Guest Editorial: Special Issue on Big Data and Computational Social Intelligence for Guaranteed Financial Security

THE innovations in technologies have led to the emergence of digital finance such as online payment, online insurance, online lending, and supply chain finance. Digital finance has greatly facilitated people's lives, accelerated the circulation of capital in various fields, and enhanced the vitality of financial markets. However, it exposes many increasing risks and hidden dangers such as stock volatility, trading fraud, credit card fraud, and privacy leakage [1], [2], [3], [4], [5], [6], [7]. How to effectively calculate, control, manage, and utilize financial big data and make full use of artificial intelligence technology to ensure financial security is an important research question. Solving it faces many challenges. These challenges not only include the complexity of data and computation but also the effectiveness of intelligent optimization algorithms and ways to deal with human behaviors and social environments [8], [9].

This Special Issue aims to explore a wide range of issues related to financial security. The central theme of the Special Issue is Big Data and Computational Social Intelligence for Guaranteed Financial Security, paying close attention to artificial intelligence, digital currency, blockchain, fraud detection and control, as well as other studies and applications closely related to financial security. Important research directions are as follows.

1) Data mining and knowledge automation for financial security.
2) Financial risk assessment and forecastings such as stock forecasting and online lending.
3) Privacy protection technology for financial security.
4) Threat models and attack techniques to finance.
5) Blockchain and digital currency.
6) Legal, ethical, and societal aspects of digital currency,
7) Regulatory technologies and policies for digital finance.
8) Storage security and high-performance computing of financial big data.
9) Prevention of financial crimes such as transaction fraud, money laundering, illegal financing, and tax evasion.

What Do We Cover in This Special Issue?

In this Special Issue, 14 papers have been accepted. Six of them are about financial fraud detection such as credit card fraud detection and loan fraud detection, two about stock risk, two about financial blockchain, two about credit scoring, one about wash trading identification, and one about the privacy protection of credit card transactions. The intelligent techniques involved in these papers include deep learning, ensemble learning, federated learning, semi-supervised learning, support vector machine, and so on.

In [A1], Nti and Somanathan design an ensemble machine learning framework including extreme gradient boosting and random forest in order to detect financial frauds. The experimental results on the IEEE-CIS fraud detection benchmark dataset illustrate that this framework can yield accurate detection results with the desired scalability and robustness.

In [A2], Yu et al. establish a business process model of business-to-customer e-commerce by incorporating the detection of user behaviors into it. The user behavior detection module is a support vector machine-based classifier that is learned through a big dataset of event logs of e-commerce. This method can well capture the dynamic changes of fraud transactions.

In [A3], Wang et al. develop a deep-learning-based attack detection system for decentralized finance, including flash loan attack detection and price manipulation attack detection. They collect 50 910 real-world decentralized financial transactions on Ethereum to form a dataset, and their system can obtain the desired detection result on this dataset. They design a novel neural network including a global model, a local model, and a fusion model to characterize these attacks, which ensures the fine detection result.

In [A4], Zhang et al. create two models, one is called the transaction character model based on a user's historical normal interaction behavior data to reflect the user's behavioral psychology, and another is called a user behavior benchmark based on the user's historical normal transaction behavior data to reflect the user's behavior pattern. They are integrated by the least-squares generalized inverse method and used to identify the fraudulent behavior effectively.

In [A5], Teng et al. design a generative adversarial network (GAN)-based method to detect online banking fraud, while one of the biggest challenges posed by this problem is the extremely imbalanced data. In their method, a fraud detection model is first pretrained by using the data generated by the generator and then the model is fine-tuned by using transfer learning on real-world datasets, addressing data imbalances well. The experimental results on two real-world bank datasets show the advantage of their method. In [A6], Ni et al. also focus on the imbalanced data problem of credit card fraud detection. Different from [A5], it makes full use of

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effective data features and then a spiral oversampling balancing technique is designed to handle this problem. Extensive experimental results on two real-world datasets demonstrate that this method can well identify credit card fraud cases.

