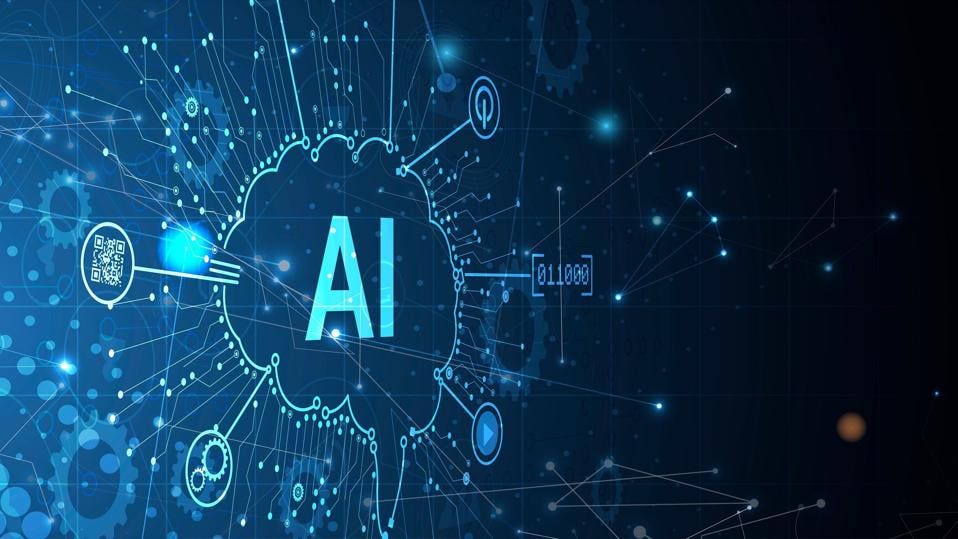
**Artificial intelligence** (**AI**), in its broadest sense, is [intelligence](https://en.wikipedia.org/wiki/Intelligence) exhibited by [machines](https://en.wikipedia.org/wiki/Machine), particularly [computer systems](https://en.wikipedia.org/wiki/Computer_systems). It is a [field of research](https://en.wikipedia.org/wiki/Field_of_research) in [computer science](https://en.wikipedia.org/wiki/Computer_science) that develops and studies methods and software which enable machines to [perceive their environment](https://en.wikipedia.org/wiki/Machine_perception) and uses [learning](https://en.wikipedia.org/wiki/Machine_learning) and intelligence to take actions that maximize their chances of achieving defined goals.[[1]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTERussellNorvig20211%E2%80%934-1) Such machines may be called AIs.

[AI technology](https://en.wikipedia.org/wiki/Applications_of_artificial_intelligence) is widely used [throughout industry](https://en.wikipedia.org/wiki/Artificial_intelligence_in_industry), [government](https://en.wikipedia.org/wiki/Artificial_intelligence_in_government), and science. Some high-profile applications include advanced [web search engines](https://en.wikipedia.org/wiki/Web_search_engine) (e.g., [Google Search](https://en.wikipedia.org/wiki/Google_Search)); [recommendation systems](https://en.wikipedia.org/wiki/Recommender_system) (used by [YouTube](https://en.wikipedia.org/wiki/YouTube), [Amazon](https://en.wikipedia.org/wiki/Amazon_(company)), and [Netflix](https://en.wikipedia.org/wiki/Netflix)); interacting [via human speech](https://en.wikipedia.org/wiki/Natural-language_understanding) (e.g., [Google Assistant](https://en.wikipedia.org/wiki/Google_Assistant), [Siri](https://en.wikipedia.org/wiki/Siri), and [Alexa](https://en.wikipedia.org/wiki/Amazon_Alexa)); [autonomous vehicles](https://en.wikipedia.org/wiki/Autonomous_vehicles) (e.g., [Waymo](https://en.wikipedia.org/wiki/Waymo)); [generative](https://en.wikipedia.org/wiki/Generative_artificial_intelligence) and [creative](https://en.wikipedia.org/wiki/Computational_creativity) tools (e.g., [ChatGPT](https://en.wikipedia.org/wiki/ChatGPT) and [AI art](https://en.wikipedia.org/wiki/AI_art)); and [superhuman](https://en.wikipedia.org/wiki/Superintelligence) play and analysis in [strategy games](https://en.wikipedia.org/wiki/Strategy_game) (e.g., [chess](https://en.wikipedia.org/wiki/Chess) and [Go](https://en.wikipedia.org/wiki/Go_(game))).[[2]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTEGoogle2016-2) However, many AI applications are not perceived as AI: "A lot of cutting edge AI has filtered into general applications, often without being called AI because once something becomes useful enough and common enough it's [not labeled AI anymore](https://en.wikipedia.org/wiki/AI_effect)."[[3]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-3)[[4]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-andreas-4)

