



Artificial intelligence (A.I.) in Social Sciences: A Primer

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ABSTRACT

Artificial intelligence (AI) is the intelligence exhibited by machines which can do similar work with human consciousness. It refers to systems that can perform tasks that in the past had required human intelligence. AI is now being used in an ever-growing range of human activities. The proliferation of AI technologies is yielding substantial societal benefits, ranging from more efficient supply chain management to more reliable medical diagnosis. This paper is a primer on the uses of AI in social sciences.

Key Words: Artificial Intelligence, Deep learning, Fuzzy logic, Machine learning, Social Sciences.

1. INTRODUCTION

We stand at the dawn of a new era. The technological revolution is transforming our lives. Emerging technologies such as big data, cloud computing, nanotechnology, biotechnology, drones, robotics or artificial intelligence are rapidly changing our society. Artificial intelligence (AI) is humanity's new frontier. It will lead to a new form of human civilization. AI is growing rapidly and finding new applications in different areas such as security, the environment, research and education, healthcare, culture, and trade [1,2].

Artificial intelligence is a field in computer science which requires multidisciplinary expertise with the goal of replicating human activities that presently require human intelligence. Many AI-powered technologies are now integrated into our personal life, the public sector, law enforcement, banking, and medical services. Computer scientists as well as data engineers are fueling innovations in AI that will soon surpass human decision-making capabilities [3].

As shown in Figure 1, AI is a science and technology based on disciplines such as Computer Science, Biology, Psychology, Linguistics, Mathematics, and Engineering [4].

AI is being employed in tasks as diverse as driving cars, scoring job candidates, determining credit scores, and rendering medical diagnoses.

The social sciences generally include economics, political science, sociology, cultural or social anthropology, social psychology, and social geography. As society changes, the social sciences find it difficult to keep pace. Scholars of the social sciences seem to be losing touch with rapid advances in AI.

2. OVERVIEW ON ARTIFICIAL INTELLIGENCE

The term "artificial intelligence" (AI) was first used at a Dartmouth College conference in 1956. AI is now one of the most important global issues of the 21st century. AI is the branch of computer science that deals with designing intelligent computer systems that mimic human intelligence, e.g. visual perception, speech recognition, decision-making, and language translation. The ability of machines to process natural language, to learn, to plan makes it possible for new tasks to be performed by intelligent systems. The main purpose of AI is to mimic the cognitive function of human beings and perform activities that would typically be performed by a human being. Without being taught by humans, machines use their own experience to solve a problem.

AI is stand-alone independent electronic entity that functions much like human expert. Today, AI is integrated into our daily lives in several forms, such as personal assistants, automated mass transportation, aviation, computer gaming, facial recognition at passport control, voice recognition on virtual assistants, driverless cars, companion robots, etc. AI is not a single technology but a range of computational models and algorithms.

Some forms of AI that are most commonly used in different applications include the following [5,6]:

- **Expert systems:** They solve problems with an inference engine that draws from a knowledge base equipped with information about a specialized domain, mainly in the form of if-then rules. Expert systems are the earliest, most extensive, the most active and most fruitful area.
- **Fuzzy logic:** This makes it possible to create rules for how machines respond to inputs that account for a continuum of possible conditions, rather than straightforward binary.
- **Neural networks:** These are specific types of machine learning systems that consist of artificial synapses designed to imitate the structure and function of brains. They are similar to the human brain. They are made up of artificial neurons, take in multiple inputs, and produce a single output. The network observes and learns as the synapses transmit data to one another, processing information as it passes through multiple layers.
- **Machine learning:** This includes a broad range of algorithms and statistical models that make it possible for systems to find patterns, draw inferences, and learn to perform tasks without specific instructions. Machine learning is a process that involves the application of AI to automatically perform a specific task without explicitly programming it. ML techniques may result in data insights that increase production efficiency. Today, artificial intelligence is narrow and mainly based on machine learning.
- **Deep learning:** This is a form of machine learning based on artificial neural networks. Deep learning architectures are able to process hierarchies of increasingly abstract features, making them especially useful for purposes like speech and image recognition and natural language processing. Deep learning networks can deal with complex non-linear problems.
- **Natural Language Processors:** For AI to be useful to us humans, it needs to be able to communicate with us in our language. Computer programs can translate or interpret language as it is spoken by normal people.
- **Robots:** These are computer-based programmable machines that have physical manipulators and sensors. Sensors can monitor temperature, humidity, pressure, time, record data, and make critical decisions in some cases. Robots have moved from science fiction to your local hospital. In jobs with repetitive and monotonous functions they might even completely replace humans. Robotics and autonomous systems are regarded as the fourth industrial revolution. Robot police with facial recognition technology have started to patrol the streets in China.

