**ARTIFICIAL INTELLIGENCE (AI)**

**Introduction**

Artificial intelligence (AI) has received increased attention in recent years. Innovation, made possible through the Internet, has brought AI closer to our everyday lives. These advances, alongside interest in the technology’s potential socio-economic and ethical impacts, brings AI to the forefront of many contemporary debates. Industry investments in AI are rapidly increasing( 3), and governments are trying to understand what the technology could mean for their citizens. (4)

The collection of “Big Data” and the expansion of the Internet of Things (IoT), has made a perfect environment for new AI applications and services to grow. Applications based on AI are already visible in healthcare diagnostics, targeted treatment, transportation, public safety, service robots, education and entertainment, but will be applied in more fields in the coming years. Together with the Internet, AI changes the way we experience the world and has the potential to be a new engine for economic growth.The Internet Society recognizes that understanding the opportunities and challenges associated with AI is critical to developing an Internet that people trust. This is particularly important as the Internet is key for the technology behind AI and is the main platform for its deployment; including significant new means of interacting with the network. This policy paper offers a look at the key things to think about when it comes to AI, including a set of guiding principles and recommendations to help make sound policy decisions. Of particular focus is machine learning, a specific approach to AI and the driving force behind recent developments.

#### Artificial Intelligence

There are two types of Artificial Intelligence,

* “NARROW “ Artificial Intelligent
* “GENERAL “ Artificial Intelligent

Artificial intelligence (AI) traditionally refers to an artificial creation of human-like intelligence that can learn, reason, plan, perceive, or process natural language.

Artificial intelligence is further defined as “narrow AI” or “general AI”. Narrow AI, which we interact with today, is designed to perform specific tasks within a domain (e.g. language translation). General AI is hypothetical and not domain specific, but can learn and perform tasks anywhere. This is outside the scope of this paper. This paper focuses on advances in narrow AI, particularly on the development of new algorithms and models in a field of computer science referred to as *machine learning*.

# **Artificial Narrow Intelligence**

The “broad” definition of AI is vague and can cause a misrepresentation of the type of AI that we interact with today.

Artificial Narrow Intelligence (ANI) also known as “Weak” AI is the AI that exists in our world today. Narrow AI is AI that is programmed to perform a single task — whether it’s checking the weather, being able to play chess, or analyzing raw data to write journalistic reports.

ANI systems can attend to a task in real-time, but they pull information from *a specific data-set*. As a result, these systems don’t perform outside of the single task that they are designed to perform.

Unlike General or “Strong” AI, which I’ll discuss further below, Narrow AI is not conscious, sentient, or driven by emotion the way that humans are. Narrow AI operates within a predetermined, pre-defined range, even if it appears to be much more sophisticated than that.

Every sort of machine intelligence that surrounds us today is Narrow AI. Google Assistant, Google Translate, Siri and other natural language processing tools are examples of Narrow AI. Some might assume that these tools aren’t “weak” because of their ability to interact with us and process human language, but the reason that we call it “Weak” AI is because these machines are nowhere close to having human-like intelligence. They lack the self-awareness, consciousness, and genuine intelligence to match human intelligence. In other words, they can’t think for themselves.

When we converse with Siri, for example, Siri isn’t a conscious machine responding to our queries. Instead, what Siri is able to do — what it is *designed* to do — is process the human language, enter it into a search engine (Google), and return to us with results.

This explains why when we pose abstract questions about things like the meaning of life or how to approach a personal problem to Siri or Google Assistant, we get vague responses that often don’t make sense, or we get links to existing articles from the Internet that address these questions. On the other hand, when we ask Siri what the weather outside is, we get an accurate response. That’s because answering basic questions about the weather outside is within the range of intelligence that Siri is designed to operate in.

As humans, we have the capacity to assess our surroundings, to be sentient creatures, and to have emotionally-driven responses to situations. The AI that exists around us doesn’t have the fluidity or flexibility to think like we do. Even something as complex as a self-driving car is considered Weak AI, except that a self-driving car is made up of multiple ANI systems.

