

How to develop web apps with React, JSX, Redux, and GraphQL

React Quickly

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Foreword by John Sonmez



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React Quickly

by Azat Mardan

Chapter 2

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Watch this chapter's introduction video by scanning this QR code with your phone or going to <http://reactquickly.co/videos/ch02>.

Baby steps with React

This chapter covers

- Nesting elements
- Creating a component class
- Working with properties

This chapter will teach you how to take baby steps with React and lays the foundation for the following chapters. It's crucial for understanding React concepts such as elements and components. In a nutshell, *elements* are instances of *components* (also called *component classes*). What are their use cases, and why do you use them? Read on!

NOTE The source code for the examples in this chapter is at www.manning.com/books/react-quickly and <https://github.com/azat-co/react-quickly/tree/master/ch02> (in the `ch02` folder of the GitHub repository <https://github.com/azat-co/react-quickly>). You can also find some demos at <http://reactquickly.co/demos>.

2.1 Nesting elements

In the last chapter, you learned how to create a React element. As a reminder, the method you use is `React.createElement()`. For example, you can create a link element like this:

```
let linkReactElement = React.createElement('a',
  {href: 'http://webapplog.com'},
  'Webapplog.com'
)
```

The problem is that most UIs have more than one element (such as a link inside a menu). For example, in figure 2.1, there are buttons in the section, video thumbnails, and a YouTube player.

The solution to creating more-complex structures in a hierarchical manner is nesting elements. In the previous chapter, you implemented your first React code by creating an `h1` React element and rendering it in the DOM with `ReactDOM.render()`:

```
let h1 = React.createElement('h1', null, 'Hello world!')
ReactDOM.render(
  h1,
  document.getElementById('content')
)
```

It's important to note that `ReactDOM.render()` takes only one element as an argument, which is `h1` in the example (the view is shown in figure 2.2).

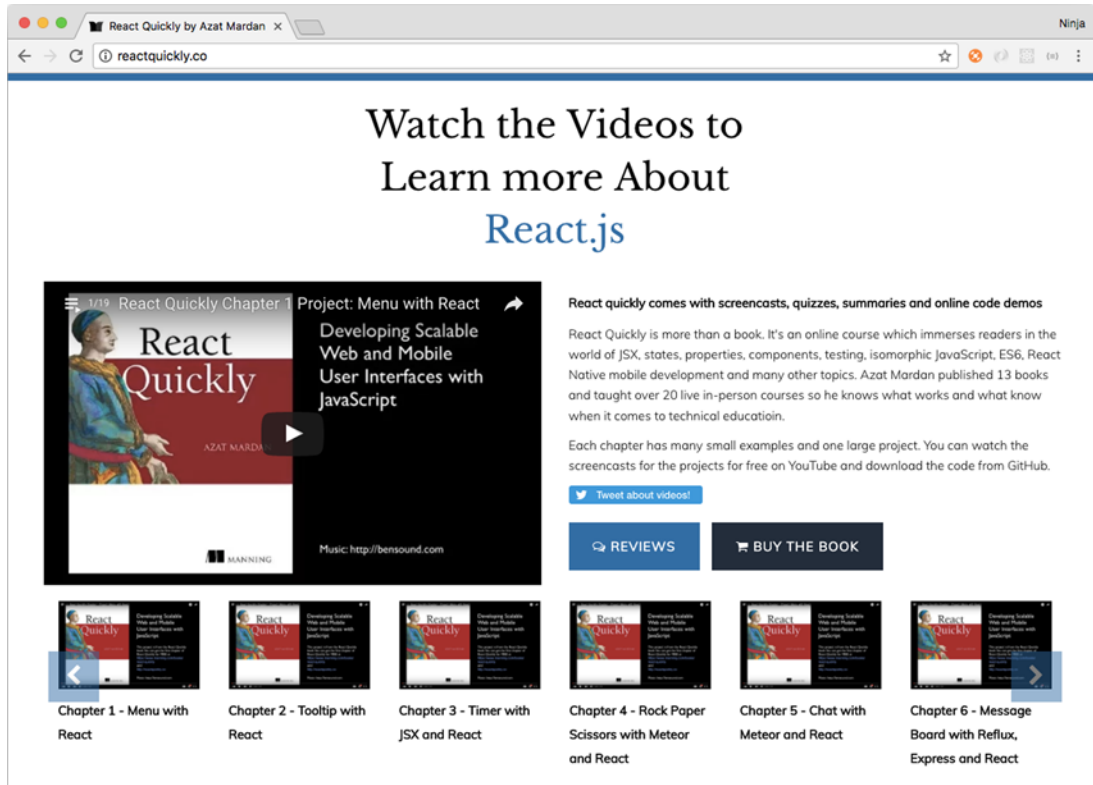


Figure 2.1 The *React Quickly* website has many nested UI elements.

