Global Knowledge®

Angular Advanced State Management and @ngrx/store

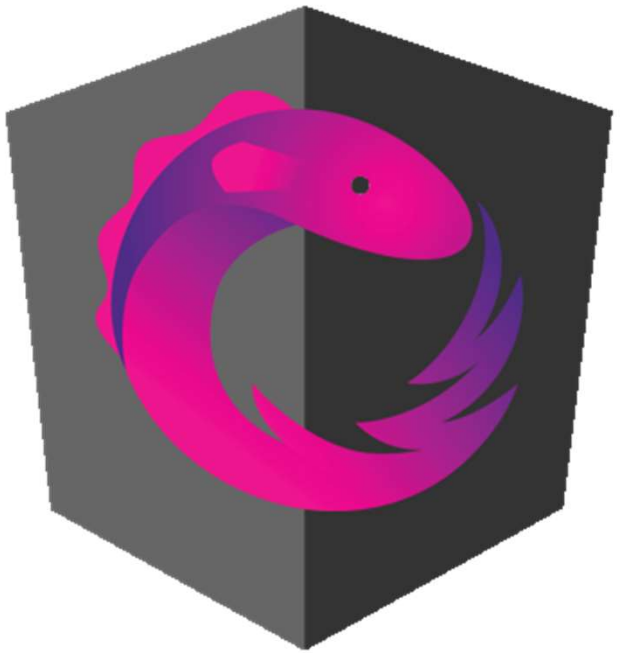
Peter Kassenaar –
info@kassenaar.com

WORLDWIDE LOCATIONS

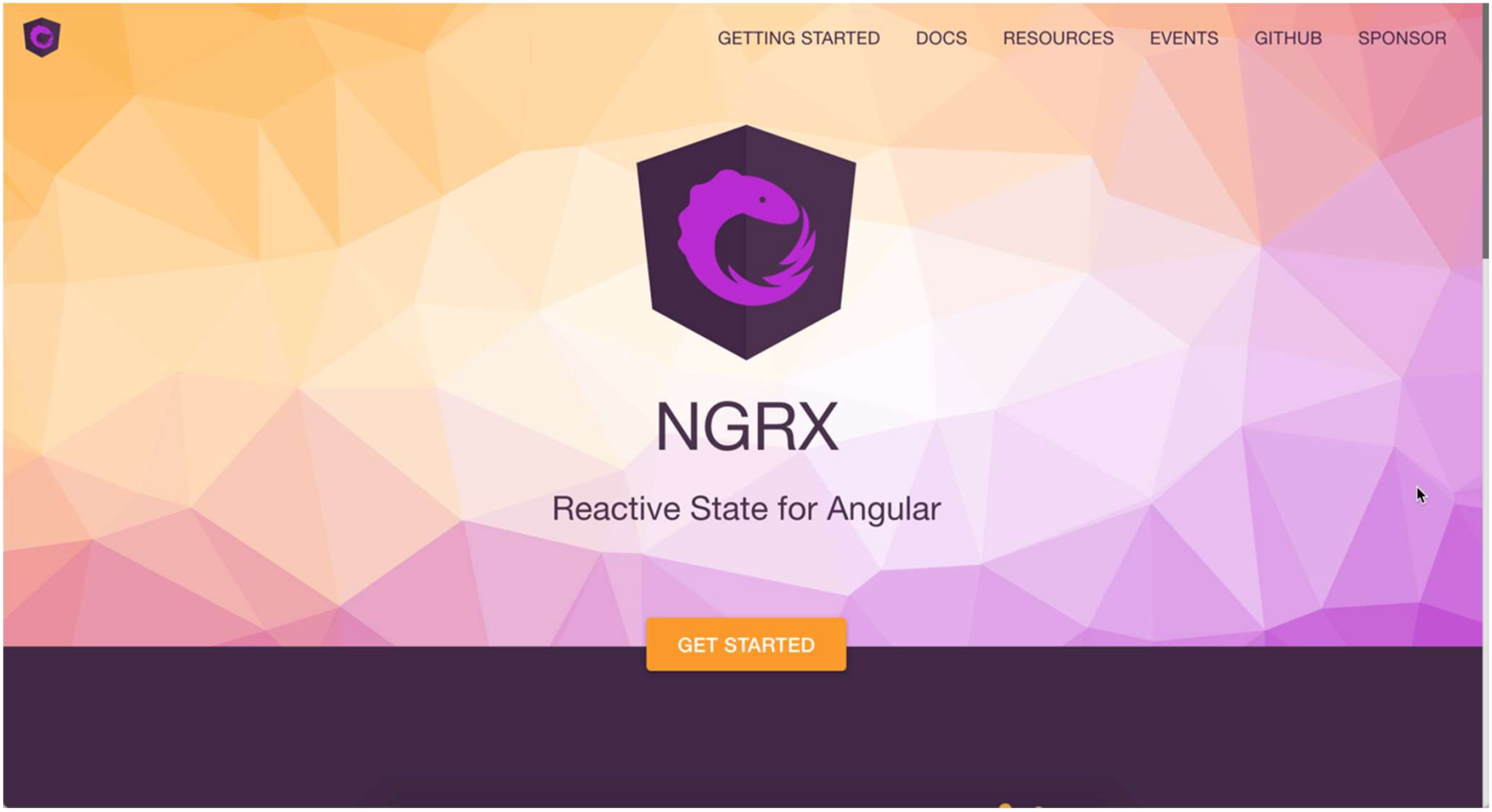
BELGIUM CANADA COLOMBIA DENMARK EGYPT FRANCE IRELAND JAPAN KOREA MALAYSIA MEXICO NETHERLANDS NORWAY QATAR
SAUDI ARABIA SINGAPORE SPAIN SWEDEN UNITED ARAB EMIRATES UNITED KINGDOM UNITED STATES OF AMERICA

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



https://ngrx.io/

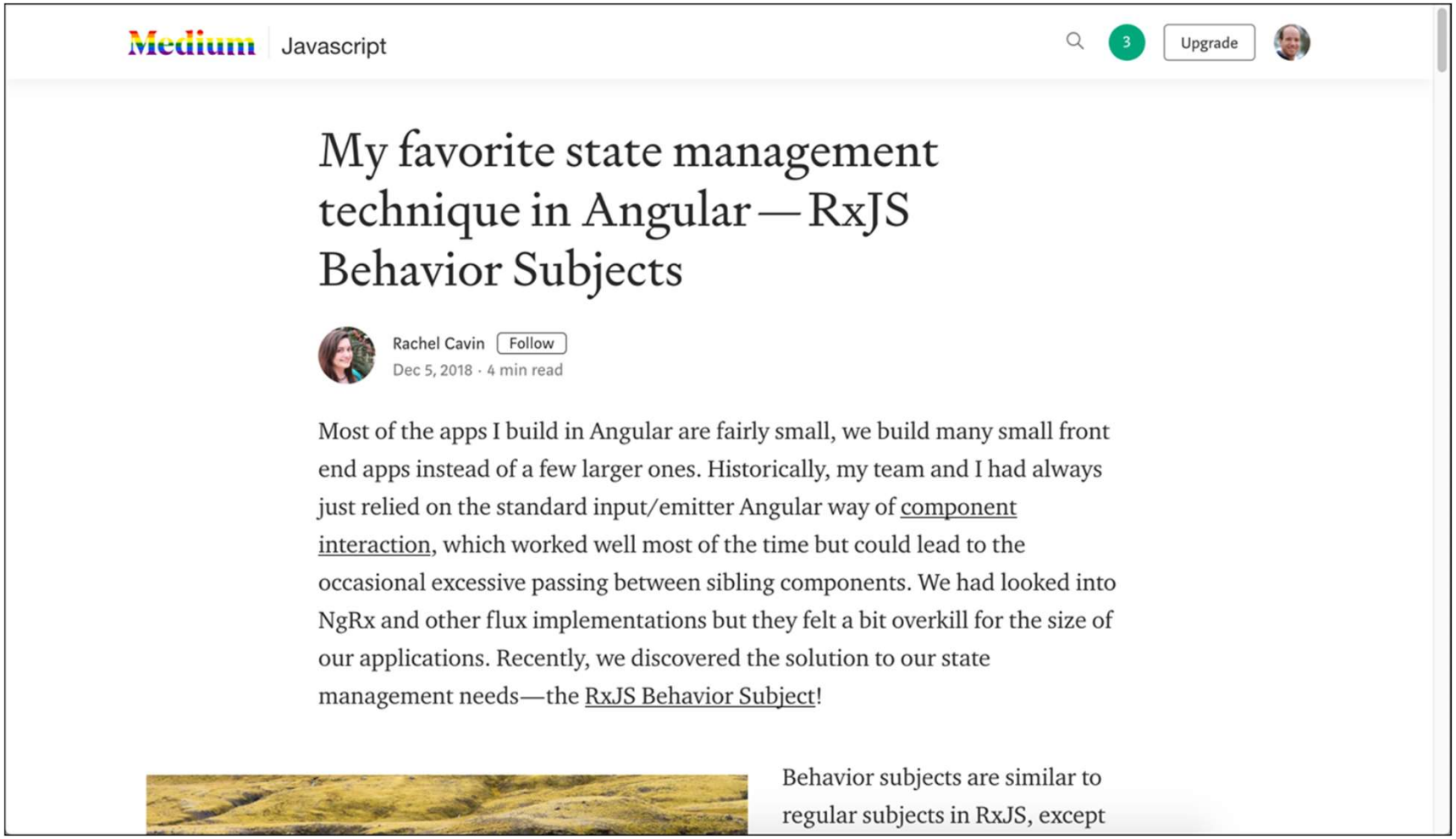


@ngrx/store – 3 generations

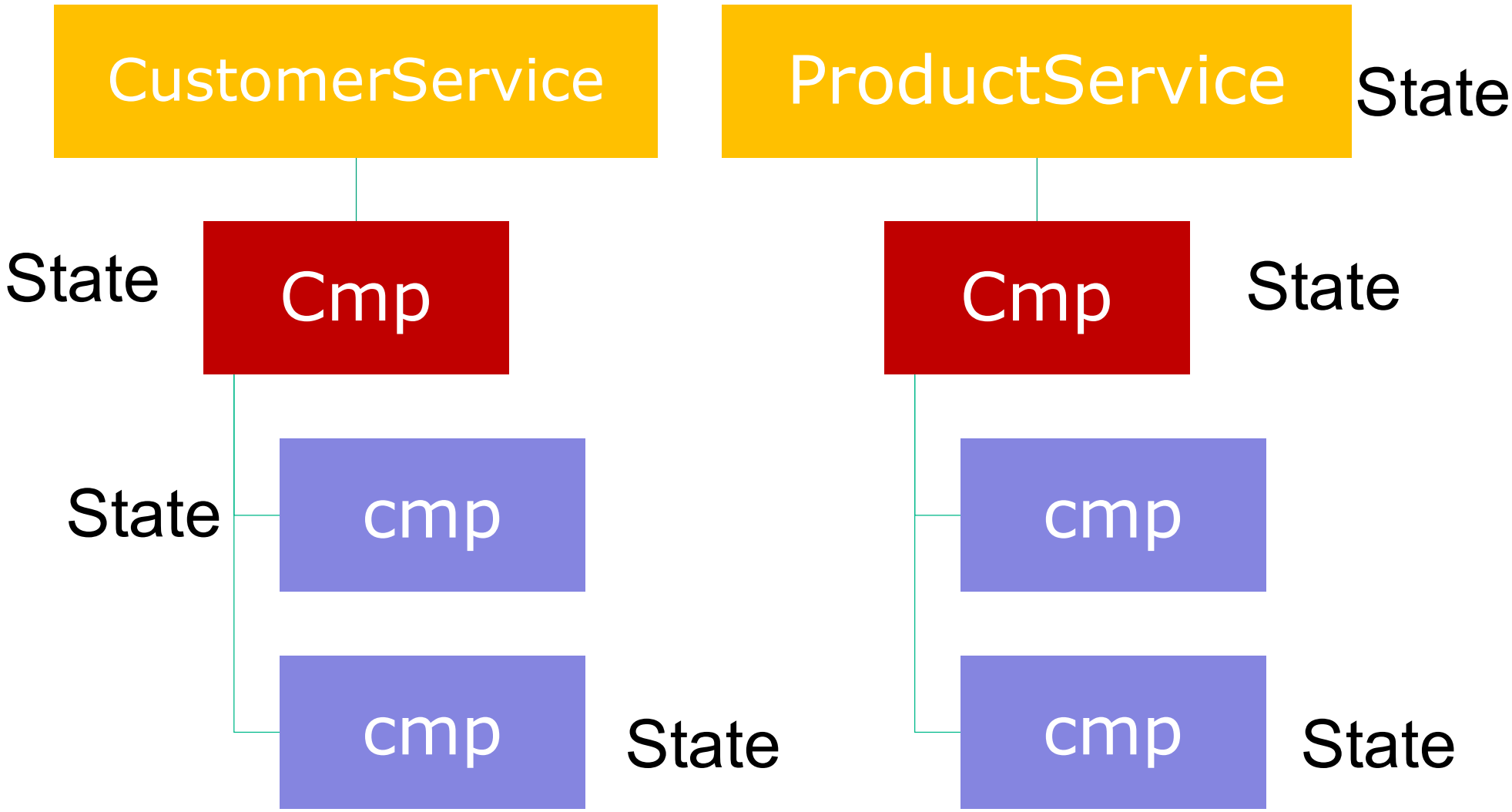
- Generation #1 – Angular 2
  - Creator: Rob Wormald
  - Simple implementation, (almost) all hand coded
- Generation #2 – Angular 4-7
  - Action Creators, custom payload
  - `@Effects`
- Generation #3 – Angular 8+
  - `createAction()`, `createReducer()` and more
  - (they try to make it) less complex…
  - …if you know the principles and where to look

