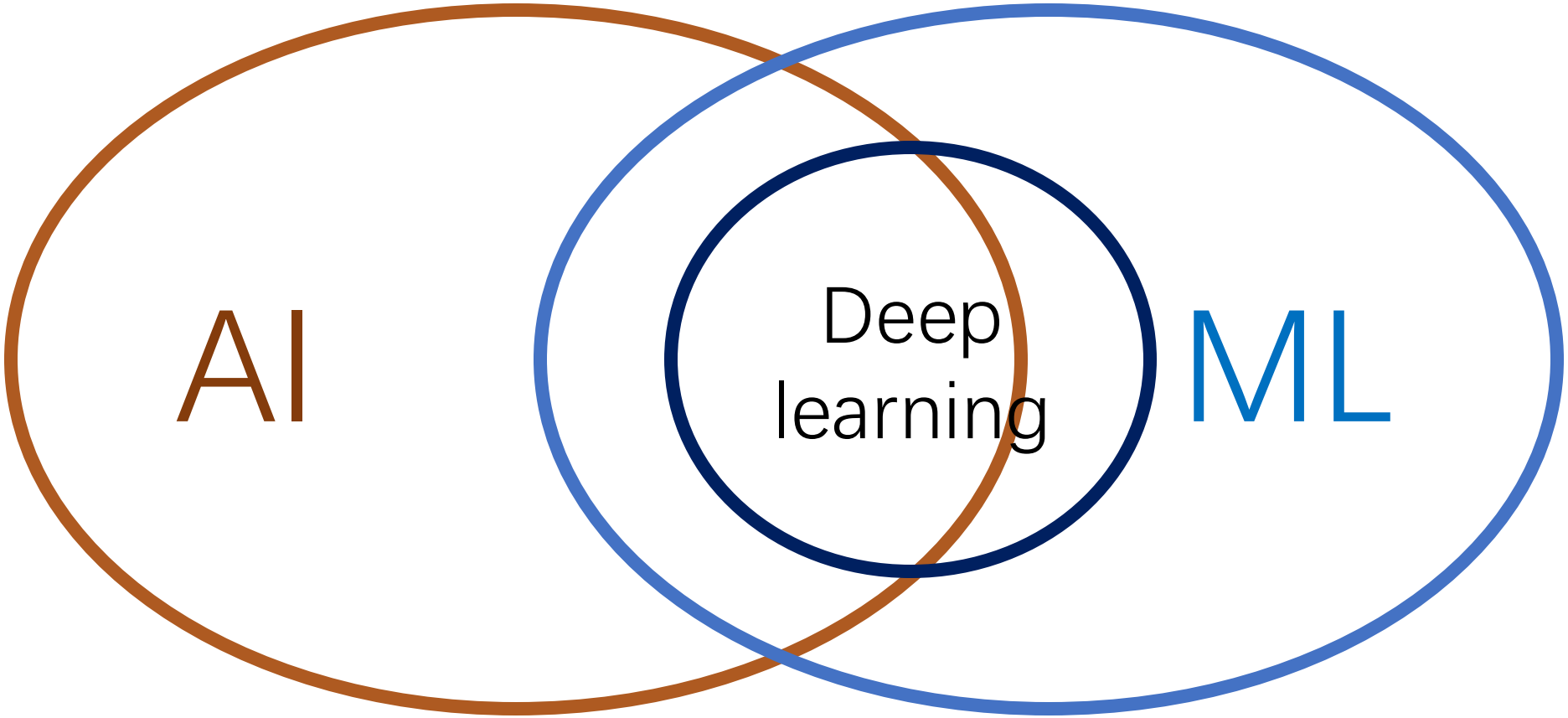
Traditional areas of AI

- Problem solving
  - Search
  - Game playing
- Knowledge and Reasoning
  - Logic
  - Theorem proving
  - Knowledge representation
- Planning
- Learning
- Natural language understanding
- Perception
- Motion and manipulation

