What is AI?

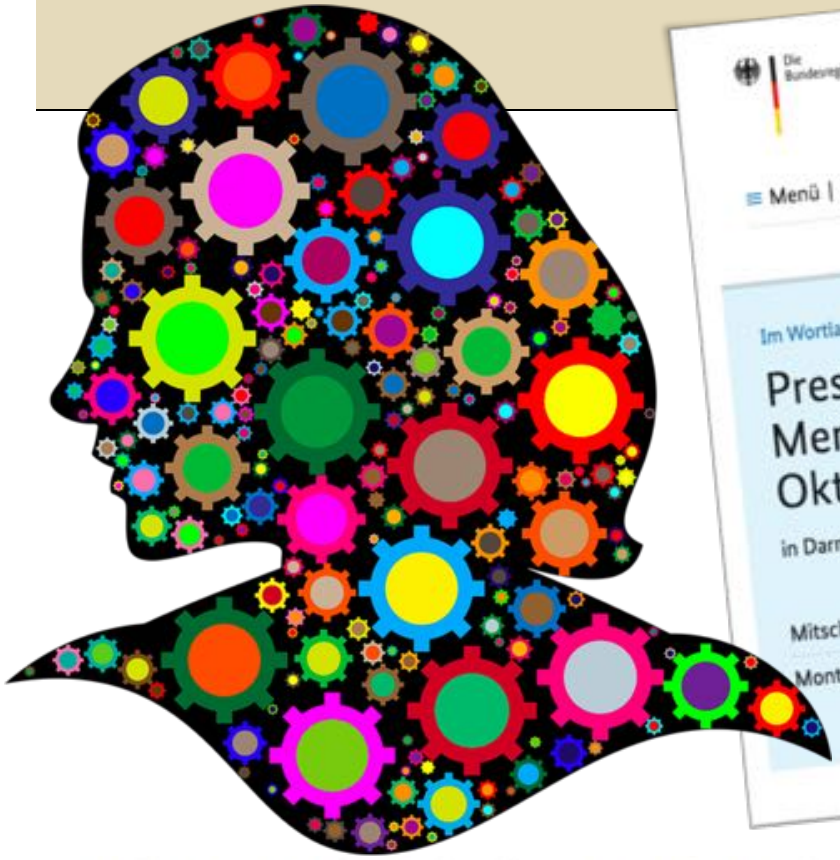
TECHNISCHE UNIVERSITÄT DARMSTADT

Centre for Cognitive Science

Fachbereich Informatik

ELLIS European Laboratory for Learning and Intelligent Systems

CLAIRE CONFEDERATION OF LABORATORIES FOR ARTIFICIAL INTELLIGENCE RESEARCH IN EUROPE



Machine Learning and Artificial Intelligence: Two Fellow Travelers on the Quest for Intelligent Behavior in Machines