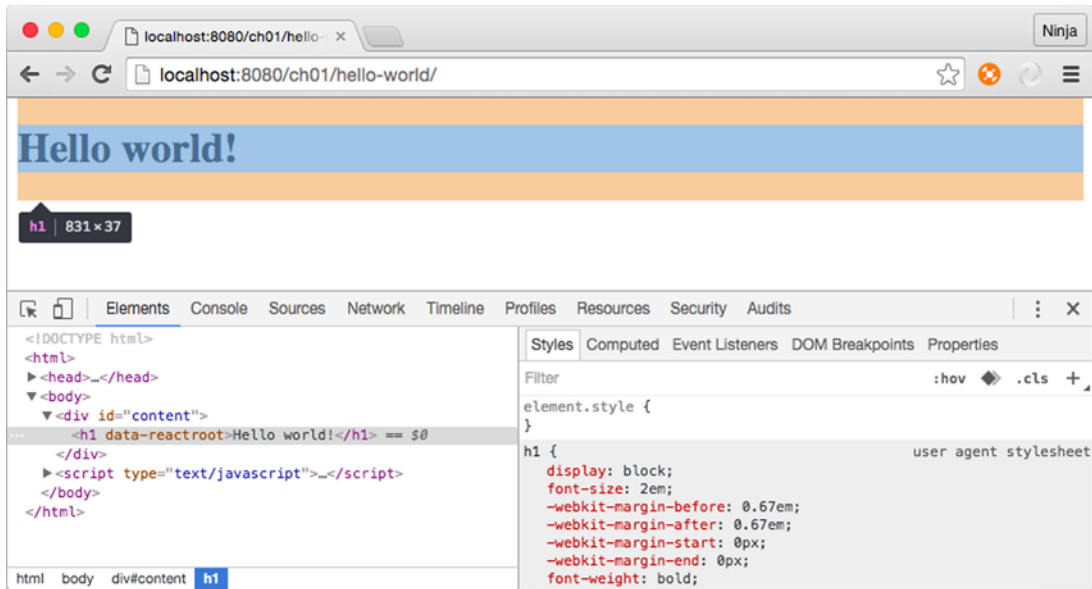
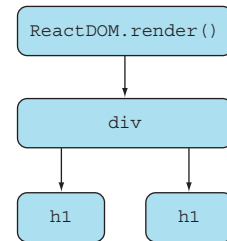
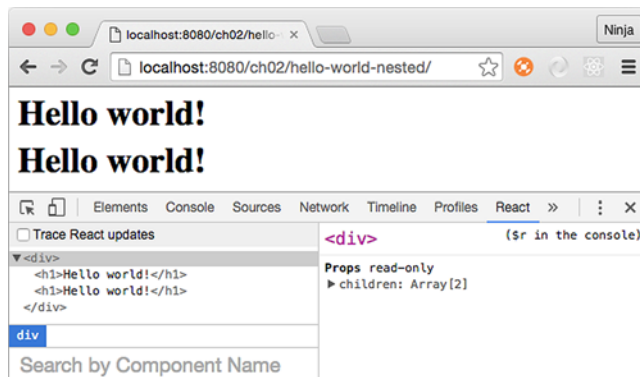


Figure 2.2 Rendering a single heading element

As I mentioned at the beginning of this section, the problem arises when you need to render two same-level elements (for example, two `h1` elements). In this case, you can wrap the elements in a visually neutral element, as shown in figure 2.3. The `<div>` container is usually a good choice, as is `<span>`.

You can pass an unlimited number of parameters to `createElement()`. All the parameters after the second one become child elements. Those child elements (`h1`, in this case) are siblings—that is, they're on the same level relative to each other, as you can see in figure 2.4, which shows DevTools open in Chrome.

Figure 2.3 Structuring a React render by using a wrapper `<div>` container to render sibling headingsFigure 2.4 React DevTools shows a `<div>` wrapper for nested sibling `h1` elements.

React Developer Tools

In addition to the Elements tab, which is included by default in Chrome DevTools, you can install an extension (or plug-in) called React Developer Tools. It's the last tab in figure 2.4. React Developer Tools is available for Firefox as well. It lets you inspect the results of React rendering closely, including the component's hierarchy, name, properties, states, and more.

Here's the GitHub repository: <https://github.com/facebook/react-devtools>. You can also find React Developer Tools for Chrome at <http://mng.bz/V276> and for Firefox at <http://mng.bz/59V9>.

