

Adaptive Intelligenz: Aktuelle Entwicklungen und Disruptionspotenzial des Maschinellen Lernens

Matthias Bethge

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Professor at Uni Tübingen for
Computational Neuroscience
& Machine Learning



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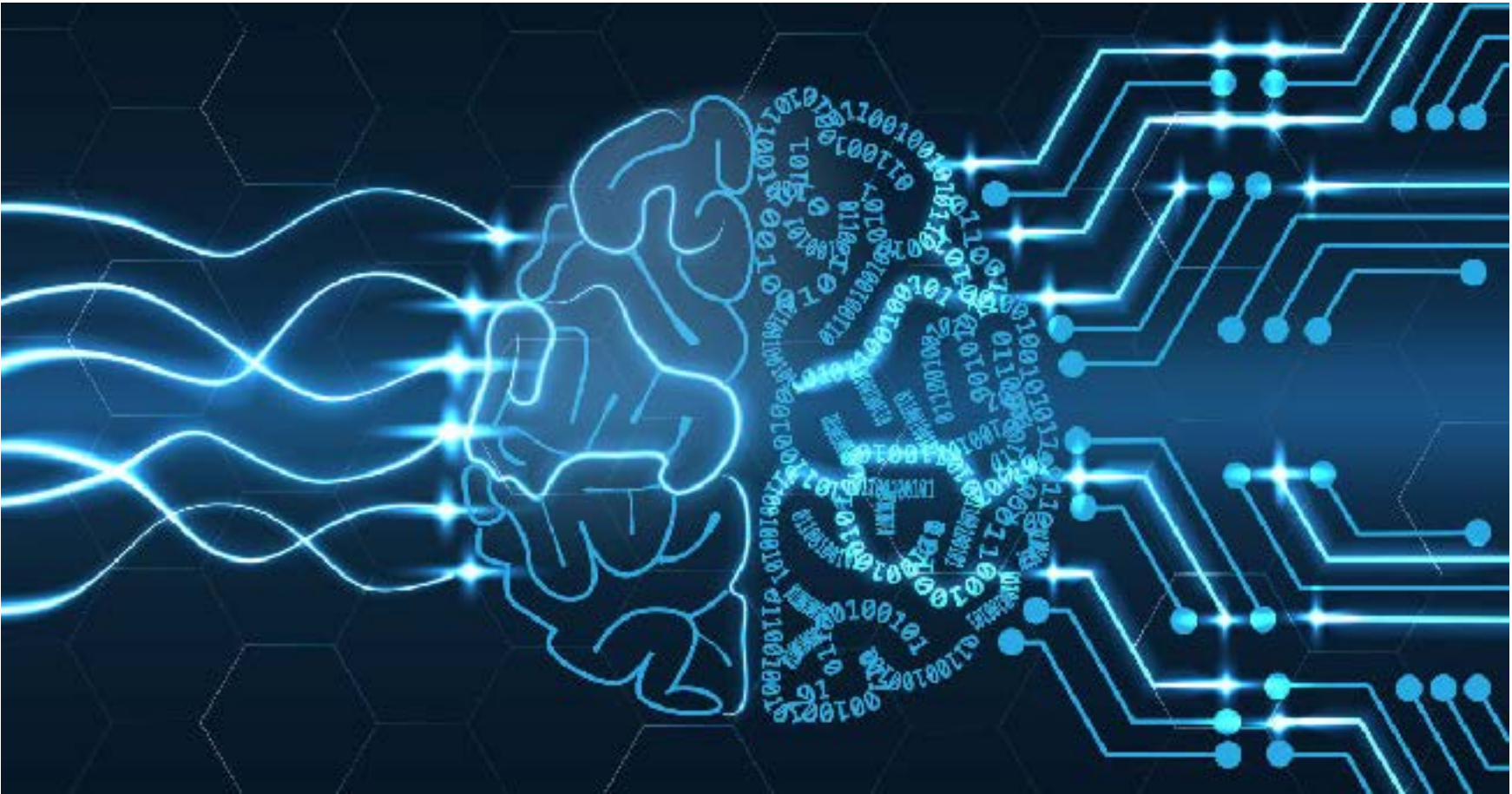
Director of the Tübingen AI Center
(BMBF Competence Center for
Machine Learning)



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AI CENTER**

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Co-Founder of the ELLIS Initiative



