SOFTWARE ARCHITECTURE GATHERING / 2022-11-16

Mayday, we're syncing!

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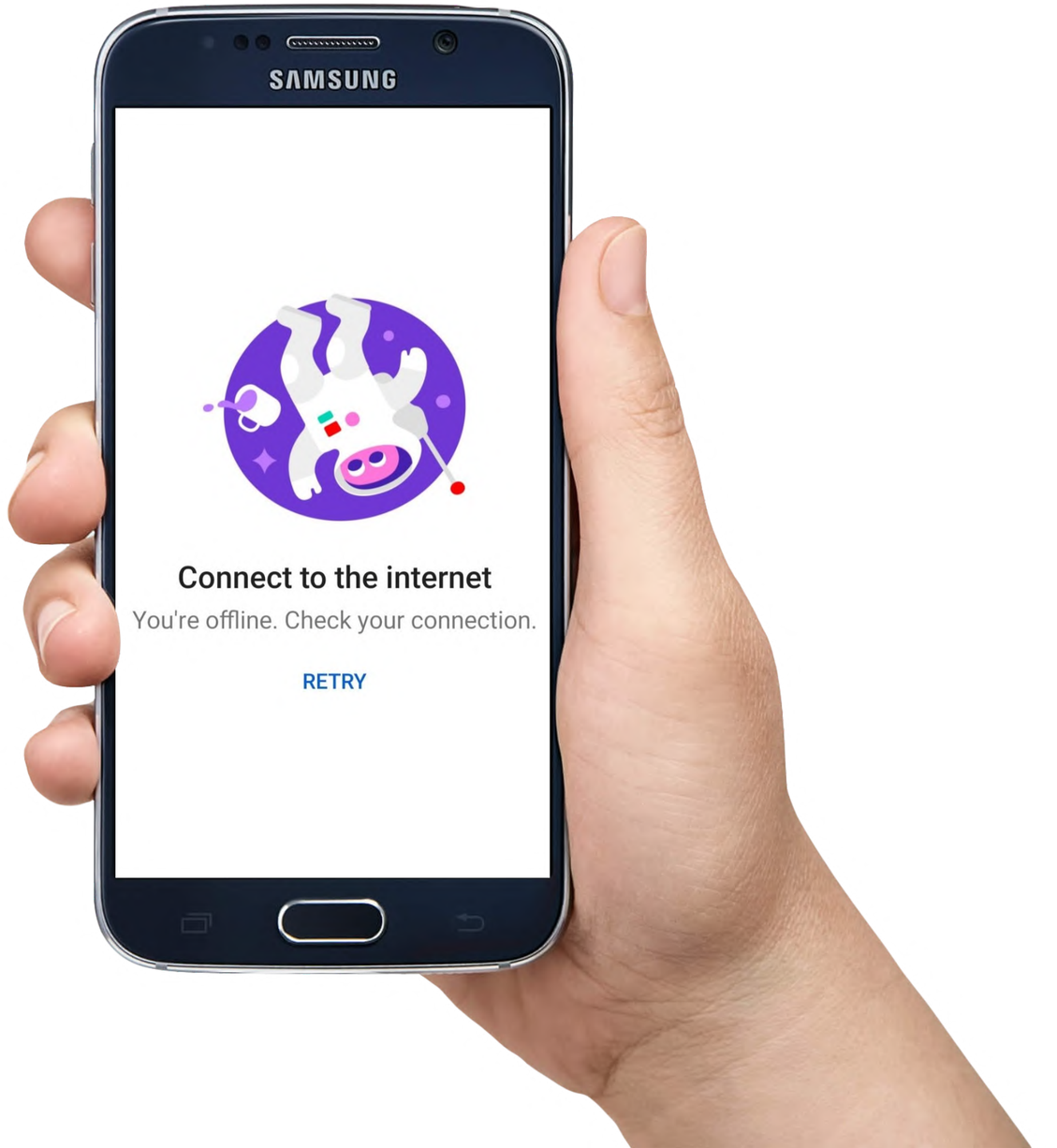
INNOQ

When everything's in the cloud

- … we are dependent on the Internet
- … we are limited in how we can work
- … we are excluding people