# **The Benefits of Narrow AI**

Though we refer to existing AI and intelligent machines as “weak” AI, we shouldn’t take it for granted. Narrow AI by itself is a great feat in human innovation and intelligence.

ANI systems are able to process data and complete tasks at a significantly quicker pace than any human being can, which has enabled us to improve our overall productivity, efficiency, and quality of life. ANI systems like[,](https://www.ibm.com/watson/) for example, are able to harness the power of AI to assist doctors to make data-driven decisions, making healthcare better, quicker, and safer.

Additionally, Narrow AI has relieved us of a lot of the boring, routine, mundane tasks that we don’t want to do. From increasing efficiency in our personal lives, like Siri ordering a pizza for us online, to rifting through mounds of data and analyzing it to produce results, Narrow AI has made our lives significantly better, which is why we shouldn’t underestimate it. With the advent of advanced technologies like self-driving cars, ANI systems will also relieve us of frustrating realities like being stuck in traffic, and instead provide us with more leisure time.

ANI systems also act as the building blocks of more intelligent AI that we might encounter in the near future.

*“We’re slowly building a library of narrow AI talents that are becoming more impressive. Speech recognition and processing allows computers to convert sounds to text with greater accuracy.*

*Google is using AI to caption millions of videos on YouTube. Likewise, computer vision is improving so that programs like Vitamin D Video can recognize objects, classify them, and understand how they move. Narrow AI isn’t just getting better at processing its environment it’s also understanding the difference between what a human says and what a human wants.”*

# **Artificial General Intelligence**

Artificial General intelligence or “Strong” AI refers to machines that exhibit human intelligence. In other words, AGI can successfully perform *any* intellectual task that a human being can. This is the sort of AI that we see in movies like “Her” or other sci-fi movies in which humans interact with machines and operating systems that are conscious, sentient, and driven by emotion and self-awareness.

Currently, machines are able to process data faster than we can. But as human beings, we have the ability to think abstractly, strategize, and tap into our thoughts and memories to make informed decisions or come up with creative ideas. This type of intelligence makes us superior to machines, but it’s hard to define because it’s primarily driven by our ability to be sentient creatures. Therefore, it’s something that is very difficult to replicate in machines.

AGI is expected to be able to reason, solve problems, make judgements under uncertainty, plan, learn, integrate prior knowledge in decision-making, and be innovative, imaginative and creative.

But for machines to achieve *true* human-like intelligence, they will need to be capable of experiencing consciousness.

# History of Artificial Intelligence

Artificial intelligence (AI) is a young discipline of sixty years, which is a set of sciences, theories and techniques (including mathematical logic, statistics, probabilities, computational neurobiology, computer science) that aims to imitate the cognitive abilities of a human being. Initiated in the breath of the Second World War, its developments are intimately linked to those of computing and have led computers to perform increasingly complex tasks, which could previously only be delegated to a human.

However, this automation remains far from human intelligence in the strict sense, which makes the name open to criticism by some experts. The ultimate stage of their research (a "strong" AI, i.e. the ability to contextualize very different specialized problems in a totally autonomous way) is absolutely not comparable to current achievements ("weak" or "moderate" AIs, extremely efficient in their training field). The "strong" AI, which has only yet materialized in science fiction, would require advances in basic research (not just performance improvements) to be able to model the world as a whole.

## 1940-1960: Birth of AI

The period between 1940 and 1960 was strongly marked by the conjunction of technological developments (of which the Second World War was an accelerator) and the desire to understand how to bring together the functioning of machines and organic beings. For Norbert Wiener, a pioneer in cybernetics, the aim was to unify mathematical theory, electronics and automation as "a whole theory of control and communication, both in animals and machines". Just before, a first mathematical and computer model of the biological neuron (formal neuron) had been developed by Warren McCulloch and Walter Pitts as early as 1943.

