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## **The role of machine learning in advancing financial technology**

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Summary: Fintech or financial technology applies modern technology to financial services to improve or automate banking and investing activities. Machine learning is useful in parsing the immense amount of information that is consistently and readily available in the world to assist in decision making. In FinTech it is a critical enabler in tech-driven banking, where efficiency and innovation are key to staying ahead of the competition.

Keywords: financial technology, machine learning, trend.

The increasing digitization of the banking, financial services, and insurance (BFSI) industry across the globe is one of the crucial aspects propelling the growth of the market. According to market research, the global AI in fintech market saw a growth from \$9.15 billion in 2022 to \$11.59 billion in 2023, with a yearly growth rate of 26.8%.

The global AI in fintech market is expected to expand from USD 13,515.7 million in 2024 to USD 58,701.4 million by 2034, reflecting a robust compound annual growth rate of 15.9% [1].

AI in fintech is extensively used for operating virtual assistance, debt collection, sentiment and predictive analysis, reporting, and customer behavior analysis. It boosts efficiency, curtails the chances of human error and can process huge volumes of data in a short interval. Along with this, AI also helps in the automated and real-time examination of cash, credit, and investment accounts for evaluating the financial health of the individual and creating customized insights for forthcoming development.

Financial forecasting plays a vital role in planning the future of an organisation. Realistic financial predictions help businesses to align financial strategies with business objectives. And based on financial forecasts, businesses can assess investment opportunities, mitigate risks and optimise capital structure.

Historically, financial forecasting and analysis were predominantly qualitative, relying on small sample data and human expertise. The methods employed were largely based on fundamental and technical analyses, which involved scrutinizing financial statements and market trends to make predictions about future market behaviors. However, the advent of AI and ML has ushered in a new era, characterized by the processing of vast amounts of data and the application of sophisticated algorithms to uncover deeper insights and patterns [2].

In contrast to traditional methodologies, the AI-subset technology that powers automated financial forecasting, machine learning has emerged as a formidable approach in financial forecasting. The allure of ML lies in its capacity to handle vast datasets, discern intricate patterns, and adapt to the dynamic and non-linear nature of financial markets. Algorithms such as artificial neural networks, support vector machines, and decision trees have been deployed to augment predictive accuracy and

capture elusive market dynamics. ML techniques have demonstrated their capability to surpass traditional methods in several aspects of financial forecasting [4].

Table 1  
Anticipated Trends in AI and ML for Fintech

Trends in AI and ML for Fintech	Transformative Impacts on Fintech	Navigating Challenges
Advanced Fraud Detection	Enhanced Efficiency	Ethical Concerns
Personalized Financial Services	Improved Risk Management	Regulatory Alignment
Explainable AI	Data Security Advancements	
Regulatory Compliance Automation	Strategic Decision Support	Data Privacy
AI-Enhanced Customer Support	Financial Inclusion	Cybersecurity Risks
Algorithmic Trading Evolution	AI Ethics and Governance	
Blockchain Integration	Evolving Partnerships	
Note - reference [3]		

Machine learning works by extracting meaningful insights from raw sets of data and provides accurate results. This information is then used to solve complex and data-rich problems that are critical to the banking & finance sector. Machine learning can be applied in a variety of areas, such as in investing, advertising, lending, organizing news, fraud detection, and more.

Countless technological advancements such as the incorporation of fintech solutions with machine learning (ML), neural networks, big data, and evolutionary algorithms, are representing other growth-inducing aspects. These technologies offer enhanced supervising of financial transactions, risk management, speech recognition and secured network access to the banking institutions.

ML works with large data sets to identify trends and meaningful patterns. Moreover, algorithms analyse historical data, market trends and economic indicators at high speeds and with accuracy. They identify insights that might be missed by traditional analytics. These algorithms have a more nuanced understanding of an industry or the performance of a business.

Predictive Analytics, which is a subset of ML, forecasts future financial trends based on historical data. It provides insights that help the business to make informed assumptions about revenue projections, market share or risks. Natural Language Processing (NLP) is another critical technology that enhances financial forecasting. It sifts through large volumes of data in different formats to provide valuable insights to analysts. NLP can extract information from sources such as text reports, news stories, transcripts of audio and video clips, social media posts, etc.

Sentiment Analysis also plays a vital role in financial forecasting. This technology assesses the mood of the market participants by analysing positive/negative patterns in a commentary. The insights provided by sentiment analysis tools influence equity pricing.

Generative AI (Gen AI) is the newest technology that has made inroads in the financial realm. Gen AI in finance enhances risk management and fraud detection, facilitates personalised services, refines investment strategies and overcomes data limitations. This technology helps increase the diversity and size of datasets, which helps in training more accurate and robust ML algorithms. Gen AI automates the creation of comprehensive financial reports including income statements and balance sheets. It helps in simulations and scenario planning by generating synthetic data.

In recent years, deep learning (DL) has been the most popular computational approach in the field of machine learning (ML), achieving exceptional results on a variety of complex cognitive tasks, matching or even surpassing human performance. Deep learning technology, which grew out of artificial neural networks (ANN), has become a big deal in computing because it can learn from data. Deep learning models are a subset of machine learning models focused on allowing a model to design itself to extract features for the underlying task. It applies algorithms to immense data sets to

find patterns and solutions within the information. Deep learning models typically have three or more layers of neural networks to help process data (Figure 1).