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AI CENTER**

Co-Founder of the ELLIS Initiative



Co-Founder
of the BWKI



**Bundeswettbewerb
Künstliche Intelligenz**

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Co-Founder of 3 Start-Ups

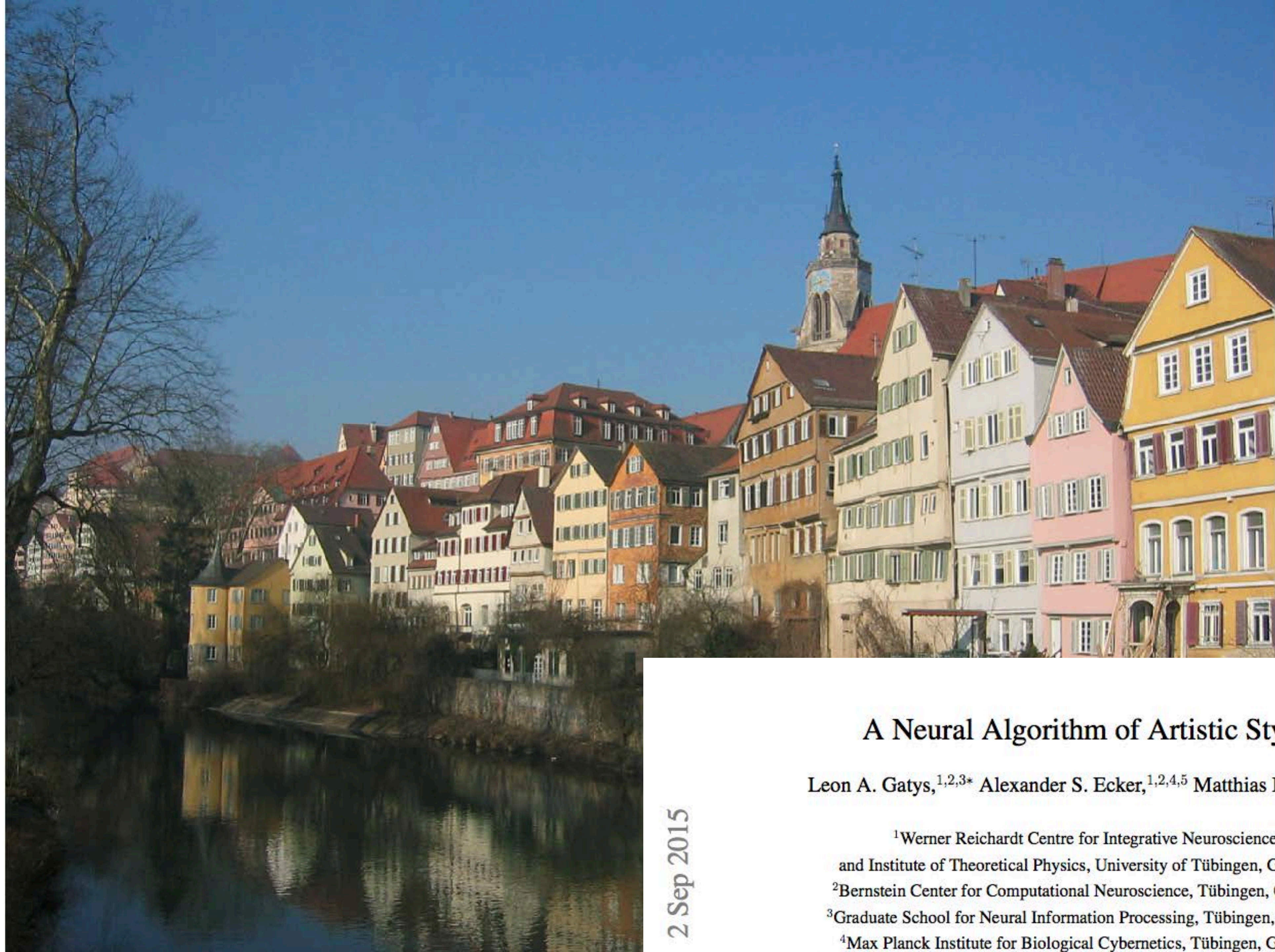


Co-Founder of the ELLIS Initiative



Co-Founder
of the BWKI





A Neural Algorithm of Artistic Style

Leon A. Gatys,^{1,2,3*} Alexander S. Ecker,^{1,2,4,5} Matthias Bethge^{1,2,4}

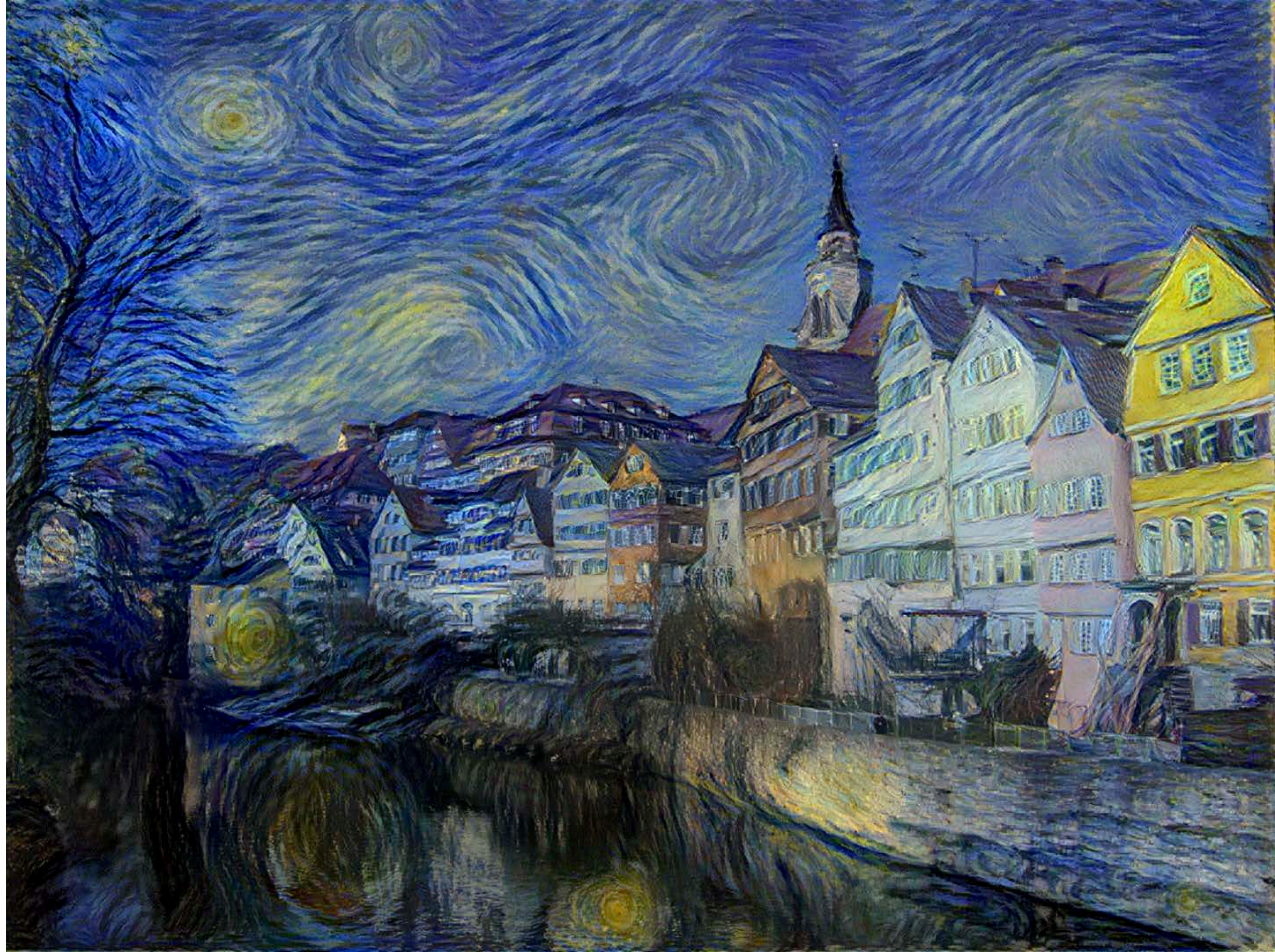
¹Werner Reichardt Centre for Integrative Neuroscience
and Institute of Theoretical Physics, University of Tübingen, Germany

²Bernstein Center for Computational Neuroscience, Tübingen, Germany

³Graduate School for Neural Information Processing, Tübingen, Germany

⁴Max Planck Institute for Biological Cybernetics, Tübingen, Germany

2 Sep 2015











DEEPART.io

try it yourself...

<https://deepart.io>

Content



Style



&

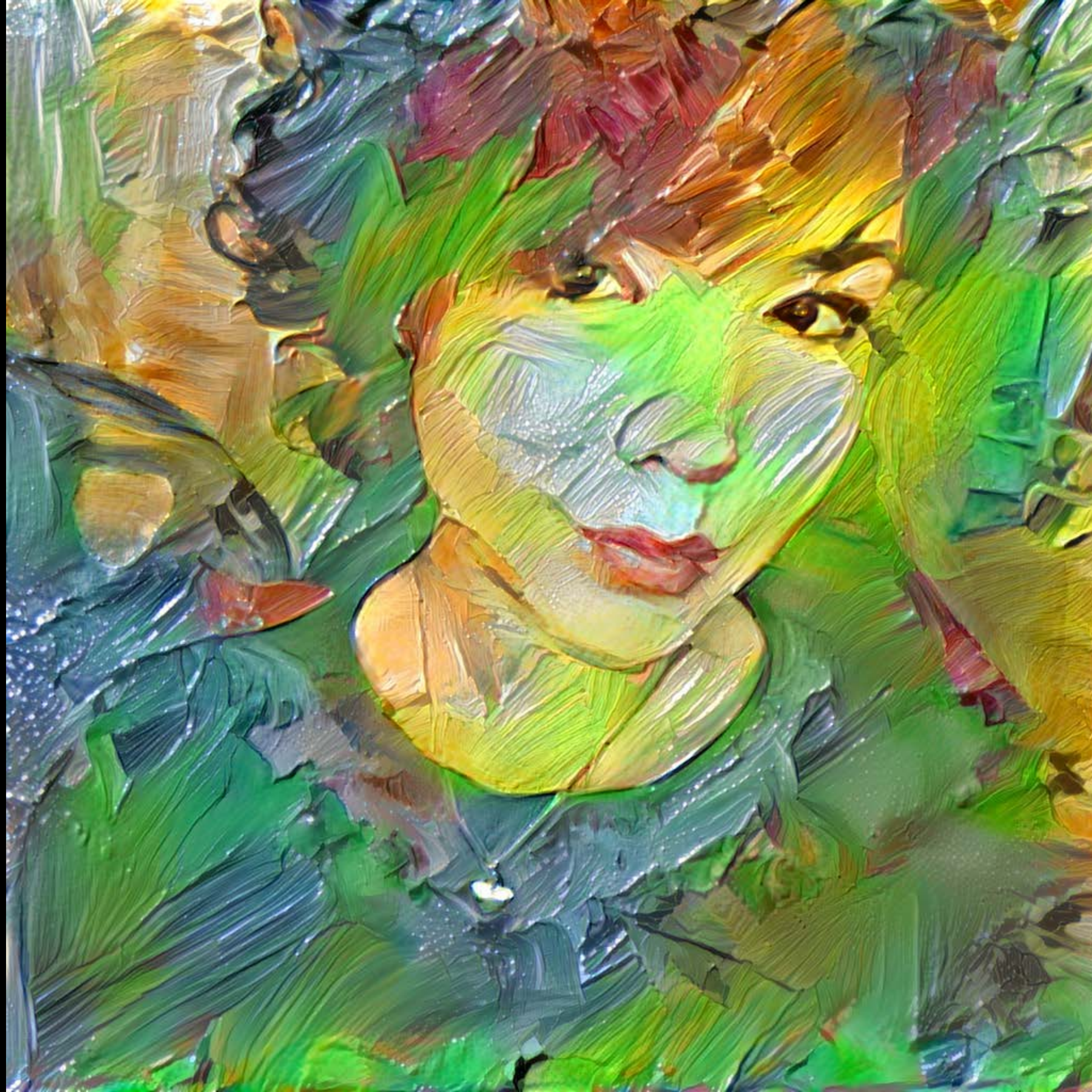
DEEPART.io

<https://deepart.io>



DEEPART.io

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Können Maschinen kreativ sein?



