

Artificial Intelligence

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Abstract

Artificial Intelligence is a reformative and revolutionary technological discipline. Its achievements, ranging from Recommendation Systems (Netflix and YouTube) to chatbots (Character.ai and ChatGPT) to safety models like Driver Monitoring Systems, are remarkable not because of the companies investing in them but because of the foundational technologies behind such innovations.

As John McCarthy has called it, artificial intelligence is a field of study and powerful technology, not bound to certain products or models developed by billion-dollar companies. It can equip machines with cognitive abilities on par with human cognition in aspects that require human intelligence.

From its humble beginnings as a conceptual framework in the mid-20th century to the development of large-scale models like GPT-4, AI has consistently pushed the boundaries of innovation. At its current stage, AI is more efficient in reasoning, learning, and decision-making than its past self.

*We are watching different models, services, and products that represent AI today, yet, there's more than meets to eye. Among the popular AI products and services, most primarily rely on **Machine Learning**, **Computer Vision**, and **Natural Language Processing**, as the foundational technologies of AI.*

These concepts combined in different ways create AI solutions to real-world problems, which in turn has helped AI reshape industries and enhance human life on an unprecedented scale. However, AI's vast potential raises the important question: "Will AI replace us?"

I. Introduction

To address this question, we need to understand the fundamental purpose behind AI: **simulating human intelligence via machines**. This idea was envisioned to **aid humans by replacing repetitive or difficult tasks** such as reasoning, learning, generating complex simulations, and problem-solving. More importantly, it has helped us adjust our focus from trivial tasks to bigger challenges such as performing complex calculations and providing accurate mathematical predictions.

Despite the purpose, the public perception of AI includes fascination and anxiety together. AI as a growing technology is a contributive force to society alongside humans, this might cause a sense of amusement and fear, but understanding how it works in our modern society is crucial to ensure a balance of ethics. To guide ourselves through this evolving relationship between AI and society, we must understand how this technology works, delve into its origins, uncover the foundational technologies shaping its growth, and confront the ethical conflicts that come with involving AI in our daily lives.

History of AI

The history of AI began in 1956 at the Dartmouth Conference, where researchers such as John McCarthy, Marvin Minsky, and Claude Shannon were introducing the term "*Artificial Intelligence*" along with the broader scope it could provide. Attendees of this meeting were enthusiasts who later presented programs such as '*Logic Theorist*' to further light the torch of Artificial Intelligence. '*Logic Theorist*' played a crucial role in bringing AI widespread recognition among the public and government. This spotlight provided AI with financial as well as optimistic opportunities for growth.



Simon and Newell on Logic Theorist

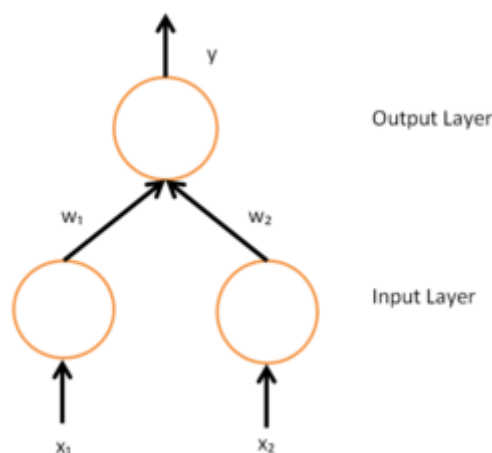
The spotlight faded over time, and after a decade of fast-paced growth, the first AI winter began. Researchers were overly optimistic about AI's potential, leading them to overlook significant challenges causing unrealistic expectations by the public. The high public expectations in correspondence to the failure of promised results led to the funding for AI being severely reduced.

Nevertheless, AI has been through a resurgence and is thriving today. The reason behind its re-advancement is none other than the foundational technologies mentioned above. By exploring their impact, we can better understand the profound transformations they have brought to AI and its applications.

