Distributed Computing III

Murphy was an optimist

CSSE6400

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April 11, 2022

Question

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Answer

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- Timeout

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What to do if fault is detected?

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Answer

- Retry
- Restart

Definition 1. Idempotency

Repeating an operation does not change receiver's state.

Byzantine Generals Problem

- *n* generals need to agree on plan
- Can only communicate via messenger
- Messenger may be delayed or lost
- Some generals are traitors
  - Send dishonest messages
  - Pretend to have not received message

Question

How to order asynchronous messages?

Question

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Answer

- Timestamps?
  - Can’t keep clocks in sync
  - Limited clock precision

Consistency

Eventual Consistency weak guarantee

Linearisability strong guarantee

Causal Ordering strong guarantee

Linearisability

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  - Regardless of replica read from

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- Leaderless replication
  - Lock value on quorum before writing

Causal Order

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  - What event needs to happen before another
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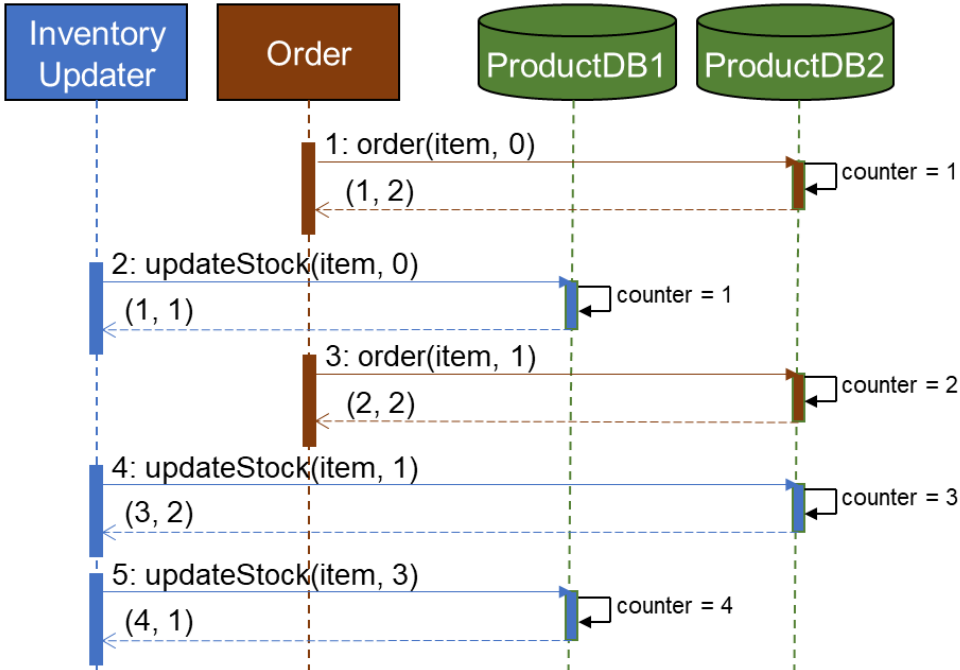
- Lamport timestamps


Inventory Updater
Order
ProductDB1
ProductDB2
1: order(item, 0)
(1, 2)
counter = 1
2: updateStock(item, 0)
(1, 1)
counter = 1
3: order(item, 1)
(2, 2)
counter = 2
4: updateStock(item, 1)
(3, 2)
counter = 3
5: updateStock(item, 3)
(4, 1)
counter = 4

Definition 2. Consensus

A set of nodes in the system agree on some aspect of the system's state.

Consensus Properties

Uniform Agreement All nodes must agree on the decision

Integrity Nodes can only vote once

Validity Result must have been proposed by a node

Termination Every node that doesn't crash must decide

Definition 3. Atomic Commit

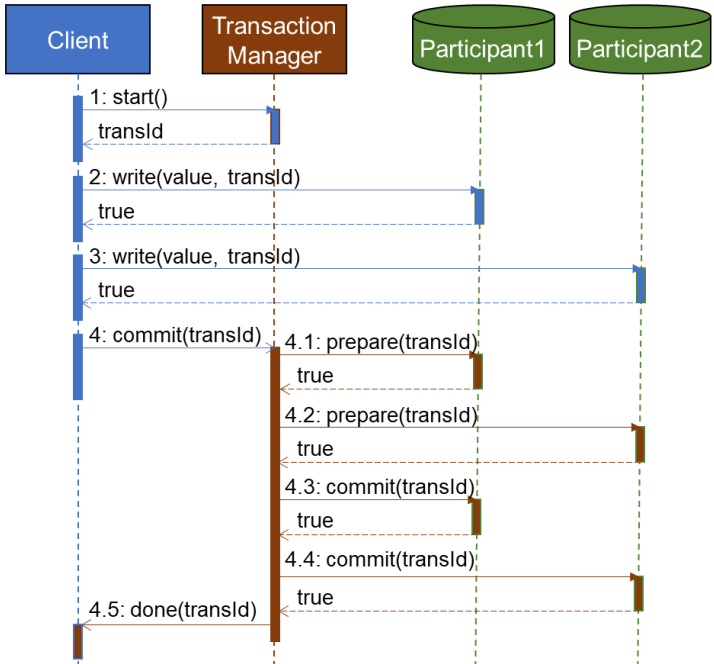
All nodes participating in a distributed transaction need to form consensus to complete the transaction.

Two-Phase Commit

Prepare Confirm nodes can commit transaction

Commit Finalise commit once consensus is reached

- Abort if consensus can't be reached


Client
Transaction Manager
Participant1
Participant2
1: start()
transId
2: write(value, transId)
true
3: write(value, transId)
true
4: commit(transId)
4.1: prepare(transId)
true
4.2: prepare(transId)
true
4.3: commit(transId)
true
4.4: commit(transId)
true
4.5: done(transId)