

Lecture

Foundations of Artificial Intelligence

Part 1 – Introduction

Dr. Mohsen Mesgar

Universität Duisburg-Essen

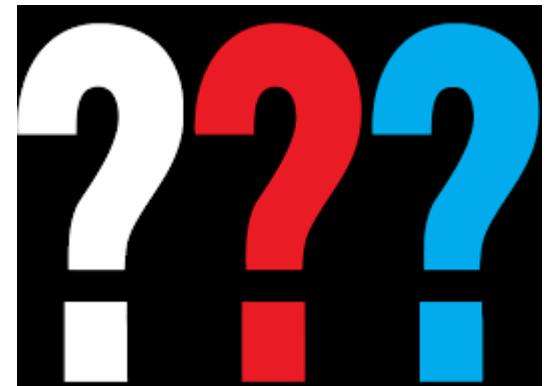
Warm up

Hands up

- Computer Science (Informatik)?
- Other disciplines?

Expectations?

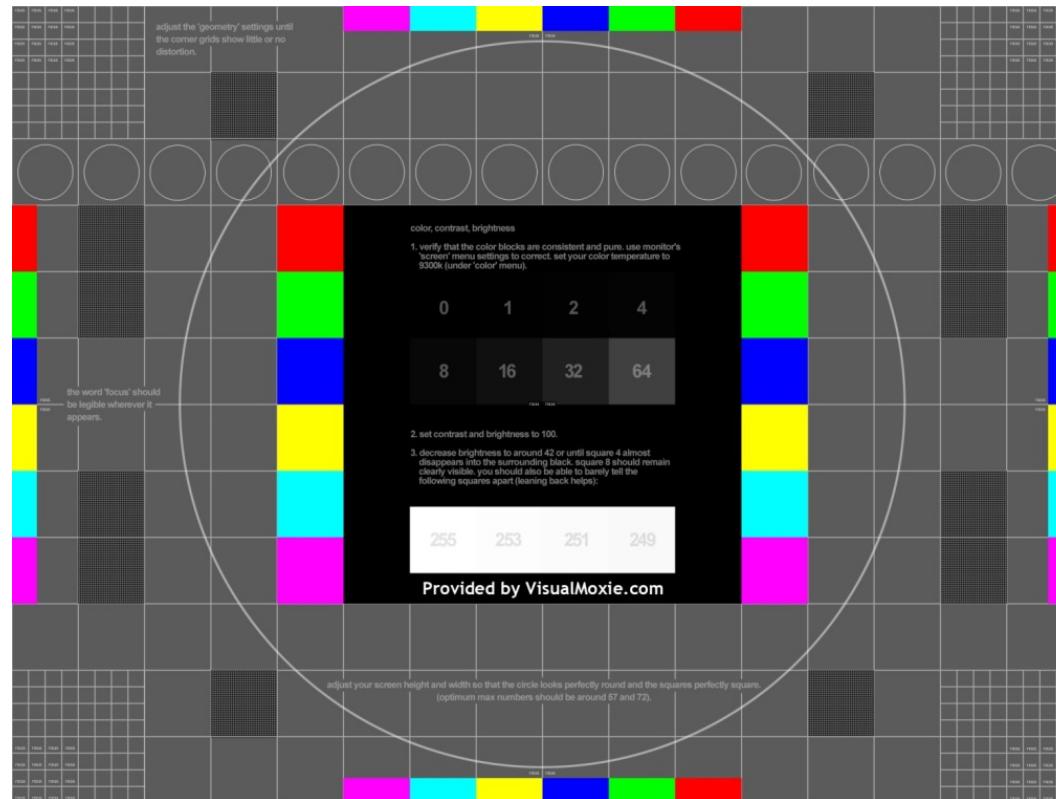
- ...



Previous Knowledge

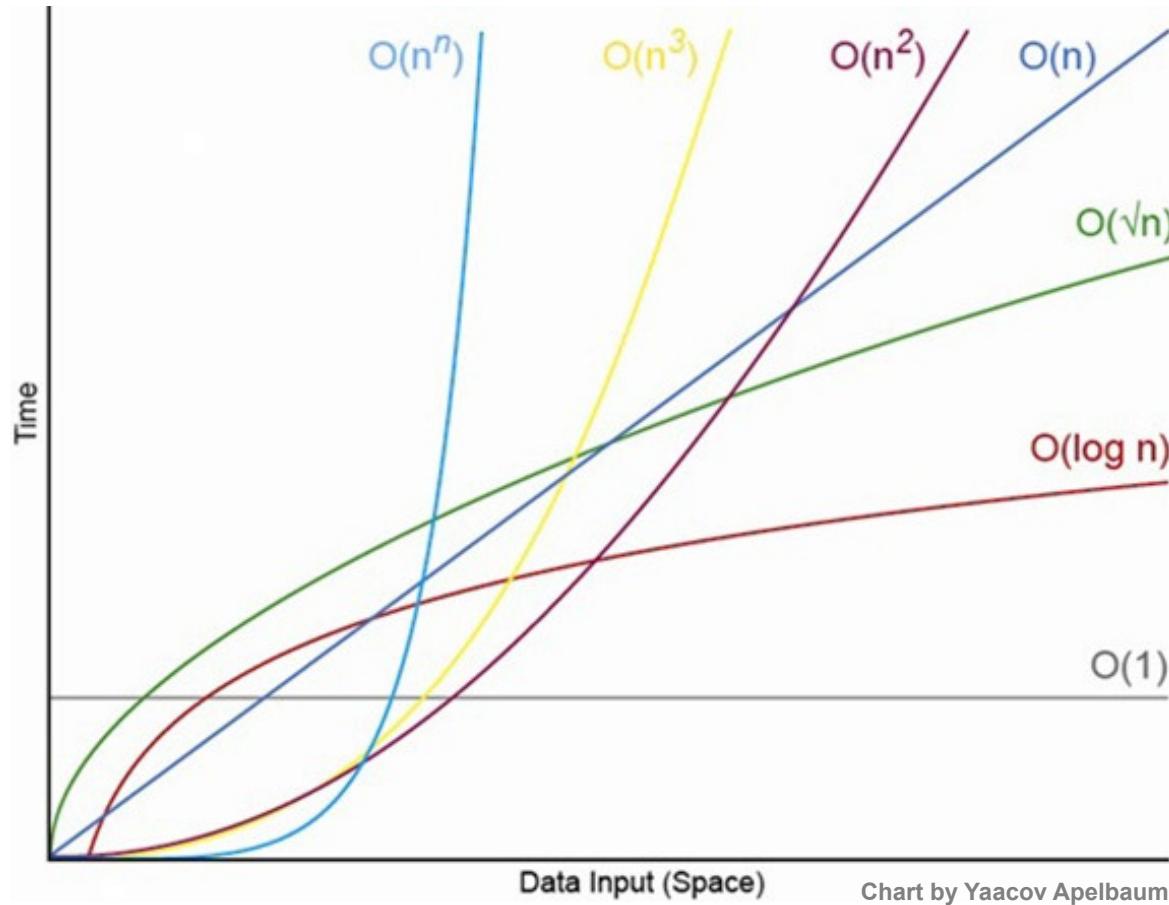
Previous knowledge on the topic?

- Calibrating ...



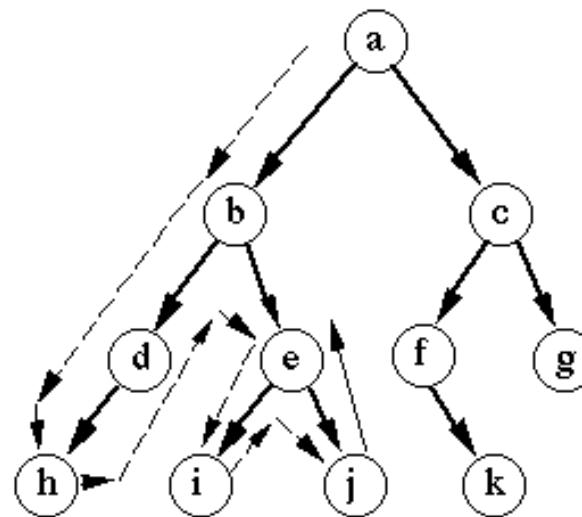
Do You Already Know ...?

Hands up if you already know the O() – Notation.