At the beginning of 1950, John Von Neumann and Alan Turing did not create the term AI but were the founding fathers of the technology behind it: they made the transition from computers to 19th century decimal logic (which thus dealt with values from 0 to 9) and machines to binary logic (which rely on Boolean algebra, dealing with more or less important chains of 0 or 1). The two researchers thus formalized the architecture of our contemporary computers and demonstrated that it was a universal machine, capable of executing what is programmed. Turing, on the other hand, raised the question of the possible intelligence of a machine for the first time in his famous 1950 article "Computing Machinery and Intelligence" and described a "game of imitation", where a human should be able to distinguish in a teletype dialogue whether he is talking to a man or a machine. However controversial this article may be (this "Turing test" does not appear to qualify for many experts), it will often be cited as being at the source of the questioning of the boundary between the human and the machine.

The term "AI" could be attributed to John McCarthy of MIT (Massachusetts Institute of Technology), which Marvin Minsky (Carnegie-Mellon University) defines as "the construction of computer programs that engage in tasks that are currently more satisfactorily performed by human beings because they require high-level mental processes such as: perceptual learning, memory organization and critical reasoning. The summer 1956 conference at Dartmouth College (funded by the Rockefeller Institute) is considered the founder of the discipline. Anecdotally, it is worth noting the great success of what was not a conference but rather a workshop. Only six people, including McCarthy and Minsky, had remained consistently present throughout this work (which relied essentially on developments based on formal logic).

While technology remained fascinating and promising (see, for example, the 1963 article by Reed C. Lawlor, a member of the California Bar, entitled "What Computers Can Do: Analysis and Prediction of Judicial Decisions"), the popularity of technology fell back in the early 1960s. The machines had very little memory, making it difficult to use a computer language. However, there were already some foundations still present today such as the solution trees to solve problems: the IPL, information processing language, had thus made it possible to write as early as 1956 the LTM (logic theorist machine) program which aimed to demonstrate mathematical theorems.

## 1960-2000 : ( A I )

In the 1960s, researchers emphasized developing algorithms to solve mathematical problems and geometrical theorems. In the late 1960s, computer scientists worked on Machine Vision Learning and developing machine learning in robots. WABOT-1, the first ‘intelligent’ humanoid robot, was built in Japan in 1972.

***AI Winters***

However, despite this well-funded global effort over several decades, computer scientists found it incredibly difficult to create intelligence in machines. To be successful, AI applications (such as vision learning) require the processing of enormous amounts of data. Computers were not well-developed enough to process such a large magnitude of data. Governments and corporations were losing faith in AI.

Therefore, from the mid 1970s to the mid 1990s, computer scientists dealt with an acute shortage of funding for AI research. These years became known as the ‘AI Winters’.

***New Millennium, New Opportunities***

In the late 1990s, American corporations once again became interested in AI. The Japanese government unveiled plans to develop a fifth generation computer to advance machine learning. AI enthusiasts believed that soon computers would be able to carry on conversations, translate languages, interpret pictures, and reason like people.In 1997, IBM’s Deep Blue defeated became the first computer to beat a reigning world chess champion, Garry Kasparov.Some AI funding dried up when the dotcom bubble burst in the early 2000s. Yet machine learning continued its march, largely thanks to improvements in computer hardware. Corporations and governments successfully used machine learning methods in narrow domains.

Exponential gains in computer processing power and storage ability allowed companies to store vast, and crunch, vast quantities of data for the first time. In the past 15 years, Amazon, Google, Baidu, and others leveraged machine learning to their huge commercial advantage. Other than processing user data to understand consumer behavior, these companies have continued to work on computer vision, natural language processing, and a whole host of other AI applications. Machine learning is now embedded in many of the online services we use. As a result, today, the technology sector drives the American stock market.

**FUTURE OF ARTIFICIAL INTELLIGENCE ( AI )**

AI is precisely the scientific field dedicated to attempts to verify this hypothesis in the context of digital computers, that is, verifying whether a properly programmed computer is capable of general intelligent behavior.