Maybe you don’t need a store…

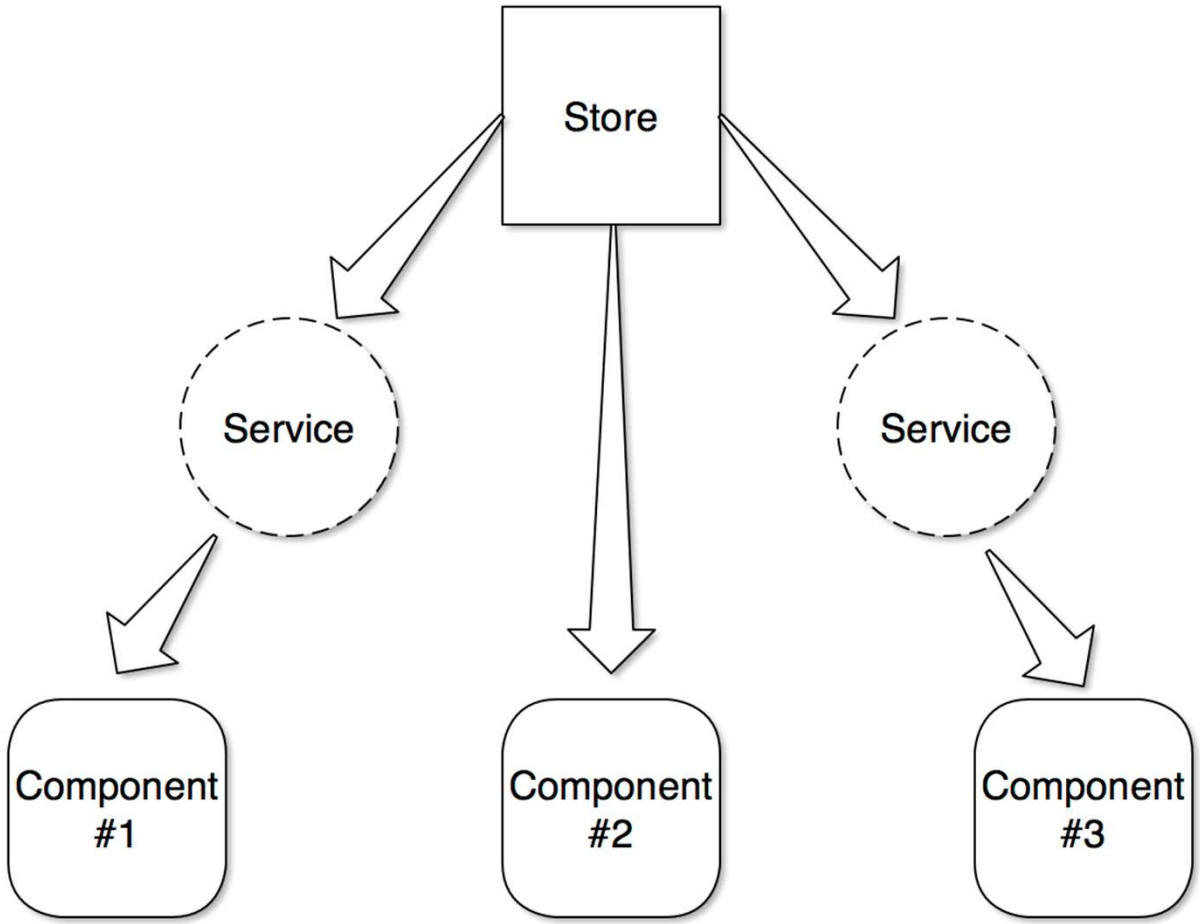
- https://medium.com/@rmcavin/my-favorite-state-management-technique-in-angular-rxjs-behavior-subjects-49f18daa31a7



State management without a store



Store architecture - #1

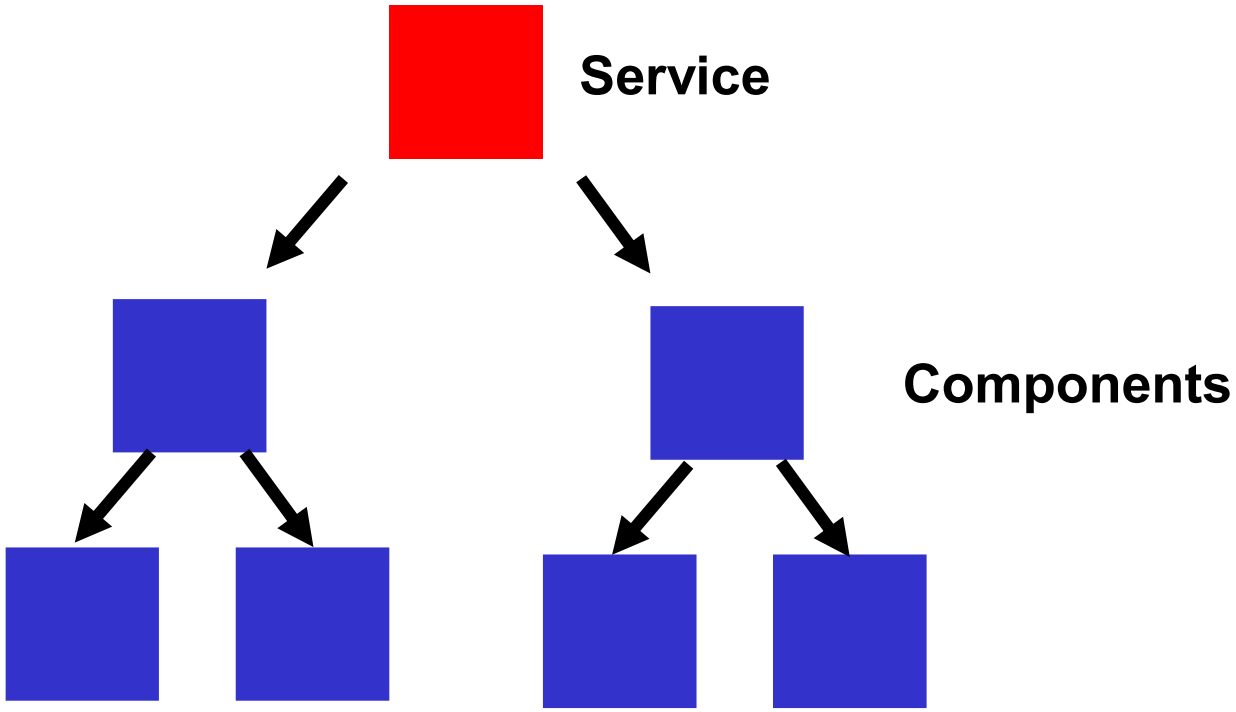


https://gist.github.com/btroncone/a6e4347326749f938510

Benefits of using a store

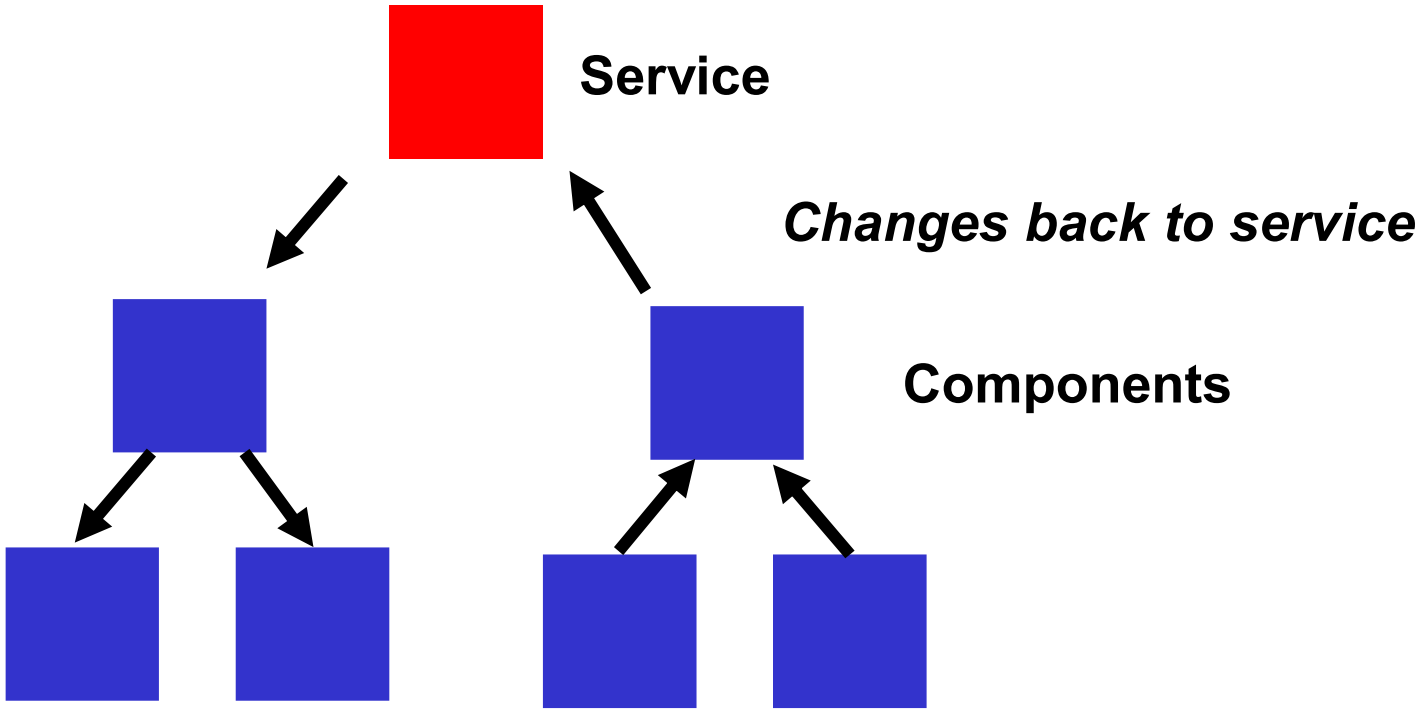
- State is only changed in a controlled way
- Component state is also driven from the store
- Based on immutable objects – b/c they are predictable
- In Angular – immutability is fast
  - Because no changes can appear, no change detection is needed!
- Developer tools available to debug and see how the store changes over time
  - "Time travelling Developer tools"