Kristian Kersting

Frontiers in Big Data
Published on 19 Nov 2018

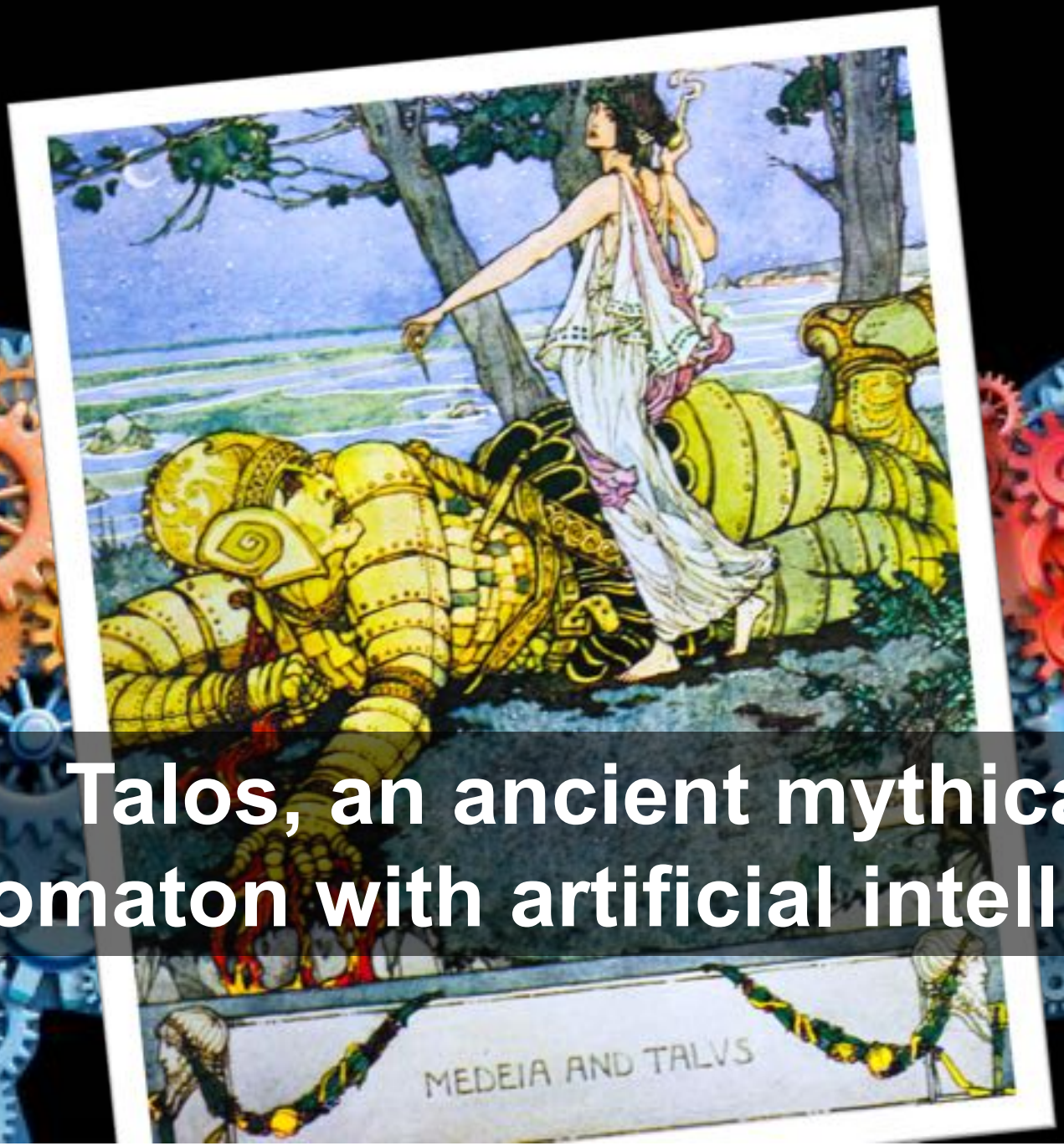
OPEN ACCESS

Prof. Dr. Kristian Kersting

Lernende Systeme
DIE PLATTFORM FÜR KÜNSTLICHE INTELLIGENZ

Federal Ministry of Education and Research

The dream of AI is not new

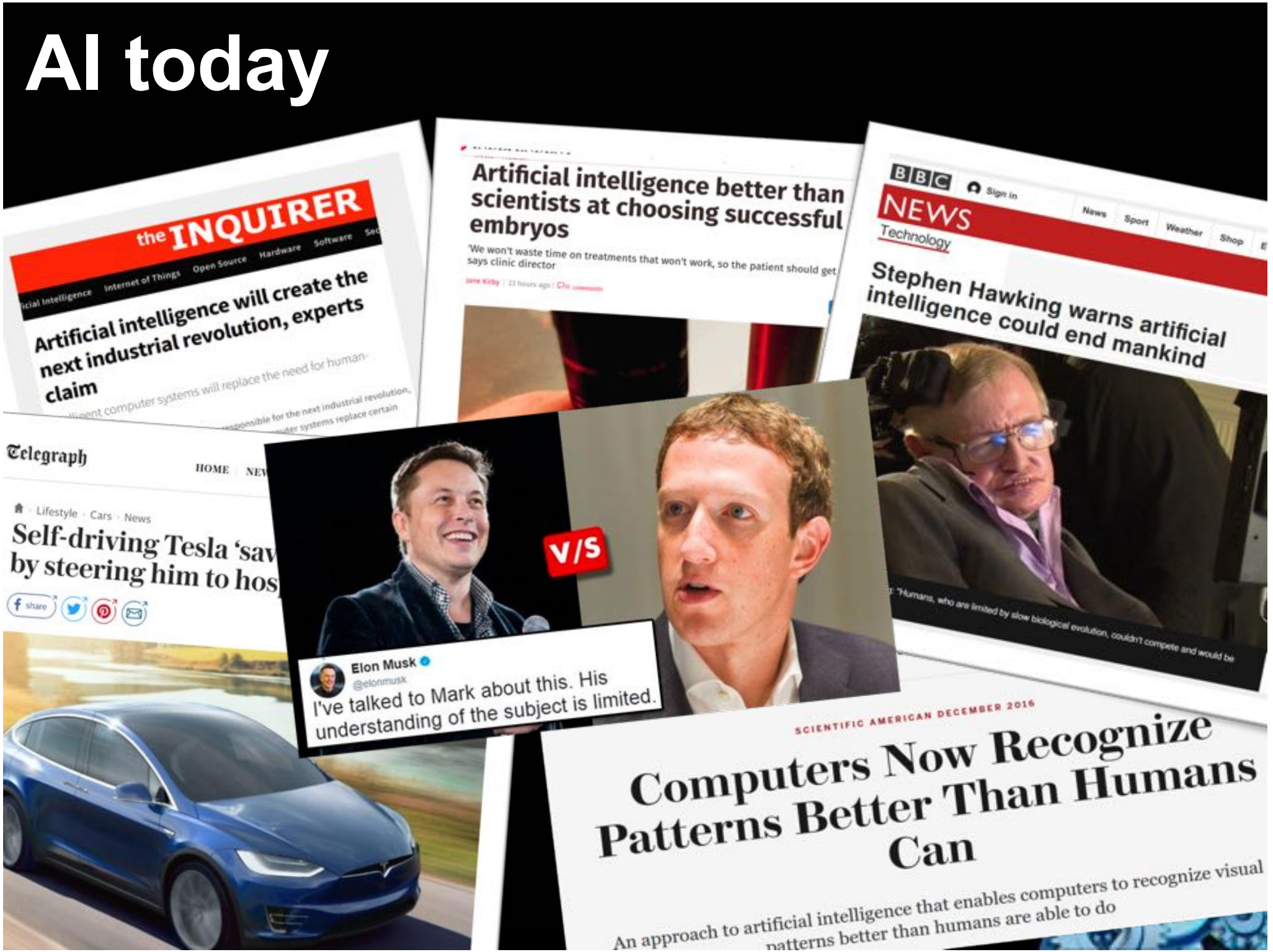


Talos, an ancient mythical automaton with artificial intelligence

The dream of AI is not new

Leibniz „philosophises about `artificial intelligence‘ (AI). In order to prove the impossibility of thinking machines, Leibniz imagines of `a machine from whose structure certain thoughts, sensations, perceptions emerge“ — Gero von Randow, ZEIT 44/2016

