@IngoPhilipp

Distant Future

Quite Likely

Near Future

Highly Unlikely

TL;DL ‹› Tool Long, Didn't Listen

Intelligence is the product of
information processing

Sam Harris

Technology will continue to **advance** in ways we can't even comprehend

Raymond Kurzweil

Human intelligence is a **minuscule dot**
in the space of all possible intelligences

Robert Miles

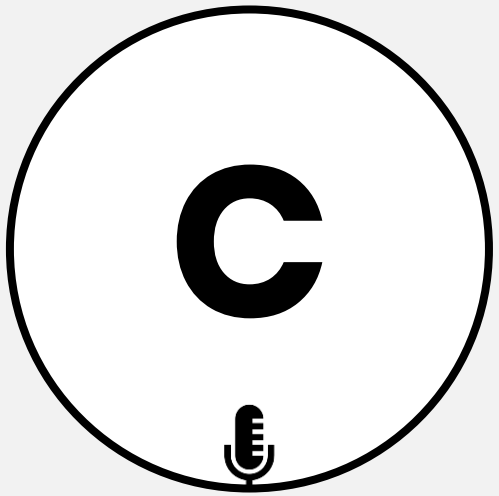
Faith is **belief** w/o evidence and reason.
That's also the definition of delusion.

Richard Dawkins

@IngoPhilipp

Exploring The Hype

Exploring Intelligence



Exploring Testing

Exploring the Near Future

Exploring
The Hype

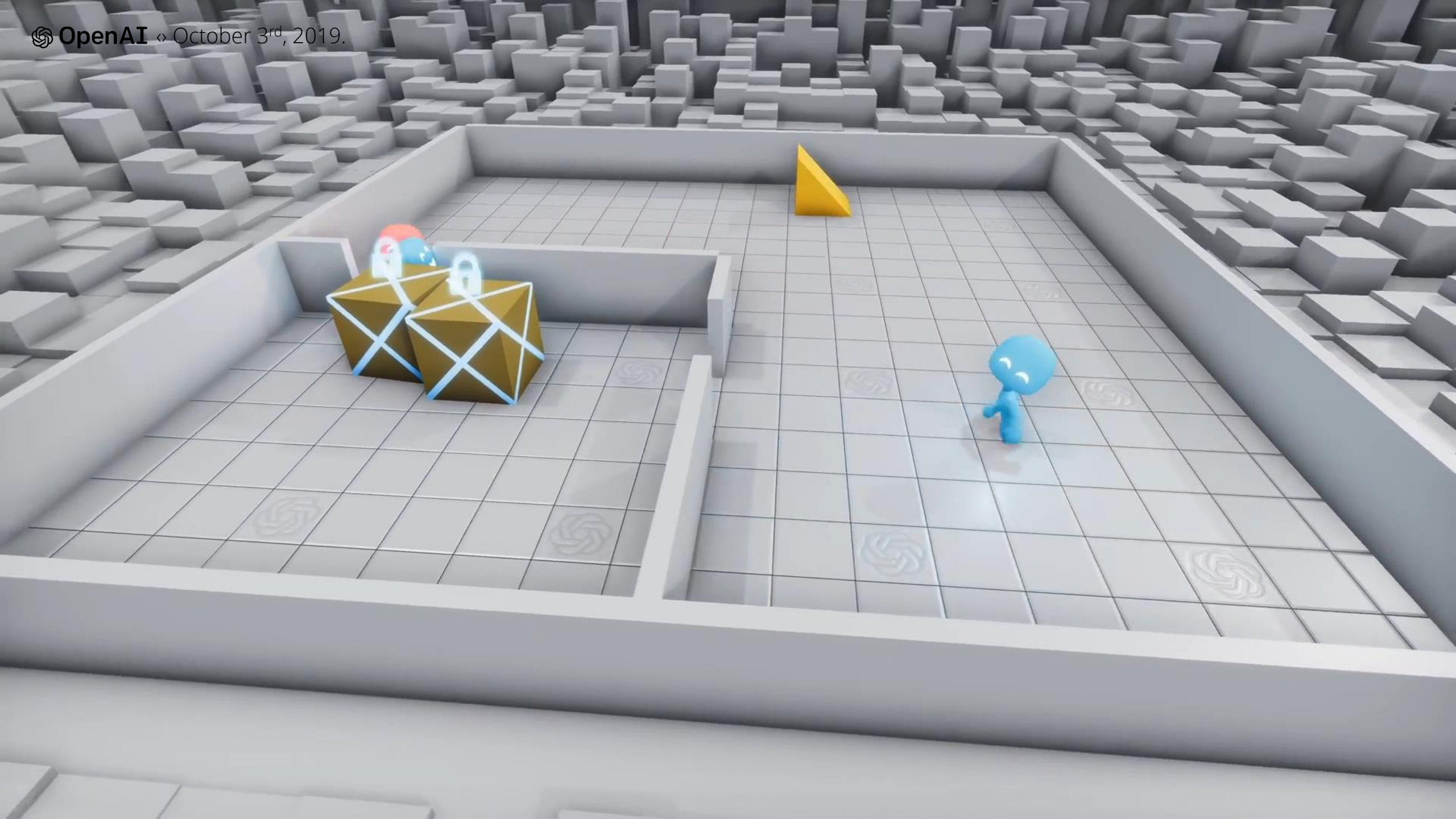
:: **Andrew Ng** ‹› Co-Founder Google Brain

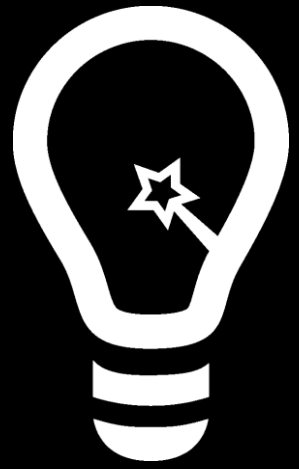
“

Just as electricity transformed almost everything 100 years ago, today I actually have a hard time thinking of an industry that I **don't** think AI will **transform** in the next several years.

Andrew Ng

OpenAI

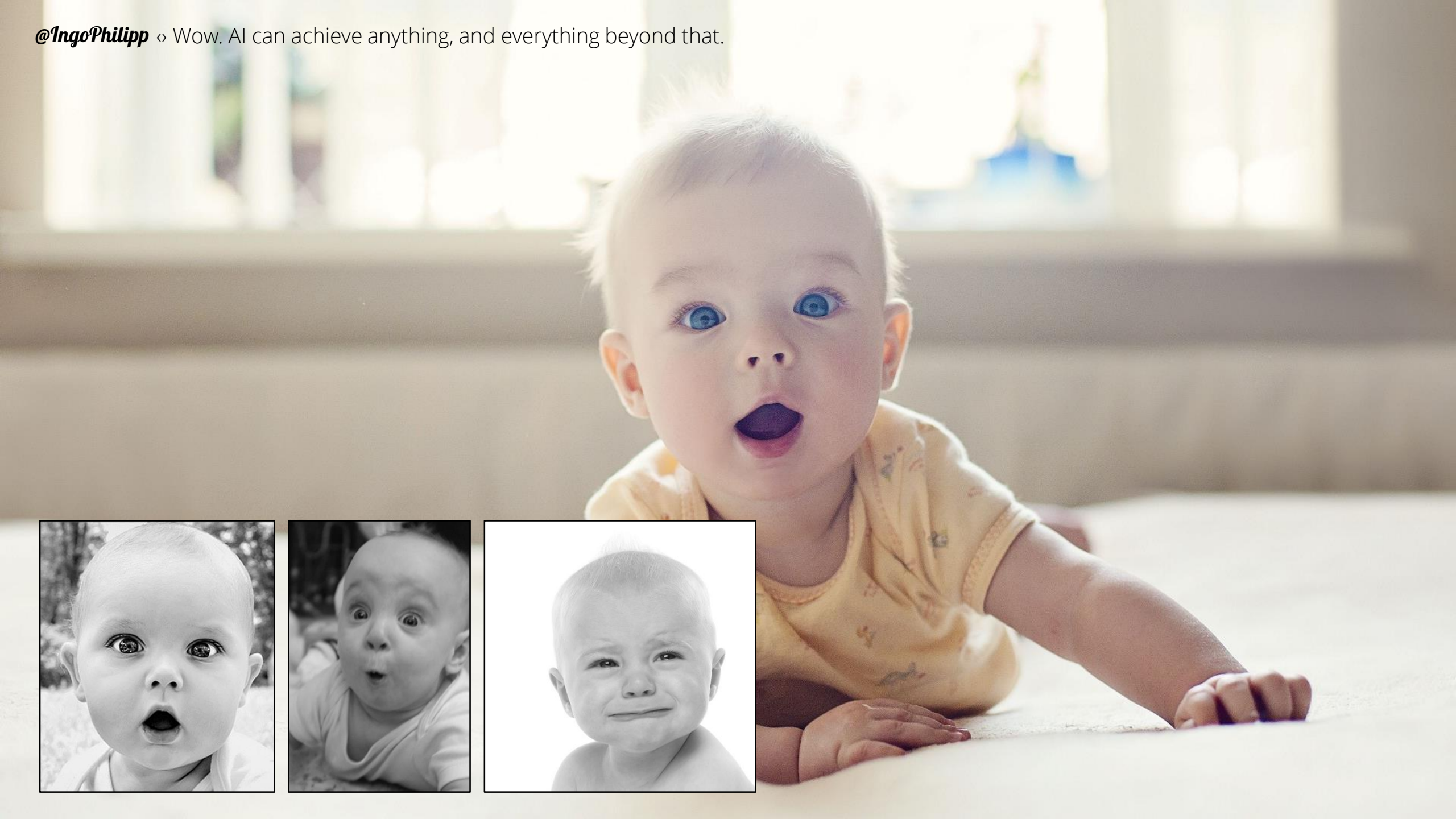




Given that pace of technology, I propose we leave **testing** to the machines and go play outside

Ingo Philipp

:: Inspired by **Bill Watterson**



@IngoPhilipp

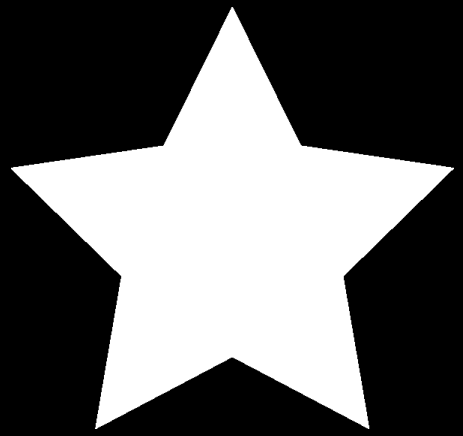
@IngoPhilipp

Intelligent computer systems aren't made of magic, they are made of **logic**

-- Linda Liukas --

Intelligent computer systems aren't made of magic, they are made of **logic**

-- Linda Liukas --



Nothing has moved as fast as **artificial intelligence** is moving right now in the enterprise

-- Paul Daugherty --

The New **Paradigm**

André Mendes

The Next **Digital Frontier**

McKinsey Institute

The Next **Disruptive Force**

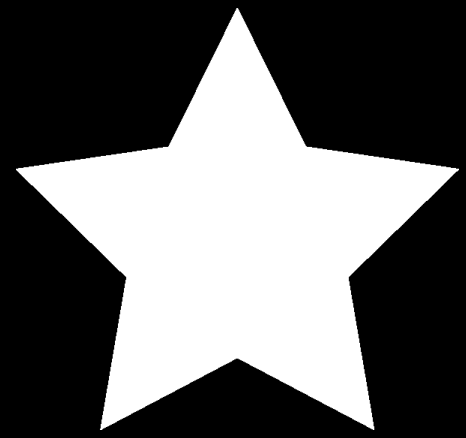
Bloomberg

The New **Black**

MIT Technology Review

The New **Electricity**

Andrew Ng



Nothing has moved as fast as **artificial intelligence** is moving right now in the enterprise

