Concurrent & Distributed Systems (COMP8064)
Research Report

Write a short (7-8 page) report on a given topic. Your report should give a fairly high level overview of the given topic but not completely avoid technical details. The report should also include reference to specific applications of your topic particularly as they pertain to computer games and references to available software libraries (especially open source) are particularly welcome. Your report should be structured appropriately and include references.

You may choose from the topics below or can suggest an alternative yourself.

1. **Consensus Algorithms in Distributed Systems**: Explore various consensus algorithms such as Paxos, Raft, and Byzantine Fault Tolerance, and their applications in distributed databases, blockchain, and cloud computing.

2. **Distributed File Systems**: Investigate distributed file systems like Hadoop Distributed File System (HDFS), Google File System (GFS), and their usage in big data processing, cloud storage, and content delivery networks.

3. **Distributed Transactions**: Discuss the challenges and techniques involved in implementing distributed transactions, and their significance in e-commerce systems, banking, and online gaming.

4. **Distributed Computing in IoT**: Analyze how distributed systems facilitate IoT (Internet of Things) applications, including sensor networks, smart cities, and industrial automation.

5. **Scalability in Distributed Systems**: Examine strategies for achieving scalability in distributed systems, including horizontal scaling, sharding, and load balancing, with practical examples from social media platforms, e-commerce sites, and online gaming services.

6. **Fault Tolerance in Distributed Systems**: Explore fault tolerance mechanisms such as replication, redundancy, and checkpointing, and their role in ensuring reliability and availability in distributed systems, with examples from cloud computing and distributed databases.

7. **Distributed Consistency Models**: Compare different consistency models such as eventual consistency, strong consistency, and causal consistency, and their applications in distributed databases, content delivery networks, and collaborative editing systems.

8. **Edge Computing**: Investigate the concept of edge computing and its implications for distributed systems, including latency-sensitive applications, real-time analytics, and mobile computing.

9. **Microservices Architecture**: Discuss the adoption of microservices architecture in distributed systems, its benefits, challenges, and practical implementations in cloud-native applications and enterprise systems.

10. **Distributed Machine Learning**: Explore distributed machine learning frameworks such as TensorFlow, PyTorch, and Apache Spark MLlib, and their applications in distributed training, federated learning, and large-scale data analytics.

11. **Blockchain and Distributed Ledgers**: Analyze the underlying principles of blockchain technology, distributed ledger systems, and their practical applications beyond cryptocurrencies, including supply chain management, identity verification, and decentralized finance (DeFi).

12. **Peer-to-Peer (P2P) Systems**: Discuss the architecture and protocols of peer-to-peer systems, their advantages, and challenges, with examples from file sharing networks, content distribution networks, and decentralized social networks.

13. **Distributed Security and Privacy**: Examine security and privacy concerns in distributed systems, including authentication, encryption, access control, and data protection mechanisms, with case studies from cloud computing, IoT, and online communication platforms.

14. **Serverless Computing**: Explore the concept of serverless computing and its impact on distributed systems architecture, resource allocation, and scalability, with examples from serverless platforms like AWS Lambda, Azure Functions, and Google Cloud Functions.

15. **Distributed Data Streaming**: Investigate distributed data streaming frameworks such as Apache Kafka, Apache Flink, and Amazon Kinesis, and their applications in real-time analytics, event-driven architectures, and log processing pipelines.