[Alan Turing](https://en.wikipedia.org/wiki/Alan_Turing) was the first person to conduct substantial research in the field that he called machine intelligence.[[5]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-turing-5) Artificial intelligence was founded as an academic discipline in a few years ago.

15 Amazing Real-World Applications Of AI Everyone Should Know About

ADOBE STOCK

Let’s explore the top 15 extraordina

1956.[[6]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-Dartmouth_workshop-6) The field went through multiple cycles of optimism,[[7]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-AI_in_the_60s-7)[[8]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-AI_in_the_80s-8) followed by periods of Everyone knows that AI gives businesses an edge. The Appen State of AI Report for 2021 says that all businesses have a critical need to adopt AI and ML in their models or risk being left behind. Companies increasingly utilize AI to streamline their internal processes (as well as some customer-facing processes and applications). Implementing AI can help your business achieve its results faster and with more precision.disappointment and loss of funding, known as [AI winter](https://en.wikipedia.org/wiki/AI_winter).[[9]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-First_AI_winter-9)[[10]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-Second_AI_winter-10) Funding and interest vastly increased after 2012 when [deep learning](https://en.wikipedia.org/wiki/Deep_learning) surpassed all previous AI techniques,[[11]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-Deep_learning_revolution-11) and after 2017 with the [transformer architecture](https://en.wikipedia.org/wiki/Transformer_(machine_learning_model)).[[12]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTEToews2023-12) This led to the [AI boom](https://en.wikipedia.org/wiki/AI_boom) of the early 2020s, with companies, universities, and laboratories overwhelmingly based in the United States pioneering significant [advances in artificial intelligence](https://en.wikipedia.org/wiki/Advances_in_artificial_intelligence).[[13]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTEFrank2023-13)

The growing use of artificial intelligence in the 21st century is influencing [a societal and economic shift](https://en.wikipedia.org/wiki/AI_era) towards increased automation, [data-driven decision-making](https://en.wikipedia.org/wiki/Data-driven_decision-making), and the [integration of AI systems](https://en.wikipedia.org/wiki/Artificial_intelligence_systems_integration) into various economic sectors and areas of life, [impacting job markets](https://en.wikipedia.org/wiki/Workplace_impact_of_artificial_intelligence), [healthcare](https://en.wikipedia.org/wiki/Artificial_intelligence_in_healthcare), government, industry, and [education](https://en.wikipedia.org/wiki/Artificial_intelligence_in_education). This raises questions about [the long-term effects](https://en.wikipedia.org/wiki/AI_aftermath_scenarios), [ethical implications](https://en.wikipedia.org/wiki/Ethics_of_artificial_intelligence), and [risks of AI](https://en.wikipedia.org/wiki/AI_risk), prompting discussions about [regulatory policies](https://en.wikipedia.org/wiki/Regulation_of_artificial_intelligence) to ensure the [safety and benefits of the technology](https://en.wikipedia.org/wiki/AI_safety).

