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Application of Artificial Intelligence in Financial Services

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ABSTRACT

In the fourth industrial revolution; Technologies and computer science are progressing and are present in all sectors of different industries. Artificial intelligence in financial services reduces costs and increases the quality of services; Which is why the use of artificial intelligence is common in many well-known financial companies of the world. Artificial intelligence in financial services has four forms of application. The first one is Artificial Neural Networks, which have underlying rules and act and makes decisions like the human brain. The second case is Expert System, which makes the best decision in financial services based on past experiences and events. The third case is the Genetic Algorithm, which is a simple and practical tool by which the ma-chine can simulate the mechanism of natural selection. The fourth case is fuzzy logic, which reduces errors and makes reliable decisions in financial services due to the high accuracy of the output

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1. Introduction

1.1. What is Artificial Intelligence?

Artificial intelligence, also called AI for short; is one of the most well-known technologies in the world today. In recent years, there have been many innovations and developments in the field of artificial intelligence, which in the past were only formed in our imaginations, but now they have become reality. Primarily, artificial intelligence involves using computers to perform tasks that normally require human intelligence. Humans can see with their eyes and process what they see. Humans can understand their environment and move around in the environment. The human brain has the ability to see patterns. Also, humans can talk to each other using different languages (Amir Zadeh, 2022; Torabi et al., 2022).

Artificial intelligence is a broad branch of computer science that is becoming more popular and well-known over time. Artificial intelligence exists and is used in all aspects of human life. For a simple answer to the question of what artificial intelligence is, you can separate the term artificial intelligence and first understand each word separately.

- Artificial: Something that did not occur naturally and was actually made by humans.
- Intelligence: It is called the ability to think and learn based on experience (Habibi, 2022a; Habibi, 2022b).

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Now, if these two words are combined, the term artificial intelligence is obtained. In order for a person to be considered smart and intelligent, learning must take place and the person must be educated. In fact, humans are not intelligent from the first day they are born, and they must be trained to become intelligent. When humans learn, they actually remember things and store information in their brains. This information stored in the brain is then used to make intelligent decisions. Regarding machines and artificial intelligence, the conditions are the same, and just like humans, computers must learn first and cannot become intelligent until they are trained. Artificial intelligence is something that is not natural but can think and learn based on experience and make decisions (Aghajani, 2021; Amir Zadeh, 2022; Habibi, 2022a).

1.2. Artificial Intelligence in Financial Services

The emergence of the Internet era has accelerated the use of technology at the levels of society, and artificial intelligence has become a popular applied technology in a short time in various fields. With the use of artificial intelligence in the financial services industry, new financial services and products that are different from traditional models have appeared and new financial models have appeared. In general, these innovations have improved the methods of providing financial services and as a result of the progress of this industry. Until now, new concepts such as internet banking and quasi-financial services have appeared in the financial services industry, and during this time, financial services have undergone many changes (Ghorbani Azar, 2021; Mostofi, 2022).

The main purpose of financial services and financial reporting is to provide the information needed for decision-making and to provide the necessary information to evaluate the performance and profitability of the economic enterprise. The disclosure of relevant information in financial statements should be such that, on the one hand, it allows users to make informed decisions, and on the other hand, it does not mislead them. Humans can make mistakes in the services they provide, and there is always the possibility of errors in financial services and financial reporting. What has been proven in recent years is that the more financial and economic sciences are combined with technology, the number of errors and mistakes have decreased (Ghorbani Azar, 2021; Morid Ahmadi Yazdi and Hajiha, 2021).

Financial companies should take help from technology to provide better and better quality services. Based on this, the main priority in the field of financial services should be the combination of strategic situations with various customer needs. In other words, customers expect financial services to be available faster, with better quality, fewer errors, etc. Internet banking, which is possible with the Internet and a computer or mobile phone; has caused the accuracy and speed of financial services to increase and the costs to decrease. We can say that technology has never opposed the development of financial services and has even led to its development (Ghorbani Azar, 2021; Morid Ahmadi Yazdi and Hajiha, 2021; Tayebi et al., 2022).

Artificial intelligence is used in various industries and sectors, and its penetration rate is increasing day by day. Artificial intelligence has gained a lot of popularity in financial services. Many financial companies use artificial intelligence to improve service quality and reduce costs. financial companies so that they can compete with their competitors and have professional activities at the international level; They should make the most of every improving method and factor of progress (Ghorbani Azar, 2021; Aziz Pooran and Moradi, 2022).