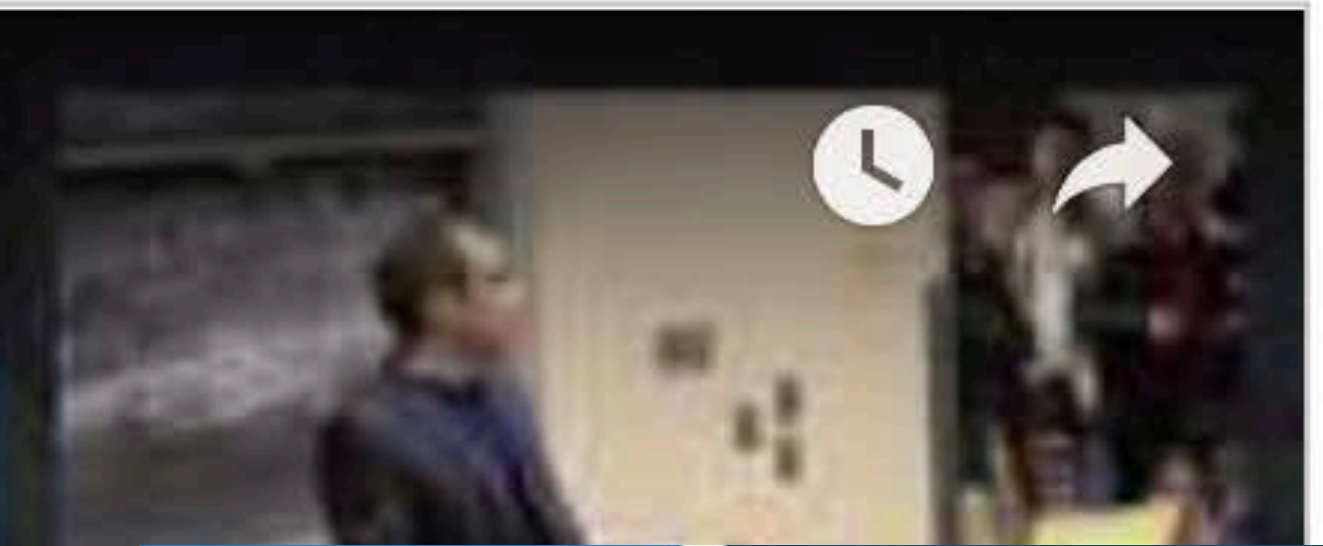
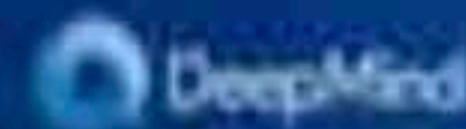
The Power of Self-Learning Systems

The Power of Self-Learning Systems

Demis Hassabis
MIT, March 2019



<https://cbmm.mit.edu/video/power>



IAS INSTITUTE FOR
ADVANCED STUDY

The Power of Self-Learning Systems

Demis Hassabis will discuss the capabilities and power of self-learning systems. He will illustrate this with reference to some of DeepMind's recent breakthroughs, and talk about the implications of cutting-edge AI research for scientific and philosophical discovery.



Saturday,
May 4
2:30 p.m.

Wolfensohn Hall
Institute for Advanced Study

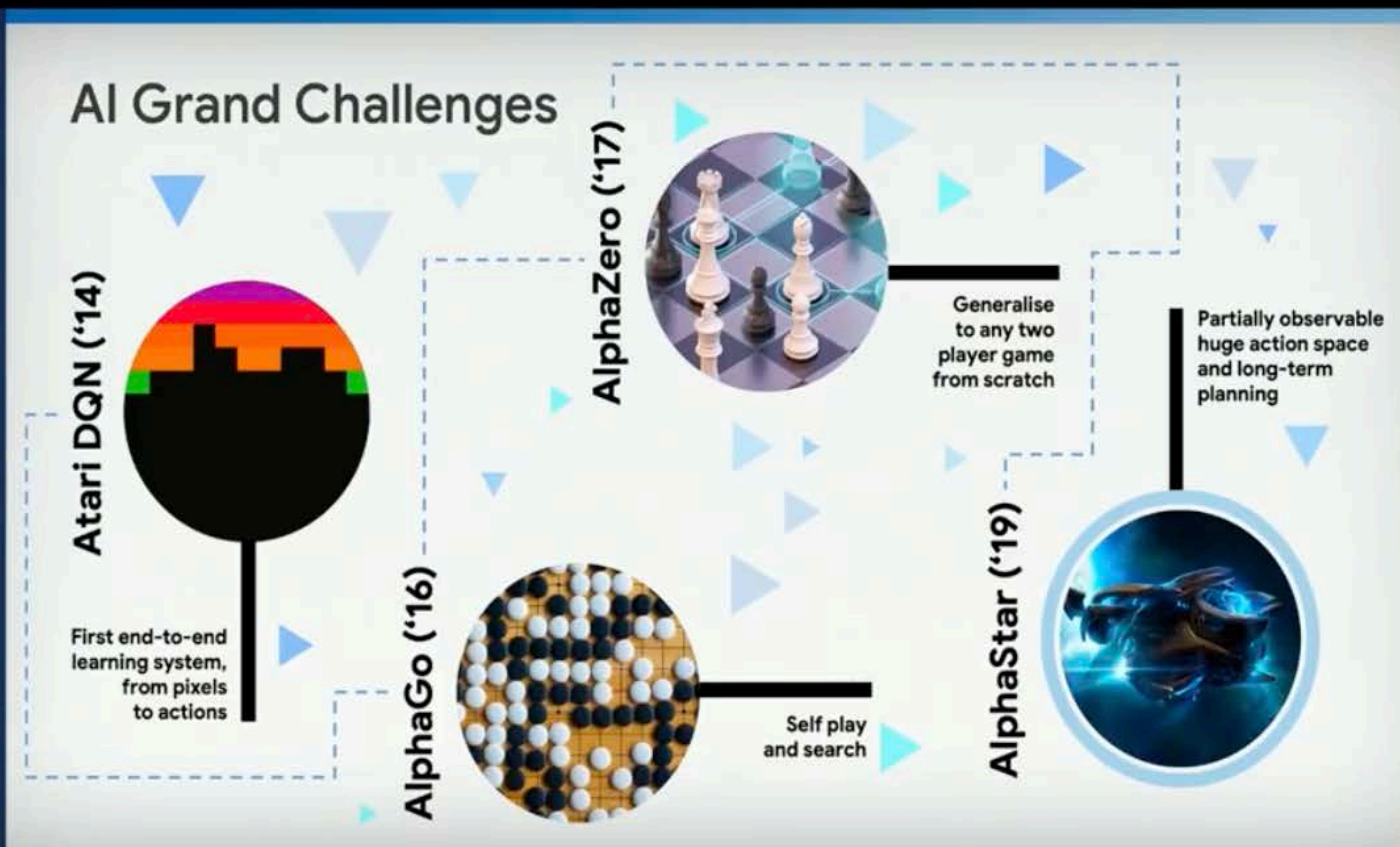
Demis Hassabis
Co-founder & CEO, DeepMind

Demis Hassabis is co-founder and CEO of DeepMind, the world's leading AI research company. DeepMind has published over 200 papers—including multiple *Nature* and *Science* publications—and achieved breakthrough results in challenging AI domains, ranging from Go to StarCraft II to protein folding. A child chess prodigy, Hassabis coded the classic game *Theme Park* at age seventeen. After graduating from Cambridge University, he founded video games company Elixir Studios and completed a PhD in cognitive neuroscience at University College London. *Science* listed his research on imagination and memory as one of 2007's top ten breakthroughs. He is a five-time World Games Champion, and a Fellow of the Royal Society and of the Royal Academy of Engineering. In 2017 he featured in the *Time* "100 Most Influential People" list, and in 2018 he was awarded a CBE.

