Towards the AI

Presented by Yasin Ceran

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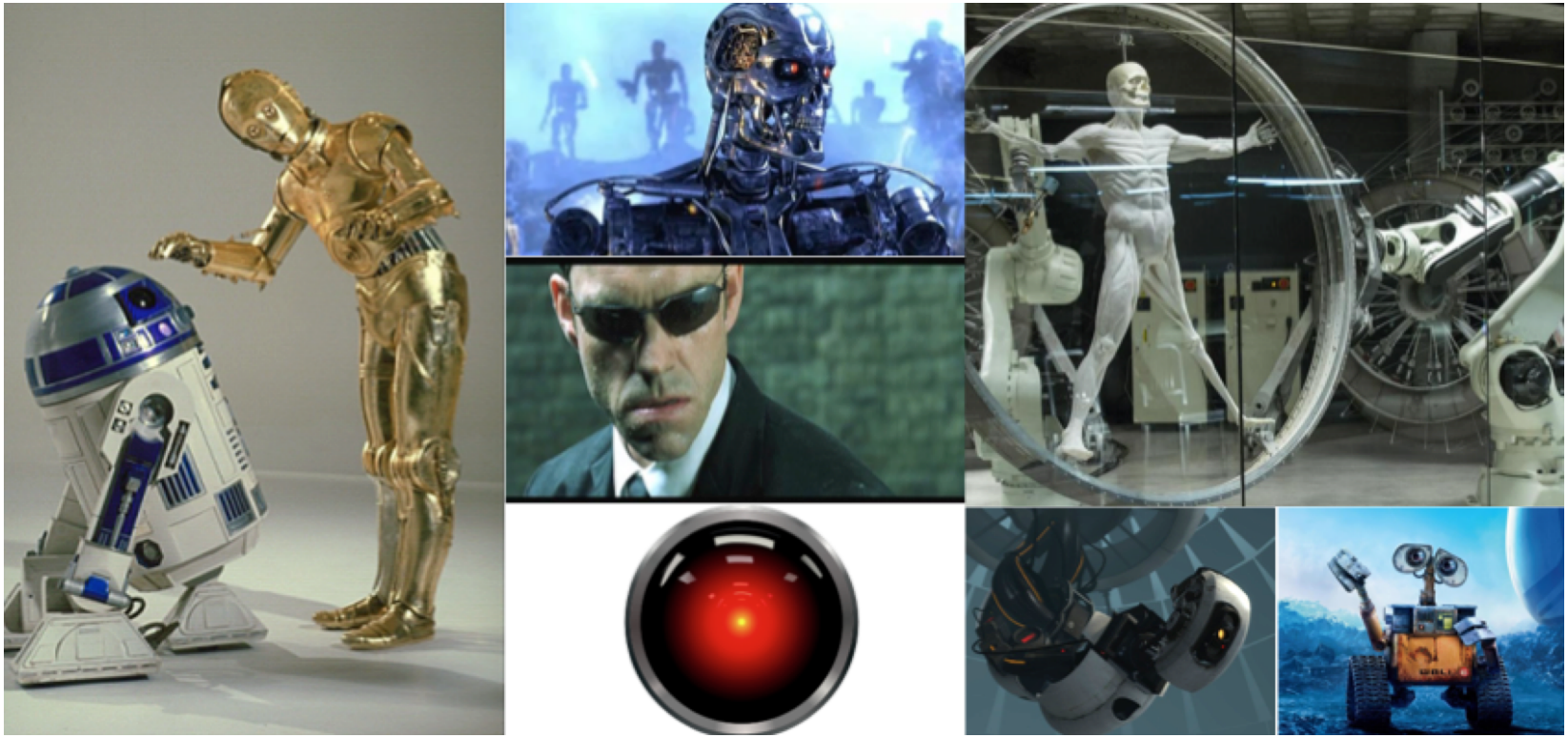
1 What is AI?

2 The History of AI?

3 The State of the Art

4 Risks of AI

What is AI?

