

The history of computational intelligence

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21/01/2019

IRIT

Creation and thought



Vulcan Presenting the Arms of Achilles to Thetis by Peter Paul Rubens. Source: wikipedia



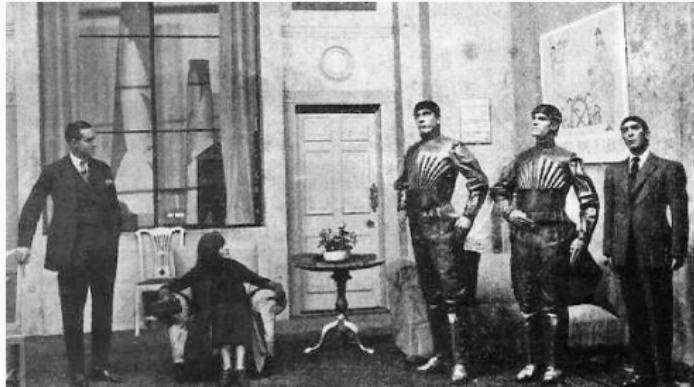
Al-Jazari's programmable humanoid robot, 1206 Source: wikipedia



Gottfried Wilhelm Leibniz, 1646 - 1716 Source: wikimedia

Automata

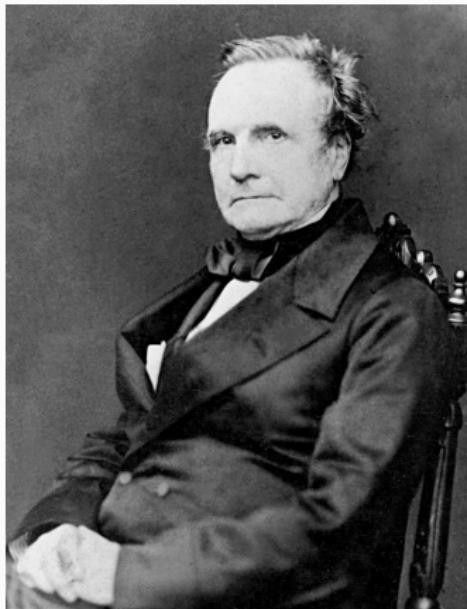
- <https://www.youtube.com/watch?v=7PiG-FA11UM>
- <https://www.youtube.com/watch?v=75CXFwgslsY>



Rossumovi Univerzální Roboti (Rossum's Universal Robots),
Karel Čapek, 1921 Source: wikipedia

Calculating machines

The Analytical Engine



Charles Babbage's Analytical Engine, formally described in 1837
Source: Wikimedia

Alan Turing



Alan Turing and a reconstructed bombe, first installed in 1940
Source: Wikimedia

Alan Turing



“Le cas Alan Turing”, Liberge and Delalande 2016

The Turing Test

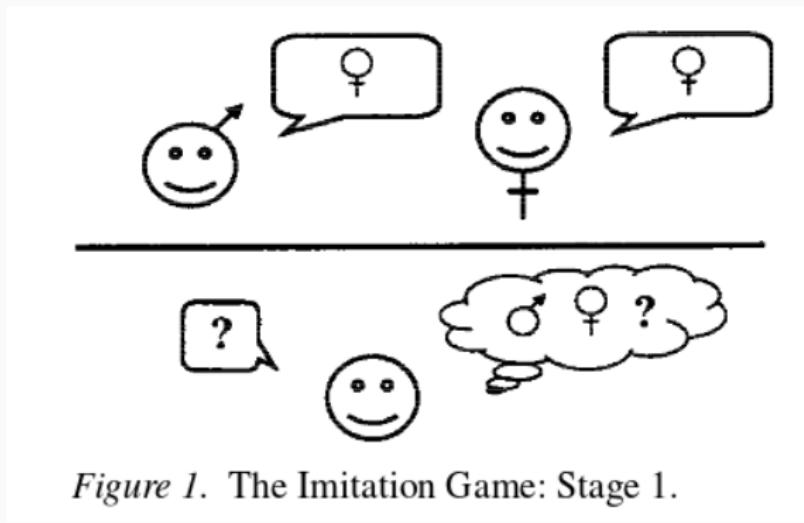
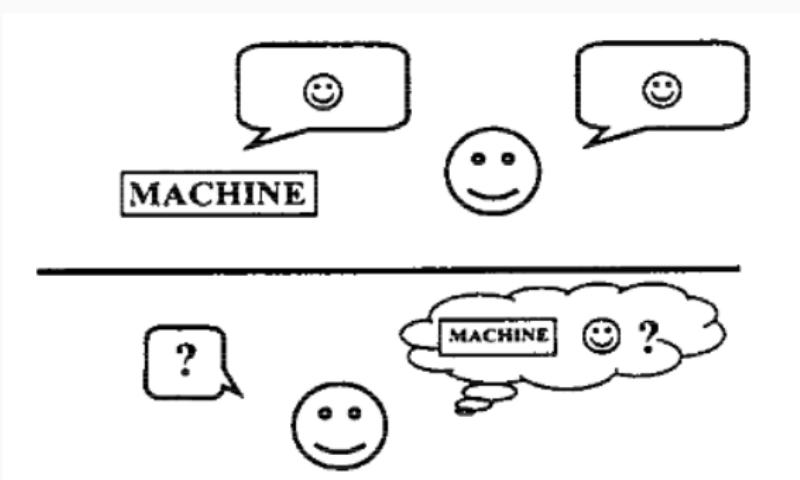


