Vue Fundamentals

Module – State Management

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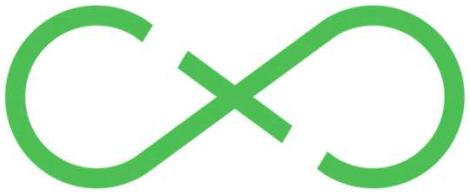
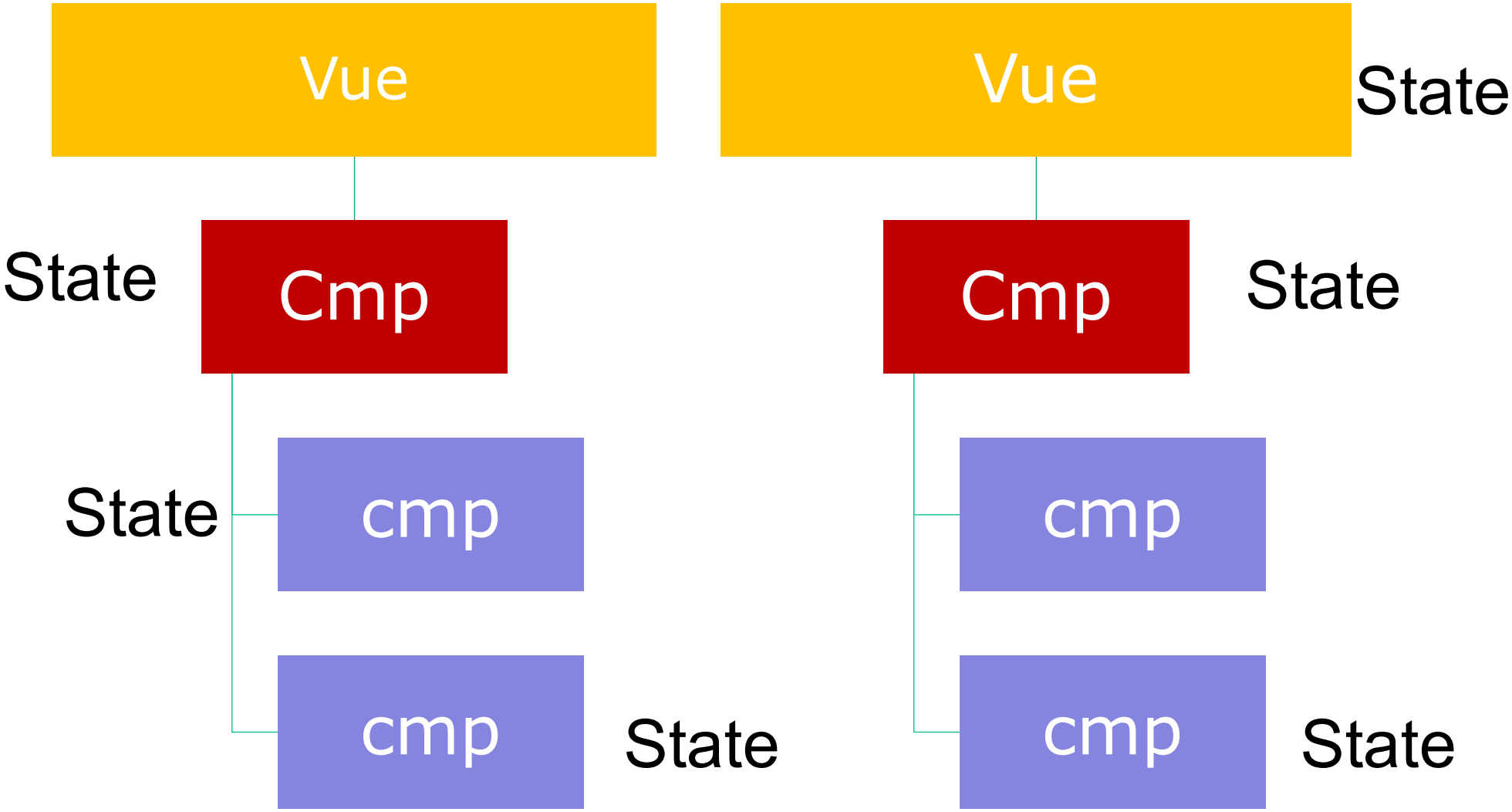
What is State Management?

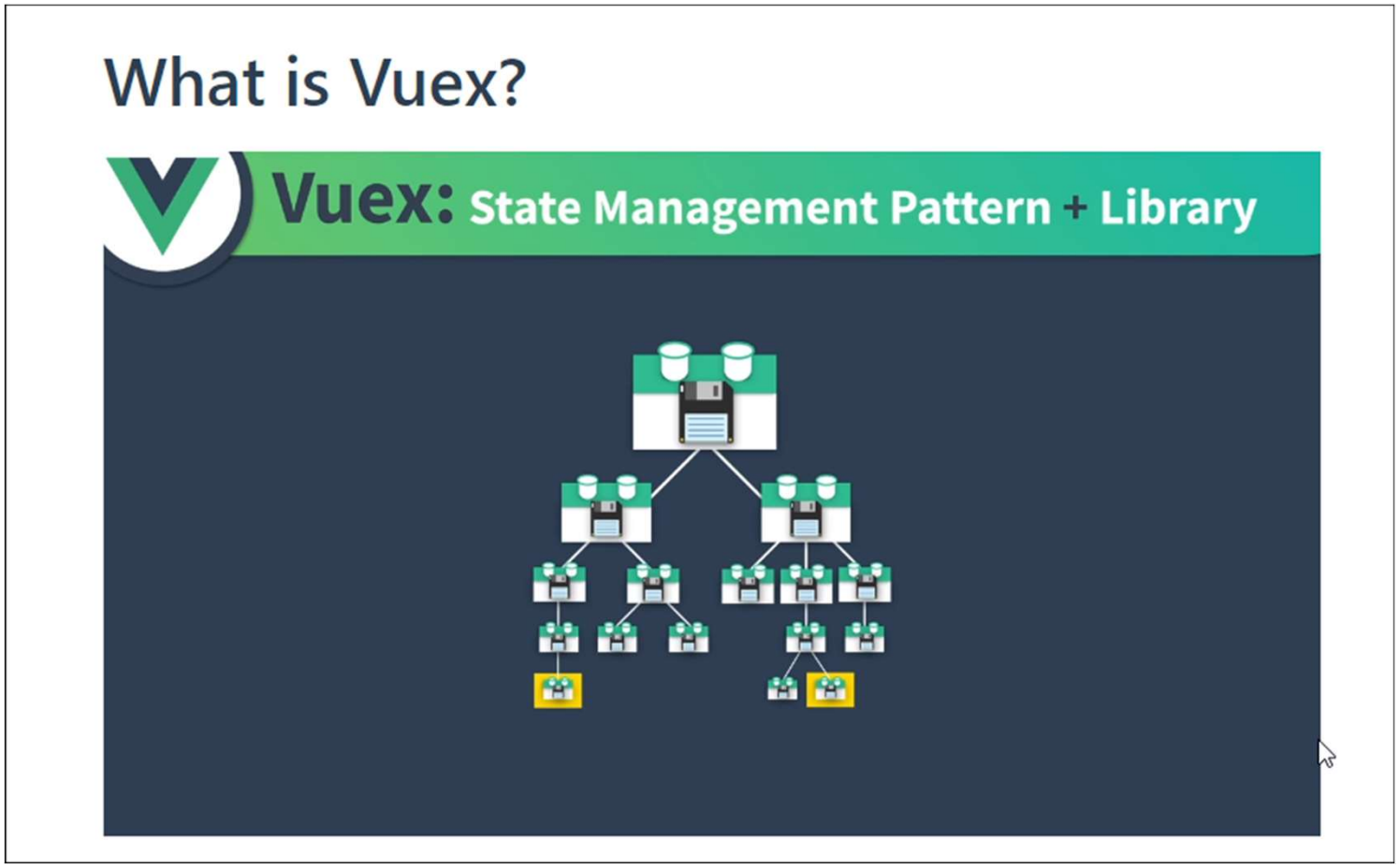
- Various design patterns, used for managing *state* (data in its broadest sense!) in your application.
- Multiple solutions possible – depends on application & framework



