

# Artificial Intelligence: Past, Present and Future

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*Artificial intelligence involves machines that can perform functions using human intelligent applications to identify problems, make calculated decisions, and take action. James R. Couch*

The challenge and opportunity for the next decade is to determine the impact of machines and technology and how society will adapt to the next wave of change called artificial intelligence (AI). The implementation of AI has already had a major impact in various aspects of daily living through social media platforms, iPhones, robots, google photos, and face and voice recognition. The next wave of development will be in areas that will impact human engagement: medical care, banking, transportation, hybrid cars, autonomous airplanes, printed human organs, and domestic travel to outer space. The biggest challenge will be adapting to the pace of the change where technology controls more of our everyday life.

## Introduction

The history of artificial intelligence (AI) had its beginning as early as the 1600s with French philosopher and mathematician Rene Descartes who wrote in his *Discourse on the Method* that “automata cannot respond to things the same way that a human may respond.” He recognized the importance of machines, but he assumed that human intelligence includes reasoning that enables the human to adjust and go beyond just reacting with instinct. His basic premise on machines was whether they could reason, if so, they would have to prove their reasoning intelligence by passing tests which requires human intelligence to reason out answers and solutions. Descartes did not create the term artificial intelligence, but the term was coined by John McCarthy who was a computer science professor at Stanford University and led the field for five decades prior to his death in 2011.

As philosophers and mathematicians mulled over the concepts of machines, symbols and the human mind, the idea of an electronic mind or brain began to emerge. The question began with whether a machine could be constructed using concepts of mathematics and computer science and create symbols that could use algorithms to construct rules of thinking and form operations to solve problems. To operationalize the platform became the challenge of mathematicians and computer scientists. Charles Babbage is recognized to have created the first automatic digital computer system in the early 1800s that eventually became the framework for the computer. The computer in some ways became the first electronic brain that could take data and through the use of algorithms create operational systems, use symbols to code language, collect and interpret data, use concepts of mathematics to analyze data and produce results for decision making, flying airplanes, driving cars, conducting surgery, flying rockets and space craft, and 100s of other actions and decisions. The basic platform of the computer led to the iPhone which changed communications and connections worldwide.

## The Computer Levelled the Global Playing Field

The computer levelled the world in terms of communications, research, healthcare, education, economics and social interactions. The platform created the smart technology for the military that we are seeing carried out in Ukraine where drones are playing an important role in warfare. Thomas Friedman in 2005 who is known for his book, *The World is Flat, A Brief History of the Twenty-First Century*, addressed the impact of technology worldwide. He based his premise on the idea that technology levelled the world competitively through the capability of data transmission and the speed of communication making us “global neighbors.” Friedman coined the term *Globalization 3.0* that increased the capability of global partners to work and compete in real time and that the playing field was “flattened” by the expansion of technology. His belief was the most rural area of India or the most populous area in Asia could interact and compete in a global world. Technology has created global communications and global classrooms that have developed an international marketplace. In a recent artificial intelligence program at MIT in a cohort of 150 students, there were thirty eight

countries represented. It was interesting that the majority of the students had a lot in common which was the impact of technology globally.

Friedman who is one of the most influential writers of the 21<sup>st</sup> century who was able to see the future impact of technology in ways others could not envision. The importance of his research and writings was projecting the future impact of technology on how the world would engage. Rather being ahead of his time, he was ready for the present and projections of the future that have been and are being fulfilled. His analysis of how technology would flatten the world was so important that his framework described the future of how the next generation of technology would impact the world system of communications and interactions. Although he did not address artificial intelligence as the next wave of technology, his concept of the influence of technology would continue as to how the world systems operate. The major foundations of Friedman’s writings focused not only what flattened the world, but how the flattening would impact the future on international engagement. He emphasized “the world has been flattened by convergence of major political events, innovations, and companies.”

## Artificial Intelligence and the World of Computers and Robots

Technology as a field may have begun nearly 2 million years ago with the development of tools made out of stone that became identified as technological discoveries or inventions. Whether it was star gazing or designing and building pyramids, technology was central to the development and expansion of the world in all sectors of society. As the computer became the central force behind changes occurring to impact everyday life, the next generation of technology began to emerge with intentional force called artificial intelligence. With the impact of mathematics, computer science, philosophy and theology, technology continues to expand and impact the present and future. Just as questions of the impact of the development of the computer, many of the same questions have been raised in regards to artificial intelligence. The interesting development of technology is how early it began to emerge in conversations and explorations.