-- Paul Daugherty --

@IngoPhilipp

“

The New **Paradigm**

André Mendes

The Next **Digital Frontier**

McKinsey Institute

The Next **Disruptive Force**

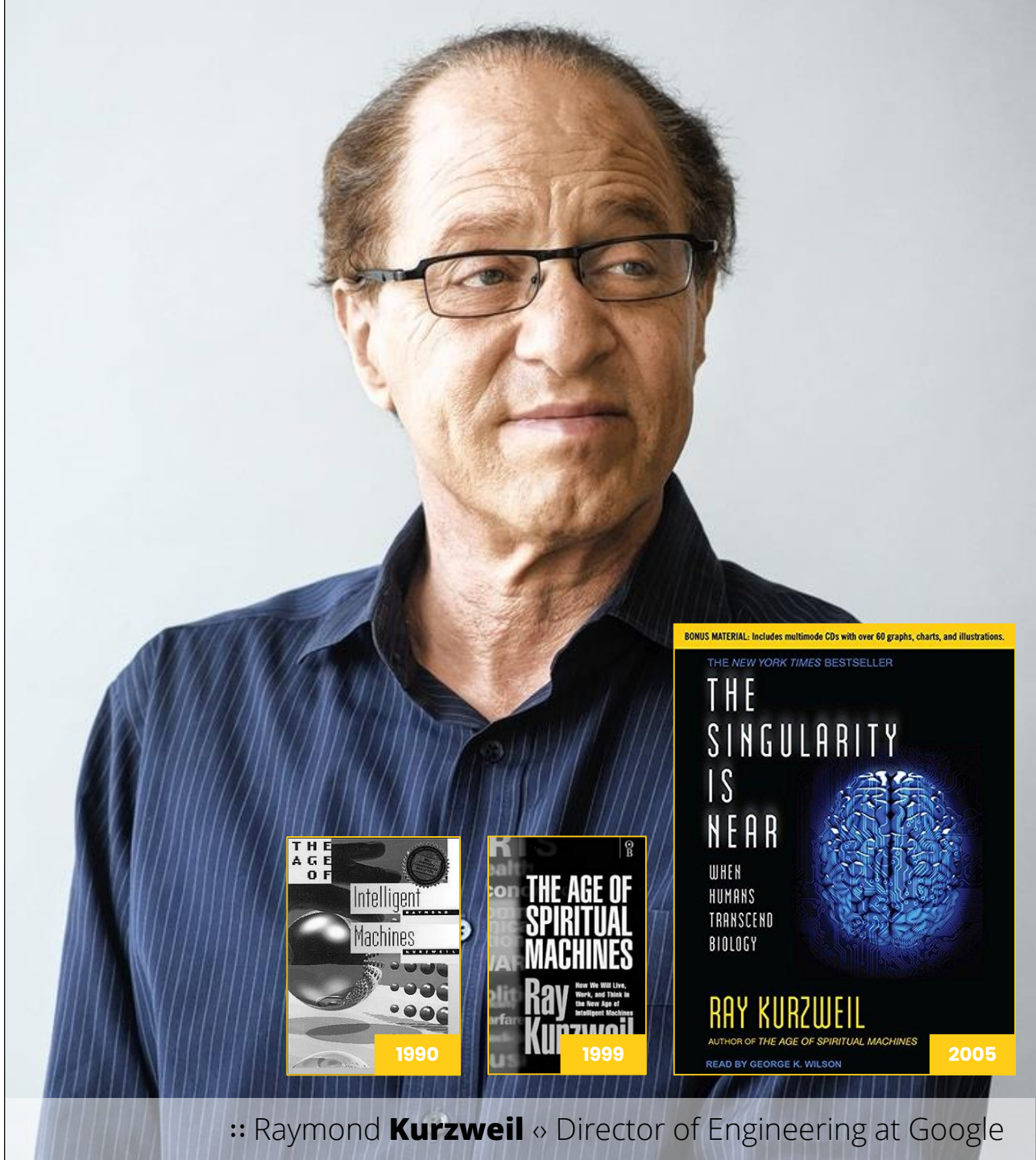
Bloomberg

The New **Black**

MIT Technology Review

The New **Electricity**

Andrew Ng



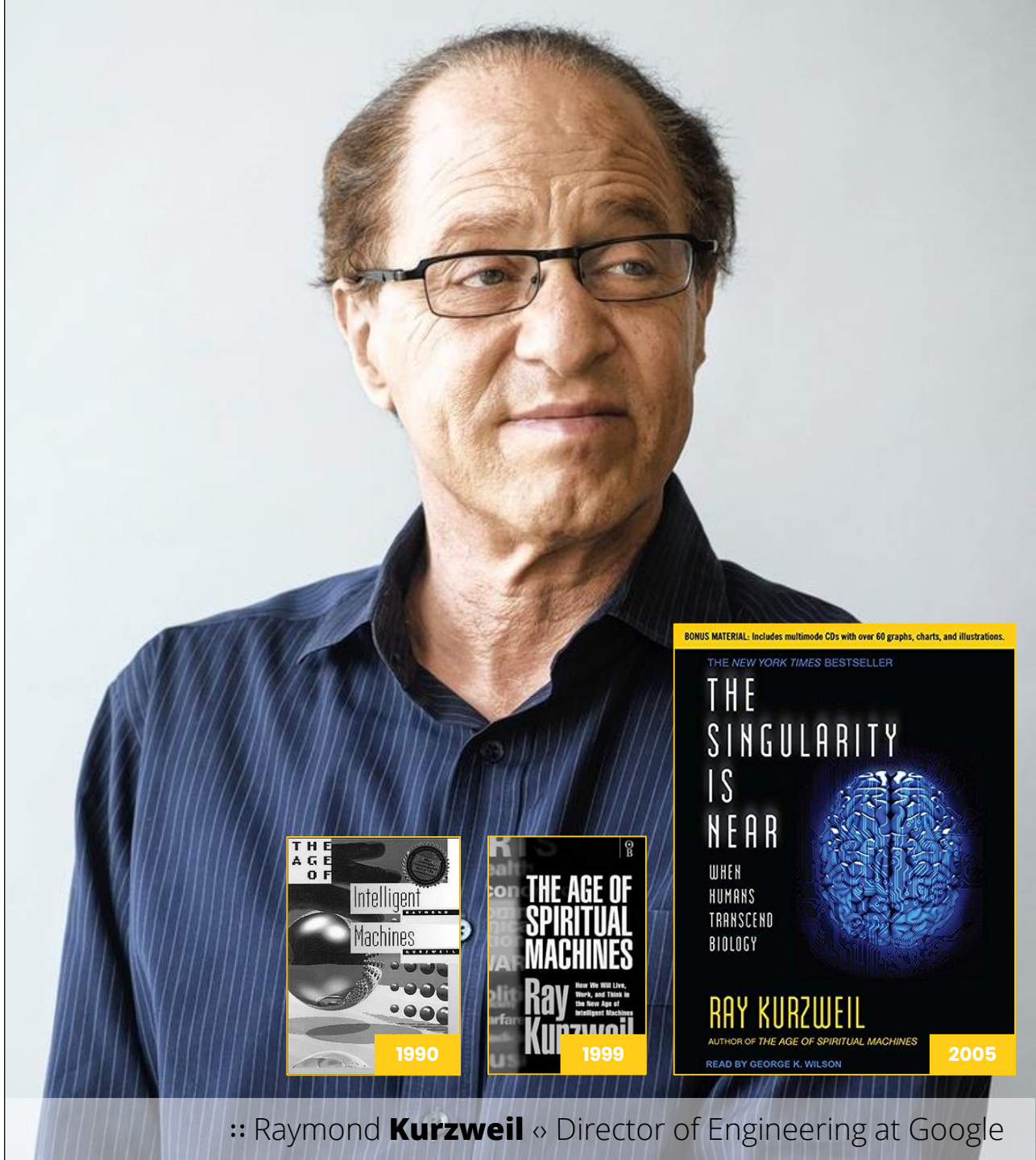
:: Raymond **Kurzweil** ‹› Director of Engineering at Google

We'll be able to fully **backup** our brains. We'll be able to think in the cloud

We're going to put **gateways** to the cloud in our brains

By the late 2030s human thought will be predominantly **non-biological**

We will be uploading our minds to computers & become **immortal** by 2045



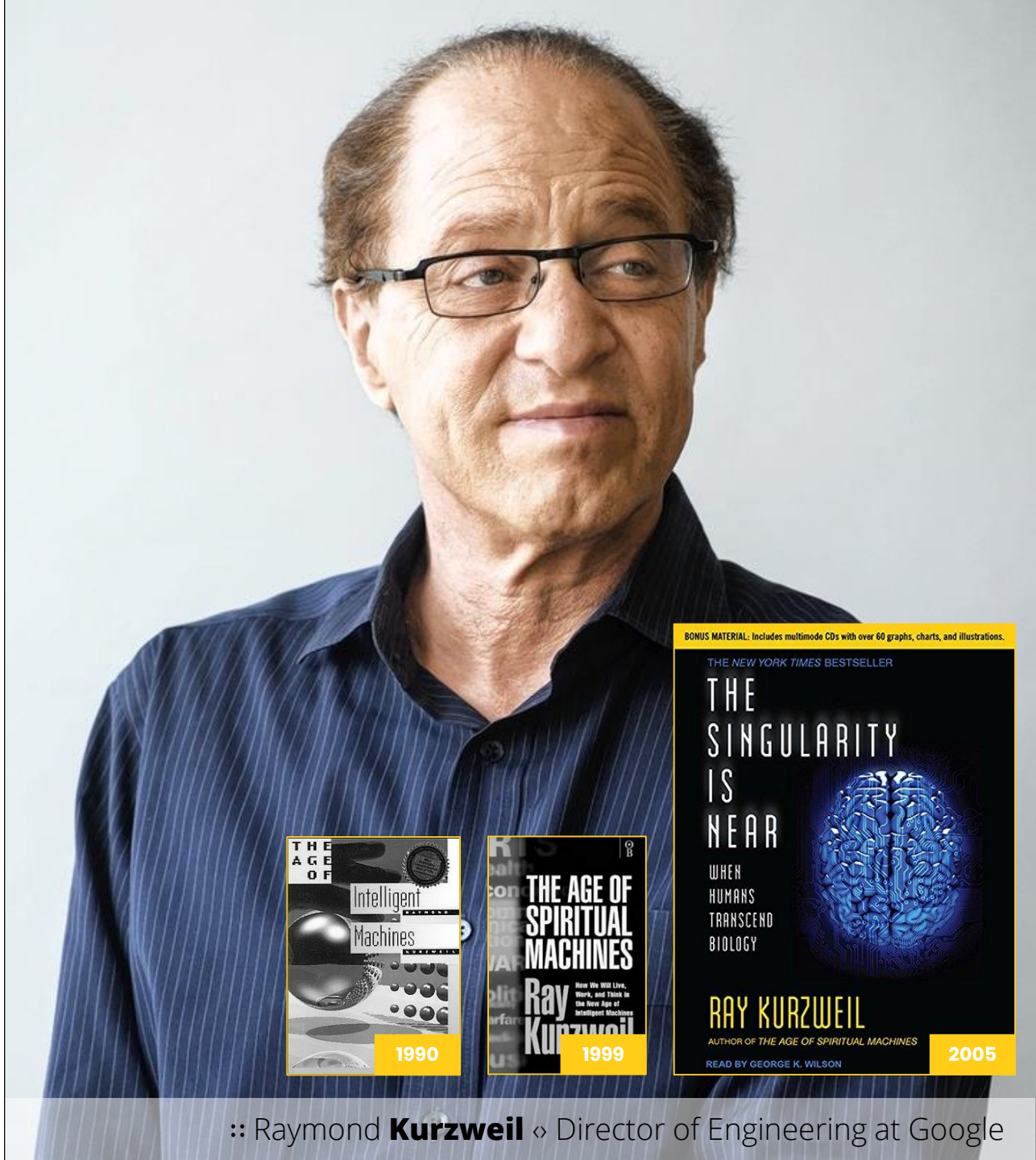
:: Raymond **Kurzweil** ‹› Director of Engineering at Google

The Law Of Accelerated Returns

Technology becomes more powerful at an accelerating rate; technological advance is exponential, not linear

Moore's Law

Number of transistors in a dense integrated circuit doubles about every two years