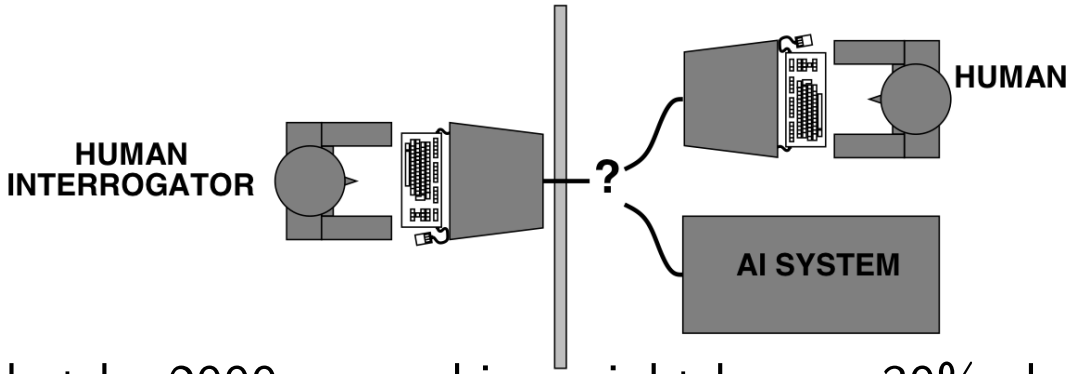


Systems that think like humans	Systems that think rationally
Systems that act like humans	Systems that act rationally

Acting humanly: The Turing test

Turing (1950) "Computing machinery and intelligence":

- "Can machines think?" $\longrightarrow$ "Can machines behave intelligently?"
- Operational test for intelligent behavior: the Imitation Game



- Predicted that by 2000, a machine might have a 30% chance of fooling a lay person for 5 minutes
- Anticipated all major arguments against AI in following 50 years
- Suggested major components of AI: knowledge, reasoning, language, understanding, learning

Thinking humanly: Cognitive Science

To say that a program thinks like a human, we must know how humans think. We can learn about human thought by:

- introspection $\longrightarrow$ trying to catch our own thoughts as they go by
- psycological experiments $\longrightarrow$ observing a person in action
- brain imaging $\longrightarrow$ observing the brain in action

Thinking rationally: Laws of Thought

- Aristotle: what are correct arguments/thought processes?

  Several Greek schools developed various forms of logic: **notation** and **rules of derivation** for thoughts

  Socrate is a man, all man are mortal, then Socrate is mortal

- Logic requires the knowledge of the world that is certain. The therory of probability allows rigorous reasoning with uncertain information

- Probability allows the construction of comprehensive model of rational thought leading from raw data to predictions about the future. However, it does not generate intelligent behavior.

Acting rationally

Rational behavior: doing the right thing

The right thing: that which is expected to maximize goal achievement, given the available information

Doesn't necessarily involve thinking—e.g., blinking reflex—but thinking should be in the service of rational action

Aristotle (Nicomachean Ethics):

Every art and every inquiry, and similarly every action and pursuit, is thought to aim at some good

Rational agents

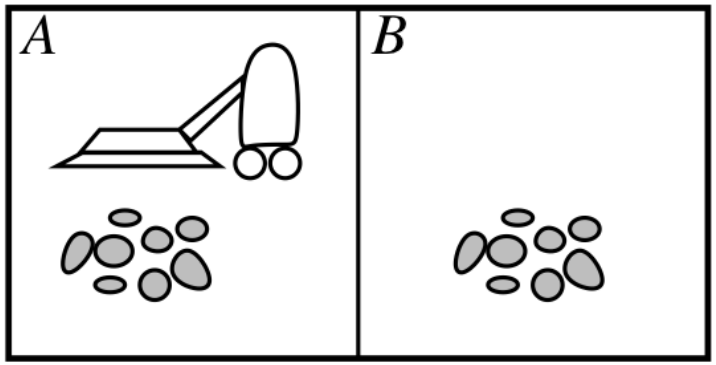
An agent is an entity that perceives and acts

Abstractly, an agent is a function from percept histories to actions:

$$f : \mathcal{P}^* \rightarrow \mathcal{A}$$

For any given class of environments and tasks, we seek the agent (or class of agents) with the best performance

Vacuum-Cleaner World



Percepts: location and contents, e.g., $[A, Dirty]$

Actions: *Left*, *Right*, *Suck*, *NoOp*

A vacuum-cleaner agent

Percept sequence	Action
[*A*, *Clean*]	*Right*
[*A*, *Dirty*]	*Suck*
[*B*, *Clean*]	*Left*
[*B*, *Dirty*]	*Suck*
[*A*, *Clean*], [*A*, *Clean*]	*Right*
[*A*, *Clean*], [*A*, *Dirty*]	*Suck*
⋮	⋮

function Reflex-Vacuum-Agent([*location*,*status*]) **returns** an action

if *status* = *Dirty* **then return** *Suck*
else if *location* = *A* **then return** *Right*
else if *location* = *B* **then return** *Left*