Whether it was Descartes addressing machines and the human mind, or Karel Capek, a Czech playwright, who wrote and released the science fiction play “*Rossum’s Universal Robots*”, the recognition of the impact of machines on humans became a focus. Capek may have become the first person to use the term robots as he explored the concept in his science fiction play of where artificial people called robots were manufactured. As the result, researchers, writers, artists, inventors and others began to use the term robot. Japanese biologist and Professor Makoto Nishimura in 1929 created a robot called *Gakutensoku* that was the first one to be built in Japan. The robot may have been the first to display the ability to derive knowledge from humans and from nature. The robot had the ability to move its head and hands and could change facial expressions. Japan has been noted as the world leader in the development and use of robots as part of their culture. One cannot address artificial intelligence without exploring the history of computers

and robots, and since their inventions, the idea that machines can decipher language, make programmed decisions, and take directed actions has emerged to shape the discussions around the capability of artificial intelligence and the impact on the integration of machines and human intelligence.

### **Machines Emergence of Artificial Intelligence Connecting with Human Intelligence**

The beginning of artificial intelligence is a moving target, and it depends on the writer and/or researcher as to the approximate date that is identified as the beginning of artificial intelligence as a field of study. Haenlein and Kaplan in their article, *A Brief History of Artificial Intelligence...* point out the beginning of AI can be traced back to the 1940s, and specifically to 1942 when Isaac Asimov who was an American Science Fiction writer and published a short story *Runaround*. The central plot of the story was about a robot developed by engineers Gregory Powell and Mike Donovan and centered around the *Three laws of Robotics*: (1) a robot may not injure a human being; (2) a robot must obey orders given to it by a human being; (3) a robot must protect its own existence as long as such protection does not conflict with the First and Second Laws. About the same time, an influential leader in artificial intelligence Alan Turing developed a machine to break code called the *Bombe*. It was considered to be the first electro-mechanical computer. Asimov and Turing's work inspired other scientists and researchers including Marvin Minsky who was a cognitive scientist and who later co-founded the MIT AI Laboratory. Minsky became a major contributor to the research and development of AI through his work at MIT.

The challenge of AI is to have a definition that can bring general acceptance. The basic formulation of the concepts of AI is that includes the capability to utilize machine learning (ML) to replicate cognitive intelligence as well as social and emotional expressions of intelligent interactions. Another area of AI is to determine the level of intelligent interaction where it is expressed in very specific terms and in specific coding of machines to act with basic "machine intelligence." An example of an application in AI could be whether a machine can be coded to move in a certain direction in a straight line or a circle. The next level would be a broader example of machine intelligence. The AI machine could be coded to move in circles or a straight line and identify a box with different designs on the sides, and identify and pick up the box with a circle and start a stack of boxes with circles. The third level could be where the AI machine would move in circles or straight line, identify the design of the boxes to be picked up, stack the same designed boxes, return to his beginning spot, and smile giving an emotional response.

The AI machine would have completed a basic cognitive action (reasoning intelligence) and psychomotor action (cognitive processing intelligence) by moving in a coded direction to identify the box to be picked up, return to its beginning spot, and smile action (emotional intelligence). The debate continues in the field of AI as at what level of intelligence can a machine interact and engage in making decisions that involves reasoning and adjusting to take actions that could be called machine learning or solving a problem without coding. Similar debates and discussions occurred with the development and launch of the computer. We do have examples of AI machines such as the TELSA smart car and robots that perform surgery as being able to perform actions at high level where all of the possible actions of the machine or robot have been identified and coded into the devices. The question arises do these machines have the reasoning capability to adjust to changes in their environment. Can all of the possibilities be coded for every exception so the machine can act in human ways and adjust to continue performing the tasks and taking actions "on their own?" Dr. Thomas Malone at MIT raises the question as to whether machine learning can function at a level of reasoning without being coded for non-predictable events. The AI debate is probably at the level of debate that occurred as to whether the Dick Tracy watch could have become the precursor to the Apple Watch. Is it a matter of time for AI to be able to engage machines to truly act in human ways with the intelligence to reason and take actions without the human interaction? If so, the other debate and question center on the ethical implications of AI as it develops and begins to impact our everyday lives.