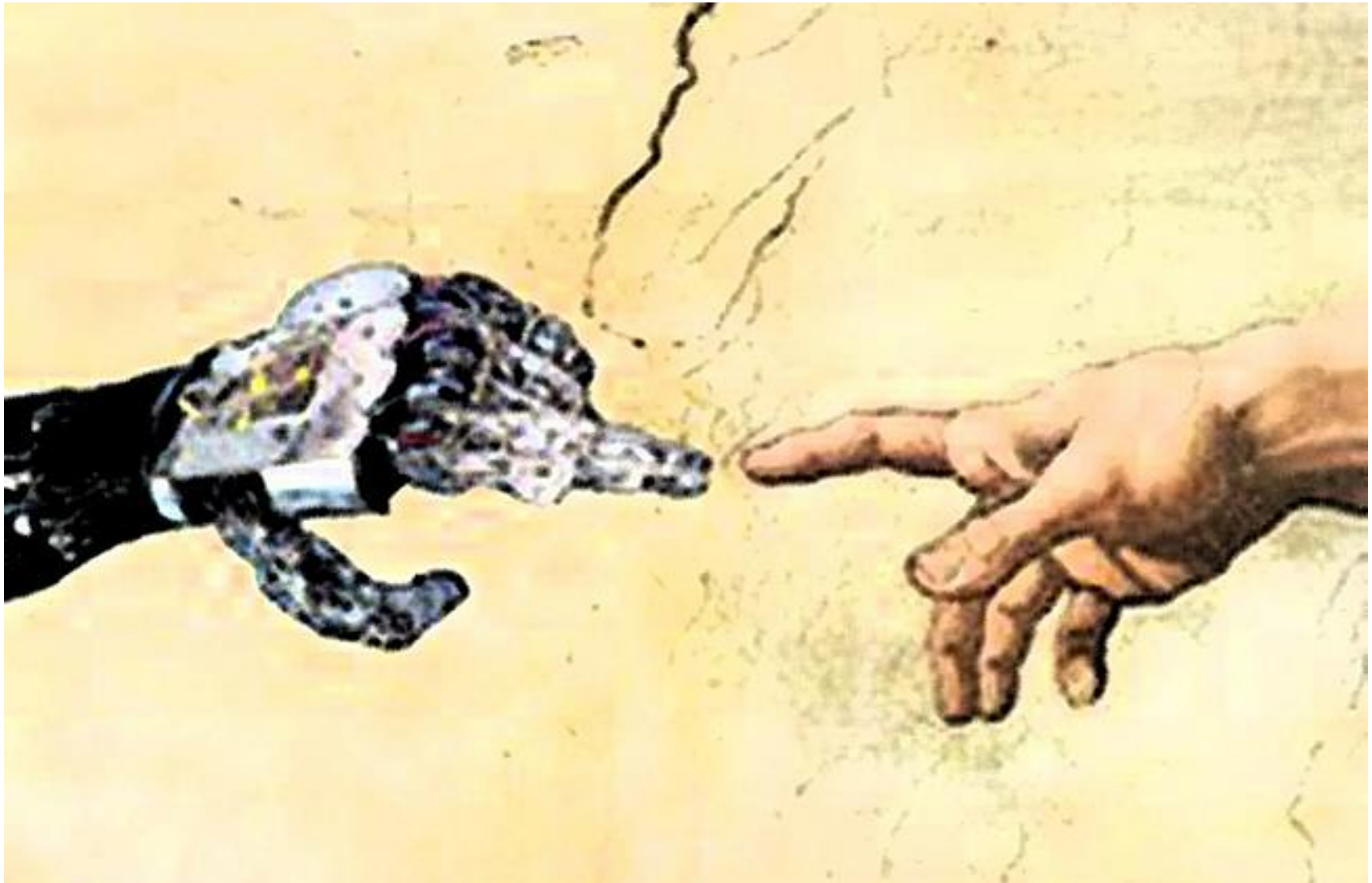


Source

AI, Machine learning, Deep learning



Human vs Machine – Who is smartest?



