

Big Data & AI in Business

How to become a data driven business

Session 1-2: Introduction to AI Strategy Framework

David G Pisano

Course Plan

SESSIONS 1 & 2 (LIVE IN-PERSON)

INTRODUCTION TO BIG DATA, ARTIFICIAL INTELLIGENCE & THE AI STRATEGY FRAMEWORK

SESSIONS 3 & 4 (LIVE IN-PERSON)

UNDERSTANDING ARTIFICAL INTELLIGENCE

SESSIONS 5 & 6 (LIVE IN-PERSON)

IDENTIFIYING THE VALUE OF ARTIFICIAL INTELLIGENCE IN DIFFERENT INDUSTRIES

SESSION 7 (LIVE IN-PERSON)

IDENTIFIYING THE VALUE OF ARTIFICIAL INTELLIGENCE IN THE ORGANIZATION

SESSION 8 (LIVE IN-PERSON)

ETHICS & LEGAL FRAMEWORK

SESSION 9 (ASYNCHRONOUS)

ETHICS DISCUSSION

SESSIONS 10 & 11 (LIVE IN-PERSON)

BUILDING A DATA STRATEGY

SESSION 12 (ASYNCHRONOUS)

TRADITIONAL CORPORATION USE CASE

SESSION 13 (LIVE IN-PERSON)

DATA DRIVEN ORGANIZATIONS

SESSION 14 (ASYNCHRONOUS)

GROUP WORK PRESENTATIONS

SESSION 15 (LIVE IN-PERSON)

FINAL EXAM

Course Evaluation

Final Exam	40%
Group Presentation	40%
Class Participation	20%

Career

About me

- Background in Molecular Biology, Statistics, Bioinformatics, Computer Science, Business Administration
- Operations & technology consulting
- Biotech & Pharma Sector
- Public Sector: 15 years in academic research (cancer genomics)
- Insurance & Healthcare Sector
- Now in the Healthtech Sector
- Teaching -postgraduate level- for 20 years



Agenda



What is AI?

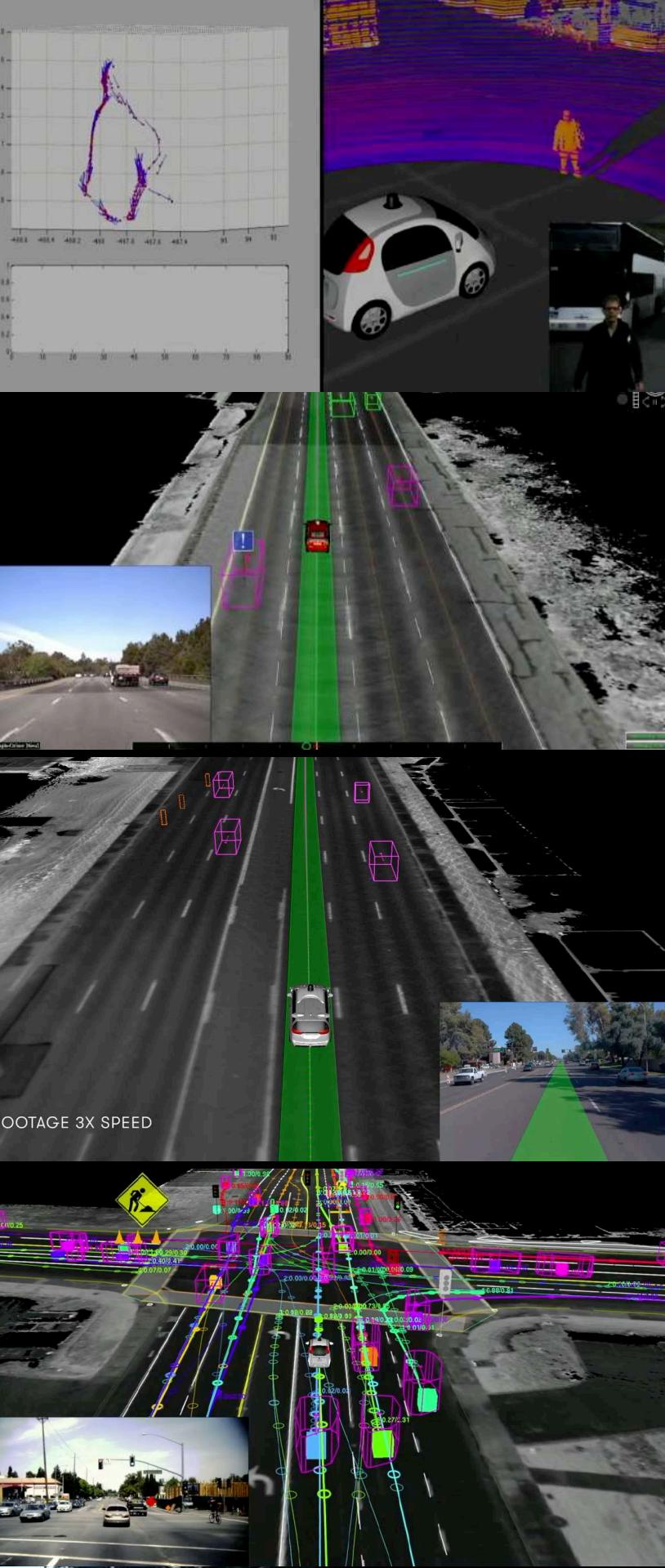
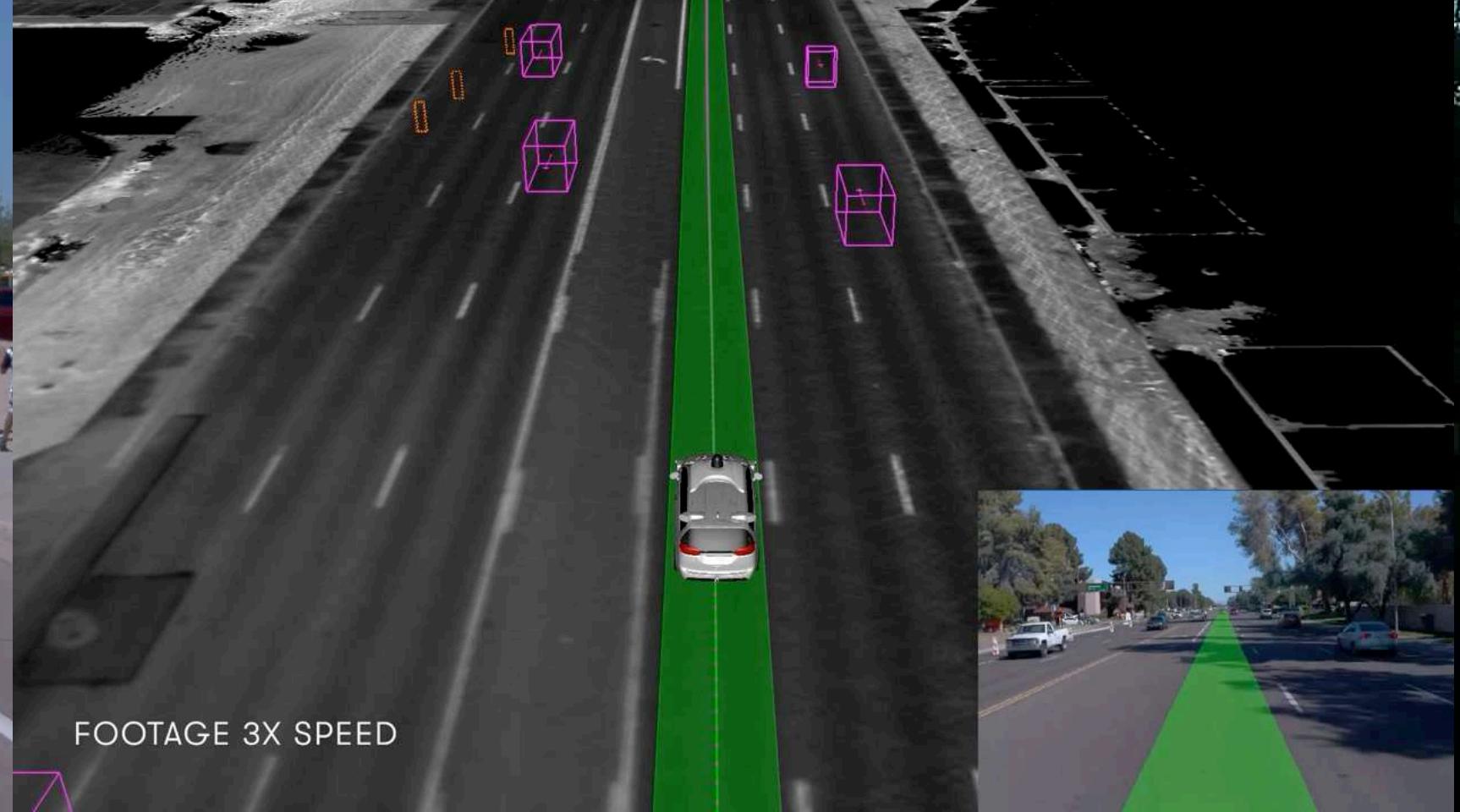
Why now?

Why is relevant?

What are the challenges?



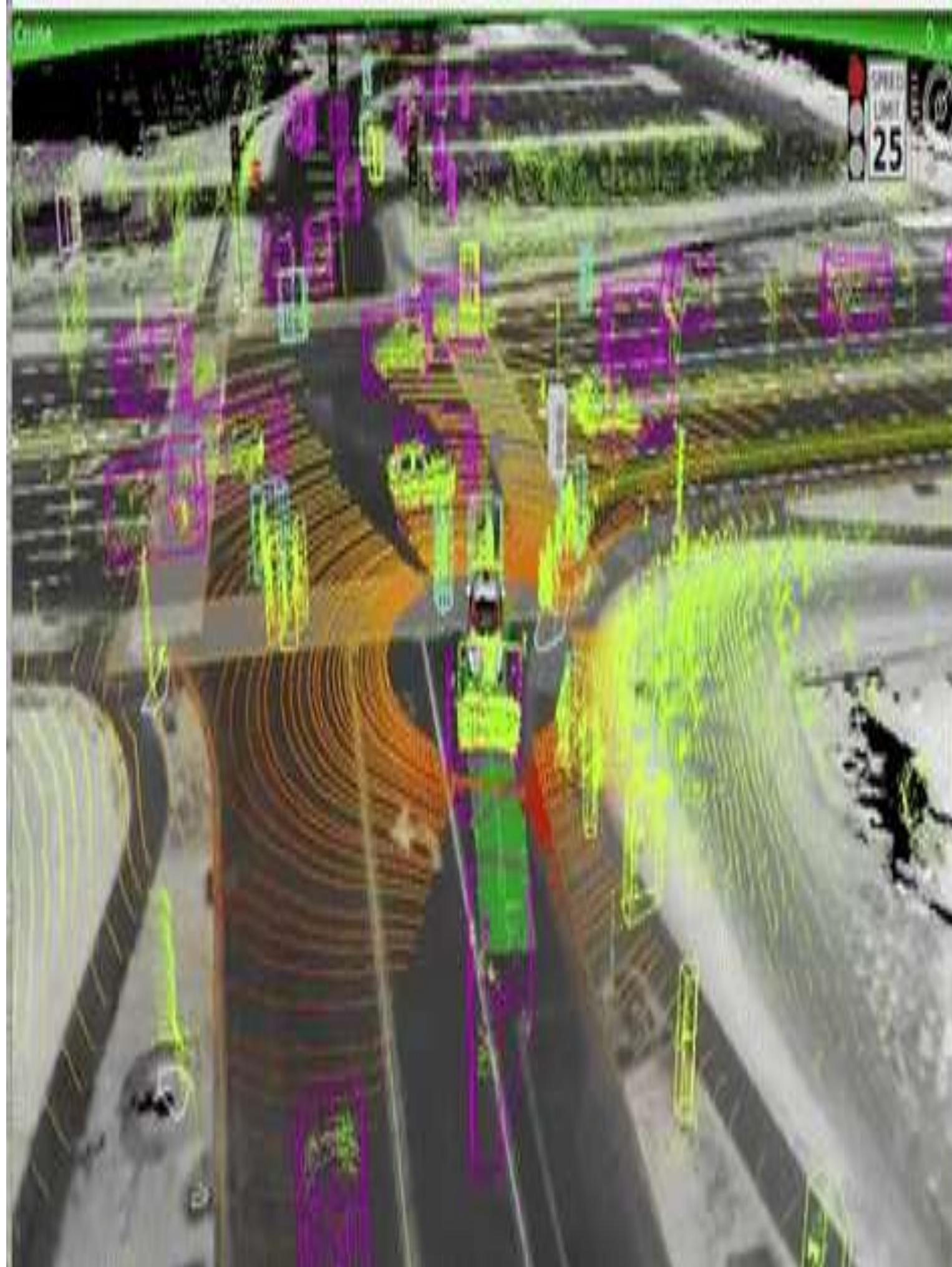
WAYMO Self-Driving CAR



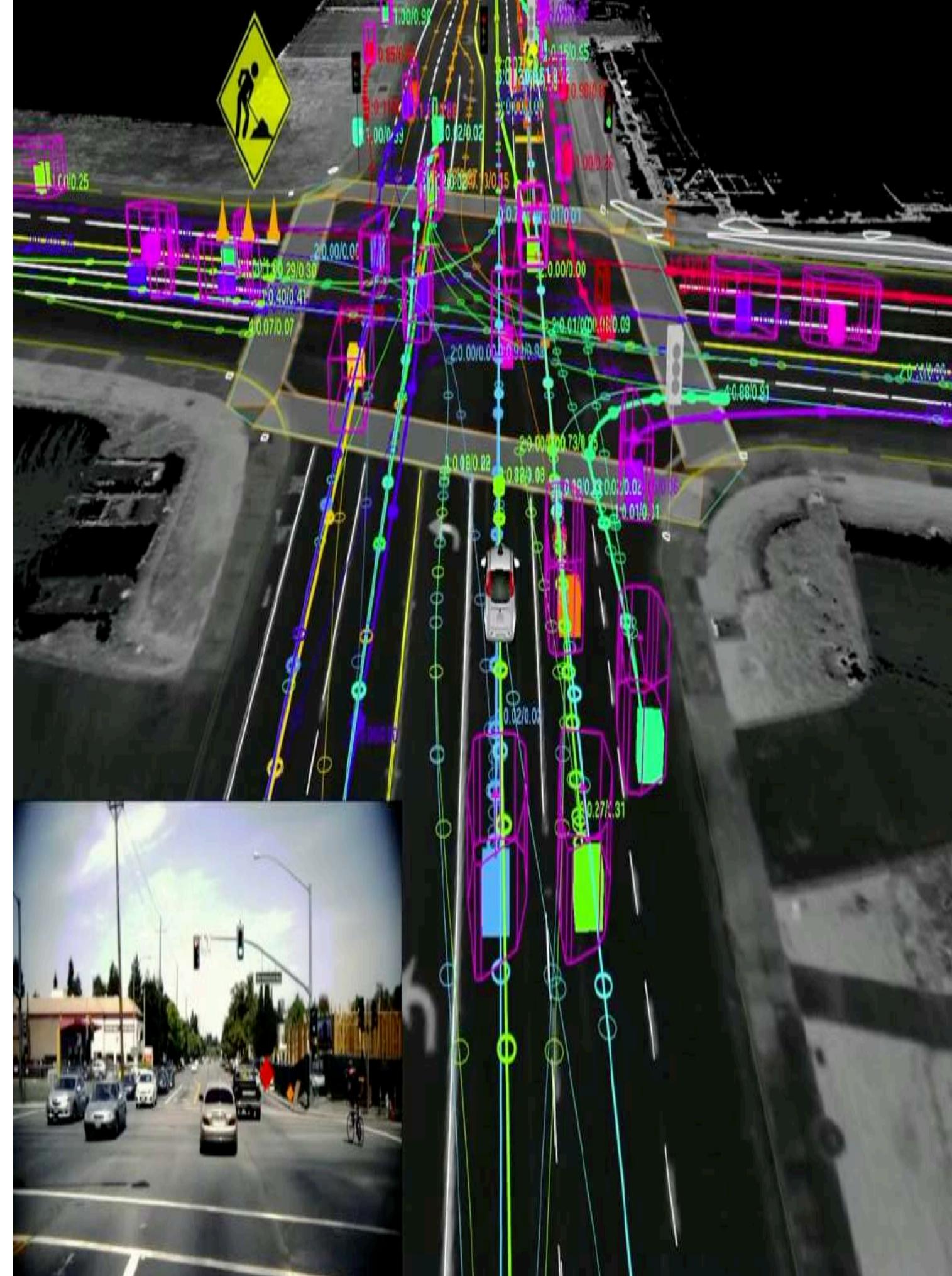
FOOTAGE 3X SPEED

How does it work?

Perception



Prediction

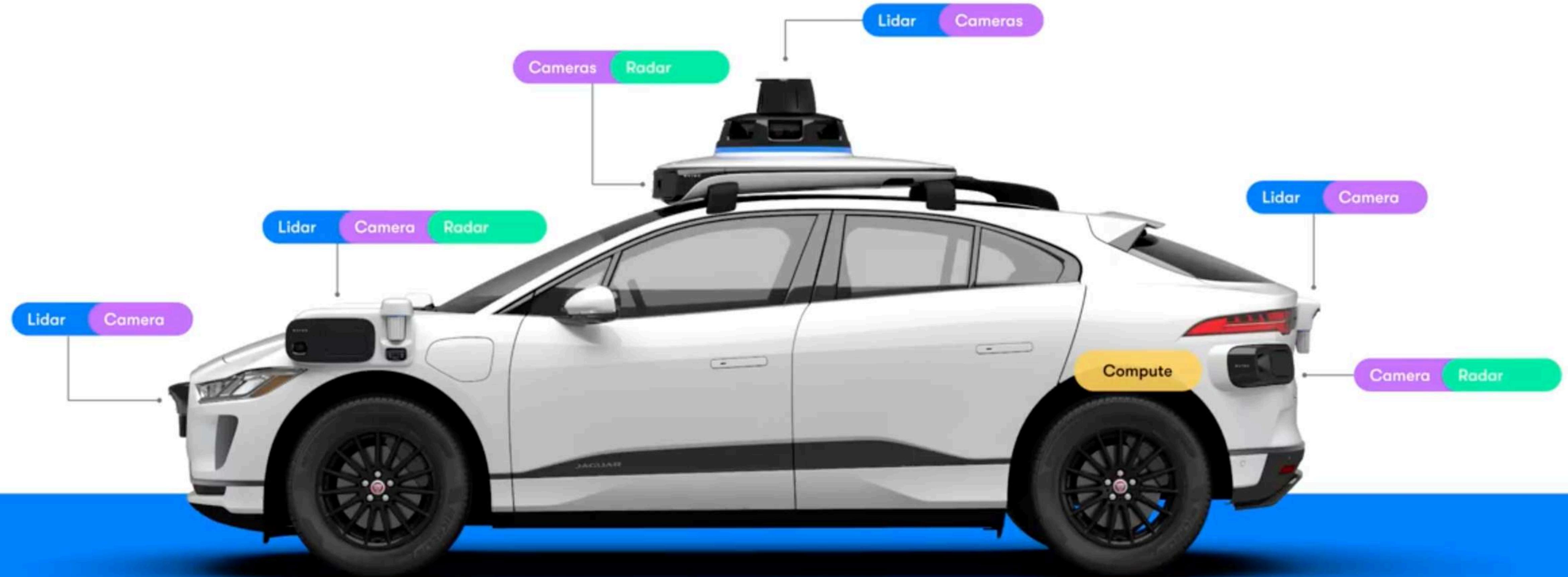


Take Action



How does it work?

Embedded & autonomous



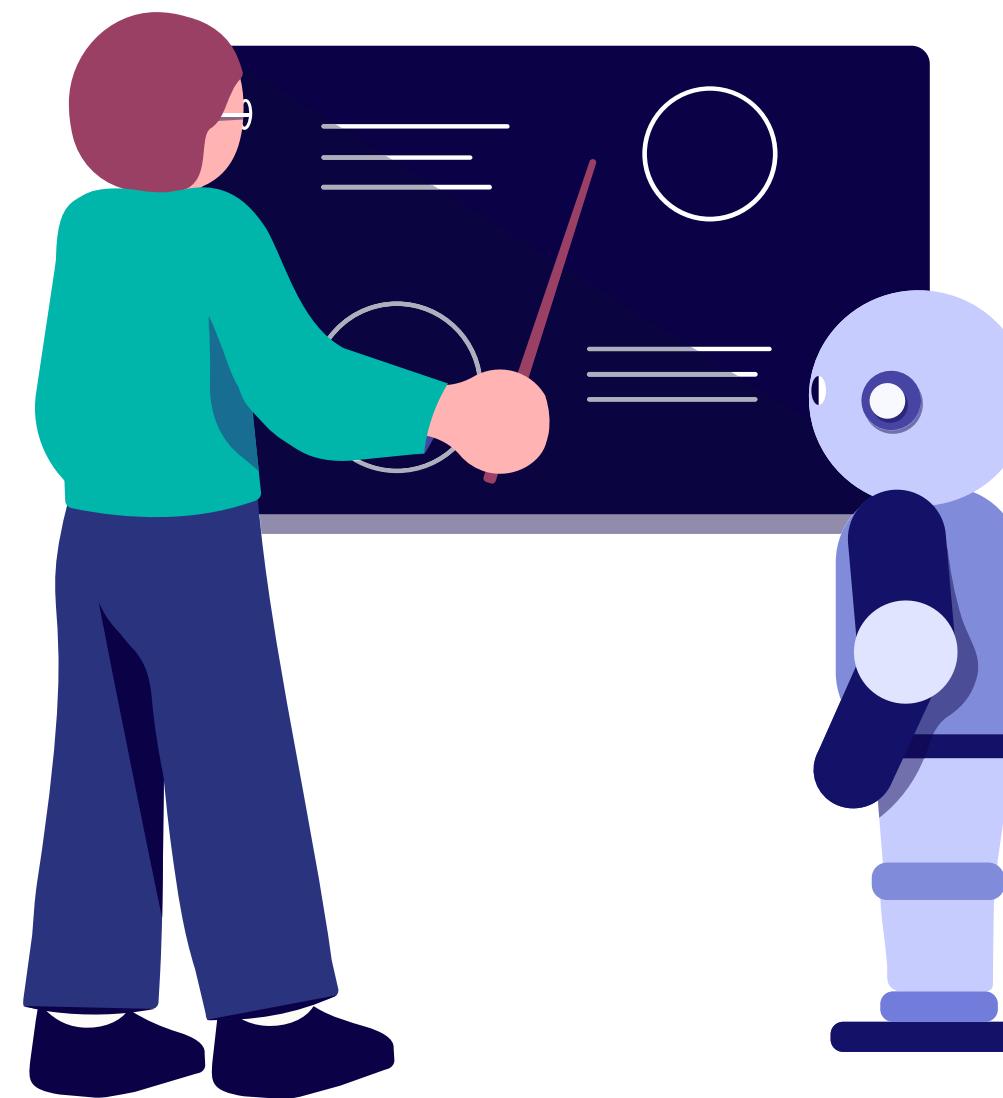
Data
Sensors capturing 1 GB/s

Processing power
30 billion transactions/s

Algorithms
Computer vision + predictive

AI is not programmed but trained

it learns in a similar way that we humans do: by **example**



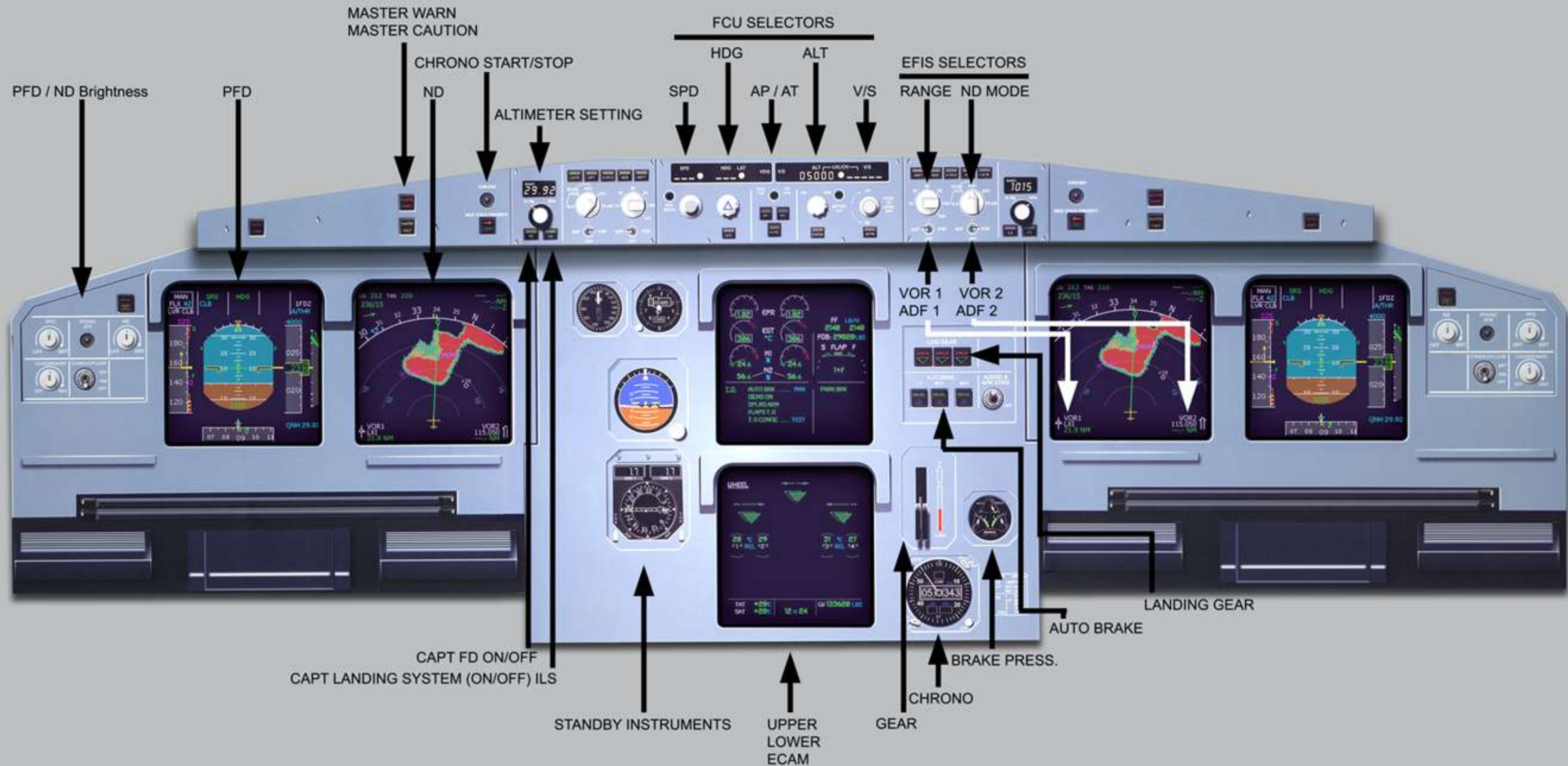
Observations
Experiences

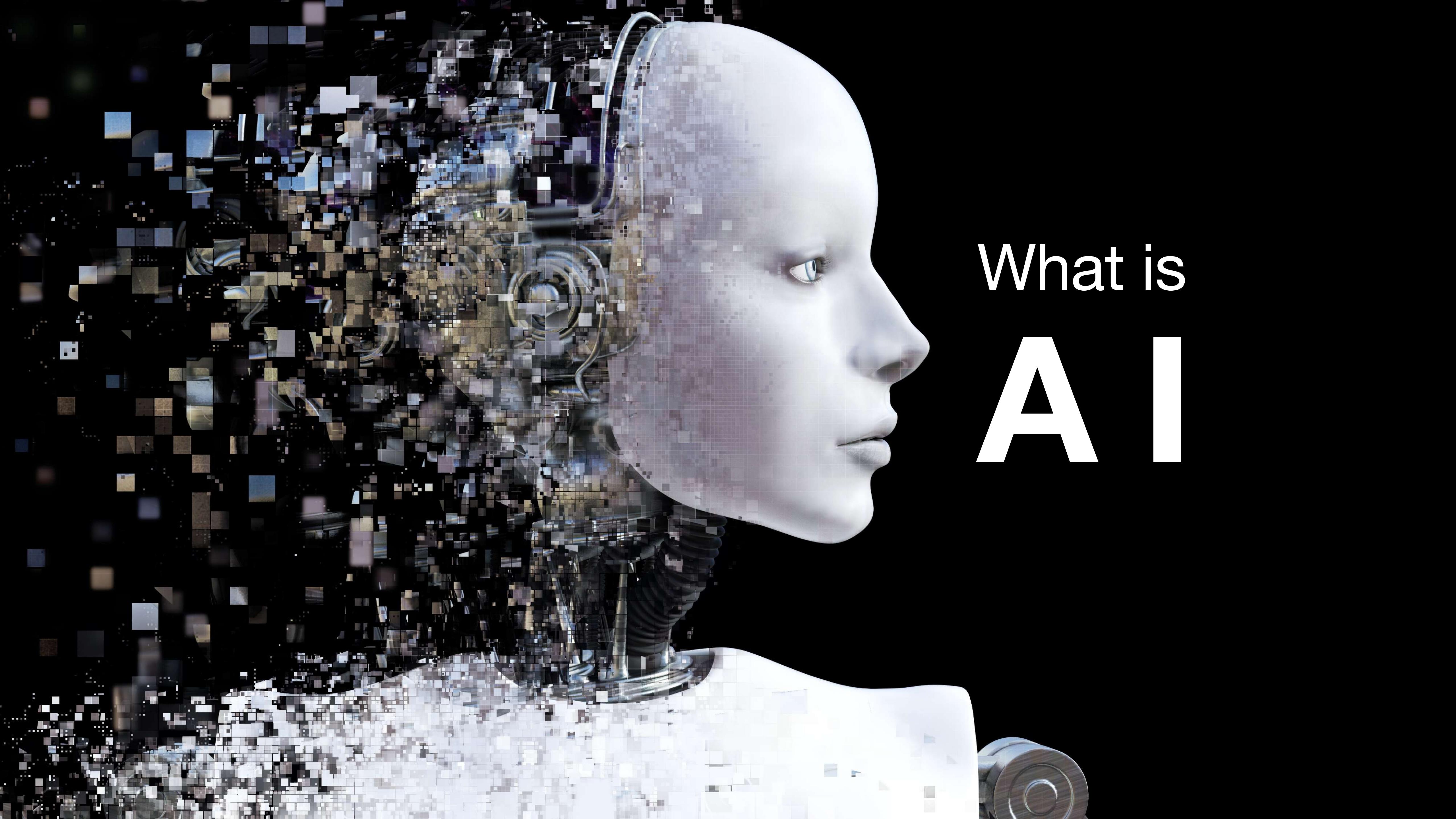
Feedback

...

Data

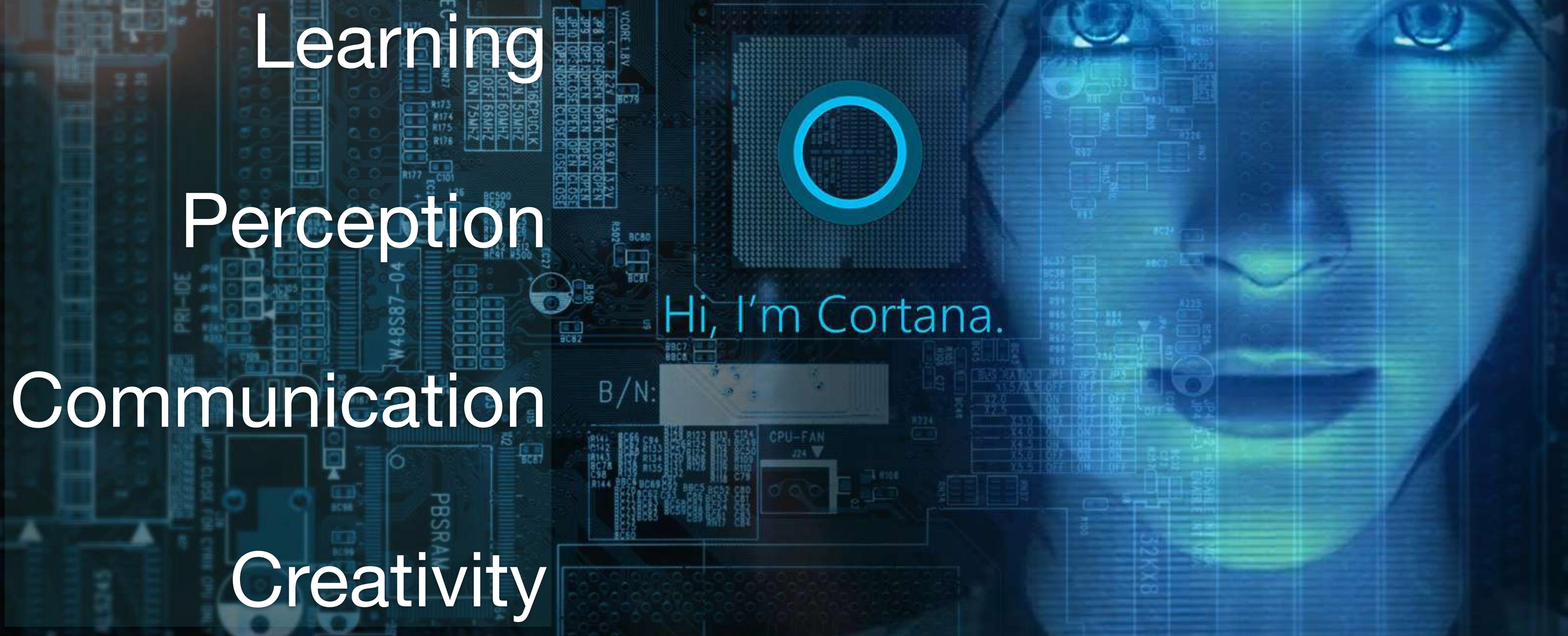
A plane autopilot is not AI: the human pilot flights the plane via automation





What is
AI

Artificial intelligence (AI) is the ability of a computer to do tasks that are usually done by humans because they require human discernment. The computer “mimics” functions we associate with human only capabilities.



