

# The Future of Artificial Intelligence, From Cognitive Science to Superintelligence

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## Abstract

Artificial intelligence, as one of the most significant developments of the cyber age, is rapidly advancing. From voice assistants to self-driving cars, AI is transforming the way we live and work. But what does the future hold for AI? Could we one day witness the creation of superintelligence that surpasses human intelligence? To answer this question, this research investigates the evolution of AI, from its roots in cognitive science to a future vision where AI might reach a level of intelligence that surpasses humans, manifesting as a superintelligence. The aim of this paper is to examine the trajectory of AI and its potential impact on the future of humanity. It also emphasizes the importance of understanding the nature of AI and developing it based on ethical principles. The researcher has employed a qualitative research approach to examine and analyze existing data, trends, and predictions about the future of AI. The results of this research indicate that the future of AI is very promising and has the potential to change the world, but it will also be accompanied by serious challenges. To make the best use of this technology and avoid its negative consequences, while humans must prepare for a future in which AI plays a significant role, research and development in this field must continue simultaneously, along with attention to ethical issues.

**Keywords:** *Artificial Intelligence, Superintelligence, Cognitive Science, Neural Networks, Machine Learning.*

## 1 Introduction

Artificial Intelligence is one of the most passionate and rapidly growing research fields in the 21st century. Its roots can be traced back to the early decades of the 20th century, but recent significant advancements in machine learning and deep learning have transformed AI into a primary driving force in many industries. The rapid progress in the field of AI has raised important questions about the future of AI and its impact on society and humanity. without any doubt One of the most important of these questions is the possibility of achieving superintelligence and its consequences for humankind.

Considering the recent advancements in AI, especially machine learning and deep neural networks, the possibility of achieving systems that surpass human intelligence is not far-fetched.

Human intelligence and artificial intelligence have long been intertwined, evolving along parallel paths throughout history. As humans have sought to understand and replicate intelligence, artificial intelligence has emerged as a field dedicated to creating systems capable of performing tasks that traditionally require human intellect [1]. Examining the future of artificial intelligence, particularly the possibility of achieving superintelligence in the cyber age, is of paramount importance for the following reasons:

- **Impact on daily life:** AI is increasingly permeating our daily lives, and understanding its future is essential for both individual and collective planning and decision-making.
- **Ethical and social challenges:** The development of AI is accompanied by serious ethical and social challenges that require careful examination and analysis.
- **New opportunities:** AI can create new opportunities to address global challenges such as diseases, climate change, and poverty.

The primary objective of this research, considering the key points of the present study (factors influencing the development of artificial intelligence, obstacles and challenges in developing superintelligence, the consequences of human achievement of superintelligence, the ethical development of artificial intelligence, and the role of humans in artificial intelligence), is to examine the evolution of artificial intelligence, from its roots in cognitive sciences to a future vision where artificial intelligence may reach a level of intelligence that surpasses humans, manifesting as a superintelligence.

Given the existing gaps in the research literature, this research endeavors to address this topic by adopting an interdisciplinary approach and considering the technical, social, and ethical dimensions of artificial intelligence.

## 2 Literature review

Based on the researcher's comprehensive review of the scientific literature on artificial intelligence, it has been concluded that: Previous research in the field of artificial intelligence has primarily focused on the technical and applied aspects of this technology. While these studies have provided valuable information about the capabilities of AI, they have not adequately addressed the social, ethical, and philosophical dimensions of this technology. Additionally, many studies have focused on short-term predictions and have paid less attention to the long-term outlook of AI. In this section, we will review several studies conducted in this scientific field, followed by an identification of the existing gaps in knowledge.

Savaliya (2024) in a study on the 'Future of Artificial Intelligence,' states that artificial intelligence has made significant advancements and has impacted various industries, increasing productivity through technologies such as machine learning and natural language processing. She further concludes that the future of AI involves advancements in cognitive science and aiming for superintelligence, emphasizing responsible development, ethical considerations, and collaboration for a smarter world [2].