The various sub-fields of AI research are centered around particular goals and the use of particular tools. The traditional goals of AI research include [reasoning](https://en.wikipedia.org/wiki/Automated_reasoning), [knowledge representation](https://en.wikipedia.org/wiki/Knowledge_representation), [planning](https://en.wikipedia.org/wiki/Automated_planning_and_scheduling), [learning](https://en.wikipedia.org/wiki/Machine_learning), [natural language processing](https://en.wikipedia.org/wiki/Natural_language_processing), perception, and support for [robotics](https://en.wikipedia.org/wiki/Robotics).[[a]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-Problems_of_AI-14) [General intelligence](https://en.wikipedia.org/wiki/Artificial_general_intelligence)—the ability to complete any task performable by a human on an at least equal level—is among the field's long-term goals.[[14]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-AGI-15)

To reach these goals, AI researchers have adapted and integrated a wide range of techniques, including [search](https://en.wikipedia.org/wiki/State_space_search) and [mathematical optimization](https://en.wikipedia.org/wiki/Mathematical_optimization), [formal logic](https://en.wikipedia.org/wiki/Logic#Formal_logic), [artificial neural networks](https://en.wikipedia.org/wiki/Artificial_neural_network), field

Why is important

Today, the amount of data that is generated, by both humans and machines, far outpaces humans’ ability to absorb, interpret, and make complex decisions based on that data. Artificial intelligence forms the basis for all computer learning and is the future of all complex decision making. As an example, most humans can figure out how to not lose at tic-tac-toe (noughts and crosses), even though there are 255,168 unique moves, of which 46,080 end in a draw. Far fewer folks would be considered grand champions of checkers, with more than 500 x 1018, or 500 quintillion, different potential moves. Computers are extremely efficient at calculating these combinations and permutations to arrive at the best decision. AI (and its logical evolution of machine learning) and deep learning are the foundational future of business decision making.

## History

## The study of mechanical or "formal" reasoning began with philosophers and mathematicians in antiquity. The study of logic led directly to [Alan Turing](https://en.wikipedia.org/wiki/Alan_Turing)'s [theory of computation](https://en.wikipedia.org/wiki/Theory_of_computation), which suggested that a machine, by shuffling symbols as simpleof mathematical reasoning.[[261]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTERussellNorvig20219-277)[[5]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-turing-5) This, along with concurrent discoveries in [cybernetics](https://en.wikipedia.org/wiki/Cybernetics), [information theory](https://en.wikipedia.org/wiki/Information_theory) and [neurobiology](https://en.wikipedia.org/wiki/Neurobiology), led researchers to consider the possibility of building an "electronic brain".[[q]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-279) They developed several areas of research that would become part of AI,[[263]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-280) such as [McCullouch](https://en.wikipedia.org/wiki/Warren_McCullouch) and [Pitts](https://en.wikipedia.org/wiki/Walter_Pitts) design for "artificial neurons" in 1943,[[264]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTERussellNorvig202117-281) and Turing's influential 1950 paper '[Computing Machinery and Intelligence](https://en.wikipedia.org/wiki/Computing_Machinery_and_Intelligence)', which introduced the [Turing test](https://en.wikipedia.org/wiki/Turing_test) and showed that "machine intelligence" was plausible.[[265]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-Turing_test-282)[[5]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-turing-5)

The field of AI research was founded at [a workshop](https://en.wikipedia.org/wiki/Dartmouth_workshop) at [Dartmouth College](https://en.wikipedia.org/wiki/Dartmouth_College) in 1956.[[r]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-284)[[6]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-Dartmouth_workshop-6) The attendees became the leaders of AI research in the 1960s.[[s]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-286) They and their students produced programs that the press described as "astonishing":[[t]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-288) computers were learning [checkers](https://en.wikipedia.org/wiki/Draughts) strategies, solving word problems in algebra, proving [logical theorems](https://en.wikipedia.org/wiki/Theorem) and speaking English.[[u]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-289)[[7]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-AI_in_the_60s-7) Artificial intelligence laboratories were set up at a number of British and U.S. Universities in the latter 1950s and early 1960s.[[5]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-turing-5)