In the fourth industrial revolution, using existing technologies, a large amount of data can be processed and classified. According to the review of other researchers mentioned in Table 1; it can be concluded that artificial intelligence can be very useful in economic, accounting, and financial sciences. Artificial intelligence can help us collect, sort, analyze, review, and report information and data(Prasongko and Adianto, 2019; Ghorbani Azar, 2021; Aziz Pooran and Moradi, 2022).

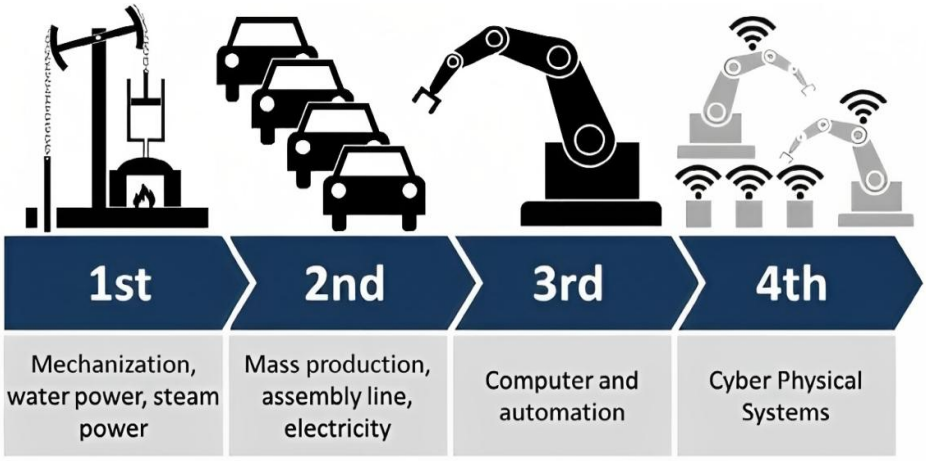


Fig. 1. Development of the World Industry starting from the First, Second, Third to the Fourth Industrial Revolution (Prasongko and Adianto, 2019).

The first industrial revolution began with the introduction of mechanical production in the second half of the 18th century. From 1871 onwards, the second industrial revolution took place with the widespread use of electricity and the division of responsibilities between managers and employees. The third industrial revolution is called the digital revolution. Around the 1970s, electronic science and information technology made great progress. This development led to the development of automation of production processes and further economic development. In the event called "Fourth Industrial Revolution"; it was attended by representatives of businesses, politicians and academics. In this event, ideas about the digitalization of the industry along with the automation of devices were proposed, which were later used as a competitive arm of the German manufacturing industry (Ehsani, 2022; Mehrabani, 2022; Ostadi et al., 2022)

We are now in the fourth industrial revolution, which is known by various names such as the fourth revolution, the fourth industrial revolution, the digital revolution, the artificial intelligence revolution, etc. The McKinsey Institute has estimated that this revolution we are in is ten times faster and three hundred times larger than the industrial revolution of the early 19th century. In a way, it can be said that the fourth industrial revolution is a continuation of the third industrial revolution, which is advancing at a faster pace. In this course, we started using computers, automating processes, and making systems intelligent using data and machine learning. When this revolution evolves, computers will connect and communicate without the presence of humans. The penetration of artificial intelligence and computers in various industries will increase and the performance of industries without artificial intelligence will be disrupted (Ajali and Saberi Fard, 2021; Mehrabani, 2022; Ostadi et al., 2022).

Table 1. The research of other researchers.

Article Name	Objectives	Findings	Recommendations
Financial Time Series Forecasting with Machine Learning Techniques: A Survey	Current machine learning and artificial intelligence research experiments used to forecast stock markets activity.	There is consensus among researchers that stock index forecasting is significant. Prevailing machine learning technology in this field is known as Artificial Neural Networks.	The researchers believe that stock index forecasts are significant. The core technology for computer education is called Artificial Neural Networks (Krollner *et al.*, 2010).
Assessing Bank Performance with Operational Research and Artificial Intelligence Techniques: Survey	Comprehensive analysis of research utilizing Artificial Intelligence and Operational Analysis methods for analyzing the efficiency of banks.	For DEA research banking and most experiments using two-stage DEA, feasibility and power productivity have been considerably reduced and their findings maybe biased.	Their viability and power efficiency have significantly reduced and their results may be skewed in the case of DEA study banking and most DEA studies (Duygun Fethi and Pasiouras, 2010).
Artificial Intelligence in Finance: Forecasting Stock Market Returns using	This study examined different applications for artificial intelligence in the field of	ARMA models were found to be the best way to minimize prediction errors, whereas	The best approach for minimizing prediction errors was identified for ARMA