Learning

Perception

Communication

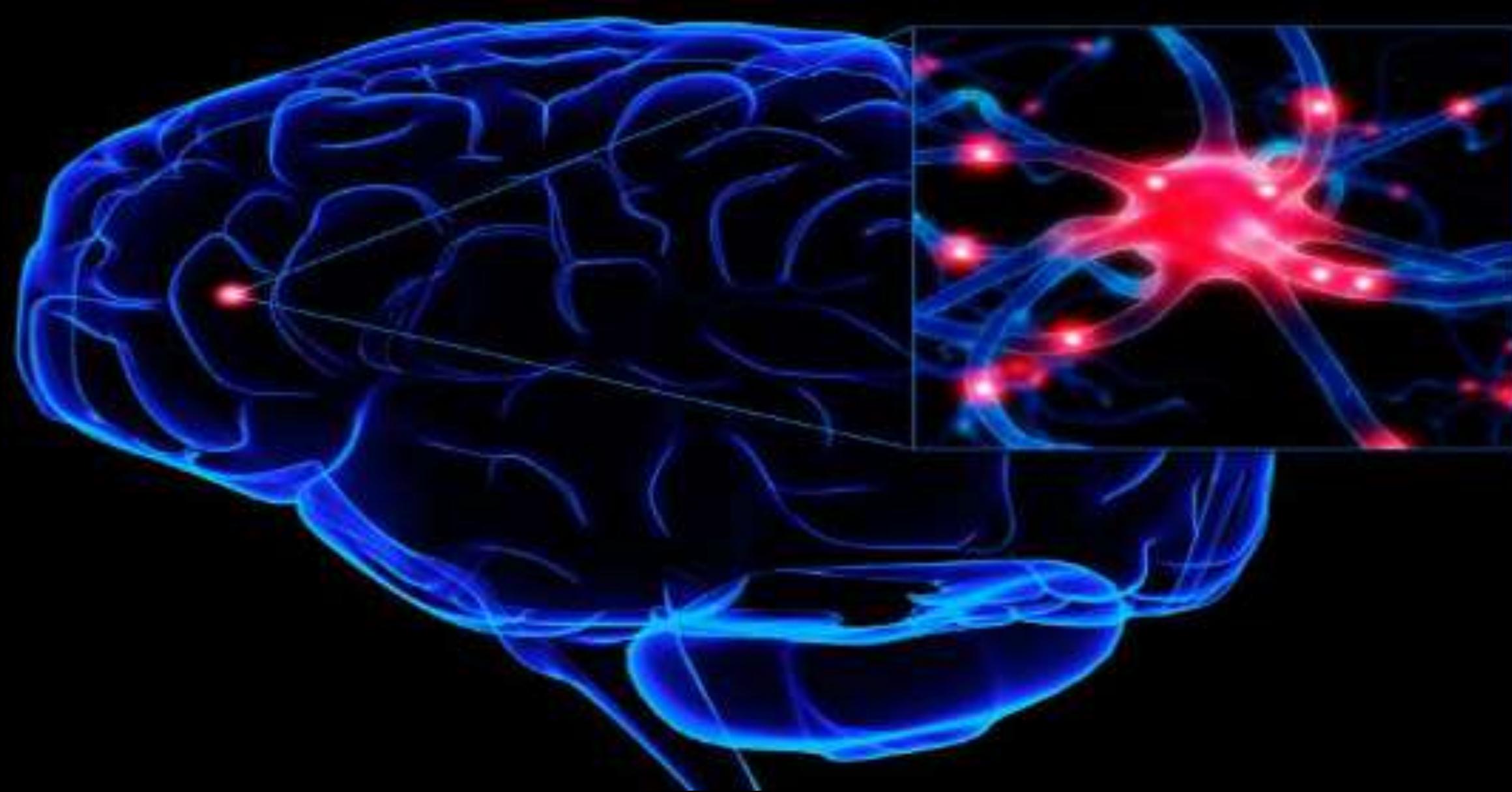
Creativity

0 2 4 6 8 ?

0 2 4 6 8 ?



0 2 4 6 8 ?



$$x_n = x_{(n-1)} + 2$$

0 2 4 6 8 10



$$x_n = x_{(n-1)} + 2$$

1. Data

0 2 4 6 8 10

2. Algorithm



3. Model

$$x_n = x_{(n-1)} + 2$$

Training Data

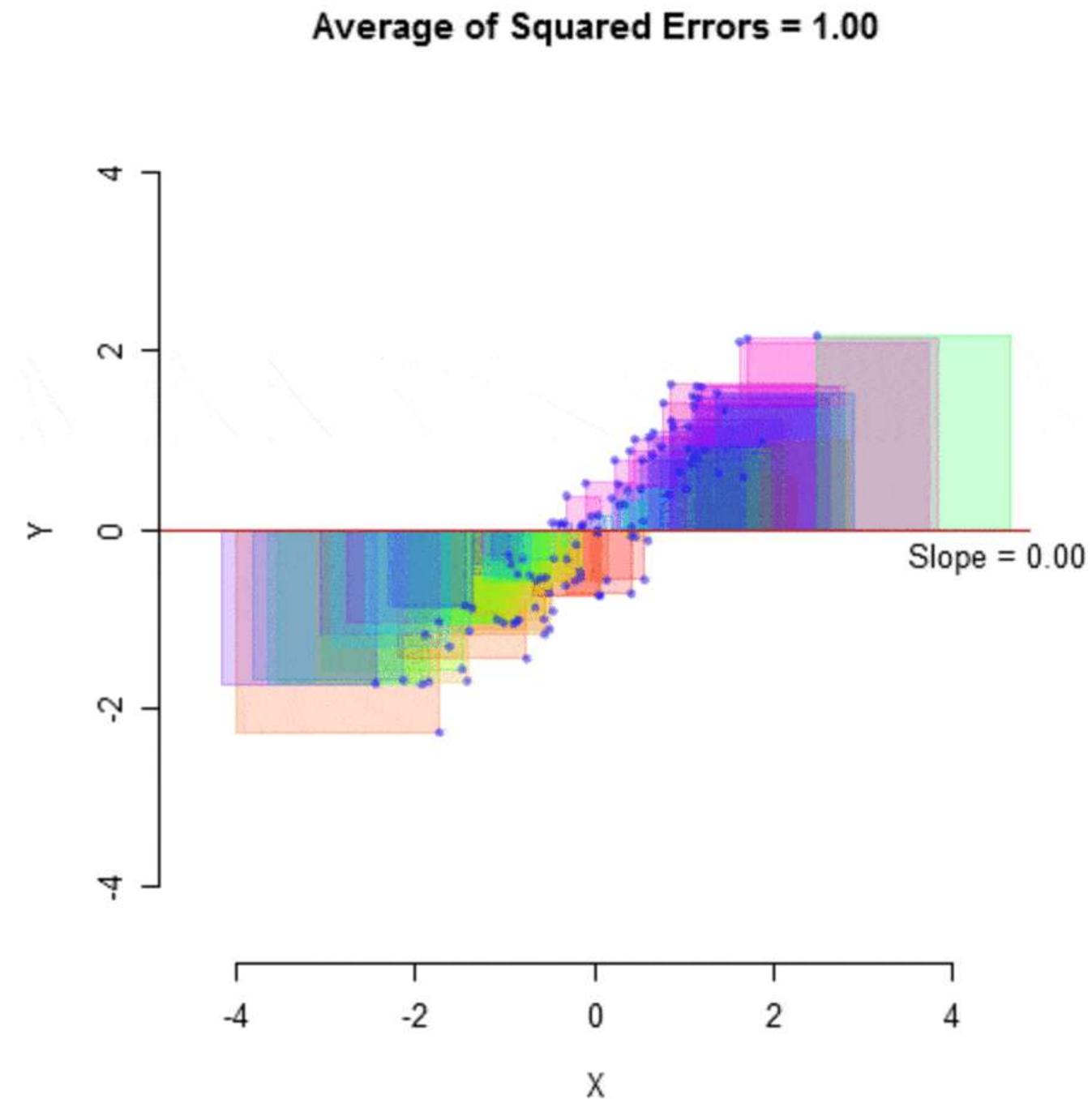
Observations										
Independent variable	x	-2	-2.1	0	0.5	1	1	1.1	...	2
Prior knowledge	y	-2.1	-2	-1	0.5	0.6	0.3	0.5	...	1

Problem: Prediction

Given a new x ,

can we predict the value of y ?

Algorithm: Least Squares



Model: Linear regression

$$\hat{y} = \beta_0 + \beta_1 X$$

Fitted Model

$$\hat{y} = -4.2 + 0.89X$$

Machine Learning

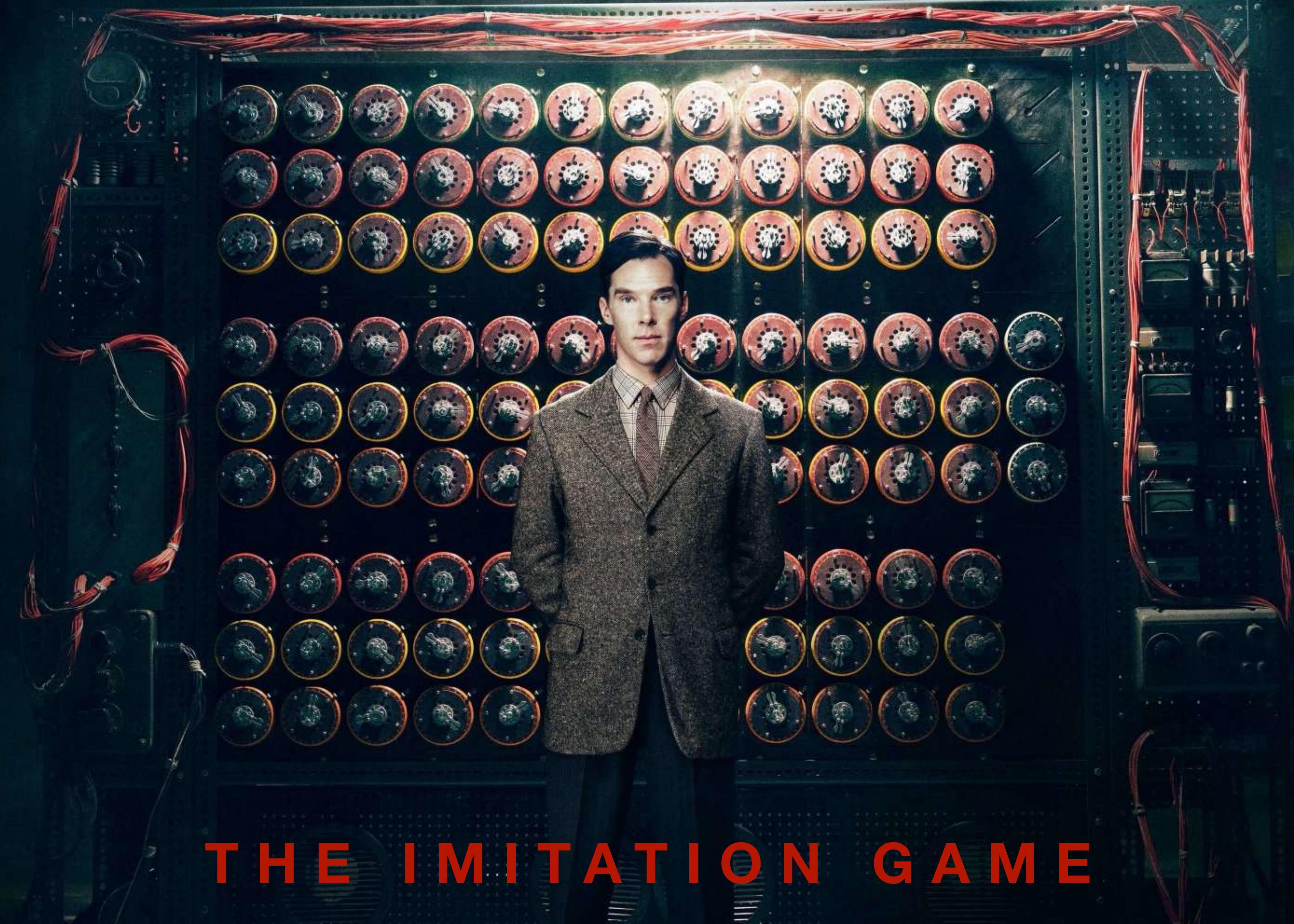
**It is a set of METHODS
to teach COMPUTERS
to perform a single TASK
using DATA**

Traditional Programming



Machine Learning





MSS. and other Communications for the Editor should
Prof. G. RYLE, Magdalen College, Oxford

VOL. LIX. No. 236.

MIND

A QUARTERLY REVIEW
OF
PSYCHOLOGY AND PHILOSOPHY

EDITED BY
PROF. GILBERT RYLE

WITH THE CO-OPERATION OF PROF. SIR F. C. BARTLETT AND PROF. C. D. BROAD

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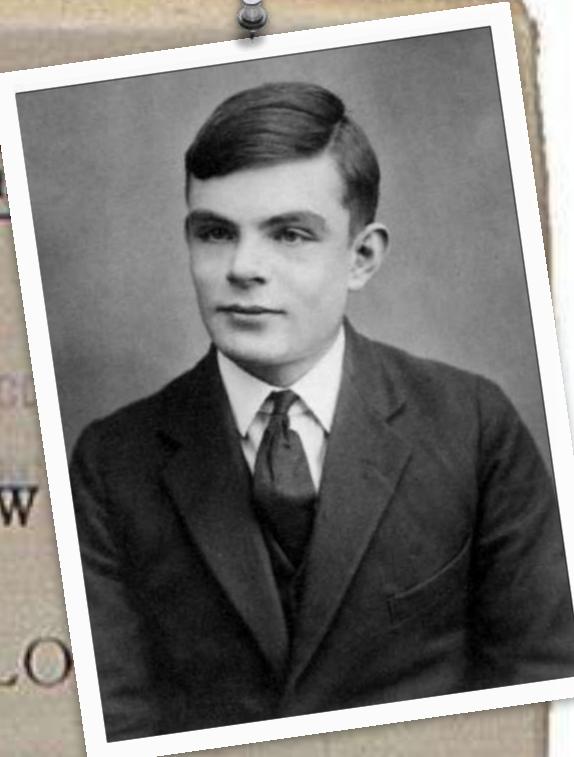
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[October, 1950

MIND

A QUARTERLY REVIEW
OF
PSYCHOLOGY AND PHILOSOPHY

I.—COMPUTING MACHINERY AND INTELLIGENCE

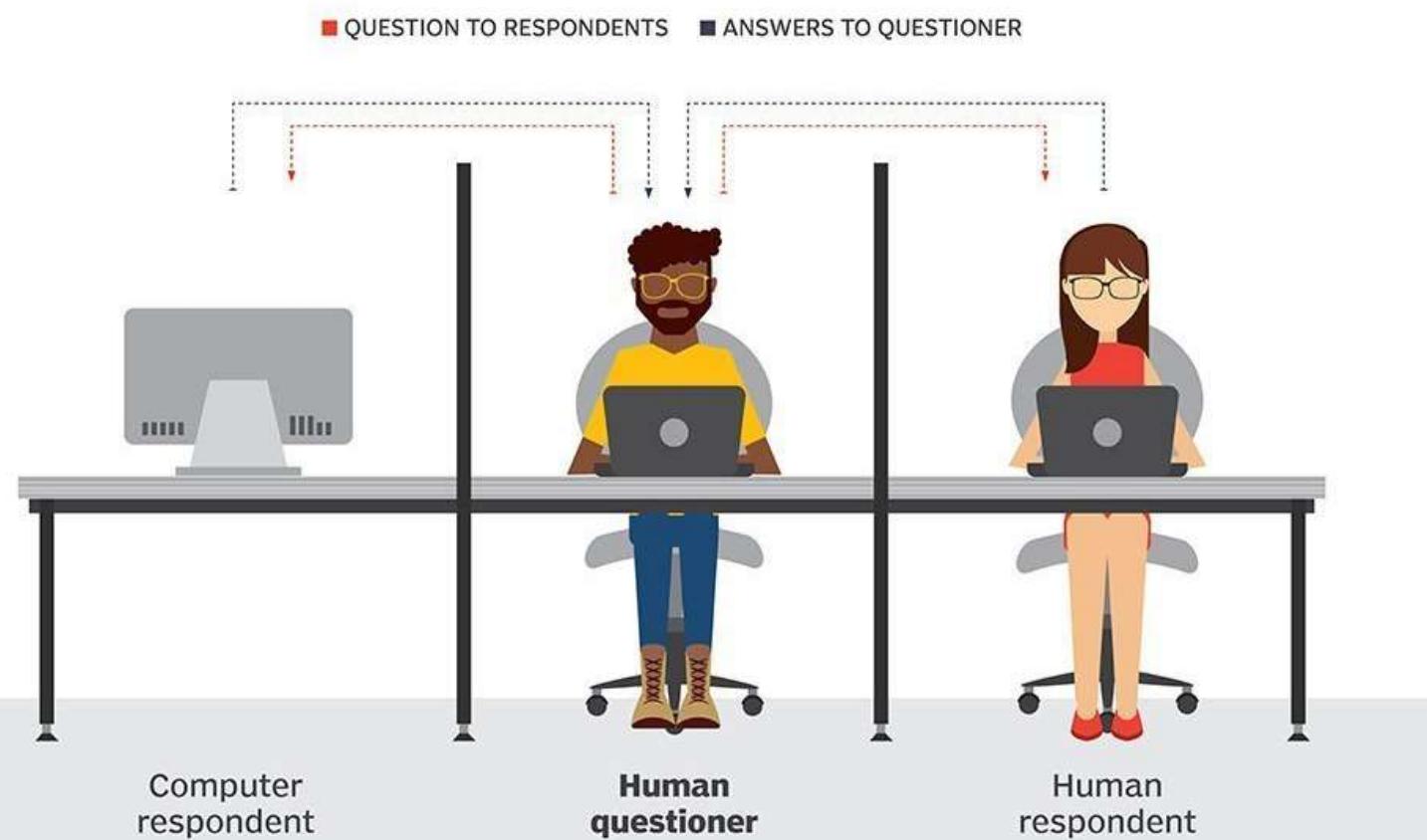
BY A. M. TURING

1. *The Imitation Game.*

I PROPOSE to consider the question, 'Can machines think?' This should begin with definitions of the meaning of the terms 'machine' and 'think'. The definitions might be framed so as to reflect so far as possible the normal use of the words, but this attitude is dangerous. If

Turing test

During the Turing test, the human questioner asks a series of questions to both respondents. After the specified time, the questioner tries to decide which terminal is operated by the human respondent and which terminal is operated by the computer.



1956 Dartmouth Conference: The Founding Fathers of AI



John McCarthy



Marvin Minsky



Claude Shannon



Ray Solomonoff



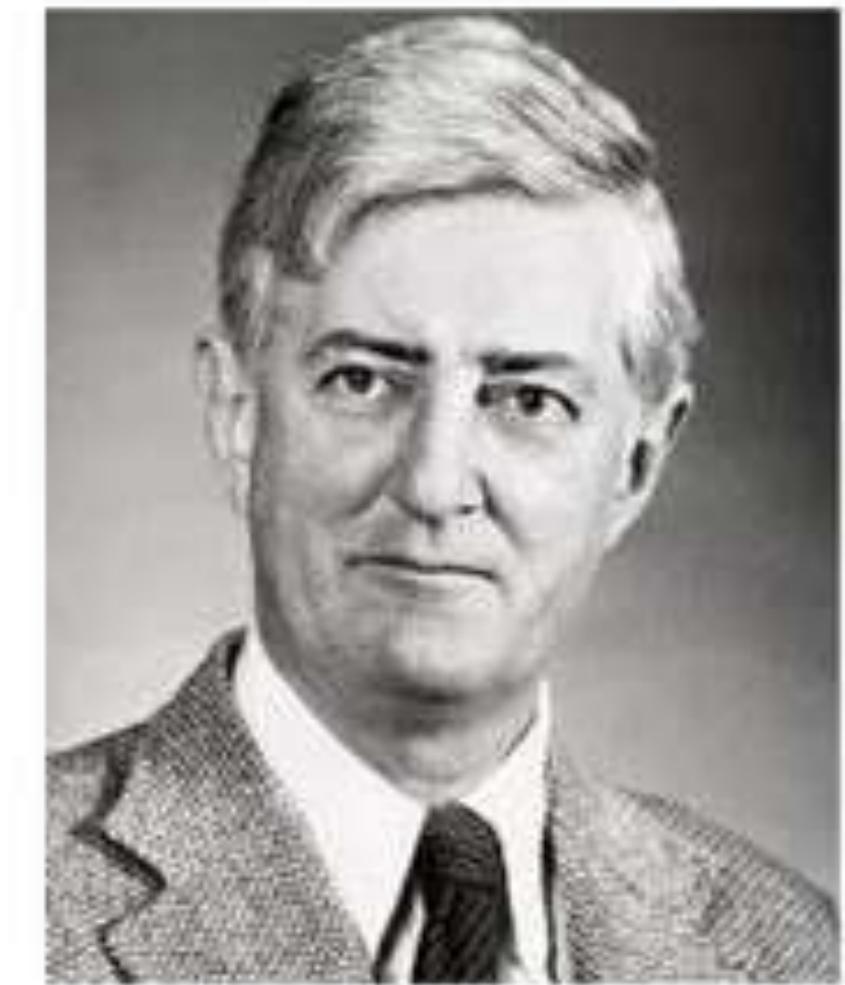
Alan Newell



Herbert A. Simon



Arthur Samuel



Oliver Selfridge



Nathaniel Rochester



Trenchard More

IN THIS BUILDING DURING THE SUMMER OF 1956

JOHN McCARTHY (DARTMOUTH COLLEGE), MARVIN L. MINSKY (MIT)
NATHANIEL ROCHESTER (IBM), AND CLAUDE SHANNON (BELL LABORATORIES)
CONDUCTED

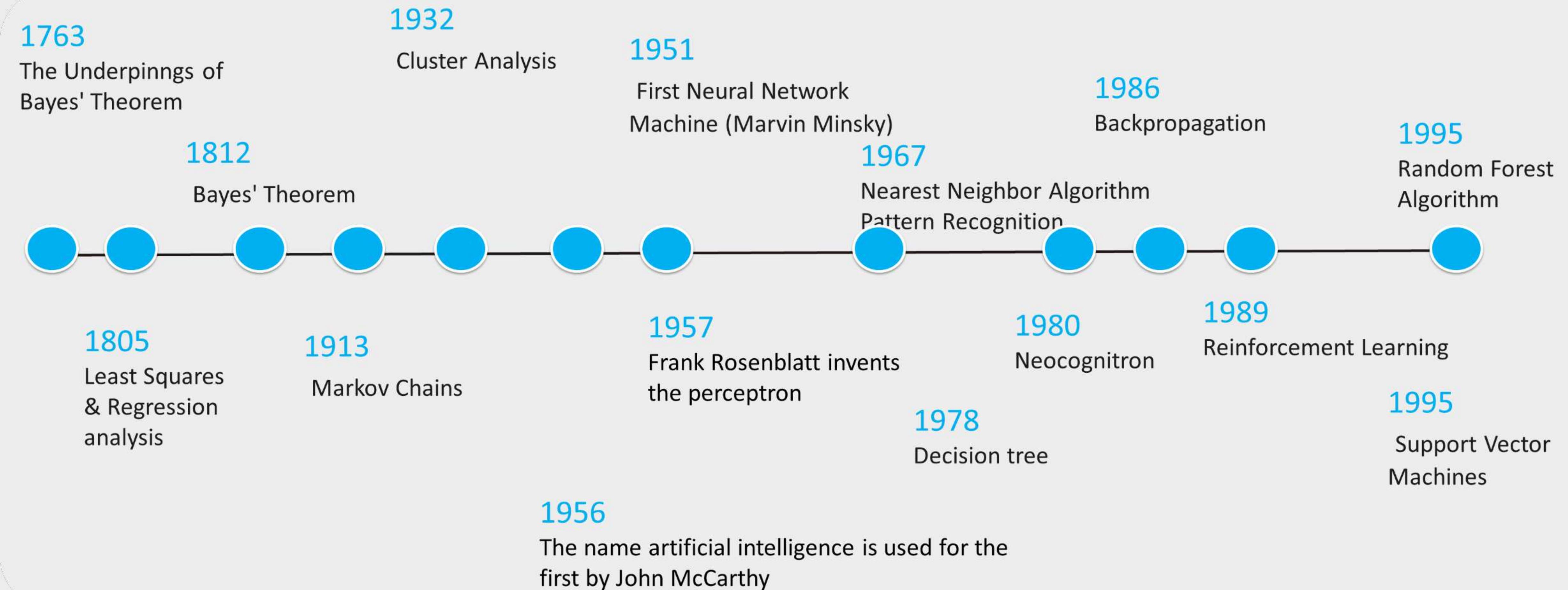
THE DARTMOUTH SUMMER RESEARCH PROJECT
ON ARTIFICIAL INTELLIGENCE

FIRST USE OF THE TERM "ARTIFICIAL INTELLIGENCE"

FOUNDING OF ARTIFICIAL INTELLIGENCE AS A RESEARCH DISCIPLINE

"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."

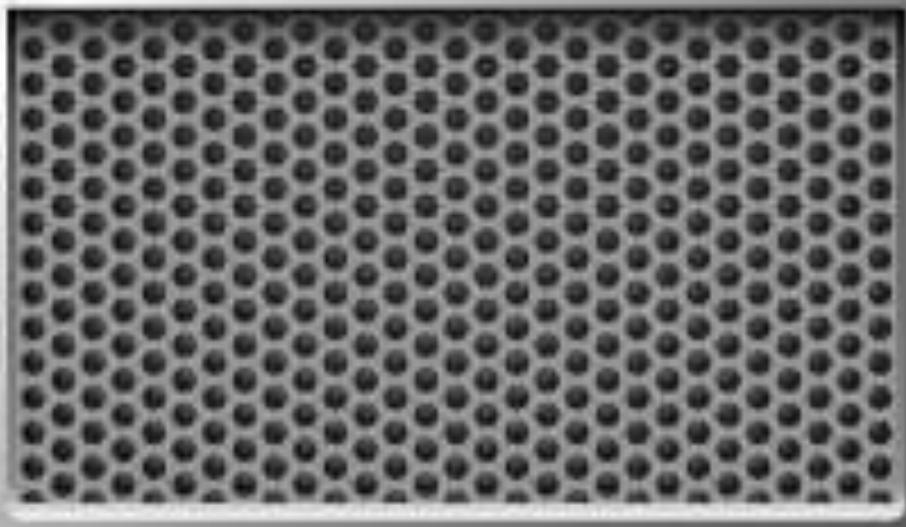
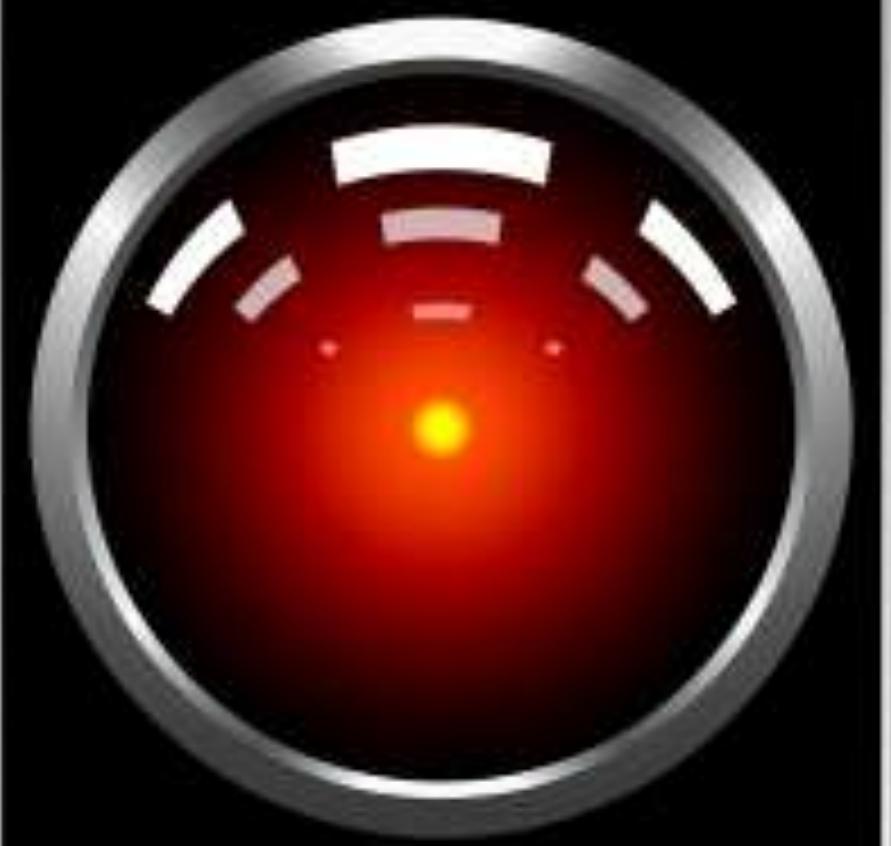
IN COMMEMORATION OF THE PROJECT'S 50th ANNIVERSARY
JULY 13, 2006

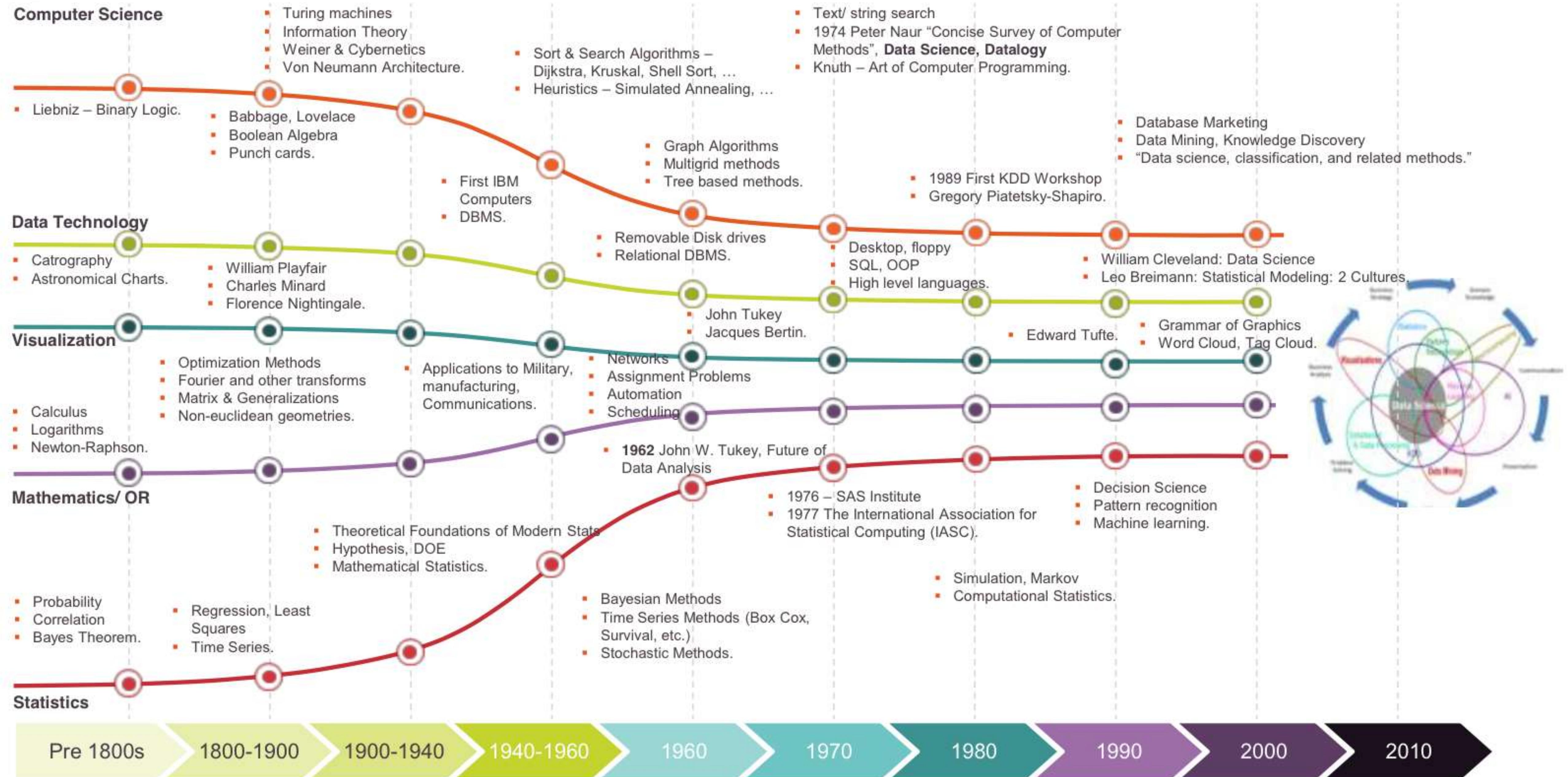


A surreal landscape featuring a bridge spanning a dark, rocky chasm. On the bridge stands a large, dark silhouette of a horse and a smaller figure, possibly a child or a person in a hooded cloak. The background is filled with dark, craggy rock formations and bare, skeletal trees. The overall atmosphere is somber and mysterious.