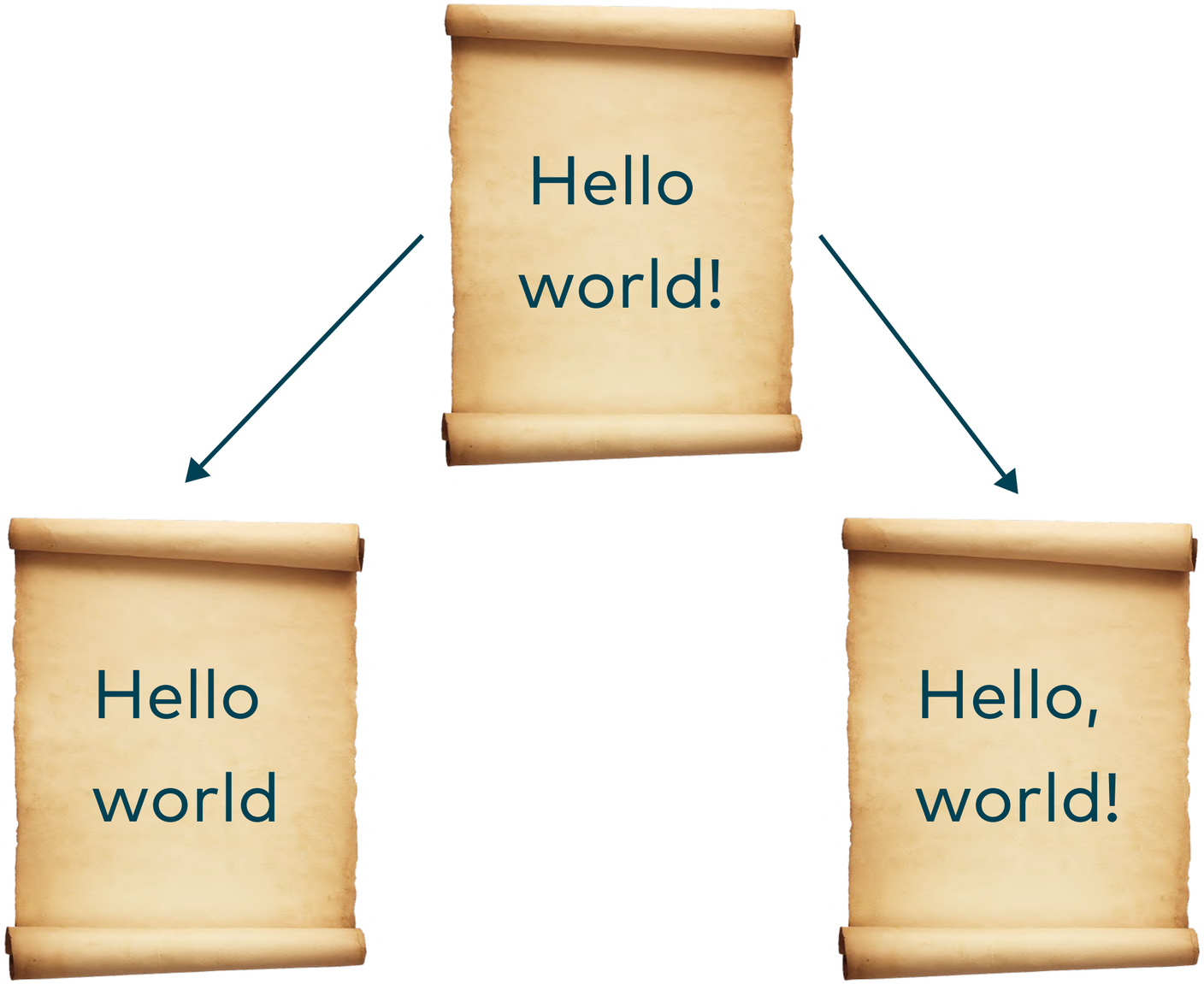


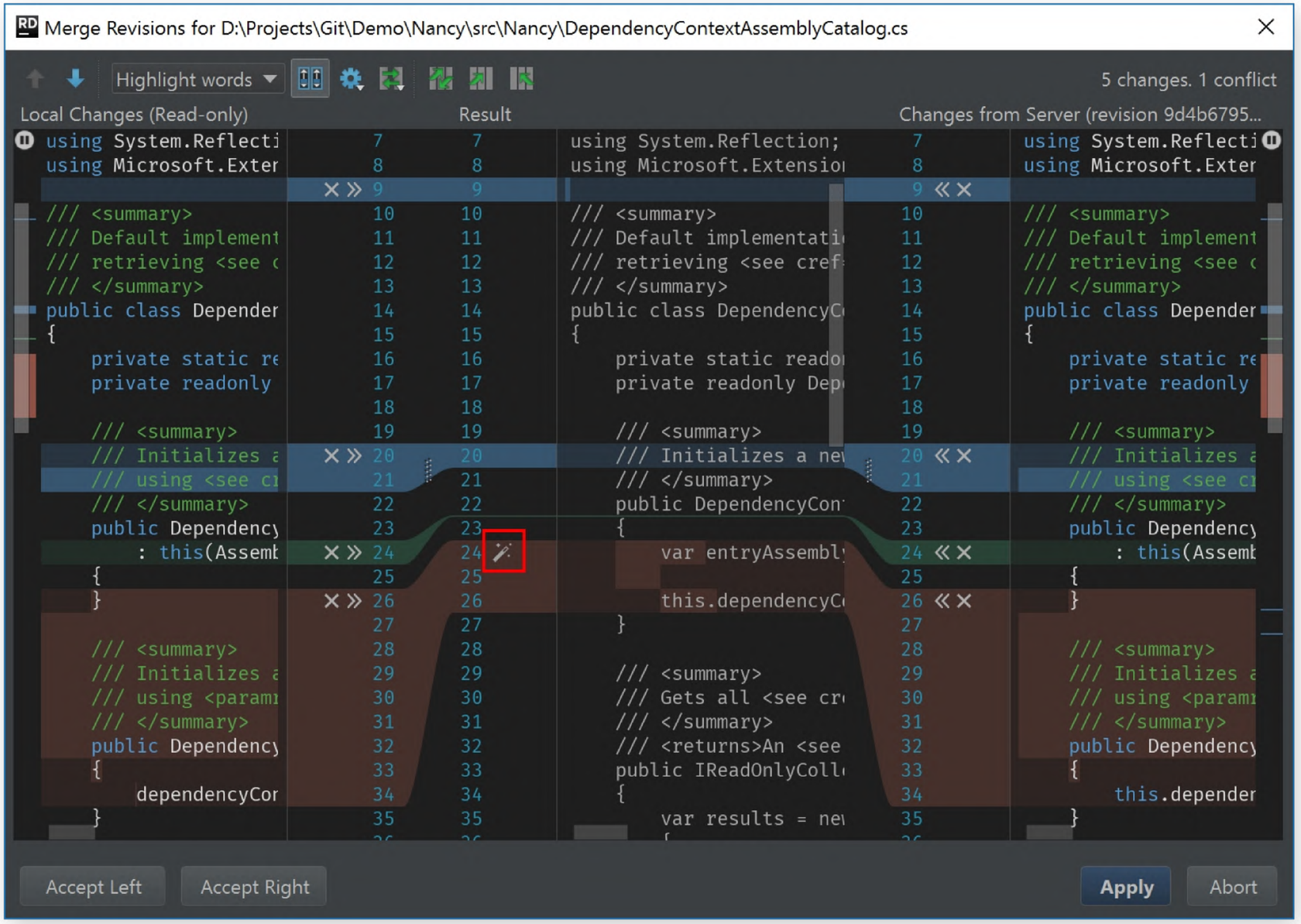
Working Offline?

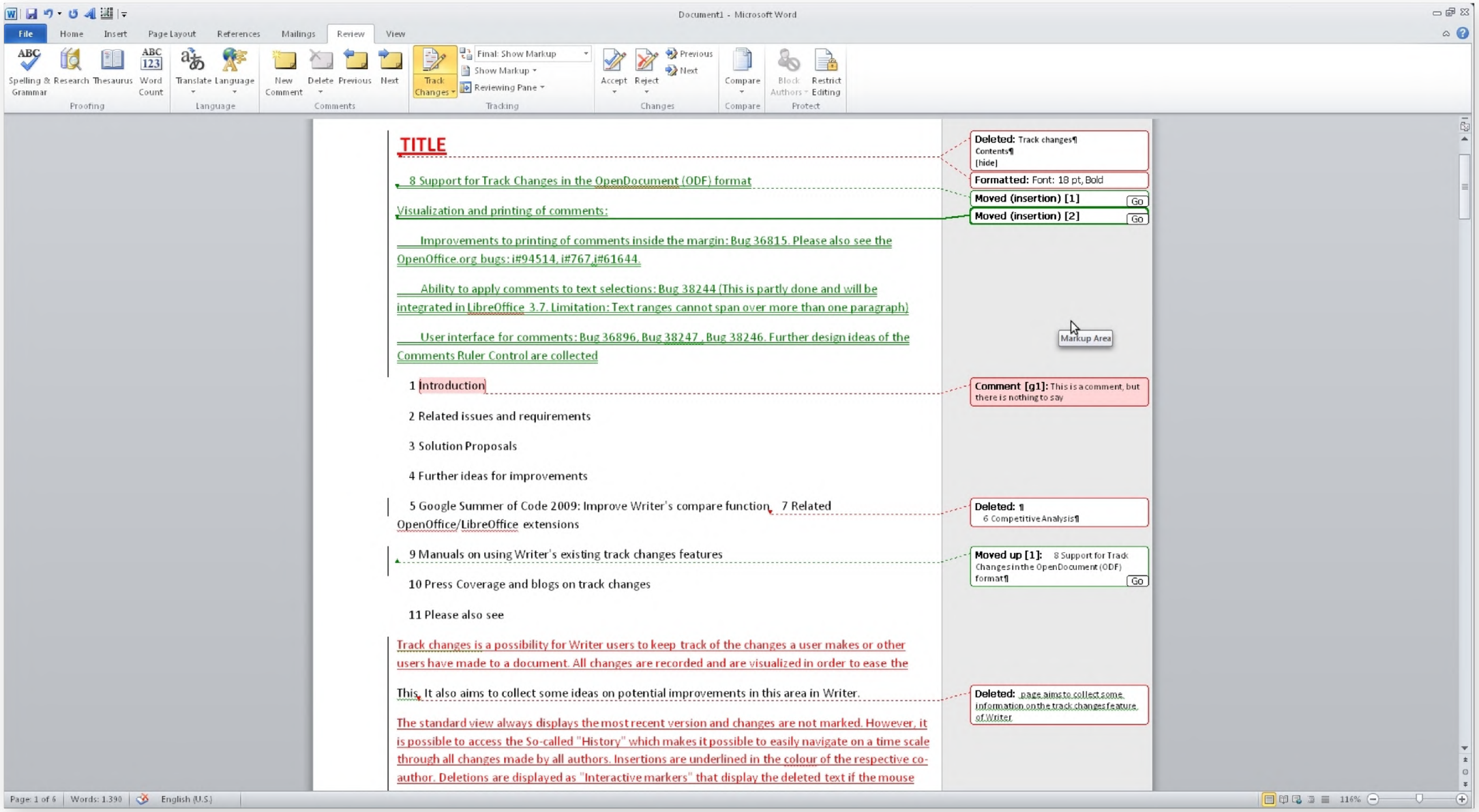
- in the Olden Days, we didn't always have a connection
- local file storage, manual sync

Offline-first is the standard for development

- we like working offline
- no one wants to use Subversion nowadays
- why do we ask our users for connectivity?


Hello
world!
Hello
world
Hello,
world!


