Introduction SPA

Browser-based Applications

Benefits

- · Work from anywhere, anytime
- · Platform independent, including mobile
- No software update, no application, easy maintenance • Software can be provided as a service (SaaS - pay as you go)
- Code separation

Liabilities

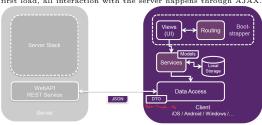
• No data sovereignty (Datenhoheit)

- · Limited/restricted hardware access
- SEO Search engines must execute JavaScript
- More complex deployment strategies

A website that fits on a single web page with a user experience similar to that of a desktop application. All code is retrieved with a single page load or resources are dynamically loaded. SPAs use AJAX and HTML5 to create responsive Web apps, without constant page reloads.

Architecture

Website interacts with user by rewriting parts of the DOM. After first load, all interaction with the server happens through AJAX.



All JS code must be delivered to the client over potentially slow networks. Bundling and minifying the source leads to smaller SPA footprint. Larger SPAs with many modules need a reliable dependency management. Initial Footprint can be reduced by loading dependent modules on-demand.

WebPack as Bundler

Entry: Start, follows the graph of dependencies to know what to

Output: Tell webpack where to bundle your application.

Loaders: Transforms these files into modules as they are added to your dependency graph.

Plugins: Perform tasks like bundle optimization, asset management and injection of env variables

Mode: Enable built-in optimization mechanisms

Routing

- · Completely on client-side by JS
- Navigation behaves as usual
- Browser needs to fake the URL to change and store page state
- · window.history.pushState

Dependency Injection

Benefits

- Reduces coupling between consumer and implementation
- Contracts between classes are based on interfaces
- Supports the open/closed principle
- Allows flexible replacement of an implementation

Decorators

- Provide a way to add annotations / meta-programming syn-
- Can be attached to a class declaration, method, accessor, property or parameter
- Widely used in Angular
- Library, kein Framework • Um User Interfaces zu bauen
- View in MVC
- Minimales Featureset
- Entwickelt von Facebook
- Verwendet für: WhatsApp, Insta, AirBnb, etc.

• Komplexes Problem aufteilen in einfachere Komponenten • Für eine bessere: Wiederverwendbarkeit, Erweiterbarkeit, Wartbarkeit, Testbarkeit, Aufgabenverteilung

Entwicklung von Uls

- Beschreibung des UIs
- Event-Handling
- Aktualisieren der Views

Komponenten und Elemente

- Funktionen die HTML zurückgeben
- Beliebige Komposition von React-Elementen und DOM-Elementen

```
function App() {
                           Parameterübergabe an Funktion
return
   <div>
     <HelloMessage name="HSR"/>
     <img src="/logo.png"/>
   </div>
                  Äquivalent zu Attribut für DOM-Element
```

React verwendet JSX (blau), eine Erweiterung von JavaScript (gelb). Überall wo JSX verwendet wird, muss react importiert

const menu = entries.map(entrv =>

<ListItem as="a" to={\^/\${entry.path}\^}>

<h1>{entry.title.toUpperCase()}</h1>

{entry.subtitle}

Styles: werden nicht als Strings sondern als Object angegeben.

```
<Container>
                                     <Container>
  <Message:
                                         ? <span>
    Fehler: {error}
                                             Fehler: {error}
  </Message>
                                          </span>
                                          <span>0K!</span>
</Container>
                                      </Container
```

Komponenten erhalten alle Parameter/Properties als props Ob-

- this.props bei Klassen
- Bei Funktionen als Parameter
- Immer read-only

Mounting: nötig um Komponenten auf Webseite anzuzeigen. ReactDOM.render

```
ReactDOM.render(
    document.getElementById('root')
```

React-Klassenkomponenten können einen veränderbaren Zustand haben Der state einer Komponente ist immer privat. Ändert der State, wird auch die Komponente aktualisiert.

```
class Counter extends React.Component {
    state = { counter: 0 }
    // ...
```

Event Handle

```
const increment = () => {
    this.setState({counter: this.state.counter +
<button onClick={this.increment}>
```