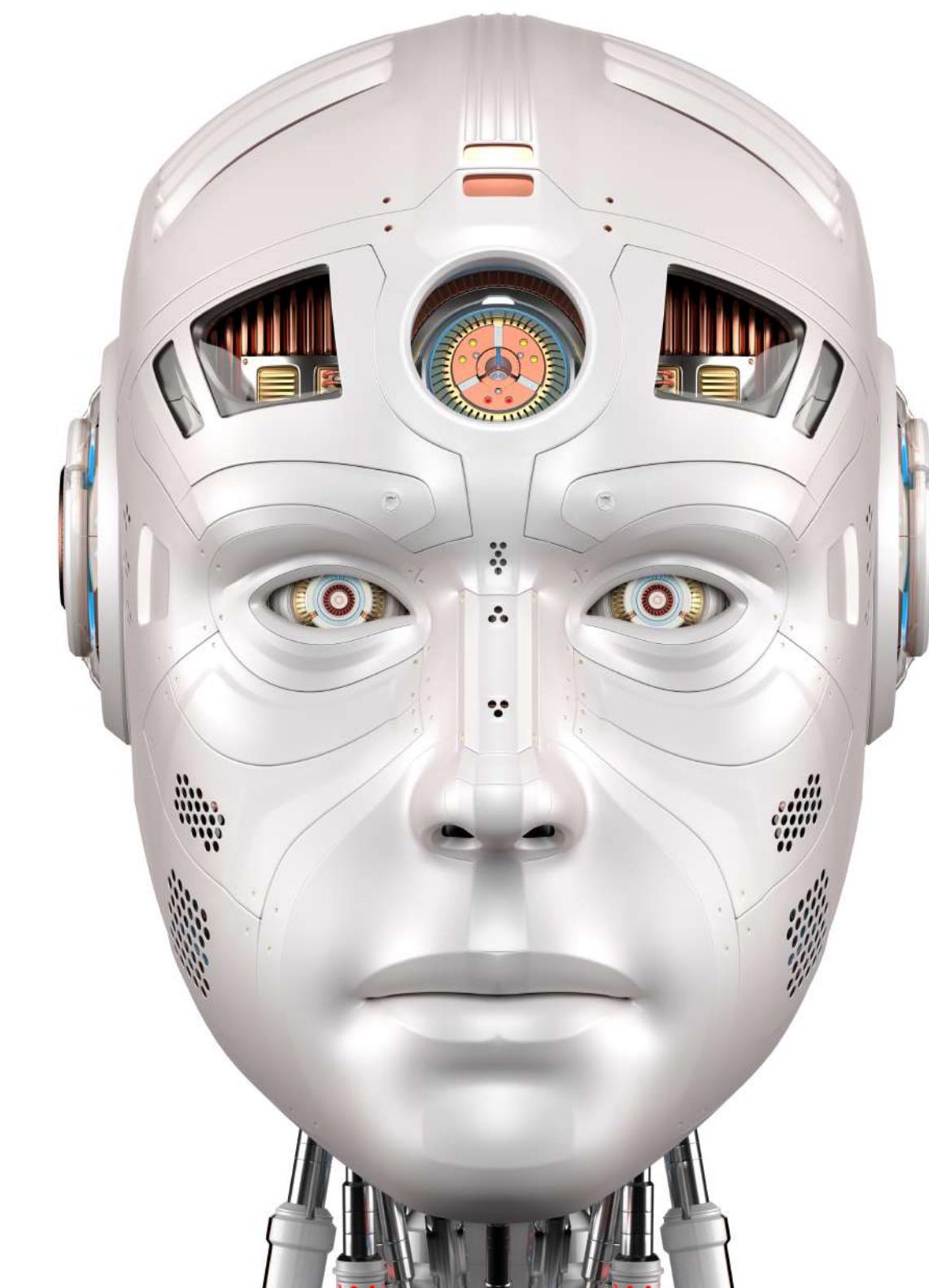
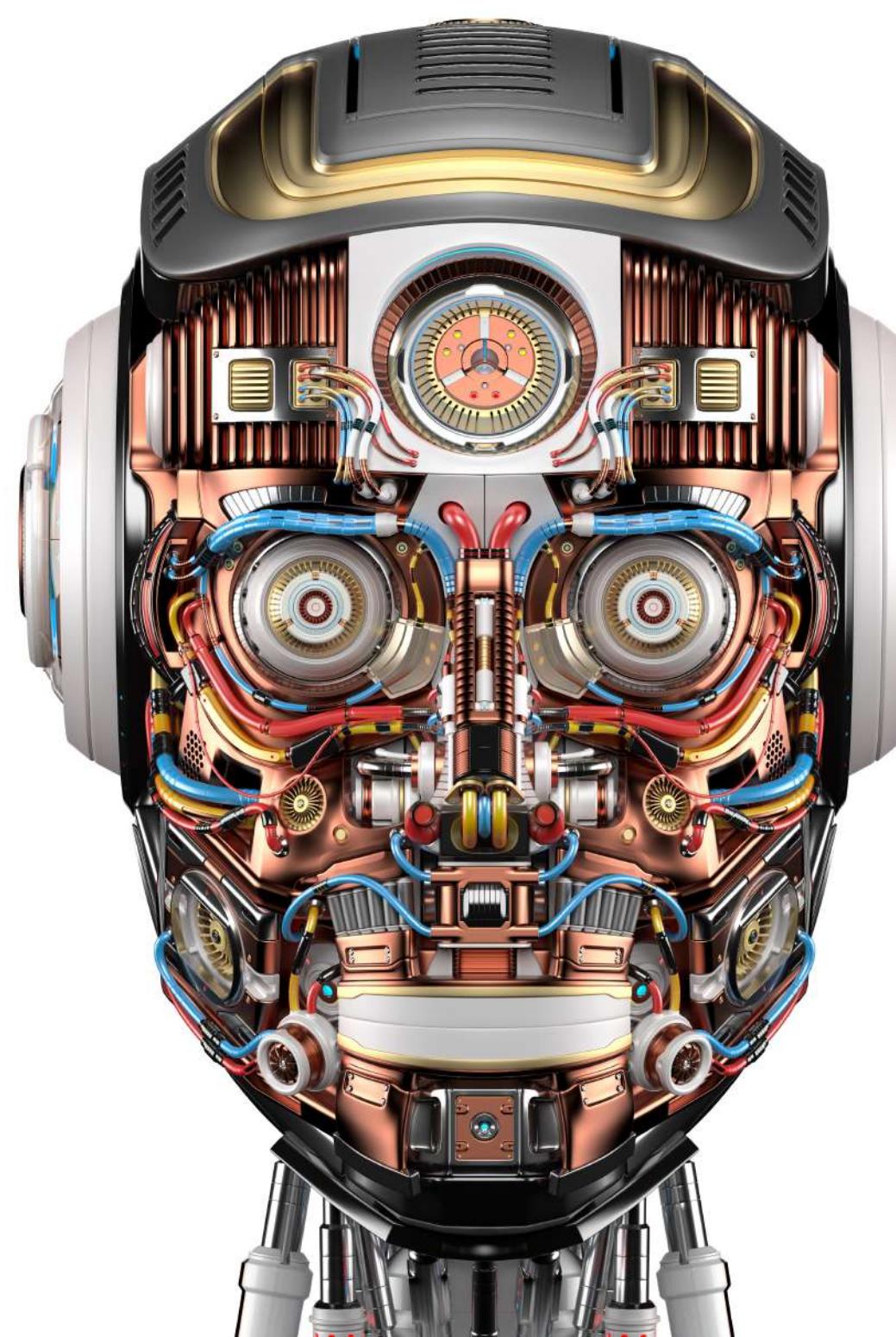
AI Winter (1960-2010)

HAL 9000





Why Now?



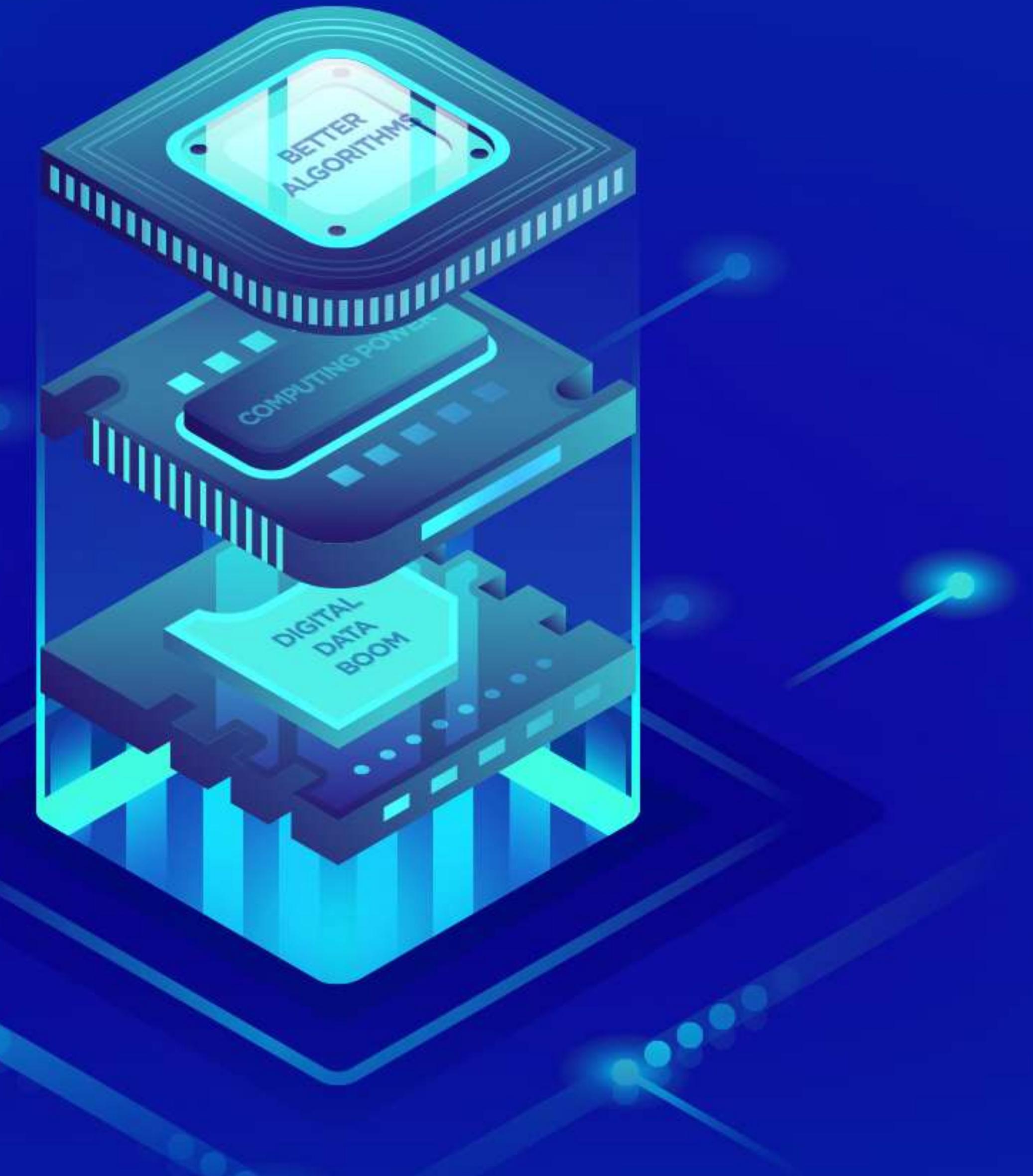
The **3 Forces** that Brought AI to Life

And Why it's Only Now
Changing the World

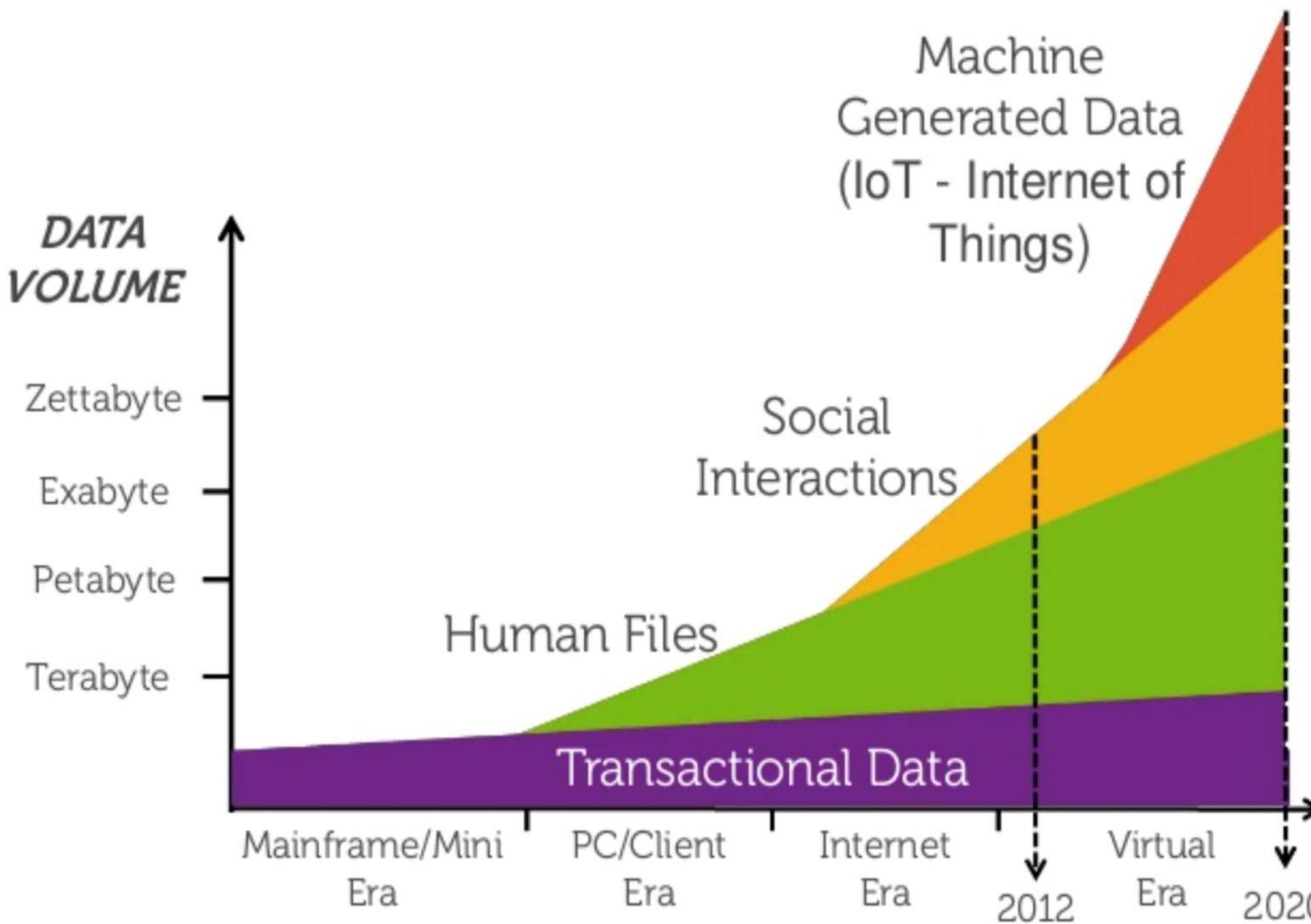
Digital Data Boom

Computing Power

Better Algorithms



The Explosion of Data



THE YEAR 1971

THE FIRST EMAIL EVER

WAS SENT BY RAY TOMLINSON

AS OF 2014

183
BILLION

EMAILS
ARE SENT
DAILY

MAY
3RD 1978

THE FIRST SPAM EMAIL

WAS SENT BY GARY THUERK

TO 400 PEOPLE WITHIN ARPANET, INVITING THEM
TO HIS COMPANY'S NEW PRODUCT DEMO

TODAY

54 BILLION SPAM EMAILS
ARE SENT DAILY



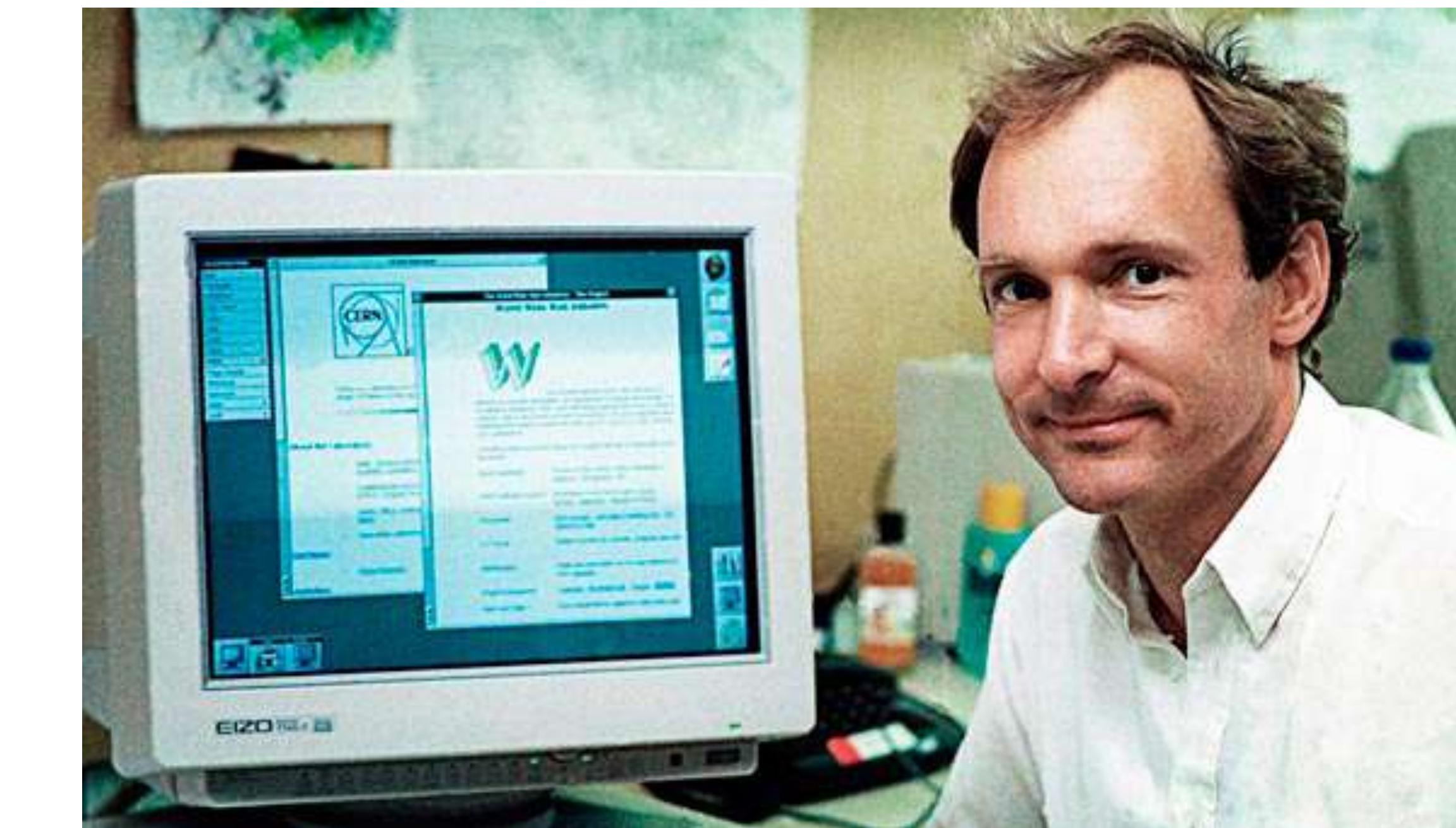
THE FIRST
WEBSITE WENT
LIVE ON
08.06.91

CREATED BY TIM BERNERS-LEE

AS OF SEPTEMBER 2014

1 BILLION WEBSITES

EXIST



World Wide Web

The WorldWideWeb (W3) is a wide-area [hypermedia](#) information retrieval initiative aiming to give universal access to a large universe of documents.

Everything there is online about W3 is linked directly or indirectly to this document, including an [executive summary](#) of the project, [Mailing lists](#), [Policy](#), November's [W3 news](#), [Frequently Asked Questions](#).

[What's out there?](#)

Pointers to the world's online information, [subjects](#), [W3 servers](#), etc.

[Help](#)

on the browser you are using

[Software Products](#)

A list of W3 project components and their current state. (e.g. [Line Mode](#), [X11 Viola](#), [NeXTStep](#), [Servers](#), [Tools](#), [Mail robot](#), [Library](#))

[Technical](#)

Details of protocols, formats, program internals etc

[Bibliography](#)

Paper documentation on W3 and references.

[People](#)

A list of some people involved in the project.

[History](#)

A summary of the history of the project.

[How can I help?](#)

If you would like to support the web..

[Getting code](#)

Getting the code by [anonymous FTP](#), etc.



Les Horribles Cernettes

SAY CHEESE

THE FIRST PHOTO

— UPLOADED TO THE INTERNET WAS IN —

1992

TODAY
1.8
BILLION

PHOTOS

ARE uploaded AND
SHARED
DAILY

ON AUGUST 11, 1994

THE FIRST ECOMMERCE

TRANSACTION

— WAS FOR —
STING'S CD "TEN SUMMONER'S TALES"
ON NETMARKET'S SITE FOR \$12.48

IN 2014, ECOMMERCE SALES

WERE PROJECTED TO BE

1.5 TRILLION



2.5 MILLION TITLES

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Amazon.com

1.5 MILLION BOOKS IN PRINT

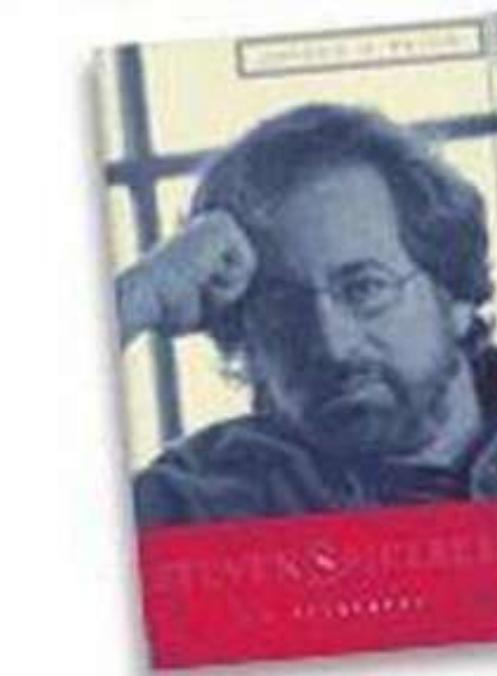
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May 28th--New on Our Shelves



Joseph McBride's new biography gives a fine spiel on *Steven Spielberg*. *The Dilbert Future* has arrived in our Computer & Internet Super Room. Plus, new titles on our *Literary Fiction*, *History*, and *Nonfiction* shelves discounted up to 40%.

Book of the Day

[Classic BOTD](#)

[Undiscovered BOTD](#)

[Science Fiction BOTD](#)

[Nonfiction BOTD](#)

[Mystery BOTD](#)

[Wacky BOTD](#)

6 new books every day
for the next 1,000 years

IN OCTOBER OF 1994
THE FIRST
BANNER AD

WAS POSTED ON HOTWIRED.COM

IT PROMOTED 7 DIFFERENT ART
MUSEUMS AND WAS SPONSORED BY AT&T

5.3 TRILLION

DISPLAY ADS

WERE SERVED TO U.S. USERS IN 2012



THE FIRST 
NON-FOUNDER TO JOIN
 FACEBOOK

WAS ARIE HASIT IN 2004
ZUCKERBERG'S ROOMATE

TODAY THERE ARE
 1.3 BILLION
MONTHLY ACTIVE USERS
1.1 BILLION OF THEM ON MOBILE

04.23.05
THE FIRST YouTube
VIDEO WAS POSTED BY
 JAWED KARIM
IT NOW HAS OVER 16 MILLION VIEWS
TODAY
 6 BILLION
HOURS OF VIDEO ARE WATCHED
 MONTHLY

THE FIRST
 TWEET
"JUST SETTING UP MY TWITTR"
WAS BY CO-FOUNDER JACK DORSEY
03.21.06
TODAY, 500 MILLION
TWEETS ARE SENT
 PER DAY

THE FIRST NON-FOUNDER TO JOIN FACEBOOK

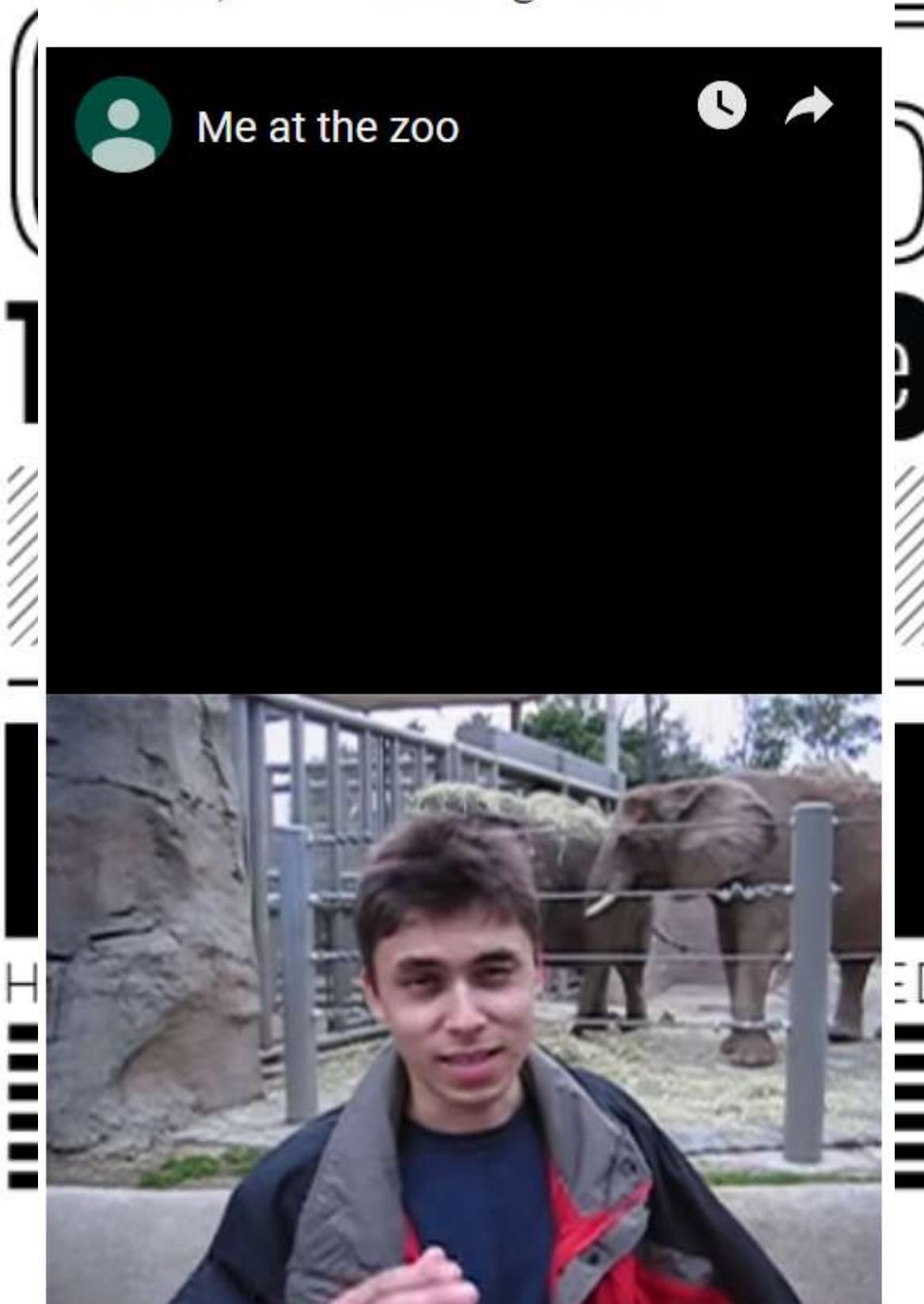
WAS ARIE HASIT IN 2004
ZUCKERBERG'S ROOMATE

TODAY THERE ARE



A screenshot of thefacebook.com showing Arie Hasit's profile. The profile picture shows three people, including Arie Hasit. The information section includes fields for Name (Arie Hasit), Member Since (January 12, 2005), Last Update (February 3, 2005), Status (Alumnus/Alumna), Sex (Male), Year (2004), Concentration (Computing Sciences/Mathematics), and other account details like Email, Phone, High School, and Extended Info. The connection section shows "This is you." and the access section indicates the user is currently logged in from a non-residential location.

#2 The first Youtube video was uploaded on April 23, 2005 and is called "**Me at the Zoo**" and features Jawed Karim, one of the founders, at the San Diego Zoo.



Jack Dorsey

@jack

just setting up my twttr

5:50 PM - 21 Mar 06 via web · Embed this Tweet

Reply Retweet Favorite

"JUST SETTING UP MY TWITTR"

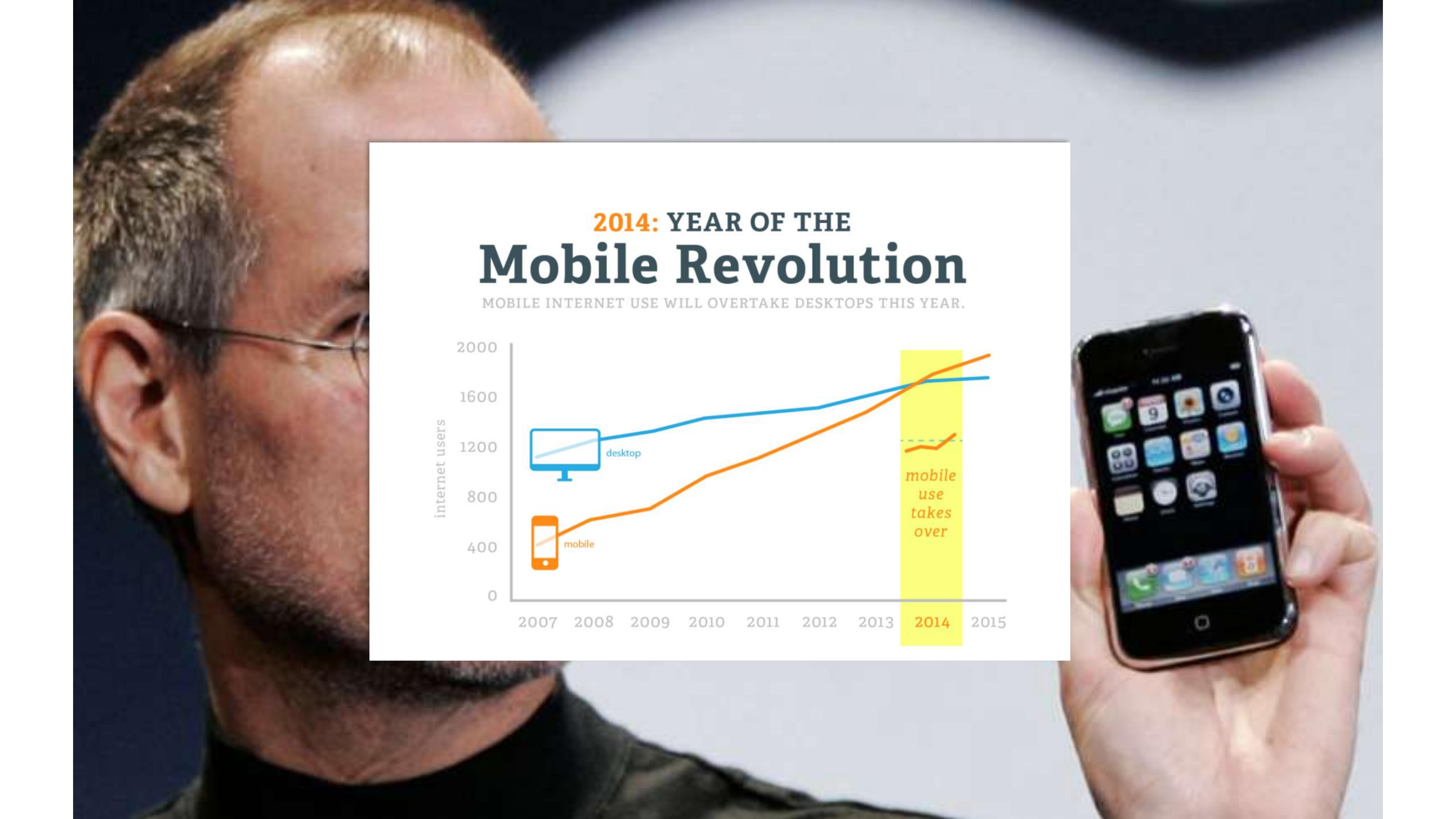
WAS BY CO-FOUNDER JACK DORSEY

03.21.06

TODAY, 500 MILLION

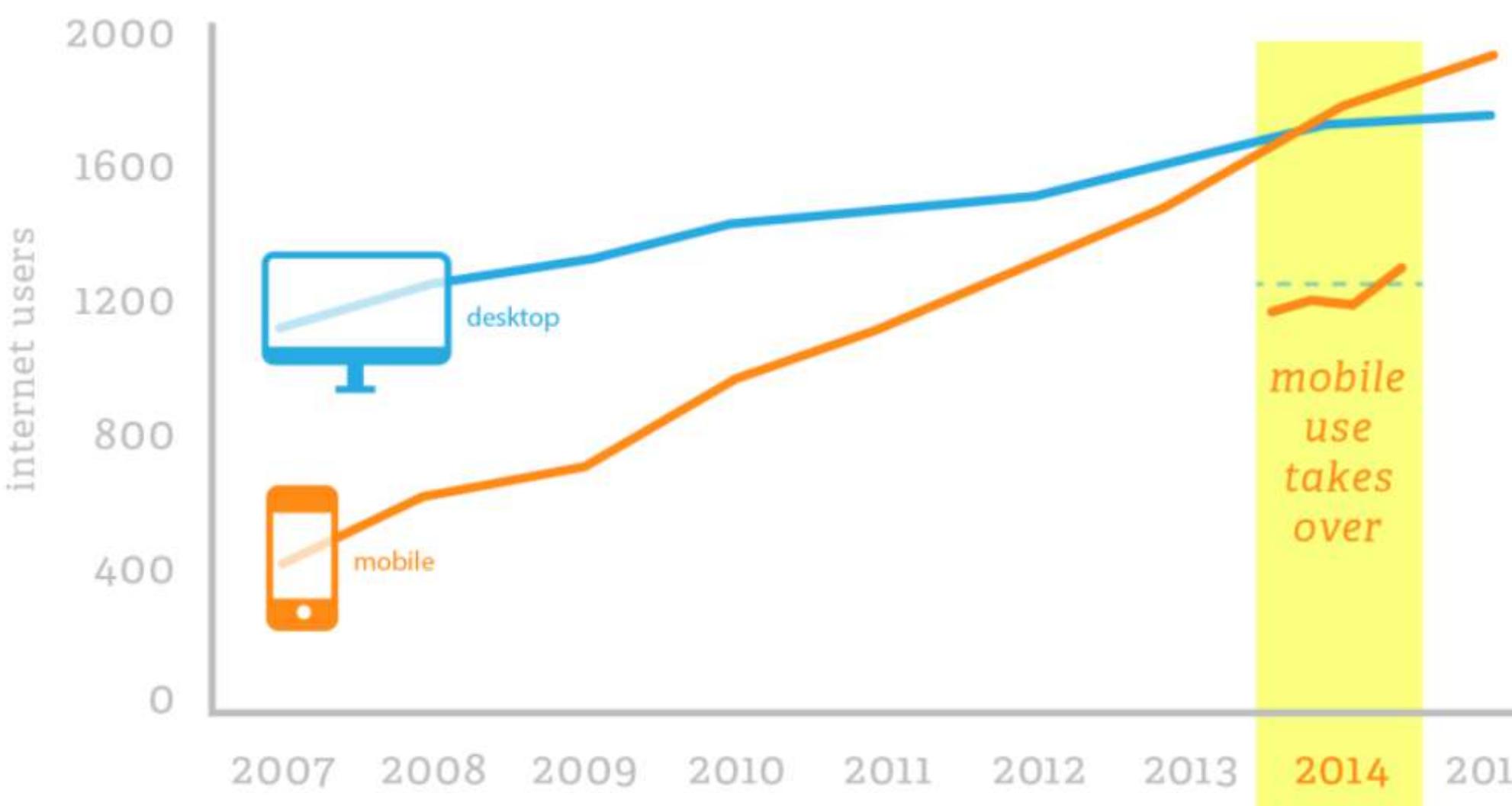
TWEETS ARE SENT
PER DAY





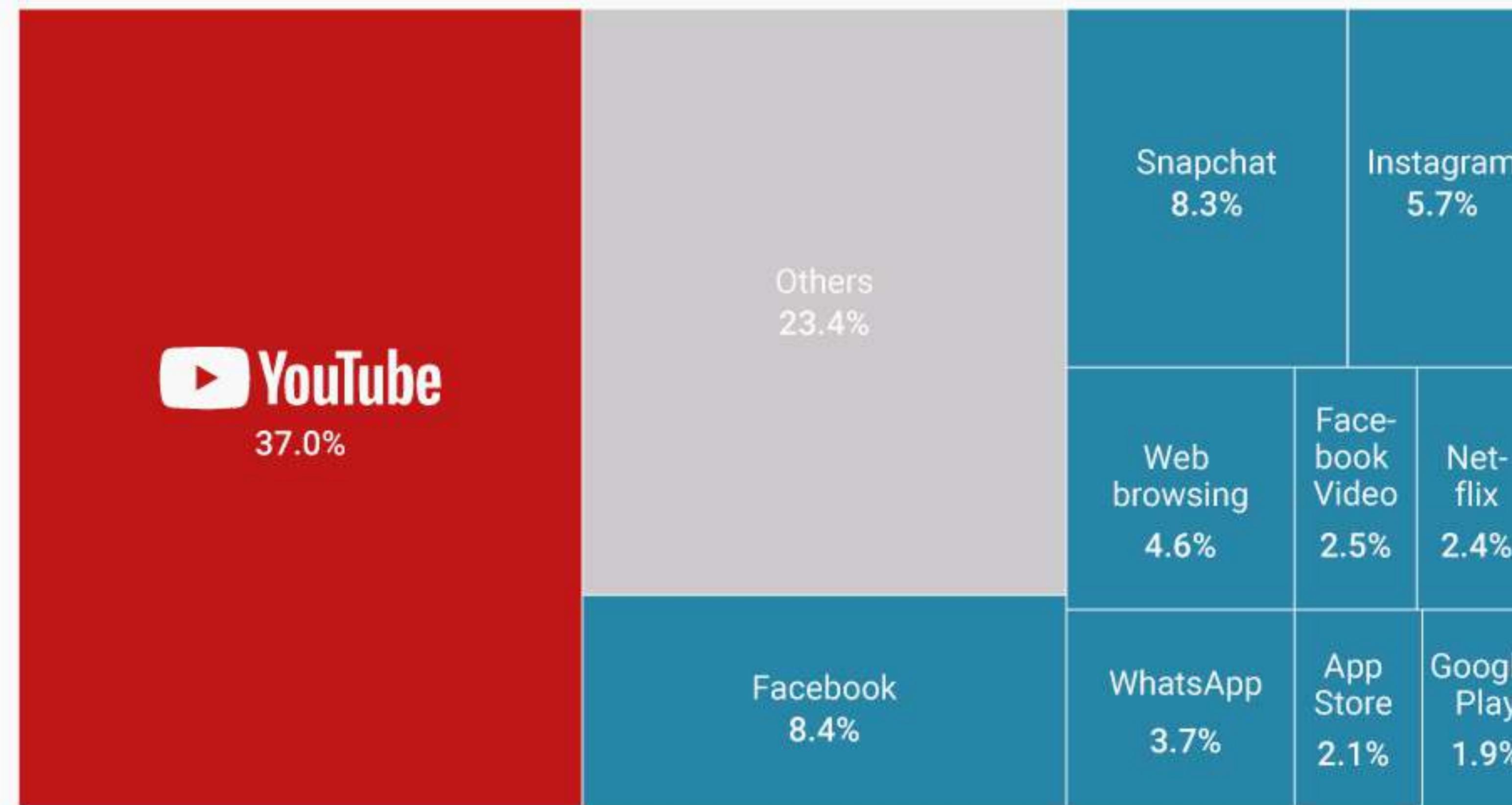
2014: YEAR OF THE Mobile Revolution

MOBILE INTERNET USE WILL OVERTAKE DESKTOPS THIS YEAR.