:: Raymond **Kurzweil** ‹› Director of Engineering at Google

@IngoPhilipp

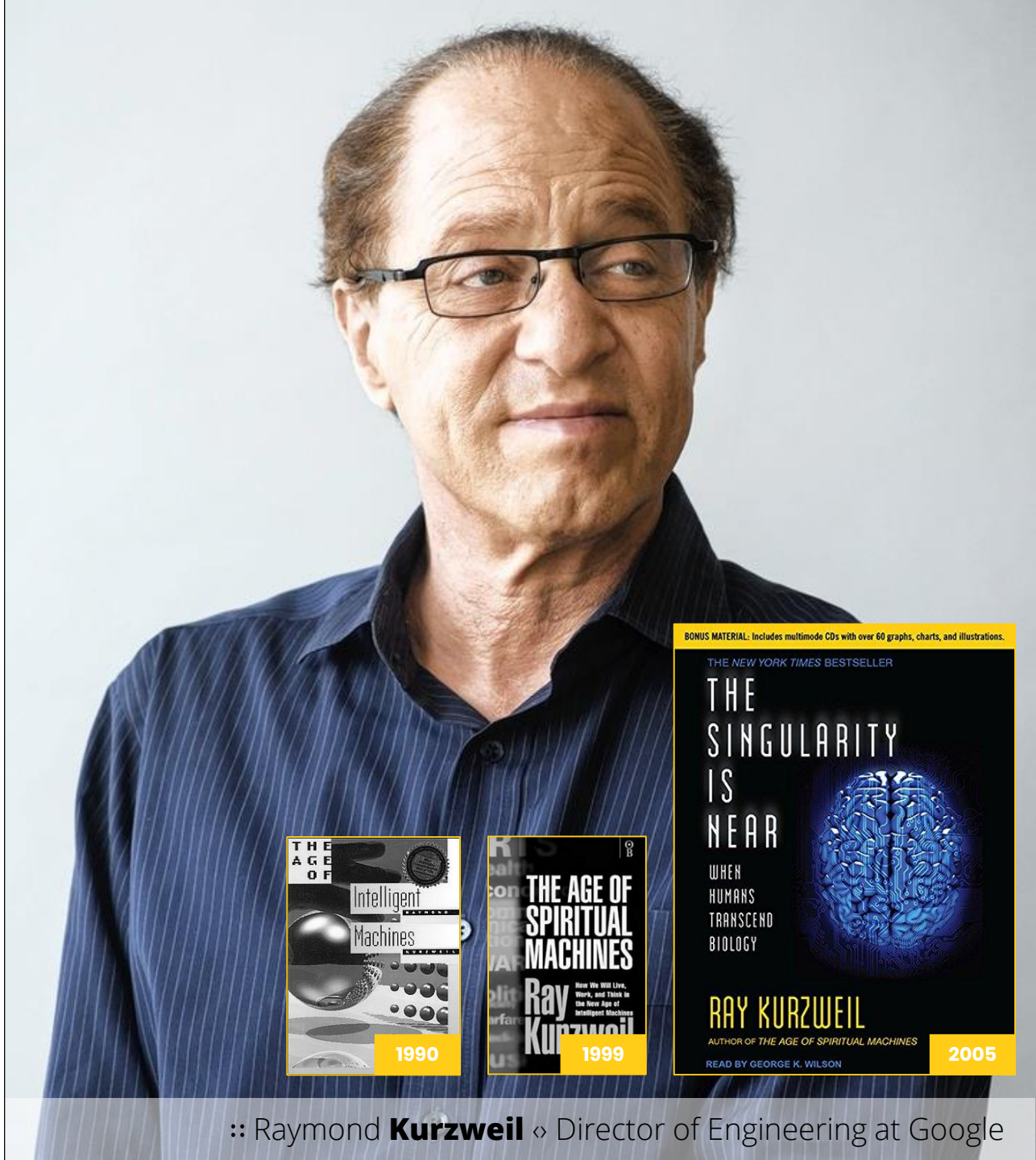
A
Hard

Master the **software**
of human thought

B
Easy

Get machines to at least match
the human brain's **computational**
power and **memory** capacity

:: **Nick Agar** ‹› Victoria University of Wellington

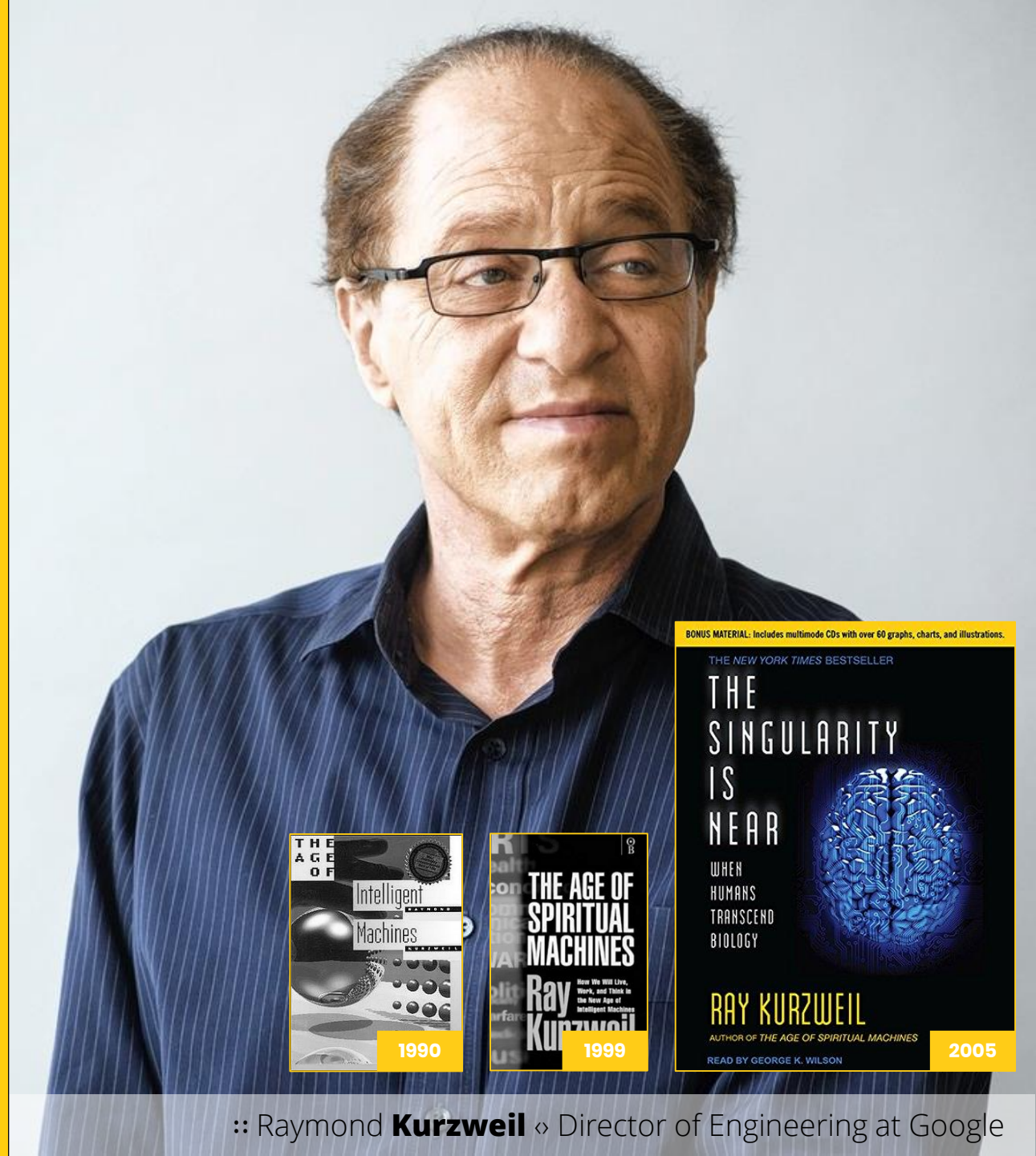


:: Raymond **Kurzweil** ‹› Director of Engineering at Google

@IngoPhilipp

We are just a baby step away from eliminating the need for **human thinking** in software testing

-- Hasty Conclusion --



:: Raymond **Kurzweil** ‹› Director of Engineering at Google

We are just a baby step
away from eliminating the
need for **human thinking**
in software testing

-- Hasty Conclusion --

I won't sell you artificial intelligence in software testing in the way miracle weight loss programs or **anti-aging** face creams are being sold to you!

:: **James Bach** ‹› The Next Step In "Test Automation" is Pure Bullshitting

I won't sell you artificial intelligence in software testing in the way miracle weight loss programs or **anti-aging** face creams are being sold to you!

:: **James Bach** ‹› The Next Step In "Test Automation" is Pure Bullshitting

Artificial Intelligence

Viewed narrowly, there seem to be almost as many **definitions** of intelligence as the number of experts asked to define it

:: Robert **Sternberg**

@IngoPhilipp

TECHNICAL REPORT IDSIA-07-07

A Collection of Definitions of Intelligence

Shane Legg

IDSIA, Galleria 2, Manno-Lugano CH-6928, Switzerland*
shane@idsia.ch www.idsia.ch/~shane

Marcus Hutter

IDSIA, Galleria 2, Manno-Lugano CH-6928, Switzerland*
RSISE/ANU/NICTA, Canberra, ACT, 0200, Australia
marcus@hutter1.net www.hutter1.net

15 June 2007

Abstract

This paper is a survey of a large number of informal definitions of "intelligence" that the authors have collected over the years. Naturally, compiling a complete list would be impossible as many definitions of intelligence are buried deep inside articles and books. Nevertheless, the 70-odd definitions presented here are, to the authors' knowledge, the largest and most well referenced collection there is.

Artificial Intelligence

Viewed narrowly, there seem to be almost as many **definitions** of intelligence as the number of experts asked to define it

:: Robert **Sternberg**

@IngoPhilipp

TECHNICAL REPORT IDSIA-07-07

A Collection of Definitions of Intelligence

Shane Legg

IDSIA, Galleria 2, Manno-Lugano CH-6928, Switzerland*

shane@idsia.ch www.idsia.ch/~shane

Marcus Hutter

IDSIA, Galleria 2, Manno-Lugano CH-6928, Switzerland*

RSISE/ANU/NICTA, Canberra, ACT, 0200, Australia

marcus@hutter1.net www.hutter1.net

15 June 2007

Abstract

This paper is a survey of a large number of informal definitions of "intelligence" that the authors have collected over the years. Naturally, compiling a complete list would be impossible as many definitions of intelligence are buried deep inside articles and books. Nevertheless, the 70-odd definitions presented here are, to the authors' knowledge, the largest and most well referenced collection there is.

Emotional Thinking	**Critical** Thinking	**Problem** Solving
Logical Thinking	**Communication** Perception	**Modelling** Planning
Abstraction Learning	**Imagination** Creativity	**Memory** Experience
Understanding Knowledge	**Judgement** Analysis	Environment **Manipulation**
Environment **Adaptation**	Strategic **Goal Setting**	Instinctive **Judgement**

TECHNICAL REPORT IDSIA-07-07

A Collection of Definitions of Intelligence

Shane Legg

IDSIA, Galleria 2, Manno-Lugano CH-6928, Switzerland*
shane@idsia.ch www.idsia.ch/~shane

Marcus Hutter

IDSIA, Galleria 2, Manno-Lugano CH-6928, Switzerland*
RSISE/ANU/NICTA, Canberra, ACT, 0200, Australia
marcus@hutter1.net www.hutter1.net

15 June 2007

Abstract

This paper is a survey of a large number of informal definitions of "intelligence" that the authors have collected over the years. Naturally, compiling a complete list would be impossible as many definitions of intelligence are buried deep inside articles and books. Nevertheless, the 70-odd definitions presented here are, to the authors' knowledge, the largest and most well referenced collection there is.

Intelligence

Intelligence is like an enormous suitcase that contains all sorts of phenomena we can't explain

> Intelligence is what is measured by **intelligence tests**
>
> Edwin Boring

- The Turing Test
- The Reverse Turing Test
- The Visual Turing Test
- The Lovelace Test
- The Lovelace 2.0 Test
- The Winograd Schema Challenge
- The Ex Machina Test
- The Tokyo Test
- The AIQ Test
- The DeepMind Test
- The Marcus Test
- The IKEA Challenge
- The NCC Test

Intelligence

Intelligence is like an enormous suitcase that contains all sorts of phenomena we can't explain

“

Intelligence is what is measured by **intelligence tests**

Edwin Boring

Intelligence measures an agent’s ability to achieve **goals** in a wide range of **environments**

Shane Legg

Artificial intelligence is **anything** machines can't yet do

Chris Bishop

Intelligence

Intelligence is like an enormous suitcase that contains all sorts of phenomena we can't explain