- 1. React Komponenten werden als virtueller DOM gerendert
- 2. Wird der state geändert, erstellt React einen virtuellen DOM
- 3. Alter und neuer DOM werden verglichen
- 4. Erst dann werden geänderte DOM-Knoten im Browser erstellt

Input Handling

```
<form onSubmit={this.handleSubmit}>
<input value={this.state.username}</pre>
        onChange={this.handleUsernameChange} //...
handleUsernameChange = (event) => {
    this.setState({username: event.target.value});
handleSubmit = (event) => {
    event.preventDefault();
```

Komponenten Lifecycle



Mounting

- constructor(props)
 - State initialisieren, sonst weglassen
- 2. static getDerivedStateFromProps(props, state)
- Von State abhängige Props initialisieren
- render()
- componentDidMount()
 - DOM ist aufgebaut
 - Guter Punkt um zum Beispiel Async-Daten zu laden
 - setState Aufruf führt zu re-rendering

- static getDerivedStateFromProps(props, state)
 - Von State abhängige Props aktualisierer
- shouldComponentUpdate(nextProps, nextState)
 - wird false zurückgegeben wird render übersprungen
- render()
- getSnapshotBeforeUpdate(prevProps, prevState)
- componentDidUpdate(prevProps, prevState,
- - Analog zu componentDidMount, DOM ist aktualisiert

- componentWillUnmount()
 - Aufräumen

Error Handling

- static getDerivedStateFromError(error)
 - Error im State abbilden
- componentDidCatch(error, info)

 - Verhindern, dass Fehler propagiert wird, analog zu
 - catch-Block in try-catch

React Router

- Komponentenbibliothek • Komponenten anzeigen oder verstecken abhängig von der
- Für React Web und React Native

Router Komponenten

<Router>

Alle Routen müssen Teil des Routers sein, typischerweise nahe der Root-Komponente

<Route exact path="/" component={Home} />

Home-Komponente wird nur gerendert, wenn der path (exakt) matcht. Mehrere Route Elemente können gleichzeitig aktiv sein. <Link to="/">Home </I.ink>

App-interne Links, welche nicht wie <a >die Seite neu laden.

<Redirect to="/somewhere/else"> Wird ausgeführt, sobald gerendert.

Problem von Lifecvele Methoden Zusammengehörender Code

ist auf mehrere Methoden verteilt (Mount/Unmount). Problem von Klassen-State State ist über verschiedene Methoden verteilt

- Fazit: Lifecycle und State ohne Klassen machen react verständlicher
- Klassen sind weiterhin unterstützt
- Hooks erlauben Logik mit Zustand einfacher wiederzugerwenden

State Hook

```
function Counter() {
   const [count, setCount] = useState(0);
   // button => setCount(count + 1)
   return( {count} );
```

Mehrere State-Variablen: useState Aufrufe müssen immer in derselben Reihenfolge gemacht werden

useEffect(() => { // Mount stuff return () => { // Unmount stuff }, [] /* <= Dependencies */);

Flow

- Erweitert JavaScript um Typenannotationen
- Typ-Annotation im Code Typ-Inferenz für lokale Definitionen
- Generics, Maybe-Types, Union and Intersection-Types

TypeScript und React

- Mehr Typensicherheit in React-Komponenten
- Props und State lassen sich typisieren

Vorteil gegenüber Flow:

- Vollwertige Programmiersprache
- Besser unterstützt von Libraries und IDEs

TypeScript Fehler müssen korrigiert werden

React Context Ermöglicht es, Props für alle Unterkomponenten zur Verfügung zu stellen. (Theme Variablen)

// provider const c = React.createContext(themes.light); const theme = useContext(c); // consumer

Library für Statemanagement (Repräsentation / Veränderung / Benachrichtigung). State wird als Tree (immutable) von Objekten dargestellt. Veränderung am Tree führt durch den Reducer zu einem neuen Tree t+1 (funktionale Programmierung). State wird im Store verwaltet