Researchers in the 1960s and the 1970s were convinced that their methods would eventually succeed in creating a machine with [general intelligence](https://en.wikipedia.org/wiki/Artificial_general_intelligence) and considered this the goal of their field.[[269]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTENewquist199486%E2%80%9386-290) [Herbert Simon](https://en.wikipedia.org/wiki/Herbert_A._Simon) predicted, "machines will be capable, within twenty years, of doing any work a man can do".[[270]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-291) [Marvin Minsky](https://en.wikipedia.org/wiki/Marvin_Minsky) agreed, writing, "within a generation ... the problem of creating 'artificial intelligence' will substantially be solved".[[271]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-292) They had, however, underestimated the difficulty of the problem.[[v]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-294) In 1974, both the U.S. and British governments cut off exploratory research in response to the [criticism](https://en.wikipedia.org/wiki/Lighthill_report) of [Sir James Lighthill](https://en.wikipedia.org/wiki/Sir_James_Lighthill)[[273]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTELighthill1973-295) and ongoing pressure from the U.S. Congress to [fund more productive projects](https://en.wikipedia.org/wiki/Mansfield_Amendment).[[274]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTENRC1999212%E2%80%93213-296) [Minsky](https://en.wikipedia.org/wiki/Marvin_Minsky)'s and [Papert](https://en.wikipedia.org/wiki/Seymour_Papert" \o "Seymour Papert)'s book *[Perceptrons](https://en.wikipedia.org/wiki/Perceptron" \o "Perceptron)* was understood as proving that [artificial neural networks](https://en.wikipedia.org/wiki/Artificial_neural_networks) would never be useful for solving real-world tasks, thus discrediting the approach altogether.[[275]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTERussellNorvig202122-297) The "[AI winter](https://en.wikipedia.org/wiki/AI_winter)", a period when obtaining funding for AI projects was difficult, followed.[[9]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-First_AI_winter-9)

In the early 1980s, AI research was revived by the commercial success of [expert systems](https://en.wikipedia.org/wiki/Expert_system),[[276]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-298) a form of AI program that simulated the knowledge and analytical skills of human experts. By 1985, the market for AI had reached over a billion dollars. At the same time, Japan's [fifth generation computer](https://en.wikipedia.org/wiki/Fifth_generation_computer) project inspired the U.S. and British governments to restore funding for [academic research](https://en.wikipedia.org/wiki/Academic_research).[[8]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-AI_in_the_80s-8) However, beginning with the collapse of the [Lisp Machine](https://en.wikipedia.org/wiki/Lisp_Machine) market in 1987, AI once again fell into disrepute, and a second, longer-lasting winter began.[[10]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-Second_AI_winter-10)

Up to this point, most of AI's funding had gone to projects which used high level [symbols](https://en.wikipedia.org/wiki/Symbolic_AI) to represent [mental objects](https://en.wikipedia.org/wiki/Mental_objects) like plans, goals, beliefs and known facts. In the 1980s, some researchers began to doubt that this approach would be able to imitate all the processes of human cognition, especially [perception](https://en.wikipedia.org/wiki/Machine_perception), [robotics](https://en.wikipedia.org/wiki/Robotics), [learning](https://en.wikipedia.org/wiki/Machine_learning) and [pattern recognition](https://en.wikipedia.org/wiki/Pattern_recognition),[[277]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTERussellNorvig202124-299) and began to look into "sub-symbolic" approaches.[[278]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTENilsson19987-300) [Rodney Brooks](https://en.wikipedia.org/wiki/Rodney_Brooks) rejected "representation" in general and focussed directly on engineering machines that move and survive.[[w]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-305) [Judea Pearl](https://en.wikipedia.org/wiki/Judea_Pearl), [Lofti Zadeh](https://en.wikipedia.org/wiki/Lofti_Zadeh) and others developed methods that handled incomplete and uncertain information by making reasonable guesses rather than precise logic.[[88]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-Uncertain_reasoning-94)[[283]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTERussellNorvig202125-306) But the most important development was the revival of "[connectionism](https://en.wikipedia.org/wiki/Connectionism)", including neural network research, by [Geoffrey Hinton](https://en.wikipedia.org/wiki/Geoffrey_Hinton) and others.[[284]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-307) In 1990, [Yann LeCun](https://en.wikipedia.org/wiki/Yann_LeCun) successfully showed that [convolutional neural networks](https://en.wikipedia.org/wiki/Convolutional_neural_networks) can recognize handwritten digits, the first of many successful applications of neural networks.[[285]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTERussellNorvig202126-308)