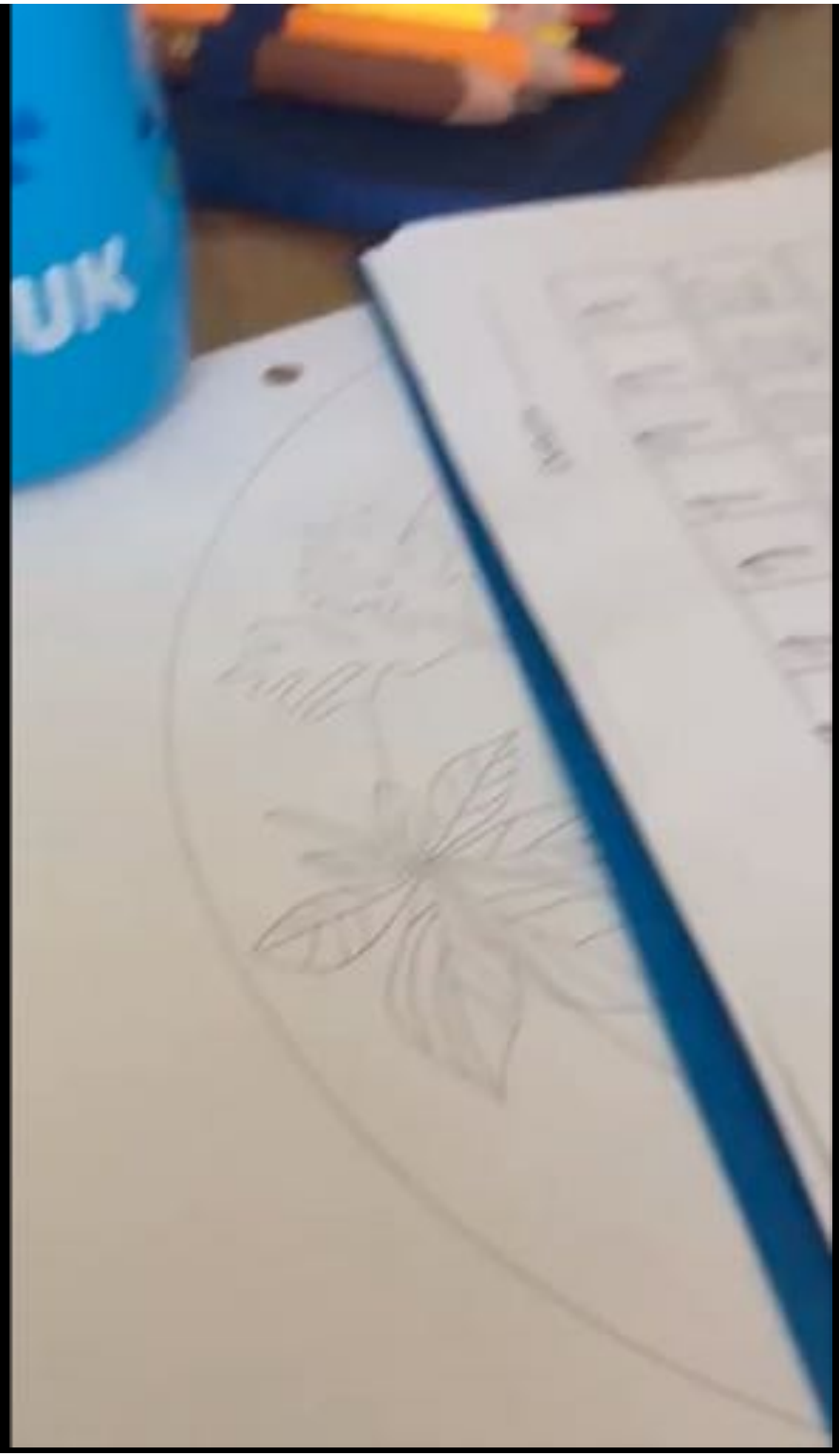
AI today


the INQUIRER
Artificial intelligence will create the next industrial revolution, experts claim
Artificial intelligence better than scientists at choosing successful embryos
'We won't waste time on treatments that won't work, so the patient should get
says clinic director
BBC
NEWS
Technology
Stephen Hawking warns artificial intelligence could end mankind
Telegraph
Lifestyle · Cars · News
Self-driving Tesla 'sav
by steering him to hos
V/S
Elon Musk
@elonmusk
I've talked to Mark about this. His understanding of the subject is limited.
SCIENTIFIC AMERICAN DECEMBER 2016
Computers Now Recognize Patterns Better Than Humans Can
An approach to artificial intelligence that enables computers to recognize visual

So, AI has many faces

Humans are smart

https://www.youtube.com/watch?v=XQ79UUlOeWc

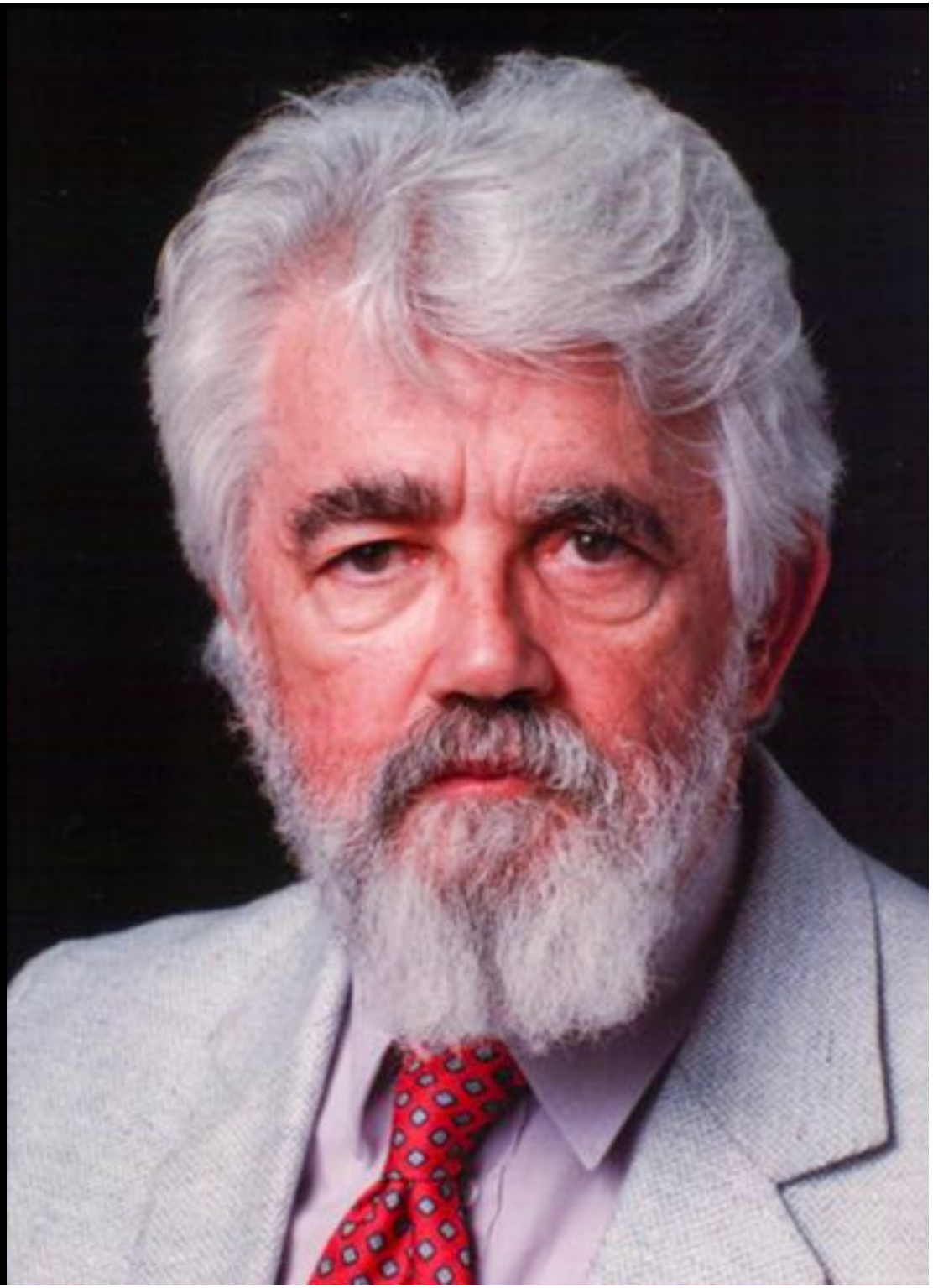


AI asks, can machines be smart, too?

„the science and engineering of making intelligent machines, especially intelligent computer programs.

It is related to the similar task of using computers to understand human intelligence, but AI does not have to confine itself to methods that are biologically observable.“