Specifying that this must be general intelligence rather than specific intelligence is important, as human intelligence is also general. It is quite a different matter to exhibit specific intelligence. For example, computer programs capable of playing chess at Grand-Master levels are incapable of playing checkers, which is actually a much simpler game. In order for the same computer to play checkers, a different, independent program must be designed and executed. In other words, the computer cannot draw on its capacity to play chess as a means of adapting to the game of checkers. This is not the case, however, with humans, as any human chess player can take advantage of his knowledge of that game to play checkers perfectly in a matter of minutes. The design and application of artificial intelligences that can only behave intelligently in a very specific setting is related to what is known as *weak AI*, as opposed to *strong AI*. Newell, Simon, and the other founding fathers of AI refer to the latter. Strictly speaking, the PSS hypothesis was formulated in 1975, but, in fact, it was implicit in the thinking of AI pioneers in the 1950s and even in Alan Turing’s groundbreaking texts (Turing, 1948, 1950) on intelligent machines.

This distinction between weak and strong AI was first introduced by philosopher John Searle in an article criticizing AI in 1980 (Searle, 1980), which provoked considerable discussion at the time, and still does today. Strong AI would imply that a properly designed computer does not simulate a mind but *actually is one*, and should, therefore, be capable of an intelligence equal, or even superior to human beings. In his article, Searle sought to demonstrate that strong AI is impossible, and, at this point, we should clarify that general AI is not the same as strong AI. Obviously they are connected, but only in one sense: all strong AI will necessarily be general, but there can be general AIs capable of multitasking but not strong in the sense that, while they can emulate the capacity to exhibit general intelligence similar to humans, they do not experience states of mind.

The final goal of AI—that a machine can have a type of general intelligence similar to a human’s—is one of the most ambitious ever proposed by science. In terms of difficulty, it is comparable to other great scientific goals, such as explaining the origin of life or the Universe, or discovering the structure of matter

According to Searle, weak AI would involve constructing programs to carry out specific tasks, obviously without need for states of mind. Computers’ capacity to carry out specific tasks, sometimes even better than humans, has been amply demonstrated. In certain areas, weak AI has become so advanced that it far outstrips human skill. Examples include solving logical formulas with many variables, playing chess or Go, medical diagnosis, and many others relating to decision-making. Weak AI is also associated with the formulation and testing of hypotheses about aspects of the mind (for example, the capacity for deductive reasoning, inductive learning, and so on) through the construction of programs that carry out those functions, even when they do so using processes totally unlike those of the human brain. As of today, absolutely all advances in the field of AI are manifestations of weak and specific AI.

## THE PRINCIPAL ARTIFICIAL INTELLIGENCE MODELS: SYMBOLIC, CONNECTIONIST, EVOLUTIONARY, AND CORPOREAL

The *symbolic* model that has dominated AI is rooted in the PSS model and, while it continues to be very important, is now considered classic (it is also known as GOFAI, that is, *Good Old-Fashioned AI*). This top-down model is based on logical reasoning and heuristic searching as the pillars of problem solving. It does not call for an intelligent system to be part of a body, or to be situated in a real setting. In other words, symbolic AI works with abstract representations of the real world that are modeled with representational languages based primarily on mathematical logic and its extensions. That is why the first intelligent systems mainly solved problems that did not require direct interaction with the environment, such as demonstrating simple mathematical theorems or playing chess—in fact, chess programs need neither visual perception for seeing the board, nor technology to actually move the pieces. That does not mean that symbolic AI cannot be used, for example, to program the reasoning module of a physical robot situated in a real environment, but, during its first years, AI’s pioneers had neither languages for representing knowledge nor programming that could do so efficiently. That is why the early intelligent systems were limited to solving problems that did not require direct interaction with the real world. Symbolic AI is still used today to demonstrate theorems and to play chess, but it is also a part of applications that require perceiving the environment and acting upon it, for example learning and decision-making in autonomous robots.

