

Exploring AI and Machine Learning Applications in Banking: A Comprehensive Review of Literature

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Abstract:- The use of Artificial Intelligence (AI) and Machine Learning (ML) within the Banking sector has dramatically transformed the industry in recent times. AI has catalyzed new advancements on both the back and front ends of financial operations. This article seeks to explore the significant impact of artificial intelligence within the banking industry. It will look at how these abilities further drive efficiency, allowing professionals in the industry to enhance the experience for their customer base. It will explore different use cases within the space and paint a picture for the future as computational intelligence continues to hold a key role in decision-making where accuracy is increasingly important. The banking industry has traditionally been an area conservative about the implementation of new technology due to security implications. However, this has begun to change as the banking industry begins to consolidate these technologies can provide an advantage in the market and catch the eye of a public who is using traditional banks less and opting to reside with tech and fin tech companies. Understanding what AI and ML are is key to getting what these technologies are about. This paper provides multiple real-world examples of how machine learning is likely to upend banking. By ingesting files and recognizing patterns, ML algorithms help banks predict behavior and make choices that will help redefine what banking is in the modern age.

I. INTRODUCTION

In recent years, there has been significant growth in the use of Machine Learning (ML) and Artificial Intelligence (AI) in the financial industry. These institutions have leveraged their significant power to provide business solutions for both front-end and back-end processes, ultimately enhancing efficiency and elevating the customer experience. Lately, we have seen how computational intelligence has become the key factor in gaining a competitive advantage through its ability to

make effective decisions. ML and AI are poised to revolutionize the banking industry with impressive outcomes. This article will reveal the ways in which Machine Learning and Artificial Intelligence are used in various areas of the banking industry and will discuss how these institutions utilize computational intelligence to enhance their business operations (Castelli et al., 2016; Donepudi, 2016). Undoubtedly, ML and AI have brought about a major transformation in the banking sector. This revolution has significantly enhanced the banking experience in numerous ways. While many financial institutions are still struggling to embrace the use of computational intelligence technologies, its implementation is rapidly spreading throughout the industry.

Hence, it is justified to state that the financial and banking services have experienced a major transformation due to the implementation of Machine Learning (ML) and Artificial Intelligence (AI). Significantly, the expansion of fintech companies is a major factor in the ongoing transformation that we are witnessing. For example, a recent Q2 analysis of India's fintech sector showed a significant increase in investment with 32 transactions completed during the same time frame, indicating strong growth in the financial services industry. Traditional banks are rapidly adopting technology such as Chatbot, but fintech companies, which have long embraced AI, are playing an important role in driving innovation and contributing significantly to financial intelligence (Das et al., 2015).

Firstly, it is essential to understand the concepts of AI and ML. John McCarthy, who is considered the father of AI, describes it as the science and engineering involved in creating intelligent machines, particularly intelligent computer programs (Kumar & Chandrakala, 2016). In general, AI involves transforming a computer into a robot or using programming codes to make computers think and act with human-like intelligence. AI involves creating computer

software and systems that can replicate human behavior and problem-solving abilities by studying human thinking patterns, learning methods, and cognitive capabilities. In essence, Artificial Intelligence is enabling computers to develop both intellectual and emotional capabilities. While AI and ML are often used as synonyms, they actually represent different concepts.

A common belief is that the basis of machine learning is the idea that machines have the ability to learn. Historically, machine learning and Artificial Intelligence have been in existence for over fifty years, as indicated by their fundamental principles. In 1959, IBM scientist Arthur Samuel was the first to utilize Machine Learning by creating a solution for a checkers game and publishing it (Arthur Samuel, 1959). He described how, for the first time, a computer was able to play checkers against humans and emerge victorious. Over time, programmers have developed increasingly advanced systems that allow machines to perform tasks typically done by humans. Another well-known example is the ancient board game "Go," which has existed for over 2500 years. It is more complex and strategic than chess, leading to the belief that no computer could surpass a human in the game of "Go." Four years ago, the long-held belief was shattered when a computer program called AlphaGo defeated an 18-time world champion in a decisive 4 to 1 victory (Taher-Uz-Zaman et al., 2014). Machine learning has sped up the transformation of banking operations. Machine learning in this area uses past data and behaviors to forecast trends and assist in making decisions (SEC Speech, 2016).