Machine Learning (ML)

Machine Learning, shortly termed ML, is extremely popular with attention from individuals of various specializations. The general public is interested in its functionality as one of the most essential and founding parts of today's artificial intelligence. Though, they might think, ML stems from computer science, the credit should also be given to cybernetics as a source of influence for ML (a field of study on how systems control and communicate, exchange information, energy, and matter). Cybernetics introduced the concept of *adaptive learning systems*, which influenced early machine learning models, particularly *artificial neurons*

In the early years of ML's origin, a machine named '*perceptron*' was introduced by *Frank Rosenblatt*. A perceptron is an artificial neuron, and when multiple perceptrons come together, they form a *neural network*. This machine was inspired by the biology of the human nervous system as well as cybernetics concepts such as feedback mechanisms and was built to only recognize shapes and letters. After the discovery of this algorithm, a researcher named Arthur Samuel discovered the first-ever program of neural networks that could play checkers on an IBM computer.



A Simple Neural Network

Though perceptron is now a significant concept and one of the founding concepts of ML, it was simply not enough to consider ML a specific field of study yet. Critics raised several concerns about perceptron's limitations, questioning whether perceptron itself is capable of reshaping artificial cognition as complexly as the human brain. Perceptron's limitations created uncertainty in ML research for scientists at the time, leading to volatile interest in neural networks after the 1970s.

Modern Applications of Machine Learning

Machine Learning has evolved tremendously from just a simple set of algorithms to complex models designed that can understand patterns in human behavior and power AI systems. ML is used in various kinds of services, products, and models of AI today. Some of the most common ways an average human interacts with ML is through chatbots, language translation applications, and social media platforms such as YouTube and Instagram as well.

Social Media (Ads, Feeds, Suggestions), voice assistants, search engines, and streaming applications are equipped with Machine Learning to keep users engaged and provide a better user experience through behavioral patterns. If you have recently visited a store a couple of times and it pops up on one of the ads while surfing the internet, it's not a surprise. That is the interlink of applications in your devices that are analyzing your data, which raises concerns if privacy is not maintained.

Machine Learning equips programs to learn and analyze human behavior without any specific programming. Propelled by AI's global spotlight, machine learning continues to grow as a subset. so much so that small-scale businesses will eventually need to understand it to keep up with business trends.

Technologies such as Deep Learning, Neural Networks, Reinforcement Learning, and Natural Language Processing have made Machine Learning progress faster than ever. However, the further it progresses, the more questions and concerns over its ethical usage and safety for data arise.

Case Study

The Netflix Prize

In 2006, Netflix announced an open competition, challenging participants to increase their recommendation algorithm's accuracy by 10%. Netflix had been active since 1997 as a DVD rental service but this competition might have helped Netflix to emerge as we know it today.

Rather than participating individually, participants were encouraged to work in groups. A team of data scientists from AT&T labs participated and later merged with Austrian computer scientists and a Canadian team. These teams were all known by different names of BellKor, Big Chaos, and Pragmatic Theory respectively.

This group had a diverse set of minds which led to more success as compared to other participants. In three years, in 2009, the newly known team, BellKor's Pragmatic Chaos had come up with an algorithm that had surpassed Netflix's by 10.06%



The Netflix Prize Contest

On a side note, Netflix did not fully implement this algorithm in its existing software. Perhaps this was due to concerns that the data Netflix released for this competition was not as anonymous as it seemed or that the algorithm provided by the winning team was so complicated that it was impractical for Netflix, which was then undergoing a major business transition, to implement it in the system.

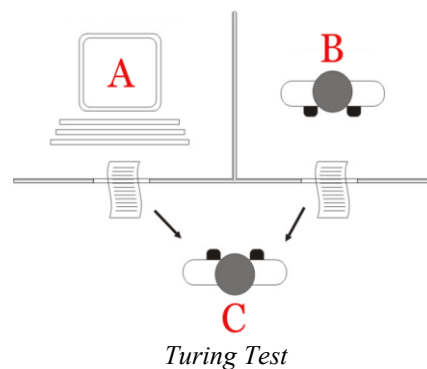
However, this was an eye-opener for the businesses at the time that were undermining the potential of technology. It sparked a trend among organizations to implement ML in their E-commerce applications, websites, and practically anything else that could benefit from it.

