



# Solid CRDTs in Practice

2<sup>nd</sup> Solid Symposium, May 3<sup>rd</sup> 2024, Leuven

CONNECTS =

# Hello, my name is Noel



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

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



# My Journey with Solid

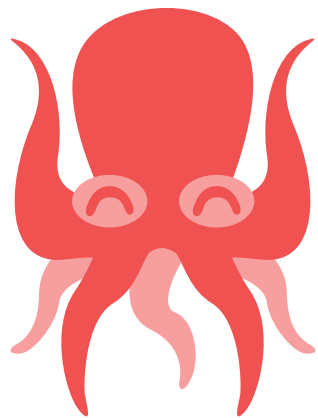


Solid Focus

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](https://solid/specification#227))

# My Journey with Solid



Umai

January 2023

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

# CRD-what?

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

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**Ink & Switch**

Local-first software

You own your data, in spite of the cloud

[inkandswitch.com/local-first/](https://inkandswitch.com/local-first/)

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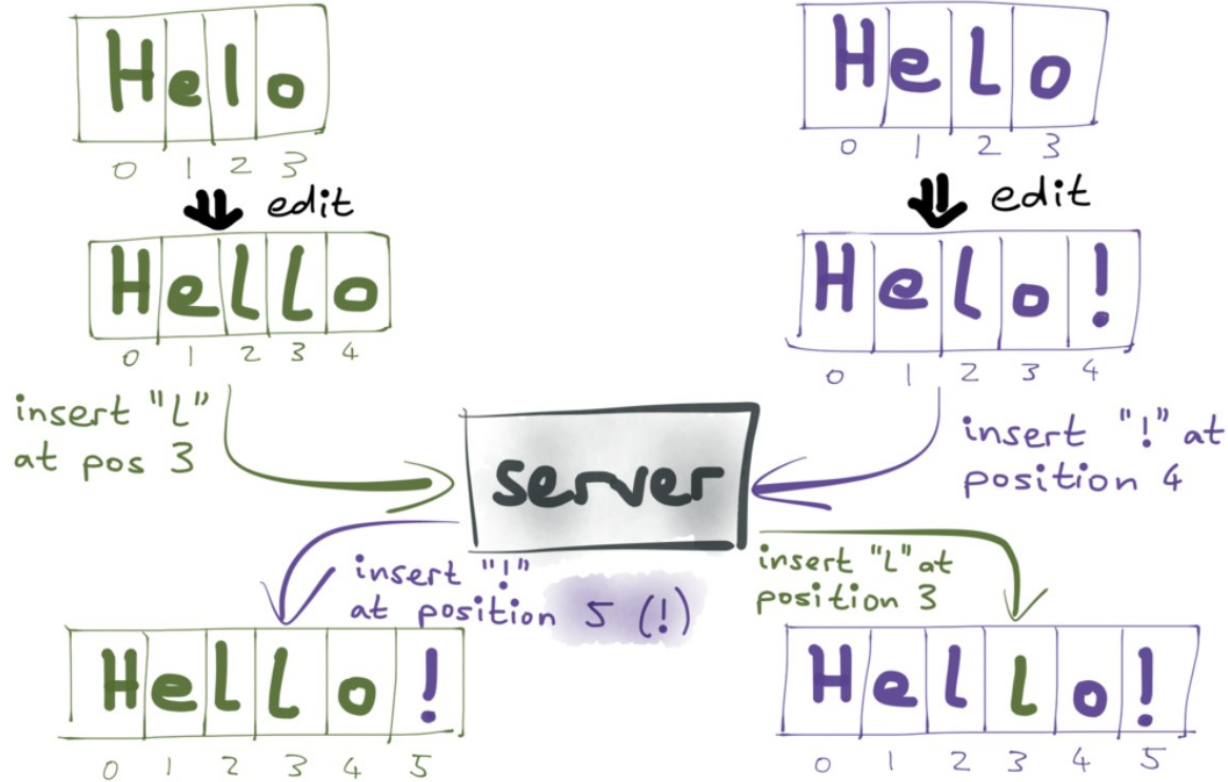


[youtu.be/DEcwa68f-jY](https://youtu.be/DEcwa68f-jY)

[noeldemartin.com/solid-symposium-crdts](https://noeldemartin.com/solid-symposium-crdts)