Knowing this, let's use `createElement()` to create the `<div>` element with two `<h1>` child elements (`ch02/hello-world-nested/index.html`).

Listing 2.1 Creating a `<div>` element with two `<h1>` children

```
let h1 = React.createElement('h1', null, 'Hello world!')
ReactDOM.render(
  React.createElement('div', null, h1, h1),
  document.getElementById('content')
)
```

If the third parameter of `createElement()` is a string, it specifies the text value of the element being created.

If the third and subsequent parameters aren't text, they specify the child elements of the element being created.

The HTML code can stay the same as in the Hello World example from chapter 1, as long as you include the necessary React and ReactDOM libraries and have the content node (`ch02/hello-world-nested/index.html`).

Listing 2.2 HTML for the nested elements example without the React code

```
<!DOCTYPE html>
<html>
  <head>
    <script src="js/react.js"></script>
    <script src="js/react-dom.js"></script>
  </head>
  <body>
    <div id="content"></div>
    <script type="text/javascript">
      ...
    </script>
  </body>
</html>
```

So far, you've only provided string values as the first parameter of `createElement()`. But the first parameter can have two types of input:

- Standard HTML tag as a string; for example, 'h1', 'div', or 'p' (without the angle brackets). The name is lowercase.
- React component classes as an object; for example, HelloWorld. The name is capitalized.

The first approach renders standard HTML elements. React goes through its list of standard HTML elements and, when and if it finds a match, uses it as a type for the React element. For example, when you pass 'p', React will find a match because p is a paragraph tag name. This will produce <p> in the DOM when/if you render this React element.

Now let's look at the second type of input: creating and providing custom component classes.

2.2 Creating component classes

After nesting elements with React, you'll stumble across the next problem: soon, there are a lot of elements. You need to use the component-based architecture described in chapter 1, which lets you reuse code by separating the functionality into loosely coupled parts. Meet *component classes*, or just *components*, as they're often called for brevity (not to be confused with web components).

Think of standard HTML tags as building blocks. You can use them to compose your own React component classes, which you can use to create custom elements (instances of classes). By using custom elements, you can encapsulate and abstract logic in portable classes (composable reusable components). This abstraction allows teams to reuse UIs in large, complex applications as well as in different projects. Examples include autocomplete components, toolboxes, menus, and so on.

Creating the 'Hello world!' element with an HTML tag in the `createElement()` method was straightforward: `createElement('h1', null, 'Hello World!')`. But what if you need to separate Hello World into its own class, as shown in figure 2.5? Let's say you need to reuse Hello World in 10 different projects! (You probably wouldn't use it that many times, but a good autocomplete component will definitely be reused.)

Interestingly, you create a React component class by extending the `React.Component` class with `class CHILD extends PARENT` ES6 syntax. Let's create a custom HelloWorld component class using `class HelloWorld extends React.Component`.

The one mandatory thing you must implement for this new class is the `render()` method. This method *must* return a single React element, `createElement()`, which is created from another custom component class or an HTML tag. Both can have nested elements.

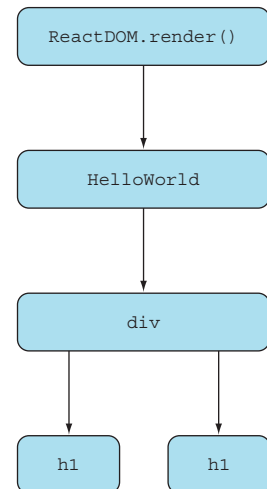
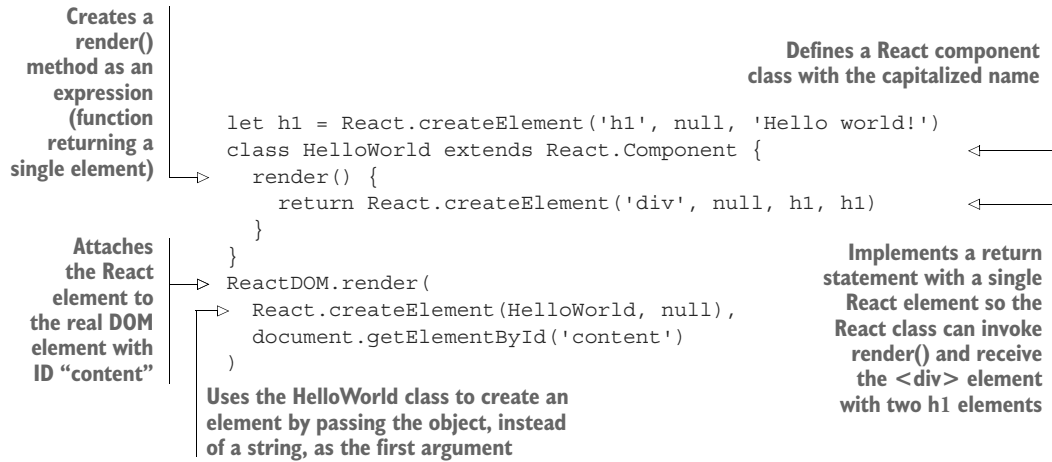


