The beginners

GUIDE TO REACT & REDUX

The Complete React Web Development Course (with Redux)

Section 1

REACT 101

- Install Visual Studio Code
- Install Node.js
- Setting up a Web Server
- Setting Up Babel
- Exploring JSX & JSX Expressions
- ES6 Variables & Arrow Functions
- Events & Attributes
- Manual Data Binding
- Forms & Input
- Arrays in JSX

In this section we will dive into the very basic fundamentals of React and setting up your own web developer environment to write and execute your own code. We will go through installing a very popular text editor release by Microsoft called Visual Studio Code to installing Node.js on your machine and then onto setting up your very own local web server and installing Babel.

Once we have setup your developer environment we will continue to learn the fundamentals of JavaScript (ES6) and JSX syntax to build our foundational skills on both languages and technologies on which the React Library is built upon.

After learning the basics we will move onto the next sections where we will start learning more about the React component architecture and will build our own applications.

It will soon become apparent why React is considered a very popular frontend JavaScript library as you are not required to learn a new language but rather learn an application architecture based on components.

INSTALLING VISUAL STUDIO CODE

There are many free and paid text editors out there available to download and use to write your own code, popular editors include Atom, Sublime Text, Notepad++ and Visual Studio Code to name a few. We will be using Visual Studio code as our text editor of choice to write our code as it allows us to install some useful packages to help write our code.

To install Visual Studio code simply visit the following website and download and install the application onto your machine: https://code.visualstudio.com/

Visual Studio Code has some useful extensions which you can install:

- Bracket Pair Colorizer
- ES7 React/Redux/GraphQL/React-Native Snippet
- Liver Server
- Prettier - Code Formatter
- Babel ES6/ES7

INSTALLING NODE.JS

Node is JavaScript on the server. You can visit the following website to download node onto your machine: https://nodejs.org/en/

Download the latest version of node that is available on their website.

To check that you have node.js installed on your machine, simply open up your terminal and enter the following command:

$ node –v

This will allow us to double check that node was installed onto our machine as we now have this new command and it also shows us what version of node you have installed on your machine. When installing node we also got NPM (node package manager) which allows us to install various dependencies/packages such as React or Yarn and other libraries. NPM and Yarn aims to do the same job. To check that you have npm installed enter the following command in your terminal:

$ nom –v

To install yarn on your machine globally run the following command in your terminal:

$ npm install –g yarn

On windows machines you will need to restart your machine to complete the installation. To check that yarn has installed successfully, run the following code in your terminal:

$ yarn ––version

SETTING UP A WEB SERVER

To setup a developer web server we can achieve this in two ways using live-server.

Firstly you will need to create a directory (folder) for your application. This folder will act as a place for all your project code. This folder can be called anything for example 'indecision-app'. In this example we will create a sub-folder called public and store our basic HTML file.

If we open VS Code and have installed live-server extension we can simply open up our html document and right-click to open the file with live-server. Every-time we update our project files in the folder, the live-server will refresh the browser which will update our application with the changes automatically.

Alternatively, we can use npm or yarn to install live-server globally onto our machines using either command in the terminal:

$ npm install –g live-server   or $ yarn global add live-server

To check that we have installed live-server on our machine correctly we would run the command:

$ live-server –v

To run live server from the terminal, navigate to your file directory using cd and the file path. Note: you can use **cd** to change directory, **ls** (or **dir** on windows) to list all the files within the folder. You can use **cd ~** to navigate back to your user folder. Once you have navigated to your project directory run the following code:

$ live-server public

Note: you would run live-server followed by the folder name in the directory you wish to serve through the live web server (in our example we had a sub-folder called public which contained our HTML file). Any changes made in the folder will automatically update in the browser.

SETTING UP BABEL

Babel is a compiler and allows you to write for example JSX, ES6, ES7 code and have it compile down to regular ES5 code, allowing your code to work on browsers which only support ES5 syntax.

https://babeljs.io/

Babel on its own has no functionality. Babel is a compiler but its not going to compile anything by default. We have to add various plugins and presets in order to get any sort of change in our code (e.g. taking JSX code and converting it into ES5 createElement calls). A preset is just a group of plugins.

We are going to install babel locally on our machines so that when we write our code in JSX/ES6/ES7 it will compile locally to our ES5 code (i.e. we want to write our code locally on our machine and update without using Babel on the web).

The babel website has a docs page which provide documentation on plugins available to you to install. We will install two presets: react preset and env preset. These presets have all the necessary plugins we require and we would not need to install the plugins individually by ourselves (*as this could get out of hand very quickly*). The env preset will include ES2015, ES2016 and ES2017 plugins which will give us access to the new JavaScript features (e.g. arrow functions, const and let variables, spread operator etc).

In our local environment we are going to install three things:
Babel itself, env preset and react preset.

In your terminal run the following command to install babel @v6.24.1 globally on your machine.

$ npm install –g babel-cli@6.24.1 or $yarn global add babel-cli@6.24.1

This will give us a new command in our terminal which we can run while in our project directory. Run the following code to check if Babel has been installed successfully. This should print out the help output in your terminal and will indicate if Babel has been installed successfully on your local machine.

$ babel −−help

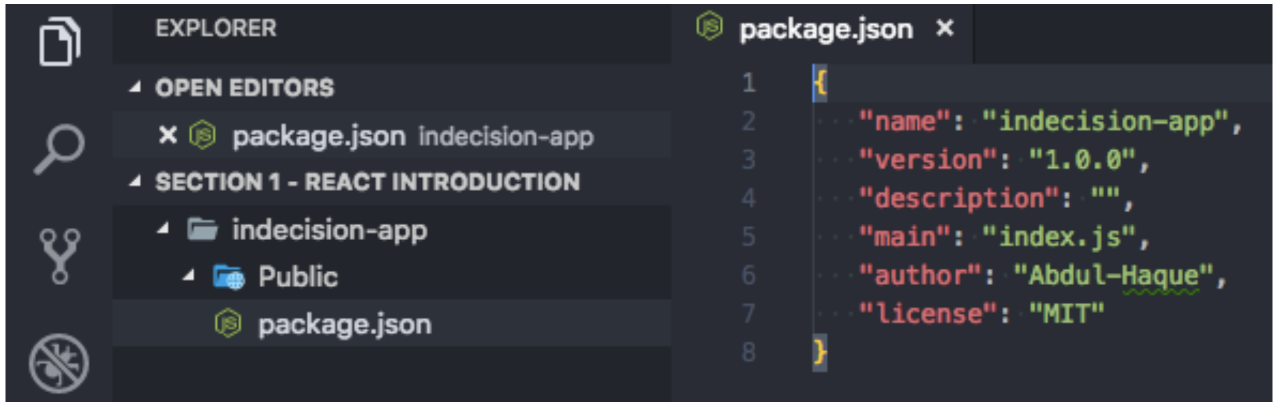
To clear the terminal enter the command line:

$ clear

The react and env presets will be installed locally in our projects (i.e. these codes will live in our projects so that babel CLI can take advantage of these codes to transform our code down to ES5 syntax). Within the project directory enter the following command:

$ npm init   or $ yarn init

This command will setup our project to use node/yarn and specify the local dependencies. This will walk us through series of questions such as the app name, version, description, entry point, repository, author and license (MIT).
All this does is, it generates a brand new file in our project called package.json (*note we could have created this file ourselves without the npm/yarn init command*). The whole point of package.json is to outline all the dependencies that the project needs in order to run. This will make it easy to install everything.

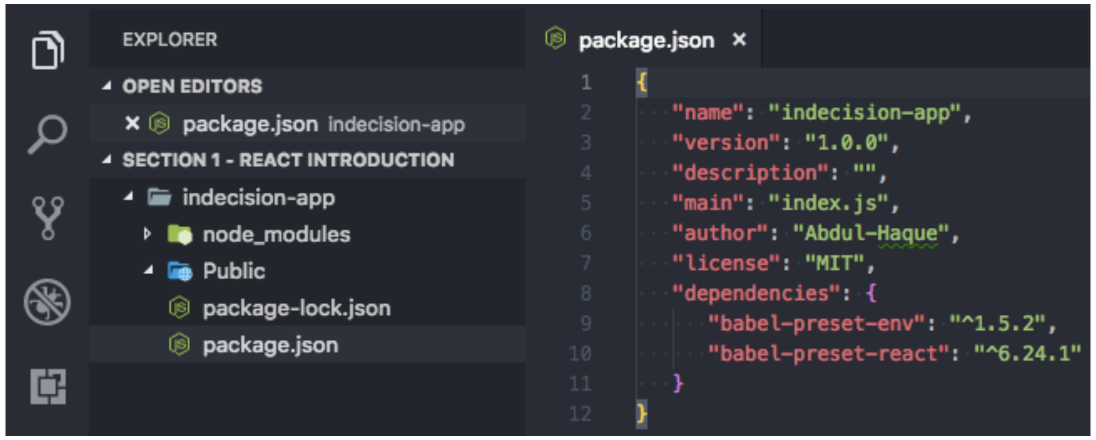


We are going to add our dependencies to this package.json file using the following commands in the terminal:

$ npm install babel-preset-react@6.24.1 babel-preset-env@1.5.2   or

$ yarn add babel-preset-react@6.24.1 babel-preset-env@1.5.2

This will install the two dependencies and will update the package.json file in our app folder which will now list our dependencies for our app. Notice that a new folder has been created called node_modules. This is where all the modules and dependencies will live.