State management without a store

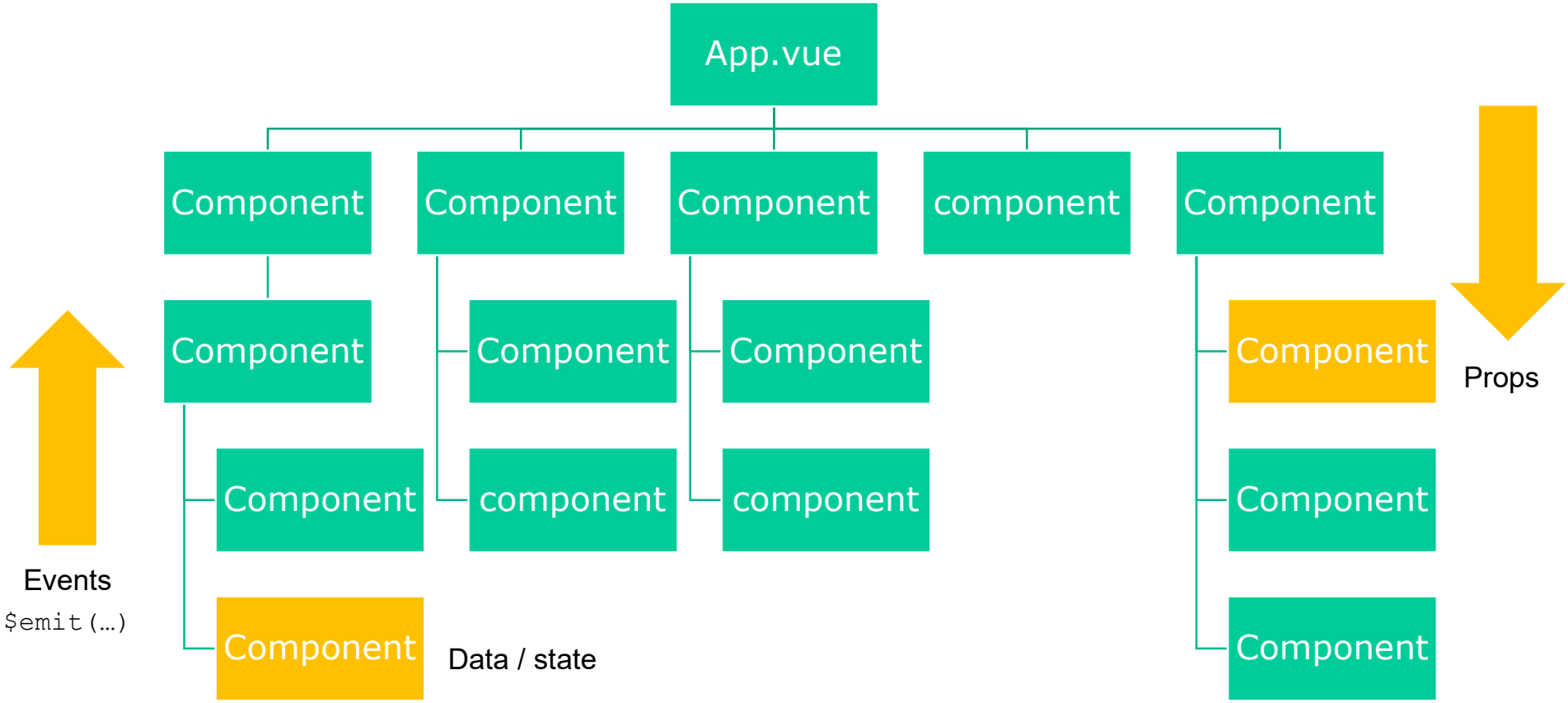


Complex data flow – use a Store



https://vuex.vuejs.org/

Data flow in complex applications



App.vue

Component

Component

Component

component

Component

Component

Component

Component

Component

Component

component

component

Component

Component

Component

Props

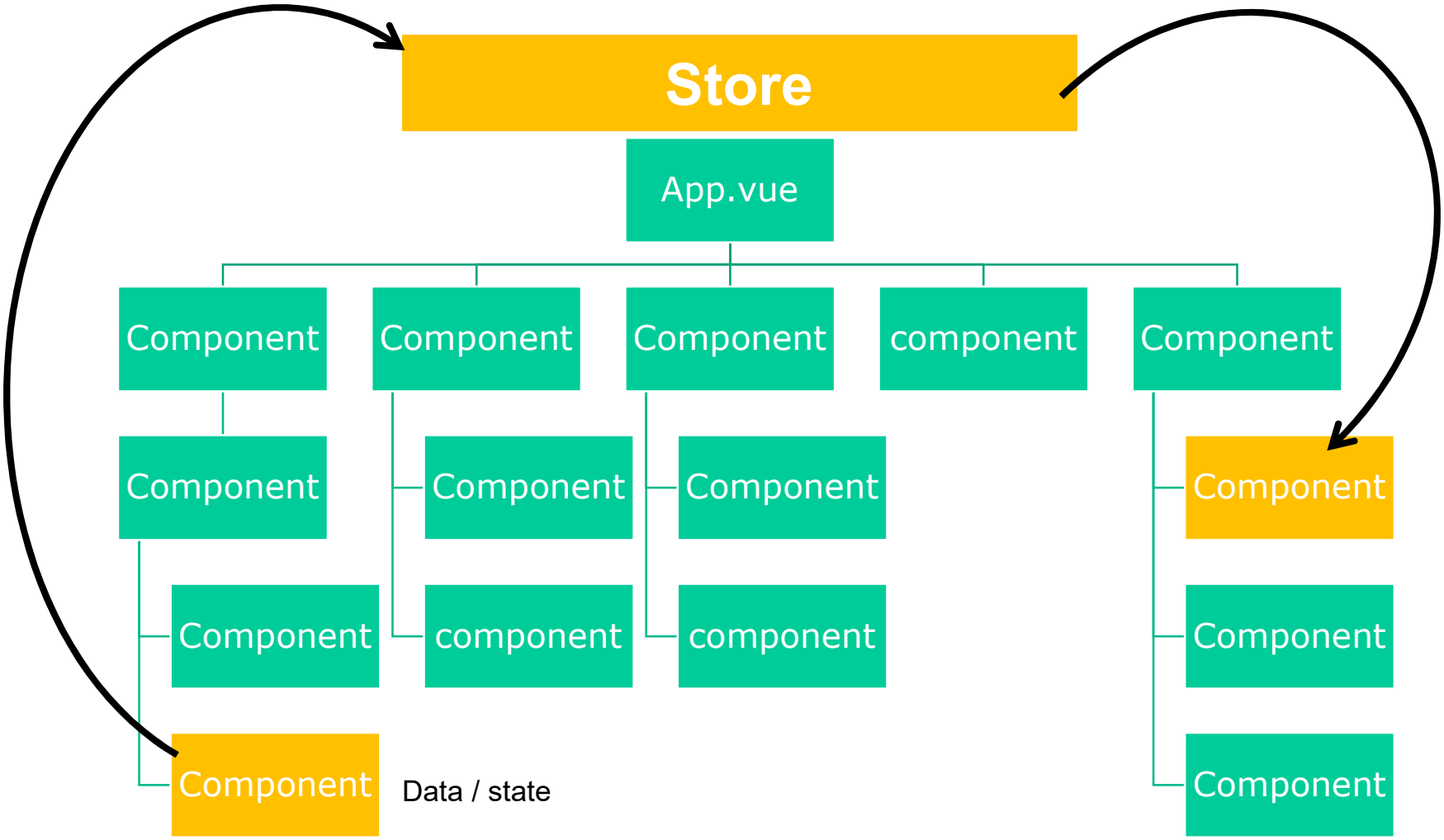
Events

`$emit(…)`

Data / state

We don’t want this…. Not very scalable

State management *with* a store



Benefits of using a store

- State is only changed in a controlled way
- Component state is also driven from the store
- Based on immutable objects – b/c they are predictable
- Developer tools available to debug and see how the store changes over time
  - "Time travelling Developer tools"