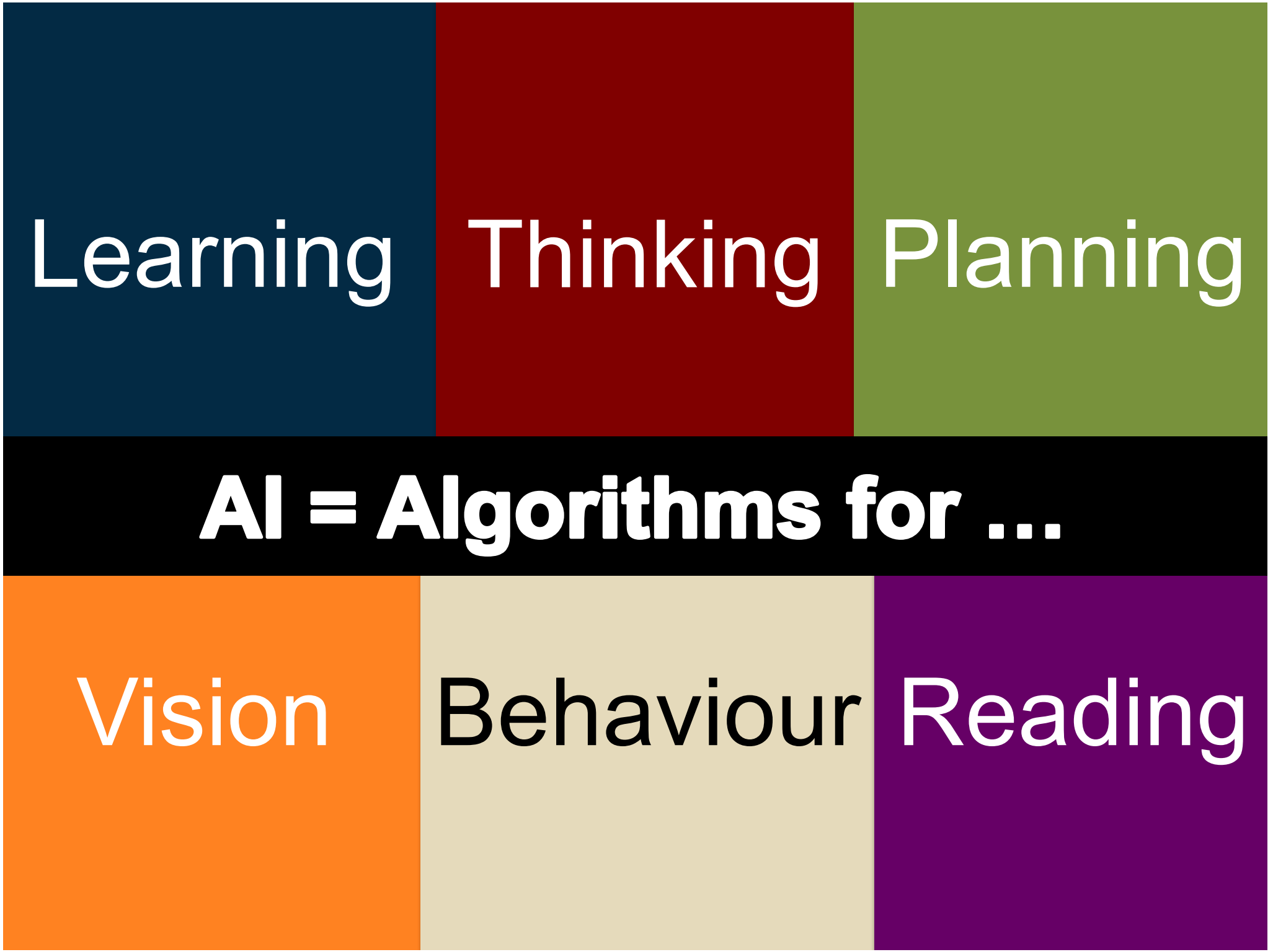
- John McCarthy, Stanford (1956), coined the term AI, Turing Awardee



AI wants to build intelligent computer programs. How do we do this?

We use algorithms:
unambiguous specifications of how to solve a class of problems – in finite time.

Think of it as a recipe!


Learning
Thinking
Planning
AI = Algorithms for ...
Vision
Behaviour
Reading

Machine Learning

the science "concerned with the question of how to construct computer programs that automatically improve with experience”

- Tom Mitchell (1997) CMU

Deep Learning

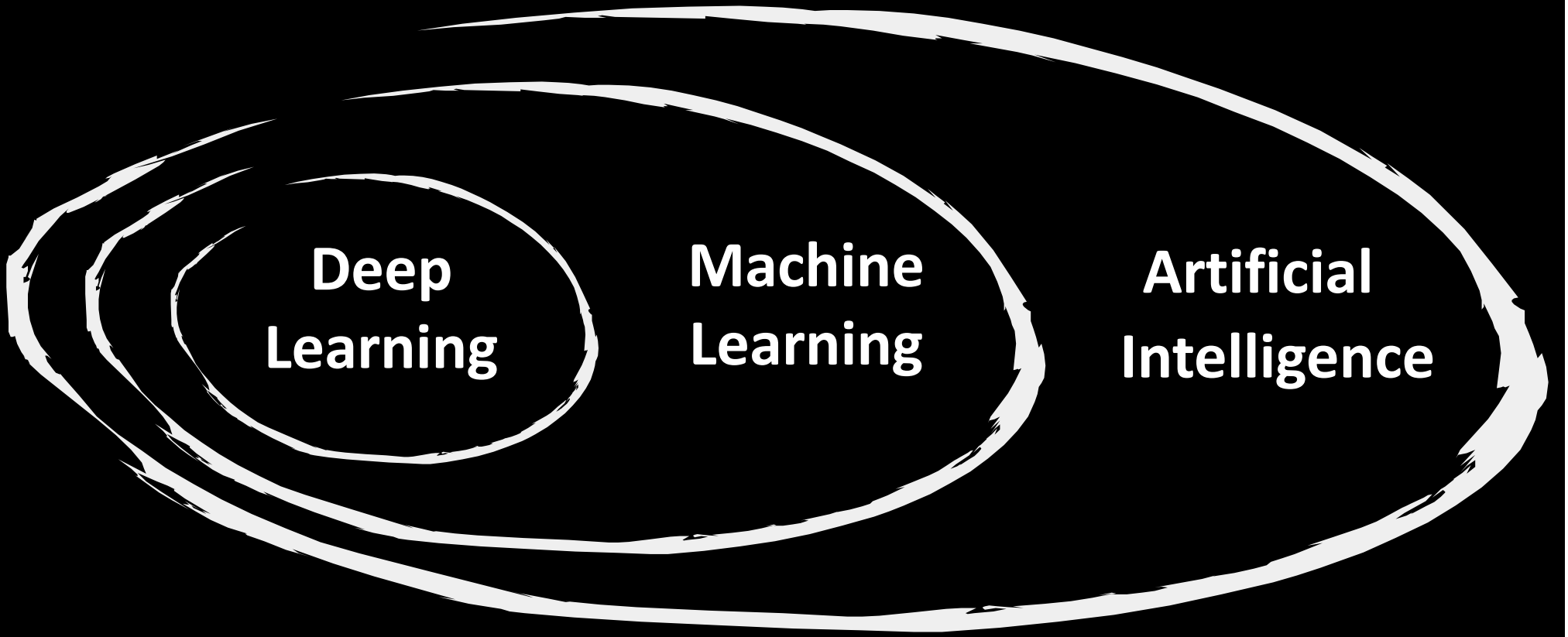
a form of machine learning that makes use of artificial neural networks

Geoffrey Hinton
Google
Univ. Toronto (CAN)

Yann LeCun
Facebook (USA)

Yoshua Bengio
Univ. Montreal (CAN)

Overall Picture



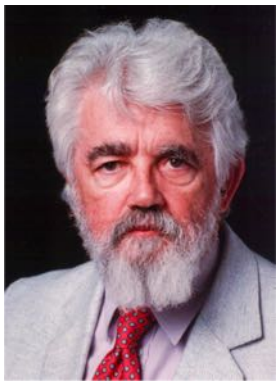
1956
AI is Born

A Proposal for the

DARTMOUTH SUMMER RESEARCH PROJECT ON ARTIFICIAL INTELLIGENCE

We propose that a 2 month, 10 man study of artificial intelligence be carried out during the summer of 1956 at Dartmouth College in Hanover, New Hampshire. 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. We think that a significant advance can be made in one or more of these problems if a carefully selected group of scientists work on it together for a summer.

