ReactJS Introduction

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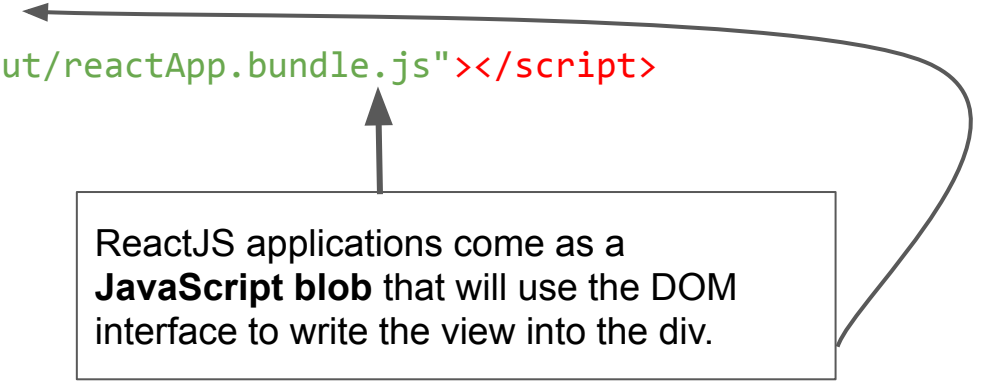
ReactJS

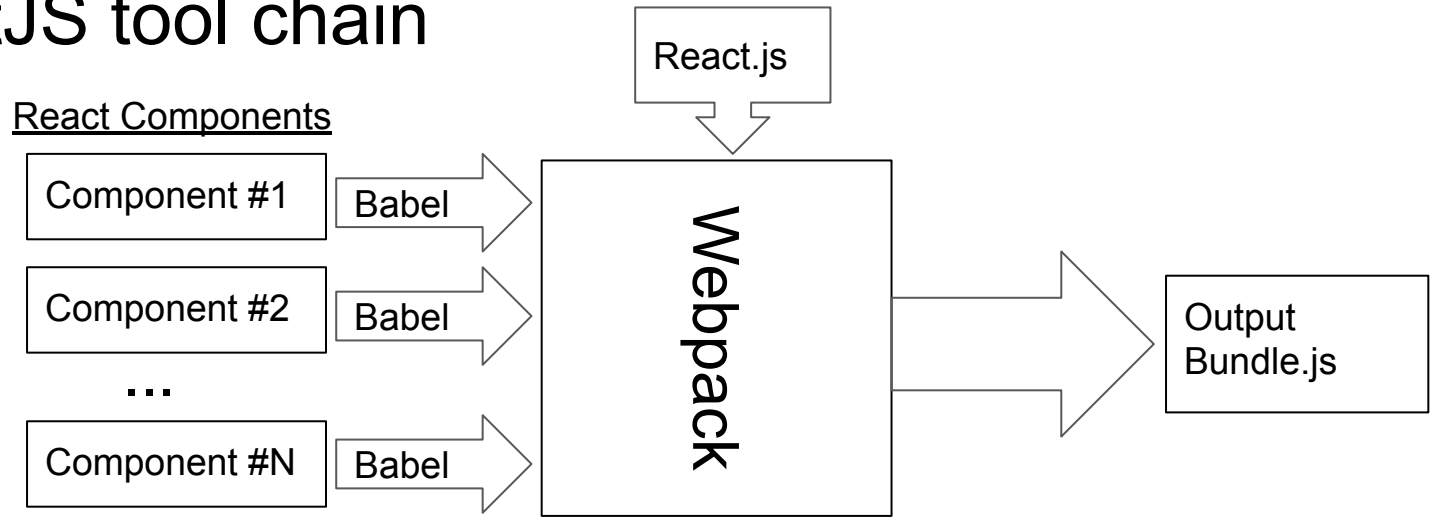
- JavaScript framework for writing the web applications
  - Like AngularJS - Snappy response from running in browser
  - Less **opinionated**: only specifies rendering view and handling user interactions
- Uses Model-View-Controller pattern
  - View constructed from Components using pattern
  - Optional, but commonly used HTML templating
- Minimal server-side support dictated
- Focus on supporting for programming in the large and single page applications
  - Modules, reusable components, testing, etc.