These AI tools are illustrated in Figure 2 [7]. Each AI tool has its own advantages. Using a combination of these models, rather than a single model, is recommended. AI systems are designed to make decisions using real-time data. They have the ability to learn and adapt as they make decisions.

3. APPLICATIONS OF AI IN SOCIAL SCIENCES

The social sciences have come across complex systems for which global behaviors are difficult to model by traditional mathematical means. Social scientists have found it difficult to discover global equations for social systems, which are generally complex. Common applications of AI in social sciences include the following:

- **Explainable AI:** This is an emerging area where researchers and practitioners seek to make their algorithms more understandable. Users do not generally trust systems that they do not understand how they work. People lack input and do not learn the context about how AI tools work. They sacrifice independence, privacy, and power over choice. Digital cooperation to serve humanity's best interests should be the top priority. Building intelligent agents capable of explanation is an uphill task. Most work in explainable artificial intelligence uses only the researchers' intuition of what constitutes a "good" explanation. Explainable AI (XAI) can benefit from existing models of how people define, generate, select, present, and evaluate explanations. Figure 3 shows the scope of explainable artificial intelligence [8].
- **AI-assisted Peer Review:** The scientific literature peer review workflow is under strain because of the increasing volume of submission to peer-review journals. There is increasing demands on peer reviewers and their time. Many platforms have started to use automated screening tools, to prevent plagiarism and failure to respect format requirements. AI tool can be trained and used to replace or assist human decisions in the quality assurance and peer-review process. Such tools can reveal correlations between the decision process and other quality proxy measures, uncovering potential biases of the review process. However, there are some ethical issues which arise from such approaches, particularly those associated with bias and the extent to which AI systems may replicate bias [9].

- *Human Behavior:* AI can be used to understand human behavior. It can help us better understand social interaction. It has brought positive social interaction in the form of a sense of rapport with a virtual peer. AI can also be used to understand, analyze, and model child behavior [10].
- *Human Labor:* Rapid advances in AI can significantly disrupt labor markets. While AI and automation can augment the productivity of some workers, they can replace workers. Rising automation is raising fears of mass technological unemployment. Researchers and policy makers are concerned about the future of work in both advanced and developing economies worldwide. With AI's potential to change the nature of work, how can policy makers facilitate the next generation of employment opportunities? [11].

4. BENEFITS AND CHALLENGES

AI can bring along diverse benefits for our health, safety, and general well-being. AI can deliver more sophisticated and accurate knowledge than human actors. The ability of AI technologies to process information faster than humans leads to more cost-effective resource allocation [12]. Robots can train in places where individual lessons would otherwise be too expensive and suitable human teachers are not readily available. In some areas, there are not enough people to provide training on a large scale. With AI, it will be easier to offer this training anywhere and everywhere. Research is ongoing into other social issues where AI can play an important role.

However, there are widespread myths and misconceptions about what AI really is and what AI tools can do. If not carefully handled, AI technologies can adversely impact certain population groups. Some applications of AI in social sciences are raising a number of complex new social and ethical issues. Can the recent progress in AI lead to conceptual advances in the social sciences? How should social scientists using AI think differently about people, economy, and society? How should the computer scientists who write AI algorithms handle the moral conundrums their technology poses? How would millions of people across the world make the difficult decisions that autonomous vehicles face (e.g., given a choice between killing a pedestrian or a passenger)? [13]. An AI-based system can perpetuate bias if the data set itself is biased. Sociologists and ethicists must address and develop solutions to machine bias, error, and stupidity. The gap between AI and social sciences is growing, making it harder to address social and ethical concerns.