Registration
Required:

[www.ias.edu/
events/hassabis](http://www.ias.edu/events/hassabis)

The Power of Self-Learning Systems



CENTER FOR
Brains
Minds+
Machines

March 20, 2019

The Power of
Self-Learning Systems

Demis Hassabis

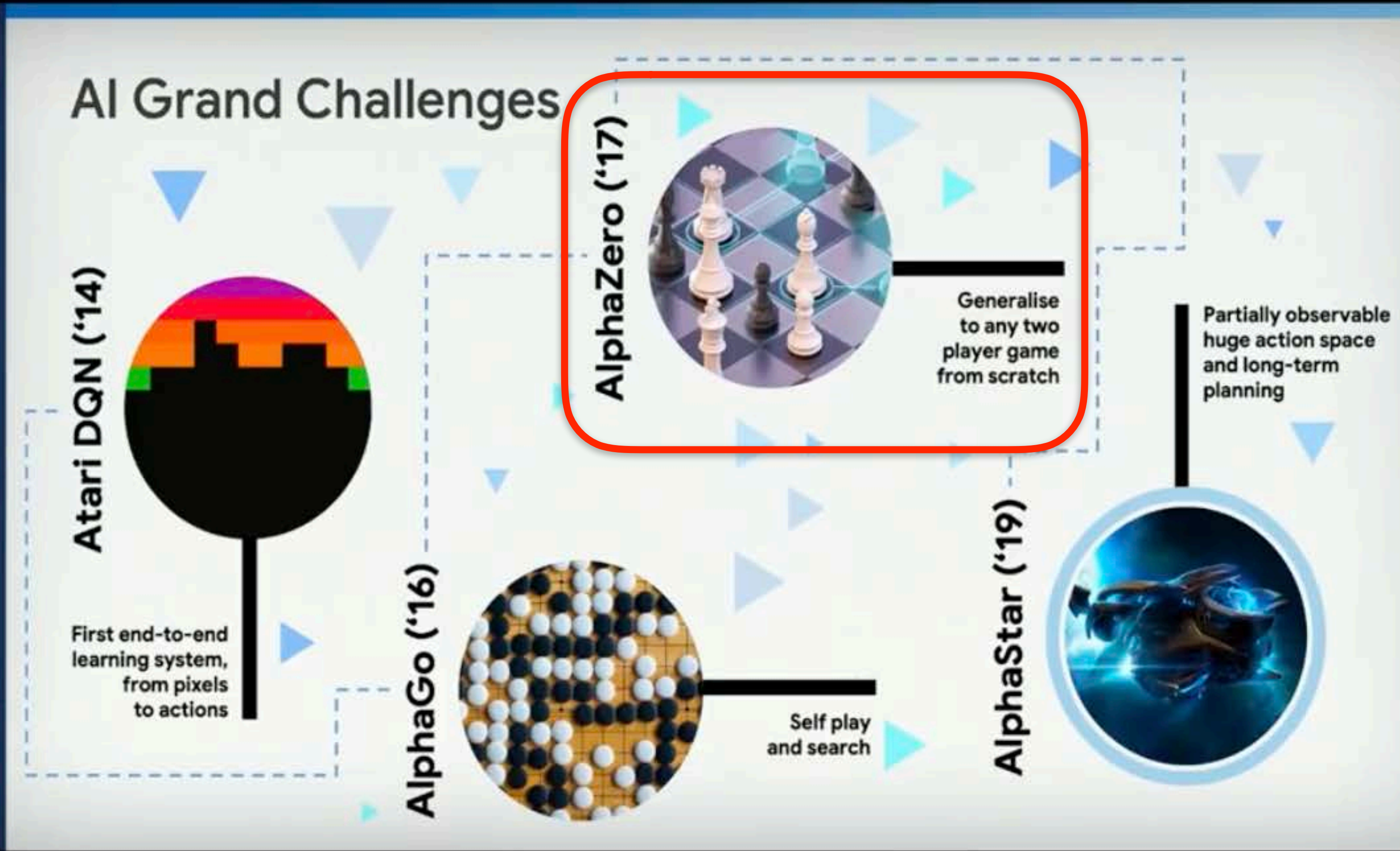
DeepMind



42:34 / 1:03:43



The Power of Self-Learning Systems



March 20, 2019

The Power of Self-Learning Systems

Demis Hassabis
DeepMind

42:34 / 1:03:43

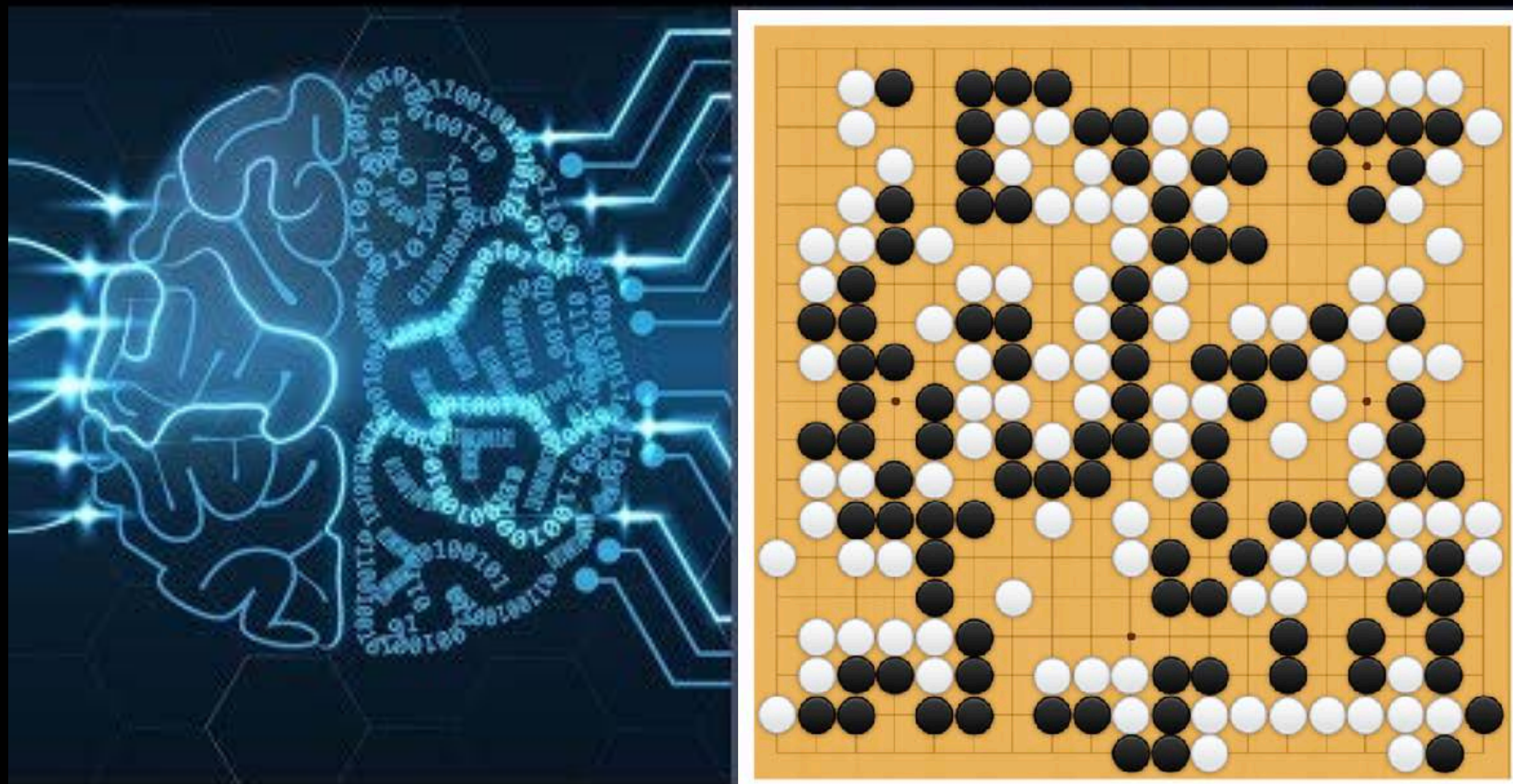


1997



1. e4 c6 2. d4 d5 3. Nc3 dxe4





ALPHA ZERO



ALPHA ZERO

4 Stunden maschinelles Lernen von Grund auf übertrifft
Jahrzehnte lange Softwareentwicklung aller Experten

ALPHA ZERO

Süddeutsche Zeitung, Oktober 2017:

“[...]”