ReactJS Web Application Page

```
<!doctype html>
<html>
   <head>
      <title>CS142 Example</title>
   </head>
   <body>
       <div id="reactapp"></div>
       <script src="./webpackOutput/reactApp.bundle.js"></script>
   </body>
</html>
```



ReactJS tool chain



Babel - Transpile language features (e.g. ECMAScript, JSX) to basic JavaScript

Webpack - Bundle modules and resources (CSS, images)

Output loadable with single `script` tag in any browser

reactApp.js - Render element into browser DOM

```
import React from 'react';
import ReactDOM from 'react-dom';

import ReactAppView from './components/ReactAppView';

let viewTree = React.createElement(ReactAppView, null);
let where = document.getElementById('reactapp');

ReactDOM.render(viewTree, where);
```

ES6 Modules - Bring in React and web app React components.

Renders the tree of React elements (single component named **`ReactAppView`**) into the browser's DOM at the div with id=reactapp.

components/ReactAppView.js - ES6 class definition

```
import React from 'react';

class ReactAppView extends React.Component {
  constructor(props) {
    super(props);
    ...
  }
  render() { ...
};

export default ReactAppView;
```

Inherits from React.Component. `props` is set to the attributes passed to the component.

Require method render() - returns React element tree of the Component's view.

ReactAppView render() method

```
<div>
   <label>Name: </label>
   <input type="text" ... />
   <h1>Hello {this.state.yourName}!</h1>
</div>
```

```
render() {
    let label = React.createElement('label', null,'Name: ');
    let input =  React.createElement('input',
           { type: 'text', value: this.state.yourName,
               onChange: (event) => this.handleChange(event) });
    let h1 = React.createElement('h1',  null,
                        'Hello ', this.state.yourName, '!');

    return React.createElement('div', null, label, input, h1);
}
```

Returns element tree with `div` (`label`, `input`, and `h1`) elements

ReactAppView render() method w/o variables

```
render() {
    return React.createElement('div', null,
        React.createElement('label', null,'Name: '),
        React.createElement('input',
           { type: 'text', value: this.state.yourName,
             onChange: (event) => this.handleChange(event) }),
        React.createElement('h1',  null,
                'Hello ', this.state.yourName, '!')
      );
}
```

Use JSX to generate calls to createElement

```
render() {
   return (
      <div>
        <label>Name: </label>
        <input
              type="text"
              value={this.state.yourName}
              onChange={(event) => this.handleChange(event)}
          />
        <h1>Hello {this.state.yourName}!</h1>
     </div>
    );
}
```

- JSX makes building tree look like templated HTML embedded in JavaScript.

Component state and input handling

```
import React from 'react';

class ReactAppView extends React.Component {
  constructor(props) {
    super(props);
    this.state = {yourName: ""};
  }
  handleChange(event) {
    this.setState({ yourName: event.target.value });
  }
  ....
```

Make `<h1>Hello {this.state.yourName}!</h1>` work

- Input calls to `setState` which causes React to call render() again

One way binding: Type 'D' Character in input box

- JSX statement: `<input type="text" value={this.state.yourName}`
  `onChange={(event) => this.handleChange(event)} />`

  Triggers `handleChange` call with `event.target.value` == "D"

- handleChange - `this.setState({yourName: event.target.value});`

  `this.state.yourName` is changed to "D"

- React sees state change and calls render again:
- Feature of React - highly efficient re-rendering

Calling React Components from events: A problem

```
class ReactAppView extends React.Component {
    ...
  handleChange(event) {
    this.setState({ yourName: event.target.value });
  }
  ...
}
```

Understand why:

```
  <input type="text" value={this.state.yourName} onChange={this.handleChange} />
```

Doesn't work!

Calling React Components from events workaround

- Create instance function bound to instance

```
class ReactAppView extends React.Component {
  constructor(props) {
    super(props);
    this.state = {yourName: ""};
    this.handleChange = this.handleChange.bind(this);
  }
  handleChange(event) {
    this.setState({ yourName: event.target.value });
  }
```

Calling React Components from events workaround

- Using public fields of classes with arrow functions

```
class ReactAppView extends React.Component {
  constructor(props) {
    super(props);
    this.state = {yourName: ""};
  }
  handleChange = (event) => {
    this.setState({ yourName: event.target.value });
  }
  ...
```

Calling React Components from events workaround

- Using arrow functions in JSX

```
class ReactAppView extends React.Component {
  ...
  handleChange(event) {
    this.setState({ yourName: event.target.value });
  }
  render() {
    return (
        <input type="text" value={this.state.yourName}
            onChange={(event) => this.handleChange(event)} />
     );
  }
```

A digression: `camelCase` vs `dash-case`

Word separator in multiword variable name

- Use dashes: `active-buffer-entry`
- Capitalize first letter of each word: `activeBufferEntry`

Issue: HTML is case-insensitive but JavaScript is not.
ReactJS's JSX has HTML-like stuff embedded in JavaScript.

