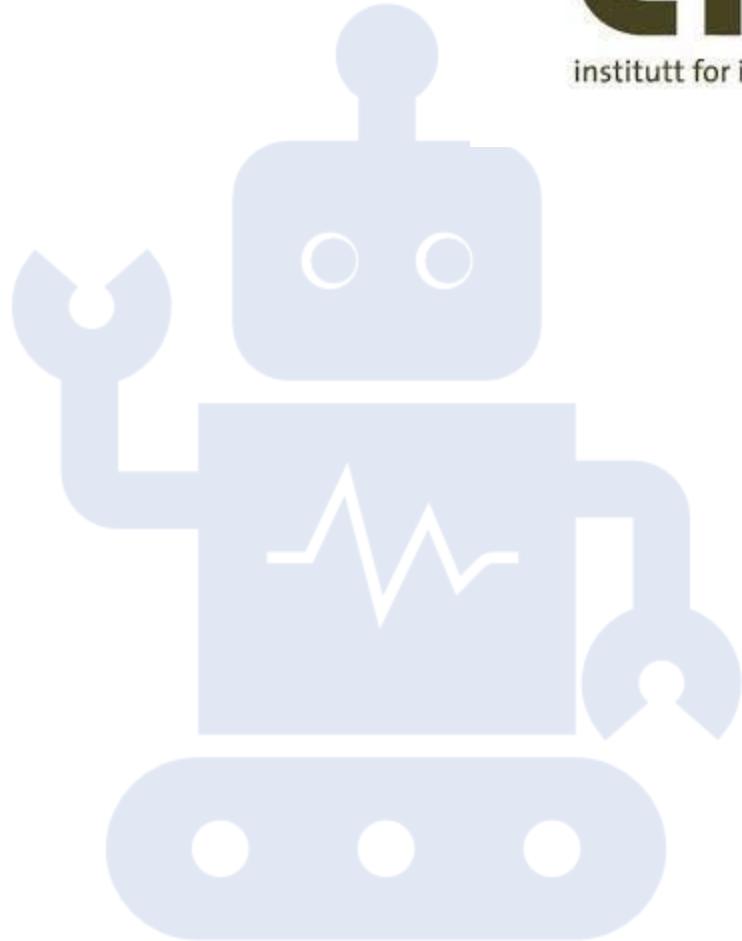


## IN3050/IN4050 - Introduction to Artificial Intelligence and Machine Learning

Lecture 1 – 2025

Course Introduction

Pooya Zakeri and Ali Ramezani-Kebrya



# Motivation/State-of-the-art

# 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**

A young boy is playing basketball. 	Two dogs play in the grass. 	A dog swims in the water. 
A group of people walking down a street. 	A group of women dressed in formal attire. 	Two children play in the water. 
A skier is skiing down a snowy hill. 	A little girl in a pink shirt is swinging. 	A dog jumps over a hurdle. 

# 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**

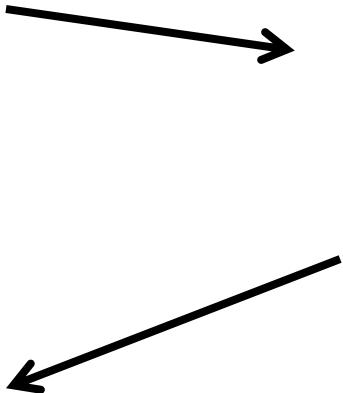


# Self-driving cars



[Source: Wikipedia](#)

