hochschule mannheim

Understanding Eventual Consistency

MSI Presentation SS2014

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1 Replicated Data Types

Introduction

„...the storage system guarantees that if no new updates are made to the object, eventually all accesses will return the last updated valuee“
–W. Vogels (2009)

„Zweites Zitat über Ev. Consistency “

The Problem

- The definitions are ambiguous
- Most big players claim to implement it
- Implementations can't be be compared... scientifically
- In real world distributed databases updates never stop

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- Two examples: Int Register **intreg**, Counter **ctr**

$$\mathrm{Op}_{\mathrm{ctr}} = \{\mathrm{rd}, \mathrm{inc}\}$$
$$\mathrm{Op}_{\mathrm{intreg}} = \{\mathrm{rd}, \mathrm{wr}(k) | k \in \mathbb{Z}\}$$

Replicated Data Types

Sequential Data Type Specification

In a *strongly consistent system*, the semantics of a data type can be described by a function

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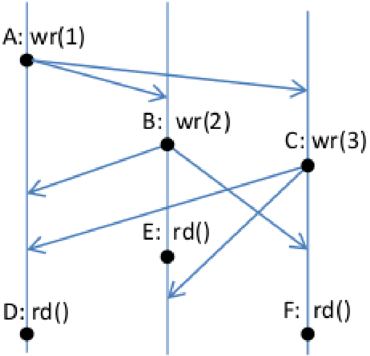
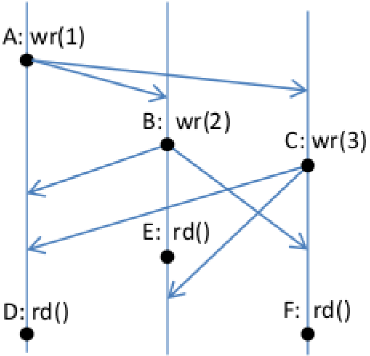


A: wr(1)
B: wr(2)
C: wr(3)
E: rd()
D: rd()
F: rd()



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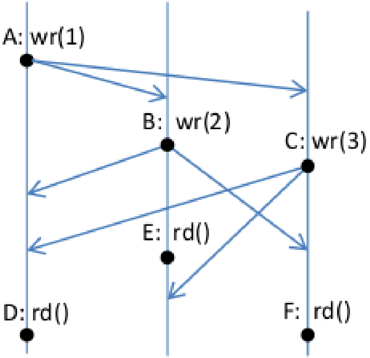
Replicated Data Types

Conflict Resolution Strategies



1. Make concurrent operations commutative
2. Order concurrent operations

Replicated Data Types

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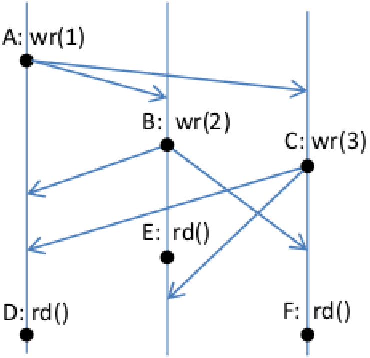

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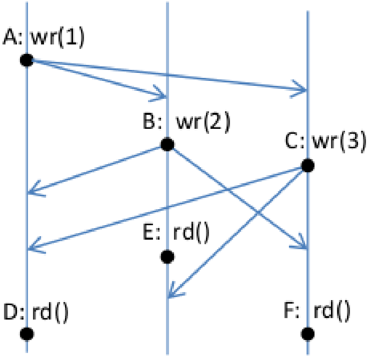

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4. Resolve conflicts semantically

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Axiomatic Specification Framework

Levels of Eventual Consistency

- With replicated data types we can define multiple forms of eventual consistency
  - Basic eventual consistency
  - Ordering guarantees
  - on-demand consistency strengthening
- Every form contains multiple axioms

Axiomatic Specification Framework

Client Interaction Model

- Clients often wish to perform multiple operations within some context
- bla

Axiomatic Specification Framework

Basic Eventual Consistency Axioms

- Axioms a database has to fulfill to be eventual consistent
- SOWF, ARWF, VISWF, RVAL, EVENTUAL, THINAIR

Axiomatic Specification Framework

Session guarantees

- Axioms that ensure that databases stay consistent within a single session with a client
- RYW, MR, WYRV, WFRA, MWV, MWA

Axiomatic Specification Framework

Causal Consistency Axioms

- POCV, POCA, COCV, COCA

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Conclusion

- Which problems does the techreport solve?
- What is not solved by it?
- What do **we** think about it?