ReactJS: Use camelCase for attributes

AngularJS: Used both: dashes in HTML and camelCase in JavaScript!

Programming with JSX

- Need to remember: JSX maps to calls to `React.createElement`
  - Writing in JavaScript HTML-like syntax that is converted to JavaScript function calls

- `React.createElement(type, props, ...children);`
  - `type`: HTML tag (e.g. `h1, p`) or `React.Component`
  - `props`: attributes (e.g. `type="text"`) Uses camelCase!
  - `children`: Zero or more children which can be either:
    - String or numbers
    - A React element
    - An Array of the above

JSX templates must return a valid `children` param

- Templates can have JavaScript scope variables and expressions
  - `<div>{foo}</div>`
    - Valid if `foo` is in scope (i.e. if foo would have been a valid function call parameter)
  - `<div>{foo + 'S' + computeEndingString()}</div>`
    - Valid if `foo & computeEndString` in scope
- Template must evaluate to a value
  - `<div>{if (useSpanish) { … } }</div>` - Doesn't work: `if` isn't an expression
  - Same problem with "for loops" and other JavaScript statements that don't return values
- Leads to contorted looking JSX: Example: Anonymous immediate functions
  - `<div>{ (function() { if …; for ..; return val;})() }</div>`

Conditional render in JSX

- Use JavaScript Ternary operator (?:)

```
<div>{this.state.useSpanish ? <b>Hola</b> : "Hello"}</div>
```

- Use JavaScript variables

```
let greeting;
const en = "Hello";  const sp = <b>Hola</b>;
let {useSpanish} = this.prop;
if (useSpanish) {greeting = sp} else {greeting = en};

<div>{greeting}</div>
```

Iteration in JSX

- Use JavaScript array variables

```
let listItems = [];
for (let i = 0; i < data.length; i++) {
   listItems.push(<li key={data[i]}>Data Value {data[i]}</li>);
}
return <ul>{listItems}</ul>;
```

- Functional programming

```
<ul>{data.map((d) => <li key={d}>Data Value {d}</li>)}</ul>
```

`key=` attribute improves efficiency of rendering on data change

Styling with React/JSX - lots of different ways

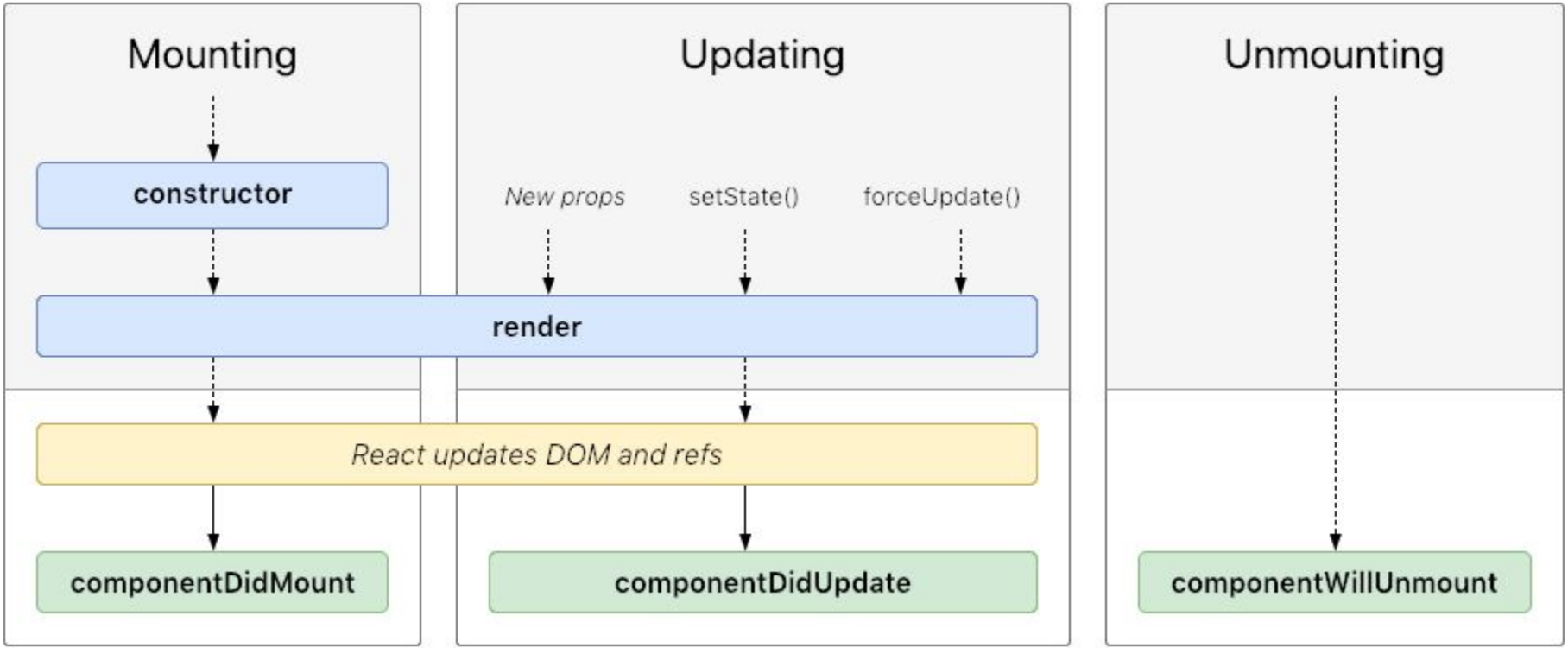
```
import React from 'react';
import './ReactAppView.css';
class ReactAppView extends React.Component {
  ...
render() {
   return (
      <span className="cs142-code-name">
        ...
      </span>
    );
```

