React

- React is a JavaScript library for building user interfaces.
- React is used to build single-page applications.
- React allows us to create reusable UI components.

Example:

```
import React from 'react’;
import ReactDOM from 'react-dom/client’;

function Hello(props) {
   return <h1>Hello World!</h1>;
}
const root =
ReactDOM.createRoot(document.getElementById("root"));
root.render(<Hello />);
```

Create React App

- To learn and test React, you should set up a React Environment on your computer.
- This tutorial uses the `create-react-app`.
- The `create-react-app` tool is an officially supported way to create React applications.
- Node.js is required to use `create-react-app`.
- Open your terminal in the directory you would like to create your application.
- Run this command to create a React application named `my-react-app`:

```
npx create-react-app my-react-app
```

- `create-react-app` will set up everything you need to run a React application.
- **Note:** If you've previously installed `create-react-app` globally, it is recommended that you uninstall the package to ensure npx always uses the latest version of `create-react-app`. To uninstall, run this command:
- `npm uninstall -g create-react-app`.

Run the React Application

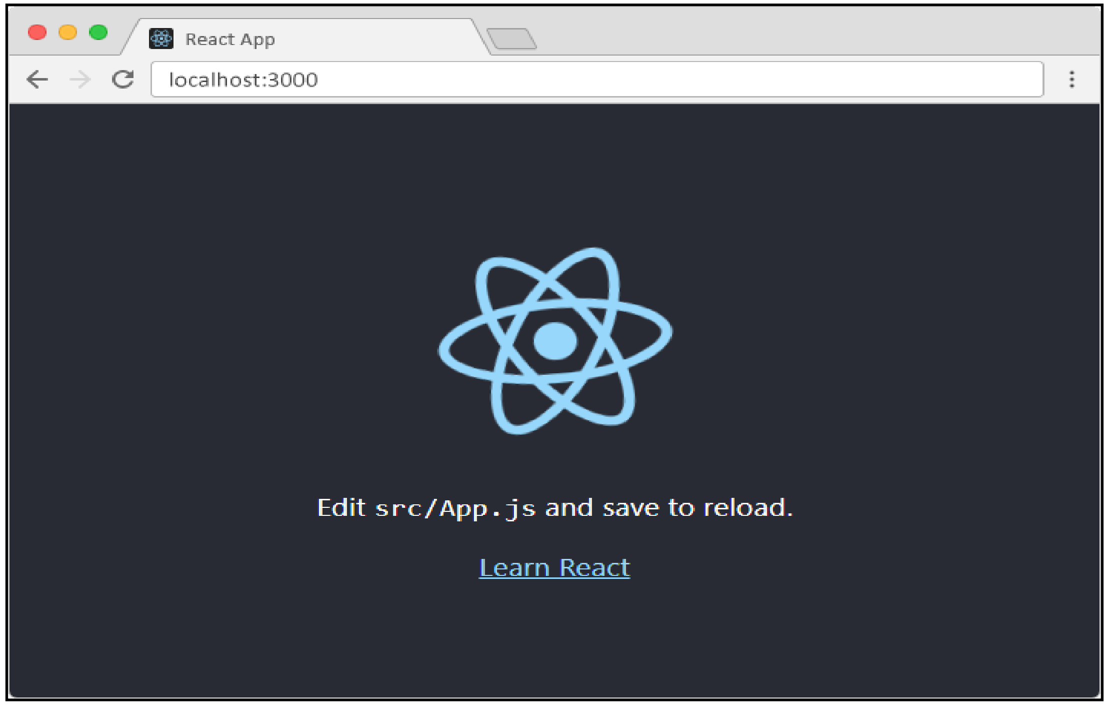
- Run this command to move to the `my-react-app` directory:

```
cd my-react-app
```

- Run this command to execute the React application `my-react-app`:

```
npm start
```

- A new browser window will pop up with your newly created React App! If not, open your browser and type `localhost:3000` in the address bar.



Edit `src/App.js` and save to reload.

Learn React

What You Should Already Know

- Before starting with React.JS, you should have intermediate experience in:
  - HTML
  - CSS
  - JavaScript
- You should also have some experience with the new JavaScript features introduced in ECMAScript 6 (ES6), you will learn about them in the React ES6 chapter.

What is React?

- React, sometimes referred to as a frontend JavaScript framework, is a JavaScript library created by Facebook.
- React is a tool for building UI components.

How does React Work?

- React creates a VIRTUAL DOM in memory.

- Instead of manipulating the browser's DOM directly, React creates a virtual DOM in memory, where it does all the necessary manipulating, before making the changes in the browser DOM.
- React only changes what needs to be changed!
- React finds out what changes have been made, and changes **only** what needs to be changed.
- You will learn the various aspects of how React does this in the rest of this tutorial.

React.JS History

- Current version of React.JS is V18.0.0 (April 2022).
- Initial Release to the Public (V0.3.0) was in July 2013.
- React.JS was first used in 2011 for Facebook's Newsfeed feature.
- Facebook Software Engineer, Jordan Walke, created it.
- Current version of `create-react-app` is v5.0.1 (April 2022).
- `create-react-app` includes built tools such as webpack, Babel, and ESLint.

What is DOM?

- DOM is an acronym that stands for Document Object Model. It's how a web browser represents a web page internally.
- The DOM determines what content should be on a page and how each element of the content relates to the other elements. Let's look at each word of the acronym.

Document

- We can think of a document as a way to structure information, including articles, books, and scientific papers. For Web Developers, a document is a name for a web page, and they consider the DOM as a model for all the stuff on the web page. The DOM calls this stuff objects.

Object

- The "stuff" on web pages are objects and are sometimes called elements or nodes. Here are some objects you may run into on a web page:
  - **Content.** The most obvious objects on a web page are the content. These can include words, videos, images, and more.
  - **Structural elements.** These include divs, containers, and sections. You may not see these elements, but you see how they affect the visible elements because they organize those elements on the web page.
  - **Attributes.** Every element on a web page has attributes. These include classes, styles, and sizes, for example. These are objects in the DOM, but they're not elements like the content and structural elements.

Model

- A model is a representation of something, and it helps us understand how something is put together. There are models for many things that need to be universally understood, analyzed, and used.
- One example of a model being used is for instructions. Blueprints, floor plans, and IKEA directions are all examples of this kind of model. They show the object being modeled with enough detail that it can be recreated.
- Another example of a model is a description. This type of model is used to simplify big ideas or complex systems so they can be understood more easily. These types of models help us to understand things like our galaxy.
- The DOM is a model for web pages. It acts as a set of instructions for web browsers.

What does the DOM look like?

- The DOM is represented as a type of data structure called a tree. Every object in the DOM is hierarchically under another object, and any object can have multiple children but only one parent.
- Each DOM object "owns" its children. If you remove an object from the DOM, all of its children will also be removed with it.
- The DOM itself is digital, so it actually doesn't "look" like anything, but it can be represented in a few different ways. These representations can help us visualize what DOM is.

Tree graph

- One way to represent the DOM is with a tree graph. A tree graph shows the relationship between parent and child objects, with lines between them representing their relationship.
- Take a family tree as an example. At the top, you'd have your grandparents. Then, below, you'd have your parents and their siblings, followed by you, your siblings, and your cousins.
- Similarly, the root node — the node at the top of the tree graph — of a web page would be the HTML element. Beneath, you'd have the head and body elements. Underneath the body element, you'll possibly find header, main, and footer elements. Below the header element, you might find img, nav, and h1 elements.

HTML

- The most common way to represent the DOM is with HTML. You can take a look at the HTML of a web page by opening the developer tools in your browser or by right-clicking on an element and choosing "Inspect element". Here's an example of HTML:

```
<html>
<head>...</head>
      <body>
           <header>
                <img src="logo.png" />
                 <h1>Example Site</h1>
                 <nav>...</nav>
           </header>
           <main>...</main>
           <footer>...</footer>
       </body>
</html>
```

- This list of elements may not look like a tree structure at first, but every indentation in the browser inspector or in the example above is like a vertical level in a tree graph.
- HTML elements wrap other elements that are its children. The img element is a child of the header element, which is a child of the body element, which is a child of the HTML element.
- Even though this is the most common way to represent the DOM, HTML isn't the DOM itself — it just represents it.

React Getting Started

- To get an overview of what React is, you can write React code directly in HTML.
- But in order to use React in production, you need npm and Node.js installed.

