1 React

React

A JavaScript library for building user interfaces.

- https://facebook.github.io/react/,
- Initial release in 2013,
- Created and developed by Facebook,
- Open-source,
- Used by Facebook and Instagram,
- *React Native* for developing native applications for iOS, Android and UWP in JS,
- Easy to integrate into legacy web applications.

1.1 JSX

JSX

- Provides syntactic sugar for expressing component structure declaratively in JS,
- Code in JSX is compiled into plain JavaScript.

Example

JSX code

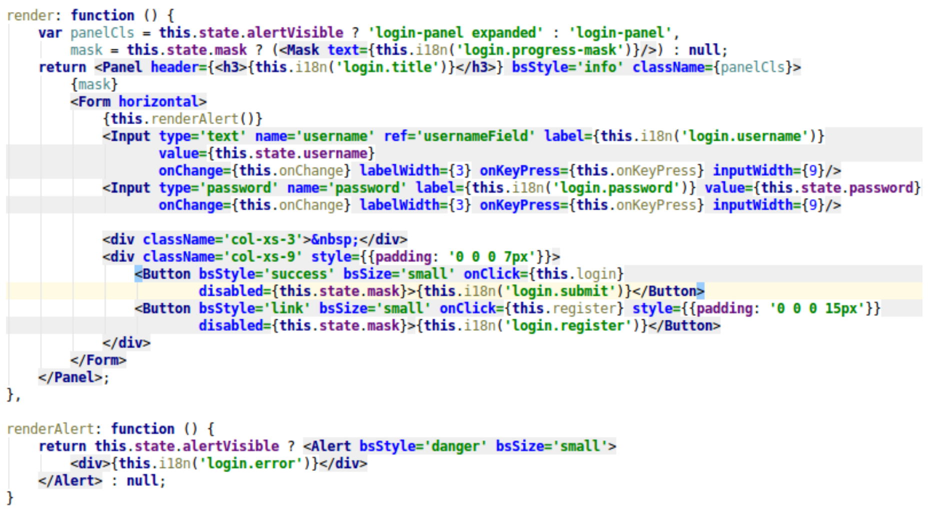
```
<MyButton color="blue" shadowSize={2}>
  Click Me
</MyButton>
```

Compiles into:

```
React.createElement(
  MyButton,
  {color: 'blue', shadowSize: 2},
  'Click Me'
)
```

JSX Principles

- Component name/tag name comes first after opening <,
- Properties specified like HTML attributes,
- Property names are *camelCased*,



```
render: function () {
    var panelCls = this.state.alertVisible ? 'login-panel expanded' : 'login-panel',
        mask = this.state.mask ? (<Mask text={this.i18n('login.progress-mask')}/>) : null;
    return <Panel header={<h3>{this.i18n('login.title')}</h3>} bsStyle='info' className={panelCls}>
        {mask}
        <Form horizontal>
            {this.renderAlert()}
            <Input type='text' name='username' ref='usernameField' label={this.i18n('login.username')}
                   value={this.state.username}
                   onChange={this.onChange} labelWidth={3} onKeyPress={this.onKeyPress} inputWidth={9}/>
            <Input type='password' name='password' label={this.i18n('login.password')} value={this.state.password}
                   onChange={this.onChange} labelWidth={3} onKeyPress={this.onKeyPress} inputWidth={9}/>

            <div className='col-xs-3'>&nbsp;</div>
            <div className='col-xs-9' style={{padding: '0 0 0 7px'}}>
                <Button bsStyle='success' bsSize='small' onClick={this.login}
                        disabled={this.state.mask}>{this.i18n('login.submit')}</Button>
                <Button bsStyle='link' bsSize='small' onClick={this.register} style={{padding: '0 0 0 15px'}}
                        disabled={this.state.mask}>{this.i18n('login.register')}</Button>
            </div>
        </Form>
    </Panel>;
},

renderAlert: function () {
    return this.state.alertVisible ? <Alert bsStyle='danger' bsSize='small'>
        <div>{this.i18n('login.error')}</div>
    </Alert> : null;
}
```

Figure 1: Example of a more complex JSX structure.

- Component names should begin with capital letter, e.g. `MyButton`,
- Child elements written between open tag and end tag,
- Tags can be without children – open tags ends with / >,
- JavaScript expressions enclosed in {},
- Value-less properties evaluate to true, e.g. `horizontal`.

