The role of Artificial Intelligence in future technology

Andreas Giannoutsos

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Abstract

Artificial intelligence (AI) has evolved significantly in recent years. The goal of this study is to understand current achievements and estimate their influence on future technologies. In this investigation, we begin by looking back at the historical evolution of artificial intelligence. Then, after completing an examination of its present accomplishments in numerous domains, we will clarify the impact it will have on future technologies. Finally, we address its limitations, the challenges it faces, and the concerns it raises.

1 Introduction

Artificial intelligence (AI) is intelligence exhibited by computational machines. Artificial intelligence research is the study of intelligent behavior and the way we seek to replicate and develop it by using computer equipment. It is also used to describe any computer that has human-like traits such as learning and problem-solving.

It is a broad term that refers to a variety of methodologies and algorithms that aim to create systems that simulate ways of thinking. It has been employed in many fields of computer science but also in other industries and businesses such as the automotive, aerospace, medical, and robotics industries.

Artificial intelligence has made significant advances in recent years, notably in the machine learning subfield known as deep learning. AI is already supporting people in their daily lives and has the potential to assist them even further by contributing to the creation of new technological tools. However, despite of this rapid progress, AI development has already revealed limitations. Concerns have also been raised about the possible uses of these advancements, as well as their impact on future technologies.

2 The Origins of AI

For a long time, people have imagined objects coming to life as sentient entities. Many ancient civilizations believed robots were mythical. The origins of current artificial intelligence may be traced back to classical philosophers' attempts to classify human thought as a symbolic system.

In our modern times, science fiction introduced the world to the notion of artificially intelligent robots in the first part of the twentieth century. By the 1950s, a generation of scientists, mathematicians, and philosophers were culturally assimilated to the notion of artificial intelligence. Alan Turing, investigated the mathematical possibilities of artificial intelligence.

Turing proposed that humans use available information as well as reason to solve problems and make decisions, so why can't machines? This was the conceptual basis for his 1950 study [63], in which he addressed how to develop intelligent machines and measure their intelligence with the famous Turing Test. The Turing Test was created to establish an adequate operational definition of intelligence. A computer passes the test if a human interrogator cannot distinguish whether the written replies are human made or from a computer. Natural language processing, knowledge representation, automated reasoning, machine learning, computer vision, and robotics are just a few of the tests that the AI system must satisfy.

However, the area of artificial intelligence was not formally established until 1956, when the phrase "artificial intelligence" was invented [40].

AI thrived from the 1950s until the mid '70s. Machine learning algorithms improved as well, and individuals became more adept at determining which method to apply to a given situation. Early demonstrations, like ELIZA, showed promise in terms of problem solving goals [67]. However, issues emerged since most early programs understood little about their subject area. The interest in AI was sparked again in the 1980s by the growth of algorithmic tools and computer processing capabilities. Researchers reinvented the backpropagation algorithm. Geoffrey Hinton, John Hopfield, and David Rumelhart pioneered "deep learning" techniques, which allowed computers to learn based on their own experiences [27] [51].

Deep learning is a technique that enables computers to learn abstract data representations through many layers of mathematical operations and parameters [34]. These methods have dramatically improved the state-of-the-art in speech recognition, visual object recognition, object detection, and many other domains such as drug discovery and genomics in today's "big data" age.

3 Applications of AI and their and Future Impact

Despite its basis in computer science, AI has become a critical component in a variety of industries. Initially, AI is used in the medicine and bio-informatics industries. The detection and diagnosis [1] in medical images using deep learning approaches in 2d [12] [49] and even 3d [14] can be made with accuracy comparable to that of a doctor. AI will not replace doctors, but it will help them to improve their everyday medical processes and hence influence positively their work. Specialities which have substantial visual elements, will be significantly shaped [20]. Furthermore, important advances in the science of protein synthesis have been made, as a result of the AlphaFold model [55] [30] . These have resulted in enormous discoveries in structural and molecular biology, which can aid in the synthesis of proteins for a number of treatments [50]. These discoveries bring us one step closer to simulating the operation of the human body, which will allow scientists to develop a framework for combating even the most challenging diseases.

AI has transformed both the fields of art and music with generative models that can create new unique pieces of art [18] [29] [31]. Research in multi-modal models has resulted in models that may produce visuals from text, offering designers new options the combination of unrelated contexts [47] [46].

In addition, AI has made significant advances in the field of Natural Language Processing. From the period of LSTMs [26] to the era of Transformers [64], language models have progressed at an unparalleled rate, reaching human-level performance in many circumstances. The development of massive language models [17] [37] [45] [9] has revolutionized numerous domains, including machine translation [69], zero-shot learning [62], question and answering [70], text classifications [61] and summarization [2]. These language models are also trained to generate semantic data, they can write code that outperforms coding competitions [13], and solve mathematical problems that outperform mathematical competitions [15] too. These models have the potential to greatly improve the professions of developers and scientists in the future and enhance their productivity to greater levels.

