

Efficient renaming in Conflict-free Replicated Data Types (CRDTs)

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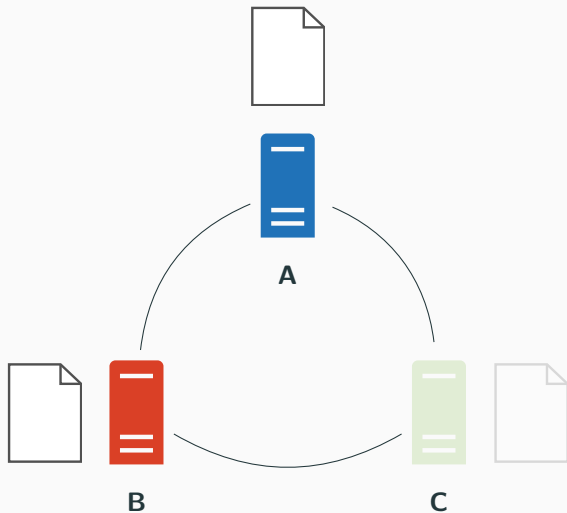
COAST team

Supervised by Gérald Oster and Olivier Perrin

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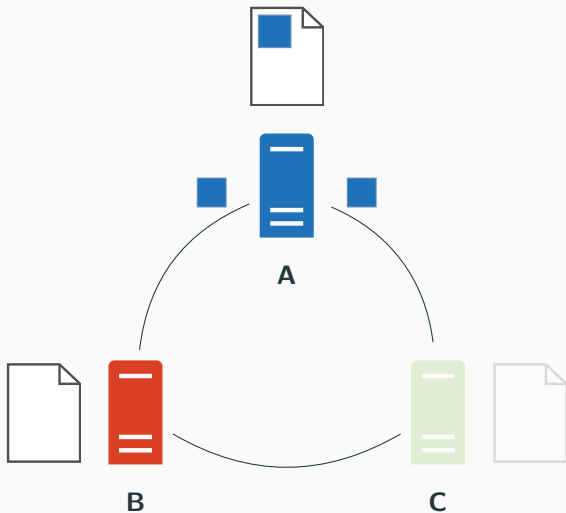


Conflict-free Replicated Data Types (CRDTs) [3]



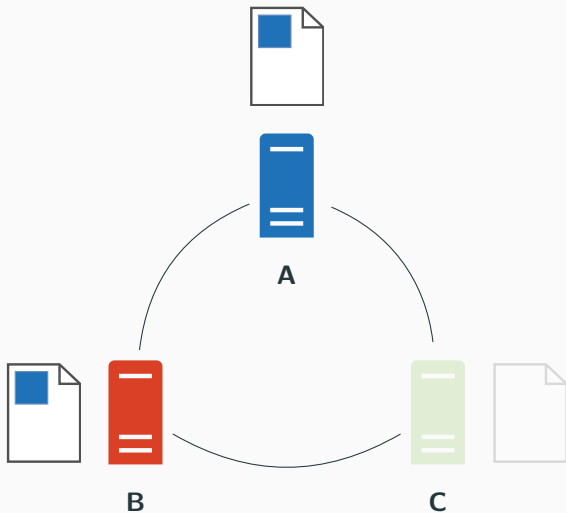
- Replicated data structure

Conflict-free Replicated Data Types (CRDTs) [3]



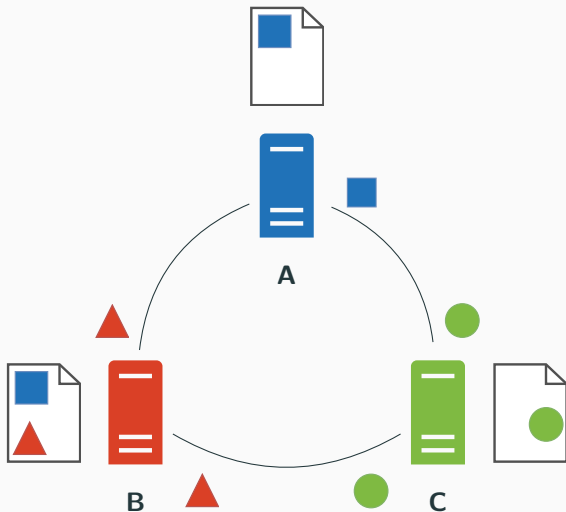
- Replicated data structure
- Updates performed without coordination

Conflict-free Replicated Data Types (CRDTs) [3]



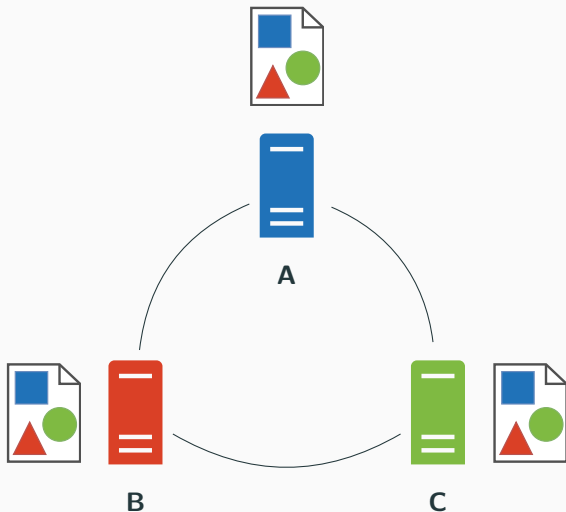
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Conflict-free Replicated Data Types (CRDTs) [3]