Dartmouth Conference



John McCarthy

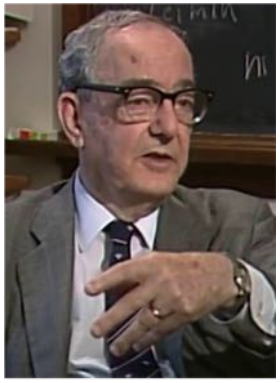
Turing Award 1971

Marvin Minsky

Turing Award 1969

Allen Newell

Turing Award 1975

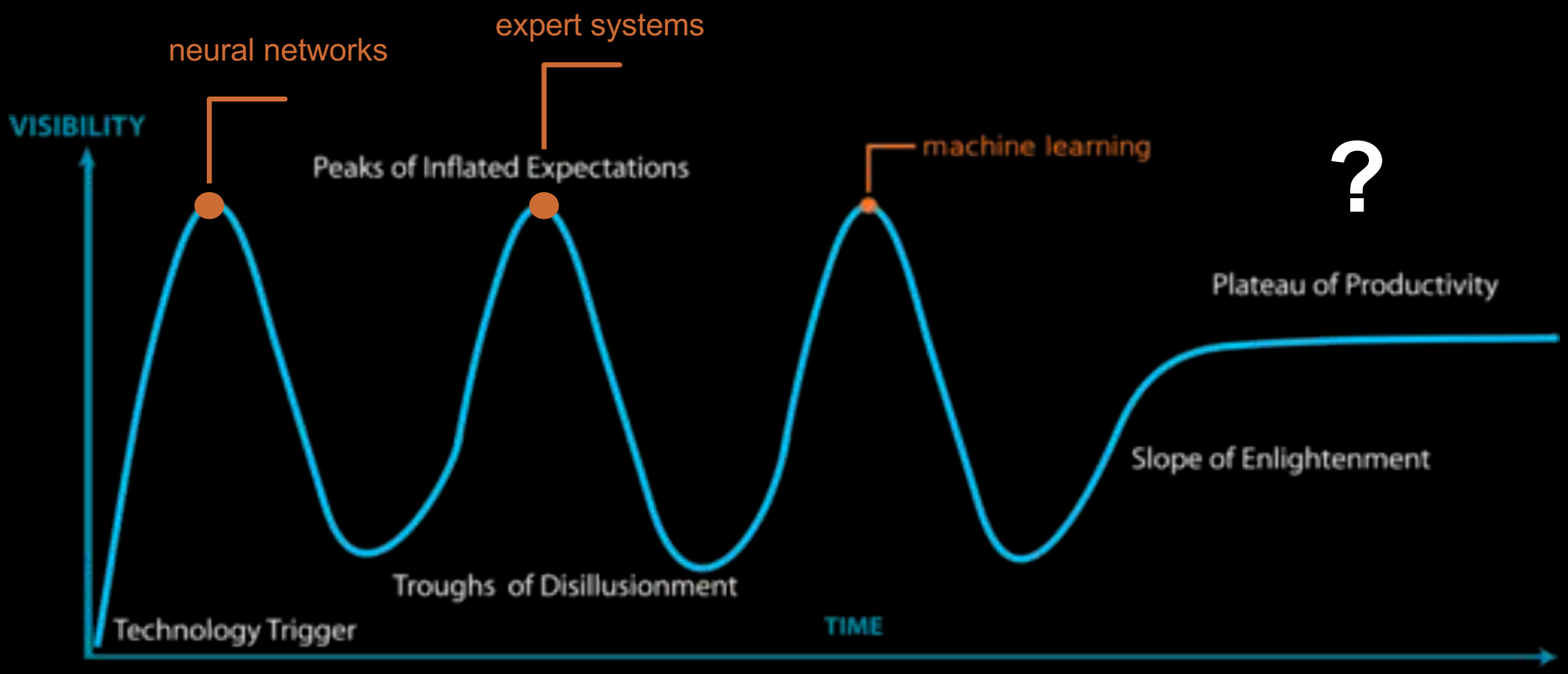


Herbert A. Simon

Turing Award 1975

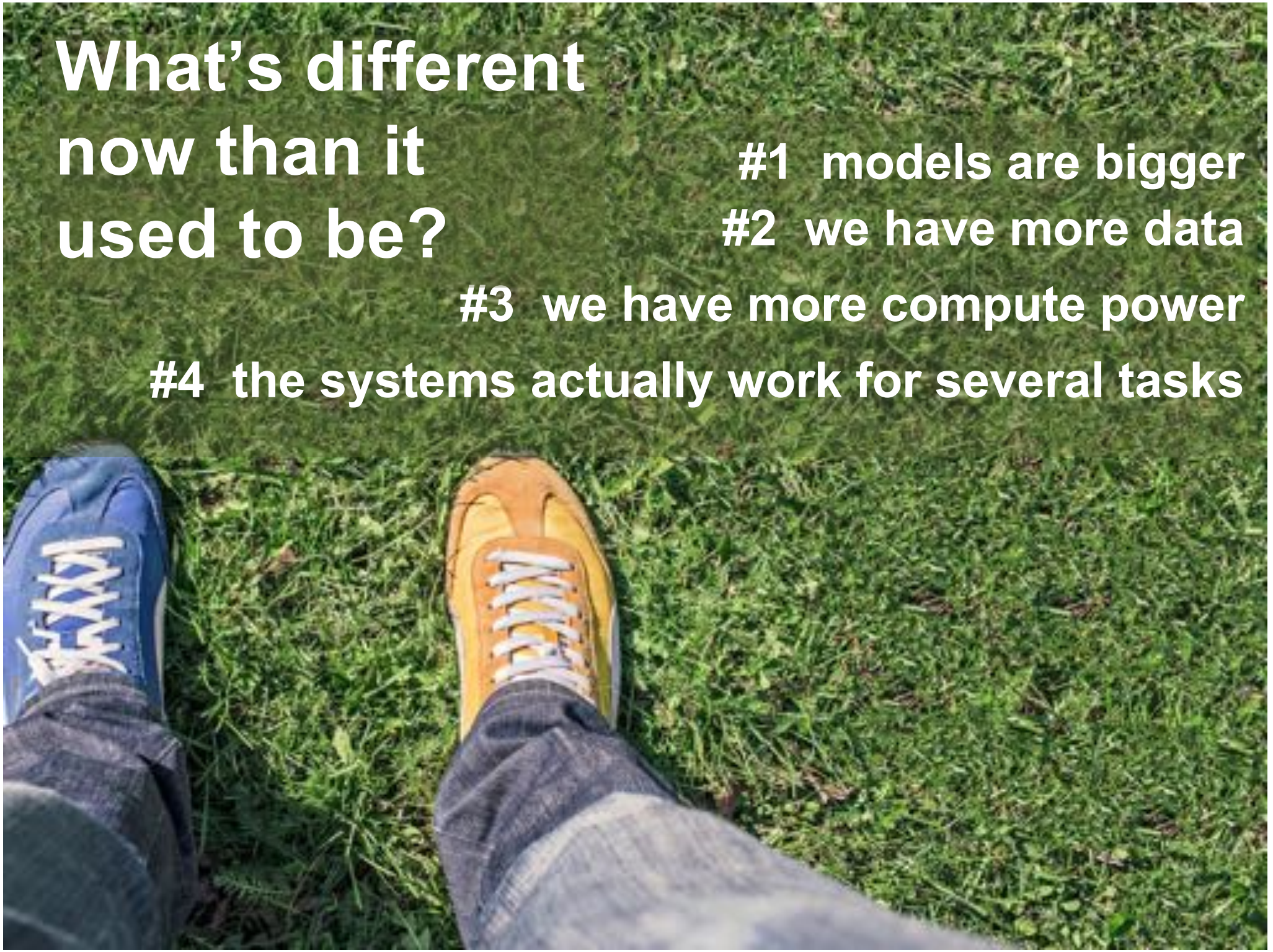
Nobel Prize 1978

Since 2010s: Deep Learning — “akin to the human brain”, millions of simple compute units process informations