Some tasks machines are better at

- **Maths/logic**

$$\nabla \dot{\xi} \cdot \frac{\partial^{\varepsilon} \chi}{\partial \mathbf{p}^{\varepsilon}} + \nabla \check{\jmath} \wedge \frac{\partial^{\gamma} \psi}{\partial \mathbf{q}^{\gamma}} = 0$$

$$\oint_{\text{全てのスペース}} (E + H \wedge T) \int_{-\infty}^{+\infty} \frac{\partial^2 \mathit{Я}}{\partial \phi \, \partial z} \, \mathrm{d}\Omega \mathrm{d}\tau = \frac{\Gamma(\mathit{И}) \, \check{\jmath}(\Omega, \tau)}{(2\pi)^{\mathit{И}} \, Ж}$$

$$\mathrm{d}\mathbf{F} = \frac{\langle \Phi | \dot{\jmath} | \Psi \rangle}{(2\pi)^{\mathit{И}} c^2} \left[\gamma \mathrm{d}\mathbf{\Sigma} + \mathbf{ь} \, \frac{\partial \ddot{\jmath}}{\partial z} \wedge \mathrm{d}\dot{\xi} \right]$$

Some tasks machines are better at

- Maths/logic
- **Board games (chess, go, etc)**



Some tasks machines are better at

- Maths/logic
- Board games (chess, go, etc).
- **Some complex computer games**
  - **Starcraft II and Dota 2 have been the focus of a lot of research in Reinforcement Learning**
  - **Minecraft is also a popular testbed due to its open-ended nature.**



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MIT Technology Review

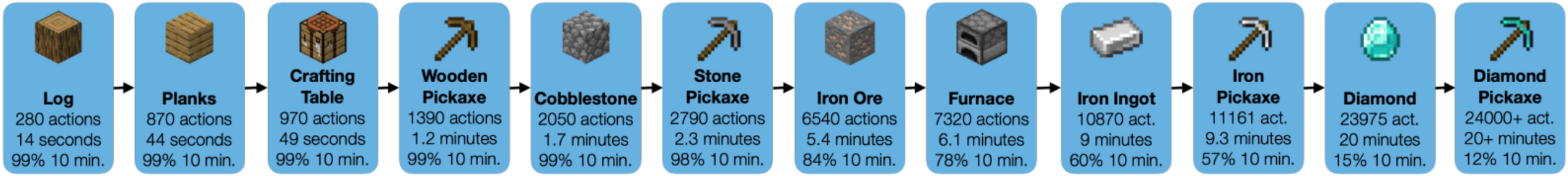
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ARTIFICIAL INTELLIGENCE

A bot that watched 70,000 hours of Minecraft could unlock AI's next big thing

Online videos are a vast and untapped source of training data—and OpenAI says it has a new way to use it.

By Will Douglas Heaven November 25, 2022



Some tasks humans are better at

- **Communicating with other humans**



ChatGPT: Towards human-level language understanding?

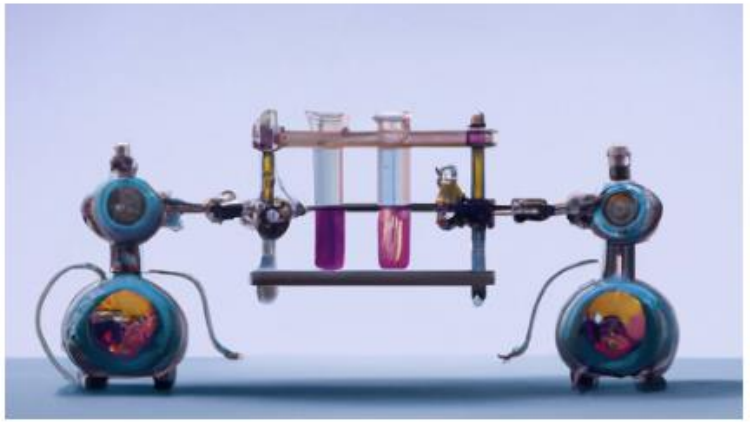
BIG THINK

SUBSCRIBE

THE FUTURE — DECEMBER 8, 2022

We gave ChatGPT a college-level microbiology quiz. It blew the quiz away.

