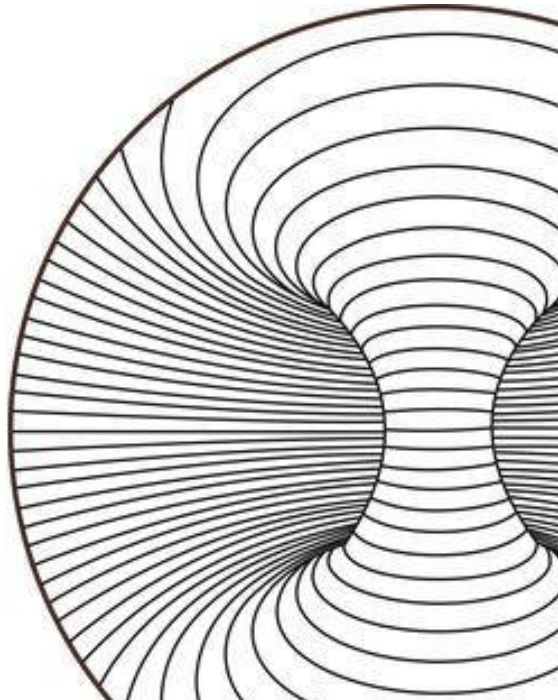
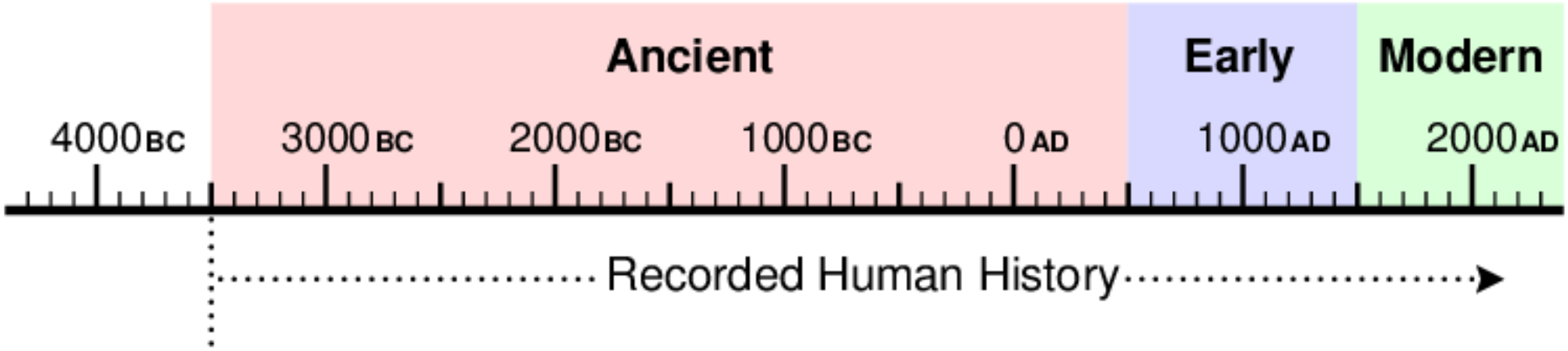
Technological Singularity

Mehdi Maleki



✗ Artificial Intelligence

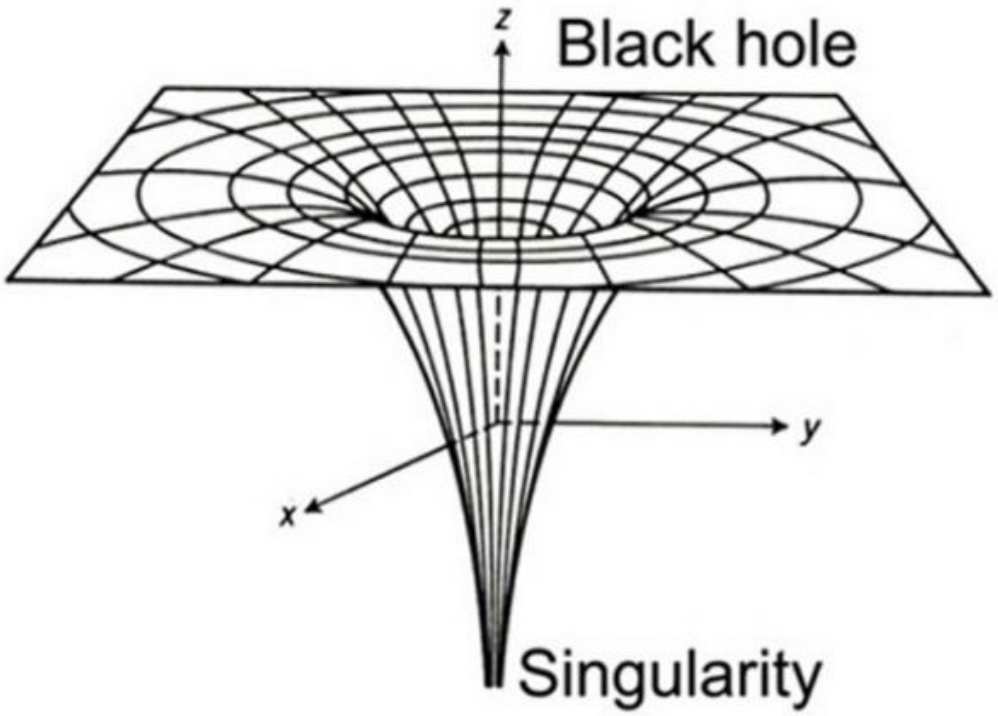
› Human

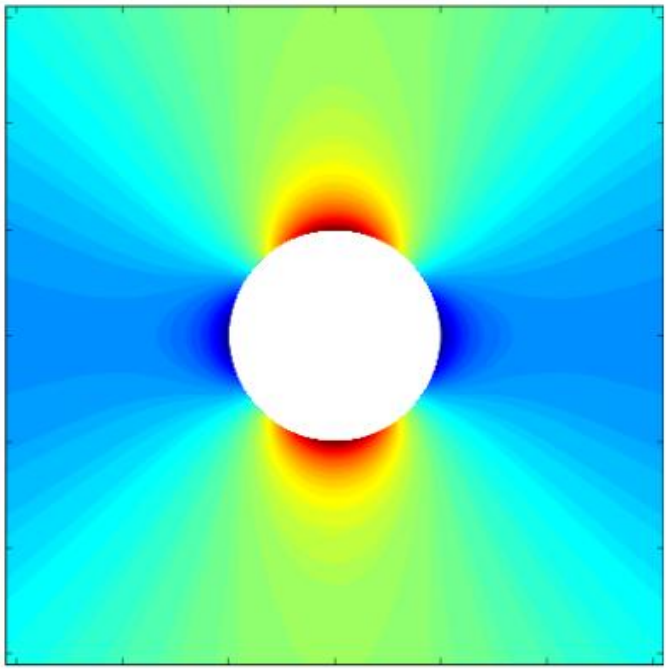


Beyond a certain point there is no return.

This point has to be reached.