React Directly in HTML

- The quickest way start learning React is to write React directly in your HTML files.

```
<!DOCTYPE html>
<html>
<head>
     <script src="https://unpkg.com/react@18/umd/react.development.js" crossorigin></script>
     <script src="https://unpkg.com/react-dom@18/umd/react-dom.development.js" crossorigin></script>
     <script src="https://unpkg.com/@babel/standalone/babel.min.js"></script>
</head>
<body>
   <div id="mydiv"></div>
   <script type="text/babel">
     function Hello() {
     return <h1>Hello World!</h1>;
     }
    ReactDOM.render(<Hello />, document.getElementById('mydiv’))
   </script>
</body>
</html>
```

Setting up a React Environment

- If you have npx and Node.js installed, you can create a React application by using `create-react-app`.
- If you've previously installed `create-react-app` globally, it is recommended that you uninstall the package to ensure npx always uses the latest version of `create-react-app`.
- To uninstall, run this command: `npm uninstall -g create-react-app`.
- Run this command to create a React application named `my-react-app`:

Modify the React Application

- So far so good, but how do I change the content?
- Look in the `my-react-app` directory, and you will find a `src` folder. Inside the `src` folder there is a file called `App.js`, open it and it will look like this:

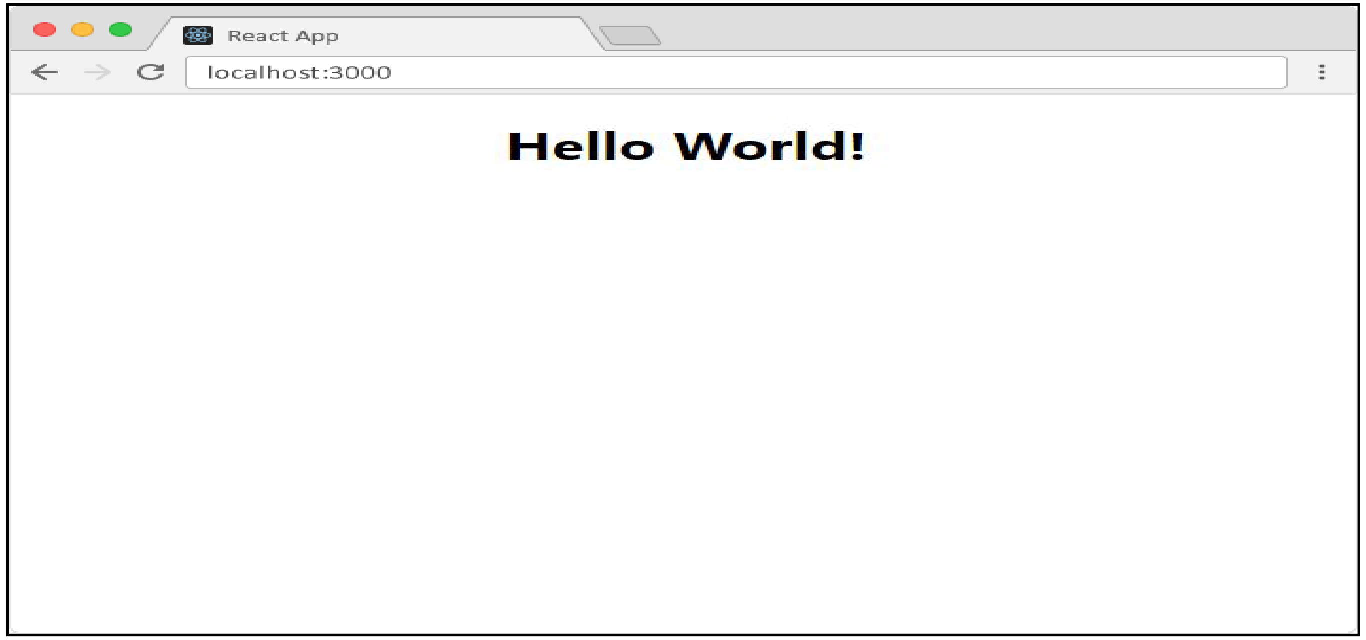
Example

```
import logo from './logo.svg’;
import './App.css’;
function App() {
    return (
             <div className="App">
               <header className="App-header">
                 <img src={logo} className="App-logo" alt="logo" />
                 <p> Edit <code>src/App.js</code> and save to reload. </p>
                 <a className="App-link" href="https://reactjs.org" target="_blank" rel="noopener noreferrer" >Learn React</a>
               </header>
             </div>
    );
}
export default App;
```

- Notice that the changes are visible immediately after you save the file, you do not have to reload the browser!

- Replace all the content inside the `<div className="App">` with a `<h1>` element.
- See the changes in the browser when you click Save.

```
function App() {
    return (
            <div className="App">
               <h1>Hello World!</h1>
            </div>
    );
}
export default App;
```


React App
localhost:3000
Hello World!

What's Next?

- Now you have a React Environment on your computer, and you are ready to learn more about React.
- In the rest of this tutorial we will use our "Show React" tool to explain the various aspects of React, and how they are displayed in the browser.
- If you want to follow the same steps on your computer, start by stripping down the `src` folder to only contain one file: `index.js`. You should also remove any unnecessary lines of code inside the `index.js` file to make them look like the example in the "Show React" tool below:

`index.js:`

```
import React from 'react’;
import ReactDOM from 'react-dom/client’;
const myFirstElement = <h1>Hello React!</h1>
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(myFirstElement);
```

What is ES6?

- ES6 stands for ECMAScript 6.
- ECMAScript was created to standardize JavaScript, and ES6 is the 6th version of ECMAScript, it was published in 2015, and is also known as ECMAScript 2015.

Why Should I Learn ES6?

- React uses ES6, and you should be familiar with some of the new features like:
    - Classes
    - Arrow Functions
    - Variables (let, const, var)
    - Array Methods like `.map()`
    - Destructuring
    - Modules
    - Ternary Operator
    - Spread Operator

Classes

- ES6 introduced classes.
- A class is a type of function, but instead of using the keyword `function` to initiate it, we use the keyword `class`, and the properties are assigned inside a `constructor()` method.

```
class Car {
    constructor(name) {
        this.brand = name;
    }
}
```

- Create an object called "mycar" based on the Car class:

```
class Car {
     constructor(name) {
        this.brand = name;
      }
}
const mycar = new Car("Ford");
```

- **Note:** The constructor function is called automatically when the object is initialized.

Method in Classes

- Create a method named "present":

```
class Car {
     constructor(name) {
          this.brand = name;
     }
     present() {
          return 'I have a ' + this.brand;
     }
}
const mycar = new Car("Ford");
mycar.present();
```

- As you can see in the example above, you call the method by referring to the object's method name followed by parentheses (parameters would go inside the parentheses).

Class Inheritance

- To create a class inheritance, use the `extends` keyword.
- A class created with a class inheritance inherits all the methods from another class:

- Create a class named "Model" which will inherit the methods from the "Car" class:

```
class Car {
     constructor(name) {
          this.brand = name;
     }
     present() {
          return 'I have a ' + this.brand;
     }
}
class Model extends Car {
     constructor(name, mod) {
          super(name);
          this.model = mod;
     }
     show() {
          return this.present() + ', it is a ' + this.model
     }
}
const mycar = new Model("Ford", "Mustang");
mycar.show();
```

- The `super()` method refers to the parent class.
- By calling the `super()` method in the constructor method, we call the parent's constructor method and gets access to the parent's properties and methods.
- To learn more about classes, check out our JavaScript Classes section.

Arrow Functions

- Arrow functions allow us to write shorter function syntax:

Before:
```
hello = function() {
    return "Hello World!";
}
```

With Arrow Function:
```
hello = () => {
    return "Hello World!";
}
```

- It gets shorter! If the function has only one statement, and the statement returns a value, you can remove the brackets *and* the `return` keyword:

Arrow Functions Return Value by Default:
```
hello = () => "Hello World!";
```

- **Note:** This works only if the function has only one statement.

- If you have parameters, you pass them inside the parentheses:

Arrow Function With Parameters:
```
hello = (val) => "Hello " + val;
```

- In fact, if you have only one parameter, you can skip the parentheses as well:

Arrow Function Without Parentheses:
```
hello = val => "Hello " + val;
```

What About this?

- The handling of this is also different in arrow functions compared to regular functions.
- In short, with arrow functions there is no binding of this.
- In regular functions the this keyword represented the object that called the function, which could be the window, the document, a button or whatever.
- With arrow functions, the this keyword *always* represents the object that defined the arrow function.
- Let us take a look at two examples to understand the difference.
- Both examples call a method twice, first when the page loads, and once again when the user clicks a button.
- The first example uses a regular function, and the second example uses an arrow function.
- The result shows that the first example returns two different objects (window and button), and the second example returns the Header object twice.

- With a regular function, this represents the object that called the function:

```
class Header {
     constructor() {
          this.color = "Red";
     }
//Regular function:
     changeColor = function() {
          document.getElementById("demo").innerHTML += this;
     }
}
const myheader = new Header();
//The window object calls the function:
window.addEventListener("load", myheader.changeColor);
//A button object calls the function:
document.getElementById("btn").addEventListener("click", myheader.changeColor);
```

- With an arrow function, `this` represents the Header object no matter who called the function:

```
class Header {
     constructor() {
          this.color = "Red";
     }
//Arrow function:
     changeColor = () => {
          document.getElementById("demo").innerHTML += this;
     }
}
const myheader = new Header();
//The window object calls the function:
window.addEventListener("load", myheader.changeColor);
//A button object calls the function:
document.getElementById("btn").addEventListener("click", myheader.changeColor);
```

- Remember these differences when you are working with functions. Sometimes the behavior of regular functions is what you want, if not, use arrow functions.