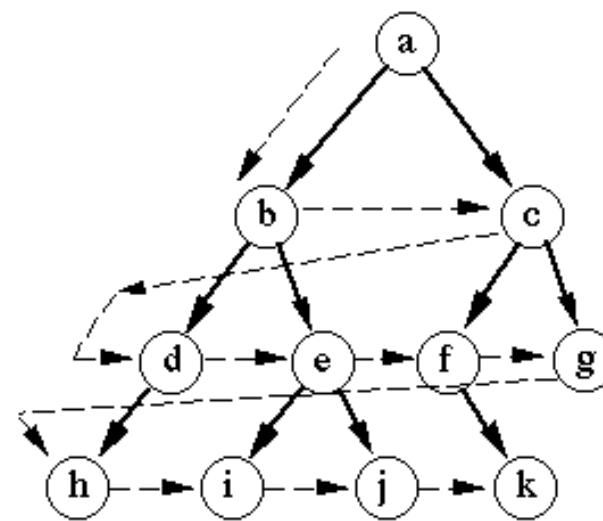


Do You Already Know ...?

Hands up if you already know Basic Search Algorithms.



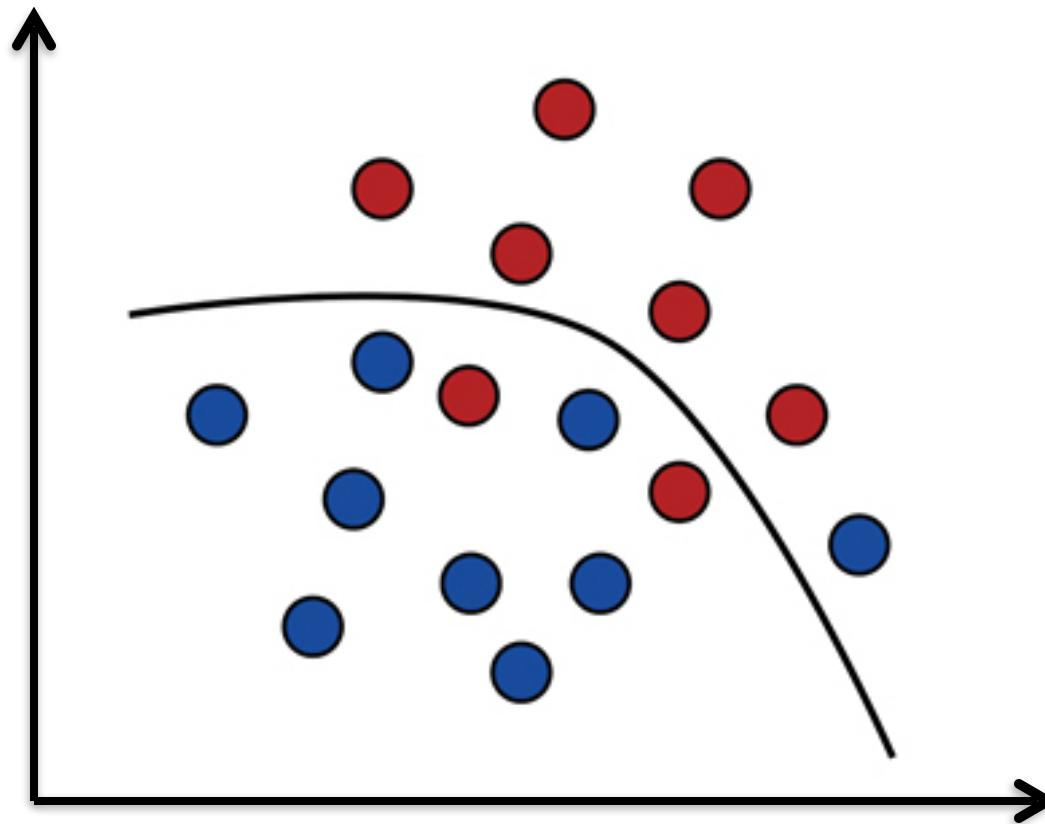
Depth-first search



Breadth-first search

Do You Already Know ...?

Hands up if you already know Machine Learning.



Who am I?



<https://mohsen-mesgar.io>

- ◊ Research: Intersection of AI/ML and Natural Language Processing (NLP)
- ◊ Conversational AI, few-shot learning, and text processing

At The End of This Lecture ...

- You learn some introductions to AI
- You learn about the administrative organization of the course

Artificial Intelligence
A (hopefully) motivating Introduction

Administrative Course Issues

What is AI?

Introduction to AI

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



Introduction to AI



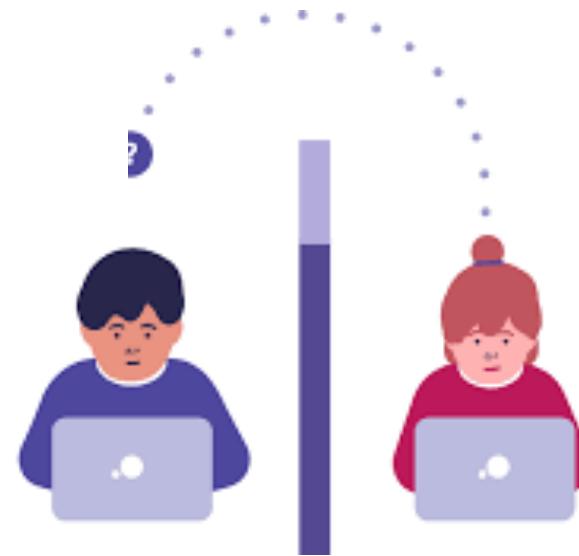
A computer would deserve to be called intelligent if it could deceive a human into believing that it was human.