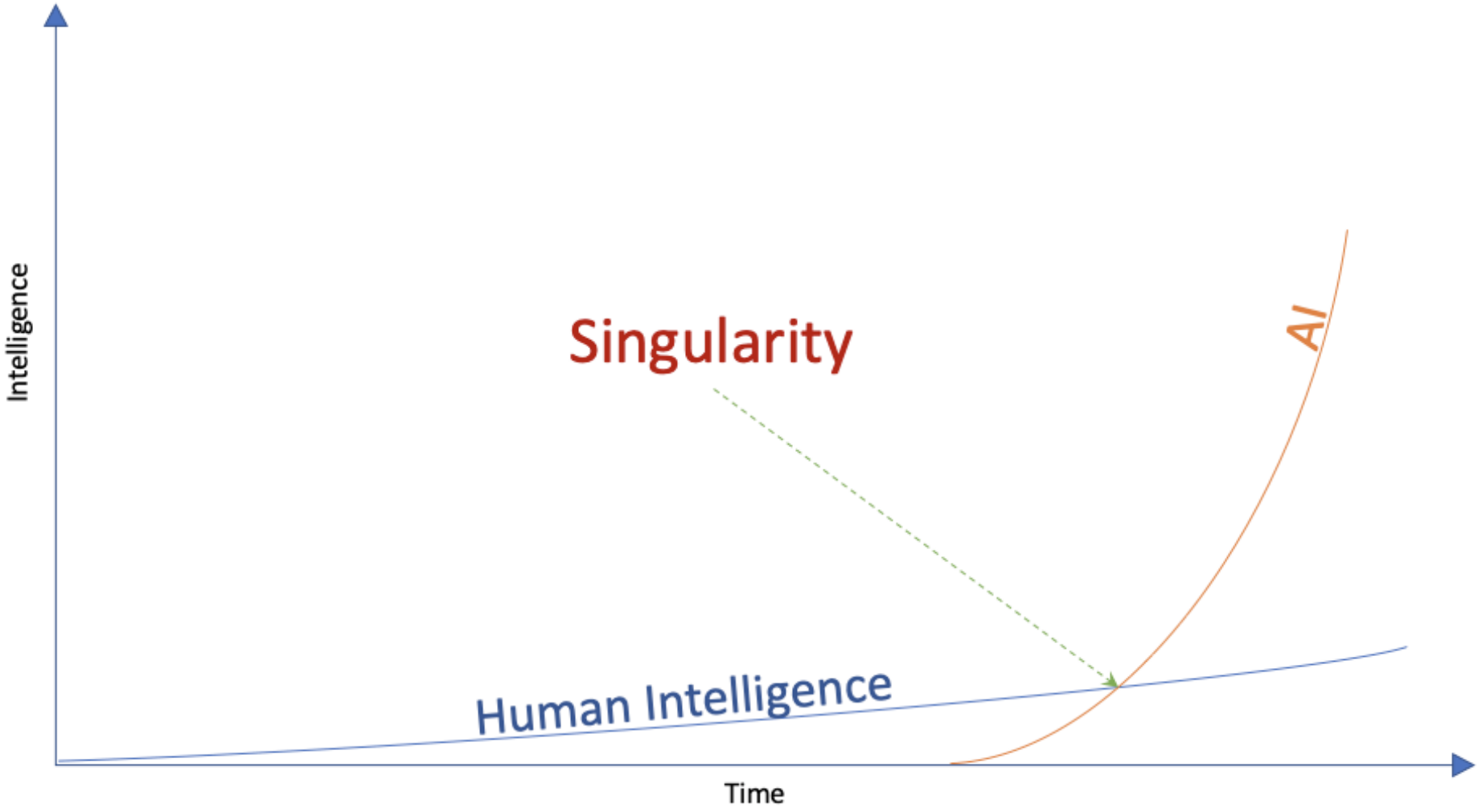
- Franz Kafka, The Trial

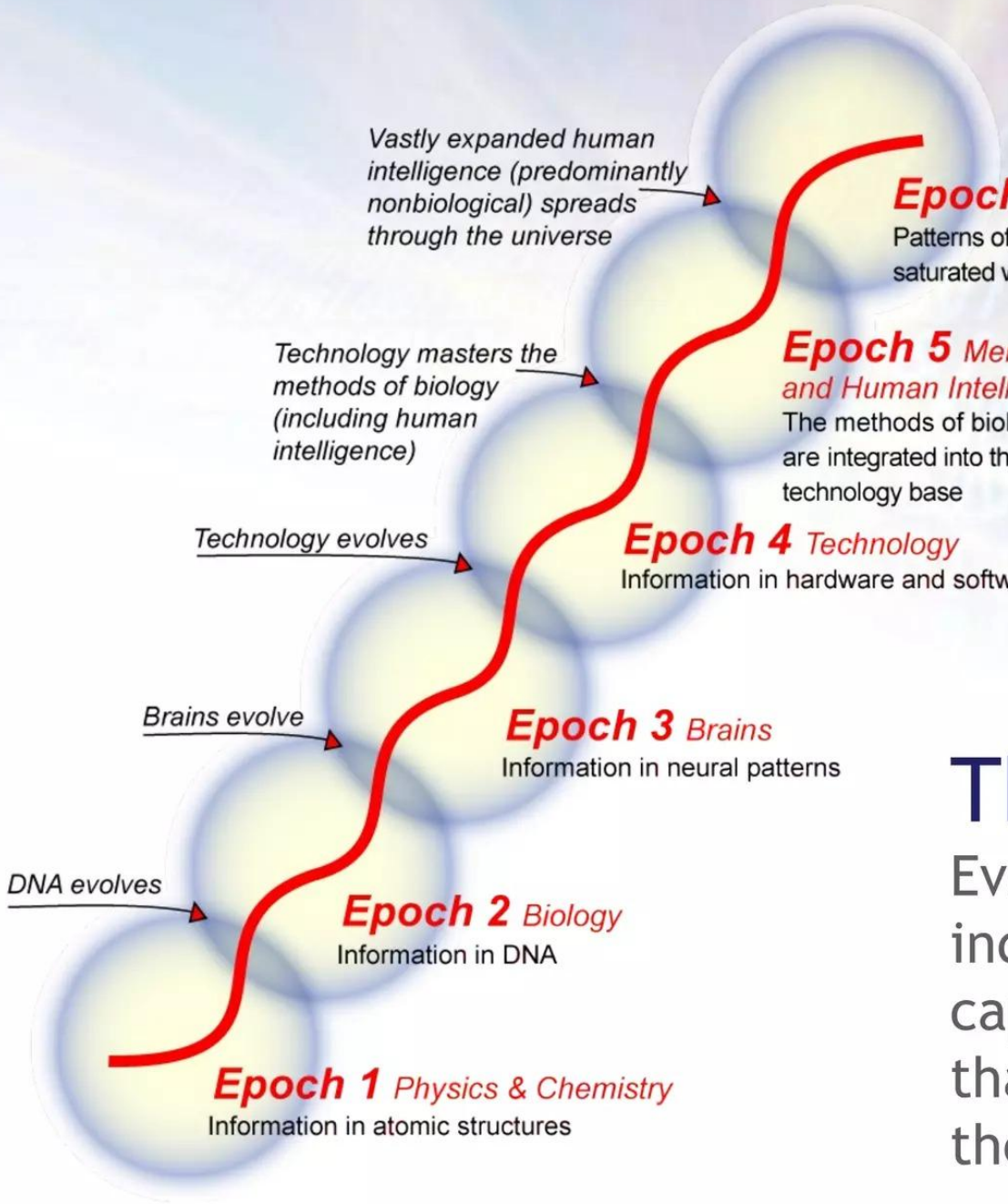




General Relativity -> Gravity = ∞

=> Big Bang


Intelligence
Singularity
AI
Human Intelligence
Time



The 6 Epochs:

Evolution works through indirection: it creates a capability and then uses that capability to evolve the next stage.

