5-2024

Finance and Artificial Intelligence

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FINANCE AND ARTIFICIAL INTELLIGENCE

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MAY 13, 2024
UNO COLLEGE OF BUSINESS
Honors Thesis

Many people are experiencing artificial intelligence for the first time every day. The rise of ChatGPT, DALL-E and other generative AI models have led many people to wonder what role it will play in our future and whose job will be taken by AI. This is also something I have pondered. As someone who works in finance, I know that there are a few things that AI is capable of but there are a lot of things that cannot be done. What many people don't know is AI has been around for much longer than many people think. Banks have been using it for several years and traders have utilized it longer than that. These are just a few examples of how AI has been implemented into finance and it will continue to do so as time goes by.

Finance itself can be divided into three different sectors, banking, financial markets, and business finance. Each of the sectors have their own history with AI and have some experience using it previously. Because of this, I will divide my analysis into three main parts, each of which will carry the respective name listed.

Before we start the analysis of AI and its effects on the various sectors of finance, we must first look at the different types of artificial intelligence, how they work and common use cases.

Artificial intelligence can be broken up into four types based on function, reactive machines, limited memory, theory of mind and self-awareness. (Hillier, 2023) It can also be broken up into three groups based on functionality. Narrow, general and super.

The first functional type is reactive machine. A reactive machine is exactly as it sounds, a machine that reacts. The machine takes the inputs it is given and gives a reaction, or response, based on a strict group of algorithms that were programed by a

human. Unlike people, reactive machines will give the same answer when given the same inputs, every time. They do not change their approach to it unless a human changes their algorithm set.

Reactive machines can be found in our everyday life. Email filters, the Netflix and Spotify For You page, and even Amazon marketplace has a reactive machine built in. One of the less commonly seen but still widely known examples of a reactive machine can be found in Deep Blue, the chess playing robot that beat a chess grandmaster. All of these are examples of reactive machines.

The second functional type is limited memory. Limited memory AI functions similar to the human brain, except in a much simpler way. The AI can't exactly think, it's more of an informed decision-making process. Unlike their reactive machine cousins, these types of AI are able to retain a tiny bit of information and use that along with the programmed algorithms to generate an answer. The algorithms used to program these types of AI are massive data sets that typically take years to compile.

Limited memory AI has been in the public spotlight a lot lately with the rise of OpenAI's ChatGPT. This is the most famous version of limited memory AI. ChatGPT's data set is essentially the entire internet which is one of the reasons for its incredible popularity. The other reason is because it runs off a large language model (LLM). This allows it to replicate human speech and speaking patterns. This LLM allows it to feel like a conversation when a user interacts with it.

The third functional type is theory of mind. As of this writing, theory of mind AI does not exist. This kind of artificial intelligence would also be capable of several functions of

the human brain. The main one being the ability to put yourself in someone else's shoes. This is also known as internal simulation and allows us the ability to see a situation from another person's point of view. This AI is not publicly available as of yet, but a lot of research and development money is being spent on it. When this is figured out, it will greatly affect our daily lives as it will allow the machine to imitate empathy. This empathy ability would allow the AI to act in the place of an unofficial therapist. It will likely never fully take their place, but it could greatly affect how we look at it.

The final functional type of AI of self-aware. Self-aware artificial intelligence is something that will not exist for a very long time if it even gets developed. This type of AI would be able to function just like a human brain including critical thought, emotion and the many other functions the brain is capable of achieving.