Singh et al (2023) in their research titled 'Artificial Intelligence, the Future' emphasize that the development of AI technologies such as machine learning, natural language processing, and computer vision has transformed processes in fields like healthcare, finance, and transportation, increasing productivity and impacting how we live and work. AI will advance from cognitive science to superintelligence, encompassing AI categories like ANI, AGI, and ASI, with predicted potential economic impacts and job shifts [3].

Verma and Nasir (2023) conducted a study titled 'Artificial Intelligence and its Future'. This paper highlights the rapid pace of AI advancement, which may be surprising given the complexity of the technology involved. Their findings suggest that the widespread penetration of AI into various industries, including those traditionally unrelated to technology, demonstrates its adaptability and unexpected versatility. The paper also indicates that the integration of AI into daily life is happening more seamlessly and quickly than anticipated, signaling a shift in societal norms regarding technology use [4].

"Artificial Intelligence, the Future is Now" is the title of a research study conducted by Baldwin (2023). This paper notes that artificial intelligence, despite its long history dating back to the 1950s, has recently seen a surge in popularity and relevance, particularly following the launch of OpenAI's ChatGPT in early 2023, which may be surprising given the previous development timeline of AI [5].

Agrawal et al (2023) in their research titled "Enhancing Perception in Artificial Intelligence through Cognitive Science Principles" delves into the cognitive functions of perception and connects cognitive science principles to artificial intelligence, which can lead to improved performance and efficiency in AI systems. It also identifies gaps in the current performance of AI compared to the capabilities of the human brain and suggests new avenues for research in perceptual systems [6].

Based on the reviews conducted in the existing research literature, the following gaps have been identified:

- **Lack of interdisciplinary research:** Most research in the field of AI is conducted within a specific discipline (such as computer science or philosophy) and has paid less attention to the interaction between different disciplines.
- **Insufficient attention to ethical dimensions:** Many studies have addressed the technical aspects of AI and have not paid sufficient attention to the ethical issues associated with this technology.
- **Absence of a comprehensive framework for assessing the future of AI:**

Despite significant progress, there is still no comprehensive and accepted framework for assessing the long-term implications of AI.

### 3 Significance and Necessity of the Research

#### 3.1 Significance of the Research

Research in the field of artificial intelligence, especially regarding its future, is of paramount importance. This significance is due to several reasons, some of which are mentioned below:

##### 3.1.1 The Widespread Impact of Artificial Intelligence on Daily Life

- **Automation of Processes:** Artificial Intelligence is transforming the way tasks are performed across numerous industries. From manufacturing to services, AI can automate processes and increase efficiency.
- **Intelligent Decision Making:** In fields such as medicine, finance, and transportation, AI can aid in making better and more accurate decisions.
- **Human Interaction and Communication:** With the advancement of AI, the ways we communicate and interact with each other and devices are changing. Voice assistants, chatbots, and virtual reality are examples of these changes.

##### 3.1.2 Ethical and Social Challenges

- **Algorithmic Bias:** Artificial intelligence can reinforce discrimination and inequality if its training data is biased.
- **Privacy:** The collection and use of personal data to train AI algorithms raises serious privacy concerns.
- **Unemployment:** The automation of processes by AI can lead to significant job losses.
- **Accountability:** Determining liability in the event of errors or harm caused by AI systems can be very complex.

##### 3.1.3 New Opportunities

- **Solving Global Challenges:** Artificial intelligence can help solve some of the world's most pressing challenges such as climate change, diseases, and poverty.
- **Innovation and Creativity:** AI can be used as a powerful tool for innovation and creativity in many fields.

- **Economic Development:** Investing in AI research and development can contribute to economic growth and the creation of new job opportunities.

#### 3.1.4 From Cognitive Science to Superintelligence

- **Cognitive Science:** The study of the human mind and cognitive processes helps researchers improve artificial intelligence algorithms and equip them with more complex capabilities such as learning, reasoning, and creativity.
- **Superintelligence:** This refers to a hypothetical intelligence that is far superior to human intelligence. Research on superintelligence seeks to understand the limitations and opportunities of such AI, as well as to develop ethical principles for its development and use.