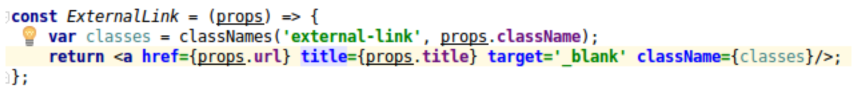
JSX Example

1.2 React Principles

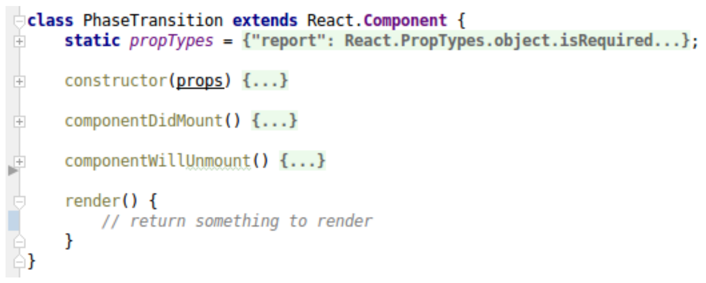
Technical Intermezzo

We use some ES6 (latest JS standard) and ES7 experimental (future JS standard) features:

- *Fat arrow function* syntax
  - `https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Functions/Arrow_functions`,
  - `http://codepen.io/ledsoft/pen/JbKbqd`
- ES6 classes
  - `https://developer.mozilla.org/cs/docs/Web/JavaScript/Reference/Classes`,
  - `http://codepen.io/ledsoft/pen/aBZpzO`
- ES7 *property initializers*,
  - `http://codepen.io/ledsoft/pen/YpWNNQ`
- *Babel* to compile everything into plain old JS supported by all modern browsers.



```
const ExternalLink = (props) => {
    var classes = classNames('external-link', props.className);
    return <a href={props.url} title={props.title} target='_blank' className={classes}/>;
};
```



```
class PhaseTransition extends React.Component {
    static propTypes = {"report": React.PropTypes.object.isRequired...};

    constructor(props) {...}

    componentDidMount() {...}

    componentWillUnmount() {...}

    render() {
        // return something to render
    }
}
```

Basic Features/Principles

- Composable components,
  - React elements – React representations of standard HTML elements, e.g. `div`, `img` etc.,
  - Components – user-defined components,
- Immutable properties (props) + mutable state,
- Virtual DOM,
- One way dataflow.

User-defined Components

1. Function taking properties and returning stuff to render,
2. Class extending `React.Component` with a `render` method, which returns stuff to render.

Components

- Must render a single element (can be null),
- Are essentially functions,
  - They take arguments (see below) and return result,
- Take a *properties* (props) object with configuration as argument/constructor parameter,
- Must behave as *pure functions* with respect to their props – i.e. props are **immutable**,
- Two kinds:

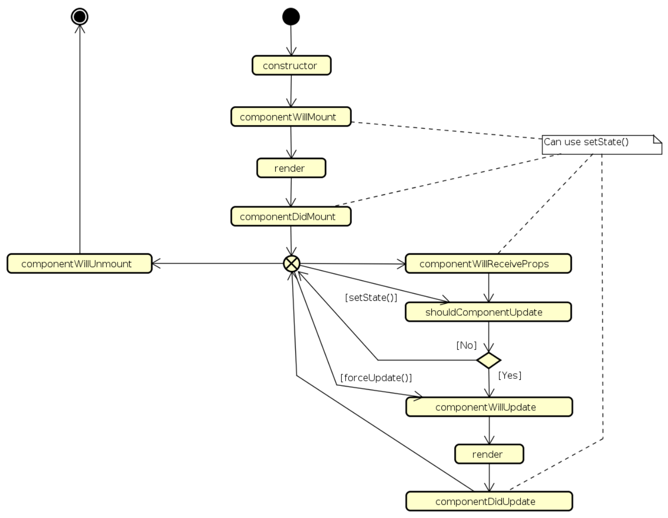


Figure 2: React component lifecycle methods.

- *Stateless* are just functions of their properties,
- *Statefull* keep their state which can be modified (usually as response to events).