Speech  $\longleftrightarrow$  text



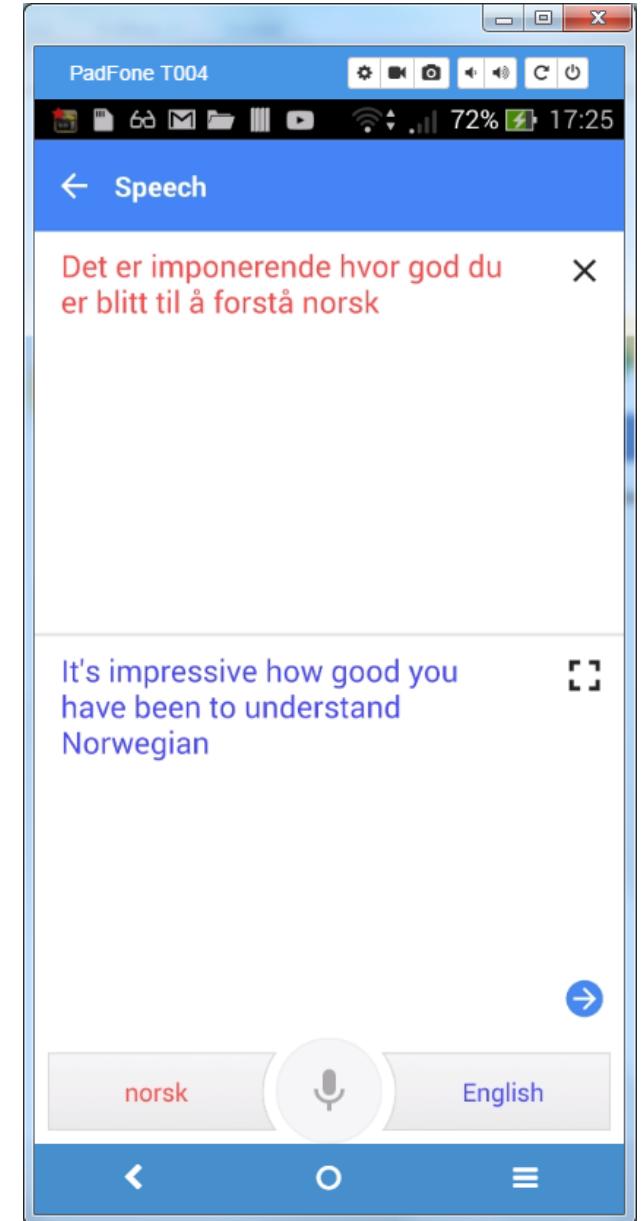
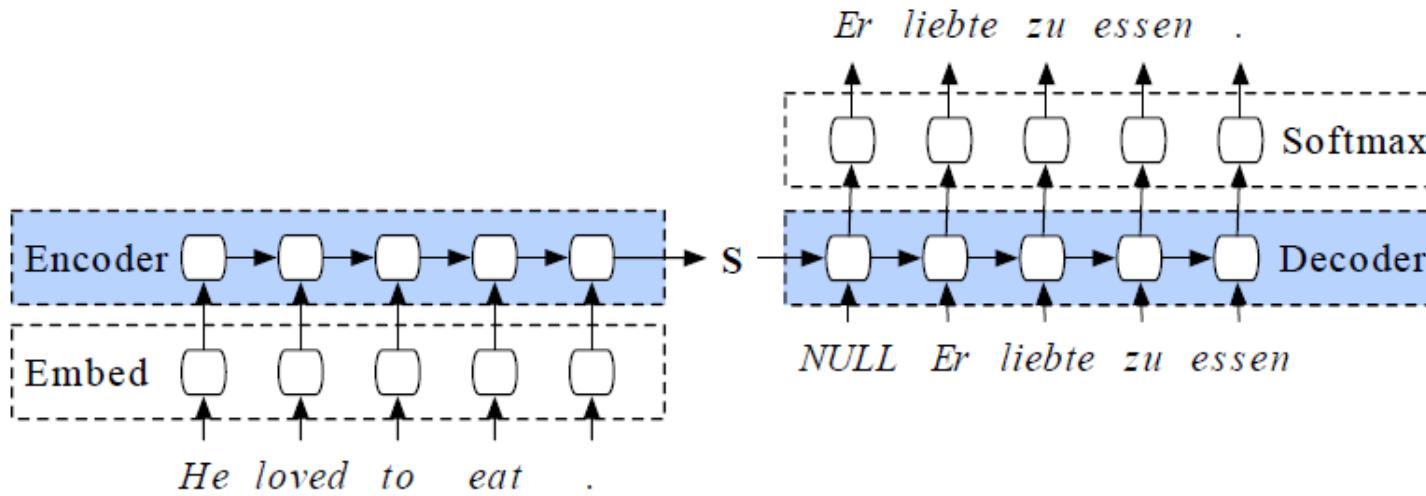
und Polarisation des Lichtes in den sogenannten kolloidalen Metallösungen. Zieht man die Folgerungen aus der elektromagnetischen Lichttheorie auf das Verhalten der trüben Medien, so kommt man zu verschiedenen Resultaten, je nachdem die trübenden Teilchen Isolatoren oder Leiter der Elektrizität sind. Die bezüglichen Rechnungen sind durchgeführt worden von Lord Rayleigh<sup>1)</sup> für Isolatoren und von J. J. Thomson<sup>2)</sup> 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