AI gradually restored its reputation in the late 1990s and early 21st century by exploiting formal mathematical methods and by finding specific solutions to specific problems. This "[narrow](https://en.wikipedia.org/wiki/Narrow_AI)" and "formal" focus allowed researchers to produce verifiable results and collaborate with other fields (such as [statistics](https://en.wikipedia.org/wiki/Statistics), [economics](https://en.wikipedia.org/wiki/Economics) and [mathematics](https://en.wikipedia.org/wiki/Mathematical_optimization)).[[286]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-AI_1990s-309) By 2000, solutions developed by AI researchers were being widely used, although in the 1990s they were rarely described as "artificial intelligence".[[287]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-AI_widely_used_1990s-310) However, several academic researchers became concerned that AI was no longer pursuing its original goal of creating versatile, fully intelligent machines. Beginning around 2002, they founded the subfield of [artificial general intelligence](https://en.wikipedia.org/wiki/Artificial_general_intelligence) (or "AGI"), which had several well-funded institutions by the 2010s.[[14]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-AGI-15)

[Deep learning](https://en.wikipedia.org/wiki/Deep_learning) began to dominate industry benchmarks in 2012 and was adopted throughout the field.[[11]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-Deep_learning_revolution-11) For many specific tasks, other methods were abandoned.[[x]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-312) Deep learning's success was based on both hardware improvements ([faster computers](https://en.wikipedia.org/wiki/Moore%27s_law),[[289]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-Moore's_Law-313) [graphics processing units](https://en.wikipedia.org/wiki/Graphics_processing_unit), [cloud computing](https://en.wikipedia.org/wiki/Cloud_computing)[[290]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTEClark2015b-314)) and access to [large amounts of data](https://en.wikipedia.org/wiki/Big_data)[[291]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-Big_data-315) (including curated datasets,[[290]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTEClark2015b-314) such as [ImageNet](https://en.wikipedia.org/wiki/ImageNet)). Deep learning's success led to an enormous increase in interest and funding in AI.[[y]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-316) The amount of machine learning research (measured by total publications) increased by 50% in the years 2015–2019.[[251]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTEUNESCO2021-267)

In 2016, issues of [fairness](https://en.wikipedia.org/wiki/Algorithmic_fairness) and the misuse of technology were catapulted into center stage at machine learning conferences, publications vastly increased, funding became available, and many researchers re-focussed their careers on these issues. The [alignment problem](https://en.wikipedia.org/wiki/AI_alignment) became a serious field of academic study.[[229]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTEChristian202067,_73-245)

In the late teens and early 2020s, [AGI](https://en.wikipedia.org/wiki/Artificial_general_intelligence) companies began to deliver programs that created enormous interest. In 2015, [AlphaGo](https://en.wikipedia.org/wiki/AlphaGo), developed by [DeepMind](https://en.wikipedia.org/wiki/DeepMind), beat the world champion [Go player](https://en.wikipedia.org/wiki/Go_player). The program was taught only the rules of the game and developed strategy by itself. [GPT-3](https://en.wikipedia.org/wiki/GPT-3) is a [large language model](https://en.wikipedia.org/wiki/Large_language_model) that was released in 2020 by [OpenAI](https://en.wikipedia.org/wiki/OpenAI) and is capable of generating high-quality human-like text.[[292]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-317) These programs, and others, inspired an aggressive [AI boom](https://en.wikipedia.org/wiki/AI_boom), where large companies began investing billions in AI research. According to 'AI Impacts', about $50 billion annually was invested in "AI" around 2022 in the U.S. alone and about 20% of the new U.S. Computer Science PhD graduates have specialized in "AI".[[293]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTEDiFeliciantonio2023-318) About 800,000 "AI"-related U.S. job openings existed in 2022.[[](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTEGoswami2023-319)

Advantage

Artificial Intelligence is a branch of computer science dedicated to creating computers and programs that can replicate human thinking. Some AI programs can learn from their past by analyzing complex sets of data and improve their performance without the help of humans to refine their programming.