Store architecture - #2 - traditional

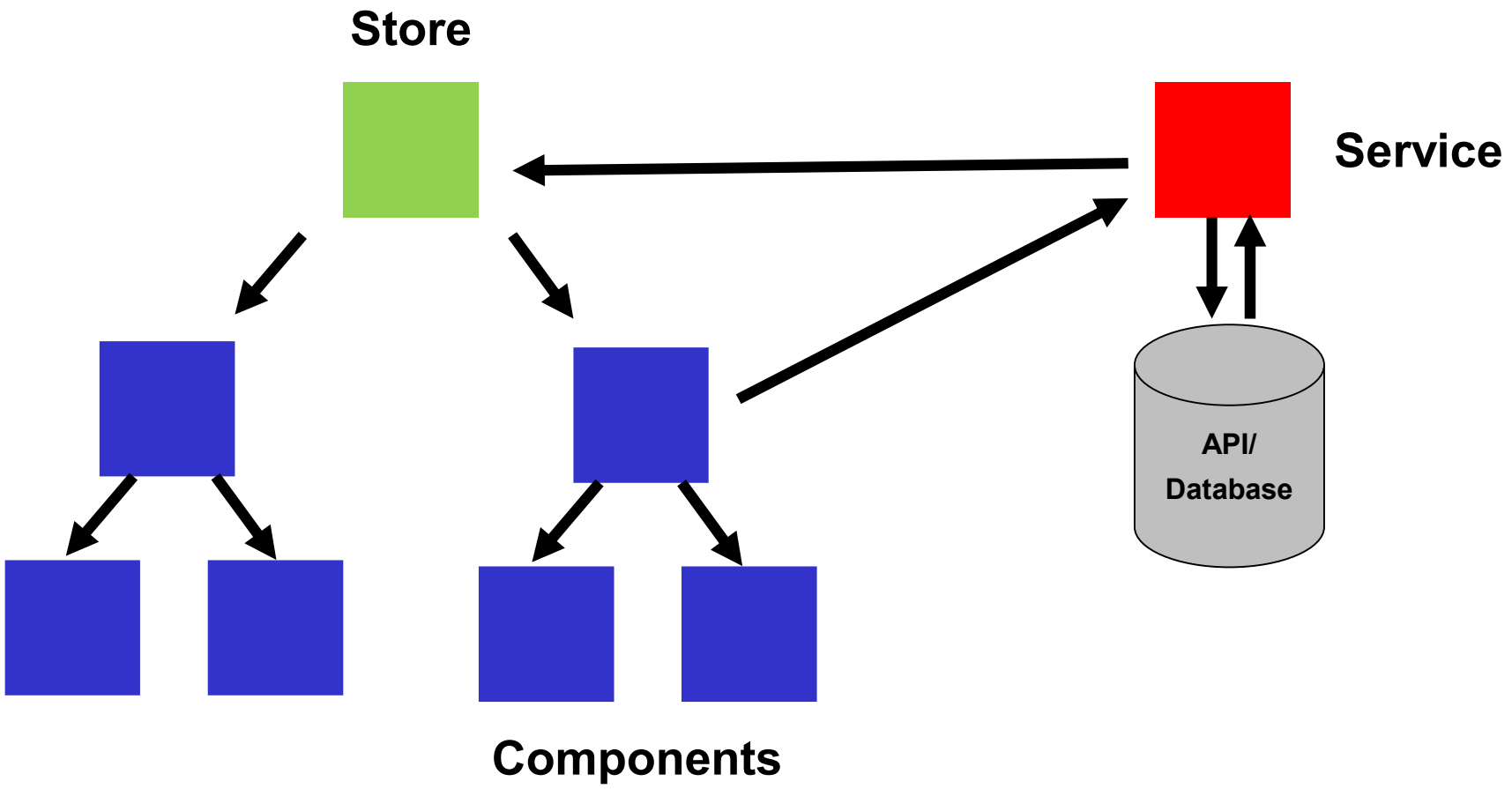


https://ultimateangular.com/angular-pro

Store architecture - #2



Store architecture - #2 with a store

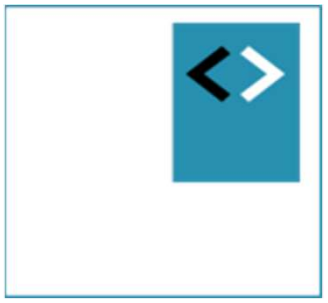


Angular State Management

- Simple applications - In the component
  - `counter : number = 0;`
  - `this.counter += 1;`
- Intermediate applications - In a service
  - `counter : number = 0;`
  - `this.counter = this.counterService.increment(1);`
  - Cache `counter` value in the service

- Larger applications - In a data store – all based on observables

```
counter$: Observable<number>;

constructor(private store: Store<State>){
        this.counter$ = store.pipe(
           select('counter')
        );
}

increment(){
        this.store.dispatch(counterIncrement());
}
```



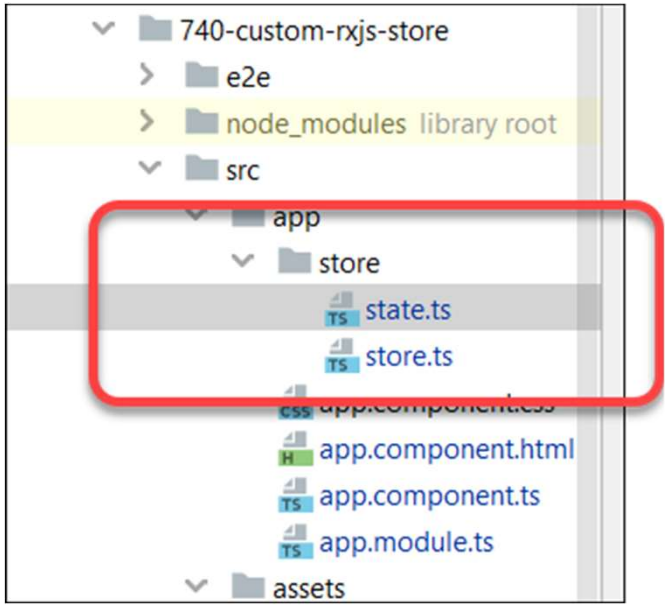
Building a store from scratch

Using observables, standard RxJS techniques and custom code, without a library

Steps in creating a simple store

1. Create a `../store` folder and `store.ts` file, add it to the module
2. Create interface `State` for the data you want to 'store' (duh…)
3. Create a constant `state` of type `State`
4. Create a subject of type `BehaviorSubject` with type `State`, initialize it with inital `state`.
5. Expose the subject as an observable
6. Create `.set()` method and `.select()` methods

Step 1 – create store, and Step 2) state




```ts
// state.ts
export interface Todo {
  id: number;
  name: string;
  done: boolean;
}
export interface State {
  todos: Todo[];
  // other slices of the store
}
```

We are now creating a *simple store*, for one application, with one (1) module.

With `@ngrx/store` things can get – way – more complex. This example is to demonstrate how store concept works.

Step 3 – create `state`, and Step 4) `BehaviorSubject`

```
// store.ts
import {State} from './state';

const state: State = {
  todos: undefined
};

export class Store {
  // use behaviorsubject to create a subject with initial state
  // the last value is also passed to new subscribers.
  // The behaviorsubject holds the data (i.e. state)
  private subject = new BehaviorSubject<State>(state);
}
```

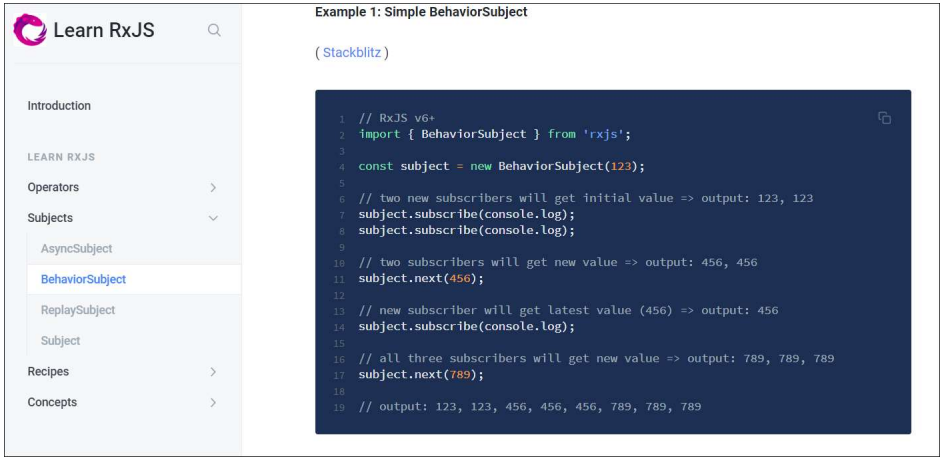
So the state is initially a list of undefined `Todo`'s.

We're going to set them later from the code. Of course you can fetch them from a backend and so on.

We use `BehaviorSubject` to create initial state. A `Subject` cannot do that.

On `BehaviorSubject<Type>()`

- `BehaviorSubject` can hold a variable (i.e. state), where a `Subject` can not.
- New subscribers get a copy of that data, i.e. the last emitted state, which of course is very useful in a store scenario.
- You pass a new piece of data to the `BehaviorSubject` with the `.next()` method.



https://www.learnrxjs.io/learn-rxjs/subjects/behaviorsubject

Step 5 - Expose the subject as an observable

```
// store.ts
export class Store {
  // use behaviorsubject to create a subject with initial state
  // the last value is also passed to new subscribers.
  // The behaviorsubject holds the data (i.e. state)
  private subject = new BehaviorSubject<State>(state);
  private store = this.subject.asObservable()
    .pipe(
      distinctUntilChanged() // make it a little bit smoother, don't overnotify the subscribers
    );
}
```

The `store` is the variable we expose to the outer world later on, so components and services deal with an observable instead of a subject directly

Step 6 – create `.set()` and `.select()` methods

- Also create a helper `get` property that returns the current value of the state

```
// store.ts
export class Store {
   …
  // internal helper function, return the current
  // value of the subject.
  get value(): any {
    return this.subject.value;
  }

  // set a new piece in the store. Update the
  // current store, using the spread operator (favor immutability)
  set(name: string, payload: any): void {
    this.subject.next({
      ...this.value, [name]: payload
    });
  }

  // select a slice from the store, use pluck to only fetch the
  // requested branch of the json-tree from the store
  select<T>(name: string): Observable<T> {
    return this.store.pipe(
      pluck(name),
    );
  }
}
```

Getter (internal)

Setter, using .next()

Dynamically set the name of the property in the store. If it doesn't exists, it creates it

Selector, using .pluck()

Access our store, only return the selected slice

This is all we need to do to create a reactive store!

7 – Done. Use the store in the component

- Import the store in the component
  - set data, retrieve that data and bind it to the UI

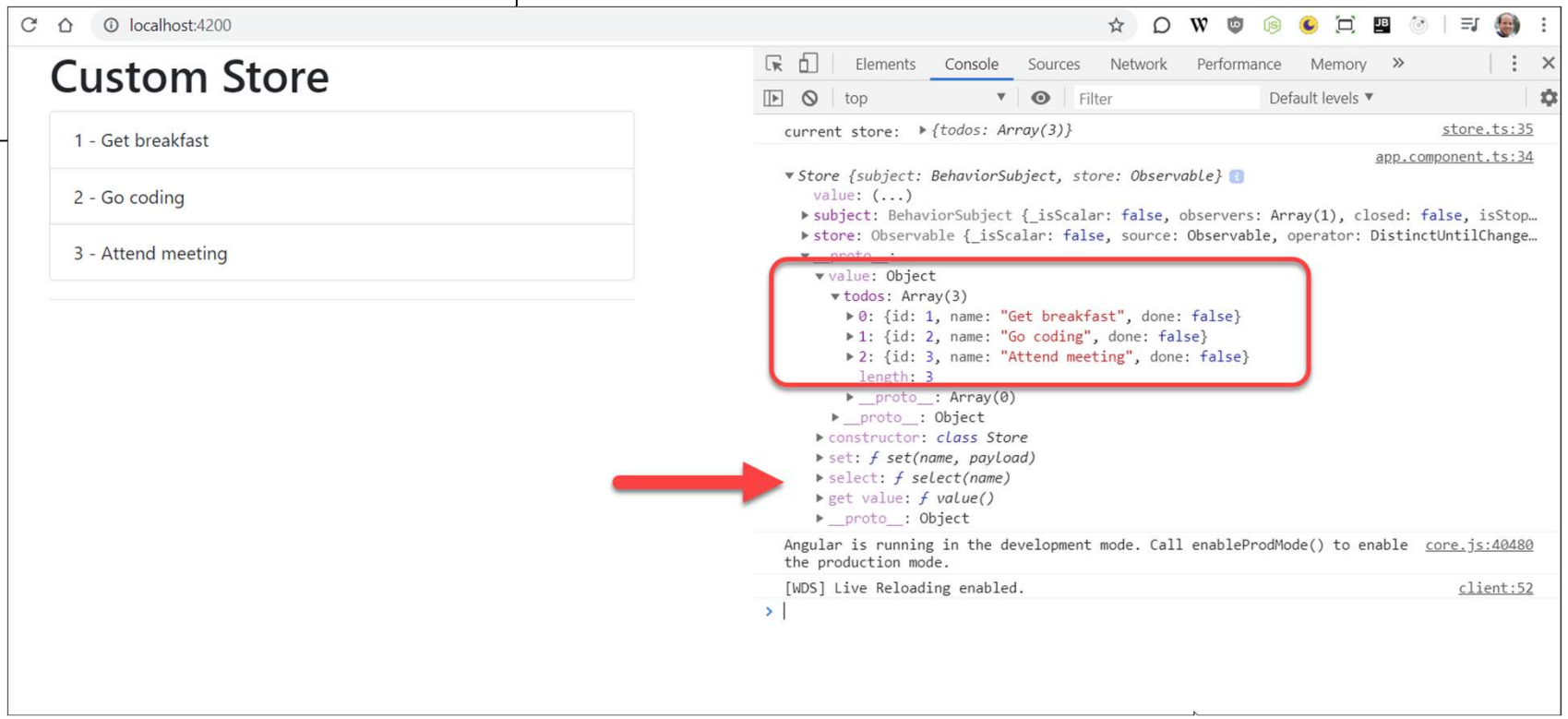
```
// app.component.ts
export class AppComponent implements OnInit {
  todo$: Observable<any>;

  constructor(private store: Store) {
  }

  ngOnInit(): void {
    // just some dummy data in the store, you can fetch this from a backend of course
    const someTodos: Todo[] = [
      {id: 1, name: 'Get breakfast', done: false},
      {id: 2, name: 'Go coding', done: false},
      {id: 3, name: 'Attend meeting', done: false},
    ];
    this.store.set('todos', someTodos);   // 1. don't set a component property directly! Instead, set data in the store
    this.todo$ = this.store.select<Todo[]>('todos'); // 2. Fetch data from the store, assign it to local property
    console.log(this.store);  // 3. Just some logging, to see if the store works
  }
}
```

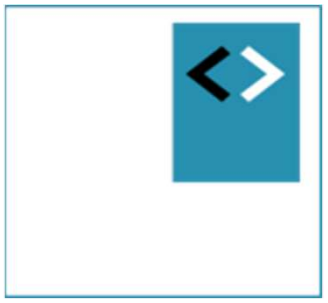
Import store

Note: no callbacks here. Everything is reactive (as one would expect from a reactive store)

Result

```
<div class="container">
  <h1>Custom Store</h1>
  <ul class="list-group">
    <li class="list-group-item"
      *ngFor="let todo of todo$ | async">
      {{ todo.id }} - {{ todo.name }}
    </li>
  </ul>
  <hr>
</div>
```





Updating the store

Writing new values in the store by writing a custom `.update()` method

Update the list of Todo's in the store

```
// Update the store, in this case a list of todos
updateTodo(name: string, payload: Todo): void {
  // 1. fetch the correct slice from the store (even if we only have one)
  const value = this.value[name];
  const newTodos: Todo[] = value.map((todo: Todo) => {
    // 2. loop over our todos and update the given item
    if (payload.id === todo.id) {
      return {...todo, ...payload};
    } else {
      return todo;
    }
  });
  // 3. Set the store with the new value of newTodos
  this.set(name, newTodos);
  // 4. Optional - write state to localStorage, save todos in backend, etc.
}
```

Get correct slice

Loop over items, use array mapping (!)

