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Article

Breakthrough Application of Machine Learning in Web3 Startups

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Abstract: With the rapid development of Web3 technology, AI has become the primary way of data analysis and automated decision making, and is being used by more and more Web3 startups. Although Web3 provides a new model for Internet applications with its decentralized approach, the complexity of the technology and market acceptance issues still hinder the development of startups. With its excellent data analysis and forecasting capabilities, AI can help Web3 startups optimize smart contracts, improve risk control capabilities in decentralized financial systems, and help make correct market price predictions in the NFT market. Through in-depth research on the association between artificial intelligence and Web3, and feasibility and effect evaluation on the application of both, this paper explains how artificial intelligence helps Web3 startups solve technical problems, reduce costs and improve operational efficiency, and puts forward the problems of resistance encountered by Web3 startups in the growth process. And promote the popularization and application of Web3 technology by discussing the new solutions that artificial intelligence technology can provide.

Keywords: machine learning; Web3; decentralized finance

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1. Introduction

Although Web3 technology is one of the future directions of the Internet, it aims to give users greater freedom of choice in the form of decentralization. However, there are still many challenges for Web3 startups, such as the complexity of the technology, the need for high computing power, and the acceptance of the market. On the other hand, with the powerful techniques of machine learning, dealing with these challenges is becoming increasingly handy. By making accurate predictions on massive amounts of data, machine learning can help Web3 startups optimize smart contracts, improve risk management for decentralized financial systems, and explain market conditions for non-homogeneous tokens (NFTS). The purpose of this article is to analyze the novel uses of machine learning for Web3 startups, their impact on technological advances, cost savings, and improved business efficiency, and how machine learning can be used to overcome the technical and market challenges Web3 startups face in their development [1].

2. Conceptual Deconstruction and Basic Theory

2.1. Definition and Core Concepts of Web3

Web3 is a network structure developed on the basis of the Web, its core is based on the application of blockchain technology, the purpose is to use a decentralized method to re-comb the basic architecture of the Internet, so that users can regain their own information on the Internet. Decentralized, user autonomous, open and transparent, immutable, and smart contracts are the core elements of Web3. In the Web3 system, the information is not in the centralized storage server, but distributed information is stored

on each node of the network through the way of blockchain, so that users can directly control their own information, no longer need to intermediate third party Internet service platform. In one sentence, the concepts of Web3 are: decentralization, identity, smart contracts, and cryptocurrencies. In the decentralized network of Web3, everyone has the opportunity to participate in the governance of the network without the need for a third-party service platform. The identity can be authenticated by the digital ID card in the blockchain; Smart contracts can automate the execution of contract terms and enable fair and stable transactions; Cryptocurrencies provide an entirely new economic system to support the flow of value in the Web3 network. web3 aims to remove the middleman role on traditional platforms, build a more fair, transparent, secure, and private online world, and provide a platform for decentralized applications (dapps) to promote blockchain [2].

2.2. Basic Concepts and Technical Framework of Machine Learning

Machine learning, as a fundamental skill, is applied to the field of computing, mainly through data-driven ways for computers to learn to find patterns and make predictions on their own. It is learning to build a model based on the given data, and based on this model, it can infer or classify unknown situations that may be encountered in the future. Machine learning generally falls into three broad categories: supervised, unsupervised, and reinforcement learning. Machine learning includes data cleaning, feature engineering, model selection, model training and model evaluation. The specific process is as follows: (1) The stage of data cleaning and conversion to improve data quality is the data preprocessing link; (2) The process of improving the accuracy of modeling according to the corresponding characteristics of task mining, that is, the feature engineering stage; (3) The process of selecting algorithms and training models, that is, the process of model selection and training; (4) The evaluation of model performance and the improvement of the model, that is, the evaluation and improvement of the model [3].

Figure 1 shows the basic flow of machine learning, from data preprocessing to feature engineering, to model selection and training, and finally to evaluation and optimization. Each step relies on the output of the previous step to ensure that the model can efficiently extract information from the data, ultimately improving the accuracy of the prediction.

Figure 1. The basic flow of machine learning.