### 3.2 Necessity of the Research

Given the widespread and profound impact of artificial intelligence on human lives and societies, research in this field is of paramount importance. Researchers should strive to develop AI technologies that are safe, ethical, and beneficial to humanity. Moreover, they should examine the social, economic, and ethical implications of AI and provide solutions to address its challenges.

In sum, research in AI is an imperative and can help us harness the benefits of this technology while mitigating its risks.

## 4 Research goals

With ambitious goals, AI research is rapidly evolving. Researchers seek to emulate the human mind, solve complex problems with intelligent systems, and ultimately, achieve artificial general intelligence. The following sections delve into specific objectives of this research:

### 4.1 Mimicking Human Intelligence

- **Deeper Understanding of the Human Mind:** Researchers are striving to develop more accurate computational models of learning, memory, decision-making, and creativity by studying the human brain and cognitive processes.
- **Development of Deep Learning Systems:** The primary goal of this area is to create systems that can learn from data and improve independently.
- **Creation of Powerful Natural Languages:** Developing systems that can understand and generate natural language to enable more effective human-machine interaction.

## 4.2 Solving Complex Problems

- **Development of Advanced Algorithms:** Creating algorithms capable of solving complex problems in various fields such as medicine, engineering, finance, and social sciences.
- **Application of AI in Various Sciences:** Utilizing AI to discover new drugs, design new materials, predict natural events, and many other applications.

## 4.3 Achieving Artificial General Intelligence (AGI)

- **Development of a system with general intelligence:** Creating systems capable of performing any task that a human can.
- **Understanding and Solving Abstract Problems:** Ability to understand abstract concepts, reason logically, and learn from experience.
- **Creativity and Innovation:** Ability to generate new ideas and solve problems in innovative ways.

## 4.4 Developing Superintelligence

- **Creating Systems with Intelligence Far Beyond Humans:** Developing systems that can surpass humans in all areas.

# 5 Research questions and hypotheses

## 5.1 Key questions

### 5.1.1 Limitations of Artificial Intelligence

- To what extent can we approximate human intelligence with artificial intelligence?
- Can AI experience creativity, consciousness, and emotions?
- What are the fundamental obstacles to creating artificial general intelligence?

### 5.1.2 Social Impacts

- How will artificial intelligence impact the job market, social structures, and international relations?
- What are the ethical and legal challenges in developing and using AI?
- How can we prevent potential risks of AI such as mass unemployment, inequality, and misuse?



### 5.1.3 Cognitive science and artificial intelligence

- How can human cognitive models be used to improve machine learning algorithms?
- What is the relationship between brain structure and artificial neural network architecture?
- Can consciousness be computationally modeled?

### 5.1.4 Artificial superintelligence

- Is it technically feasible to develop artificial superintelligence, and if so, what timeline is realistic?
- What are the existential risks associated with the development of superintelligence?
- How can we ensure the safe and beneficial development of superintelligence?

## 5.2 Research Hypotheses

- **Convergence Hypothesis:** This hypothesis says as technology advances and our understanding of the brain deepens, the gap between artificial intelligence and human intelligence will gradually narrow.
- **Evolution Hypothesis:** Similar to living organisms, artificial intelligence will become more complex and intelligent through continuous evolution and learning.
- **Fundamental Limitations Hypothesis:** Artificial intelligence will always face inherent limitations and will never be able to fully replicate human intelligence.
- **Existential Risk Hypothesis:** The development of superintelligence could pose a serious threat to human survival unless appropriate safeguards are put in place.
- **Coexistence Hypothesis:** Humans and artificial intelligence can coexist and evolve together.