Und auch über den Nutzen von Systemen wie Alpha Go Zero jenseits der Brettspiele wird noch zu diskutieren sein. **Denn sein Erfolg beruht auf Kenntnis der Spielregeln,** bemerkt Christian Bauckhage von Fraunhofer-Institut für Intelligente Analyse- und Informationssysteme in Sankt Augustin: "Doch in welcher Situation in der echten Welt kennen wir schon alle Regeln?"

The Power of Self-Learning Systems

AI Grand Challenges

Atari DQN ('14)



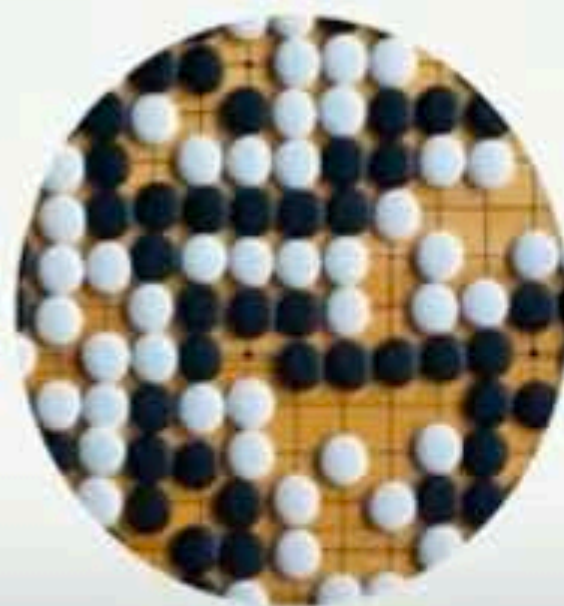
First end-to-end learning system, from pixels to actions

AlphaZero ('17)



Generalise to any two player game from scratch

AlphaGo ('16)



Self play and search

AlphaStar ('19)



Starcraft II



Match results

AlphaStar wins

10/0

In two official 5 game matches



42:34 / 1:03:43

The Power of Self-Learning Systems

AI Grand Challenges

Atari DQN ('14)



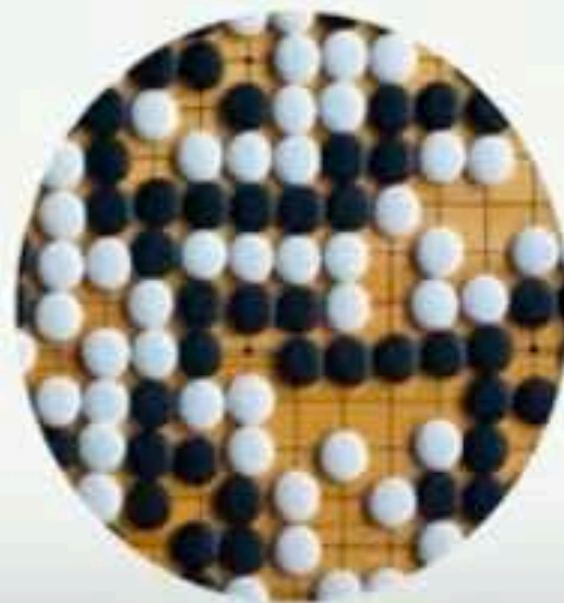
First end-to-end learning system, from pixels to actions