Figure 1. The Imitation Game: Stage 1.

Saygin, Cicekli, and Akman 2000

The Turing Test



Saygin, Cicekli, and Akman 2000

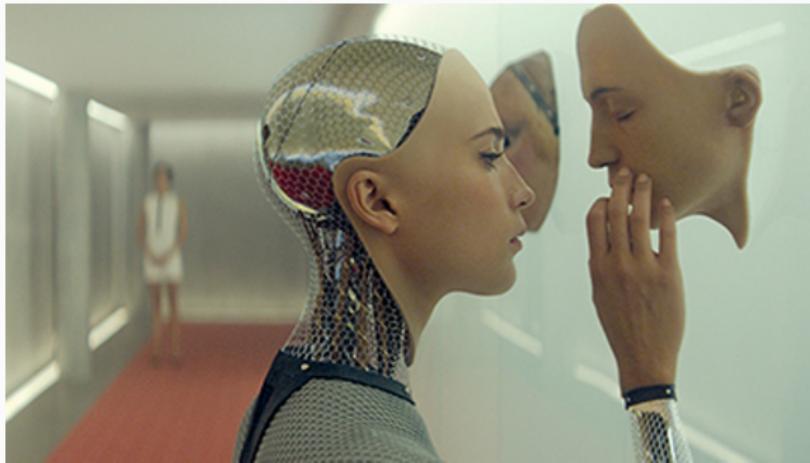
The Turing Test



Lady Ada Lovelace

Source: Wikimedia

The Turing Test



Source: Ex Machina (2014)



THREE LAWS OF ROBOTICS

1. A robot must not injure a human being or, through inaction, allow a human being to come to harm.
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 Laws.



ANDROID AUTHORITY

Asimov and his three laws of robotics, 1950

Source: wikimedia, android authority

- “A logical calculus of the ideas immanent in nervous activity”, McCulloch and Pitts, 1943
- “First Draft of a Report on the EDVAC”, Von Neumann et al, 1945
- “Computing Machinery and Intelligence”, Turing, 1950
- “Programming a Computer for Playing Chess”, Shannon, 1950

AI as a field

Dartmouth Conference: The Founding Fathers of AI



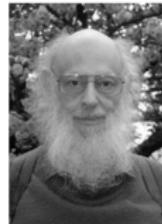
John McCarthy



Marvin Minsky



Claude Shannon



Ray Solomonoff

Alan Newell



Herbert Simon



Arthur Samuel



And three others...

Oliver Selfridge
(Pandemonium theory)

Nathaniel Rochester
(IBM, designed 701)

Trenchard More
(Natural Deduction)