Variables

- Before ES6 there was only one way of defining your variables: with the `var` keyword. If you did not define them, they would be assigned to the global object. Unless you were in strict mode, then you would get an error if your variables were undefined.
- Now, with ES6, there are three ways of defining your variables: `var`, `let`, and `const`.

var

```
var x = 5.6;
```

- If you use `var` outside of a function, it belongs to the global scope.
- If you use `var` inside of a function, it belongs to that function.
- If you use `var` inside of a block, i.e. a for loop, the variable is still available outside of that block.
- `var` has a *function* scope, not a *block* scope.

let

```
let x = 5.6;
```

- `let` is the block scoped version of `var`, and is limited to the block (or expression) where it is defined.
- If you use `let` inside of a block, i.e. a for loop, the variable is only available inside of that loop.
- `let` has a *block* scope.

const

```
const x = 5.6;
```

- `const` is a variable that once it has been created, its value can never change.
- `const` has a *block* scope.
- The keyword `const` is a bit misleading.
- It does not define a constant value. It defines a constant reference to a value.
- **Because of this you can NOT:**
  - Reassign a constant value
  - Reassign a constant array
  - Reassign a constant object

But you CAN:
- Change the elements of constant array
- Change the properties of constant object

Array Methods

- There are many JavaScript array methods.
- One of the most useful in React is the `.map()` array method.
- The `.map()` method allows you to run a function on each item in the array, returning a new array as the result.
- In React, `map()` can be used to generate lists.

Generate a list of items from an array:

```
const myArray = ['apple', 'banana', 'orange’];
const myList = myArray.map((item) => <p>{item}</p>)
```

Destructuring

- To illustrate destructuring, we'll make a sandwich. Do you take everything out of the refrigerator to make your sandwich? No, you only take out the items you would like to use on your sandwich.
- Destructuring is exactly the same. We may have an array or object that we are working with, but we only need some of the items contained in these.
- Destructuring makes it easy to extract only what is needed.

Destructing Arrays

- Here is the old way of assigning array items to a variable:

```
const vehicles = ['mustang', 'f-150', 'expedition’];
// old way
const car = vehicles[0];
const truck = vehicles[1];
const suv = vehicles[2];
```

- Here is the new way of assigning array items to a variable:

With destructuring:

```
const vehicles = ['mustang', 'f-150', 'expedition’];
const [car, truck, suv] = vehicles;
```

- When destructuring arrays, the order that variables are declared is important.
- If we only want the car and suv we can simply leave out the truck but keep the comma:

```
const vehicles = ['mustang', 'f-150', 'expedition’];
const [car,, suv] = vehicles;
```

Destructuring comes in handy when a function returns an array:

```
function calculate(a, b) {
     const add = a + b;
     const subtract = a - b;
     const multiply = a * b;
     const divide = a / b;
     return [add, subtract, multiply, divide];
}
const [add, subtract, multiply, divide] = calculate(4, 7);
```

Destructuring Objects

- Here is the old way of using an object inside a function:

```
const vehicleOne = {
     brand: 'Ford’,
     model: 'Mustang’,
     type: 'car’,
     year: 2021,
     color: 'red’
}
myVehicle(vehicleOne);
function myVehicle(vehicle) {    // old way
     const message='My ' + vehicle.type + ' is a ' + vehicle.color + ' ' + vehicle.brand + ' ' + vehicle.model + '.’;
}
```

- **Here is the new way of using an object inside a function:**

```
const vehicleOne = {    // With destructuring:
     brand: 'Ford’,
     model: 'Mustang’,
     type: 'car’,
     year: 2021,
     color: 'red’
}
myVehicle(vehicleOne);

function myVehicle({type, color, brand, model}) {
     const message = 'My ' + type + ' is a ' + color + ' ' + brand + ' ' + model + '.’;
}
```

- Notice that the object properties do not have to be declared in a specific order.

- We can even destructure deeply nested objects by referencing the nested object then using a colon and curly braces to again destructure the items needed from the nested object:

Example
```
const vehicleOne = {
     brand: 'Ford’,
     model: 'Mustang’,
     type: 'car’,
     year: 2021,
     color: 'red’,
     registration: {
          city: 'Houston’,
          state: 'Texas’,
          country: 'USA’
     }
}
myVehicle(vehicleOne)

function myVehicle({ model, registration: { state } }) {
     const message = 'My ' + model + ' is registered in ' + state + '.’;
}
```

Spread Operator

- The JavaScript spread operator (`...`) allows us to quickly copy all or part of an existing array or object into another array or object.

```
const numbersOne = [1, 2, 3];
const numbersTwo = [4, 5, 6];
const numbersCombined = [...numbersOne, ...numbersTwo];
```

$\Rightarrow$

```
1,2,3,4,5,6
```

- **The spread operator is often used in combination with destructuring**.
- Assign the first and second items from `numbers` to variables and put the rest in an array:

```
const numbers = [1, 2, 3, 4, 5, 6];
const [one, two, ...rest] = numbers;
```

```
1
2
3,4,5,6
```

- **We can use the spread operator with objects too:**
- Combine these two objects:

```
const myVehicle = {
     brand: 'Ford’,
     model: 'Mustang’,
     color: 'red’
}
const updateMyVehicle = {
     type: 'car’,
     year: 2021,
     color: 'yellow’
}
const myUpdatedVehicle = {...myVehicle, ...updateMyVehicle}
```

- Notice the properties that did not match were combined, but the property that did match, `color`, was overwritten by the last object that was passed, `updateMyVehicle`. The resulting color is now yellow.

Modules

- JavaScript modules allow you to break up your code into separate files.
- This makes it easier to maintain the code-base.
- ES Modules rely on the `import` and `export` statements.

Export

- You can export a function or variable from any file.
- Let us create a file named `person.js`, and fill it with the things we want to export.
- There are two types of exports: Named and Default.

Named Exports

- You can create named exports two ways. In-line individually, or all at once at the bottom.

In-line individually:

`person.js`

```
export const name = "Jesse"
export const age = 40
```

All at once at the bottom:

`person.js`

```
const name = "Jesse"
const age = 40
export { name, age }
```

Default Exports

- Let us create another file, named `message.js`, and use it for demonstrating default export.
- You can only have one default export in a file.

```
const message = () => {
    const name = "Jesse";
    const age = 40;
    return name + ' is ' + age + 'years old.’;
};
export default message;
```

Import

- You can import modules into a file in two ways, based on if they are named exports or default exports.
- Named exports must be destructured using curly braces. Default exports do not.

Import from named exports

- Import named exports from the file person.js:

```
import { name, age } from "./person.js";
```

Import from default exports

- Import a default export from the file message.js:

```
import message from "./message.js";
```

Ternary Operator

- The ternary operator is a simplified conditional operator like `if` / `else`.

- Syntax: `condition ? <expression if true> : <expression if false>`
- Here is an example using `if` / `else`:

Before:
```
if (authenticated) {
     renderApp();
} else {
      renderLogin();
}
```

- Here is the same example using a ternary operator:

With Ternary
```
authenticated ? renderApp() : renderLogin();
```

React Render HTML

- React's goal is in many ways to render HTML in a web page.
- React renders HTML to the web page by using a function called `ReactDOM.render()`.

The Render Function

- The `ReactDOM.render()` function takes two arguments, HTML code and an HTML element.
- The purpose of the function is to display the specified HTML code inside the specified HTML element.
- But render where?
- There is another folder in the root directory of your React project, named "public". In this folder, there is an `index.html` file.
- You'll notice a single `<div>` in the body of this file. This is where our React application will be rendered.

Example

- Display a paragraph inside an element with the id of "root":

```
ReactDOM.render(<p>Hello</p>, document.getElementById('root’));
```

- The result is displayed in the `<div id="root">` element:

```
<body>
    <div id="root"></div>
</body>
```

- Note that the element id does not have to be called "root", but this is the standard convention.

The HTML Code

- The HTML code in this tutorial uses JSX which allows you to write HTML tags inside the JavaScript code:
- Do not worry if the syntax is unfamiliar, you will learn more about JSX in the next chapter.

```
const myelement = (
<table>
    <tr>
        <th>Name</th>
    </tr>
    <tr>
        <td>John</td>
    </tr>
    <tr>
        <td>Elsa</td>
    </tr>
</table>
);
ReactDOM.render(myelement, document.getElementById('root'));
```

The Root Node

- The root node is the HTML element where you want to display the result.
- It is like a *container* for content managed by React.
- It does NOT have to be a `<div>` element and it does NOT have to have the `id='root'`:
- The root node can be called whatever you like:

```
<body>
    <header id="sandy"></header>
</body>
```

- Display the result in the `<header id="sandy">` element:

```
ReactDOM.render(<p>Hallo</p>, document.getElementById('sandy'));
```

What is JSX?