2.3. Integration of WEB3 and Machine Learning: Exploring the Intersection

Machine learning DApps based on Web3 realize innovation under the new framework and provide distributed data source from Web3 for data storage and processing; In addition, through the technology of machine learning, this novel data source can be used to drive the development of machine learning for Web3 applications. Especially in the scope of blockchain, the characteristics of data that is difficult to change and highly transparent provide a certain data foundation for machine learning models. In the Web3 environment, the decentralized economic collaboration model and smart contracts allow us to share and collaborate on data when using machine learning models. For example, with a federated learning approach, machine learning models deployed on different nodes can train collaboratively without directly interacting with raw data, and benefit from richer multidimensional datasets. Similarly, in decentralized financial Markets (DeFi), we use machine learning to predict market conditions, assess trading risk, and improve trading strategies. In decentralized authentication scenarios, we use machine

learning to efficiently and accurately detect abnormal behavior, thereby improving the security of the system [4].

Table 1 shows the combination of Web3 and machine learning in four main application areas. By combining machine learning, Web3 is able to provide smarter functionality in areas such as decentralized finance, data privacy protection, identity authentication, and smart contract optimization, thereby improving its overall performance and security.

Table 1. Application fields of Web3 combined with machine learning.

Application field	Web3 function	Machine learning function	Combination mode
Decentralized Finance (DeFi)	Decentralized trading, smart contracts	Market forecast, trading strategy optimization, risk assessment	Machine learning provides market forecasting and automated decision support in DeFi
Data privacy protection	Anonymity, data encryption	Data security analysis, anomaly detection	Machine learning enhances data privacy and security in Web3
Decentralized identity authentication	Decentralized authentication, blockchain certificates	User behavior analysis, identity fraud detection	Machine learning helps verify and identify the security of decentralized identities
Smart contract optimization	Smart contract execution and verification	Automate policy and contract vulnerability detection	Machine learning optimizes smart contract execution and vulnerability detection

3. Obstacles for Web3 Startups

3.1. Technical Complexity and System Integration Difficulties

In Web3 startups, the complexity of technology and the integration of systems creates bottlenecks. Web3 technology involves the capability requirements of many specialized technologies such as blockchain, decentralized storage, smart contracts, and cryptography, each of which requires developers to have the development capabilities of multiple specialized technologies and accurate architecture design. For example, decentralization means to cancel the traditional centralized management model, distributed ledger, smart contracts, and solve the unity of each node, which is a great challenge to research and development work. On the other hand, because blockchain systems are limited by their own performance, massive amounts of data and smart contracts sometimes face efficiency problems. The consensus algorithms of the blockchain itself, such as proof of work (Pow) and proof of stake (Pos), occupy a lot of computing power and restrict the TPS and concurrency of the Web3 platform. In addition, smart contracts may be limited by resource competition and execution time delays during execution, which will also lead to reduced system efficiency [5].

3.2. Calculation of Cost and Resource Requirements

Due to the high computing cost and huge resource consumption in the process of technology implementation, blockchain technology based on consensus algorithms such as proof of work (Pow) usually requires huge computing resource consumption, and each node must constantly perform calculation, transaction confirmation and consensus calculation. The calculation and operation requirements of nodes are high. As distributed

networks continue to expand, computing tasks increase exponentially, resulting in increasingly high operating costs. In addition, since Web3 is decentralized, all nodes have the potential to participate in processes such as the execution of smart contracts and transaction confirmation. The data that Web3 needs to process must have more computing power than traditional centralized systems to cope with the massive amount of transaction information and smart contract execution. Each transaction activity and the execution of smart contracts must be implemented through a distributed network of nodes, so the computing power and storage capacity of each node are relatively high, which leads to the huge computing cost of Web3 system. Calculation cost C can be estimated by the following formula:

$$C = N \times (P \times H + S) \quad (1)$$

Where, N is the number of participating nodes, P is the processing capacity of each node, H is the unit price of processing capacity, and S is the storage cost of each node.

3.3. Market Acceptance and User Education

Although Web3 technology has many advantages such as decentralization, self-managed data, privacy protection, etc., it is difficult to achieve large-scale user popularity and use, because most users do not understand the core Web3 concepts, such as blockchain, smart contracts, storage and cryptocurrency, etc., making it confusing and uncomfortable in use. Especially in DeFi, crypto and other fields, consumers need to know how to set up digital wallets, how to handle private keys, how to identify crypto asset risks and other knowledge. Therefore, Web3 startups need to invest a lot of manpower and educate consumers, which is a serious challenge for Web3 startups. In addition, consumer awareness of privacy protection is also a difficult factor in the promotion of Web3 applications. While the decentralized nature of Web3 allows its users to enjoy a higher level of privacy, guiding and getting them to trust this new technology is still a problem that needs to be solved.