Props vs. State

props Component receives props as parameters for rendering,

state Component keeps state and operates on it, possibly passing it to its children as their *props*. State is modified by calling the `setState` lifecycle method of the component. Component functions do not have state.

`http://codepen.io/ledsoft/pen/YpWNNQ`

Component Lifecycle

Virtual DOM

- DOM manipulation is expensive,
- React uses in-memory abstract model of DOM,
- On update:
  1. Calls render of each component,
  2. Compares the result with its original in the virtual DOM,
  3. Calculates changes for the real DOM,

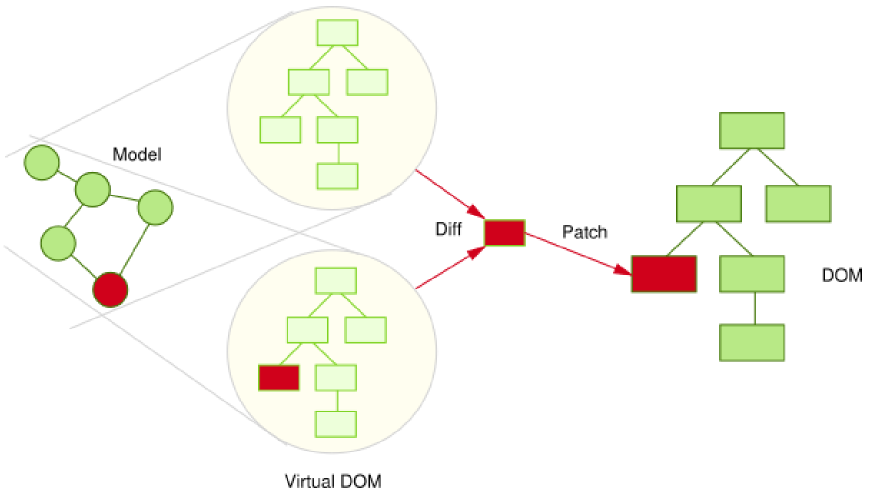


Figure 3: React Virtual DOM. Source: `http://teropa.info/images/onchange_vdom_change.svg`

4. Performs necessary updates to the real DOM,

- Heuristics turn $O(n^3)$ problem into a linear one.

Virtual DOM

One Way Dataflow

- Data flow from ancestor components to their descendants,
- Handlers passed down to handle user's input,
- Typically:
  - A component keeps state of a portion of the view,
  - It passes the state down to its descendants as props,
  - It may also pass handlers for updating the state,
  - Descendants are stateless components displaying data according to their props,
- Makes it easier to reason about the application's state,
- `http://codepen.io/ledsoft/pen/KNNmaa`.

2 Flux

Why another UI pattern?

Two way binding used usually in MVC can lead to messy code. Difficult to track application state and its changes.

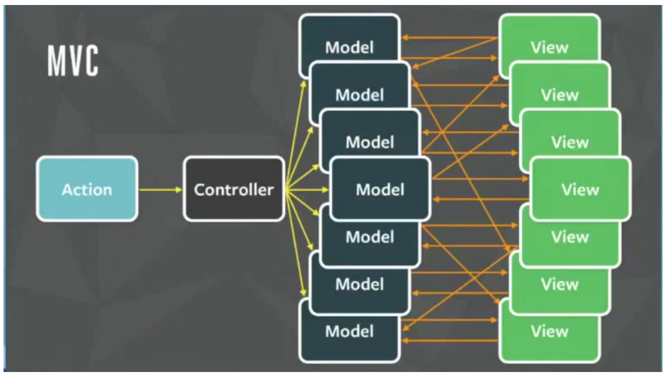


Figure 4: MVC problems. Source: `https://youtu.be/nYkdrAPrdcw`.