Functional Types of AI

Artificial Narrow Intelligence (ANI)

Artificial narrow intelligence, or narrow for short, is a type of artificial intelligence that can do specific but limited tasks. This was the first function that AI was capable of and is the most used. All current types of artificial intelligence that exist fall under this category. (Hillier, 2023)

Artificial General Intelligence (AGI)

Artificial general intelligence, or general for short, would be an artificial intelligence that has the level of thought and knowledge of the average human brain. This includes understanding emotions, responding to stimuli and making connections between different areas of study, among many other processes. (Hillier, 2023)

Artificial Super Intelligence (ASI)

Artificial super intelligence, or super for short, is a type of artificial intelligence that would be able to surpass the cognitive abilities of a human. This AI could process data and make decisions in an instant. It also would be able to evolve and grow on its own. This is the kind of AI that has people worried about taking over the world. Think of Skynet from the Terminator movies or Ultron from Avengers. (IBM, 2023)

Types of Artificial Intelligence Currently Used

The first type of artificial intelligence is chatbots. Chat bots, originally known as chatter bots are defined as “a computer program that simulates and processes human conversation (either written or spoken), allowing humans to interact with digital devices as if they were communicating with a real person.” (Oracle) This is one type of AI that a lot of people are familiar with as they often pop up on a website or other electronic services. I know personally that I find them more annoying than anything else, and especially not helpful for finding what I am looking for. There are two types of chatbots, task oriented and data driven. The task oriented, also known as declarative chatbots, are most commonly found on a website asking if you need help, but also can be found in the McDonalds drive through taking your order. These bots use a set of rules, some natural language processing (NLP) and a tiny bit of machine learning (ML) to function. They work the best for situations that require few variables like the aforementioned McDonalds drive through or a website answering FAQs. (Oracle)

The second type of chatbot, data driven bots, are more commonly known as virtual assistants. A couple examples of this would be Apple’s Siri, Amazon’s Alexa and android’s

Google Assistant. “These chatbots are contextually aware and leverage natural-language understanding (NLU), NLP, and ML to learn as they go” (Oracle) This allows them to work with more variables and more complicated situations. These programs get better at what they do the more you use them. This is because they learn the user’s preferences and use that to provide recommendations and predict needs. (Oracle)

The next type of artificial intelligence currently used is algorithms. An algorithm is defined as “a procedure for solving a mathematical problem (as of finding the greatest common divisor) in a finite number of steps that frequently involves repetition of an operation.” (Merriam Webster) Algorithms are used in many places in the finance world. From fraud detection to trading and even risk management, algorithms have been an integral part of finance for a while now.

The third type of artificial intelligence used is pattern recognition. This type of artificial intelligence does exactly what its name suggests, it recognizes patterns. Some could argue that this should fall under the algorithm category, as it does contain an algorithm. But there are enough differences between the two to separate them. Pattern recognition is defined as “the process of recognizing patterns by using a machine learning algorithm. Pattern recognition can be defined as the classification of data based on knowledge already gained or on statistical information extracted from patterns and/or representation.” (GeeksforGeeks, 2024) These are very applicable for detection of irregularities in spending, behavior and even conversations with a customer service representative. Basically, it takes your past history and then compares it to any new activity that comes in and determines if it is within the range of your usual activity. This is the program responsible for rejecting your card when you travel to a new state or city.

Many companies offer the ability to alert them that you are traveling in order to have uninterrupted usage of your card and/or service. This alert allows them to temporarily update the algorithm to allow purchases in the state and then they can remove it once your trip is over.

Now that the different types of AI have been covered, we can move to how it is affecting the different sectors.

Banking

First up is banking. Banking is an industry that has been implementing artificial intelligence for several years before it was trending. This was primarily driven by the market shifting toward online banking and a greater need for cyber security and fraud detection. Over time, banks have evolved from using real people to detect fraudulent activity to a machine learning algorithm. Just like most AI the algorithm only gets better with age. As a machine learning algorithm takes in more information, it becomes much faster and way more accurate.

AI has also allowed banking to become a lot more efficient by automating mundane processes that are repetitive but need to be done. It also allows for customer service to be offered 24/7 and a chatbot does not need to sleep. Right now, these bots are limited in what they can do but they will improve as time goes on. Banking has been doing this for many years now and the industry is eagerly anticipating the rise of generative AI like ChatGPT.

