

Ital-IA 2025

“L’ultima invenzione”: Quale futuro con l’IA?

Roberto Trotta
SISSA & Imperial College London

Image: K. Karchev with Stable Diffusion XL

**Imperial College
London**

SISSA

www.robertotrotta.com
datascience.sissa.it



“La prima macchina ultra-intelligente è l’ultima invenzione che l’umanità dovrà mai fare...”

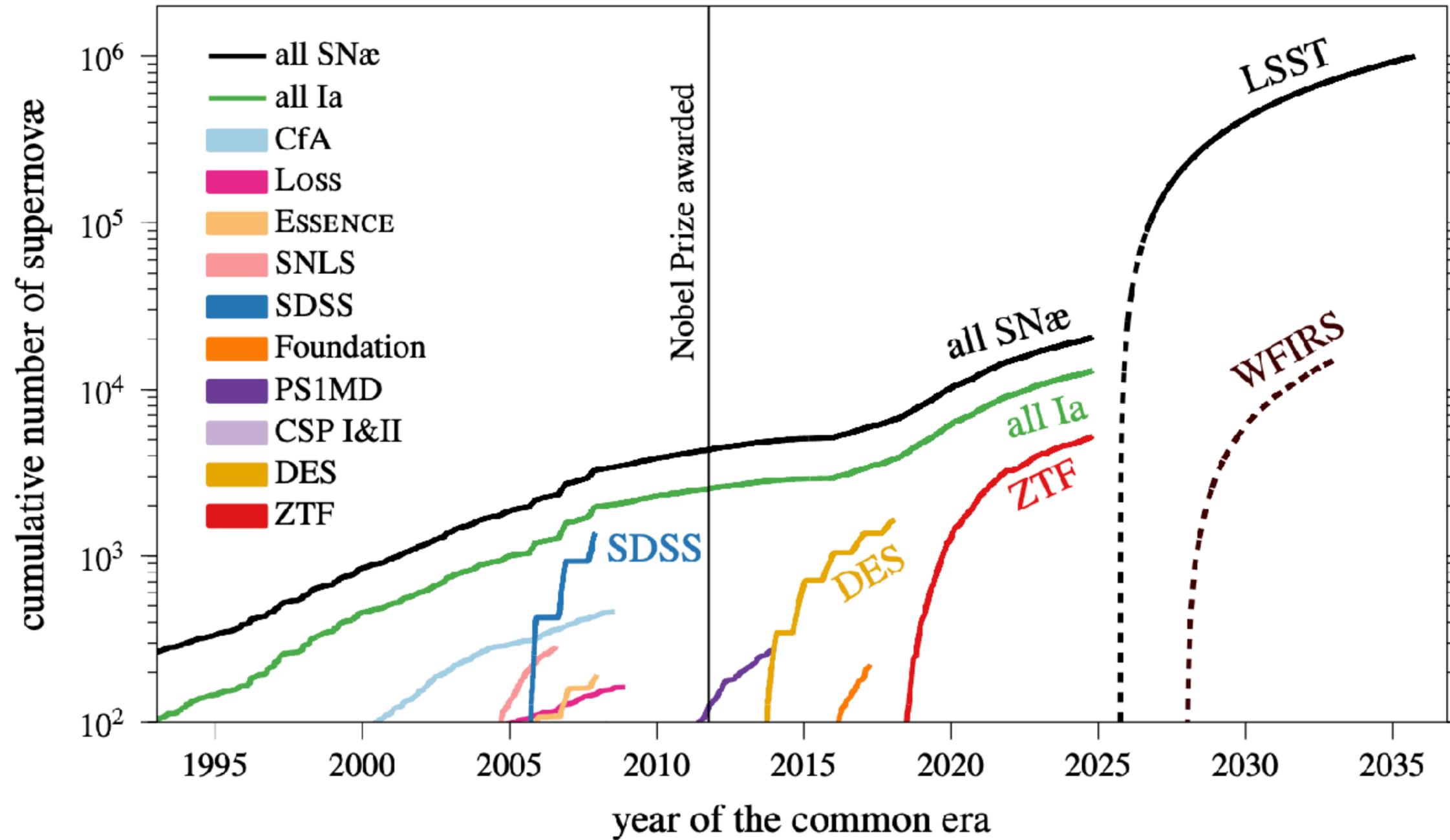
“...sempre che la macchina sia sufficientemente docile da dirci come tenerla sotto controllo”

–Irving John Good (1965)



Credit: the Vera Rubin Observatory

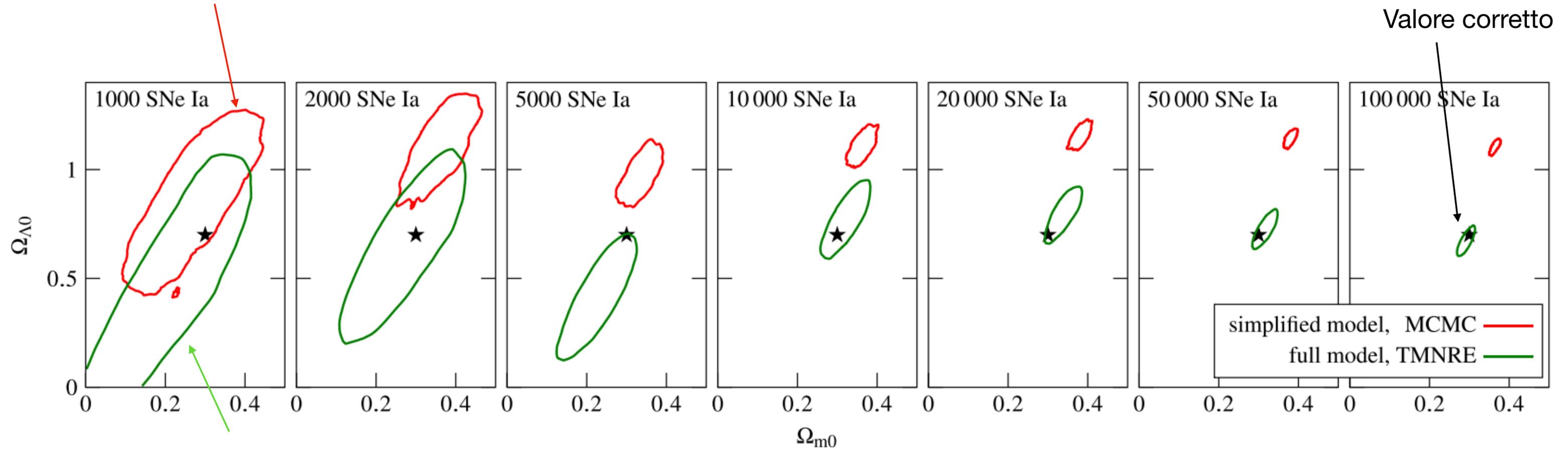
Una valanga di dati



Il prezzo di un'alta precisione

Come fidarci dell'IA quando alternative tradizionali non funzionano?

Modello semplificato (inferenza tradizionale)

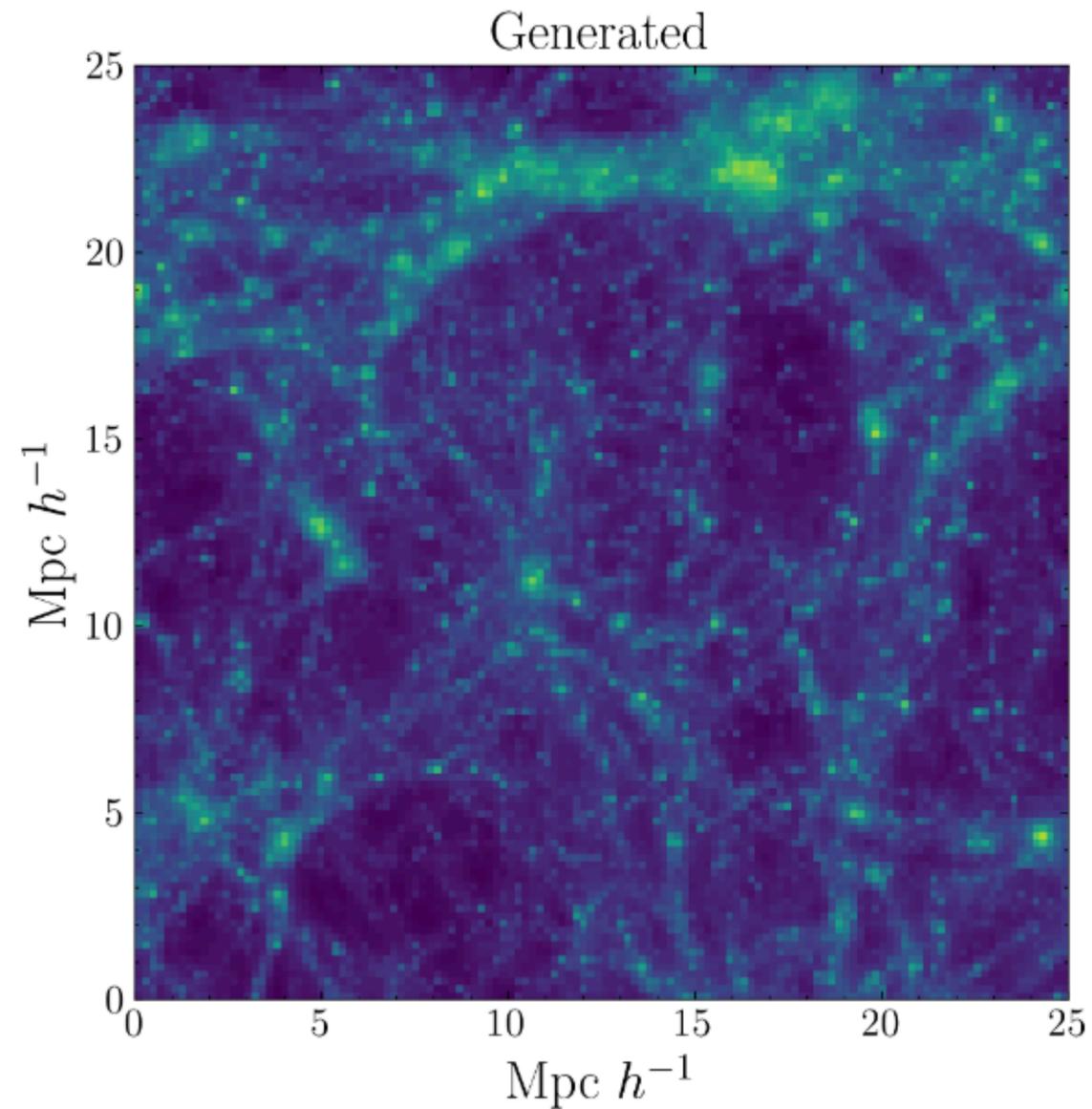


Modello completo (usa AI)

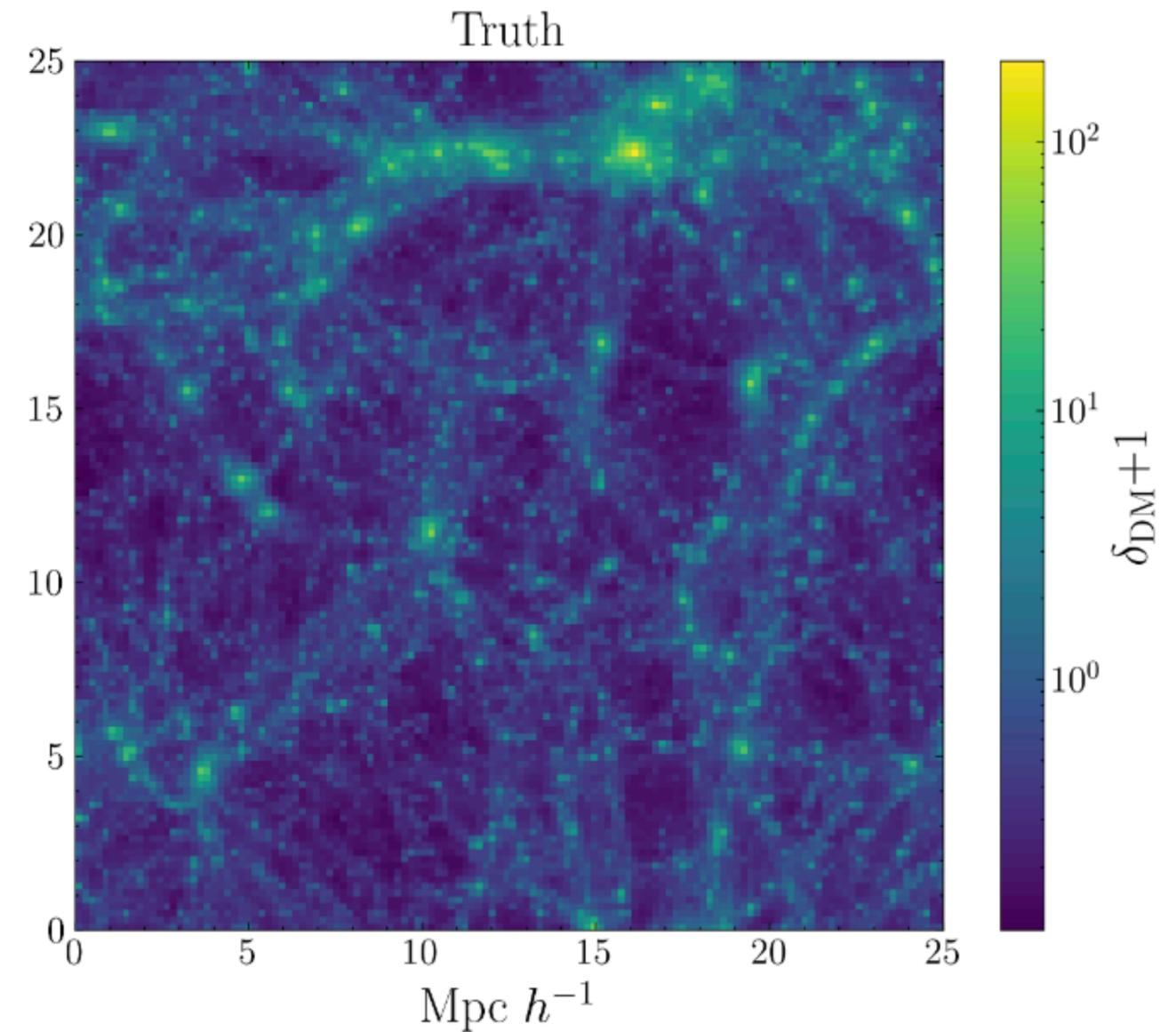
Numero di oggetti

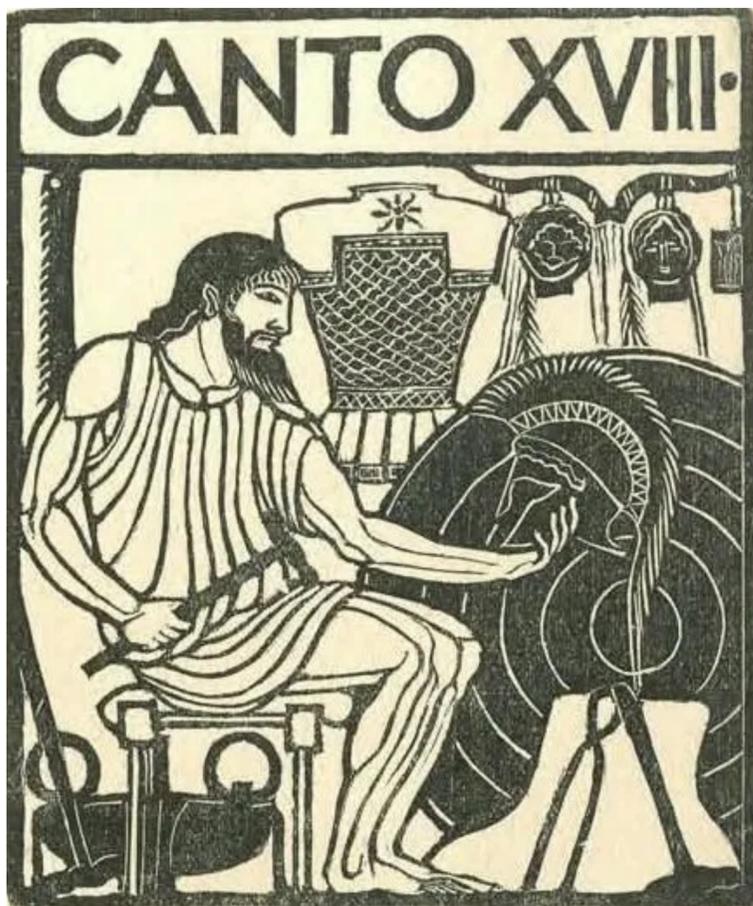


Prodotto dall'IA



Simulazione con supercomputer





Omero, Iliade, 18.368ff

Così disse [Efesto] e, staccandosi dall'incudine, lo storpio sbuffante si scostò,

zoppicando. Di sotto, gli stinchi sottili arrancavano.