ChatGPT's capabilities are astonishing.



Credit: Annelisa Leinbach, DALL-E AI

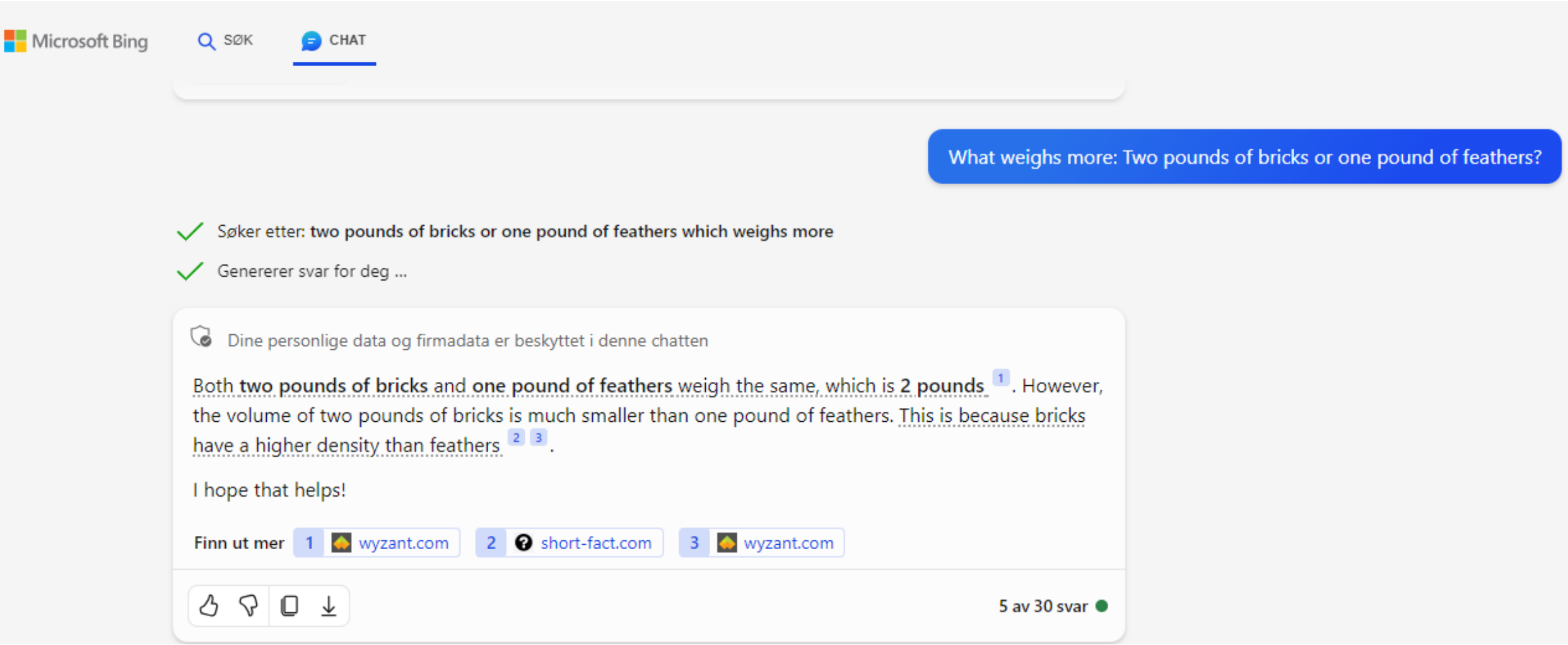
https://bigthink.com/the-future/chatgpt-microbiology-quiz-aced/

But there are still important limitations



What weighs more: Two pounds of bricks or one pound of feathers?