9

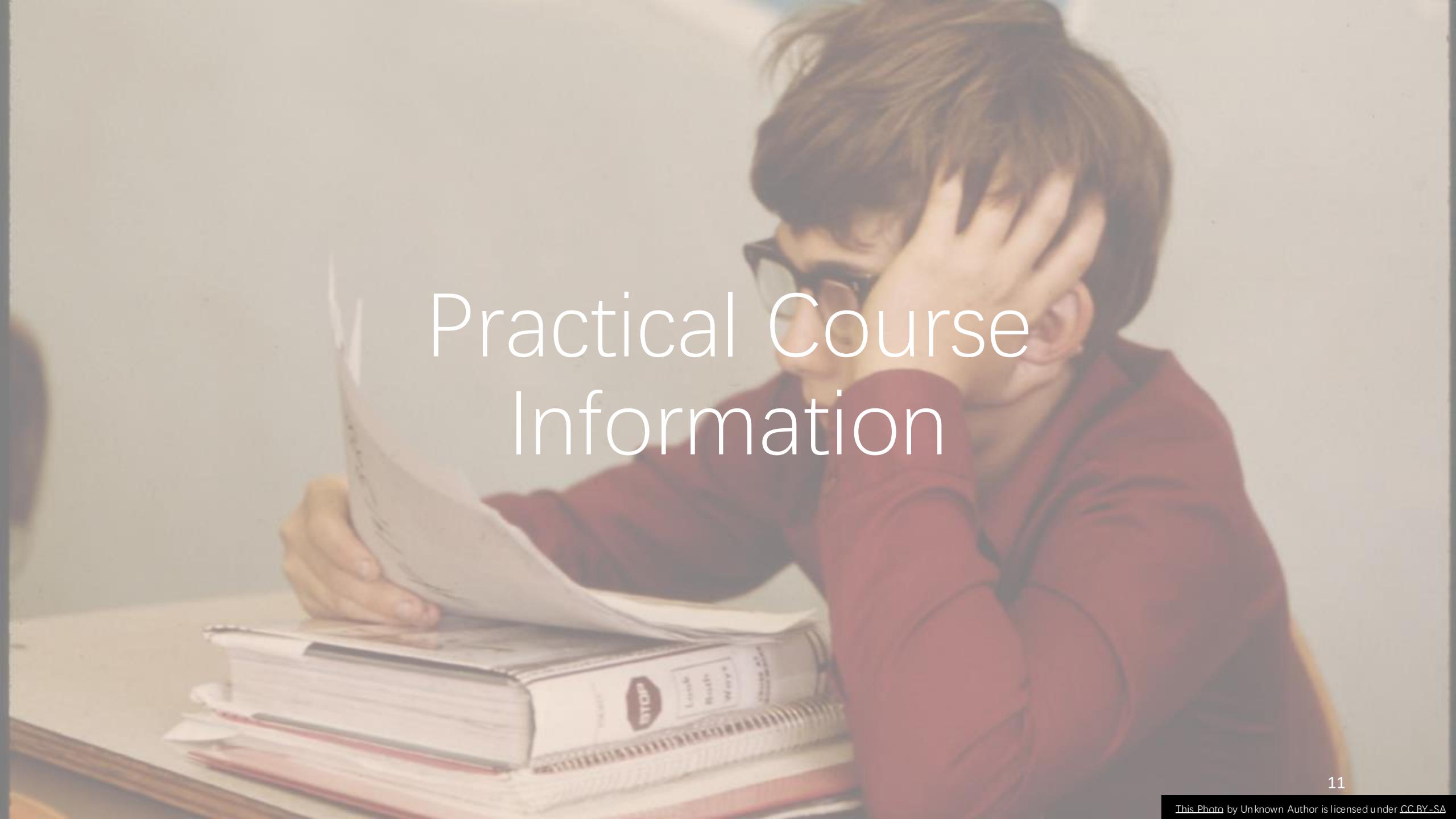
10/31/2018

[https://smerity.com/media/images/articles/2016/gnmt\\_arch\\_1\\_enc\\_dec.svg](https://smerity.com/media/images/articles/2016/gnmt_arch_1_enc_dec.svg)





Who are we?

A photograph of a person with short brown hair and glasses, wearing a red and black striped shirt, sitting at a desk. They are looking down at a stack of books and papers. The person's right hand is resting on their forehead, suggesting they are tired or stressed. The background is a plain, light-colored wall.

# Practical Course Information

# IN3050/4050 – Fall 2025

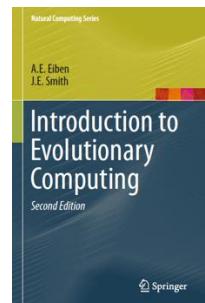
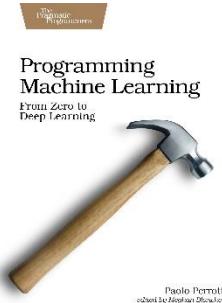
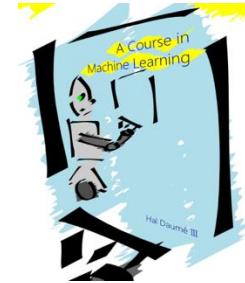
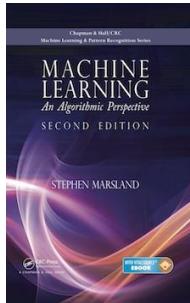
- **Lecturers:**
  - Pooya Zakeri ([zakeri@ifi.uio.no](mailto:zakeri@ifi.uio.no))
  - Ali Ramezani-Kebrya ([ali@ifi.uio.no](mailto:ali@ifi.uio.no))
- **Lecture time:** Thursday 10.15-12.00
- **Course web page:**

<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



[Source](#)

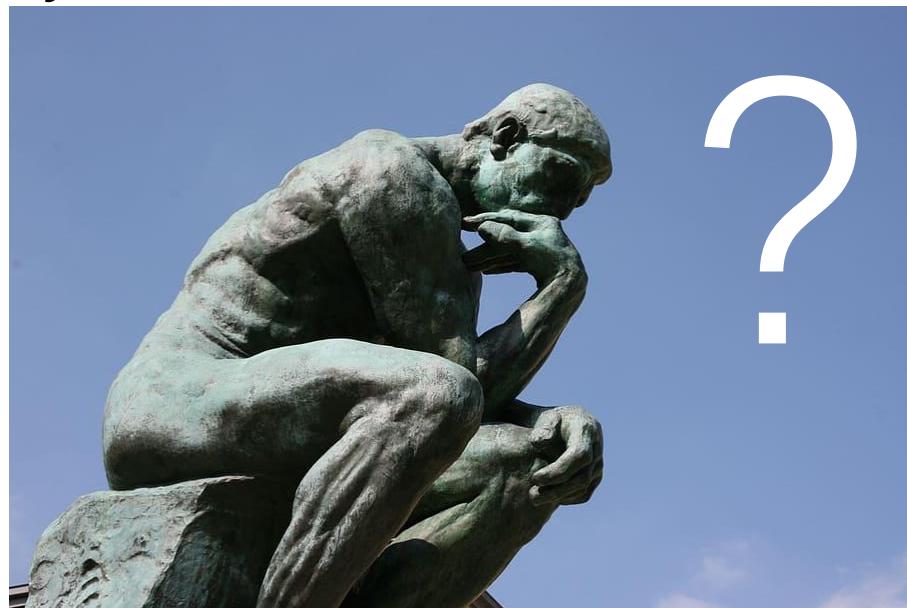
- Are animals intelligent?
- Can machines be intelligent?