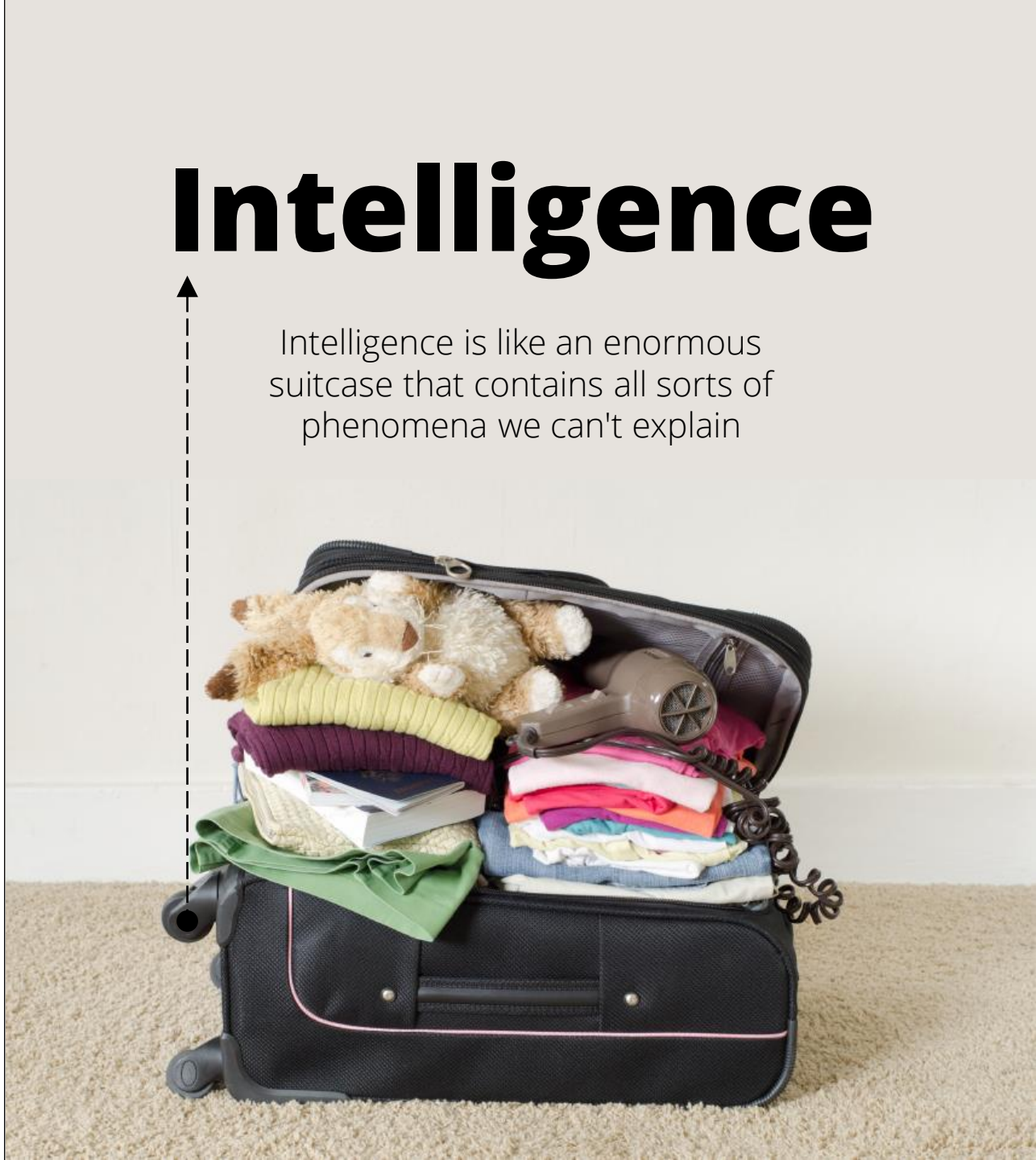
Artificial
General
Intelligence

A machine with the ability to apply intelligence to **any problem**

:: **aka** ‹› Pure ‹› Strong ‹› Full ‹› General-Purpose **AGI**

Intelligence

Intelligence is like an enormous suitcase that contains all sorts of phenomena we can't explain



Artificial **General** *Intelligence*

A machine with the ability to apply intelligence to **any problem**

:: **aka** ‹› Pure ‹› Strong ‹› Full ‹› General-Purpose **AGI**

Will humans **ever create** artificial general intelligence?

▸ No, because humans aren't generally intelligent.

@IngoPhilipp

Artificial General Intelligence

A machine with the ability to apply intelligence to **any problem**

:: **aka** ‹› Pure ‹› Strong ‹› Full ‹› General-Purpose **AGI**

AGI is the study of what we could do with machines we don't have.

... and probably will never have

:: Inspired by **Scott Aaronson**

@IngoPhilipp

Artificial General Intelligence

A machine with the ability to apply intelligence to **any problem**

:: **aka** ‹› Pure ‹› Strong ‹› Full ‹› General-Purpose

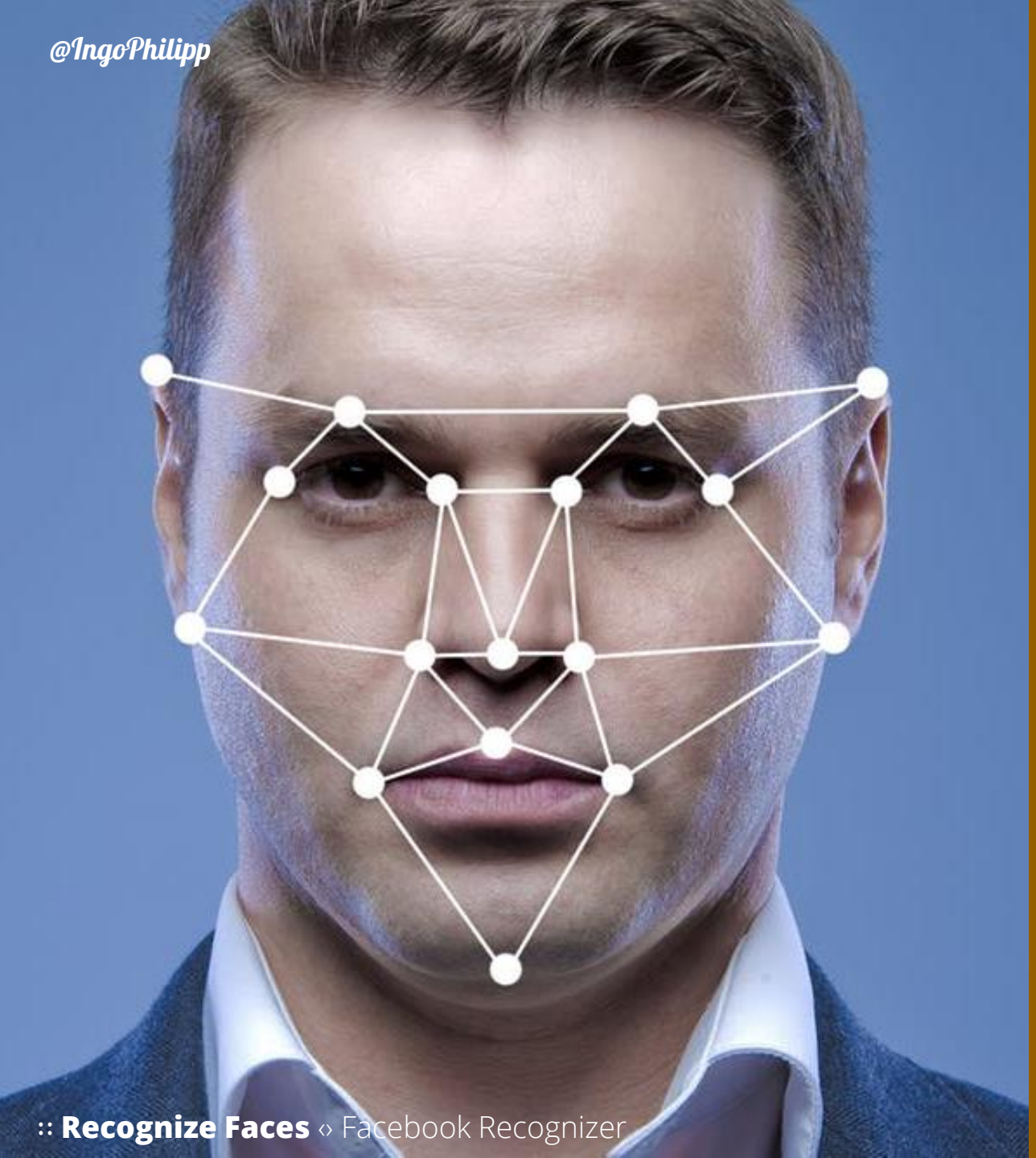
AGI

Artificial Narrow Intelligence

A machine with the ability to apply intelligence to a **specific problem**

:: **aka** ‹› Specialized ‹› Weak ‹› Purpose-Specific

ANI



Artificial Narrow Intelligence

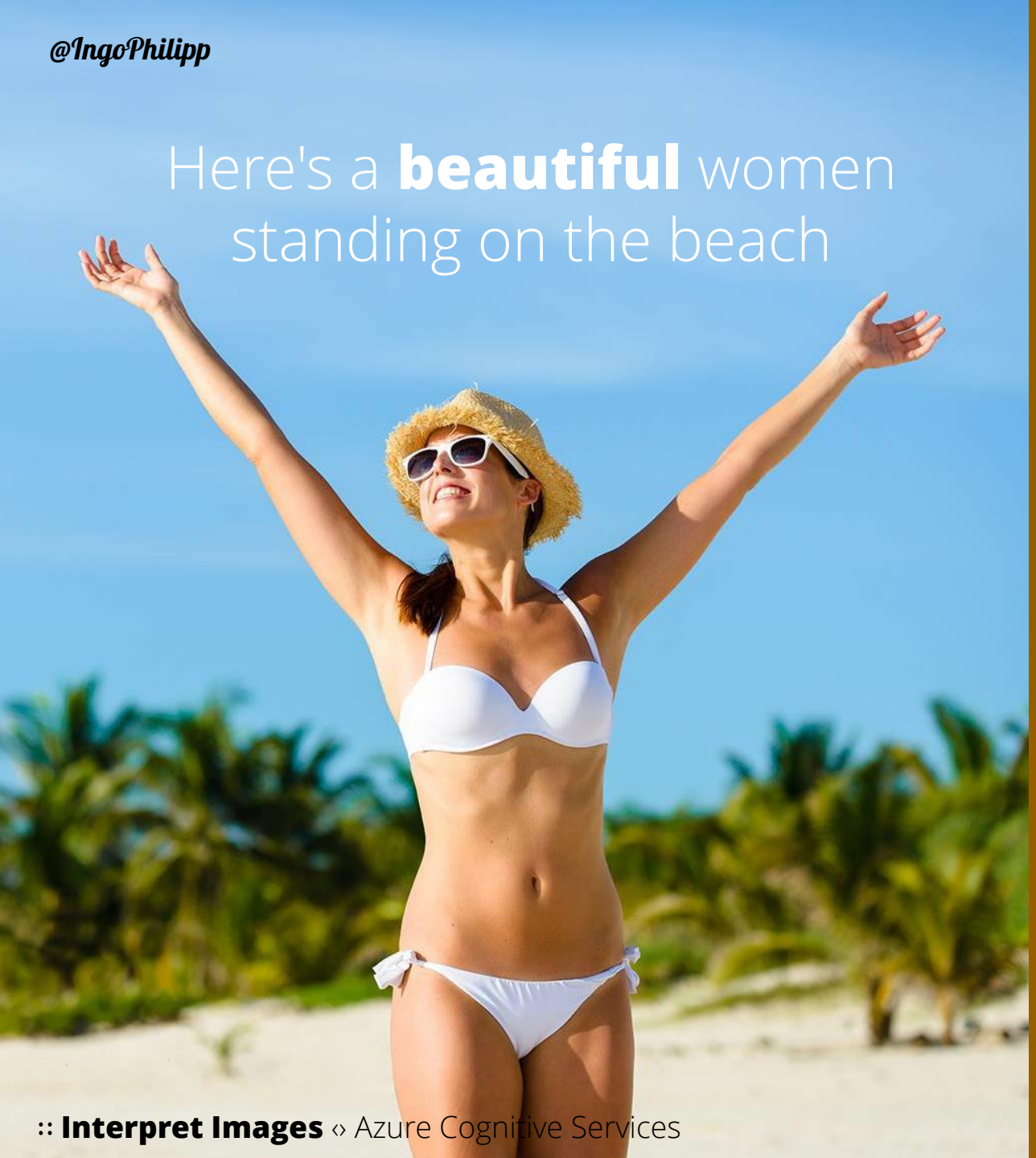
A machine with the ability to apply intelligence to a **specific problem**

