CISC 5597/6935 Distributed Systems

Lab 3: 2 Phase Commit Protocol

Background:

Two-phase commit (2PC) is a standardized protocol that ensures atomicity, consistency, isolation and durability (ACID) of a transaction; it is an atomic commitment protocol for distributed systems.

Lab Assignment:

Based on RPCs that you created in Lab-2, we are going to simulate the 2PC protocol with two transactions.

1. Transfer 100 dollars from account A to account B.
2. Add a 20% bonus to A and add the same amount (0.2 * A) to B.

Requirements:

1. There are **THREE** "computing nodes" in your cluster. They are fully connected through RPC calls, meaning that they know each other's IPs and corresponding ports.
2. Within the 3-node cluster, Node-1 is the **coordinator**; Node-2 is a **participant** that manages account A; Node-3 is **another participant** that manages account B.
3. The account values are stored as a file on the disk.
4. There is a client that sends the transaction request to the coordinator.
5. The cluster uses 2PC to ensure consistency.

The cluster needs to simulate the following items.

1. Simulate the basic 2PC protocol as discussed. There are 3 scenarios to be simulated.
    a. A has 200 and B has 300 in their accounts initially. Everything works as expected, with no failures.
        i. Simulate all scenarios;
    b. A has 90 and B has 50 in their accounts initially. Everything works as expected, with no failures.
        i. Simulate all scenarios;
    c. A has 200 and B has 300 in their accounts initially.
        i. Node-2 crashed (e.g., represented by a long sleep time) ***before*** responding to the coordinator.
        ii. Node-2 crashed (e.g., represented by a long sleep time) ***after*** responding to the coordinator.
        iii. (6935-only) Node-1 crashed after sending out the request and potential solutions to recovery from the crash.

2. ***(6935 Required and 5597 Bonus)***: Each of Node-2 and Node-3 have two replicas. Therefore, the cluster will have 1 coordinator, 3 nodes for account A, and another 3 nodes for account B. For accounts A and B, we use Paxos OR Raft to achieve consensus on the values of A and B.
    a. It basically integrates your Lab-2 into this system.

Grading Rubric: *This lab allows a group of 2* students.

Your code should be elegant and well-documented (with comments).

1. The submission can not run successfully. (0 points)
2. A cloud-based video demonstration (10%)
3. The three computing nodes can communicate with each other through RPCs. (5%)
4. Requirement 1.a (15%)
5. Requirement 1.b (20%)
6. Requirement 1.c.i (20% or 15%)
7. Requirement 1.c.ii (20% or 15%)
8. Requirement 1.a.iii (10%)
9. Report (10%)