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CSE 531: Distributed and Multiprocessor Operating Systems

Logical Clock Written Report

Problem Statement

Implement Lamport's logical clock on top of Project 1 of the banking system to show the flow of customer and branch processes and to understand coordination between the processes.

Goal

The goal of the project is to understand coordination between processes making use of Lamports's logical clocks. The existing Project is to be modified to incorporate Lamport's logical clocks to keep track of different customer and branch processes.

Setup

Tech Stack:

- **Python** 3.9
- **gRPC** 1.58.0
- **Protobuf** 4.24.3
- **IDE** : IDEA IntelliJ 2023.2 Community Edition
- **Operating System** : macOS Ventura 13.5.2
- **Github** : Free,Pro, and Team

Implementation Processes

1. Modify the protocol buffer messages and add an integer clock representing the logical clocks passed among the processes
2. Use the Protobuf file to generate the gRPC server stub code in python
3. Implement concurrent execution of customers as opposed to sequential execution in Project 1
4. Modify the results from Project 1 to form output_1.json which stores the first part of results of Project 2
5. Implement local logical clocks to branch servers which keep track of the branch processes

6. Create temporary files to store outputs of each branch and finally join them to form output_2.json which contains all the branch events ordered by id
7. Make use of the logical clocks passed as parameters in gRPC calls to keep track of the various client and branch processes for each customer request
8. For each customer requests, create temporary files that store these events and finally combine them to form output_3.json
9. Execute run_branch and run_customer on the inputs given in Project Description
10. Test the code against input file given as test case in canvas modules
11. Verify the banking operations are functionally correct and validate the test cases with checker scripts
12. Push final code to github with README file explaining the running of the project

Results

1. **Understanding of gRPC concepts**
    - **Result** : Thorough understanding of the fundamentals of gRPC, such as protocol buffers, service definitions, and remote procedure calls
    - **Justification**: Through the course of the project, students have understood the fundamentals of gRPC which is crucial to understand modern communication protocols used in various software applications
2. **Lamport's Logical Clock Algorithm**
    - **Result**: Implement logical clocks in the existing Project 1
    - **Justification**: Implementing the logical clocks in Project 2 has helped students understand the Lamport's logical clock algorithm
3. **Understanding Coordination**
    - **Result**: Implement logical clocks in customer and branch processes
    - **Justification**: Implementing these clocks helps us understand the flow of events in both customer and branch processes and how they coordinate with each other
4. **Functionality**
    - **Result**: The banking system supports essential functionalities like querying account balances, depositing funds, and withdrawing funds while keeping the balances consistent across all branches
    - **Justification**: Fulfilling these fundamental banking operations ensures that the system serves its purpose of enabling users to manage their accounts effectively