Tolse i mantici dal fuoco e dentro una cassetta d'argento mise a posto i suoi strumenti di lavoro.

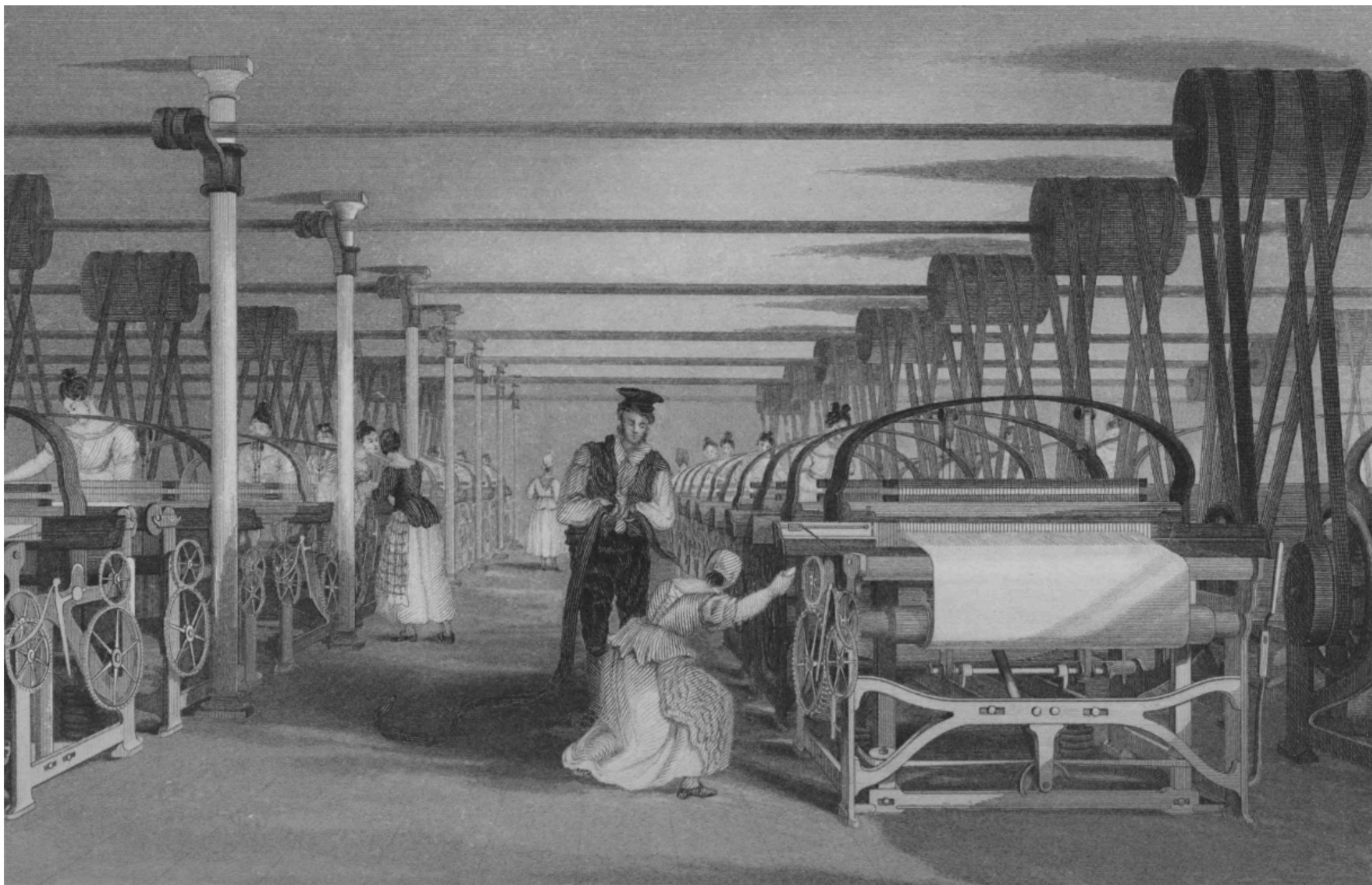
Con una spugna si lavava il volto, le braccia, il collo robusto e il petto villosa.

Poi indossò una tunica, prese il suo grosso bastone e uscì, zoppicando. **Due ancelle d'oro lo sostenevano, simili a giovinette vive:**

esse avevano intelligenza, voce e forza,

ed erano esperte nei lavori delle Dee immortali;

si affaccendavano ai cenni del loro signore.



Incisione di un telaio meccanico (1835) Public domain. Source: <https://www.worldhistory.org/image/17133/power-looms-in-a-textile-mill/>

Karel Čapek, 1920:

R.U.R.: Rossum's Universal Robots

Robot da "robota", "lavoro forzato"



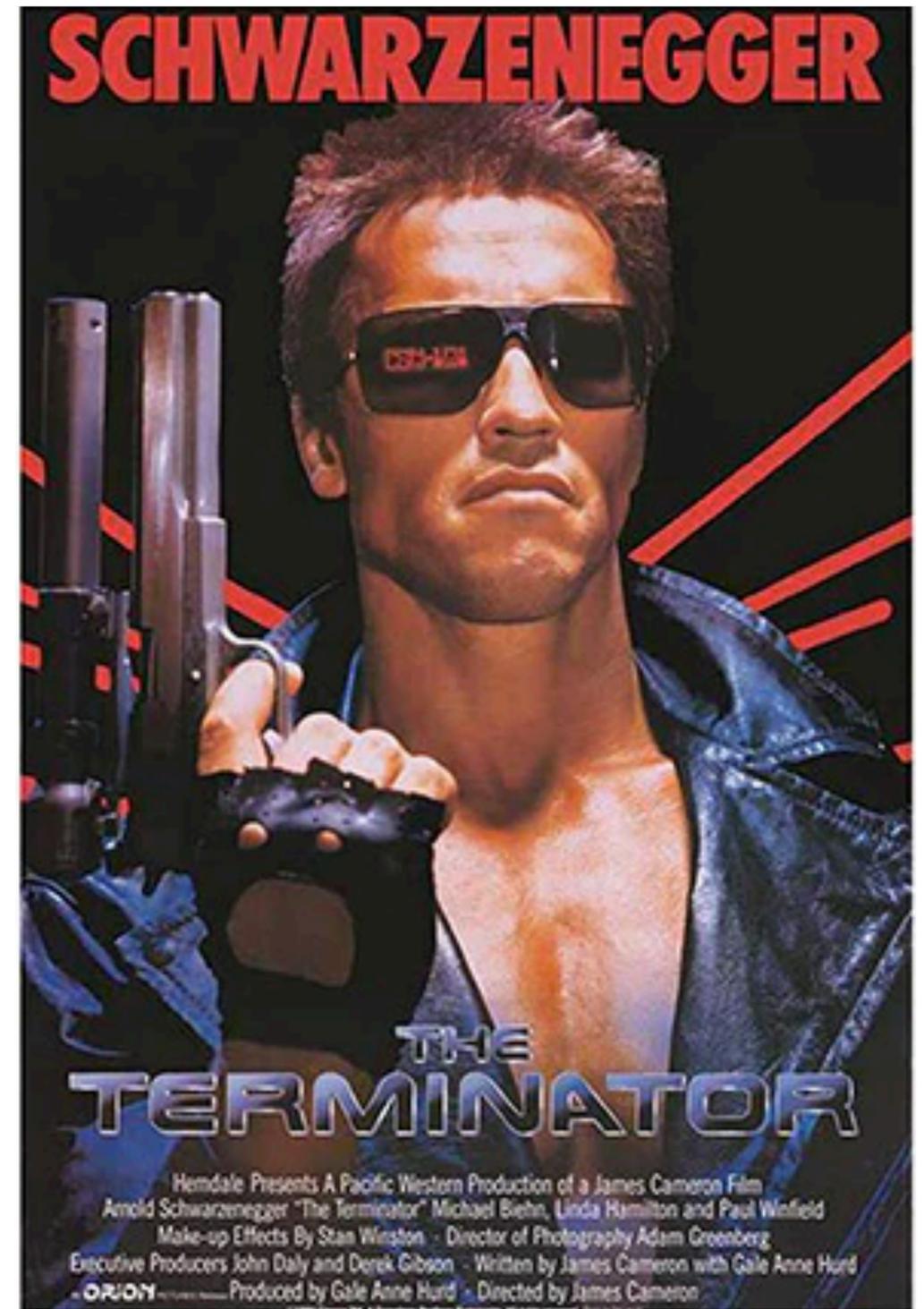
<https://youtu.be/gdtZv3XROnc>

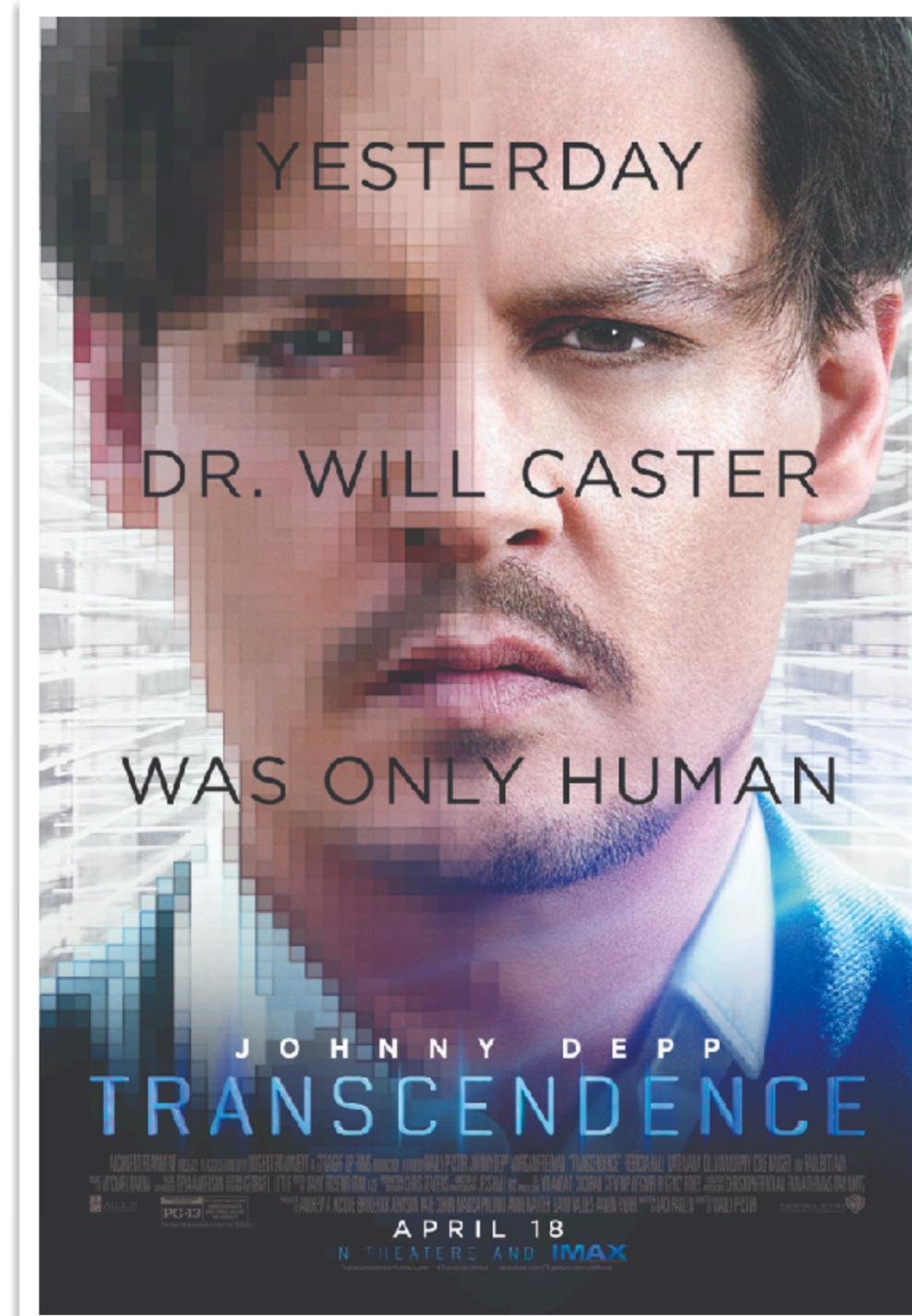
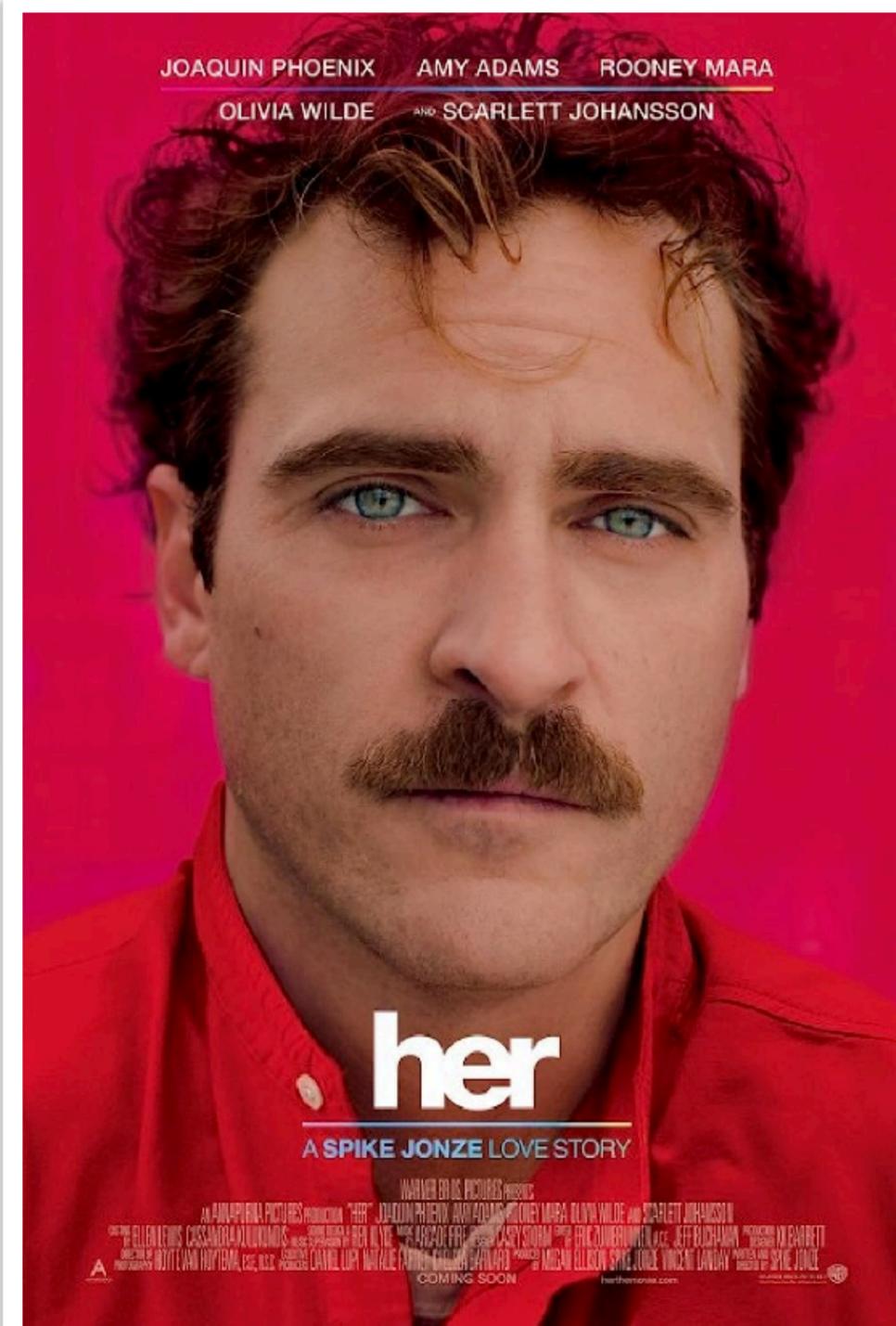
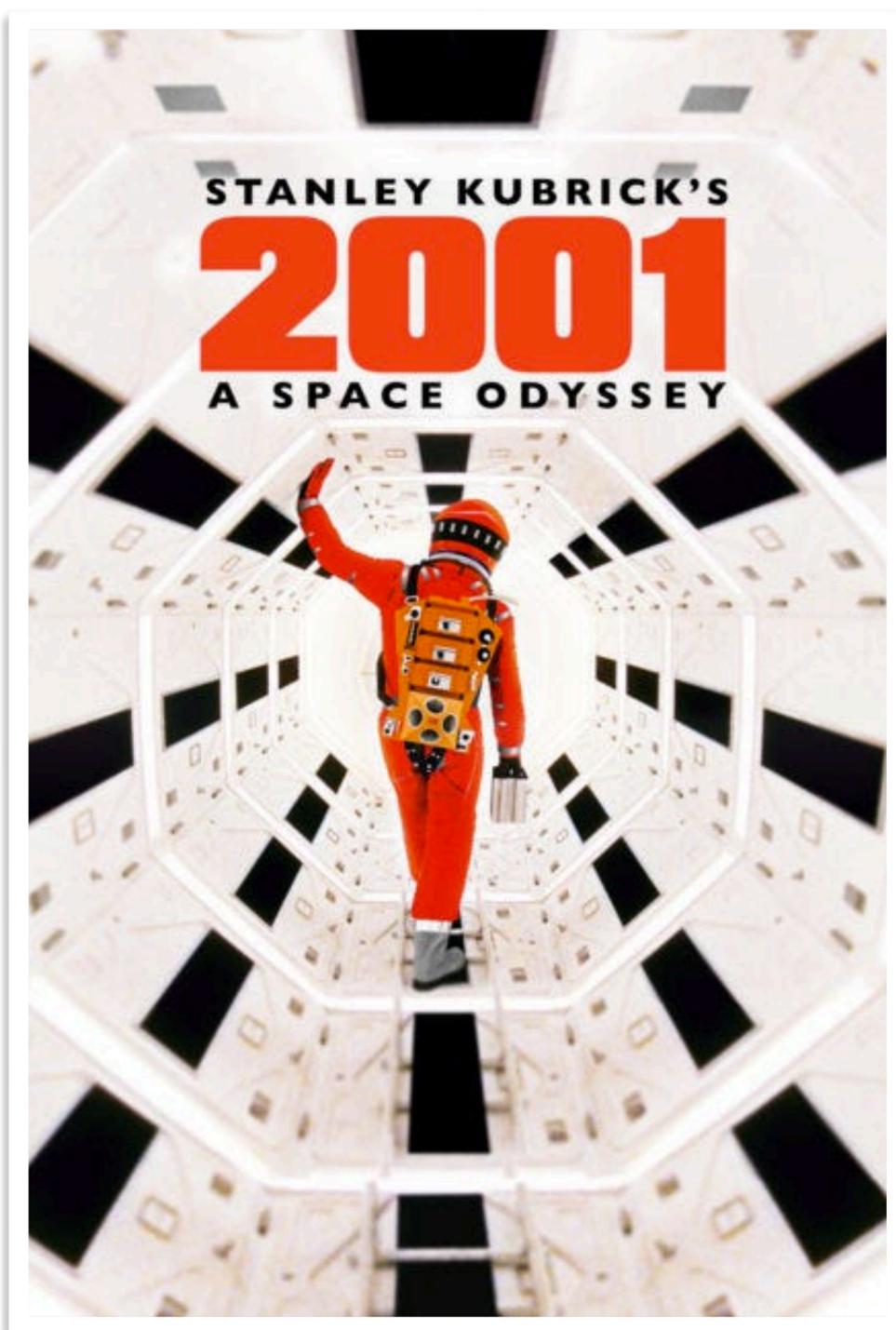
Metropolis