Return updated item…

Or simply return if not applicable

Write new array in the store

Update the UI and logic for component

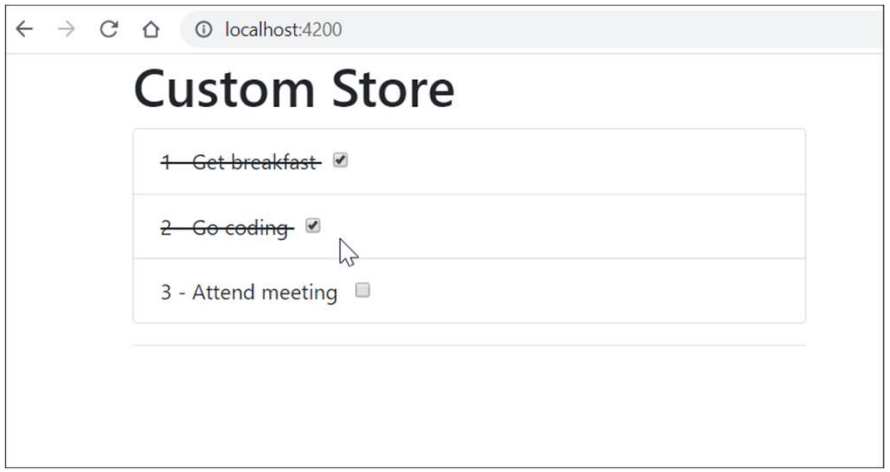
```
<ul class="list-group">
  <li class="list-group-item"
    *ngFor="let todo of todo$ | async">
    <span [ngClass]="{'todo-done': todo.done}">
      {{ todo.id }} - {{ todo.name}}
    </span>
     
    <input type="checkbox" [checked]="todo.done" (change)="updateTodo(todo)">
  </li>
</ul>
```

custom CSS class

Add behavior

```
// update the state of a todo item
updateTodo(todo: Todo) {
  // toggle the state of item
  todo.done = !todo.done;
  this.store.updateTodo('todos', todo);
}
```

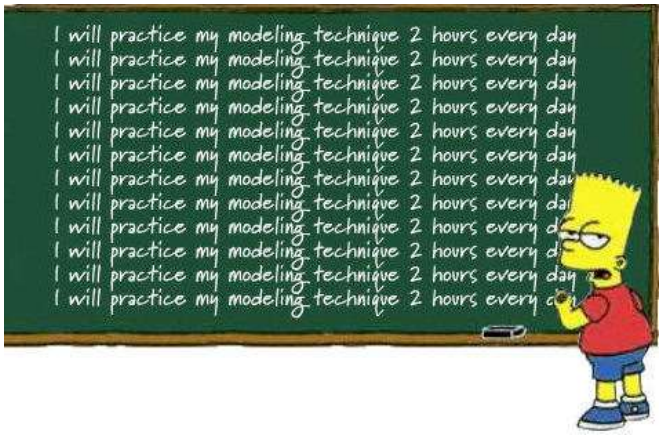
Toggle state and update the store



Result

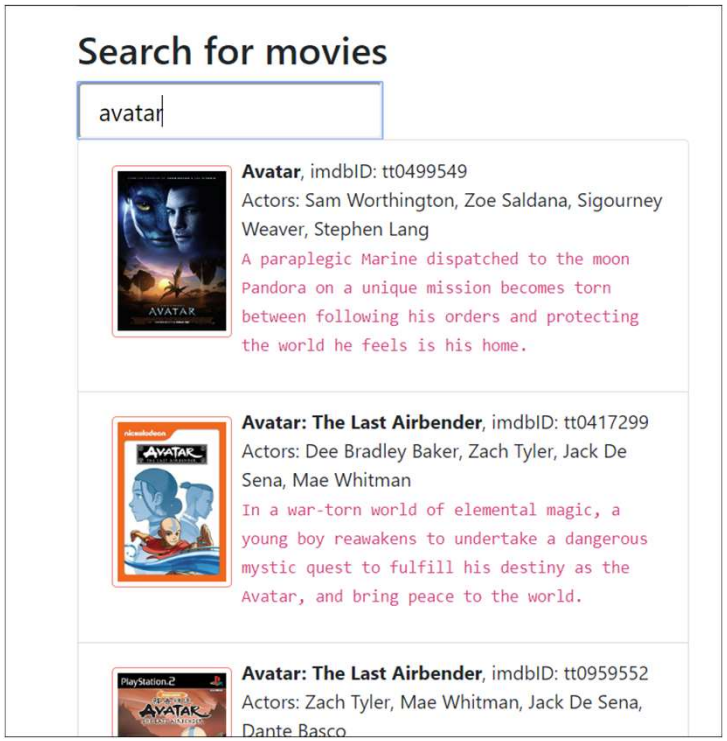
Workshop - 1

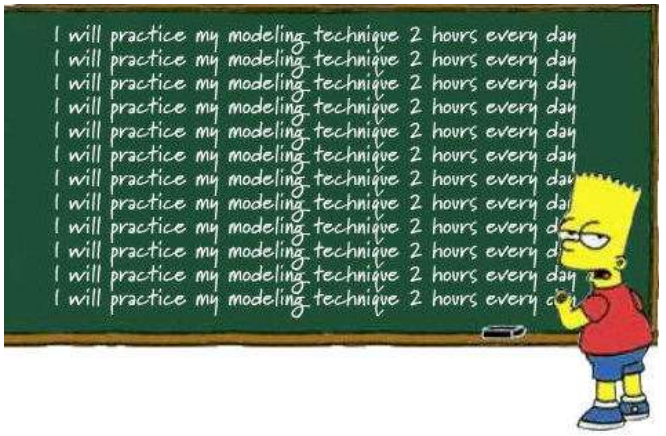
- Create a new app, Create a custom store, as described in the slides
- OR: Start from `../740-custom-rxjs-store`
- Create a `counter$` property and add it to the store.
  - In your component: show buttons to `increment()`, `decrement()` and `reset()` the `counter` in the store
  - Add it –for now – to the *same* component, for simplicity
- Some UI and logic is already available in the example, but first try it yourself!



Workshop - 2

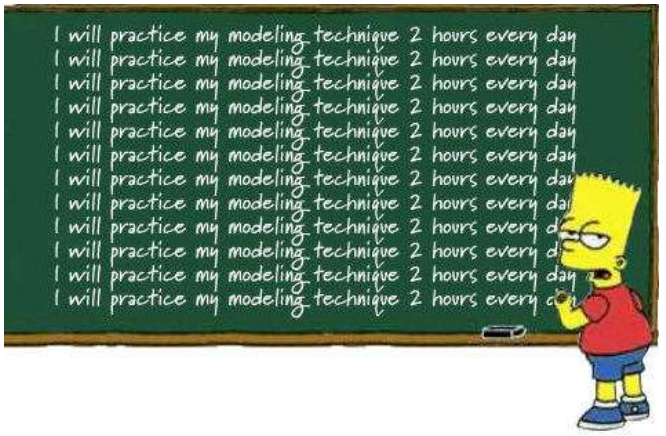
- Create a `movies$` property and add it to the store.
- Add a textbox to search for movies, put movies in the store.
- Search for movie details, based on the imdbID which is now available.
- Some UI and logic is already available in the example, but first try it yourself!





Optional workshop - 3

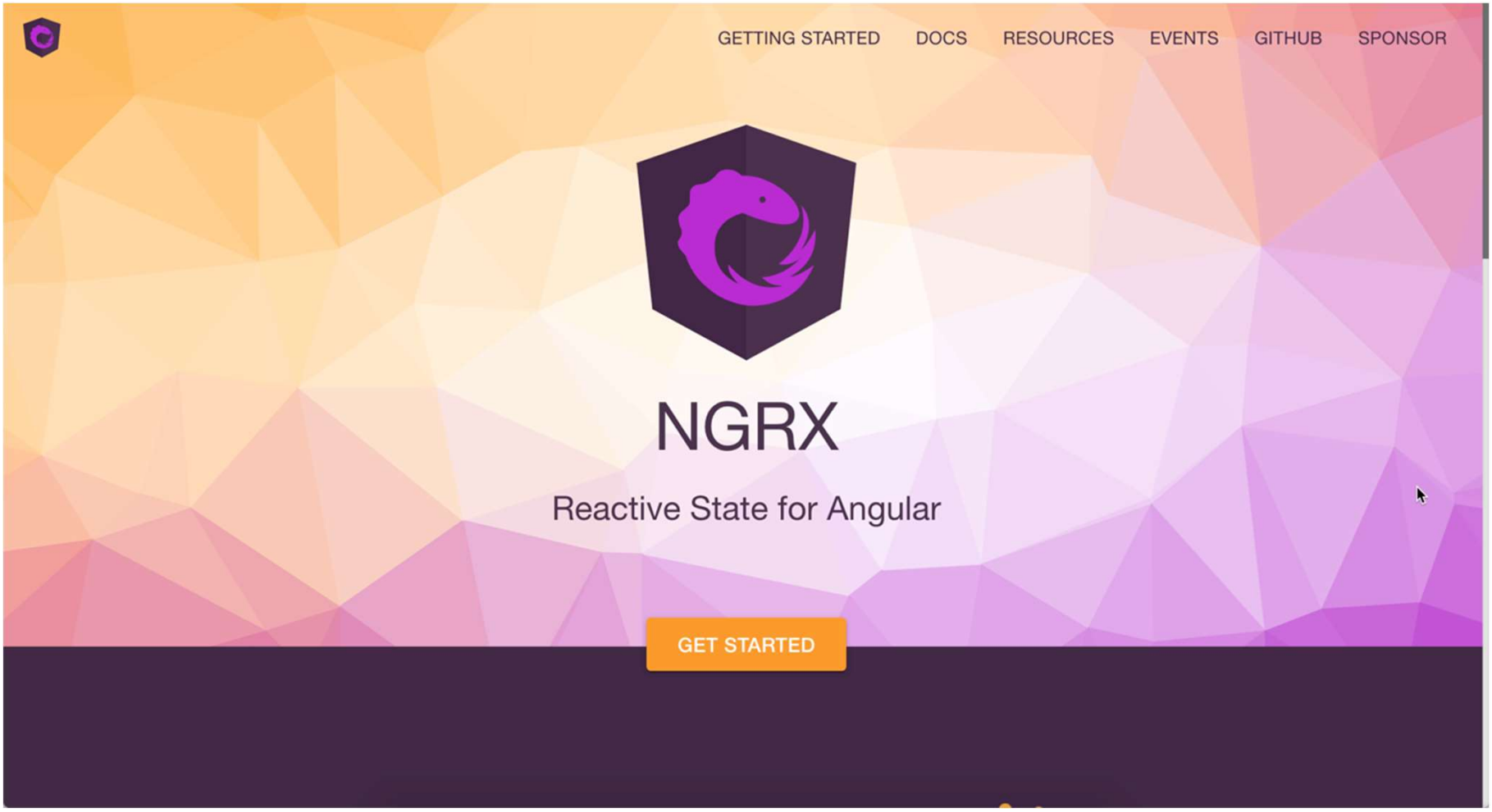
- Add the router, (like in `../740-custom-rxjs-store`)
- Make sure that the store contents survive a switch in components.
  - E.g. Movies retain in the store, the `counter` value is preserved, and so on.
- Tip: *don't reinitialize* the store in the `ngOnInit()` of every component, instead, do it once during store initialization and work from there.



@ngrx/store Terminology and concepts

Working with `@ngrx/store`, the officially endorsed state management library for Angular

https://ngrx.io/



Important Store terminology / concepts

Store

"The store can be seen as your client side database. But more importantly, it reflects the state of your application. You can see it as the single source of truth."