Benötigt um Stateänderungen zu machen. Wird an den Store gesendet / dispatched. Action ist eine reine Beschreibung der Action. {type: 'TRANSFER', amount: 100 }

Reducer Pure Funktionen, haben keine Seiteneffekte.

function balance(state = 0, action) { switch (action.type) { case 'TRANSFER return (state + action.amount); default: return state;

Reducer kombinieren: Jeder Reducer erhält einen Teil des States, für den er zuständig ist. Resultat wird in einem neuen

```
State-Objekt kombiniert.
function rootReducer(state = {}, action) {
        balance: balance(state.balance, action),
        transactions: transactions(state.
             transactions, action)
// Hilfsfunktion combineReducers:
const rootReducer = combineReducers({
   balance, transactions
});
```

Store ersteller

const store = createStore(rootReducer); Mit dem root-Reducer kann der Store erstellt werden. In Kombination mit React führt das zu einem re-rendering der Komponenten.

React < 3 Redux

```
Redux mit React verbinden:
const mapStateToProps = (state) => {
   return {
        transactions: state.transactions
const mapDispatchToProps = {
   fetchTransactions
export default connect(mapStateToProps.
     mapDispatchToProps)(Component):
// Root Komponente
const store = createStore(
   rootReducer, applyMiddleware(thunkMiddleware));
    <Provider store={store}>
        <App />
    </Provider>
   document.getElementById('root')
```

mapStateToProps: erhält State und kann daraus Props ableiten. Die Komponente bekommt auch die dispatch Methode des Stores als Prop. Das Resultat von connect ist eine React-Komponente die

mit dem Store verbunden ist. Store muss der Root-Komponente mitgegeben werden. thunkMiddleware: Erlaubt es, anstelle eines Objektes eine Funktion zu dispatchen (benötigt für asynchrone Actions).

Thunk Actions

function fetchTransactions(token) { return (dispatch, getState) => {
 dispatch({type: "FETCH_TRANSACTIONS_STARTED "}): api.getTransactions(token) .then(({result: transactions}) => { dispatch({type: " FETCH TRANSACTIONS SUCCEEDED" transactions }): })

Selectors

Getter bei den Reducern, die einen Subtree des Stores zurückgeben. Wissen über den Aufbau des State-Trees bleibt bei

Läuft in der Google Cloud Platform. Hauptfokus von Firebase sind Mobile- und Web-Apps.

Firebase Authentication

Backend Services für Authentifizierung und einfache Userverwaltung SDKs für diverse Plattformen Vorgefertigte III Libraries

Firebase Hosting

Einfaches Hosting für statischen Content.

- Immer per HTTPS ausgeliefert
- · Automatisches Caching in CDNs

Dynamischer Content nur über Cloud Function, wenn das nicht reicht:

- PaaS: Google App Engine
- Docker: Google Container oder Kubernetes Engine

Serverless Computing

Cloud Provider verwaltet Functions:

- · Deployment geschieht on-demand
- Plattform bestimmt die Parallelisierung
- Entwickler hat keine Kontrolle über laufende Instanzen
- Funktionen sind Stateless
- Abgerechnet werden Aufrufe und Laufzeit der Funktion

Limitationen: Ausführungszeit / Memory begrenzt. Teilweise hohe Latenz.

Firebase Cloud Functions

Anwendungszenarien: Code als Reaktion auf einen Event ausführen, Administration (Cron Jobs), REST API für Mobile und SPAs zur Verfügung stellen.