The dependencies will have their own package.json file which will list the dependencies they require to run. This will install the all the sub-dependencies of their own in the node_modules folder. The package.json file makes it easy to install all the dependencies and sub-dependencies your application will need.

We will never need to go into the node_modules folder to change any of the code. This folder is a auto-generated folder from the package.json file and we can always delete and reinstall this folder/modules using the dependencies information from the package.json file (*we would use the command $ npm install or $ yarn install to install the node_modules folder again*).

This command has also generated a package-lock.json file (*if you used yarn this file will be called yarn.lock*) in our project folder. We will not need to edit/manually change this file. This file lists out all the dependencies in the node_module folder, the version used and where exactly it got that package from. This helps npm/yarn behind the scenes.

We are now able to use Babel locally on our machines within our project directory to compile our React JSX code into regular ES2015 code. In the terminal we will need to run the following command with a few arguments:

$ babel src/app.js ––out–file=public/scripts/app.js ––presets=env, react ––watch

The first argument specifies the path to our code we wan to compile (*in our example above it lives in the src folder and the file is called app.js*).
The second argument specifies the output file (in our example above it lives in the public/scripts folder and is also called app.js). This file will always be overridden by Babel.
The third argument specifies the presets we would like to use (this is a *comma separated list of the presets we wish to use*).
Finally, the last argument will watch for any changes in the first specified file to update (compile) the second specified file automatically.

Babel will compile the JSX/ES6/ES7 code in one file into regular ES2015 code the browser will understand in the other file.

EXPLORING JSX

In JSX you can only have a single root element. If you want to add more elements side by side we will need to wrap it within a single root element for example:

```
var template = <div><h1 id="someid">Header Text</h1><p>Paragraph Text</p></div>;

var appRoot = document.getElementById('app');

ReactDOM.render(template, appRoot);
```

When we are creating JSX expressions, we can get really complex expressions to include a lot of information/nested elements - however, we must have a single root element.

We can make our JSX expression more readable by formatting the elements on separate lines i.e. format as we would do in our html code for example:

```
var template = (
    <div>
        <h1 id="someid">Header Text</h1>
        <p>Paragraph Text</p>
    </div>
);
```

The above would still be seen as valid JSX expression and table will successfully render the expression down to ES2015.

The above is more readable to the eye and easily understood. We can make the expression even more complex and as long as there is a single parent root element (the <div> wrapper) then this will be seen by Babel as valid JSX. Below is another example of a complex JSX expression with nested elements.

```
var template = (
    <div>
        <h1 id="someid">Header Text</h1>
        <p>Paragraph Text</p>
        <ol>
            <li>Item One</li>
            <li>Item Two</li>
        </ol>
    </div>
);
```

All this is doing is creating nested React.createElement() functions calls to create each element in the ES2015 syntax.

```
    React.createElement('ol', null,
        React.createElement('li', null, 'Item One'),
        React.createElement('li', null, 'Item Two')
    )
```

This is why we do not write our React code in React.createElement calls as it is difficult to read and write, instead we use JSX.

We can make our JSX code dynamic by using variables to store data and then referencing these variables within our JSX expressions. For Example:

```
var userName = 'John Doe';

var template = (

    <div>

        <h1> { userName .toUpperCase()} </h1>

    </div>
```

We use the curly brackets to write any JavaScript expressions. Therefore we can enter the JavaScript variable within the curly braces to output the variable value in our JSX code. This allows our JSX to be dynamic rather than static.

In our JavaScript expressions we can use different types such as strings, numbers, operators, arrays, objects, functions etc. To render an object in React we must specify the object property, for example:

```
var user { name: 'John Doe',   age: 28,   location: 'Derby' } ;

var template = (

    <div>

        <h1> Name: { user.name } </h1>

        <h1> Age: { user.age } </h1>

        <h1> Location: { user.location } </h1>

    </div>

);
```

We have now dynamically injected our data from our variables into our JSX expression.

We should now have knowledge on how to use JavaScript expression in React, how to render JavaScript strings and number types and that we cannot render object but we can render the object properties.

There are still many more other JavaScript types. We are going to continue to look at JavaScript expressions and how we can make truly dynamic and useful JSX.

Conditional Rendering and conditional logic in general is at the very core of software development. The same will be true for our React interfaces for example, is the user logged into the app? If true, then show the logout button, else show the login button.

To perform Conditional rendering in our JSX we will need to use JavaScript expressions. We can continue using the regular conditional statements we have been using in vanilla JavaScript and do not need to learn any weird syntax.

The conditional JavaScript tools that are available are:
1) If Statements.
2) Ternary operators.
3) Logical and operator.

IF STATEMENTS:
A if statement is not an expression and therefore cannot live inside the curly brackets (i.e. JavaScript expression). However, calling a function is an expression. We can add whatever we want in our function including if statements. The return value from the function will show up in the JSX. For example:

```
var user = {
    user: 'John Doe',
    age: 28,
    location: 'Derby'
}
```

```
function getLocation(){
    if (location) {
        return location;
    } else {
        return 'unknown';
    }
};
var template = (
    <div> <h1> { getLocation(user.location) } </h1> </div>
) ;
```

We can use the function to operate the if statement and whatever is returned from our function can be used in our JavaScript expression to pass the data into our JSX to display.

We can use other JSX expression such as {123} and {<h3>Heading 3</h3>} and this will render in our browser. This is equivalent to writing JSX expression outside of the curly brackets. This is useful as it allows us to setup getLocation() to return a separate JSX expression. For example:

```
function getLocation(){
    if (location) {
        <h1> { getLocation(user.location) } </h1>
    } else {
```

```
        return undefined;
    }
};
var template = (
    <div> { getLocation(user.location) } </div>
) ;
```

Important Note: undefined is implicitly returned if you do not explicitly return it. Therefore the above getLocation() function can be simplified without returning the else statements:

```
function getLocation(){
    if (location) {
        <h1> { getLocation(user.location) } </h1>
    }
};
```

This will implicitly return undefined when the statement returns false. If the Statement returns true this will return the JSX expression value within the other JSX expression curly brackets. This will then render in our browser.

TERNARY OPERATORS:
A ternary operator is a expression and not a statement and therefore we do not need to add it to a function. A ternary operator allows us to write if statements more concisely. For example:

```
True ? ‘Return True’ :  ' Return False’;                    [This will return ‘Return True’ as the statement is true]
```

False ? ‘Return True’ : ' Return False’;   [This will return ‘Return False’ as the statement is false]

These two ternary operator will check whether the statement is true or false. If true it will return the first value else it will return the false value. Therefore the first example will return ‘Return True’ while the second example will return ‘Return False’. We use the ? to return something when the statement equates to true while we use the : to return something when the statement equates to false.

The first part of the ternary operator is the statement we wish to check the value i.e. whether it will return true or false. Depending on the answer we want to return the first value else we return the second value. For example:

```
{ app.option.length >0 ? <p>’Here are your options’</p> : <p>’No options’</p> }
```

LOGICAL AND OPERATOR:

Much like the undefined, null and the boolean values true and false are all ignored by JSX. Therefore we can write a JSX expression of {true}, {false}, {null} or {undefined} and all will be ignored by JSX and will not be rendered on the screen. This is a very useful feature.

If we want to display a JSX expression e.g. <p> tag for age, only if the user is 18yrs or older else we do not want to display the age of the use if they are under age. We could use the function technique, however, we are going to explore this new technique which is just as concise as the ternary operator.