# 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."

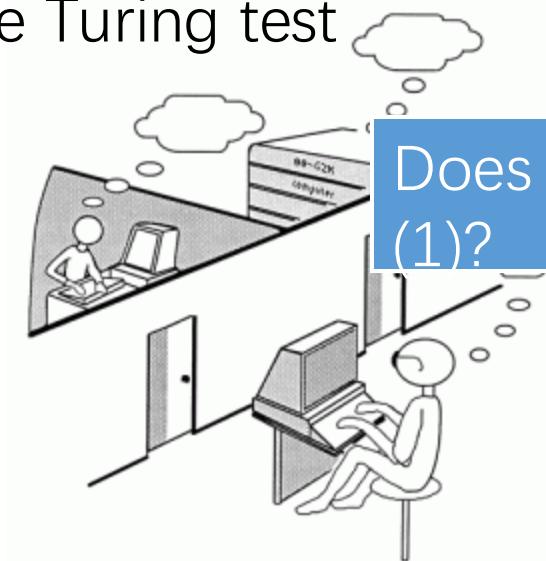
But, one necessary condition for considering a task intelligent is that it is genuinely human – and cannot be carried out by an animal and even less a machine



# Goals of AI

## 1. Theoretical:

- Build models of how humans think and act
- Understand ourselves
- The Turing test



## 2. Practical:

- Replace human activities that demand intelligence
- Assist us



# Main approaches to AI

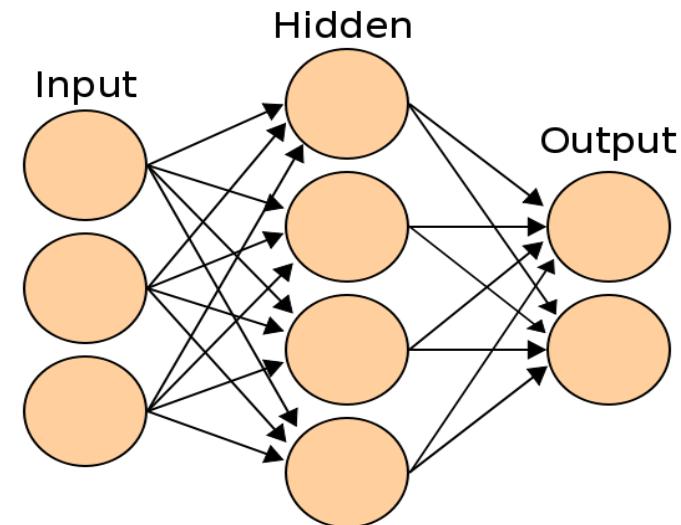
## Rule-based

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

$\forall x(\text{human}(x) \rightarrow \exists y(\text{mother\_of}(y,x)))$

## Machine learning

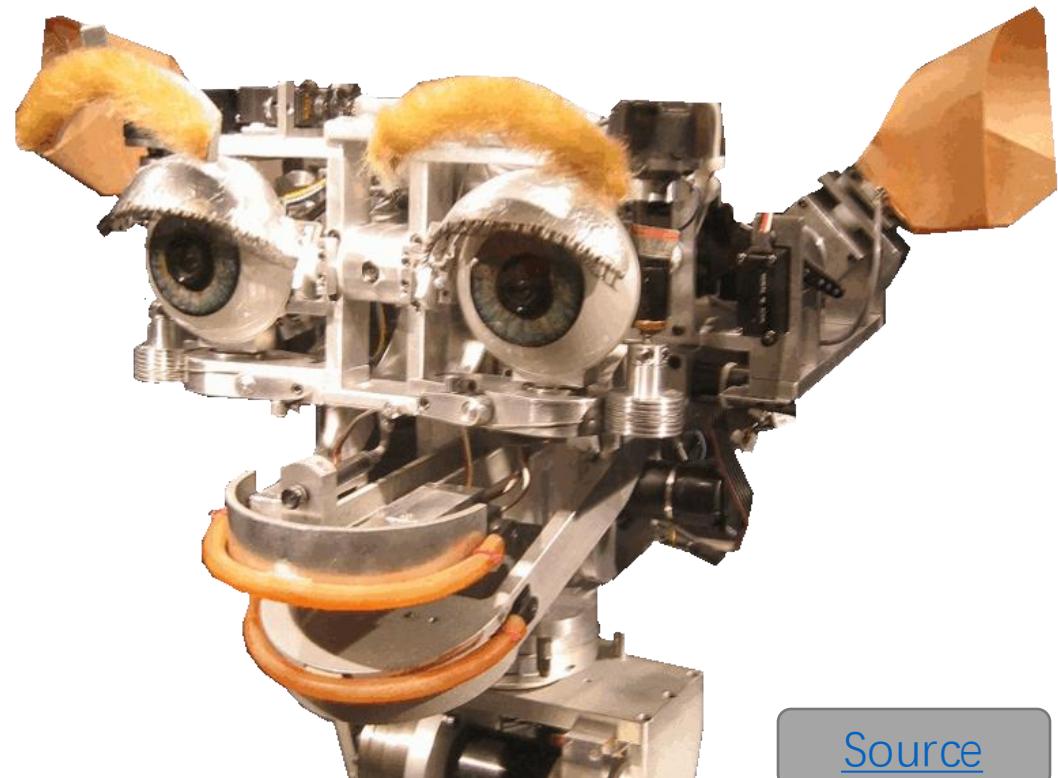
- Induction rather than deduction
- Adapt to the environment
- Main-focus in this course