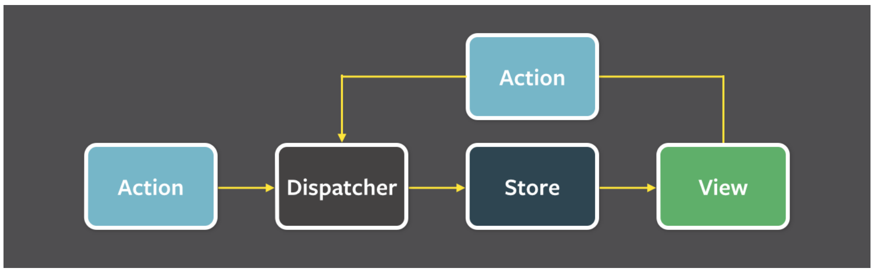


Figure 5: Flux architecture. Source: `https://facebook.github.io/flux/img/flux-simple-f8-diagram-with-client-action-1300w.png`

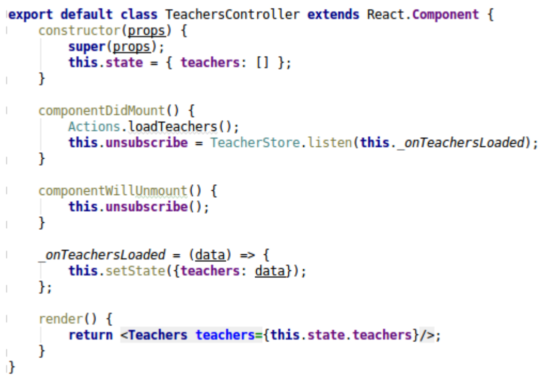
Flux

- Architectural pattern rather than framework,
- One way flow simplifies tracking application state and its changes,
- Separate business logic from UI components,
- works well with the *one way dataflow* philosophy of React.

Flux Parts

Actions

- Represent events to which application logic should respond,
- May encapsulate data with them,
- Fired by:
  - UI components,
  - Communication with backend.



```
export default class TeachersController extends React.Component {
    constructor(props) {
        super(props);
        this.state = { teachers: [] };
    }

    componentDidMount() {
        Actions.loadTeachers();
        this.unsubscribe = TeacherStore.listen(this._onTeachersLoaded);
    }

    componentWillUnmount() {
        this.unsubscribe();
    }

    _onTeachersLoaded = (data) => {
        this.setState({teachers: data});
    };

    render() {
        return <Teachers teachers={this.state.teachers}/>;
    }
}
```

Dispatcher

- Single dispatcher per application,
- Processes actions and dispatches them to the stores,
- Facebook provides open source implementation, which it also uses in production.

Flux Parts II

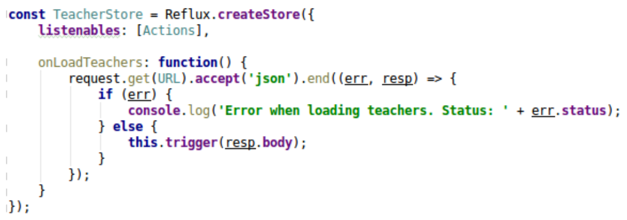
Stores

- Represent application state and business logic,
- Stores listen to actions and perform operations,
- Can be a collection of business objects,
- Or represent a single domain model object.

Views

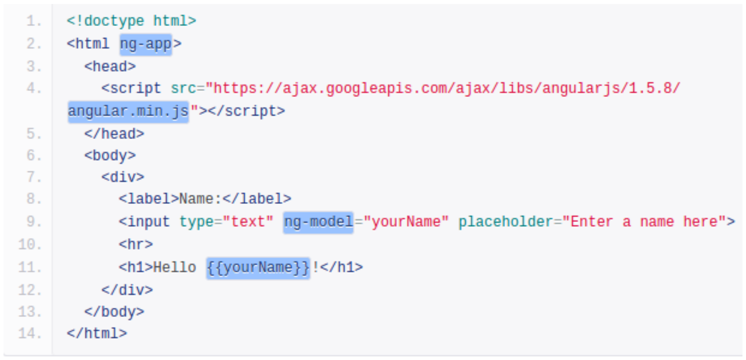
- Standard React components,
- Usually one component acts as a *Controller-View*,
  - Listens for store triggers,
  - Loads data from store into its own state,
  - Passes data down to sub-components,
- Controller-View can be one for the whole page, or multiple for sections of a page.