The Logical And Operator uses the && to check if two arguments returns true to run the code. If both do not return true we do not want to run the code. We will examine the Logical AND Operator to understand the technique and how it can be used to solve the above problem without using to the function technique.

```
true && ‘Some Age’;
```

If we run the above, this will return the value ‘Some Age’. So in Logical And Operator if the first value is true it is not going to use/return that first value; however, if the second value is also true it will use/return the second value.

```
False && 'Some Age';
```

If we now run the above, this will return false. So in this instance, where the first value is false, that value is what actually gets used/returned and ignores the second value ever exists.

Therefore if we check for age and the user is below 18 a boolean (false) is returned and this is ignored by JSX. We can use this tools and technique to add this conditional rendering in our JSX.

The ternary function is great for when you want to do one of two things, while the Logical And Operator is useful for when you want a condition to do one thing else you want to do nothing at all.

We can make our Logical And Operator even more complex by checking two things in our first value to equate to true or false for example we can check if the age exists at all and is above 18 to return our JSX. For example:

```
{ (user.age && user.age >=18) && <p>Age: { user.age } </p> }
```

We have now explored the very basics of conditional rendering techniques we will use over and over again. Eventually, over time and lots of practice, we will eventually master all three strategies. However, we should now be confident of being able to make our JSX expressions more dynamic.

ES6 ASIDE: LET & CONST

ES6 introduces let and const variables keywords which are alternatives to the var variable keyword. Is there anything inherently broken with var? No. The only problem with var is that it can be easily misused creating unnecessarily weird situations. For example: not only can you reassign a var variable but you can also redefine the variable. This means if recreate a var variable without knowing that you have created it elsewhere in your code, you are essentially overriding the original variable value and therefore you will run into hard to debug issues.

```
var nameVar = 'John Doe';

var nameVar = 'Mike';
```

The let and const variables prevents you from reassigning/redefining existing variables.

The let variable allows you to reassign the variable however you cannot redefine the variable (i.e. you cannot redeclare the same variable. You can however reassign it to another type e.g. a string to a number).

```
let nameLet =  'John Doe';

let nameLet = 'Mike';            > Uncaught SyntaxError: Identifier 'nameLet' has already been declared at...
```

The const variable does not allow you to reassign nor redefine the variable again.

```
const nameConst = 'Frank';

const nameConst = 'Barry';       > Uncaught SyntaxError: Identifier 'nameLet' has already been declared at...

nameConst = 'Barry';             > Uncaught TypeError: Assignment to content variable at...
```

By default you should always use the const variable when creating a new variable, however, if you need to reassign the variable then you should switch to the let variable instead. You should stop using the var variable.

There are a few other differences between var, let and const variables i.e. the scoping of the variables are also different.

The var, let and const variable are all function–scoped meaning that the variable within the function cannot be accessed outside the function.

```
function getName(){
    name = 'Paul';
}
getName();
console.log(name);          > Uncaught ReferenceError: name is not defined at...
```

Note: we could create the variable called name outside the function and set the value to the function which will work.

The let and const variables are all block-scoped whereas var is not. Bock Scoping is where the variable are also bound to the code block (e.g. the code block for an if statement or a code block for a for loop). For example: if we had a variable in an if statement this variable can be accessible outside this code block provided this variable uses var instead of let and const.

```
const fullName = 'John Doe';
If(fullName) {
    const firstName = fullName.split(' ');
}
console.log(firstName)          > Uncaught ReferenceError: name is not defined at...
```

Remember the rule: '*const first; if we need to reassign, let; … var never!*'

ES6 ASIDE: ARROW FUNCTIONS

Arrow functions is a new ES6 syntax and is used heavily throughout React, therefore, it is important to have a basic grasp of how arrow functions operate.

We are going to compare and contrast a regular ES2015 function with a ES6 Function. The function we are going to create will square a number.

ES2015 Regular Function Syntax:

```
const square = function(x) {
    return x * x;
};
console.log(square(5));
```

ES6 Arrow Function Syntax:

```
const square =  (x) => {
    return x * x
};
```

Arrow functions do not need the function keyword. We start with the function argument(s) followed by an arrow and then the function body.

Arrow functions are always anonymous (*unlike ES2015 functions where we can give the function a name*). To give an arrow function a name we must always declare a const or let variable first and assign the arrow function to it as we did above. Example of ES2015 Function with a Name:

```
function square (x) {

     return x* x;

};

console.log(square(5));
```

If an arrow function body returns only a single expression we can use the new syntax. We no longer require the curly brackets. The expression is implicitly returned and therefore we do not need to write the return keyword (compared to the ES2015 syntax where we need to explicitly return):

```
const square = (x) => x * x
```

The argument object s and this keywords are no longer bound to the arrow function. This means that if you try to access the arguments, it is not going to work.

ES2015 Example:

```
const add = function (a, b) {

    console.log(arguments);

    return a + b;

};

console.log(add(1, 2, 3);
```

The arguments will have access to the 100 object even though this has not been defined in the function and is outside the function.

However this has gone away with arrow functions as we cannot access objects outside the arrow function.

```
const add = (a, b) => {
    console.log(arguments);
    return a + b;
};
console.log(add(1, 2, 3)        > Uncaught ReferenceError: argument is not defined at…
```

In ES2015 when we use a regular functions and we define it on an object property, the this keyword is bound by that object e.g. we have access to the values for example:

```
const user = {
    name: 'John',
    cities: ['Bristol', 'Bath', 'Birmingham']
    printPlacesLived: function () {
        this.names;
        this.cities.forEach(function(city) {
            console.log(this.name + ' has lived in ' + city);
        });
    }
};
```

The forEach function takes in a single function as a parameter and will be called once for each item in the array with a single argument called city. However, this will return an error in the JavaScript console of Uncaught TypeError: Cannot read property 'name' of undefined at… This is because the this.name is not accessible inside the forEach function but is accessible in the printPlacesLived function which is and object inside of the user object. The past workaround was to create a const variable called that and assign the this value to it and then in the nested function use the that.name which will make the function work without causing the error message.

With arrow functions, they no longer bind their own values, instead they use the value of the context they were created in i.e. it would just use its parent 'this' value. We no longer require the ES2015 workaround.

```
const user = {
    name: 'John',
    cities: ['Bristol', 'Bath', 'Birmingham']
    printPlacesLived: function () {
        this.names;
        this.cities.forEach((city) => {
            console.log(this.name + ' has lived in ' + city);
        });
    }
};
```

There is no need for the const that = this workaround as arrow functions will use the value from the parent this keyword.

There are places where you would not want to use the arrow function for the very reason above such as methods for example if we turned the printPlacesLived method into an arrow function this will return and error message of Uncaught TypeError: Cannot read property 'name, cities' of undefined at… because the arrow function is no longer equal to the user object and will look to its parent level which is the global scope and therefore undefined causing the error.

ES6 does introduce a new method syntax where we can remove the ES2015 function keyword and have the above work.

```
    printPlacesLive() {…};
```

Map is an array method like the forEach() but it works a little differently. This function gets called one time for every item in the array. Just like the forEach we have access to the item via the first argument (e.g. we can call them city). The difference is that the forEach method just lets you do something each time e.g. print to the screen, whereas, the map allows you to actually transform each item and return a new item back. We can therefore transform our array and get a new array back.

```
const userMap = {
	name: 'Peter Parker',
	cities: ['New York', 'London', 'Rome']

	printPlacesLived() {
		return this.cities.map((city) => this.name + ' has live in ' + city);
	}
};
console.log(printPlacesLived());
```

This will return a new array object of ['Peter Parker has lived in New York', 'Peter Parker has lived in London', 'Peter Parker has lived in Rome']. Maps are used a lot in React development.

EVENTS & ATTRIBUTS

Responding to user interactions via events is at the core of all web apps.

Attributes sit within the opening tag of an html element for example id and class are attributes. The class attributes are used to add an identifier across multiple elements while id is a unique identifier.
However, in JSX some attributes remain the same while others have been renamed. An example of a renamed attribute is class which JSX refers to as className.

Regular HTML Attribute:
```
<div class='row'></div>
```

JSX HTML Attribute:
```
<div className='row'></div>
```

Certain keywords are reserved words in JavaScript such as let, const, class etc. and therefore certain HTML attributes required a name change in order to work with JSX. The React document page provides a full list of HTML attributes that have been renamed (scroll down to the All supported HTML Attributes section):
https://reactjs.org/docs/dom-elements.html

In JSX al the keywords have become camelCase for example autofocus is now autoFocus in JSX.

We would use the onClick attribute to create a function that would be run every time the button is clicked. We would reference the function within a JSX expression.

```
<button onClick={addOne}>Click Me</>
```

The function should be created elsewhere before the JSX expression i.e. define the function before calling it.

```
const addOne = () => {
    console.log('addOne');
};
```

This will display the addOne every time we click on the button which will indicate the function is being fired off every time the button is clicked. This allows us to create meaningful events for when the user interacts with our application but running functions.