YouTube Is Responsible for 37% of All Mobile Internet Traffic

Share of global downstream mobile traffic, by app

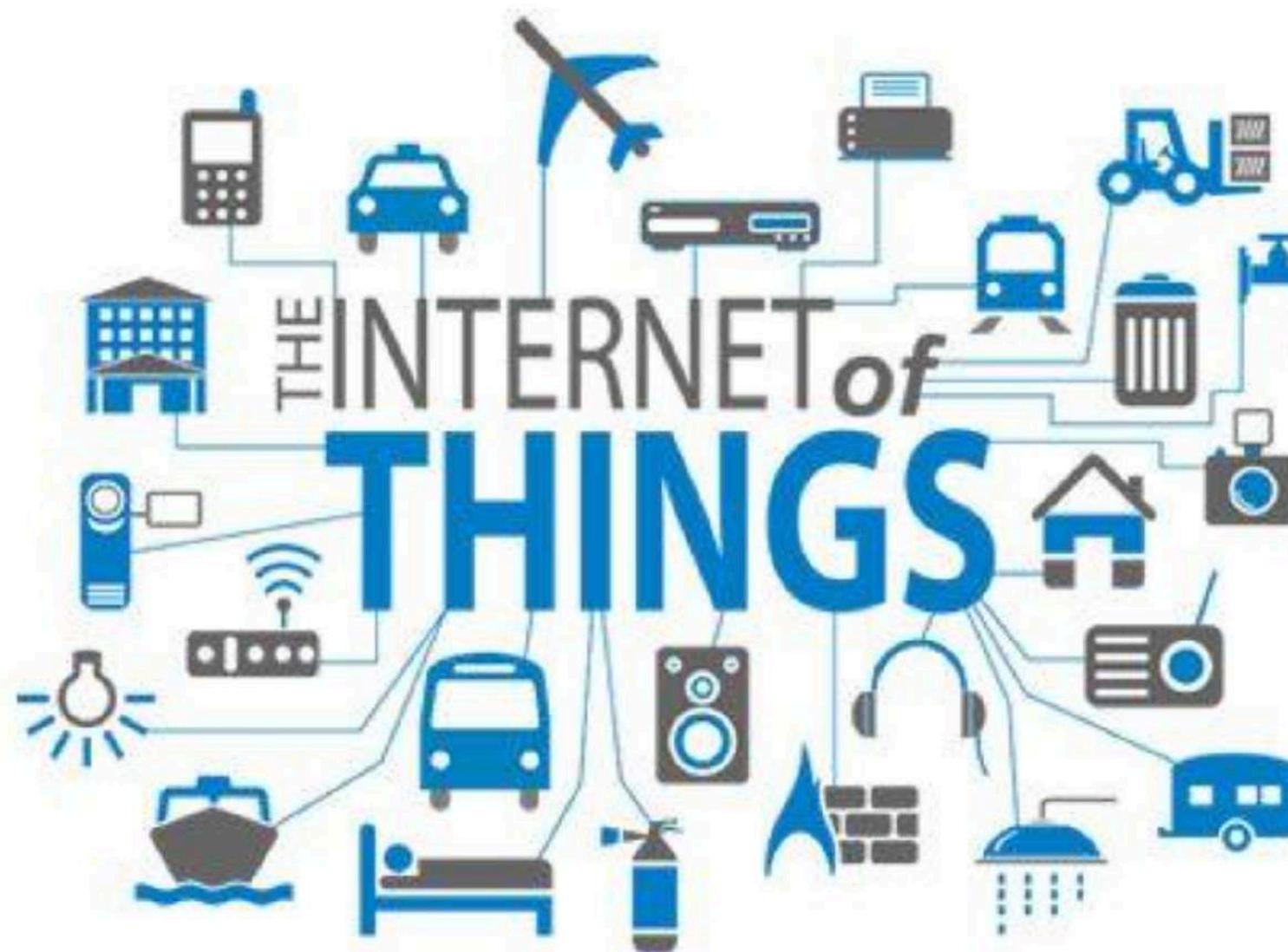


@StatistaCharts

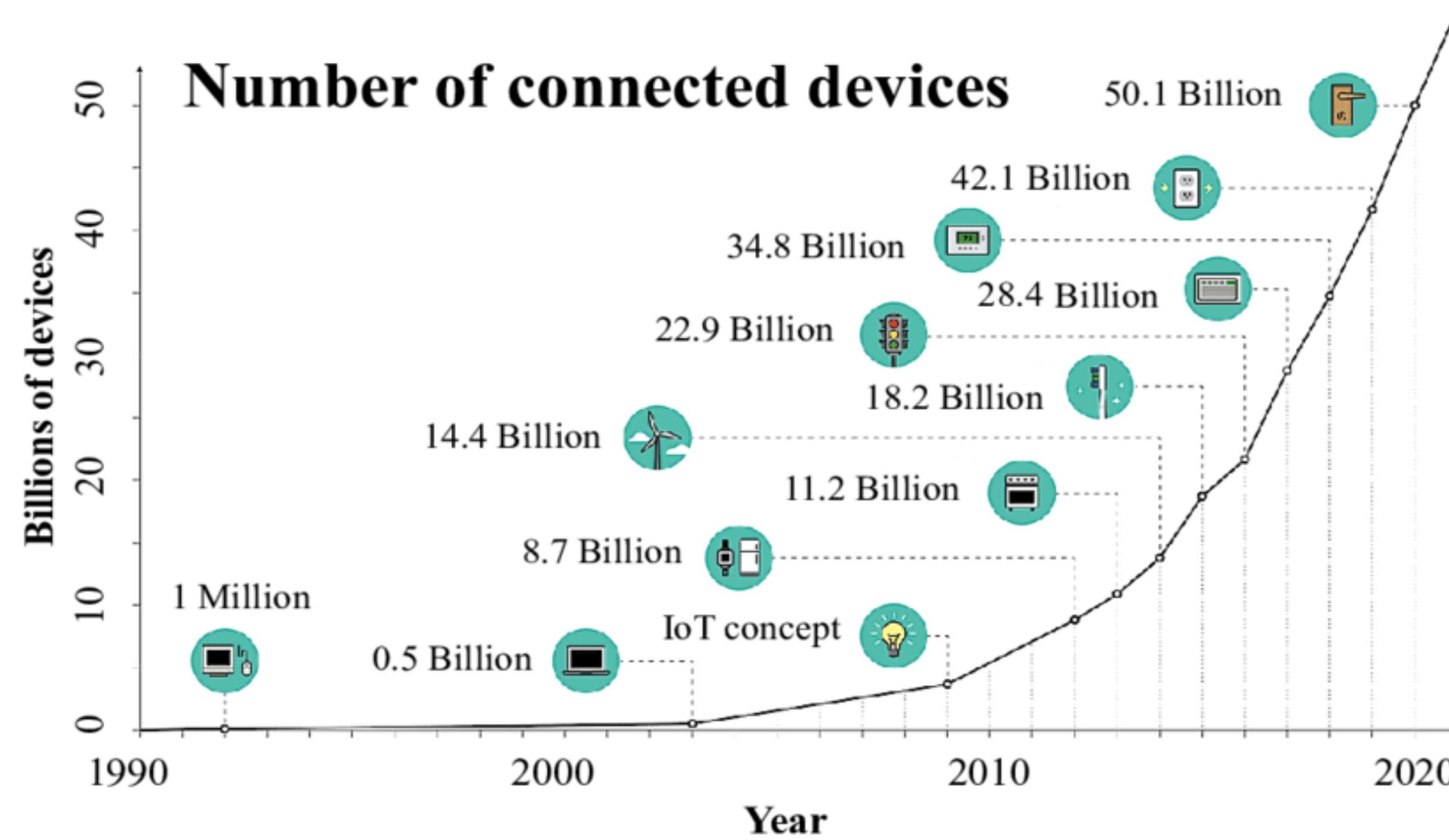
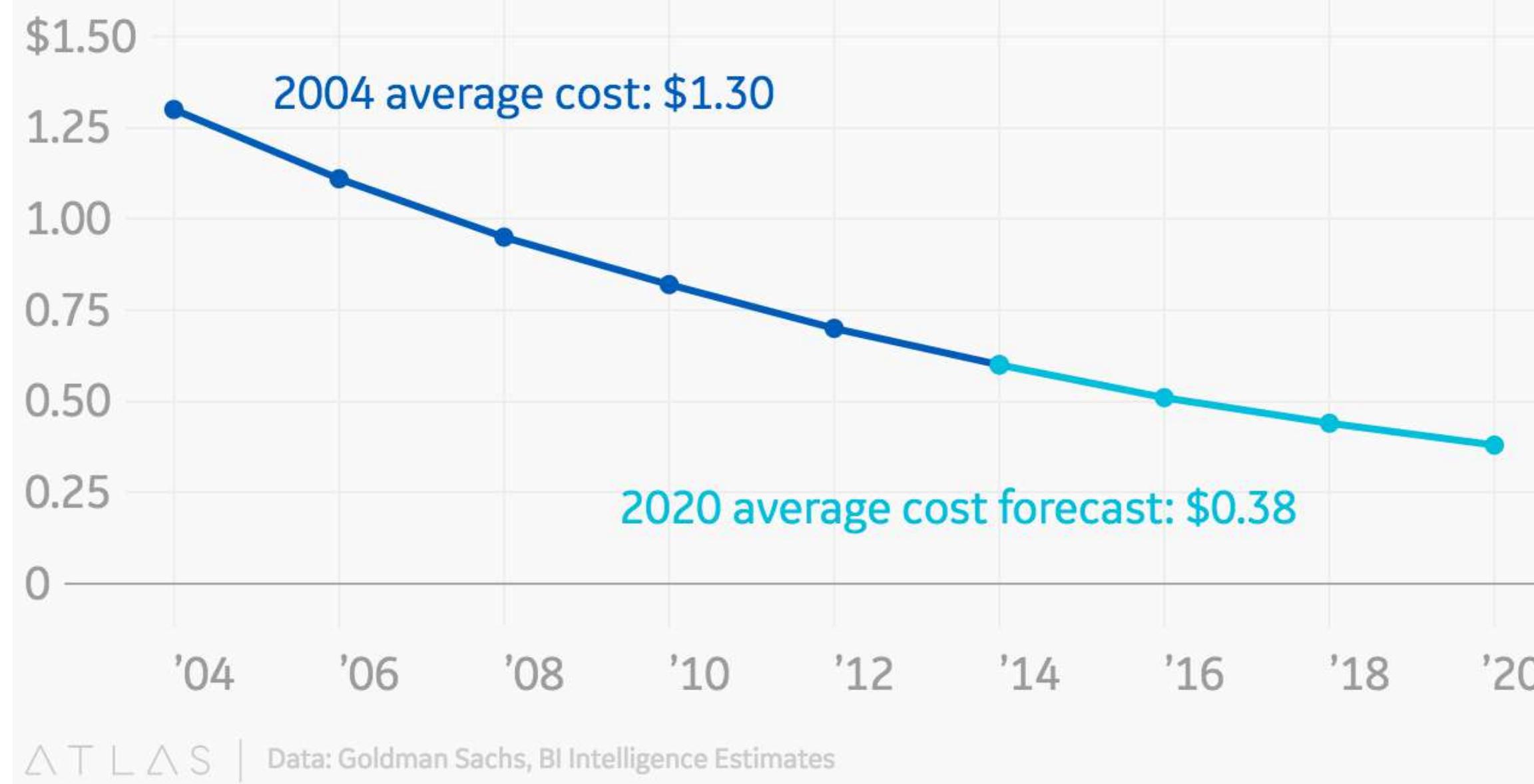
Source: Sandvine | The Mobile Internet Phenomena Report (February 2019)



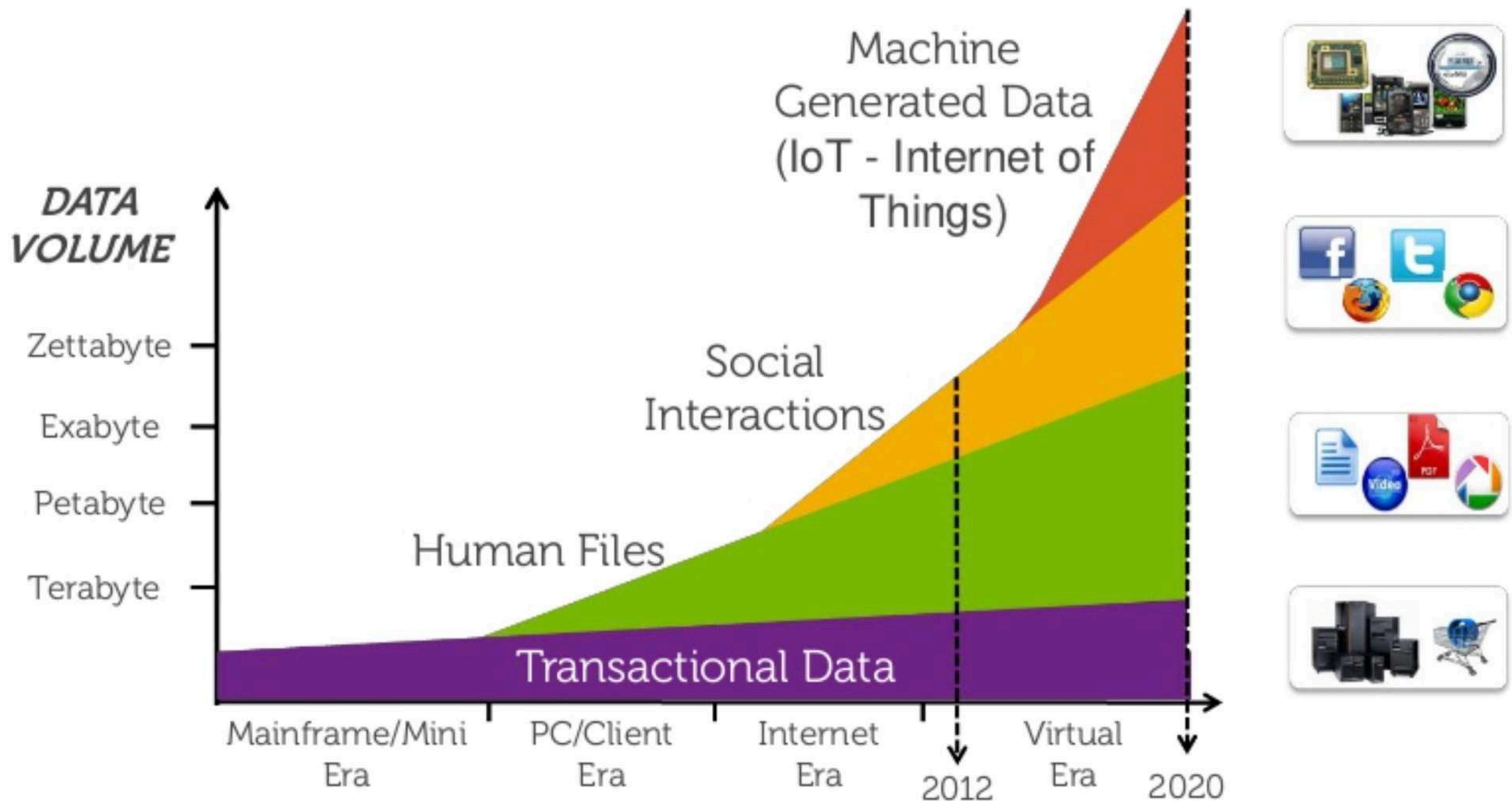
statista



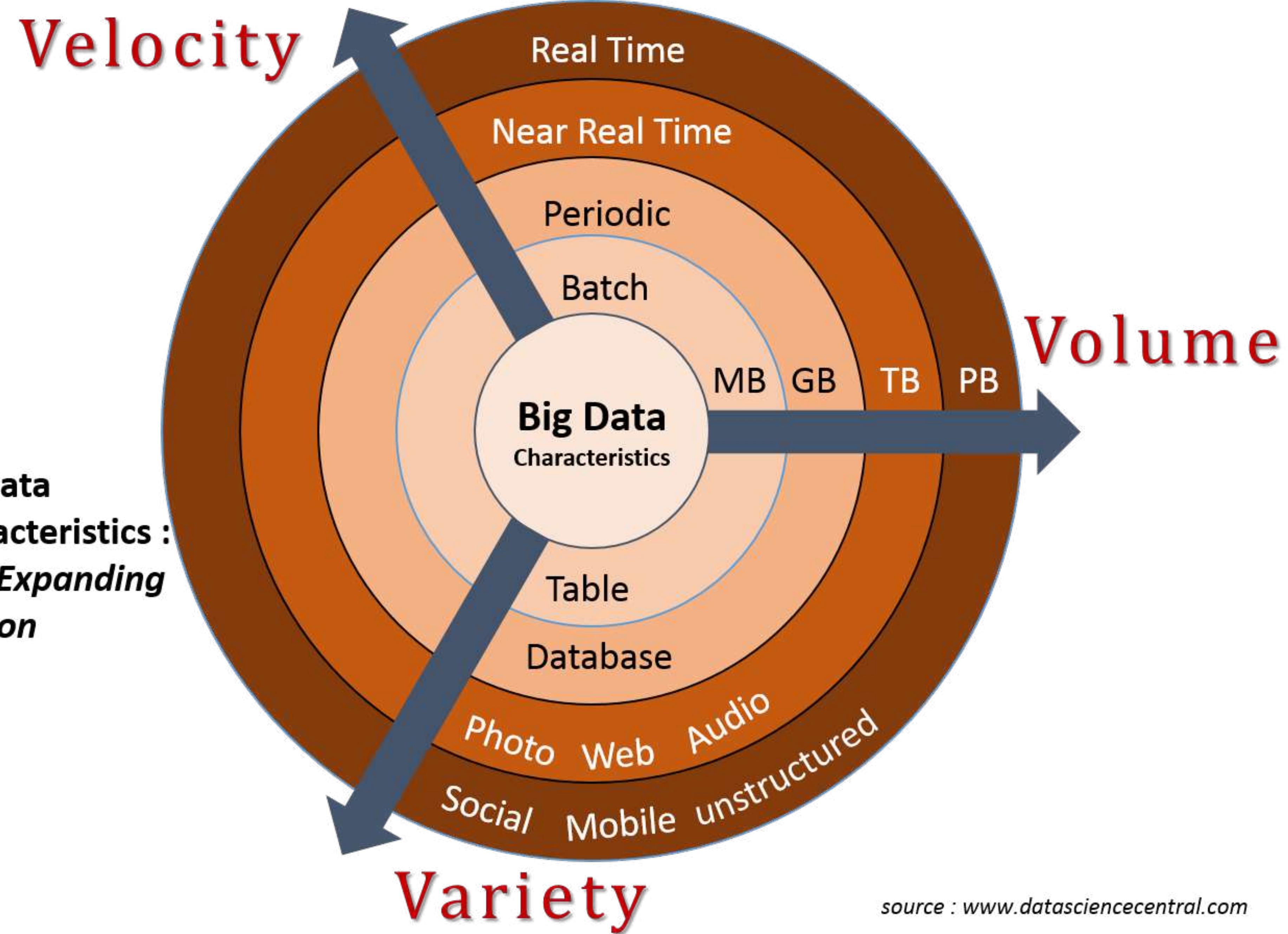
The average cost of IoT sensors is falling



The Explosion of Data



**Big Data
Characteristics :**
*Ever Expanding
horizon*



source : www.datasciencecentral.com

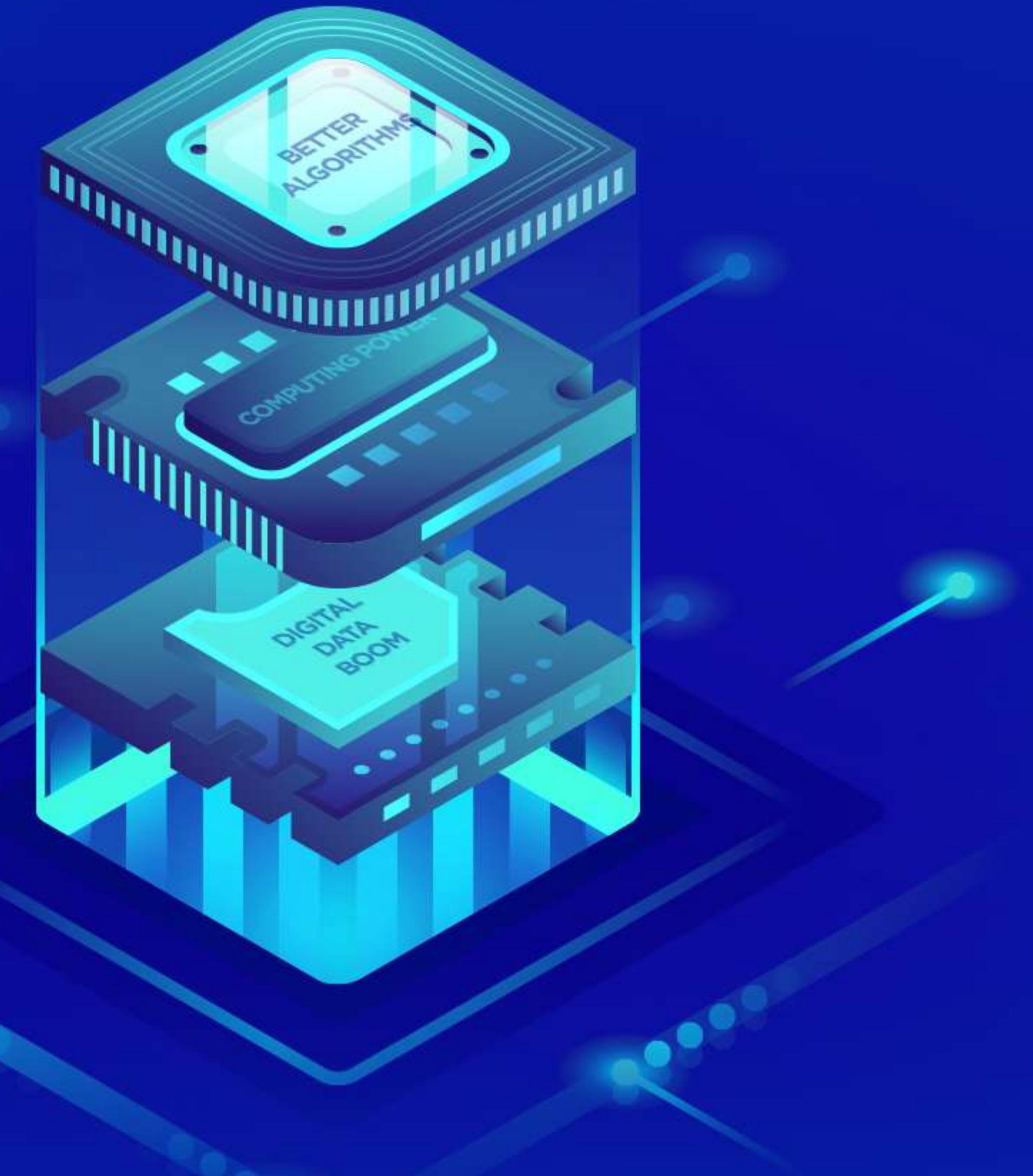
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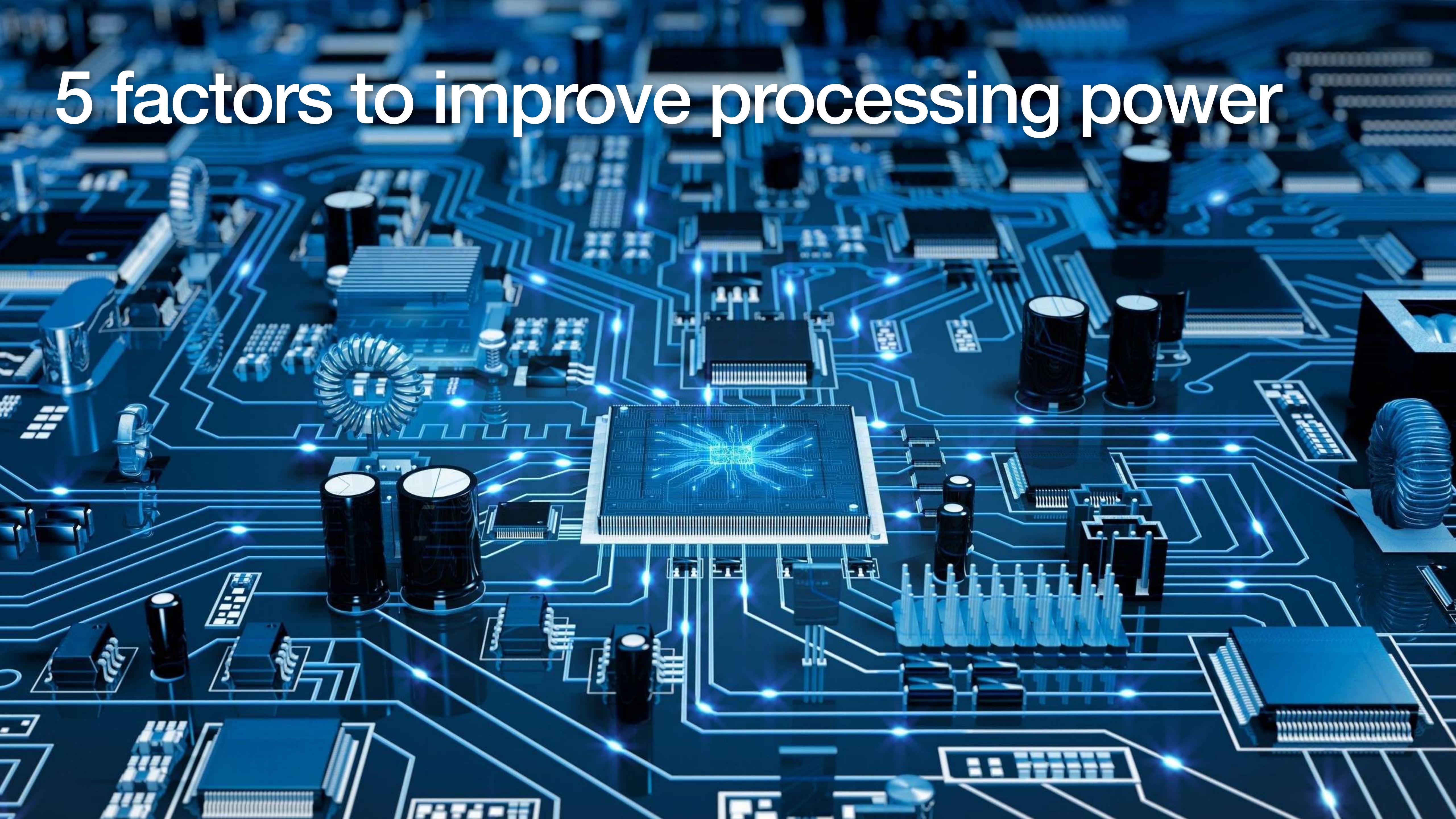
Digital Data Boom

Computing Power

Better Algorithms



5 factors to improve processing power



Gordon E Moore

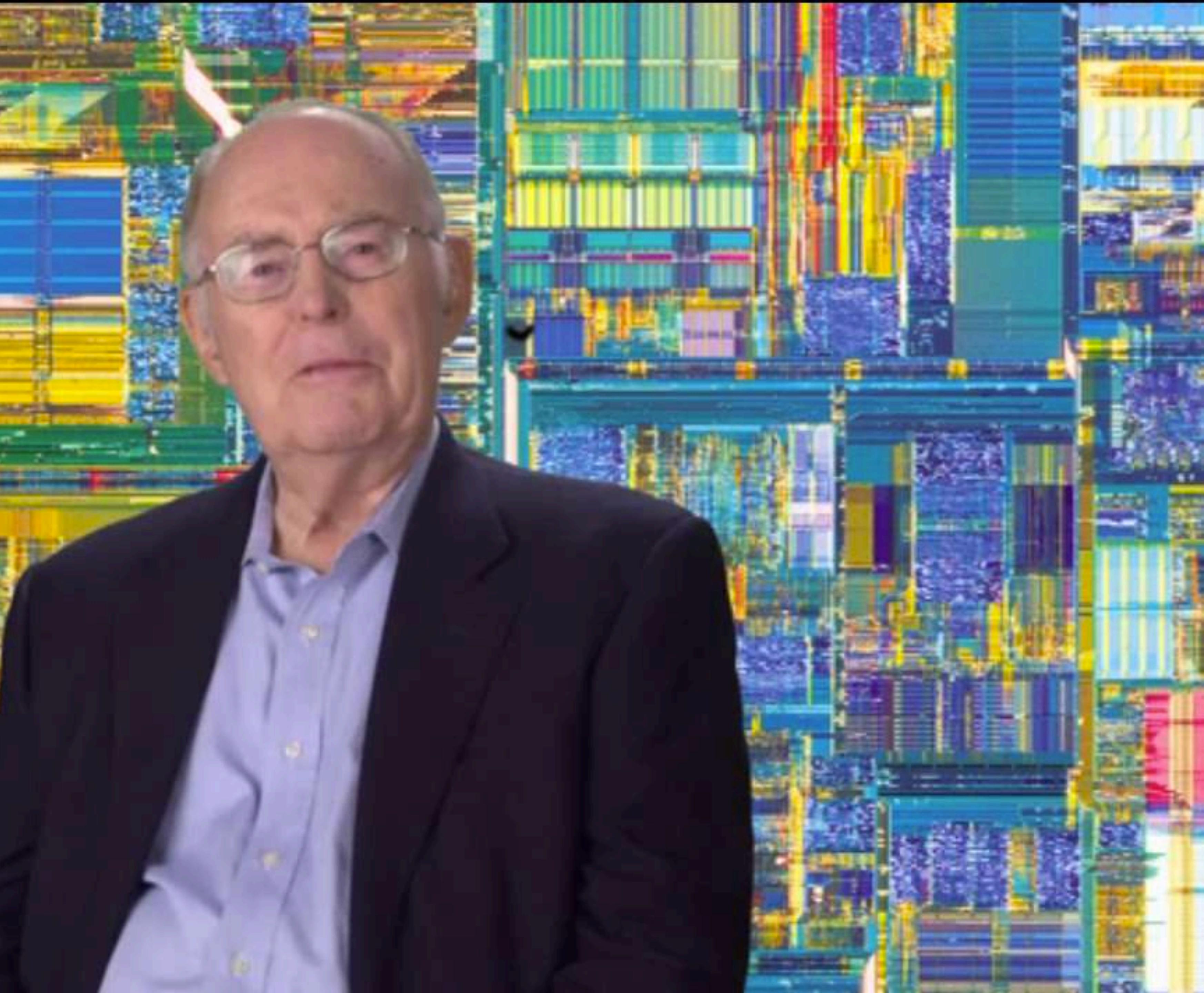
Intel Co-founder

In an article published in 1965, Moore observed that the number of components (transistors, resistors, diodes, or capacitors) in a dense integrated circuit had **doubled approximately every year** and speculated that it would continue to do so for at least the next ten years.

In 1975, he revised the forecast rate to approximately **every two years**.

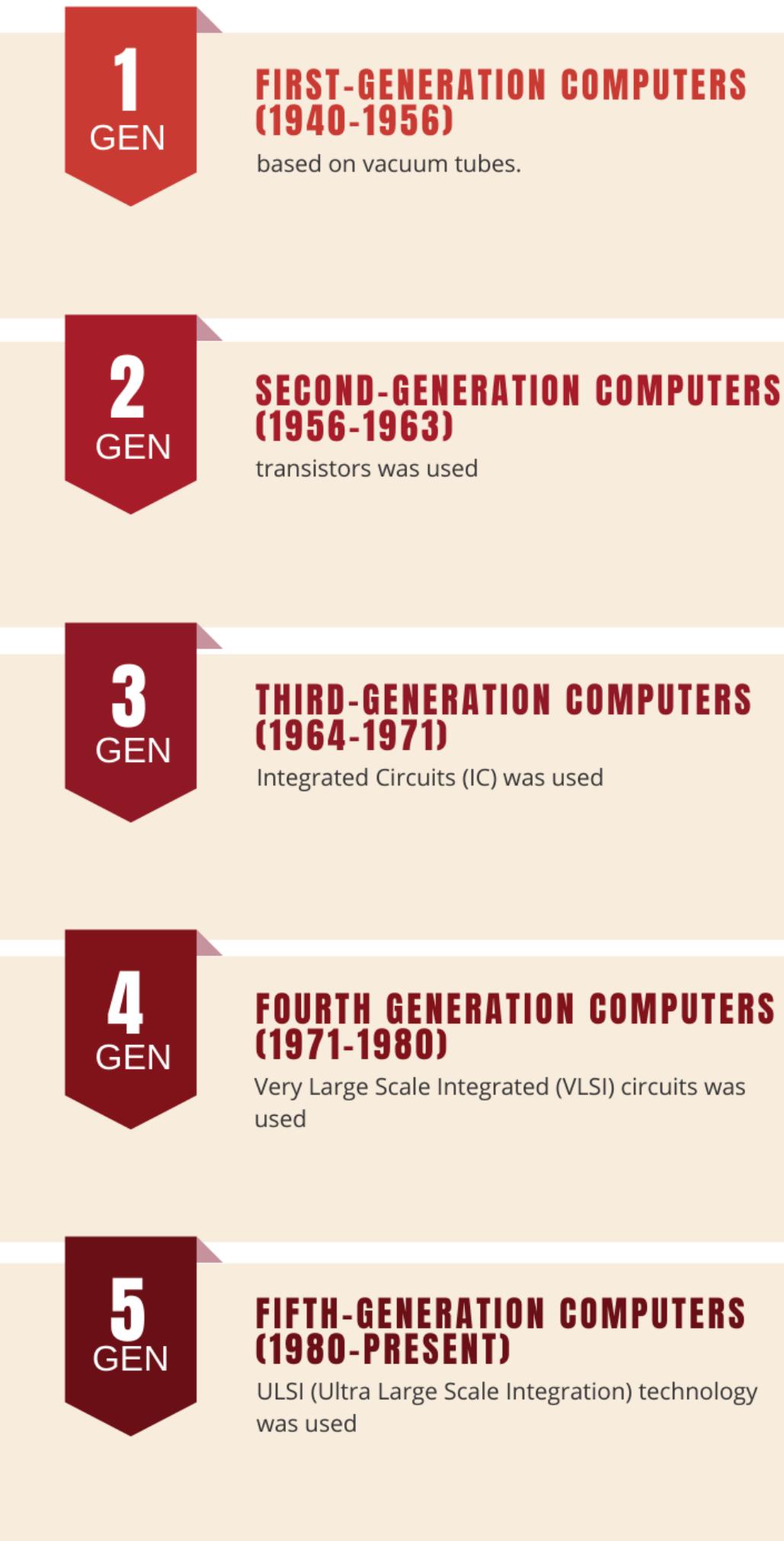
The phrase **Moore's law** was popularised.