Generative AI will greatly affect everything and banking is no exception to that. It can be said very well like this.

> “The powerful possibilities offered by Generative AI stem from its ability to create content based on the analysis of large amounts of data, including text, image, video, and code. That capability means it can, for example, be used to summarize content, answer questions in a chat format, and edit or draft new content in different formats. More specifically that means generative AI in banking could rapidly and cheaply (once the models are deployed at scale) generate hyper-personalized products and services, or accelerate software engineering, IT migration, and modernization of programs. It could also augment humans' abilities, through AI chatbots or virtual assistants--this is the focus of a partnership between Morgan Stanley and OpenAI, the U.S. research laboratory behind ChatGPT.” (Fernández, CFA, 2023)

The generative AI could greatly improve the quality of service while at the same time saving the banks money because it is more efficient. This is a rare win-win situation where both the customers and companies benefit from implementing an innovation.

Business

Second up we have the business sector of finance. This sector is still relatively new to artificial intelligence and computer-controlled processes. To truly understand the effect, it has had on business finance, we must first cover its history and what this sector is. The business finance sector is compiled of two groups, the finance people and the accounting people. Business finance has had AI like spell check, Excel and the designer option on Power Point for several years now. These have only grown in popularity and accuracy as time has gone on and their usage has increased. The biggest effect the new innovations have on business finance is an indirect effect. That is, it makes accounting

much more efficient. Accounting is notorious for being slow and painful as well as pointing out a problem but not providing a solution for it. AI being able to compile and process all of the data makes accounting much more efficient thus leaving time for the workers to do more important tasks like solving the problems the accounting discovered.

AI is also able to compile financial data and other large data sets much faster than a human. This leads to a much higher productivity rate and more work getting done. This also allows businesses to spend less on payroll. This saves costs and allows businesses to be more profitable. If this is a publicly traded company, then it leads to higher earnings per share which typically leads to a higher stock price. A higher stock price means investors make more money. Artificial intelligence working in these departments has great potential to boost the economy as a whole by a lot with the help of just one or two computers.

Investing

Finally, we have investing. This sector of the finance industry has the longest history with artificial intelligence of the three and thus has seen the most change. Artificial intelligence was first used in the stock market way back in 1991 by a man names Louis Mendelsohn. (NASDAQ, 2017) His company, Market Technologies, was launched in 1979. It was 12 years later he launched VantagePoint, the first commercially successful trading software that utilized AI. VantagePoint is still around today and is offered in more than 120 countries. This software was not the super advanced and highly capable type of AI we see today, rather it was simply capable of strategy backtesting. To put it simply, strategy backtesting works sort of like a time machine. It allows you to see a what could have been by going into the past and seeing what would have happened if you had taken

a certain strategy for that trade. This can be a very helpful learning tool for traders, especially those who are just starting out. While the market is borderline impossible to correctly predict all the time, there are certain trends and actions that tend to lead to the same result the majority of the time. Backtesting allows one to learn the signs and have a higher chance of making money. A key limitation of this first software was it only focused on a single market. As the market's continued to evolve and become more globalized, Mendelsohn realized that he lacked the computing power to continue further. This computing power eventually arrived in the late 90's and his company took off again. During that same period, the stock market switched to electronic trading with the launch of the NASDAQ in 1971. (StreetStocks, 2024) This allowed for much faster trades and thus a higher volume. A short 20 years later the internet was born and the stock market we know today started to take shape. The internet allowed individuals to bypass brokerage firms and make trades for themselves. This further increased the volume of trades and desire for financial information and advancements.