One-way data flow

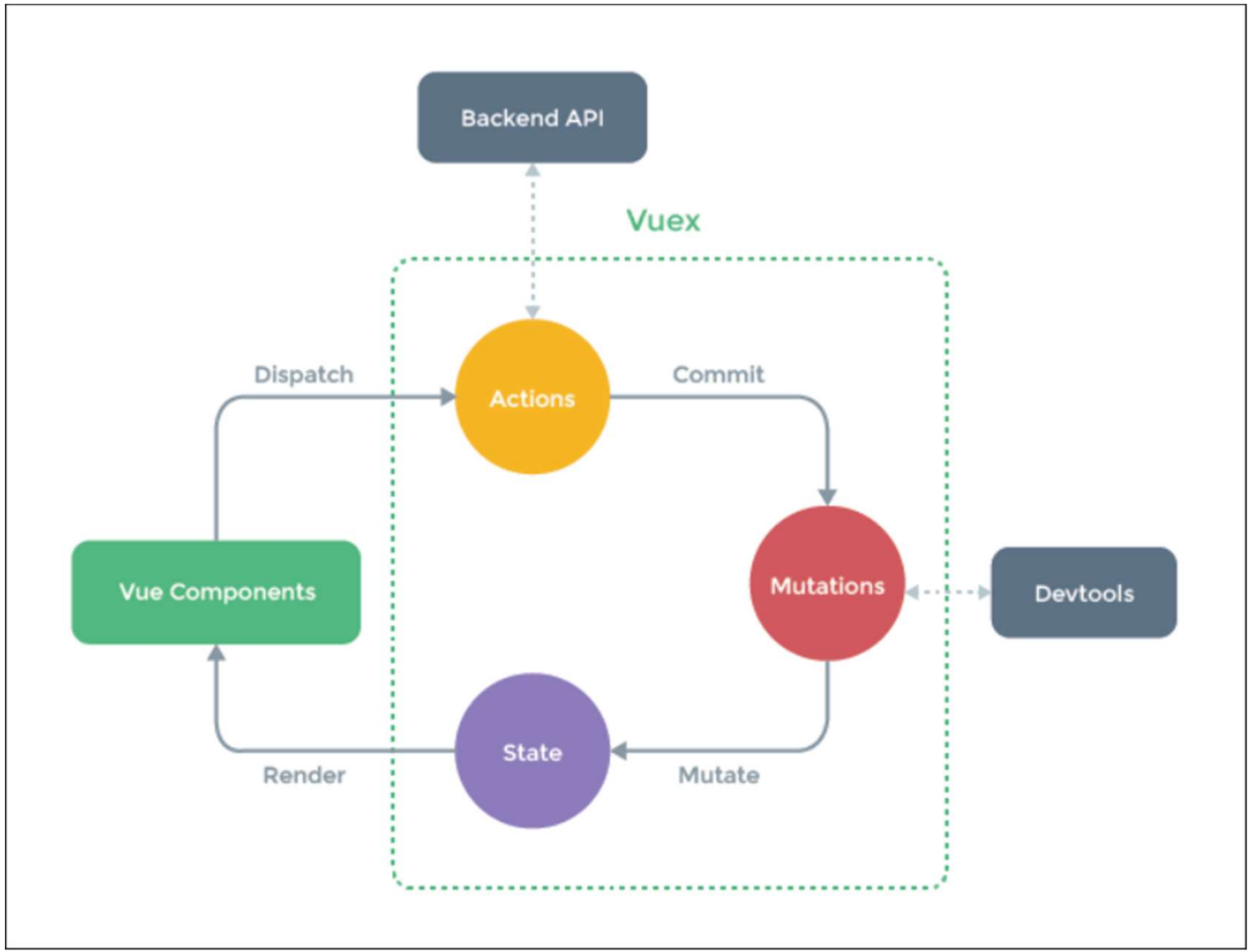
*"Vuex is a **state management pattern + library** for Vue.js applications. It serves as a centralized store for all the components in an application, with rules ensuring that the state can only be mutated in a predictable fashion."*

https://vuex.vuejs.org/

Real life apps/store – more complex

- Solution: *extract* the shared state out of the components, and manage it in a global singleton
- The component tree becomes one big "view"
  - *any* component can access the state or trigger actions, no matter where they are in the tree
  - State and the store are a *single source of truth* for your application

Store architecture



https://vuex.vuejs.org/

Store concepts

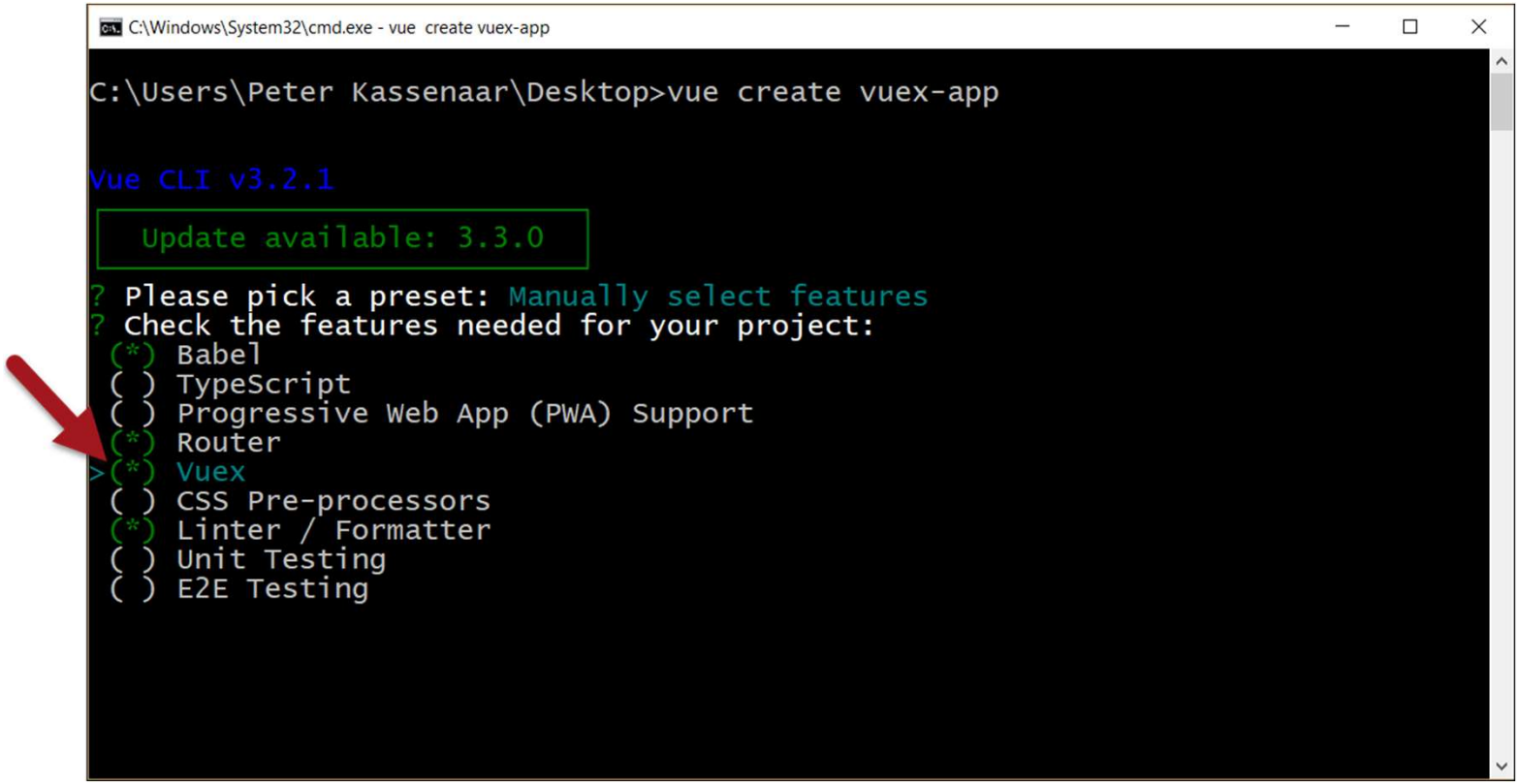
- Store – holds a `state` object. Your single source of truth for the application
- Mutations – commit and track state changes
- Actions – update the state via mutations. It is bad practice to update the state directly
- Getters – access the state, to only get a portion of the state you are interested in
- Dispatch – dispatch an action from a vue component

Let’s build a Store

Starting with the ‘Hello World’-example for stores….