Figure 2.5 Rendering a <div> element created from a custom component class instead of rendering it directly

Listing 2.3 (ch02/hello-world-class/js/script.js) shows how you can refactor the nested Hello World example (listing 2.1) into an app with a custom React component class, `HelloWorld`. The benefit is that with a custom class, you can reuse this UI better. The mandatory `render()` method of the `HelloWorld` component returns the same `<div>` element from the previous example. Once you've created the custom `HelloWorld` class, you can pass it as an object (not as a string) to `ReactDOM.render()`.

Listing 2.3 Creating and rendering a React component class



By convention, the names of variables containing React components are capitalized. This isn't required in regular JS (you can use the lowercase variable name `helloWorld`); but because it's necessary in JSX, you apply this convention here. (In JSX, React uses uppercase and lowercase to differentiate a custom component like `<HelloWorld/>` from a regular HTML element such as `<h1/>`. But in regular JS, it's differentiated by passing either a variable such as `HelloWorld` or a string such as `'h1'`. It's a good idea to start using capitalization convention for custom components now.) More about JSX in chapter 3.

ES6+/ES2015+ and React

The component class example defines `render()` using ES6 style, in which you omit the colon and the word `function`. It's exactly the same as defining an attribute (a.k.a. key or object property) with a value that's a function: that is, typing `render: function()`. My personal preference, and my recommendation to you, is to use the ES6 method style because it's shorter (the less you type, the fewer mistakes you make).

Historically, React had its own method to create a component class: `React.createClass()`. There are slight differences between using the ES6 class to extend `React.Component` and using `React.createClass()`. Typically, you'd use either `class` (recommended) or `createClass()`, but not both. Moreover, in React 15.5.4, `createClass()` is deprecated (that is, no longer supported).

(continued)

Although you may still see the `React.createClass()` method used by some teams, the general tendency in the React world is to move toward a common standard: using the ES6 class approach. This book is forward thinking and uses the most popular tools and approaches, so it focuses on ES6. You can find ES5 examples for some of this book's projects in the GitHub repository, prefixed with `-es5`; they were for an early version of the book.

As of August 2016, most modern browsers support these ES6 (and almost all other) features natively (without extra tools),¹ so I assume you're familiar with it. If you're not, or if you need a refresher or more information on ES6+/ES2015+ and its primary features as they relate to React, see appendix E or a comprehensive book such as *Exploring ES6* by Dr. Axel Rauschmayer (free online version: <http://exploringjs.com/es6>).

Analogous to `ReactDOM.render()`, the `render()` method in `createClass()` can *only* return a single element. If you need to return multiple same-level elements, wrap them in a `<div>` container or another unobtrusive element such as `<span>`. You can run the code in your browser; the result is shown in figure 2.6.

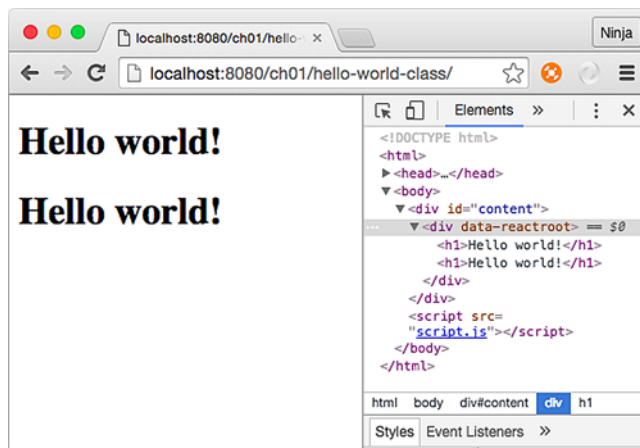


Figure 2.6 Rendering an element created from a custom HelloWorld component class

You may think you didn't gain much with the refactoring; but what if you need to print more Hello World statements? You can do so by reusing the HelloWorld component multiple times and wrapping them in a `<div>` container:

```
...
ReactDOM.render(
  React.createElement(
    'div',
    null,
    React.createElement(HelloWorld),
    React.createElement(HelloWorld),
```

¹ ECMAScript 6 Compatibility Table, <https://kangax.github.io/compat-table/es6>.

```

    React.createElement(HelloWorld)
  ),
  document.getElementById('content')
)

```

This is the power of component reusability! It leads to faster development and fewer bugs. Components also have lifecycle events, states, DOM events, and other features that let you make them interactive and self-contained; these are covered in the following chapters.