Artificial Neural Networks	finance.	networks are often more reliable to predict paths or symbols.	models, while networks are often more accurate for predicting paths or symbols (Zavadskaya, 2017).
Some Financial Regulatory Implications of Artificial Intelligence	History of artificial intelligence with big strengths and weaknesses and some aspects in which Artificial Intelligence influences the future of the political and financial systems.	The rapid development and use of Artificial intelligence technologies will change the financial services sector and many industries in the real economy. To the extent that this potential is realized, financial behavior and prudential supervisors will have significant consequences for Artificial intelligence.	The rapid development and use of Artificial Intelligence technologies would change the financial services sector and many real-economy sectors. If this ability is understood, Artificial Intelligence may suffer significant implications for financial conduct and prudential supervisors (Wall, 2018).
Artificial Intelligence, Finance, and the Law	analysis of the threats and drawbacks shows that technological knowledge and uncertainty can affect regulation, economy, and culture and discourage that from being carried out.	The rise and growth in financial and other artificial intelligence would be one of the most important legal, business, and social innovations of the years to come. The early development provides insights in to the immense capabilities of financial artificial intelligence and the opportunity.	The rise and development of financial and other artificial intelligence will undoubtedly be one of the biggest legal, economic, and social advances of the coming years. The early advances gave insight into the enormous potential and ability of financial AI (Lin, 2019).
Artificial Intelligence in Finance	Explore current Artificial Intelligence literature on research, practice and regulation.	The financial services industry is still in the early stages of artificial intelligence. Throughout banking, Artificial Intelligence has become more omnipresent, and the are more problems, including political, cultural, economic, and social hurdles.	There is still AI in the early stages of the financial services industry. AI is more omnipresent in banking and challenges, including financial, technological, economic, and social hurdles, are that (Buchanan, 2019).
Fintech Risk Management: A Research Challenge for Artificial Intelligence in Finance	Targeting the new topic of finance technologies by defining primary technical forces of transition such as Big Data Analytics,AI Blockchain technology.	The study has found it financial technology evolves and expands, making it competitive, and raising potential negative effects on customers and investors.	The goal can be accomplished by implementing effective risk management techniques, the enforcement pressure of which can be constrained by the system (Giudici, 2018).

2. Application of artificial intelligence in accounting and finance

Artificial intelligence has a special place in financial and accounting affairs and has many applications, which include the following:

- Artificial Neural Networks,
- Expert System,
- Genetic Algorithm,
- Fuzzy Logic (Li and Zheng, 2018; Buchanan, 2019; Wang et al., 2020).

2.1. Artificial Neural Networks

An artificial neural network is a model whose components are directly similar to real nerve components. This model was first proposed by McCulloch and Pitts by imitating a biological neuron. One of the important characteristics of the artificial neural network and its common feature with the human brain is the ability to receive information, learn and make decisions. The difference between the artificial neural network and the human brain is that instead of following a set of pre-defined rules and regulations, it uses some underlying rules (Darabi and Karimi, 2013; Habibi, 2023).

The artificial neural system has many applications in finance and accounting. With the help of neural networks and hybrid models, the value of securities and other assets can be obtained. In this case, we have to simulate the human evaluation process, which is possible in the artificial neural network. We can also program the artificial neural system in such a way that its input information, data related to customers, and its output, analyzed decisions have validity. An artificial neural network system can be configured and specified to mimic the decisions of human experts by reviewing data and actual decisions made in the past. In such conditions, artificial intelligence can perform better than humans and act accurately (Burrell and Folarin, 1997; Ahn et al., 2000; Darabi and Karimi, 2013).

2.2. Expert System

An expert system is a system that uses human knowledge through computers to solve problems that often require human expertise. The expert system is a method to include the knowledge of experts in the computer. These systems try to incorporate aspects of human knowledge and reasoning into the computer to analyze problems and reach appropriate results. One of the most appropriate fields of application of expert systems is the field of accounting and finance. Today, many types of expert systems have been developed for different applications in this branch of knowledge, which are used by different groups of decision-makers such as company managers, accountants, financial analysts, economists, etc. With the help of this system, financial analysts, accountants and economists provide accurate and appropriate analyses (Jafari, 2021; Lashkari, 2022).