In [A7], Wang et al. construct a new jump model to investigate the impacts of monetary policies on the jump risk of the Chinese stock market, and to investigate the interaction effect of monetary policy and investor sentiment on the jump intensity. This study shows that the announcement of an interest rate policy has a significantly positive effect on it, while the effects of the announcement and implementation of a required reserve ratio policy are not significant. Thus, it is of guiding significance for policymakers and investors to fully learn the time-varying volatility and jump risk of stock markets. In [A8], Yan et al. construct a return-on-equity network for portfolio optimization and successfully apply it to the Chinese stock market. This network can be used to obtain great optimization performance and high return-risk efficiency.

In [A9], Zhang et al. designed a cross-chain digital asset system for secure trading and payment. They build two parallel chains, i.e., digital asset chain and payment chain, and then a cross-chain to realize cross-chain interoperability. The cross-chain message format and authority setting are designed to endow parallel chains with the ability to recognize, and the decentralized characteristic of the cross-chain allows cross-chain messages to be safely transmitted to ensure secure trading and payment. The experimental results show that this system can provide more secure trading and payment than its peers. In [A10], Saba et al. also focus on the blockchain technique in financial data. Different from the work in [A9], their work designs a blockchain-based protocol for financial data transmission. This protocol can be used to provide data integrity with a high level of network availability and cope with the financial security of big data by investigating cryptographic approaches.

In [A11], Guo et al. focus on the credit scoring issue of post-loan. Traditional credit scoring methods tackle this issue by assuming that the missing labels for rejected samples are missing at random and by measuring sample similarity directly in the original feature space. They find that this assumption is unreasonable and thus propose a novel credit-scoring model inspired by metric learning and transductive learning. They mathematically prove that their model is equivalent to the unbalanced label propagation algorithm (LPA) while surpassing LPA in terms of generalization capability and computational efficiency. The experimental results indicate the advantages of their method. In [A12], Zhao et al. present a capsule network-based method to score the credibility of users on the basis of the data of social networks. They extend the traditional single-interest representation to user multi-interest embedding for their capsule network, which alleviates the noise in social networks and user data sparsity problems.

In [A13], Tahmasbi et al. propose a method to find the closed cycles in transaction graphs in order to identify potential wash trading cases at four different levels, breaking the traditional single-level identification limitation and thus obtaining a fine result. This method is applied to Nifty Gateway, one of the largest nonfungible token markets.

In [A14], Qiao et al. propose a privacy-aware and incremental defense method against GAN-based poisoning attacks in federated learning. They use multiple trust domains to reduce the rate of misjudging benign participants as adversaries and differentiated differential privacy is utilized before the global model sending to protect the privacy of participants' training datasets. The experimental results on the dataset of European Credit Card Transactions show that this method can detect malicious participants well and protect privacy.

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APPENDIX: RELATED ARTICLES

[A1] I. K. Nti and A. R. Somanathan, "A scalable RF-XGBoost framework for financial fraud mitigation," *IEEE Trans. Computat. Social Syst.*, vol. 11, no. 2, pp. 1556–1563, Apr. 2024.

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[A14] F. Qiao, Z. Li, and Y. Kong, "A privacy-aware and incremental defense method against GAN-based poisoning attack," *IEEE Trans. Computat. Social Syst.*, vol. 11, no. 2, pp. 1708–1721, Apr. 2024.

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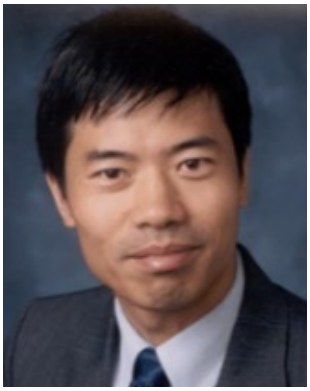

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