Alan Turing

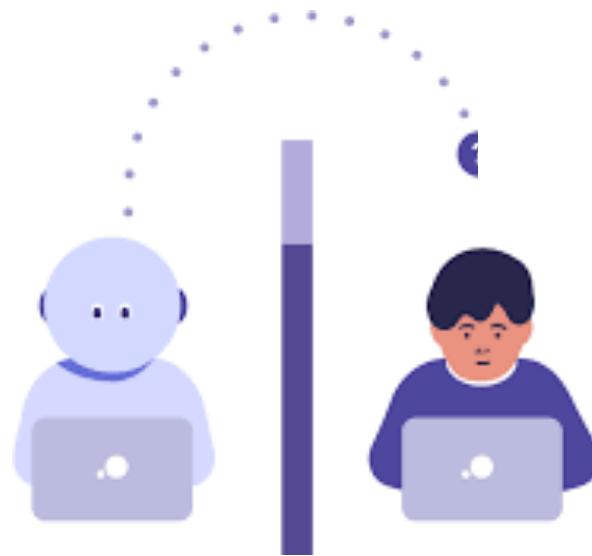
Turing Test



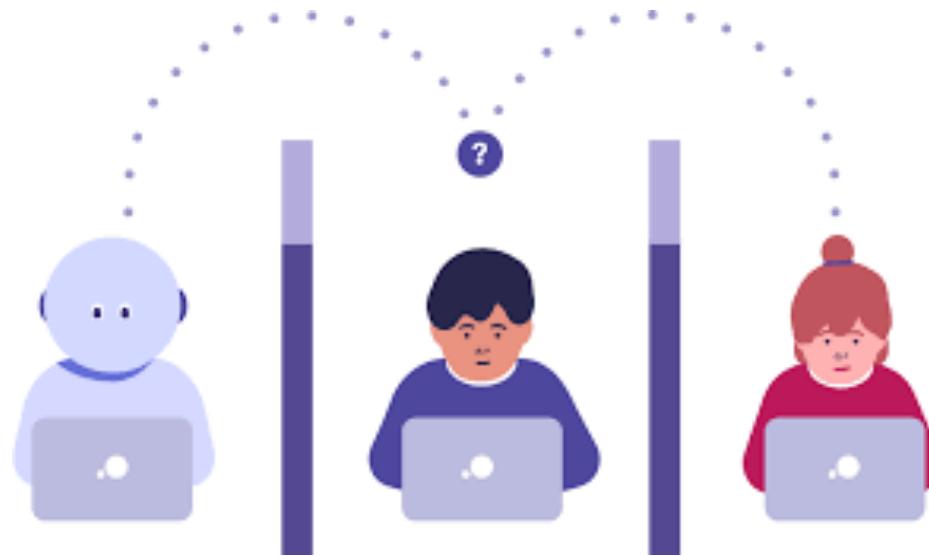
Turing Test



Turing test



Turing Test



Introduction to AI

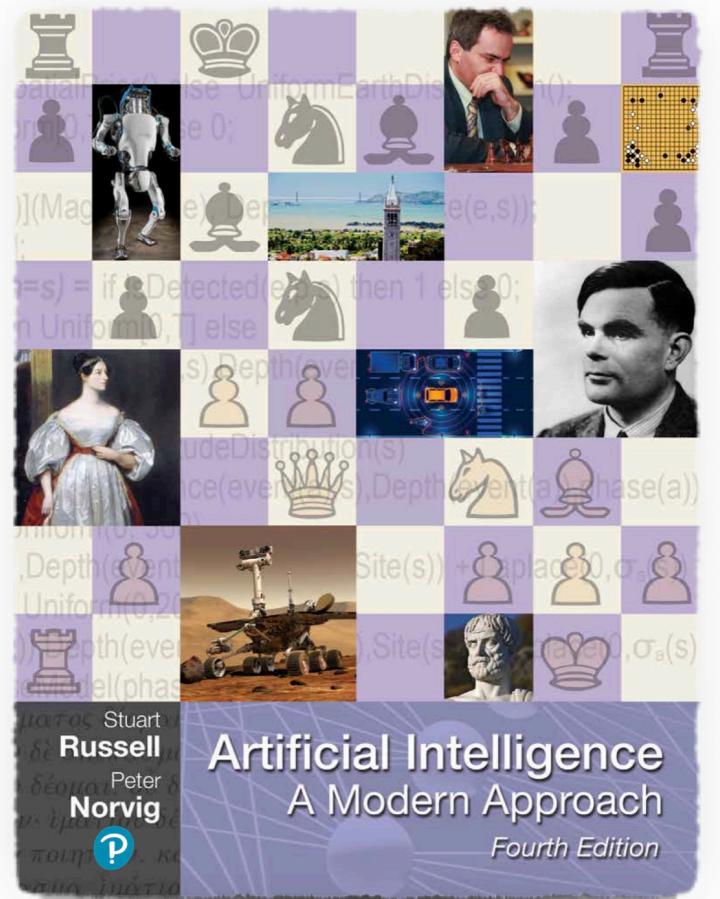
- Russell and Norvig delve into four potential definitions of AI:

Human approach:

- Systems that **think like humans**
 - Systems that **act like humans**

Ideal approach:

- Systems that **think rationally**
 - Systems that **act rationally**



Introduction to AI

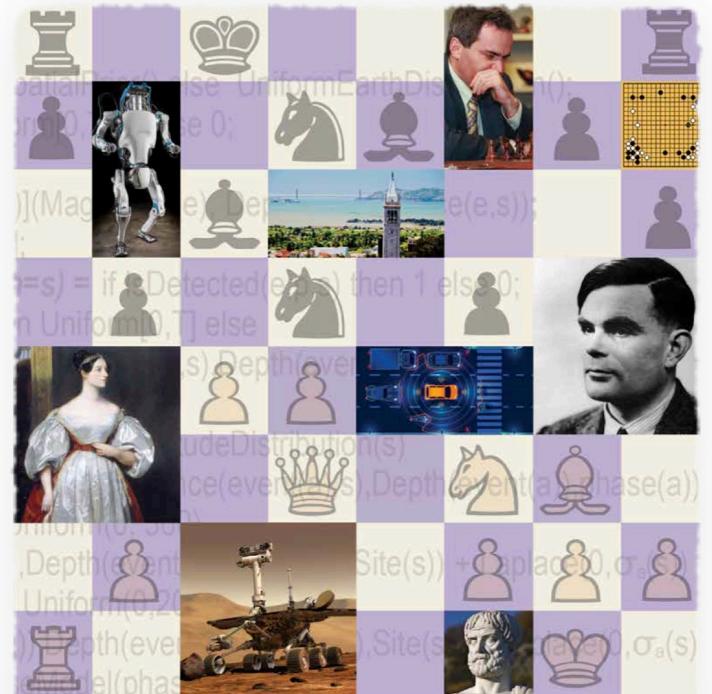
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Look at Your Cellphone

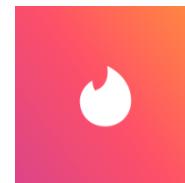
- Which apps are intelligent?



amazon



You Tube



Google
Translate



XTRADE
ONLINE CFD TRADING

- <https://rb.gy/mui9md>
- If the above link does not work use the following:
 - <https://jamboard.google.com/d/1KPTv9WWt4bX83W-vupSiUiKxFOxm3N66gV9GZptj7sg/edit?usp=sharing>

AI in daily life (on your phone)

- Automatic translation
- Chess computer (Game AI in general)
- Face recognition
- Handwriting recognition
- Recommender systems (Amazon)
- Spam-filter
- Speech recognition (Alexa, Cortana, Siri)
- Stock trading
- Weather forecast
- Web search

Chess



- 1997: Deep Blue wins against chess world champion Garry Kasparov

It was an impressive achievement, of course, and a human achievement by the members of the IBM team, but Deep Blue was only intelligent the way your programmable alarm clock is intelligent. Not that losing to a \$10 million alarm clock made me feel any better.

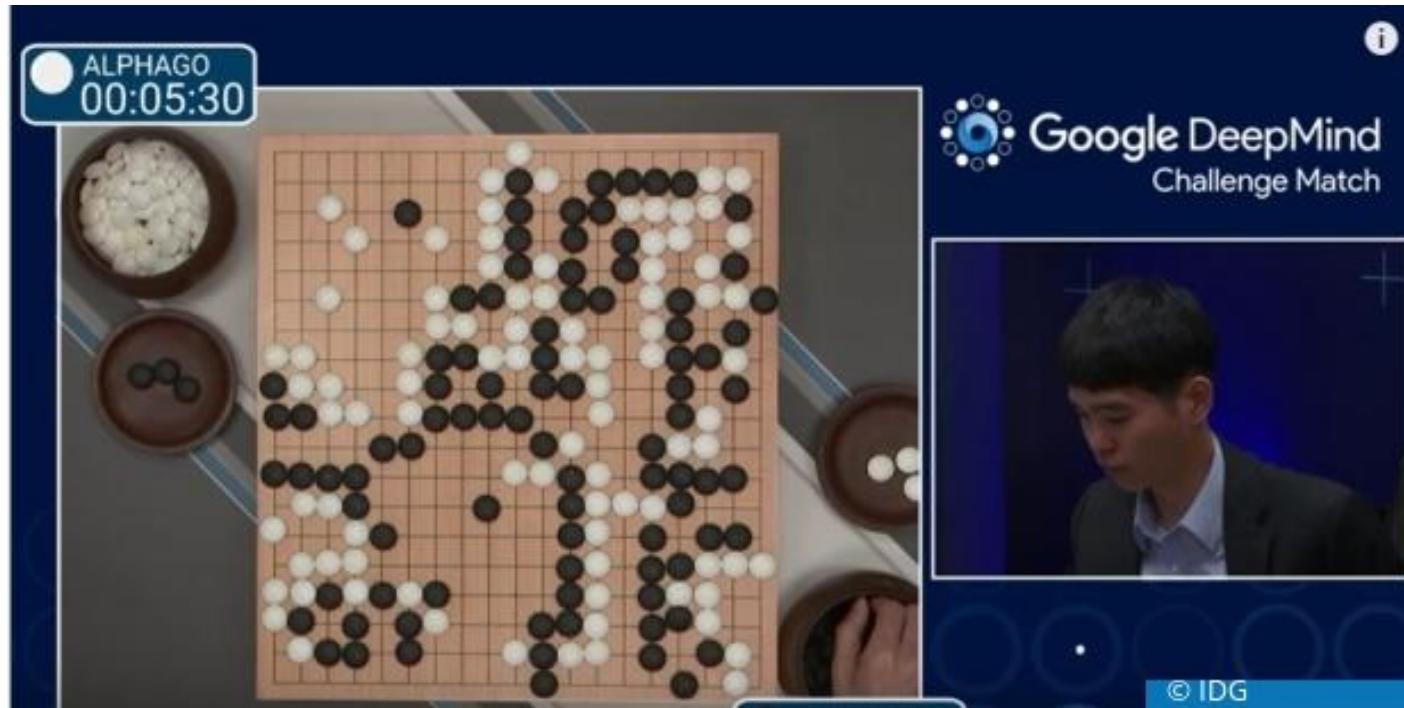
Garry Kasparov





AlphaGo

- 2016: AlphaGo wins against Lee Sedol



<https://www.alphagomovie.com/>

Poker

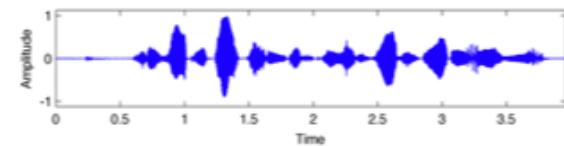
- 2017: Libratus and Deepstack win against professional poker players.