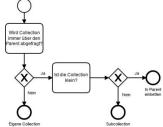
Cloud Firestore

- NoSQL, document-oriented database
- DB besteht aus mehreren Collections mit Documents
- Document ist ein JSON-Objekt
- Document kann Collections beinhalten
- Vergleichbar mit MongoDB
- Stark eingeschränkte Queries (keine Volltextsuche)

// Auf Collections / Documents zugreifen const colRef = db.collection("todos");

const docRef = db.collection("todos").doc("..."); // Dokumente erstellen db.collection("todos").add({text: "..."}); // Dokument bearbeiten .doc("...").update({text: "..."}); // Daten Abfragen db.collection("todos").doc("...").get().then(d => { if(!doc.exists) { /* ... */ } else { console.log(d.data()); } }).catch(err => { /* ... */ }); // Daten abfragen mit Filter db.collection("todos").where("checked", "==", true) .orderBy("createdAt").get().then(snapshot => {

}); NoSQL One-To-Many



NoSQL Many-To-Many

- Wie in relationaler Datenbank mit Assoziationstabelle
- Kein kopieren von Daten
- Komplexere Abfragen, keine Joins im Firestore
- Oder Daten kopieren und einbetten

Kopieren der Daten: muss kein Nachteil sein. Preisänderung eines Produktes hat keinen Einfluss auf vergangene Bestellungen Adressänderung eines Kunden verändert keine alten Bestellungen Kopierte Daten können mittels Trigger und Cloud Function wieder synchronisiert werden

Angular

Flexible SPA Framework for CRUD applications

- Typescript 4.1 based
- Reduces boilerplate Code
- Dependency Injection Mechanism JS-optimized 2-way binding
- Clearly structured, information hiding
- Increases testability / maintainability of client-side code

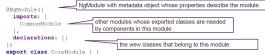
ngModules: Cohesive block of code dedicated to closely related set of capabilities. (module) Directives: Provides instructions to transform the DOM. (class) Components: Directive-witha-template; it controls a section of the view. (class) Templates: Form of HTML defining how to render the component. (HTML / CSS) Metadata: Describes a class and defines how to process it. (decorator) Services: Provides logic of any value, function or feature that the app needs. (class)

Angular Modules (ngModule)

Base for Angular modularity system. Every app has at least one Module, the root Module (a.k.a app). Root Module ist launched to bootstrap the app. Modules export features (directives, services) required by other modules.

TypeScript Module vs. ngModule:

ngModule is a logical block of multipe TypeScript modules linked together. The ngModule declaration itself is placed into a TypeScript module. Modules can accommodate submodules. All public TS members are exported as an overall barrel



declarations: View Classes that belong to this module (Components, Directives, Pipes)

exports: Subset of declarations that should be visible and usable by

imports: Specifies the modules which exports/providers should be imported.

- forChild-Import: returns an object with a providers and ng-Module property
 - allows you to configure services for the current Module level
 - Use if you need to configure the foreign module
- forRoot-Import: returns an object with a providers and ng-Module property
 - It provides and condigures services at the same time
 - Will instantiate the required services exactly once, globally

- If no configuration is required, use tree shakable providers { providedIn: 'root'} providers: Creators of services that this module contributes to the

global collection of services (DI Container). They become accessible in all parts of the app.

bootstrap: Main application view, root component. Only the root module should set this property.

Module Types

Root / App Module: Provides the entry point (bootstrap component) for the app. Has no reason to export anything. Feature Modules: Specifies boundaries between app features.

- Domain Modules: Deliver a UI dedicated to a app domain
- · Routing Modules: Specifies routing configurations
- · Service Modules: Provides utility services
- · Widget Modules: Makes components, directives and pipes available to external modules
- Lazy Modules: Lazily loaded feature modules

Shared Modules: Provides globally used components/directives/pipes. Is a global UI component module. Do not specify app-wide singleton providers in a shared module. Core Module: Keeps your Root Module clean. Contains components/directives/pipes used by the Root Module. Globally used services can be declared here. Only imported by the Root Module

Components

Manages the view and binds data from the model. Consists of:

- Controller (App logic), TS Class with @Component decorator
- HTML file, visual interface (HTML / template expression) (S)CSS file, styles behind HTML

Can be nested, results in Component tree.

