



Solid CRDTs in Practice

2nd Solid Symposium, May 3rd 2024, Leuven

Noel De Martin

Hello, my name is Noel



- Developer & Entrepreneur.
- 4-day workweek @ [Moodle](#).
- Making Solid Apps on the side.
- Working in the Open.

noeldemartin.com | noeldemartin.social | [@NoelDeMartin](https://twitter.com/NoelDeMartin)



My Journey with Solid

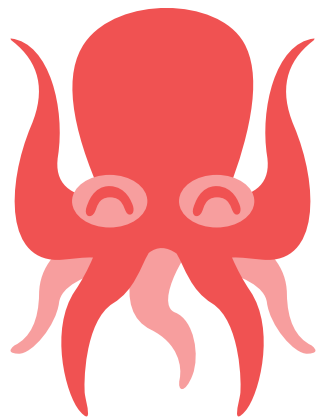


Solid Focus

August 2019

- Task Manager
- First encounter with Solid (and RDF!)
- Plain CRUD over a Solid POD
- Reloading UX wasn't great...

My Journey with Solid



Media Kraken

July 2020

- Media Tracker
- First attempt at caching POD data locally
- Reloading UX improved, but still wasn't great...
(See solid/specification#227)

My Journey with Solid



Umai

January 2023

- Recipes Manager
- Local-first
- Good reloading UX (thanks to CRDTs!)

CRD-what?

- CRDT= **C**onflict-Free **R**eplicated **D**ata **T**ype



Local-first software

You own your data, in spite of the cloud

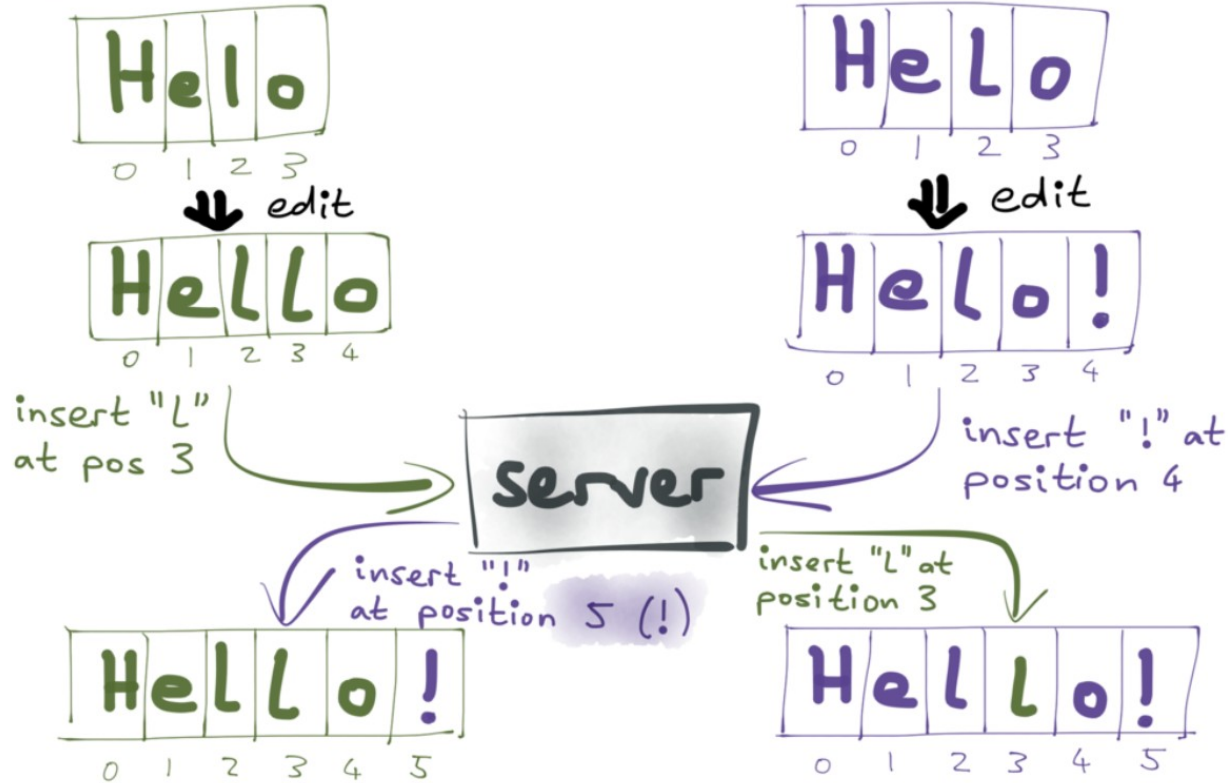
inkandswitch.com/local-first/



youtu.be/DEcwa68f-jY

noeldemartin.com/solid-symposium-crdts

GOOGLE DOCS (NUTSHELL)



Source: [Conflict Resolution for Eventual Consistency](#) • Martin Kleppmann • GOTO 2016

Design Constraints

- ✓ Should work with any spec-compliant Solid POD.
- ✓ No server-side dependencies.
(besides the Solid POD)
- ✓ Interoperable with other apps.