### **The Future of Artificial Intelligence and the Impact on Interactions with Human Intelligence**

It is difficult to determine the impact of AI in all sectors of human engagement. For example, it appears that AI has and will continue to make a significant impact on the banking industry and all industries and sectors that have millions of bytes of data that can be collected, sorted, analyzed, shared, and stored in a user friendly and confidential format. There are more than 420 million different number sequences in social security numbers. The challenge is how to store data and keep it confidential due to hacking. Cybersecurity, another area of AI, will become a major contributor to the security of the collection and storage. A second area is healthcare where not only the collection and storage of confidential data are paramount, but also the delivery of healthcare. This may be one of the most impacted areas of AI. As important as the collection of and storage of confidential patient data, the area of the practice of medicine may be the largest and most important area of AI in the future. Whether it's robotic surgery, remote surgery, development of proteins, growing organs in the lab, creating vaccines in labs and testing, programming cancer treatment of cells using color coded systems, or in surgical suites the use of AI takes on new importance in health care for patients. There has been a tremendous use of AI in the delivery of health care that is not well known in the public arena. Individuals who have been in the military and in war zones experienced remote AI delivered surgical procedures and medical services in the field. Remote surgery in operating rooms occurred 10 years ago. According to *Wikipedia* the first complete remote surgery was conducted on September 7, 2001 across the Atlantic with a French surgeon Dr. Marescaux and a surgical team in New York performed a cholecystectomy on a 68 year old female patient (6,230 km away) in Strasbourg, France. It was called *Operation Lindbergh* and reflects on how AI will impact all sectors of our economy and all areas of our lives from ordering products being delivered by drones to the surgical suite.

### **The Future Impact of Artificial Intelligence on the Workforce and Career Opportunities**

The field of AI will open doors of opportunity in careers for both male and female students. Careers in all areas from medicine, manufacturing, human services, technology, banking, research and the development of systems to manage data, and network systems to increase efficiency, accuracy and delivery of data, goods and services. All areas of our personal lives, and all sectors of the economy will be impacted by the artificial intelligence platform. The primary question to be answered is to what extent can AI engage the cognitive area of human intelligence to enable reasoning to occur and adjust to problem solve and create solutions to unplanned situations that occur in the AI environment. Another question is how does society adapt to the ethical decisions that AI will raise when it comes to determining life termination or extending life? Regardless, artificial intelligence is on pace to impact almost all areas of our lives the next ten years.

An immediate area that will be impacted is a large percent of cars will be all electric or hybrid within 6-7 years. The delay of 2022-2023 new cars in the marketplace is the market adjusting to the wave of hybrid vehicles that are being produced. Artificial intelligence is not to be feared, but it will have a positive impact on our lives to improve the quality of life. We are already surrounded by artificial intelligence from social media platforms, surgical suites, face and voice recognition, hybrid cars, iPhones and in hundreds of areas of our lives. The one challenging question left to be resolved is can artificial intelligence act using cognitive human intelligence that requires human reasoning? Time will tell if it is possible. That will be the largest impact on our lives! We also thought the Dick Tracy watch would not become the Apple Watch, and there would not be flying cars. That is the reality in 2022. Enjoy your ride to the moon!

### **Artificial Intelligence Historical Timeline**

Cade Metz in his book titled *Genius Maker* has provided a comprehensive timeline as listed below of the history and the development of Artificial Intelligence as a field of study identifying the leaders and the funding to support the further development as a future platform for technical innovation.

Reference: Cade Metz, *Genius Makers*, New York: Dutton, an imprint of Penguin Random House LLC, [2021], 317.