- JSX stands for JavaScript XML.
- JSX allows us to write HTML in React.
- JSX makes it easier to write and add HTML in React.

Coding JSX

- JSX allows us to write HTML elements in JavaScript and place them in the DOM without any `createElement()` and/or `appendChild()` methods.
- JSX converts HTML tags into react elements.

- You are not required to use JSX, but JSX makes it easier to write React applications.
- Here are two examples. The first uses JSX and the second does not:

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

const myElement = <h1>I Love JSX!</h1>;
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(myElement);
```

With JSX

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

const myElement = React.createElement('h1', {}, 'I do not use JSX!');
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(myElement);
```

Without JSX

- As you can see in the first example, JSX allows us to write HTML directly within the JavaScript code.
- JSX is an extension of the JavaScript language based on ES6, and is translated into regular JavaScript at runtime.

Expressions in JSX

- With JSX you can write expressions inside curly braces { }.
- The expression can be a React variable, or property, or any other valid JavaScript expression. JSX will execute the expression and return the result:

```
import React from 'react’;
import ReactDOM from 'react-dom/client’;

const myElement = <h1>React is {5 + 5} times better with JSX</h1>;
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(myElement);
```

React is 10 times better with JSX

Inserting a Large Block of HTML

- To write HTML on multiple lines, put the HTML inside parentheses:

```
import React from 'react’;
import ReactDOM from 'react-dom/client’;

const myElement = (
     <ul>
          <li>Apples</li>
          <li>Bananas</li>
          <li>Cherries</li>
     </ul>
);
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(myElement);
```

•Apples
•Bananas
•Cherries

One Top Level Element

- The HTML code must be wrapped in *ONE* top level element.
- So if you like to write *two* paragraphs, you must put them inside a parent element, like a `div` element.

- Wrap two paragraphs inside one DIV element:

```
const myElement = (
     <div>
          <p>I am a paragraph.</p>
          <p>I am a paragraph too.</p>
     </div>
);
```

- JSX will throw an error if the HTML is not correct, or if the HTML misses a parent element.

- Alternatively, you can use a "fragment" to wrap multiple lines. This will prevent unnecessarily adding extra nodes to the DOM.
- A fragment looks like an empty HTML tag: `<></>`.

Wrap two paragraphs inside a fragment:

```
const myElement = (
     <>
          <p>I am a paragraph.</p>
          <p>I am a paragraph too.</p>
     </>
);
```

Elements Must be Closed

- JSX follows XML rules, and therefore HTML elements must be properly closed.

Close empty elements with `/>`

```
const myElement = <input type="text" />;
```

- JSX will throw an error if the HTML is not properly closed.

Attribute class = className

- The `class` attribute is a much used attribute in HTML, but since JSX is rendered as JavaScript, and the `class` keyword is a reserved word in JavaScript, you are not allowed to use it in JSX.
- Use attribute `className` instead.
- JSX solved this by using `className` instead. When JSX is rendered, it translates `className` attributes into `class` attributes.

```
import React from 'react’;
import ReactDOM from 'react-dom/client’;

const myElement = <h1 className="myclass">Hello World</h1>;
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(myElement);
```

⇨ **Hello World**

Conditions - if statements

- React supports `if` statements, but not *inside* JSX.
- To be able to use conditional statements in JSX, you should put the `if` statements outside of the JSX, or you could use a ternary expression instead:

Option 1:
Write `if` statements outside of the JSX code:

Write "Hello" if `x` is less than 10, otherwise "Goodbye":

```
const x = 5;
let text = "Goodbye";
if (x < 10) {
    text = "Hello";
}
const myElement = <h1>{text}</h1>;
```

Option 2:
Use ternary expressions instead:

Write "Hello" if `x` is less than 10, otherwise "Goodbye":

```
const x = 5;
const myElement = <h1>{(x) < 10 ? "Hello" : "Goodbye"}</h1>;
```

- **Note** that in order to embed a JavaScript expression inside JSX, the JavaScript must be wrapped with curly braces, `{}`.

React Components

- Components are independent and reusable bits of code. They serve the same purpose as JavaScript functions, but work in isolation and return HTML.
- Components come in two types, Class components and Function components, in this tutorial we will concentrate on Function components.
- In older React code bases, you may find Class components primarily used. It is now suggested to use Function components along with Hooks, which were added in React 16.8. There is an optional section on Class components for your reference.

Create Your First Component

- When creating a React component, the component's name *MUST* start with an upper case letter.

Class Component

- A class component must include the `extends React.Component` statement. This statement creates an inheritance to React.Component, and gives your component access to React.Component's functions.
- The component also requires a `render()` method, this method returns HTML.

Create a Class component called `Car`

```
class Car extends React.Component {
    render() { return <h2>Hi, I am a Car!</h2>; }
}
```

Function Component

- Here is the same example as above, but created using a Function component instead.
- A Function component also returns HTML, and behaves much the same way as a Class component, but Function components can be written using much less code, are easier to understand, and will be preferred in this tutorial.

Create a Function component called `Car`

```
function Car() { return <h2>Hi, I am a Car!</h2>; }
```

Rendering a Component

- Now your React application has a component called Car, which returns an `<h2>` element.
- To use this component in your application, use similar syntax as normal HTML: `<Car />`

```
import React from 'react’;
import ReactDOM from 'react-dom/client’;

function Car() {
    return <h2>Hi, I am a Car!</h2>;
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Car />);
```

⇨ **Hi, I am a Car!**

Props

- Components can be passed as `props`, which stands for properties.
- Props are like function arguments, and you send them into the component as attributes.
- You will learn more about `props` in the next chapter.

```
import React from 'react’;
import ReactDOM from 'react-dom/client’;

function Car(props) {
    return <h2>I am a {props.color} Car!</h2>;
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Car color="red"/>);
```

⇨ **I am a red Car!**

Components in Components

We can refer to components inside other components:

Use the Car component inside the Garage component:

```
function Car() {
    return <h2>I am a Car!</h2>;
}
function Garage() {
    return ( <> <h1>Who lives in my Garage?</h1> <Car /> </> );
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Garage />);
```

Components in Files

- React is all about re-using code, and it is recommended to split your components into separate files.
- To do that, create a new file with a `.js` file extension and put the code inside it:
- Note that the filename must start with an uppercase character.

This is the new file, we named it "Car.js":

```
function Car() {
    return <h2>Hi, I am a Car!</h2>;
}
export default Car;
```

- To be able to use the Car component, you have to import the file in your application.

- Now we import the "Car.js" file in the application, and we can use the `Car` component as if it was created here.

```
import React from 'react’;
import ReactDOM from 'react-dom/client’;
import Car from './Car.js’;

const root = ReactDOM.createRoot(document.getElementById('root’));
root.render(<Car />);
```

React Class Components

- Before React 16.8, Class components were the only way to track state and lifecycle on a React component. Function components were considered "state-less".
- With the addition of Hooks, Function components are now almost equivalent to Class components. The differences are so minor that you will probably never need to use a Class component in React.
- Even though Function components are preferred, there are no current plans on removing Class components from React.
- This section will give you an overview of how to use Class components in React.
- Feel free to skip this section, and use Function Components instead.

React Components

- Components are independent and reusable bits of code. They serve the same purpose as JavaScript functions, but work in isolation and return HTML via a render() function.
- Components come in two types, Class components and Function components, in this chapter you will learn about Class components.

Create a Class Component

- When creating a React component, the component's name must start with an upper case letter.
- The component has to include the `extends React.Component` statement, this statement creates an inheritance to React.Component, and gives your component access to React.Component's functions.
- The component also requires a `render()` method, this method returns HTML.

Create a Class component called `Car`

```
class Car extends React.Component {
    render() { return <h2>Hi, I am a Car!</h2>; }
}
```

- Now your React application has a component called Car, which returns a `<h2>` element.
- To use this component in your application, use similar syntax as normal HTML: `<Car />`

```
import React from 'react’;
import ReactDOM from 'react-dom/client’;

class Car extends React.Component {
    render() { return <h2>Hi, I am a Car!</h2>; }
}
ReactDOM.render(<Car />, document.getElementById('root'));
```

Component Constructor

- If there is a `constructor()` function in your component, this function will be called when the component gets initiated.
- The constructor function is where you initiate the component's properties.
- In React, component properties should be kept in an object called `state`.
- You will learn more about `state` later in this tutorial.
- The constructor function is also where you honor the inheritance of the parent component by including the `super()` statement, which executes the parent component's constructor function, and your component has access to all the functions of the parent component (`React.Component`).

```
class Car extends React.Component {
    constructor() {
        super();
        this.state = {color: "red"};
    }
    render() {
        return <h2>I am a Car!</h2>;
    }
}
```

- Use the color property in the render() function:

```
class Car extends React.Component {
    constructor() {
        super();
        this.state = {color: "red"};
    }
    render() {
        return <h2>I am a {this.state.color} Car!</h2>;
    }
}
```

Props

- Another way of handling component properties is by using `props`.
- Props are like function arguments, and you send them into the component as attributes.
- You will learn more about `props` in the next chapter.