Note we can add function inline with our JSX rather than separating the function out and this is perfectly viable, however, your code could end up looking unreadable. Good practice is to reference your function elsewhere and then call on that function within your JSX.

```
const template = {
    <button onClick={ () =>{
        console.log('addOne');
    } }></button>
}
```

We have now explored a little user interaction between the user and the React app.

MANUAL DATA BINDING

```
let count = 0;

count addOne = () => { count++ };

const template = (

	<div>

		<h1>Count: { count }</h1>

		<button onClick={addOne}>+1</button>

	<div>

);

const appRoot = document.getElementById('app');

ReactDOM.render(template, appRoot);
```

The above function will not update the count shown in the <h1> because the <h1> element has already been rendered to the screen and the application is not re-rendering to show the new count value.

JSX does not have built in data binding. When we create JSX, all the data that gets used inside of it, that happens at the time the code runs. Therefore, count is always going to be 0.

To fix this we need to rerun our template code and the ReactDOM.render function again when our data changes. We would use React Components to do that later on, but for now we will explore how to manually do this to understand how React works before we dive into React.

```
const renderCounterApp = () => {
    const template = (
        <div>
            <h1>Count: { count }</h1>
            <button onClick={addOne}>+1</button>
        <div>
    );
    ReactDOM.render(template, appRoot);
};
renderCounterApp();
```

With this new function renderCounterApp, this will render our application. We would want to initialise the function so that when we run our application for the very first time we would render the template to the screen. However, whenever we make changes to the data using event functions, we would want to call on that same function to re-render the template with the new data which allows our application to update in real-time.

This simple technique above illustrates exactly how React does this thing really well and we will look at the advanced techniques in more details later. It is important to understand that this is essentially what is happening behind the scenes in React.

React is actually very efficient behind the scenes as it does not re-render the whole application every time there is a change. React uses some virtualDOM algorithms in JavaScript to determine the minimal number of changes that needs to be made in order to correctly render the new application. Therefore, the whole application does not need to re-render which would be very taxing and make the application not scalable. Using ReactDOM.render we are getting all the capabilities of React and we are using the virtualDOM algorithm to efficiently render and re-render our application.

FORMS & INPUTS

The structure of forms will looks exactly the same as regular HTML, angular or any other templating frameworks. Forms are usually used to allow the user to input in information using the form and then doing something when the user submits the form. This allows applications to be more interactive. To create a form in html you will use a <form> tag and place everything you want in your form within these tags.

```
<form>
    <input type='text' name='identifier' />
    <button>Add Option</button>
</form>
```

The input tag has some attributes which remain the same as regular html. The type indicates the type of input field, while the name provides a unique identifier for the field which would allows us to collect the data from the input field when we listen for the form submission.

The above will create a textbook input field and a button. When we enter something in the input field and press the button this will refresh the page but add to the end of the url an ?option=input-field-value – for example if we used the text test and pressed the button our url would look something like:

http://127.0.0.1:5500/indecision-app/Public/index.html?option=test

We do not want to go through this method a full refresh of the page, that sort of technique is useful for older server side rendered applications. We want to handle the form submission on the client, we want to run some JavaScript code that pushes and item onto the array and re-renders the application. To do that we would need to setup an event handler for the form submission.

In the React documents there is a page on all the different event handlers we could use in our react application (*supported events: Form Events = onChange, onInput, onInvalid, onSubmit. These are the various event handlers for forms*): **https://reactjs.org/docs/events.html**

We would want to use the onSubmit event handler on our <form> tag. When we use the event handler we need to set it to a JavaScript expression where we want to reference a function we want to have fired when the event happens.

```
const onFormSubmit = (e) => {…}

<form onSubmit={ onFormSubmit } >

    <input type="text" name='option'>

</form>
```

When using event handler functions, we usually have access to an event (e) object that is passed in as a parameter within our event handler function. This event object holds various information and methods we can use. For forms we have a event object method which allows us to prevent the full page refresh when the user submits a form.

```
const onFormSubmit = (e) => {

    e.preventDefault();

} ;
```

In our onSubmit we want to reference the function but do not want to call the function because if we call the function it is equivalent to calling undefined.

<form onSubmit={ onFormSubmit } >…</form> make reference to the function and not call it.

~~<form onSubmit={ onFormSubmit() } >…</form>~~ using () at the end of the function will try to call it.

We can use the event object to call on the target.elements to have reference to all the elements from our form which are referenced by name. In the above example we can look at the input field with the name='option' and return the value.

```
e.target.elements.option.value
```

We can use the value and set it to a variable and then have our function to perform actions using that information.

```
const onFormSubmit = (e) => {
    e.preventDefault();
    const option = e.target.elements.option.value;

    if(option) {
        app.options.push(option);
        e.target.elements.option.value = '';
    };
};
```

Forms are a useful way of recording information from users of your application and then perform some sort of function using that information that is returned from the e event object, the above example takes the input field value and stores it in the app.options array object.

ARRAYS IN JSX

So far we know that JSX supports both strings and numbers, it does not support objects and it ignores booleans, null and undefined.

The good news is that JSX also supports arrays and it actually works with them really well. We would put the array in an JSX expression to render onto the screen.

```
{
    [98, 99, 100]
}
```

The above is the same as writing the JSX expression of:

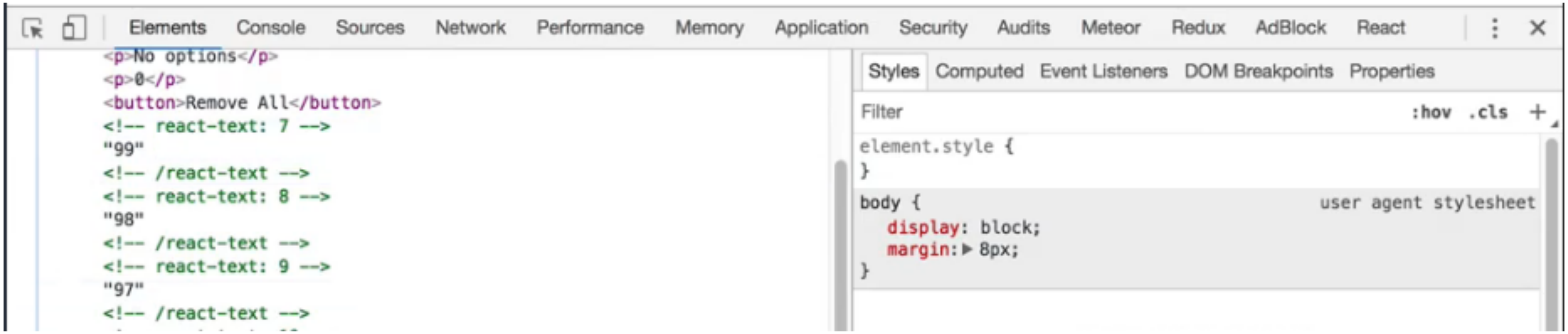
```
{98}{99}{100};
```

This will add each array item side by side which will display 9899100 in the browser. This is what is happening behind the scenes i.e. it is taking your array and breaking them our as individual JSX expression and is rendering them all to the screen. We know that numbers and strings will show up on the browser. Booleans, null and unidentified can also be used in arrays however they will not show up in the browser.

```
{
    [99, 98, 97, 'Mike', null, undefined, true, false]
}
```

We cannot use objects within arrays as they are not supported by JSX expressions.

If we inspect the developer tools in our browser and within the Elements tab, we can see exactly what gets rendered in the DOM for the array object. React creates various comments (react text nodes) for our array object, and this is how React keeps track of various items and where they are rendered inside the DOM. This also allows React to update an individual array item if the value changes as opposed to needing to update everything contained within the array. This makes React efficient when working with arrays.



We already know that we can render JSX within JSX for example:
{<p>Paragraph</p>}

Therefore, we can also render arrays of JSX.
{ [<p>a</p>, <p>b</p>, <p>c</p>] }

When we use JSX in arrays we are going to see a warning error of:
Warning: Each child in an array or iterator should have a unique "key" prop. Check the top–level render call using <div> see … for more information.

All we have to do in the JSX is to add in a key prop attribute which must be unique amongst the array.

{ [<p key='1'>a</p>, <p key='2'>b</p>, <p key='3'>c</p>] }

This allows React behind the scenes optimise the application using the key properties to monitor changes to each individual JSX so that only the changes value is re-rendered rather than the whole array.