Merge Revisions for D:\Projects\Git\Demo\Nancy\src\Nancy\DependencyContextAssemblyCatalog.cs
Highlight words
5 changes. 1 conflict
Local Changes (Read-only)
Result
Changes from Server (revision 9d4b6795...
Accept Left
Accept Right
Apply
Abort


Document1 - Microsoft Word
File
Home
Insert
Page Layout
References
Mailings
Review
View
Spelling & Grammar
Research
Thesaurus
Word Count
Proofing
Translate
Language
Language
New Comment
Delete
Previous
Next
Comments
Track Changes
Final: Show Markup
Show Markup
Reviewing Pane
Tracking
Accept
Reject
Previous
Next
Changes
Compare
Compare
Block Authors
Restrict Editing
Protect
TITLE
8 Support for Track Changes in the OpenDocument (ODF) format
Visualization and printing of comments:
Improvements to printing of comments inside the margin: Bug 36815. Please also see the OpenOffice.org bugs: i#94514, i#767,i#61644.
Ability to apply comments to text selections: Bug 38244 (This is partly done and will be integrated in LibreOffice 3.7. Limitation: Text ranges cannot span over more than one paragraph)
User interface for comments: Bug 36896, Bug 38247 , Bug 38246. Further design ideas of the Comments Ruler Control are collected
1 Introduction
2 Related issues and requirements
3 Solution Proposals
4 Further ideas for improvements
5 Google Summer of Code 2009: Improve Writer's compare function
7 Related OpenOffice/LibreOffice extensions
9 Manuals on using Writer's existing track changes features
10 Press Coverage and blogs on track changes
11 Please also see
Track changes is a possibility for Writer users to keep track of the changes a user makes or other users have made to a document. All changes are recorded and are visualized in order to ease the
This. It also aims to collect some ideas on potential improvements in this area in Writer.
The standard view always displays the most recent version and changes are not marked. However, it is possible to access the So-called "History" which makes it possible to easily navigate on a time scale through all changes made by all authors. Insertions are underlined in the colour of the respective co-author. Deletions are displayed as "Interactive markers" that display the deleted text if the mouse
Deleted: Track changes¶ Contents¶ [hide]
Formatted: Font: 18 pt, Bold
Moved (insertion) [1]
Go
Moved (insertion) [2]
Go
Markup Area
Comment [g1]: This is a comment, but there is nothing to say
Deleted: ¶ 6 Competitive Analysis¶
Moved up [1]: 8 Support for Track Changes in the OpenDocument (ODF) format¶
Go
Deleted: page aims to collect some information on the track changes feature of Writer
Page: 1 of 6
Words: 1.390
English (U.S.)
116%

$$\frac{dN}{dt} = \frac{1}{\tau_{act}} - g_0 (N - N_0)(1 - \varepsilon S) S + \frac{N_e}{\tau_n} - \frac{N}{\tau_p}$$

$$\frac{dS}{dt} = \Gamma_b g_0 (N - N_e)(1 - \varepsilon S) S + \Gamma_b \beta \frac{N}{\tau_n} - \frac{S}{\tau_p}$$