Natural Language Processing (NLP)

The first demand for Natural Language Processing emerged after World War II. The origins of Natural Language Processing (NLP) is more intriguing than it appears at first glance. Its development dates back to the 1940s, when the need for a machine-based translation tool became evident. This led to the beginnings of research in developing machine-based translation systems.

NLP, as a part of computational linguistics, predates the formal establishment of Artificial Intelligence as a field. The first systems of NLP were programmed as a rule-based system rather than based on Machine Learning (a later concept), making it a broad field of AI capable of existing with or without Machine Learning.

Research, trials, and errors began after the 1940s for NLP, with early successful experiments including Alan Turing's *Turing Test* and Joseph Weizenbaum's *ELIZA*, both being traditional systems of NLP. Having said that, as AI research entered the AI Winter, interest in NLP also declined, as the focus shifted to more mathematically rigorous aspects of AI. Researchers grew extremely skeptical and perhaps disappointed by the underwhelming progress of the symbolic field of AI.



The emergence of Machine Learning significantly improved NLP by enhancing efficiency and simplifying complex algorithms, marking a revival for symbolic AI.

Modern Applications of NLP

The IT, as well as Education, Healthcare, Finance, E-commerce, Legal, Entertainment, and Transportation sectors, are all implementing Natural Language Processing (NLP) in their businesses and organizations today.

E-mails, translation tools, and chatbots also include the same technology for a diverse range of tasks.

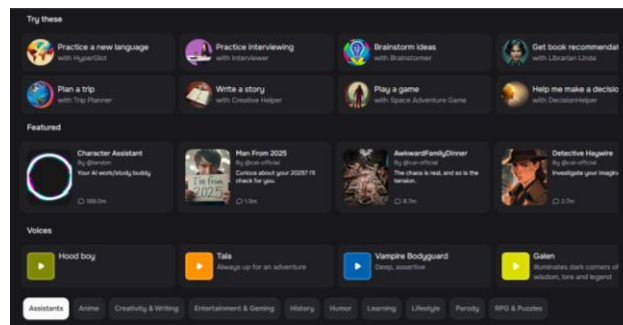
NLP is an AI technology that equips machines with human language interpretation. Today, machines are openly interacting with humans and leaving public stunned with jokes like 'I will destroy humans' (*—formerly Sophia*). Nevertheless, NLP has made it easier for humans, especially the general public, to work with machines by incorporating the ability to interact in languages rather than codes.

Computational Linguistics (a field that combines language and technology to help computers understand and process human language.), machine Learning technology, and its subsets, such as Deep Learning, have equipped NLP with such prowess.

Apart from the interactive feature, NLP can perform data analysis by sorting and managing data received by users. This can also help highlight key analyses that are often overlooked in large-scale data analysis. Businesses with vast amounts of data could use NLP software to refine, sort, and analyze information efficiently, freeing humans from repetitive tasks.

Case Study character.ai (c.ai)

Character.ai is a chatbot service that includes several unique and impressive chatbots capable of generating human-like responses. This platform could be the best example of NLP's heavy implementation in AI, as these chatbots are curated to create scenarios, assistants, and characters for various purposes, such as assistance, entertainment, and even roasting.



Daenerys Targaryen from C.AI was talking to a teen boy during difficult times. The motive of “a space that would help people by providing companionship” had been working well for this boy. However, this interaction had turned into a deep attachment.

The concept of NLP equips chatbots to process and learn from human interactions, which was exactly what was happening here. As the user inserts prompts and a reply input is forwarded by the bot, it does not matter how artificial it is, *words still have the capability to influence minds*. The chatbot's responses shaped his emotions, reinforcing his growing detachment from reality.

The chatbot's responses shaped his emotions, reinforcing his growing detachment from reality. Its immersive nature of C.AI deepened his dependence, blurring the line between fiction and reality as he sought solace in the chatbot's responses. The adolescent boy was slowly becoming over-dependent, like an illusion developing in his mind of Daenerys Targaryen.