5. CONCLUSION

Artificial intelligence (AI) is already present in our lives, impacting gradually more and more domains. Smart AI-based technologies are built by people, to act as people, for people and the human factor is therefore of highly important. Ethical issues also arise when considering the coexistence of AI and human beings.

Just as AI needs to pay more attention to social science, social scientists need to pay more attention to AI technology. There is the need for AI researchers to collaborate across disciplines. They should engage with disciplines such as psychology, philosophy, economics, and political science, which could help them address inevitable ethical and social issues [14]. More information about AI in social sciences can be found in the books in [15,16] and related journals: *Artificial Intelligence* and *Arts and Social Sciences Journal*

REFERENCES

- [1] M. N. O. Sadiku, *Emerging Internet-Based Technologies*. Boca Raton, FL: CRC Press, 2019.
- [2] United Nations, "Towards an ethics of artificial intelligence," <https://www.un.org/en/chronicle/article/towards-ethics-artificial-intelligence>
- [3] M. N. O. Sadiku, "Artificial intelligence", *IEEE Potentials*, May 1989, pp. 35-39.
- [4] "Artificial intelligence – Overview," July 2020, <https://digicloud.com.ph/artificial-intelligence-overview/>
- [5] M. N. O. Sadiku, Y. Zhou, and S. M. Musa, "Natural language processing in healthcare," *International Journal of Advanced Research in Computer Science and Software Engineering*, vol. 8, no. 5, May 2018, pp. 39-42.
- [6] "Applications of AI and machine learning in electrical and computer engineering," July, 2020,

<https://online.egr.msu.edu/articles/ai-machine-learning-electrical-computer-engineering-applications/#:~:text=Machine%20learning%20and%20electrical%20engineering,can%20%E2%80%9Csee%E2%80%9D%20the%20environment.>

[7] https://www.researchgate.net/figure/AI-domains-see-online-version-for-colours_fig2_327215281

[8] T. Miller, "Explanation in artificial intelligence: Insights from the social sciences," *Artificial Intelligence*, vol. 267, 2019, pp. 1-38.

[9] A. Checco et al., "AI-assisted peer review," *Humanities and Social Sciences Communications*, vol. 8, no. 25, 2021.

[10] J. Cassell, "Artificial intelligence for a social world," *Science and Technology*, vol. 35, no. 4, Summer 2019, pp. 29-36.

[11] M. R. Frank et al., "Toward understanding the impact of artificial intelligence on labor," *PNAS*, vol. 116, no. 14, April 2019, pp. 6531-6539.

[12] "Why AI needs the social sciences,"

<https://www.mcgill.ca/arts/article/arts-research/why-ai-needs-social-sciences>

[13] M. R. Frank et al., "AI and the social sciences used to talk more. Now they've drifted apart," July 2019,

<https://insight.kellogg.northwestern.edu/article/artificial-intelligence-ethics-social-questions>

[14] L. Pogan and R. I. Popa, "A theoretical and practical comprehensive framework for artificial intelligence and socio-psychological challenges," *Bulletin of the Transilvania*, vol. 13(62), no. 1, 2020.

[15] M. Tambe and E. Rice (eds.), *Artificial Intelligence and Social Work*. Cambridge, UK:: Cambridge University Press, 2019.

[16] P. Attewell and D. Monaghan, *Data Mining for the Social Sciences: An Introduction*. Oakland, CA: University of California Press, 2015.