Simplest example – a counter

- First : install `vuex`
  - From the CLI, by choosing `Vuex` as an option when creating a new project
  - OR: afterwards, by using `vue add vuex`.



Setting up your store – Vue 2.x

- Create a folder `../store`
- Create an `index.js` inside that folder
- Again, this is opinion – you can have a `store.js` file anywhere you want

```
// ../store/index.js
import Vue from 'vue';
import Vuex from 'vuex';

Vue.use(Vuex);

export  default new Vuex.Store({

})
```

```
// main.js
import Vue from 'vue'
import App from './App.vue'
import store from './store'

Vue.config.productionTip = false;

new Vue({
    render: h => h(App),
    store
}).$mount('#app');
```

Tell `main.js` to use the store

Creating a simple counter

- Store some data in the store
  - Create a `state` object – and initialize it!
  - Store cannot set properties that have no default value

```
export default new Vuex.Store({
    state: {
        counter: 0
    },
    …
})
```

Add mutations

Mutations always take an exisiting `state` object, and the data you want to update (called `status` over here, often called `payload`)

```
export default new Vuex.Store({
    state: {
        counter: 0
    },
    mutations: {
        INCREMENT(state, status) {
            state.counter += status;
        },
        DECREMENT(state, status) {
            state.counter -= status
        },
        RESET(state) {
            state.counter = 0;
        }
    },
    …
})
```

You *can* call mutations directly by using `this.$store.commit()`, but it is not considered best practice to do so.

Add actions

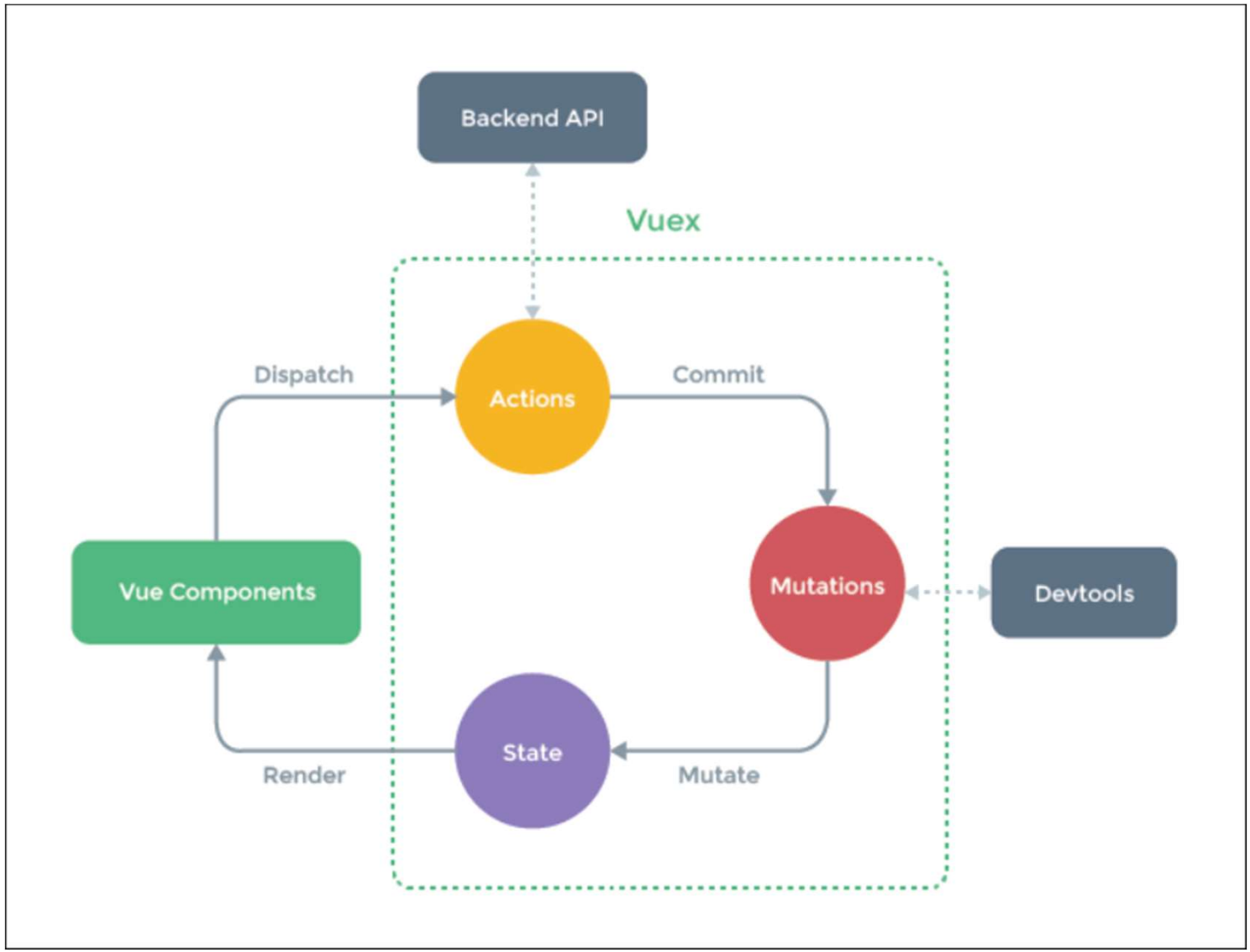
- It is best practice to call mutations through actions, so lets add them

```
export default new Vuex.Store({
    …
    actions:{
        increment(context, value){
            context.commit('INCREMENT', value)
        },
        decrement(context, value){
            context.commit('DECREMENT', value)
        },
        reset(context){
            context.commit('RESET')
        }

    }
})
```

In this simple use case our actions have the same name as the mutations, but this is not necessary. You *can* do multiple `commits` in one action.

Store architecture



https://vuex.vuejs.org/

Last step – create/update component(s)

- Add some simple UI to the component
- Create a computed property on the component to read the current state
  - it is updated as the state changes
- Create methods that call actions on the store
  - In this example: `increment()`, `decrement()` and `reset()`