[Source](#)

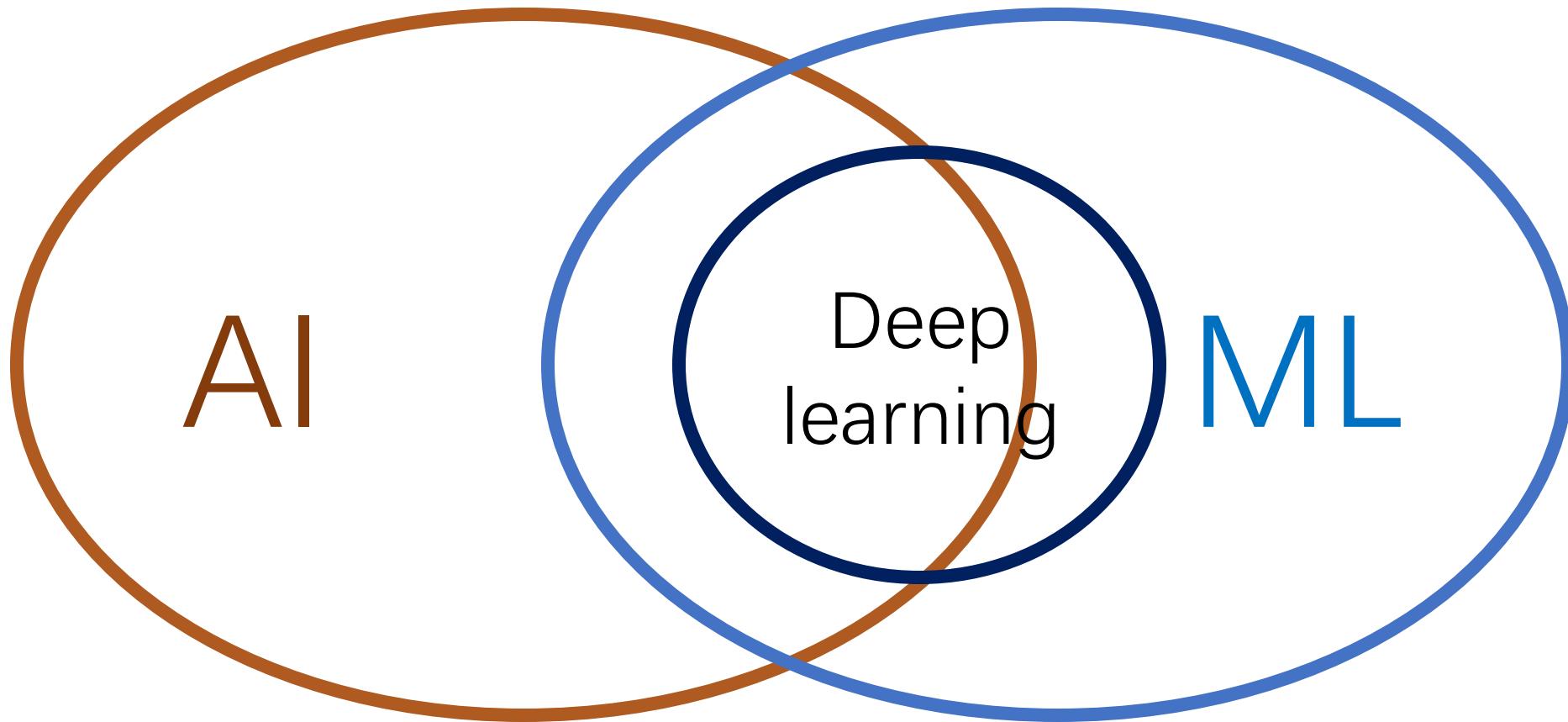
# Traditional areas of AI

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

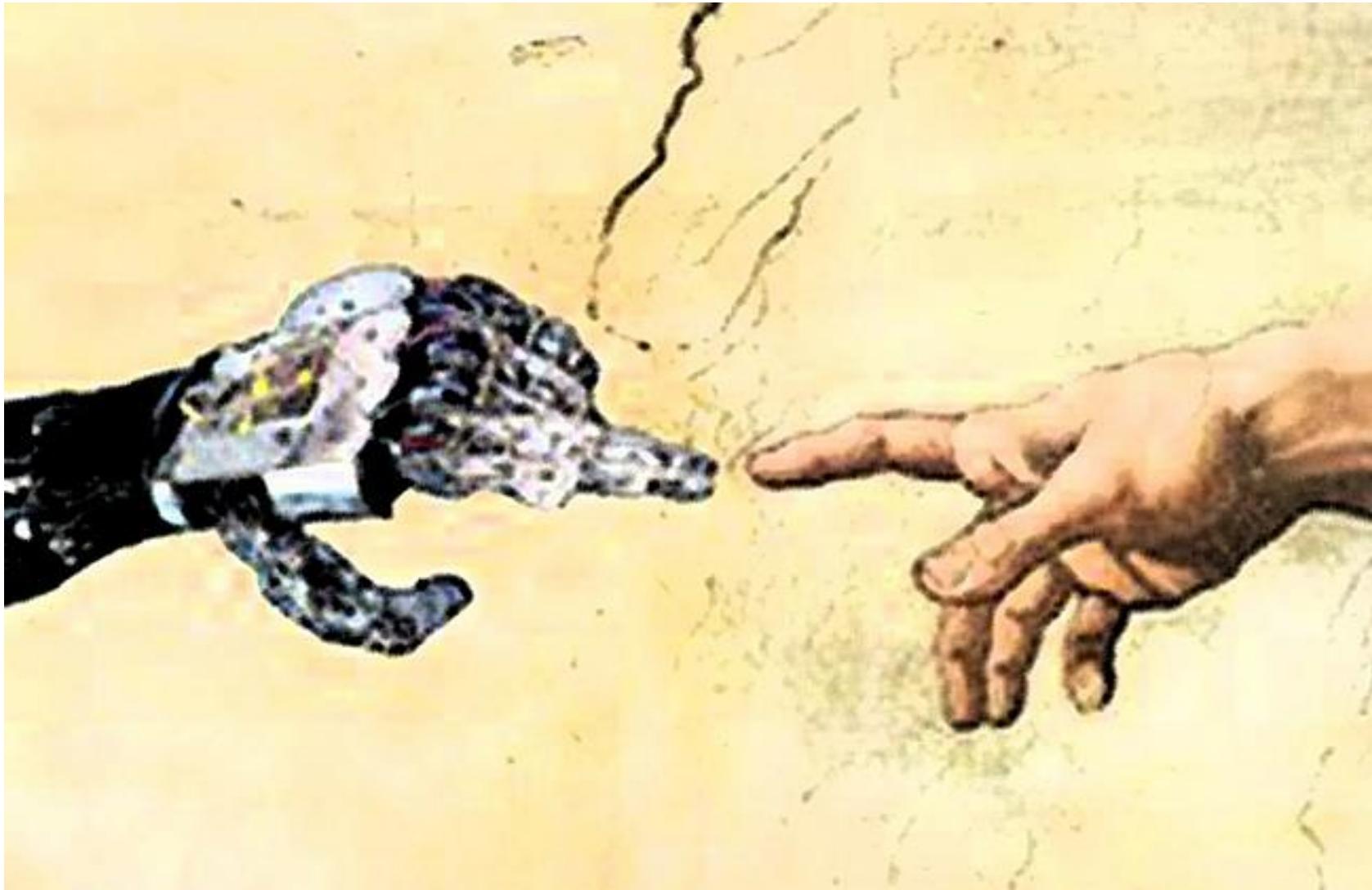


[Source](#)

# AI, Machine learning, Deep learning



# Human vs Machine – Who is smartest?



# Some tasks machines are better at

- Maths/logic

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

$$\oint_{\text{全てのスペース}} (E + H \wedge T) \int_{-\infty}^{+\infty} \frac{\partial^2 \mathcal{Y}}{\partial \phi \partial z} d\Omega d\tau = \frac{\Gamma(\mathcal{N}) \check{J}(\Omega, \tau)}{(2\pi)^\mathcal{N} \mathbb{X}}$$

$$dF = \frac{\langle \Phi | \check{J} | \Psi \rangle}{(2\pi)^\mathcal{N} C^2} \left[ \gamma d\Sigma + \mathbf{b} \frac{\partial \check{\zeta}}{\partial z} \wedge d\dot{\xi} \right]$$