Flux Example



```javascript
const TeacherStore = Reflux.createStore({
    listenables: [Actions],

    onLoadTeachers: function() {
        request.get(URL).accept('json').end((err, resp) => {
            if (err) {
                console.log('Error when loading teachers. Status: ' + err.status);
            } else {
                this.trigger(resp.body);
            }
        });
    }
});
```



```html
<!doctype html>
<html ng-app>
  <head>
    <script src="https://ajax.googleapis.com/ajax/libs/angularjs/1.5.8/
angular.min.js"></script>
  </head>
  <body>
    <div>
      <label>Name:</label>
      <input type="text" ng-model="yourName" placeholder="Enter a name here">
      <hr>
      <h1>Hello {{yourName}}!</h1>
    </div>
  </body>
</html>
```

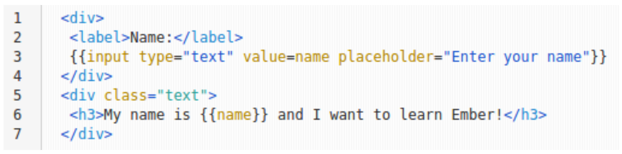
3 React vs Other JS Frameworks

AngularJS

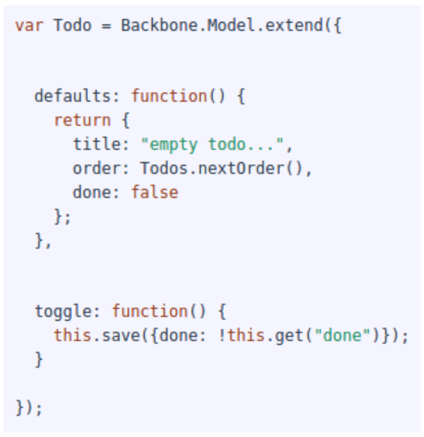
- Developed by Google, recently published v2,
- Encourages use of MVC with two-way binding,
- HTML templates enhanced with hooks for the JS controllers,
- New components created using *directives*,
- Built-in routing, AJAX,
- `https://angularjs.org/`.

Ember

- Open source framework,
- Templates using Handlebars,
- Encourages MVC with two-way binding,
- New components created using Handlebars templates + JS,
- Built-in routing, AJAX,
- `http://emberjs.com/`.



```
<div>
 <label>Name:</label>
 {{input type="text" value=name placeholder="Enter your name"}}
</div>
<div class="text">
 <h3>My name is {{name}} and I want to learn Ember!</h3>
</div>
```



```
var Todo = Backbone.Model.extend({


  defaults: function() {
    return {
      title: "empty todo...",
      order: Todos.nextOrder(),
      done: false
    };
  },


  toggle: function() {
    this.save({done: !this.get("done")});
  }

});
```

BackboneJS

- Open source framework,
- Provides models with key-value bindings, collections,
- Views with declarative event handling,
- View rendering provided by third-party libraries - e.g. jQuery, React,
- Built-in routing, AJAX,
- `http://backbonejs.org/`.

4 Useful Libraries

Useful Libraries

React Router

- Routing in React applications,
- Mapping views to URL and handling route transitions,
- `https://github.com/ReactTraining/react-router`.

React Bootstrap

- React components based on the Bootstrap UI library,
- Makes building good looking application easier,
- `https://react-bootstrap.github.io/`.

SuperAgent

- Lightweight AJAX API,
- Useful for communication with backend web services,
- `https://visionmedia.github.io/superagent/`.

Useful Libraries II

Reflux

- Alternative implementation of Flux,
- Simplifies stores, provides dispatcher,
- `https://github.com/reflux/refluxjs`.

Redux

- Alternative to React's Flux,
- State container for JavaScript applications,
- `https://github.com/reactjs/redux`.

React Intl

- Internationalization for React applications,
- React components + API for formatting, translations, handling plurals etc.,
- `https://github.com/yahoo/react-intl`.

Useful Libraries III

Babel

- JavaScript compiler,
- Enables use of advanced and novel JS features in a way compatible with older browsers,
- `https://babeljs.io/`.

Jasmine

- BDD-style test framework for JavaScript,
- `https://jasmine.github.io/`.

Jest

- JavaScript test framework,
- Developed and used by Facebook,
- `https://facebook.github.io/jest/`.

The End

Thank You

Resources

- `http://todomvc.com/`,
- `https://babeljs.io/blog/2015/06/07/react-on-es6-plus`,
- `http://teropa.info/blog/2015/03/02/change-and-its-detection-in-javascript-frameworks.html`,
- `https://facebook.github.io/react/`,
- `https://facebook.github.io/flux/docs/overview.html`.