## 6 Research method

Given the interdisciplinary and future-oriented nature of the topic, designing a classic quantitative study with a defined population and standardized measurement tools is challenging. Instead, a combined approach of qualitative and quantitative methods may be more suitable for answering the research questions. The research design adopted in this study was conducted in four stages. In stages two through four, data was collected from 120 experts in related fields (opinion leaders, professors, and students) at universities in Tehran Province, and subsequently analyzed:

**1) Systematic Literature Review:** To identify, evaluate, and synthesize previous research in the fields of artificial intelligence, cognitive sciences, superintelligence, ethics in AI, and its social impacts, reputable scientific databases such as Scopus, Web of Science, and Google Scholar were used to search for relevant articles, books, and reports.

**2) Semi-structured Interviews:** In order to collect qualitative data from experts in the fields of artificial intelligence, communications, and sociology to gain a deeper understanding of the challenges, opportunities, and diverse perspectives on the future of AI, a guide questionnaire, including open and closed-ended questions, was used.

**3) Content Analysis:** To identify patterns, key concepts, and dominant viewpoints in texts and interviews, the qualitative data was coded manually and using the NVivo content analysis software.

**4) Delphi Method:** To achieve expert consensus on the future of AI and prioritize its challenges and opportunities, several interviews were conducted with a selected group of experts. In this stage, the initial opinions were presented to the participants, and this process was repeated until consensus was reached.

In this research, to increase validity, methods such as content validity and construct validity were used, and to increase reliability, methods such as intra-rater reliability and inter-rater reliability were employed. In order to analyze the data, qualitative analysis methods such as coding, categorization, and interpretation were used to identify patterns, concepts, and main themes in the interview data and texts. Given this design, the present study can achieve comprehensive results regarding the future of AI and assist policymakers, researchers, and the general public in making informed decisions.

## 7 Core concepts of the research

### 7.1 Cognitive Science and Artificial Intelligence

Cognitive science delves into the study of human mental processes, encompassing perception, learning, language, and decision-making. Its primary objective is to comprehend the nature of intelligence and construct computational models thereof. Inspired by cognitive science, artificial intelligence endeavors to create systems capable of performing tasks analogous to those carried out by humans.

Cognitive science uses a framework based on four key concepts: emergence, non-linearity, self-organization, and universality. This framework incorporates ideas from systems theory, nonlinear dynamics, and synergy. By using this approach, cognitive science can study cognition in its various complex forms using a variety of methods. [7].



## 7.2 Machine Learning

Machine learning is a critical subfield of artificial intelligence that empowers systems to learn from data and improve over time. Machine learning algorithms are inspired by the human brain's learning processes.

The scientific study of algorithms and statistical models when used by computer systems to perform a specific task without being explicitly programmed is known as machine learning. These algorithms construct a mathematical model based on sample data [8].

## 7.3 Artificial Neural Networks

Artificial neural networks are inspired by the structure of the human brain. These networks consist of a large number of interconnected artificial neurons that can process information.

Artificial neural networks can successfully solve prediction problems by using a combination of flexible nonlinear functions and delayed variables [9].

## 7.4 Superintelligence

Superintelligence refers to a hypothetical agent that possesses intellectual ability far surpassing that of the brightest and most gifted human mind. Such a system would be capable of solving extremely complex problems, making groundbreaking discoveries, and potentially even exerting dominance over humans.

Superintelligence refers to a hypothetical intelligence that significantly exceeds the intellectual capacity of the brightest and most gifted human minds [10].

# 8 Research findings

Research into the future of artificial intelligence, particularly in relation to cognitive science and superintelligence, will yield highly diverse and extensive results due to the rapid pace of advancements and complexities within this field. However, based on current trends and existing research, some of the most significant outcomes can be summarized as follows:

## 8.1 A deeper understanding of the human brain and intelligence

- **More accurate brain models:** By combining cognitive science and artificial intelligence, we can create far more accurate models of the human brain's functions, leading to a better understanding of learning, memory, decision-making, and creativity.
- **Treatment of brain diseases:** This deep understanding can lead to new and more effective treatments for brain diseases such as Alzheimer's and Parkinson's.

