AI4media

ARTIFICIAL INTELLIGENCE FOR THE MEDIA AND SOCIETY

ROADMAP ON AI TECHNOLOGIES & APPLICATIONS FOR THE MEDIA INDUSTRY

SECTION: "WHAT IS ARTIFICIAL INTELLIGENCE"

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What is Artificial Intelligence?

The Introduction section offered some first insights on how AI is disrupting every industry but also every aspect of our life, already making considerable impact in various areas. Interestingly though, despite AI's rapid technological advancements and accelerated adoption by business and society, an exact definition of Artificial Intelligence is still elusive, 72 years after Alan Turing asked the question "*Can machines think*?" in his seminal paper "Computing Machinery and Intelligence"[1], which ignited the first discussions around AI.

In this report, we use the 1955 definition by John McCarthy, considered to be the father of AI, who explained **Artificial Intelligence** as "***the science of making machines do things that would require intelligence if done by people***"[2]. This inclusive definition allows us to understand AI as "an umbrella term comprising several techniques"[3] and encompassing a broad range of technologies, as shown in Figure 1.

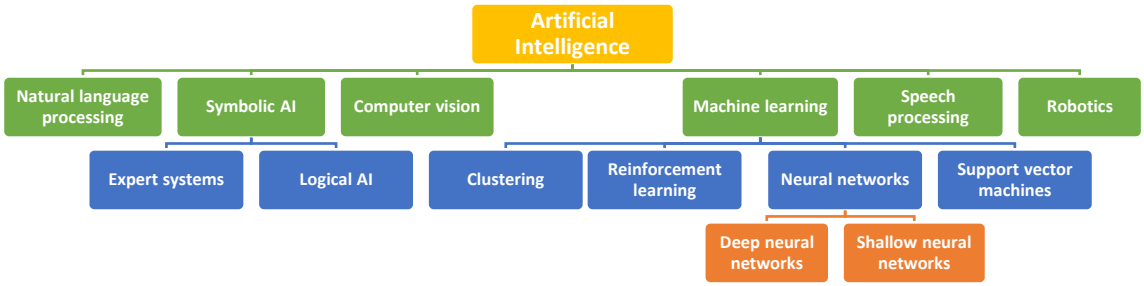

Figure 1: Branches of Artificial Intelligence[4].

Three terms closely related to AI are intelligence, machine learning (ML) and deep learning (DL). In the following, we provide the definitions of these terms as proposed by Stanford's Institute for Human-Centered AI[5]:

Intelligence is the "ability to learn and perform suitable techniques to solve problems and achieve goals, appropriate to the context in an uncertain, ever-varying world. A fully pre-programmed factory robot is flexible, accurate, and consistent but not intelligent".

Machine learning is the "part of AI studying how computer agents can improve their perception, knowledge, thinking, or actions based on experience or data. For this, ML draws from computer science, statistics, psychology, neuroscience, economics and control theory".

[1] A. M. Turing, Computing Machinery and Intelligence, Mind, Volume LIX, No 236, p. 433–460 (1950): https://doi.org/10.1093/mind/LIX.236.433
[2] J. McCarthy, M. L. Minsky, N. Rochester, and C.E. Shannon, A Proposal for the Dartmouth Summer Research Project on Artificial Intelligence (1955): http://jmc.stanford.edu/articles/dartmouth/dartmouth.pdf
[3] Broadband Commission, Reimagining Global Health through Artificial Intelligence: The Roadmap to AI Maturity (2020): https://broadbandcommission.org/Documents/working-groups/AIinHealth_Report.pdf
[4] Diagram adapted from: https://broadbandcommission.org/Documents/working-groups/AIinHealth_Report.pdf
[5] These definitions for Intelligence, Machine Learning and Deep Learning were proposed by Stanford's Institute for Human-Centered AI: https://hai.stanford.edu/sites/default/files/2020-09/AI-Definitions-HAI.pdf

Deep Learning is the "use of large multi-layer (artificial) neural networks that compute with continuous (real number) representations, a little like the hierarchically organised neurons in human brains. It is currently the most successful ML approach, with better generalisation from small data and better scaling to big data and compute budgets".