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Self play and search

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Starcraft II



Match results

AlphaStar wins

10/0

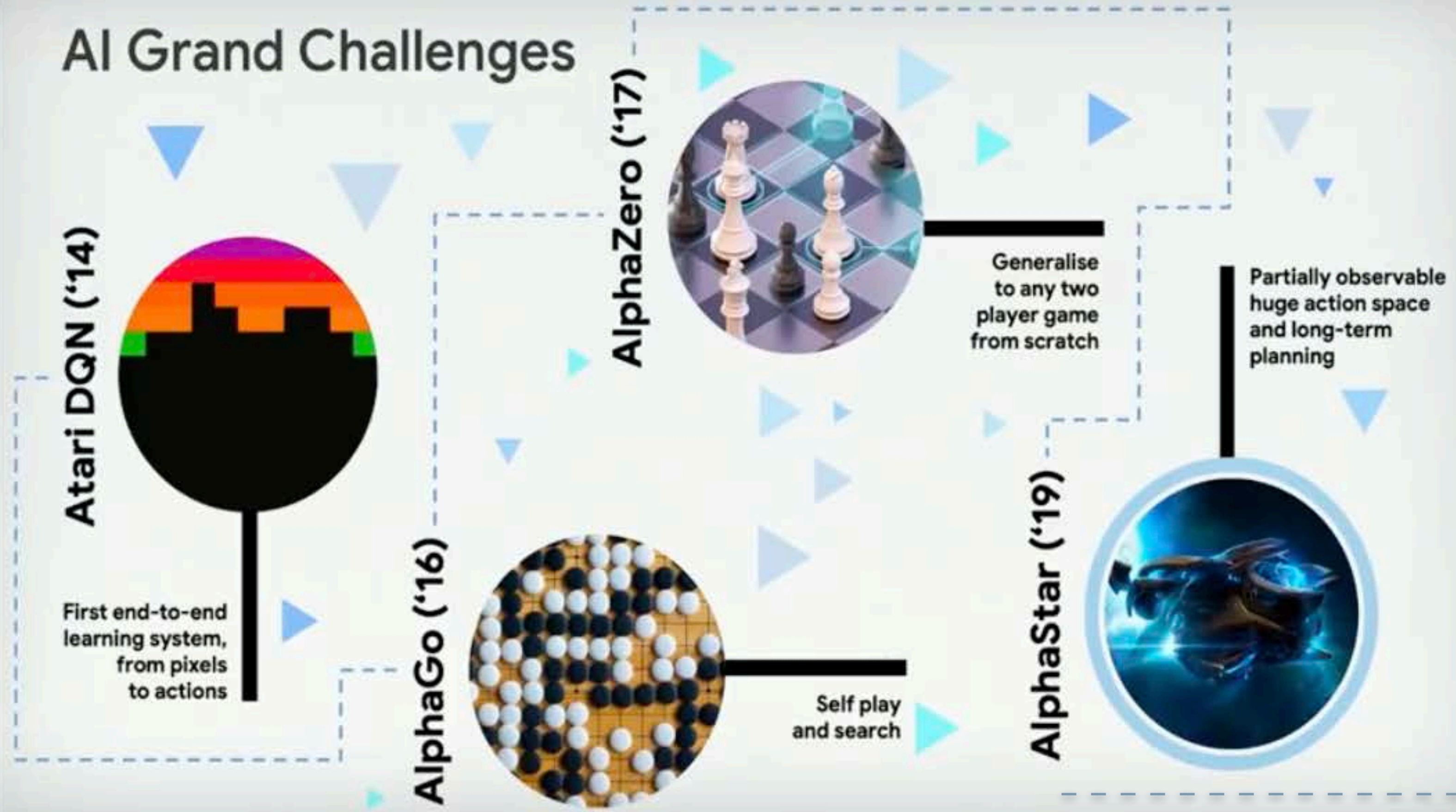
In two official 5 game matches



42:34 / 1:03:43

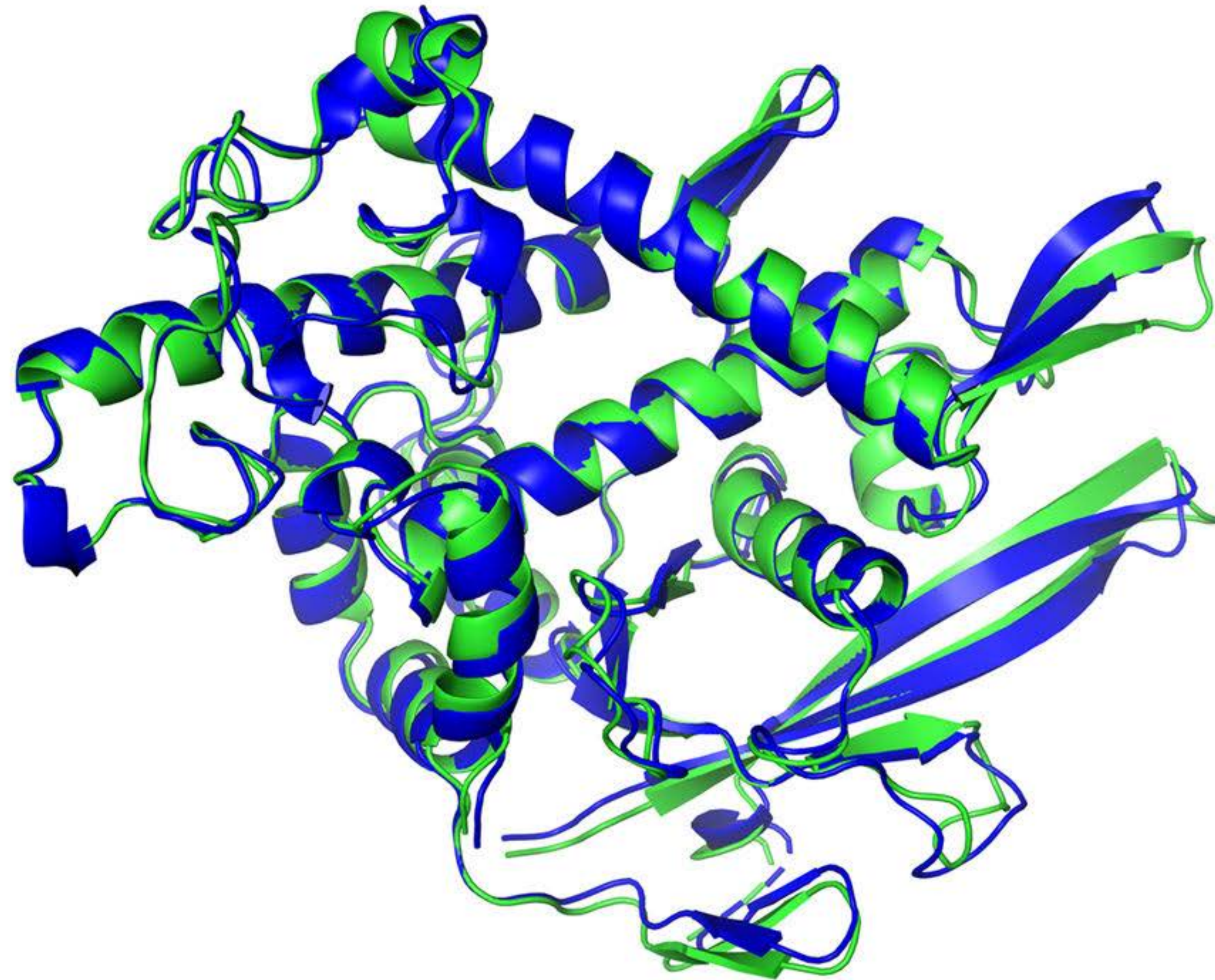
The Power of Self-Learning Systems

AI Grand Challenges



November 2019: MuZero lernt Spielregeln selbst und spielt besser als seine Vorgänger

Scientific Discovery (AlphaFold)
Medical Applications
Robotics
...
Anything



‘The game has changed.’ AI triumphs at solving protein structures

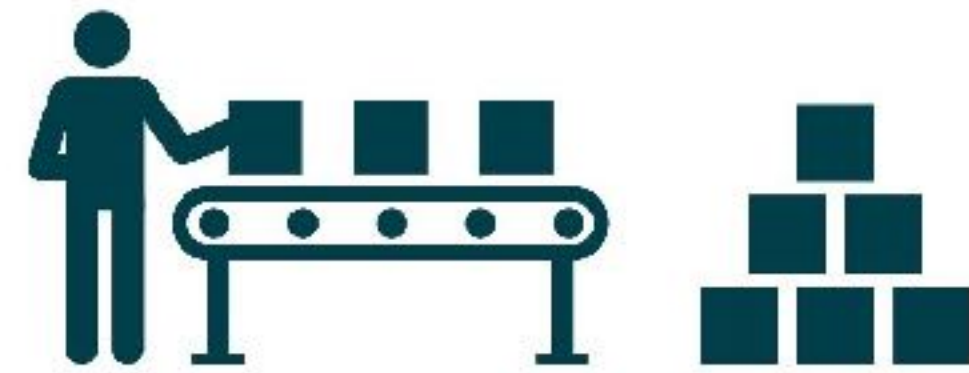
Industrial Revolutions

The political perspective



INDUSTRY 1.0

Mechanization, steam power, weaving loom



INDUSTRY 2.0

Mass production, assembly line, electrical energy



INDUSTRY 3.0

Automation, computers and electronics

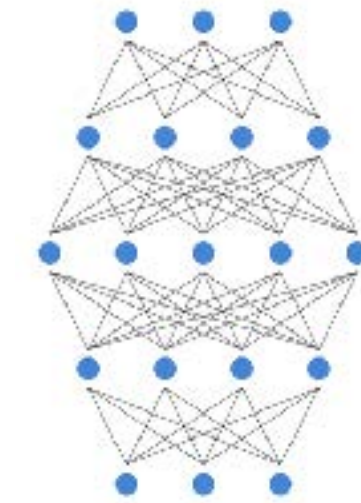
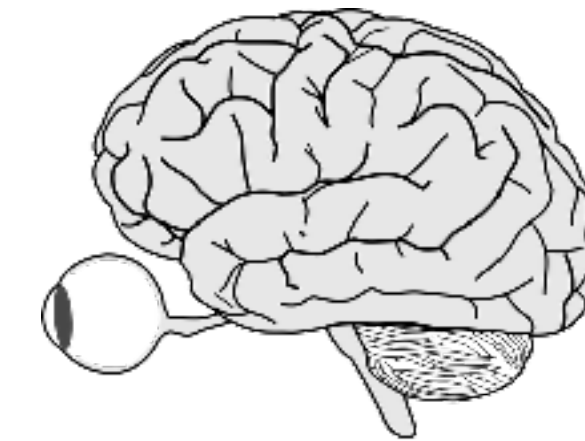
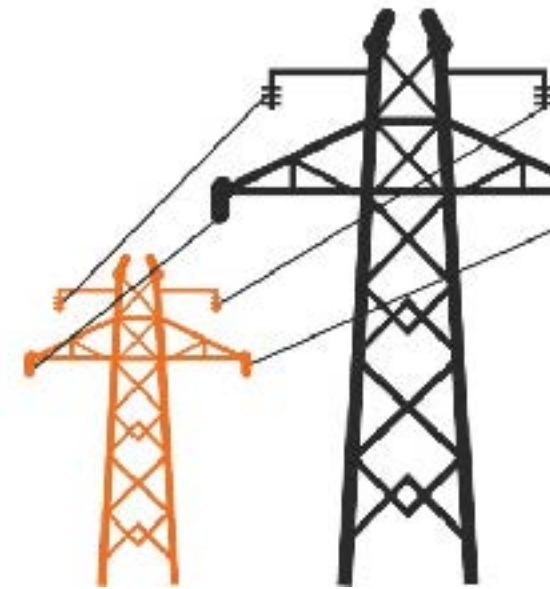


INDUSTRY 4.0

Cyber Physical Systems, internet of things, networks

Industrial Revolutions

A scientific perspective



THERMODYNAMICS
TRANSFORMATION
AND STORAGE OF
ENERGY

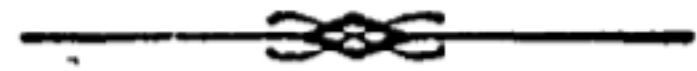
POWER GRIDS
EFFICIENT
DISTRIBUTION OF
ENERGY OVER LONG
DISTANCES