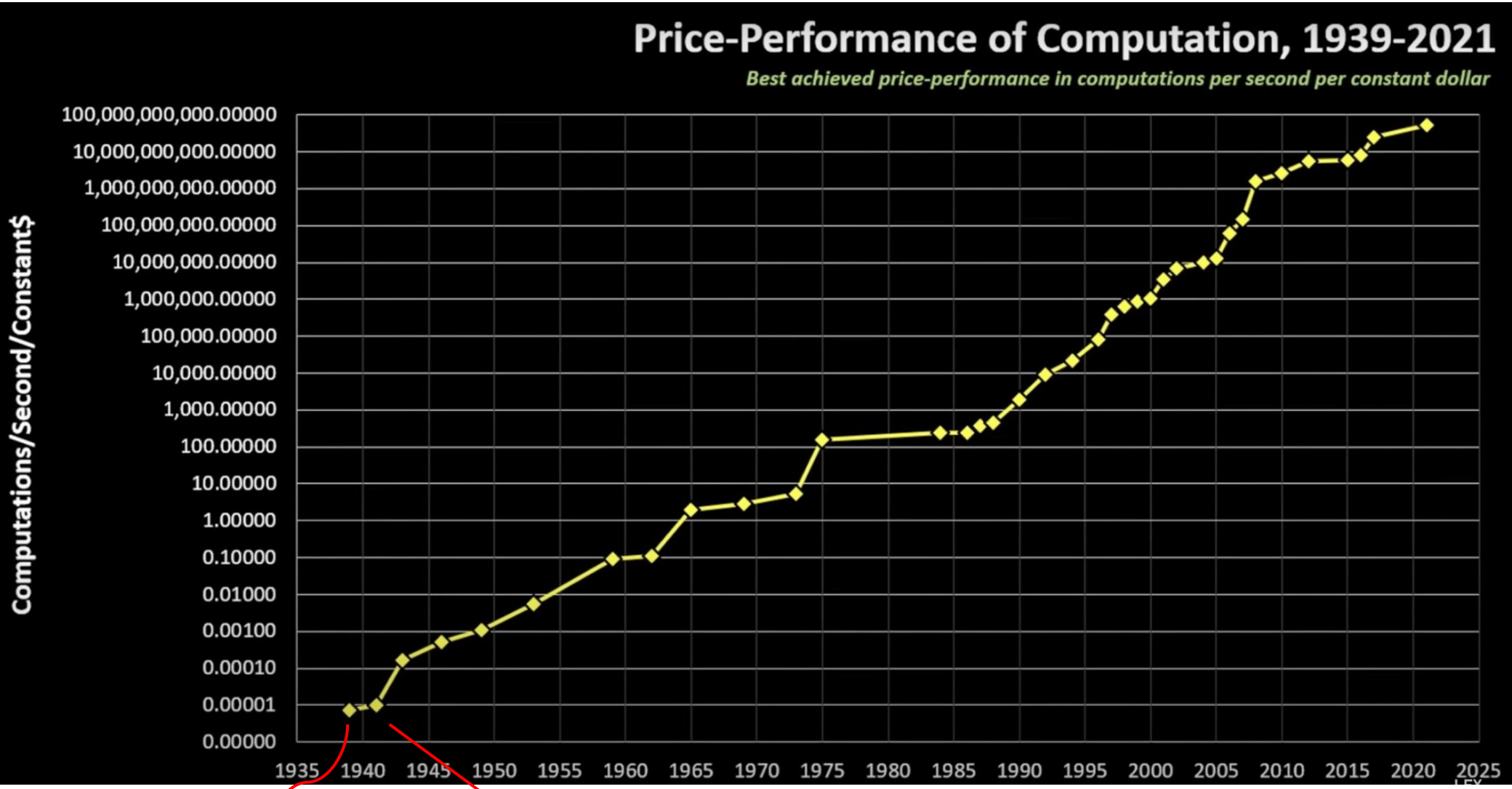
IBM 5 MB Hard Drive

1956

SanDisk 512 GB MicroSD

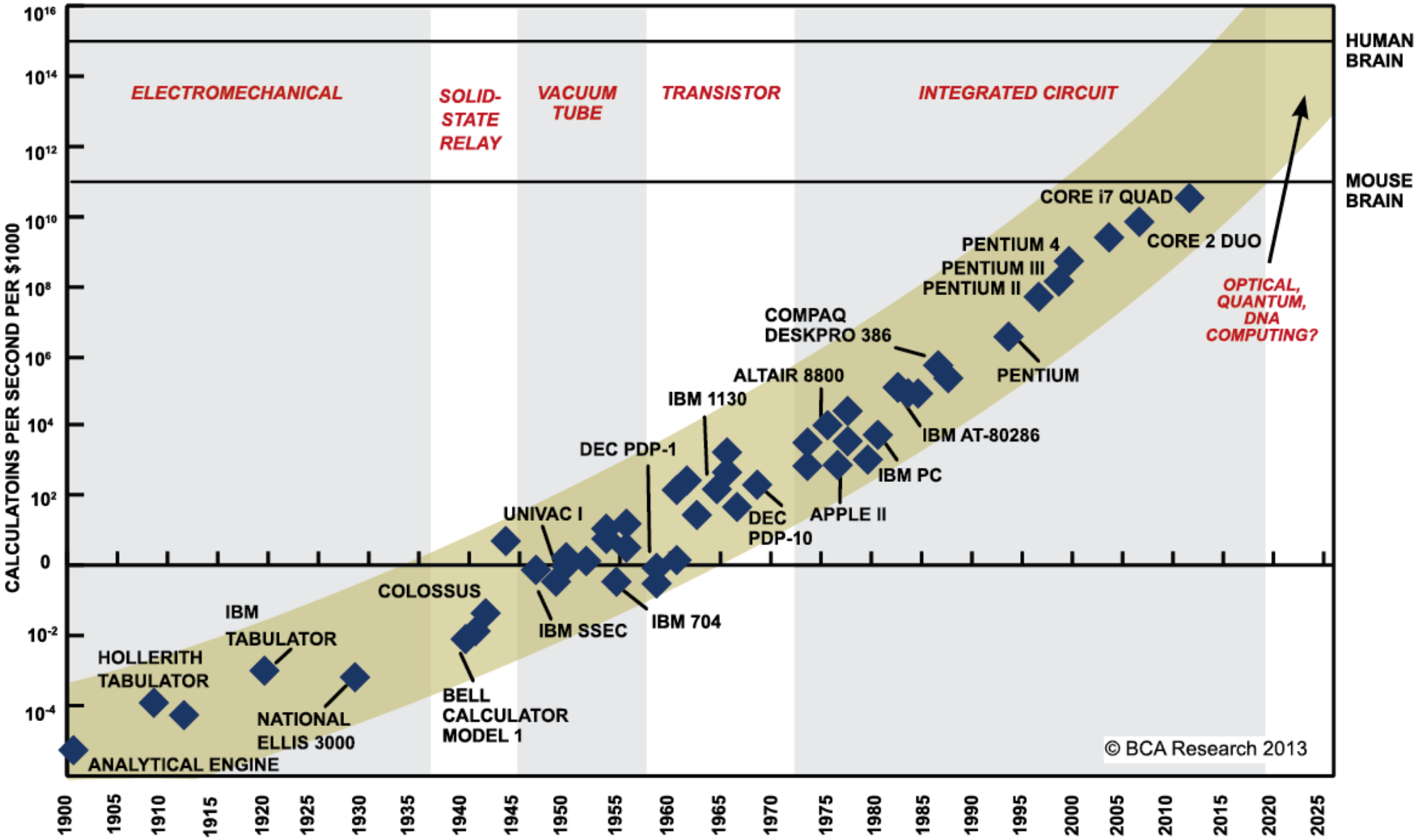
2016

512 GB = 524288 MB
524288/5 = 104,857.6



Z1 – Konrad Zuse

The Bombe – Alan Turing => Colossus …



SOURCE: RAY KURZWEIL, "THE SINGULARITY IS NEAR: WHEN HUMANS TRANSCEND BIOLOGY", P.67, *THE VIKING PRESS*, 2006. DATAPOINTS BETWEEN 2000 AND 2012 REPRESENT BCA ESTIMATES.

1 The accelerating pace of change ...

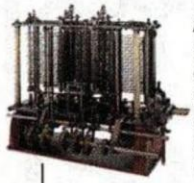
Agricultural Revolution ← 8,000 years → Industrial Revolution ← 120 years → Light-bulb ← 90 years → Moon landing ← 22 years → World Wide Web ← 9 years → Human genome sequenced

2 ... and exponential growth in computing power ...

Computer technology, shown here climbing dramatically by powers of 10, is now progressing more each hour than it did in its entire first 90 years

3 ... will lead to the Singularity

COMPUTER RANKINGS
By calculations per second per $1,000



Analytical engine
Never fully built, Charles Babbage's invention was designed to solve computational and logical problems

Colossus
The electronic computer, with 1,500 vacuum tubes, helped the British crack German codes during WW II

UNIVAC I
The first commercially marketed computer, used to tabulate the U.S. Census, occupied 943 cu. ft.

Apple II
At a price of $1,298, the compact machine was one of the first massively popular personal computers

Power Mac G4
The first personal computer to deliver more than 1 billion floating-point operations per second