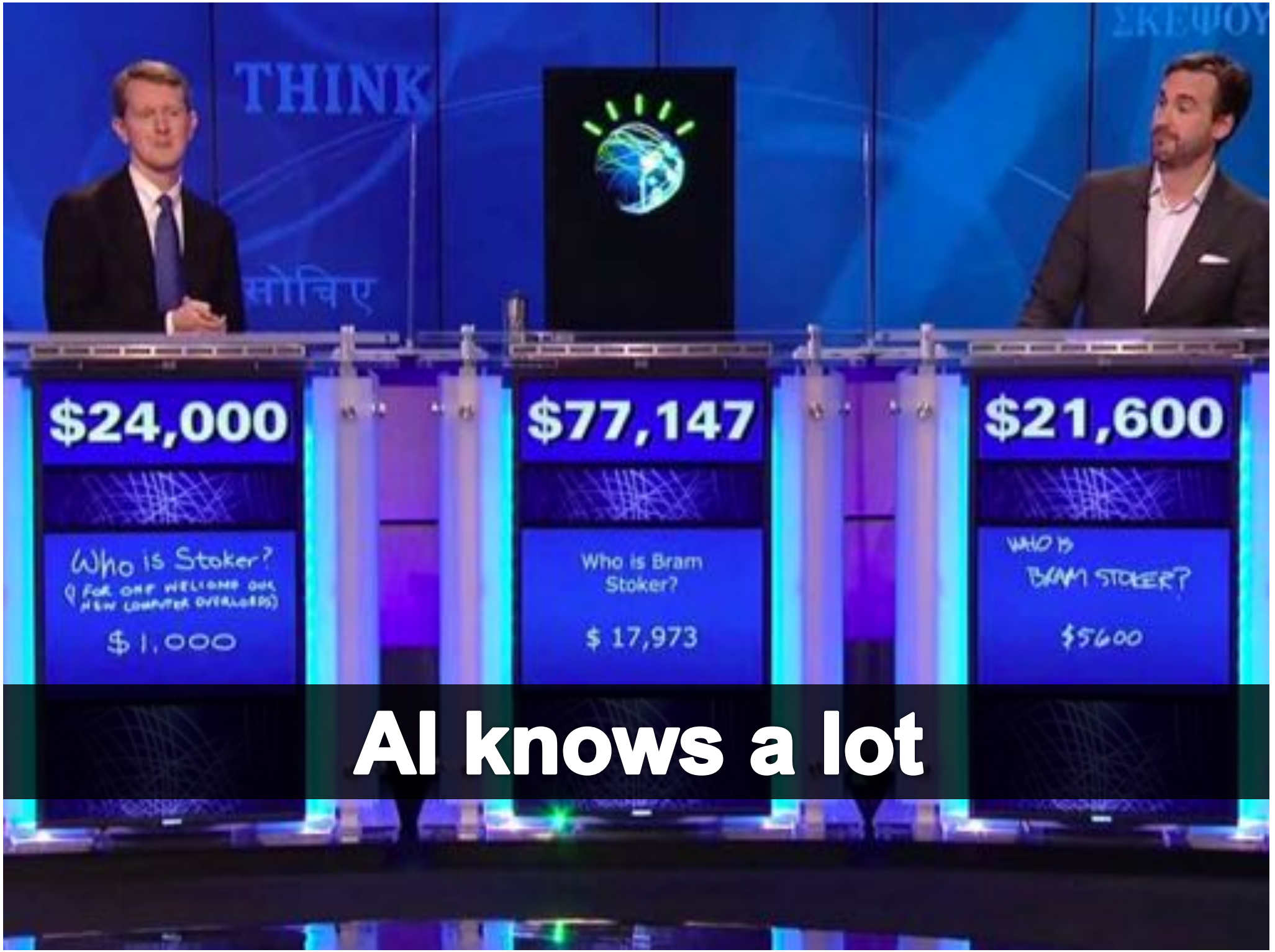


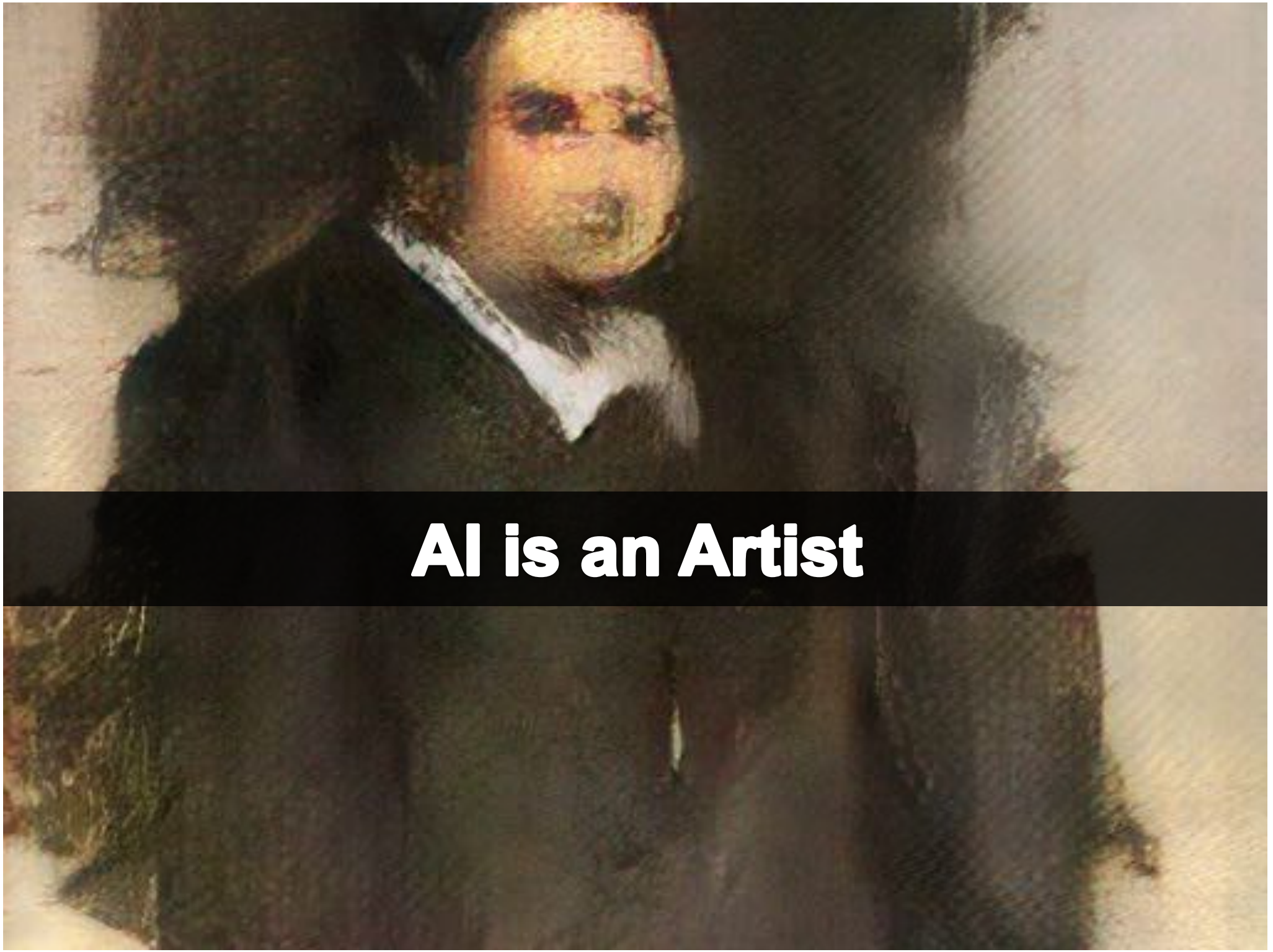
1956

2019


What's different now than it used to be?
#1 models are bigger
#2 we have more data
#3 we have more compute power
#4 the systems actually work for several tasks


AI does the
laundry


THINK
$24,000
Who is Stoker?
$ 1,000
$77,147
Who is Bram Stoker?
$ 17,973
$21,600
WHO IS BRAM STOKER?
$5600
AI knows a lot


AI is an Artist

TECHNISCHE UNIVERSITÄT DARMSTADT

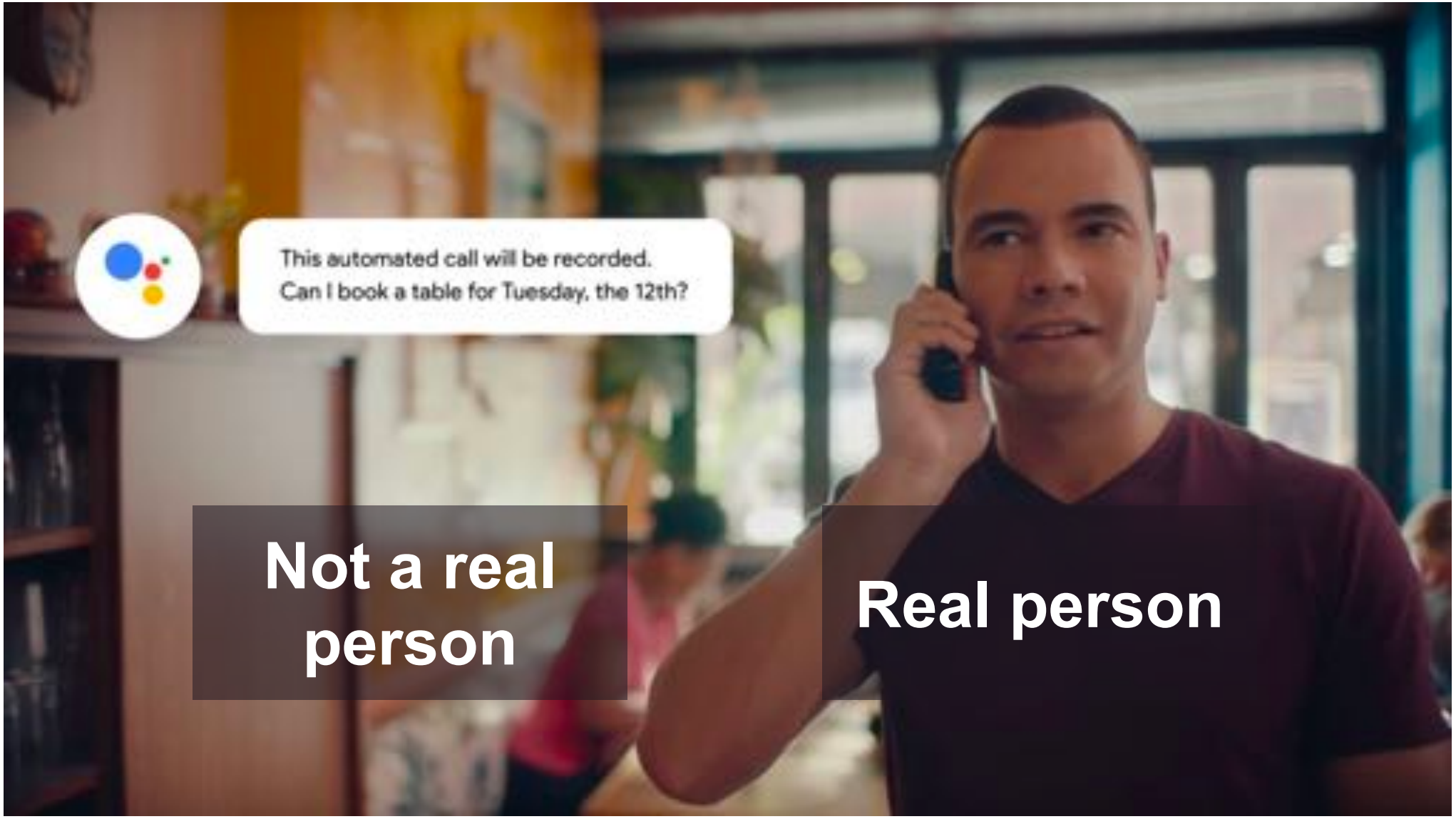
Schachmatt durch „CrazyAra" 19.02.2019

Künstliche Intelligenz schlägt mehrfachen Weltmeister im Einsetzschach

Der von den TU-Studierenden Johannes Czech, Moritz Willig und Alena Beyer entwickelte Bot „CrazyAra" hat den Schachprofi Justin Tan in einem Online-Match der Schach-Variante „Crazyhouse" mit 4:1 geschlagen. Gelernt hat der Bot mittels künstlicher neuronaler Netze, was ihm erlaubt, vorausschauend Entscheidungen zu treffen. Das Besondere: Die Studierenden konnten damit einen Erfolg auf einem Feld feiern, das sonst von Giganten wie Google dominiert wird.