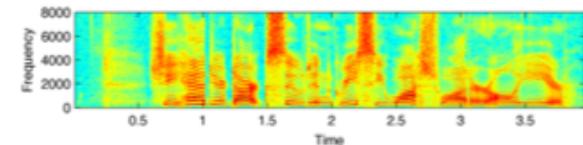
Speech Recognition



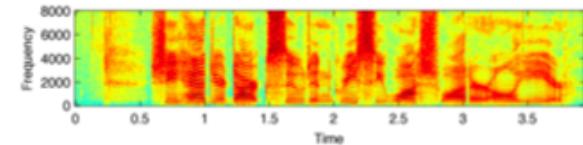
**Time Domain
Waveform**



Spectrogram



**MFCC
Spectrogram**



Machine Translation

German ▾

Künstliche Intelligenz ist ein spannendes Thema, bei dem man immer wieder überrascht ist, wie gut bestimmte Anwendungen funktionieren, während andere vollkommen versagen.



170 / 5000

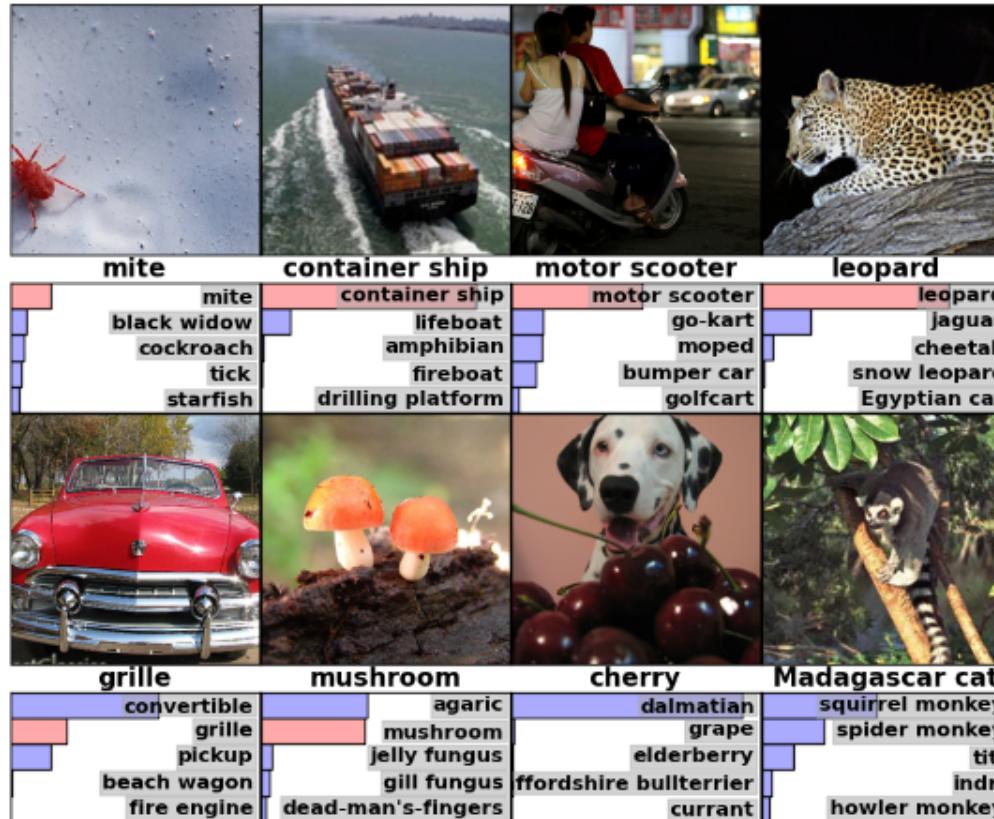


English (US) ▾

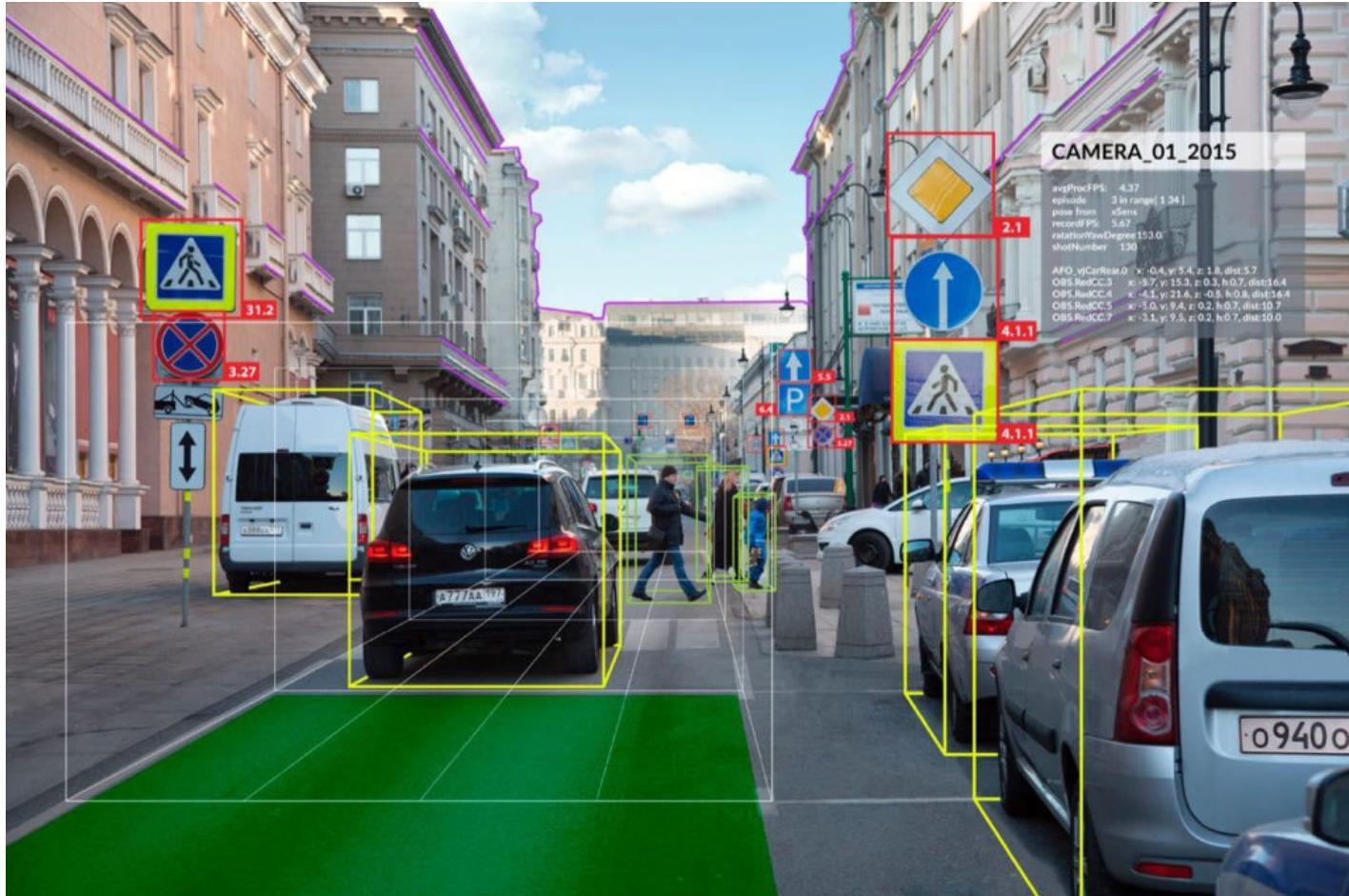
Artificial intelligence is an exciting topic, where one is always surprised at how well certain applications work while others fail completely.