# Some tasks machines are better at

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



# AI learns the art of Diplomacy

Meta's algorithm tackles both language and strategy in a classic board game that involves negotiation

22 NOV 2022 • 10:00 AM • BY MATTHEW HUTSON



# 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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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?

≡ 🔎

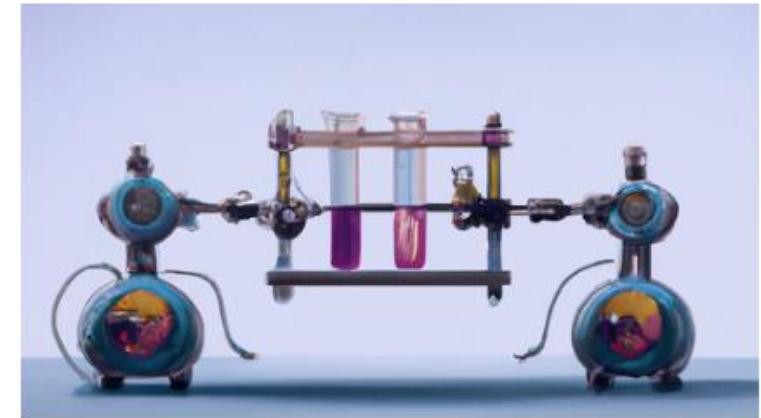
BIG THINK

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

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 <sup>1</sup>. 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 <sup>2</sup> <sup>3</sup>.

I hope that helps!