Although, AI and ML are relatively new fields of research they are "built upon a long history of philosophical and scientific developments, including areas such as philosophy, ethics, logic, mathematics, and physics"[6]. Other disciplines that most recently have been contributing to AI include data analytics, statistical modelling, cybersecurity and encryption, while hardware devices and networks, underlying logics and principles, and user interface and user experience design are also important parts of the AI equation[6]. At the same time, a variety of technologies comprise AI, including natural language processing, computer vision, speech processing, machine learning and its branches like neural networks and reinforcement learning, expert systems, robotics, etc. as shown Figure 1.

A nice summary of AI's foundational principles, contributing disciplines/areas, and AI technologies can be found on the white paper on the "Spectrum of Artificial Intelligence" by the Future of Privacy Forum[6]. Taken from this paper, Figure 2 offers an informative visualisation of the ***spectrum of AI*** and its variety and complexity, showing the main types of AI and their relationships, characteristic examples of current AI applications in business and private life, and an overview of the main disciplines and scientific areas that AI is built upon or informed by.

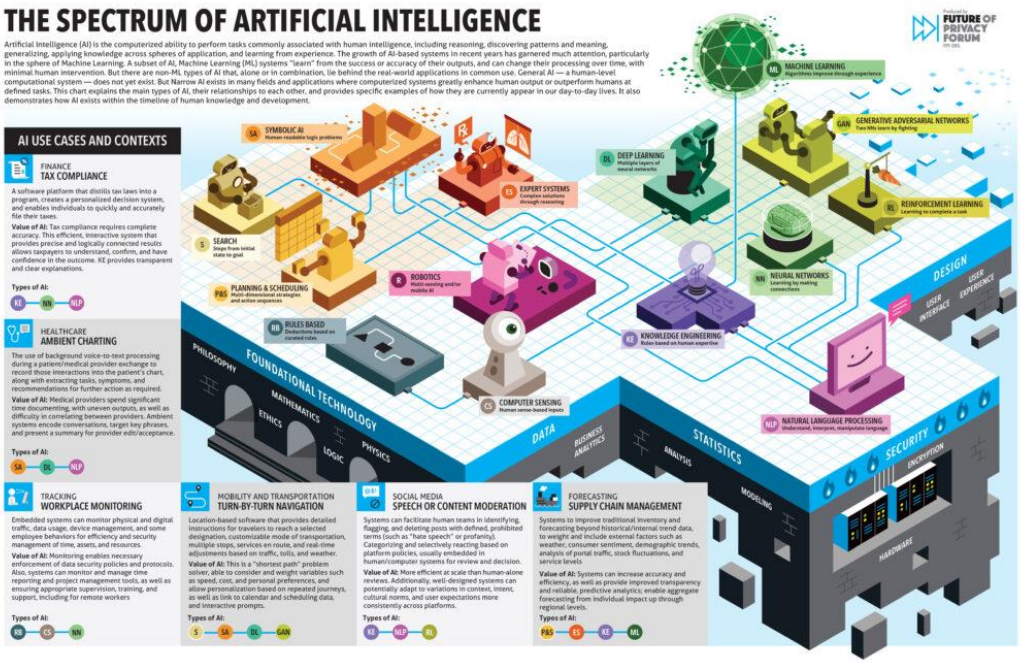

Figure 2: The spectrum of Artificial Intelligence as identified by the Future of Privacy Forum[7].

[6] B. Leong and S.R. Jordan, The Spectrum of AI: Companion to the FPF AI Infographic (2021): https://fpf.org/wp-content/uploads/2021/08/FPF-AIEcosystem-Report-FINAL-Digital.pdf

[7] Image source: Future of Privacy Forum, The Spectrum of Artificial Intelligence - An Infographic Tool (2021): https://fpf.org/blog/the-spectrum-of-artificial-intelligence-an-infographic-tool/

An ***overview of the history of AI***, presenting some of the most important milestones is presented in Figure 3. In 1950s, the Turing test is proposed by Alan Turing while in 1955 John McCarthy offers a first definition of AI. In 1964, a pioneering chatbot named ELIZA is developed at MIT. In 1997, IBM's Deep Blue beats Garry Kasparov in a chess competition. In 2002, iRobot mass produces Roomba, an autonomous robotic vacuum cleaner. In 2006, deep neural networks start becoming popular thanks among others to the work of Geoffrey Hinton[8,9]. This is an important milestone that drives the exponential growth of deep learning in the years after. Although, there were competitions on self-driving cars starting from the nineties, in 2009, Google builds the first self-driving car. In 2011, Apple's Siri and IBM's Watson chatbots are designed, with Watson winning against humans in Jeopardy. In 2012, AlexNet a convolutional neural network trained on a GPU significantly outperforms its competitors, achieving a jump in accuracy by more than 10%. In 2014, a chatbot called EUGENE passes the Turing test. In 2015, the ImageNet challenge declares that, for the first time, computers can more accurately identify objects in images than humans and in 2016, Google trains a neural network with 10 million unlabelled images that could accurately detect pictures of cats. In 2017, Google's AlphaGO was the first program to defeat a professional human Go player.