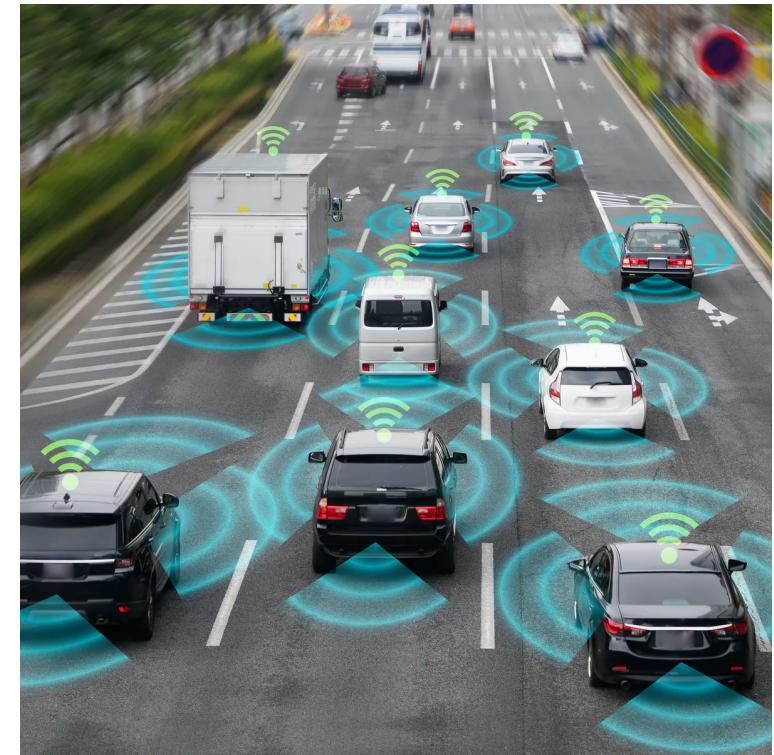
Object Recognition



Object Recognition



Autonomous Vehicles

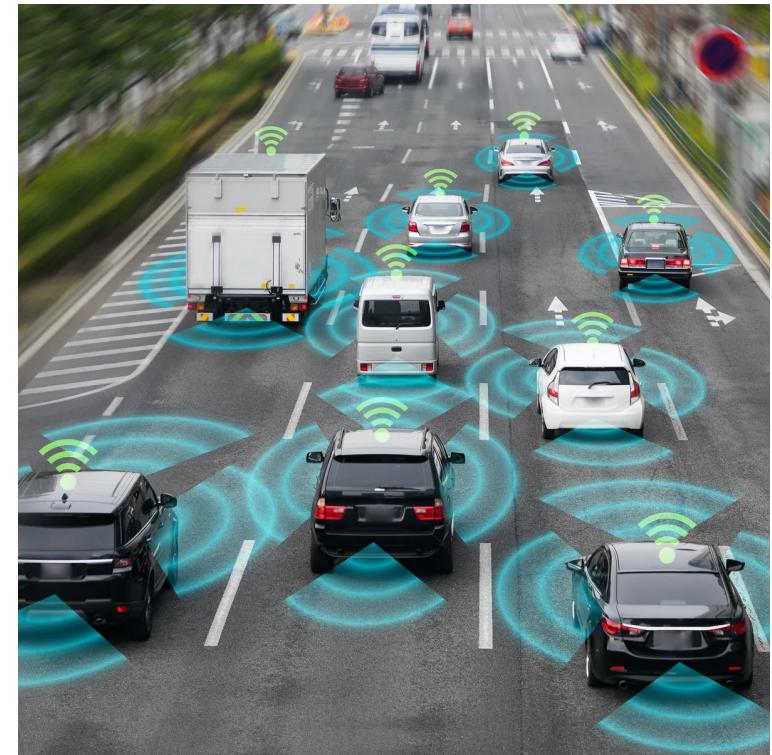


- Put your suggestions in a category of AI applications
 - Image processing
 - Video processing
 - Text processing
 - Signal processing
 - Planning
- <https://rb.gy/mui9md>
- If the above link does not work use the following:
 - <https://jamboard.google.com/d/1KPTv9WWt4bX83W-vupSiUiKxFOxm3N66gV9GZptj7sg/edit?usp=sharing>
 - <https://jamboard.google.com/d/1KPTv9WWt4bX83W-vupSiUiKxFOxm3N66gV9GZptj7sg/edit?usp=sharing>

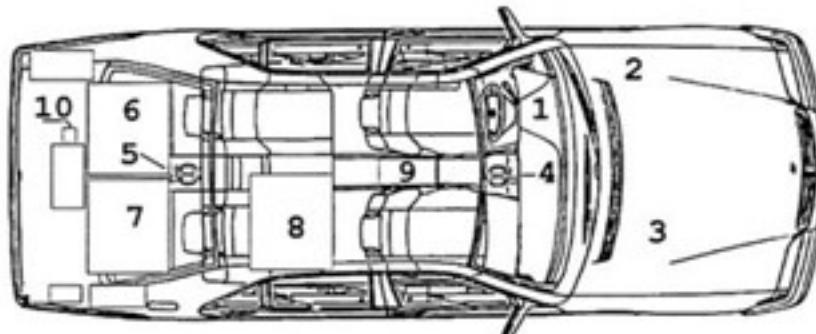
AI Applications

- Put your suggestions in a category of AI applications
 - Image processing
 - Video processing
 - Text processing
 - Signal processing
 - Planning
- These applications have a long history

Autonomous Vehicles



Autonomous Vehicles

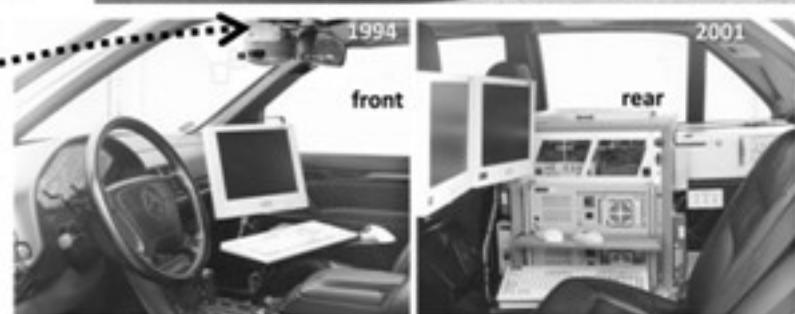


- 1 electrical steering motor
2 electrical brake control
3 electronic throttle
4 front pointing platform for CCD-cameras
5 rear pointing platform

- 6 Transputer Image Processing system
7 platform and vehicle controllers
8 electronics rack, human interface
9 accelerometers (3orthogonal)
10 inertial rate sensors



At distance $L_s \sim 20 \text{ m} (\sim 60 \text{ m})$,
the resolution is 5 cm/pixel



Developed in the 1980ies

1995: a nearly 2000-km drive at up to 130 km/h, almost completely autonomously

Machine Translation

German ▾

Künstliche Intelligenz ist ein spannendes Thema, bei dem man immer wieder überrascht ist, wie gut bestimmte Anwendungen funktionieren, während andere vollkommen versagen.



