Undo and Redo Support for Replicated Registers

A Guided Research Project with Martin Kleppmann

Leo Stewen

October, 2023

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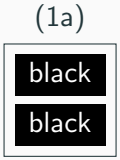
Semantics of Undo and Redo with Multiple Users

Two Registers



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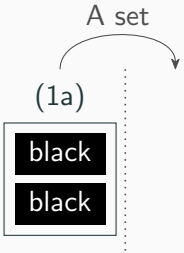

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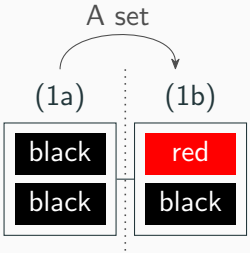

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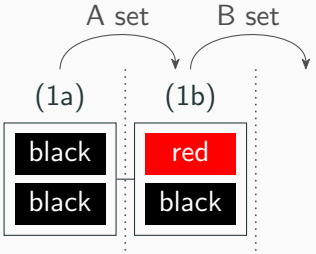

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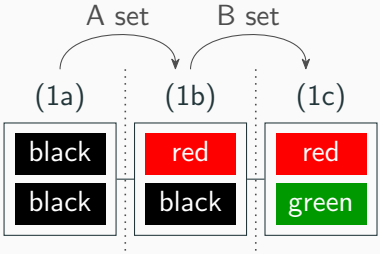

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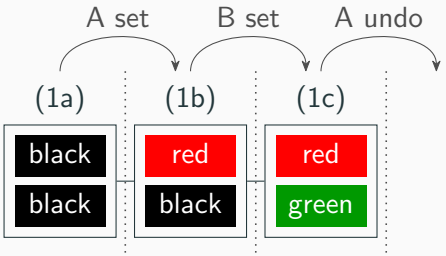

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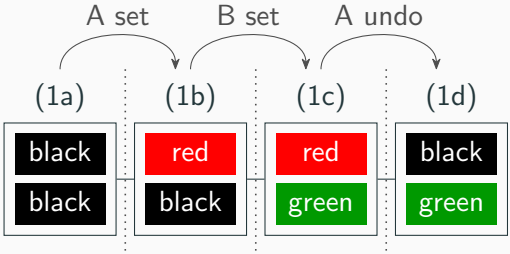

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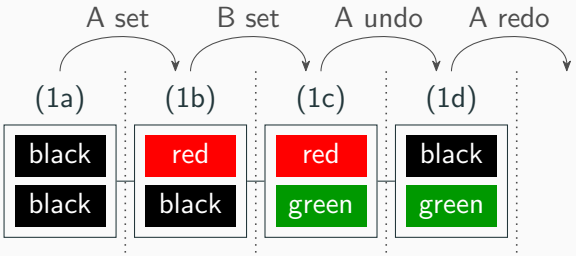

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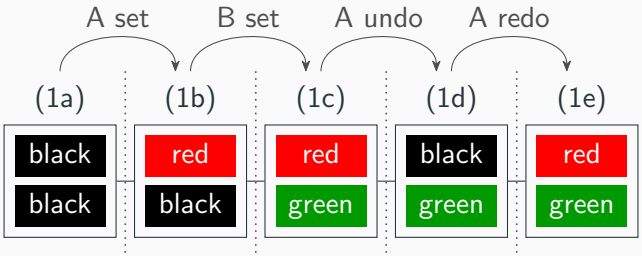

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One Register

Figure 2: Canvas with one Replicated Register.

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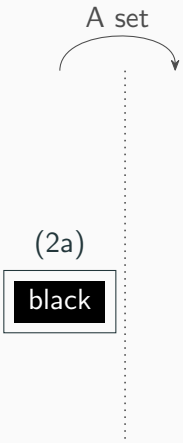

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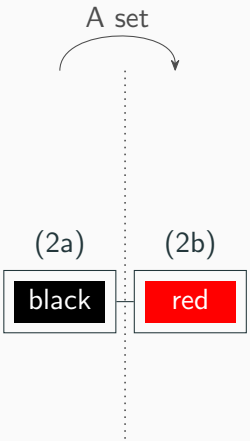

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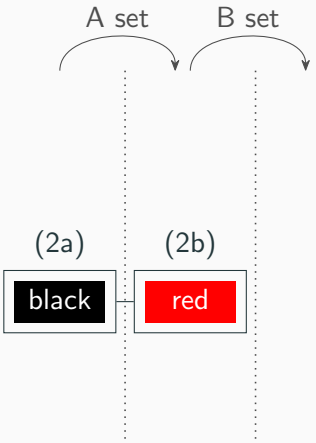