Chat with Bing Chat January 2023


Microsoft Bing
SØK
CHAT
What weighs more: Two pounds of bricks or one pound of feathers?
Søker etter: two pounds of bricks or one pound of feathers which weighs more
Genererer svar for deg ...
Dine personlige data og firmadata er beskyttet i denne chatten
Both two pounds of bricks and one pound of feathers weigh the same, which is 2 pounds [1]. However, the volume of two pounds of bricks is much smaller than one pound of feathers. This is because bricks have a higher density than feathers [2] [3].
I hope that helps!
Finn ut mer
1 wyzant.com
2 short-fact.com
3 wyzant.com
5 av 30 svar

Some tasks humans are better at

- Communicating with other humans
- **Moving around**



Some tasks humans are better at

- Communicating with other humans
- Moving around
- **Understanding from vision**
  - **Machines are getting close to human performance**

GPT-4 visual input:

What is funny about this image? Describe it panel by panel.





Source: https://www.reddit.com/r/hmmm/comments/ubab5v/hmmm/

GPT-4

The image shows a package for a "Lightning Cable" adapter with three panels.

Panel 1: A smartphone with a VGA connector (a large, blue, 15-pin connector typically used for computer monitors) plugged into its charging port.

Panel 2: The package for the "Lightning Cable" adapter with a picture of a VGA connector on it.

Panel 3: A close-up of the VGA connector with a small Lightning connector (used for charging iPhones and other Apple devices) at the end.

The humor in this image comes from the absurdity of plugging a large, outdated VGA connector into a small, modern smartphone charging port.

The state of Computer Vision and AI: we are really, really far away.

Oct 22, 2012



Can you explain to me why someone might find this image funny?





✓ Analyserer bildet: Ansikter kan være uskarpe for å beskytte personvernet

✓ Søker etter: **why someone might find an image funny**

✓ Genererer svar for deg ...

Dine personlige data og firmadata er beskyttet i denne chatten

I'm sorry, but I cannot infer the context of the image from the description you provided. However, humor is a complex and subjective phenomenon that can be influenced by various factors such as culture, personality, and context [1]. It is possible that the image contains elements that are unexpected, absurd, or ironic, which can trigger a humorous response in some individuals.

If you could provide me with more information about the image or the context in which it was shared, I might be able to provide a more informed opinion. Alternatively, you could try sharing the image with your friends or colleagues to see if they find it funny. Sometimes, humor can be contagious and shared laughter can be a great way to bond with others [1].

Finn ut mer 1 psychologytoday.com 2 boredpanda.com 3 freethink.com

1 av 30 svar

Some tasks humans are better at

- Communicating with other humans
- Moving around
- Visual tasks
- **Creative tasks**
  - **Machines are improving**

A painting of a fox sitting in a field at sunrise in the style of Claude Monet

Dall-E 1 (2021)



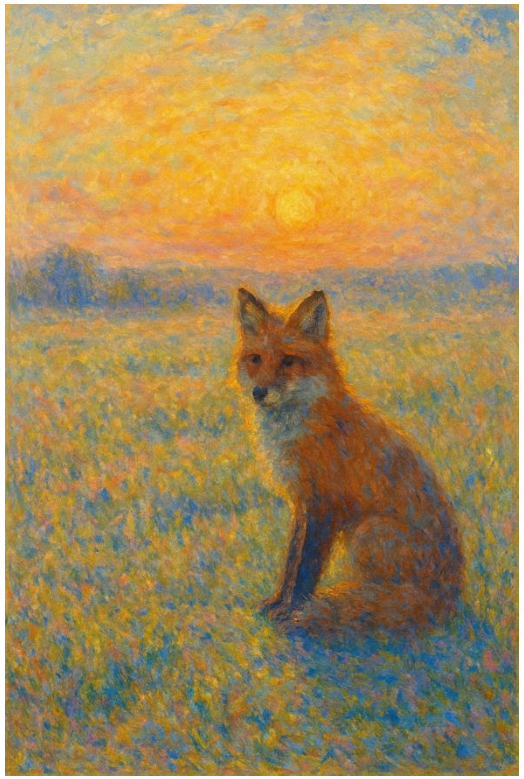
Dall-E 2 (2022)



Dall-E 3 (2023)



Dall-E 3 4o (2025)



Stable Diffusion (2025)