We can use the map() function to loop through an array and return a new array items. This allows us to take the original array and and iterate through the items to create new JSX expression array items.

For example we have an array of numbers we want to use the map to iterate through the array to create JSX paragraph tags for each item in the array so that we can display each item in the array within in the browser.

```
const numbers = [50, 100, 150];

cost template = (

    {

        <div>

            numbers.map((x) => {

                return <p key={x}>Number: {x}</p>

            })

        <div>

    }

);
```

What this does it takes the numbers array and iterates through each item in the array. Each item will pass in as an argument called x and this value is used within our JSX to generate a paragraph tag for each item, essentially creating/rendering the html element for our application which will be rendered in the DOM:

```
<div>

    <p key=50>Number: 50</p>

    <p key=100>Number: 100</p>

    <p key=150>Number: 150</p>

<div>
```

SECTION ONE REVIEW

We have now covered the fundamentals of JSX. We started off knowing absolutely nothing about React and JSX, but we are now at a place where we can now build out a little application such as a task list and task selector app.

What we have learned:

- How to setup your environment and Babel.
- How JSX works.
- How to inject values in our JSX.
- Add conditional rendering.
- Setup event handlers e.g. form submits and button click and generate dynamic elements based off some application data.
- How to pre-render and re-render the UI to keep up to date with our app data.

Extra Knowledge/Tips:

We can make <button> elements disabled using the disabled attribute. If this is set to true then the button will be disabled and if set to false then the button will not be disabled. We can set the disabled attribute to a JSX expression which will allow our button to be disabled/not disabled based on a condition that can evaluate to true or false:

```
<button disabled={app.option.length ===0}></button>
```

This will evaluate to true if the options array is equal to zero, whereas if an item is added to the array then the JSX expression will evaluate to false. This will make the button act dynamically based on the application data.

Wrap up:

Now that we understand the fundamentals of JSX, in the next section we will look at the intermediate concept of React Components.

Section 2

REACT COMPONENT

- Thinking in React
- ES6 Classes
- Creating a React Component
- Nesting Components
- Component Props
- Events & Methods
- Component State
- Props vs State

In this section we are going to learn all about React Components.

React components allows us to break up our application into small reusable chunks. Each little component has its own set of JSX that it renders to the browser screen, it can handle events for those JSX elements and it allows us to create these little self-contained units.

At the end of this section we should be able to think in React for our application and be able to create our own React Components. We are also going to analyse the difference between Component Props and State and when we would use them.

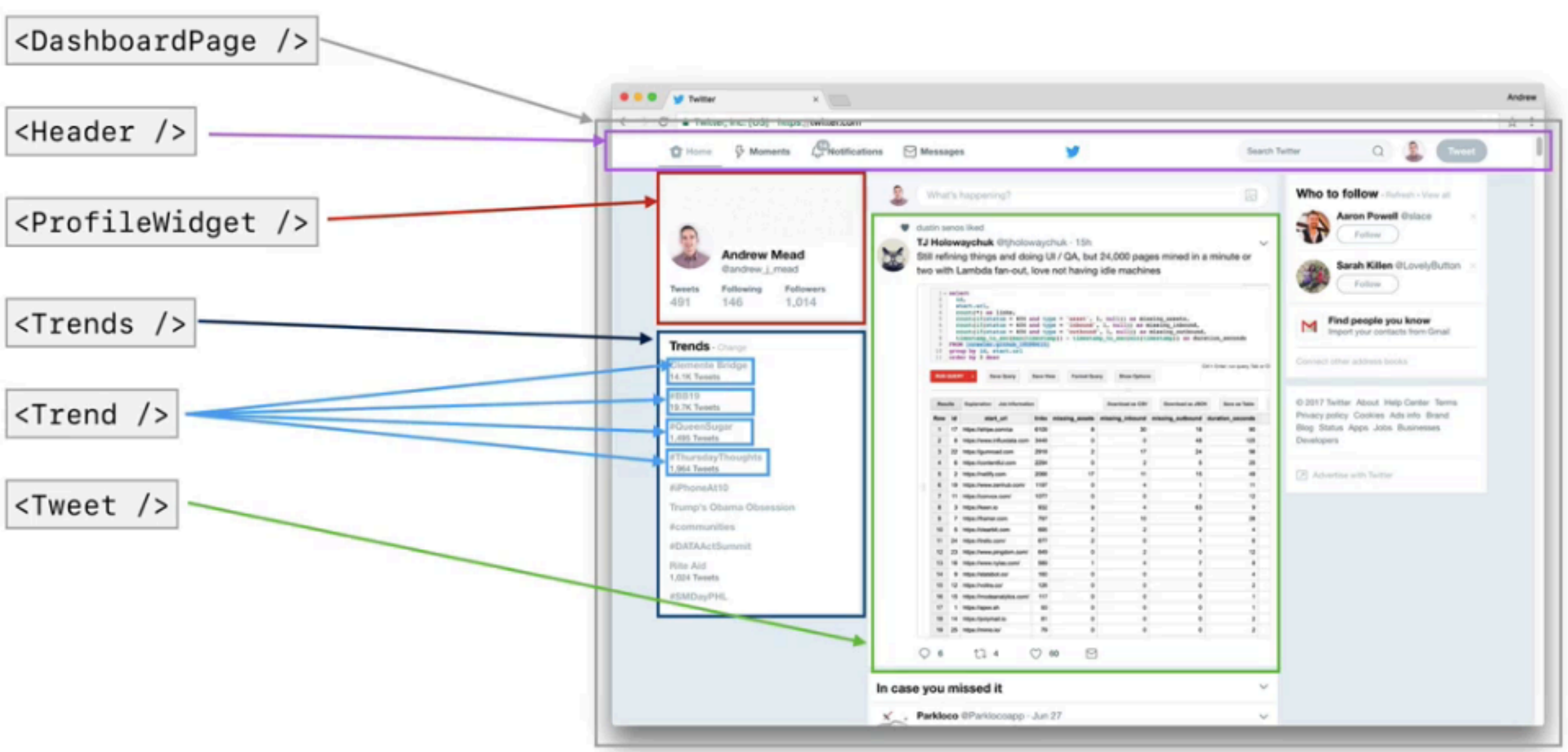
THINKING IN REACT

What is a React Component? We should think of it as an individual piece of the UI.

These components are reused all over the place within the application for example the navigation bar can appear in multiple pages. We would have a single component for the navigation and we could reuse it wherever we need the navigation bar to appear in our application.

We can analyse web applications and break them down into different UI components. The data in the components could change, but the underlying structure of the JSX for the component remains the same.

Below is a basic structure of React components we could make if we were to break up the Twitter UI elements for the below image.



We would have a parent component (page) which will wrap around all the individual child components (UI) that make up the parent page.

The child components are reusable UI and are siblings to each other. A Child Component can have its own children components.

Just like HTML, we will also be nesting React components.

ES6 CLASSES

The purpose of Classes is to be able to reuse code. A Class is like a blue print and we will be able to make multiple instances of that class for the individual items.

To create a class we would use the class keyword followed by the class name (just like how we name our variables and functions). The convention for class names is to have the first character of the class name to be upper case. This will let other developers know that this is the name of a class and not just some other object. Within the curly brackets this is where we would define our class.

```
class Person {} ;
```

To create an instance of the class we would create a new variable and set it using the new keyword followed by the class name and then the opening and closing brackets calling it as a function.

```
const customer = new Person();
```

When we create a new instance of our class, we have the ability to pass in any amount of data/arguments which can be of any data type (e.g. string, number, boolean, object, array etc.), however, nothing will happen with our data unless we define them within our class using something called a constructor.

Constructors are functions that get called when we make a new instance of the class and it will get called with all of our arguments passed into the new instance of the class. Example of adding a constructor to our Person class:

```
class Person {
    constructor(name) {
```

```
        this.name = name;
    }
};
const customer = new Person('John Doe');
console.log(customer);                    <JavaScript console> Person { name: "John Doe" }
```

We now have a blueprint to allow us to create multiple instances of the Person class but the name argument can be unique to each instances.

Do you have to provide all the constructor arguments? No. This will return the class object with undefined for each property (**<JavaScript console>** *Person* { name: *undefined* }).

We can also add a default value to our arguments by assigning it a value (*we do not need a default value for all our arguments*):

```
constructor(firstName = 'Anonymous', lastName) {
    this.firstName = firstName;
    this.lastName = lastName;
}
```

We can create instances of Person and we can define what makes each Person unique. However, what about the things that each Person shares? We can setup methods that allows us to reuse codes across every instance of the class.
Unlike constructor which has a specific name and gets implicitly called when we make a new instance of the class, methods on the other hand has a name that we can pick (it can be anything we like) and the function will only run if we explicitly call it.