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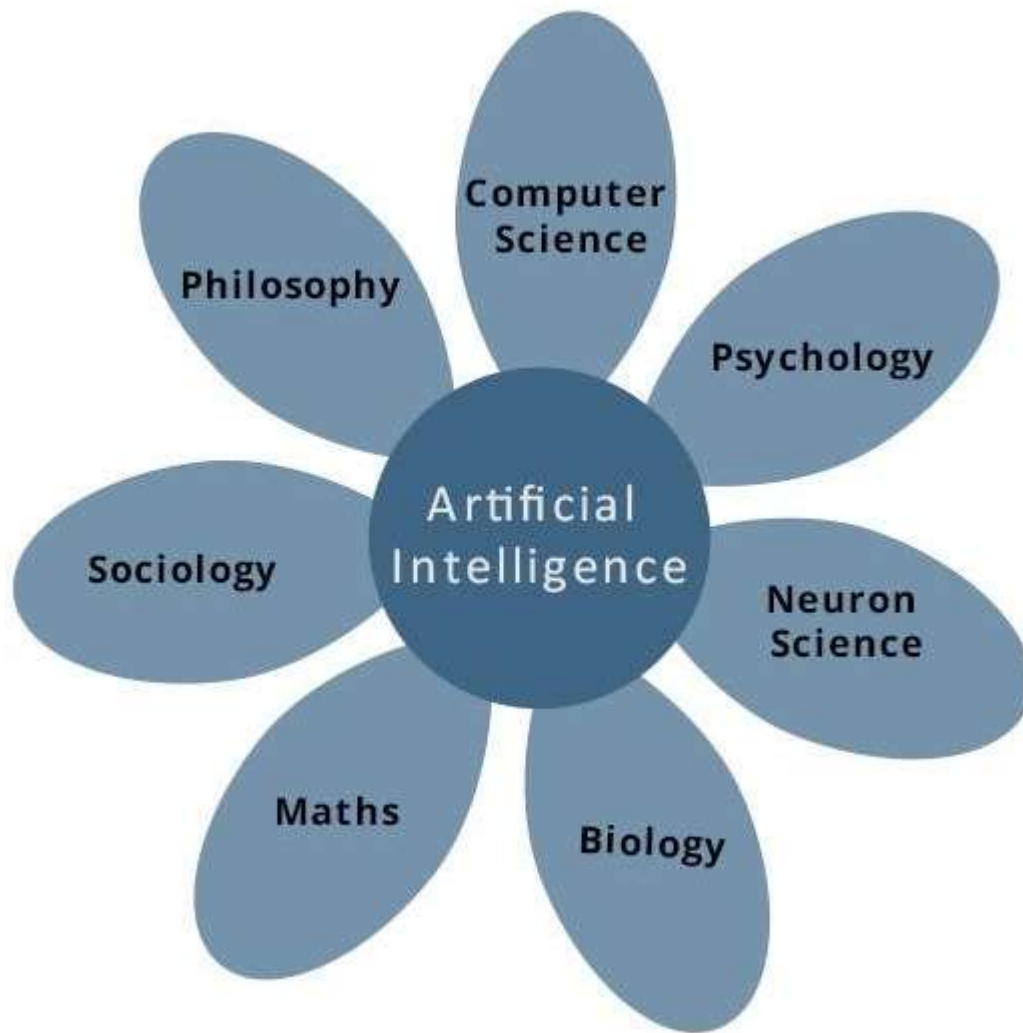


Figure 1 Artificial intelligence comprises of fields such as computer science, neuron science, psychology, mathematics, engineering, etc. [4].