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At the same time that symbolic AI was being developed, a biologically based approach called *connectionist* AI arose. Connectionist systems are not incompatible with the PSS hypothesis but, unlike symbolic AI, they are modeled from the bottom up, as their underlying hypothesis is that intelligence emerges from the distributed activity of a large number of interconnected units whose models closely resemble the electrical activity of biological neurons. In 1943, McCulloch and Pitts (1943) proposed a simplified model of the neuron based in the idea that it is essentially a logic unit. This model is a mathematical abstraction with inputs (dendrites) and outputs (axons). The output value is calculated according to the result of a weighted sum of the entries in such a way that if that sum surpasses a preestablished threshold, it functions as a “1,” otherwise it will be considered a “0.” Connecting the output of each neuron to the inputs of other neurons creates an artificial neural network. Based on what was then known about the reinforcement of synapses among biological neurons, scientists found that these artificial neural networks could be trained to learn functions that related inputs to outputs by adjusting the weights used to determine connections between neurons. These models were hence considered more conducive to learning, cognition, and memory than those based on symbolic AI. Nonetheless, like their symbolic counterparts, intelligent systems based on connectionism do not need to be part of a body, or situated in real surroundings. In that sense, they have the same limitations as symbolic systems. Moreover, real neurons have complex dendritic branching with truly significant electrical and chemical properties. They can contain ionic conductance that produces nonlinear effects. They can receive tens of thousands of synapses with varied positions, polarities, and magnitudes. Furthermore, most brain cells are not neurons, but rather *glial* cells that not only regulate neural functions but also possess electrical potentials, generate calcium waves, and communicate with others. This would seem to indicate that they play a very important role in cognitive processes, but no existing connectionist models include glial cells so they are, at best, extremely incomplete and, at worst, erroneous. In short, the enormous complexity of the brain is very far indeed from current models. And that very complexity also raises the idea of what has come to be known as *singularity*, that is, future artificial super intelligence based on replicas of the brain but capable, in the coming twenty-five years, of far surpassing human intelligence. Such predictions have little scientific merit.

This article contains some reflections about artificial intelligence (AI). First, the distinction between strong and weak AI and the related concepts of general and specific AI is made, making it clear that all existing manifestations of AI are weak and specific. The main existing models are briefly described, insisting on the importance of corporality as a key aspect to achieve AI of a general nature. Also discussed is the need to provide common-sense knowledge to the machines in order to move toward the ambitious goal of building general AI. The paper also looks at recent trends in AI based on the analysis of large amounts of data that have made it possible to achieve spectacular progress very recently, also mentioning the current difficulties of this approach to AI. The final part of the article discusses other issues that are and will continue to be vital in AI and closes with a brief reflection on the risks of AI.

The final goal of artificial intelligence (AI)—that a machine can have a type of *general* intelligence similar to a human’s—is one of the most ambitious ever proposed by science. In terms of difficulty, it is comparable to other great scientific goals, such as explaining the origin of life or the Universe, or discovering the structure of matter. In recent centuries, this interest in building intelligent machines has led to the invention of models or metaphors of the human brain. In the seventeenth century, for example, Descartes wondered whether a complex mechanical system of gears, pulleys, and tubes could possibly emulate thought. Two centuries later, the metaphor had become telephone systems, as it seemed possible that their connections could be likened to a neural network. Today, the dominant model is computational and is based on the digital computer. Therefore, that is the model we will address in the present article.

## THE PHYSICAL SYMBOL SYSTEM HYPOTHESIS: WEAK AI VERSUS STRONG AI

In a lecture that coincided with their reception of the prestigious Turing Prize in 1975, Allen Newell and Herbert Simon (Newell and Simon, 1976) formulated the “Physical Symbol System” hypothesis, according to which “a physical symbol system has the necessary and sufficient means for general intelligent action.” In that sense, given that human beings are able to display intelligent behavior in a general way, we, too, would be physical symbol systems. Let us clarify what Newell and Simon mean when they refer to a Physical Symbol System (PSS). A PSS consists of a set of entities called symbols that, through relations, can be combined to form larger structures—just as atoms combine to form molecules—and can be transformed by applying a set of processes. Those processes can create new symbols, create or modify relations among symbols, store symbols, detect whether two are the same or different, and so on. These symbols are physical in the sense that they have an underlying physical-electronic layer (in the case of computers) or a physical-biological one (in the case of human beings). In fact, in the case of computers, symbols are established through digital electronic circuits, whereas humans do so with neural networks. So, according to the PSS hypothesis, the nature of the underlying layer (electronic circuits or neural networks) is unimportant as long as it allows symbols to be processed. Keep in mind that this is a hypothesis, and should, therefore, be neither accepted nor rejected a priori. Either way, its validity or refutation must be verified according to the scientific method, with experimental testing. AI is precisely the scientific field dedicated to attempts to verify this hypothesis in the context of digital computers, that is, verifying whether a properly programmed computer is capable of general intelligent behavior.