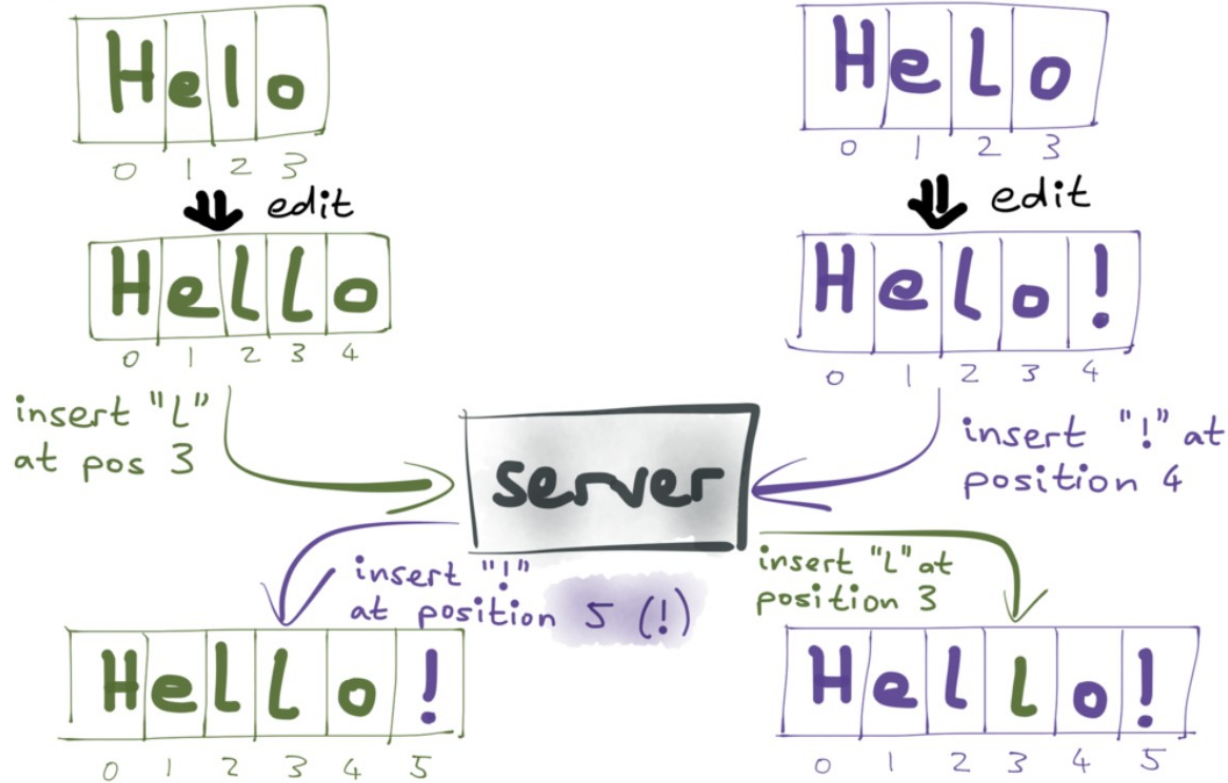


# GOOGLE DOCS (NUTSHELL)



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

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- ✓ Should work with any spec-compliant Solid POD.

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(besides the Solid POD)

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

# CRDTs in Solid

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(or "[RDF Properties](#)")

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**Remove Property**

[vocab.noeldemartin.com/crdt/](http://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

(1 update)