Provide Information Hiding:

- Each Component declares part of the UI
- Should be implemented as small coherent piece to support:



Components must be declared within the containing module so its selector is registered for all sub-components of that module. They can be exported, so other modules can import and use then

Component Lifecycle

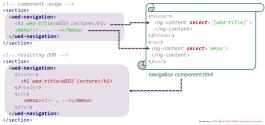
Most important events are ngOnInit (Creation / Hydration) and ngOnDestroy (Destruction / Dehydration). ngAfter... events are mainly for control



developers to handle sub-components and their DOM. To hook into the lifecycle, interfaces of the Angular core can be implemented. Each interface has a single hook method, prefixed with ng. (OnInit contains method ngOnInit).

```
export class CounterComponent implements OnInit, OnDestroy (
ngOnInit() {
  console.log("OnInit");
  ngOnDestroy() {
   console.log("OnDestroy"):
```

Content Projection



Templates

View in MVC. Written in HTML annotated with Angular template syntax:

- HTML5 except script-Tag
- · Angular extends the HTML with
 - Interpolation (...)
 - Template Expression/Statements
 - Binding Syntax

 - Template Reference Variables
 - Template Expression Operators

Binding

```
Two Way Binding / Banana in a box [( ... )]
                                                                export class CounterComponent
<input type="text" [(ngModel)]="counter.team"> ←
                                                                    public counter: any = {
                                                                  get team() { return ...; },
set team(val) { },
eventHandler: ()=>{ }
One Way (from View to Model / Event Binding) ( ...
<button (click)="counter.eventHandler($event</pre>
                                                                              Model Object
One Way (from Model to View / Property Binding) [ ... ] or {{ ... }}
,... {{counter.team}} ←..
```

Binding targets must be declared as Inputs or Outputs: Targets stand on the left side of the binding declaration. e.g. the click / title property: <wed-navigation (click)="..." [title]="..."> @Component({...})

```
export class NavigationComponent {
 @Output() click =
            new EventEmitter<any>();
 @Input() title: string;
```


Similar to a component, but without a template. TypeScript class with an @Directive() function decorator.

Changes the appearance or behaviour of an element, component or another directive. Applied to a host element as an attribute. NaStyle Directive

```
Sets the inline styles dynamically, based on the state of the component
<div [style.font-size]="isSpecial ? 'x-large' : 'smaller'">
</div>
NaClass Directive
Bind to the naClass directive to add or remove several classes simultaneously
<div [class.special]="isSpecial">
c/divs
```

Structural Directives

Responsible for HTML layout. Reshape the DOM's structure by adding, removing or manipulating elements. Applied to a host element as an attribute. Asterisk (*) precedes the directive attribu-

They need a directive or component which takes over this part.

```
Nglf Directive
           Takes a boolean value and makes an entire chunk of the DOM appear or disappea
           <div *ngIf="hasTitle"></-- shown if title available --></div</pre>
           NgFor Directive
<ng-template #toReference></-- content --></ng-template> Aren't rendered directly.
```

Can be referenced by their id: <div *ngIf="hasTitle: else toReference"></-- conditional content --></div> Template Reference Variables

References a DOM element within a template. Can also be a reference to an component or directive. A hash () declares a reference

```
variable.
<input placeholder="phone number" #phone
<button (click)="callPhone(phone value)">Call</button;</pre>
```

Provides any value, function or feature. Typical Services: logging service, data service, message bus, tax calculator, etc.

Strongly related to DI: Angular uses DI to provide components with needed services. Therefore, services must be registered within the DI container.

```
@Injectable ({ providedIn: 'root' })
export class CounterService { /* ... */ }
providedIn: 'root': The service is registered for the whole application.
                    Decorator function
                    to mark class as ar
@Injectable ({ providedIn: 'root' })
                                       @Component (...)
                                       export class CounterComponent (
export class CounterService -
                                         counter?: CounterModel;
 private model: CounterModel
    = new CounterModel():
                                         constructor (private counterService:
 public load():CounterModel {...}
                                             CounterService) {
                                           this.counter = counterService.load()
 public up():CounterModel (...)
```

Angular Forms is an external, optional ngModule called FormsModule. It's a combination of multiple provided services and multiple directives (ngModel, ngForm, ngSubmit).

