ZIHAO ZHANG

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East China Normal University, Shanghai, China
School of Data Science and Engineering

Research Interests

Distributed Database System, Consensus Protocol, and Transaction Processing
Research Summary: During my PhD, I worked on *improving the performance of transaction processing in distributed database systems by co-designing transaction protocols and consensus protocols.* In modern distributed database systems, data is partitioned into shards and replicated across multiple data centers, for both scalability and high availability, which introduces atomic commit protocols like two-phase commit to guarantee the atomicity of transactions, and consensus protocols like Paxos and Raft to maintain the consistency among replicas. Therefore, my research aims to clarify the interactions between consensus protocols and transaction protocols (i.e., concurrency control and atomic commit protocols) in databases, and to explore the optimization space to achieve high throughput and low latency transaction processing.

My research vision is to make distributed database systems high-performance and consistency-verifiable, i.e., design efficient consensus and transaction protocols, and explore consistency guarantees for distributed database systems.

Education

Ph.D. in Data Science and Engineering
East China Normal University, Shanghai, China 2018 - 2023
Academic Advisor: Xuan Zhou and Huiqi Hu

Bachelor in Software Engineering
East China Normal University, Shanghai, China 2014 - 2018

Publications

- **Zihao Zhang**, Huiqi Hu, Xuan Zhou, and Jiang Wang. *Starry: Multi-master Transaction Processing on Semi-leader Architecture.* In Proceedings of the VLDB Endowment **(PVLDB)**, 2022.
  keywords: multi-master architecture, conflict resolution, consensus protocol
  Multi-master transaction processing is a key technology to improve scalability and availability in cloud databases. Starry proposed a new transaction commit protocol for multi-master architecture that integrates leaderless consensus protocol with concurrency control mechanism. By combining fast decentralized commit and centralized conflict resolution, Starry achieves high throughput and low latency transaction processing, and can efficiently handle conflicts among multiple master nodes.
- **Zihao Zhang**, Huiqi Hu, Zhihui Xue, Changcheng Chen, Yang Yu, Cuiyun Fu, Xuan Zhou, and Feifei Li. *SlimStore: A Cloud-based Deduplication System for Multi-version Backups.* In 2021 IEEE 37th International Conference on Data Engineering **(ICDE)**, 2021.
  keywords: cloud storage, object storage service, data deduplication, database backup
  SlimStore is an efficient deduplication system for cloud storage. With the history-aware deduplication algorithm and global view restore caching, it can efficiently perform data deduplication and restoration. In addition, SlimStore takes into account the characteristics of cloud storage, avoiding the performance loss caused by the high access latency of cloud storage through a lightweight index structure and parallel prefetching strategy, and maximizing the restore performance by fully utilizing the multi-channel read capability of the cloud storage.

- **Zihao Zhang**, Huiqi Hu, Yang Yu, Weining Qian, and Ke Shu. *Dependency Preserved Raft for Transactions.* In International Conference on Database Systems for Advanced Applications **(DASFAA)**, 2020.
  keywords: consensus protocol, parallel log replication, transaction dependency
  Raft is widely used in database systems for high availability, but its seriality requirements limit the performance of transaction processing. DP-Raft works to resolve the conflict between the strict seriality of Raft and the high concurrency of database transaction processing. By analyzing transaction dependencies, DP-Raft allows parallel log replication for those transactions that do not require strict serial order, thus improving system parallelism.

Experience

Research Intern April 2020 - January 2021
Alibaba Cloud *Shanghai, China*

- Built **SlimStore**, which is an efficient deduplication system based on cloud storage, that can effectively reduce the data volume of database backup on the cloud.

Teaching Assistants Spring 2020 & Spring 2019
Course Name: The Implementation of Database Systems *East China Normal University*

Teaching Assistants Fall 2018
Course Name: Computer Systems *East China Normal University*