Source: Wikimedia

The golden years

Great expectations



<https://www.youtube.com/watch?v=aygSMgK3BEM>

Source: chess-site.com

Foundations of modern robotics

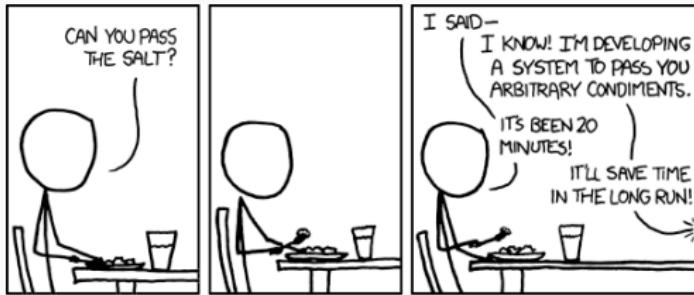


<https://www.youtube.com/watch?v=GmU7SimFkpU>

Source: SRI

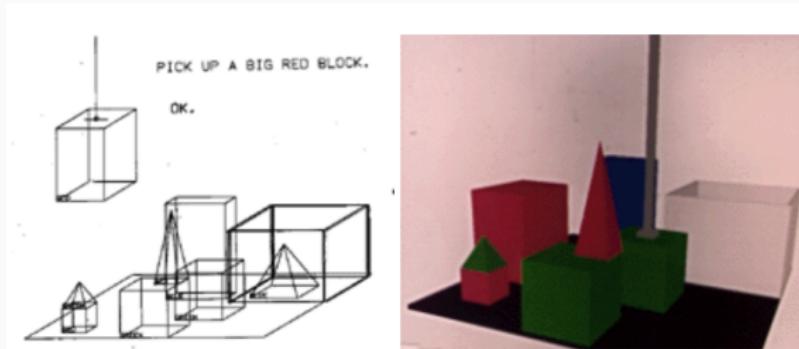
Foundations of search and reasoning

- 1959 - Dijkstra's
- 1959 - General Problem Solver
- 1960 - Binary search trees
- 1966 - Graph traveler
- 1968 - A* search



Source: XKCD

Foundations of NLP



<https://www.youtube.com/watch?v=QAJz4YKUwqw>

Source: Stanford HCI

Foundations of HCI

ELIZA Weizenbaum 1966

<https://www.masswerk.at/elizabot/eliza.html>

Winters and summers

Moravec's paradox

It is comparatively easy to make computers exhibit adult level performance on intelligence tests or playing checkers, and difficult or impossible to give them the skills of a one-year-old when it comes to perception and mobility.

- Hans Moravec, 1988

We're more aware of simple processes that don't work well than of complex ones that work flawlessly.

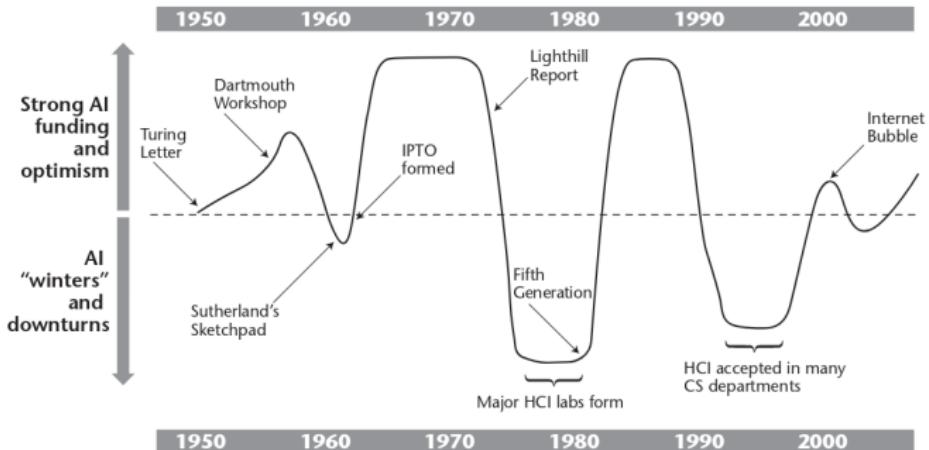
- Marvin Minsky, 1968

Lighthill report

Artificial Intelligence: A General Survey, James Lighthilll, 1973

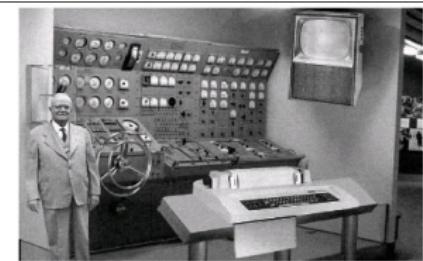
<https://www.youtube.com/watch?v=FLnqHzpLPws>