Required services (dependencies) are

automatically injected by Angulars injector

Template-driven forms: Angular Template syntax with the form-specific directives and techniques. Less code but places validation logic into HTML. (Useful for small forms)

Reactive / model driven forms: Import ReactiveFormsModule. Form is built within the Controller (FormBuilder). Validation logic is also part of the controller (easier to test).

Template-driven

```
<input type="text" class="form-control" id="name"</pre>
       required
      [(ngModel)]="model.name" name="name"
       #nameField="ngModel">
div [hidden]="nameField.valid || nameField.pristine" class="alert alert-danger">
    me is required
```

</div> Two-Way-Binding: [(ngModel)] directive to bind values. Reads out the value of the model for the first time. Updates are automatically written back into the bound model.

Validation: Reference the [ngModel] directive and check its valid property

Submitting the form:



Asynchronous Services

Event Emitter example: @Injectable({providedIn: 'root'}) export class SampleService (Create emitter instance. The type private samples: SampleModel[] = []; // simple cache argument specifies the kind of public samplesChanged: EventEmitter<SampleModel[]> = object to be passed to the new EventEmitter<SampleModel[]>(); - subscriber constructor(/* inject data resource service */) { load(): void { /* in real word app, invoke data resource service here */
this.samples = [new SampleModel()]; Logic to execute when data ready. this.samplesChanged.emit(this.samples); 1 Emit changed event to notify the

```
export class SampleModel { }
export class SampleComponent implements OnInit, OnDestroy {
                                                                  Subscription is used to unsubscrib
 private samples: SampleModel[];
private samplesSubscription: Subscription; -
                                                                 the update event when the
                                                                component is de-hydrated
  constructor(private sampleService: SampleService) {
                        Register samplesChanged event on underlying business service when component
                        is hydrated. Subscribe() returns a Subscription which is used for deregistration
  ngOnTnit() {
    this.samplesSubscription = this.sampleService.samplesChanged.subscribe(
      (data: SampleModel[]) => { this.samples = data; }}:
                                                                 Update procedure: refresh data on
                                                                the I II level
  ngOnDestrov() {
    this.sampleSubscription.unsubscribe();
                                                              Unsubscribe the update event when
                                                             the component is de-hydrated.
```

registrars (e.g. UI components).

Data Access

HTTP Client API

Implements asynchronisms by using the RxJS library. RxJS is a third-party library that implements the Observable pattern. An Observable can be turned into a promise.

Hot Observables: Sequences of events (mouse moves / stock tickers). Shared amoung all subscribers. Postfix hot-observables

Cold Observables: Start running on subscriptions (such as async web requests). Not shared amoung subscribers. Are automatically closed after Task is finished.
var subscription = this.http.get('api/samples').subscribe(

function (x) { /* onNext -> data received (in x) */ }, function (e) { /* onError -> the error (e) has been thrown */ }. function () { /* onCompleted -> the stream is closing down */ }

Routing

External, optional NgModule called RouterModule. Combination of multiple provided services and directives: RouterOutlet. Router-Link RouterLinkActive

Defining Routes: The router must be configured with a list of route definitions. Each definition maps a route to a component.

- .forRoot(): use exactly once to declare routes on root level - contains all the directives, the given routes and the router service itself
 - Every app has one singleton instance of the router
- .forChild(): When declaring sub-routings
- contains all directives and the given routes

Each ngModule defines its own routes. Load modules on-demand (lazy load) with the import-Syntax.

```
@NgModule({
       exports: [ RouterModule ]
export class AppRoutingModule {}
                          export class WelcomeRoutingModule {}
```

Router Outlet: Directive from the Router module. Defines where the Router should display the views.

<router-outlet></router-outlet>

Route Configuration: const appRoutes: Routes = [// matches /hero/42, 42 saved in param {path: 'hero/:id', component: 'Hero'}, // redirect {path: '', redirectTo: '/heroes', pathMatch: ' full'} // Wildcard route {path: '**', component: PageNotFound}

The router uses a first-match-wins strategy.