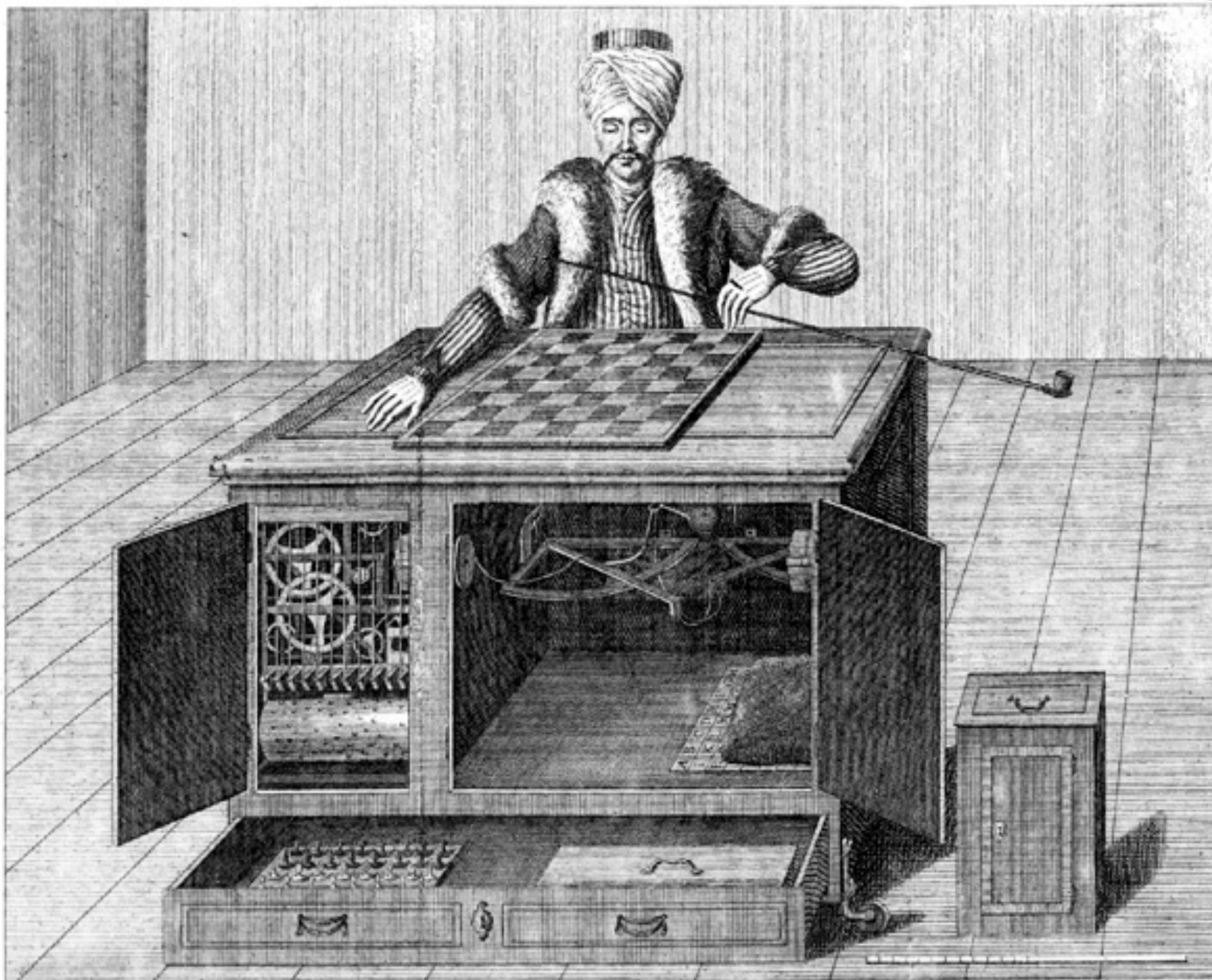
Fritz Lang

1927







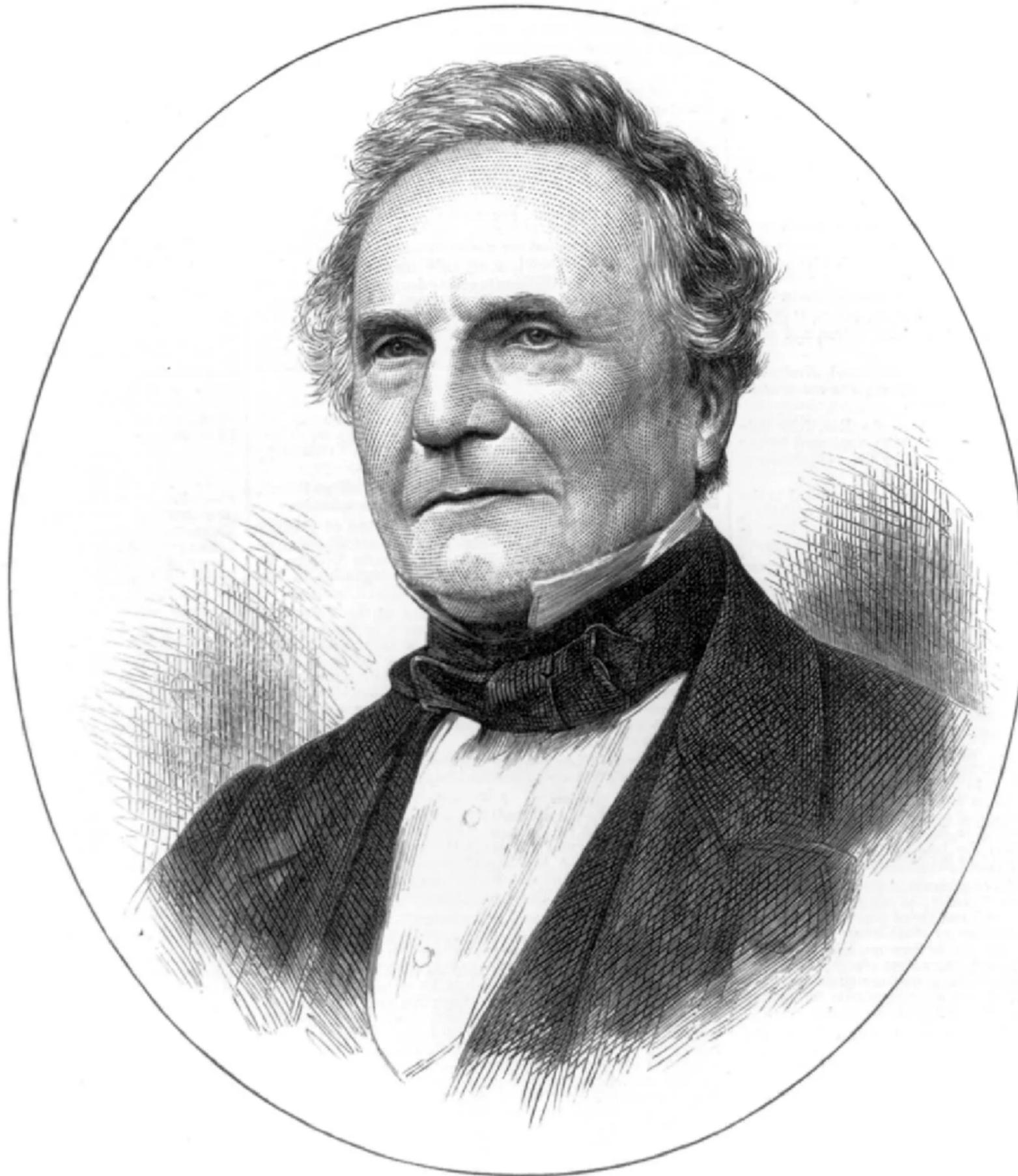


W. de Kempelen del.

Ch. a Mechel excud. Basilea.

P.G. Piatz sc.

Der Schach-Spieler, wie er vor dem Spiele gezeiget wird von vorne. Le Joueur d'Échecs, tel qu'on le montre avant le jeu, par devant.



Source: Encyclopedia Britannica

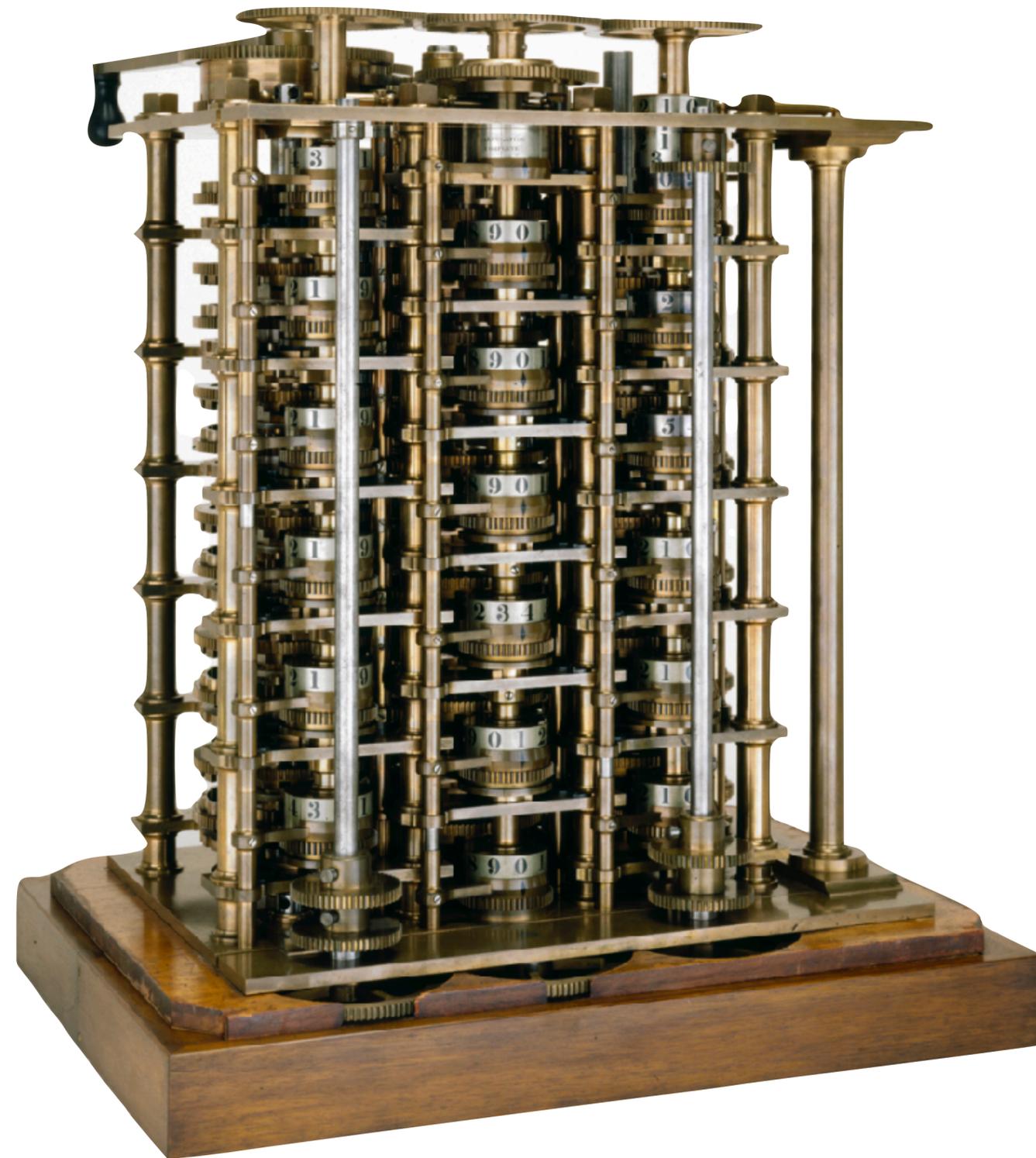
14	Sinus	Tangens	Secans
31	2506616	2589280	10329781
32	2509432	2592384	10330559
33	2512248	2595488	10331339
34	2515063	2598593	10332119
35	2517879	2601699	10332901
36	2520694	2604805	10333683
37	2523508	2607911	10334467
38	2526323	2611018	10335251
39	2529137	2614126	10336037
40	2531952	2617234	10336823
41	2534766	2620342	10337611
42	2537579	2623451	10338399
43	2540393	2626560	10339188
44	2543206	2629670	10339979
45	2546019	2632780	10340770
46	2548832	2635891	10341563
47	2551645	2639002	10342356
48	2554458	2642114	10343151
49	2557270	2645226	10343946
50	2560082	2648339	10344743
51	2562894	2651452	10345540
52	2565705	2654566	10346338
53	2568517	2657680	10347138
54	2571328	2660794	10347938
55	2574139	2663909	10348740
56	2576950	2667025	10349542
57	2579760	2670141	10350346
58	2582570	2673257	10351150
59	2585381	2676374	10351955
60	2588190	2679492	10352762