AI plays chess and GO

AI assists you



However

The New York Times

Opinion

A.I. Is Harder Than You Think

By Gary Marcus and Ernest Davis

Mr. Marcus is a professor of psychology and neural science. Mr. Davis is a professor of computer science.

May 18, 2018


https://www.youtube.com/watch?v=sdUHX72qxeY
1863

Current Biology

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Volume 27, Issue 18, p2827–2832.e3, 25 September 2017
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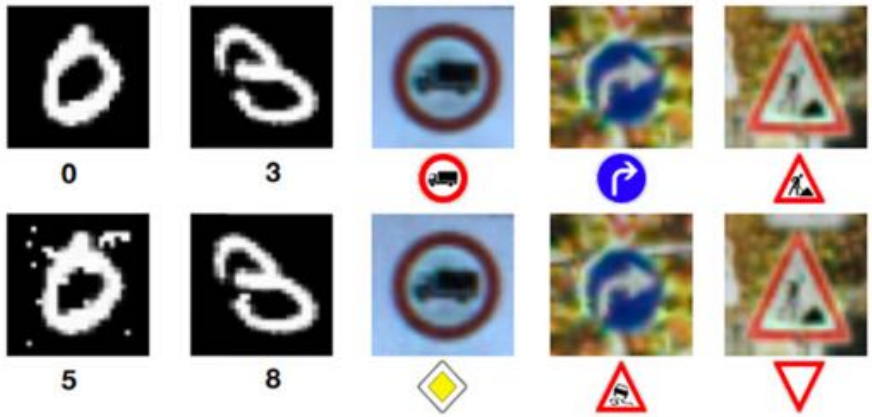
REPORT

Humans, but Not Deep Neural Networks, Often Miss Giant Targets in Scenes

Miguel P. Eckstein, Kathryn Koehler, Lauren E. Welbourne, Emre Akbas

Optical Illusions



Stereotypes

Target words	Attrib. words	Original Finding				Our Finding			
		Ref	N	d	p	N_T	N_A	d	p
Flowers vs insects	Pleasant vs unpleasant	(5)	32	1.35	10^{-8}	25×2	25×2	1.54	10^{-7}
Instruments vs weapons	Pleasant vs unpleasant	(5)	32	1.66	10^{-10}	25×2	25×2	1.63	10^{-8}
Eur.-American vs Afr.-American names	Pleasant vs unpleasant	(5)	26	1.17	10^{-5}	32×2	25×2	0.58	10^{-2}
Eur.-American vs Afr.-American names	Pleasant vs unpleasant	(7)	Not applicable			18×2	25×2	1.24	10^{-3}
Eur.-American vs Afr.-American names	Pleasant vs unpleasant from (5)	(7)	Not applicable			18×2	8 × 2	0.72	10^{-2}
Male vs female names	Career vs family	(9)	39k	0.72	10^{-2}	8 × 2	8 × 2	1.89	10^{-4}
Math vs arts	Male vs female terms	(9)	28k	0.82	$< 10^{-2}$	8 × 2	8 × 2	0.97	.027
Science vs arts	Male vs female terms	(10)	91	1.47	10^{-24}	8 × 2	8 × 2	1.24	10^{-2}
Mental vs physical disease	Temporary vs permanent	(23)	135	1.01	10^{-3}	6 × 2	7 × 2	1.30	.012
Young vs old people's names	Pleasant vs unpleasant	(9)	43k	1.42	$< 10^{-2}$	8 × 2	8 × 2	−.08	0.57

https://www.hr-fernsehen.de/sendungen-a-z/hauptsache-kultur/sendungen/hauptsache-kultur,sendung-56324.html

[Jentzsch, Schramowski, Rothkopf, Kersting AIES 2019]

AAAI / ACM conference on ARTIFICIAL INTELLIGENCE, ETHICS, AND SOCIETY

„Moral“ Choices

Algorithms of intelligent behaviour teach us a lot about ourselves

The twin science: cognitive science

"How do we humans get so much from so little?" and by that I mean how do we acquire our understanding of the world given what is clearly by today's engineering standards so little data, so little time, and so little energy.

Centre for Cognitive Science at TU Darmstadt

Establishing cognitive science at the Technische Universität Darmstadt is a long-term commitment across multiple departments (see Members to get an impression on the interdisciplinary of the supporting groups and departments). The TU offers a strong foundation including several established top engineering groups in Germany, a prominent computer science department (which is among the top four in Germany), a

Centre for Cognitive Science

Josh Tenenbaum, MIT

Lake, Salakhutdinov, Tenenbaum, Science 350 (6266), 1332-1338, 2015

Tenenbaum, Kemp, Griffiths, Goodman, Science 331 (6022), 1279-1285, 2011

UNIVERSITY OF CAMBRIDGE

UBER AI Labs

Max Planck Institute for Intelligent Systems

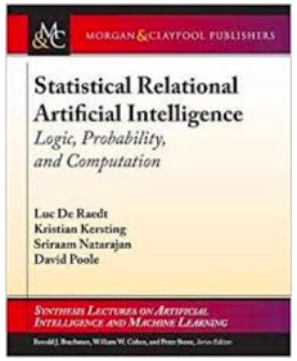
UNI GRAZ

FLOW

TECHNISCHE UNIVERSITÄT DARMSTADT

Microsoft Research

UBER AI Labs



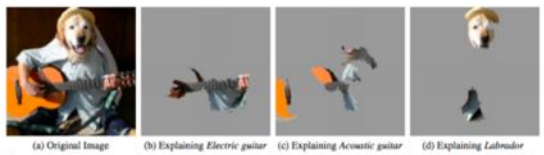
relationalAI
AI for the enterprise

Getting deep systems that reason and know what they don't know

Responsible AI systems that explain their decisions and co-evolve with the humans

Open AI systems that are easy to realize and understandable for the domain experts

„Tell the AI when it is right for the wrong reasons and it adapts ist behavior“



(a) Original Image (b) Explaining *Electric guitar* (c) Explaining *Acoustic guitar* (d) Explaining *Labrador*

Figure 4: Explaining an image classification prediction made by Google's Inception network, highlighting positive pixels. The top 3 classes predicted are "Electric Guitar" ($p = 0.32$), "Acoustic guitar" ($p = 0.24$) and "Labrador" ($p = 0.21$)

Teso, Kersting AIES 2019

AAAI / ACM conference on ARTIFICIAL INTELLIGENCE, ETHICS, AND SOCIETY

And this is AI

It is a revolution but there is still a lot to be done! This is a team sport. We need you!

Prof. Dr. Kristian Kersting

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Federal Ministry of Education and Research