The History of Artificial Intelligence

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Abstract

This paper explores the progress of artificial intelligence (AI) across time, starting with its theoretical foundations and continuing through multiple phases of development, failures, and successes. It starts with a look at the early theories and conceptions of artificial intelligence, emphasizing Alan Turing's foundational work—the Turing Test, which laid the groundwork for future developments in AI. Continuing on to the Dartmouth Conference in 1956, a pivotal event marking the birth of modern AI, and discusses the early triumphs and challenges in the field during this era. The 1970s to 1990s, also referred to as the AI Winter, are given a lot of attention. This section explores the causes of the decreased funding and interest in AI, highlighting the disparity between expectations and reality as well as the constraints of processing capacity. The paper then looks at the return of AI, due to the improvements in processing power and the emergence of big data. The advances in deep learning, machine learning, and neural networks have led to the development of contemporary applications like voice assistants and driverless cars that define modern-day usage of AI.

Introduction

Artificial Intelligence (AI) mimics human intelligence, including learning, problem-solving, and decision-making. The idea of AI, fantasized by many, took a concrete shape in the mid-20th century. The term "Artificial Intelligence" was discussed at the 1956 Dartmouth conference, a significant meeting where scientists like John McCarthy and Marvin Minsky discussed how machines could simulate human intelligence. They focused on enabling machines to understand language, conceptualize, solve complex problems, and self-improve. Over the years, AI advanced with programs capable of logical reasoning and problem-solving. However, progress stalled during the AI winter due to limited technology and funding. The digital age and internet boom of the 21st century reignited AI development. This era focuses on deep learning, complex neural networks, and integrating AI into daily life.

Early Developments and Theoretical Foundations

In the 1950s, the early stages of Artificial Intelligence (AI) drew interest from scientists, mathematicians, and philosophers. A key figure in this era was Alan Turing, whose work "Computing Machinery and Intelligence" laid the groundwork for AI. Turing suggested that if humans use data and reasoning to solve problems and make decisions, machines should be able to do the same. In Turing's paper, he asked the question, "Can machines think?" and introduced the Turing Test as a possible answer. This test involved an imitation game with three participants: a human interrogator, a machine, and another human. The goal was for the interrogator to identify the machine based on text-based questions and answers. Furthermore, even though “Machine Learning” was not coined at the time, he argued the concept that machines over time can learn and adapt on their own. For this reason, the Turing test has had a great impact on the development of Artificial intelligence. [1]

Additionally, Turing's 1936 paper "On Computable Numbers, with an Application to the Entscheidungsproblem" was vital for AI's evolution. He presented the concept of a universal machine, capable of performing any computation a human could, given enough time and memory. This theory laid the foundation for modern computers, providing a theoretical basis for programmable machines that underpin today's AI systems.[2]

The birth of modern AI

The modern era of artificial intelligence (AI) traces its origins back to the summer of 1956 during the Dartmouth Conference. This landmark event, organized by Claude Shannon, Nathaniel Rochester, John McCarthy, and Marvin Minsky, is notable for introducing the term "artificial intelligence." It marked the start of AI as a formal scientific field. The conference's main goal was to find ways for machines to mimic human abilities like using language, forming

abstract concepts, solving complex problems, and self-improvement. This meeting sparked significant investment and research in AI over the following decades. [4]

Some of the problems discussed about Artificial Intelligence are:

1. Automatic Computers: Emphasizes that the main challenge in AI is not the computational capacity of machines, but the difficulty in creating sophisticated programs that fully utilize available resources.

2. Language Use by Computers: Suggests that a significant part of human thought involves manipulating words according to specific rules, and explores how computers might be programmed to use language and form generalizations.

3. Neuron Nets: Discusses the arrangement of hypothetical neurons to form concepts, mentioning the significant theoretical and experimental work done in this area, although it remains partially unresolved.

4. Theory of the Size of a Calculation: Focuses on the need for a criterion to measure the efficiency of calculations, which requires understanding the complexity of calculating devices and functions.

5. Self-improvement: Proposes that intelligent machines should be capable of self-improvement, a concept that can be studied both practically and abstractly.

6. Abstractions: Discusses the significance of characterizing and comprehending various kinds of abstractions as well as how machines can be trained to create them using information from other sources and senses.

7. Randomness and Creativity: The idea that creative thinking can be distinguished from more methodical, competent thinking by incorporating a controlled amount of randomness that is guided by intuition.