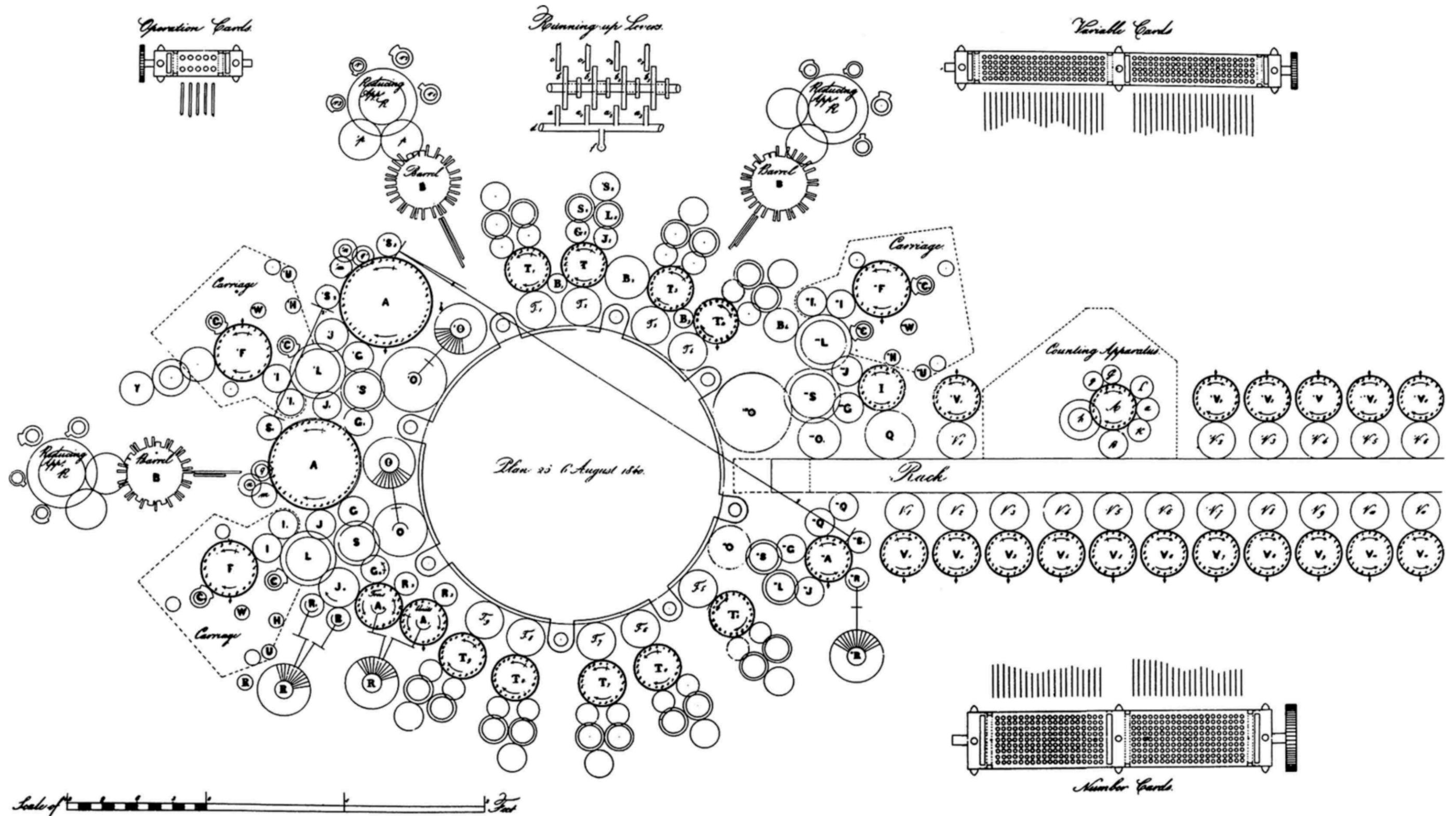
61

	Sinus	Tangens	Secans
29	9680748	38620782	39894421
28	9680018	38574537	39849654
27	9679288	38528396	39804991
26	9678557	38482358	39760431
25	9677825	38436424	39715975
24	9677092	38390591	39671621
23	9676358	38344861	39627369
22	9675624	38299233	39583219
21	9674888	38253707	39539171
20	9674152	38208281	39495224
19	9673415	38162957	39451379
18	9672678	38117733	39407633
17	9671939	38072609	39363988
16	9671200	38027585	39320443
15	9670459	37982661	39276997
14	9669718	37937835	39233651
13	9668977	37893109	39190403
12	9668234	37848481	39147254
11	9667490	37803951	39104203
10	9666746	37759519	39061250
9	9666001	37715185	39018395
8	9665255	37670947	38975637
7	9664508	37626807	38932976
6	9663761	37582763	38890411
5	9663012	37538815	38847943
4	9662263	37494963	38805570
3	9661513	37451207	38763293
2	9660762	37407546	38721112
1	9660011	37363980	38679025
0	9659258	37320508	38637033

75 |

Prototipo del “Difference Engine” N. 1 (1832)





LAPLACE

1749.

1827

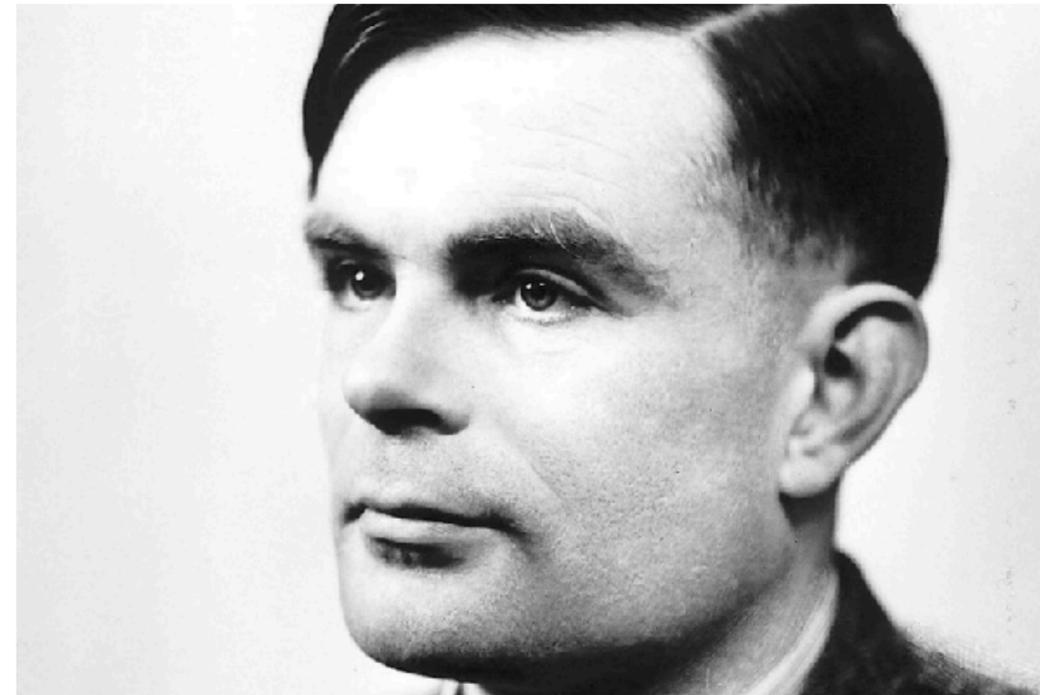


Il demone di Laplace

“Dobbiamo dunque considerare lo stato attuale dell’universo come l’effetto del suo stato passato e come la causa di quello che seguirà. Supponendo che, per un istante, esista un’intelligenza in grado di comprendere tutte le forze che animano la natura e la posizione rispettiva degli esseri che la compongono—**un’intelligenza sufficientemente vasta da sottomettere questi dati all’analisi**—essa abbraccerebbe in un’unica formula i movimenti dei corpi più grandi dell’universo e quelli dell’atomo più leggero; per essa nulla sarebbe incerto e il futuro, al pari del passato, sarebbe presente ai suoi occhi.”

Laplace, *A Philosophical Essay on Probabilities* (1814)

Un balzo concettuale



Alan Turing

Source: Wikimedia

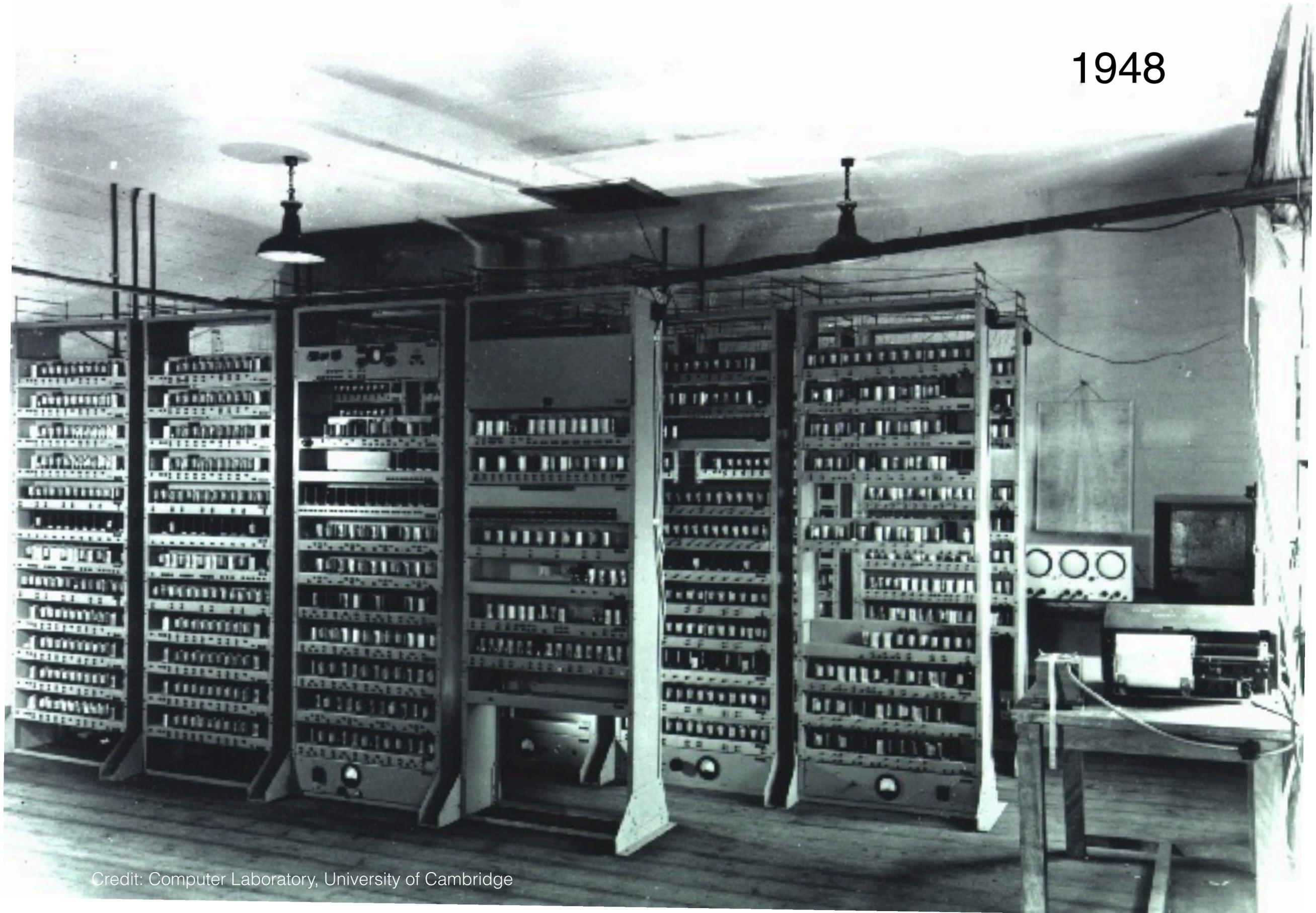
“Vogliamo delle macchine capaci di imparare dall’esperienza”

– Alan Turing, *Lecture on the Automatic Computing Engine* (1947)

“Possiamo sperare che le macchine un giorno competano con gli uomini in tutti i campi puramente intellettuali.”

– Alan Turing, *Computer Machinery and Intelligence* (1950)

1948



Credit: Computer Laboratory, University of Cambridge

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.

1956

1956 Dartmouth Conference: The Founding Fathers of AI



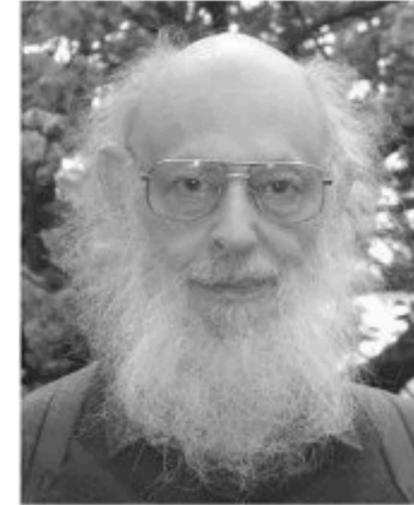
John MacCarthy



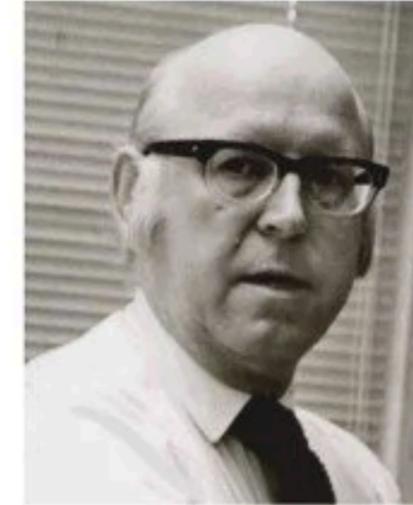
Marvin Minsky



Claude Shannon



Ray Solomonoff



Alan Newell



Herbert 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

J. McCarthy, Dartmouth College
M. L. Minsky, Harvard University
N. Rochester, I.B.M. Corporation
C.E. Shannon, Bell Telephone Laboratories

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.