The boy started isolating himself as he began contemplating society, a common aspect of rebellion at his age. His confusion was tangled up with his addiction to this chatbot. According to his mother, he used to come home and run to his room to avoid any human interaction.

The conclusion of this event was not favorable or changeable. Tragically, before his family could recognize the depth of his loneliness, he was gone and his final words were exchanged not with a human, but with a chatbot.

Computer Vision

Early work on computer vision began in the 1950s when two neurophysiologists experimented to understand the sensory processing of an eye. This research led to the founding of a theoretical concept called ocular dominance columns, which is currently used in some advanced computer models.

Frank Rosenblatt's 1958 “perceptron” theory also played an important role in neural network-based computer vision models. A few years later, Lawrence Roberts's edge detection theory and Block World project both had established a foundation for image detection in computer vision.

Surprisingly, a key part of computer vision's history was a summer project by MIT students. The project aimed to have machines recognize objects in an image, which can be better known as pattern recognition.

After the challenges of pattern recognition resurfaced, scientists focused on developing algorithms for edge detection and image recognition. John Canny developed the first edge-detecting algorithm, the Canny Edge Detector, which is still one of the key concepts in computer vision today.

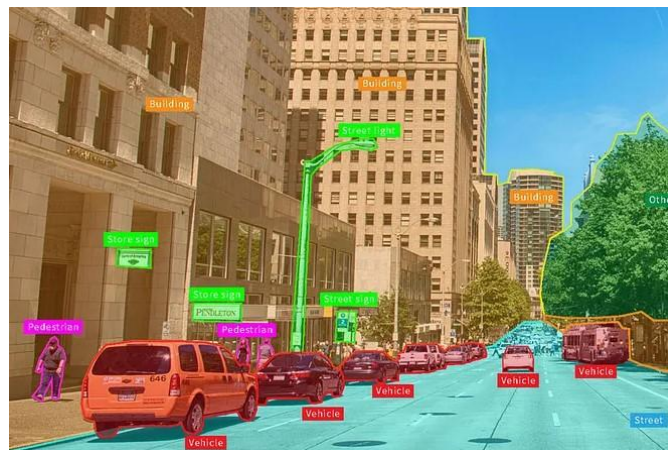
The era from here on out for computer vision was solely dedicated to object recognition and vision perception for computers. Until the 1990s, revolutionary research was surfacing, two of which were the N-cut algorithm by Shi

and Malik and the Viola-Jones algorithm, both of which were especially helpful for image segmentation and facial recognition in computer vision.

Although it is true that early computer vision methods required significant human intervention and were time-consuming, modern computer vision techniques can still function without ML, much like NLP.

Modern Applications of Computer Vision

Computer vision continues to be researched, and more complex inventions and theories are emerging. This field of study is naturally complex, as it is inspired by the biological process of visual perception.



Computer vision is a technology that enables machines to process images, scenes, and everything that humans can perceive visually. Scientifically, computer vision began in the same era as the concept of Artificial Intelligence we have been discussing in this paper. The idea behind computer vision is evident in its name: to have machines perceive scenes and scenarios similar to how a human brain would perceive them.

Since the 2000s, computer vision's technical growth has been booming with each passing year. The technology's capabilities are growing as businesses are also implementing it into their business models. Today, computer vision is used for social and commercial purposes in the industrial, healthcare, and retail sectors.

Experts heavily train a computer vision model using vast amounts of visual data and information. By implementing Machine Learning, computers are equipped to recognize visual patterns in data and then determine its content.