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Conflict-free Replicated Data Types (CRDTs) [3]



- Replicated data structure
- Updates performed without coordination
- Strong Eventual Consistency [3]

Identifier-based CRDTs

Main idea

- Attach an identifier to each inserted element

Allow to achieve commutative updates

- By identifying uniquely elements
- By ordering them relatively to each other

- State of the art of *Sequence CRDTs*
- Relies on *identifiers* to ensure convergence, noted here as letters and words
- Elements are ordered by their identifier

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LogootSplit [1]

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- Relies on *identifiers* to ensure convergence, noted here as letters and words
- Elements are ordered by their identifier



Figure 1: The state of a sequence which contains the elements "helo" and their corresponding identifiers



Figure 2: The state of a sequence which contains the block "helo"

Example

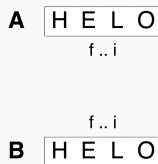


Figure 3: Example of concurrent *insert* operations

Example

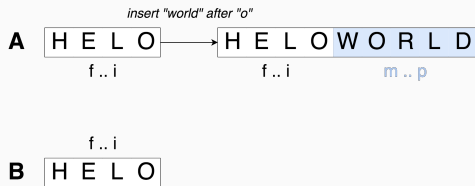


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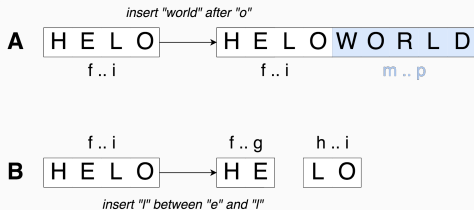


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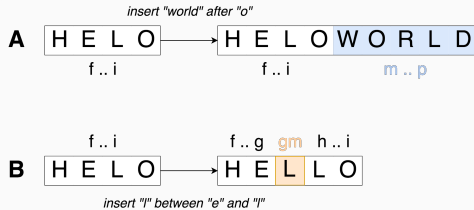


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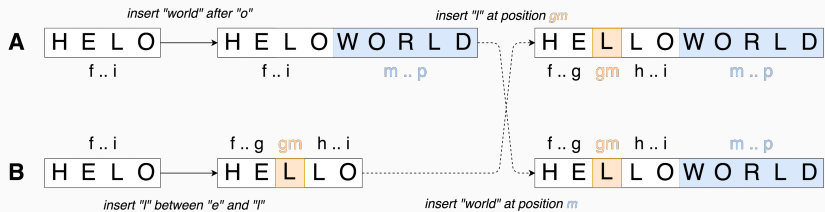


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Declining performances

- Operations performed may lead to an inefficient internal representation

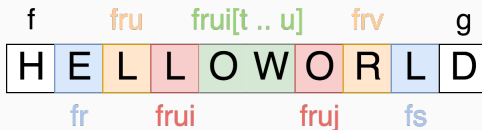


Figure 4: Example of inefficient internal representation

- The more blocks we have:
 - The more metadata we store
 - The longer it takes to browse the sequence to *insert* or *delete* an element

How to reduce the footprint of the metadata ?

Renaming mechanism

- Introduce a *rename* operation

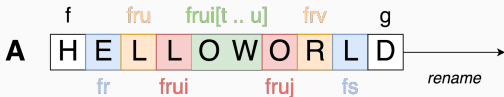


Figure 5: Example of renaming

Renaming mechanism

- Introduce a *rename* operation

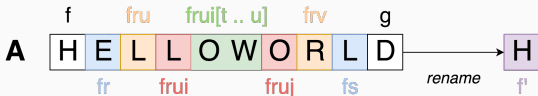


Figure 5: Example of renaming

- Generates a new identifier to the first element, based on its previous identifier

Renaming mechanism

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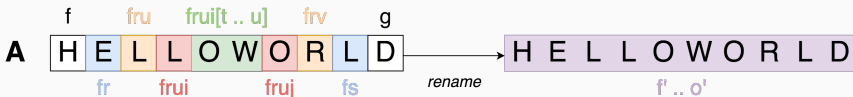


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- Propose a distributed renaming mechanism for *LogootSplit*
- Allows to reset the footprint of the CRDT without coordination
- Implemented in MUTE [2], our P2P collaborative text editor

Provide a formal proof

- Need to ensure the correctness of our algorithm

Benchmark the mechanism

- Measure its impact on the performances
- Compare different strategies

Generalize the approach to other CRDTs

Thanks for your attention, any questions?



- [1] L. André, S. Martin, G. Oster, and C.-L. Ignat.

Supporting adaptable granularity of changes for massive-scale collaborative editing.

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