NEW NAVY DEVICE LEARNS BY DOING

Psychologist Shows Embryo of Computer Designed to Read and Grow Wiser

WASHINGTON, July 7 (UPI)
—The Navy revealed the embryo of an electronic computer today that it expects will be able to walk, talk, see, write, reproduce itself and be conscious of its existence.

The embryo—the Weather Bureau's \$2,000,000 "704" com-

The New York Times,
8 luglio 1958

The service said it would use this principle to build the first of its Perceptron thinking machines that will be able to read and write. It is expected to be finished in about a year at a cost of \$100,000.

Later Perceptrons will be able to recognize people and call out their names and instantly translate speech in one language to speech or writing in another language, it was predicted.



Frank Rosenblatt
(1928-1971)

Garry Kasparov v DeepBlue, 1996-1997



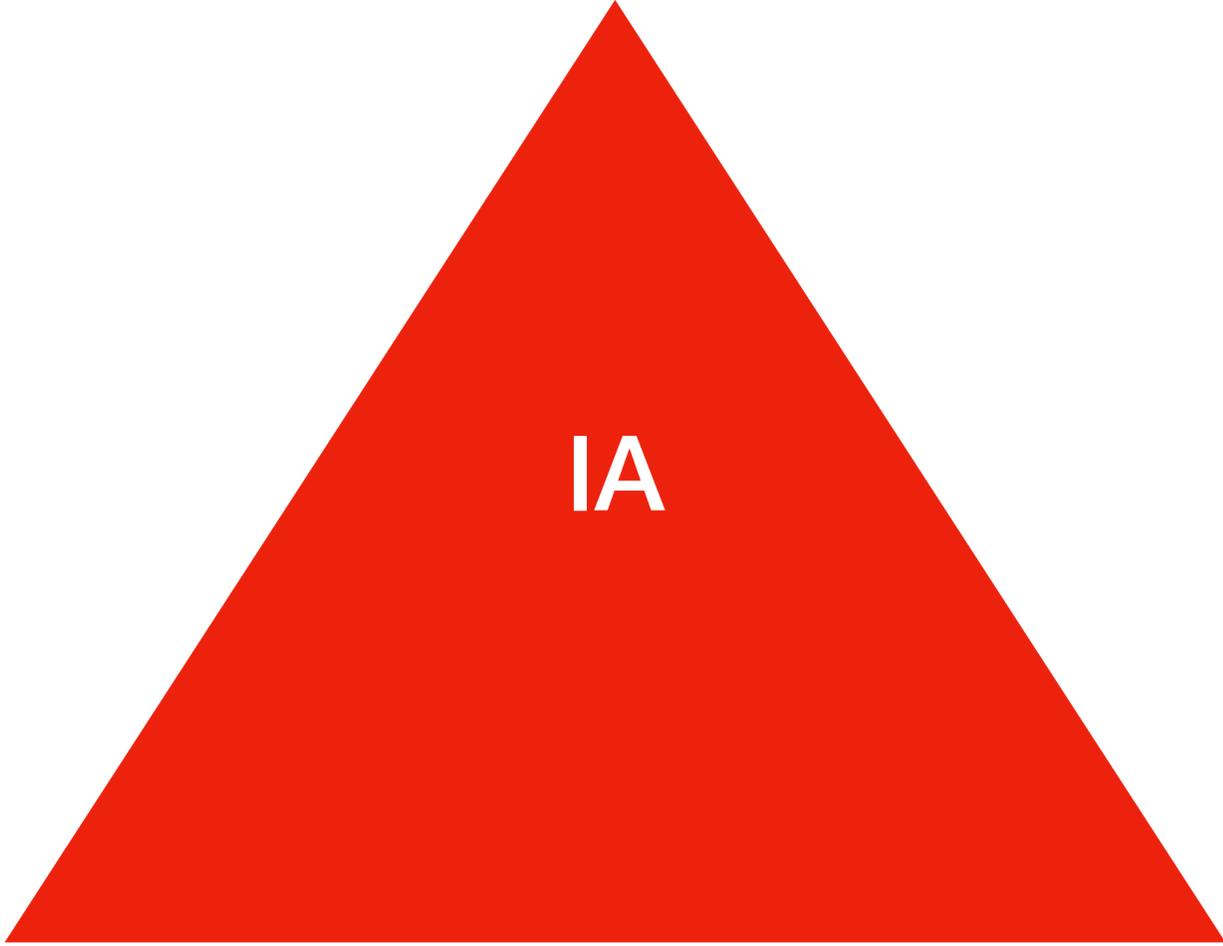
Lee Sedol v AlphaGo, 2016



Perché ci arriviamo solo oggi?

Dati

175 zettabytes nel 2025 (10^{21} bytes, 36,000 miliardi di anni di video HD)



IA

Capacità di
calcolo

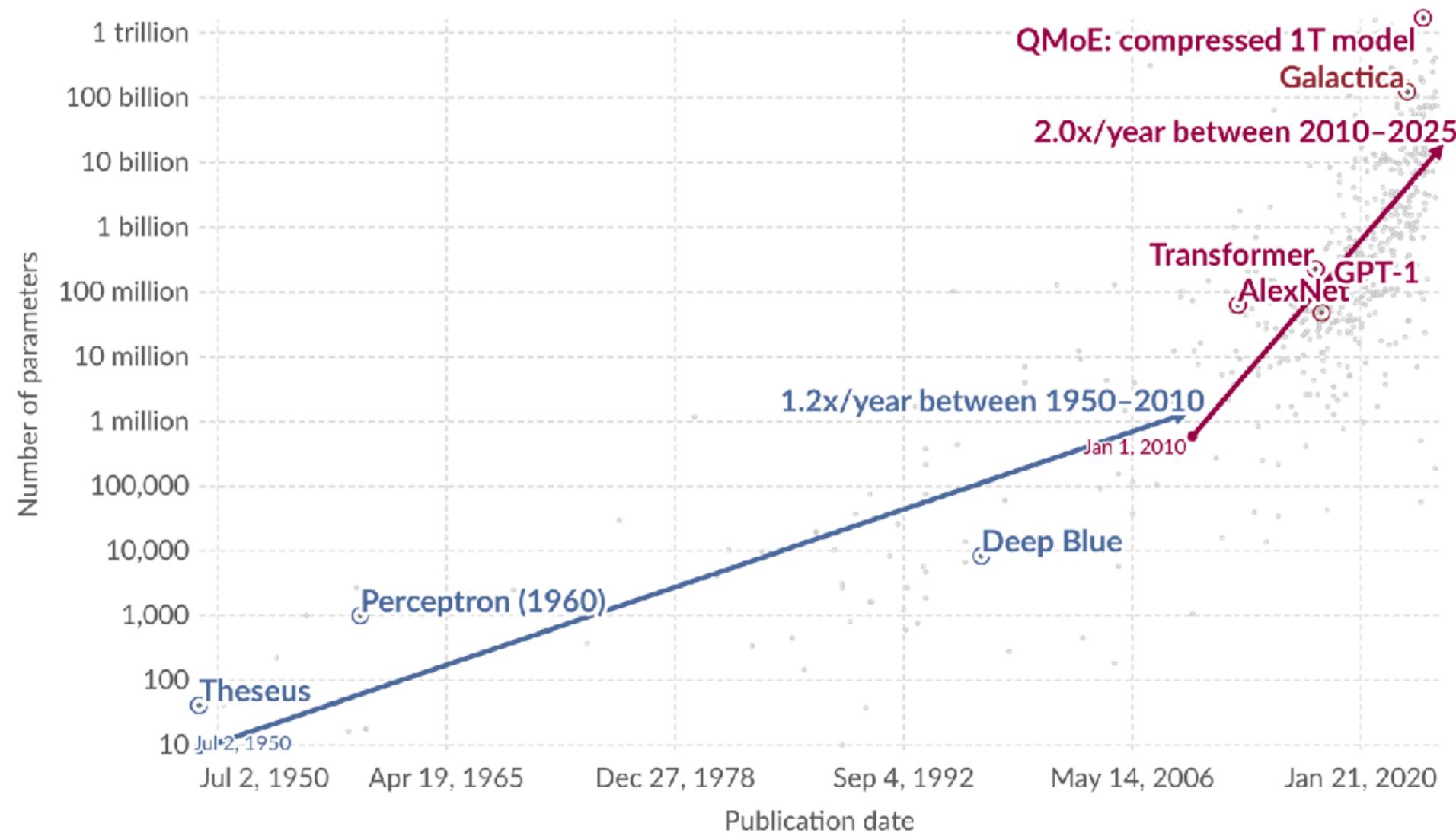
Supercalcolo:
 10^{18} flops/s

Algoritmi

Is bigger always better?

Exponential growth of parameters in notable AI systems

Parameters are variables in an AI system whose values are adjusted during training to establish how input data gets transformed into the desired output; for example, the connection weights in an artificial neural network.



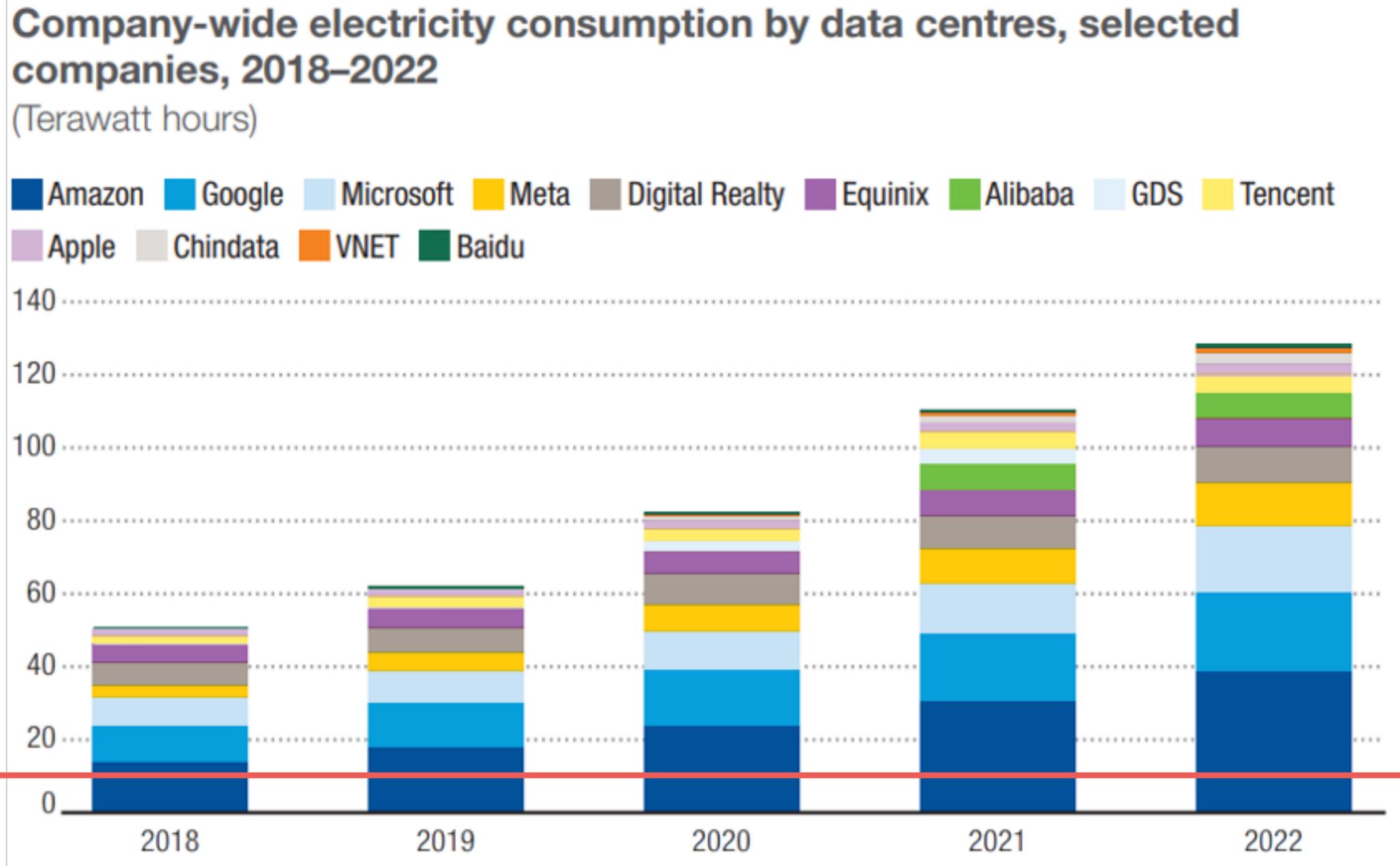
Performance?
Sostenibilità?
Dati di allenamento?
Costi ambientali?
Fragilità dei sistemi?
Impatto sociale?
AGI?

Data source: Epoch (2024)

OurWorldinData.org/artificial-intelligence | CC BY

Note: Parameters are estimated based on published results in the AI literature and come with some uncertainty. The authors expect the estimates to be correct within a factor of 10.