$$\frac{S}{P_t} = \frac{\Gamma \tau_p \lambda_0}{V_a \hbar \omega_0}$$

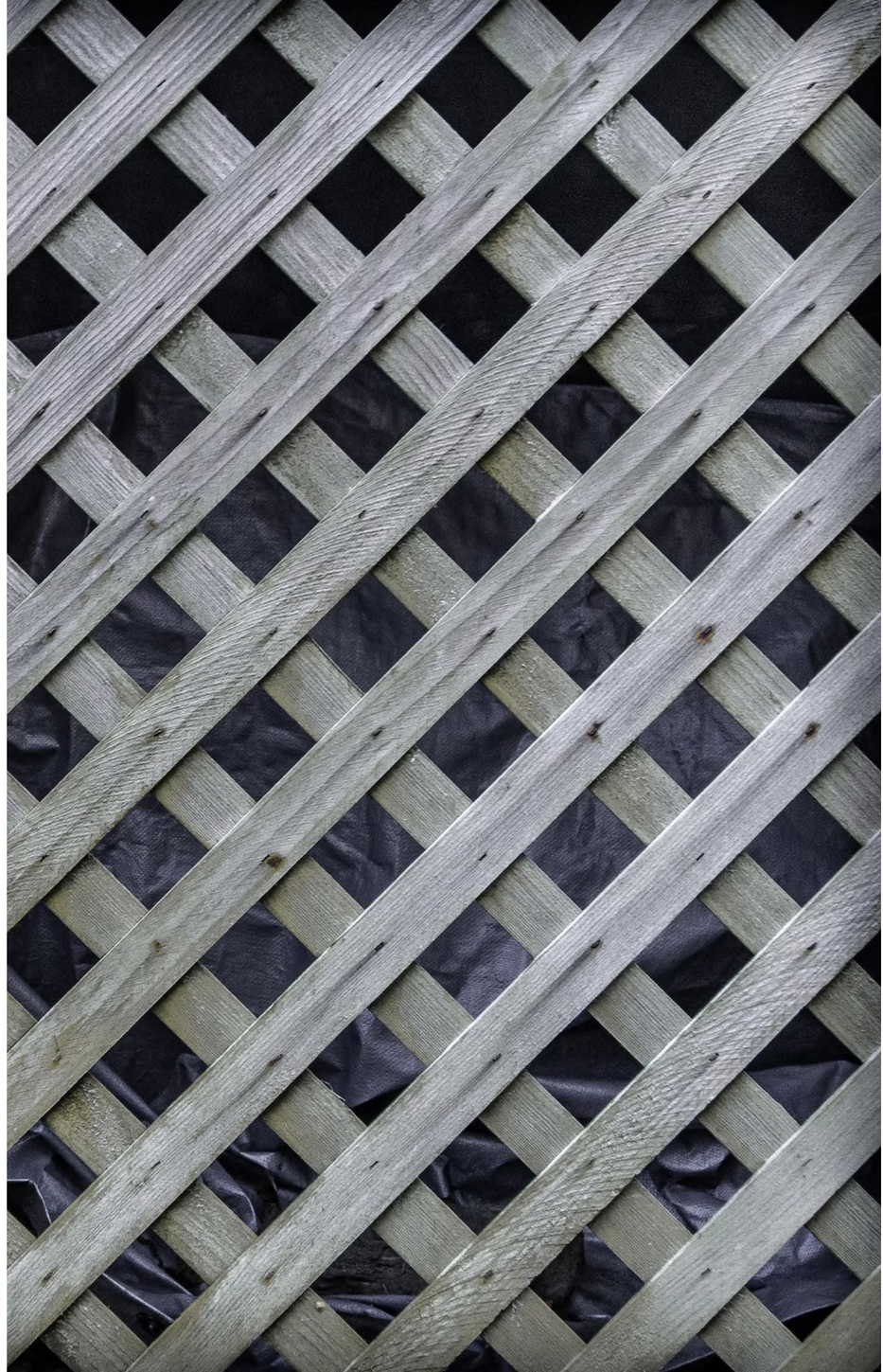
$$S \leq \frac{1}{\varepsilon}$$

$$N - N$$

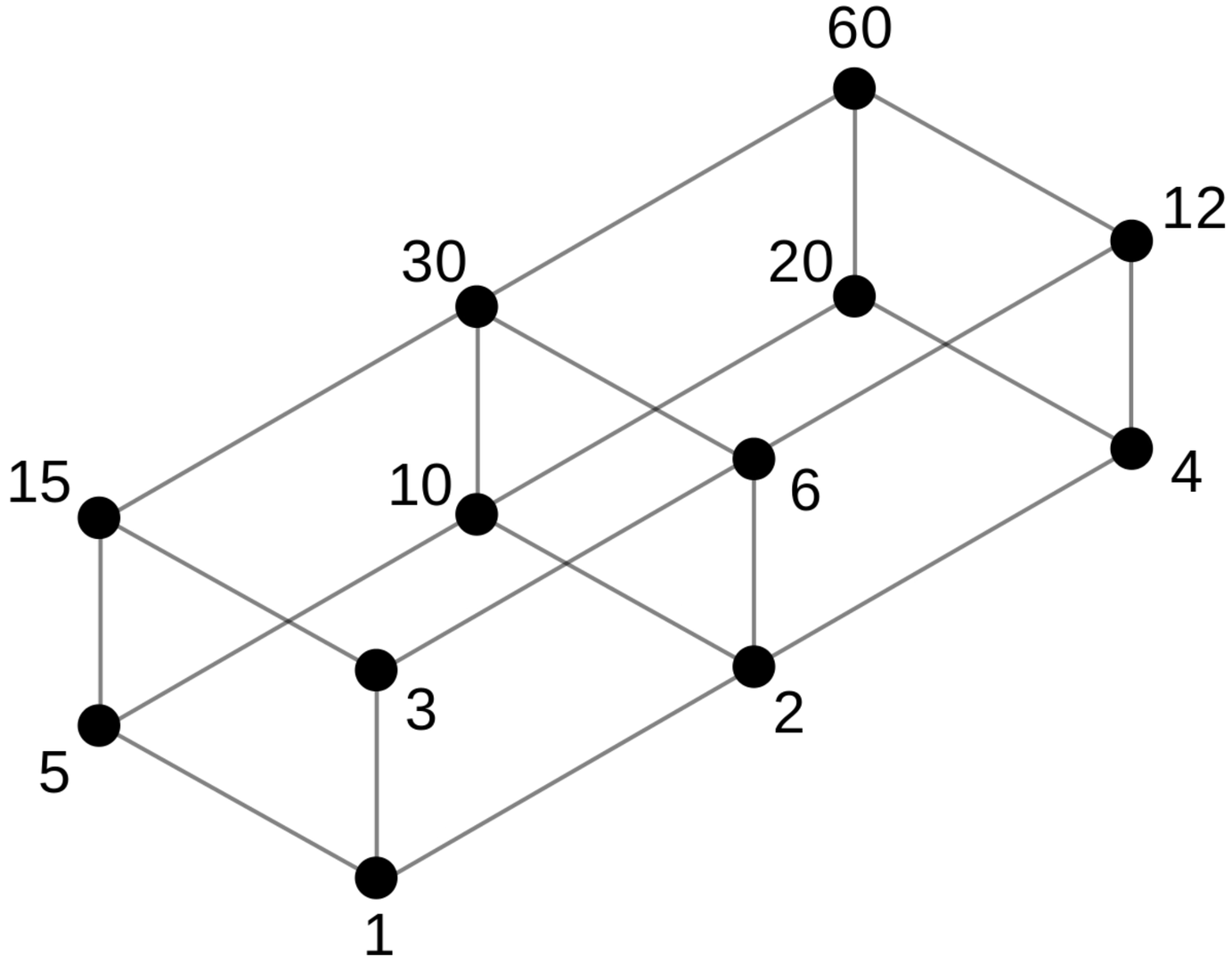
$$P_t = (m$$

Lattices

- mathematical structure
- abstract definition of ordering

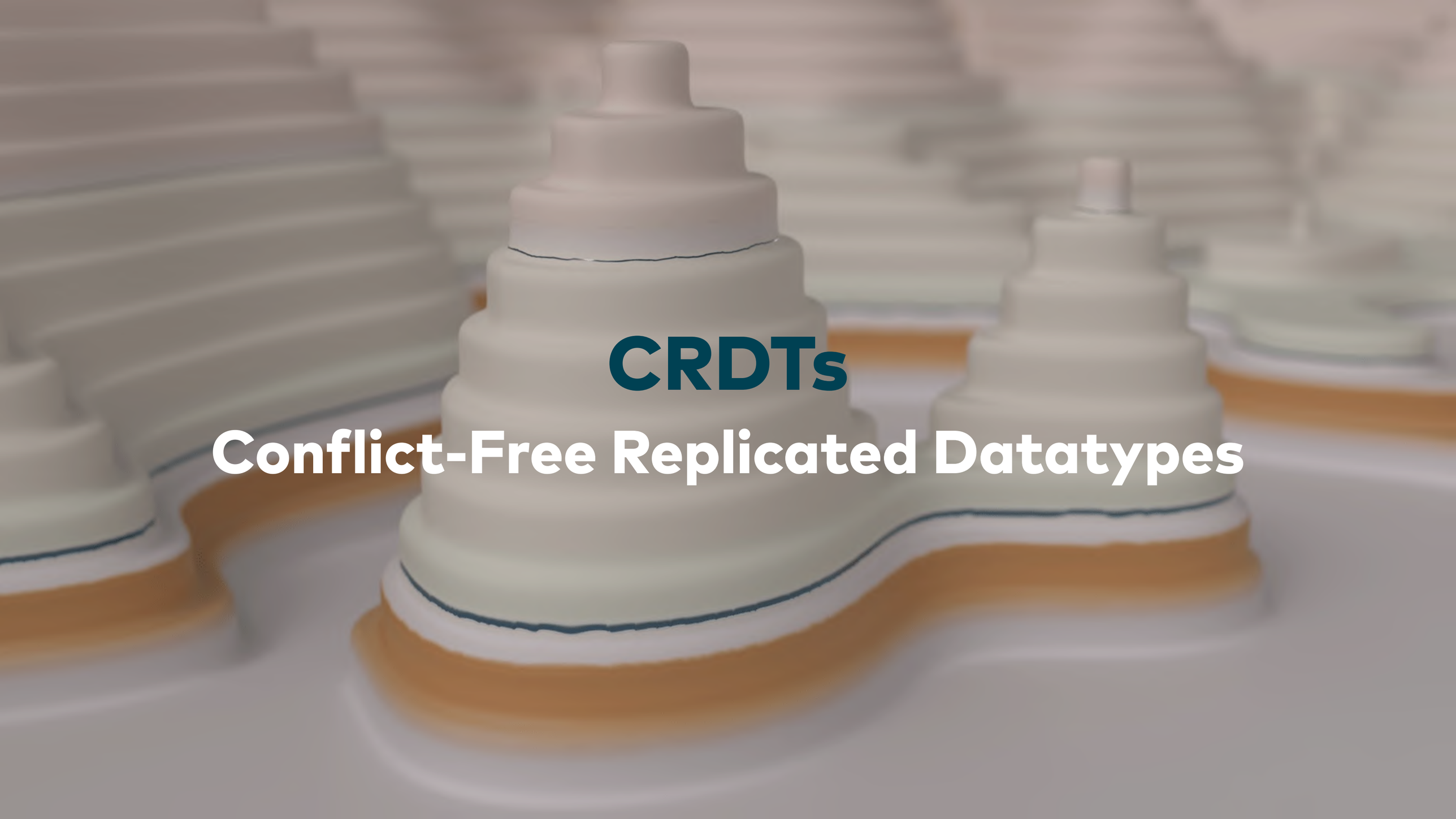


```
interface Lattice<T> {
  join(left: T, right: T): T;
  lteq(left: T, right: T): boolean;
}

// 1. join(x, y) == join(y, x)
// 2. join(x, x) == x
// 3. join(x, join(y, z)) == join(join(x, y), z)
// ...
```