The prediction has become a **target for miniaturization** in the semiconductor industry and has had widespread **impact in many areas of technological change**.

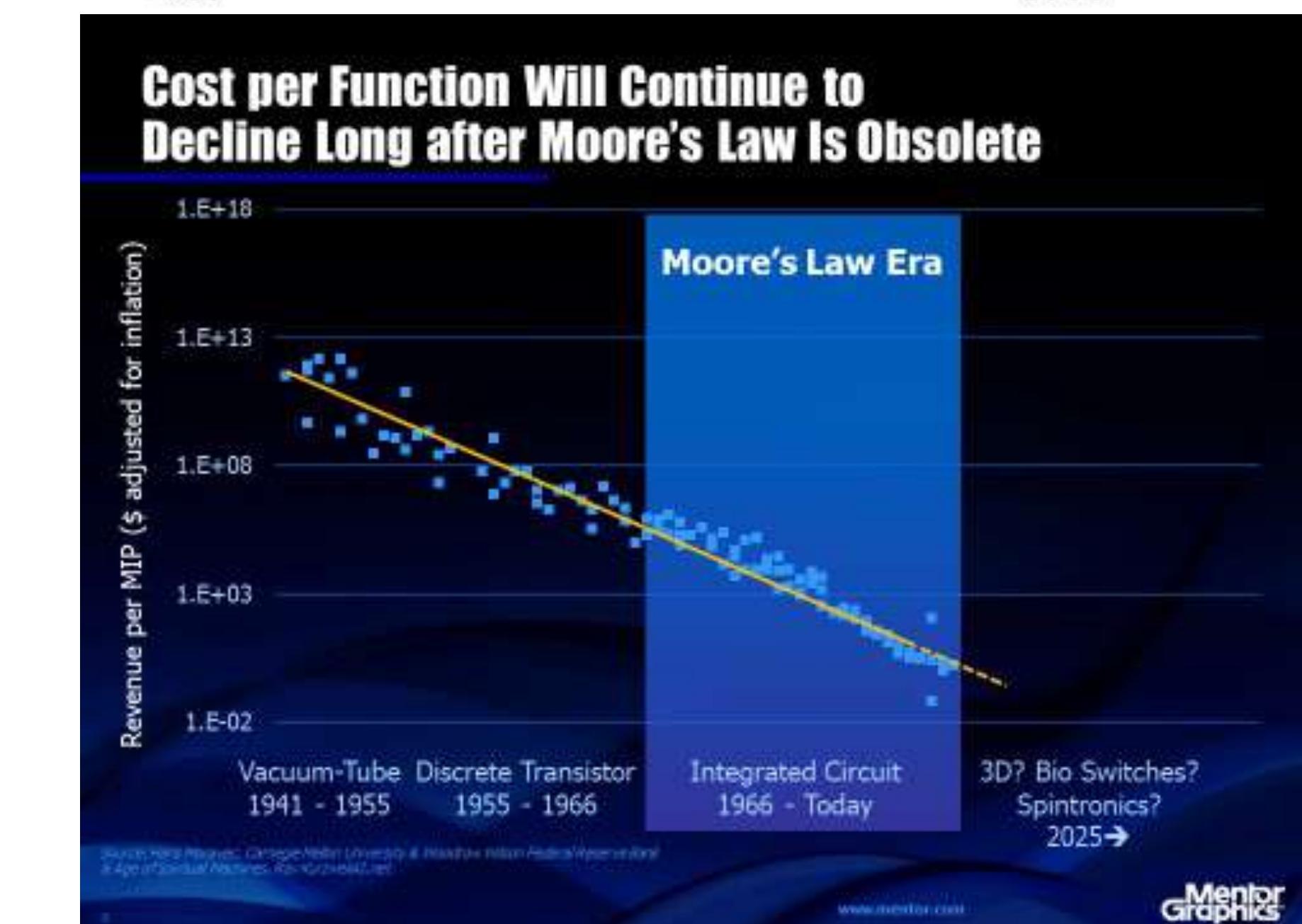
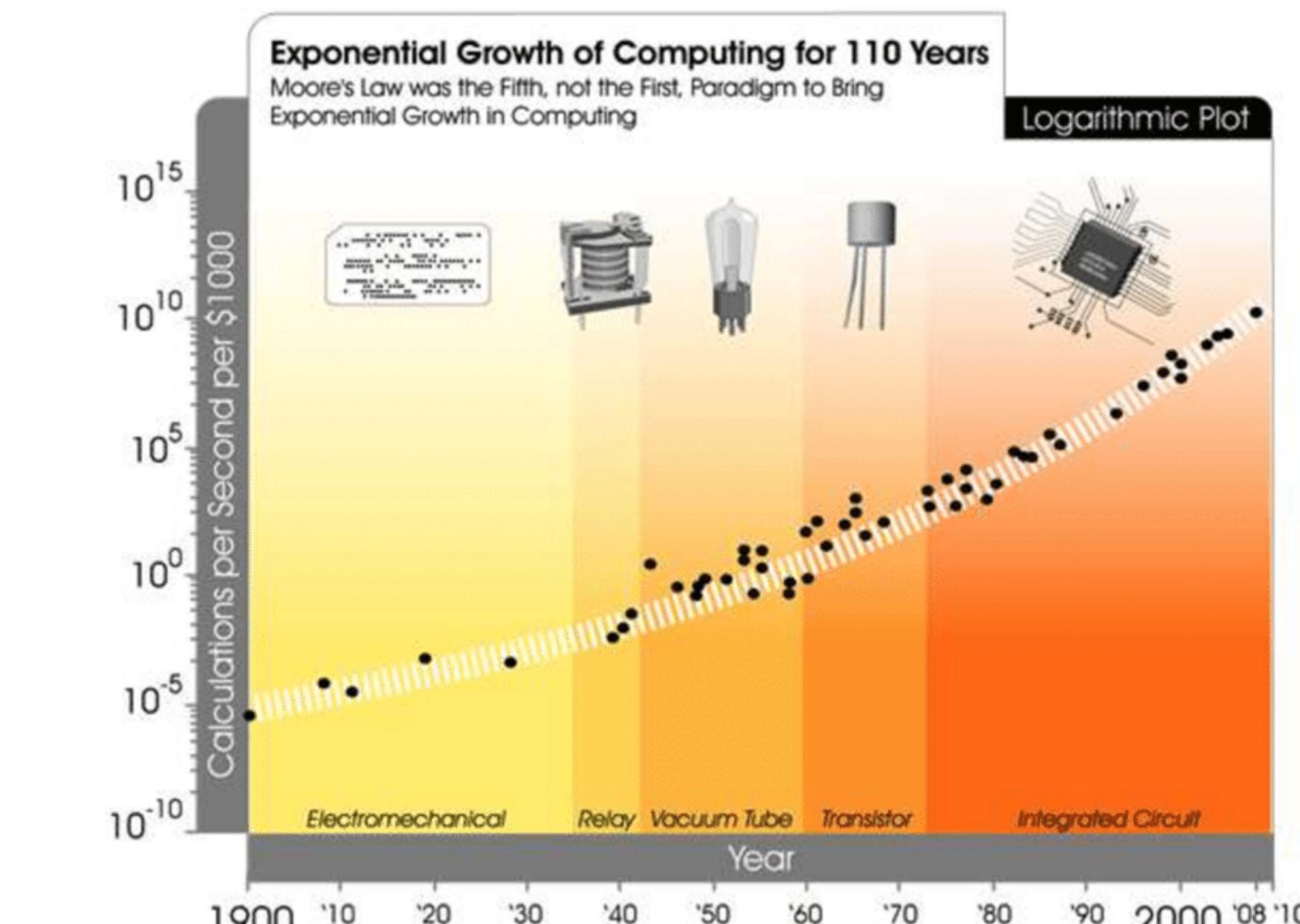


1. Moore's Law: miniaturisation in the semiconductor industry

GENERATION OF COMPUTERS



windowsground.com



Mentor Graphics

2. Big data technologies: pushing the demand for more power

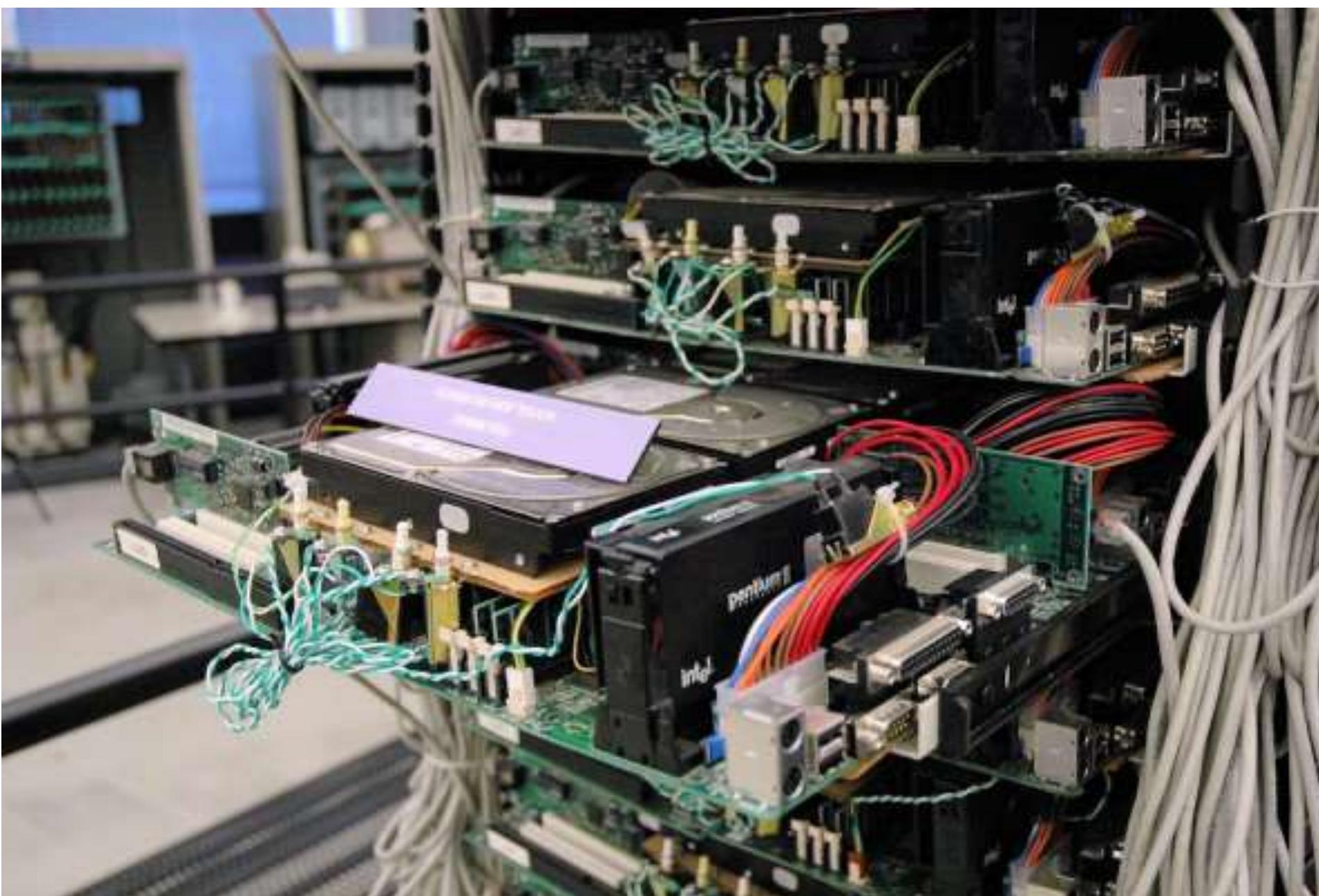
Google! BETA



Copyright ©1998 Google Inc.

1998

1997



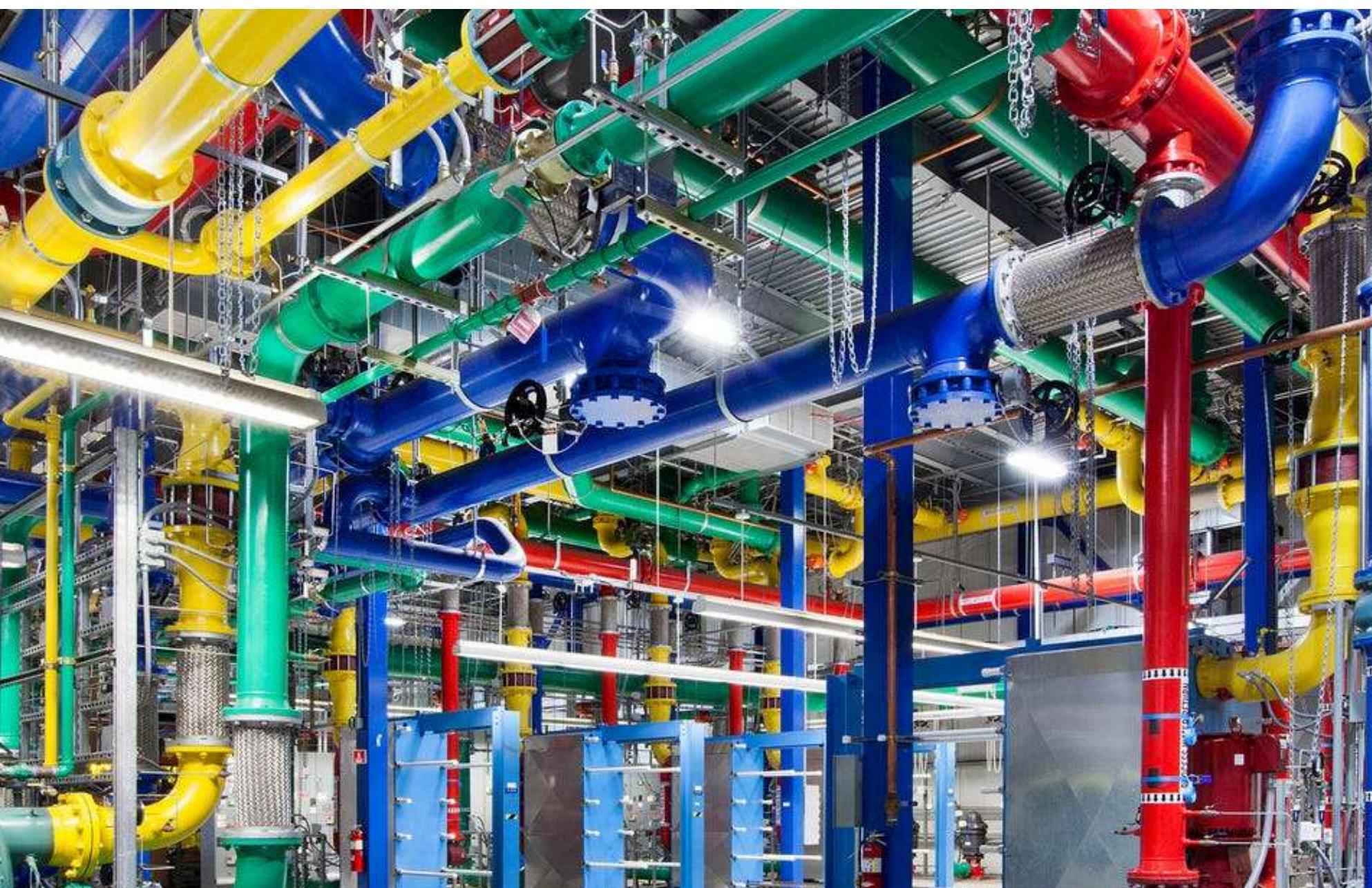
1999



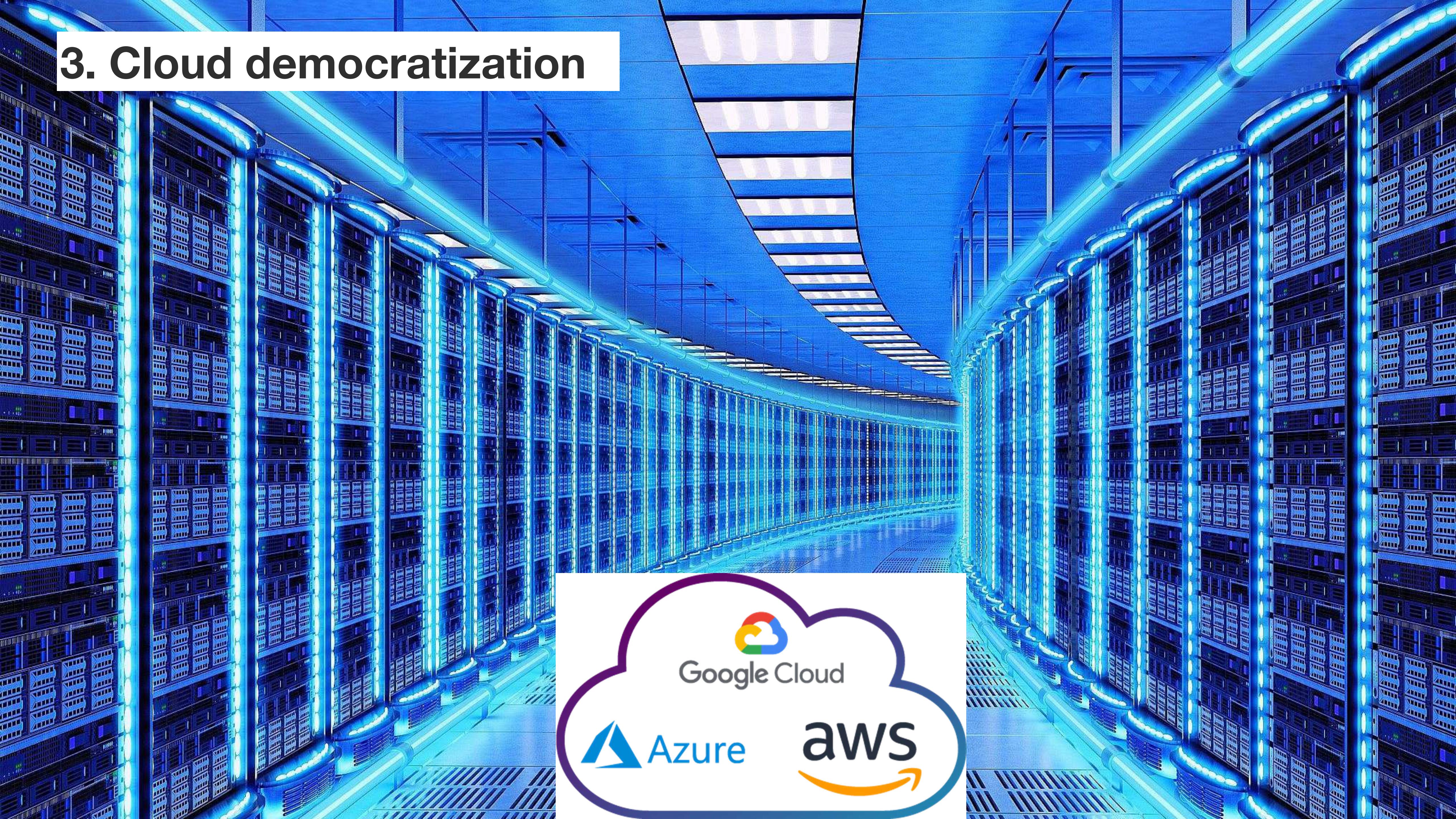
2004



today



3. Cloud democratization



Switch TAHOE RENO

The Citadel Campus

Designed for up to 7.2 million square feet of data center space and up to 650 megawatts (MW) of power

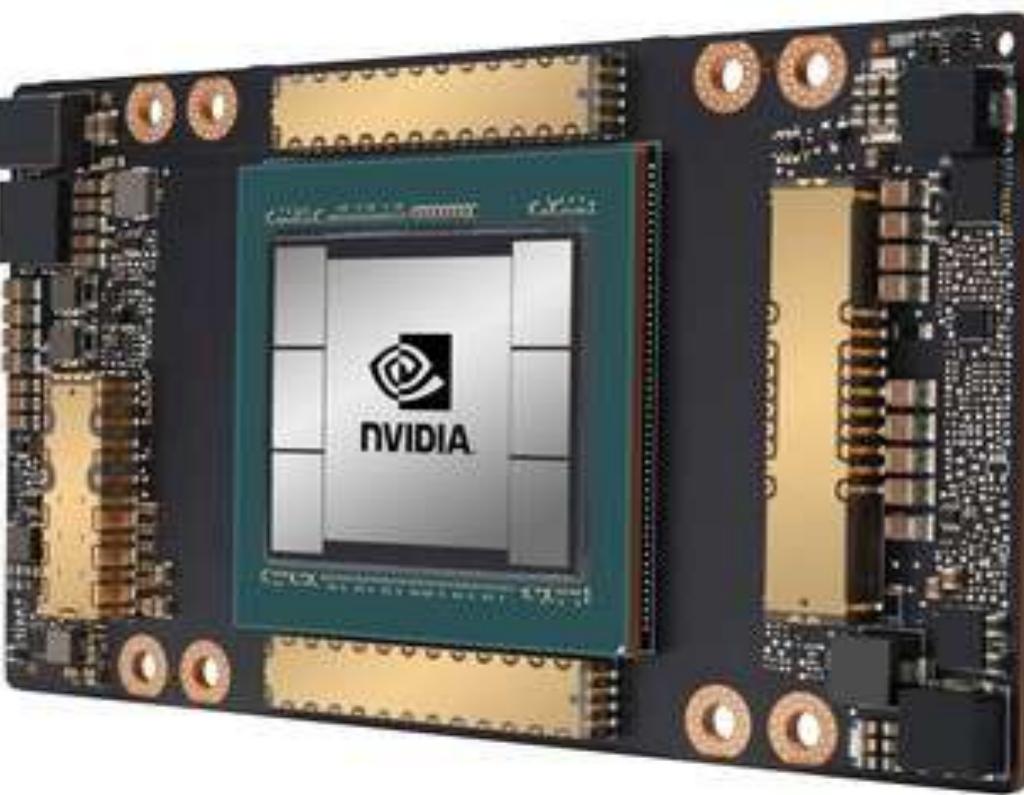


4. AI specialized Processing Units

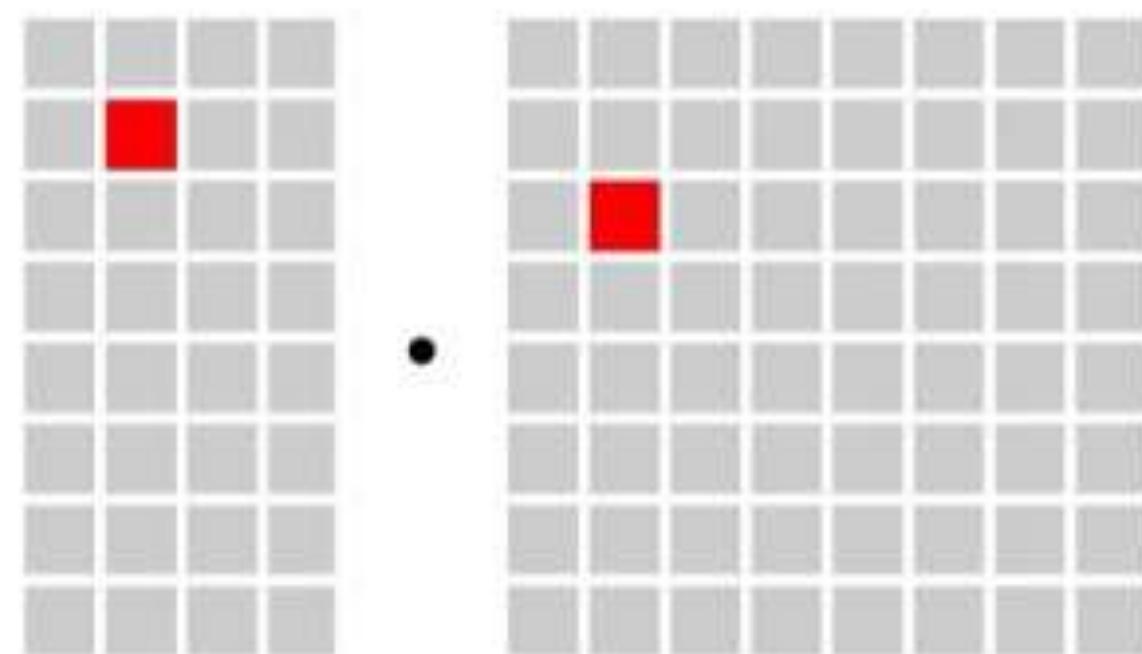
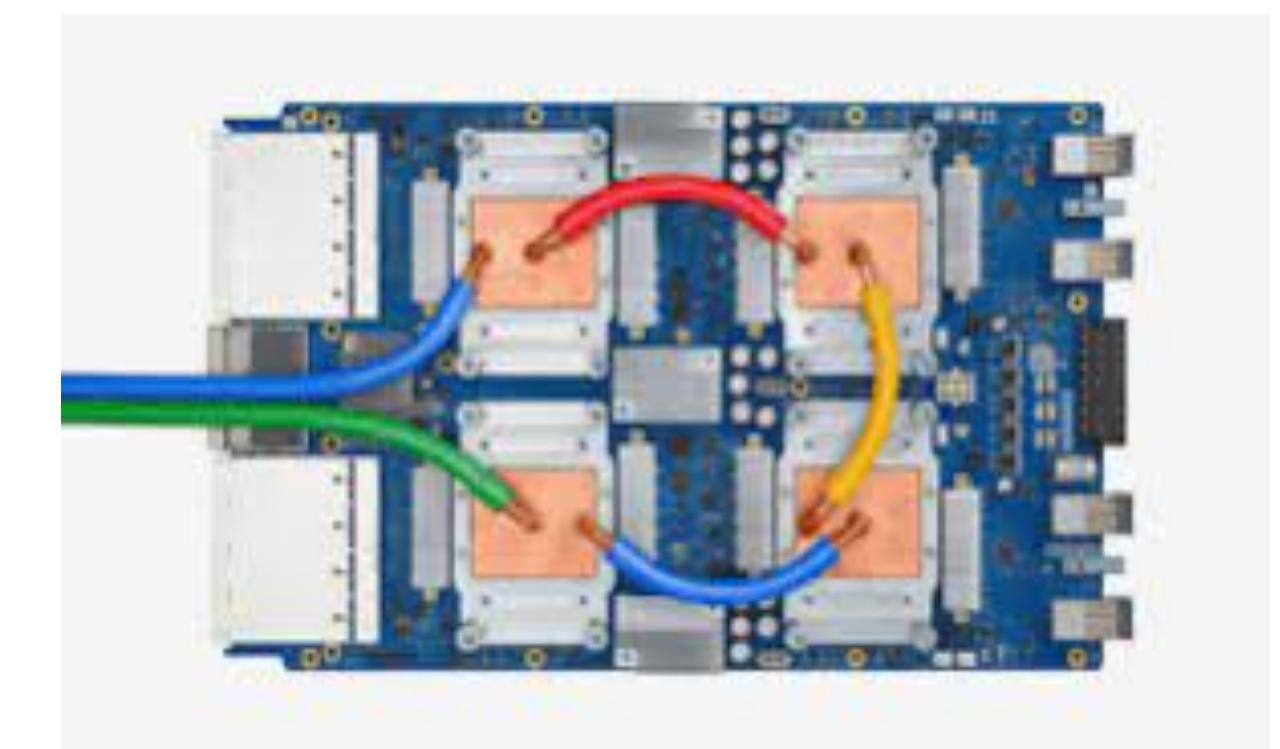
CPU
Central Processing Unit



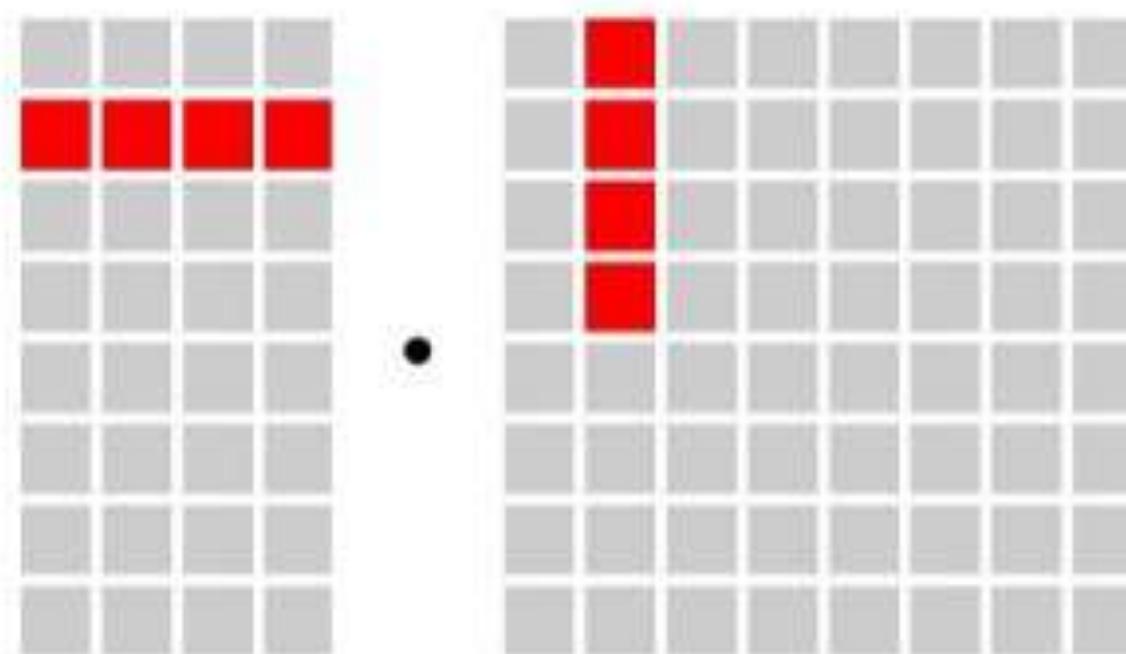
GPU
Graphic Processing Unit



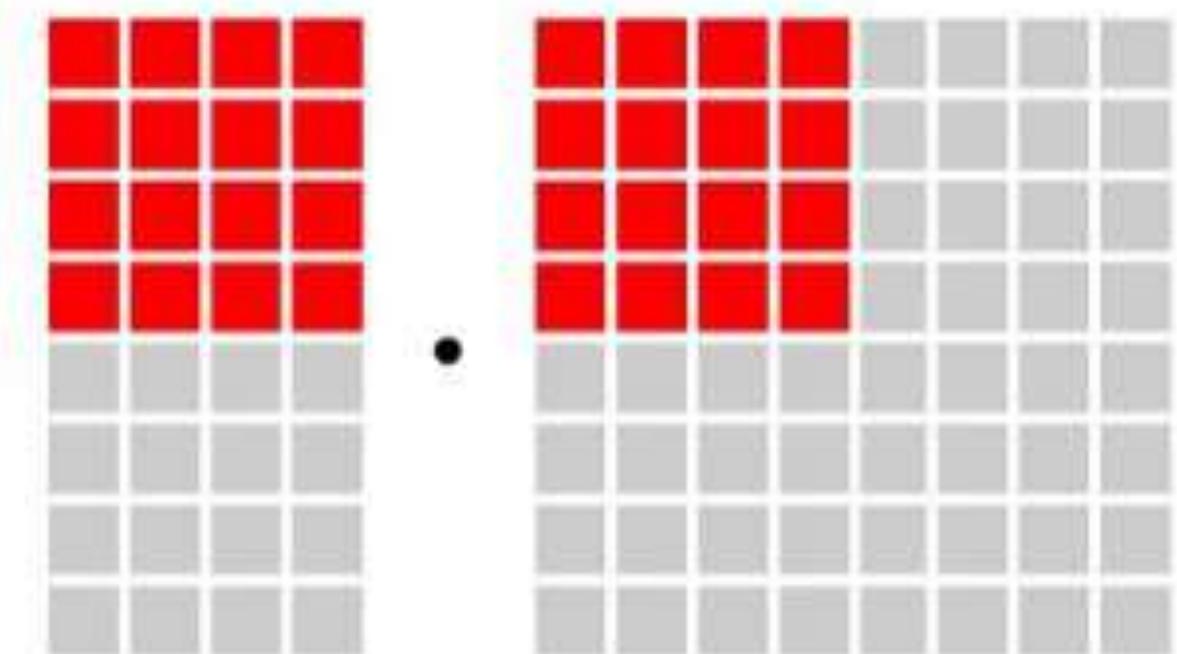
TPU
Tensor Processing Unit



scalar



vector



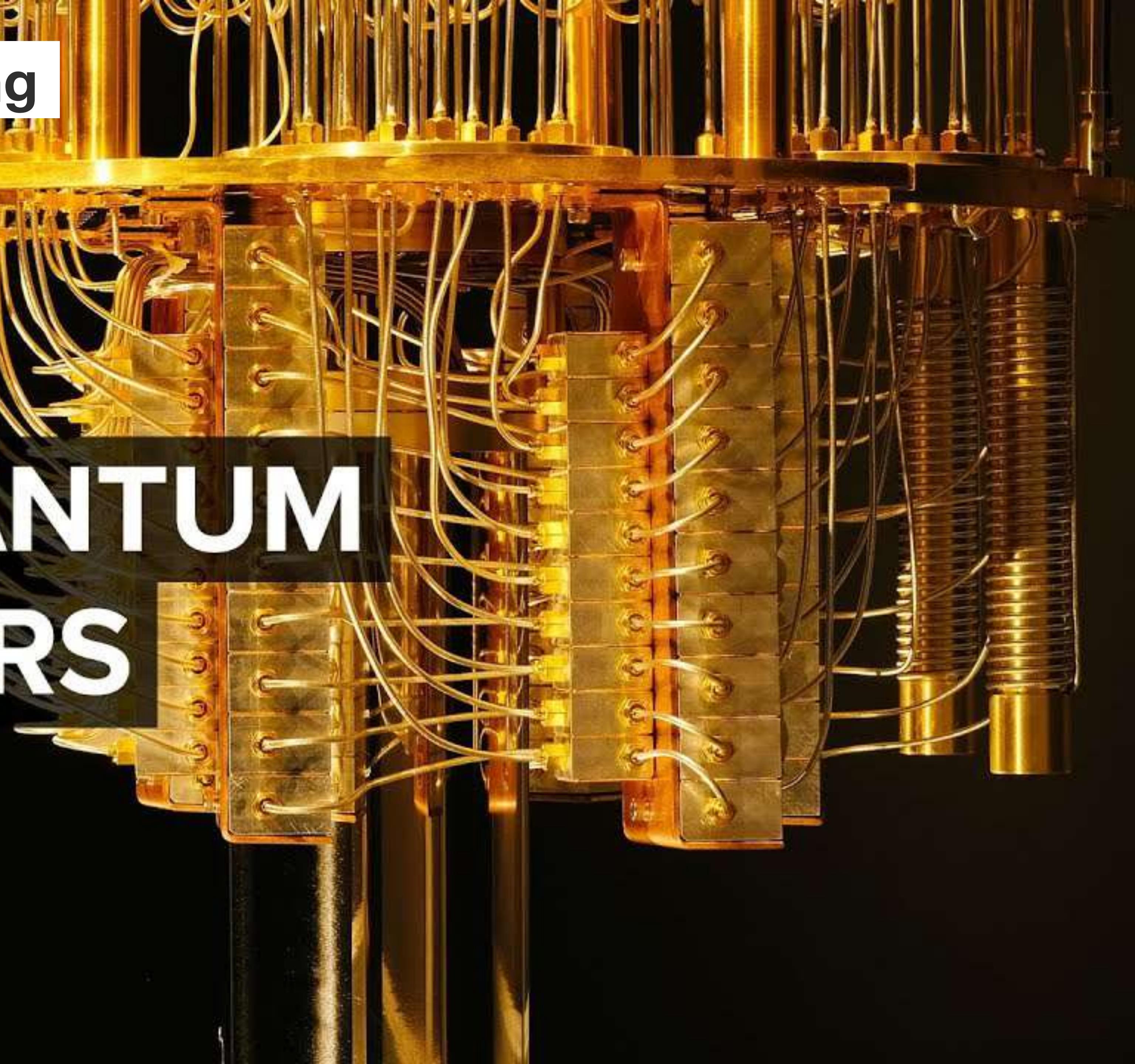
tensor

5. Quantum computing



THE HYPE OVER QUANTUM COMPUTERS

In October 2019, Google made a big announcement. It announced its 53-qubit quantum computer named Sycamore had achieved '**quantum supremacy**.' That's when quantum computers **can complete tasks exponentially more quickly** than their classical counterparts. In this case, Google said its quantum machine completed a task **in 200 seconds** that would have taken the world's most powerful computer **10,000 years*** to complete.