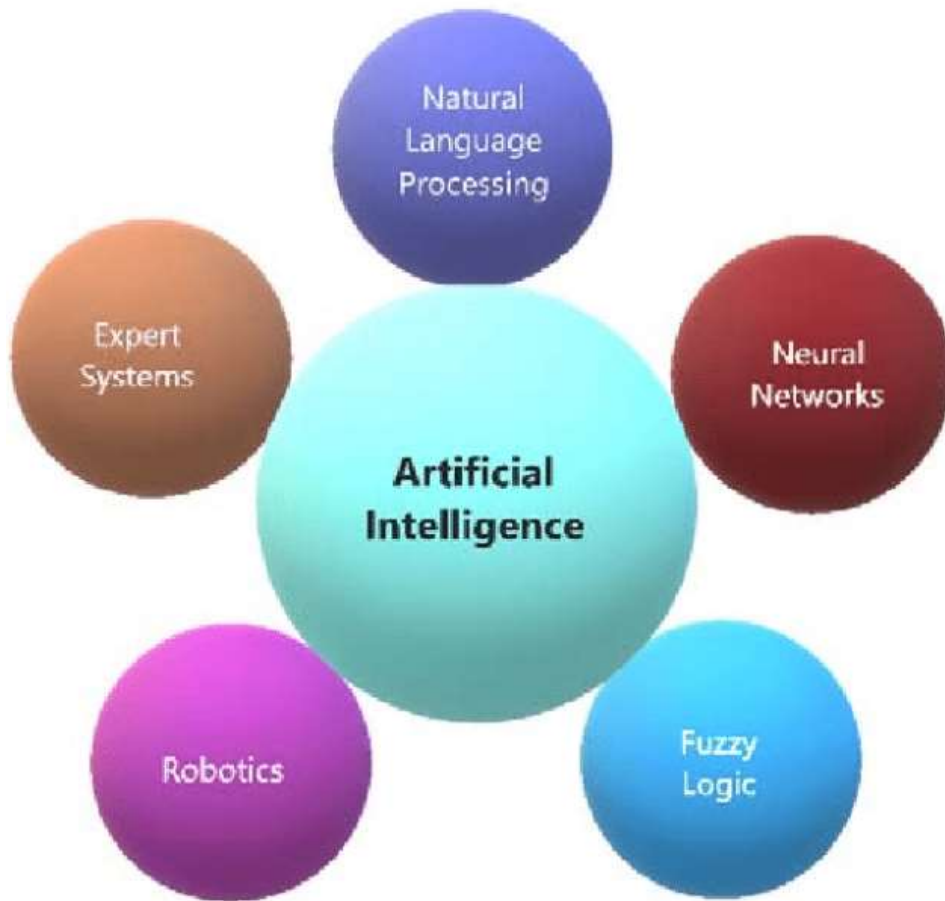


Figure 2 AI tools [7].

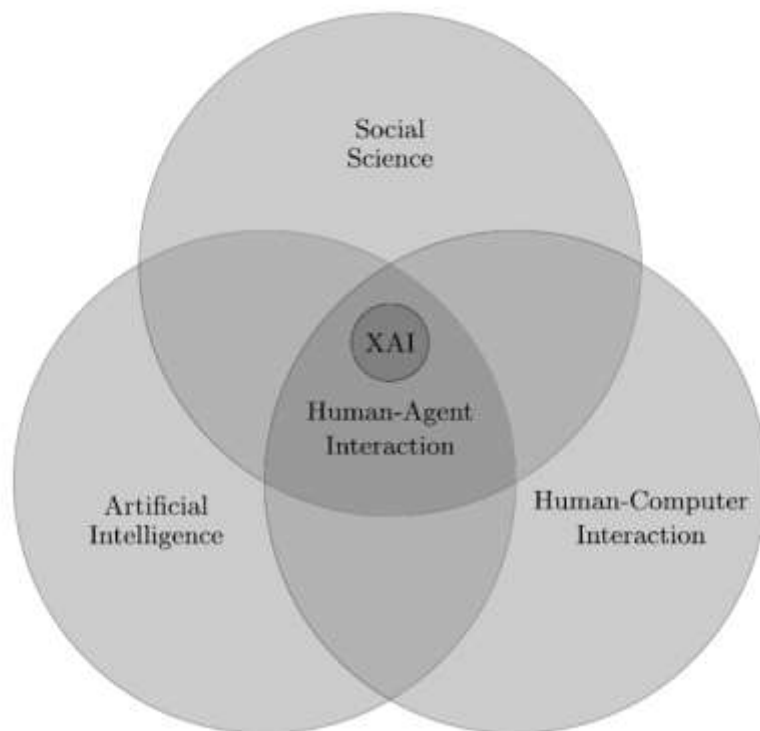


Figure 3 Scope of explainable artificial intelligence (XAI) [8].