- Use an attribute to pass a color to the Car component, and use it in the render() function:

```
class Car extends React.Component {
     render() { return <h2>I am a {this.props.color} Car!</h2>; }
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Car color="red"/>);
```

Props in the Constructor

- If your component has a constructor function, the props should always be passed to the constructor and also to the React.Component via the `super()` method.

```
class Car extends React.Component {
     constructor(props) {
          super(props);
     }
     render() { return <h2>I am a {this.props.model}!</h2>; }
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Car model="Mustang"/>);
```

Components in Components

- We can refer to components inside other components:

Use the Car component inside the Garage component:

```
class Car extends React.Component {
    render() { return <h2>I am a Car!</h2>; }
}
class Garage extends React.Component {
    render() { return ( <div> <h1>Who lives in my Garage?</h1> <Car /> </div> ); }
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Garage />);
```

Components in Files

- React is all about re-using code, and it can be smart to insert some of your components in separate files.
- To do that, create a new file with a `.js` file extension and put the code inside it:
- Note that the file must start by importing React (as before), and it has to end with the statement `export default Car;`.

This is the new file, we named it `Car.js`:

```
import React from 'react’;

class Car extends React.Component {
    render() { return <h2>Hi, I am a Car!</h2>; }
}
export default Car;
```

- To be able to use the `Car` component, you have to import the file in your application.
- Now we import the `Car.js` file in the application, and we can use the `Car` component as if it was created here.

```
import React from 'react';
import ReactDOM from 'react-dom/client';
import Car from './Car.js';

const root =
ReactDOM.createRoot(document.getElementById('root'));
root.render(<Car />);
```

React Class Component State

- React Class components have a built-in `state` object.
- You might have noticed that we used `state` earlier in the component constructor section.
- The `state` object is where you store property values that belongs to the component.
- When the `state` object changes, the component re-renders.

Creating the state Object

- The state object is initialized in the constructor:

Specify the `state` object in the constructor method:

```
class Car extends React.Component {
    constructor(props) {
        super(props);
        this.state = {brand: "Ford"};
    }
    render() { return ( <div> <h1>My Car</h1> </div> ); }
}
```

- The state object can contain as many properties as you like:

Specify all the properties your component need:

```
class Car extends React.Component {
    constructor(props) {
    super(props);
        this.state = {
            brand: "Ford",
            model: "Mustang",
            color: "red",
            year: 1964
        };
    }
    render() {
        return (
            <div>
                <h1>My Car</h1>
            </div>
        );
    }
}
```

Using the `state` Object

- Refer to the `state` object anywhere in the component by using the `this.state.propertyname` syntax:

Refer to the `state` object in the `render()` method:

```
class Car extends React.Component {
    constructor(props) {
        super(props);
        this.state = {
            brand: "Ford",
            model: "Mustang",
            color: "red",
            year: 1964
        };
    }
    render() {
    return (
        <div>
            <h1>My {this.state.brand}</h1>
            <p>
                It is a {this.state.color} {this.state.model}
                from {this.state.year}.
            </p>
        </div> );
    }
}
```

Changing the state Object

- To change a value in the state object, use the this.setState() method.
- When a value in the state object changes, the component will re-render, meaning that the output will change according to the new value(s).

Add a button with an onClick event that will change the color property:

```
class Car extends React.Component {
    constructor(props) {
        super(props);
        this.state = {
            brand: "Ford",
            model: "Mustang",
            color: "red",
            year: 1964
        };
    }
    changeColor = () => {
        this.setState({color: "blue"});
    }
    render() {
        return (
            <div>
                <h1>My {this.state.brand}</h1>
                <p> It is a {this.state.color} {this.state.model} from {this.state.year}. </p>
                <button type="button" onClick={this.changeColor} >Change color</button>
            </div>
        );
    }
}
```

- Always use the setState() method to change the state object, it will ensure that the component knows its been updated and calls the render() method (and all the other lifecycle methods).

Lifecycle of Components

- Each component in React has a lifecycle which you can monitor and manipulate during its three main phases.
- The three phases are: **Mounting**, **Updating**, and **Unmounting**.

Mounting

- Mounting means putting elements into the DOM.
- React has four built-in methods that gets called, in this order, when mounting a component:
    1. `constructor()`
    2. `getDerivedStateFromProps()`
    3. `render()`
    4. `componentDidMount()`
- The `render()` method is required and will always be called, the others are optional and will be called if you define them.

constructor

- The `constructor()` method is called before anything else, when the component is initiated, and it is the natural place to set up the initial `state` and other initial values.
- The `constructor()` method is called with the `props`, as arguments, and you should always start by calling the `super(props)` before anything else, this will initiate the parent's constructor method and allows the component to inherit methods from its parent (`React.Component`).

The constructor method is called, by React, every time you make a component:

```
class Header extends React.Component {
    constructor(props) {
        super(props);
        this.state = {favoritecolor: "red"};
    }
    render() {
        return (
            <h1>My Favorite Color is {this.state.favoritecolor}</h1>
        );
    }
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Header />);
```

getDerivedStateFromProps

- The `getDerivedStateFromProps()` method is called right before rendering the element(s) in the DOM.
- This is the natural place to set the `state` object based on the initial `props`.
- It takes `state` as an argument, and returns an object with changes to the `state`.
- The example below starts with the favorite color being "red", but the `getDerivedStateFromProps()` method updates the favorite color based on the `favcol` attribute:

The `getDerivedStateFromProps` method is called right before the render method:

```
class Header extends React.Component {
     constructor(props) {
          super(props);
          this.state = {favoritecolor: "red"};
     }
     static getDerivedStateFromProps(props, state) {
          return {favoritecolor: props.favcol };
     }
     render() {
          return ( <h1>My Favorite Color is {this.state.favoritecolor}</h1> );
     }
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Header favcol="yellow"/>);
```

render

- The `render()` method is required, and is the method that actually outputs the HTML to the DOM.

```
class Header extends React.Component {
     render() {
          return (
               <h1>This is the content of the Header component</h1>
          );
     }
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Header />);
```

componentDidMount

- The `componentDidMount()` method is called after the component is rendered.
- This is where you run statements that requires that the component is already placed in the DOM.

- At first my favorite color is red, but give me a second, and it is yellow instead:

```
class Header extends React.Component {
    constructor(props) {
    super(props);
    this.state = {favoritecolor: "red"};
    }
    componentDidMount() {
        setTimeout(() => {
            this.setState({favoritecolor: "yellow"})
        }, 1000)
    }
    render() {
        return (
            <h1>My Favorite Color is {this.state.favoritecolor}</h1>
        );
    }
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Header />);
```

Updating

- The next phase in the lifecycle is when a component is *updated*.
- A component is updated whenever there is a change in the component's `state` or `props`.
- React has five built-in methods that gets called, in this order, when a component is updated:
  1. `getDerivedStateFromProps()`
  2. `shouldComponentUpdate()`
  3. `render()`
  4. `getSnapshotBeforeUpdate()`
  5. `componentDidUpdate()`
- The `render()` method is required and will always be called, the others are optional and will be called if you define them.

getDerivedStateFromProps

- Also at *updates* the `getDerivedStateFromProps` method is called. This is the first method that is called when a component gets updated.
- This is still the natural place to set the `state` object based on the initial props.
- The example below has a button that changes the favorite color to blue, but since the `getDerivedStateFromProps()` method is called, which updates the state with the color from the favcol attribute, the favorite color is still rendered as yellow:

If the component gets updated, the `getDerivedStateFromProps()` method is called:

```
class Header extends React.Component {
     constructor(props) {
          super(props);
          this.state = {favoritecolor: "red"};
     }
     static getDerivedStateFromProps(props, state) {
          return {favoritecolor: props.favcol };
     }
     changeColor = () => {
          this.setState({favoritecolor: "blue"});
     }
     render() {
          return (
               <div>
                    <h1>My Favorite Color is {this.state.favoritecolor}</h1>
                    <button type="button" onClick={this.changeColor}>Change color</button>
               </div>
          );
     }
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Header favcol="yellow" />);
```

shouldComponentUpdate

- In the `shouldComponentUpdate()` method you can return a Boolean value that specifies whether React should continue with the rendering or not.
- The default value is `true`.
- The example below shows what happens when the `shouldComponentUpdate()` method returns `false`:

Stop the component from rendering at any update:

```
class Header extends React.Component {
     constructor(props) {
          super(props);
          this.state = {favoritecolor: "red"};
     }
     shouldComponentUpdate() { return false; }
     changeColor = () => {
          this.setState({favoritecolor: "blue"});
     }
     render() {
          return (
               <div>
                    <h1>My Favorite Color is {this.state.favoritecolor}</h1>
                    <button type="button" onClick={this.changeColor}>Change color</button>
               </div
          );
     }
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Header />);
```

Same example as above, but this time the `shouldComponentUpdate()` method returns `true` instead:

```
class Header extends React.Component {
     constructor(props) {
          super(props);
          this.state = {favoritecolor: "red"};
     }
     shouldComponentUpdate() { return true; }
     changeColor = () => {
          this.setState({favoritecolor: "blue"});
     }
     render() {
          return (
               <div>
                    <h1>My Favorite Color is {this.state.favoritecolor}</h1>
                    <button type="button" onClick={this.changeColor}>Change color</button>
               </div>
          );
     }
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Header />);
```

render

- The `render()` method is of course called when a component gets *updated*, it has to re-render the HTML to the DOM, with the new changes.
- The example below has a button that changes the favorite color to blue:

Click the button to make a change in the component's state:

```
class Header extends React.Component {
     constructor(props) {
          super(props);
          this.state = {favoritecolor: "red"};
     }
     changeColor = () => {
          this.setState({favoritecolor: "blue"});
     }
     render() {
          return (
               <div>
                    <h1>My Favorite Color is {this.state.favoritecolor}</h1>
                    <button type="button" onClick={this.changeColor}>Change color</button>
               </div>
          );
     }
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Header />);
```

getSnapshotBeforeUpdate

- In the `getSnapshotBeforeUpdate()` method you have access to the `props` and `state` *before* the update, meaning that even after the update, you can check what the values were *before* the update.
- If the `getSnapshotBeforeUpdate()` method is present, you should also include the `componentDidUpdate()` method, otherwise you will get an error.
- The example below might seem complicated, but all it does is this:
- When the component is *mounting* it is rendered with the favorite color "red".
- When the component *has been mounted,* a timer changes the state, and after one second, the favorite color becomes "yellow".
- This action triggers the *update* phase, and since this component has a `getSnapshotBeforeUpdate()` method, this method is executed, and writes a message to the empty DIV1 element.
- Then the `componentDidUpdate()` method is executed and writes a message in the empty DIV2 element:

Example:
Use the getSnapshotBeforeUpdate() method to find out what the state object looked like before the update:

```
class Header extends React.Component {
     constructor(props) {
          super(props);
          this.state = {favoritecolor: "red"};
     }
     componentDidMount() {
          setTimeout(() => {
          this.setState({favoritecolor: "yellow"})
          }, 1000)
     }
     getSnapshotBeforeUpdate(prevProps, prevState) {
          document.getElementById("div1").innerHTML = "Before the update, the favorite was " + prevState.favoritecolor;
     }
     componentDidUpdate() {
          document.getElementById("div2").innerHTML = "The updated favorite is " + this.state.favoritecolor;
     }
     render() {
          return (
               <div>
                    <h1>My Favorite Color is {this.state.favoritecolor}</h1>
                    <div id="div1"></div>
                    <div id="div2"></div>
               </div>
          );
     }
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Header />);
```

componentDidUpdate

- The `componentDidUpdate` method is called after the component is updated in the DOM.
- The example below might seem complicated, but all it does is this:
- When the component is *mounting* it is rendered with the favorite color "red".
- When the component *has been mounted,* a timer changes the state, and the color becomes "yellow".
- This action triggers the *update* phase, and since this component has a `componentDidUpdate` method, this method is executed and writes a message in the empty DIV element:

The `componentDidUpdate` method is called after the update has been rendered in the DOM:

```
class Header extends React.Component {
     constructor(props) {
          super(props);
          this.state = {favoritecolor: "red"};
     }
     componentDidMount() {
          setTimeout(() => {
               this.setState({favoritecolor: "yellow"})
          }, 1000)
     }
     componentDidUpdate() {
          document.getElementById("mydiv").innerHTML = "The updated favorite is " + this.state.favoritecolor;
     }
     render() {
          return (
               <div> <h1>My Favorite Color is {this.state.favoritecolor}</h1> <div id="mydiv"></div> </div>
          );
     }
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Header />);
```

Unmounting

- The next phase in the lifecycle is when a component is removed from the DOM, or *unmounting* as React likes to call it.
- React has only one built-in method that gets called when a component is unmounted:
- componentWillUnmount()

componentWillUnmount

- The componentWillUnmount method is called when the component is about to be removed from the DOM.

Click the button to delete the header:

```
class Container extends React.Component {
     constructor(props) {
          super(props);
          this.state = {show: true};
     }
     delHeader = () => {
          this.setState({show: false});
     }
     render() {
          let myheader;
          if (this.state.show) {
          myheader = <Child />;
          };
          return (
               <div> {myheader}
                    <button type="button" onClick={this.delHeader}>Delete Header</button>
               </div>
          );
     }
}
class Child extends React.Component {
     componentWillUnmount() {
          alert("The component named Header is about to be unmounted.");
     }
     render() {
          return ( <h1>Hello World!</h1> );
     }
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Container />);
```

React Props

- React Props are like function arguments in JavaScript *and* attributes in HTML.
- To send props into a component, use the same syntax as HTML attributes:

Add a "brand" attribute to the Car element:

```
const myElement = <Car brand="Ford" />;
```

- The component receives the argument as a `props` object:

```
import React from 'react’;
import ReactDOM from 'react-dom/client’;

function Car(props) {
    return <h2>I am a { props.brand }!</h2>;
}

const myElement = <Car brand="Ford" />;
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(myElement);
```

Pass Data

- Props are also how you pass data from one component to another, as parameters.

Send the "brand" property from the Garage component to the Car component:

```
function Car(props) {
      return <h2>I am a { props.brand }!</h2>;
}
function Garage() {
      return (
            <>
                  <h1>Who lives in my garage?</h1>
                  <Car brand="Ford" />
            </>
      );
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Garage />);
```

- If you have a variable to send, and not a string as in the example above, you just put the variable name inside curly brackets:

Create a variable named `carName` and send it to the `Car` component:

```
function Car(props) {
      return <h2>I am a { props.brand }!</h2>;
}
function Garage() {
      const carName = "Ford";
      return (
            <>
                  <h1>Who lives in my garage?</h1>
                  <Car brand={ carName } />
            </>
      );
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Garage />);
```

Create an object named `carInfo` and send it to the `Car` component:

```
function Car(props) {
     return <h2>I am a { props.brand.model }!</h2>;
}
function Garage() {
     const carInfo = {
          name: "Ford",
          model: "Mustang"
     };
     return (
          <>
               <h1>Who lives in my garage?</h1>
               <Car brand={ carInfo } />
          </>
     );
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Garage />);
```

- **Note:** React Props are read-only! You will get an error if you try to change their value.

React Events

- Just like HTML DOM events, React can perform actions based on user events.
- React has the same events as HTML: click, change, mouseover etc.

Adding Events

- React events are written in camelCase syntax:
- `onClick` instead of `onclick`.
- React event handlers are written inside curly braces:
- `onClick={shoot}` instead of `onClick="shoot()"`.

React:

```
    <button onClick={shoot}>Take the Shot!</button>
```

HTML:

```
    <button onclick="shoot()">Take the Shot!</button>
```

- Put the `shoot` function inside the `Football` component:

```
function Football() {
    const shoot = () => {
        alert("Great Shot!");
    } return (
        <button onClick={shoot}>Take the shot!</button>
    );
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Football />);
```

Passing Arguments

- To pass an argument to an event handler, use an arrow function.

Send "Goal!" as a parameter to the shoot function, using arrow function:

```
function Football() {
     const shoot = (a) => {
          alert(a);
     }
     return (
          <button onClick={() => shoot("Goal!")}>Take the shot!</button>
     );
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Football />);
```

React Event Object

- Event handlers have access to the React event that triggered the function.
- In our example the event is the "click" event.

Arrow Function: Sending the event object manually:

```
function Football() {
     const shoot = (a, b) => {
          alert(b.type);
          /* 'b' represents the React event that triggered the function, in this case the 'click' event */
     }
     return (
          <button onClick={(event) => shoot("Goal!", event)}>Take the shot!</button>
     );
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Football />);
```

- This will come in handy when we look at Form in a later chapter.

React Conditional Rendering

- In React, you can conditionally render components.
- There are several ways to do this.

`if` Statement

- We can use the `if` JavaScript operator to decide which component to render.

