ARTIFICIAL INTELLIGENCE

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1 What is Artificial intelligence

Artificial intelligence is the simulation of human intelligence processes by machines, especially computer systems. Artificial intelligence (AI) is a wide-ranging branch of computer science concerned with building smart machines capable of performing tasks that typically require human intelligence. While AI is an interdisciplinary science with multiple approaches, advancements in machine learning and deep learning, in particular, are creating a paradigm shift in virtually every sector of the tech industry.
Artificial intelligence allows machines to model, or even improve upon, the capabilities of the human mind. And from the development of self-driving cars to the proliferation of generative AI tools like ChatGPT and Google's Bard, AI is increasingly becoming part of everyday life — and area companies across every industry are investing in it.

2 Basics of Artificial Intelligence

Broadly speaking, artificially intelligent systems can perform tasks commonly associated with human cognitive functions — such as interpreting speech, playing games and identifying patterns. They typically learn how to do so by processing massive amounts of data, looking for patterns to model in their own decision-making. In many cases, humans will supervise an AI's learning process, reinforcing good decisions and discouraging bad ones. But some AI systems are designed to learn without supervision — for instance, by playing a video game over and over until they eventually figure out the rules and how to win.

2.1 Strong AI

Strong AI, also known as artificial general intelligence, is a machine that can solve problems it's never been trained to work on — much like a human can. This is the kind of AI we see in movies, like the robots from Westworld or the character Data from Star Trek: The Next Generation. This type of AI doesn't actually exist yet.
The creation of a machine with human-level intelligence that can be applied to any task is the Holy Grail for many AI researchers, but the quest for artificial general intelligence has been fraught with difficulty. And some believe

strong AI research should be limited, due to the potential risks of creating a powerful AI without appropriate guardrails.
In contrast to weak AI, strong AI represents a machine with a full set of cognitive abilities — and an equally wide array of use cases — but time hasn't eased the difficulty of achieving such a feat.

2.2 Weak AI

Weak AI, sometimes referred to as narrow AI or specialized AI, operates within a limited context and is a simulation of human intelligence applied to a narrowly defined problem (like driving a car, transcribing human speech, or curating content on a website).
Weak AI is often focused on performing a single task extremely well. While these machines may seem intelligent, they operate under far more constraints and limitations than even the most basic human intelligence.
Weak AI examples include:

- Siri, Alexa and other smart assistants
- Self-driving cars
- Google search
- Conversational bots
- Email spam filters
- Netflix's recommendations

2.3 Machine Learning Vs. Deep Learning

Although the terms "machine learning" and "deep learning" come up frequently in conversations about AI, they should not be used interchangeably. Deep learning is a form of machine learning, and machine learning is a subfield of artificial intelligence.

2.4 Machine Learning

A machine learning algorithm is fed data by a computer and uses statistical techniques to help it "learn" how to get progressively better at a task, without

necessarily having been specifically programmed for that task. Instead, ML algorithms use historical data as input to predict new output values. To that end, ML consists of both supervised learning (where the expected output for the input is known thanks to labeled data sets) and unsupervised learning (where the expected outputs are unknown due to the use of unlabeled data sets).

2.5 Deep Learning

Deep learning is a type of machine learning that runs inputs through a biologically inspired neural network architecture. The neural networks contain a number of hidden layers through which the data is processed, allowing the machine to go "deep" in its learning, making connections and weighting input for the best results.

3 How does Artificial Intelligence work

AI requires a foundation of specialized hardware and software for writing and training machine learning algorithms. No single programming language is synonymous with AI, but Python, R, Java, C++ and Julia
In general, AI systems work by ingesting large amounts of labeled training data, analyzing the data for correlations and patterns, and using these patterns to make predictions about future states.
AI programming focuses on cognitive skills that include the following:
Learning. This aspect of AI programming focuses on acquiring data and creating rules for how to turn it into actionable information. The rules, which are called algorithms, provide computing devices with step-by-step instructions for how to complete a specific task.
Reasoning. This aspect of AI programming focuses on choosing the right algorithm to reach a desired outcome.
Self-correction. This aspect of AI programming is designed to continually fine-tune algorithms and ensure they provide the most accurate results possible.
Creativity. This aspect of AI uses neural networks, rules-based systems, statistical methods and other AI techniques to generate new images, new text, new music and new ideas.