One of the early successes in AI during this period was the development of simple problem-solving and decision-making programs. A notable example is the Logic Theorist, developed by Allen Newell and Herbert A. Simon in 1955. The Logic Theorist was a machine made to think like human mathematicians. It worked on solving problems from "Principia Mathematica," a famous math book by Russell and Whitehead. Out of 52 problems in the book's second chapter, it solved 38, sometimes giving better solutions than the original authors. This accomplishment showed how AI can improve and simplify problem-solving procedures, especially when it comes to mathematical logic. It was one of the first programs to use a method

called a search tree to solve mathematical problems, influencing later computer languages like LISP, which is still used in AI research. Its ability to think in a non-numerical way led to important debates in philosophy about whether machines could have minds, a concept known as "Strong AI." [5]

However, there were also a lot of difficulties and restrictions during this time. The difficulty of mimicking human intelligence was quickly recognized by the AI community. One significant obstacle was the limited computational capacity and memory of the computers available at the time, which restricted the complexity of issues that could be solved.

AI Winter and Its Causes

AI winter refers to the period coined by the AI community where the optimism of advancement in the development of AI came to a halt due to a lack of interest, and the limitations of computing power. This period ranged from the 1970s to the 1990s, the first of which was in the mid-1970s and the other from the late 1980s to the early 1990s. One of the main reasons for the AI winter was the over-expectation of AI. In the early days of AI research, AI had a lot of expectations and it was anticipated that these human-like machines would be easily integrated into society. However, as the field expanded, it was noticeable that the challenges of developing such a machine outweighed the initial expectations. The failure to meet these expectations led to further disinterest and funding from the government and the industry. The limited processing power available at the time was another important factor contributing to the AI Winter. In the 1970s and 1980s, the computational resources needed to handle the complexity of AI algorithms were either unaffordable or nonexistent. Because of this restriction, AI research has not advanced as quickly as it could have because the hardware available was unable to handle the processing power required for increasingly complex AI models. [6]

Resurgence and Advancements

The resurgence and advancement in the AI field in the 1990s can be attributed to several factors, the main factor being the increase in computing power and the availability of vast amounts of data. The 1990s was the rise of the digital world where there was vast advancement in technology. The development of graphic processing units and advancements in parallel processing have made it much more possible to train AI models. Further, the rise of the internet and digitalization of many industries have allowed access to gather large datasets and train and improve AI models. [6]

Another breakthrough in the modern AI field is the development of deep learning, which involves algorithms inspired by the structure and function of the brain called artificial neural networks. Some of the prominent deep learning algorithms are:

1. Convolutional Neural Networks (CNNs): These are excellent for tasks involving images, like recognizing objects in photos, identifying faces, and analyzing medical images. They work by learning patterns in visual data.
2. Recurrent Neural Networks (RNNs) and Long Short-Term Memory (LSTMs) are used for data that comes in sequences, like speech or written text. RNNs are great for understanding the context of language because they remember previous data in the sequence.
3. Autoencoders: These are used for tasks that involve compressing data and then reconstructing it, which helps reduce the size of data and in learning efficient representations.
4. Generative Adversarial Networks (GANs): Comprising two parts, a creator and a judge, GANs are used to create realistic images and videos. They learn to generate new data that are similar to the original data set.
5. Deep Reinforcement Learning: Combining deep learning and decision-making, this is used in situations where a system needs to make a series of decisions, like in playing video games or controlling a self-driving car.
6. Transformer Models: These are groundbreaking in understanding and generating human language. They are particularly skilled at understanding the context and subtleties of language because they look at entire sentences at once, rather than one word at a time.

During this period from the 1990s to the present, AI has been integrated very much into modern society. Some applications are voice assistants, autonomous vehicles, robotics, arts, and more.

Conclusion

In conclusion, the development of Artificial Intelligence has made a drastic advancement from its early beginnings. The Initial spark and vision were driven by Alan Turing, his theoretical and early discussion on AI, helped lay the foundational works for the AI field. Further, the Dartmouth Conference helped raise hype and funds for further research in the field, during this time many advancement was made, but sadly the expectation of AI did not meet the reality of what was expected. Due to this reason, the field went into an “AI winter”, some of the reasons range from lack of funding to limitations in computational power. However, this came to an end by the 1990s when there was a big technological bloom in the industry with the rise of the internet and new computational power. Access to large amounts of data sets from the internet allowed scientist to train more complex models and develops system for various products such as voice assistant, self-driving cars, and robotics.

Work Cited

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