As AI has boomed in recent years, it’s become commonplace in both business and everyday life. People use AI every day to make their lives easier – interacting with AI-powered virtual assistants or programs. Companies use AI to streamline their production processes, project gains and losses, and predict when maintenance will have to occur Everyone knows that AI gives businesses an edge. The Appen State of AI Report for 2021 says that all businesses have a critical need to adopt AI and ML in their models or risk being left behind. Companies increasingly utilize AI to streamline their internal processes (as well as some customer-facing processes and applications). Implementing AI can help your business achieve its results faster and with more precisionEveryone knows that AI gives businesses an edge. The Appen State of AI Report for 2021 says that all businesses have a critical need to adopt AI and ML in their models or risk being left behind. Companies increasingly utilize AI to streamline their internal processes (as well as some customer-facing processes and applications). Implementing AI can help your business achieve its results faster and with more precision.

Disadvantage

There are always pros and cons to any technological advancement. There is a ton of debate about the benefits and [risks of AI](https://www.tableau.com/data-insights/ai/risks) at every level. But beyond the headlines that either peddle hype or fear, what does AI do?

The advantages range from streamlining, saving time, eliminating biases, and automating repetitive tasks, just to name a few. The disadvantages are things like costly implementation, potential human job loss, and lack of emotion and creativity. So where do we net out?

Future

### Superintelligence and the singularity

A [superintelligence](https://en.wikipedia.org/wiki/Superintelligence) is a hypothetical agent that would possess intelligence far surpassing that of the brightest and most gifted human mind.[[313]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTERoberts2016-340)

If research into [artificial general intelligence](https://en.wikipedia.org/wiki/Artificial_general_intelligence) produced sufficiently intelligent software, it might be able to [reprogram and improve itself](https://en.wikipedia.org/wiki/Recursive_self-improvement). The improved software would be even better at improving itself, leading to what [I. J. Good](https://en.wikipedia.org/wiki/I._J._Good) called an "[intelligence explosion](https://en.wikipedia.org/wiki/Intelligence_explosion)" and [Vernor Vinge](https://en.wikipedia.org/wiki/Vernor_Vinge) called a "[singularity](https://en.wikipedia.org/wiki/Technological_singularity)".[[329]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-Singularity-357)

However, technologies cannot improve exponentially indefinitely, and typically follow an [S-shaped curve](https://en.wikipedia.org/wiki/S-shaped_curve), slowing when they reach the physical limits of what the technology can do.[[330]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTERussellNorvig20211005-358)

### Transhumanism

Robot designer [Hans Moravec](https://en.wikipedia.org/wiki/Hans_Moravec), cyberneticist [Kevin Warwick](https://en.wikipedia.org/wiki/Kevin_Warwick), and inventor [Ray Kurzweil](https://en.wikipedia.org/wiki/Ray_Kurzweil) have predicted that humans and machines will merge in the future into [cyborgs](https://en.wikipedia.org/wiki/Cyborg) that are more capable and powerful than either. This idea, called transhumanism, has roots in [Aldous Huxley](https://en.wikipedia.org/wiki/Aldous_Huxley) and [Robert Ettinger](https://en.wikipedia.org/wiki/Robert_Ettinger).[[331]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-359)

[Edward Fredkin](https://en.wikipedia.org/wiki/Edward_Fredkin) argues that "artificial intelligence is the next stage in evolution", an idea first proposed by [Samuel Butler](https://en.wikipedia.org/wiki/Samuel_Butler_(novelist))'s "[Darwin among the Machines](https://en.wikipedia.org/wiki/Darwin_among_the_Machines)" as far back as 1863, and expanded upon by [George Dyson](https://en.wikipedia.org/wiki/George_Dyson_(science_historian)) in his book of the same name in 1998.[[332]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-360)