II. ROLE OF ARTIFICIAL INTELLIGENCE AND MACHINE LEARNING IN BANKING

As AI and ML are increasingly adopted by financial institutions, the world is witnessing a growing range of applications for these technologies daily. Nevertheless, the potential risks associated with both are on the rise. Computational intelligence technology is rapidly expanding its influence beyond the banking sector and into industries like insurance and capital markets. Artificial intelligence and machine learning are widely used in the banking sector to automate processes, conduct analysis, and facilitate decision-making, ultimately leading to the development of innovative business strategies. Purdy & Daugherty (2016) found that artificial intelligence and machine learning will shape the future of customer interactions in banking. A recent study conducted by the BCG consulting group indicates that China is significantly leading the way in the implementation of AI and ML in its financial industry, particularly in the area of fintech, compared to other countries. The study indicates that by 2027, approximately a quarter of the finance job market will have evolved due to the significant impact of AI and ML in improving efficiency and automating processes. Below are several uses of Artificial Intelligence (AI) and Machine Learning (ML) in the banking industry (Yu et al., 2016)

➤ *AML and Fraud Pattern Detection*

AML is a collection of measures and rules created to prevent the laundering of money obtained through unlawful activities. Many banks use AI-powered mechanisms, which are more resilient and sophisticated than traditional AML models. With ongoing advancements and enhancements in AI, these systems are poised to become more precise and efficient. A large number of countries have started to adopt the potential of AI and ML in identifying and preventing fraud. The National Stock Exchange of India has recently revealed plans to implement policies that will allow it to use machine learning to detect market trends and oversee the exchange to prevent manipulation of its High-Frequency Trading (HFT) markets. They are enhancing their security by integrating artificial intelligence and machine learning into their surveillance system.

➤ *Personalized Banking and Automation*

This could be an area where AI has excelled with its creative solutions and strategies for providing banking users with more accessible and convenient options. AI is making a significant impact on the banking industry by offering tailored services to customers, such as chatbots that offer self-service solutions, ultimately decreasing the burden on call centers. Nowadays, voice-activated virtual assistants are offering more intelligent support to customers in all their interactions. Whether it's verifying balances, setting up payments, reviewing account activity, and other related tasks. Furthermore, in today's market, there are numerous applications available that provide customized financial guidance. An AI application has been developed that monitors individual earnings, monthly costs, and spending behavior, providing tailored recommendations and financial advice for an optimized financial strategy. It's not surprising that industry leaders are now incorporating robotic process automation into their future strategies to cut operational expenses and improve productivity through intelligent character recognition. The integration of AI and ML in the banking industry reduces the risks of human error in tasks that require frequent repetition.

➤ *Customer Recommendations*

The use of computational intelligence has significantly contributed to the development of recommendation engines in the banking industry. The process involves using historical user data to generate personalized recommendations that align with the user's preferences and past interactions. Recommendation engines have long been a key factor in the increased profits that numerous banks have experienced over the years.

➤ *Risk Management*

The fundamental principles of AI and ML involve learning from past data. It is no surprise that ML and AI are rapidly taking over the banking industry, as they excel in managing financial records and transactions. An example would be how credit cards work. For a considerable amount of time, we have relied on credit scores to determine eligibility

for credit cards, but it's time for a change. This approach creates a distinction between those with and without, which is detrimental to business. Instead, the banking sector can gather data about each person's loan repayment behavior, the number of loans they are currently managing, the number of credit cards they have, and similar details. This data can help customize the interest rate on a card to better align with the goals of the institution providing it. AI and ML play a crucial role in this scenario, as they can analyze a large number of individual financial documents to generate a solution. AI, which relies on data and is driven by it, can analyze large amounts of data and make recommendations for loan credit offers (Bauguess et al., 2017).

III. WHY USE MACHINE LEARNING AND AI IN BANKING?

Machine learning and artificial intelligence enable machines to perform a wide range of intricate tasks in place of humans. In a world where technology is prevalent in nearly every industry, financial institutions need to incorporate advanced technology to stay competitive, improve their IT systems, and meet current market needs. To elaborate on this, here is the reason why ML and AI are essential for banking.

The use of machine learning in banking is driving progress in the financial services industry (Analytics Vidhya, 2019). With the help of innovative solutions, financial institutions can now transform the constant flow of data they generate into valuable insights for a wide range of stakeholders, including top executives, operational teams, marketing, and business development. Companies are increasingly using machine learning applications in finance to enhance security, user experience, and customer support, and streamline processing with minimal gaps. The combined advantages are so significant that AI and analytics could potentially add up to a value of \$1 trillion annually for the global banking industry.

According to Analytics Vidhya (2019), machine learning involves analyzing large volumes of data to gain insights and proficiency in performing specific tasks, such as distinguishing counterfeit legal documents from authentic ones. The finance industry generates a large amount of intricate and vast data, which machine learning is highly skilled at handling. The following are five ways in which the banking and finance industry has been influenced by machine learning.