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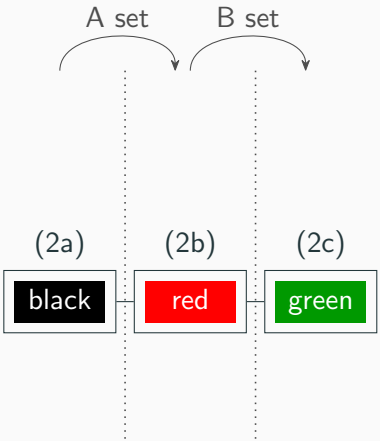

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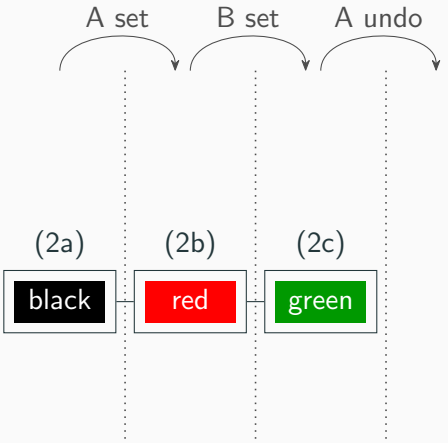

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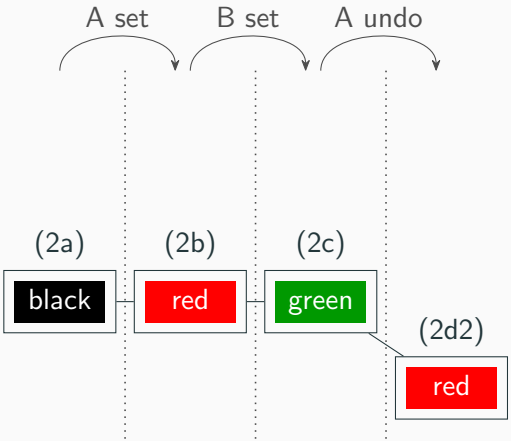

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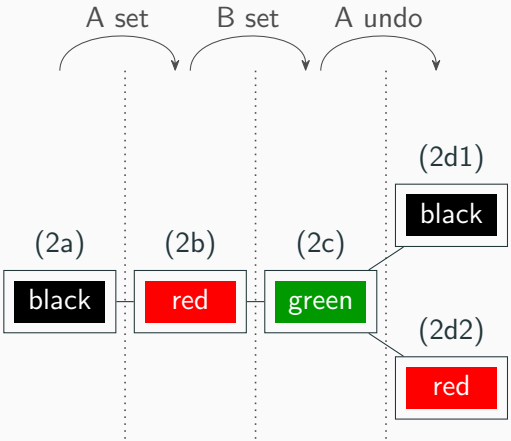

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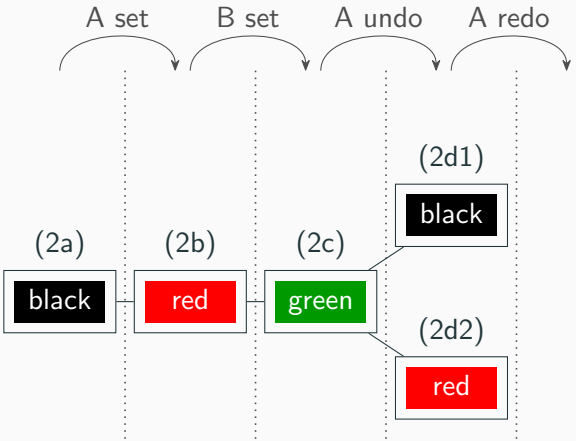

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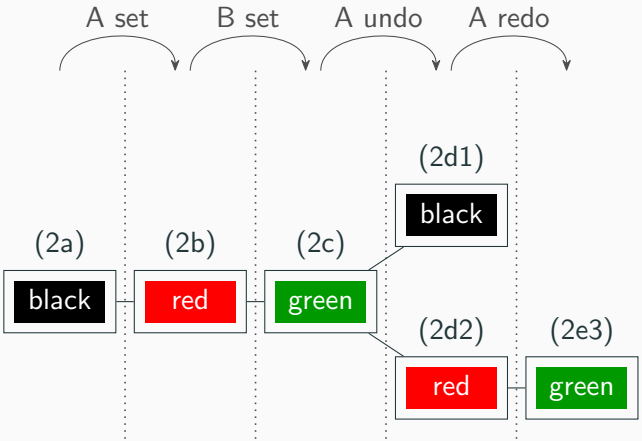