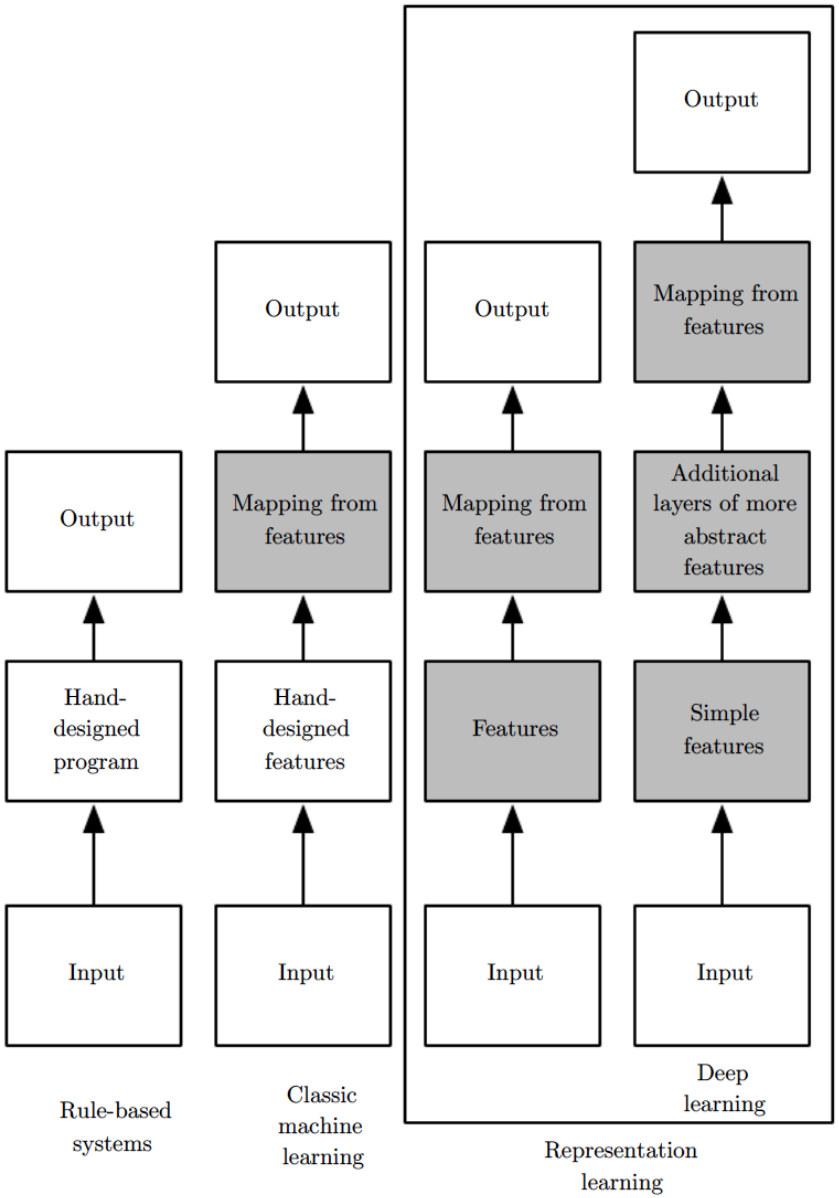
What is the **right** function?
Can it be implemented in a small agent program?

History of AI

1943-1956	The inception of artificial intelligence
1952–69	Early enthusiasm, great expectations
1966–73	AI discovers computational complexity
	Neural network research almost disappears
1969–86	Expert systems industry booms
1986–	Neural networks return to popularity
1987–	Probabilistic reasoning and Machine Learning
2001–	Big Data
2011–	Deep Learning