➤ *Anomaly Detection*

Identifying anomalies in the asset-serving division of companies is extremely challenging. Mistakes or issues in everyday processes can lead to unusual occurrences. It is important to detect any unusual or abnormal activities in the fintech industry as they may be linked to illegal activities such as account takeover, fraud, hacking, or money laundering, ultimately leading to unforeseen consequences. Anomaly

detection can be tackled using different methods, with machine learning being just one of them. Sophisticated anti-fraud systems using financial machine learning can detect subtle user behavior patterns and relationships. To detect potentially fraudulent transactions, the system can analyze large amounts of data and evaluate different factors simultaneously and in real-time.

Using machine learning in payment processes provides benefits to the payment industry. Owing to technology, payment service companies can reduce transaction costs, leading to a rise in customer engagement. One of the advantages of using machine learning in payments is its ability to enhance payment routing based on pricing, performance, functionality, and various other factors.

Machine learning systems can effectively allocate traffic to the best-performing variables by analyzing different sources of data. This ability allows financial institutions to deliver optimal results to merchants according to their specific objectives. Today, there is a wide range of machine learning applications designed for use in the finance sector. These tools offer great potential for businesses to address common challenges and generate significant value. Payment service providers can use machine learning in payment processing to decide if a transaction should continue or if it needs to go through a two-step verification process.

➤ *Robo-Advisors (Portfolio Management)*

Automated financial guidance and assistance is provided by online tools known as robo-advisors. They provide automated portfolio management services, using algorithms and data to create and manage a client's investment portfolio. These online investment platforms streamline the investment process, easing the potential intimidation factor for some individuals. Furthermore, the cost of using these services is much lower compared to the fees of a financial advisor. In addition, a significant number of them have very low or no account minimum requirements. Betterment and Wealthfront are two digital investment companies that provide automated portfolio management and financial advice through an app or online platform.

These companies are digital financial advisors that use technology to help clients manage their money. Betterment uses computer algorithms to suggest a fitting distribution of assets for investors. The conclusion is based on the investors' reactions to questions about their intended use of the funds and their projected time frame. Wealthfront leverages the advantages of technology to provide its investment services in an impersonal manner. The software is programmed to implement established investment strategies, identify high-quality investment opportunities, and consistently manage the optimal investment portfolio. Nutmeg is one of the largest online investment management companies in the UK. The Nutmeg robo-advisor uses financial goals and risk tolerance to allocate funds into a diverse portfolio.

➤ *Algorithmic Trading*

Algorithmic trading allows the execution of large transactions by breaking them into smaller "child orders" and delivering them to the market at intervals. Hedge fund managers are the primary users of machine learning in finance, as they also utilize automated trading systems. To stay ahead of the competition, it allows traders to automate certain tasks. Additionally, the technology allows for cross-marketplace operation, improving opportunities for trading. Another benefit for financial institutions that employ machine learning is the ability of the algorithms to continuously adapt and respond to current market events, giving them a competitive edge.

➤ *Banking Processes That Use AI*

Banks use machine learning technology for a range of functions. Below are the most common benefits that banking and financial institutions receive from the use of ML and AI.

➤ *Credit Scoring*

One of the most promising uses of machine learning in banking is likely to be credit scoring (Ram, T, 2023). It evaluates a customer's financial capability and their likelihood of devising a repayment strategy for their debts. There is a critical demand for credit scoring solutions due to the large number of unbanked individuals worldwide, with only about half of the population meeting the requirements for credit. Various types of information such as work history, total earnings, financial transactions, and credit records are all considered in the evaluation process for machine learning scoring. It is a statistical and accounting-based mathematical model. Hence, machine learning algorithms can produce credit score evaluations that are more precise, responsive, and customized, allowing a greater number of individuals to obtain credit.

Machine learning systems can assess borrowers in an unbiased manner, unlike human evaluators. Additionally, machine learning in banking can help organizations eradicate biases based on gender, race, or other conscious or unconscious factors, allowing them to serve a broader range of customers. ML in credit scoring has numerous benefits, such as allowing customers to easily apply for loans from their homes with just a couple of clicks.

IV. ONBOARDING AND DOCUMENT PROCESSING

In the past, handling documents has required a significant amount of time and effort. Ultimately, machine learning can expedite the classification, labeling, and processing of documents. Before machine learning algorithms can analyze the context of scanned documents, optical character recognition (OCR) needs to be used on copies to interpret the text. The machine learning model categorizes and organizes data for future reference.

Traditional banks that are still relying on paper forms for new client onboarding can take advantage of machine learning technology for processing documents. Machine learning is a powerful and scalable method for onboarding, able to handle various types of data such as ID scans or invoices. Clients can quickly open a bank account and complete necessary verifications in real time. Machine learning applications help companies develop positive and enduring connections with their clients.