170 / 5000



English (US) ▾

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Glossary



Machine Translation

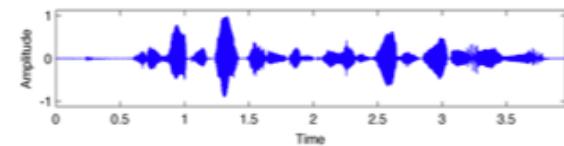


1950ies

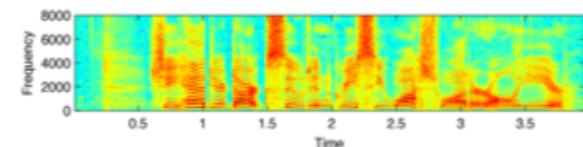
Speech Recognition



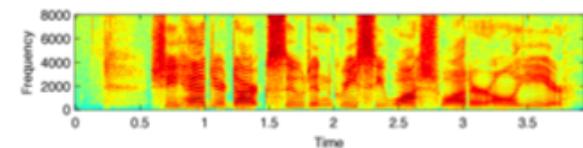
**Time Domain
Waveform**



Spectrogram



**MFCC
Spectrogram**



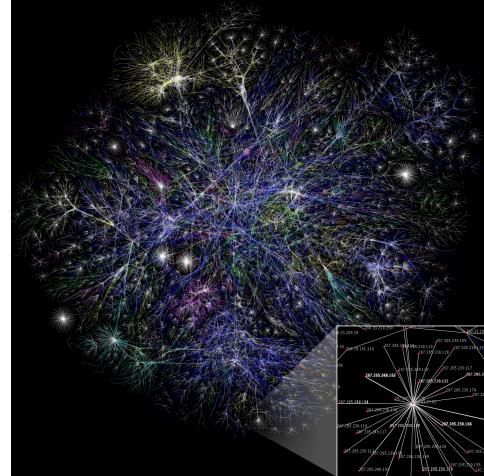
Speech Recognition



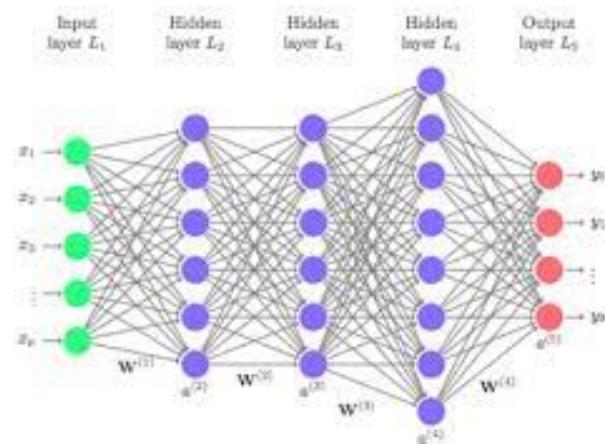
1960ies

Why now?