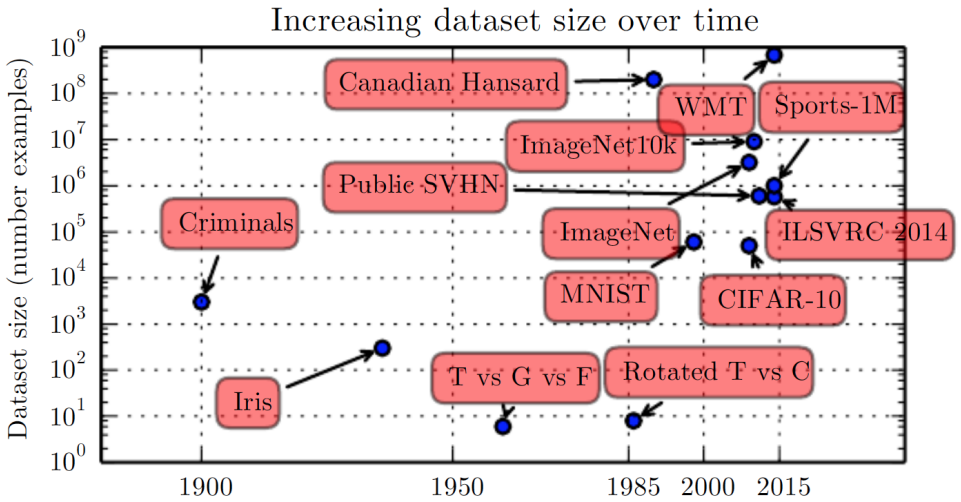
Watch the short movie on History of AI

ML vs DL


Output
Hand-designed program
Input
Rule-based systems
Output
Mapping from features
Hand-designed features
Input
Classic machine learning
Output
Mapping from features
Features
Input
Output
Mapping from features
Additional layers of more abstract features
Simple features
Input
Deep learning
Representation learning

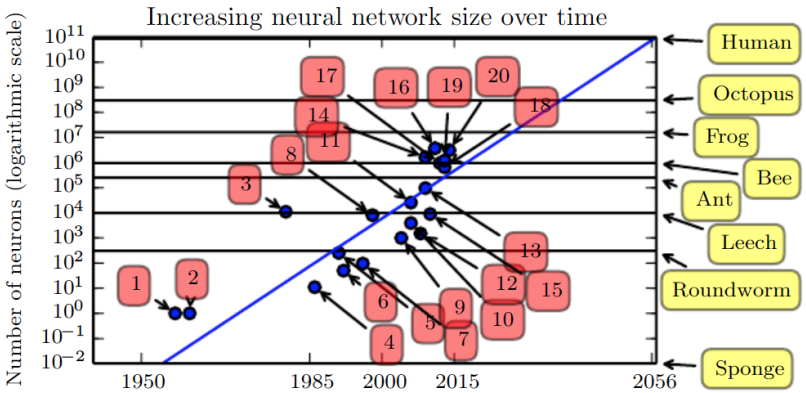
Deep Learning and Increasing Data Sizes

- The amount of skill required reduces as the amount of training data increases. The learning algorithms reaching human performance on complex tasks today are nearly identical to the learning algorithms that struggled to solve toy problems in the 1980s
- As of 2016, a rough rule of thumb is that a supervised deep learning algorithm will generally achieve acceptable performance with around 5,000 labeled examples per category, and will match or exceed human performance when trained with a dataset containing at least 10 million labeled examples.



Deep Learning and Increasing Model Sizes

- Another key reason that neural networks are wildly successful today after enjoying comparatively little success since the 1980s is that we have the computational resources to run much larger models today.
- One of the main insights of connectionism is that animals become intelligent when many of their neurons work together. An individual neuron or small collection of neurons is not particularly useful.



AI is Around Us

- AI papers increased 20-fold between 2010 and 2019: 20,000 year
- About 70% of the news article on AI are positive. The most common issues are: data privacy and algorithm bias
- Course enrollment increased 5-fold in the Us and 16-fold internationally from a 2010 baseline
- AI professors worldwide are about 80% male and 20% female
- AI startups in the US increased 20-fold to over 800
- China publishes more papers than US and about as many as all of Europe
- Error rates for object detection in visual applications improved from 28% in 2010 to 2% in 2017, exceeding human performance
- Accuracy on question answering increased from 60 to 95% from 2015 to 2019, exceeding human performance
- By 2019, AI systems had reportedly met or exceeded human-level performance in chess, Go, poker, PacMan, Jeopardy, ImageNet object detection, speech recognition in a limited domain, Chinese-to-English translation, various Atari games, skin and prostate cancer detection

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State of the Art

- Play a decent game of table tennis
- Drive safely along a curving mountain road
- Drive safely along at KAIST
- Buy a week's worth of groceries on the web
- Discover and prove a new mathematical theorem
- Design and execute a research program in molecular biology
- Write an intentionally funny story
- Give competent legal advice in a specialized area of law
- Translate spoken English into spoken Swedish in real time
- Converse successfully with another person for an hour
- Perform a complex surgical operation
- Unload any dishwasher and put everything away

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AI in Medicine

AI algorithms now equal or exceed expert doctors at diagnosing many conditions, particularly when the diagnosis is based on images.

Watch AI_Healthcare.mp4

AI in Robotic Vehicles

- The history of robotic vehicles go back to radio-controlled cars of 1920
- The first demonstrations of autonomous cars occurred in 1980s
- In 2018, Waymo test vehicles passed the landmark of 10 million driven in public roads without a serious accident

Watch 5-AI_AutoVehicles.mp4

Behavioral Prediction

Is it only utility based service or violation of privacy?

Watch 6-AI_Privacy.mp4