According to the problems in the field of finance, expert systems related to the subject of finance are divided into four groups based on the type of assistance to the problems. The first group of applications of expert systems for the financial analysis of companies. One of the advantages of expert systems is that in addition to quantitative ratios such as profitability, total profit, and short-term and long-term debt, etc., they can deal with qualitative ratios such as market position, employee organization, marketing flexibility, etc.. The second group of applications of expert systems is used to analyze the causes of successful or unsuccessful business development. In these types of systems, a specific business development case with a specific project performs analysis and forecasting by looking at previous and subsequent events and using the ability to track data that changes over time (Bahrini and Alahyari, 2019; Derakhshani Diarjan, 2021; Jafari, 2021).

The third group of applications of expert systems is used for market analysis. If a product is already produced by the company, its sales can be analyzed by the expert system. The system has the ability to provide appropriate solutions to increase sales and increase profitability by considering different factors that may reduce sales. The fourth group of applications of expert systems is used to acquire knowledge in the financial subfield. These types of expert systems are widely used in the training of managers and other financial professionals. The basic knowledge of these systems can be quickly developed and upgraded. Training your financial managers improves the quality of financial services (Abassi and Jamalodini, 2012; Bahrini and Alahyari, 2019; Shokri, 2019; Derakhshani Diarjan, 2021).

Table 2. Advantages and disadvantages of using expert systems in finance and accounting.

Advantages	Disadvantages
Faster decision-making in expert systems than in human experts	The loss of the conscience of humanity and the lack of complete knowledge in solving the problem
Relatively high productivity and efficiency	Difficulty adapting to a constantly changing environment
Reducing the costs of hiring employees and financial experts	The need for relatively high investment and ongoing maintenance costs
Compatibility and validity of expert systems in different conditions of risk and profitability of the company	Lack of sufficient ability in some cases for an interdisciplinary approach (Sheykh Veysi *et al.*, 2018; Shokri, 2019)

2.3. Genetic Algorithm

The genetic algorithm was first proposed by John Henry Holland in the 1960s and was developed by him, his students, and several colleagues in the 1960s and 1975s. John Henry Holland is also known as the father of genetic algorithm. At the University of Michigan, today the term algorithm is used by most experts in this field in a different concept from the original concept intended by John Henry Holland. Genetic Algorithm is a non-classical optimization and direct search method that deals with only the function itself. Genetic algorithms are a simple and useful tool by which a machine can simulate the mechanism of natural selection. This action is done by searching the problem space to find the best solution (Purzamani, 2013; Esmaeilzade and Khosravian, 2022).

The first application that can be mentioned of the genetic algorithm is related to bankruptcy prediction; A risk that threatens many economic enterprises. Bankruptcy is a very important global problem with high social costs. Based on this, the prediction and analysis of bankruptcy are very important for businesses and managers. To solve the problem and risk of bankruptcy, researchers have obtained a set of rules or conditions using genetic algorithm. Based on these rules and conditions, the probability of bankruptcy of the company and business can be checked and estimated accurately. Genetic programming can minimize the number of variables that have been identified as important using traditional models and statistical selection methods in bankruptcy prediction (Purzamani, 2013; Sang, 2021).

The next application of the genetic algorithm is related to portfolio selection and management. Stock market investors participate and invest in this economic activity with the sole purpose of making a profit. In investment, it is very important to identify the effective and determining factors of the investment volume and choose a diverse set of stocks, and to spread the capital among different stocks. The competence of the best financial and economic managers in stock selection and stock management is determined; because this is one of the most sensitive and complex issues in the field of finance and investment (Mahfoud and Mani, 2010; Benbouziane, 2012; Purzamani, 2013; Sang, 2021).

In this situation, there are several stocks and it is supposed that buying stocks that have the highest purchase value and the lowest amount of risk, it will bring profit to the business and the company. Considering the uncertainty that exists in the stock market and also taking into account the different desires of investors, it will be necessary to find a reliable way to choose a suitable set of different stocks with the lowest risk and the highest return. Therefore, according to the successful and accurate performance of the genetic algorithm in optimization problems, this algorithm can provide investors with a suitable method to form the best investment portfolio (Mahfoud and Mani, 2010; Benbouziane, 2012; Purzamani, 2013; Sang, 2021).