https://commons.wikimedia.org/wiki/File:Lattice_of_the_divisibility_of_60.svg

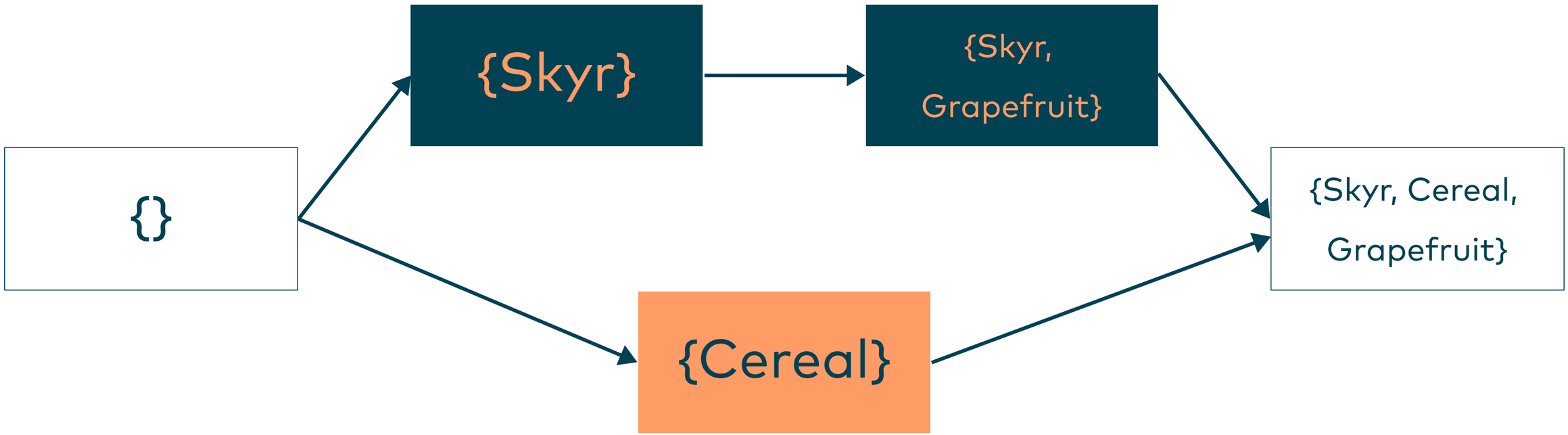
```
const divisionLattice: Lattice<number> = {
  join(left: number, right: number) {
    return leastCommonMultiple(left, right);
  },
  lteq(left: number, right: number) {
    return right % left == 0;
  }
}
```



CRDTs

Conflict-Free Replicated Datatypes

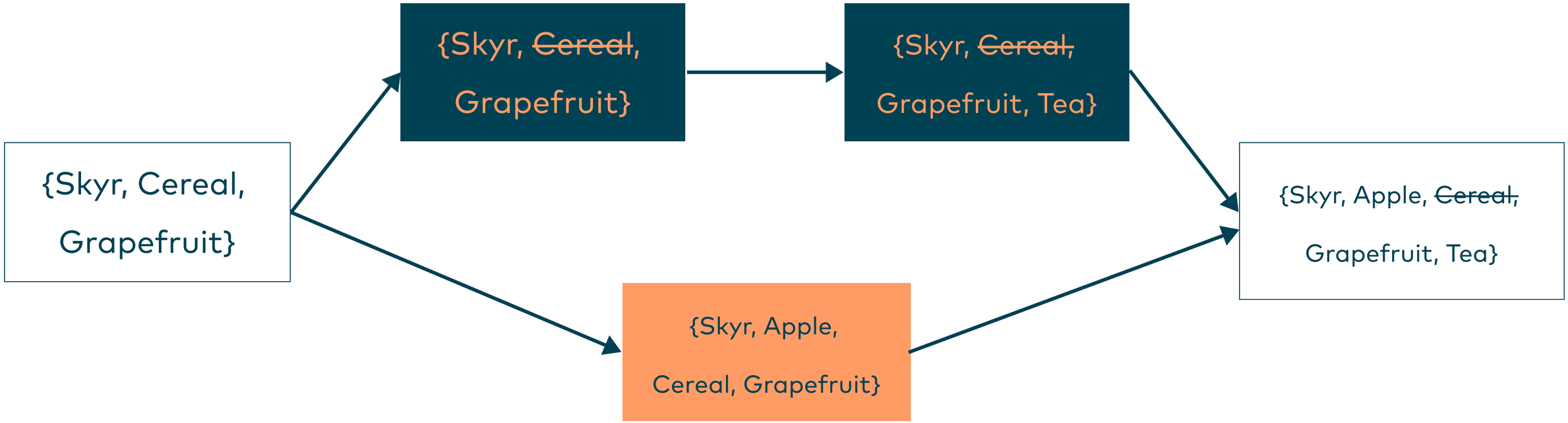
Example: G-Sets



Tombstones

- deletion is not monotonic ☹️
- solution: mark as deleted

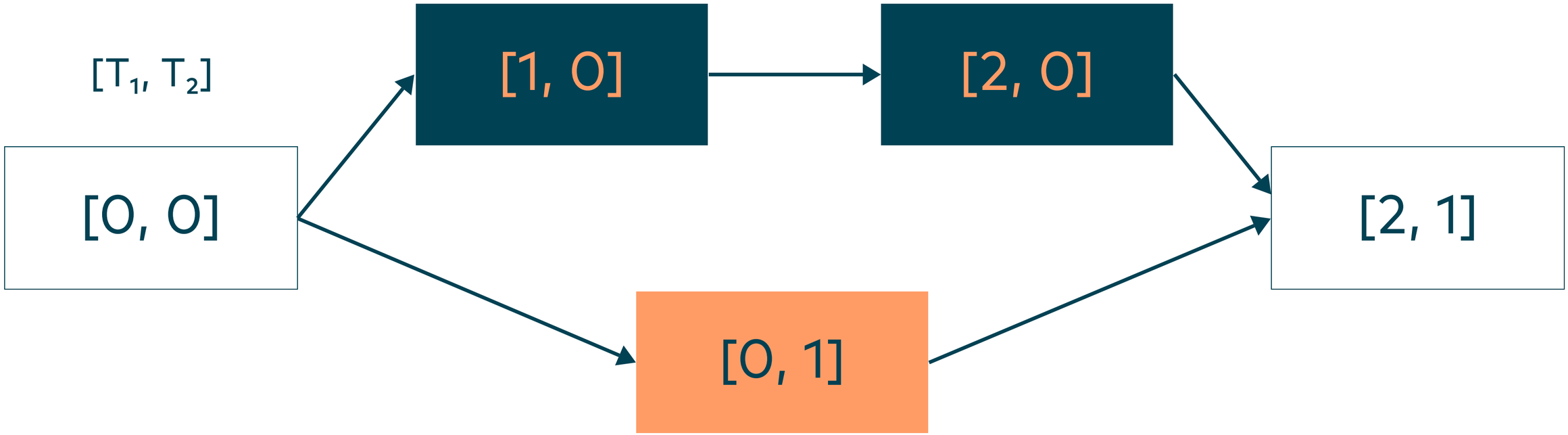
Example: 2P-Sets



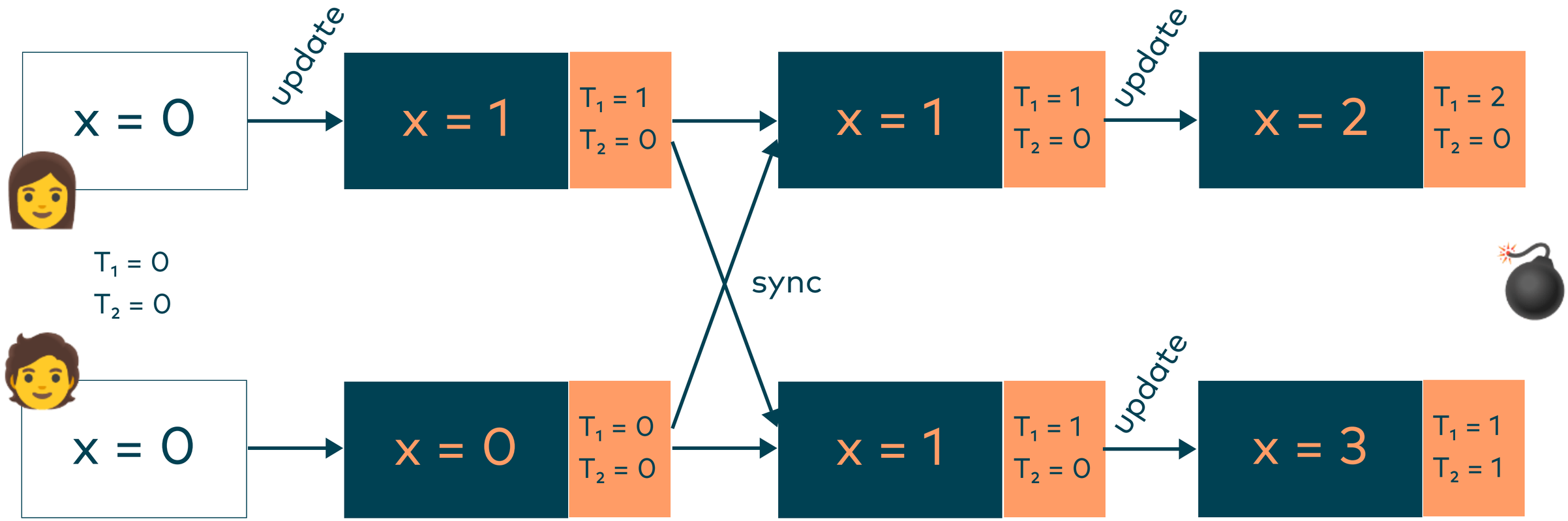
Vector Clocks

- each of the *n* devices gets its own timestamp
- the global timestamp for all devices is composed of those *n* timestamps
- it represents the last known state