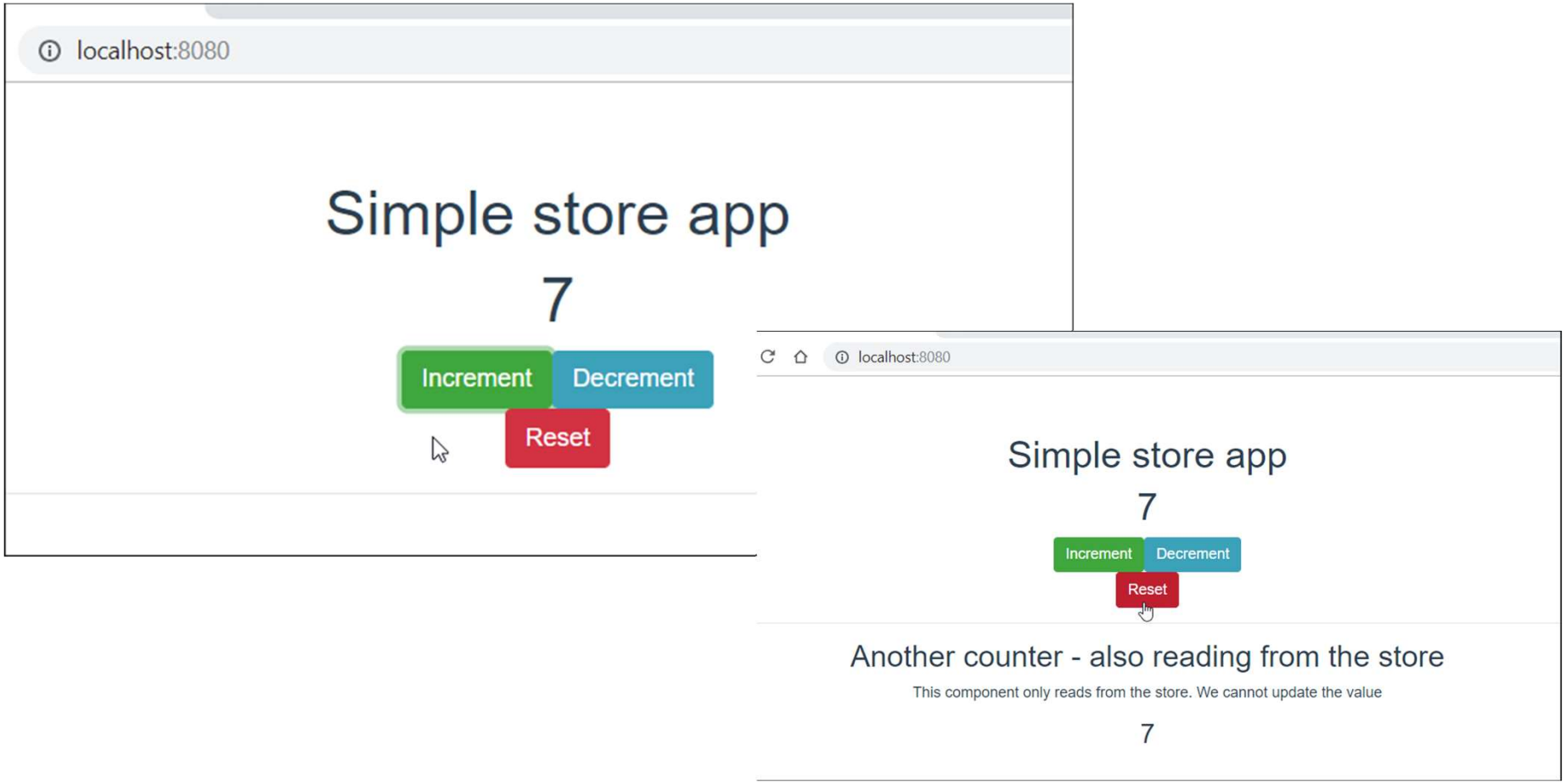
```
<div>
    <button @click="increment()" class="btn btn-success">Increment</button>
    <button @click="decrement()" class="btn btn-info">Decrement</button>
    <br>
    <button @click="reset()" class="btn btn-danger">Reset</button>
</div>
```

Call `this.$store.dispatch` on the component

```
<script>
    export default {
        name: "Counter",

        methods: {
            increment() {
                this.$store.dispatch('increment', 1)
            },
            decrement() {
                this.$store.dispatch('decrement', 1)
            },
            reset(){
                this.$store.dispatch('reset')
            }
        },
        computed:{
            counter(){
                return this.$store.state.counter;
            }
        }
    }
</script>
```

Result



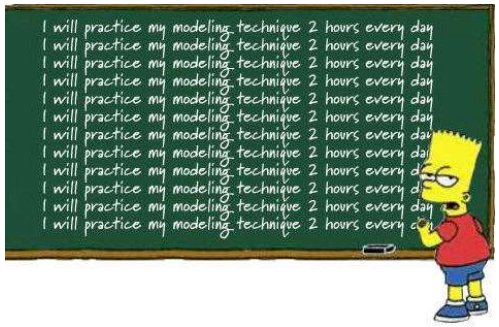
And after adding another component,

also reading the state from the store

Workshop

1. Start a new application from scratch, using the CLI or add Vuex to an existing app
   - Implement the `counter` example, shown in the previous slides
   - OR:
2. Add a `state`-variabele `message` to the store:
   - Users can set the `message` via a textbox
   - The message is shown in the component and in another component

- Example: `../400-vuex-basics`



Don’t “Vuex” everything!

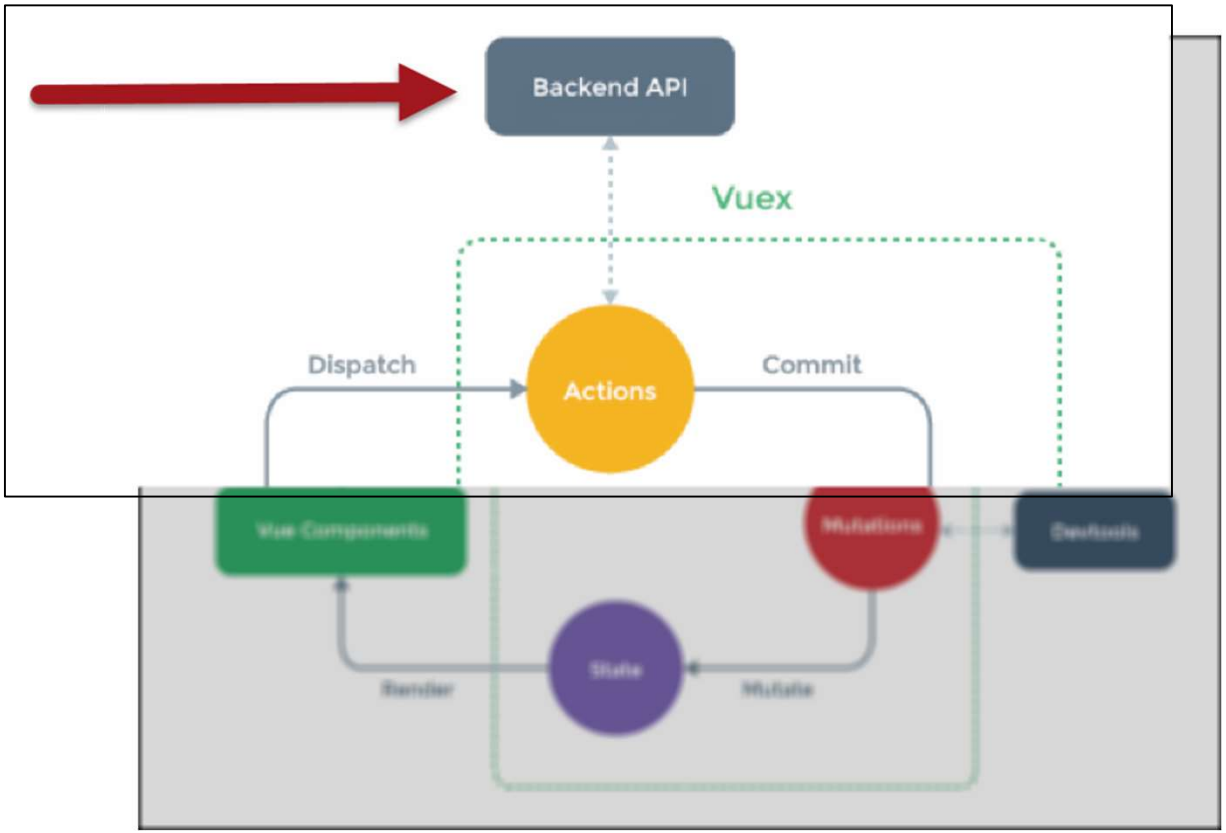
“***Components Can Still Have Local State -*** *Using Vuex doesn't mean you should put* ***all*** *the state in Vuex. If a piece of state strictly belongs to a single component, it could be just fine leaving it as local state.”*

https://vuex.vuejs.org/guide/state.html#components-can-still-have-local-state

More complex state operations

Talking to external API’s, storing results in the Store

More complex operations



Using external API's

- Steps on creating and updating the store

1. Import `axios`
2. Create inital `state`
3. Create `mutations` to set the `state`
4. Create `actions` to call `mutations` and update the `state`.
   - In the actions the `http`-request is made