**Desktop**

**Ramen**

Ramen is life

createdAt T0  
updatedAt T2

--

T2: update description

# 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;
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  crdt:value "Ramen is life";
  crdt:date "T2"^^xsd:dateTime.
```

# Active Record to the rescue!

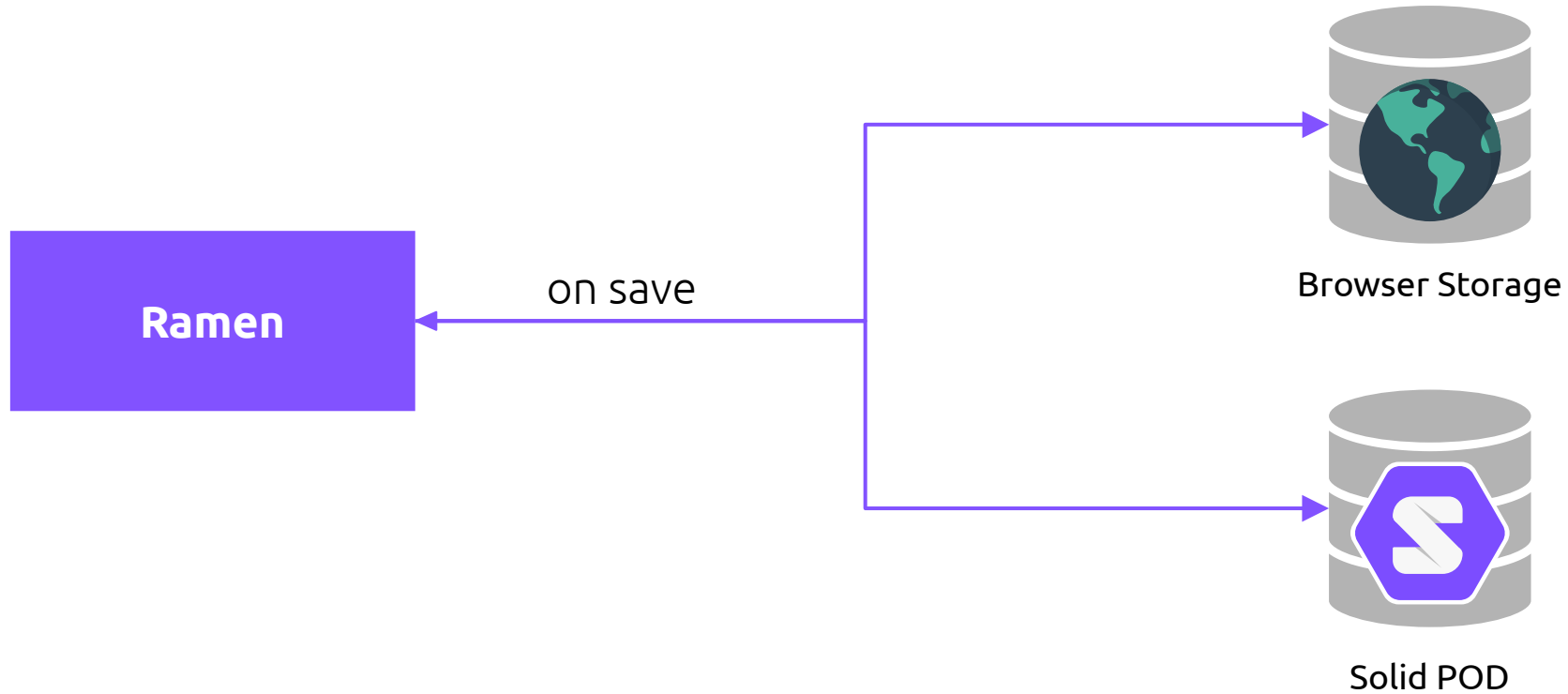
“An object that wraps a row in a database table or view, encapsulates the database access, and adds domain logic on that data.”



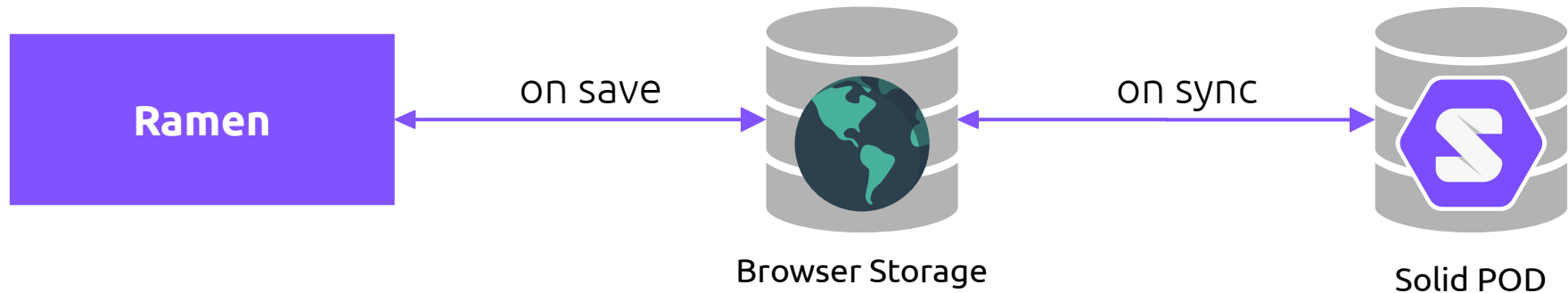
# Active Record to the rescue!

An object that wraps *an RDF resource in a container*,  
**encapsulates the database access**, and adds  
domain logic on that data.

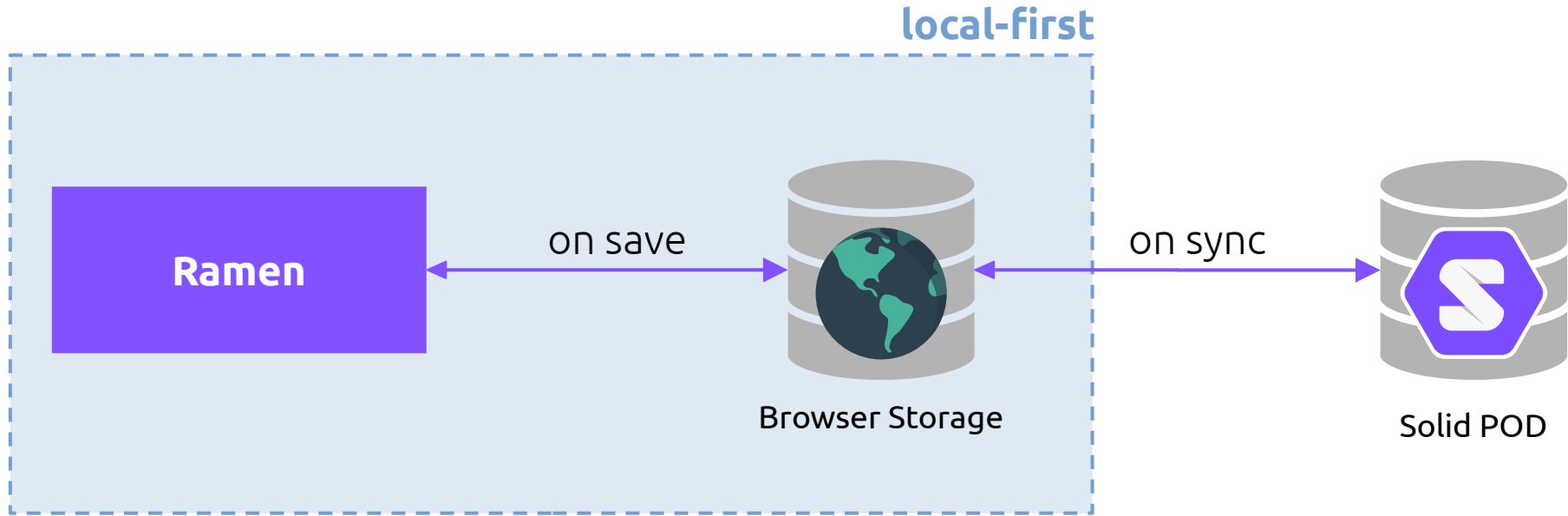
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```
const ramen = await Recipe.create({
  name: 'Ramen',
  description: 'Ramen is awesome',
});

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