3.1 Differences between AI, machine learning and deep learning

AI, machine learning and deep learning are common terms in enterprise IT and sometimes used interchangeably, especially by companies in their marketing materials. But there are distinctions. The term AI, coined in the 1950s, refers to the simulation of human intelligence by machines. It covers an ever-changing set of capabilities as new technologies are developed. Technologies that come under the umbrella of AI include machine learning and deep learning.
Machine learning enables software applications to become more accurate at predicting outcomes without being explicitly programmed to do so. Machine learning algorithms use historical data as input to predict new output values. This approach became vastly more effective with the rise of large data sets to train on. Deep learning, a subset of machine learning, is based on our understanding of how the brain is structured. Deep learning's use of artificial neural networks structure is the underpinning of recent advances in AI, including self-driving cars and ChatGPT.

4 Types of Artificial Intelligence

AI can be divided into four categories, based on the type and complexity of the tasks a system is able to perform. there are

- Reactive machines
- Limited memory
- Theory of mind
- Self-awareness

4.1 Reactive Machines

A reactive machine follows the most basic of AI principles and, as its name implies, is capable of only using its intelligence to perceive and react to the world in front of it. A reactive machine cannot store memory and, as a result, cannot rely on past experiences to inform decision-making in real-time.
Perceiving the world directly means that reactive machines are designed to

complete only a limited number of specialized duties. Intentionally narrowing a reactive machine's worldview has its benefits, however: This type of AI will be more trustworthy and reliable, and it will react the same way to the same stimuli every time.

4.2 Limited Memory

Limited memory AI has the ability to store previous data and predictions when gathering information and weighing potential decisions — essentially looking into the past for clues on what may come next. Limited memory AI is more complex and presents greater possibilities than reactive machines.
Limited memory AI is created when a team continuously trains a model in how to analyze and utilize new data or an AI environment is built so models can be automatically trained and renewed.
When utilizing limited memory AI in ML, six steps must be followed:

- Establish training data
- Create the machine learning model
- Ensure the model can make predictions
- Ensure the model can receive human or environmental feedback
- Store human and environmental feedback as data
- Reiterate the steps above as a cycle

4.3 Theory of Mind

Theory of mind is just that — theoretical. We have not yet achieved the technological and scientific capabilities necessary to reach this next level of AI.
The concept is based on the psychological premise of understanding that other living things have thoughts and emotions that affect the behavior of one's self. In terms of AI machines, this would mean that AI could comprehend how humans, animals and other machines feel and make decisions through self-reflection and determination, and then utilize that information to make decisions of their own. Essentially, machines would have to be able to grasp and process the concept of "mind," the fluctuations of emotions in

decision-making and a litany of other psychological concepts in real time, creating a two-way relationship between people and AI.

4.4 Self Awareness

Once theory of mind can be established, sometime well into the future of AI, the final step will be for AI to become self-aware. This kind of AI possesses human-level consciousness and understands its own existence in the world, as well as the presence and emotional state of others. It would be able to understand what others may need based on not just what they communicate to them but how they communicate it.
Self-awareness in AI relies both on human researchers understanding the premise of consciousness and then learning how to replicate that so it can be built into machines.

5 Importance of Artificial Intelligence

AI is important for its potential to change how we live, work and play. It has been effectively used in business to automate tasks done by humans, including customer service work, lead generation, fraud detection, and quality control. In a number of areas, AI can perform tasks much better than humans. Particularly when it comes to repetitive, detail-oriented tasks, such as analyzing large numbers of legal documents to ensure relevant fields are filled in properly, AI tools often complete jobs quickly and with relatively few errors. Because of the massive data sets it can process, AI can also give enterprises insights into their operations they might not have been aware of. The rapidly expanding population of generative AI tools will be significant in fields ranging from education and marketing to product design.

6 Examples of AI technology and way to use today

AI is incorporated into a variety of different types of technology. Here are seven examples.
Automation. When paired with AI technologies, automation tools can expand the volume and types of tasks performed. An example is robotic process

automation (RPA), a type of software that automates repetitive, rules-based data processing tasks traditionally done by humans. When combined with machine learning and emerging AI tools, RPA can automate bigger portions of enterprise jobs, enabling RPA's tactical bots to pass along intelligence from AI and respond to process changes.