Later, you update the component to alter the state

Step 1 – import axios

- We're using `axios` here, so import that.
- Also set the url.
- File: `../store/index.js`

```
// store/index.js
…

import axios from 'axios';

const url = 'https://restcountries.com/v2/all';
```

Step 2 – set initial state

```
export default new Vuex.Store({
    state: {
        loadingStatus: 'notloading',
        countries: [],
        errors: []
    },
…
```

Of course you can add more properties to the state, if needed

Step 3 – add mutations

```
export default new Vuex.Store({
    …
    mutations: {
        SET_LOADING_STATUS(state, payload) {
            state.loadingStatus = payload;
        },
        SET_COUNTRIES(state, payload) {
            state.countries = payload;
        },
        CLEAR_COUNTRIES(state) {
            state.countries = []
        },
        ADD_ERROR(state, payload) {
            state.errors = […state.errors, payload]
        }
    }
…,
```

Mutations create a new `state` in the store via the second parameter, called `payload`

Step 4 – add actions

```
actions: {
    fetchCountries(context) {
        // 1. Set loading status
        context.commit('SET_LOADING_STATUS', 'loading');
        // 2. Make http-request
        axios.get(url)
            .then(result => {
                context.commit('SET_LOADING_STATUS', 'notloading');
                context.commit('SET_COUNTRIES', result.data);
            })
            .catch(err => {
                context.commit('SET_LOADING_STATUS', 'notloading');
                context.commit('SET_COUNTRIES', []);
                context.commit('ADD_ERROR', err);
            })

    },
    clearCountries(context) {
        context.commit('CLEAR_COUNTRIES')
    }
},
```

Remember, `actions` don't update the store directly. They call `mutations` to commit data to the store. Note the use of the `context` parameter.

Create component to view data from store

Template, `ApiVuexComponent.vue`

```
<template>
    <div>
        <h2>Countries via API - stored in Vuex store</h2>
        <button @click="fetchCountries()" class="btn btn-success">Fetch countries</button>
        <button @click="clearCountries()" class="btn btn-danger">Clear countries</button>
        <!--Loading indicator/spinner-->
        <div v-if="!loading">
            <img src="../assets/spinner.gif" alt="Loading indicator...">
        </div>
        <!--List with country data-->
        <ul class="list-group" v-if="countries && countries.length">
            <li class="list-group-item"
               <h4>{{ country.name }} </h4>
               …
            </li>
        </ul>
    </div>
</template>
```

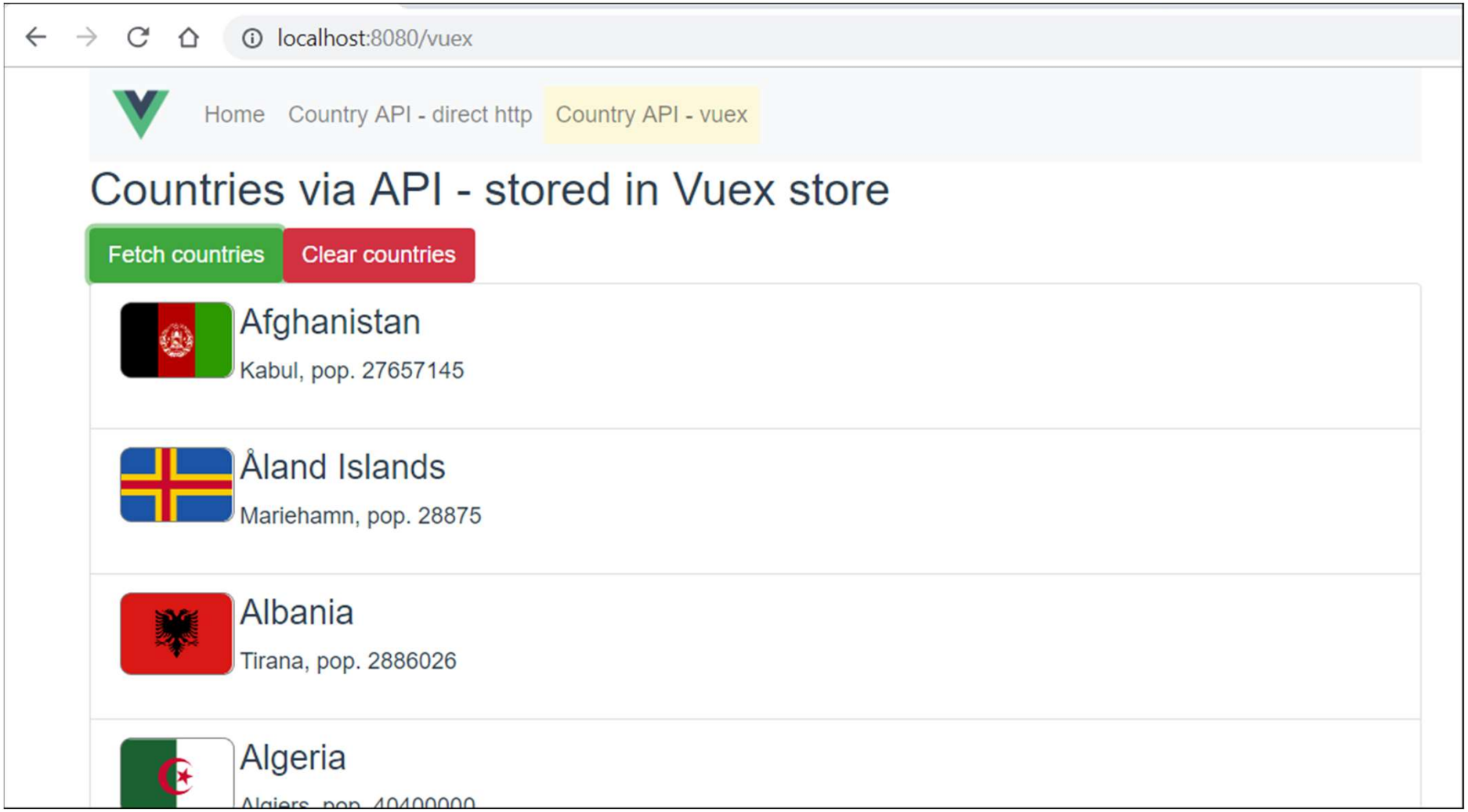
Component logic

```
export default {
    name: "ApiVuexComponent",
    methods: {
        // 1. fetch all countries from the store
        fetchCountries() {
            this.$store.dispatch('fetchCountries')
        },
        // 2. clear countries from the store
        clearCountries() {
            this.$store.dispatch('clearCountries')
        },
    },
    computed: {
        countries() {
            return this.$store.state.countries;
        },
        loading(){
            return this.$store.state.loadingStatus === 'notloading'
        }
    }
}
```

Note – no data in this component anymore. Only store calls.

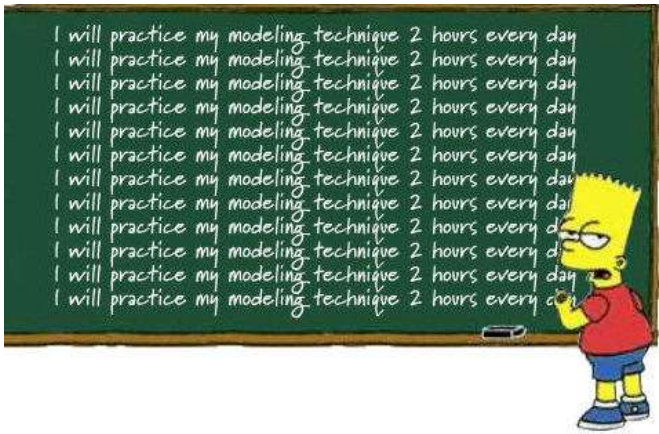
The computed properties are bound to the store state(s)

Result


localhost:8080/vuex
Home
Country API - direct http
Country API - vuex
Countries via API - stored in Vuex store
Fetch countries
Clear countries
Afghanistan
Kabul, pop. 27657145
Åland Islands
Mariehamn, pop. 28875
Albania
Tirana, pop. 2886026
Algeria