"The store holds all the data. You modify it by dispatching ***actions*** *to it."*

Actions

*"Actions are the payload that contains needed information to alter your store. Basically, an action has a **type** and a **payload** that your reducer function will take to alter the state."*

Reducer

"Reducers are functions that know what to do with a given action and the previous state of your app.

Reducers will take the previous state from your store and apply a pure function to it. From the result of that pure function, you will have a new state. The new state is put in the store."

Dispatcher

"Dispatchers are simply an entry point for you to dispatch your action. In Ngrx, there is a dispatch method directly on the store. I.e., you call `this.store.dispatch({…})`*"*

Source: https://www.toptal.com/angular-js/ngrx-angular-reaction-application

Reducers, Store and Components - The complete picture

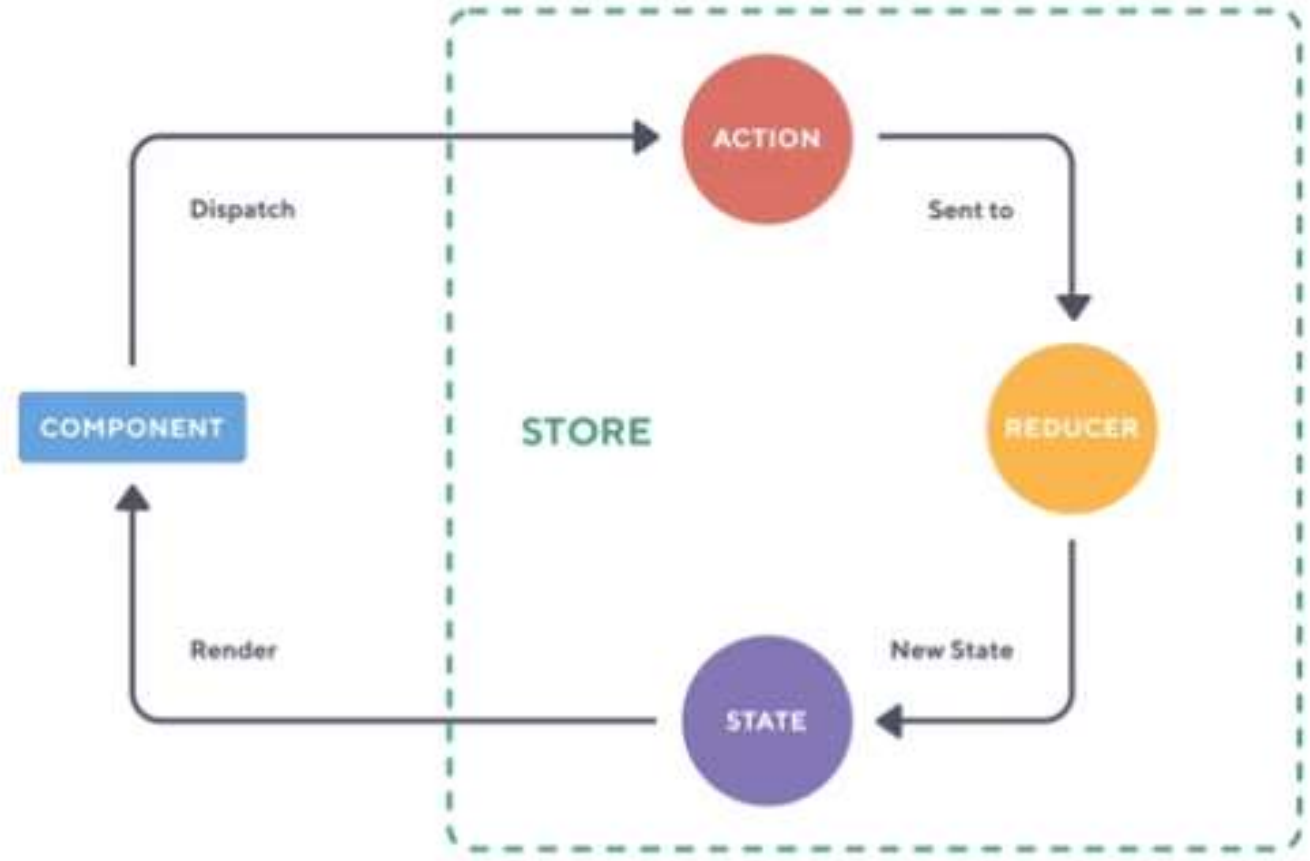
The **Component** first dispatches an Action. When the **Reducer** gets the Action, it will update the state(s) in the **Store**.

The Store has been injected to the Component, so the View will update based on the store state change (it is `subscribed`).

https://hongbo-miao.gitbooks.io/angular2-server/content/part4/add-ngrx-store.html

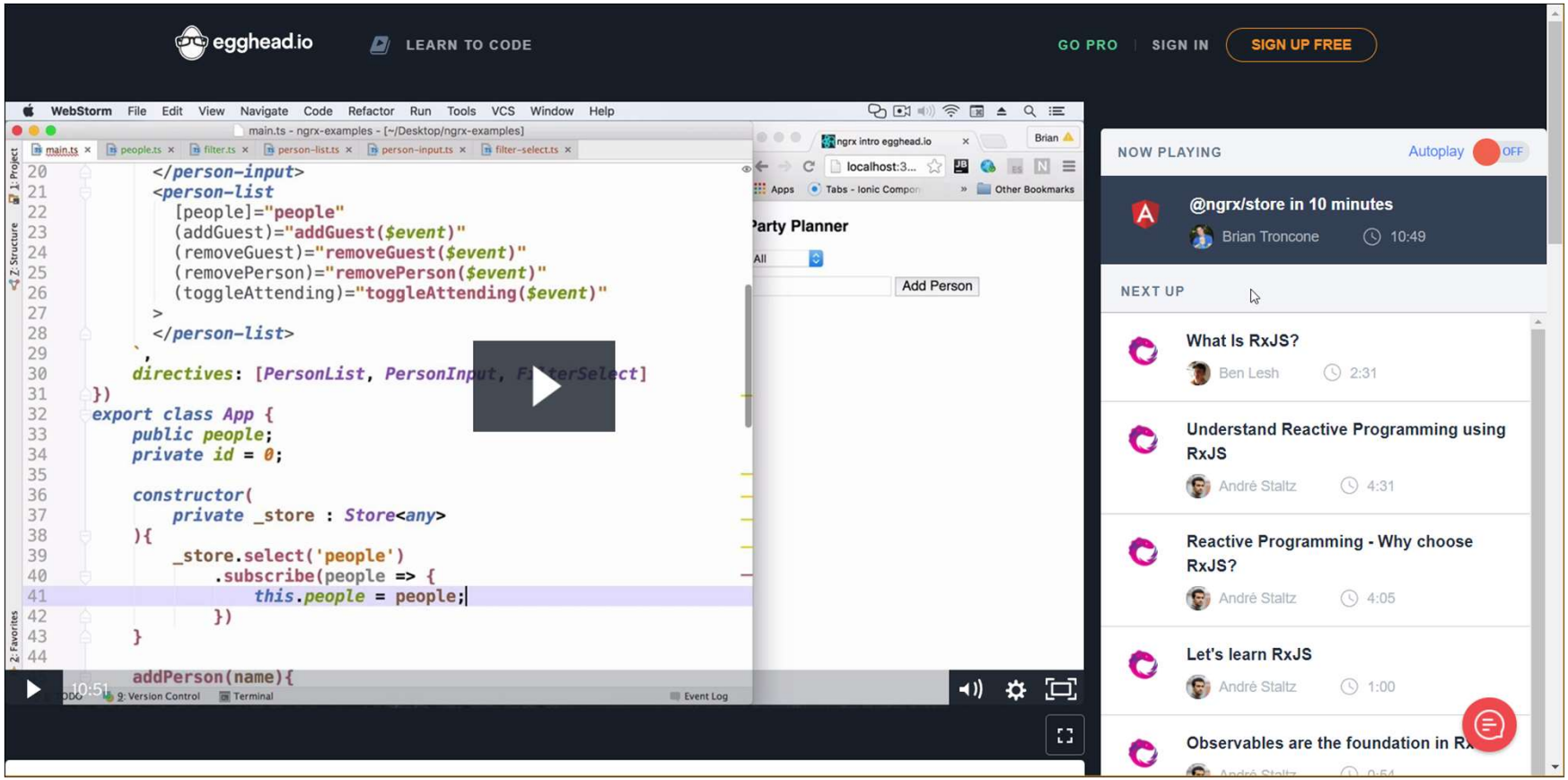
REDUX ARCHITECTURE

One-way dataflow



https://platform.ultimateangular.com/courses/ngrx-store-effects/lectures/3788532

Store concepts in a video (a little bit old now)



https://egghead.io/lessons/angular-2-ngrx-store-in-10-minutes

Setting up @ngrx/store

- Install core files & store files
- Create new project or add to existing project
- Via `npm install` or `ng add`
- Older versions have different installations!

```
npm install @ngrx/store --save
```

OR

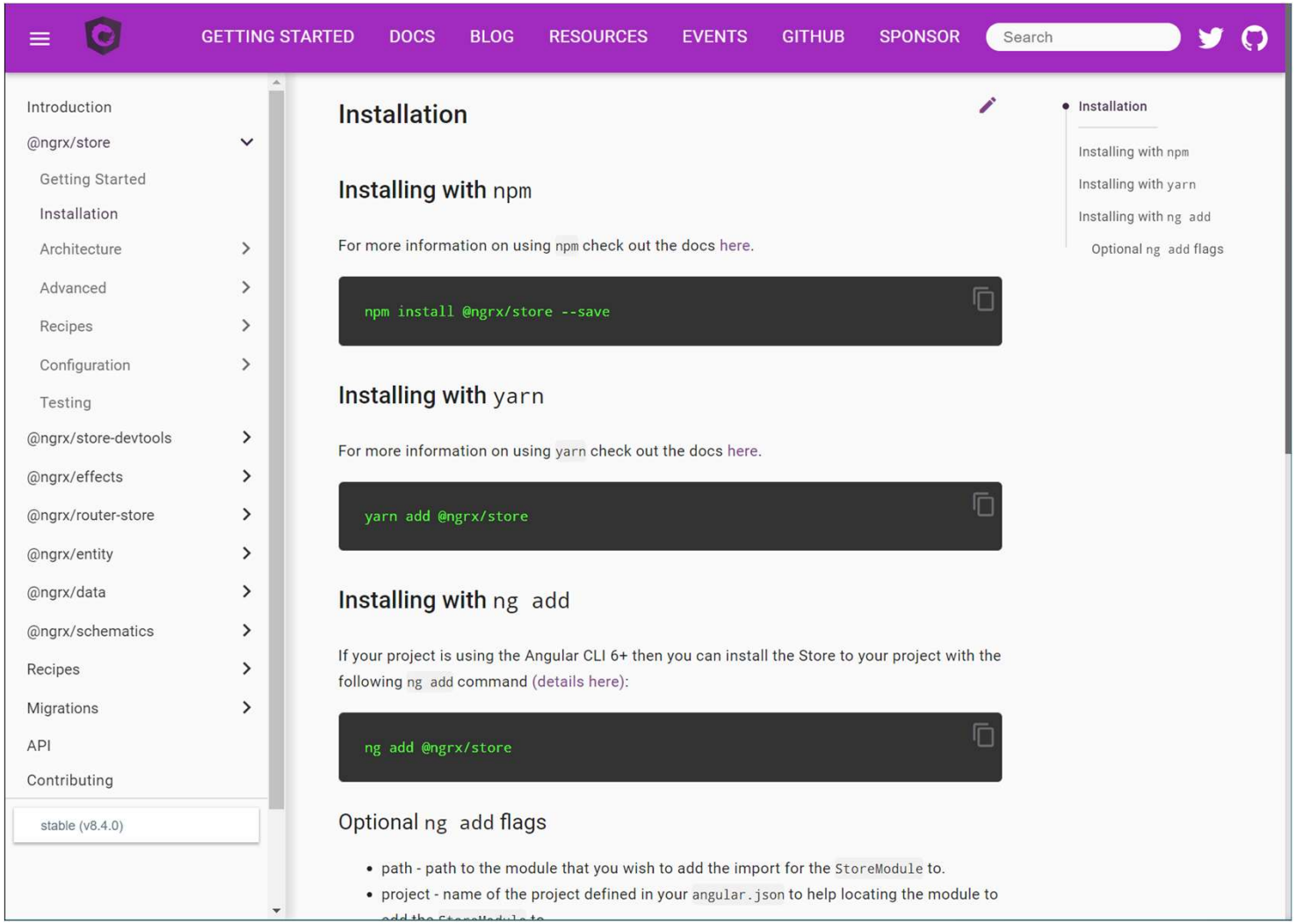
```
ng add @ngrx/store
```

Adding via Angular CLI

- **`ng add @ngrx/store`**
- Option flags, see https://ngrx.io/guide/store/install

- Adding via Angular CLI will do the following
  - Update dependencies in `package.json` and `npm install`
  - Create `src/app/reducers` folder.
  - Create `src/app/reducers/index.ts` file with an empty `State` interface, an empty reducers map, and an empty metaReducers array.
  - Update `src/app/app.module.ts`.