DATA NETWORKS
EFFICIENT
COMMUNICATION OF
INFORMATION OVER
LONG DISTANCES

MACHINE LEARNING
EFFICIENT
AUTOMATIZATION OF
MACHINE
INFORMATION
PROCESSING



MIND
A QUARTERLY REVIEW
OF
PSYCHOLOGY AND PHILOSOPHY

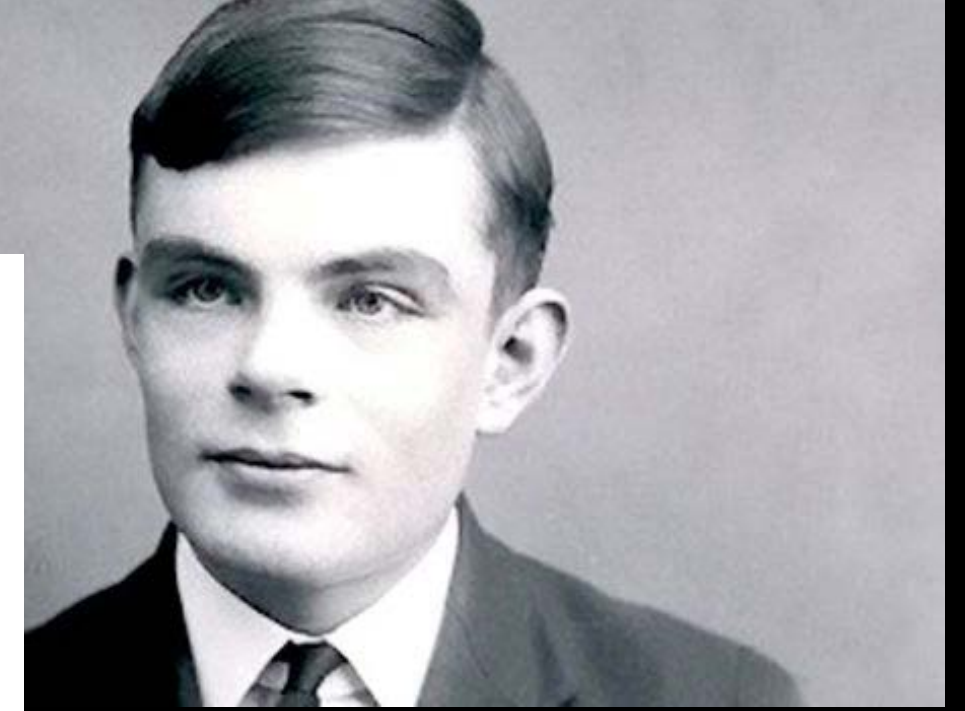


I.—COMPUTING MACHINERY AND
INTELLIGENCE

BY A. M. TURING

1. *The Imitation Game.*

I PROPOSE to consider the question, 'Can machines think?'



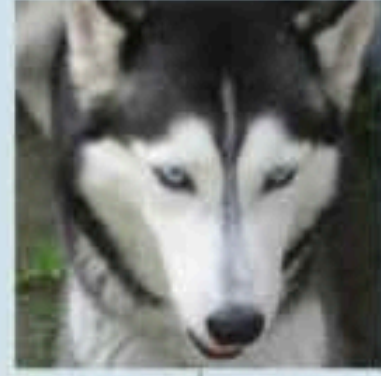


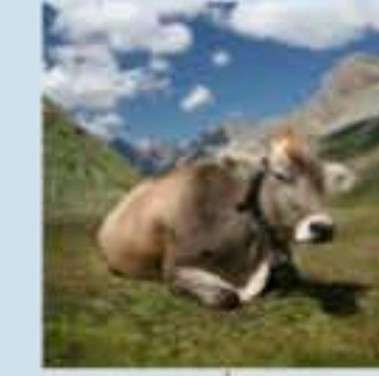








Shortcut Learning: Discrepancies between human & machine vision

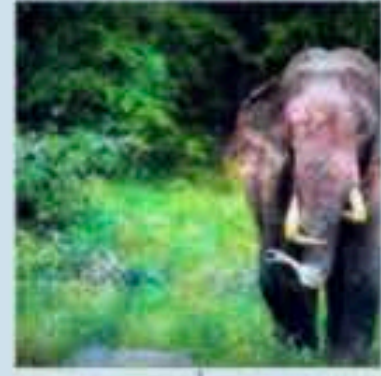

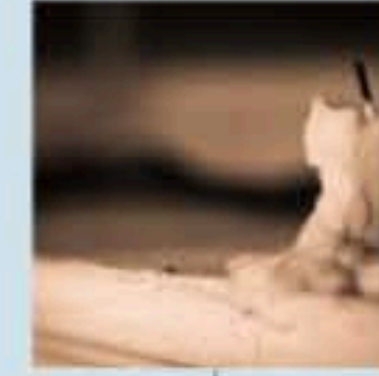
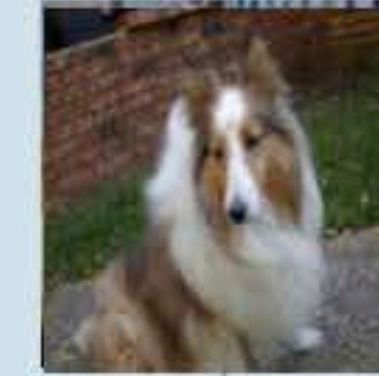
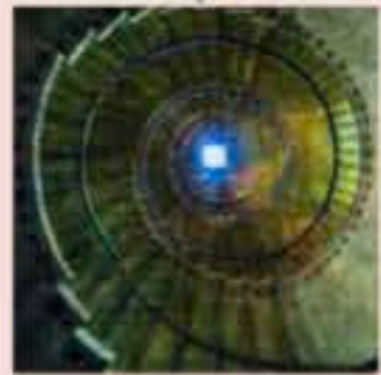
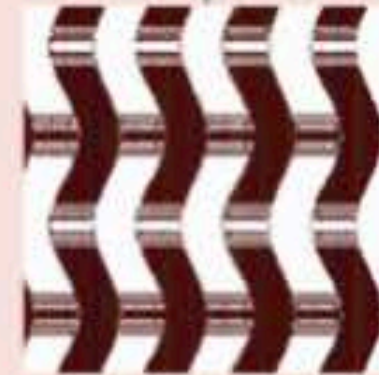
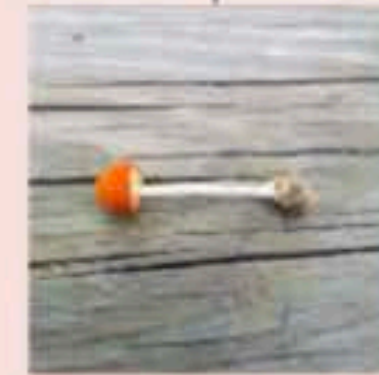
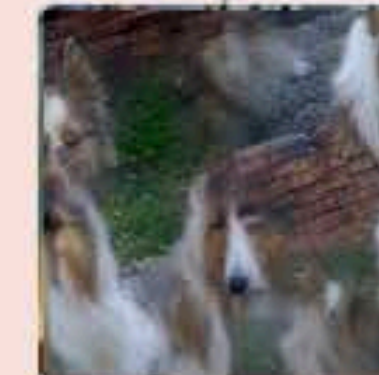
Same category for **humans**
but different category for **DNNs**

Same category for **DNNs**
but different category for **humans**

i.i.d.

					
adversarial examples e.g. Szegedy '13	domain shift e.g. Wang '18	distortions e.g. Dodge '19	pose Alcorn '19	texture Geirhos '19	background Beery '18
					

o.o.d.

			
excessive invariance Jacobsen '19	fooling images Nguyen '15	natural adversarials Hendrycks '19	texturised images Gatys '15, Brendel '19
			

29 Oct 2020 | 15:00 GMT

Understanding Causality Is the Next Challenge for Machine Learning

Teaching robots to understand "why" could help them transfer their knowledge to other environments

By **Payal Dhar**





TÜBINGEN
AI CENTER



Federal Ministry
of Education
and Research

Shaping the next generation of machine intelligence to develop more robust, efficient and accountable learning systems.