Lazy Loading Configuration { path: 'config'.

loadChildren: () => import('./cfg/cfg.module').then(m => m.CfgModule), canLoad: [AuthGuard] }

Angular Architectures

MVC+S

Observable Business Data Service: Provides data to multiple parts of the app in a stream-like manner. An Observable is provided. Stores/Caches business objects.

BxJS Subject: Heart of an observable data service. EventEmit ter_iT_{δ} derives from Subject. Hot Observable and does not provide the latest value.

Behaviour Subject: Emits the initial state. Can be called some kind of warm. Stores the data and emits next() events on change. Do not expose to the Service API.

Data Resources: Return cold Observables. Must be converted into a hot Observable (share()).

Data Observable Business Service Example: @Injectable({providedIn: 'root'}) Event bus which is used to store the last state and to export class SampleService { notify subscribers about updates.

private samples: BehaviorSubject<SampleModel[]> = new BehaviorSubject([]);

```
public samples$: Observable<SampleModel[]> = this.samples.asObservable();
 Postfix hot-observables
                                      Convert event bus into an observable, which can be provided to the UI or other services.
 (streams) with a $.
    private resourceService: SampleResourceService)
public addSample(newSample: SampleModel): Observable<anv> {
  return this.resourceService
                                                   Call data resource service to store the
    .post(newSample)
                                                   data into the underlying backend-server.
    .pipe(
        tap(res => +
          this.samples.next([...this.samples.getValue(), newSample]);
        catchError((err) => this.han
                                               or(err)));
private handleError(err: Ht Store the retrieved data into the BehaviorSubject and emit the
 return new ErrorObservabl data changed event. It is important to create a new array with
                              the new data; otherwise, the async pipe won't track the change.
```

Flux Architecture

Invented by Facebook. Enforces a unidirectional data flow. More of a pattern that a formal framework.



Redux Architecture

ngrx: implements the Redux pattern using RxJS. Benefits:

- Enhanced debugging, testability and maintainability
- · Undo/redo can be implemented easily
- · Reduced code in Angular Components

Liabilities:

- · Additional 3rd party library required
- More complex architecture
- Lower cohesion, global state may contain UI / business data
- Data logic may be fragmented into multiple effects/reducers

Can be applied within a template expression to make small transformations

```
{p>{{counter.team |
                 uppercase}}
                 uppercase | lowercase}}
{p>{f counter.team |
{{counter.date | date: 'longDate'}}
```

Pure-Pipes: Executed when it detects a pure change to the input expression, Implemented as pure functions, Restricted but fast. Impure-Pipes: Executed on every component change detection cycle (every keystroke etc.). To reduce processing time, caching is often used

Predefined-Pipes: date, number, currency, async etc.

Angular does not provide Filter- / OrderBy-Pipes because of poor performance.

Custom-Pipes: A class decorated with @Pipe(). It implements the PipeTransform interface's transform() method. Needs to be added to the declarations of the current Module.



Async Pipes: Binds Observables directly to the UI. Changes are automatically tracked. Automatically subscribes and unsubscribes from the bound Observable.

```
{{s.name}}
                        → public sampleService:SampleService)
</section>
```

View Encapsulation

Component Styles: Apps are styled with standart CSS. The CLI transpiles SCSS to CSS. The selectors of a component's styles apply only within this own template.

Special Selectors:

- . :host Target styles in the element that hosts the component · :host-context - Looks for a CSS class in any ancestor of the host element
- Link Styles to Component Options:

```
Add a styles array property to the @Component
 @Component({ /*.
    styles: ['h1 { font-weight: normal; }']
 export class WedNavComponent { }
```

Add styleUrls attribute into a components @Component decorator

```
styleUrls: ['app/nav.component.css']
export class WedNavComponent { }
```

Template inline tags/styles @component({ /*...*/
template: `<style>...</style> ... link rel="stylesheet" href="app/nav.component.css">`

export class WedNavComponent { } Controlling View Encapsulation:

- Native: Uses the browsers native shadow DOM
- Emulated: Emulates the behaviour of shadow DOM by preprocessing (and renaming) the CSS
- None: No view encapsulation (scope rules) applied. All CSS added to the global styles.