2.4. Fuzzy Logic

In the binary logic that was first proposed by Aristotle; we consider the states definitively in two states, true or false. In another language, it can be said that in this logic, an element belongs to a set or it does not, and there will never be a state other than these two states. Through binary logic, natural events can be measured and defined correctly and with certainty. While in business, economic and financial sciences and some other sciences, natural states are ambiguous and the distance between "what is" and "what is not" is not properly defined. Professor Lotfi Zadeh founded the theory of Fuzzy sets in 1965 to face the ambiguity in the world, which developed and gained practical application in the 1970s (Eslami, 2012; Abdi, 2016).

Fuzzy logic is widely used in the field of artificial intelligence and control theory. By using fuzzy logic in these fields, computers can make calculations and decisions based on non-deterministic and non-explicit data. Fuzzy logic is used to solve problems with approximate answers and it is also possible to create two solutions or answers for the same problem. In contrast to fuzzy logic, there is Boolean logic, which has a structure of 0 or 1, and there will be no state other than this (Eslami, 2012; Abdi, 2016).

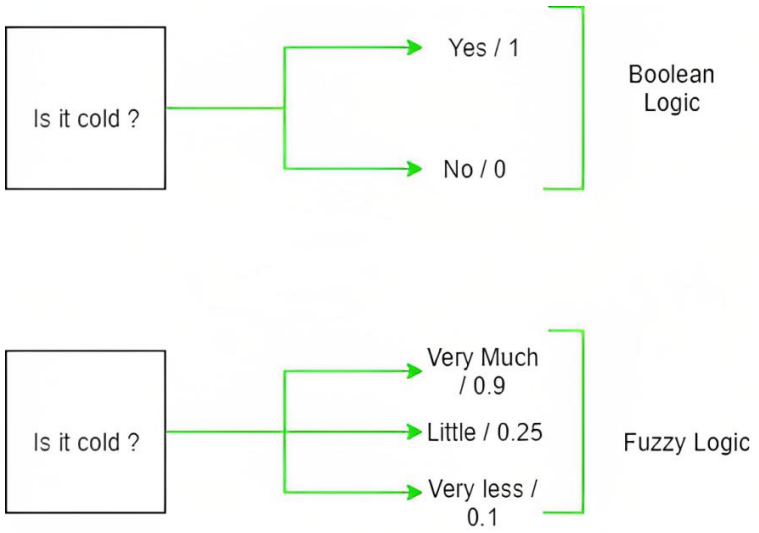


Fig. 2. Boolean logic and fuzzy logic answer to a question (2023)

Consider the question that asked, is it cold? In Boolean logic, the answer will be yes or no and it cannot be separated from this state. In other words, in Boolean logic, the answer is 0 or 1. In contrast, there is fuzzy logic to answer this question. In fuzzy logic, you can see that the answers are different and are not absolutely 0 or 1. Based on this, it can be said that the answer to fuzzy logic is more accurate and valid for analysis and decision-making (2023).

Fuzzy logic in financial and accounting sciences has applications that are very effective in managers' decisions. One of the most important applications of fuzzy logic in financial and accounting sciences is decision making. This application can bring non-deterministic inputs to definite answers by using values and time conditions. In financial services, there is a lot of uncertain information that can be managed with this application of fuzzy logic. Fuzzy logic can help accountants measure and manage audit risk probability and ambiguity in the audit environment. Also, fuzzy logic is very useful in allocating assets. A special asset allocation model can be designed based on a person's age and degree of risk taking to allocate a person's total assets to three sectors: savings, income investment, and growth investment. Also, fuzzy logic can measure investment factors and provide different outputs to be available to decision makers (Eslami, 2012; Korol, 2012).

3. Conclusion

Any tool that improves the quality of financial and accounting services; should be developed and used more. With the advent of the computer, many financial services were provided quickly and with high accuracy until a complementary and professional tool called artificial intelligence was created. Artificial intelligence works like humans or even better than humans and makes it possible for financial services to be provided in the best possible way. For financial companies to progress and win in competition with their competitors; They should make good use of new technologies in the field of artificial intelligence. The use of artificial intelligence can also have risks; But considering the advantages of using artificial intelligence in financial services, it can be said that the advantages of using it are more than its disadvantages. In the face of increasing demand for financial services, the need to use artificial intelligence in the financial services industry has increased and more and more diverse application models are offered so that this issue has become an inevitable trend.

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