We'll use these two components:

```
function MissedGoal() {
     return <h1>MISSED!</h1>;
}
function MadeGoal() {
     return <h1>Goal!</h1>;
}
```

Now, we'll create another component that chooses which component to render based on a condition:

```
function Goal(props) {
     const isGoal = props.isGoal;
          if (isGoal) {
               return <MadeGoal/>;
          }
          return <MissedGoal/>;
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Goal isGoal={false} />);
```

- Try changing the `isGoal` attribute to `true`:

```
import React from 'react';
import ReactDOM from 'react-dom/client';
function MissedGoal() {
     return <h1>MISSED!</h1>;
}
function MadeGoal() {
     return <h1>GOAL!</h1>;
}
function Goal(props) {
     const isGoal = props.isGoal;
     if (isGoal) {
          return <MadeGoal/>;
     }
     return <MissedGoal/>;
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Goal isGoal={true} />);
```

Logical && Operator

- Another way to conditionally render a React component is by using the && operator.

We can embed JavaScript expressions in JSX by using curly braces:

```
function Garage(props) {
     const cars = props.cars;
     return (
          <>
               <h1>Garage</h1>
               {cars.length > 0 && <h2> You have {cars.length} cars in your garage. </h2> }
          </>
     );
}
const cars = ['Ford', 'BMW', 'Audi’];
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Garage cars={cars} />);
```

- If `cars.length` is equates to true, the expression after && will render.
- Try emptying the `cars` array:

```
const cars = []; const root =
ReactDOM.createRoot(document.getElementById('root'));
root.render(<Garage cars={cars} />);
```

Ternary Operator

- Another way to conditionally render elements is by using a ternary operator.

```
condition ? true : false
```

- We will go back to the goal example.

- Return the `MadeGoal` component if `isGoal` is `true`, otherwise return the `MissedGoal` component:

```
function Goal(props) {
     const isGoal = props.isGoal;
     return (
          <>
               { isGoal ? <MadeGoal/> : <MissedGoal/> }
          </>
     );
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Goal isGoal={false} />);
```

React Lists

- In React, you will render lists with some type of loop.
- The JavaScript `map()` array method is generally the preferred method.
- If you need a refresher on the `map()` method, check out the ES6 section.

Let's render all of the cars from our garage:

```
function Car(props) {
     return <li>I am a { props.brand }</li>;
}
function Garage() {
     const cars = ['Ford', 'BMW', 'Audi’];
     return (
          <>
               <h1>Who lives in my garage?</h1>
               <ul>
                    {cars.map((car) => <Car brand={car} />)}
               </ul>
          </>
     );
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Garage />);
```

- When you run this code in your `create-react-app`, it will work but you will receive a warning that there is no "key" provided for the list items.

Keys

- Keys allow React to keep track of elements. This way, if an item is updated or removed, only that item will be re-rendered instead of the entire list.
- Keys need to be unique to each sibling. But they can be duplicated globally.
- Generally, the key should be a unique ID assigned to each item. As a last resort, you can use the array index as a key.

Let's refactor our previous example to include keys:

```
function Car(props) {
    return <li>I am a { props.brand }</li>;
}
function Garage() {
    const cars = [ {id: 1, brand: 'Ford'}, {id: 2, brand: 'BMW'}, {id: 3, brand: 'Audi'} ];
    return (
        <>
            <h1>Who lives in my garage?</h1>
            <ul> {cars.map((car) => <Car key={car.id} brand={car.brand} />)} </ul>
        </>
    );
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Garage />);
```

Adding Forms in React

- You add a form with React like any other element:

Add a form that allows users to enter their name:

```
function MyForm() {
    return ( <form> <label>Enter your name: <input type="text" /> </label> </form> )
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<MyForm />);
```

- This will work as normal, the form will submit and the page will refresh.
- But this is generally not what we want to happen in React.
- We want to prevent this default behavior and let React control the form.

Handling Forms

- Handling forms is about how you handle the data when it changes value or gets submitted.
- In HTML, form data is usually handled by the DOM.
- In React, form data is usually handled by the components.
- When the data is handled by the components, all the data is stored in the component state.
- You can control changes by adding event handlers in the `onChange` attribute.
- We can use the `useState` Hook to keep track of each inputs value and provide a "single source of truth" for the entire application.
- See the React Hooks section for more information on Hooks.

Use the useState Hook to manage the input:

```
import { useState } from 'react’;
import ReactDOM from 'react-dom/client’;
function MyForm() {
     const [name, setName] = useState("");
     return (
          <form>
               <label>Enter your name: <input type="text" value={name} onChange={(e) => setName(e.target.value)} />
               </label>
          </form>
     )
}
const root = ReactDOM.createRoot(document.getElementById('root’));
root.render(<MyForm />);
```

Submitting Forms

- You can control the submit action by adding an event handler in the `onSubmit` attribute for the `<form>`:

Add a submit button and an event handler in the onSubmit attribute:

```
import { useState } from 'react’;
import ReactDOM from 'react-dom/client’;

function MyForm() {
     const [name, setName] = useState("");
     const handleSubmit = (event) => {
          event.preventDefault();
          alert(`The name you entered was: ${name}`)
     }
     return (
          <form onSubmit={handleSubmit}>
               <label>
                    Enter your name:
                    <input type="text" value={name} onChange={(e) => setName(e.target.value)} />
               </label>
               <input type="submit" />
          </form>
     )
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<MyForm />);
```

Multiple Input Fields

- Write a form with two input fields:

```
import { useState } from 'react';
import ReactDOM from 'react-dom/client';
function MyForm() {
     const [inputs, setInputs] = useState({});
     const handleChange = (event) => {
          const name = event.target.name;
          const value = event.target.value;
          setInputs(values => ({...values, [name]: value}))
     }
     const handleSubmit = (event) => {
          event.preventDefault();
          alert(inputs);
     }
     return (
          <form onSubmit={handleSubmit}>
               <label>
                    Enter your name:
                    <input type="text" name="username" value={inputs.username || ""} onChange={handleChange}
                    />
               </label>
               <label>
                    Enter your age:
                    <input type="number" name="age" value={inputs.age || ""} onChange={handleChange} />
               </label>
               <input type="submit" />
          </form>
     )
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<MyForm />);
```

- You can control the values of more than one input field by adding a `name` attribute to each element.
- We will initialize our state with an empty object.
- To access the fields in the event handler use the `event.target.name` and `event.target.value` syntax.
- To update the state, use square brackets [bracket notation] around the property name.

- **Note:** We use the same event handler function for both input fields, we could write one event handler for each, but this gives us much cleaner code and is the preferred way in React.

Textarea

- The textarea element in React is slightly different from ordinary HTML.
- In HTML the value of a textarea was the text between the start tag `<textarea>` and the end tag `</textarea>`.

```
<textarea> Content of the textarea. </textarea>
```

- In React the value of a textarea is placed in a value attribute. We'll use the `useState` Hook to mange the value of the textarea:

A simple textarea with some content:

```
import { useState } from 'react’;
import ReactDOM from 'react-dom/client’;
function MyForm() {
     const [textarea, setTextarea] = useState( "The content of a textarea goes in the value attribute" );
     const handleChange = (event) => {
          setTextarea(event.target.value)
     }
     return (
          <form>
               <textarea value={textarea} onChange={handleChange} />
          </form>
     )
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<MyForm />);
```

Select

- A drop down list, or a select box, in React is also a bit different from HTML.
- in HTML, the selected value in the drop down list was defined with the `selected` attribute:

HTML:

```
<select> <option value="Ford">Ford</option> <option
value="Volvo" selected>Volvo</option> <option
value="Fiat">Fiat</option> </select>
```

- In React, the selected value is defined with a `value` attribute on the `select` tag:

A simple select box, where the selected value "Volvo" is initialized in the constructor:

```
function MyForm() {
     const [myCar, setMyCar] = useState("Volvo");
     const handleChange = (event) => { setMyCar(event.target.value) }
     return (
          <form>
               <select value={myCar} onChange={handleChange}>
                    <option value="Ford">Ford</option>
                    <option value="Volvo">Volvo</option>
                    <option value="Fiat">Fiat</option>
               </select>
          </form>
     )
}
```

- By making these slight changes to `<textarea>` and `<select>`, React is able to handle all input elements in the same way.

React Router

- Create React App doesn't include page routing.
- React Router is the most popular solution.

Add React Router

- To add React Router in your application, run this in the terminal from the root directory of the application:

```
npm i -D react-router-dom
```

- **Note:** This tutorial uses React Router v6.
- If you are upgrading from v5, you will need to use the @latest flag:

```
npm i -D react-router-dom@latest
```

Folder Structure

- To create an application with multiple page routes, let's first start with the file structure.
- Within the `src` folder, we'll create a folder named `pages` with several files:

  `src\pages\`:
  - `Layout.js`
  - `Home.js`
  - `Blogs.js`
  - `Contact.js`
  - `NoPage.js`
- Each file will contain a very basic React component.