- Internet
- Compute power
- Algorithms
- Data
- People



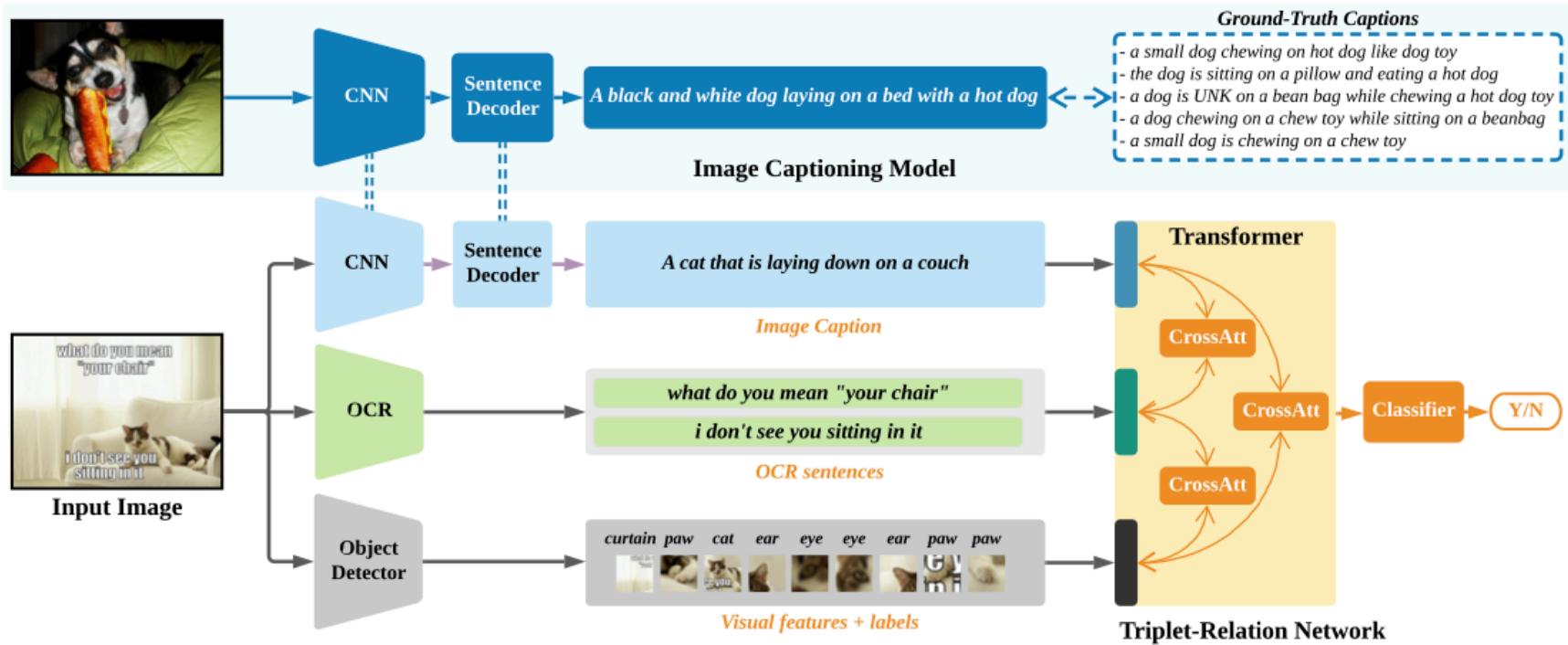
CPU vs TPU vs GPU



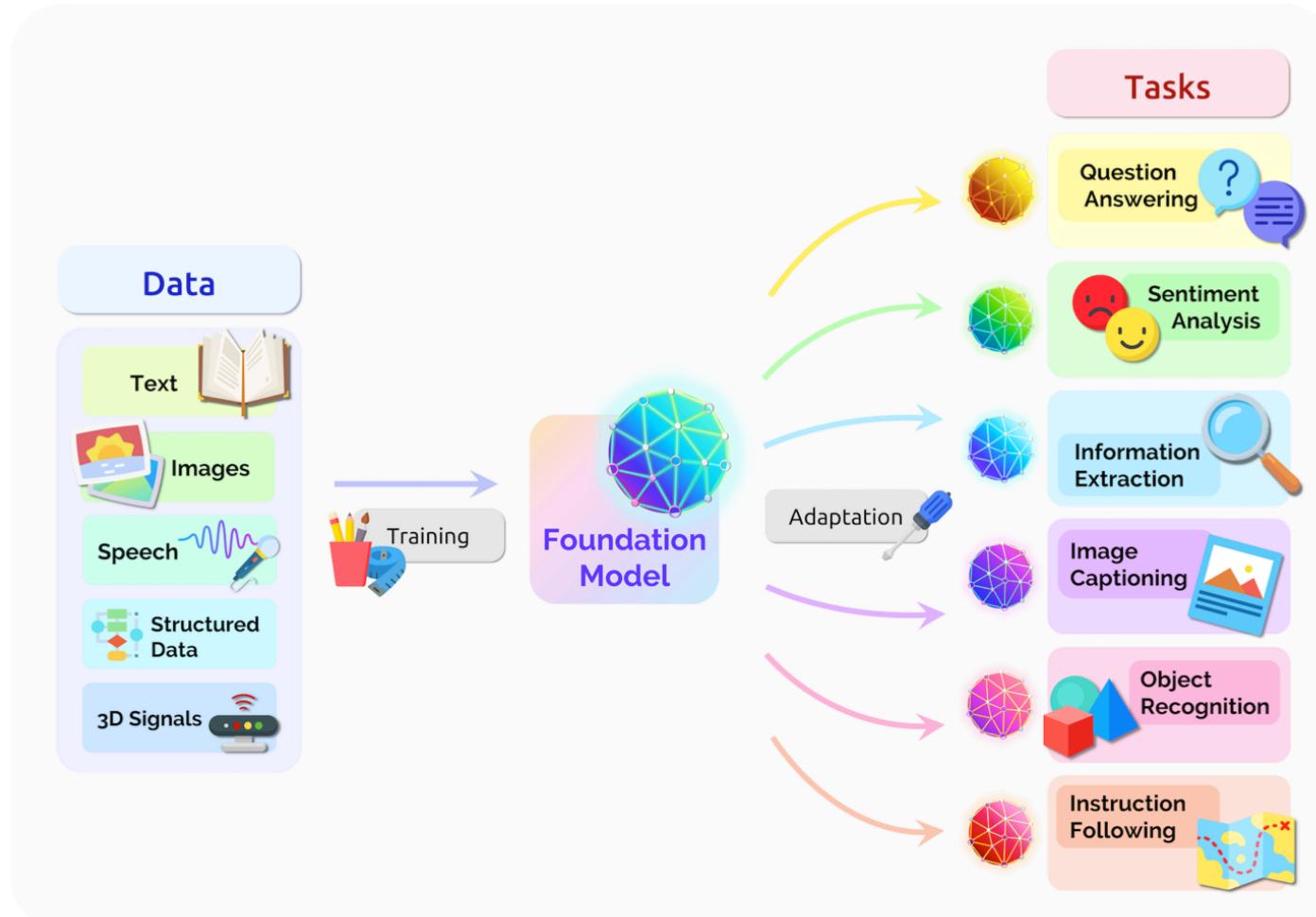
New directions



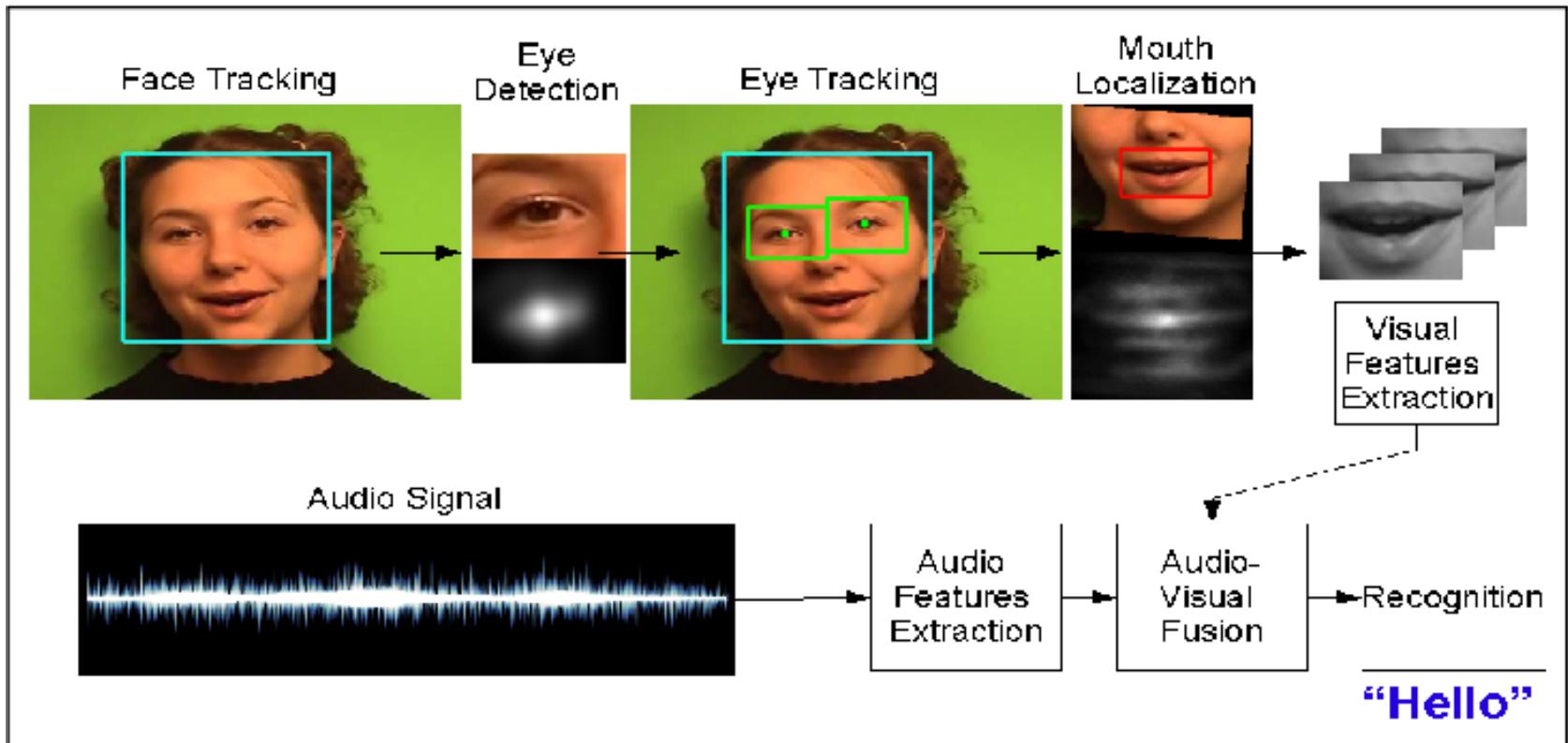
Hateful Meme Detection



Foundation Models



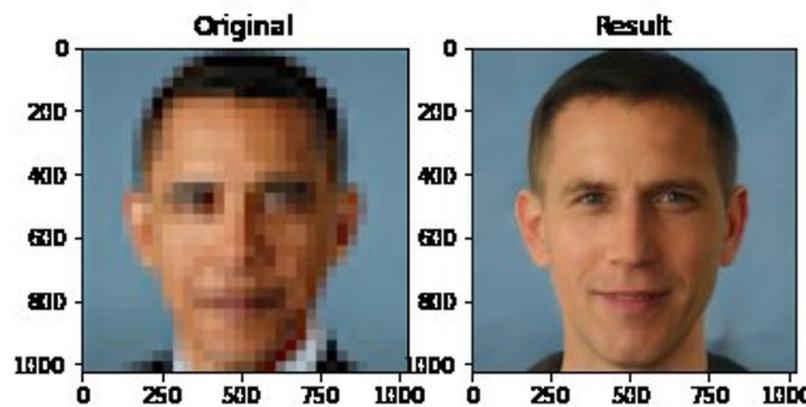
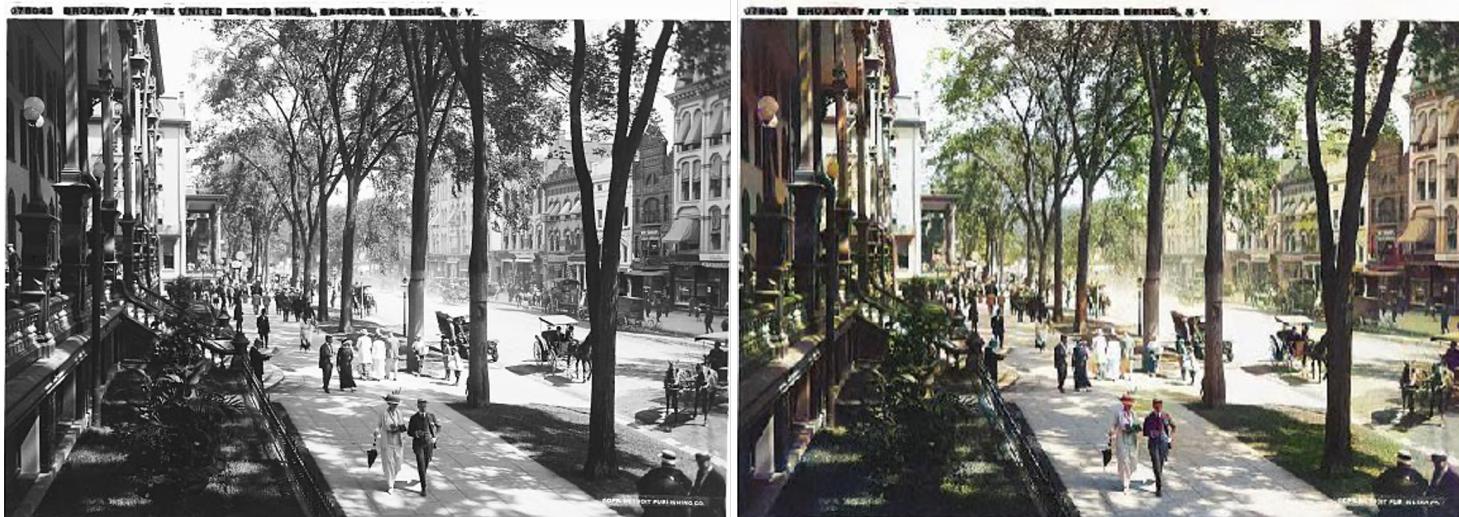
Multi-modal



Dual Use



Dual Use – Image Enhancement



Dual Use – Face Recognition



Dual Use – Social Bots

(1). This model of psychotherapy is being modified because software programs that talk like people (i.e., conversational artificial intelligence, chatbots, digital assistants) are now beginning to provide mental health care (2). Conversational artificial intelligence (AI) is gathering diagnostic information (3, 4) and delivering evidence-based psychological interventions (5–7). Additionally, conversational AI is providing clinicians with feedback on their psychotherapy (8) and talking to young people about suicide, sex, and drug use (9, 10).