Note: we cannot use a comma after the constructor closing curly bracket to separate the constructor from the method as this illegal and will cause an error.

```
class Person() {
    constructor(firstName = 'Anonymous', lastName) {
        this.firstName = firstName;
        this.lastName = lastName;
    }
    getGreeting(){
        return 'Hello';
    }
};
const customer = new Person('John', 'Doe');
console.log(customer.getGreeting());
```

The customer class has access to the getGreeting() method from the Person class and so we can explicitly call the method. This will return a static 'Hello' greeting for all instances that calls on this method regardless if this is a different person.
We can make the greeting message dynamic/unique to the class for example we can greet using the first and last name. In our method we have access to the 'this' keyword which relates to the current instance.

```
    getGreeting(){
        return this.firstName;
    }
```

We can use concatenation or use template literals to make the message more complex. The getGreeting() method is now accessible to all our instances and has the same behaviour without us having to redefine our properties.

```
    return 'Hello ' + this.firstName + ' ' + this.lastName;
    return `Hello ${this.firstName} ${this.lastName}`;
```

Now that we know the fundamentals of a ES6 classes and how to set them up, we are now going to focus on a advance ES6 class topic which is how to setup/create a subclass using the ES6 syntax.

If we were going to create a website for students we would create a class call Students. We would realise that the student is actually just a Person with some modification i.e the Person would have a firstName, lastName and age. The student also has a qualification/subjects studied that we would like to keep a track of. So instead of copying and pasting the code from the Person class into the Student class and modifying to meet the needs of the Student class, we can extend Person from Student. This will provide us with all the functionality of the Person class but also allows us to override functionality we might want to change.

In order to achieve the above we would create the class name, after the class name and before the opening curly bracket we will add the 'extends' keyword to indicate that we want this new class to extend from an existing class.

```
class Student extends Person {};
```

The Student class extends from the Person class and this allows us to continue to use the Person properties and methods on the Student class and this will continue to run the code and function the same.

```
const customerOne = new Student('John', 'Doe', 28);

console.log(customerOne.getGreeting());
```

We have now created a sub-class of Person called Student but we want to modify.override the Person constructor to take in an extra argument for the subject. In order to do this we would use the constructor function and pass in our arguments list and then setup our function body. We would not need to setup the properties and defaults for the extended class again, however, we must call on the parent constructor function to run. To do this we would use the super() function – super refers to the Parent (extended) class and is the same as accessing the Parent constructor() function.

```
class Students extends Person {

    constructor(firstName, lastName, age, subject){

        super(firstName, lastName, age);

        this.subject = subject;
```

```
    }
};
```

We no longer need to re-write the code from the Person class as we are passing in the values that come through into the super function and allowing that to be passed into the parent Person constructor to set the correct values.

```
const studentOne = new Student('John', 'Doe', 28, 'Maths');

console.log(studentOne);
```

<JavaScript console> *Student* { firstName: "*John*", lastName: "*Doe*", age: 28, subject: "*Maths*" }

Adding a new method on the sub-class remains exactly the same i.e. define the name of the function and add the function to the function body. This can then be called/accessed on the class instance.

We can also override a Parent method behaviour in our sub-class by redefining the method. We can completely override the method or we can get the parent method and modify it:

Original Parent getDescription() method:

```
getDescription() {
    return `${firstName} is ${age} year(s) old.`;
}
```

Completely override the Parent method behaviour:

```
getDescription() {
    return 'original behaviour completely overridden';
}
```

Modify the Parent method:

```
getDescription() {

    let description = super.getDescriptiom();

    if(this.subject) {

        return description += ` They are studying ${this.subject}`;

    }

    return description;

}
```

We can use super again to get the parent class but this time we use the . followed by the method name and assign this to a variable we can return. We can now modify the original method and add the subject to the end using the if statement to check if there is a subject for the student.

We have now learnt how to extend from another class and do something new and this is really important because this is exactly what you would be doing with React Components. React requires new Components to extend from the original React Components class. It is therefore very important to get a good understanding and a grasp of creating ES6 classes and sub-classes.

```
class Person {
  constructor(firstName = 'Anonymous', lastName, age=0) {
    this.firstName = firstName;
    this.lastName = lastName;
    this.age = age;
  }
  getGreeting(){
    const {firstName, lastName, age} = this;                      //Destructuring.
    return `Hello ${firstName} ${lastName}`;
  }
  getDescription(){
    const {firstName, lastName, age} = this;                      //Destructuring.
    return `${firstName} ${lastName} is ${age} year(s) old.`;
  }
};
```

<u>Tips/Techniques:</u>
Destructuring is an important and useful technique as it allows you to extract values from the 'this' keyword and assign it to variables which we can then reference in our functions without making references to the 'this' keyword. This helps make the code look much more cleaner and readable.

CREATING A REACT COMPONENT

A React Component is simply a ES6 class. To create a component we will be creating our own class that extends from the React Component class. We already know that there are two globals we get from our two scripts, React and ReactDOM. We are going to grab the Component class from the React global library.

```
class Header extends React.Component {

    render() {

        return <p>This is from Header</p>;

    }

};
```

In ES6 classes we can have no method defined and that is completely valid. Whereas, with React Component we must define render (this is a special method and we must always call render when we use React Component class, else it will not work and error).

The render returns all the JSX expressions we want to render i.e. show up in our browser.

To render the component to the screen we would use the ReactDOM.render() method passing in our two arguments.

```
ReactDOM.render(jsx, document.getElementById('app'));
```

The jsx will be our variable holding all our JSX expression we want to inject/parse into our <div id='app'></div> element in our html. In this jsx variable we can pass in what looks to be custom html element tags but are simply tags that reference our class names which have our JSX expressions.

```
const jsx = (
    <div>
        <Header />
    </div>
)
```

This will render our header component's JSX expression and display it in our browser screen. We have now created a React component. What makes React Components great is that we are able to reuse these components (code) multiple times by just using the component tags for example we can have two or more instances of the <Header/> tag being rendered to the screen without us having to retype/repeating the same code:

```
const jsx = (
    <div>
        <Header />
        <Header />
    </div>
)
```

Note React enforces the upper case letters of class names (*ES6 does not require the upper case names of classes but is merely a convention*) therefore, when naming our React Components we must use upper case for the first letter in our class name. If we use all lower case for our class component name, this will not fail but it will not render the component to the browser screen. This is how React distinguishes the html element tags from our custom Components tags behind the scenes. Therefore, it is good practice to keep to this naming convention when creating ES6 classes.

NESTING REACT COMPONENT

Nesting components is essential for creating meaningful React apps. We can create a parent component and then have all the other components created nested within the parent component. This allows us to get rid of the const jsx variable and we can now use our parent component directly in the ReactDOM.render() function directly. For example:

```
Class IndecisionApp extends React.Comonent = {
    render() {
        return (
            <div>
                <Header />
                <Action />
                <Options />
            <div>
        )
    };
};
ReactDOM.render(<IndecisionApp />, document.getElementById('app'));
```

We have nested all the various components within the IndecisionApp component which acts as the parent component. We can render all the various components for this application through this Parent component.

COMPONENT PROPS

React Component Props are at the very core of allowing our components to communicate with one another. The data we pass in when we initialise an instance of our components is known as props. This allows our components to be reusable and unique based on the information passed into our component. We use key:value pairs in our components elements, similar to how we do this in HTML attributes.

```
<Header title='Title Header' />
```

To have access to this data value, we would go to the component class and within the render() method we have access to the this keyword which gives us access to the data passed in for the current instance of the class.

```
class Header extends React.Component {
    render() {
        console.log(this.props);            <JavaScript console>Object {title: "Title Header"}
        return(
            <h1>{ this.props.title }</h1>
        )
    };
};
```

What this does, it takes the HTML attribute looking data and it converts it into an object of a key:value pairs. We can use this string value using JSX expression to make the render of the title dynamic based on the data passed into our components. Whenever we use the <Header /> component we can now pass in data to change the header to a relevant header title.

When we create instances of our React Components we can also choose to pass some data into it. The data looks very much like HTML attributes but is in reality just a set of key value pairs where the key is always some sort of string and the value can be anything (any JavaScript data type) we would like for example a string, number, array etc.

When we pass in pass in data into a component we can use that data inside of the component itself. We can use that information to correctly render our components. All of the props are available on this.props and we can access the specific data by adding the key string.

Props allows us to setup one way communication for example:
The Parent component can communicate with its child components and the child component can communicate with its children components (sub-child). We can also add props when we use the ReactDOM.render() method by adding the props attributes to the React Component.