Installation docs



https://ngrx.io/guide/store/install

Creating your first store

Set up a simple store – explaining all the concepts

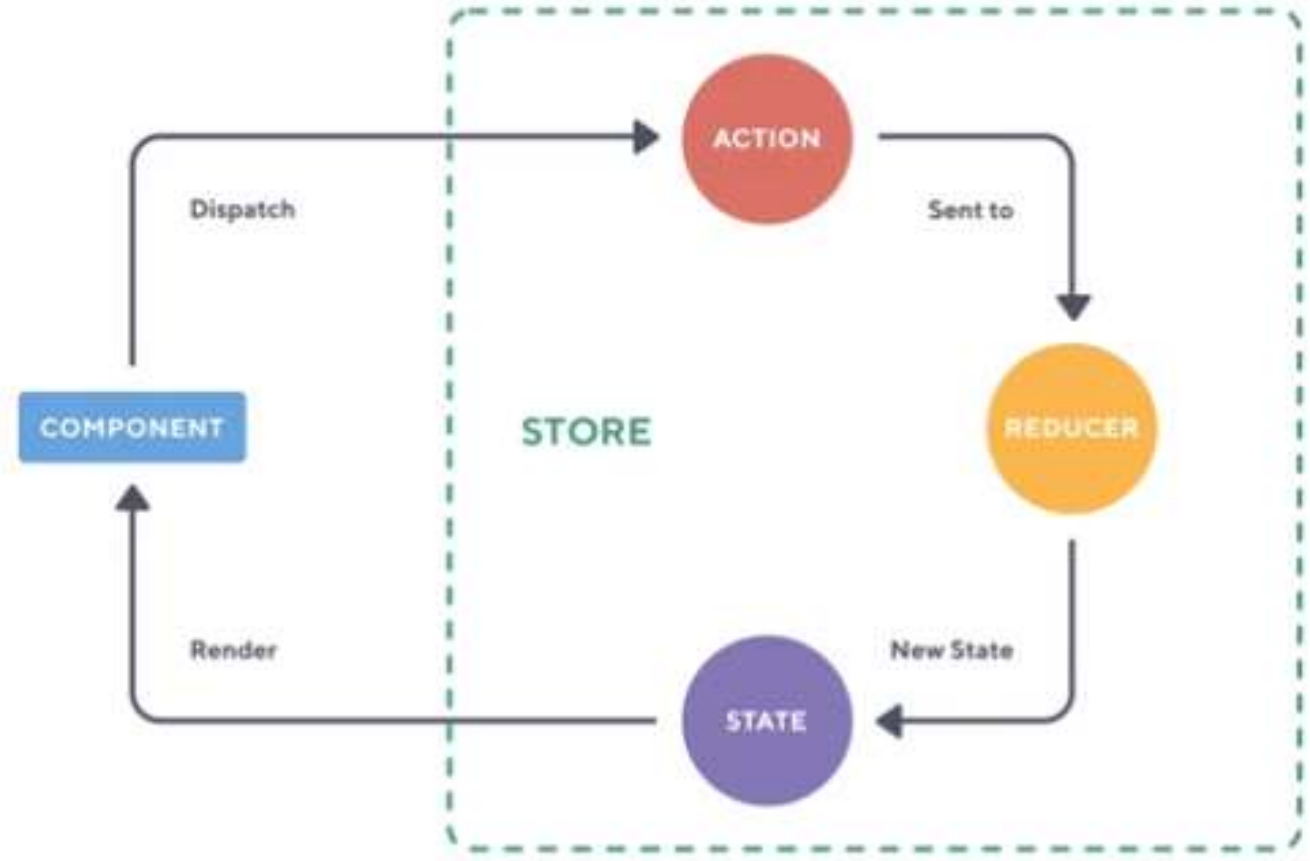
Step 0 – install core files

- We’re adding the store manually to explain all concepts

```
npm install @ngrx/store --save
```

REDUX ARCHITECTURE

One-way dataflow

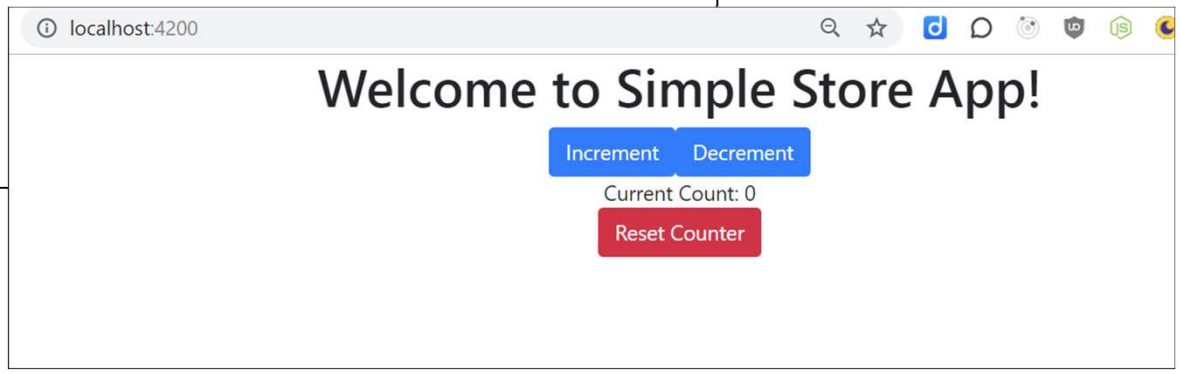


https://platform.ultimateangular.com/courses/ngrx-store-effects/lectures/3788532

Start somewhere, then work clockwise

- 1. For instance, first create a **component**

```
<!-- Simple Component, holding a counter store -->
<div>
  <h1>
    Welcome to {{ title }}!
  </h1>
  <button (click)="increment()">Increment</button>
  <button (click)="decrement()">Decrement</button>
  <div>Current Count: {{ count$ | async }}</div>

  <button class="btn btn-danger" (click)="reset()">
    Reset Counter
  </button>
</div>
```



2. Create your actions

- Create a new file, `../store/counter.actions.ts`
- The architecture can be complex, with nested (sub) folders etc, but it doesn't matter for the internals

```
// counter.actions.ts - the Actions for our counter
import {createAction} from '@ngrx/store';

// export our actions as constants
export const increment = createAction('COUNTER - increment');
export const decrement = createAction('COUNTER - decrement');
export const reset = createAction('COUNTER - reset');
```

3. Create your reducers

- A reducer is simply an exported function with a name.
- It takes two parameters:
  - Current `state`, or otherwise empty object/initial state
  - `action`, of type `Action`
- We're going to create more complex actions, with `payload` later on
- You'll need the exported reducer function to support AOT-compiling
- https://ngrx.io/guide/store/reducers

```
// Import store stuf and available actions
import {Action, createReducer, on} from '@ngrx/store';
import {decrement, increment, reset} from './counter.actions';

// Initial state: counter=0
export const initialState = 0;

// Internal variable/function with reducers. It receives a state from
// the actual (exported) counterReducer below
const reducer = createReducer(initialState,
  on(increment, state => state + 1),
  on(decrement, state => state - 1),
  on(reset, state => 0)
);


// The exported reducer function is necessary
// as function calls are not supported by the AOT compiler.
export const counterReducer = (state = 0, action: Action) => {
  return reducer(state, action);
};
```

4. Adding store and reducer to module

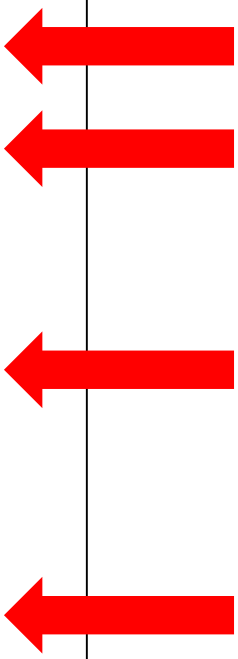
- Register the state container with your application.
- Import reducers
- Use `StoreModule.forRoot()` to add it to the module
- More complex: we can have a *map* of reducers, or child modules holding their own stores

```
…
// 1. import store stuff
import {StoreModule} from '@ngrx/store';
import {counterReducer} from './store/counter.reducer';

@NgModule({
  declarations: [
    AppComponent,
    …
  ],
  imports: [
    BrowserModule,
    // 2. Add the StoreModule to the AppModule,
    // to make the store known inside the application
    StoreModule.forRoot({count: counterReducer}),
  ],
  providers: [],
  bootstrap: [AppComponent]
})
export class AppModule {
}
```

5. Using/calling the Store in component

- Import and inject the `Store` service to components
- Initialize the store with correct Type
  - More complex: create a custom `AppState` interface
- Use `store.pipe(select())` to select slice(s) of the state
- Add methods to dispatch actions
  - `increment()`
  - `decrement()`
  - `etc..`

```
// app.component.ts
import {Component, OnInit} from '@angular/core';
import {Observable} from 'rxjs';
import {Store, select} from '@ngrx/store';

// Import all possible actions
import {increment, decrement, reset} from './store/counter.actions';

@Component({
  selector: 'app-root',
  templateUrl: './app.component.html'
})
export class AppComponent implements OnInit {
  title = 'Simple Store App';
  count$: Observable<number>;

  constructor(private store: Store<{ count: number }>) {}

  ngOnInit() {
    // Select the 'count' property from the store and
    // assign it to count$ variable.
    this.count$ = this.store.pipe(
      select('count')
    );
  }

  // dispatch actions for the store. They are imported above
  increment() {
    this.store.dispatch(increment());
  }
  …
}
```

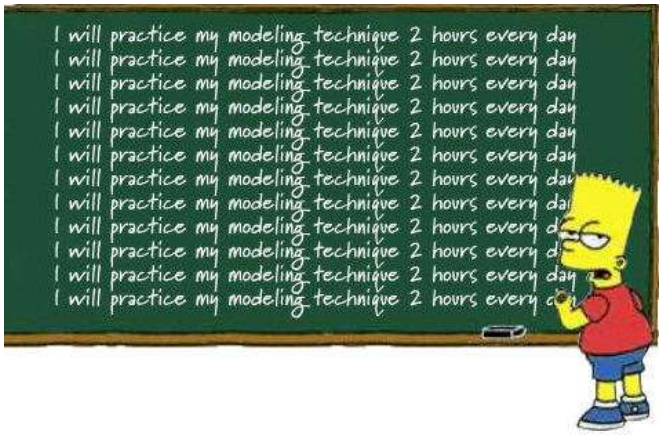


Run the app

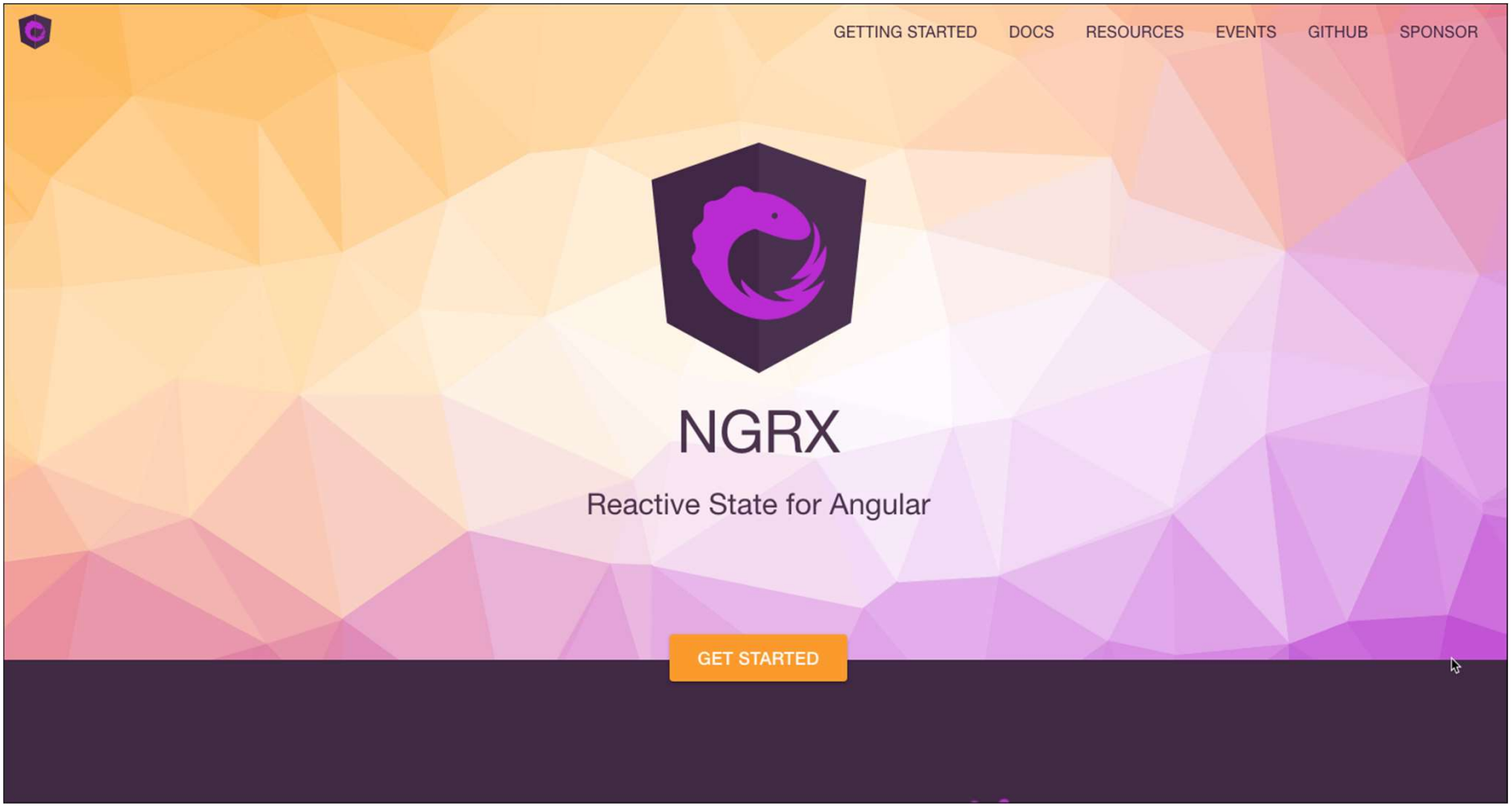
Add new components, subscribe to store, enhance store, etc.