<https://www.frontiersin.org/articles/10.3389/fpsy.2019.00746/full#B4>

Write With Transformer distil-gpt2 ⓘ

🔀 Shuffle initial text ⓘ Trigger autocomplete or tab Select suggestion ↑ ↓ and enter Cancel suggestion esc

I think vaccination is dangerous because

the more I get the more I need it.

it may cause cancer or some other illness that makes it difficult to vac...

vaccines are not good for them," he said.

The screenshot shows a user input "I think vaccination is dangerous because" followed by three AI-generated responses. The first response is "the more I get the more I need it." The second response is "it may cause cancer or some other illness that makes it difficult to vac...". The third response is "vaccines are not good for them," he said. The interface includes a unicorn icon, model selection "distil-gpt2", and various keyboard shortcut keys for interacting with the AI suggestions.

Not even dual use

DeepNude deep-nuked: AI photo app stripped clothes from women to render them naked. Now, it's stripped from web

The creator of DeepNude, an app that used a machine learning algorithm to "undress" images of clothed women announced Thursday that he's killing the software, after viral backlash for the way it objectifies women.

Long Road



Next breakthrough?



WE WANT YOU!



Moral
Problems

—SHIFT—



Chat Bots

UNIVERSITÄT
DUISBURG
ESSEN

Offen im Denken



What does such an agent need to do?

- Model world knowledge
- Search for the answer
- Cluster and classify results
- Have confidence about the answer (= deal with uncertainty)
- Learn from previous rounds

→ We will discuss all of these topics.

Course Goals

Intelligent agents:

- intelligence, environments, performance and utility measures

Search in the problem space:

- search and planning algorithms

Dealing with uncertainty:

- probabilistic decision processes

Learning from examples:

- machine learning algorithms
 - e.g. clustering, classification, regression, and deep learning

Artificial Intelligence A (hopefully) motivating Introduction

Administrative Course Issues

Administrative Organization

Moodle page: you are here, so you know where it is ... :)

Office hours: send me a request in Moodle or email me

Literature:

- **Mandatory readings** are crucial for the exam
- **Optional readings** are relevant for your education

Exam

- Written
- Bonus points will be added to exam results (about **10% of final results**)
- Extra bonus points can be used like normal bonus points
 - If maximum bonus points are already reached, up to 5 extra points can be added on top of that
- A single handwritten paper (double-sided) of notes will be allowed in the exam
- Date and room(s) – TBA

Practice Class

- Montag 16-18 Uhr - Jenny - Online - German
- Mittwoch 8-10 Uhr - Clara- In Person - German
- Mittwoch 16-18 Uhr - Mohammed - In Person - English
- Donnerstag 14-16 Uhr - Mohammed - In Person - English
- Freitag 14-16 Uhr - Clara - In Person - German

Start: April 11, 2022



Bonus System

- Each **lecture** contains **homework**, which will be **graded**.
- **Homework is not mandatory**, but you can improve your grade in the exam.
- **Maximum of 10 bonus points**.

- **You can work in groups up to a size of 4.**
- Pay attention to the submission guidelines! **Wrong format is rejected directly.**



Bonus Points for Improvements

Extra bonus points are assigned to students who make substantial improvements to the course:

- Nice visualizations
- Python codes for the practice classes
- Additional practice tasks
- Etc
- **It is left to my sole discretion to decide what counts as substantial.**
“No, making all boxes green is not a substantial change.”
If in doubt, get in touch first.
- Bonus points will be added to exam results (about 10% of final result). Extra bonus points can be used like normal bonus points. If maximum bonus points are already reached, up to 5 extra points can be added on top of that.

Bonus Points for Spotting Mistakes

Everyone makes mistakes. **Lecturers make a lot of them** 😅

One extra bonus point per week is assigned to students who find the most mistakes in the lecture and/or practice class.

- It is left to my sole discretion to decide what counts as a mistake and about the granularity of mistakes.

“No, spotting two typos in one word is not counted as two mistakes.
“

- It is left to my sole discretion to award extra bonus points for mistakes that were especially hard to find.

Your Role

Ask, wonder, doubt, correct, engage, contribute, discuss, argue!



Your Role

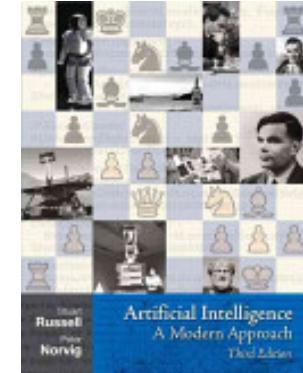
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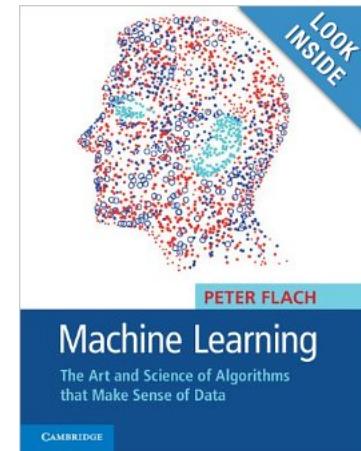
Textbooks

- Stuart Jonathan Russell and Peter Norvig:
Artificial Intelligence: A Modern Approach
Third Edition, Prentice Hall, 2010
<http://aima.cs.berkeley.edu/>

Deutsche Ausgabe: Künstliche Intelligenz: Ein Moderner Ansatz



- Peter Flach:
Machine Learning: The Art and Science of Algorithms that Make Sense of Data
First Edition. Cambridge University Press,
2012



Mandatory Reading

Mandatory:

1. Russell & Norvig
 - Section 1.3: *The history of artificial intelligence*, p.16-27
 - Section 1.4: *The state of the art*, p.27-28
2. Brenden M. Lake, Tomer D. Ullman, Joshua B. Tenenbaum, Samuel J. Gershman (2016): *Building Machines That Learn and Think Like People*.
<https://arxiv.org/pdf/1604.00289.pdf>
 - Section 6: *Looking forward*, p. 38-44.

Optional:

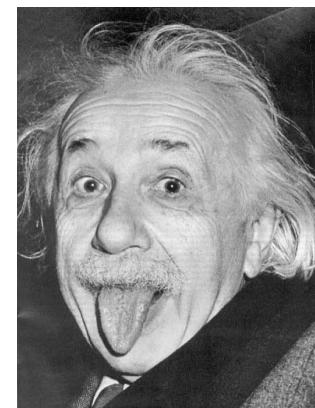
- Russel & Norvig, Section 1.2: *The foundations of artificial intelligence*

Reading Questions: Russel & Norvig

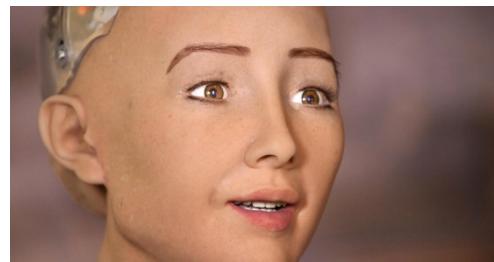
Please answer the following questions in Moodle:

- Early AI systems operated in so-called *microworlds*. Why is it so hard to improve these systems to tackle real-world problems?
Die ersten KI-Systeme waren auf sogenannte *microworlds* beschränkt. Warum ist es so schwierig, diese Systeme auf reale Probleme anzuwenden?
- Explain the term *domain knowledge*. Choose a common smartphone app and describe which kind of knowledge it uses.
Erklären Sie den Begriff Domänenwissen. Wählen Sie eine bekannte Smartphone App und beschreiben Sie, welche Art von Wissen verwendet wird.

Next lecture: What is Intelligence?



Artificial Intelligence = Robots?



Questions

Any questions, suggestions, ...?

Post a message in the Moodle forum

Thank you.