Lecture Notes in Networks and Systems 541

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The International Conference on Deep Learning, Big Data and Blockchain (DBB 2022)

Springer

Lecture Notes in Networks and Systems

Volume 541

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ISSN 2367-3370 ISSN 2367-3389 (electronic)
Lecture Notes in Networks and Systems
ISBN 978-3-031-16034-9 ISBN 978-3-031-16035-6 (eBook)
https://doi.org/10.1007/978-3-031-16035-6

This Springer imprint is published by the registered company Springer Nature Switzerland AG
The registered company address is: Gewerbestrasse 11, 6330 Cham, Switzerland

Preface

It was a great pleasure to welcome all the participants of the 3rd International Conference on Deep Learning, Big Data and Blockchain (DBB 2022). The conference was held during August 22–24, 2022, in the historic city of Rome, Italy. Rome is one of the World Heritage sites, which attracts millions of visitors from all over the world. It is full of museums, squares, Roman landmarks and sights and other attractions such as shopping areas and restaurants.

The DBB 2022 conference involved hard work, time and commitment from the conference organizing and technical committees. The goal was to provide participants with an opportunity to share and exchange ideas on different topics related to the conference's theme, including machine/deep learning, blockchain, big data and their integration in modern applications and convergence in new and emerging research and development areas.

The call for papers of the conference included innovative and timely topics in the aforementioned areas and their sub-topics, such as learning-based models; clustering, classification and regression; data analysis, insights and hidden pattern; blockchain protocols and applications; verification; security and trust; and applications of deep learning, blockchain and big data in areas such as business, finance and healthcare among others. Blockchain and smart contract tools and methods are increasingly used in new and emerging systems to ensure transparency of data and transactions. For instance, machine learning techniques have been used by businesses in order to analyze a large volume of (big) data and to identify useful patterns in the data so that they can be used for purposes of intelligent and timely decision making.

The conference technical committee created a fascinating technical program to provide a forum where participants could present, discuss and provide constructive feedback on different aspects of deep learning, big data and blockchain.

Though the ongoing pandemic has affected the number of submissions, the DBB conference has attracted many good-quality papers from different countries worldwide. The conference followed a rigorous review process wherein all submitted papers were reviewed by multiple members of the technical program

committee. Based on the reviews, ten papers were accepted for the conference, which gave an acceptance rate of 34% of the total submissions.

The accepted papers included interesting work on different topics such as deep learning and biologically inspired methods; security, privacy and trust; blockchain algorithms and protocols; smart contracts; re-enforcement learning; smart video surveillance systems; identifying illicit accounts; and stake consensus protocol. The papers also included work on practical applications such as clinical trials, crime detection, and financial applications and transactions.

We sincerely thank all the members of the program committee who have spent their valuable time reviewing the submitted papers and providing useful feedback to the authors. We were also thankful to all the authors for their contributions to the conference.

We were grateful to the conference organizers: General Chair, Prof Salima Benbernou; Workshop Coordinator, Dr. Filipe Portela; Publicity Chair, Dr. Mourad Ouziri; and Journal Special Issue Coordinator, Prof Natalia Kryvinska.

We sincerely thank Springer's team for the time and support they provided throughout the production of the conference proceedings.

August 2022

Irfan Awan
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Blockchain and Applications

Apply Trust Computing and Privacy Preserving Smart Contracts to Manage, Share, and Analyze Multi-site Clinical Trial Data

Yusen Wu[1,2(✉)], Chao Liu[2], Lawrence Sebald[2], Phuong Nguyen[1,2], and Yelena Yesha[1]

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Abstract. Multi-site clinical trial systems face security challenges when streamlining *information sharing* while protecting patient privacy. In addition, patient enrollment, transparency, traceability, data integrity, and reporting in clinical trial systems are all critical aspects of maintaining data compliance. A Blockchain-based clinical trial framework has been proposed by lots of researchers and industrial companies recently, but its limitations of lack of data governance, limited confidentiality, and high communication overhead made data-sharing systems insecure and not efficient.

We propose Soteria, a privacy-preserving smart contracts framework, to manage, share and analyze clinical trial data on fabric private chaincode (FPC). Compared to public Blockchain, fabric has fewer participants with an efficient consensus protocol. Soteria consists of several modules: patient consent and clinical trial approval management chaincode, secure execution for confidential data sharing, API Gateway, and decentralized data governance with adaptive threshold signature (ATS). We implemented two versions of Soteria with non-SGX deploys on AWS blockchain and SGX-based on a local data center. We evaluated the response time for all of the access endpoints on AWS Managed Blockchain, and demonstrated the utilization of SGX-based smart contracts for data sharing and analysis.

Keywords: Permissioned Blockchain · Healthcare · Smart contracts · Clinical trials · Patient consent

1 Introduction

Clinical trials are experiments done in clinical research (e.g., to determine the safety or effectiveness of drugs) that involve human subjects. Centralized clinical trial systems are commonly used but insecure and inefficient when managing and

I. Awan et al. (Eds.): DBB 2022, LNNS 541, pp. 3–14, 2023.
https://doi.org/10.1007/978-3-031-16035-6_1

sharing data across multiple disparate organizations, and it is difficult without compromising patient and data privacy. In addition, patient enrollment, data confidentiality, and privacy, traceability, data integrity, and reporting in centralized systems are all critical aspects to maintain data compliance. Traditional solutions use informed consent [7] or electronic consents (E-consents) to create a process of communication between patients and health care providers that often generates agreement or permission for care, treatment, or services. As every patient owns the right to ask questions or get all sensitive information before treatment, current electronic documents, such as E-consents, are just electronic paperwork where the centralized signatures can lead to a lack of traceability and trustworthiness. Furthermore, multiple parties, such as hospitals, can not audit consents stored in electronic medical records (e.g., EMRs [13]), and also the clinical research generally is managed in local systems, such as REDCap [8].

Permissioned Blockchain, such as Hyperledger Fabric [12], is a shared, immutable ledger that facilitates the process of recording transactions and tracking assets in a decentralized network. Its advantages of immutability, visibility, and traceability bring unprecedented trust to sensitive data, for example, recording medical transactions in a multi-copy, immutable ledger shared with different organizations. In fact, Blockchain has seen adoption by a wide range of applications and uses in healthcare recently, such as Akiri [1], BurstIQ [3], Factom [5], etc. These applications have implemented different types of functions in healthcare with both public and permissioned Blockchain, for example, keeping a decentralized and transparent log of all patient data in permissioned Blockchain to share information quickly and safely or verify the sources and destinations of data in real-time.

Leveraging Blockchain technology for informed consent processes and patient engagement in a clinical trial pilot is a new research field that is recently being proposed [23,28,29]. The rationale for the use of Blockchain technologies is to give patients control over who can access their data and when the consent expires. The innovation here is to surface data ownership, increase data confidence and prevent the leakage of sensitive information. Current work, however, has at least the following limitations:

(L1): **Heavy communication overhead**. Some patient consents and clinical trials are stored in a public Blockchain, such as Ethereum. The patient consents in a public Blockchain are shared with all the organizations or users of that Blockchain transparently; sensitive data must be encrypted via cryptographic functions and only the user who gets the private key can access the *ciphertext*. These public Blockchains could have the most negative impact on data sharing, their limited scalability and speed are core limitations. A public Blockchain network typically requires all the nodes to validate transactions; the consensus and validation of all the nodes in a network increase the usage of storage, bandwidth, and communication costs.

(L2): **Limited confidentiality for public smart contract**. The advantages of using a permissioned Blockchain to store patient data are explicit. For example, as a new member needs to be invited and approved by a plu-