Right now, the `HelloWorld` elements will all be the same. Is there a way to customize them? What if you could set element attributes and modify their content and/or behavior? Meet properties.

2.3 Working with properties

Properties are a cornerstone of the declarative style that React uses. Think of properties as unchangeable values within an element. They allow elements to have different variations if used in a view, such as changing a link URL by passing a new value for a property:

```
React.createElement('a', {href: 'http://node.university'})
```

One thing to remember is that properties are *immutable within their components*. A parent assigns properties to its children upon their creation. The child element isn't supposed to modify its properties. (A *child* is an element nested inside another element; for example, `<h1/>` is a child of `<HelloWorld/>`.) For instance, you can pass a property `PROPERTY_NAME` with the value `VALUE`, like this:

```
<TAG_NAME PROPERTY_NAME=VALUE/>
```

Properties closely resemble HTML attributes. This is one of their purposes, but they also have another: you can use the properties of an element in your code as you wish. Properties can be used as follows:

- To render standard HTML attributes of an element: `href`, `title`, `style`, `class`, and so on
- In the JavaScript code of a React component class via `this.props` values; for example, `this.props.PROPERTY_NAME` (replacing `PROPERTY_NAME` with your arbitrary name)

Under the hood, React will match the property name (`PROPERTY_NAME`) with the list of standard attributes. If there's a match, the property will be rendered as an attribute of an element (the first scenario). The value of this attribute is also accessible in `this.props.PROPERTY_NAME` in the component class code.

If there's no match with any of the standard HTML attribute names (the second scenario), then the property name isn't a standard attribute. It won't be rendered as an attribute of an element. But the value will still be accessible in the `this.props` object; for example, `this.props.PROPERTY_NAME`. It can be used in your code or rendered explicitly in the `render()` method. This way, you can pass different data to

Object.freeze() and Object.isFrozen()

Internally, React uses `Object.freeze()`² from the ES5 standard to make the `this.props` object immutable. To check whether an object is frozen, you can use the `Object.isFrozen()` method.³ For example, you can determine whether this statement will return `true`:

```
class HelloWorld extends React.Component {
  render() {
    console.log(Object.isFrozen(this.props))
    return React.createElement('div', null, h1, h1)
  }
}
```

If you're interested in more details, I encourage you to read the React changelog⁴ and search on React's GitHub repository.⁵

different instances of the same class. This allows you to reuse components, because you can programmatically change how elements are rendered by providing different properties.

You can even take this feature of properties a step further and completely modify the rendered elements based on the value of a property. For example, if `this.props.heading` is `true`, you render “Hello” as a heading. If it's `false`, you render “Hello” as a normal paragraph:

```
render() {
  if (this.props.heading) return <h1>Hello</h1>
  else return <p>Hello</p>
}
```

In other words, you can use the same component—but provided with different properties, the elements rendered by the component can be different. Properties can be rendered by `render()`, used in components' code, or used as HTML attributes.

To demonstrate the properties of components, let's slightly modify `HelloWorld` with props. The goal is to reuse the `HelloWorld` component such that each instance of this class renders different text and different HTML attributes. You'll enhance the `HelloWorld` headings (`<h1>` tag) with three properties (see figure 2.7):

- `id`—Matches the standard attribute `id` and is automatically rendered by React
- `frameworkName`—Doesn't match any standard attributes for `<h1>`, but is explicitly printed in the text of headings
- `title`—Matches the standard attribute `title` and is automatically rendered by React

² Mozilla Developer Network, `Object.freeze()`, <http://mng.bz/p6Nr>.

³ Mozilla Developer Network, `Object.isFrozen()`, <http://mng.bz/0P75>.

⁴ GitHub, 2016-04-07-react-v15, <http://mng.bz/j6c3>.

⁵ GitHub, “freeze” search results, <http://mng.bz/2l0Z>.