:: **Recognize Faces** ‹› Facebook Recognizer

:: **aka** ‹› Specialized ‹› Weak ‹› Purpose-Specific

ANI

@IngoPhilipp



:: **Interpret Images** ‹› Azure Cognitive Services

Artificial
Narrow
Intelligence

A machine with the ability to apply intelligence to a **specific problem**

:: **aka** ‹› Specialized ‹› Weak ‹› Purpose-Specific

ANI

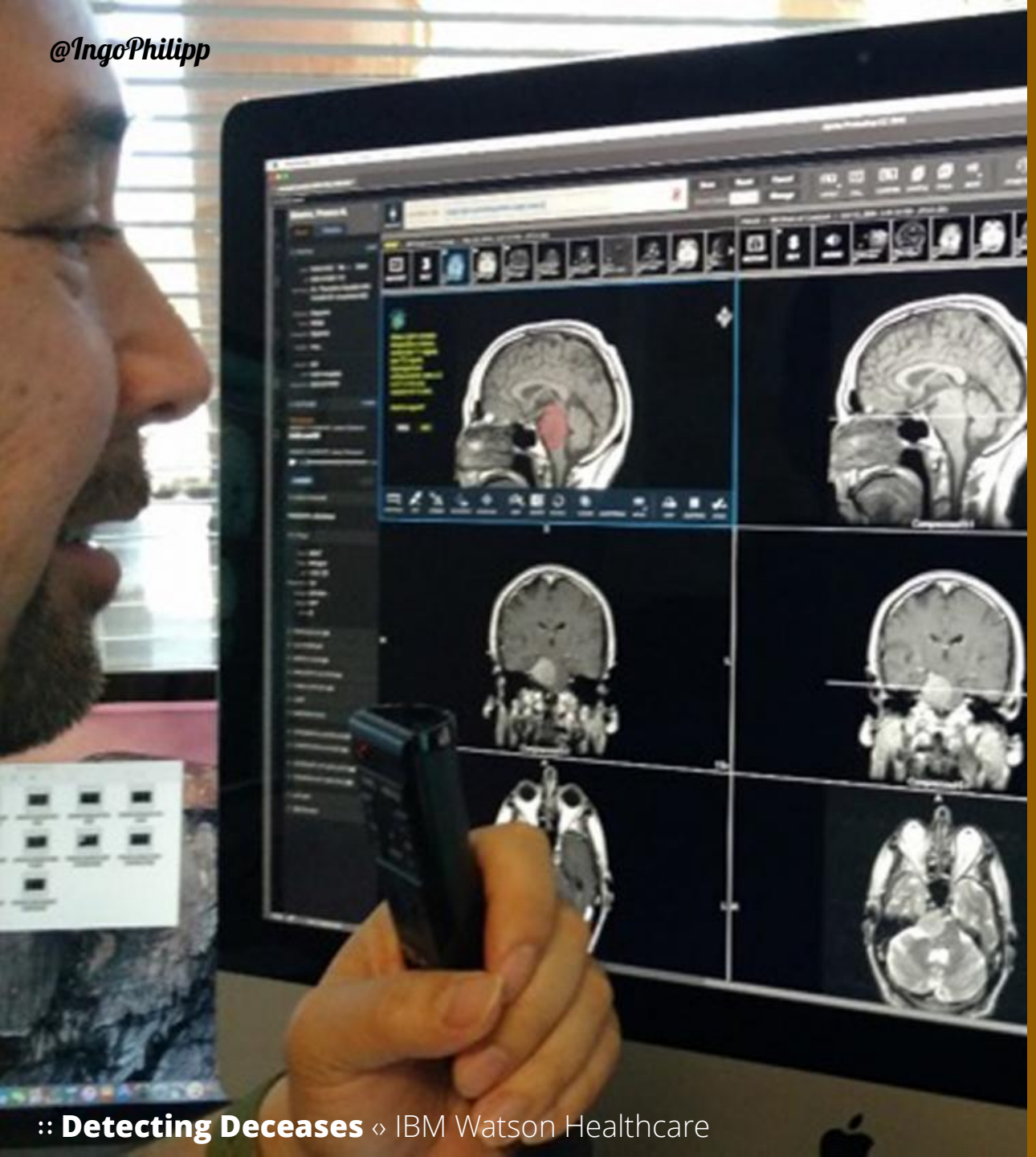
:: **Playing Jeopardy** ‹› IBM Watson Jeopardy

Artificial
Narrow
Intelligence

A machine with the ability to apply intelligence to a **specific problem**

:: **aka** ‹› Specialized ‹› Weak ‹› Purpose-Specific

ANI



:: **Detecting Deceases** ‹› IBM Watson Healthcare

Artificial
Narrow
Intelligence

A machine with the ability to apply intelligence to a **specific problem**

:: **aka** ‹› Specialized ‹› Weak ‹› Purpose-Specific

ANI

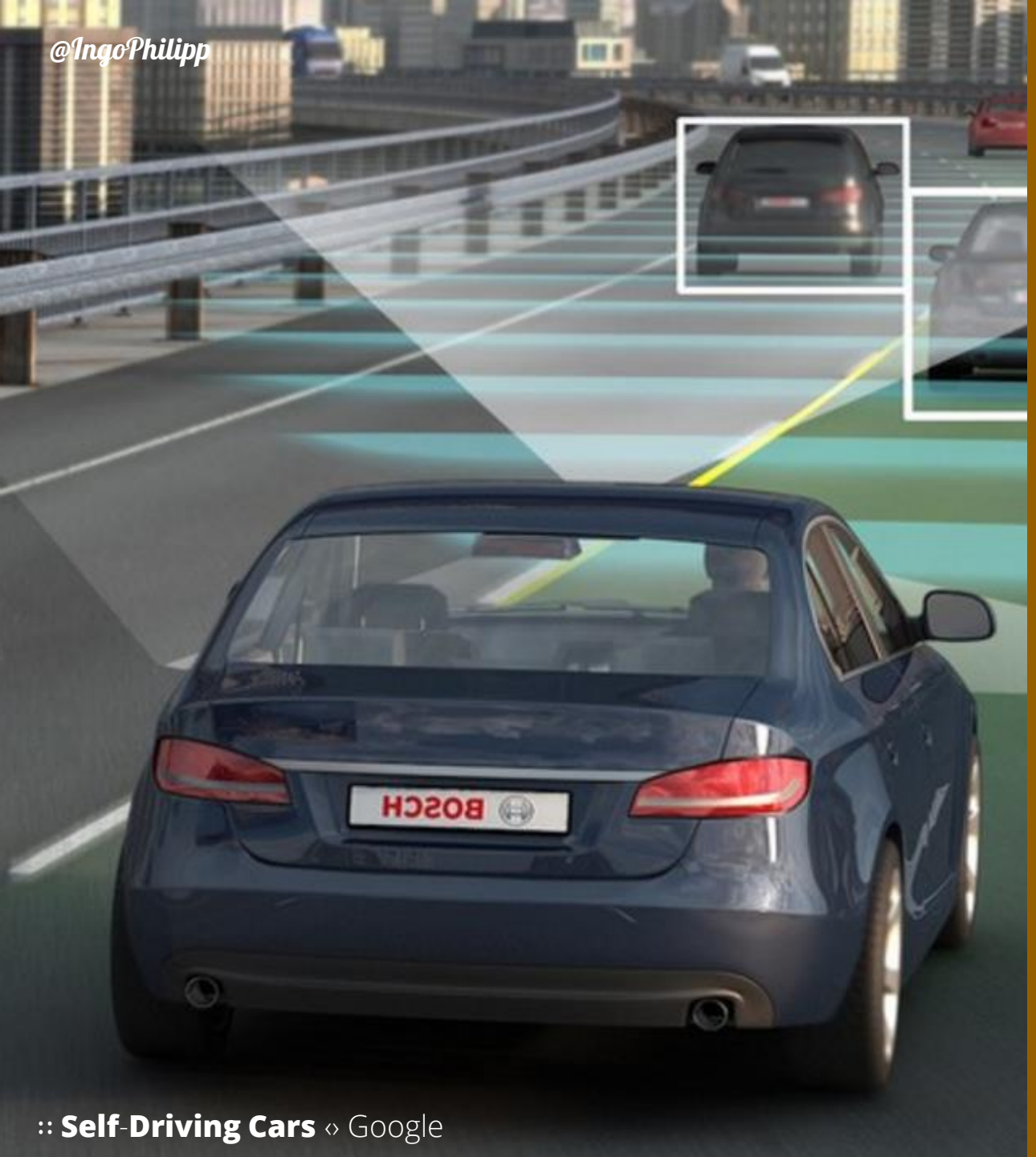
:: **Playing Go** ‹› AlphaGo ‹› "AI is an entity that cannot be defeated."