## 8.2 Significant Advances in Artificial Intelligence

- **Artificial General Intelligence:** The possibility of achieving Artificial General Intelligence (AGI), capable of performing any intellectual task that a human being can, is a serious one.
- **Creative AI:** AI could, in the future, engage in creative endeavors such as art, music, and literature, generating novel works.
- **Conscious AI:** Some researchers believe that we may one day achieve conscious AI, although this remains a highly controversial topic.

## 8.3 Socioeconomic Transformations

- **Labor market:** Artificial intelligence can significantly transform the labor market, eliminating or altering many jobs.
- **Inequality:** Increasing economic inequality is a major concern regarding the development of AI.
- **Governance and politics:** AI can play a significant role in political and social decision-making, potentially leading to new forms of governance.

## 8.4 Ethical and Social Challenges

- **Bias and discrimination:** AI algorithms may contain human biases and lead to discrimination against certain groups.
- **Accountability:** Determining accountability for decisions made by complex AI systems is challenging.
- **Security:** Securing AI systems and preventing their misuse is a significant challenge.

## 8.5 New Opportunities

- **Solving global problems:** Artificial intelligence can play a significant role in solving some of the world's most pressing problems, such as climate change, disease, and poverty.
- **Increasing productivity:** AI can lead to increased productivity in many industries.
- **Improving quality of life:** AI can contribute to improving the quality of human life by providing better services in healthcare, education, and transportation.

## 8.6 The Role of Humans in the Future of Artificial

Over the past few decades, information technologies have encompassed all human knowledge and skills, ultimately including the pattern recognition capabilities, problem-solving skills, and emotional and moral intelligence of the human brain itself [11].

With the advancement of artificial intelligence, the human role in society will transform. Many existing jobs will be automated, and new ones will emerge. Humans must adapt to these changes and acquire new skills.

As advancements in AI allow it to live and work alongside humans as independent agents, human-AI collaboration (HAIC), where people work with autonomous AI agents, has become increasingly common [12].

In the future, rather than competing with AI, we should seek to collaborate with it. AI can be used as a powerful tool to augment human capabilities. The ethical development of AI is of paramount importance. We must ensure that AI is developed for the benefit of all humanity and is not misused.

A crucial aspect in this context is addressing the challenges that arise. Self-regulation plays a significant role in tackling these ethical dilemmas. Self-regulation involves the ability to monitor and adjust one's behavior and decisions. In AI development, self-regulation empowers developers to oversee how the technology is used and ensure its ethical application [13].

## 9 Discussion and Conclusion

This research aims to provide a comprehensive overview of the future of artificial intelligence by deeply examining the relationship between cognitive science and artificial intelligence. By analyzing recent advancements in AI and exploring the challenges ahead, it concludes that AI has the potential to fundamentally transform many aspects of human life. On the one hand, AI can play a significant role in solving complex global problems such as diseases, climate change, and poverty. On the other hand, the uncontrolled and unregulated development of AI can pose serious threats to humanity. As a result, the researcher emphasizes the importance of appropriate regulations, ethical development of AI, and international cooperation in this field. Furthermore, this study highlights the role of cognitive science in AI development, suggesting that a better understanding of the human brain can lead to the creation of more powerful and intelligent AI systems. Ultimately, the researcher concludes that the future of AI depends on our current decisions and actions, and we must prepare for a future where AI plays a central role.

based on current trends and the data collected in this research, we will first review some of the most significant findings. Subsequently, we will present a proposed model of the "conceptual framework of the future of artificial intelligence and cognitive science" that has been specifically developed and formulated by the researcher;

### 9.1 A Giant Leap on the Horizon

Research in the field of artificial intelligence, particularly at the intersection with cognitive sciences, points to a massive and fundamental transformation in the human future. With the rapid advancement of technology, AI has moved beyond theoretical boundaries and has become a reality of our daily lives.