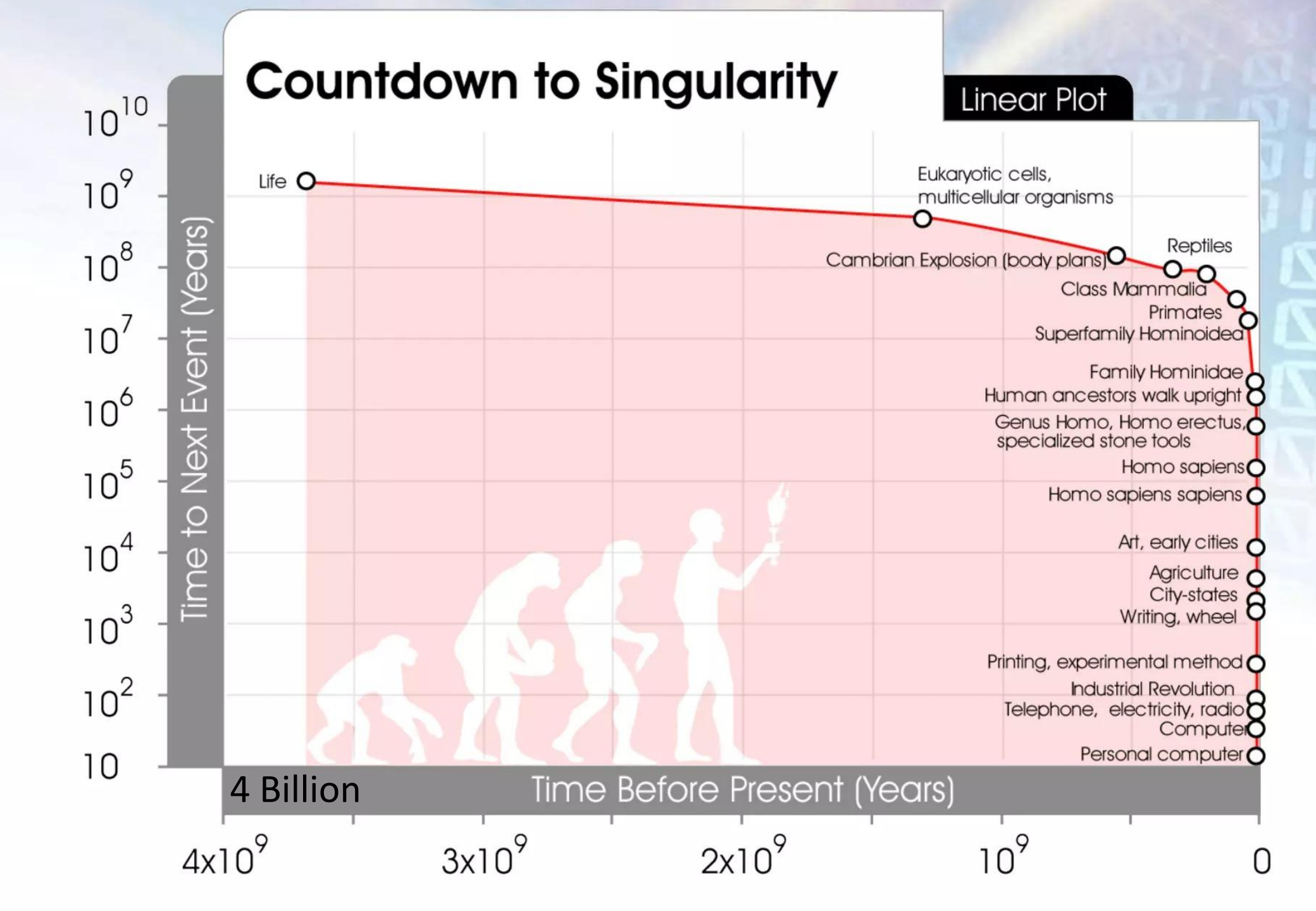
Hollerith Tabulator
IBM Tabulator
National Ellis 3000
Zuse 2
Zuse 3
ENIAC
BINAC
IBM SSEC
EDVAC
Whirlwind
Datamatic 1000
IBM 1620
DEC PDP-4
IBM 1130
DEC PDP-10
Data General Nova
Intellec-8
IBM PC
Compaq Deskpro 386
Pentium PC
Pentium II PC
Dell Dimension 8400
Mac Pro
Nvidia Tesla GPU & PC

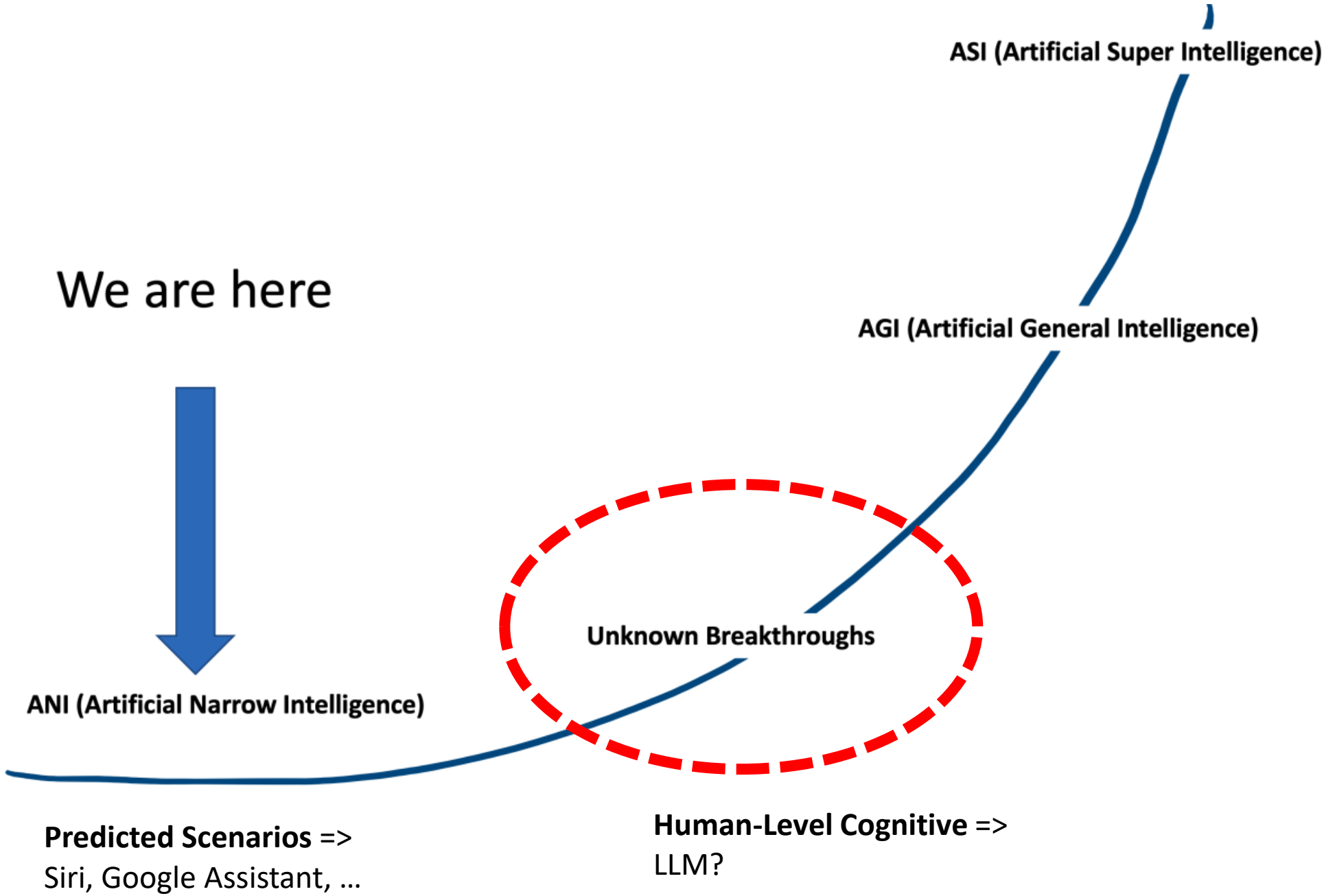
10^{26} — **2045** Surpasses brainpower equivalent to that of all human brains combined
10^{20} — Surpasses brainpower of human in 2023
10^{15}
10,000,000,000 — Surpasses brainpower of mouse in 2015
100,000
1
0.00001

ELECTROMECHANICAL → RELAYS → VACUUM TUBES → TRANSISTORS → INTEGRATED CIRCUITS →

1900 1920 1940 1960 1980 2000 2011 2020 2045

Source: Time Magazine

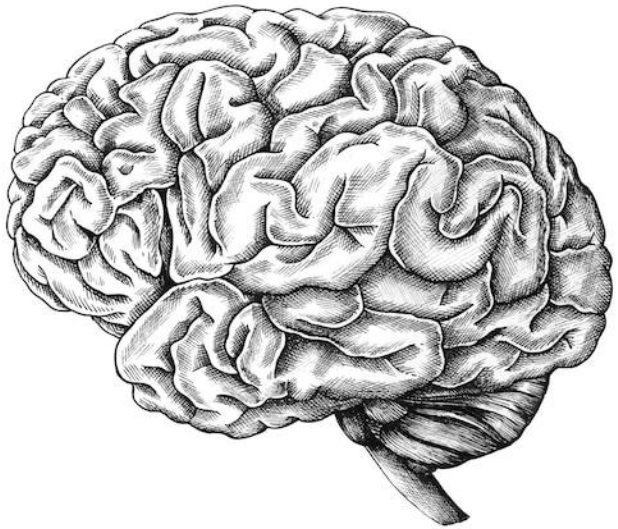

Countdown to Singularity
Linear Plot
Time to Next Event (Years)
10^{10}
10^{9}
10^{8}
10^{7}
10^{6}
10^{5}
10^{4}
10^{3}
10^{2}
10
Life
Eukaryotic cells, multicellular organisms
Cambrian Explosion (body plans)
Reptiles
Class Mammalia
Primates
Superfamily Hominoidea
Family Hominidae
Human ancestors walk upright
Genus Homo, Homo erectus, specialized stone tools
Homo sapiens
Homo sapiens sapiens
Art, early cities
Agriculture
City-states
Writing, wheel
Printing, experimental method
Industrial Revolution
Telephone, electricity, radio
Computer
Personal computer
4 Billion
Time Before Present (Years)
$4x10^9$
$3x10^9$
$2x10^9$
10^9
0


ASI (Artificial Super Intelligence)
We are here
AGI (Artificial General Intelligence)
Unknown Breakthroughs
ANI (Artificial Narrow Intelligence)
Predicted Scenarios =>
Siri, Google Assistant, …
Human-Level Cognitive =>
LLM?