Artificial **Narrow** *Intelligence*

A machine with the ability to apply intelligence to a **specific problem**

:: **aka** ‹› Specialized ‹› Weak ‹› Purpose-Specific

ANI



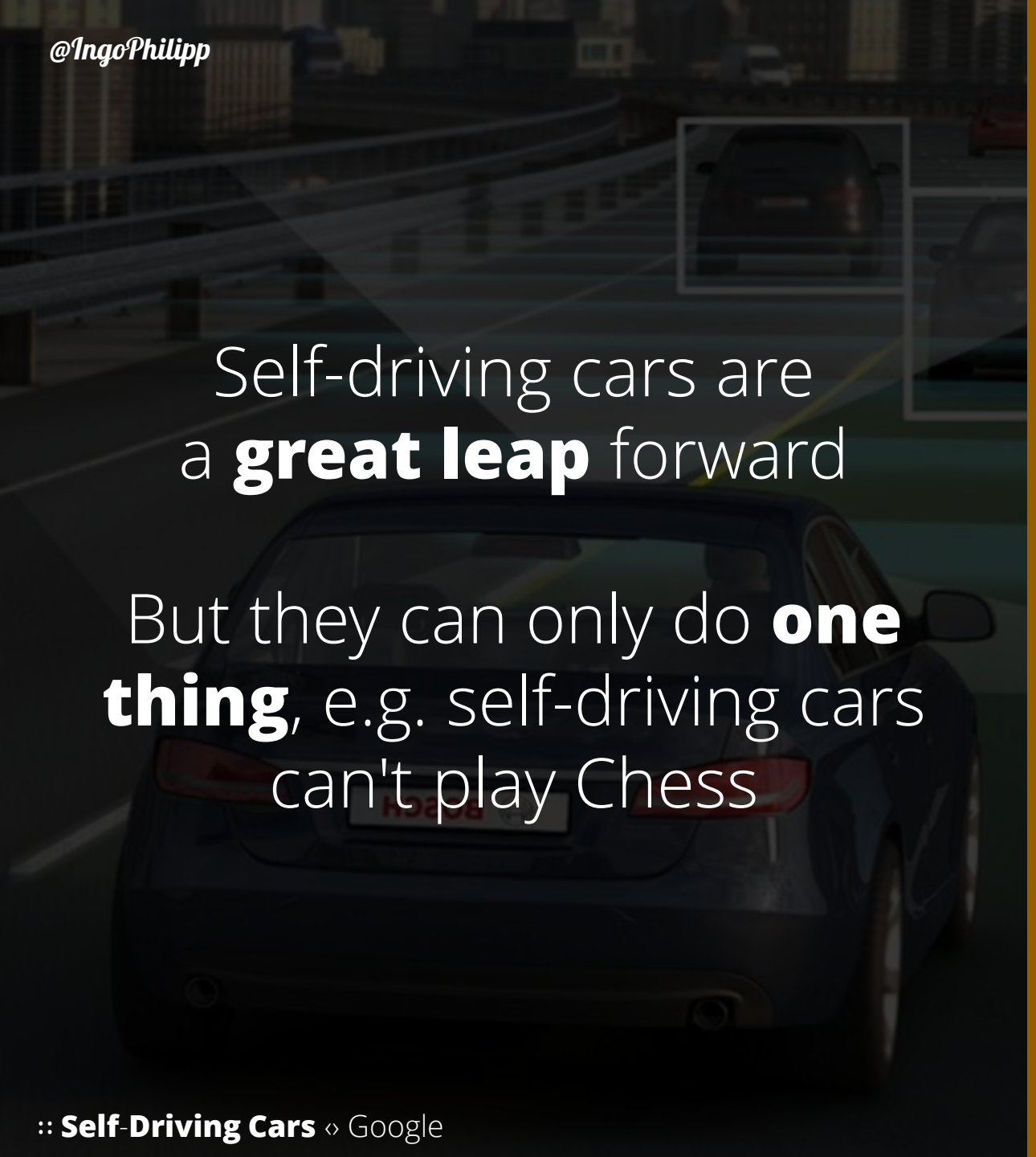
:: **Self-Driving Cars** ‹› Google

Artificial
Narrow
Intelligence

A machine with the ability to apply intelligence to a **specific problem**

:: **aka** ‹› Specialized ‹› Weak ‹› Purpose-Specific

ANI



Self-driving cars are a **great leap** forward

But they can only do **one thing**, e.g. self-driving cars can't play Chess

:: **Self-Driving Cars** ‹› Google

AGI

Artificial **Narrow** *Intelligence*

A machine with the ability to apply intelligence to a **specific problem**

:: **aka** ‹› Specialized ‹› Weak ‹› Purpose-Specific

ANI

@IngoPhilipp

:: **Ben Goertzel** ‹› CEO & Founder SingularityNET & OpenCog

AGI

Artificial
Narrow
Intelligence

A machine with the ability to apply intelligence to a **specific problem**

:: **aka** ‹› Specialized ‹› Weak ‹› Purpose-Specific

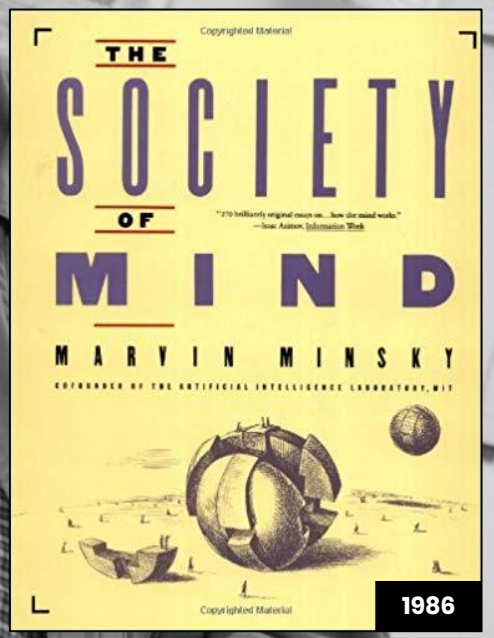
ANI

@IngoPhilipp

:: **Marvin Minsky** ‹› Co-Founder MIT AI Lab

Sofia ▪ Hanson Robotics

:: **Ben Goertzel** ‹› CEO & Founder SingularityNET & OpenCog



1986

@IngoPhilipp

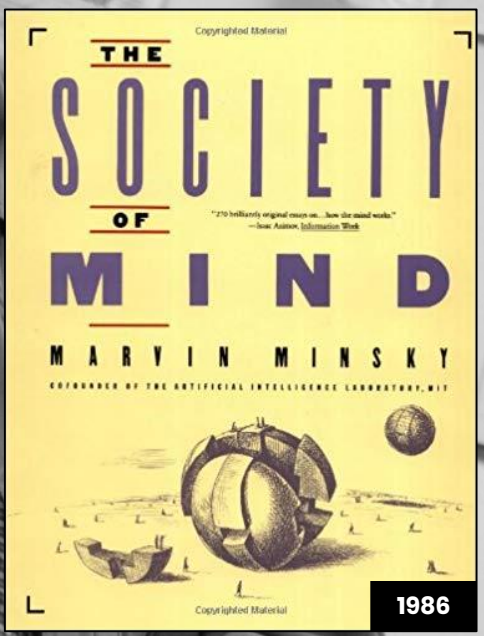
Beta March, 2019

SingularityNET

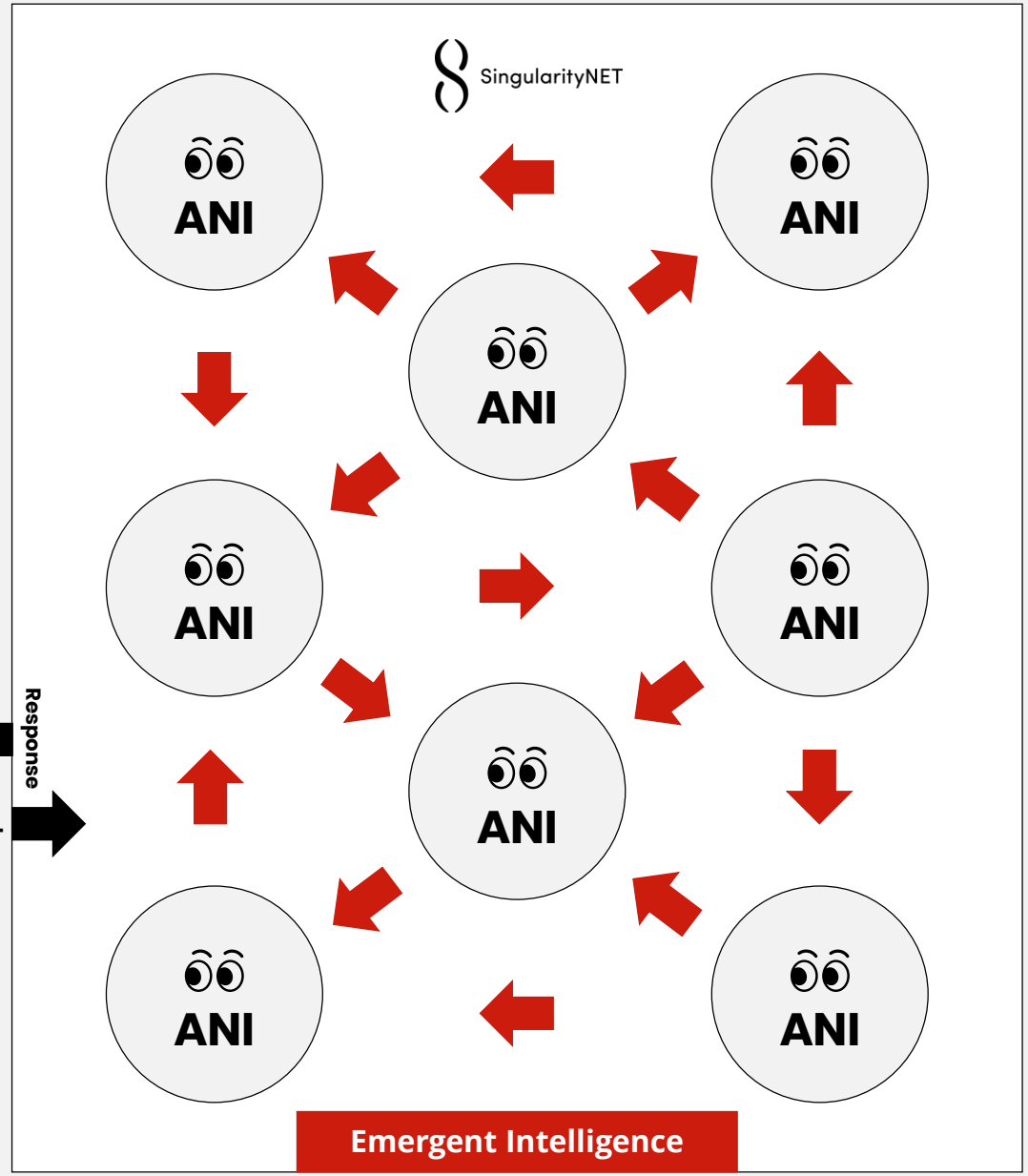
Lets anyone create, share, and monetize AI services at scale. The world's decentralized AI network has arrived.

Decentralized AI Network ‹› Blockchain-Based AI Platform

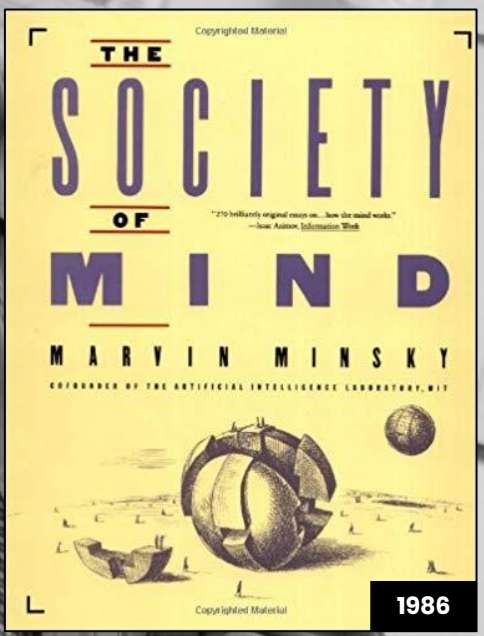
:: **Marvin Minsky** ‹› Co-Founder MIT AI Lab