These models have the ability to process data that's unstructured or unlabeled, creating their own methods for identifying and understanding the information without a person telling the computer what to look for or solve.

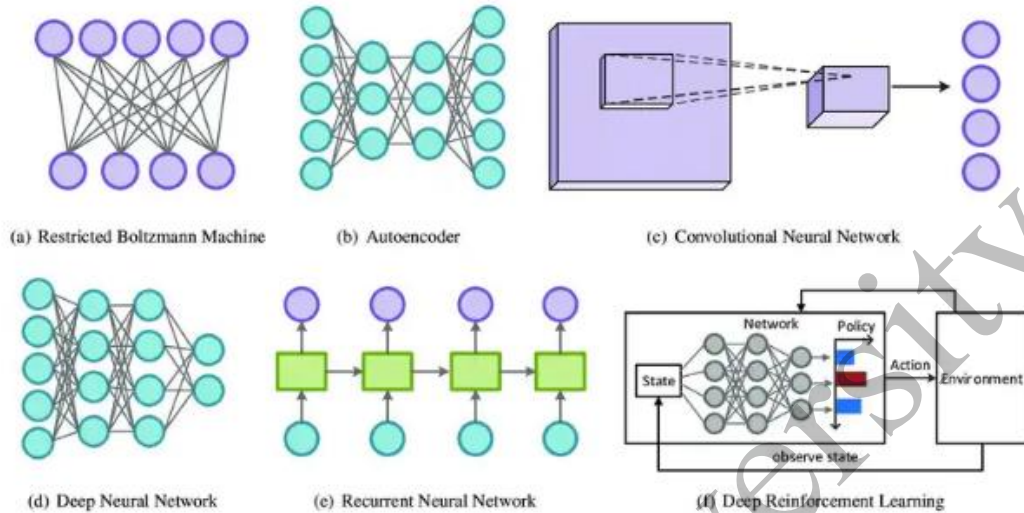


Figure 1. Deep learning models

Note - reference [5]

Selecting the appropriate DL model for financial applications depends on several factors, such as the nature of the data, the task at hand, and the desired trade-off between accuracy, interpretability, and computational efficiency. While some models, like FNNs, excel in static tasks like credit scoring, others, like RNNs and their variants (LSTMs and GRUs), are more suited to sequential data, such as stock price forecasting. Models like CNNs and GANs are better suited to specialized tasks like anomaly detection and synthetic data generation, respectively, [5].

Table 2  
Comparison of DL models in financial applications

Model	Advantages	Disadvantages	Suitable Applications
FNN	Simple, computationally efficient	Limited ability to handle sequential or unstructured data	Credit scoring, classification tasks
RNN	Handles sequential data, captures temporal dependencies	Susceptible to vanishing gradient problem	Time-series analysis, stock price prediction
LSTM	Overcomes vanishing gradient problem, handles long-term dependencies	Higher computational cost compared to RNN	Financial time-series analysis, anomaly detection
GRU	Simplified structure, faster training time than LSTM	May not capture long-term dependencies as well as LSTM	Predictive analytics, high-frequency trading
CNN	Effective for pattern recognition, robust to noise	Not designed for sequential data	Fraud detection, anomaly detection, pattern recognition
Transformer	Captures long-range dependencies, efficient parallel processing	Requires large datasets, computationally expensive	Sentiment analysis, market trend prediction
GAN	Generates realistic synthetic data, handles complex data distributions	Training instability, computational complexity	Synthetic financial data generation, stress testing, portfolio optimization

<b>Deep RL</b>	Optimizes dynamic decision making, learns from interaction with environment	Requires significant computational resources and training data	Trading strategy optimization, portfolio management
Note - reference [6]			

Machine Learning has a potential to play a crucial role in different aspects of the financial ecosystem from managing assets, assessing risks, providing investment advice, dealing with fraud in finance, document authentication and much more. While ML algorithms are dealing with a myriad of tasks, they are constantly learning from the volumes of data, and bridging the gap by bringing the world closer to a completely automated financial system [7].

Machine learning in FinTech can be also used in document management to automate tasks such as data extraction, classification, and validation, reducing manual effort and minimizing errors. By applying ML algorithms, FinTech companies can process large volumes of documents quickly and accurately, enabling more efficient workflows. Blockchain adds an extra layer of transparency and security by ensuring that all document interactions are immutably recorded, reducing fraud. Besides, financial institutions using machine learning can better detect and prevent fraud, tailor financial products to individual customer needs, and improve overall efficiency.

In conclusion, the integration of machine learning and AI technologies in fintech is revolutionizing the financial services industry by enhancing efficiency, improving decision-making, and driving innovation. The rapid growth of the AI in fintech market underscores its transformative impact, with technologies such as predictive analytics, natural language processing, and deep learning becoming essential tools in financial forecasting, risk management, and customer service. As these technologies continue to evolve, they promise to further automate financial operations, reduce human error, and enable more accurate insights, positioning fintech as a key player in reshaping the future of global financial systems.

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