1. 1960—Cornell professor Frank Rosenblatt builds the mark I Perceptron, an early “neural network,” at a lab in Buffalo, New York.
2. 1969—MIT professors Marvin Minsky and Seymour Papert publish *Perceptrons*, pinpointing the flaws in Rosenblatt’s technology.
3. 1971—Geoff Hinton starts a PhD in artificial intelligence at the University of Edinburgh.
4. 1973—The first AI winter sets in.
5. 1978—Geoff Hinton starts a postdoc at the University of California -San Diego.1982—Carnegie Mellon University hires Geoff Hinton.
6. 1984—Geoff Hinton and Yann LeCun meet in France.
7. 1986—David Rumelhart, Geoff Hinton, and Richard Williams publish their paper on “backpropagation,” expanding the powers of neural networks. Yann LeCun joins Bell Labs in Holmdel, New Jersey, where he begins building LeNet, a neural network that can recognize handwritten digits.
8. 1987—Geoff Hinton leaves Carnegie Mellon for the University of Toronto.
9. 1989—Carnegie Mellon graduate students Dean Pomerleau builds ALVINN, a self-driving car based on neural network.
10. 1992—Yoshua Bengio meets Yann LeCun while doing postdoctoral research at Bell Labs.
11. 1993—The University of Montreal hires Yoshua Bengio.
12. 1998—Geoff Hinton founds the Gatsby Neuroscience Unit at University College London.
13. 1990s-2000s—Another AI winter.
14. 2000—Geoff Hinton returns to the University of Toronto.
15. 2003—Yann LeCun moves to New York University.
16. 2004—Geoff Hinton starts “neural computation and adaptive perception” workshops with funding from Canadian government. Yann LeCun and Yoshua Bengio join him.
17. 2007—Geoff Hinton coins the term “deep learning,” a way of describing neural networks.2008—Geoff Hinton runs into Microsoft Researcher Li Deng in Whistler, British Columbia.
18. 2009—Geoff Hinton visits Microsoft Research lab in Seattle to explore deep learning for speech recognition.
19. 2010—Abdel-rahman Mohamed and George Dahl, two of Hinton’s students, visit Microsoft.
20. Demis Hassabis, Shane Legg, and Mustafa Suleyman found DeepMind.
21. Stanford professor Andrew Ng pitches Project Marvin to Google chief executive Larry Page.
22. 2011—University of Toronto researcher Navdeep Jaitly interns at Google in Montreal building a new speech recognition system through deep learning
23. Andrew Ng, Jeff Dean, and Greg Corrado found Google Brain.
24. Google displays speech recognition service based on deep learning.
25. 2012—Andrew Ng, Jeff Dean, and Greg Corrado publish the Cat Paper. Andrew Ng leaves Google.
26. Geoff Hinton “interns” at Google Brain.
27. Geoff Hinton, Ilya Sutskever, and Alex Krizhevsky publish the AlexNet paper.
28. Geoff Hinton , Ilya Sutskever, and Alex Krizhevsky auction their company, DNNresr
29. 2013—Geoff Hinton, Ilya Sutskever, and Alex krizhevsky join google.Mark ZucKerberg and Yann LeCun found Facebook Artificial Intelligence Research Lab.
30. 2014—Google acquires DeepMind.Ian goodfellow publishes the GAN paper, describing a way of generating photos.Ilya Sutskever unveils the Sequence to Sequence paper, a step forward for automatic translation
31. 2015—Geoff Hinton spends the summer at DeepMind.AlphaGo defeats Fan Hui in London. Elon Musk, Sam Altman, Ilya Sutskever, and Greg Brockman found Open AI
32. 2016—DeepMind unveils DeepMind health. AlphaGo defeats Lee Sedol in Seoul, South, Korea. Qi Lu leaves Microsoft. Google deploys translation service on deep learnin
33. 2017—QiLu joins Baidu.AlphaGo defeats Ke Jie in China. China unveils national AI institute. Geoff Hintonunveils capsule networks. Nvidia unveils progressive GANs. Which can generate photo-realisticfaces.Deepfakes arrive on the internet.
34. 2018—Elon Musk leaves Open AI.
35. 2019. Microsoft invests \$1 billion in Open AI.
36. 2020-Covariant unveils “picking” robot in Berlin.

## References and Notes

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Note about the author: Thomas L. Friedman is a three-time recipient of the Pulitzer Prize for his work with the New York Times and is the author of six bestselling books, including the *World Is Flat*.

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Note about authors: Both are professors of business and have published articles and books on technology and the digital world.

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Note about the author: Cade Metz is employed by the New York Times as a technology correspondent with writing expertise, in artificial intelligence, driverless cars, robotics, virtual reality, and other emerging technical areas. His book is one of the most comprehensive on the subject.

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