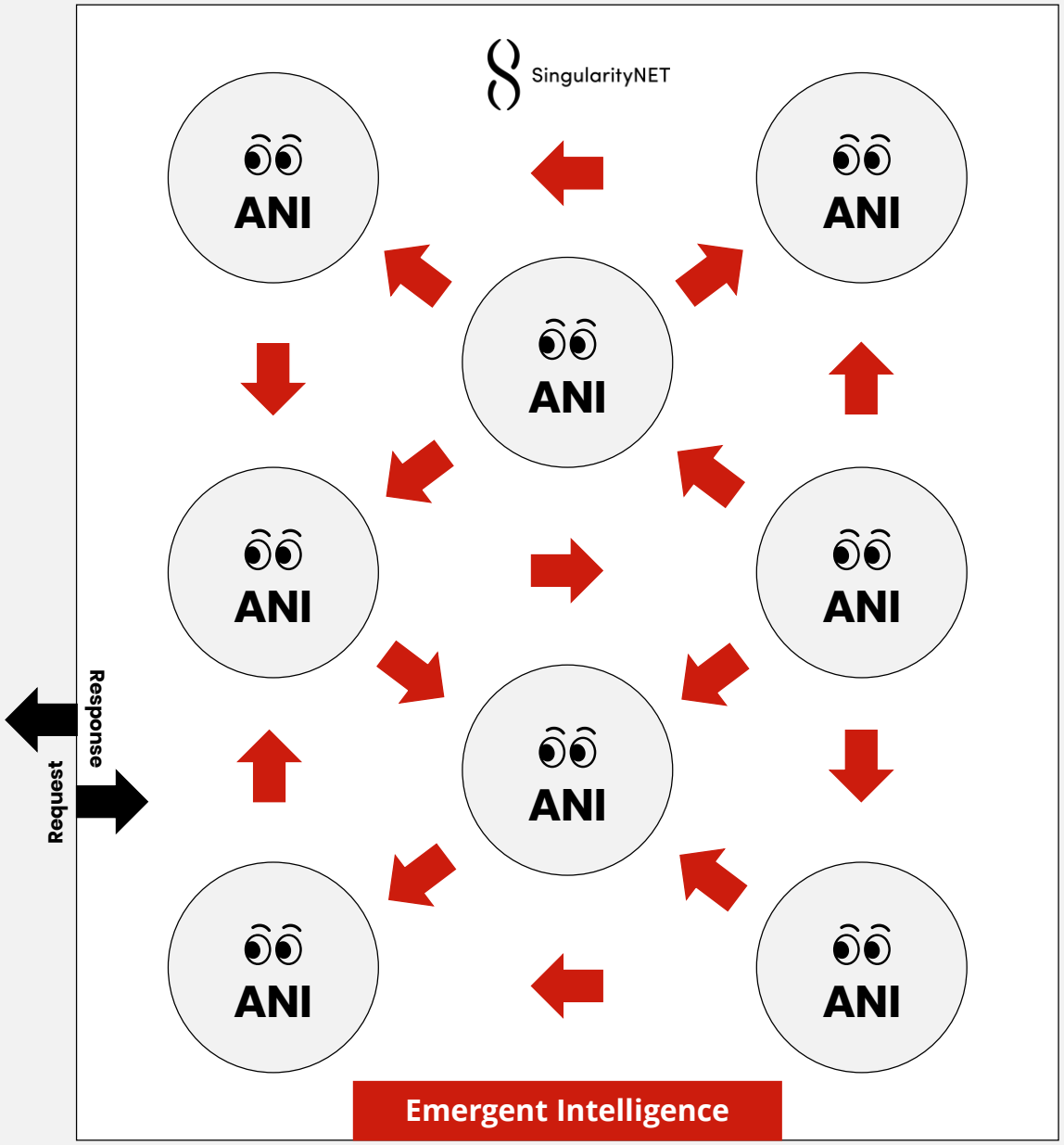


1986

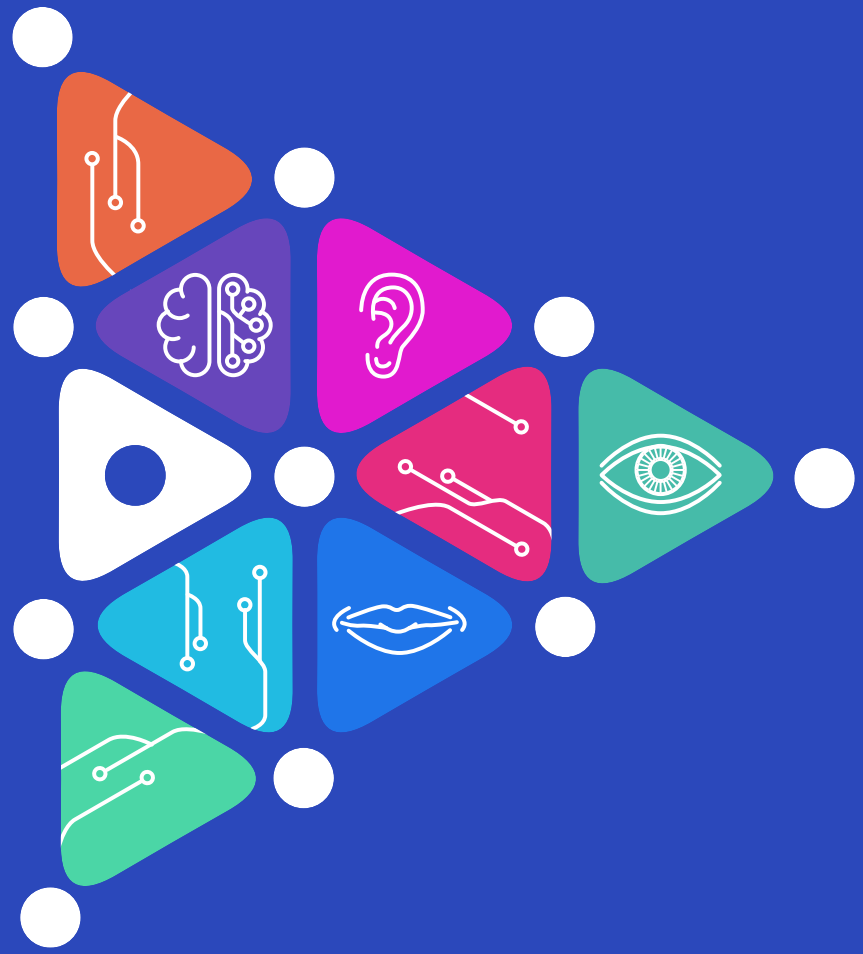


:: **Marvin Minsky** ‹› Co-Founder MIT AI Lab

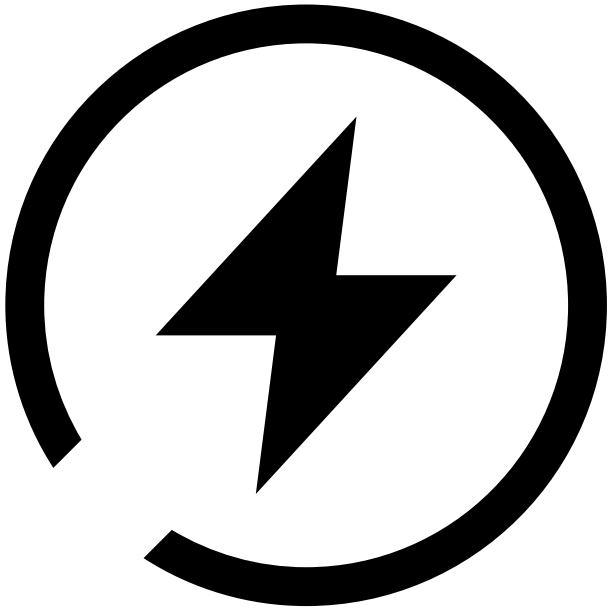




Exploring
Testing



- Ecosystem of Ecosystems ‹› Network of Networks

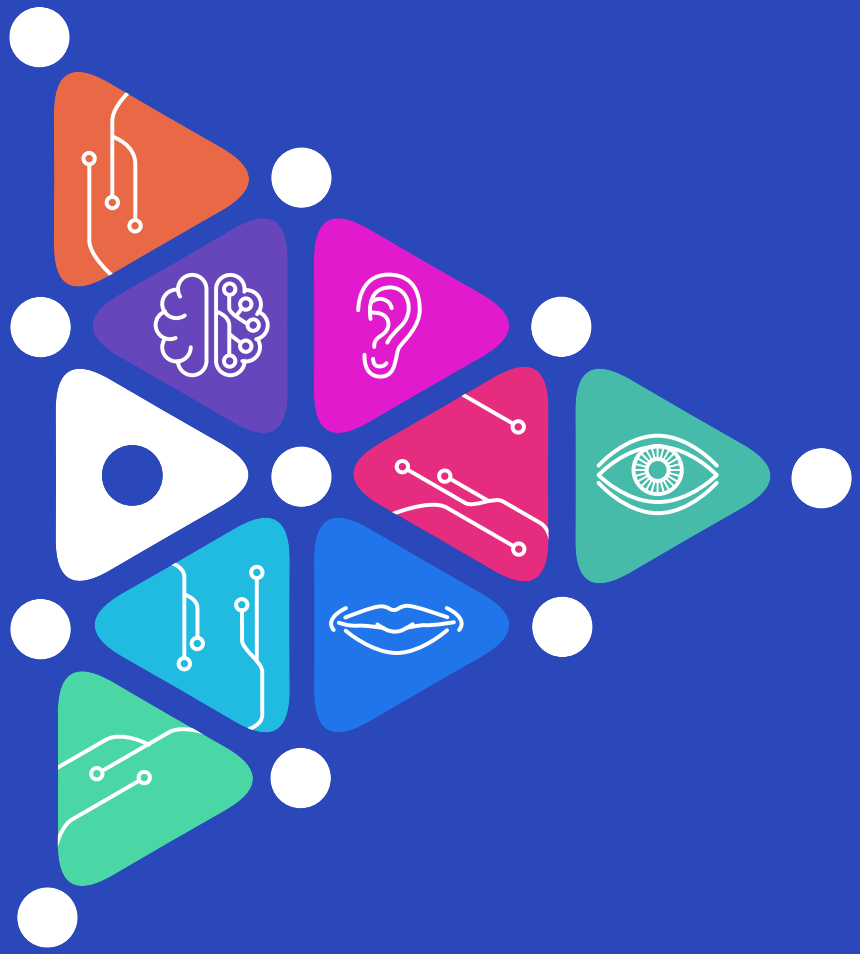


Software Testing

:: **aka** ‹› How to challenge software to evaluate it?

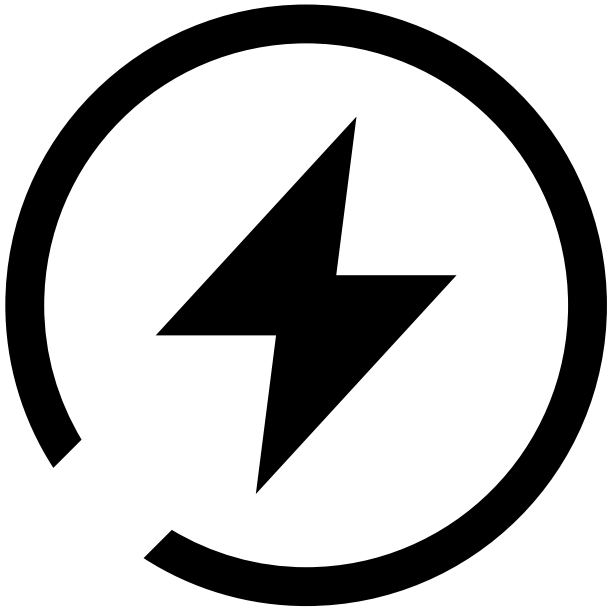
:: **DAIA** ‹› Decentralized AI Alliance

👀 Exploring **Testing**



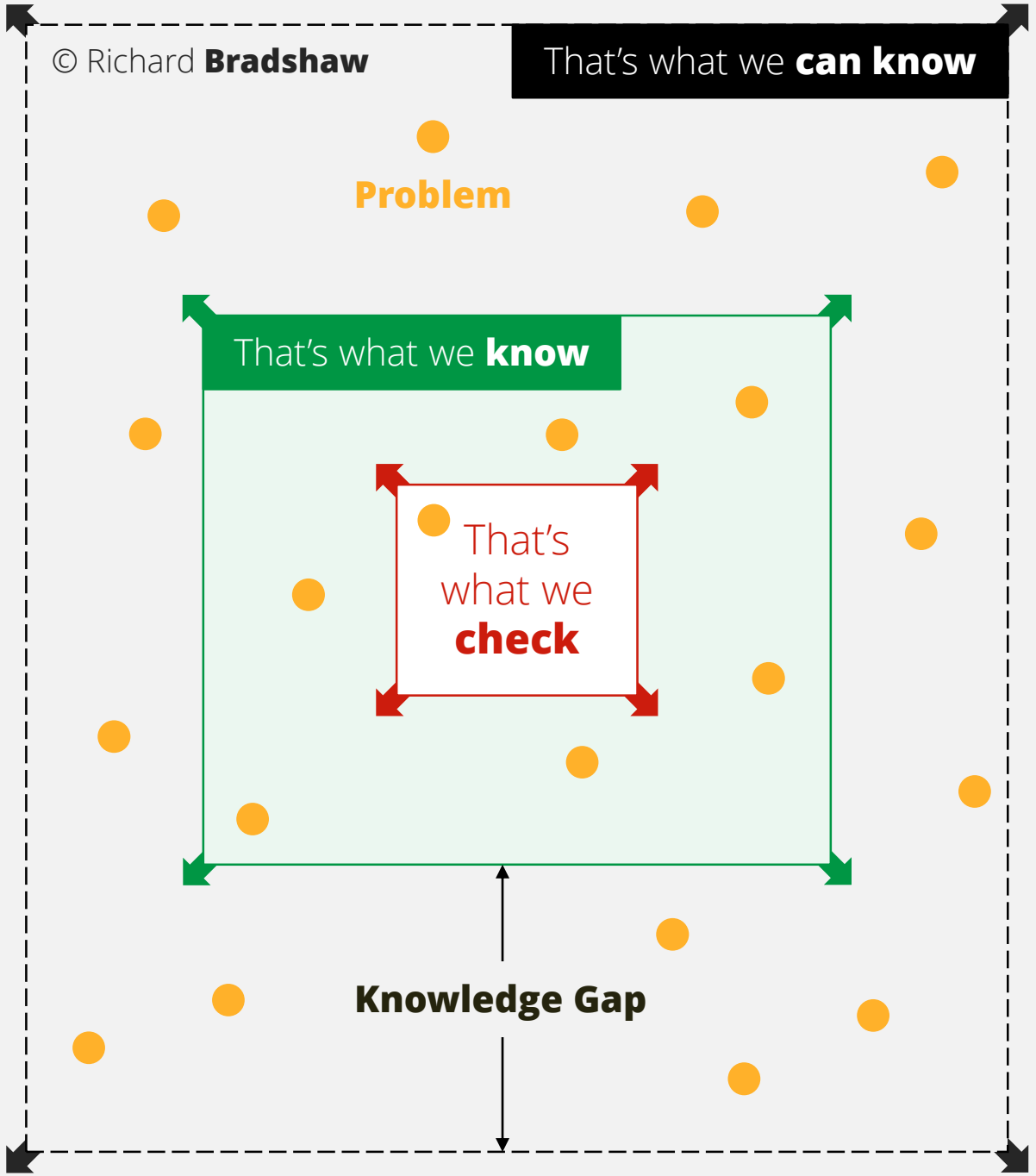
▸ Ecosystem of Ecosystems ‹› Network of Networks

@IngoPhilipp



Software Testing

:: **aka** ‹› How to challenge software to evaluate it?



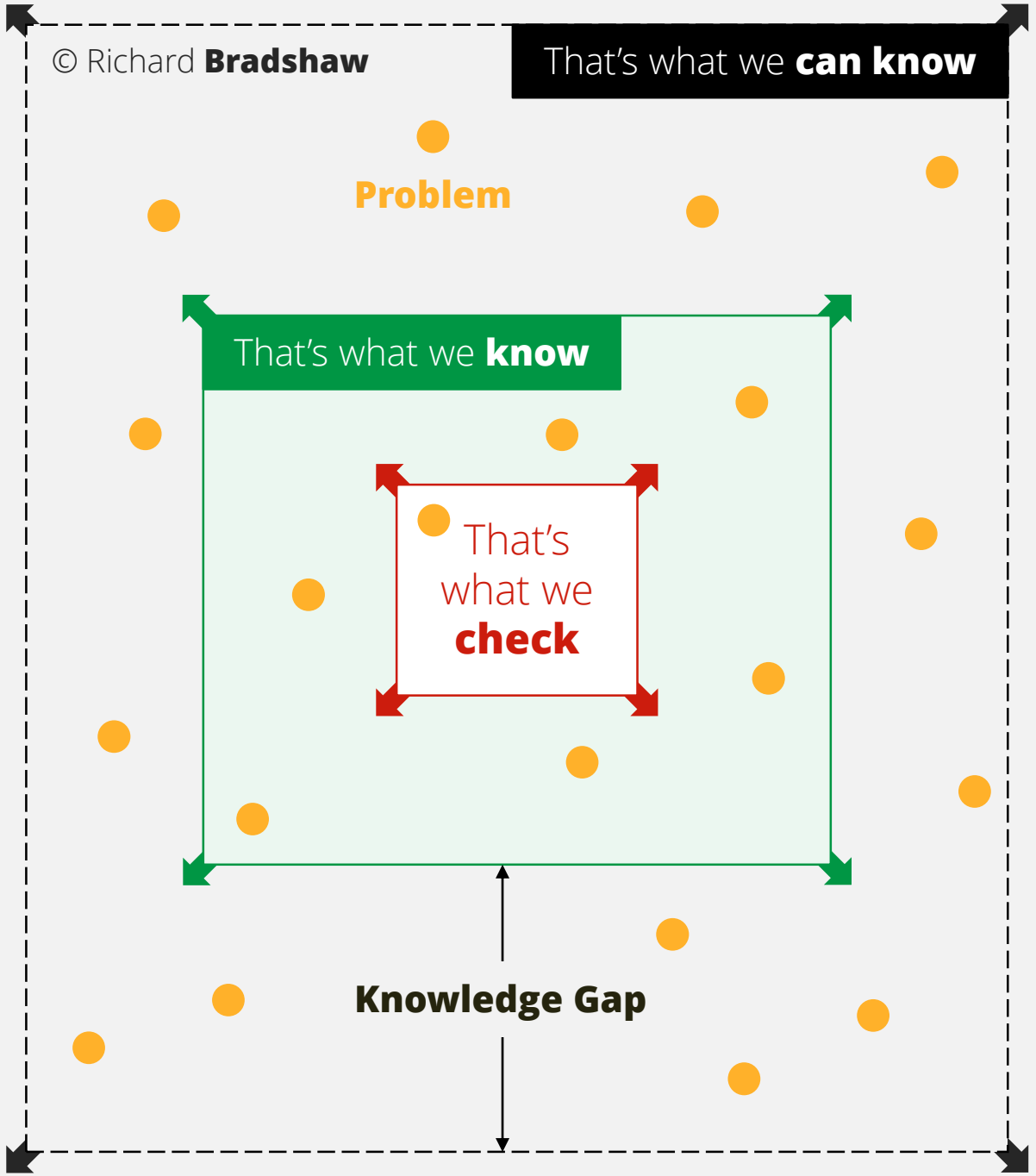
The purpose of testing is to close the **knowledge** gap