CRDTs in Solid

- RDF Triples are the atomic unit.
(or "[RDF Properties](#)")
- Operations:

Set Property

Add Property

Delete

Unset Property

Remove Property

vocab.noeldemartin.com/crdt/

CRDTs in Solid



Ramen is awesome

SHARE

EDIT

CRDTs in Solid

T0: Recipe exists in both devices and Solid POD

Mobile

Ramen

Ramen is awesome

createdAt T0
updatedAt T0

Solid POD

Ramen

Ramen is awesome

createdAt T0
updatedAt T0

Desktop

Ramen

Ramen is awesome

createdAt T0
updatedAt T0

CRDTs in Solid

T1: Recipe is updated in Mobile

Mobile

Ramen!!!

Ramen is awesome

createdAt T0
updatedAt T1

Solid POD

Ramen

Ramen is awesome

createdAt T0
updatedAt T0

Desktop

Ramen

Ramen is awesome

createdAt T0
updatedAt T0

CRDTs in Solid

T2: Recipe is updated in Desktop

Mobile

Ramen!!!

Ramen is awesome

createdAt T0
updatedAt T1

Solid POD

Ramen

Ramen is awesome

createdAt T0
updatedAt T0

Desktop

Ramen

Ramen is life

createdAt T0
updatedAt T2

CRDTs in Solid

T3: Desktop synchronizes with the POD

Mobile

Ramen!!!

Ramen is awesome

createdAt T0
updatedAt T1

Solid POD

Ramen

Ramen is awesome

createdAt T0
updatedAt T0

(no updates)



Desktop

Ramen

Ramen is life

createdAt T0
updatedAt T2

CRDTs in Solid

T3: Desktop synchronizes with the POD

Mobile

Ramen!!!

Ramen is awesome

createdAt T0
updatedAt T1

Solid POD

Ramen

Ramen is life

createdAt T0
updatedAt T2

Desktop

Ramen

Ramen is life

createdAt T0
updatedAt T2

(1 update)



CRDTs in Solid

T4: Mobile synchronizes with the POD

Mobile

Ramen!!!

Ramen is awesome

createdAt T0
updatedAt T1



(1 update)



Solid POD

Ramen

Ramen is life

createdAt T0
updatedAt T2

Desktop

Ramen

Ramen is life

createdAt T0
updatedAt T2

CRDTs in Solid

T0: Recipe exists in both devices and Solid POD

Mobile

Ramen

Ramen is awesome

createdAt T0
updatedAt T0

Solid POD

Ramen

Ramen is awesome

createdAt T0
updatedAt T0

Desktop

Ramen

Ramen is awesome

createdAt T0
updatedAt T0

CRDTs in Solid

T1: Recipe is updated in Mobile

Mobile

Ramen!!!

Ramen is awesome

createdAt T0
updatedAt T1

--

T1: update name

Solid POD

Ramen

Ramen is awesome

createdAt T0
updatedAt T0

Desktop

Ramen

Ramen is awesome

createdAt T0
updatedAt T0

CRDTs in Solid

T2: Recipe is updated in Desktop

Mobile

Ramen!!!

Ramen is awesome

createdAt T0
updatedAt T1

--

T1: update name

Solid POD

Ramen

Ramen is awesome

createdAt T0
updatedAt T0

Desktop

Ramen

Ramen is life

createdAt T0
updatedAt T2

--

T2: update description

CRDTs in Solid

T3: Desktop synchronizes with the POD

Mobile

Ramen!!!

Ramen is awesome

createdAt T0
updatedAt T1

--

T1: update name

Solid POD

Ramen

Ramen is awesome

createdAt T0
updatedAt T0

(no updates)

Desktop

Ramen

Ramen is life

createdAt T0
updatedAt T2

--

T2: update description

CRDTs in Solid

T3: Desktop synchronizes with the POD

Mobile

Ramen!!!

Ramen is awesome

createdAt T0
updatedAt T1

--

T1: update name

Solid POD

Ramen

Ramen is life

createdAt T0
updatedAt T2

--

T2: update description

Desktop

Ramen

Ramen is life

createdAt T0
updatedAt T2

--

T2: update description

(1 update)



CRDTs in Solid

T4: Mobile synchronizes with the POD

Mobile

Ramen!!!

Ramen is life

createdAt T0
updatedAt T2

--

T1: update name

T2: update description

Solid POD

Ramen

Ramen is life

createdAt T0
updatedAt T2

--

T2: update description

Desktop

Ramen

Ramen is life

createdAt T0
updatedAt T2

--

T2: update description

(1 update)



CRDTs in Solid

T4: Mobile synchronizes with the POD

Mobile

Ramen!!!