Claude Monet

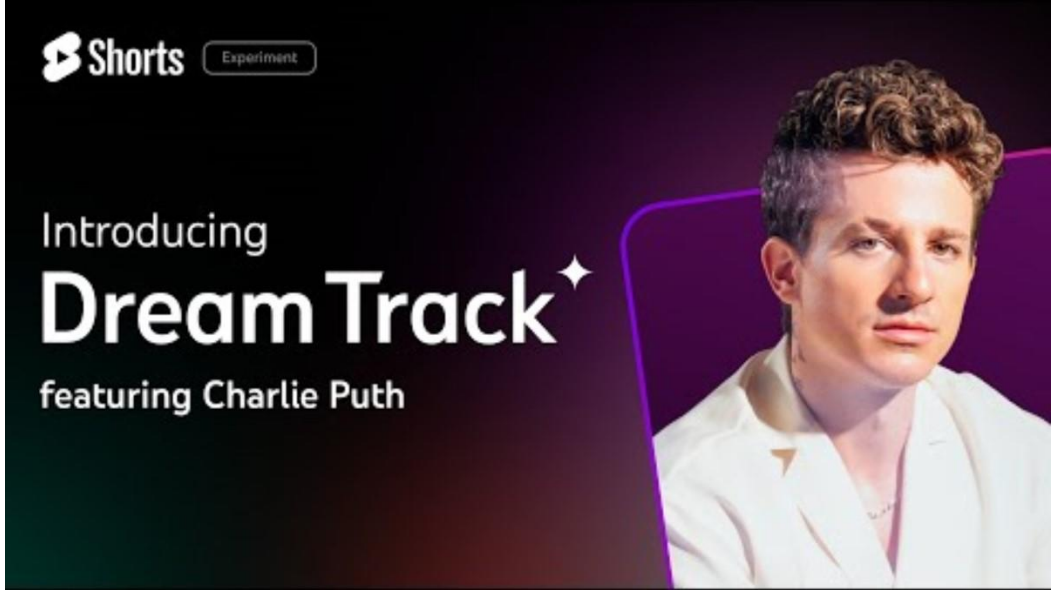
Women with a Parasol – Madame Monet and Her Son
1875



Sunrise,1872



AI for music is also coming



- **AI's role in music is growing rapidly**
  - Composing melodies, harmonizing, and even creating entire songs.
  - They may lack the emotional depth and cultural context that human composers bring.
- **Ethical implications of AI in art and creativity**
  - Who owns the rights to AI-generated art?
  - What are the implications for artists whose work might be influenced or even replaced by AI?
  - *A need for clear guidelines and protections to ensure that AI contributes positively to the creative industries.*

LLMs and the Clock Enigma

- Draw me a clock with the time 4:20!
- Draw me a clock with the time 10 minutes past 5:30!
- Illustrate the time as 4:25!

LLMs and the Clock Enigma











Moravec's Paradox: What is easy for humans is hard for machines

- Robotics researcher Hans Moravec (1988):

«it is comparatively **easy** to make computers exhibit adult level performance on **intelligence tests or playing checkers**, and **difficult** or impossible to give them the skills of a one-year-old when it comes to **perception and mobility**»