As we move toward the 2010's, this is where AI started to take a bigger role. Suddenly it could make trades, not just analyze beforehand. Algorithmic trading was revolutionary as it allowed the trader to set up a potential trade and then let it sit. In the past if a trader wanted to trade a stock when it fell to a certain price, they would have to wait for it to drop and then hope they catch it when it does. AI now allows them to set it up with certain parameters and move on with their day without having to watch it. As we progressed through that decade, the technology only further advanced. Now we can have multiple "if this then this" orders set up at once and they can be open as long as desired. These algorithmic trades do have some downsides though. There have been a few

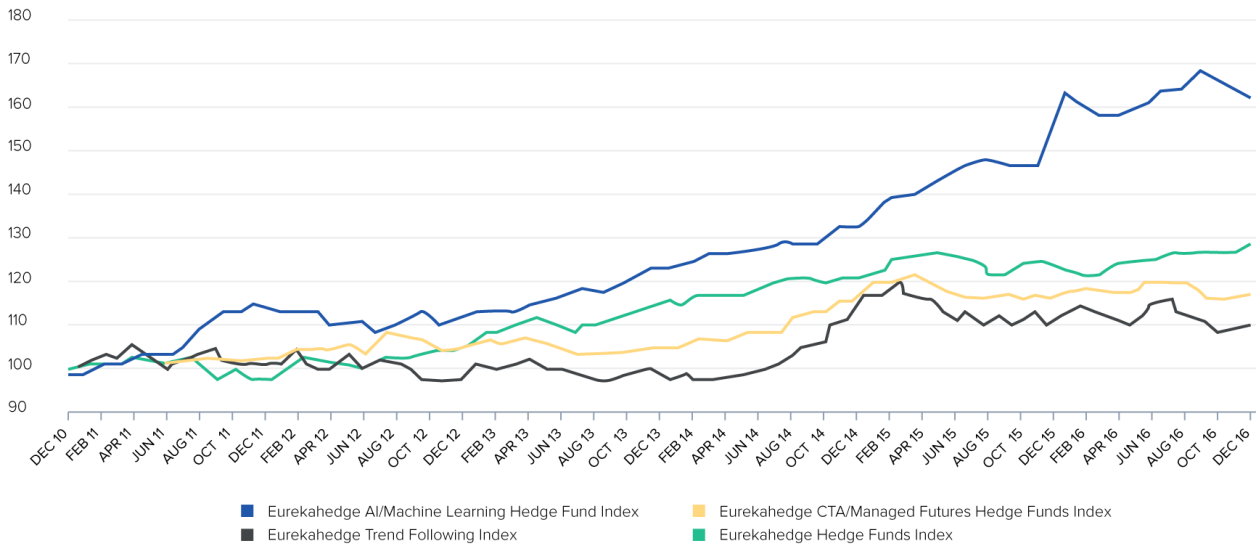
instances where it resulted in a trade being made that, based on the circumstances, would not have otherwise been made. The most recent of these being Lyft. When Lyft reported their Q4 earnings for 2023, there was a typo on the report and the situation is described below.

> “On the worst day on Wall Street since last March, shares of rideshare service Lyft blew up briefly in after-hours trading after the company posted erroneous earnings projections in an earnings press release that sent investors into a frenzy.
>
> Shares of Lyft were up 63% at one point in the post-market, spiking from a $12.13 per share at market close (a 2% drop) to just shy of $20, an area it hasn’t been close to since May 2022. That surge came after the company said in an earnings release that it expected “adjusted EBITDA margin expansion (calculated as a percentage of gross bookings) of approximately 500 basis points year-over-year.” (Morris, 2024)

This would be an incredibly exceptional jump and would cause a lot of people to take a pause at a too good to be true number. Unfortunately, or fortunately, depending on what side you were on, this caused a jump in the company’s stock price. This jump in price triggered a lot of algorithmic trading that had been set up prior to the earnings release which only further increased the stock price as more “buys” were triggered. Reaching an increase of 63% at one point. The price eventually settled out at up 18%, which is still outstanding, but it had a wild ride to get to that point. This is just a small example of how algorithmic trading can affect the market, even if you don’t use it yourself.