Webpack can import CSS style sheets:

```
.cs142-code-name {
  font-family: Courier New, monospace;
}
```

Must use `className=` for HTML `class=` attribute (JS keyword conflict)

Component lifecycle and methods



http://projects.wojtekmaj.pl/react-lifecycle-methods-diagram/

Example of lifecycle methods - update UI every 2s

```
class Example extends React.Component {
     ...
    componentDidMount() {    // Start 2 sec counter
       const incFunc =
         () => this.setState({ counter: this.state.counter + 1 });
       this.timerID = setInterval(incFunc, 2 * 1000);
    }

    componentWillUnmount() {  // Shutdown timer
       clearInterval(this.timerID);
    }
   ...
```

Stateless Components

- React Component can be function (not a class) if it only depends on props

```
function MyComponent(props) {
  return <div>My name is {props.name}</div>;
}
```

Or using destructuring...

```
function MyComponent({name}) {
  return <div>My name is {name}</div>;
}
```

- Much more concise than a class with `render` method
  - But what if you have one bit of state…

React Hooks - Add state to stateless components

- Inside of a "stateless" component add state: `useState(initialStateValue)`
  - `useState` parameter: `initialStateValue` - the initial value of the state
  - `useState` return value: An two element polymorphic array
    - 0th element - The current value of the state
    - 1st element - A set function to call (like `this.setState`)
- Example: a bit of state:

```
const [bit, setBit] = useState(0);
```

- How about lifecycle functions (e.g. componentDidUpdate, etc.)?
  - `useEffect(lifeCycleFunction, dependency array)`
    - `useEffect` parameter `lifeCycleFunction` - function to call when something changes

React Hooks Example - useState

```
import React, { useState} from 'react';
function Example() {
  const [count, setCount] = useState(0);
  return (
    <div>
      <p>You clicked {count} times</p>
      <button onClick={() => setCount(count + 1)}>
           Click me
      </button>
    </div>
  );
}
```

React Hooks Example - `useEffect` Model fetching

```
import React, { useState, useEffect } from 'react';
function Example() {
  const [count, setCount] = useState(0);
  const [fetch, setFetch] = useState(false);
  useEffect(() =>{setCount(modelFetch()); setFetch(true);}, [fetched]);
  return (
    <div>
      <p>You clicked {count} times</p>
      <button onClick={() => setCount(count + 1)}>
           Click me
      </button>
    </div>
  );
}
```

Communicating between React components

- Passing information from parent to child: Use props (attributes)

```
<ChildComponent param={infoForChildComponent} />
```

- Passing information from child to parent: Callbacks

```
this.parentCallback = (infoFromChild) =>
        { /* processInfoFromChild */};

<ChildComponent callback={this.parentCallback}> />
```

- React Context (https://reactjs.org/docs/context.html)
  - Global variables for subtree of components