Vector Clocks

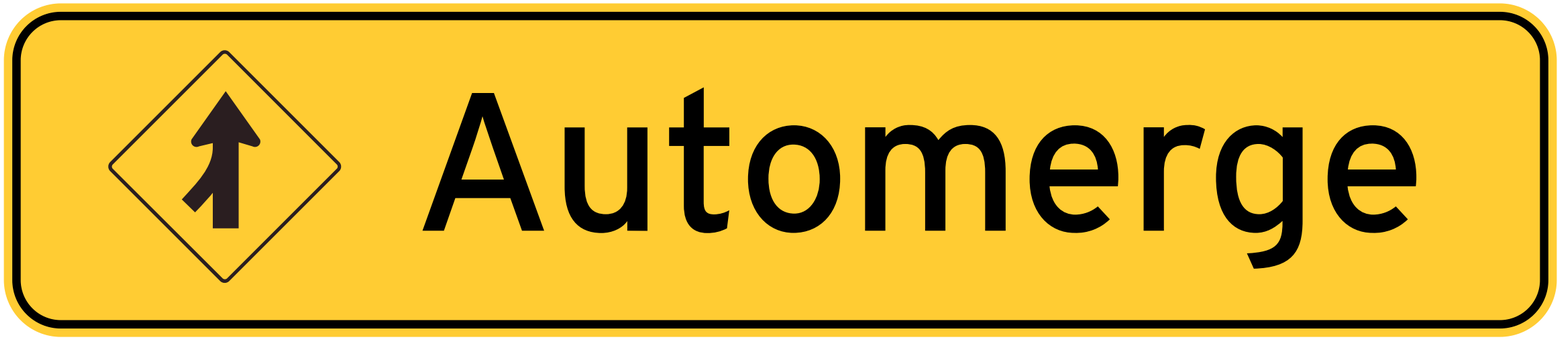


Example: MV-Register



"Any two object replicas of a CvRDT eventually converge, assuming the system transmits payload infinitely often between pairs of replicas over eventually-reliable point-to-point channels."


b,d=this,e=this
(c.router.
),a(document.
),c.router.
undelegateEvents
sed").toggleCl
PreviewDeviceBut
eyEvent:function
maybeRequestFile
bone.View.exten
To(c.collection
),c.announceSe
function(){c.over


Automerge

Automerge

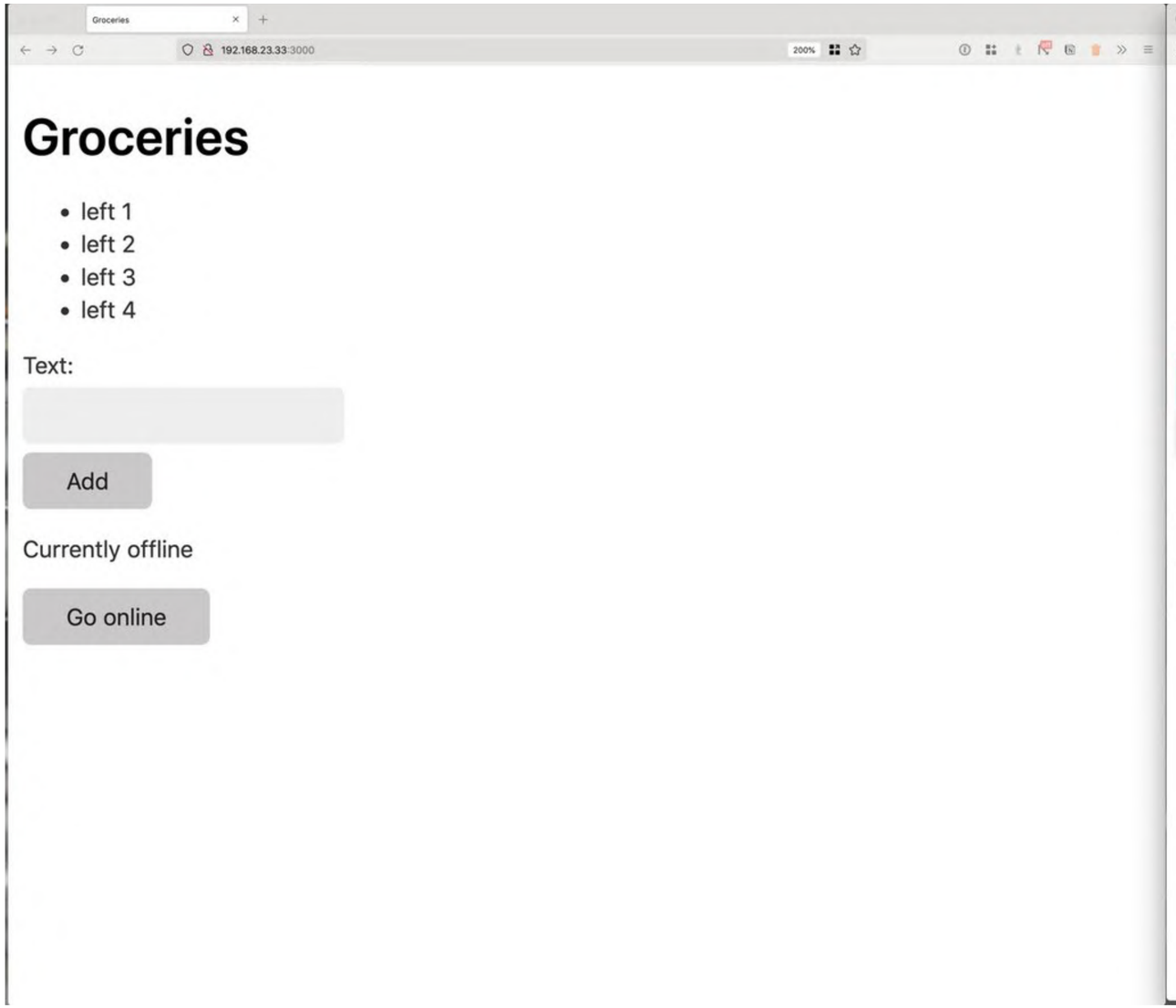
- JavaScript Library for Browser & Node
- offers JSON documents as datatype
  - 💡 they are CRDTs