Workshop

- Pick one of your own projects, or see example at:
  - `../410-vuex-countries`
- Create a small application using one of the API's in the file `JavaScript API's.txt`
- Store and fetch data in a store. Use for instance:
  - Pokemon API
  - Open Movie Database API
  - OpenWeatherMap API
  - …



Fetching details from the store

Working with `getters`

Using Getters

- Sometimes you only need a *piece* of the `state`, for example a specific country
  - You can add a `find` function to every component that needs it:
  - `return this.$store.state.countries.find (c=> c.name ===`
    `'<some-name>')`
  - If multiple components need this logic, it's better to write a *getter*
- https://vuex.vuejs.org/guide/getters.html

Writing a getter

- In our case: pass argument to the store by returning a function

```
// ../store/index.js
…
getters: {
    // only return the requested country from the store
    getCountry: (state) => (name) => {
        return state.countries.find(c => c.name === name)
    }
}
```

- Use the getter to retrieve value in a Detail Component
  - Example: `ApiVuexDetail.vue`

Detail component – via Routeparameters

```
<!--ApiVuexDetail.vue-->
<template>
    <div v-if="country">
        <h2>Details for {{ country.name }}</h2>
        …
        </table>
    </div>
</template>

<script>
    export default {
        name: "ApiVuexDetail",
        created() {
            // get name from the route parameter.
            this.name = this.$route.params.name;
        },
        computed: {
            country() {
               return this.$store.getters.getCountry(this.name);
            }
        }
    }
</script>
```

Benefits b/c now a store is used

- Data is already in the store – no additional http-call needed
- Use routing and parameters as you already know
- Study for yourself:
  - Property-Style Access
  - Method-Style Access (like we're using here)
  - The mapGetters helper

The `mapGetters` Helper

The `mapGetters` helper simply maps store getters to local computed properties:

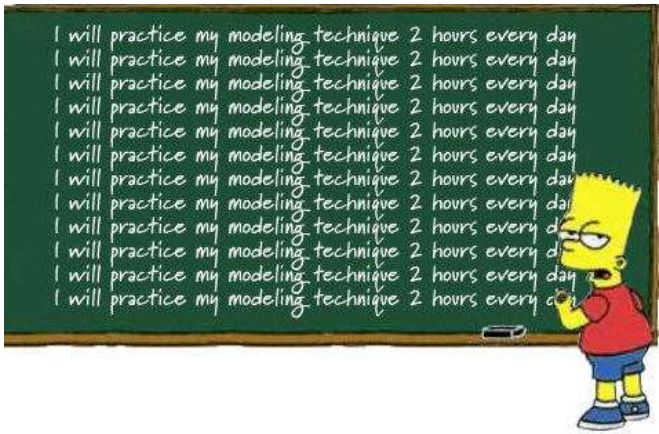
```js
import { mapGetters } from 'vuex'

export default {
  // ...
  computed: {
    // mix the getters into computed with object spread operator
    ...mapGetters([
      'doneTodosCount',
      'anotherGetter',
      // ...
    ])
  }
}
```

https://vuex.vuejs.org/guide/getters.html

Workshop

- Continue with your own project, or see example at:
  - `../410-vuex-countries`
- Create a detail option for your own project, using a getter
- Read the documentation on getters at https://vuex.vuejs.org/guide/getters.html

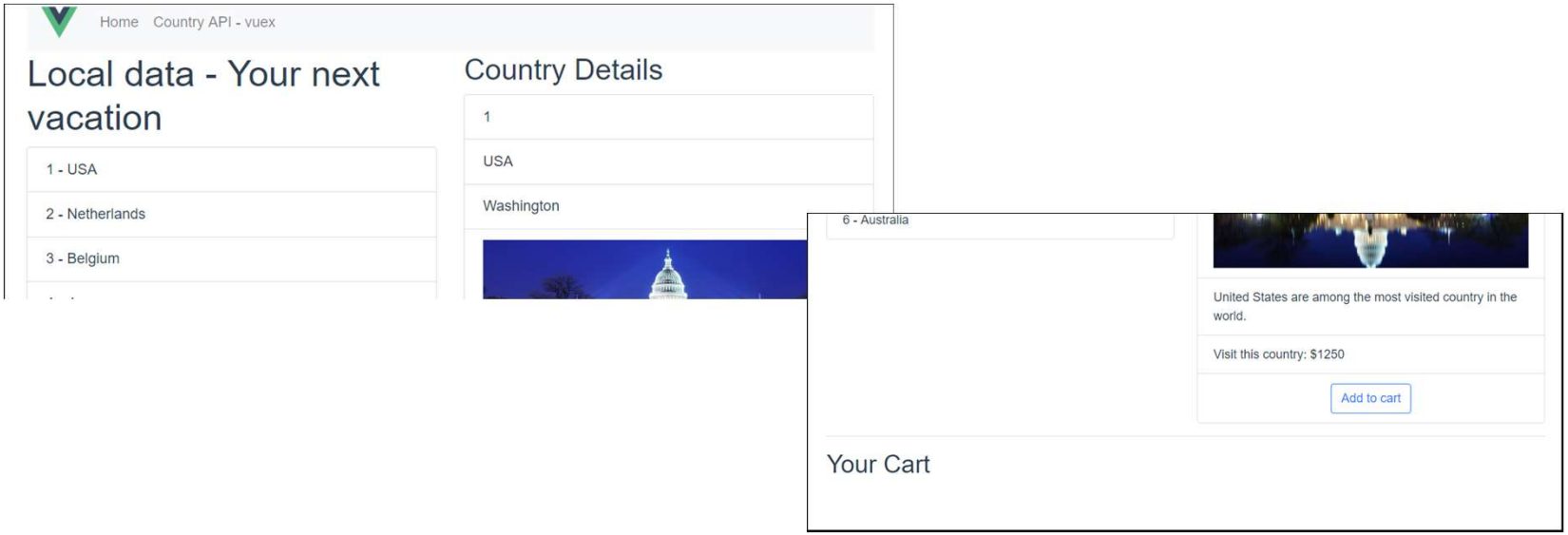


Case – a country shopping cart

Booking trips to a country and saving them in a shopping cart in the store

Going back to our static country data (for now)

- Use case
  - In our list of countries, every country has a `cost` property
  - When clicked, we see details and price of a trip to that country
  - We add an `Add to cart` button to every country
  - When clicked, a `ShoppingCart.vue` component is populated
  - The cart shows every item and offers a (fake) `checkout` option



1. Update the store

- Update the state with array of countries (here, called `items: []`)
- Add mutations to Add and Remove items and to Clear the cart
  - `ADD_TO_CART`
  - `REMOVE_FROM_CART`
  - `CLEAR_CART`
- Add Actions that call the various mutations
  - `addCountryToCart`
  - `removeCountryFromCart`
  - `checkout`
  - `clearCart`
- Add getters that return cart information
  - `cartProducts`
  - `cartTotalPrice`