Narrow AI	General AI
○ Application specific/ task limited	○ Perform general (human) intelligent action
○ Fixed domain models provided by programmers	○ Self-learns and reasons with its operating environment
○ Learns from thousands of labeled examples	○ Learns from few examples and/or from unstructured data
○ Reflexive tasks with no understanding	○ Full range of human cognitive abilities
○ Knowledge does not transfer to other domains or tasks	○ Leverages knowledge transfer to new domains and tasks
○ Today's AI	○ Future AI?

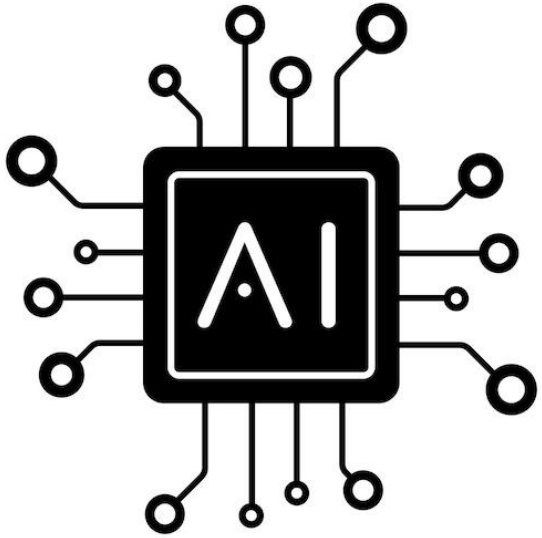
AGI: **Human-Level Cognition**, **Reasoning** , **Problem Solving**, **Learn** and **Conscious**

A.



- Biological Engineering
- Genetic Engineering
- Brain-Computer Interface
- Nootropic Drugs
- Mind Uploading
- Nanorobotics

B.



- Enhancing Computer Performance & Accelerating Change
- Algorithm Improvements

B.

- **Structural Obstacles**
- **Correlation Obstacles**
- **Manifestation Obstacles**

AGI

1. Enhancing Computer Performance & Accelerating Change:

Whenever a technology approaches some kind of a barrier, a new technology will be invented.

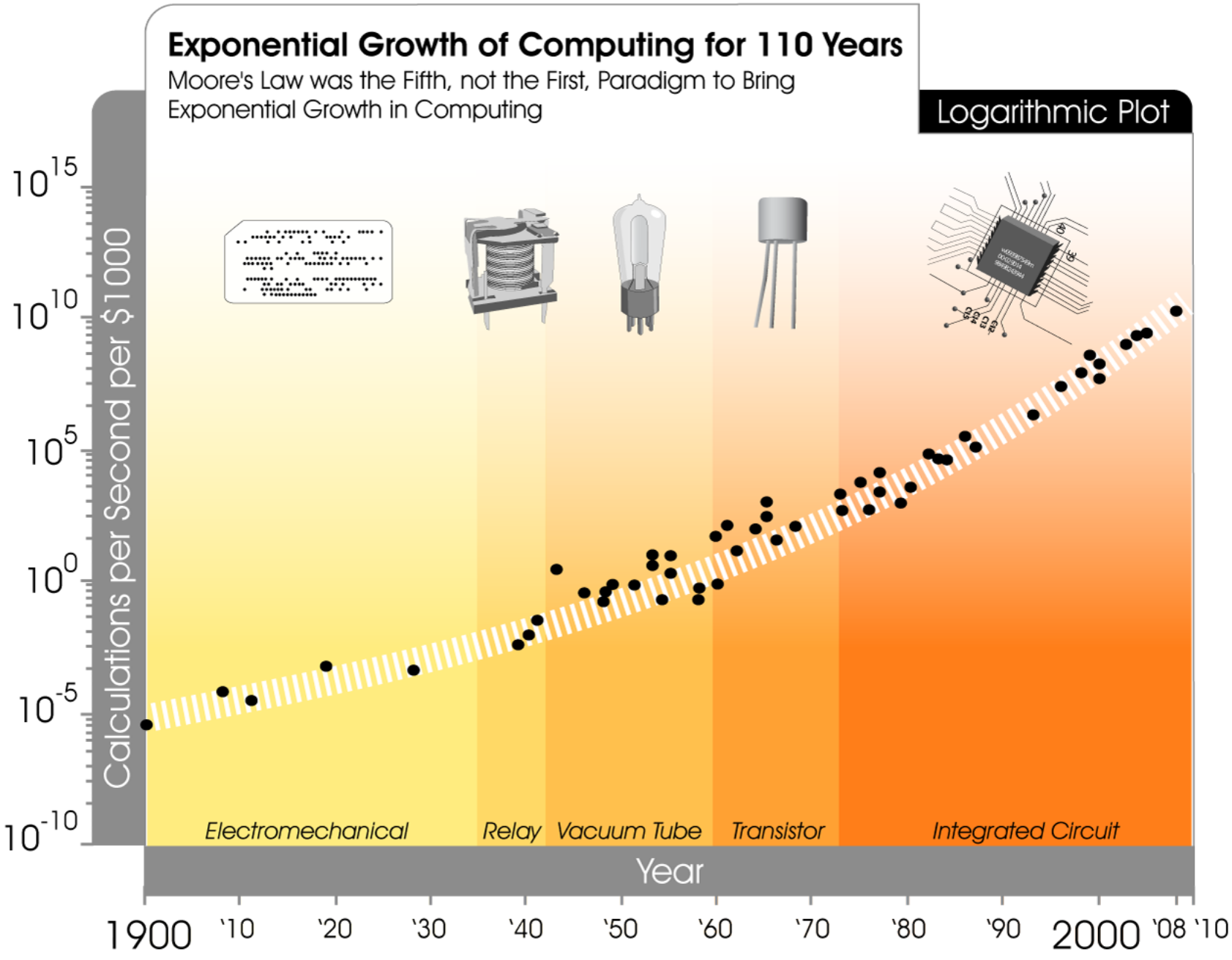
=> Paradigm Shift -> 3D IC

2. Algorithm Improvements:

potential to make themselves faster, also more efficient, by modifying their source code.

=> Recursive Self-improvement -> Seed AI

1.


Exponential Growth of Computing for 110 Years
Moore's Law was the Fifth, not the First, Paradigm to Bring Exponential Growth in Computing
Logarithmic Plot
Calculations per Second per $1000
10^15
10^10
10^5
10^0
10^-5
10^-10
Electromechanical
Relay
Vacuum Tube
Transistor
Integrated Circuit
Year
1900
'10
'20
'30
'40
'50
'60
'70
'80
'90
2000
'08
'10

2.