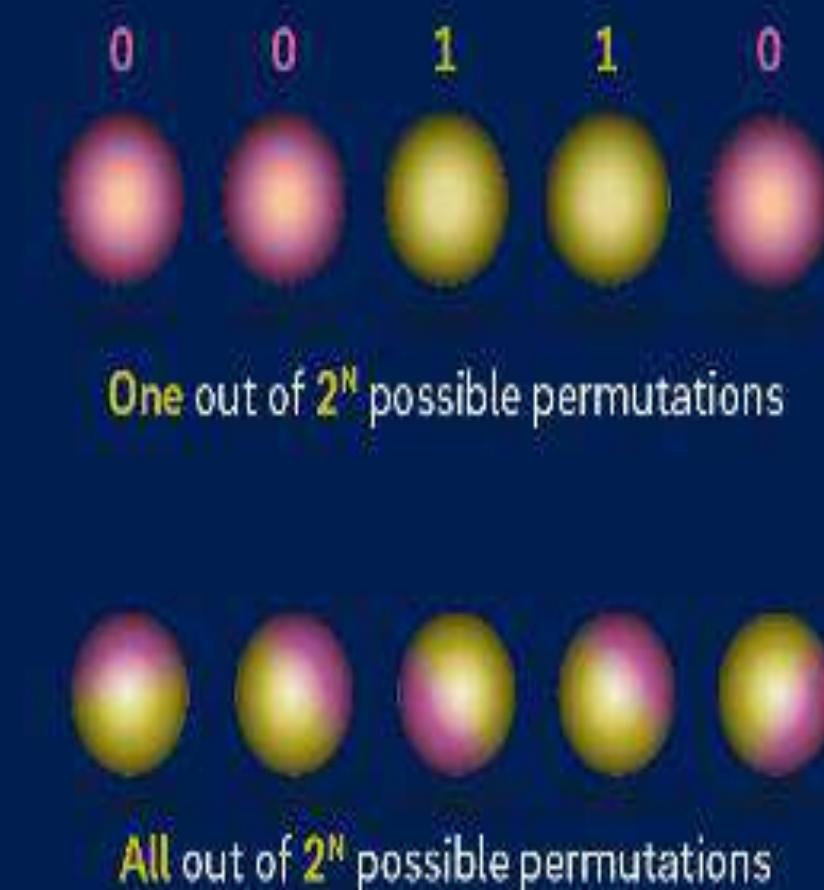
*2.5 days according to IBM

CALCULATING A COMPUTING REVOLUTION

Quantum computing is not just a case of adapting classic approaches to a new system. It requires a different way of thinking altogether, one that recalculates the building blocks of computing based on the complex principles of quantum mechanics.

What's so special about a qubit?
Superposition.

While conventional computing uses bits that work in binary code, 0s and 1s, qubits have the peculiar ability to be in two states at once – both 0 and 1. This mirrors nature: The electrons of a molecule are in a superposition of all possible states available to them. It is only when we observe or measure them that they are in a particular location.



Quantum-powered

How long would it take to work out which two prime numbers are multiplied together to get a 2048 bit number, like those used in encryption?

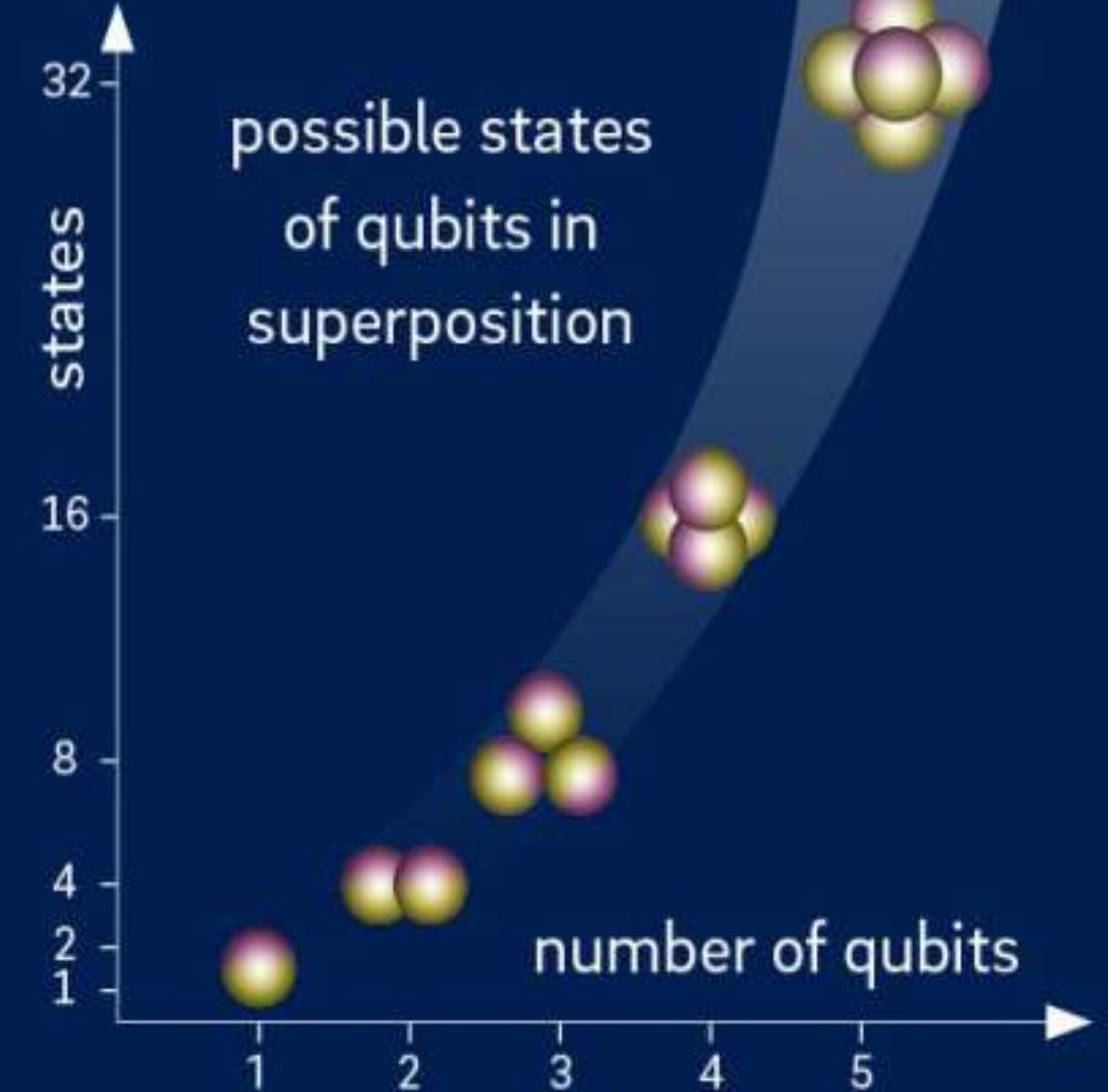


Classical
computing
=
a billion years



Quantum
computing
=
100 seconds

Exponential growth



The **3 Forces** that Brought AI to Life

And Why it's Only Now
Changing the World

1

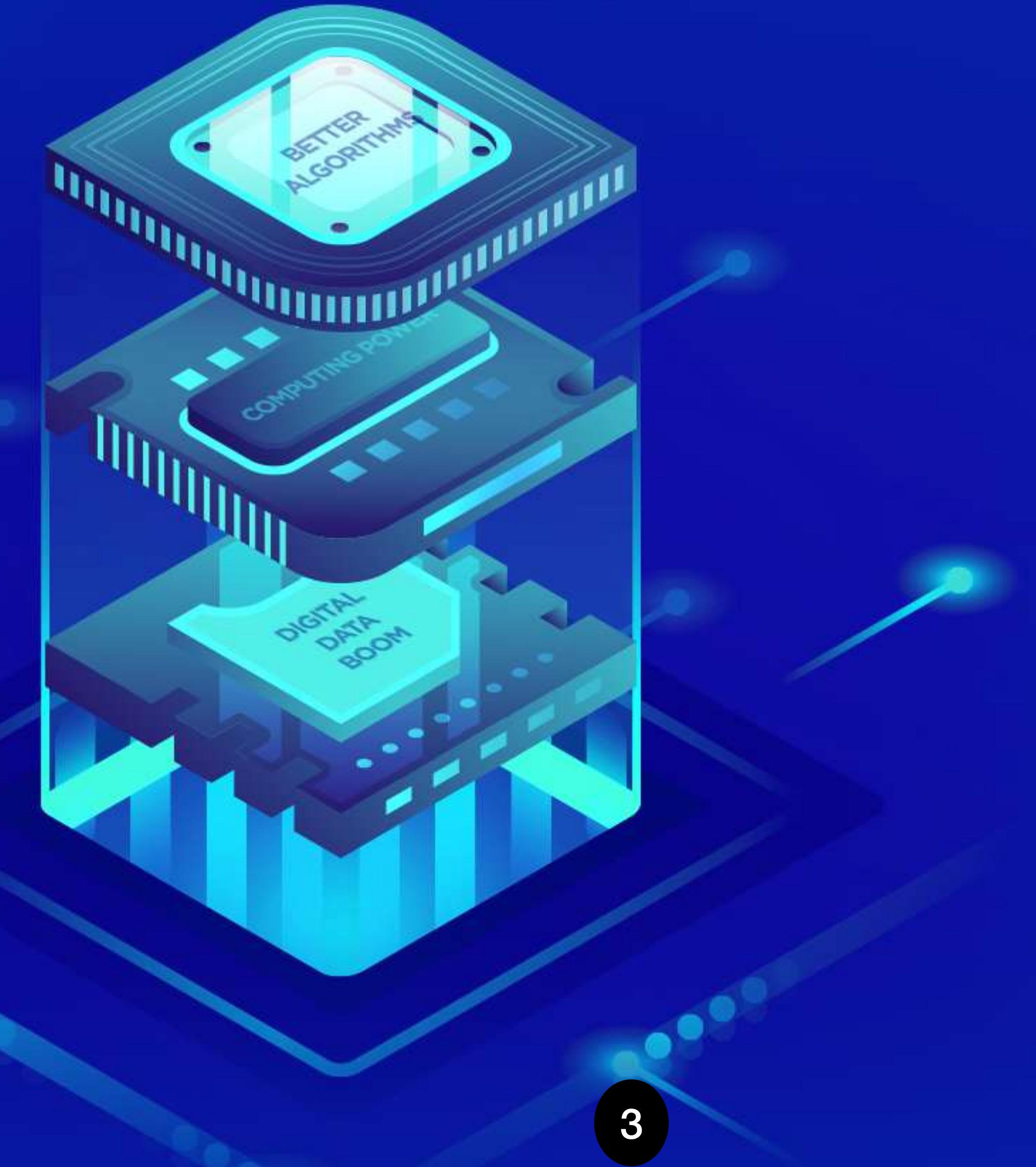
Digital Data Boom

2

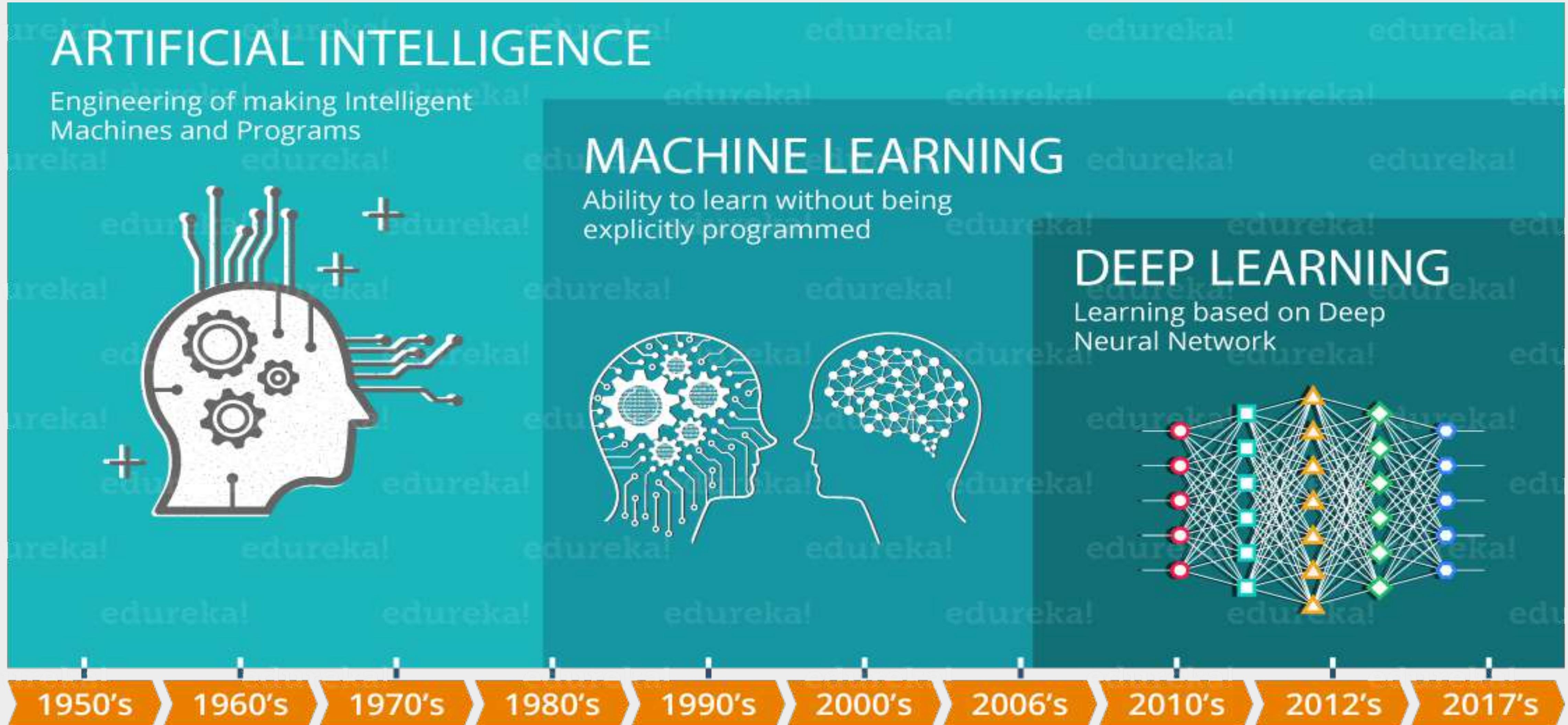
Computing Power

3

Better Algorithms

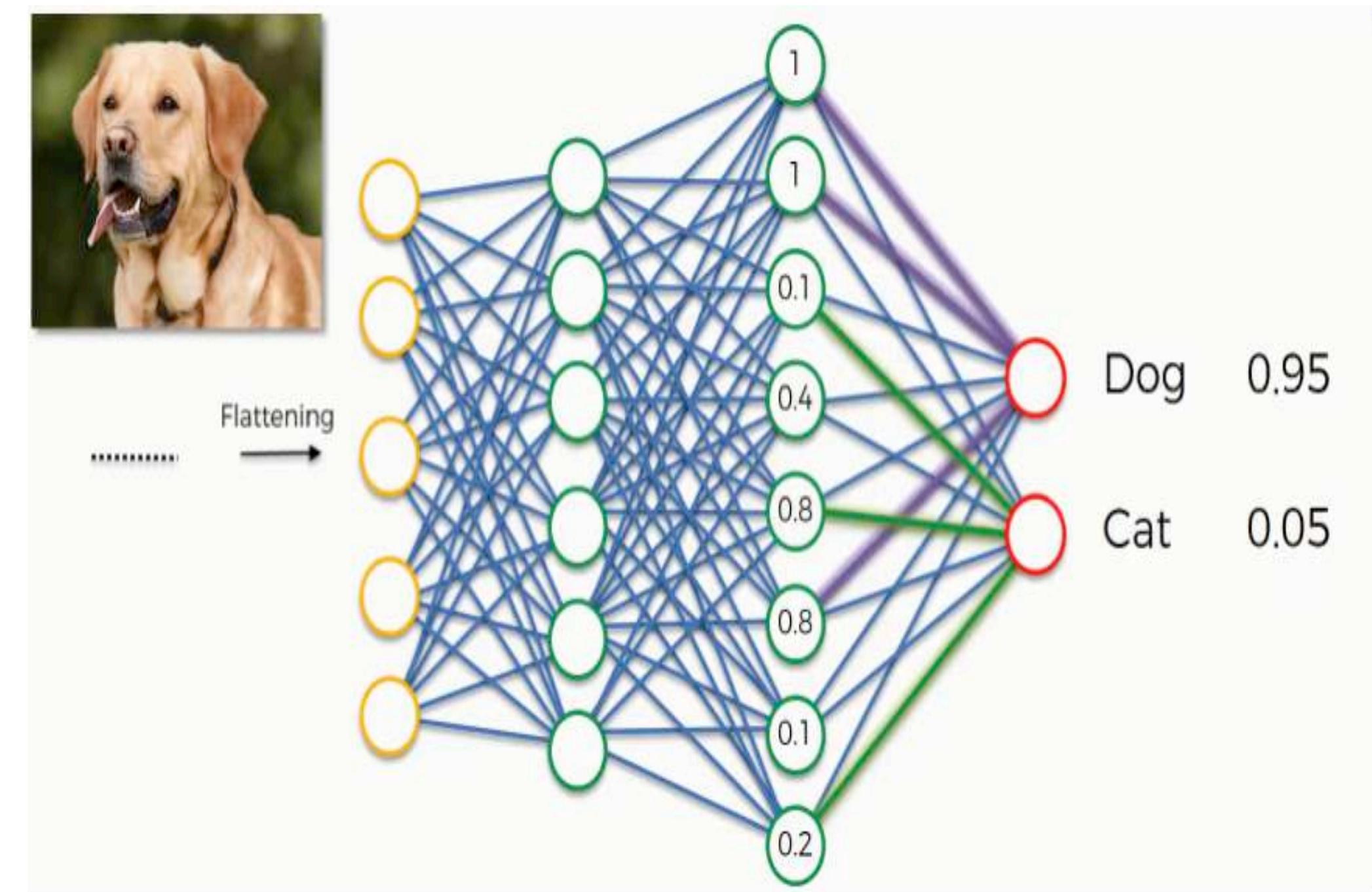
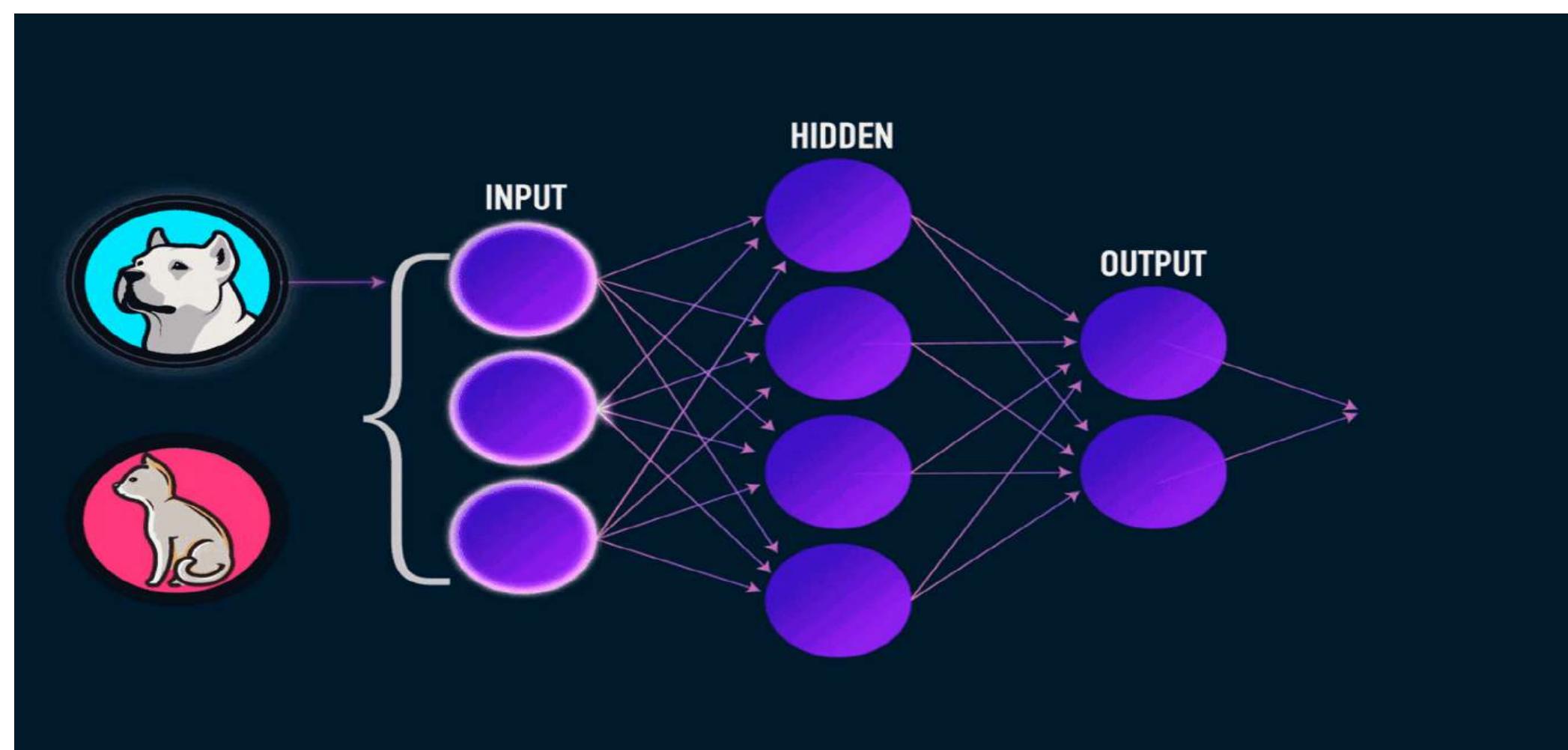
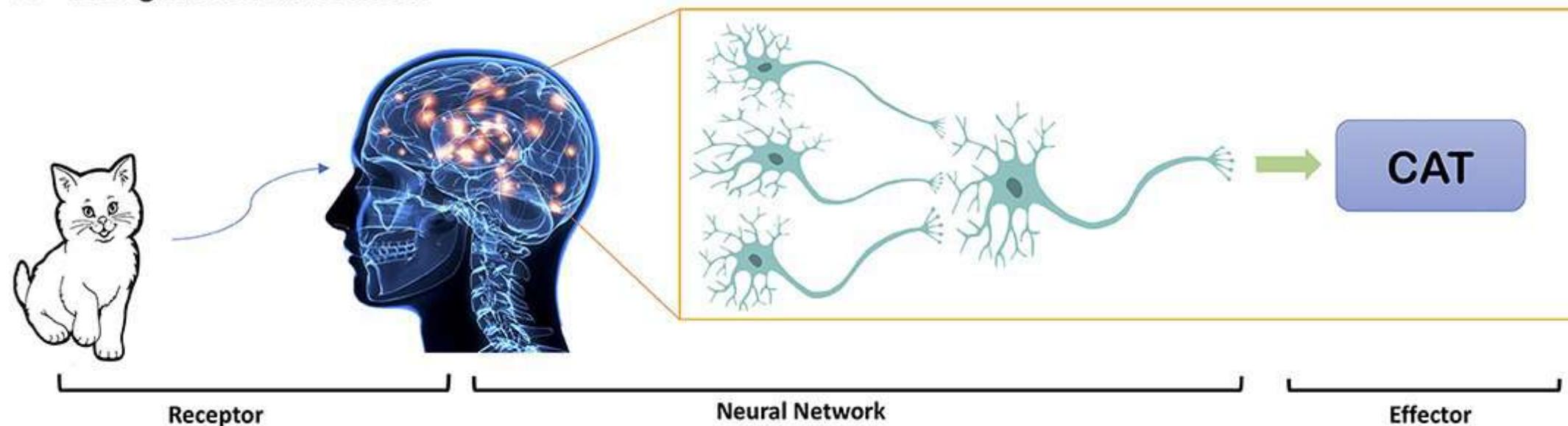