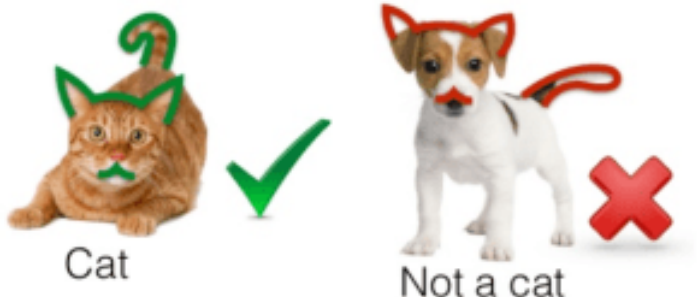


Wikipedia

Moravec's Paradox

Humans



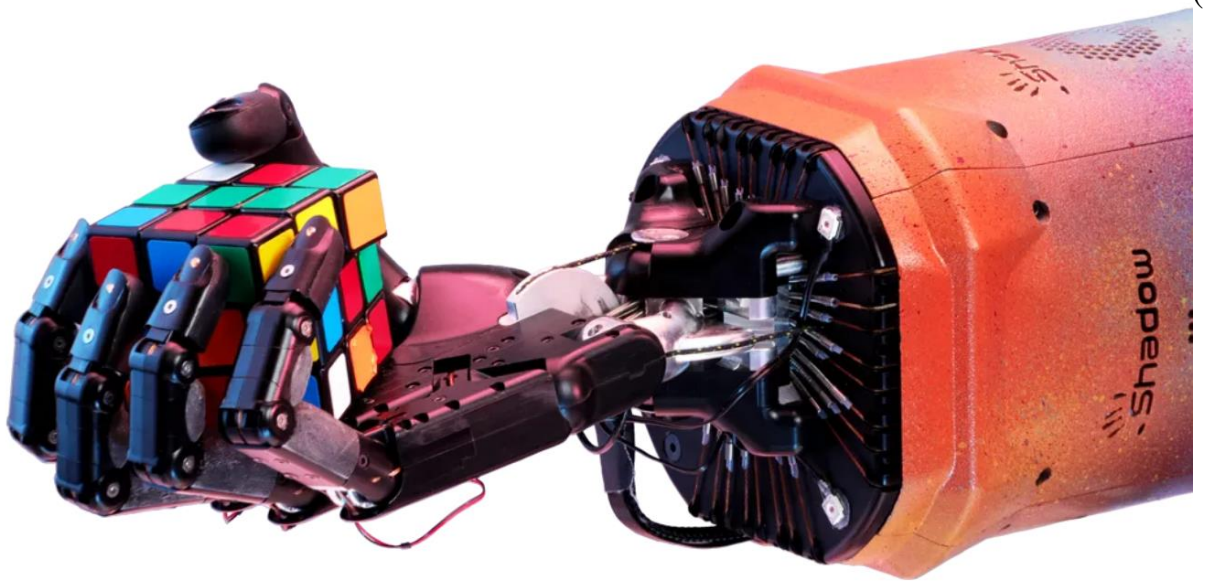


Machines

$$\nabla \dot{\xi} \cdot \frac{\partial^{\varepsilon} \chi}{\partial \mathbf{p}^{\varepsilon}} + \nabla \check{J} \wedge \frac{\partial^{\gamma} \psi}{\partial \mathbf{q}^{\gamma}} = 0$$

$$\oint_{\text{全てのスペース}} (E + H \wedge T) \int_{-\infty}^{+\infty} \frac{\partial^2 \mathit{Я}}{\partial \phi \, \partial z} \, \mathrm{d}\Omega \mathrm{d}\tau = \frac{\Gamma(\mathit{Ⱶ}) \, \jmath(\Omega, \tau)}{(2\pi)^{\mathit{Ⱶ}} \, Ж}$$

$$\mathrm{d}\mathbf{F} = \frac{\langle \Phi | \eth | \Psi \rangle}{(2\pi)^{\mathit{Ⱶ}} c^2} \left[\gamma \mathrm{d}\mathbf{\Sigma} + \mathbf{Ь} \frac{\partial \bar{\mathit{Ꞩ}}}{\partial z} \wedge \mathrm{d}\dot{\xi} \right]$$





Simplified Worlds vs. Messy Reality

- **Claim (Moravec):** Humans evolved strong motor/perceptual skills but weak abstract reasoning
- logic feels hard for us but easy for AI.
- **Counterpoint:** Logic & math aren't evolutionary niches; they're **human-made simplifications** of reality.
- **Why AI excels:** Computers are designed to operate on **narrow, consistent symbolic systems**, not messy real-world complexity.
- No paradox — AI is good at what we engineered it for; life itself remains the harder problem.

Next week: Search/Optimization

- Optimization: A principle behind most of the other topics in this course
- We'll talk about what optimization problems are and begin to think about ways to solve them