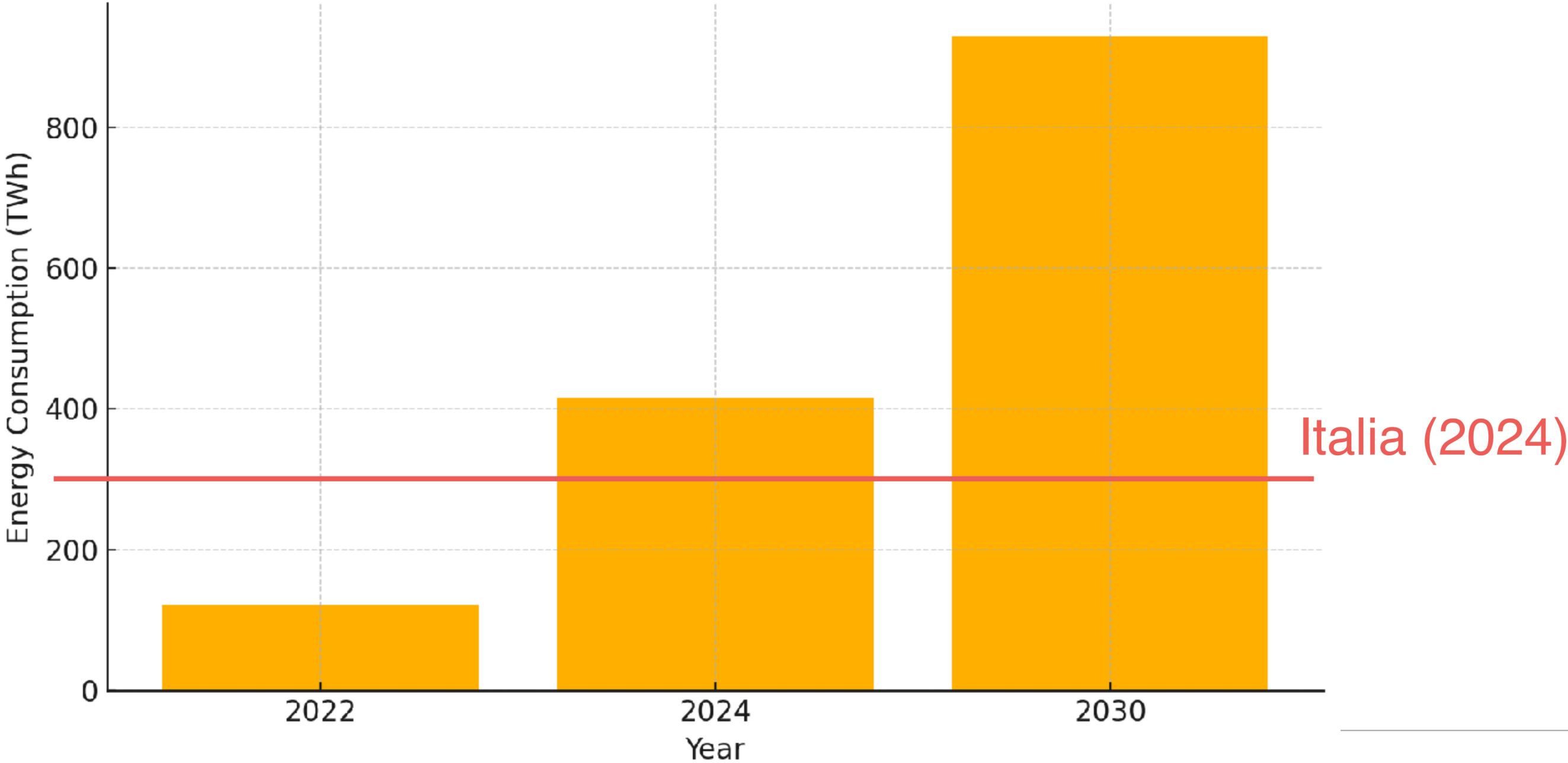
Consumo energetico in forte aumento



Consumo FVG

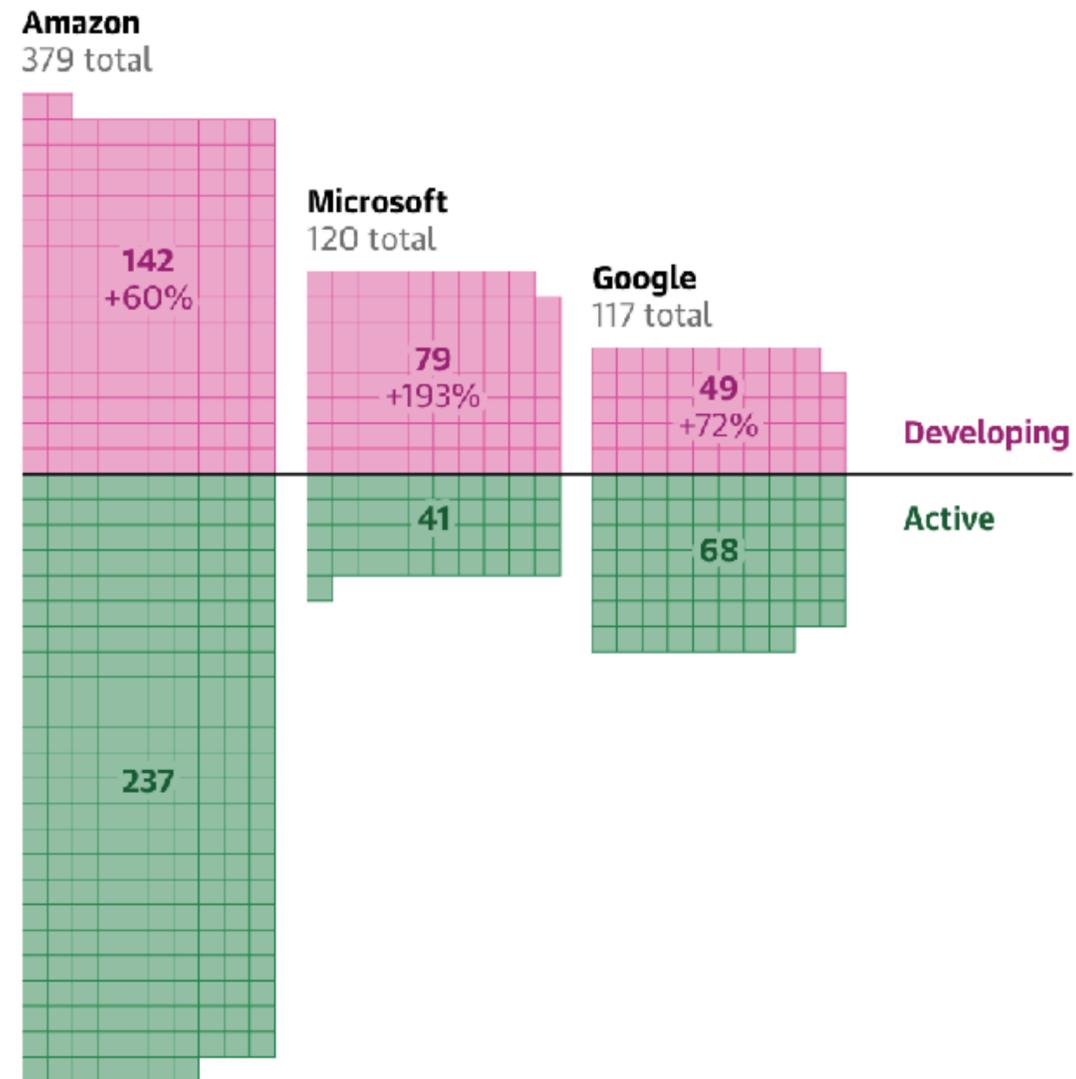
Consumo energetico in forte aumento

Energy Consumption Over Time



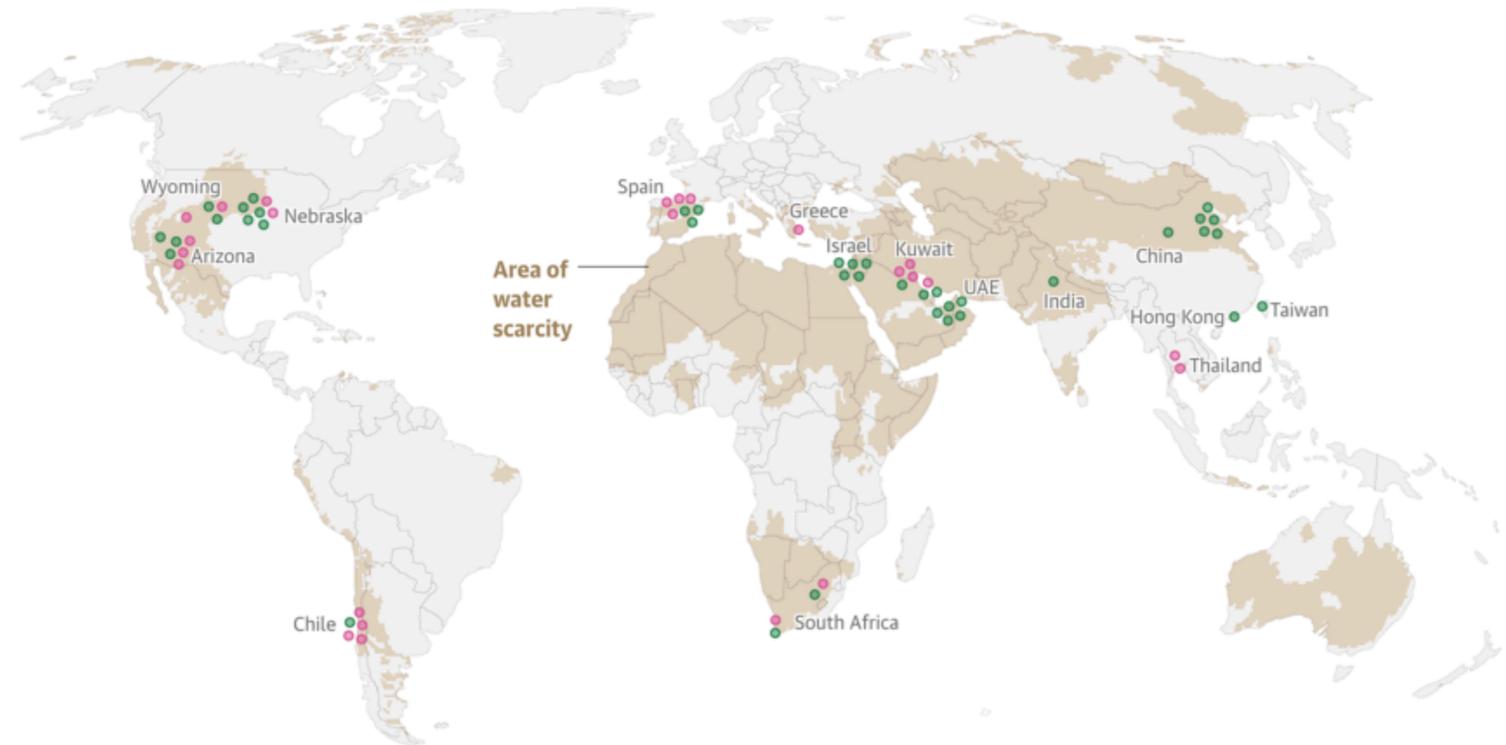
Espansione dei data centres

Tech giants' datacentres to expand by a combined 78%



Datacentres in areas of water scarcity

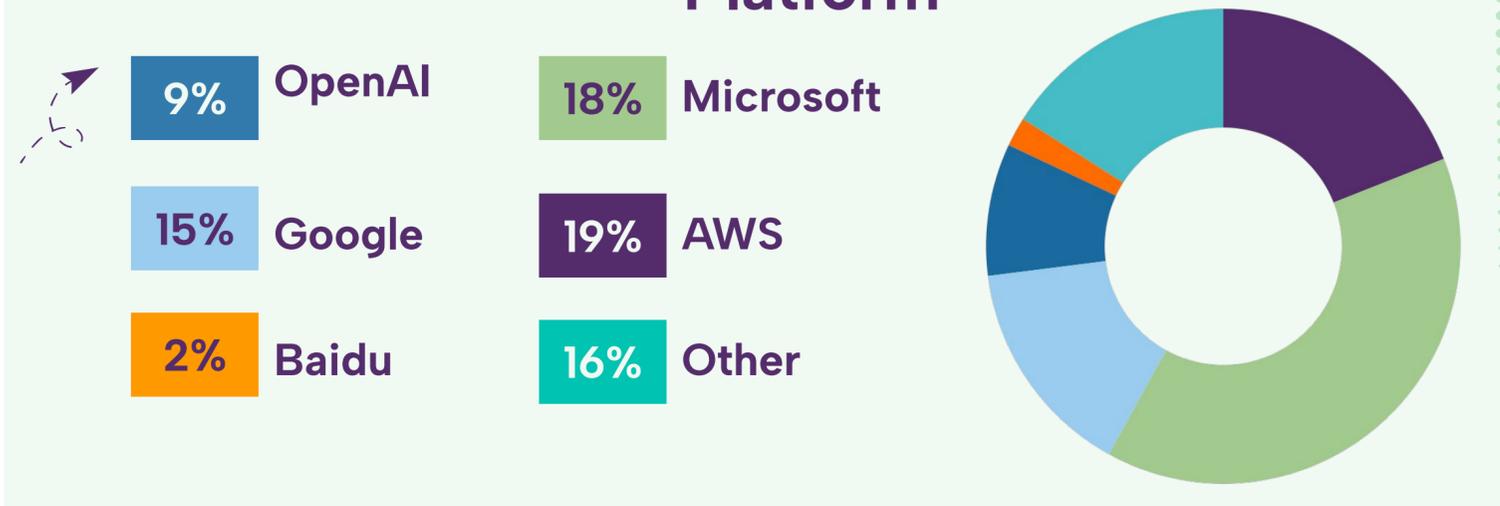
● Active ● Developing



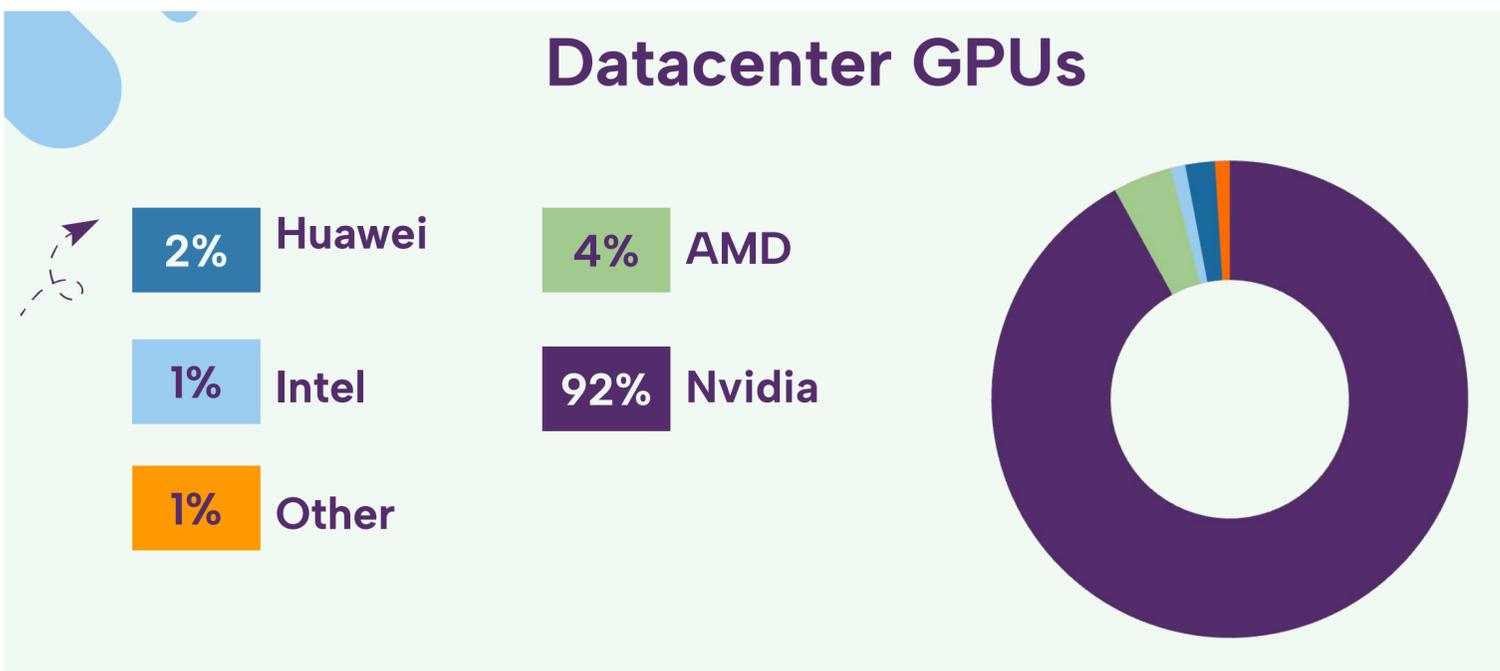
Guardian graphic. Note: Locations are approximate.

Guardian graphic. Note: Sixteen centres' development status were unable to be determined.