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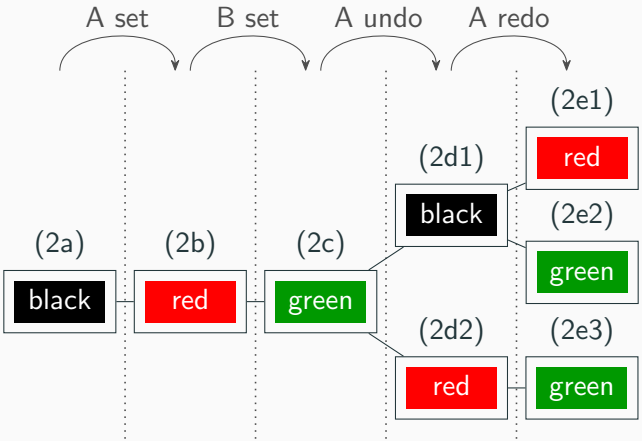

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A Taxonomy of Undo Behavior

	Generating Replica	Any Replica
Reverse Chronological	local undo	global undo
Selective	revert[1]	

[1] often called *selective undo* in the literature

Local Undo and Global Redo

One Register

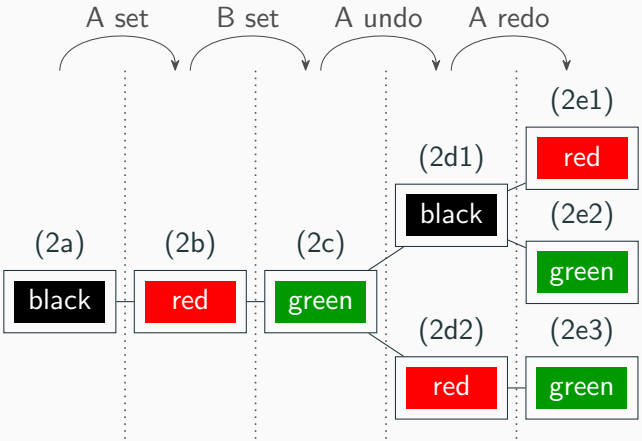

Figure 3: Canvas with one Replicated Register.

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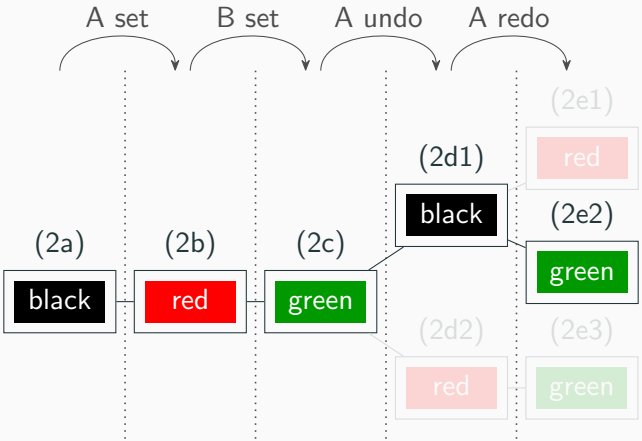

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Algorithm

Exemplary Operation History

Register: [1]

Figure 4: An operation history with undo and redo. Internally, both undo and redo operations are *RestoreOp*s. Their respective anchor operations are indicated by blue dashed arrows.

Exemplary Operation History

Register: [2]

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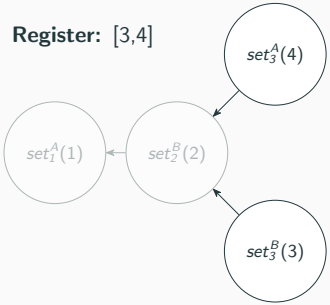

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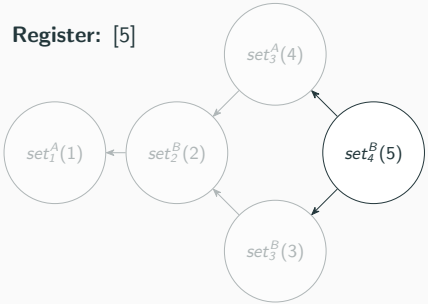

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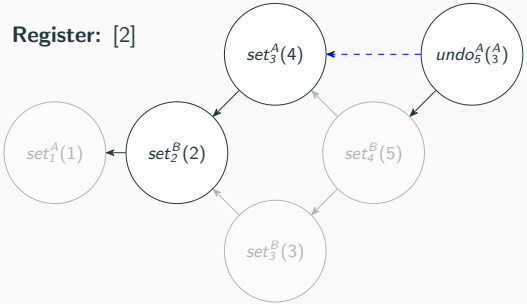

