

Distributed Computing III

Murphy was an optimist

CSSE6400

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Question

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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?

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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

- Once value is written, all reads see same value
 - Regardless of replica read from

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- Multi-leader replication can't be linearised
- Leaderless replication
 - Lock value on quorum before writing

Causal Order

- Order is based on causality
 - What event needs to happen before another
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 - Record sequence number of writes in log
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Causal Order

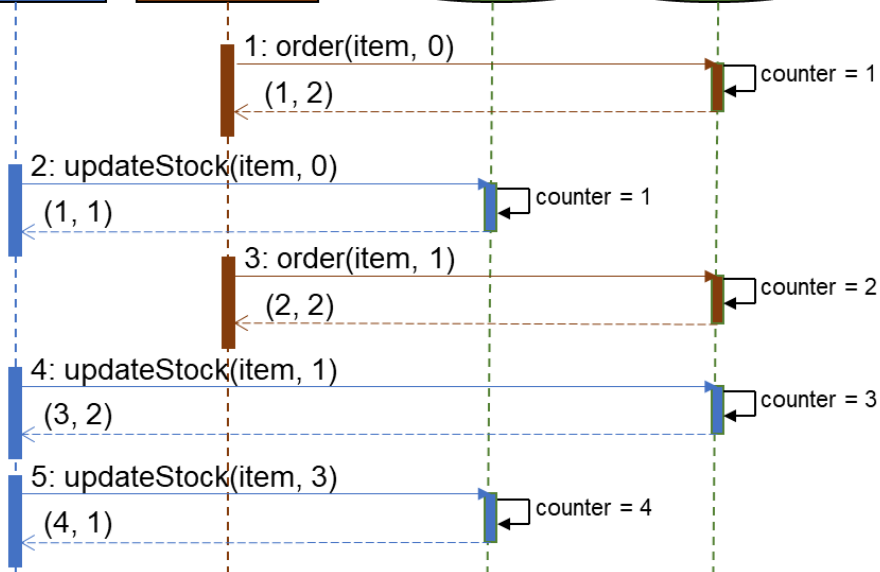
- Order is based on causality
 - What event needs to happen before another
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- Single-leader replication
 - Record sequence number of writes in log
 - Followers read log to execute writes
- Lamport timestamps

Inventory
Updater

Order

ProductDB1

ProductDB2



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