Workshop

- Create a new app, follow the previous steps to add a Store
- OR: Start from `../200-ngrx-simple-store`
- Make yourself familiar with the store concepts and data flow. Study the example code.
- Create some extra actions on the reducer. For example:
  - Add `+5` with one click
  - Subtract `-5` with one click
  - Reset counter to 0 if `counter >= 10`;



Official site

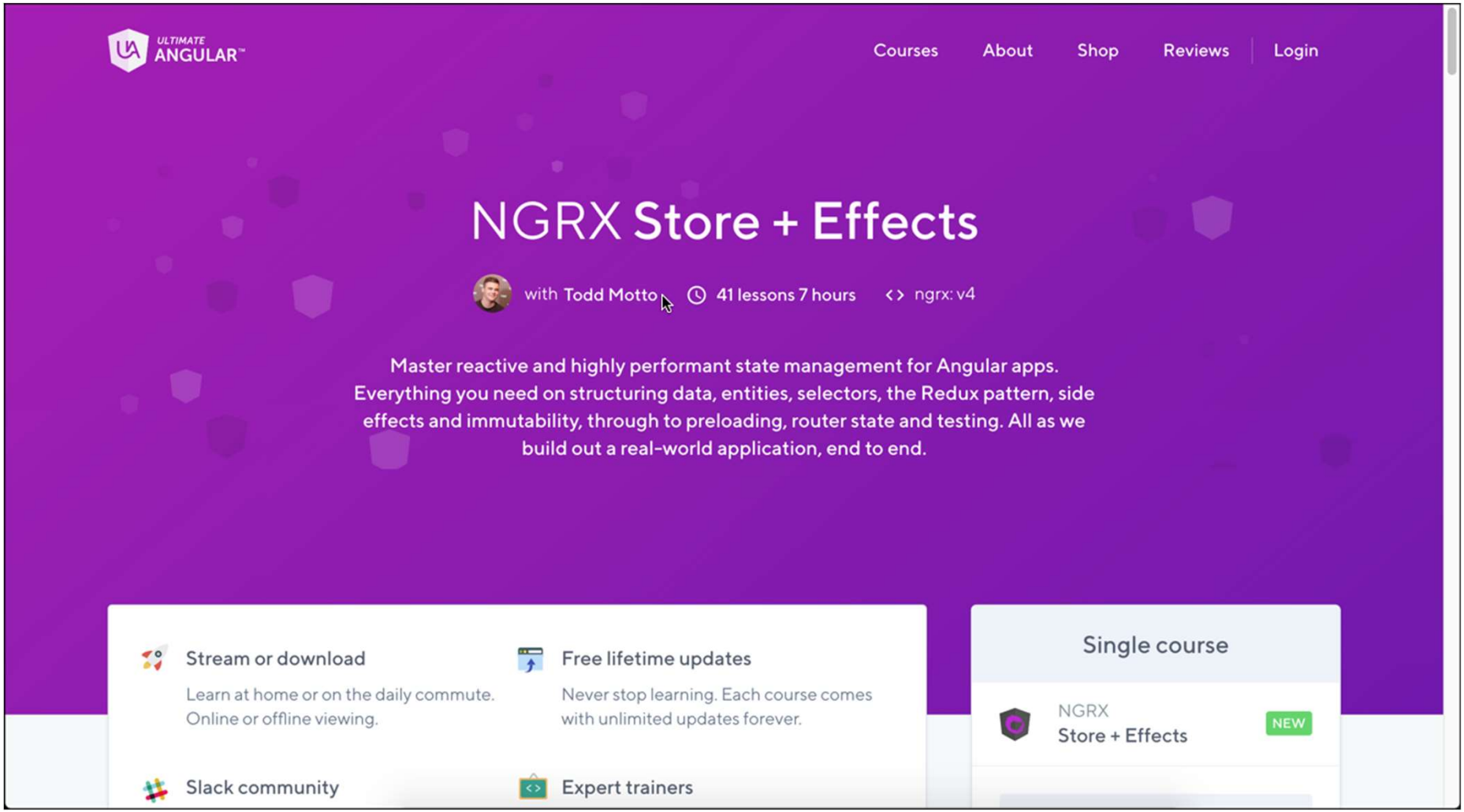


https://ngrx.io/

Rob Wormald - co-created @ngrx/store (1st gen!)

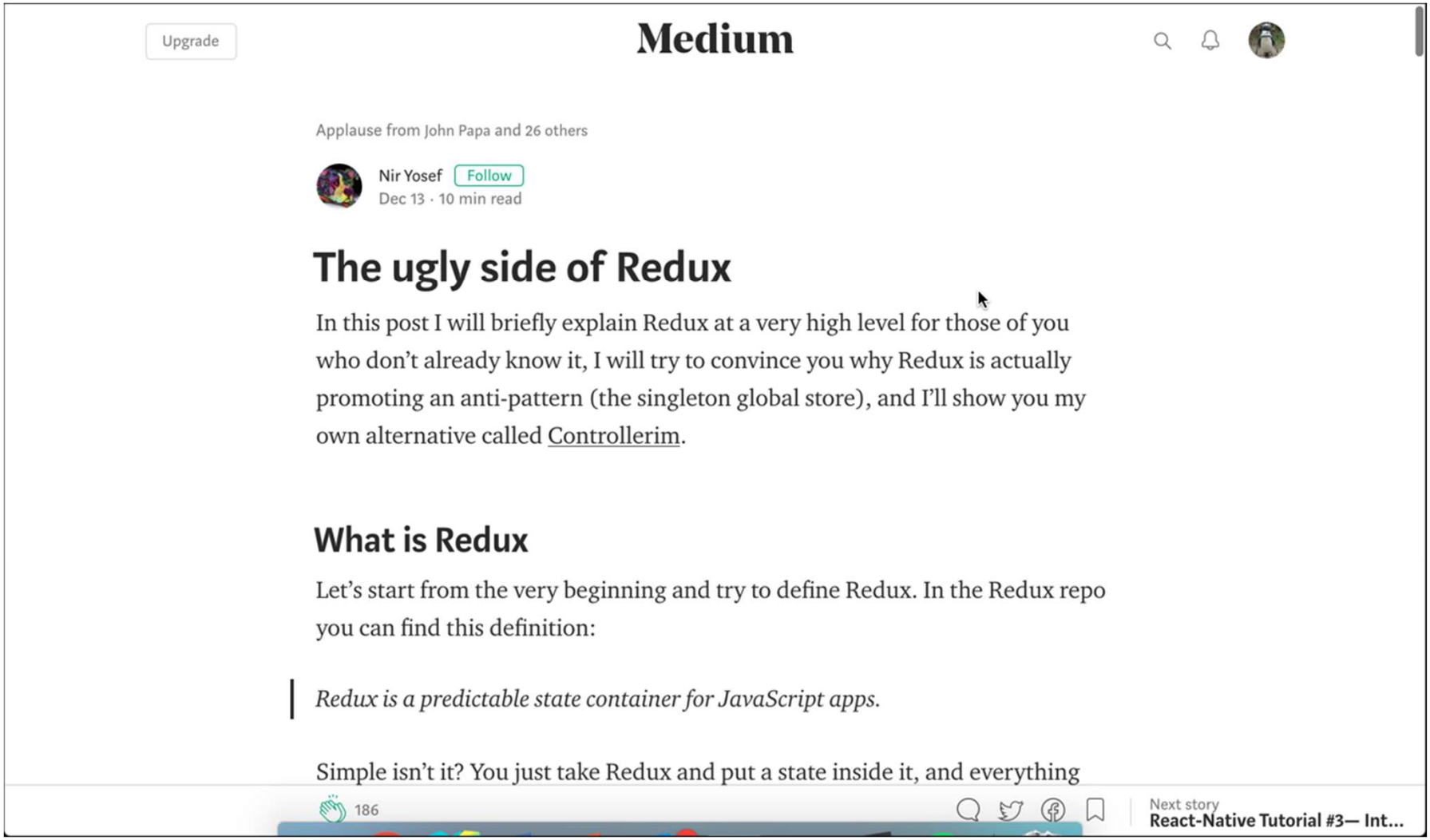
https://www.youtube.com/watch?v=mhA7zZ23Odw - and more

Online Training by Todd Motto (2nd gen!)



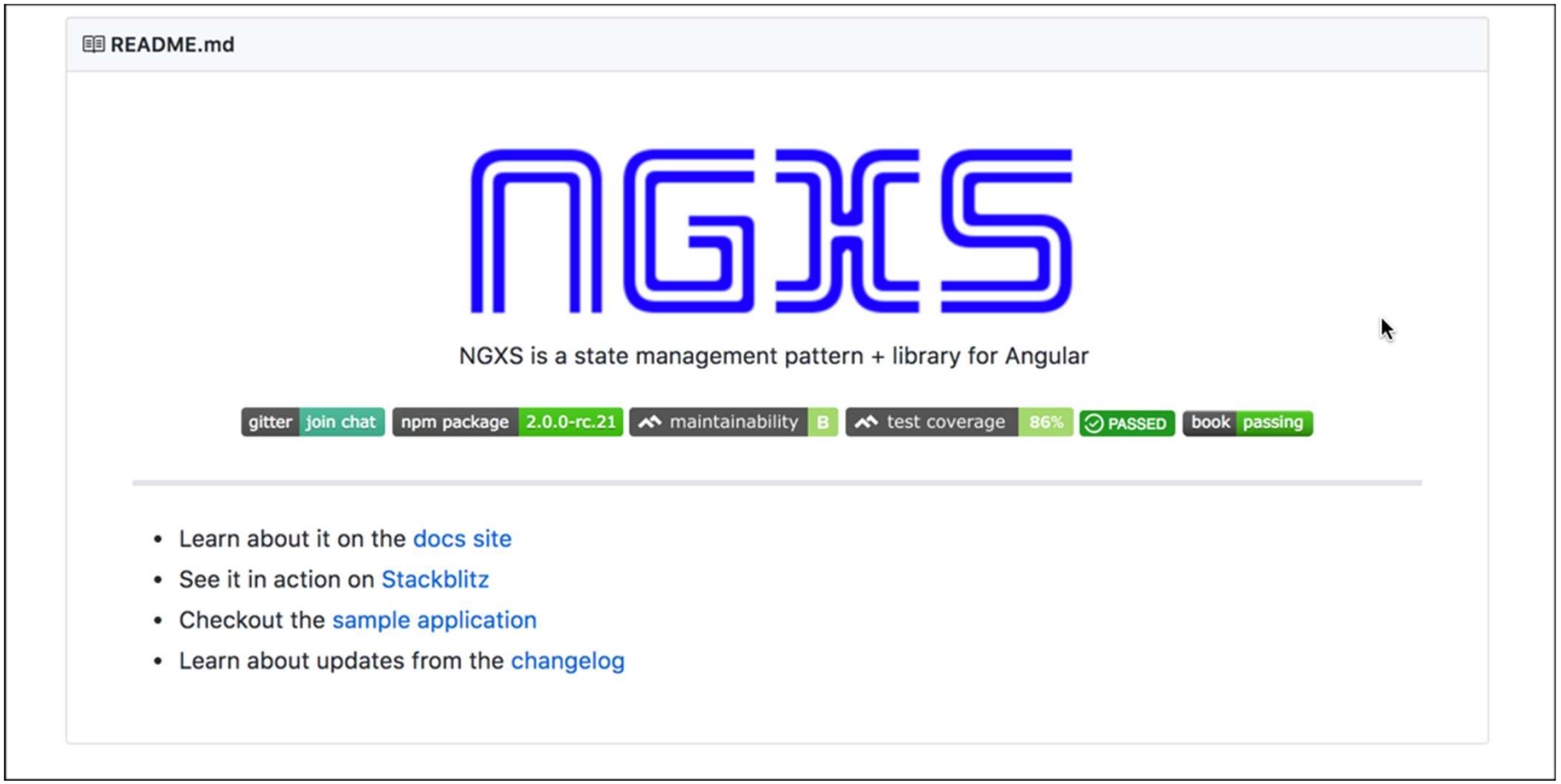
https://ultimateangular.com/ngrx-store-effects