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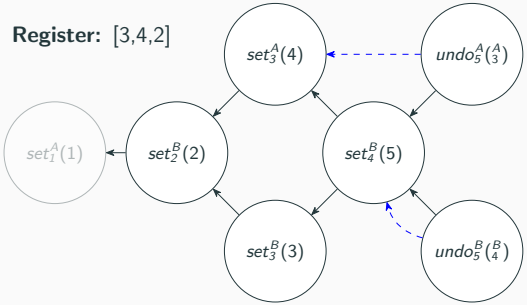

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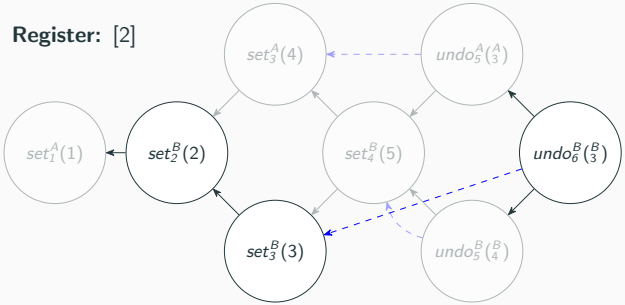

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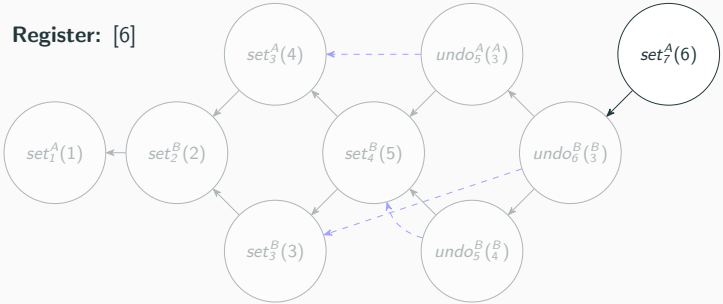

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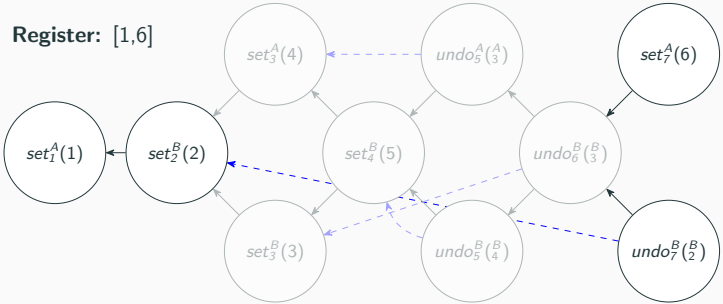

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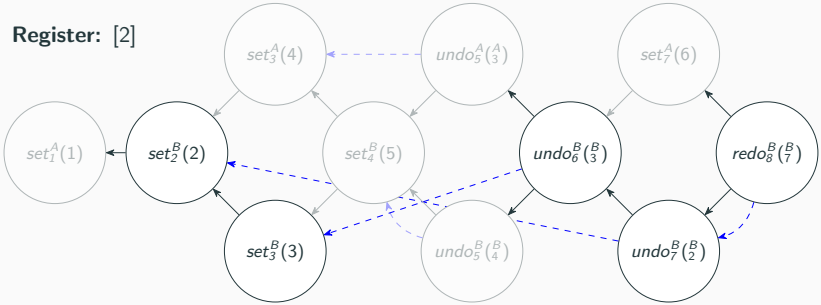

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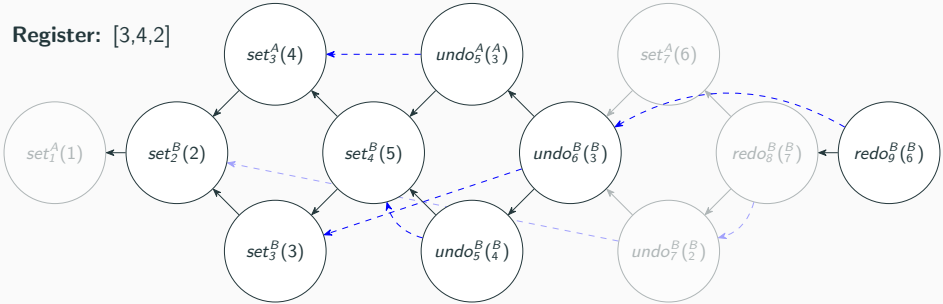