Ramen is life

createdAt T0
updatedAt T2

--
T1: update name
T2: update description

(1 update)



Solid POD

Ramen!!!

Ramen is life

createdAt T0
updatedAt T2

--
T1: update name
T2: update description

Desktop

Ramen

Ramen is life

createdAt T0
updatedAt T2

--
T2: update description

CRDTs in Solid

T5: Desktop synchronizes with the POD

Mobile

Ramen!!!

Ramen is life

createdAt T0
updatedAt T2

--
T1: update name
T2: update description

Solid POD

Ramen!!!

Ramen is life

createdAt T0
updatedAt T2

--
T1: update name
T2: update description

(1 update)

Desktop

Ramen!!!

Ramen is life

createdAt T0
updatedAt T2

--
T1: update name
T2: update description

CRDTs in Solid

T5: Desktop synchronizes with the POD

Mobile

Ramen!!!

Ramen is life

createdAt T0
updatedAt T2

--
T1: update name
T2: update description

Solid POD

Ramen!!!

Ramen is life

createdAt T0
updatedAt T2

--
T1: update name
T2: update description

Desktop

Ramen!!!

Ramen is life

createdAt T0
updatedAt T2

--
T1: update name
T2: update description

(no updates)



CRDTs in Solid

T6: Everything is up to date!

Mobile

Ramen!!!

Ramen is life

createdAt T0
updatedAt T2

--
T1: update name
T2: update description

Solid POD

Ramen!!!

Ramen is life

createdAt T0
updatedAt T2

--
T1: update name
T2: update description

Desktop

Ramen!!!

Ramen is life

createdAt T0
updatedAt T2

--
T1: update name
T2: update description

CRDTs in Solid

```
<#it> a schema:Recipe;  
  schema:description "Ramen is life";  
  schema:name "Ramen!!!".
```

```
<#it-metadata> a crdt:Metadata;  
  crdt:resource <#it>;  
  crdt:createdAt "T0"^^xsd:dateTime;  
  crdt:updatedAt "T2"^^xsd:dateTime.
```

CRDTs in Solid

```
<#it-operation-8d1be37f-eb6a-4909-9dbd-cf3c7e16f913> a crdt:SetPropertyOperation;  
  crdt:resource <#it>;  
  crdt:property schema:name;  
  crdt:value "Ramen";  
  crdt:date "T0"^^xsd:dateTime.
```

```
<#it-operation-ac7692d2-039a-4a74-a738-35eb73f8bd89> a crdt:SetPropertyOperation;  
  crdt:resource <#it>;  
  crdt:property schema:description;  
  crdt:value "Ramen is awesome";  
  crdt:date "T0"^^xsd:dateTime.
```

CRDTs in Solid

```
<#it-operation-843ced83-ad18-4330-a86d-36cb5355e0b4> a crdt:SetPropertyOperation;  
  crdt:resource <#it>;  
  crdt:property schema:name;  
  crdt:value "Ramen!!!";  
  crdt:date "T1"^^xsd:dateTime.
```

```
<#it-operation-91853fcc-9992-41fa-95a2-8d2051ae2459> a crdt:SetPropertyOperation;  
  crdt:resource <#it>;  
  crdt:property schema:description;  
  crdt:value "Ramen is life";  
  crdt:date "T2"^^xsd:dateTime.
```

CRDTs in Solid



```
@prefix schema: <https://schema.org/> .
@prefix crdt: <https://vocab.noeldemartin.com/crdt/> .
@prefix xsd: <http://www.w3.org/2001/XMLSchema#> .

<#it> a schema:Recipe;
  schema:description "Ramen is life";
  schema:name "Ramen!!!".

<#it-metadata> a crdt:Metadata;
  crdt:resource <#it>;
  crdt:createdAt "T0"^^xsd:dateTime;
  crdt:updatedAt "T2"^^xsd:dateTime.

<#it-operation-8d1be37f-eb6a-4909-9dbd-cf3c7e16f913> a crdt:SetPropertyOperation;
  crdt:resource <#it>;
  crdt:property schema:name;
  crdt:value "Ramen";
  crdt:date "T0"^^xsd:dateTime.

<#it-operation-ac7692d2-039a-4a74-a738-35eb73f8bd89> a crdt:SetPropertyOperation;
  crdt:resource <#it>;
  crdt:property schema:description;
  crdt:value "Ramen is awesome";
  crdt:date "T0"^^xsd:dateTime.

<#it-operation-843ced83-ad18-4330-a86d-36cb5355e0b4> a crdt:SetPropertyOperation;
  crdt:resource <#it>;
  crdt:property schema:name;
  crdt:value "Ramen!!!";
  crdt:date "T1"^^xsd:dateTime.

<#it-operation-91853fcc-9992-41fa-95a2-8d2051ae2459> a crdt:SetPropertyOperation;
  crdt:resource <#it>;
  crdt:property schema:description;
  crdt:value "Ramen is life";
  crdt:date "T2"^^xsd:dateTime.
```