1. A robot may not injure a human.

2. A robot must obey the orders given it by human beings except where such orders would conflict with the First Law.

3. A robot must protect its own existence as long as such protection does not conflict with the First or Second Law.

0. A robot may not injure humanity.

- **Structural Obstacles**
  - Performance
  - Algorithm

- **Correlation Obstacles**
  - Unpredicted Scenarios
  - Independent Conditions
  - Cognitive Skills
  - Communication with other AIs
  - Conflict of Interest and …

- **Correlation Obstacles**
  - Disasters
  - Epidemic Diseases
  - Conflict Between Countries
  - Wars and Security Sabotage
  - Legal Restrictions and …

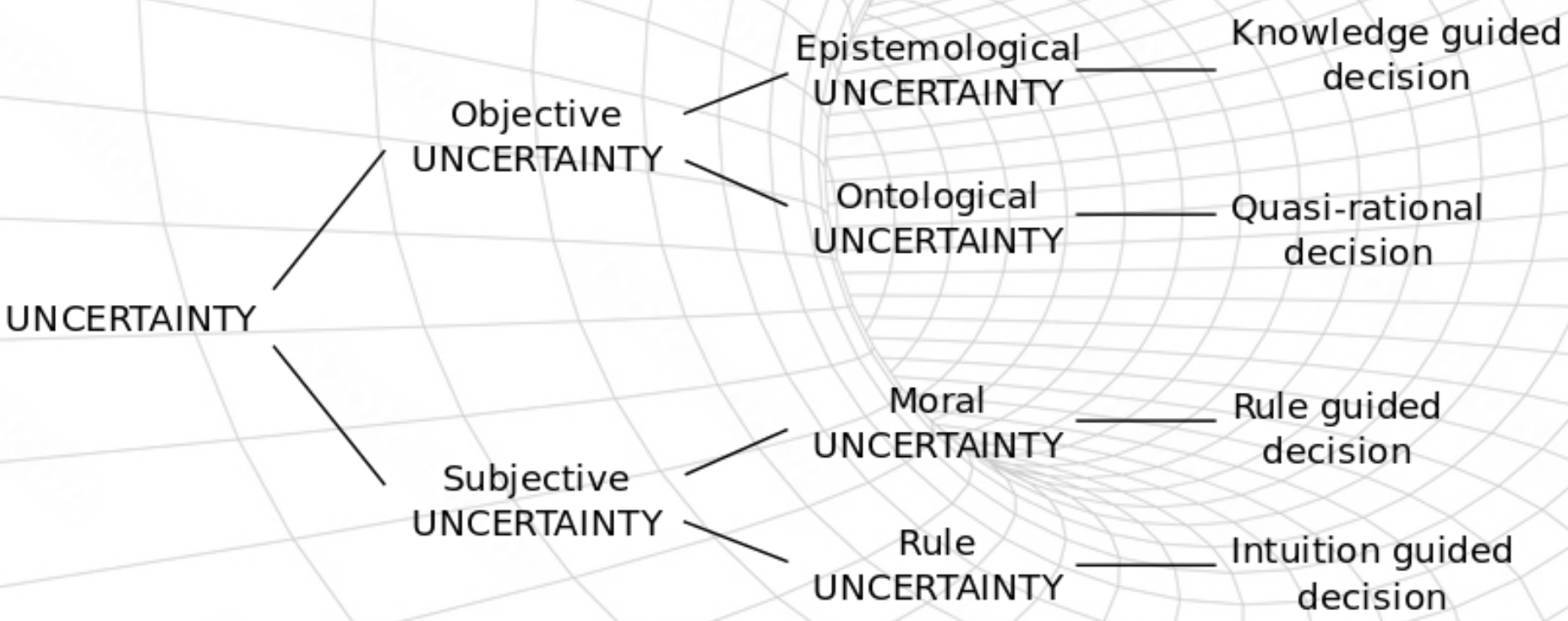
Impact & consequences

Modern Times - 1936

I.

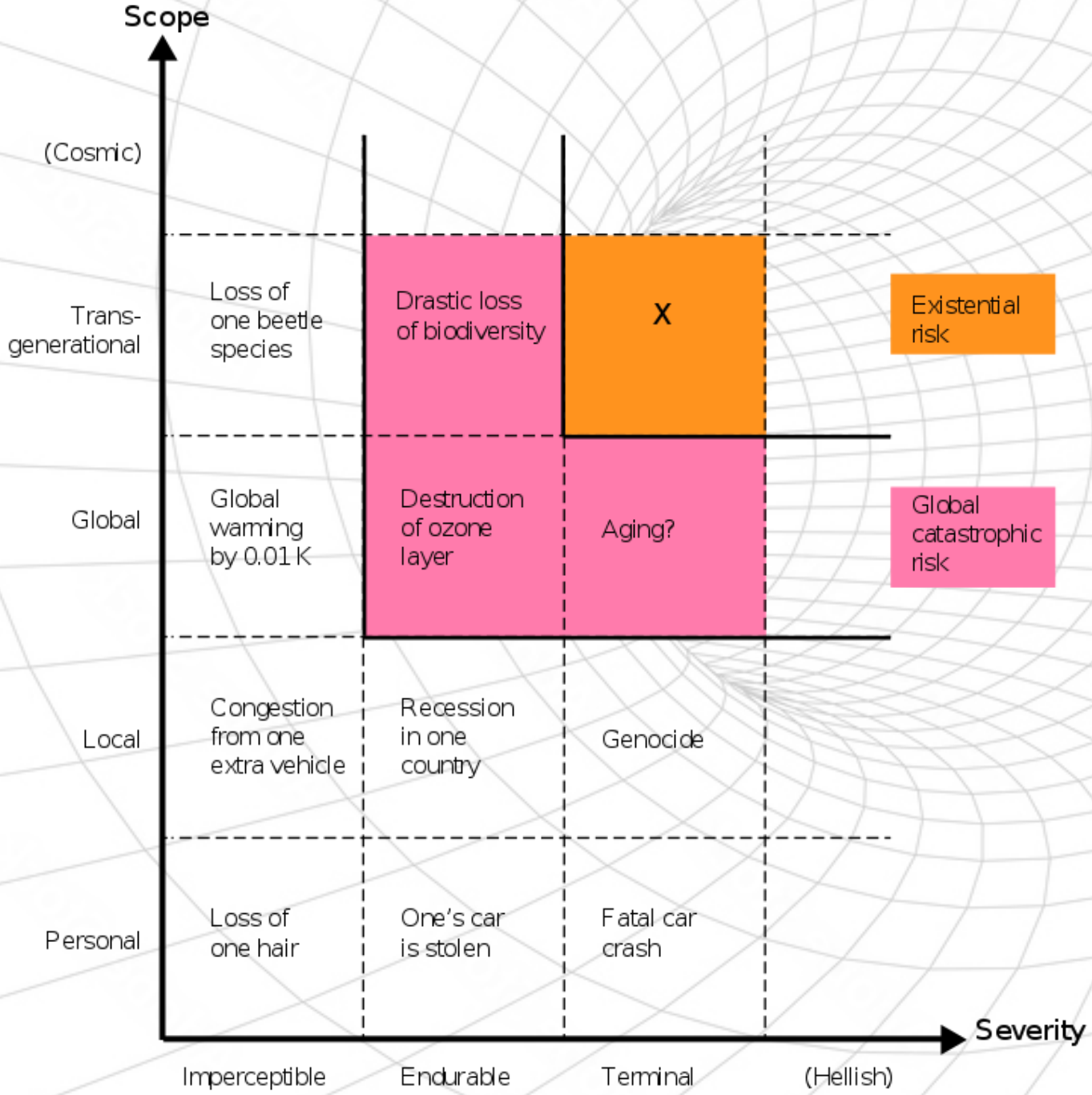
- Uncertainty
- Rewriting AI Safety rules
- Resource War
- Better Solutions vs Human Solutions
- Increasing Class Conflict
- Loss of Morality
- Totalitarianism & Authoritarianism
- High Potential for Law Breaking
- Existential Risk
- Loneliness and Isolation

I.