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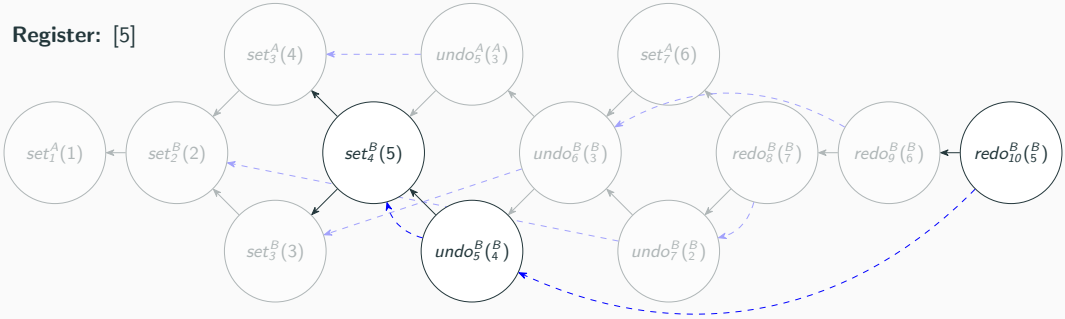

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Evaluation

Common Editing Scenario (Constant Runtime)

Figure 5: Runtime of the last undo/redo operation in a sequence of n consecutive undo/redo operations.

Degenerate Editing Scenario

Figure 6: Sequence of alternating undo-redo operations.

Degenerate Editing Scenario

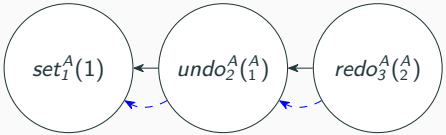

Figure 6: Sequence of alternating undo-redo operations of length 1.

Degenerate Editing Scenario

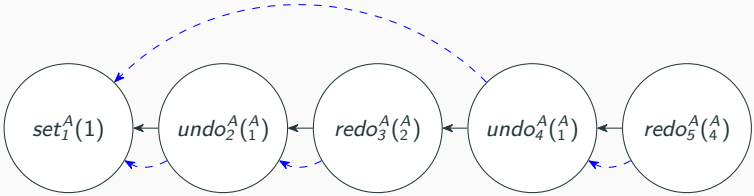

Figure 6: Sequence of alternating undo-redo operations of length 2.

Degenerate Editing Scenario

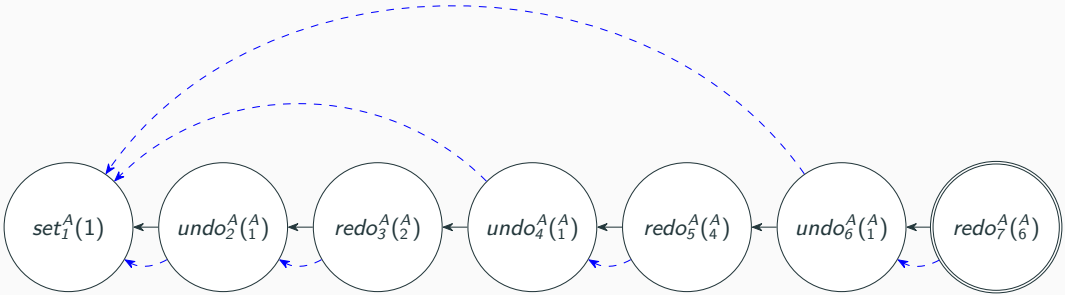

Figure 6: Sequence of alternating undo-redo operations of length 3.

Degenerate Editing Scenario (Linear Runtime)

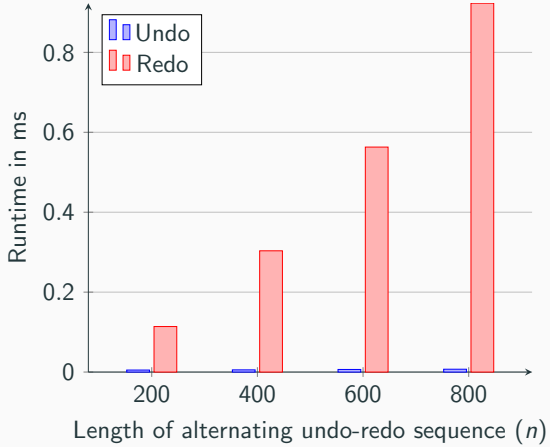

Figure 7: Runtime of the last undo/redo operation in a sequence of alternating undo-redo operations of length n.

Future Work

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- Integration with Automerge (the Counter CRDT...)
- How does undo and redo work with text CRDTs?
- Support other kinds of undo: selective undo, global undo?

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Questions? Feedback?

Reach me at lstwn@mailbox.org