### 9.2 From Brain Understanding to Artificial Intelligence Creation

One of the significant outcomes of research in this field is a deeper understanding of the human brain's functioning. By meticulously studying cognitive processes, researchers have been able to create more complex computational models of the brain. These models not only assist us in better comprehending and treating brain diseases but also serve as templates for developing artificial intelligence.

### 9.3 Superintelligence

One of the most significant questions raised in this field is the possibility of achieving superintelligence.

Superintelligence refers to an artificial intelligence system that surpasses human intelligence in all domains. Although this idea is still theoretical, many researchers believe that achieving superintelligence is inevitable.

### 9.4 Social and Ethical Implications of Artificial Intelligence Development

Especially superintelligence, will have vast social and ethical implications. Some of these implications include changes in the job market, increased inequality, security and privacy issues, and even the existential threat to humanity.

### 9.5 Key Points to Remember

- Artificial intelligence is rapidly advancing and has the potential to transform the world.
- Humans must prepare for a future where AI plays a significant role.
- AI can be both an opportunity and a threat.
- To harness the benefits of AI, we need careful planning and management.
- The development of AI must be done with consideration for ethical and social issues.

## 9.6 This research helps us to

- Gain a better understanding of the future of artificial intelligence.
- Recognize the importance of research in the field of artificial intelligence.
- Pay attention to the ethical challenges associated with artificial intelligence.

## 9.7 Future Research Directions

- **Explainable AI:** Developing algorithms that can justify their decisions.
- **Ethical AI:** Designing AI systems aligned with human values.
- **Interactive AI:** Creating systems that can interact naturally with humans.
- **Physical AI:** Developing robots with complex physical and cognitive abilities.
- **Collective AI:** Creating networks of intelligent agents that can collectively solve complex problems.

The future of artificial intelligence is one filled with both hope and challenges. On the one hand, AI can help solve many of the world's problems, such as diseases, poverty, and climate change. On the other hand, if not managed properly, it can pose serious threats to humanity. To reap the benefits of AI and mitigate its risks, we need international cooperation, appropriate regulations, and the ethical development of AI. Ultimately, the future of AI is one where humans and machines will coexist, and the future we create depends on the decisions and actions we take today.

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Table 1: A Conceptual Model of the Future of AI and Cognitive Science

Component	Description	Relationship to AI	Relationship to Cognitive Science
<b>AI Subfields</b>	Machine learning, deep learning, natural language processing, computer vision, robotics	These subfields will continue to advance and interact with cognitive science to develop more sophisticated AI systems.	Cognitive science provides insights into human cognition, which can be used to inform the development of AI algorithms.
<b>Cognitive Science Subfields</b>	Cognitive psychology, neuroscience, linguistics, anthropology	These subfields study human cognition, perception, language, and behavior, providing valuable insights for AI development.	The study of human cognition provides a foundation for understanding and modeling intelligent behavior in AI systems.
<b>Interdisciplinary Research</b>	Neuroinformatics, cognitive robotics, computational neuroscience	These fields combine AI and cognitive science to develop hybrid systems that integrate AI algorithms with biological principles.	Interdisciplinary research is crucial for bridging the gap between AI and cognitive science and developing more human-like AI.
<b>Ethical Considerations</b>	Bias, fairness, transparency, privacy	As AI systems become more integrated into society, it is essential to address ethical concerns and ensure that they are developed and used responsibly.	Cognitive science can help to understand the potential biases and limitations of AI systems and inform the development of ethical guidelines.
<b>Applications</b>	Healthcare, education, finance, transportation, entertainment	AI has the potential to revolutionize various industries by automating tasks, improving efficiency, and creating new opportunities.	Cognitive science can help to ensure that AI applications are aligned with human needs and values.
<b>Societal Impact</b>	Job displacement, economic inequality, privacy concerns	The development and deployment of AI raise important questions about the future of work, the distribution of wealth, and individual privacy.	Cognitive science can help to understand the potential social and economic implications of AI and inform the development of policies and regulations.

Note: This model is a conceptual framework that can be adapted and expanded upon based on specific research and developments.



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