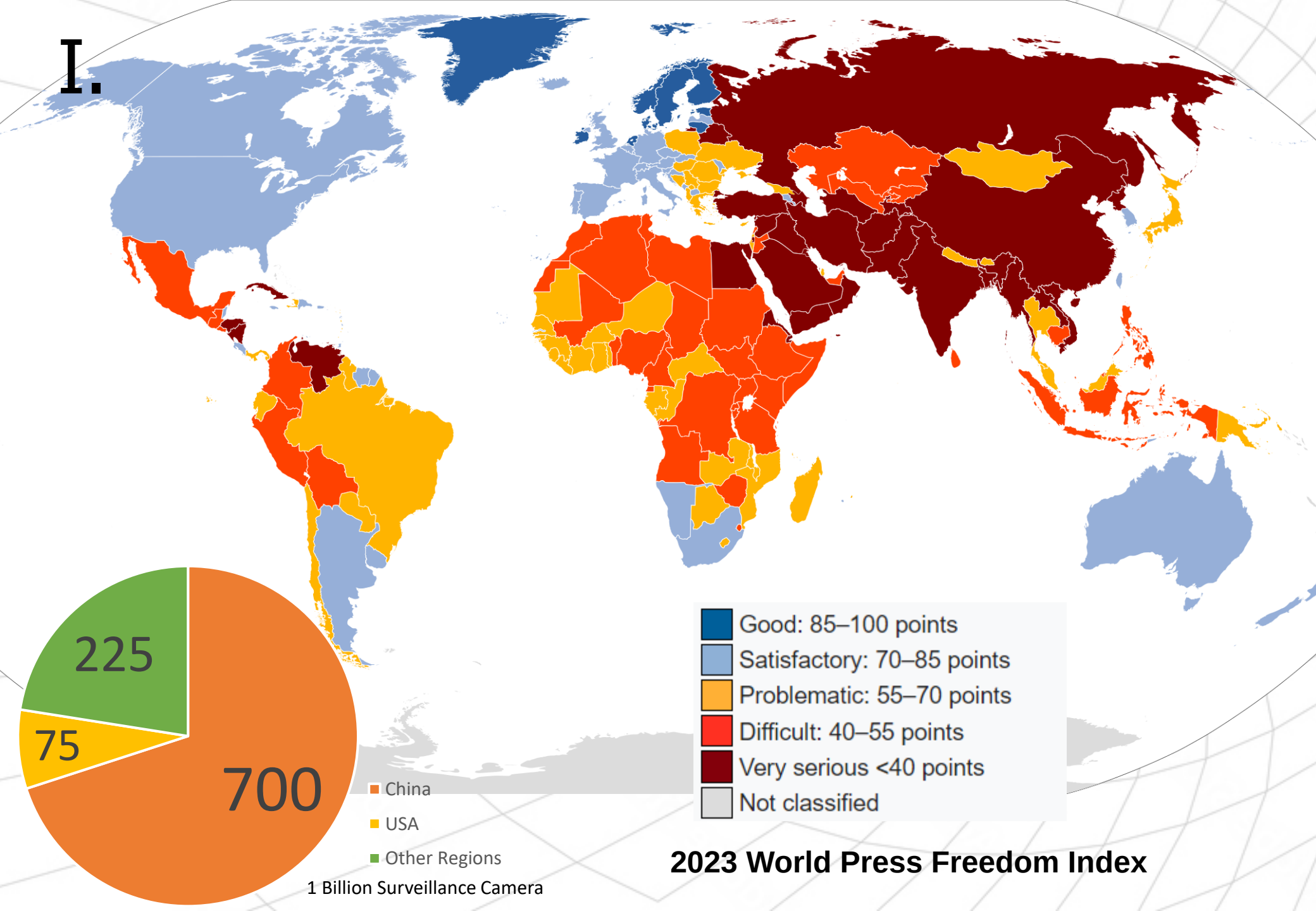


(Uncertainty Principle + Complexity)

I.


Scope
(Cosmic)
Trans-generational
Global
Local
Personal
Loss of one beetle species
Drastic loss of biodiversity
X
Existential risk
Global warming by 0.01 K
Destruction of ozone layer
Aging?
Global catastrophic risk
Congestion from one extra vehicle
Recession in one country
Genocide
Loss of one hair
One's car is stolen
Fatal car crash
Severity
Imperceptible
Endurable
Terminal
(Hellish)

I.