Basic Usage

- Now we will use our Router in our `index.js` file.

Use React Router to route to pages based on URL:
index.js:

```
import ReactDOM from "react-dom/client";
import { BrowserRouter, Routes, Route } from "react-router-dom";
import Layout from "./pages/Layout";
import Home from "./pages/Home";
import Blogs from "./pages/Blogs";
import Contact from "./pages/Contact";
import NoPage from "./pages/NoPage";
export default function App() {
    return (
        <BrowserRouter>
            <Routes>
                <Route path="/" element={<Layout />}>
                    <Route index element={<Home />} />
                    <Route path="blogs" element={<Blogs />} />
                    <Route path="contact" element={<Contact />} />
                    <Route path="*" element={<NoPage />} />
                </Route>
            </Routes>
        </BrowserRouter>
    );
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<App />);
```

Example Explained

- We wrap our content first with `<BrowserRouter>`.
- Then we define our `<Routes>`. An application can have multiple `<Routes>`. Our basic example only uses one.
- `<Route>`s can be nested. The first `<Route>` has a path of `/` and renders the `Layout` component.
- The nested `<Route>`s inherit and add to the parent route. So the `blogs` path is combined with the parent and becomes `/blogs`.
- The `Home` component route does not have a path but has an `index` attribute. That specifies this route as the default route for the parent route, which is `/`.
- Setting the `path` to `*` will act as a catch-all for any undefined URLs. This is great for a 404 error page.

Pages / Components

- The Layout component has <Outlet> and <Link> elements.
- The <Outlet> renders the current route selected.
- <Link> is used to set the URL and keep track of browsing history.
- Anytime we link to an internal path, we will use <Link> instead of <a href="">.
- The "layout route" is a shared component that inserts common content on all pages, such as a navigation menu.

```
Layout.js:
import { Outlet, Link } from "react-router-dom";
const Layout = () => {
    return (
        <>
            <nav>
                <ul>
                    <li> <Link to="/">Home</Link> </li>
                    <li> <Link to="/blogs">Blogs</Link> </li>
                    <li> <Link to="/contact">Contact</Link> </li>
                </ul>
            </nav>
            <Outlet />
        </>
    )
};
export default Layout;
```

```
Home.js:
const Home = () => {
return <h1>Home</h1>;
};
export default Home;
```

```
Blogs.js:
const Blogs = () => {
return <h1>Blog Articles</h1>;
};
export default Blogs;
```

```
Contact.js:
const Contact = () => {
return <h1>Contact Me</h1>;
};
export default Contact;
```

```
NoPage.js:
const NoPage = () => {
return <h1>404</h1>;
};
export default NoPage;
```

React Memo

- Using `memo` will cause React to skip rendering a component if its props have not changed.
- This can improve performance.

Problem

- In this example, the `Todos` component re-renders even when the todos have not changed.

`index.js`:

```
import { useState } from "react";
import ReactDOM from "react-dom/client";
import Todos from "./Todos";
const App = () => {
     const [count, setCount] = useState(0);
     const [todos, setTodos] = useState(["todo 1", "todo 2"]);
     const increment = () => {
          setCount((c) => c + 1);
     };
     return (
          <>
               <Todos todos={todos} /> <hr />
               <div>
                    Count: {count}<button onClick={increment}>+</button>
               </div>
          </>
     );
};
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<App />);
```

`Todos.js`:

```
const Todos = ({ todos }) => {
     console.log("child render");
     return (
          <>
            <h2>My Todos</h2>
               {todos.map((todo, index) => {
                    return <p key={index}>{todo}</p>;
               })}
          </>
     );
};
 export default Todos;
```

- When you click the increment button, the `Todos` component re-renders.
- If this component was complex, it could cause performance issues.

Solution

- To fix this, we can use memo.
- Use memoto keep the Todos component from needlessly re-rendering.
- Wrap the Todos component export in memo:

index.js:

```
import { useState } from "react";
import ReactDOM from "react-dom/client";
import Todos from "./Todos";
const App = () => {
    const [count, setCount] = useState(0);
    const [todos, setTodos] = useState(["todo 1", "todo 2"]);
    const increment = () => {
        setCount((c) => c + 1);
    };
    return (
        <>
            <Todos todos={todos} /> <hr />
            <div>
                Count: {count}
                <button onClick={increment}>+</button>
            </div>
        </>
    );
};
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<App />);
```

Todos.js:

```
import { memo } from "react";
const Todos = ({ todos }) => {
    console.log("child render");
    return (
        <>
            <h2>My Todos</h2>
            {todos.map((todo, index) => {
                return <p key={index}>{todo}</p>;
            })}
        </>
    );
};
export default memo(Todos);
```

- Now the Todos component only re-renders when the todos that are passed to it through props are updated.

Styling React Using CSS

- There are many ways to style React with CSS, this tutorial will take a closer look at three common ways:
  - Inline styling
  - CSS stylesheets
  - CSS Modules

Inline Styling

- To style an element with the inline style attribute, the value must be a JavaScript object:

Insert an object with the styling information:

```
const Header = () => {
    return (
        <>
            <h1 style={{color: "red"}}>Hello Style!</h1>
            <p>Add a little style!</p>
        </>
    );
}
```

Note: In JSX, JavaScript expressions are written inside curly braces, and since JavaScript objects also use curly braces, the styling in the example above is written inside two sets of curly braces `{{}}`.

camelCased Property Names

- Since the inline CSS is written in a JavaScript object, properties with hyphen separators, like `background-color`, must be written with camel case syntax:

Use `backgroundColor` instead of `background-color`:

```
const Header = () => {
    return (
        <>
            <h1 style={{backgroundColor: "lightblue"}}>Hello Style!</h1>
            <p>Add a little style!</p>
        </>
    );
}
```

JavaScript Object

- You can also create an object with styling information, and refer to it in the style attribute:

Create a style object named `myStyle`:

```
const Header = () => {
     const myStyle = {
          color: "white",
          backgroundColor: "DodgerBlue",
          padding: "10px",
          fontFamily: "Sans-Serif"
     };
     return (
          <>
               <h1 style={myStyle}>Hello Style!</h1>
               <p>Add a little style!</p>
          </>
     );
}
```

CSS Stylesheet

- You can write your CSS styling in a separate file, just save the file with the `.css` file extension, and import it in your application.

App.css:
Create a new file called "App.css" and insert some CSS code in it:

```
body {
     background-color: #282c34;
     color: white;
     padding: 40px;
     font-family: Sans-Serif;
     text-align: center;
}
```

- **Note:** You can call the file whatever you like, just remember the correct file extension.

Import the stylesheet in your application:

index.js:

```
import React from 'react’;
import ReactDOM from 'react-dom/client’;
import './App.css’;
const Header = () => {
     return (
          <>
               <h1>Hello Style!</h1>
               <p>Add a little style!.</p>
          </>
     );
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Header />);
```

CSS Modules

- Another way of adding styles to your application is to use CSS Modules.
- CSS Modules are convenient for components that are placed in separate files.
- The CSS inside a module is available only for the component that imported it, and you do not have to worry about name conflicts.
- Create the CSS module with the `.module.css` extension, example: `my-style.module.css`.

Create a new file called "my-style.module.css" and insert some CSS code in it:

my-style.module.css:

```css
.bigblue {
     color: DodgerBlue;
     padding: 40px;
     font-family: Sans-Serif;
     text-align: center;
}
```

Import the stylesheet in your component:

Car.js:

```js
import styles from './my-style.module.css’;
const Car = () => {
     return <h1 className={styles.bigblue}>Hello Car!</h1>;
}
export default Car;
```

Import the component in your application:

index.js:

```js
import ReactDOM from 'react-dom/client’;
import Car from './Car.js'; const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Car />);
```

What is Sass

- Sass is a CSS pre-processor.
- Sass files are executed on the server and sends CSS to the browser.
- You can learn more about Sass in our Sass Tutorial.

Can I use Sass?

- If you use the `create-react-app` in your project, you can easily install and use Sass in your React projects.
- Install Sass by running this command in your terminal:

```
>npm i sass
```

Create a Sass file

- Create a Sass file the same way as you create CSS files, but Sass files have the file extension `.scss`
- In Sass files you can use variables and other Sass functions:

my-sass.scss:

Create a variable to define the color of the text:

```
$myColor: red;
h1 {
     color: $myColor;
}
```

Import the Sass file the same way as you imported a CSS file:

index.js:

```
import React from 'react’;
import ReactDOM from 'react-dom/client’;
import './my-sass.scss’;
const Header = () => {
     return (
          <>
               <h1>Hello Style!</h1>
               <p>Add a little style!.</p>
          </>
     );
}
const root = ReactDOM.createRoot(document.getElementById('root'));
root.render(<Header />);
```