FERHARD KARLS
UNIVERSITÄT
TÜBINGEN



Max-Planck-Institut für
Intelligente Systeme

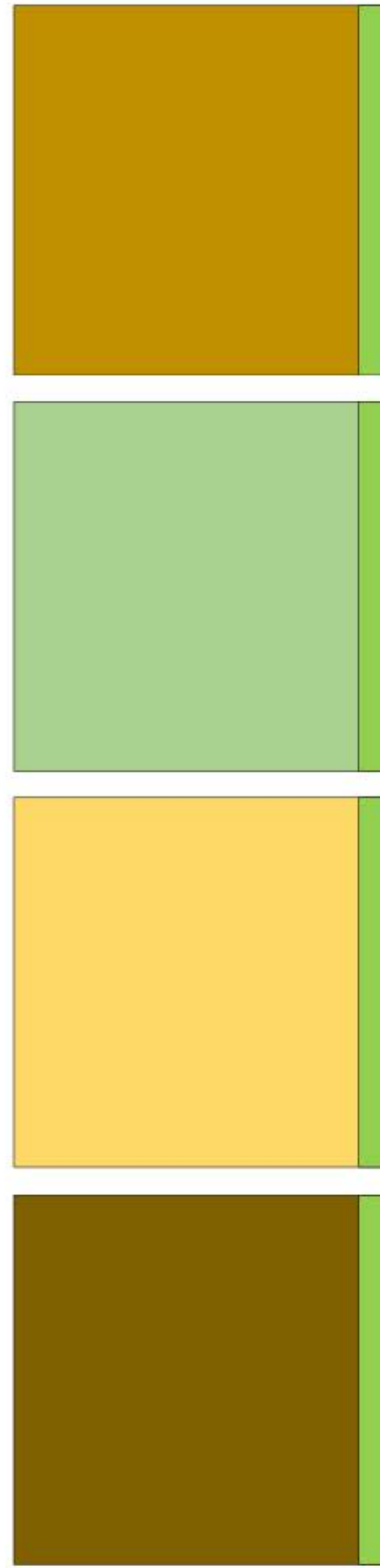
<https://tue.ai>





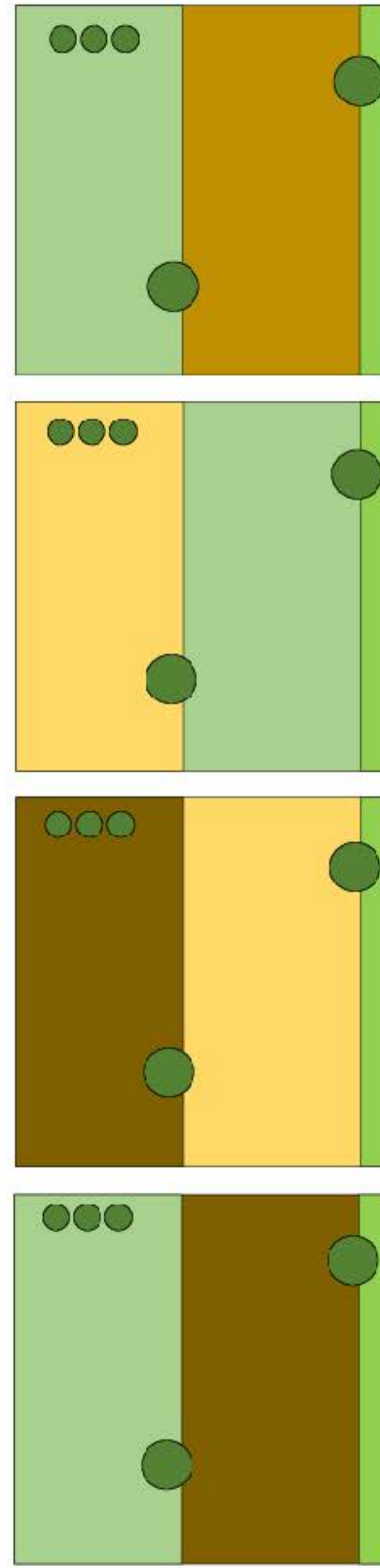


© Hans Balmer, Verein Permakultur-Landwirtschaft, hans.balmer@permakultur-landwirtschaft.org

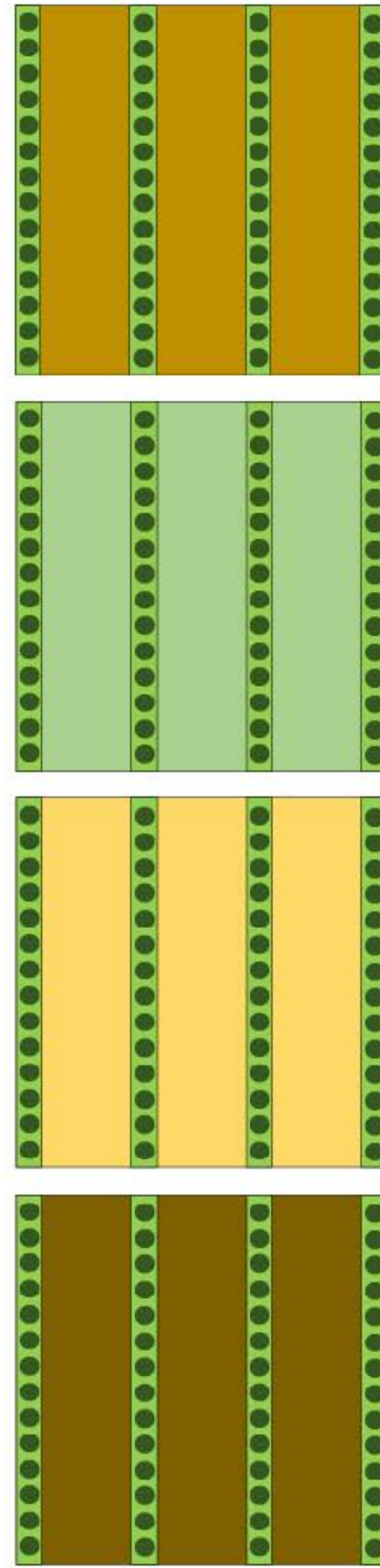


ÖLN

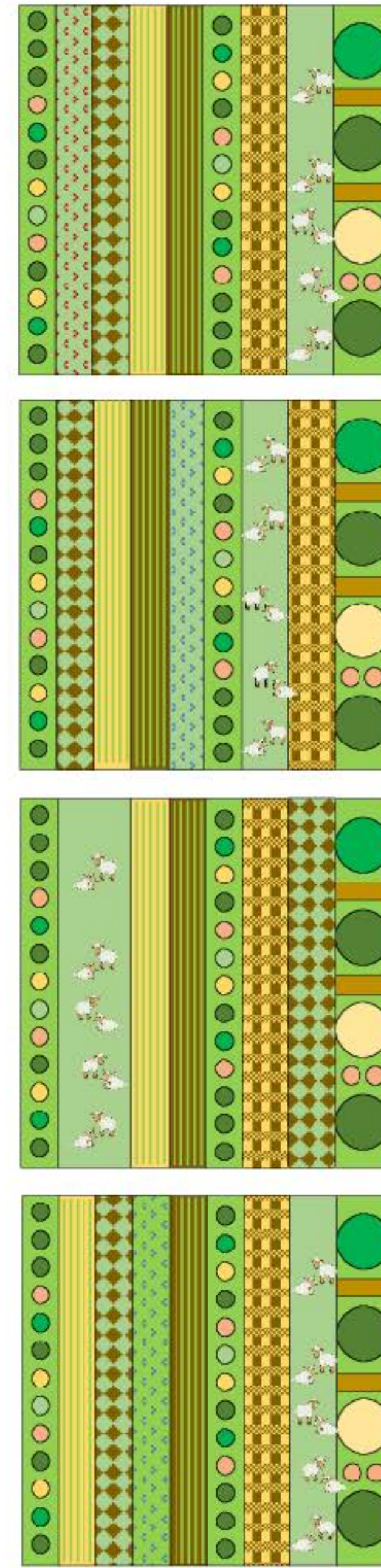
↓ Geregelte Fruchtfolge



Bio



Agroforst



Permakultur



Zusammenfassung

- **Maschinelles Lernen** ist die Grundlage adaptiver Intelligenz
- **Adaptive Intelligenz** kann eine Trendwende der industriellen Revolution ermöglichen: Anpassung von Maschinen an Mensch, Natur und Umwelt statt der Anpassung von Mensch und Umwelt an die Maschinen
- Abgeändert von Niels Bohr: “Wir hängen in den aktuellen technologischen Möglichkeiten”
- Besser verstehen, wie unser Verständnis von technologischer Machbarkeit unsere ethischen Schlussfolgerungen bestimmen.

Vielen Dank!



Probleme kann man niemals mit derselben
Denkweise lösen, durch die sie entstanden sind.

(Albert Einstein)