Machine learning. This is the science of getting a computer to act without programming. Deep learning is a subset of machine learning that, in very simple terms, can be thought of as the automation of predictive analytics. There are three types of machine learning algorithms:

- Supervised learning. Data sets are labeled so that patterns can be detected and used to label new data sets.
- Unsupervised learning. Data sets aren't labeled and are sorted according to similarities or differences.
- Reinforcement learning. Data sets aren't labeled but, after performing an action or several actions, the AI system is given feedback.

Machine vision. This technology gives a machine the ability to see. Machine vision captures and analyzes visual information using a camera, analog-to-digital conversion and digital signal processing. It is often compared to human eyesight, but machine vision isn't bound by biology and can be programmed to see through walls, for example. It is used in a range of applications from signature identification to medical image analysis. Computer vision, which is focused on machine-based image processing, is often conflated with machine vision.

Natural language processing (NLP). This is the processing of human language by a computer program. One of the older and best-known examples of NLP is spam detection, which looks at the subject line and text of an email and decides if it's junk. Current approaches to NLP are based on machine learning. NLP tasks include text translation, sentiment analysis and speech recognition.

Robotics. This field of engineering focuses on the design and manufacturing of robots. Robots are often used to perform tasks that are difficult for humans to perform or perform consistently. For example, robots are used in car production assembly lines or by NASA to move large objects in space. Researchers also use machine learning to build robots that can interact in social settings.

Self-driving cars. Autonomous vehicles use a combination of computer vision, image recognition and deep learning to build automated skills to pilot a vehicle while staying in a given lane and avoiding unexpected obstructions, such as pedestrians.
Text, image and audio generation. Generative AI techniques, which create various types of media from text prompts, are being applied extensively across businesses to create a seemingly limitless range of content types from photo realistic art to email responses and screenplays.

7 Applications of Artificial Intelligence

Artificial intelligence has made its way into a wide variety of markets.
AI in healthcare. The biggest bets are on improving patient outcomes and reducing costs. Companies are applying machine learning to make better and faster medical diagnoses than humans. One of the best-known healthcare technologies is IBM Watson. It understands natural language and can respond to questions asked of it. The system mines patient data and other available data sources to form a hypothesis, which it then presents with a confidence scoring schema. Other AI applications include using online virtual health assistants and chatbots to help patients and healthcare customers find medical information, schedule appointments, understand the billing process and complete other administrative processes. An array of AI technologies is also being used to predict, fight and understand pandemics such as COVID-19.
AI in business. Machine learning algorithms are being integrated into analytics and customer relationship management (CRM) platforms to uncover information on how to better serve customers. Chatbots have been incorporated into websites to provide immediate service to customers. The rapid advancement of generative AI technology such as ChatGPT is expected to have far-reaching consequences: eliminating jobs, revolutionizing product design and disrupting business models.
AI in education. AI can automate grading, giving educators more time for other tasks. It can assess students and adapt to their needs, helping them work at their own pace. AI tutors can provide additional support to students, ensuring they stay on track. The technology could also change where and how students learn, perhaps even replacing some teachers. As demonstrated by ChatGPT, Bard and other large language models, generative AI can help

educators craft course work and other teaching materials and engage students in new ways. The advent of these tools also forces educators to rethink student homework and testing and revise policies on plagiarism.

AI in finance. AI in personal finance applications, such as Intuit Mint or TurboTax, is disrupting financial institutions. Applications such as these collect personal data and provide financial advice. Other programs, such as IBM Watson, have been applied to the process of buying a home. Today, artificial intelligence software performs much of the trading on Wall Street.

AI in software coding and IT processes. New generative AI tools can be used to produce application code based on natural language prompts, but it is early days for these tools and unlikely they will replace software engineers soon. AI is also being used to automate many IT processes, including data entry, fraud detection, customer service, and predictive maintenance and security.

Security. AI and machine learning are at the top of the buzzword list security vendors use to market their products, so buyers should approach with caution. Still, AI techniques are being successfully applied to multiple aspects of cybersecurity, including anomaly detection, solving the false-positive problem and conducting behavioral threat analytics. Organizations use machine learning in security information and event management (SIEM) software and related areas to detect anomalies and identify suspicious activities that indicate threats. By analyzing data and using logic to identify similarities to known malicious code, AI can provide alerts to new and emerging attacks much sooner than human employees and previous technology iterations.