AI and HCI



Grudin 2009

The Fifth generation



First Generation



Second Generation



Third Generation



Fourth Generation

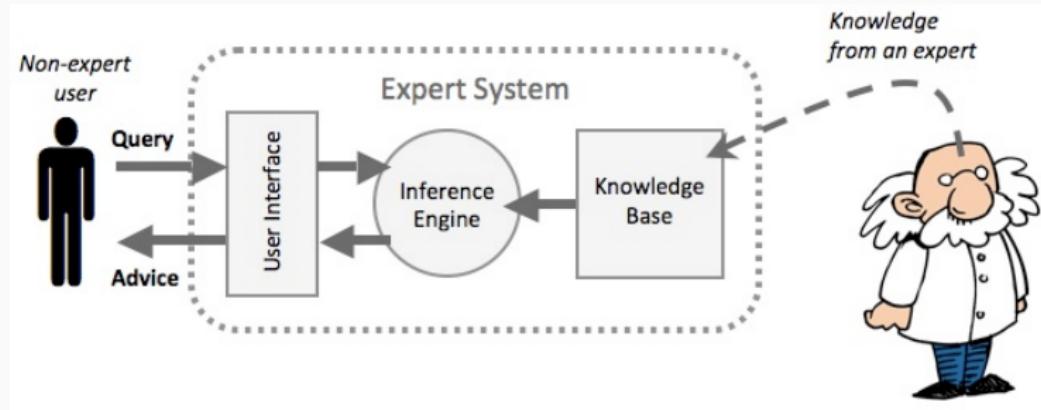


Fifth Generation

1981, Fifth generation project in Japan, \$850 million

Source: techno-crypto.com

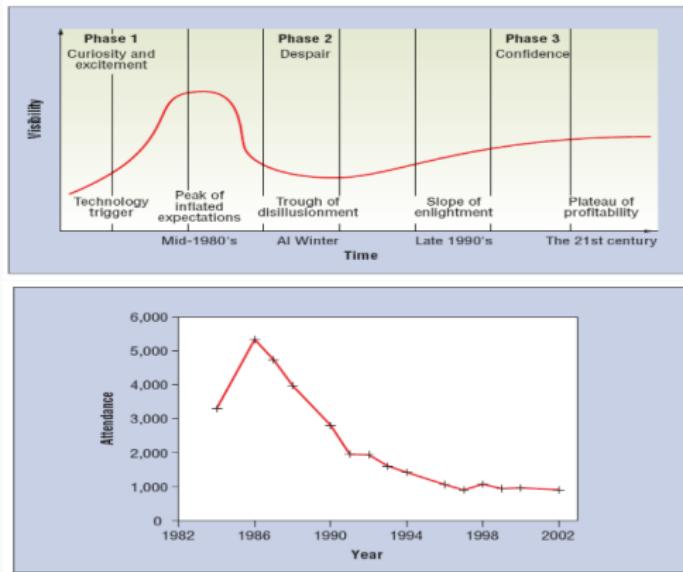
Expert systems



<https://www.youtube.com/watch?v=Mu8zyHh4vTg>

Source: igcseict.info

A second winter



"The History of Artificial Intelligence", Smith, 2006



"Elephants don't play chess", Rodney Brooks, 1990

Source: digitalsynopsis.com

Winters and summers

AI HAS A LONG HISTORY OF BEING “THE NEXT BIG THING”...

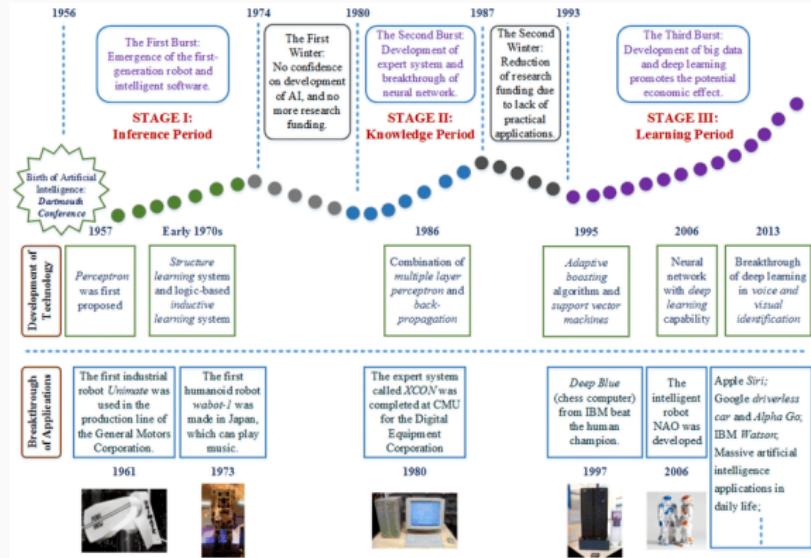


Timeline of AI Development

- 1950s-1960s: First AI boom - the age of reasoning, prototype AI developed
- 1970s: AI winter I
- 1980s-1990s: Second AI boom: the age of Knowledge representation (appearance of expert systems capable of reproducing human decision-making)
- 1990s: AI winter II
- 1997: Deep Blue beats Gary Kasparov
- 2006: University of Toronto develops Deep Learning
- 2011: IBM's Watson won Jeopardy
- 2016: Go software based on Deep Learning beats world's champions