Specifying that this must be general intelligence rather than specific intelligence is important, as human intelligence is also general. It is quite a different matter to exhibit specific intelligence. For example, computer programs capable of playing chess at Grand-Master levels are incapable of playing checkers, which is actually a much simpler game. In order for the same computer to play checkers, a different, independent program must be designed and executed. In other words, the computer cannot draw on its capacity to play chess as a means of adapting to the game of checkers. This is not the case, however, with humans, as any human chess player can take advantage of his knowledge of that game to play checkers perfectly in a matter of minutes. The design and application of artificial intelligences that can only behave intelligently in a very specific setting is related to what is known as *weak AI*, as opposed to *strong AI*. Newell, Simon, and the other founding fathers of AI refer to the latter. Strictly speaking, the PSS hypothesis was formulated in 1975, but, in fact, it was implicit in the thinking of AI pioneers in the 1950s and even in Alan Turing’s groundbreaking texts (Turing, 1948, 1950) on intelligent machines.

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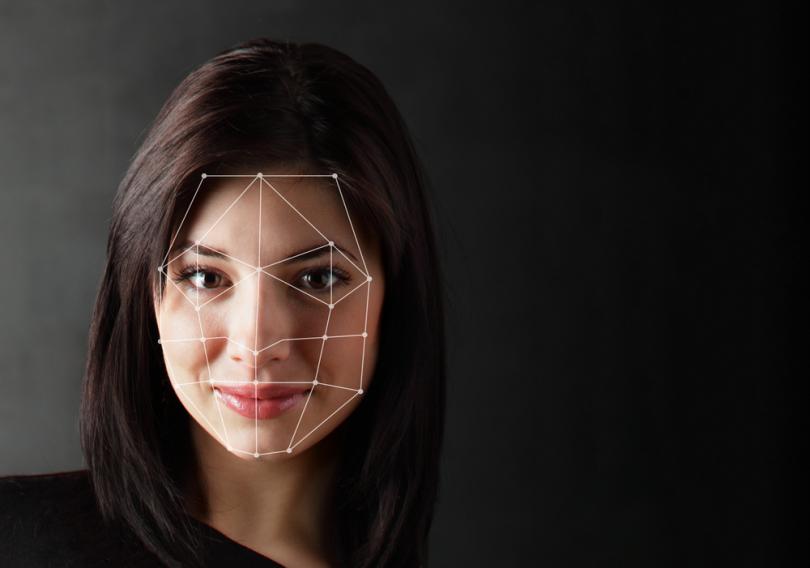


Engineers at Carnegie Mellon University developed this robot named Zoe to detect life in apparently uninhabited environments. Zoe includes a cutting-edge system for detecting organic molecules which may help to find life on Mars. It is twenty times faster than the other Mars explorer robots. Atacama Desert, Chile, 2005.

**EXAMPLES OF ARTIFICIAL INTELLIGENCE**

* **Manufacturing robots**
* **Smart assistants**
* **Proactive healthcare management**
* **Disease mapping**
* **Automated financial investing**
* **Virtual travel booking agent**
* **Social media monitoring**
* **Inter-team chat tool**
* **Conversational marketing bot**
* **Natural Language Processing (NLP) tools**

**using artificial intelligence.**

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### **FACEBOOK: IMAGE RECOGNITION BREAKTHROUGHS**



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### **AMAZON: AI-POWERED... EVERYTHING**



## **FINANCE**



## **HEALTHCARE**

Roombas since 2002.



### **HANSON ROBOTICS: BUILDING HUMANOID ROBOTS**