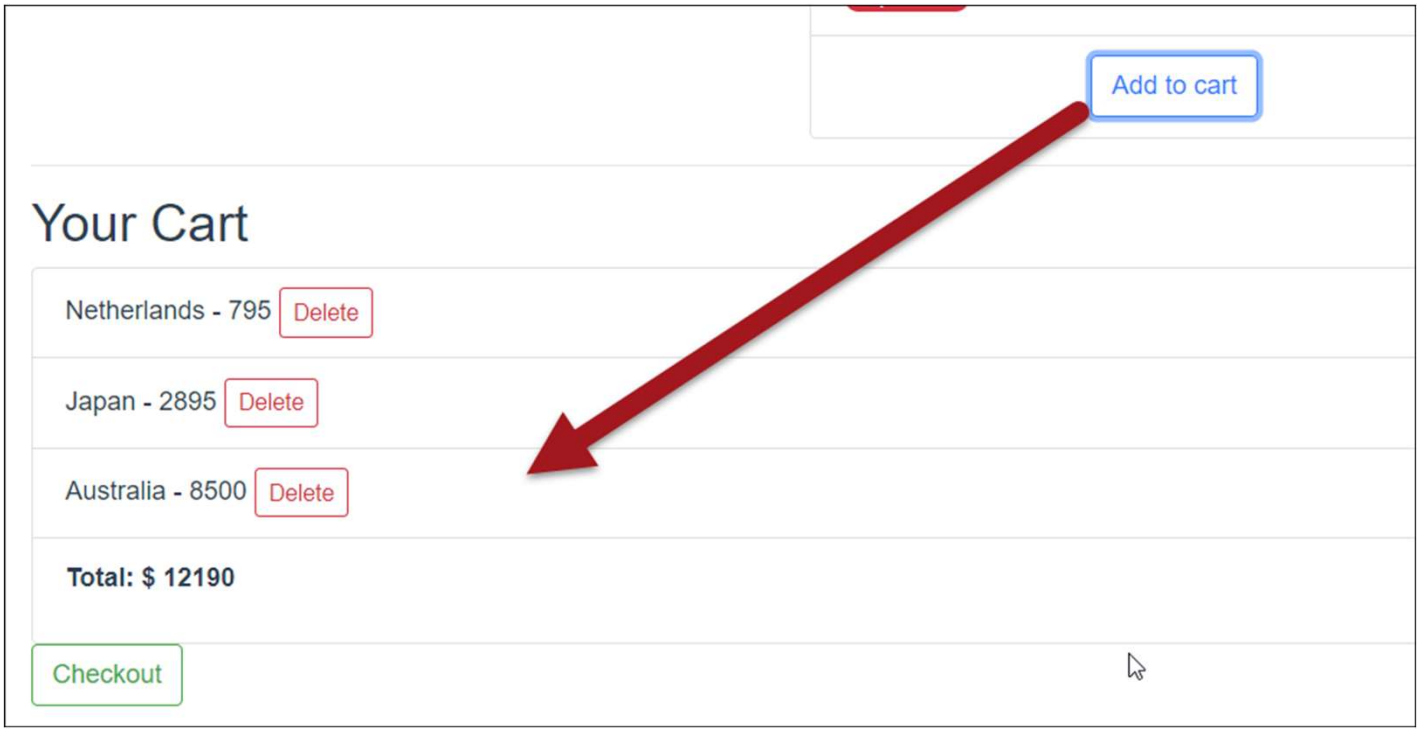
`../store/index.js`

2. Create the ShoppingCart component

- Show a div if there are no items in the shopping cart
- Show a list or table if there are items in the shopping cart
- `../components/ShoppingCart.vue`

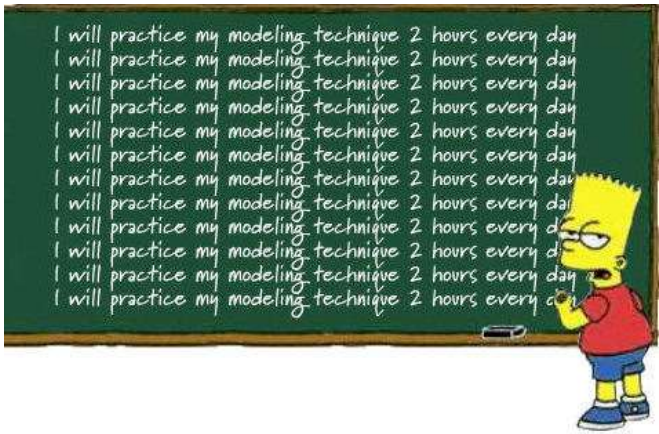
3. Update the CountryDetail component

- Add a button `Add to Cart` to the detail component
- Dispatch action to the store if the button is clicked
- `../components/CountryDetail.vue`



Workshop

- Create a simple e-commerce application using the store and adding a shopping cart.
  - Example: `../420-vuex-shopping-cart`
- Study the example
- Update the example so you can get multiple trips to the same country (i.e. the same product) in the store
  - Create a `counter` or `quantity` field to record how many items of the product are in the cart



Checkpoint

- You know what a Vuex State Management Store is
- You are familiar with store concepts like Actions, Mutations, Payload and Dispatching
- You know how to work with store Getters
- You can call `http` from your store and put retrieved data in a store

On Store Vuex 4.x

Vuex store 4.x works with Vue 3.x

Check documentation

- No (or very sparse) TypeScript examples

Vuex

Guide API Reference Release Notes v4.x Languages GitHub

Introduction

- What is Vuex?
  - What is a "State Management Pattern"?
  - When Should I Use It?
- Installation
- Getting Started

Core Concepts

- State
- Getters
- Mutations
- Actions
- Modules

Advanced

- Application Structure
- Composition API
- Plugins

What is Vuex?

> NOTE
>
> This is the docs for Vuex 4, which works with Vue 3. If you're looking for docs for Vuex 3, which works with Vue 2, please check it out here.

Vuex is a **state management pattern + library** for Vue.js applications. It serves as a centralized store for all the components in an application, with rules ensuring that the state can only be mutated in a predictable fashion.

What is a "State Management Pattern"?

Let's start with a simple Vue counter app:

```js
const Counter = {
  // state
  data () {
    return {
      count: 0
    }
  },
  // view
```

Composition API

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Composition API

To access the store within the `setup` hook, you can call the `useStore` function. This is the equivalent of retrieving `this.$store` within a component using the Option API.

```js
import { useStore } from 'vuex'

export default {
  setup () {
    const store = useStore()
  }
}
```

Accessing State and Getters

In order to access state and getters, you will want to create `computed` references to retain reactivity. This is the equivalent of creating computed properties using the Option API.

```js
import { computed } from 'vue'
import { useStore } from 'vuex'

export default {
  setup () {
    const store = useStore()

    return {
      // access a state in computed function
      count: computed(() => store.state.count),

      // access a getter in computed function
      double: computed(() => store.getters.double)
    }
  }
}
```

https://next.vuex.vuejs.org/guide/composition-api.html

TypeScript Support

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TypeScript Support

Vuex provides its typings so you can use TypeScript to write a store definition. You don't need any special TypeScript configuration for Vuex. Please follow Vue's basic TypeScript setup to configure your project.

However, if you're writing your Vue components in TypeScript, there're a few steps to follow that require for you to correctly provide typings for a store.

Typing `$store` Property in Vue Component

Vuex doesn't provide typings for `this.$store` property out of the box. When used with TypeScript, you must declare your own module augmentation.

To do so, declare custom typings for Vue's `ComponentCustomProperties` by adding a declaration file in your project folder:

```ts
// vuex.d.ts
import { ComponentCustomProperties } from 'vue'
import { Store } from 'vuex'

declare module '@vue/runtime-core' {
  // declare your own store states
  interface State {
    count: number
  }

  // provide typings for `this.$store`
  interface ComponentCustomProperties {
    $store: Store<State>
  }
}
```

Typing `useStore` Composition Function

When you're writing your Vue component in Composition API, you will most likely want `useStore` to

https://next.vuex.vuejs.org/guide/typescript-support.html

`InjectionKey` and `useStore` composition Function

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Typing `useStore` Composition Function

When you're writing your Vue component in Composition API, you will most likely want `useStore` to return the typed store. For `useStore` to correctly return the typed store, you must:

1. Define the typed `InjectionKey`.
2. Provide the typed `InjectionKey` when installing a store to the Vue app.
3. Pass the typed `InjectionKey` to the `useStore` method.

Let's tackle this step by step. First, define the key using Vue's `InjectionKey` interface along with your own store typing definition:

```ts
// store.ts
import { InjectionKey } from 'vue'
import { createStore, Store } from 'vuex'

// define your typings for the store state
export interface State {
  count: number
}

// define injection key
export const key: InjectionKey<Store<State>> = Symbol()

export const store = createStore<State>({
  state: {
    count: 0
  }
})
```

Next, pass the defined injection key when installing the store to the Vue app:

```ts
// main.ts
import { createApp } from 'vue'
import { store, key } from './store'

const app = createApp({ ... })

// pass the injection key
```

https://next.vuex.vuejs.org/guide/typescript-support.html#typing-usestore-composition-function