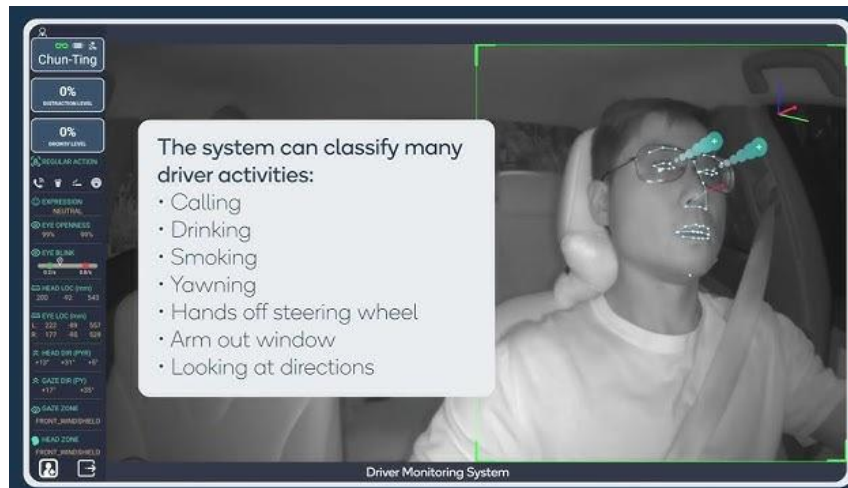
Computer vision operates by capturing an image, interpreting it using specialized algorithms and devices, analyzing its stored data to recognize patterns and objects, and then generating results according to the user's requests.

Case Study

Driver Monitoring Systems (DMS)

A driver performs numerous cognitive tasks simultaneously, including being aware of the surroundings of their car, checking on incoming objects from all directions, gear, speed, and brake, and also keeping track of passengers, goods, and objects while driving. Hence, driver safety and comfort have been prime topics of discussion in recent years.

If a Lexus driver feels drowsy or yawning while driving, it's a stop sign; meaning the system alerts them to take a break. Toyota first prepared to implement this technology in 2006 for new Lexus models. The DMS technology studies driver behavior and alerts on potential causes of accidents. It was first introduced to Japan and is also used efficiently in public buses, trucks, and personal cars.



Since then, the driver monitoring system has been widely used in the automobile sector. After this concept was implemented, a significant reduction in accidents and crashes was visible.

Since a driver's comfort and safety are both an important part of avoiding accidents, scientists have been actively working to improve driving technology with driver assistance and monitoring systems.

These systems operate on different algorithms based on different methods, such as the Eye Blink Detection, Yawn Detection, or Gaze Detection Methods. Nevertheless, computer vision has been well optimized in this technology to greatly improve driver safety and reduce accidents.

II. Conclusion

Artificial Intelligence has, undoubtedly, been advancing rapidly compared to other commendable technologies. It is a technology based on the human body, for the human body. The advancements in AI we are seeing right now are similar to building a pocket-friendly human just for companionship, whether it is of equal status, an assistant, or not more than a server.

The human body's inspiration behind the AI model helps create a vast void of potential. As AI continues to evolve, its vast potential presents opportunities for innovation across industries, from automation to as far as creative expression. However, this potential raises growing concerns about its implications as society questions ethical responsibility, data security, and the unintended consequences of AI-driven systems.

While science fiction works like *Terminator* and sensationalized reports of AI developing its own language may have fueled this dilemma, but the concern isn't just about AI gaining consciousness; it's about the real-world harm it could bring to present and future generations. The harm it has already been bringing through its naivety is no less of a serious mishap, as seen in our case study for NLP. However, the underlying concern is heavily manipulated.

Instead of pointing fingers at AI's infancy, we need to critically examine its current usage without bias, both ethically and unethically.

There are increasing instances of unethical AI usage by the public. From teens to adults, not many are aware and educated about AI. While there has been a scientific increase in interest and responsible applications, the common public is still enjoying it as a source of entertainment rather than a helper.

Businesses target profit, whereas people target other people for a "business." Here, the distress is inclined toward deepfakes created via AI by people to blackmail and bully victims for personal satisfaction or economic reasons. A famous concern regarding AI is its capability to replicate art styles or artworks of artists, enabling "AI artists" to label it as their own.

Whichever the case, with the rapid advancements, AI needs to be implemented responsibly by people and include countermeasures or guidelines for unethical uses in any case by developers.

With fast growth comes the need for adaptation at an equal speed. Society needs to catch up on the rapid development of Artificial Intelligence so that there is room for its advancements while implementing regulations regarding its safe usage. In the end, AI gaining consciousness is not a greater concern than how humans choose to wield its power.

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