EVENTS & METHODS

In Section 1 we looked at how we could create event handlers that will call on global functions, however, in React we would want to create self-contained methods within the React Component class. This method will appear in the class components before the render() method.

```
class Action extends React.Component {
    handlePick() {
        alert('Run handlePick');
    };
    render() {
        return(
            <button onClick={this.hadlePick}>Click Me</button>
        )
    };
} ;
```

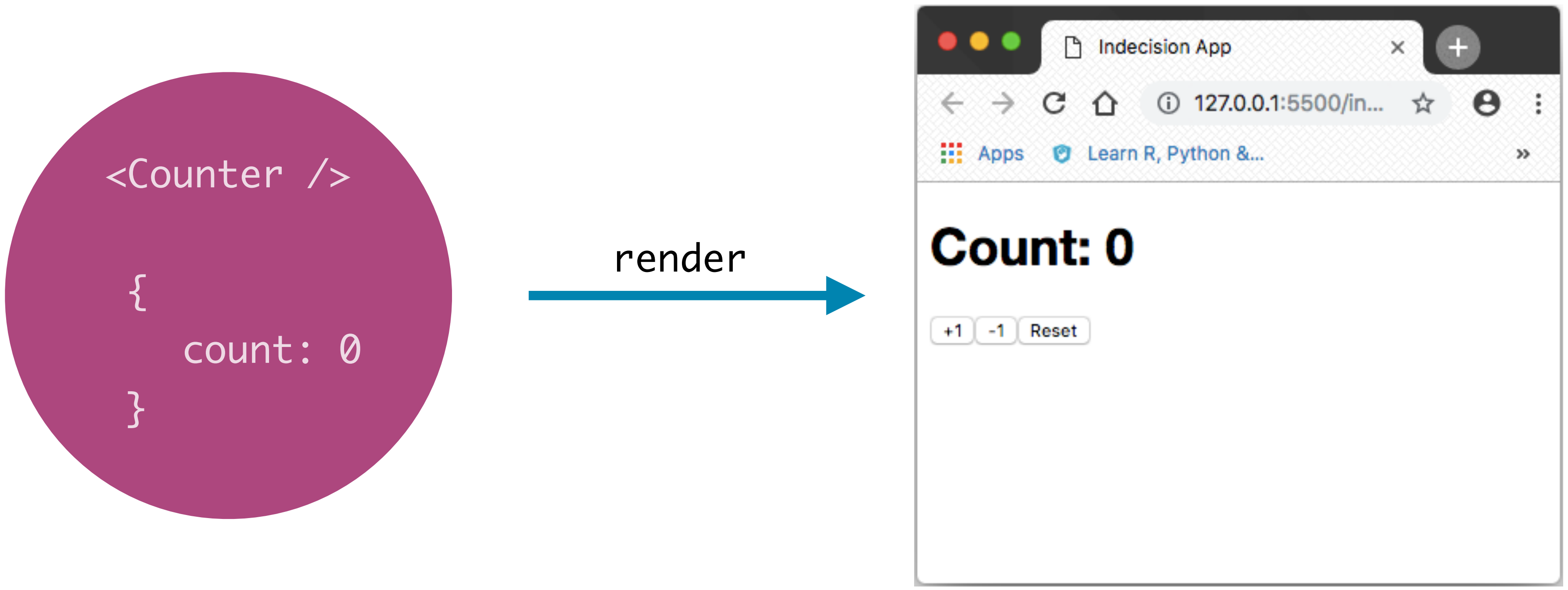
On the button we have a onClick event handler which will call the handlePick function which is a self-contained function of the class which is why we can use the this keyword to access it. We do not want to execute the method right away and therefore we would only make reference to the method in our onClick event handler (and do not add () at the end). When the button is clicked this would execute the handlePick() function.

COMPONENT STATE

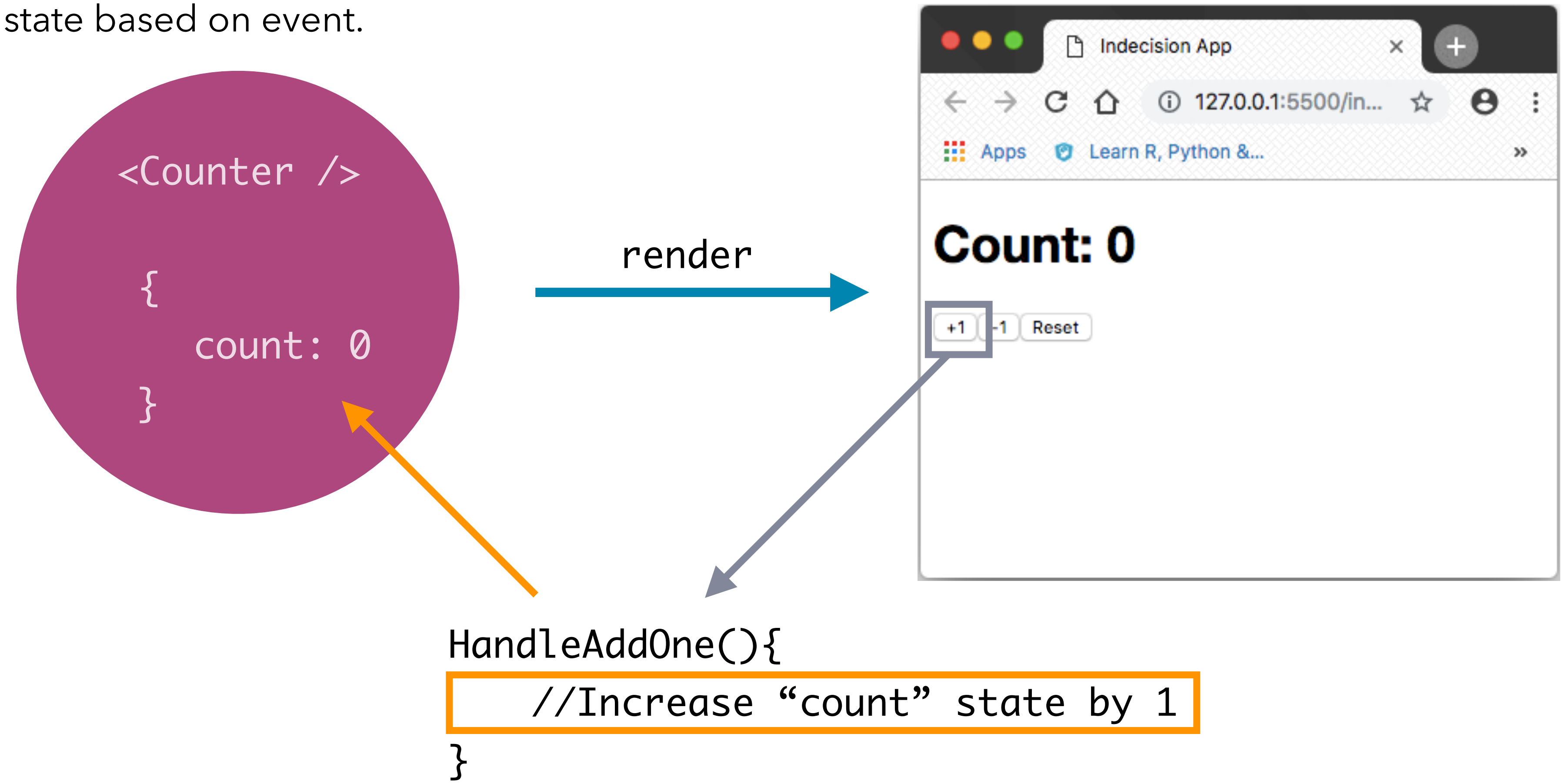
Component State allows our components to manage some data (think of data as an object with various key value pairs). When that data changes, the component will automatically re-render to reflect those changes. In component state, all we have to do is manipulate the data and the component will take care of the re-rendering of itself i.e. we do not need to manually call the render function every time the data changes.