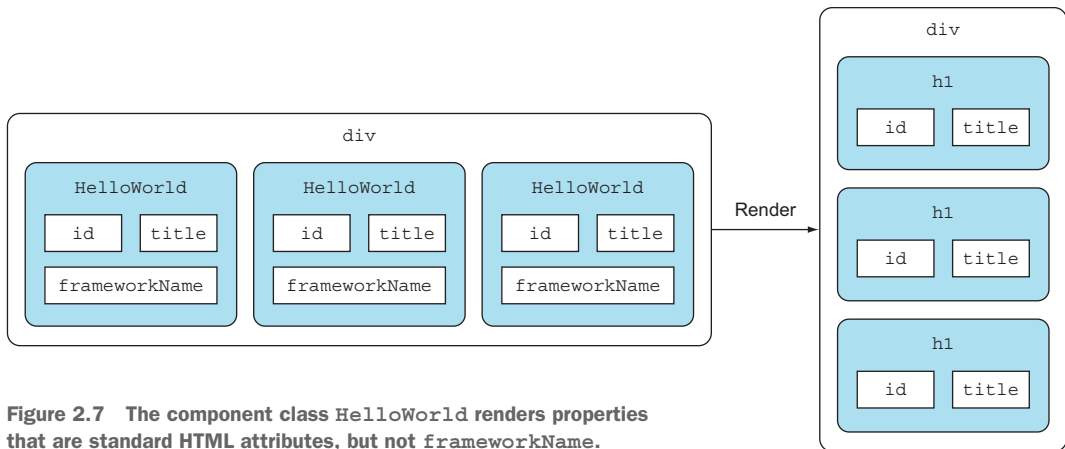


Figure 2.7 The component class `HelloWorld` renders properties that are standard HTML attributes, but not `frameworkName`.

If a property's name matches a standard HTML attribute, it will be rendered as an attribute of the `<h1>` element, as shown in figure 2.7. So the two properties `id` and `title` will be rendered as `<h1>` attributes, but not `frameworkName`. You may even get a warning about the unknown `frameworkName` property (because it's not in the HTML specification). How nice!

Let's zoom in on the `<div>` element implementation (figure 2.8). Obviously, it needs to render three child elements of the `HelloWorld` class, but the text and attributes of the resulting headings (`<h1/>`) must be different. For example, you pass `id`, `frameworkName`, and `title`. They'll be part of the `HelloWorld` class.

Before you implement `<h1/>`, you need to pass the properties to `HelloWorld`. How do you do this? By passing these properties in an object literal in the second argument to `createElement()` when you create `HelloWorld` elements in the `<div>` container:

```
ReactDOM.render(
  React.createElement(
    'div',
    null,
    React.createElement(HelloWorld, {
      id: 'ember',
      frameworkName: 'Ember.js',
      title: 'A framework for creating ambitious web applications.'}),
    React.createElement(HelloWorld, {
      id: 'backbone',
      frameworkName: 'Backbone.js',
      title: 'Backbone.js gives structure to web applications...'}),
    React.createElement(HelloWorld, {
      id: 'angular',
      frameworkName: 'Angular.js',
      title: 'Superheroic JavaScript MVW Framework'})
  ),
  document.getElementById('content')
)
```