Another option that has come to light only in the past few years is the idea of a Robo Advisor. This is probably the most intriguing innovation that has come out in the last few decades. A robo advisor is exactly what the name would imply. It is a robot that makes trades on your behalf in order to make you money. These actually started back in 2010 to lackluster results not much better than a human team could do. As they started to learn and the overall technology improved, they started to outperform the human hedge funds gradually until eventually they surpassed them and now have double their returns. The best part is that they have lower fees than a human fund manager, mainly because they are robots and the fees go toward maintenance, not compensation for labor. The below chart illustrates the pull away in returns that has occurred over time. (Lin, 2017)

Chart 2: AI/Machine Learning Hedge Funds Index vs. Quants and Traditional Hedge Funds



Source: Eurekahedge

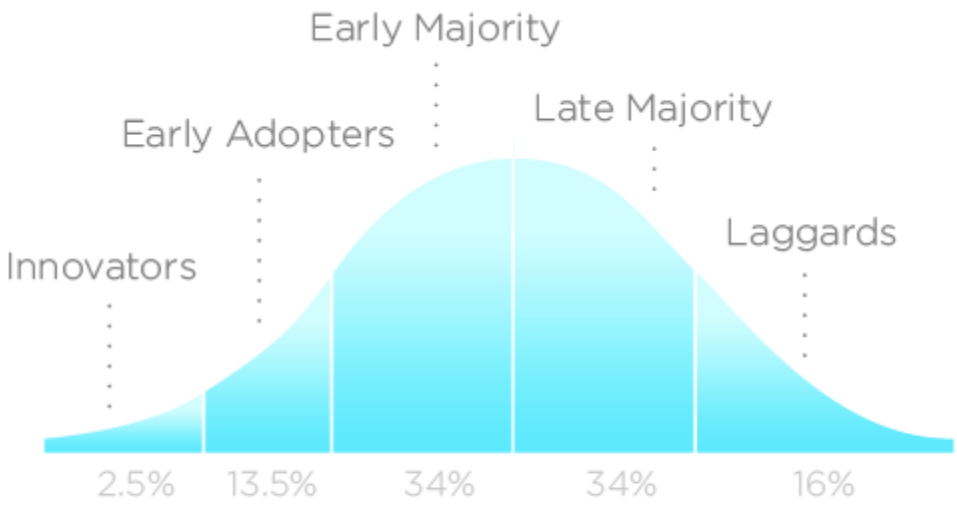
toptal

There is a lot of speculation about how the machines are able to outperform a team of the greatest quantitative investment analysts, or quants as they are called on Wall Street. Some say that it is blind luck, others the style of investing and yet others the fact that

computers can process large amounts of data faster than humans. The main reason that a robo advisor is able to outperform a team of quants is the fact that it is a machine. Humans struggle with inherent biases, even the most skilled analyst. This is because we can feel emotions and thus those influence our decision making weather, we know they do or not. A machine cannot feel emotions as it is not human. This allows it to literally be as unbiased as possible and choose investments based on the numbers and only the numbers. This is what makes them excel.

The only question left here is why very few individuals are using the robo advisors over the traditional quants. The answer to this question has two parts. The first part is that it is a machine and the second is emotions. This time it is not the emotions of the fund manager; it is the emotions of the people that hold the money. Many of the investors that possess the larger sums of money have worked their whole lives to amass that wealth. Older investors are typically more risk adverse and adopting a new investment strategy or tool is often considered risky.