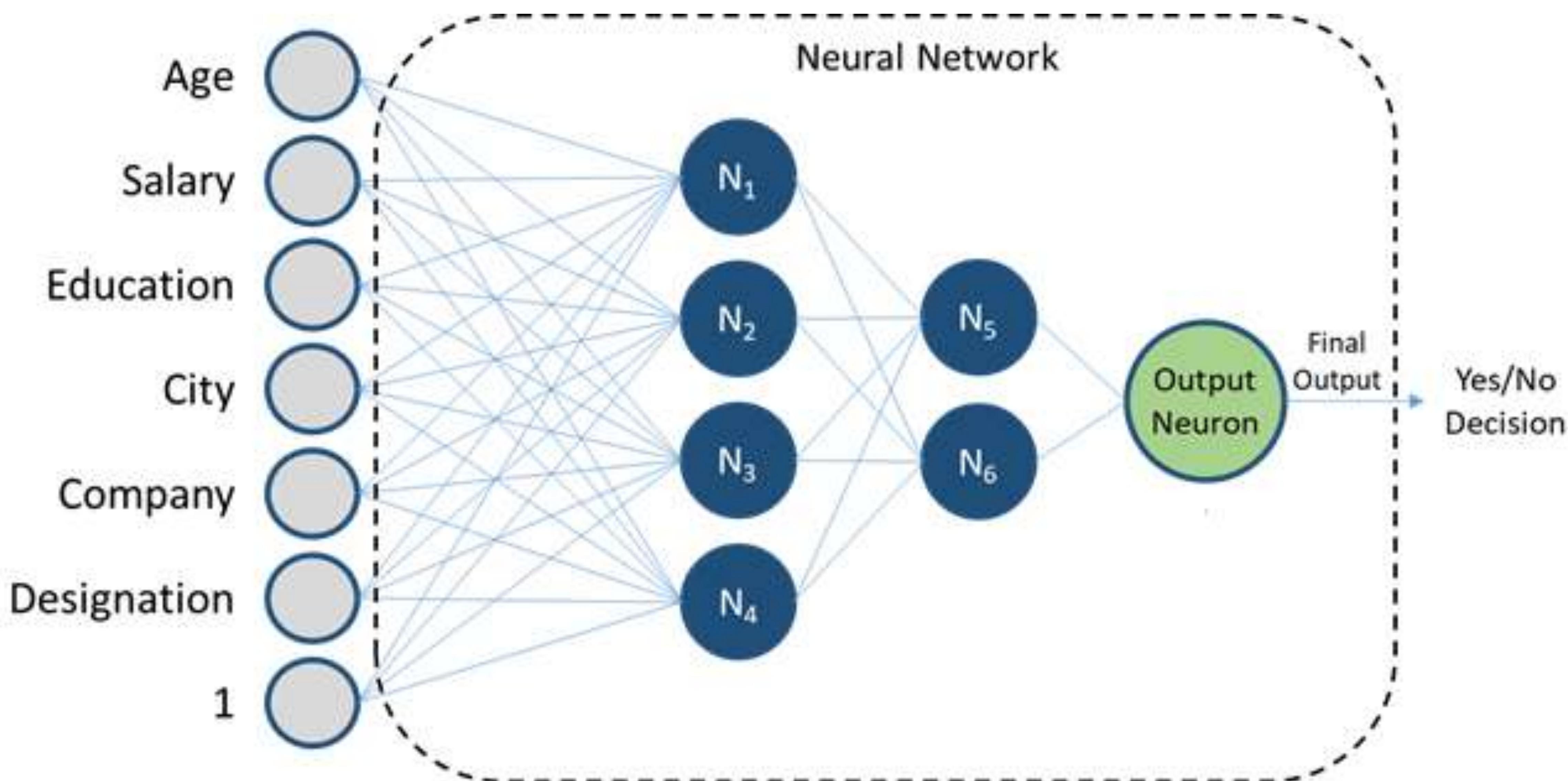
The explosion of Deep Learning

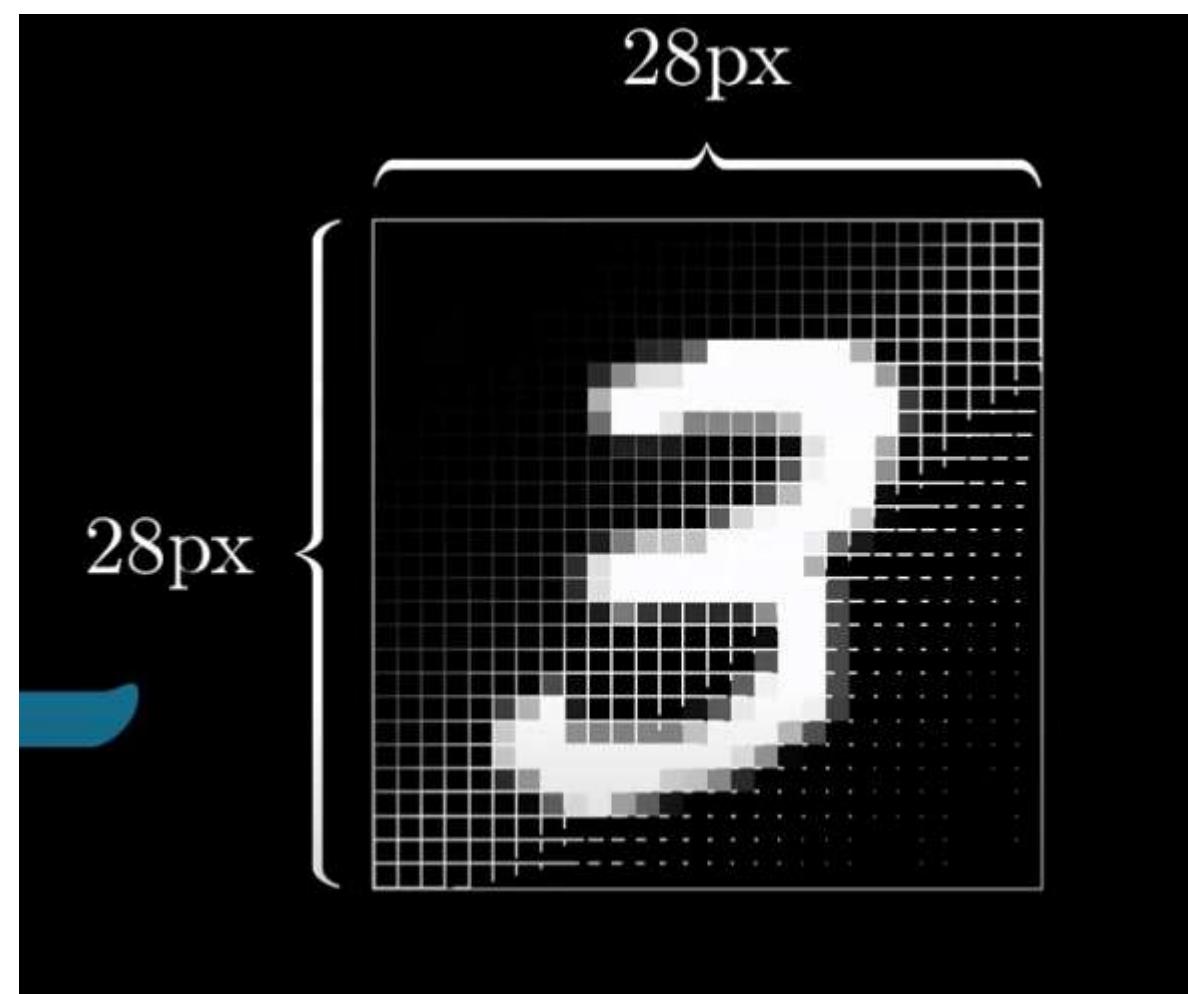


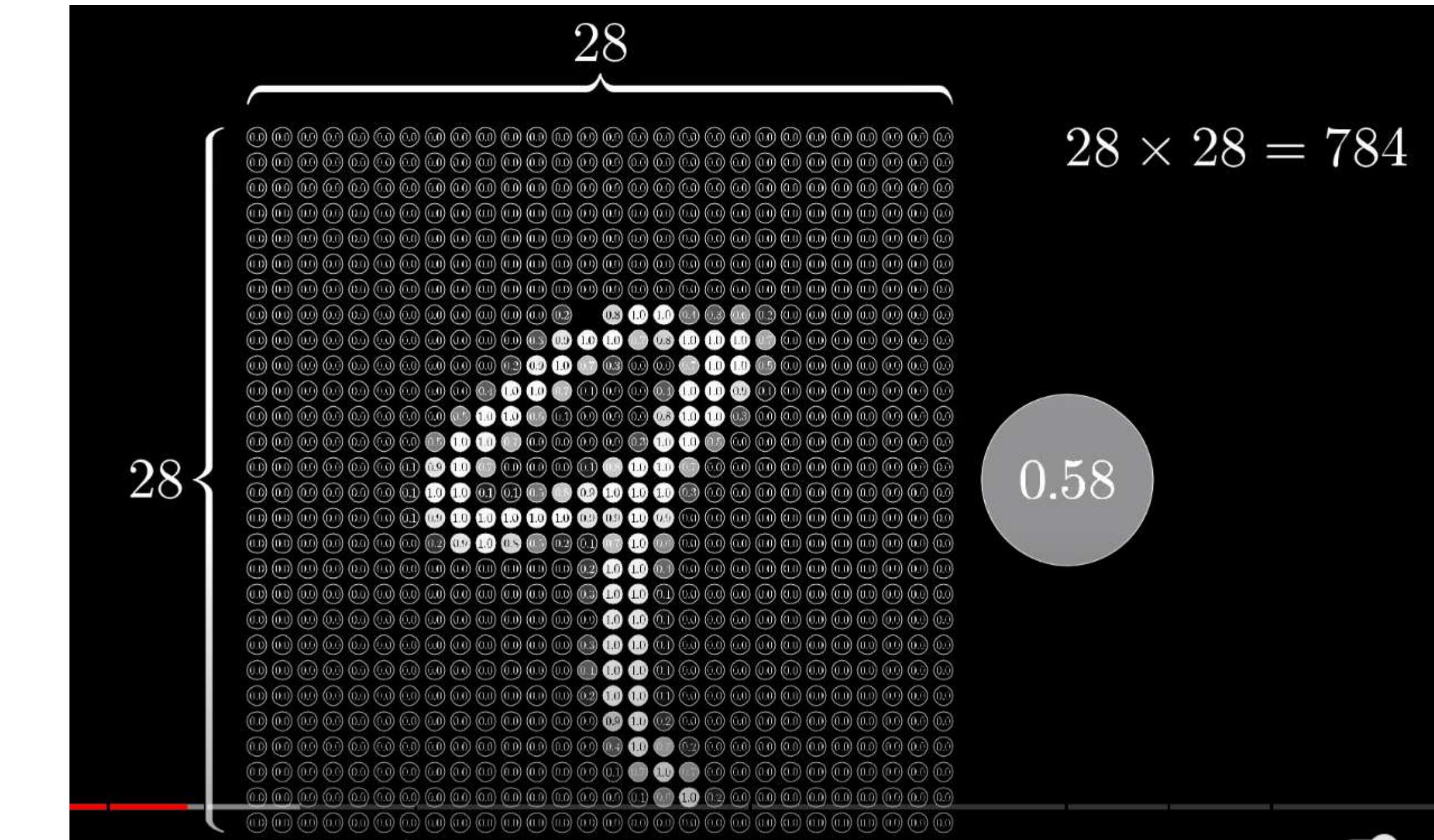
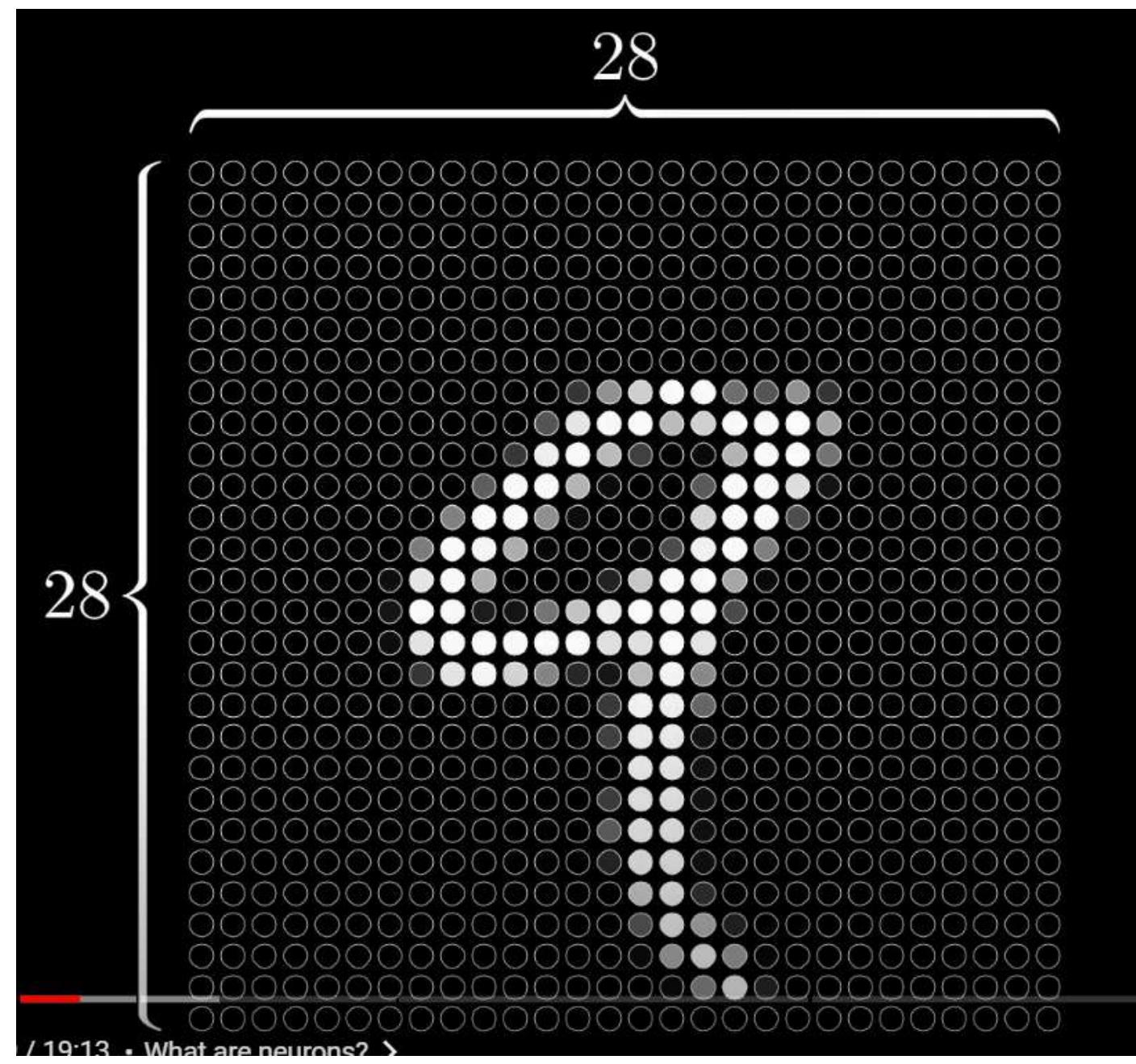
What is Deep Learning?

A Biological Neural Network



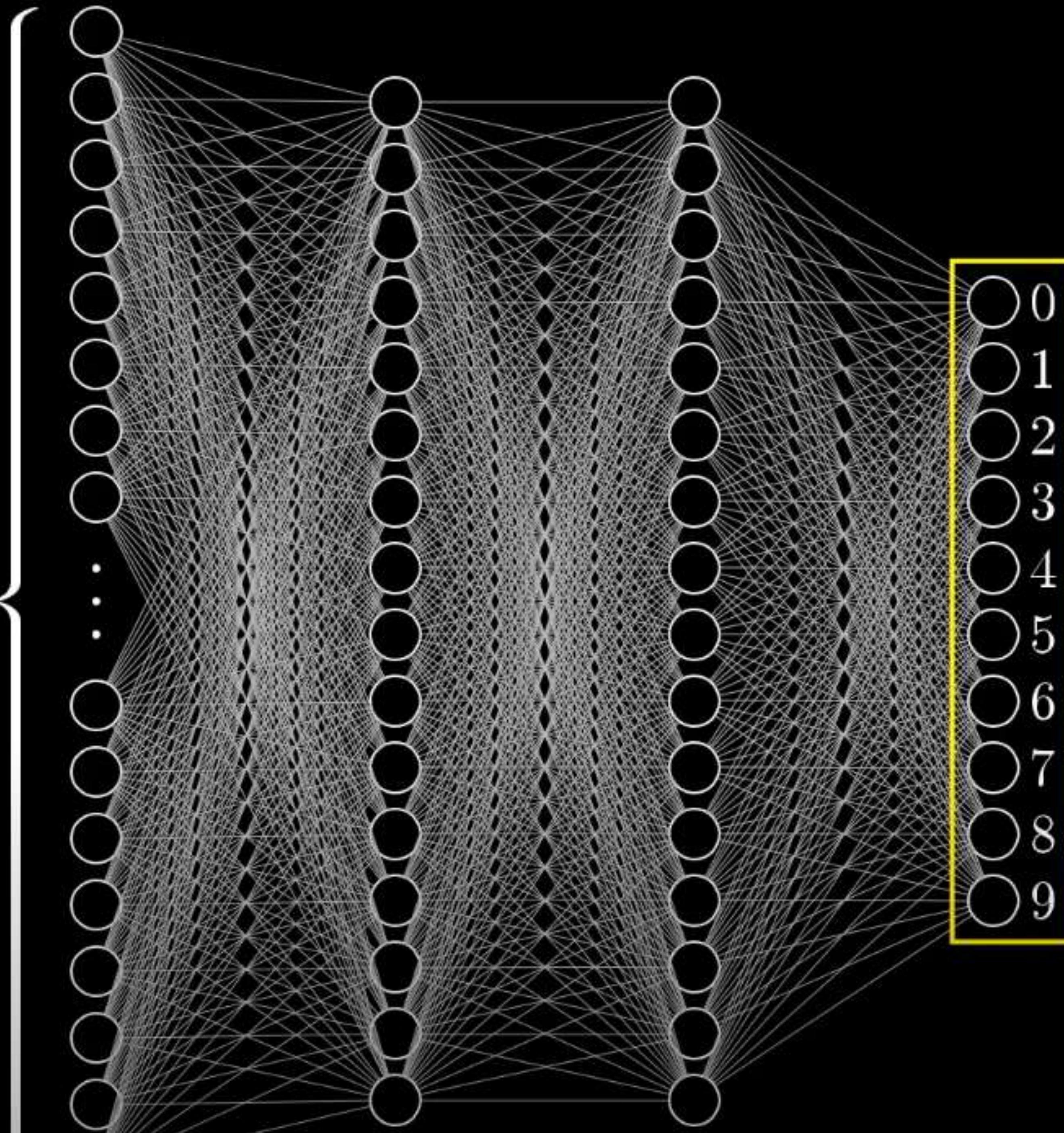






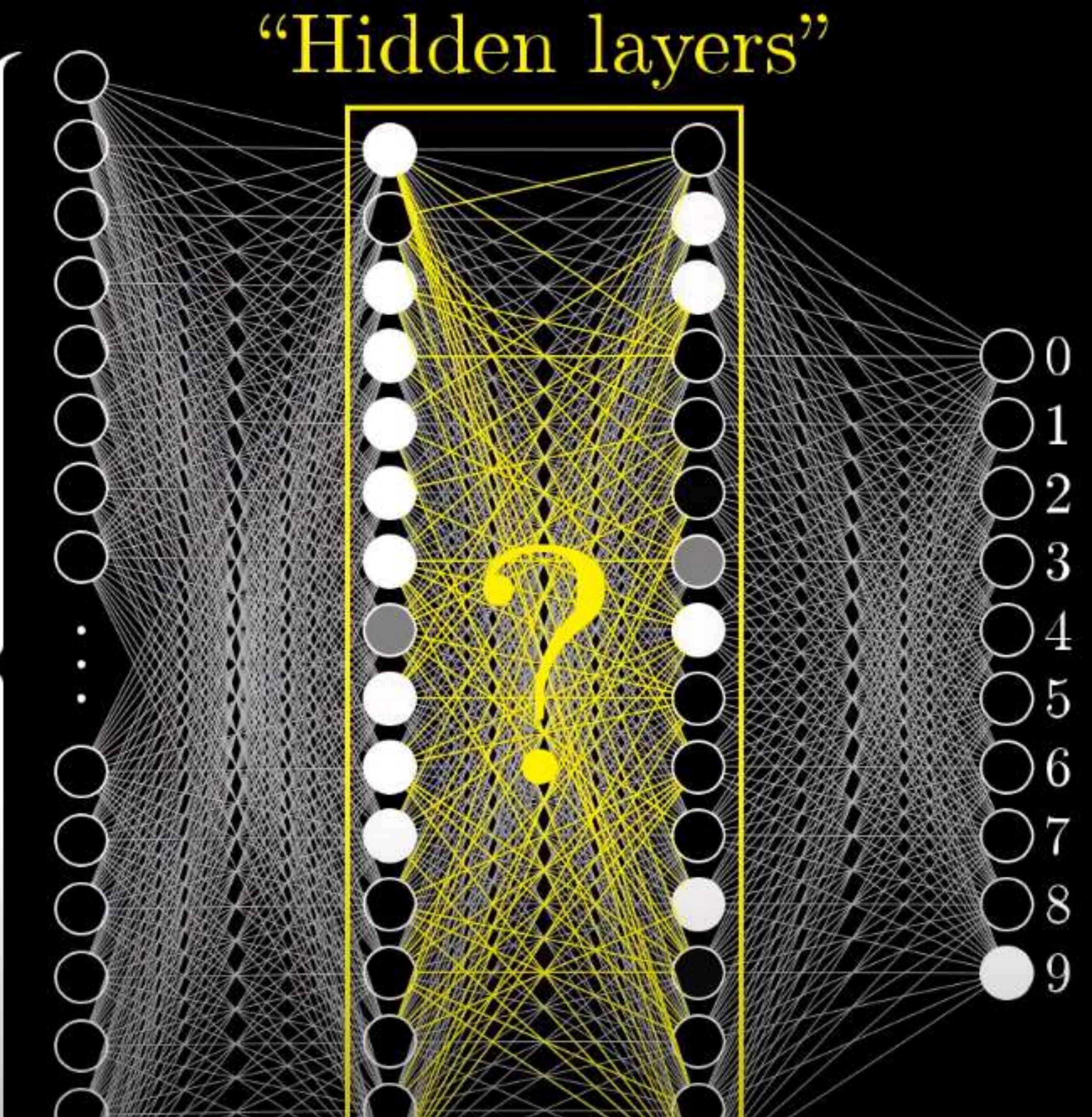


784



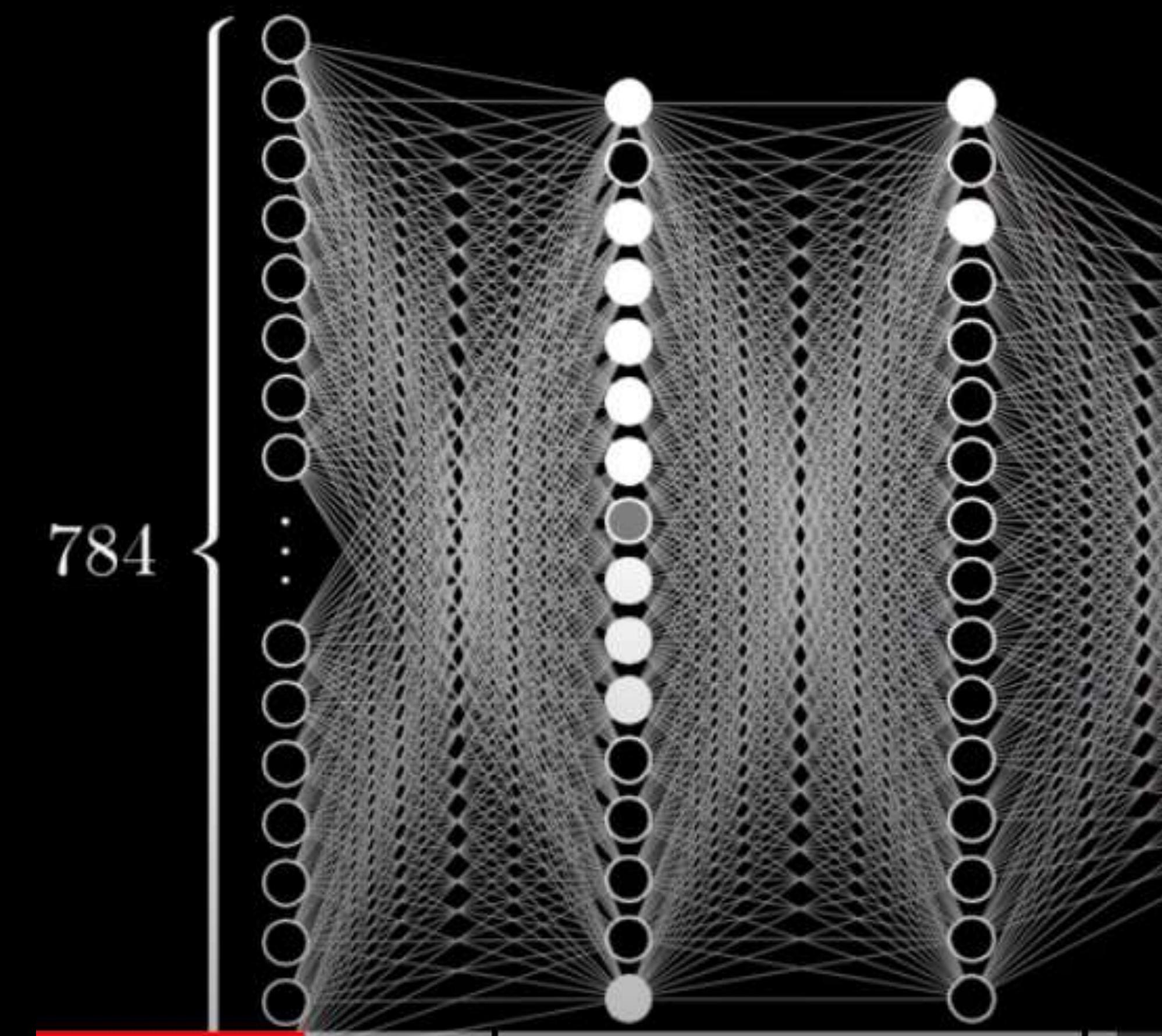


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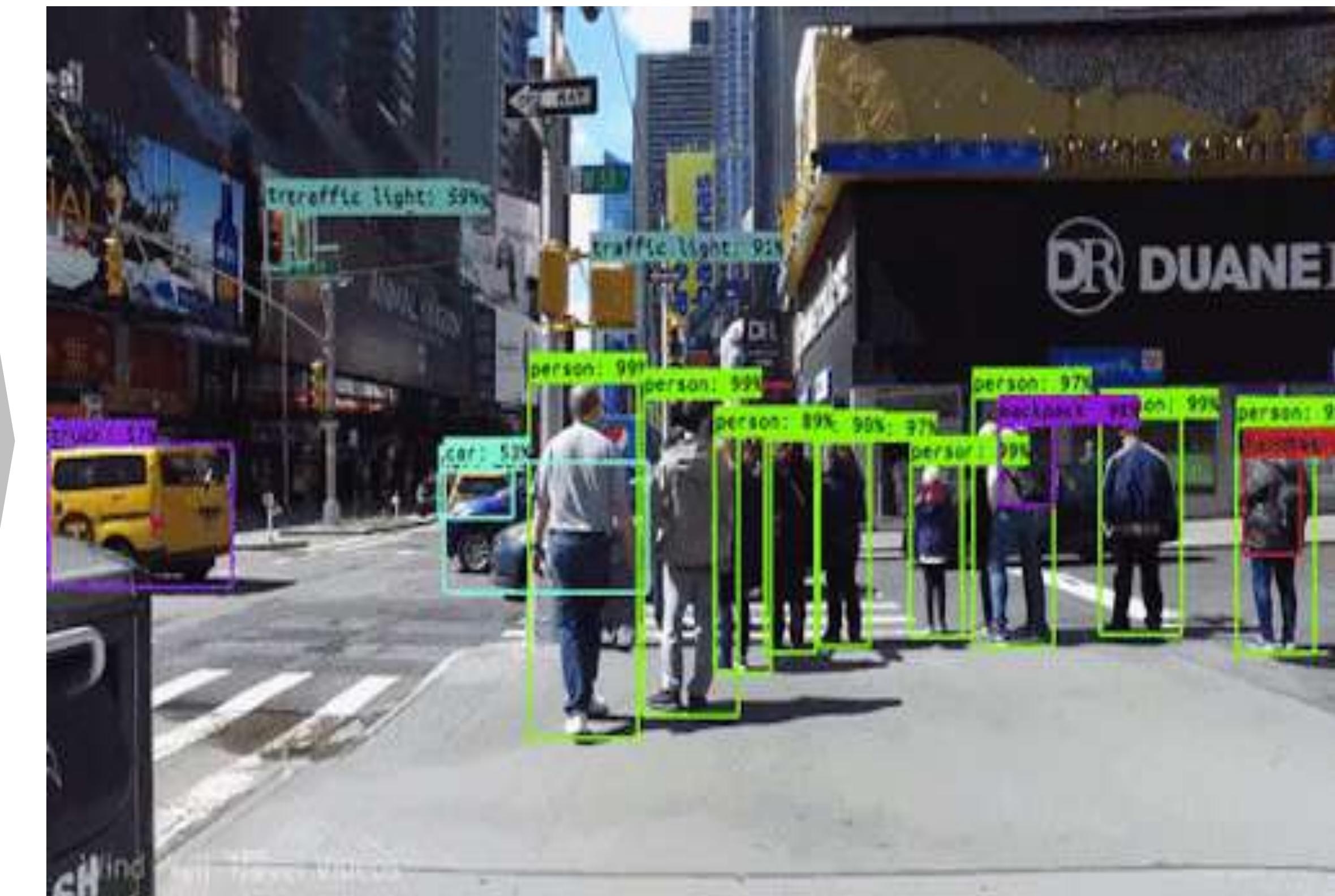
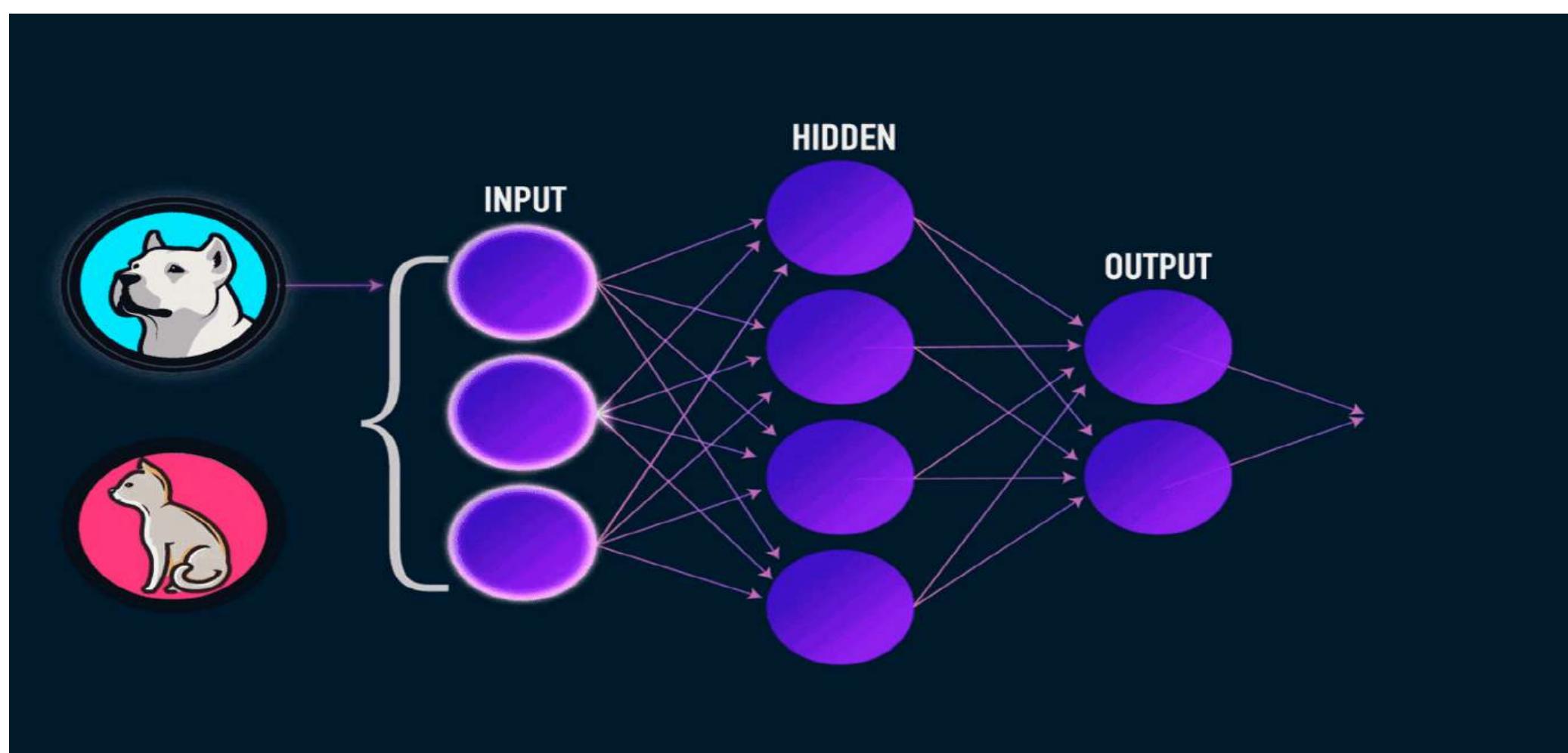
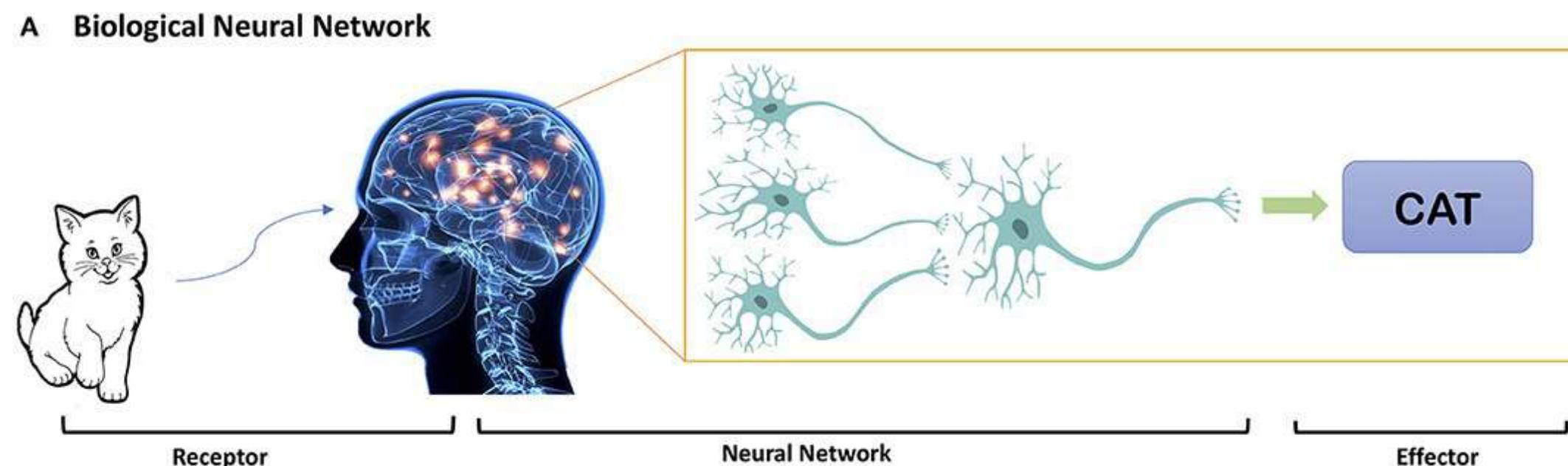




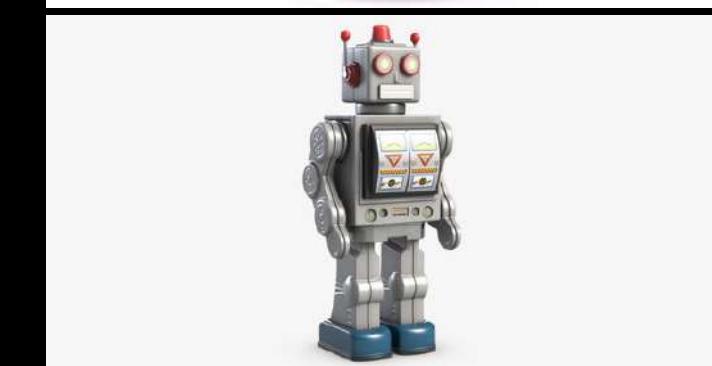
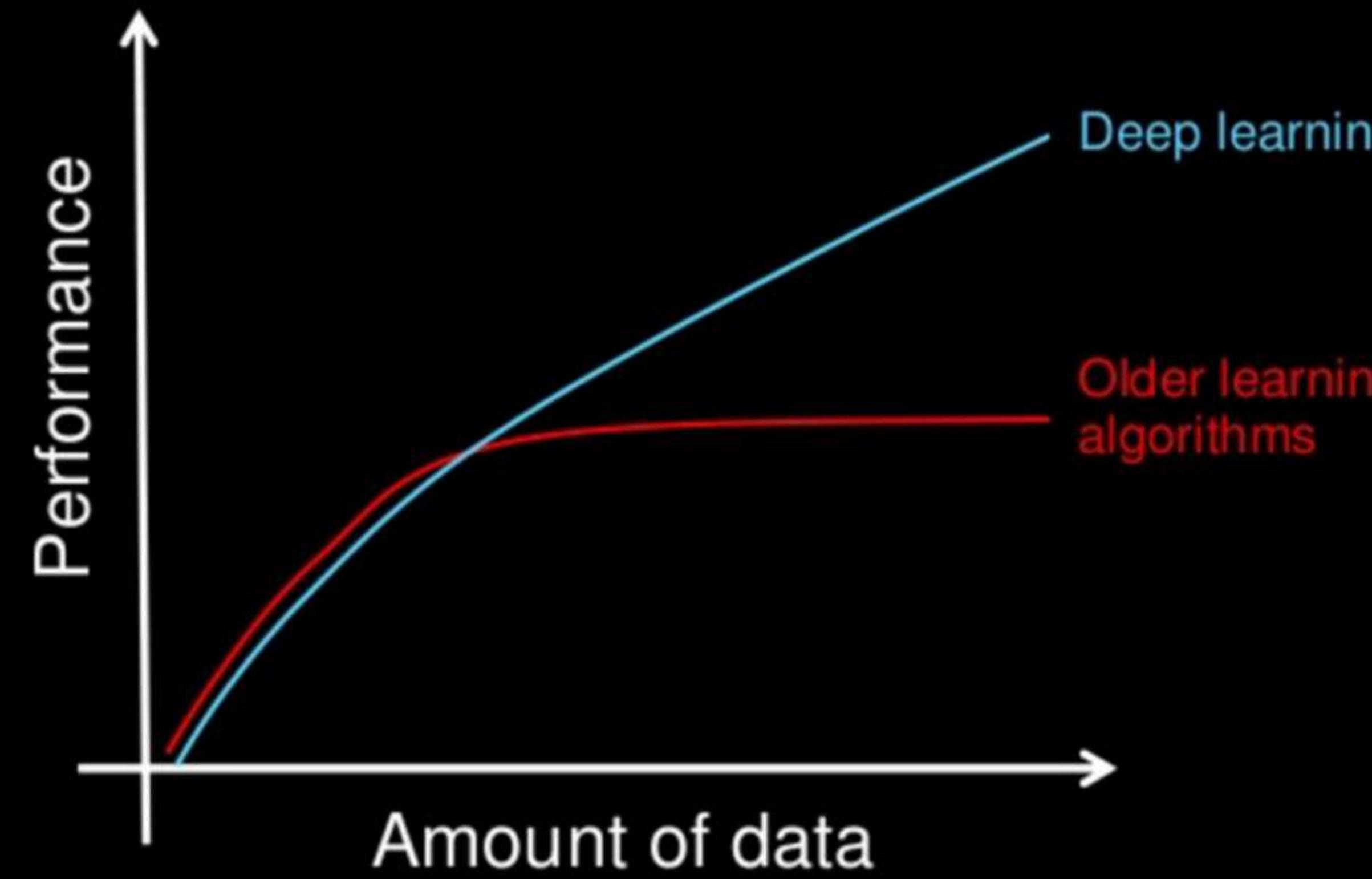
$$\begin{aligned} q &= \text{digit} + \text{noise} \\ g &= \text{digit} + \text{noise} \end{aligned}$$



What is Deep Learning?

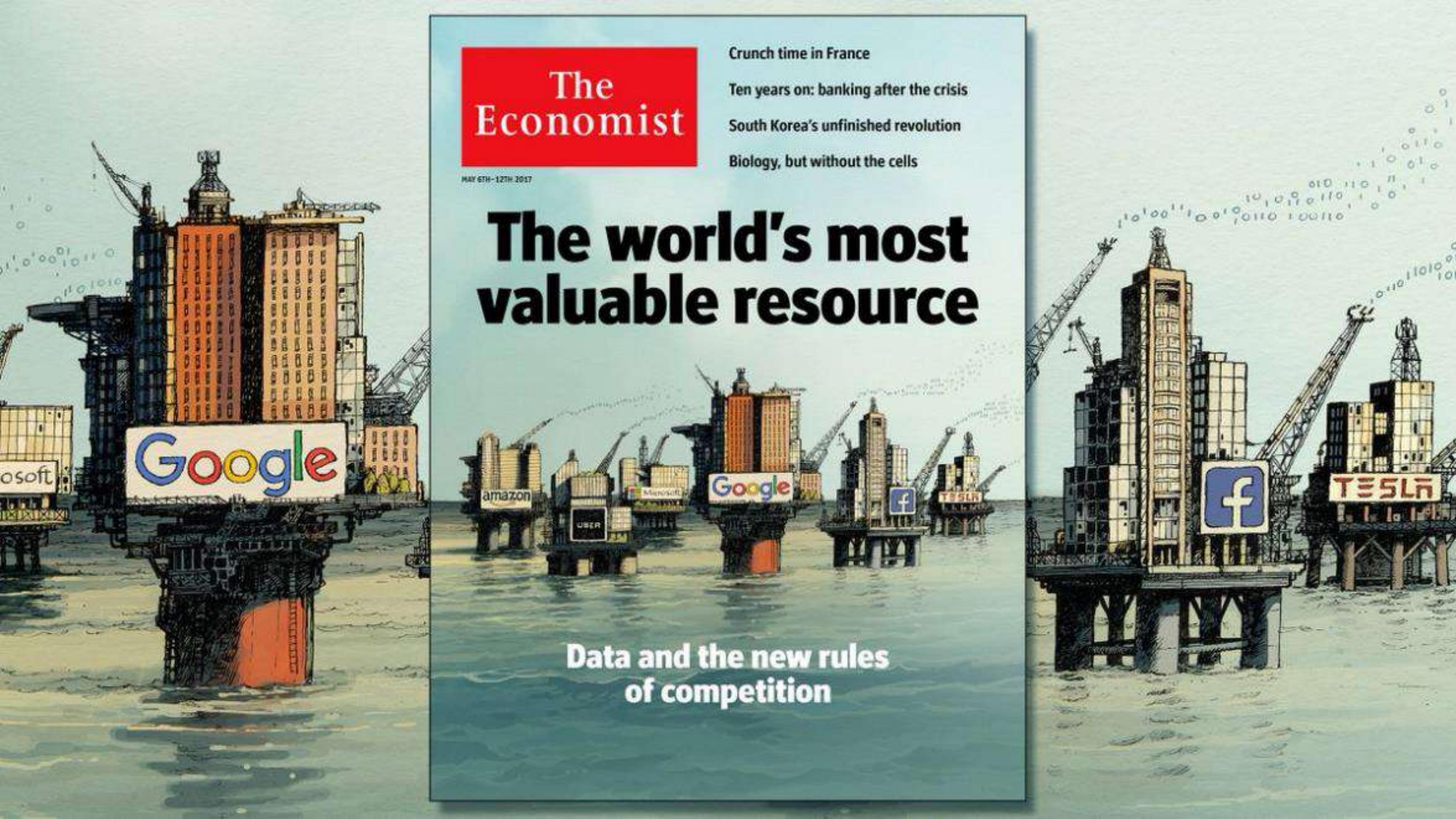


Water is to electricity what data is to deep learning



Why is Relevant?