In the realm of Reinforcement Learning, AI has taken a major step. This type of AI provides the ability to teach robotic agents to perform new complicated processes without the need for pre-existing data [4] [22]. This will result in the development of robots that will learn from their environment and assist people in many aspects of their lives. With the introduction of new innovative algorithms like [43] and [54] more and more Reinforcement Learning systems manage to outperform humans in incredibly complex operations. From the AlphaZero system [56] that beat humans in the already complex game of chess, to other AI systems that beat human masters in the games of Go [57], Dota [6] and Starcraft [65] which are more complicated and demand greater intelligence and long term strategic skills, machines outperform humans in tasks that they never imagined.

Moreover, AI has benefited the field of computer vision. Due to the complexity of the optical process, the abundance of data and the recent deep learning approaches have facilitated major strides in computer vision challenges. In the area of image classification, machines have reached the level of humans [52], while significant progress has been made in object detection [21], image segmentation [38], and object tracking [3]. Following that work, the Dynamic Vision and Learning Group laboratory at the Technical University of Munich is aiming to improve the evaluation metrics of object tracking [36] [66] while at the same time trying to increase them. The TrackFormer model [42] which predicts multiple objects in space and time in an end-to-end manner, outperforms more complicated models that rely on motion and graph models. These advancements, will accelerate the productivity and the safety of workers, and in turn, they have the potential to be applied to a wide range of fields, like in transportation with self-driving cars [11] and pedestrian tracking [25], in manufacturing with quality management [68], in agriculture with yield assessment [32] and in many others sectors.

Aside from computer vision, AI has been used in physics to accelerate the modeling of physical phenomena such as fluid and physics simulations [53] [33] [39], as well as weather forecasting [48]. It has also been used to answer fusion reaction mysteries [16] [19], to analyze particle accelerator discoveries [23] and to enhance the entanglement capacity of quantum systems [35]. The value that AI will provide through facilitating scientific study in the field of physics is immeasurable, as most of today's technology feats stem on scientific discoveries made in the past century.

Finally, the combination of these new ideas, methods and people together will contribute to various prospective AI applications that will have a significant influence on future technology [24].

4 Limitations and Concerns

While breakthroughs in artificial intelligence research are projected to bring significant and innovative applications in the future, the technology may be less revolutionary in the long run than many anticipate.

Although artificial intelligence may outperform humans in complicated activities such as video games and chess, it cannot replicate human behaviour. Because of this contradiction, researchers have classified AI into two types: artificial general intelligence (AGI) or strong AI [44] and weak or narrow AI. Strong AI is able to learn any task that humans can execute. Weak AI, on the other hand, is not supposed to have cognitive capabilities; it is a system designed to tackle a specific issue.

The evolution of strong AI is considered particularly difficult as many factors that contribute to biological intelligence and their incorporation into the artificially intelligent one are not yet understood. Intuitive physics is the ability of humans to grasp how things interact with one another. Humans have an intuitive understanding of physics that helps them to traverse the environment and make predictions, even in completely new situations. AI, on the other hand, is currently incapable of replicating this behavior. Furthermore, modern AI systems luck intuitive psychology, which is the ability to obtain insight into the motivations of sentient creatures and make predictions based on them. This intuition enables individuals to foresee and prepare their reactions to the behaviors of others. AI struggles in this area too. These particular structures in the human brain allow this subconscious decision-making. Researchers are struggling to replicate the adaptive behavior process in AI systems since the determination of terminal loss or reward function for such dynamic processes is a very hard task [58]. Therefore, in the future, the development of the Singularity [10] is quite unlikely.

On the other hand, the development of narrow AI, guided by recent innovations, discoveries and progress in recent times, seems quite promising. Advanced programming, mathematical and data-engineering techniques will result in more sophisticated single-task accomplishments. This type of AI has applications in many industries, but it has limitations since it cannot perform another function after it has been devoted to one. Nonetheless, weak AI could free up human labor capacities and allow for more accurate work. It may also help to reduce expenses and improve task efficiencies.

While artificial general intelligence is highly unlikely to be developed in the near future, it also remains a major societal worry. AGI might supplement human intelligence by providing a greater capacity to address the world's issues. Alternatively, whoever owns it might use it maliciously.

Nonetheless, even today, while being far from AGI, phenomena like the Cambridge Analytica scandal [28] [7] have been witnessed in which AI was utilized to drastically impact public opinion. Many research have also found that these AI models discriminate between social groups of humans [41] [5] [8]. Furthermore, the present large deep learning models, as well as the increased computer power required for their training, have a high carbon footprint and negatively contribute to climate change [59] [60]. As a result, various improvements and upgrades to the models' performance and energy requirements are necessary. It is also vital to create better methods to avoid bias rather than simply filtering the discriminatory data generated by people.

In such instances, the outcome might be determined by the AGI's goals: whether it seeks something beneficial for humans, the planet, itself, or something altogether else.

5 Conclusion

The origins and evolution of AI can teach us a lot about future advancement. The progression of AI nowadays is triggered by the increase in computational capacity as well as the abundance of data. However, there are limitations to this remarkable breakthrough, as the nature of deep learning mathematical models makes AGI development challenging. Simultaneously, there are concerns regarding the misuse of AI. As a result, appropriate financing and a broader strategy focusing on AI research and development based on ethics and the enhancement of people's lives are essential. As with any technical invention, it is up to people to decide if it will be utilized for positive or negative purposes.

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