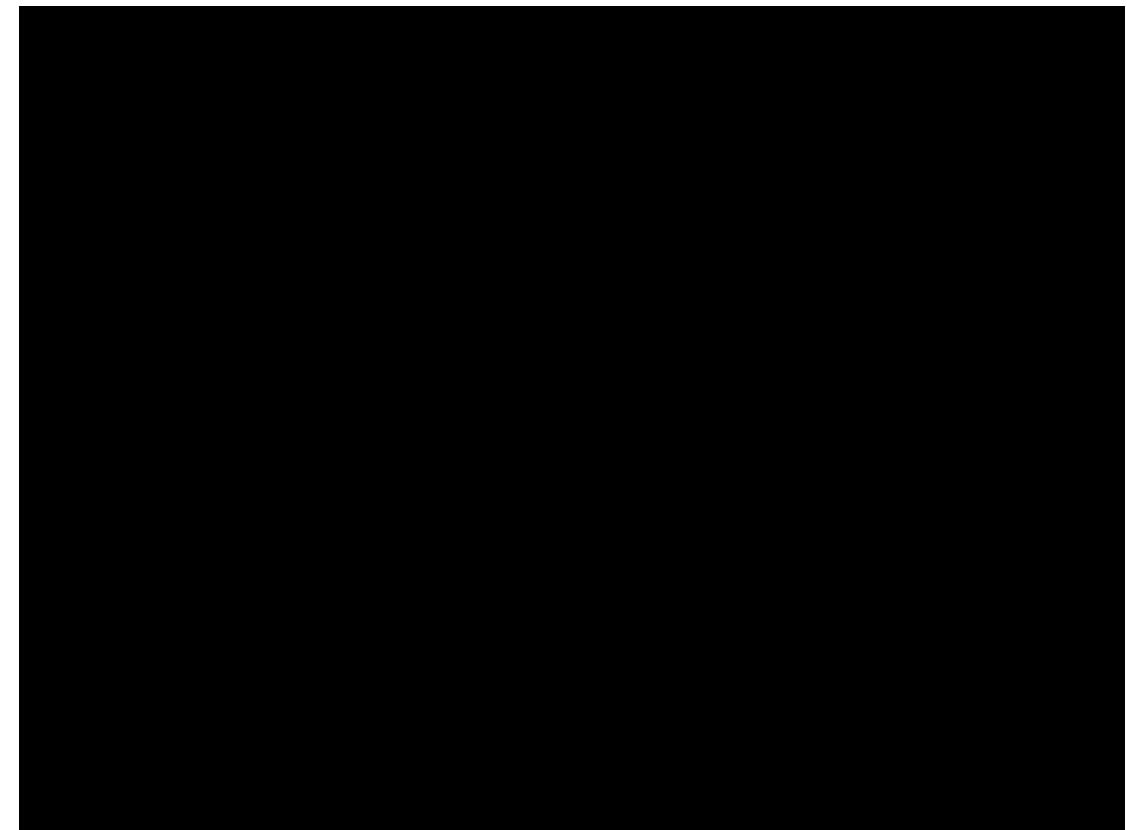
Finn ut mer 1  wyzant.com 2  short-fact.com 3  wyzant.com



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 <sup>1</sup>. 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 <sup>1</sup>.