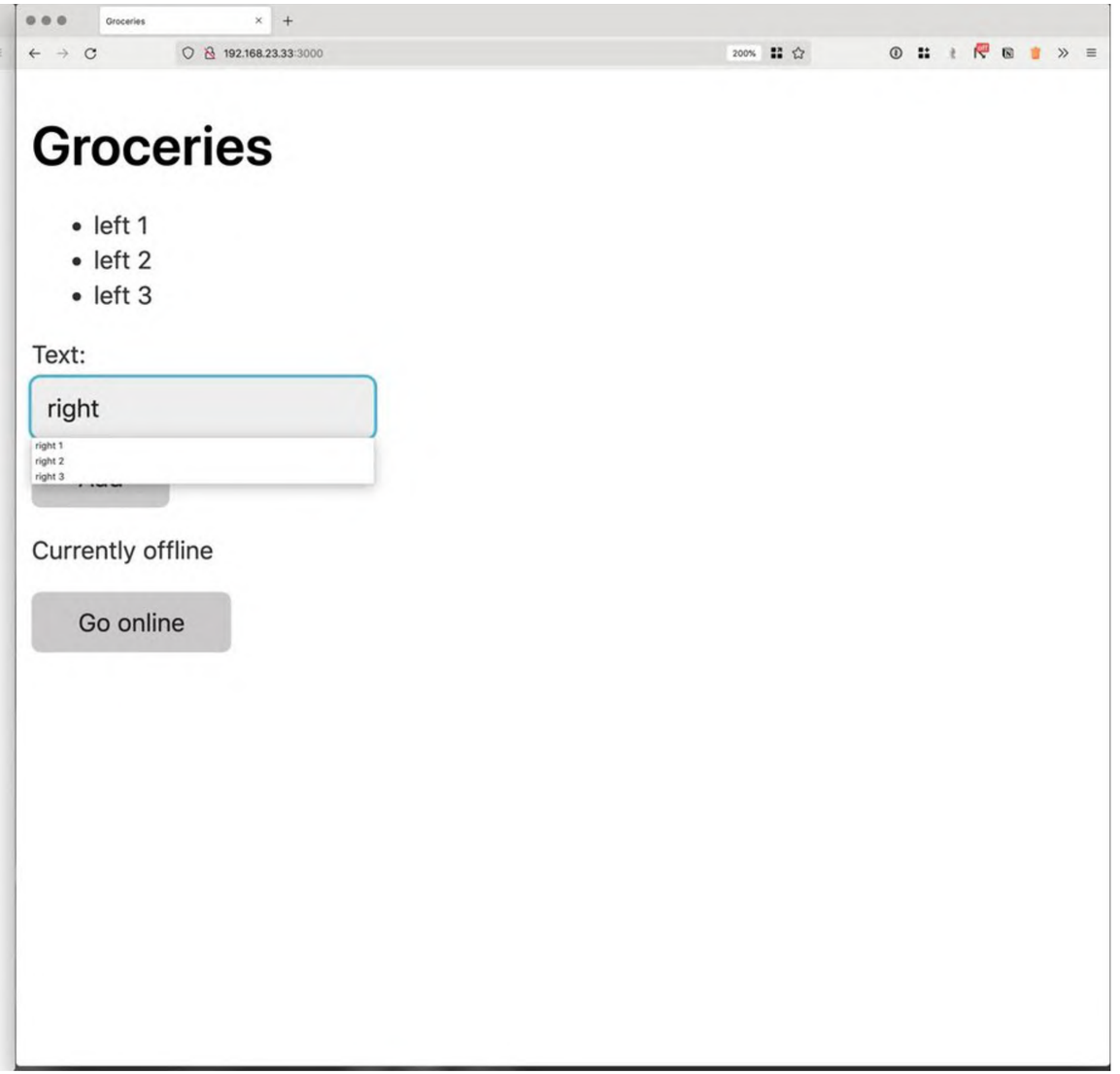
Usage

```
doc1 = Automerge.from({ todos: [] })

doc2 = Automerge.change(doc1, 'Add cereal', doc => {
  doc.todos.push({ text: 'Cereal', done: false })
})

doc3 = Automerge.change(doc1, 'Add skyr', doc => {
  doc.todos.push({ text: 'Skyr', done: false })
})

doc4 = Automerge.merge(doc2, doc3)
// contains traces of cereal & skyr
```