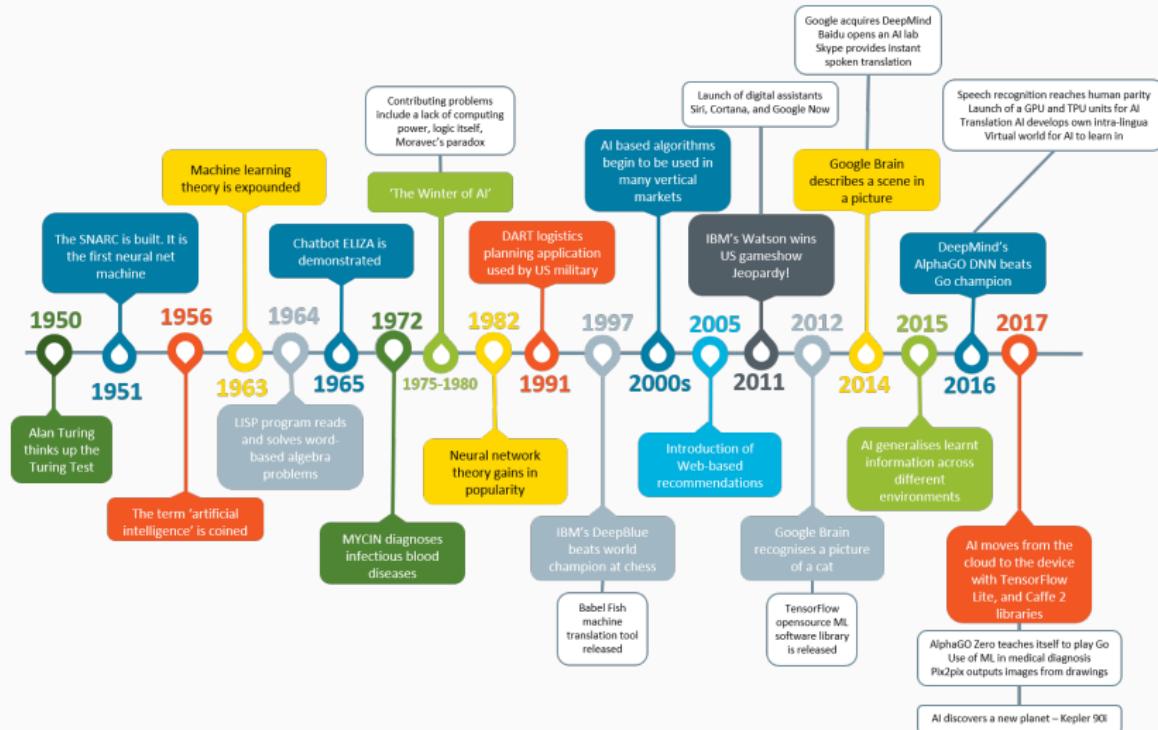
Source: actuaries.digital

Ups and downs?



“State-of-the-Art Mobile Intelligence: Enabling Robots to Move Like Humans by Estimating Mobility with Artificial Intelligence”,
Jin et al, 2018

Or a straight line?