This is likely to change as time passes. Just like a lot of technology, more people will adopt it as time goes by. This is laid out really well in the below graph. (Beal & Bohlen, 1970)

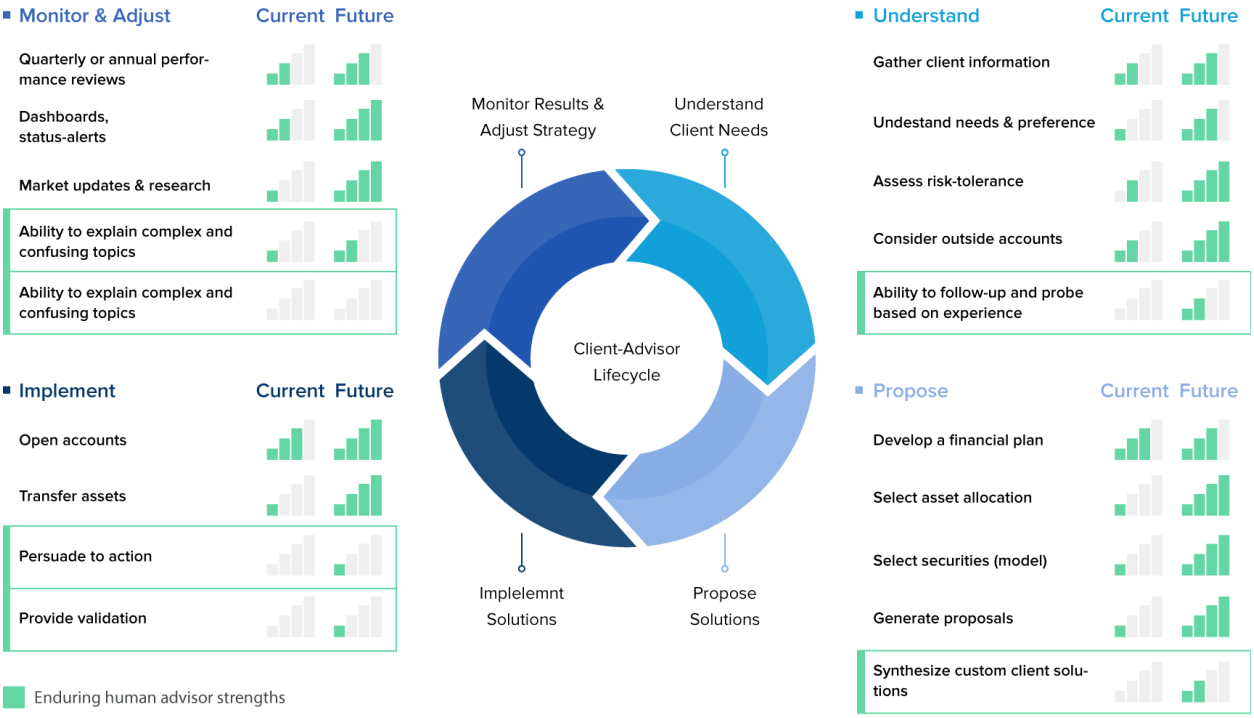


INNOVATION ADOPTION LIFECYCLE

As you can see by the graph, new tech typically takes a while to take off. The different phases of the graph have different timelines depending on the technology. Based off the current environment, I would warrant to say we are at the end of the innovators phase or just at the beginning of the early adopter phase.

As we start moving forward past the early adopter phase, more people will start utilizing robo advisors and at the same time their capabilities will increase as time goes by. This is once again better represented by a graph. (Armstrong, 2023)

Chart 3: Current and Future Robo-Advice Capabilities



Source: Accenture Research

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This graph displays two things, the first is the current capability of the robo advisors and the predicted capability of the robo advisors in the future. There are a few areas where they are least likely to take over the areas surrounded by green. These are the areas that are dominated by a human presence now and per the graph, is likely to dominated by humans in the future.

Artificial intelligence already does most of the work for processes that are pretty standard like opening new accounts and developing a financial plan. The areas where AI falls short currently and will likely fall short for the near future are the more complex and serious topics.

A lot of people might look at this chart and say that a human's place in finance will not exist in the near future. That is not the case. The role of humans will definitely evolve,

but not cease in finance as AI becomes more advanced. There are a lot of industries that the company that fails to adopt the newest and best technology falls behind and possibly even goes bankrupt. There is no where this is more apparent than the financial industry. The stock market has always been fast paced and has only become more fast paced with advances in technology. AI is another one of those advances that the last one to adopt will likely fall way behind the competition.