Figure 2 shows the educational difficulty of different types of users, indicating that it is easier for users with strong technical background to learn Web3 technology, while the general public faces a higher learning threshold.

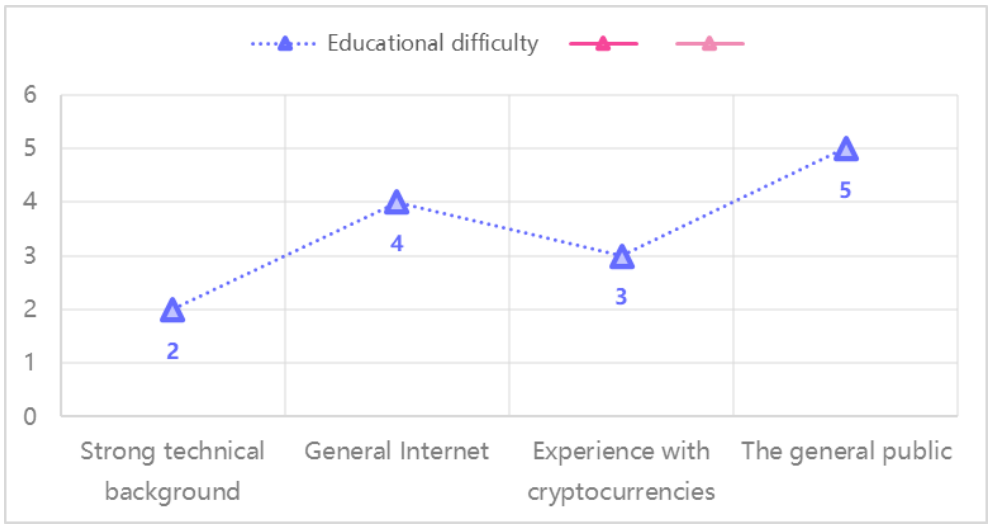

Figure 2. Educational difficulty of different user groups.

4. Breakthrough Application of Machine Learning in Web3 Startups

4.1. Smart Contract Optimization and Automation

As the underlying technology of Web3, smart contracts are rapidly disrupting the application model of decentralized applications (DApps). It is a programmed, self-executing protocol that performs the work itself through an agreed code of conduct,

reducing the involvement of the middleman and improving efficiency and transparency. However, in the actual use of smart contracts, there will inevitably be programming errors, slow operation, and poor security defects. Machine learning (ML) can provide fully automated solutions to overcome these deficiencies. The application of machine learning in smart contracts is mainly concentrated in the following four application areas: (1) Automated operation of smart contracts. By deploying machine learning models, Web3 startups can achieve higher operating efficiency and better results in the execution of smart contracts; (b) Smart contract vulnerability detection, through the deployment of machine learning algorithms, can uncover vulnerabilities or hidden risk factors from the historical contract execution process; (c) By deploying deep learning technology to predict and protect against insecure threats during the execution of smart contracts; (d) Through the deployment of machine learning, realize the parameter debugging of smart contracts, enhance contract performance, machine learning can analyze the path of contract execution, and automatically optimize the deployment of computing resources within the contract according to the path characteristics, reduce unnecessary computing costs, improve execution efficiency.

Figure 3 shows the optimization flow of machine learning in smart contracts. First of all, machine learning extracts key features by collecting and analyzing smart contract data, and then optimizes the contract with the trained model, and finally realizes the performance improvement and automation of the execution efficiency of the smart contract.

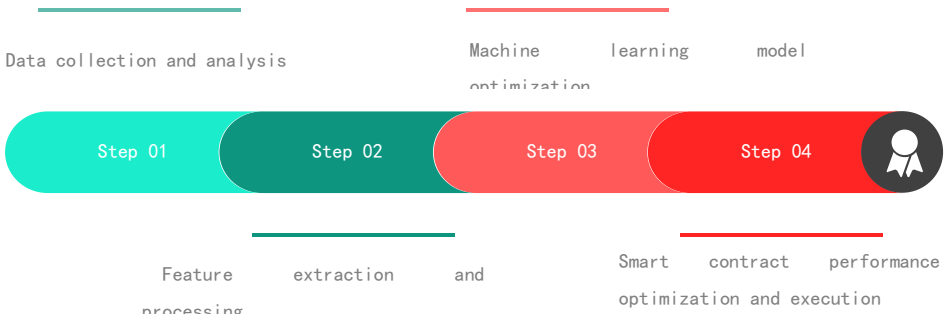

Figure 3. Smart contract optimization and automation processes.