Foundation Model and Model Management Platform



Datacenter GPUs



Le 6 grandi aziende di Big Tech controllano:

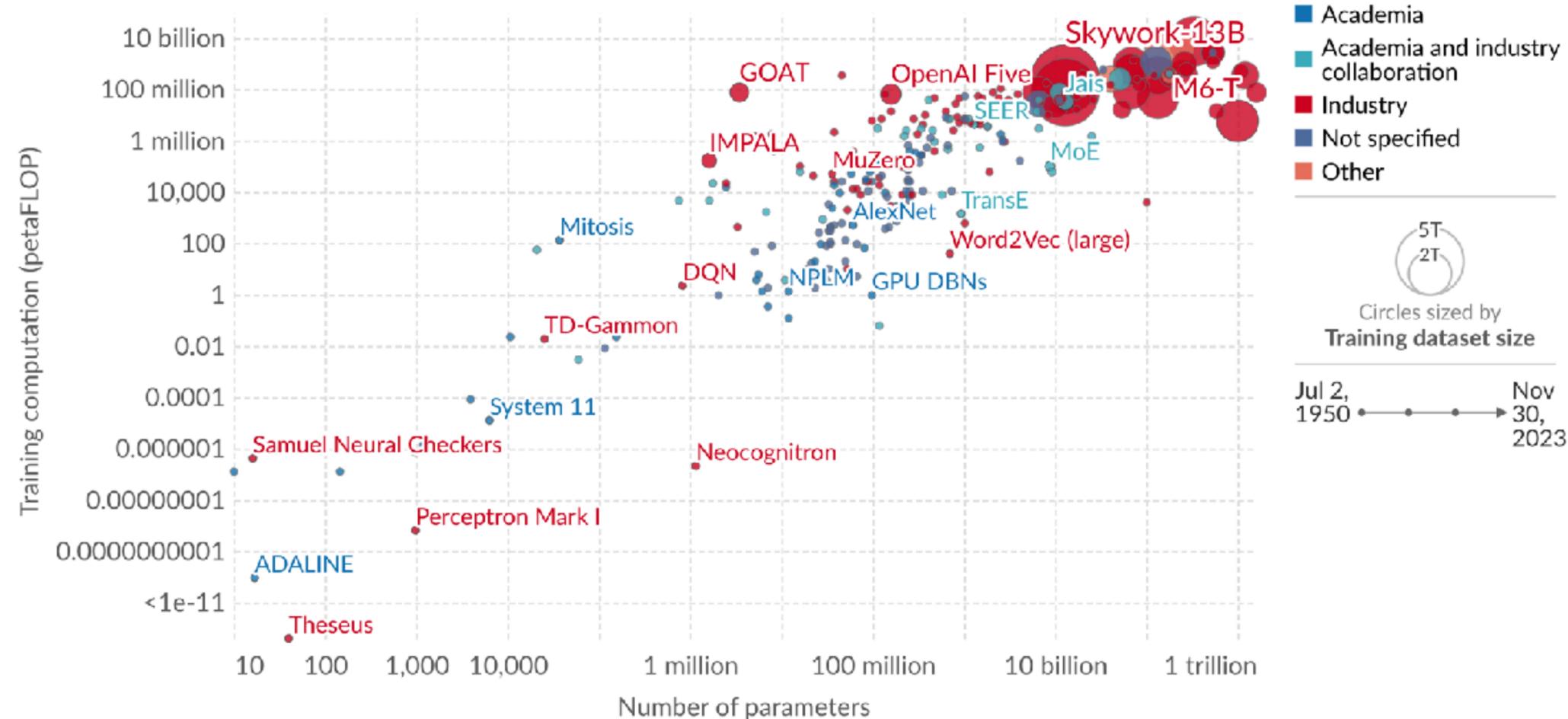
- I dati di allenamento
- Infrastruttura cloud
- Accesso al mercato (acquisizioni mirate)
- Closed source codes
- Talento

Quale il ruolo delle istituzioni accademiche?

Training computation vs. parameters in notable AI systems, by researcher affiliation

Our World
in Data

Computation is measured in total petaFLOP, which is 10^{15} floating-point operations¹ estimated from AI literature, albeit with some uncertainty. Parameters are variables in an AI system whose values are adjusted during training to establish how input data gets transformed into the desired output.



Competere sulla scala
con Big Tech impossibile
Leonardo: 14,000 GPU
Microsoft: 600,000 GPU

Innovazione al di fuori
del paradigma 'bigger is
better': modelli più
efficienti, più trasparenti,
più robusti

Data source: Epoch (2023)

OurWorldInData.org/artificial-intelligence | CC BY

Note: Each domain's training data has a specific unit; for example, for vision it is images and for language it is words. This means systems can only be compared directly within the same domain.

'It was as if my father were actually texting me': grief in the age of AI



At the Intersection of A.I. and Spirituality

Modern relig
as earlier ge

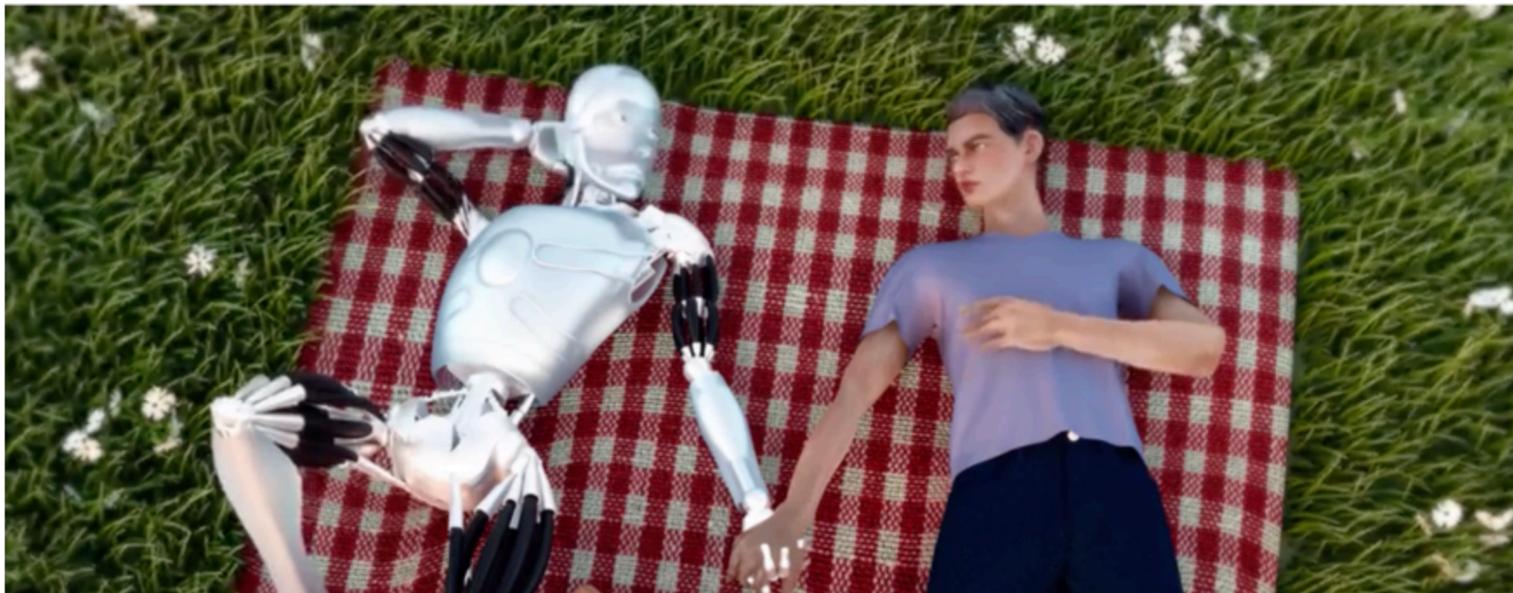


YOUR A.I. LOVER WILL CHANGE YOU

A future where many humans are in love with bots may not be far off. Should we regard them as training grounds for healthy relationships or as nihilistic traps?

By Jaron Lanier

March 22, 2025



Say Goodbye to Your Kid's Imaginary Friend

The New York Times

This Therapist Helped Clients Feel Better. It Was A.I.

In the first clinical trial of its kind, an A.I. chatbot eased mental health symptoms among participants. The technology may someday help solve the provider shortage.

In Taiwan and China, young people turn to AI chatbots for 'cheaper, easier' therapy

Experts say there is huge potential for AI in the mental health sector, but there are risks of turning to technology, rather than human beings when in distress

The New York Times

ice > | [Weather Forecasting](#) | [Making Cartoons Cheaper](#) | [ChatGPT on Campus?](#) | [Trump's Outsourcing Deal](#)

They Asked an A.I. Chatbot Questions. The Answers Sent Them Spiraling.

Generative A.I. chatbots are going down conspiratorial rabbit holes and endorsing wild, mystical belief systems. For some people, conversations with the technology can deeply distort reality.

[Home](#) | [Tech](#)

IN THE SPOTLIGHT

AI hallucinations are getting worse

And no one knows why it is happening

[f](#) [x](#) [in](#) [✉](#) Newsletter sign up



Un esempio di model collapse?

“Allucinazioni”
(informazioni inventate ma plausibili) sono solo una parte del problema.

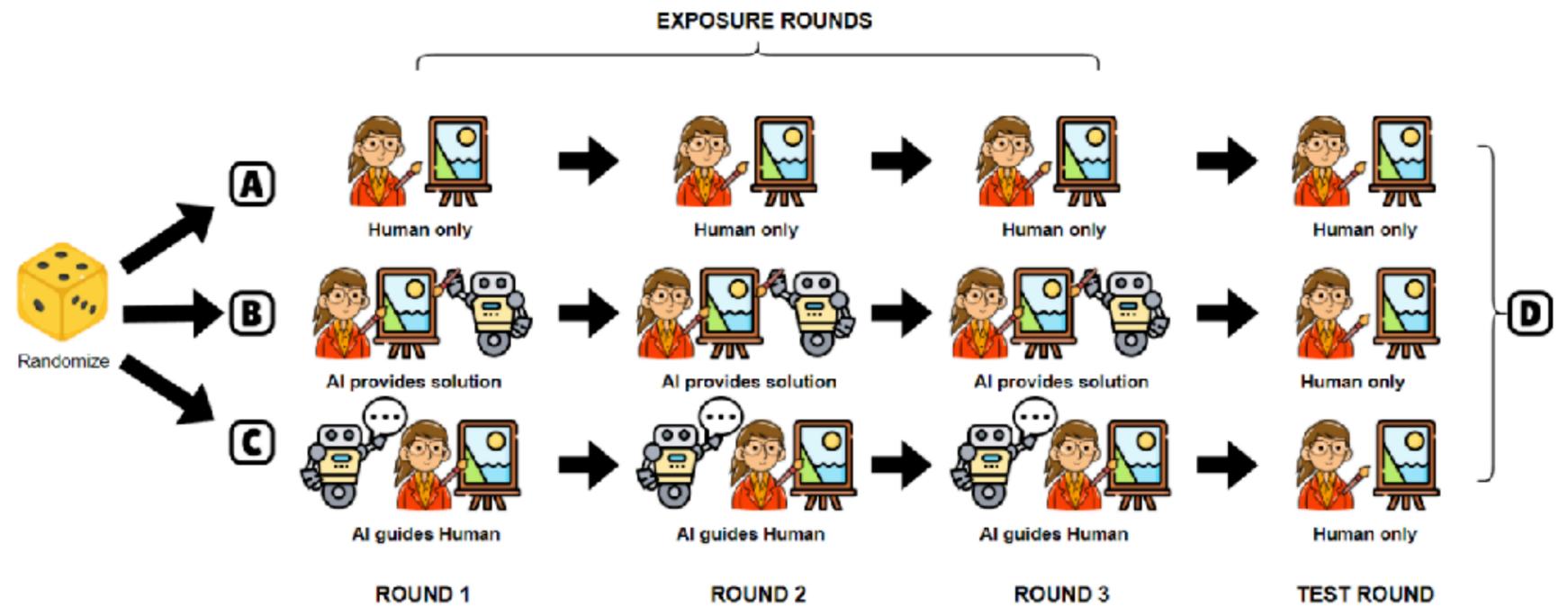
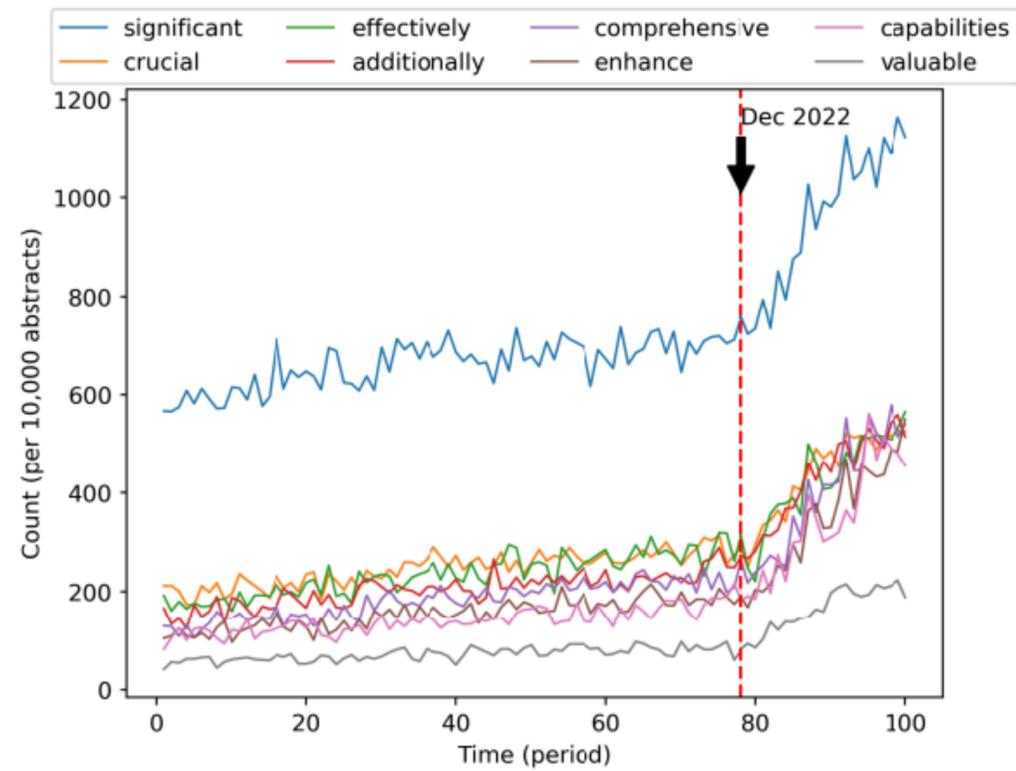
Sistemi di IA ottimizzano una ‘funzione valore’ che non può essere neutra.



Saremo sostituiti dai robots?

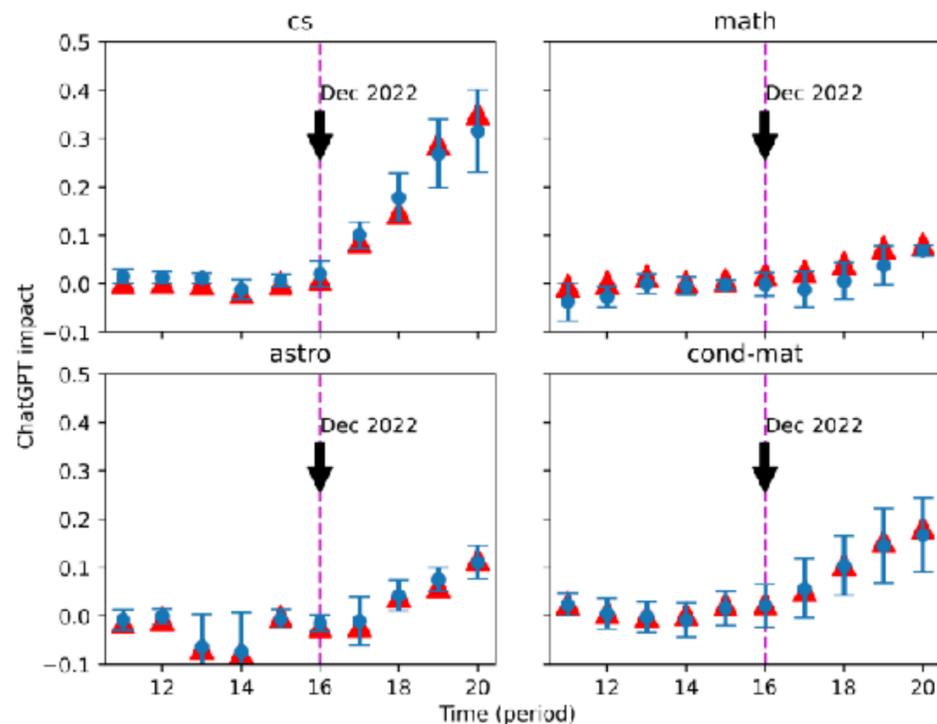
- programmazione in rapido declino
- Lavori 'white collar' in maggior pericolo
- Spirito critico e di analisi sempre più importante: come distinguere le allucinazioni?
- Come educare futuri cittadini/e nell'era dell'IA?