The stock market has gone through many different events in its history, with a few that have had a lasting effect on the industry as a whole. The first few are disasters with the first being Black Monday and Tuesday in October 1929, the start of the Great Depression. The second is also named Black Monday and took place in October but this time it was 1987. The third disaster is the not so long ago 2008 financial crisis. All three of these were not expected and led to different legislation that affected the industry greatly and still does.

The next few major events were technological advances. The first major event being the telegraph. This allowed for instant communication between parties. The second is the invention of the telephone. This allowed for instant conversations, not just quick messages back and forth. The third is computers. Computers allowed for much faster trading and live quote streaming. The final major invention that changed the stock market is the internet. Suddenly the consumer was able to bypass the broker-dealer and manage their own assets and make trades instantly. Many people thought the internet would be the last major technological change to affect the landscape of the stock market, but they were wrong. We are currently in the beginning of another with AI. There is a large change brewing in the finance industry, and this will have an impact like no other. All the other

events lead to an increased human role or more rules to follow. This evolution could result in a number of people in finance having their jobs forever changed by an AI of some sort. While the actual timeframe for this happening is likely a long way out, if it does happen, it will result in dramatic change. Change is coming to finance and those that fail to jump on the artificial intelligence train will likely be left behind.

Conclusion

In conclusion, the integration of artificial intelligence (AI) into finance represents a significant evolution in the industry, one that has been ongoing for years but is now accelerating rapidly. As explored in this paper, AI encompasses various forms and functions, from reactive machines to limited memory systems, and from narrow intelligence to the potential for superintelligence. These technologies are already reshaping how banking, business finance, and investing operate.

In banking, AI has been instrumental in bolstering cybersecurity and fraud detection, leveraging machine learning algorithms to continuously improve accuracy and efficiency. Similarly, in business finance, AI tools like chatbots and algorithms are streamlining processes, enhancing productivity, and reducing costs. Meanwhile, in investing, AI-driven solutions such as robo advisors are offering superior returns by leveraging data analysis and eliminating human biases.

However, while AI promises transformative benefits, it also raises questions about the future of human involvement in finance. While certain tasks may become automated, it's essential to recognize that AI cannot fully replace human judgment, especially in complex and nuanced decision-making scenarios. Moreover, the adoption

of AI represents a strategic imperative for financial institutions to remain competitive in a rapidly evolving landscape.

Looking ahead, the impact of AI on finance is poised to continue growing, potentially leading to profound shifts in how the industry operates. Whether it's adapting to new regulatory frameworks or harnessing the power of AI to drive innovation, organizations that embrace this technological revolution will likely thrive in the years to come.

In summary, the fusion of finance and artificial intelligence is not merely a trend but a fundamental transformation that demands attention and adaptation. As we navigate this new era, it's crucial to balance the opportunities of AI with a thoughtful consideration of its implications, ensuring that the future of finance remains both innovative and human centric.

Abstract:

The integration of artificial intelligence (AI) into finance represents a significant evolution in the industry, one that has been ongoing for years but is now accelerating rapidly. This paper explores the various forms and functions of AI, from reactive machines to the potential for superintelligence, and examines its impact on banking, business finance, and investing.

In banking, AI has bolstered cybersecurity and fraud detection, leveraging machine learning algorithms to continuously improve accuracy and efficiency. Similarly, in business finance, AI tools like chatbots and algorithms streamline processes, enhance productivity, and reduce costs. In investing, AI-driven solutions such as robo advisors offer superior returns by leveraging data analysis and eliminating human biases.

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Looking ahead, the impact of AI on finance is poised to continue growing, potentially leading to profound shifts in how the industry operates. Organizations that embrace this technological revolution will likely thrive, balancing the opportunities of AI with a thoughtful consideration of its implications to ensure that the future of finance remains both innovative and human-centric.

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