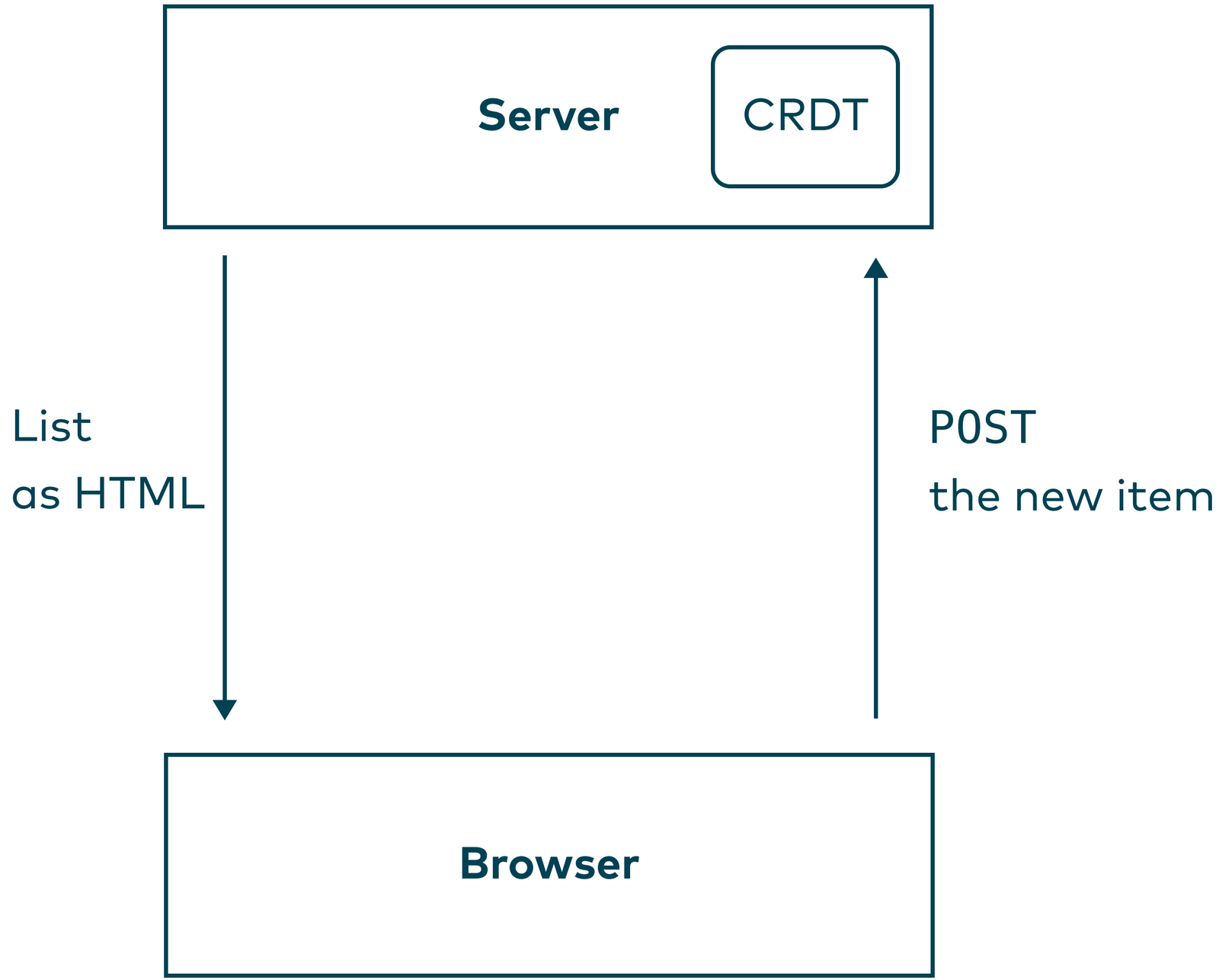
Demo

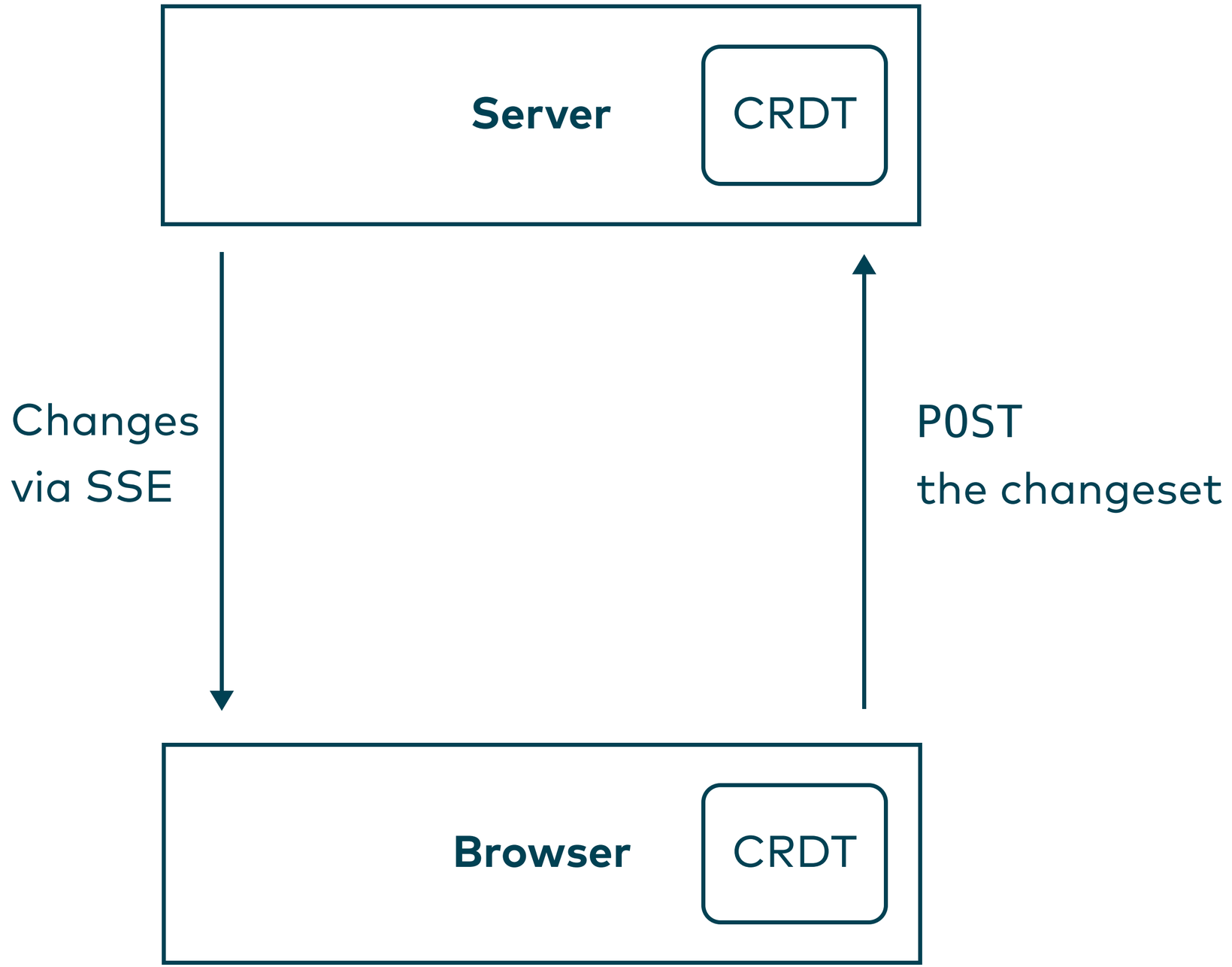
Shopping List


Groceries
192.168.23.33:3000
200%
Groceries
left 1
left 2
left 3
left 4
Text:
Add
Currently offline
Go online


Groceries
192.168.23.33:3000
200%
Groceries
left 1
left 2
left 3
Text:
right
right 1
right 2
right 3
Currently offline
Go online

https://github.com/innoq/groceries


Server
CRDT
List
as HTML
POST
the new item
Browser


Server
CRDT
Changes
via SSE
POST
the changeset
Browser
CRDT

Subscribe via SSE

```
const source = new EventSource("/stream");
source.addEventListener("message", (ev) => {
    list.applyChanges(ev.data);
});
```

Push Changes

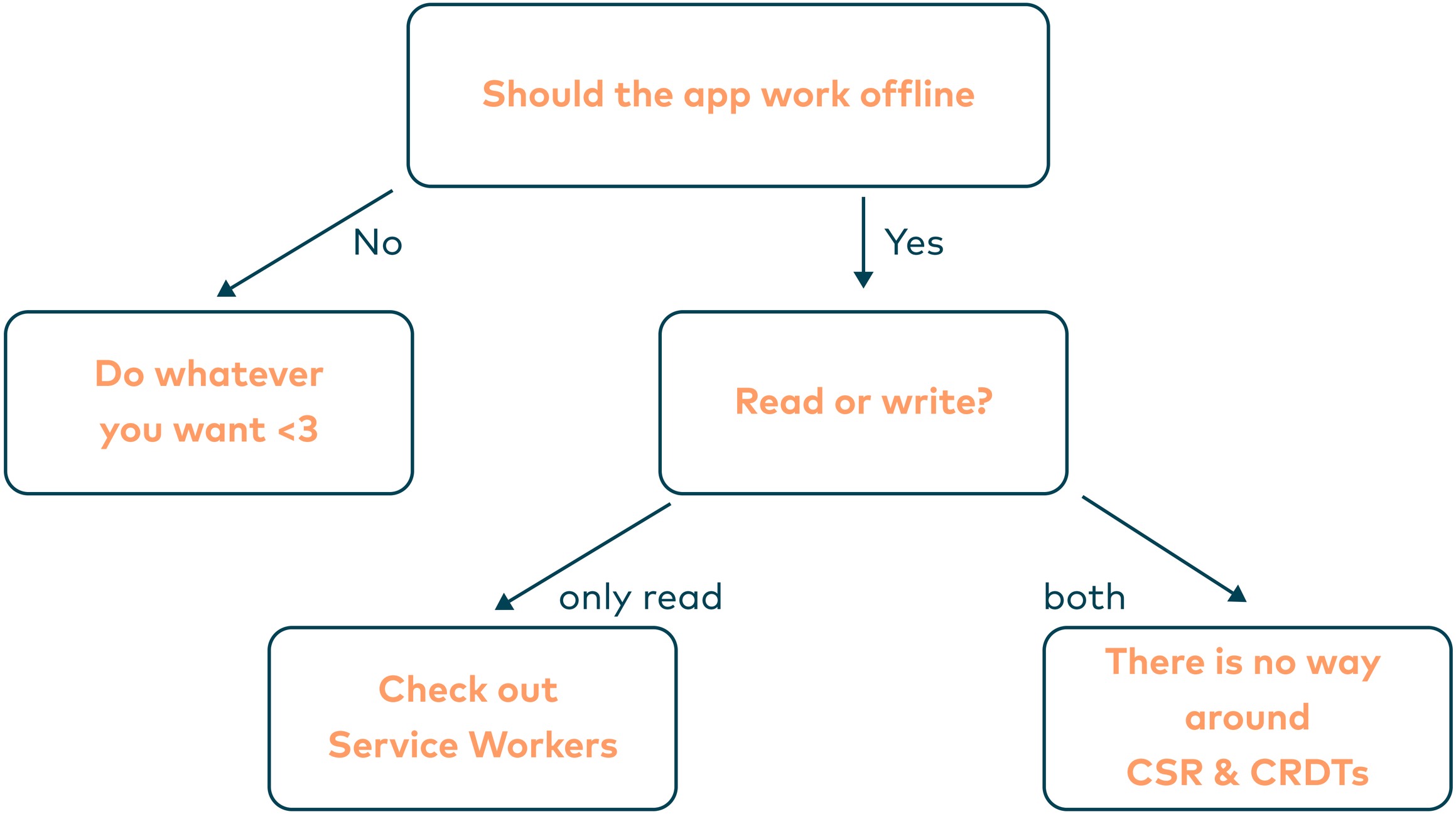
```
class List {
  constructor() {
    // ...
    this.changes = [];
    this.interval =
        setInterval(this.pushChanges.bind(this), 1000);
  }
}
```

Push Changes

```
async pushChanges() {
  try {
    await fetch("/", {
      method: "POST",
      headers: { "Content-Type": "application/json" },
      body: JSON.stringify({ changes: this.changes }),
    });
    this.changes = [];
  } catch(e) { /* ... */ }
}
```

More Features

- other datatypes
  - Counter
  - Text (collaborative editing)
    - Peritext
  - table
- P2P with Hypermerge


Should the app work offline
No
Yes
Do whatever you want <3
Read or write?
only read
both
Check out Service Workers
There is no way around CSR & CRDTs

Q&A

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