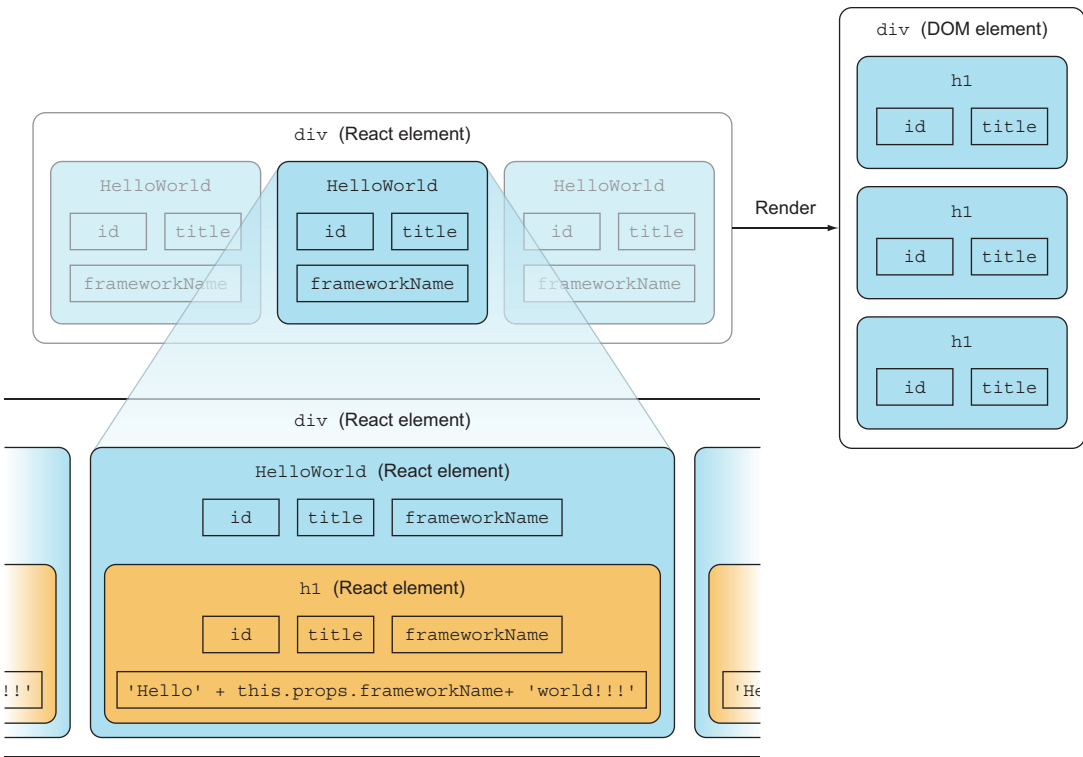


Figure 2.8 The `HelloWorld` class is used three times to generate three `h1` elements that have different attributes and innerHTML.

Now let's look at the `HelloWorld` component implementation. The way React works is that the second parameter to `createElement()` (for example, `{id: 'ember'...}`) is an object whose properties are accessible via the `this.props` object inside the component's `render()` method. Therefore, you can access the value of `frameworkName` as shown in the following listing.

Listing 2.4 Using the `frameworkName` property in the `render()` method

```
class HelloWorld extends React.Component {
  render() {
    return React.createElement(
      'h1',
      null,
      'Hello ' + this.props.frameworkName + ' world!!!'
    )
  }
}
```

Concatenates (combines) three strings:
"Hello", "this.props.frameworkName",
and "world!!!"

The keys of the `this.props` object are exactly the same as the keys of the object passed to `createElement()` as the second parameter. That is, `this.props` has `id`,

frameworkName, and title keys. The number of key/value pairs you can pass in the second argument to `React.createElement()` is unlimited.

In addition, you may have already guessed that it's possible to pass all the properties of `HelloWorld` to its child `<h1/>`. This can be extremely useful when you don't know what properties are passed to a component; for example, in `HelloWorld`, you want to leave the style attribute value up to a developer instantiating `HelloWorld`. Therefore, you don't limit what attributes to render in `<h1/>`.

Listing 2.5 Passing all the properties from `HelloWorld` to `<h1>`

```
class HelloWorld extends React.Component {
  render() {
    return React.createElement(
      'h1',
      this.props,
      'Hello ' + this.props.frameworkName + ' world!!!'
    )
  }
}
```

Passes all the properties to the child heading element

Then, you render three `HelloWorld` elements into the `<div>` with the ID content, as shown in the following listing (ch02/hello-js-world/js/script.js) and figure 2.9.

Listing 2.6 Using properties passed during element creation

```
class HelloWorld extends React.Component {
  render() {
    return React.createElement(
      'h1',
      this.props,
      'Hello ' + this.props.frameworkName + ' world!!!'
    )
  }
}

ReactDOM.render(
  React.createElement(
    'div',
    null,
    React.createElement(HelloWorld, {
      id: 'ember',
      frameworkName: 'Ember.js',
      title: 'A framework for creating ambitious web applications.'
    },
    React.createElement(HelloWorld, {
      id: 'backbone',
      frameworkName: 'Backbone.js',
      title: 'Backbone.js gives structure to web applications...'
    },
    React.createElement(HelloWorld, {
      id: 'angular',
      frameworkName: 'Angular.js',
      title: 'Superheroic JavaScript MVW Framework'
    })
  ),
  document.getElementById('content')
)
```

Outputs the frameworkName property as text in `<h1>`

Any properties passed into `HelloWorld` when `createElement` is called are passed into this `<h1>` element.

id and title correspond to standard HTML attributes for `<h1>` and are rendered as those attributes.

frameworkName isn't a standard HTML attribute for `<h1>`, so it won't be rendered unless you do something with it.