Think about this – “The Ugly side of Redux”



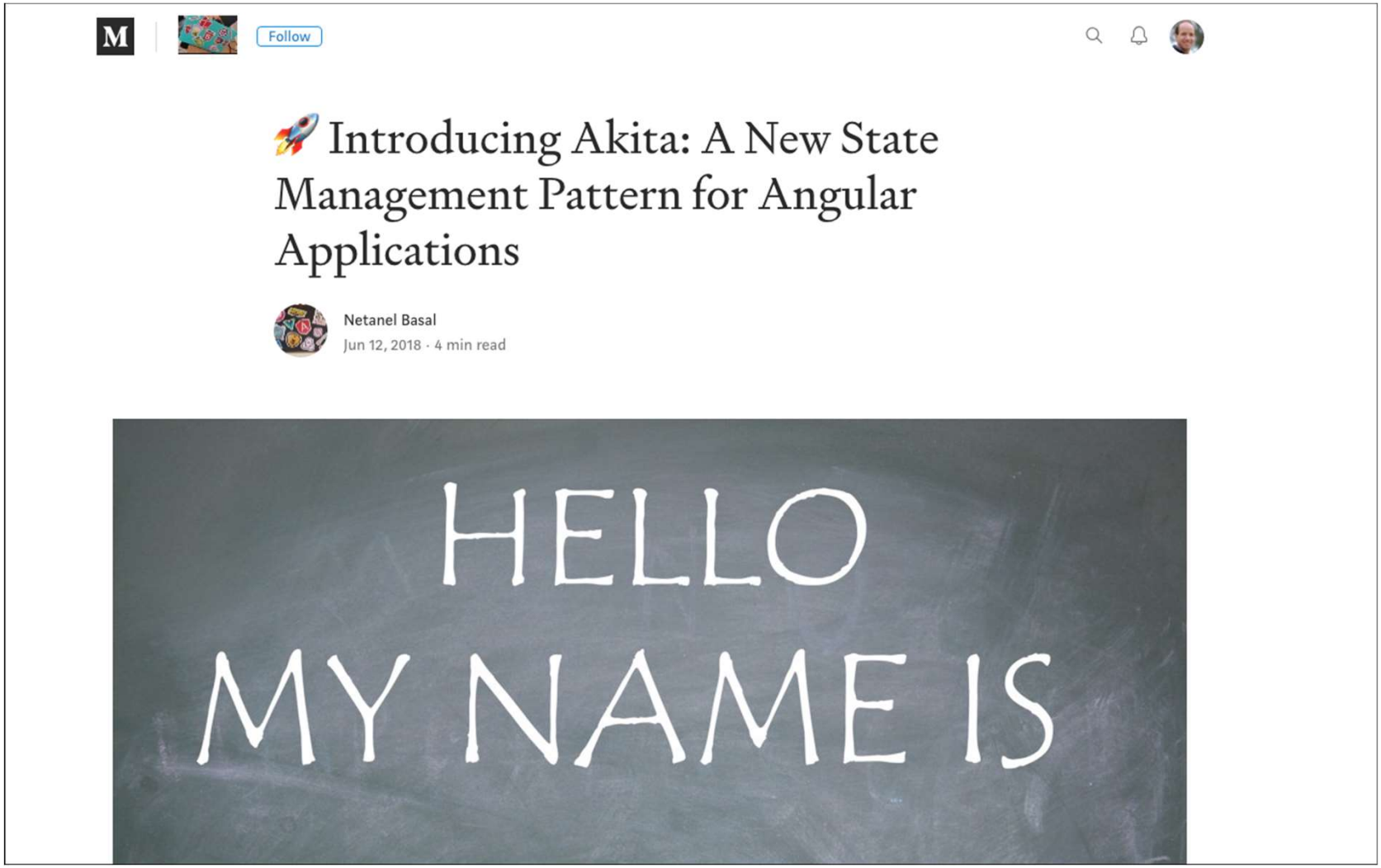
https://medium.com/@niryo/the-ugly-side-of-redux-6591fde68200

Alternative State Management solution



https://github.com/amcdnl/ngxs

Akita – another state management alternative

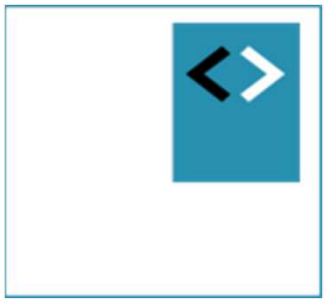


https://netbasal.com/introducing-akita-a-new-state-management-pattern-for-angular-applications-f2f0fab5a8

Next Steps

- @ngrx/effects - Side Effect model for @ngrx/store to model event sources as actions.
- @ngrx/router-store - Bindings to connect the Angular Router to @ngrx/store
- @ngrx/store-devtools - Store instrumentation that enables a powerful time-travelling debugger
- @ngrx/entity - Entity State adapter for managing record collections.
- @ngrx/schematics - Scaffolding library for Angular applications using NgRx libraries

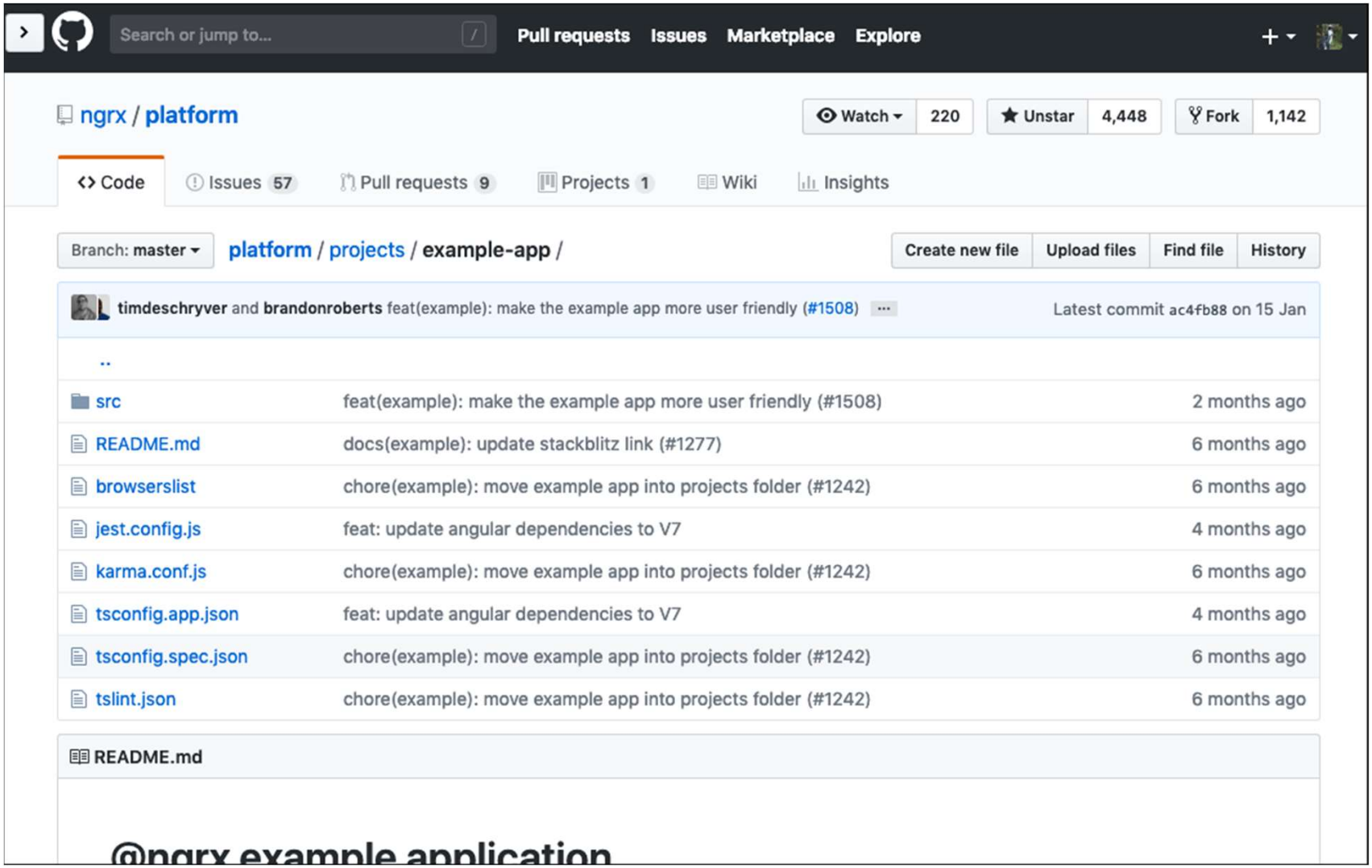
https://ngrx.io/docs



Sample Store apps

Some study material

Ngrx store platform sample app

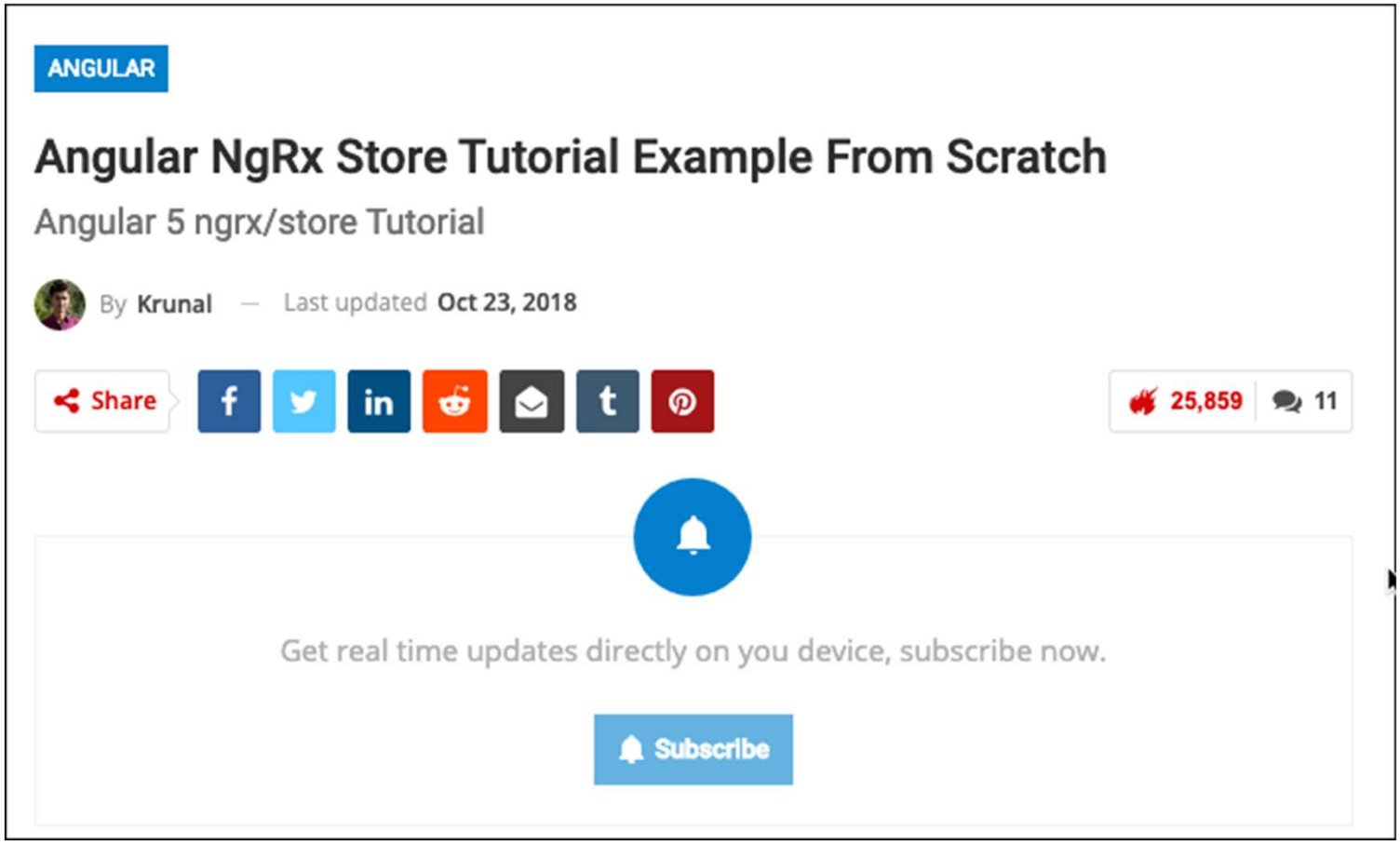


https://github.com/ngrx/platform/tree/master/projects/example-app

More info

https://medium.com/@gregor.woiwode/ngrx-8-meet-the-new-upcoming-factory-methods-of-the-next-major-release-a97a079cc089

Store tutorial from scratch (2nd gen!)



https://appdividend.com/2018/01/31/angular-ngrx-store-tutorial-example-scratch/