Finn ut mer ▼ 1 psychologytoday.com

2 boredpanda.com

3 freethink.com



# 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)

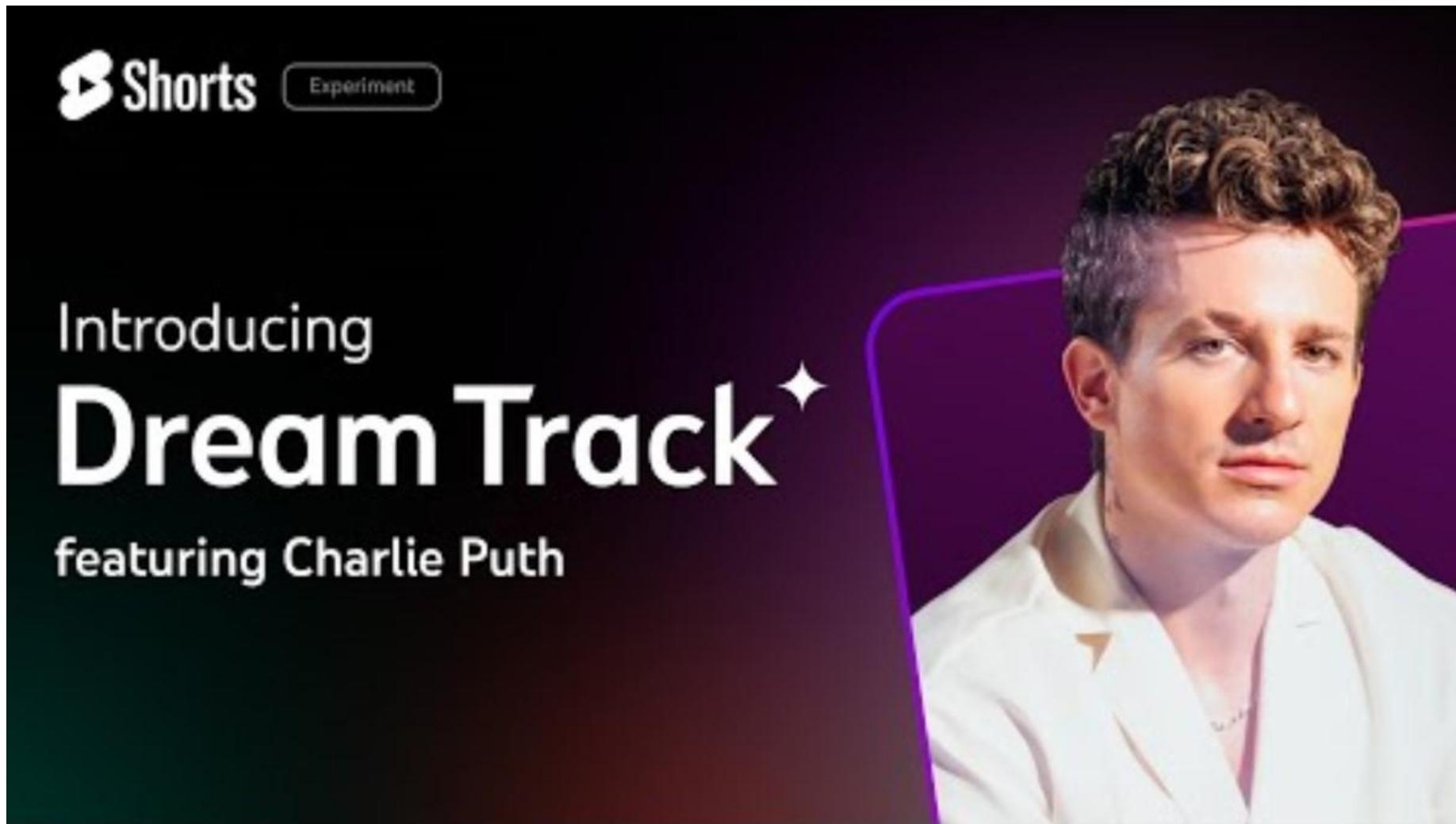


Dall-E 3 (2023)





# AI for music is also coming



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

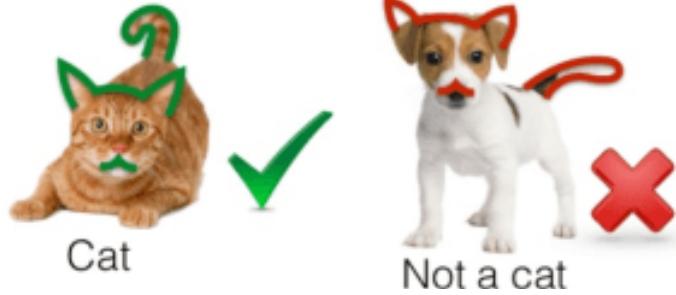
- Robotics researcher Hans Moravec (1988):  
«it is comparatively **easy** to make computers exhibit adult level performance on **intelligence tests or playing checkers**, and **difficult** or impossible to give them the skills of a one-year-old when it comes to **perception and mobility**»



Wikipedia

# Moravec's Paradox

Humans

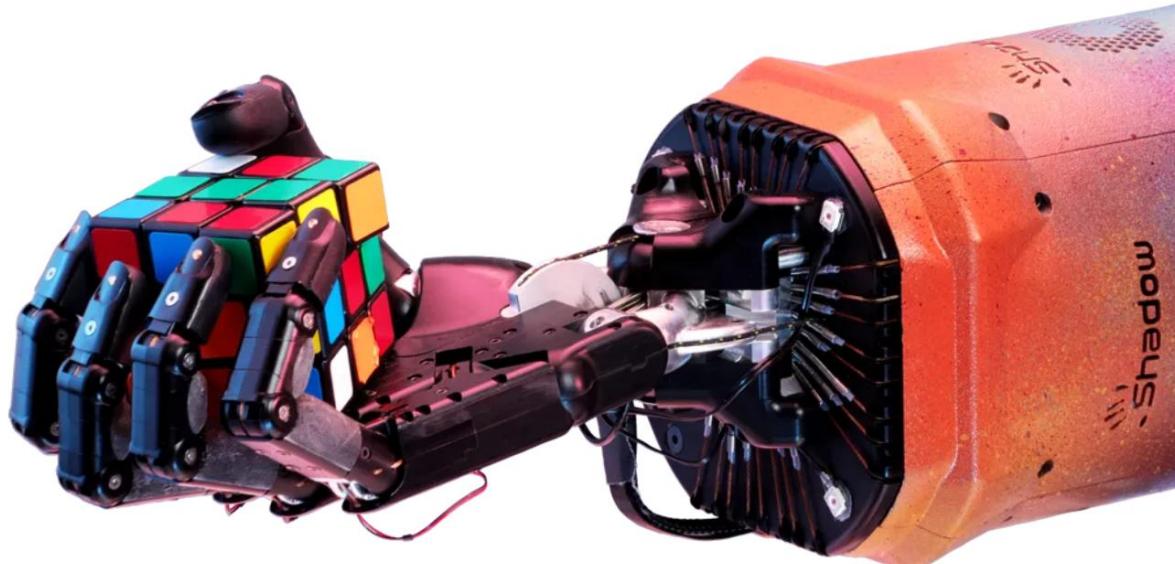


Machines

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

$$\oint_{\text{全てのスペース}} (E + H \wedge T) \int_{-\infty}^{+\infty} \frac{\partial^2 \mathcal{R}}{\partial \phi \partial z} d\Omega d\tau = \frac{\Gamma(\nu) J(\Omega, \tau)}{(2\pi)^{\nu} \mathbb{K}}$$

$$dF = \frac{\langle \Phi | \dot{J} | \Psi \rangle}{(2\pi)^{\nu} c^2} \left[ \gamma d\Sigma + \mathbf{b} \frac{\partial \mathcal{G}}{\partial z} \wedge d\dot{\xi} \right]$$



# 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
- You will also test this yourselves in Mandatory Exercise 1