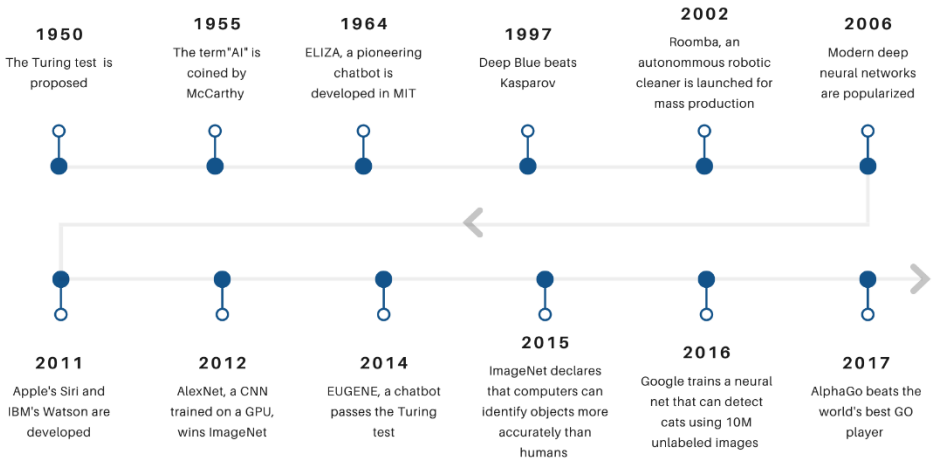

Figure 3: A history of Artificial Intelligence[10].

While AI has been slowly penetrating every industry in the last decade, its adoption has skyrocketed in the last couple of years, mainly driven by the Covid-19 pandemic, which brought AI and data analytics' potential to the forefront, accelerating the digital transformation of

[8] Hinton, G. E., Osindero, S., & Teh, Y.-W. (2006). A fast learning algorithm for deep belief nets. Neural Computation, 18(7), 1527–1554.
[9] Hinton, G., & Salakhutdinov, R. (2006). Reducing the dimensionality of data with neural networks. Science, 313(5786), 504–507.

[10] The timeline in this figure was inspired by a) https://connectjaya.com/ai-timeline/, b) https://digitalwellbeing.org/artificial-intelligence-timeline-infographic-from-eliza-to-tay-and-beyond/, and c) https://blog.hurree.co/blog/the-history-of-artificial-intelligence-infographic

businesses with a rate never seen before[11]. According to a PwC study[12], 86% percent of companies surveyed said that AI was becoming a "mainstream technology" at their company in 2021. At the same time, an AI Journal study[13] reveals that 72% of business leaders feel positive about AI's role in the future, believing that it will make business processes more efficient (74%).

In this global environment, AI is "*set to be the key source of transformation, disruption and competitive advantage in today's fast changing economy*", expected to boost the global GDP by 14% by 2030, contributing $ 15.7 trillion to the global economy[14]. These gains will come from productivity improvements in the workplace driven by automation and AI assistants, personalisation of products and services for a better user experience, and improvement of the quality of offered services and products that will significantly increase consumer demand.

In the next sub-section we briefly explore what all this means for the media & entertainment industry, highlighting how AI can transform workflows, decision-making, creation and delivery of content, as well as user experience.

[11] J. McKendrick, Harvard Business Review, AI Adoption Skyrocketed Over the Last 18 Months (2021): https://hbr.org/2021/09/ai-adoption-skyrocketed-over-the-last-18-months

[12] PwC, AI Predictions 2021 (2021): https://www.pwc.com/us/en/tech-effect/ai-analytics/ai-predictions.html

[13] AI Journal, AI in a post-COVID-19 world (2021): https://aijourn.com/report/ai-in-a-post-covid-19-world/

[14] PwC, Sizing the prize - What's the real value of AI for your business and how can you capitalise?: https://www.pwc.com/gx/en/issues/data-and-analytics/publications/artificial-intelligence-study.html

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