Esempi di impatto di IA



“Our findings reveal that while LLM assistance can provide short-term boosts in creativity during assisted tasks, it may inadvertently hinder independent creative performance when users work without assistance, raising concerns about the long-term impact on human creativity and cognition.”

IA come steroidi / scarpette / allenatore?



Il nuovo Oppenheimer?



Ilya Sutskever



Sam Altman



Mira Murati



Greg Brockman



TECH

Peter Thiel invests in group to recreate the Olympics on steroids — literally

Sarah Jackson Jan 31, 2024, 11:25 PM CET

Share Save



Peter Thiel is one of the investors in an organization that wants to build an Olympic Games that doesn't prohibit, but rather encourages, the use of performance-enhancing drugs.

Mario Ballo/Getty Images

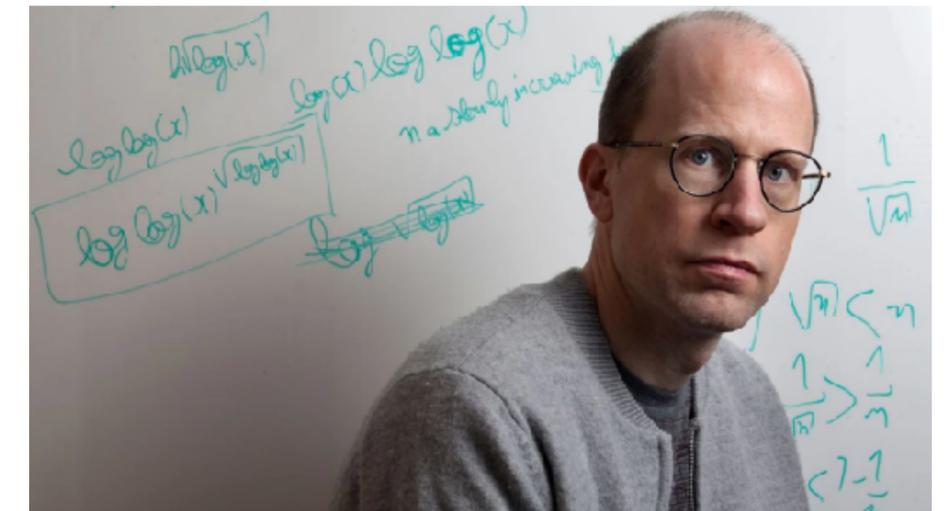
VICE Video TV News Tech Rec Room



Prominent AI Philosopher and 'Father' of Longtermism Sent Very Racist Email to a 90s Philosophy Listserv

"Blacks are more stupid than whites," Nick Bostrom wrote in an email sent to a transhumanism listserv in the 1990s that he apologized for in a letter.

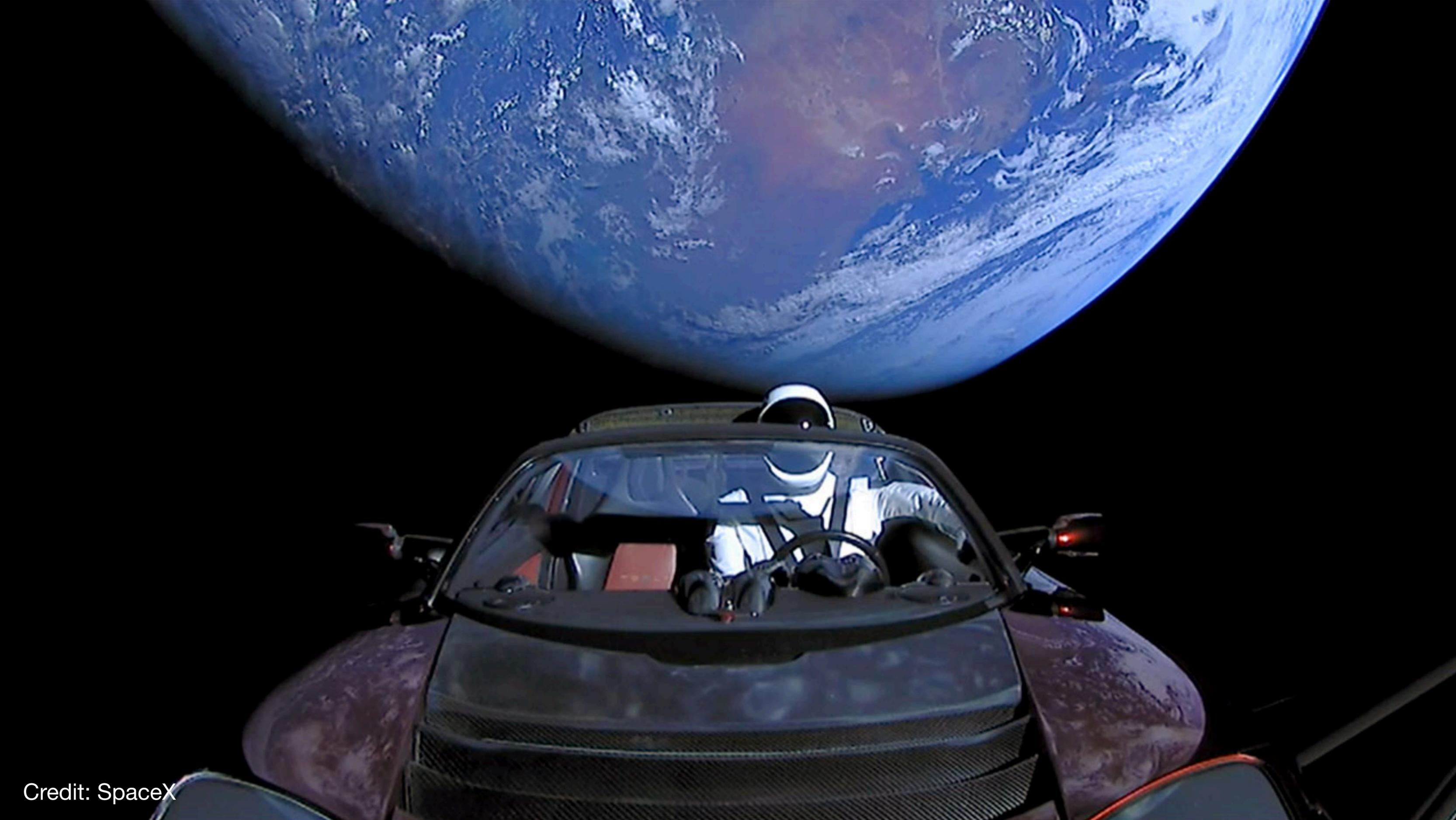
Nick Bostrom



“You back up your hard-drive; we should do the same with life” (Elon Musk, 2015)

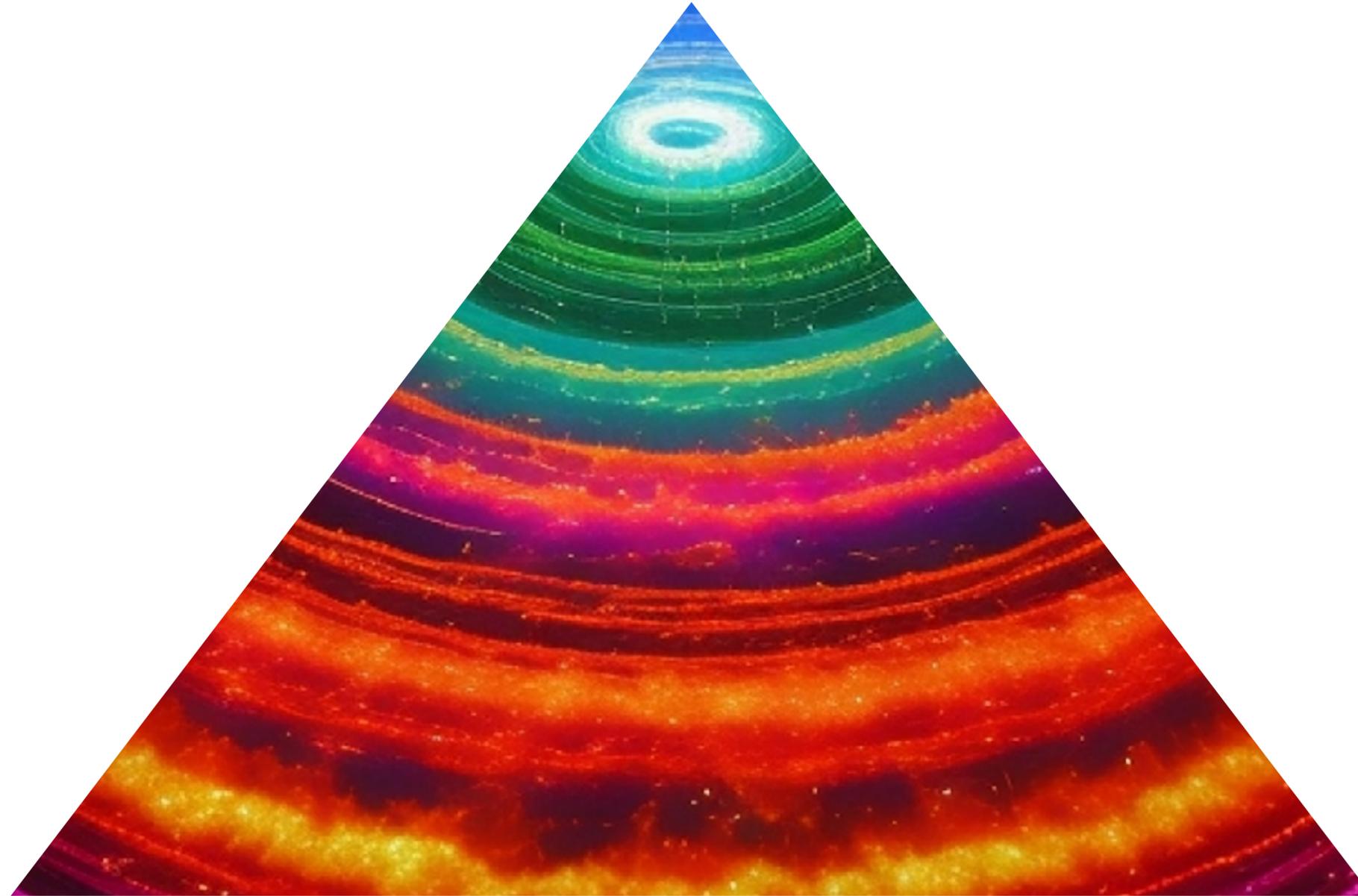
“With very advanced technology, a very large population of people living happy lives could be sustained in the accessible region of the universe” (Nick Bostrom, 2008)

“By 2029, computers will have human-level intelligence, [be] inside our brains, connecting them to the cloud, expanding who we are (Ray Kurzweil, 2017)



Credit: SpaceX

AGI
Coscienza non biologica



Transumanismo
& upload della mente sul cloud

Lungotermismo e
imperialismo spaziale

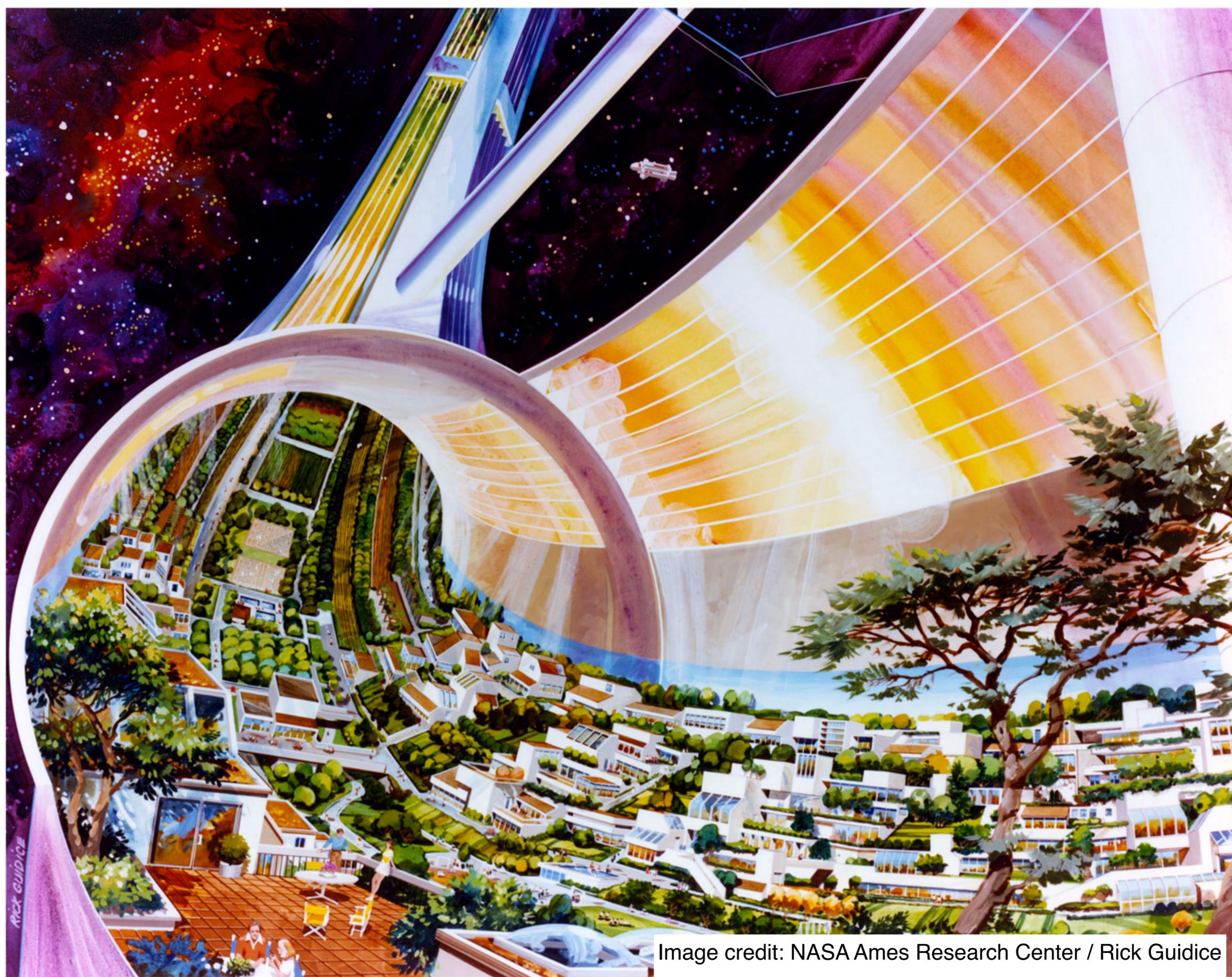


Image credit: NASA Ames Research Center / Rick Guidice



Harry Bates, *Pandora*, exhibited 1891, Tate Gallery collection

A deep field galaxy image showing a vast field of galaxies in various colors (white, yellow, orange, red, blue) and shapes (spiral, elliptical, irregular). The image is overlaid with a grid of thin blue lines and features several prominent starburst patterns, which are bright, multi-pointed star-like structures. The background is a dark, starry space.

Grazie!

www.robertotrotta.com