

EDUCATION

M.Sc. (*August 2018 - Present*)

Major: Cyberspace Security, *School of Cyber Engineering, Xidian University* (211 university)

Average score: 85.55%

Supervisor: Prof. Qingqi Pei

B.E. (*September 2014 - June 2018*)

Major: Information Security, *Software College, Northeastern University* (Double First-Class university, 985 university)

Average score: 83.31%

Supervisor: Prof. Yuan Liu

RESEARCH INTEREST

Blockchain Content Retrieval, Data Structure Optimization in Blockchain

PUBLICATIONS AND PATENTS

Qingqi Pei, **Enyuan Zhou***, Yang Xiao, Deyu Zhang, and Dongxiao Zhao, "An efficient query scheme for hybrid storage blockchains based on Merkle semantic trie," *2020 39th International Symposium on Reliable Distributed Systems (SRDS)*, accepted on July 2020 (Best paper runner up award, CCF B) (*Enyuan Zhou is corresponding author).

Zhihui Wu, Yang Xiao, **Enyuan Zhou**, Qingqi Pei, and Quan Wang, "A Solution to Data Accessibility Across Heterogeneous Blockchains," *IEEE International Conference on Parallel and Distributed Systems (ICPADS)*, accepted on October 2020 (CCF C).

Qingqi Pei, **Enyuan Zhou**, Dongxiao Zhao, and Jingwei Li, "Blockchain-based distributed file indexing system and method, cloud storage server," Chinese patent, submitted in April 2019.

AWARDS AND HONORS

The Outstanding Graduate Student Honor, Xidian University (*October 2020*)

The Outstanding Postgraduate Cadre, Xidian University (*October 2020*)

National scholarship, Xidian University (*September 2020*)

First-class Academic Scholarship, Xidian University (*December 2019*)

The Outstanding Graduate Student Honor, Xidian University (*November 2019*)

Third place in the first financial technology competition of WeBank, Shenzhen (*August 2019*)

EXTRACURRICULAR ACTIVITIES

Team Leader, Visit to Old people's Home, Jinan (*July 2014*)

- Taught members cooking skills
- Helped the elderly clean up their institutions

Member, Food Quality Committee, Northeastern University (*October 2014 - July 2015*)

- Inspected the school canteen and collected students' opinions

Director, Alma mater publicity activities, Jinan (*July 2016 - August 2016*)

- Contacted the school manager
- Made plans for the speech

Member, School situation reflection organization, Xidian University (*September 2018 - November 2020*)

- Collected opinions on students' life
- Communication and feedback with school leaders

CURRENT PROJECT

Content Retrieval in Hybrid Storage Blockchains (*March 2019 - Present*)

- **Motivation:** With the prevalent of blockchain technology in various application scenarios, large volumes of valuable data are stored on the blockchain. Currently, the most popular blockchains, like Storj and IPFS, adopt hybrid data storage architectures that combines on-chain data with off-chain storage. Unfortunately, most existing content retrieval schemes for blockchain are designed only for on-chain data and the relevance between on-chain and off-chain data are not taken into consideration. Therefore, it is of great significance to design efficient content retrieval algorithm for real-time search of on-chain and off-chain data on blockchains with such hybrid data storage architectures.
- **Solution:** Considering the real-time search of on-chain and off-chain data, there are three challenges: (1) it is difficult to determine the association rule between on-chain and off-chain data; (2) traditional blockchain systems do not support the function of fast retrieval; (3) the append-only data structure of blockchain requires the highly time-consuming process of traversing the entire blockchain when undertaking one search. In order to deal with these challenges, one solution based on a novel index structure, namely merkle semantic trie, is put forward. Firstly, an improved TF-IDF model is used to extract the semantic information of off-chain data. The extracted semantic information together with the addressing structure of off-chain data are stored on the chain in a transactional manner. By this way, the relationship between on-chain and off-chain data can be established. Then, an index structure, called merkle semantic trie (MST), is constructed by the inverted index on the blockchain, hash pointer and B + tree. This serves as a basic foundation for fast retrieval of the semantic information of off-chain data. Lastly, let the newly constructed index structure be stored in the latest block. The main advantage of this is that users only need to use the index structure in the latest block to perform a full-chain search. In addition, a fast verification of the search results is also supported by this solution.
- The research outcome of this project has so far resulted in the following paper:
Qingqi Pei, **Enyuan Zhou***, Yang Xiao, Deyu Zhang, and Dongxiao Zhao, "An efficient query scheme for hybrid storage blockchains based on Merkle semantic trie," *2020 39th International Symposium on Reliable Distributed Systems (SRDS)*, accepted on July 2020 (CCF B).

UNDERGRADUATE GRADUATION PROJECT

Performance Optimization for Public Blockchain Systems (*September 2017 - June 2018*)

- **Motivation:** With the dramatic increase of transactions, the problem of low transaction efficiency in public blockchain systems has become more obvious. Long transaction confirmation times and low transaction throughput have led to poor availability of blockchain systems. The reason for this mainly comes from the underlying on-chain data structure and the inefficient consensus mechanisms. Thus in this work, I have tried to solve the problems of long blockchain transaction confirmation time and low transaction capacity per unit time.

- **Solution:** The bottleneck of the transaction efficiency of the blockchain is mainly reflected in the blockchain's chain data structure and the consensus mechanism of the proof-of-work(POW). The chain data structure causes all transactions to be on the same chain, which is difficult to process. At the same time, the POW mechanism takes a lot of time to confirm and verify transactions. Aiming at the efficiency bottleneck of the blockchain, it is necessary to optimize both the data structure and the consensus mechanism. In terms of data structure, the chain connection structure between blocks has been changed to a directed acyclic graph (DAG) connection structure, so that transactions on different nodes can be concurrently performed to improve transaction throughput. In terms of the consensus mechanism, a main chain consensus mechanism is designed to replace the proof-of-work mechanism. Here, the double spend problem is solved through the pointing sequence and timestamp in the directed acyclic graph, ensuring fair transactions and reducing transaction verification time.

ENGINEERING EXPERIENCE

Social governance system based on blockchain

- A blockchain system is used to implement a social governance system. The underlying platform is built using the FISCO-BCOS alliance chain, and the identity information is uploaded to the chain after the face recognition of the snapshot machine to achieve distributed identity authentication. Using solidity smart contract to provide incentive mechanism to achieve user behavior governance, zero-knowledge proof and secure multi-party computing (MPC) to achieve secure sharing of data in the system, providing web services through SpringBoot, and the automatic deployment and operation and maintenance management of distributed applications are realized through docker technology.

University blockchain experimental platform

- Designed an online blockchain experimental platform for college students. The underlying platform adopts OpenStack architecture and combines KVM, libvirt and other virtualization technologies to provide students with dynamic customized virtual machine instances in the background. The front end provides students with two experimental environments. The first is web-ide, which can be used for online solidity smart contract compilation and debugging, the second is a private blockchain environment construction experiment, students can use VNC to manipulate the command line to conduct private blockchain construction experiments.

SKILLS

Programming: C++, C, JAVA, and learning Golang now

PERSONALITY

Creative, hardworking, energetic, optimistic