The Economist

MAY 6TH-12TH 2017

Crunch time in France

Ten years on: banking after the crisis

South Korea's unfinished revolution

Biology, but without the cells

The world's most valuable resource

Data and the new rules
of competition

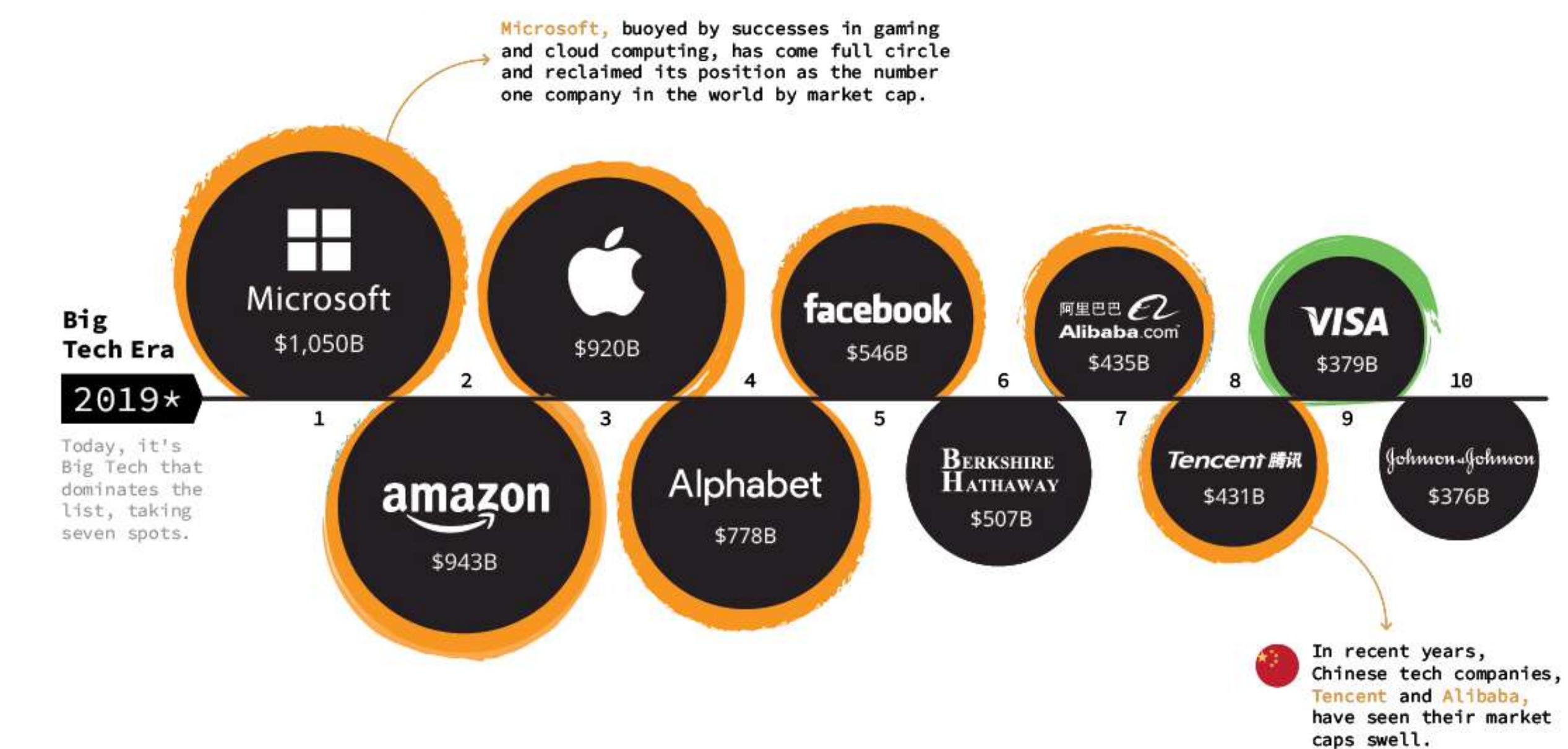
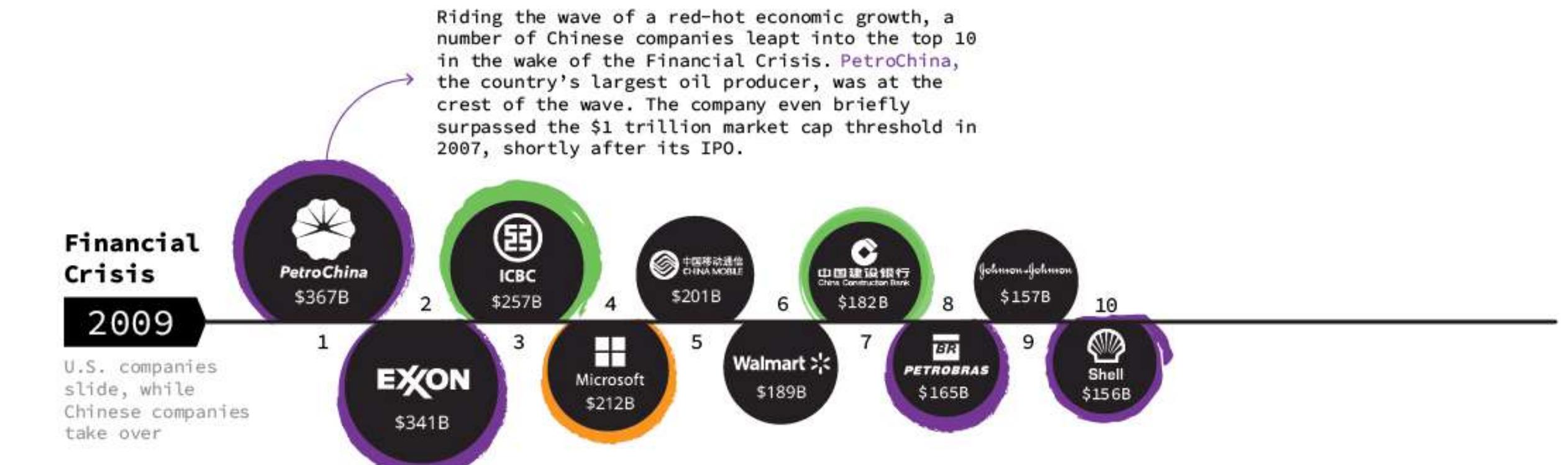
**Banking
Industry
Leisure
Retail
Telco
Media
Energy
Travel**

THE WAR OF THE WORLDS



Google
Amazon
Apple
Airbnb
Netflix
Uber

The 5 companies
with the largest
market capitalization
in the world are also
the companies
leading the
investment in and
development of AI



AI Research availability

Hypercompetitive business models

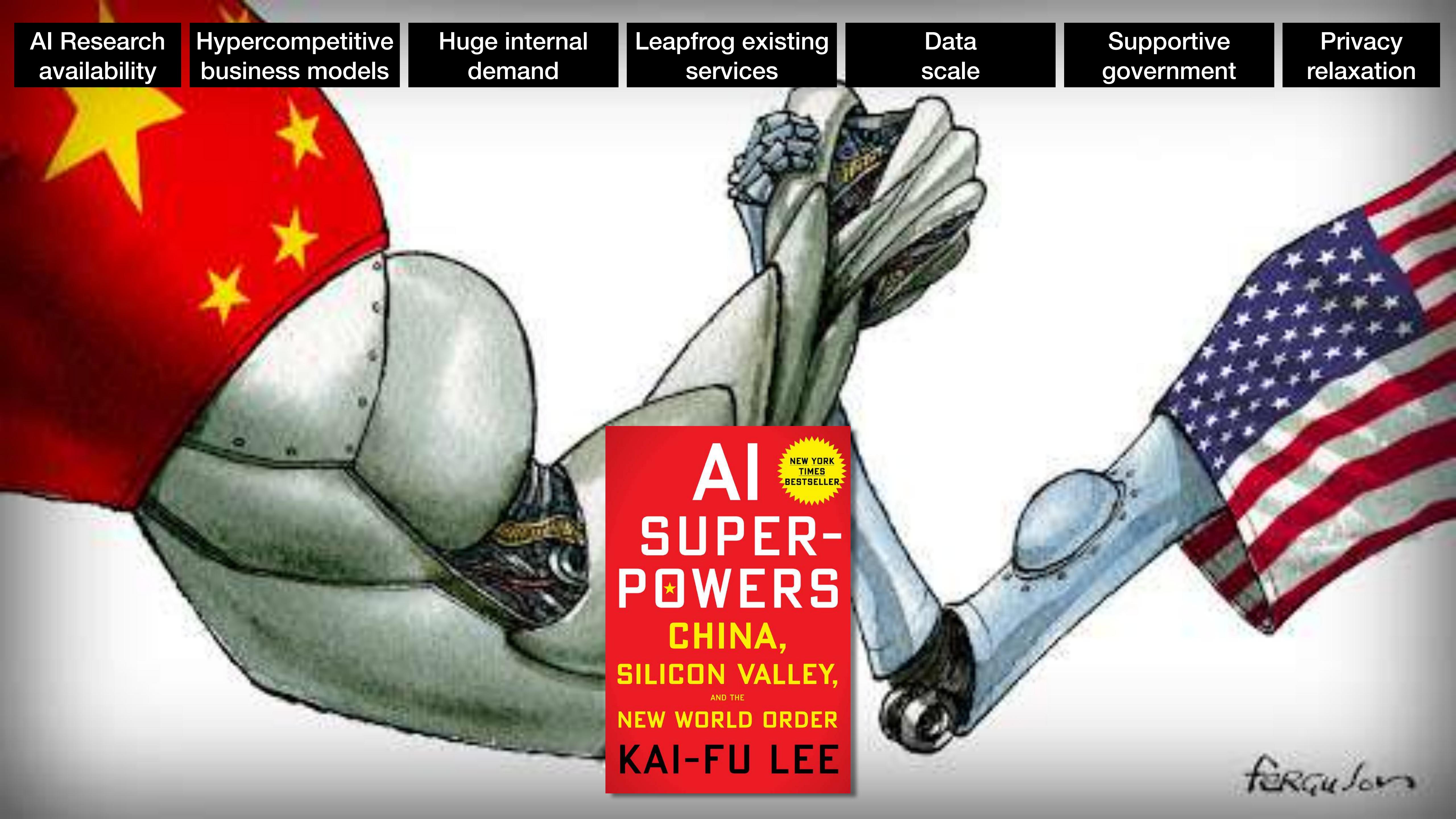
Huge internal demand

Leapfrog existing services

Data scale

Supportive government

Privacy relaxation



ferguson



Artificial intelligence,
robotics and other innovations
must contribute to the
service of humanity.

Pope Francis
Message to the World Economic Forum
Annual Meeting 2018

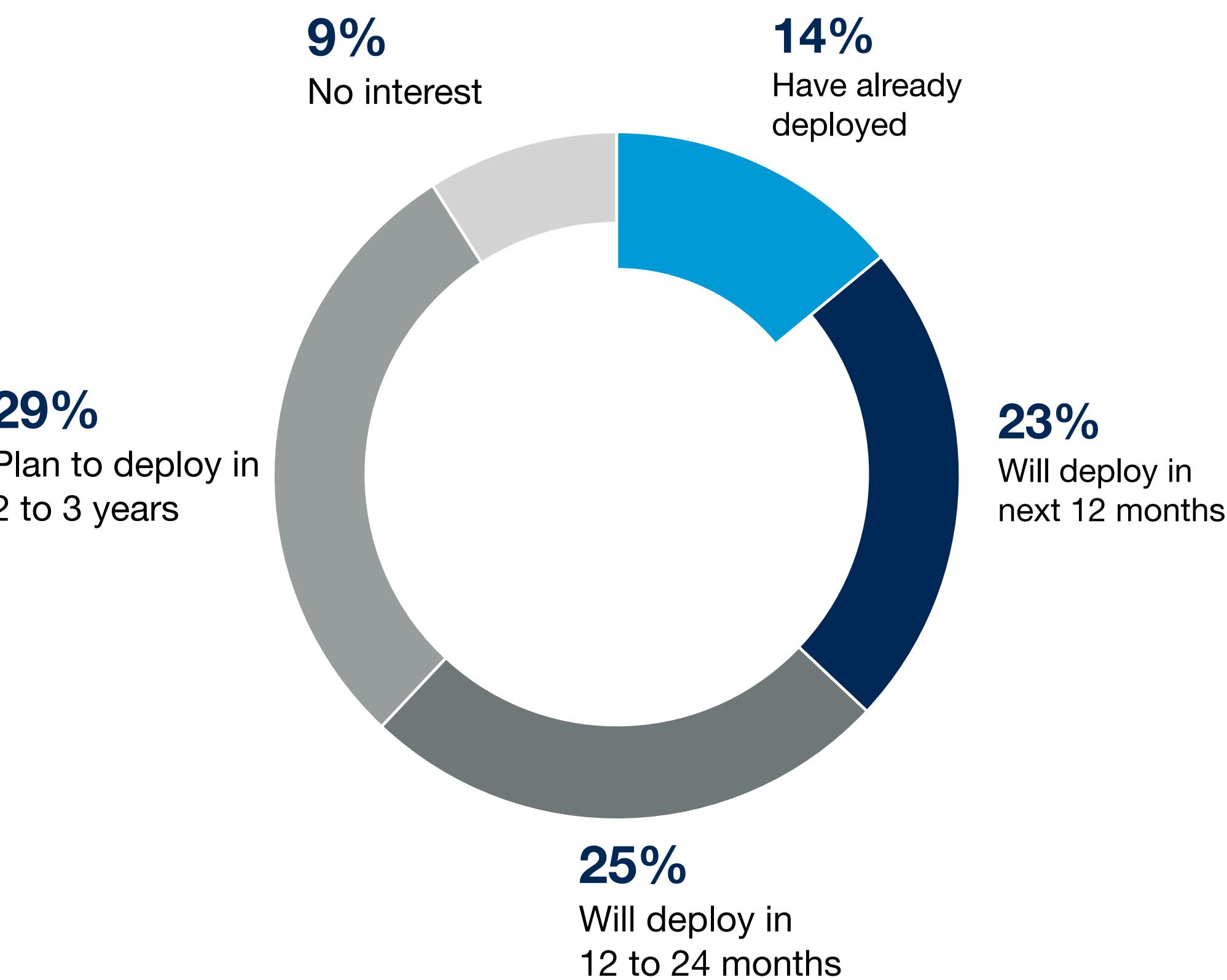
What are the challenges?



2018: CIOs Are Switching on to Artificial Intelligence

Q: What are your organization's plans in terms of artificial intelligence?

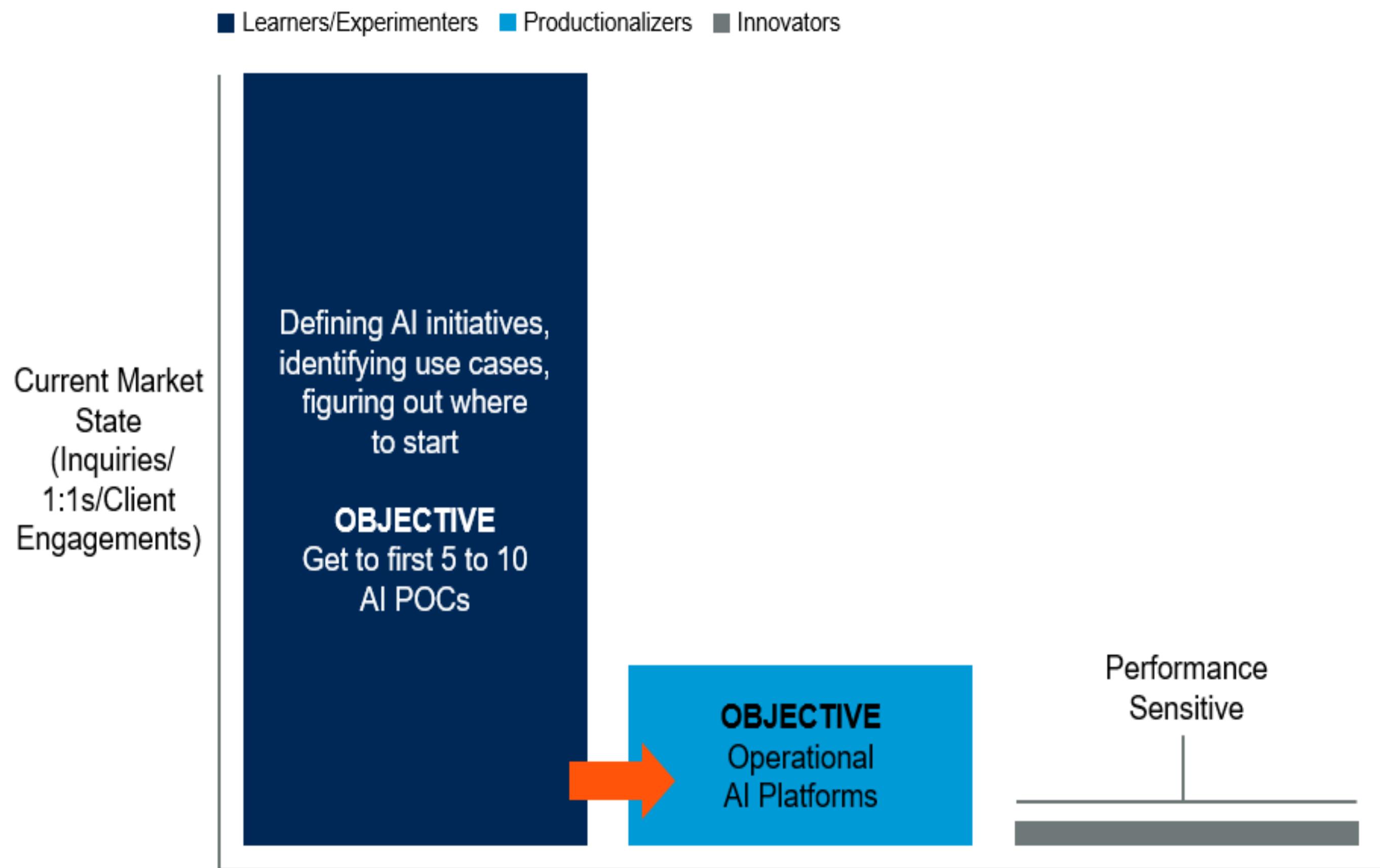
Percentage of Respondents



Base: All Answering, n = 2,882

Most organisations are just experimenting with AI

Current State of AI Implementations



Source: Gartner (November 2019)

ID: 387677

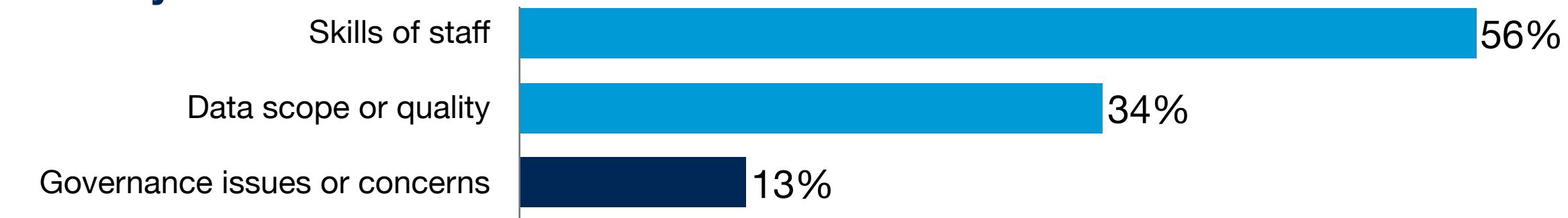
- Organisations have gone from **experimenting with ML and AI** back in 2017 to **productising and deploying AI-based systems in production**
- The percentage of enterprises that have deployed AI has **grown from 4% in 2018 to 14% in 2019**, according to Gartner's annual CIO surveys. This near quadrupling of implementations indicates that AI as an emerging technology is already delivering significant results.
- Figure 2 represents the current state of the market as observed through client engagements and inquiries at Gartner. As shown in the graphic, a **significant number of organisations** are in the **initial learning/experimenting phase** and **struggling to productise AI implementations**.
- It is all due to the **lack of operationalisation** of the **machine learning development life cycle** which is the **core for delivering AI solutions**

Top Hurdles:
Skills of staff,
followed by
understanding
the benefits/
uses when it
comes to the
adoption of AI
and ML

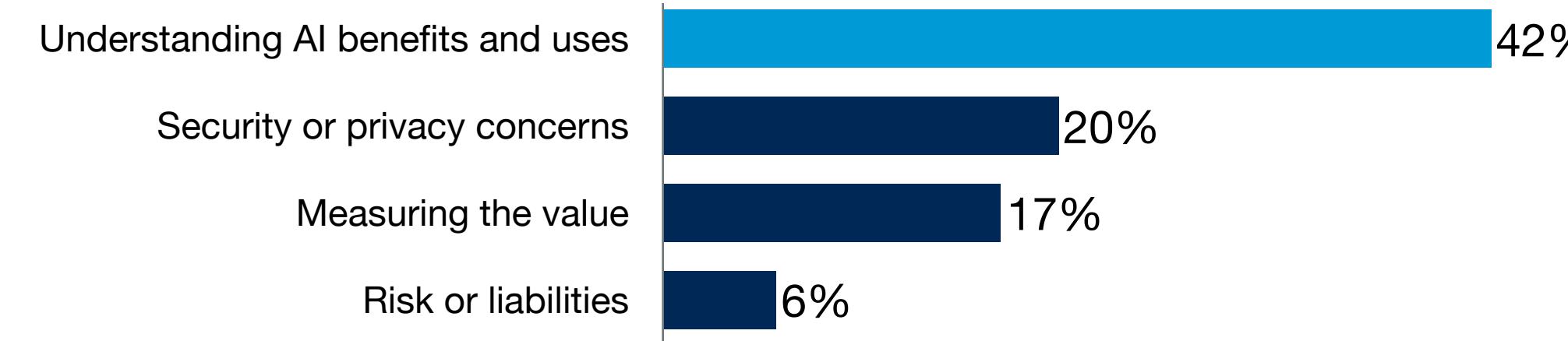
Top 3 Challenges to AI/ML Adoption

Sum of 1-3 rank

Enterprise maturity



Fear of unknown



Finding a starting point



Vendor strategy



Percentage of Respondents

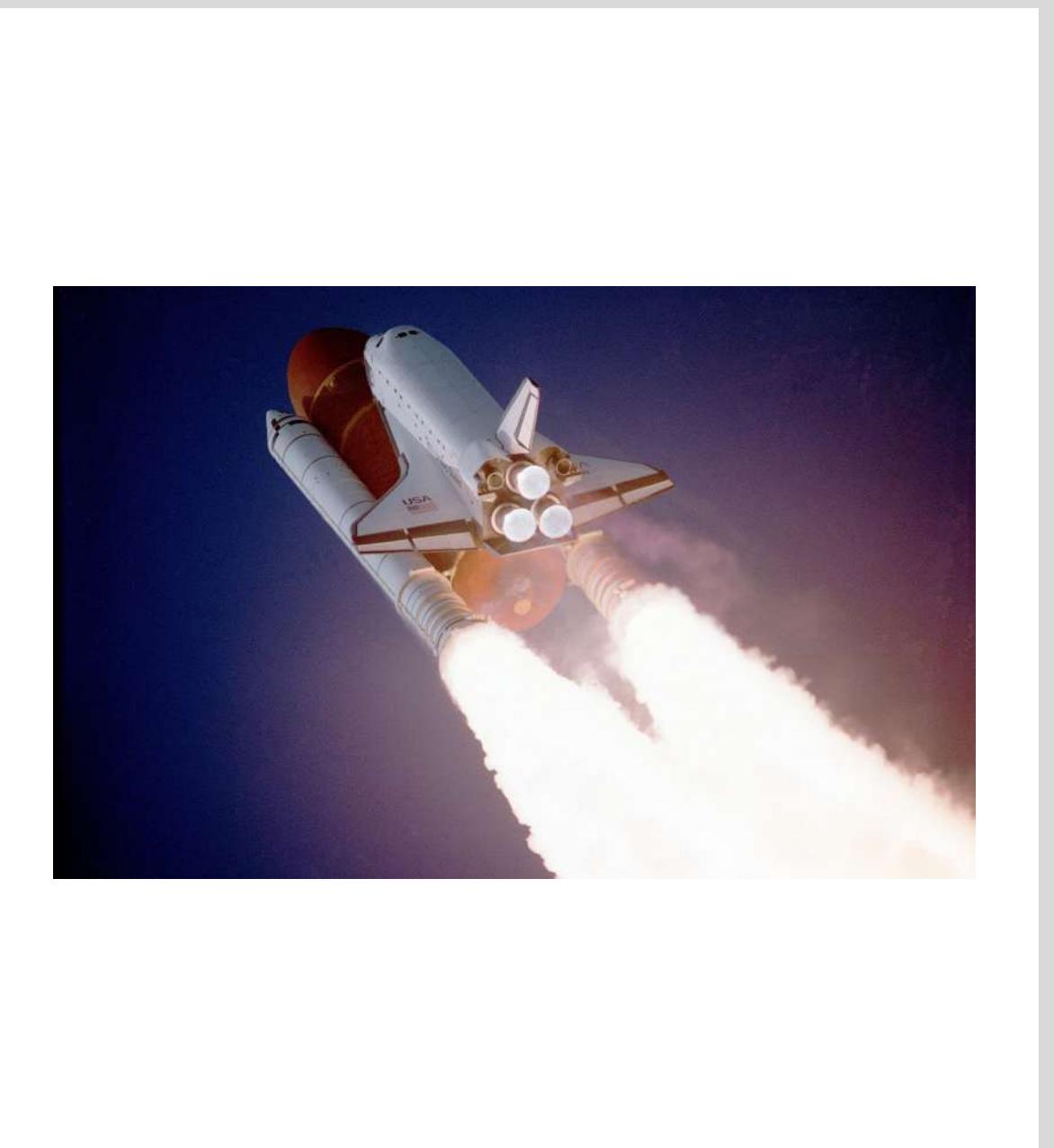
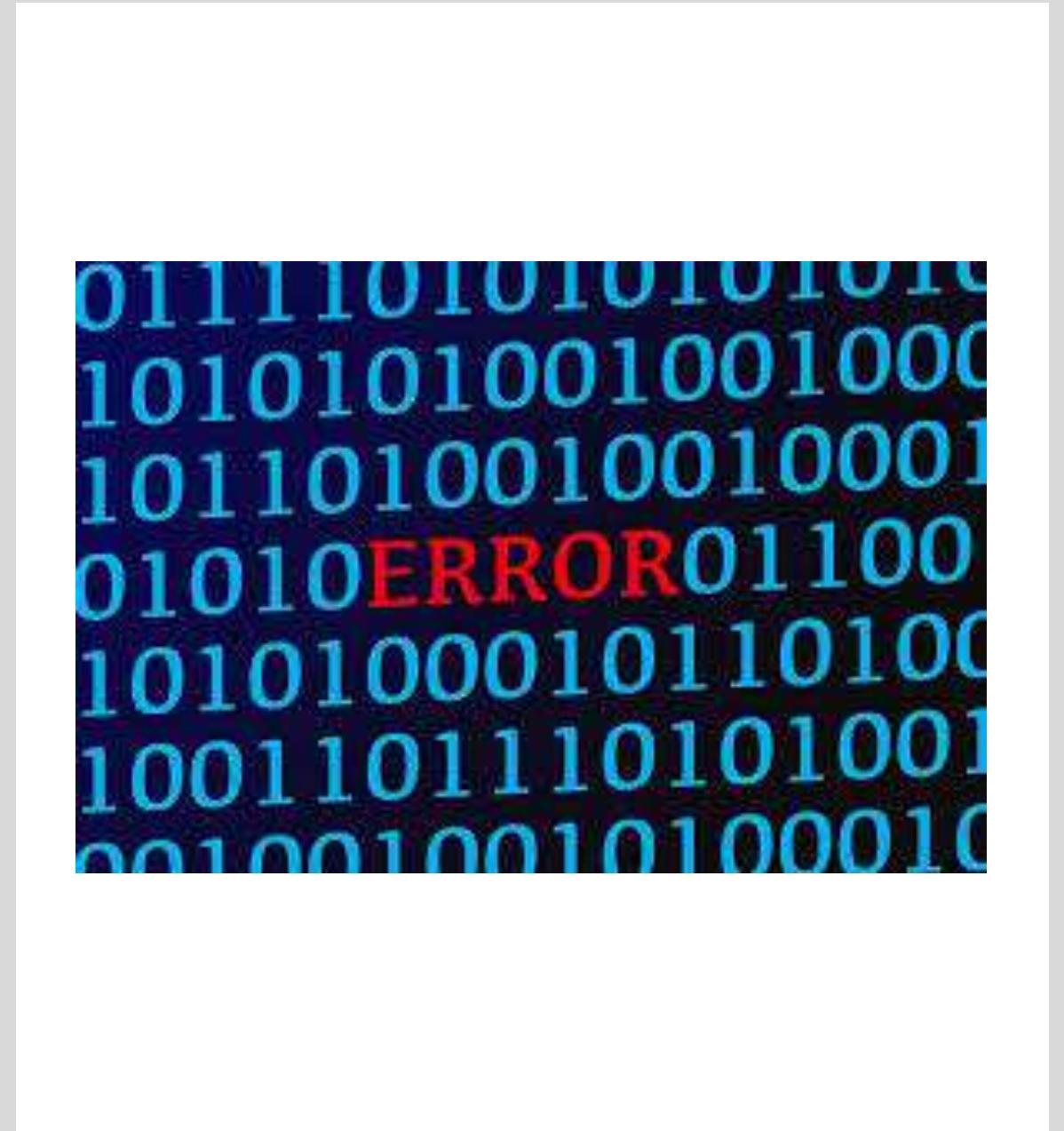
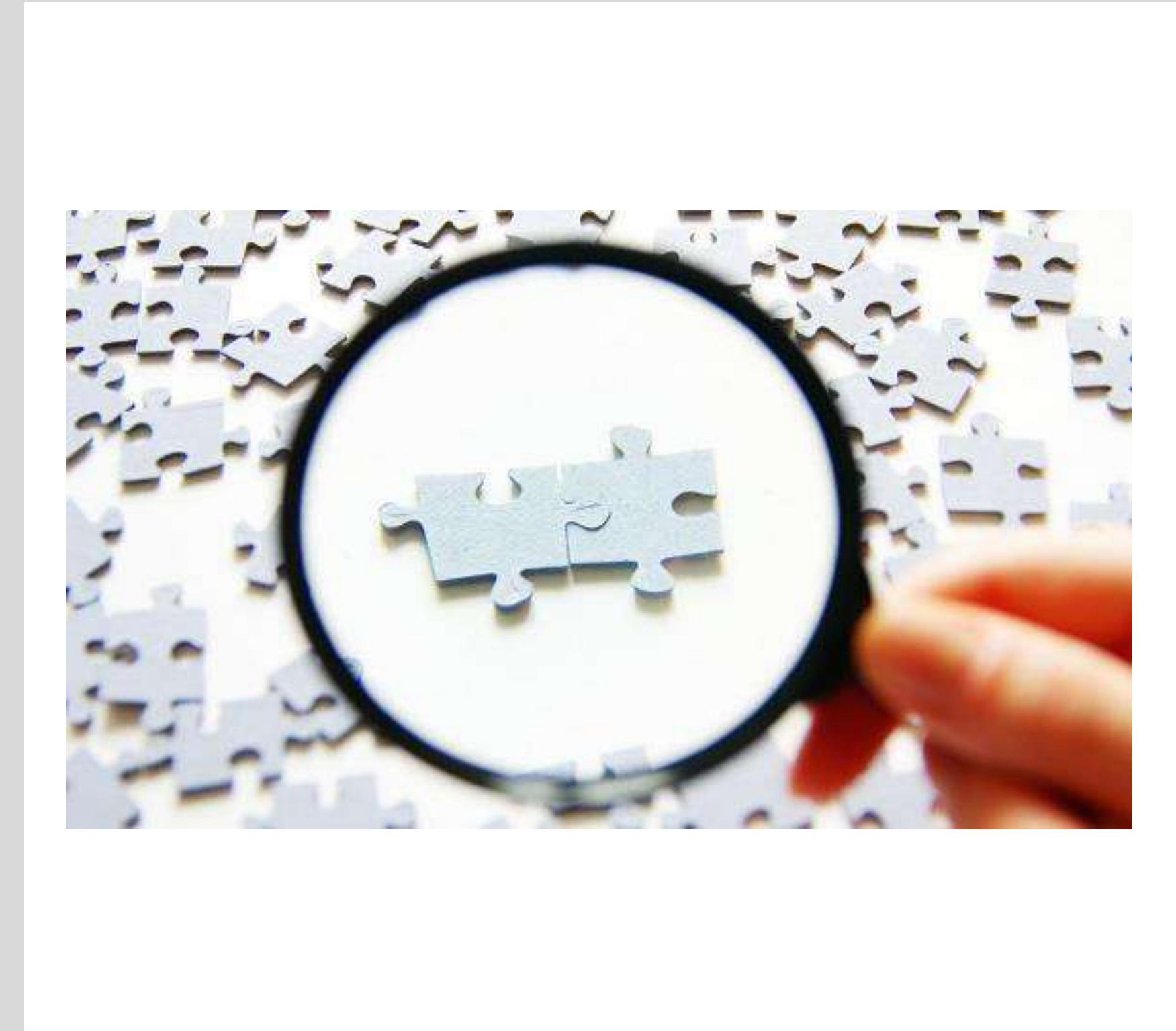
Base: n = 106 Gartner Research Circle Members; excluding "not sure"

Q. What are the top 3 challenges or barriers to the adoption of AI and ML within your organization? Please rank up to 3.

Why?

The most common challenges faced by technical professionals on executing an AI strategy are:

- **identifying value**
- access to good quality **data**
- sourcing **staff** and skills sets
- **industrializing** the deployment of AI models into business workflow



AI STRATEGY FRAMEWORK

AI VALUE

AI OPERATIONS

AI CULTURE

1	Business Impact	I. Experimenting II. Piloting III. Escaling IV. Transforming	4	Data Platform	I. Datawarehouse II. Data Lake III. Lake House IV. Beyond state of Art	7	Organization	I. Decentraliced II. Centraliced (HuB) III. Hub & Spoke IV. Holystic
2	AI Maturity	I. Descriptive II. Predictive III. Prescriptive IV. Autonomous	5	Data Governance	I. No Governance II. Partial Governance III. Full Governance IV. AI driven Govern.	8	Skills	I. No Skills II. Few Experts III. Re/Up Skilling IV. CitizenDatascientists
3	Ethics	I. Framework II. Principles III. Tools IV. Ethics Board	6	ML OPS	I. Craft Process II. ML Deploy OPS III. Total ML OPS IV. AUTO ML for Citizen	9	Sourcing	I. Rent II. Buy III. Build IV. Sell

The **AI strategy** aims to obtain the maximum potential of this technology for our businesses by **solving all the barriers** to its implementation.



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