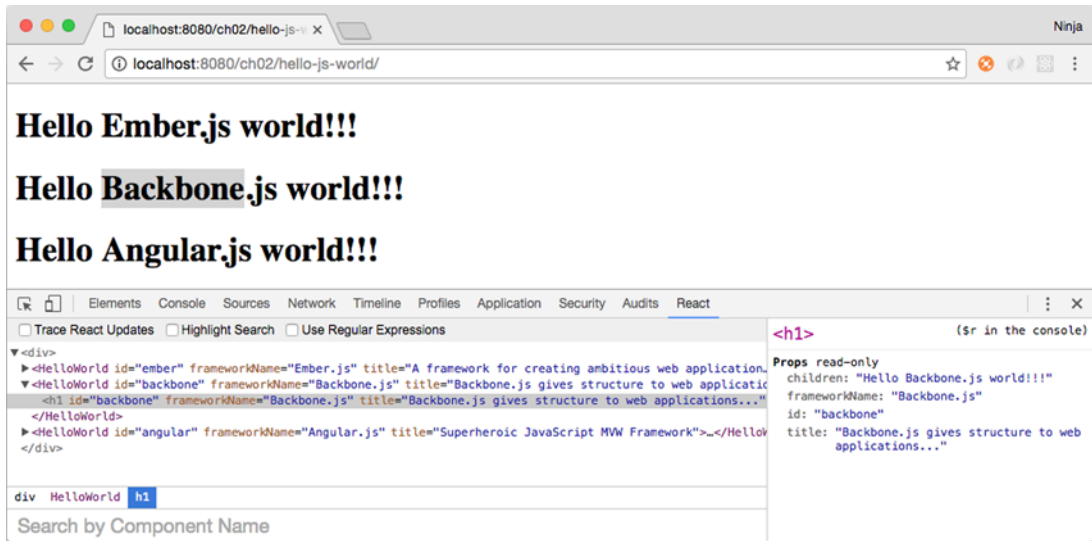


Figure 2.9 Result of reusing HelloWorld with different properties to render three different headings

As usual, you can run this code via a local HTTP web server. The result of reusing the HelloWorld component class is three different headings (see figure 2.9).

You used `this.props` to render different text for the headings. You used properties to render different titles and IDs. Thus, you effectively reused most of the code, which makes you the master of React HelloWorld component classes!

We've covered several permutations of Hello World. Yes, I know, it's still the boring, good-old Hello World. But by starting small, we're building a solid foundation for future, more-advanced topics. Believe me, you can achieve a lot of great things with component classes.

It's very important to know how React works in regular JavaScript events if you (like many React engineers) plan to use JSX. This is because in the end, browsers will still run regular JS, and you'll need to understand the results of the JSX-to-JS transpilation from time to time. Going forward, we'll be using JSX, which is covered in the next chapter.

2.4 Quiz

- 1 A React component class can be created with which of the following?
`createComponent()`, `createElement()`, `class NAME extends React.Component`, `class NAME extends React.Class`
- 2 The only mandatory attribute or method of a React component is which of the following?
`function`, `return`, `name`, `render`, `class`
- 3 To access the `url` property of a component, you use which of the following?
`this.properties.url`, `this.data.url`, `this.props.url`, `url`

- 4 React properties are immutable in a context of a current component. True or false?
- 5 React component classes allows developers to create reusable UIs. True or false?

2.5 Summary

- You can nest React elements using third, fourth, and so on arguments in `createElement()`.
- Create elements from custom component classes.
- Modify the resulting elements using properties.
- You can pass properties to child element(s).
- To use a component-based architecture (one of the features of React), you create components.

2.6 Quiz answers

- 1 class NAME extends React.Component, because there's no React.Class and others will fail due to ReferenceError (not defined).
- 2 `render()` because it's the *only* required method; also, because `function`, `return`, `render`, and `class` are not valid, and `name` is optional.
- 3 `this.props.url` because only `this.props` gives the properties object.
- 4 True. It's impossible to change a property.
- 5 True. Developers use new components to create reusable UIs.

React Quickly

AZAT MARDAN

Successful user interfaces need to be visually interesting, fast, and flowing. The React.js JavaScript library supercharges view-heavy web applications by improving data flow between UI components. React sites update visual elements efficiently and smoothly, minimizing page reloads. React is developer friendly, with a strong ecosystem to support the dev process along the full application stack. And because it's all JavaScript, React is instantly familiar.

React Quickly is the tutorial for web developers who want to get started fast with React.js. Following carefully chosen and clearly explained examples, you'll learn React development using your existing JavaScript and web dev skills. You'll explore a host of different projects as you learn about web components, forms, and data.

WHAT'S INSIDE

- Master React fundamentals
- Build full web apps with data and routing
- Test components
- Optimize React apps

This book is for developers comfortable building web applications with JavaScript.

Azat Mardan is a Tech Fellow at Capital One with extensive experience using and teaching JavaScript and Node, and author of several books on JavaScript, Node, React, and Express.

Technical proofreader: *German Frigerio*



"Simply the best way to learn React.js."

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—Peter Cooper
Editor of *JavaScript Weekly*

"Perfect for new React developers and seasoned veterans alike."

—Matthew Heck, TechChange

"An absolutely engaging read, where theory meets practice!"

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