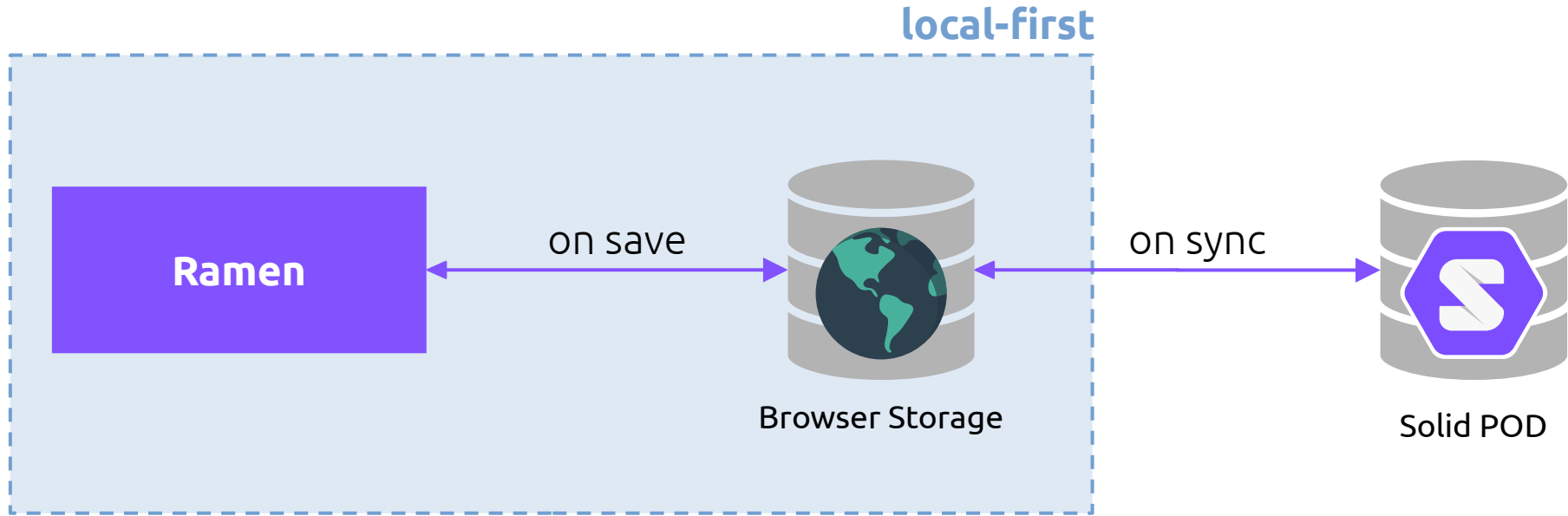
Active Record to the rescue!

“An object that wraps a row in a database table or view, encapsulates the database access, and adds domain logic on that data.”

Active Record to the rescue!

An object that wraps an RDF resource in a container, encapsulates network requests, and adds domain logic on that data.

Active Record to the rescue!

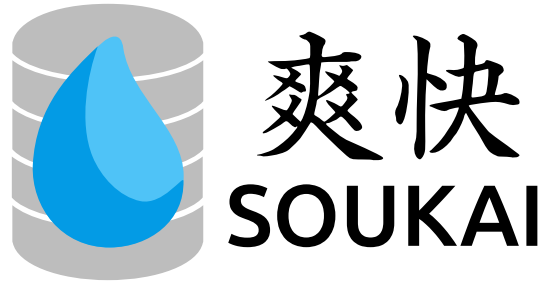


Active Record to the rescue!

```
const ramen = await Recipe.create({
  name: 'Ramen',
  description: 'Ramen is awesome',
});

await ramen.update({ name: 'Ramen!!!' });
await ramen.update({ description: 'Ramen is life' });
```

Active Record to the rescue!



soukai.js.org

github.com/NoelDeMartin/soukai-solid

Aerogel The Lightest Solid

Work in Progress!

[Watch a Sneak Peek](#)

[View the Source Code](#)

aerogel.js.org

noeldemartin.com/solid-symposium-dx

noeldemartin.com/solid-symposium-crtdts

Known Issues & Improvements

- Custom ontology (lack of interoperability).
- Data duplication (no single source of truth).
- Data overhead.
- Logical clocks.
- Real “Real Time” using notifications.

Thanks!

Follow my work at noeldemartin.com/now

Questions?