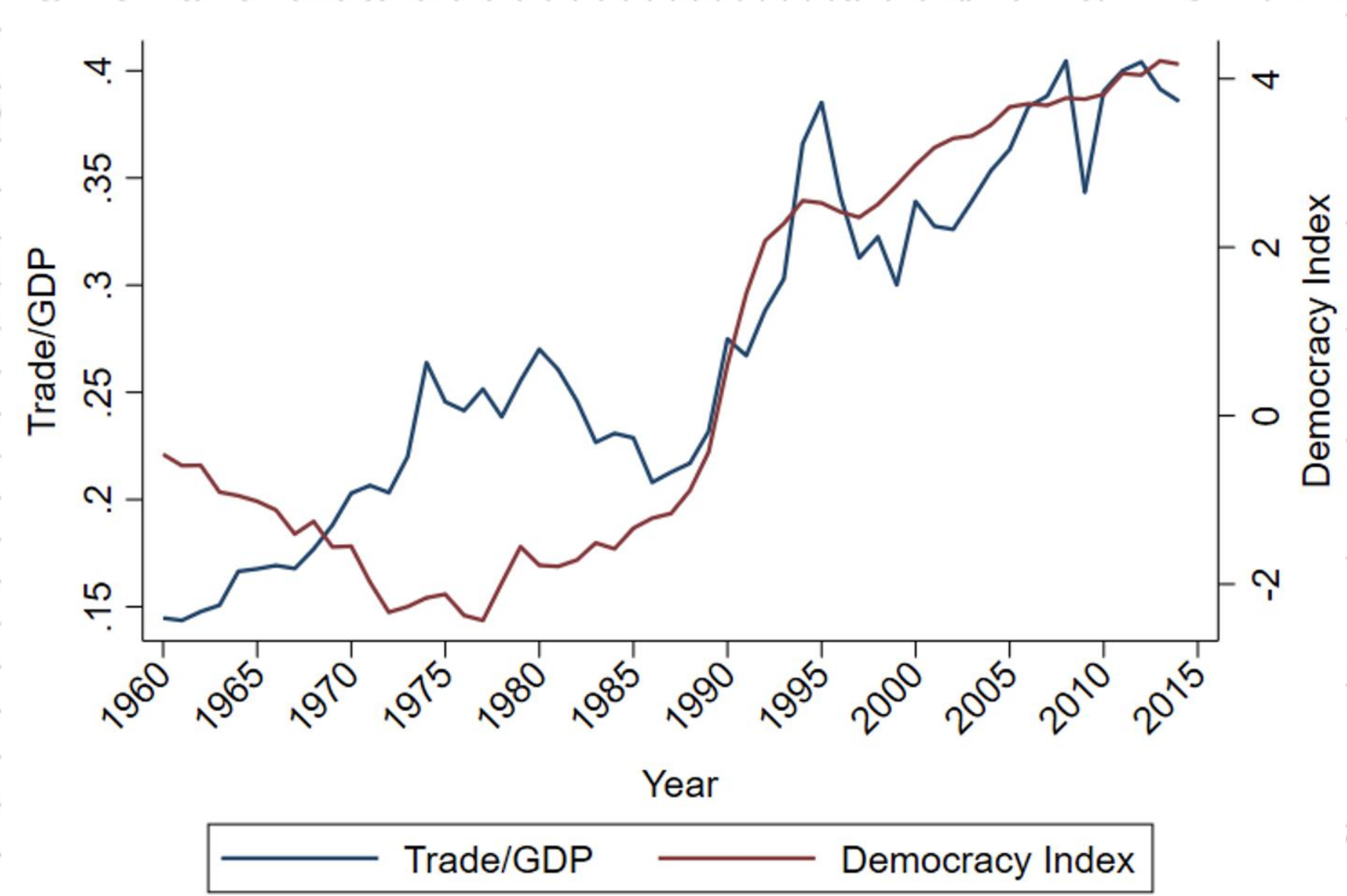
2023 World Press Freedom Index

1 Billion Surveillance Camera

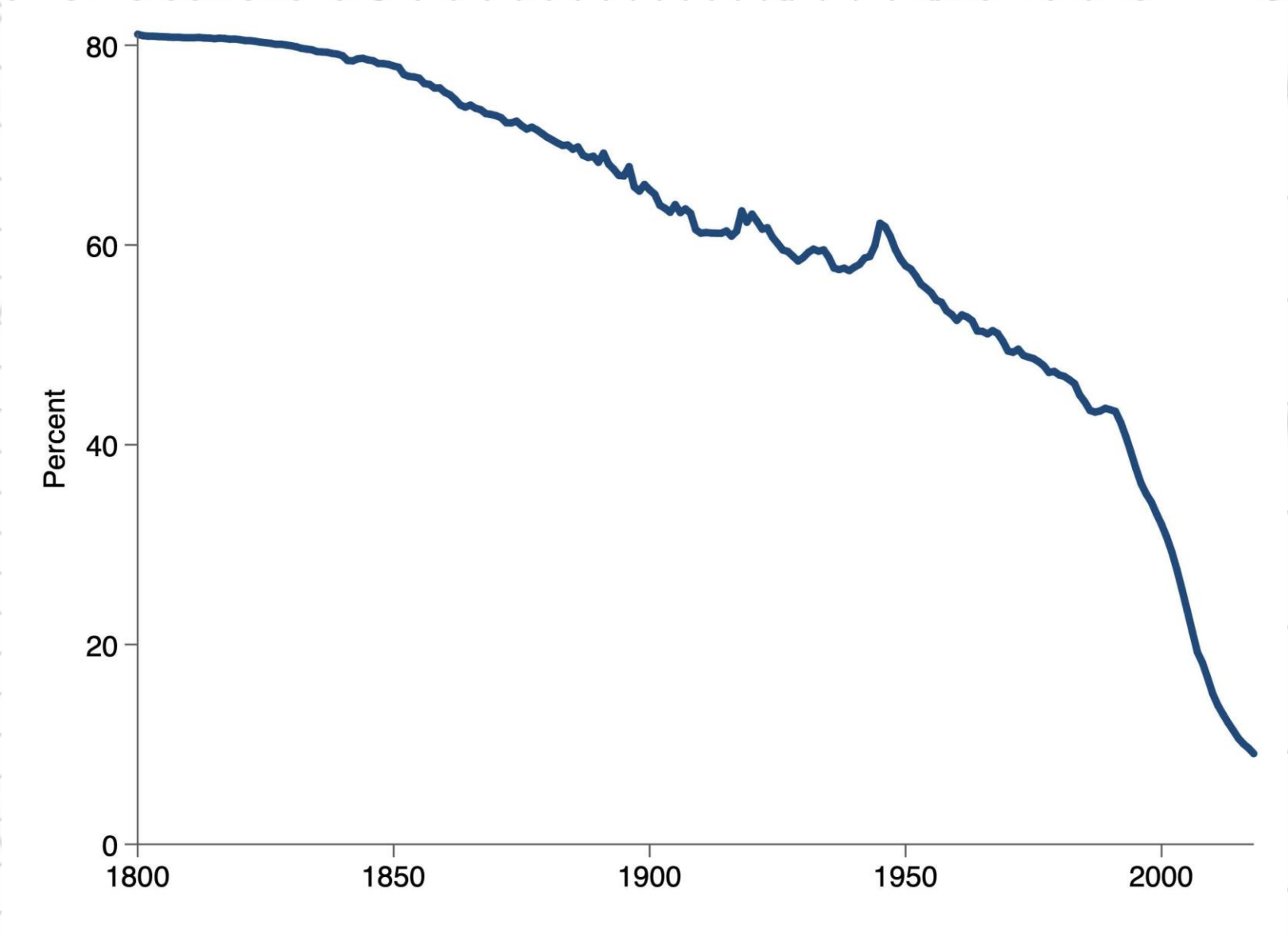
II.

- Advances in Science
- Improving Human Lifestyle
- Eliminate Jobs for the Benefit of Humans
- Prevention and Treatment of Diseases & Disorders
- Correct Upbringing of Children
- Decentralization of Traditional Governments (Democracy)
- Extensive Automation and Controlling Robots
- The Complete Transformation of Communication
- Integrated Life in the Digital World
- Human Clones from Past Generations
- Superhumans
- Immortality

II.


Trade/GDP
.15
.2
.25
.3
.35
.4
Democracy Index
-2
0
2
4
1960
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
Year
Trade/GDP
Democracy Index

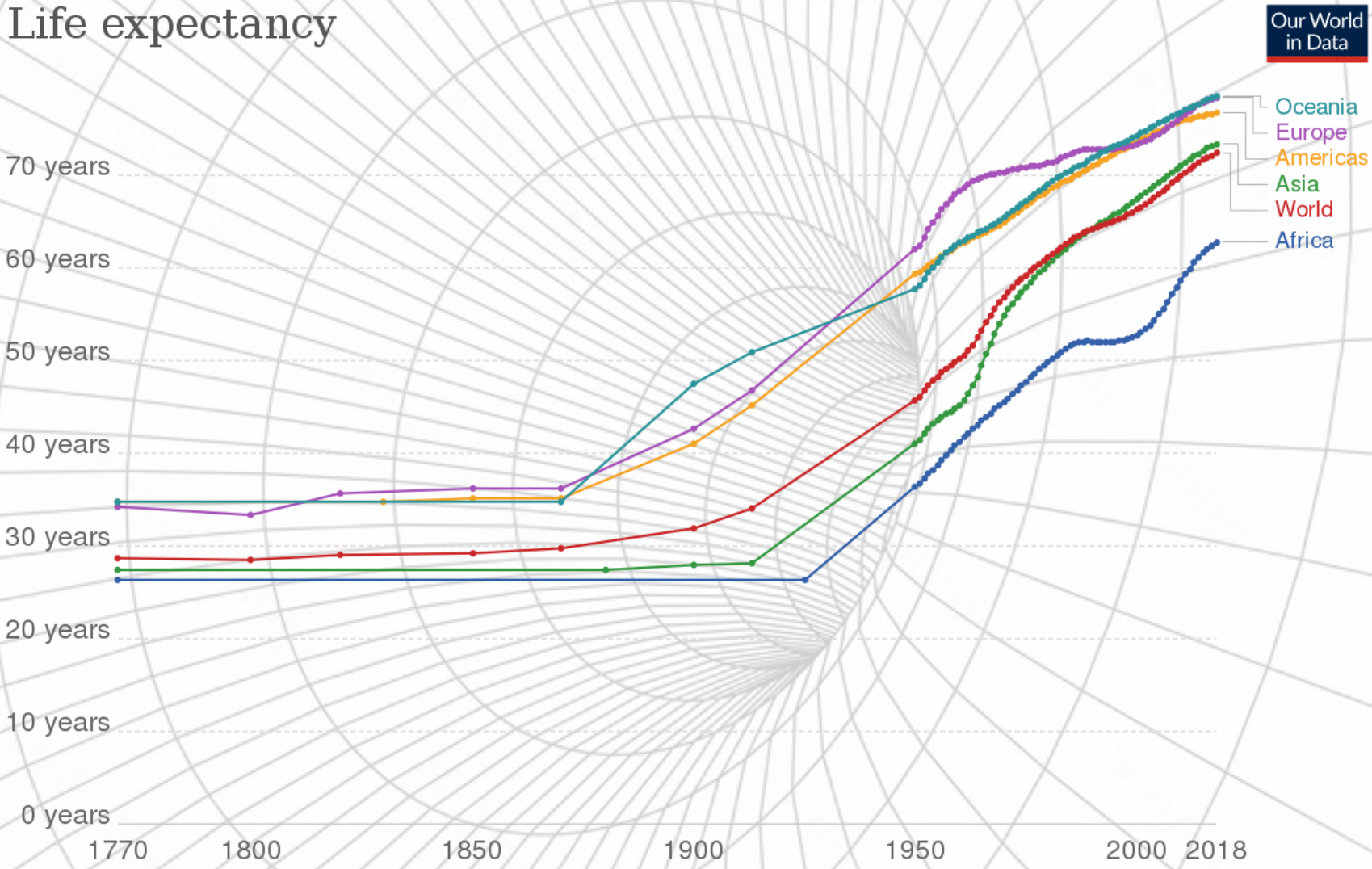
II.



A History of Poverty Worldwide

II.

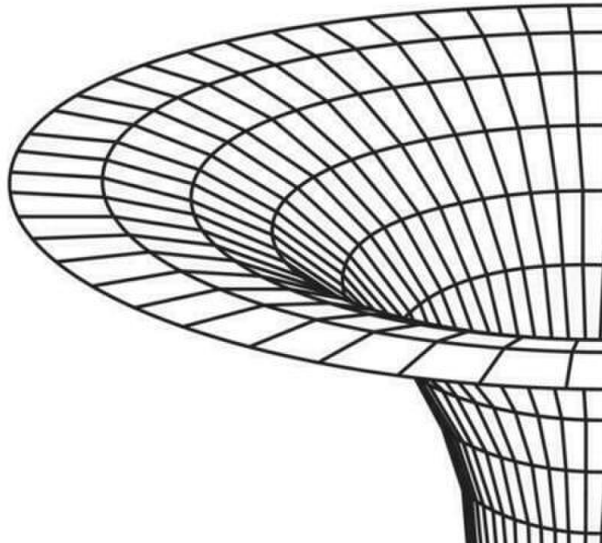
Life expectancy



Source: Riley (2005), Clio Infra (2015), and UN Population Division (2019)
Note: Shown is period life expectancy at birth, the average number of years a newborn would live if the pattern of mortality in the given year were to stay the same throughout its life.

Criticism

- Not All Dreams Come True
- Technology Paradox (Negative Feedback: Job-Investment)
- Decline in Clock Rates
- Invalidity of pseudo-Moore's law Graphs
- Law of Diminishing Returns (Patents)
- Margin of Scientific Accuracy
- Religious Motives



There are no happy endings in history, only crisis points that pass.

- Isaac Asimov, The Gods Themselves