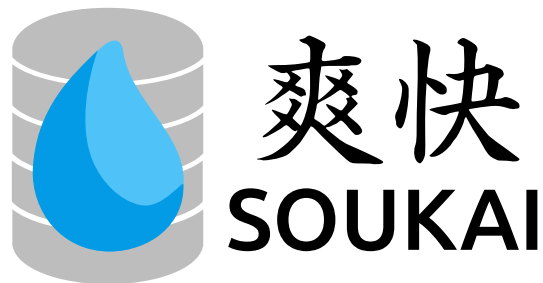
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[soukai.js.org](http://soukai.js.org)

[github.com/NoelDeMartin/soukai-solid](https://github.com/NoelDeMartin/soukai-solid)

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## Aerogel

# The Lightest Solid

Work in Progress!

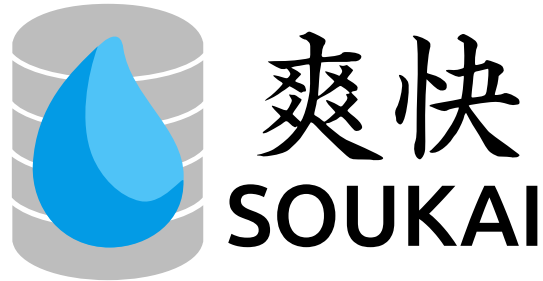
[Watch a Sneak Peek](#)

[View the Source Code](#)

[aerogel.js.org](https://aerogel.js.org)

[noeldemartin.com/solid-symposium-crds](https://noeldemartin.com/solid-symposium-crds)

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- Custom ontology (lack of interoperability).
- Data duplication (no single source of truth).
- Data overhead.
- Logical clocks.
- Real “Real Time” using notifications.
- Peer-to-peer and other communication channels.

# Thanks!

Follow my work at [noeldemartin.com/now](https://noeldemartin.com/now)

# Questions?