4.2. Risk Management of Decentralized Finance (DeFi)

Decentralized finance (DeFi) centralizes the entire financial system, providing a way to provide financial services such as lending, buying and selling, and insurance without intermediaries. But decentralization also brings security threats, market volatility and liquidity issues. With machine learning, we can use a lot of past information to help identify these problems and deal with them. For example, machine learning is used to predict market conditions, user behavior, and past price fluctuations to assist DeFi products in the possibility of risk. For example, using regression analysis or time series of machine learning to predict the market of digital assets can assist DeFi financial institutions to make effective risk management quickly. How to control and manage the crisis of liquidity is the key to DeFi, because it may lead to large fluctuations in asset values. Machine learning techniques can predict liquidity crises from liquidity and trading behavior in various markets and provide recommendations on how to govern liquidity pools. In addition, machine learning can also build a quantitative model to measure the credit risk of borrowers based on the borrower's past behavior records and rating scores, which is very necessary for the lending platform in DeFi, which can help them timely adjust interest rates or reduce credit risk strategies. DeFi risk prediction model formula:

$$R_t = \alpha \cdot X_t + \beta \cdot Y_t + \gamma \cdot Z_t + \in_t \quad (2)$$

Where: R_t is the predicted risk value at time t, X_t is the historical market data feature, Y_t is the user behavior data, $Z_t$is the liquidity index, α, β, γ is the weight coefficient of the model, and $\in_t$ is the error term.

4.3. Non-Homogeneous Token (NFT) Market Analysis and Forecast

As one of the highlight technologies of Web3, NFT is gradually applied in digital art, collectibles, games and other aspects. However, due to the high growth of the NFT market in recent years, its market value is variable and complex, which makes it more necessary to use machine learning methods to explore and predict. NFT market analysis based on machine learning can be shown from the following perspectives: (1) NFT price prediction, the use of historical price data and market intelligence and other information, the use of machine learning technology commonly used linear regression, support vector machine (SVM) and neural network algorithms, can provide investors with decision-making reference. (2) User behavior analysis. Machine learning can find possible rules and needs by analyzing users' past behavior of purchasing NFT. For example, for classification research, machine learning can detect potentially valuable NFT types and creators to help them make investment decisions. (3) Sentiment analysis of social media data, posts and discussions, and machine learning can help NFT platforms predict changes in market sentiment and optimize marketing strategies.

Table 2 shows the application of machine learning to NFT market analysis, covering price forecasting, user behavior analysis, and market sentiment analysis. Using methods such as historical data analysis, cluster analysis, and sentiment analysis, machine learning helps predict price movements, identify potential trends, and assess market sentiment.

Table 2. Application of machine learning in NFT market analysis.

Application field	Machine learning method	goal	Primary data source	Correlation algorithm
Price forecast	Historical data analysis, regression analysis	Forecast NFT price movement	Historical transaction data, market transaction records	Linear regression, SVM, neural networks
User behavior analysis	Cluster analysis, behavior analysis	Identify potential trends and discover high-value NFT categories	User purchase history and transaction records	K-means clustering, decision tree
Market sentiment analysis	Emotion analysis, text mining	Assess market sentiment and predict market fluctuations	Social media comments, forum discussions, news articles	Natural language processing (NLP), sentiment analysis

5. Conclusion

By observing the practical application of machine learning in Web3 startups, machine learning is used to improve smart contracts, decentralized financial risk control and NFT market prediction to carry out new applications, which has injected a strong impetus to Web3 technology. This can make the system more efficient and secure, and at the same time guide Web3 startups to provide more effective and accurate decision data to a greater extent, so that startups can make more rational decisions in the case of technical difficulties and market fluctuations. The development path of Web3 startups is very long, and they need to overcome technical difficulties, financial difficulties, and market education difficulties, but the introduction of machine learning is undoubtedly a help to

promote the development of Web3 technology and its practical application. As machine learning continues to improve and optimize, the importance of machine learning in the development of Web3 technology will be further realized, and can help Web3 startups solve more complex practical problems, while enabling the entire decentralized ecosystem to flourish. In the future, the integration of machine learning and Web3 will further promote the digital process and help the development of scientific and technological innovation around the world.

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