Source: innovationobservatory.com

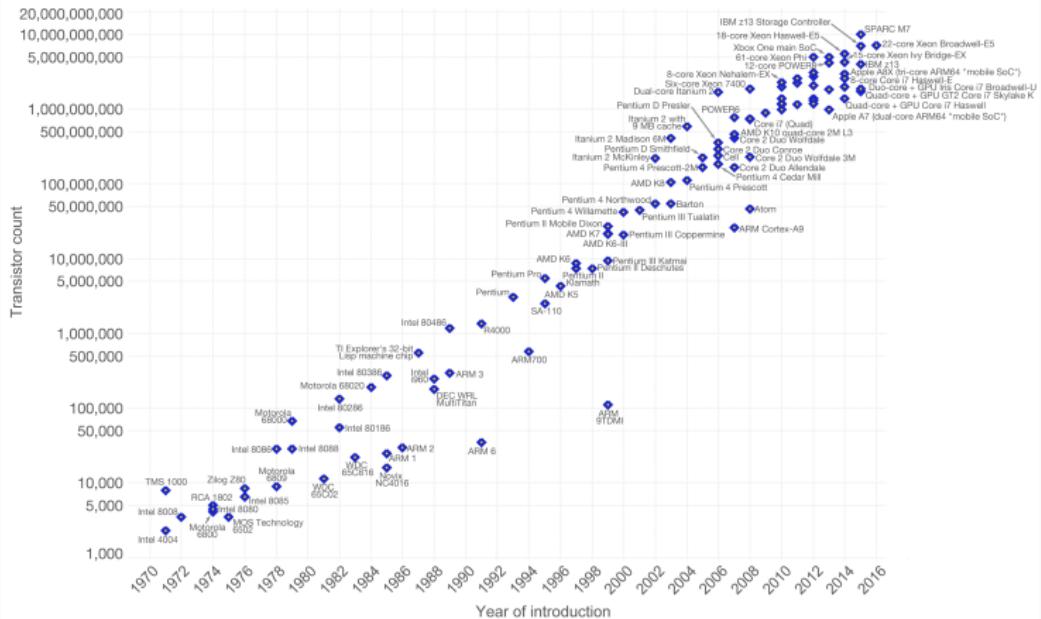
Modern era

Moore's Law

Moore's Law – The number of transistors on integrated circuit chips (1971-2016)



Moore's law describes the empirical regularity that the number of transistors on integrated circuits doubles approximately every two years. This advancement is important as other aspects of technological progress – such as processing speed or the price of electronic products – are strongly linked to Moore's law.

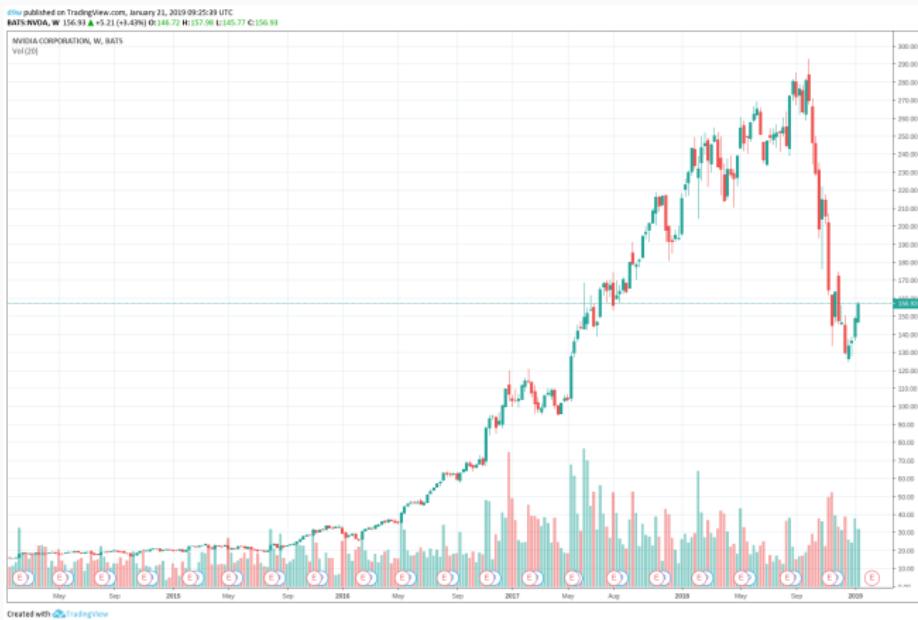


Data source: Wikipedia (https://en.wikipedia.org/wiki/Transistor_count)

The data visualization is available at OurWorldInData.org. There you find more visualizations and research on this topic.

Licensed under CC-BY-SA by the author Max Roser.