## **In fiction**

*Main article:*[*Artificial intelligence in fiction*](https://en.wikipedia.org/wiki/Artificial_intelligence_in_fiction)

[](https://en.wikipedia.org/wiki/File:Capek_play.jpg)The word "robot" itself was coined by [Karel Čapek](https://en.wikipedia.org/wiki/Karel_%C4%8Capek) in his 1921 play [*R.U.R.*](https://en.wikipedia.org/wiki/R.U.R.), the title standing for "Rossum's Universal Robots".

Thought-capable artificial beings have appeared as storytelling devices since antiquity,[[333]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-AI_in_myth-361) and have been a persistent theme in [science fiction](https://en.wikipedia.org/wiki/Science_fiction).[[334]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTEMcCorduck2004340%E2%80%93400-362)

A common [trope](https://en.wikipedia.org/wiki/Trope_(literature)) in these works began with [Mary Shelley](https://en.wikipedia.org/wiki/Mary_Shelley)'s [*Frankenstein*](https://en.wikipedia.org/wiki/Frankenstein), where a human creation becomes a threat to its masters. This includes such works as [Arthur C. Clarke's](https://en.wikipedia.org/wiki/2001:_A_Space_Odyssey_(novel)) and [Stanley Kubrick's](https://en.wikipedia.org/wiki/2001:_A_Space_Odyssey_(film)) *2001: A Space Odyssey* (both 1968), with [HAL 9000](https://en.wikipedia.org/wiki/HAL_9000), the murderous computer in charge of the [*Discovery One*](https://en.wikipedia.org/wiki/Discovery_One) spaceship, as well as [*The Terminator*](https://en.wikipedia.org/wiki/The_Terminator) (1984) and [*The Matrix*](https://en.wikipedia.org/wiki/The_Matrix) (1999). In contrast, the rare loyal robots such as Gort from [*The Day the Earth Stood Still*](https://en.wikipedia.org/wiki/The_Day_the_Earth_Stood_Still) (1951) and Bishop from [*Aliens*](https://en.wikipedia.org/wiki/Aliens_(film)) (1986) are less prominent in popular culture.[[335]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTEButtazzo2001-363)

[Isaac Asimov](https://en.wikipedia.org/wiki/Isaac_Asimov) introduced the [Three Laws of Robotics](https://en.wikipedia.org/wiki/Three_Laws_of_Robotics) in many books and stories, most notably the "Multivac" series about a super-intelligent computer of the same name. Asimov's laws are often brought up during lay discussions of machine ethics;[[336]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTEAnderson2008-364) while almost all artificial intelligence researchers are familiar with Asimov's laws through popular culture, they generally consider the laws useless for many reasons, one of which is their ambiguity.[[337]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTEMcCauley2007-365)

Several works use AI to force us to confront the fundamental question of what makes us human, showing us artificial beings that have [the ability to feel](https://en.wikipedia.org/wiki/Sentience), and thus to suffer. This appears in [Karel Čapek](https://en.wikipedia.org/wiki/Karel_%C4%8Capek)'s [*R.U.R.*](https://en.wikipedia.org/wiki/R.U.R.), the films [*A.I. Artificial Intelligence*](https://en.wikipedia.org/wiki/A.I._Artificial_Intelligence) and [*Ex Machina*](https://en.wikipedia.org/wiki/Ex_Machina_(film)), as well as the novel [*Do Androids Dream of Electric Sheep?*](https://en.wikipedia.org/wiki/Do_Androids_Dream_of_Electric_Sheep%3F), by [Philip K. Dick](https://en.wikipedia.org/wiki/Philip_K._Dick). Dick considers the idea that our understanding of human subjectivity is altered by technology created with artificial intelligence.[[338]](https://en.wikipedia.org/wiki/Artificial_intelligence#cite_note-FOOTNOTEGalvan1997-366)