✸

The goal is **information**, not gratuitous automation

✸

Testing is and always will be a **search** for information



Checking

Monitoring Known Risks

+

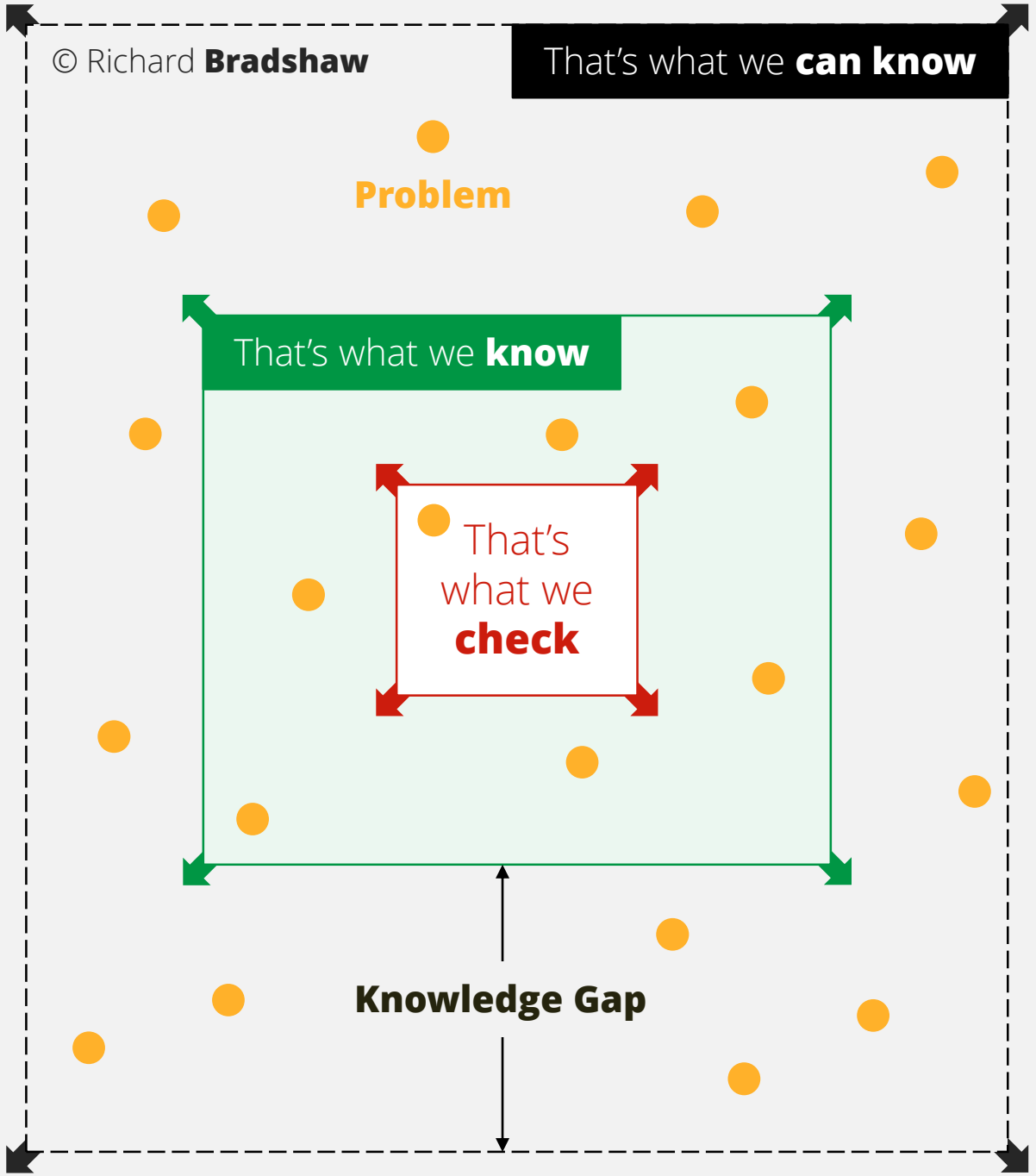
Exploring

Analyzing Potential Risks

=

Testing

:: **Elisabeth Hendrickson** ‹› Testing Equation



@IngoPhilipp

Change Detector

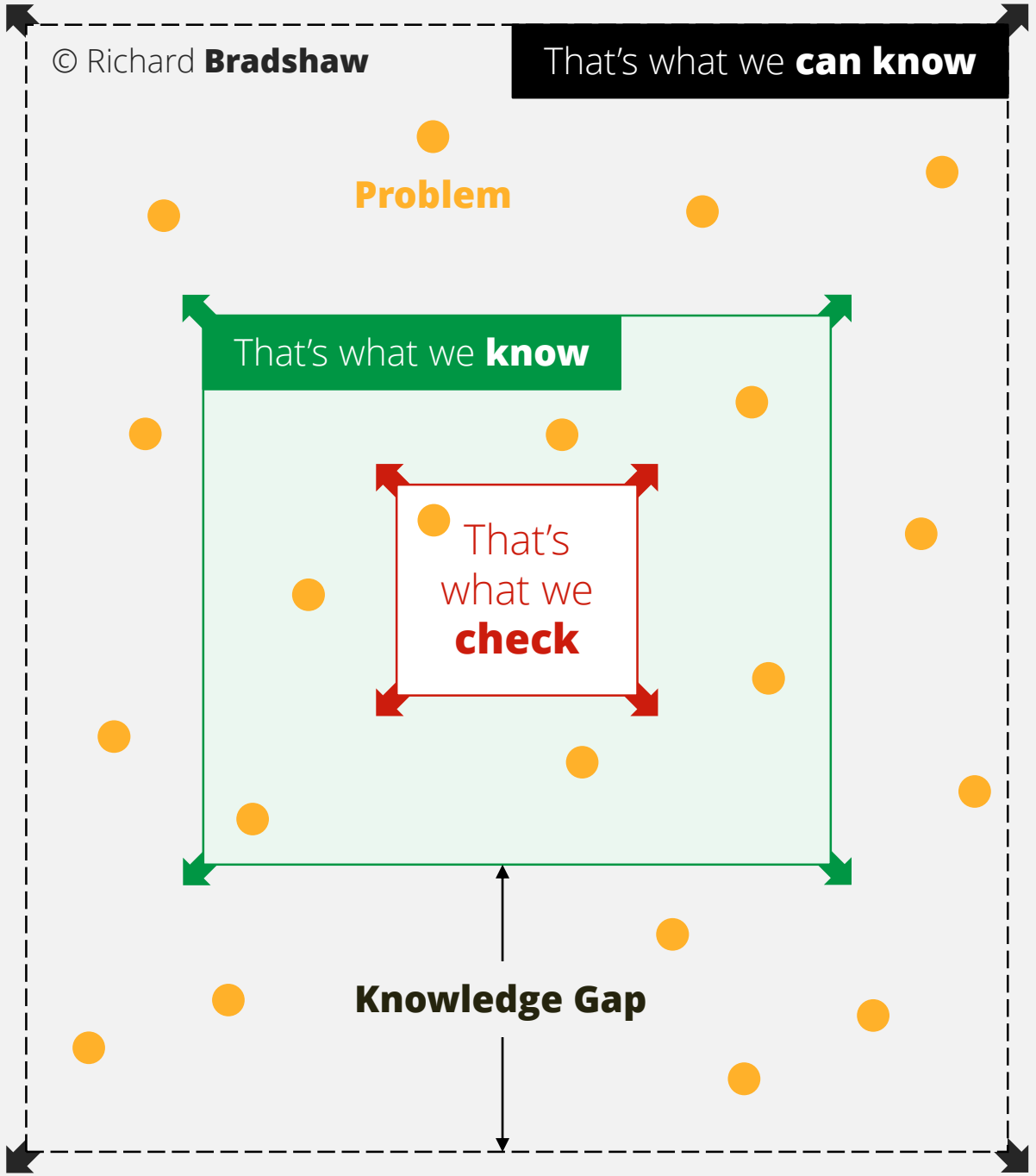
Does this assertion pass or fail?

Evaluate a product by applying **algorithmic** decision rules to specific observations of a product

Checking

« Requires **Processing** »

:: **Bolton** ‹› **Kaner** ‹› **Bach**



@IngoPhilipp

Change Detector

Does this assertion pass or fail?

Evaluate a product by applying **algorithmic** decision rules to specific observations of a product

Checking

« Mechanical Process »

:: **Bolton** ‹› **Kaner** ‹› **Bach**

Easy

Hard

Problem Detector

Is there a problem here?

Evaluate a product by learning about it through **exploration** and experimentation

Exploring

« Creative Process »

@IngoPhilipp

Before Checking

‹› Before the check happens ‹›

You must **learn** about your software
That takes testing skill

You must **understand** your software
That takes testing skill

You must **recognize**, identify & prioritize a risk
That takes testing skill

You must **translate** that risk into a test idea
That takes testing skill

You must **express** a test idea yes-or-no question
That takes testing & programming skill

You must **turn** the question into code
That takes programming skill

You must **find** a trigger to launch the check
That takes testing skill

You must **encode** the trigger to automate it
That takes programming skill

Perform
Check

After Checking

‹› After the check happened ‹›

You must **read** the bit
That takes programming skill

You must **aggregate** bits
That takes programming skill

You must **design** a report
That takes design & testing skill

You must **encode** the report
That takes programming skill

You must **observe** the report
That takes testing skill

You must **determine** meaning
That takes testing & product mgmt. skill

You must **judge** significance
That takes testing & project mgmt. skill

You must **respond**
That takes at least one of several of the skills above

@IngoPhilipp ‹› Exploration isn't something special in testing, it is central to testing, and so all true testing is exploratory.

Automated Checking is a tiny
little dot in the vast space of testing

Ingo Philipp

:: **Michael Bolton** ‹› Checking is a guest in the house of testing, exploration is a permanent resident**.**

Here's a **substitution** of testing

- Learning
- Exploration
- Experimentation
- Modelling
- Studying
- Drawing inferences
- Questioning facts
- Assessing risks
- Prioritizing risks
- Analyzing coverage metrics
- Making decisions
- Designing test labs
- Preparing test labs
- Advocating testability
- Applying judgement
- Applying critical thinking
- Applying emotional thinking
- Applying logical thinking

Can testing be automated?

:: **Michael Bolton** ‹› Deeper Testing ‹› Automating Testing

- **autonomiq**.io
  Claim. Automate every step of the testing life-cycle
- **accelq**.com
  Claim. Automate test design, test planning, and test execution
- **functionize**.com
  Claim. Autonomous testing
- **testrigor**.com
  Claim. Autonomous, more stable exploratory & regression testing
- **test**.ai
  Claim. Automate testing for the most impactful user experiences
- **testim**.io
  Claim. Speed-up authoring, execution & maintenance of automated tests
- **apptest**.ai
  Claim. Automate exploratory & performance testing
- **mabl**.com
  Claim. Adapt tests automatically to changing app

"AI-Based" Testing Tools

Just as there's no automated programming
yet, there's no **automated testing** yet

Ingo Philipp

Quality

Quality is **value** to some **person**
who matters at some time

Jerry Weinberg

Our software
is a **solution** to
someone's problem.
If the problem is not
solved, the software
doesn't work

Quality

Quality is **value** to some **person**
who matters at some time

Jerry Weinberg

Quality is **subjective**

Different **stakeholders**
will perceive the same product as
having different levels of quality

We must look for **different**
things for different stakeholders

A bug is something that **bugs**
somebody. A bug is a relationship
between a person and a product

Quality

Quality is **value** to some **person**
who matters at some time

Jerry Weinberg

Quality is **subjective**

Different **stakeholders**
will perceive the same product as
having different levels of quality

We must look for **different things** for different stakeholders

A bug is something that **bugs somebody**. A bug is a relationship between a person and a product

- Testing means challenging software to evaluate it.

Social Science

Testing means studying humans.
Social science is the study of humans.
Testing is a social science.

:: **Cem Kaner** ‹› Testing is a social science.

Quality is **subjective**

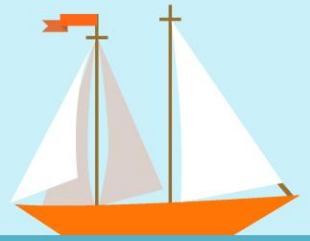
Different **stakeholders**
will perceive the same product as
having different levels of quality

We must look for **different**
things for different stakeholders

A bug is something that **bugs**
somebody. A bug is a relationship
between a person and a product

Tacit Knowledge

Studying humans means
managing tacit knowledge



Explicit Knowledge

Facts
Files
Records
Data

Easy to share
Can be formally expressed

Hard to share
Cannot be formally expressed

You **know** more than you can tell

90% knowledge
in any organization is
in peoples' heads.

-- Buckman Labs --

Hunches
Intuition
Feelings
Perception
Experience

Tacit Knowledge

Automating
Software Testing
▼
Automating
Social Science
▼
Automating
Tacit Knowledge

If the human brain were so **simple** that we could understand it, we would be so simple that we couldn't

Emerson M. Pugh

:: If humans were so simple that we could describe them algorithmically, we would be too simple to build these algorithms

@IngoPhilipp

The number one testing tool is not the computer, it is still the **human brain**

Jerry Weinberg

Don't expect AI to solve all your problems soon, do something about **natural stupidity** in testing now

Ingo Philipp

:: Inspired by **Steve Polyak**

:: Picture by **Shelly Palmer**

A bot that will steal your spot in software testing will steal **everyone's spot** everywhere too

Ingo Philipp

Questions

Walk in with questions, walk out with answers