➤ *Fraud Detection and Compliance*

Fraud poses a significant challenge for financial institutions, and it is one of the primary reasons for implementing machine learning in the banking industry. Machine learning systems can identify fraudulent activity by utilizing different algorithms to analyze large amounts of data. Banks can oversee transactions, observe client behavior, and record data for additional compliance and regulatory systems to reduce overall risk in regulatory compliance. Fraud is becoming a growing concern for businesses in the fintech industry, regardless of their customer base or scale. Financial machine learning can analyze large sets of simultaneous transactions in real time. Simultaneously, ML has the potential to decrease human involvement by continuously improving models and gaining knowledge from results.

Financial institutions can use machine learning to identify and verify user behavior, as well as promptly address cyber threats. Automated artificial intelligence is now widely connected to global fraud detection (Ray, S., 2023) With the ability to easily recognize patterns as irregularities, businesses are now capable of making intelligent predictions about fraud. AI and machine learning have the potential to enhance the precision of real-time approvals, resulting in an overall enhancement of regulatory compliance. Furthermore, by saving financial institutions a substantial amount of money, financial organizations can improve the accuracy and efficiency of their operations.

In 2015, banks and retailers worldwide experienced a total of £16.74 billion (\$2184 billion) in fraud losses on debit, credit, and prepaid payment cards, as reported by Bloomberg. Valuing an investment requires a complex series of calculations. The method involves collaborating with multiple teams responsible for different aspects of investment asset management, as well as product specialists and portfolio managers. These teams should consider different approaches to investing. The solution to this problem lies in using machine learning to process large amounts of data from various sources in real-time while also capturing and understanding biases and preferences related to risk tolerance, investments, and time horizon.

➤ *Personalized Offers*

The banking industry faces a major obstacle in the form of fraud, which is why the implementation of machine learning is necessary. Machine learning systems use various

algorithms for analyzing vast amounts of data and detecting fraudulent activity. Banks can monitor transactions, observe customer activities, and maintain records for additional compliance and regulatory systems to minimize overall risk in regulatory compliance. Fraud is an increasing worry for businesses in the fintech sector, regardless of their size or the type of customers they serve. Financial machine learning can process vast amounts of concurrent transactions instantly. At the same time, ML can reduce human intervention by constantly enhancing models and learning from outcomes.

Financial institutions can utilize machine learning to detect and confirm user activity and to quickly combat cybersecurity risks. Automated artificial intelligence has become extensively integrated into global fraud detection, allowing businesses to effectively identify irregular patterns and make informed forecasts about potential fraudulent activities (Ray, S., 2023). Artificial intelligence and machine learning can improve the accuracy of immediate approvals, leading to an overall improvement in meeting regulatory standards. Additionally, through cost savings for financial institutions, financial organizations can enhance the precision and effectiveness of their processes.

In 2015, Bloomberg reported that banks and retailers globally suffered a combined loss of £16.74 billion (\$2184 billion) due to fraudulent activity on debit, credit, and prepaid payment cards. Evaluating an investment involves a sophisticated set of mathematical calculations. The approach requires working closely with several teams overseeing various aspects of investment asset management, along with product experts and portfolio managers. These teams ought to explore alternative strategies for investment. The answer to this issue is to use machine learning to analyze vast quantities of real-time data from different sources, while also identifying and understanding biases and preferences concerning risk tolerance, investments, and time frame.

The financial industry, as well as the overall economy, are being significantly impacted by the rising influence of artificial intelligence and machine learning. The significance of artificial intelligence and machine learning in banking has piqued interest, especially in risk management, following the worldwide financial crisis. The research is centered on exploring how artificial intelligence and machine learning can be used to enhance banking risk management. The paper aims to investigate the chances of successful implementation while also considering potential obstacles and their corresponding solutions. Artificial intelligence and machine learning can help address current global economic and financial difficulties, including those stemming from the COVID-19 pandemic.

This article primarily explores the management of credit risk, with a secondary focus on examining the use of artificial intelligence and machine learning in various other risk management areas. It is determined that a strategic and well-planned expansion of artificial intelligence, machine learning,

deep learning, and big data analytics can have a beneficial effect, especially in the risk management sectors of credit, liquidity, market, operational risk, and related areas.

V. CONCLUSION

In conclusion, the fusion of Machine Learning (ML) and Artificial Intelligence (AI) marks a major change in the banking sector, signaling a fresh era of effectiveness, creativity, and customer focus. The far-reaching impact of computational intelligence is clear in all areas of banking, as it improves decision-making and interaction with customers. Although there were some initial concerns, financial institutions are now realizing the essential role of AI and ML in staying competitive and relevant in the digital era.

The combined efforts of traditional banks and fintech companies are speeding up the process of transformation, promoting an environment of creativity and adaptability in the industry. As we explore through the challenges of a changing financial environment, it is crucial to continue to explore and apply AI and ML technologies to maintain growth, adaptability, and customer happiness. By making strategic investments and forming partnerships, banks can fully utilize computational intelligence to bring about significant changes and influence the future of the banking industry.

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