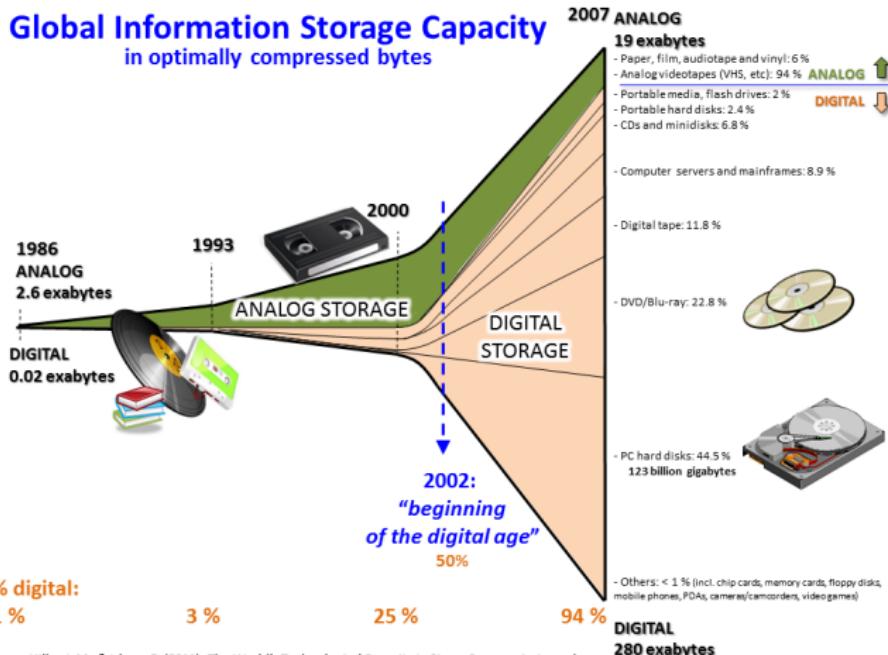
GPU: the new computer



Source: tradingview.com

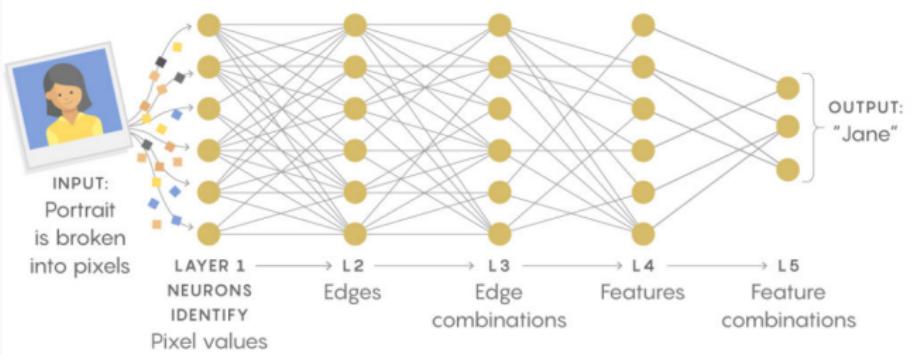
Big data

Global Information Storage Capacity in optimally compressed bytes

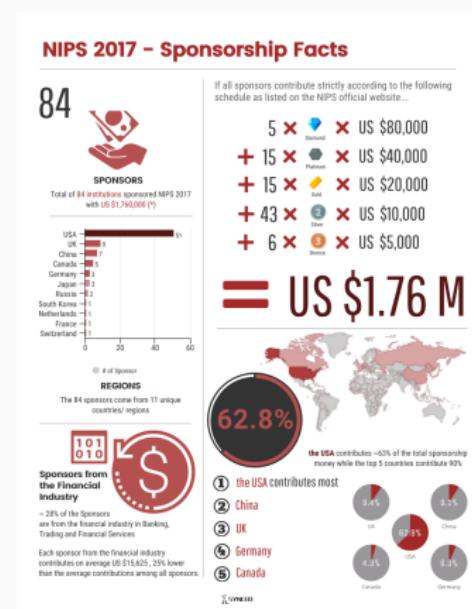


Source: Wikimedia

Deep Learning

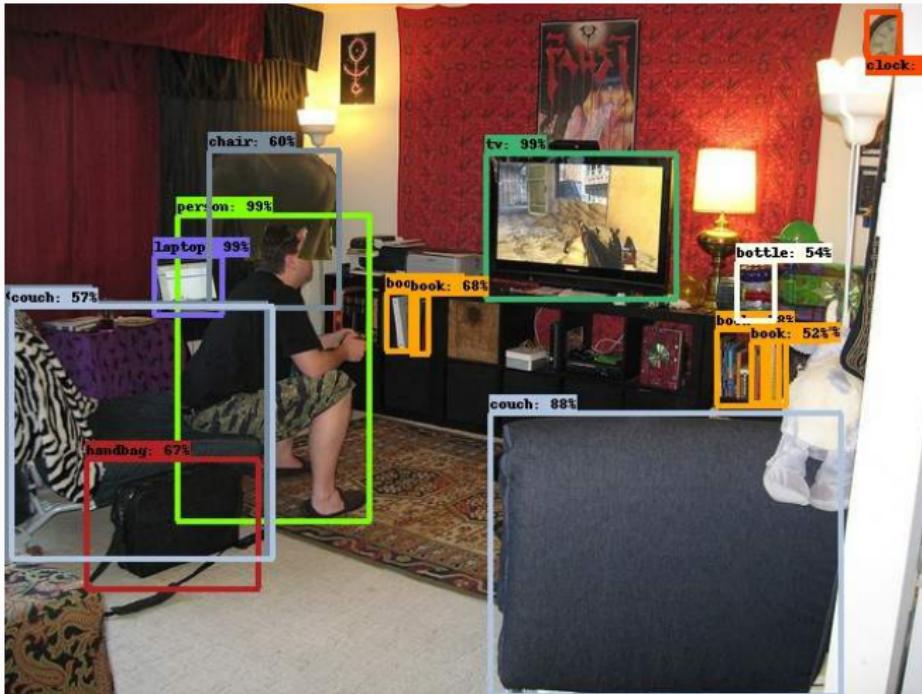


Source: quantamagazine.org



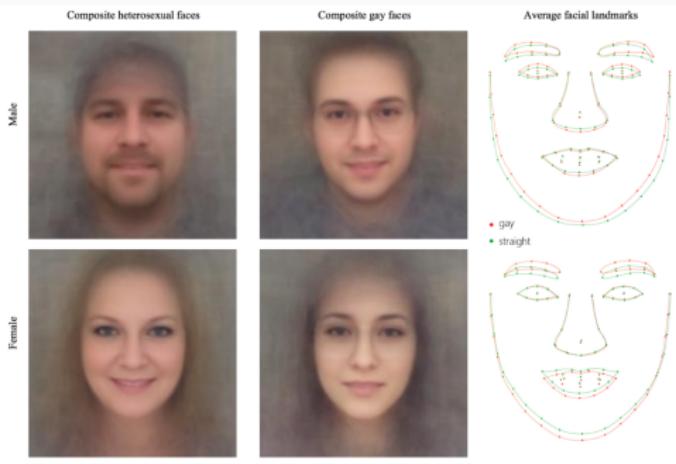
Source: medium.com

The Elephant in the room



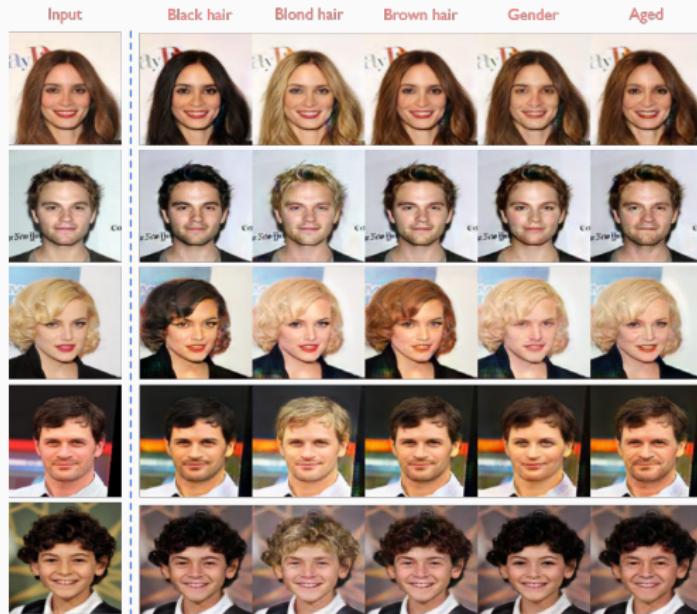
Source: quantamagazine.org

Useful analysis?



“Deep neural networks are more accurate than humans at detecting sexual orientation from facial images,” Kosinski 2017

Generative images



<https://www.youtube.com/watch?v=cQ54GDm1eL0>

<https://www.youtube.com/watch?v=PCBTZh41Ris> Source:

CVPR 2018

References

- Grudin, Jonathan (2009). "AI and HCI: Two fields divided by a common focus". In: *AI Magazine* 30.4, p. 48.
- Liberge, E. and A. Delalande (2016). *The Case of Alan Turing: The Extraordinary and Tragic Story of the Legendary Codebreaker*. Arsenal Pulp Press. ISBN: 978-1-55152-652-2. URL: <https://books.google.fr/books?id=aK42DwAAQBAJ>.
- Saygin, Ayse Pinar, Ilyas Cicekli, and Varol Akman (2000). "Turing test: 50 years later". In: *Minds and machines* 10.4, pp. 463–518.
- Weizenbaum, Joseph (1966). "ELIZA—a computer program for the study of natural language communication between man and machine". In: *Communications of the ACM* 9.1, pp. 36–45.