How to setup a Component State:
Step 1. Setup a default state object.
Step 2. The component rendered with default state values. *

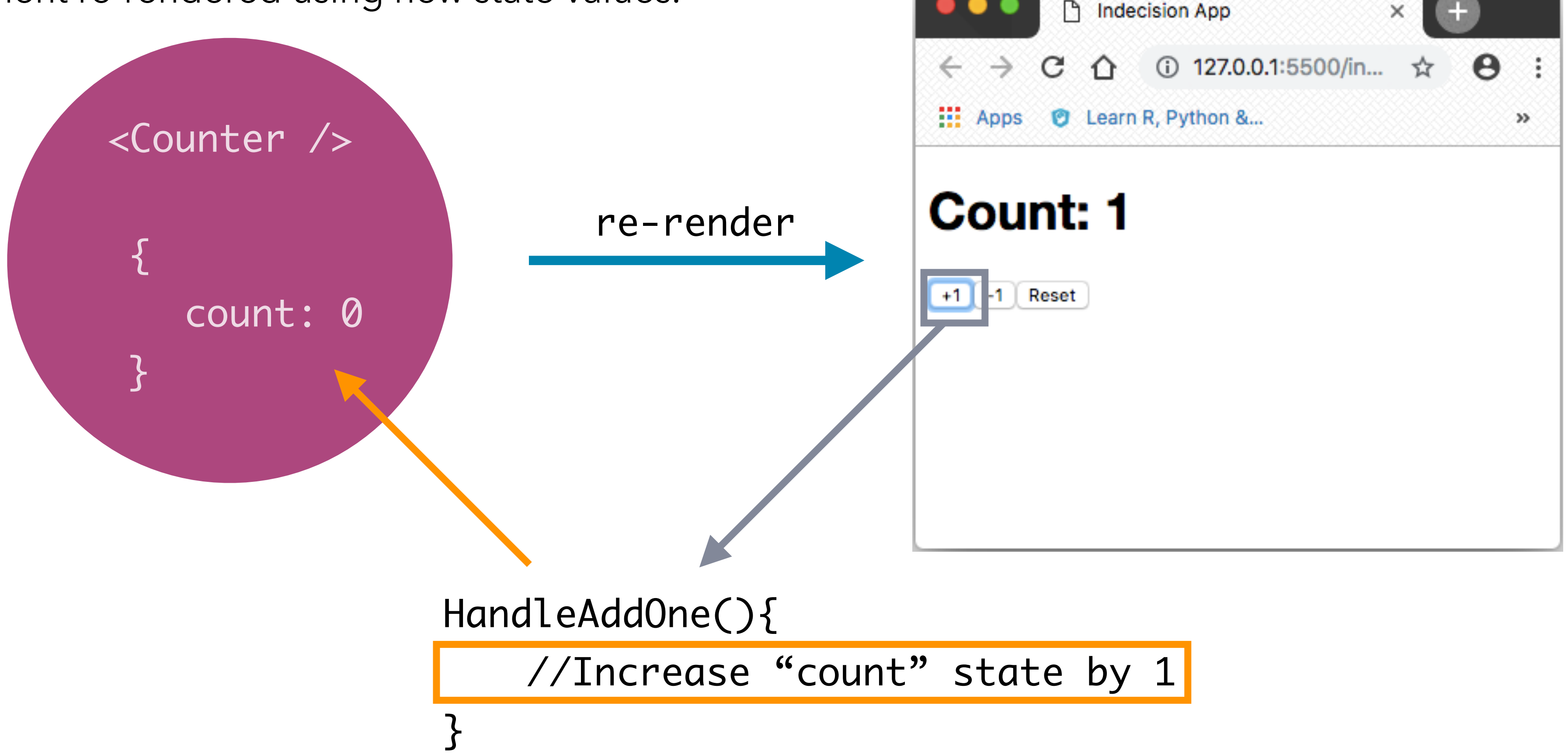
* Implicitly run behind the scenes.



Step 3. Change state based on event.



Step 4. Component re-rendered using new state values. *



Step 5. Start again at step 3.

Component State is essential for interactive applications. The above diagram is an abstract flow of react component state. So to recap: the state is just an object with a set of key value pairs, we define our initial data (state) and this gets rendered to the screen when the application initialises. The state object can be changed by the user i.e. based off some event for example a button click, form submission or finishing of a http request that returns JSON data etc. When the state changes the application will automatically re-render itself. React will update the UI on the screen with the updated data.

To set a state we would add this.state in the constructor and set this to an object defining all of the pieces of state we want to track for example:

```
class Counter extends React.Component {
    constructor (props) {
        super(props);
        this.state = {
            count: 0
        };
    }
    render() {
        return (
            <h1>Count: {this.state.count}</h1>
        )
    };
} ;
```

We now have a default state for our components which renders on initialisation of the application (steps 1 and 2).

We can create events to change the state. However, we must use a special method to change the state object which will re–render our application when the state changes an that is called setState() for example:

```
class Counter extends React.Component {
    this.state = {
        count: 0
    };
    handleAddOne() {
        this.setState( (prevState) => {
            return {
                count: prevState.count + 1
            };
        });
    }
    render() {
        return (
            <h1>Count: {this.state.count}</h1>
            <button onClick={handleAddOne}>+1</button>
        )
    };
};
```

ALTERNATE METHOD (AVOID USING):

The setState() method allows us to manipulate the state object but then refresh the application to render the changes automatically (steps 3 and 4). This methods gets called with a single argument using an arrow function to define our updates we want to make (an updater function). To define our updates we return an object where we state the various state values we want to change and the new values we want to assign. I our updater function (arrow function) we have access to our current state via the first argument commonly called prevState (but we can call this anything e.g. prevState, state, x etc.). We can use this value and select a specific key property from the state to update/manipulate its value. The setState() will update the state and re-render the application component to render the change onscreen automatically. We can call on this event handler as many times as we want to update the state and have it refresh the render (step 5).

Common things related to this.setState():

1) If you have multiple pieces of state on your component, you do not need to provide them in the setState() return object. You only provide the key of the state(s) you wish to change. When we are defining the updates in the setState() updater function (anonymous function), we are not overriding the state object completely. We are just changing specific values i.e. it is the same as writing this.state.count = this.state.count +1 which is changing the value of the specific object key value.
2) The setState() function will automatically render the component after the updater function has run to update the specific state key value. This will render the new value onto the screen without you manually calling a render method to update the components render to the screen.
3) If we do not care about the previous state value we do not need to pass in the prevState argument in our updater function argument, for example if we do not care about the previous count state value:

```
handleReset() {
    this.setState( () => {
        return {
            count: 0
        };
    });
}
```

There is an alternative way that we can use this.setState() method. This method also allows you to pass in an object directly into the method instead of using a function. This is the previous (older) approach. The updater function is the more recent and more preferred method and rumours has it that in future versions of React, the updater function will be the only way to update the state and render the application using the setState() method.

The older obsolete syntax example:

```
handleReset() {
    this.setState({
        count: 0
    });
}
```

There is nothing wrong with this syntax, however, the problem is where you are trying to update the state based on the current state value. For example if we have back to back calls:

```
handleReset() {
    this.setState({
        count: 0
    });
    this.setState({
        count: this.setState.count +1
    });
}
```

The problem we have with this is that when we click the handleReset() function this will not reset the state to 0 and add +1, instead it will continue to +1 only. The reason for this is because our calls to the State are Asynchronous. This means just because we started the process of changing the count, this doesn't mean the count will be changed. In our second setState function we are still getting back the old state value. We have started the process of getting the count to zero but it hasn't completed yet. So when we have the second process called this is grabbing the old state value. React behind the scenes is very efficient and does everything all at once and batches together our setState() operations allowing it to rerun less often, only then does it bring the state up to speed. We would end up running into weird situations like this one where we are accessing stale and outdated data.

So what is the solution to the above? The solution is aways to use the this.setState() with an updater function. It never suffers from the same problem because it does not access this.state, instead React passes in the prevState as an argument. For example the below will return 1 correctly:

```
handleReset() {
    this.setState( () => {
        return {
            count: 0
        };
    });
    this.setState( (prevState) => {
        return {
            count: prevState +1
        };
    });
}
```

The reason this works correctly in this instance is because the first setState() called, React goes ahead and calls our function. It is going to pass in the previous state which we did not use here and it is going to get the object back. So React knows that you want to change the count to 0. It will go off to do its asynchronous computation in the virtual DOM. Before it actually finished all of that and before the component gets re-rendered, another this.setState() call comes in. React sees this and asks itself whether it wants to render this twice or should it render this once. React will try to batch these together in order to figure out what needs to change here and make sure the DOM reflects that and only then will it update. This will prevent it from being updating a bunch of times which can get really inefficient.

So what happens is React know right away when this second call comes in that the state just computed and the count was zero. This is now out of date, so it goes ahead and tries to figure out what changes were made and actually passes that state in. It passes in the state where the count is zero and not the original state before the first this.setState() call. This would mean when we add +1, it is being added to 0 and not whatever the original outdated state value was before the function was called.

There is nothing inherently wrong with passing an object into the this.setState(), as long as you don't need access to the previous state values.

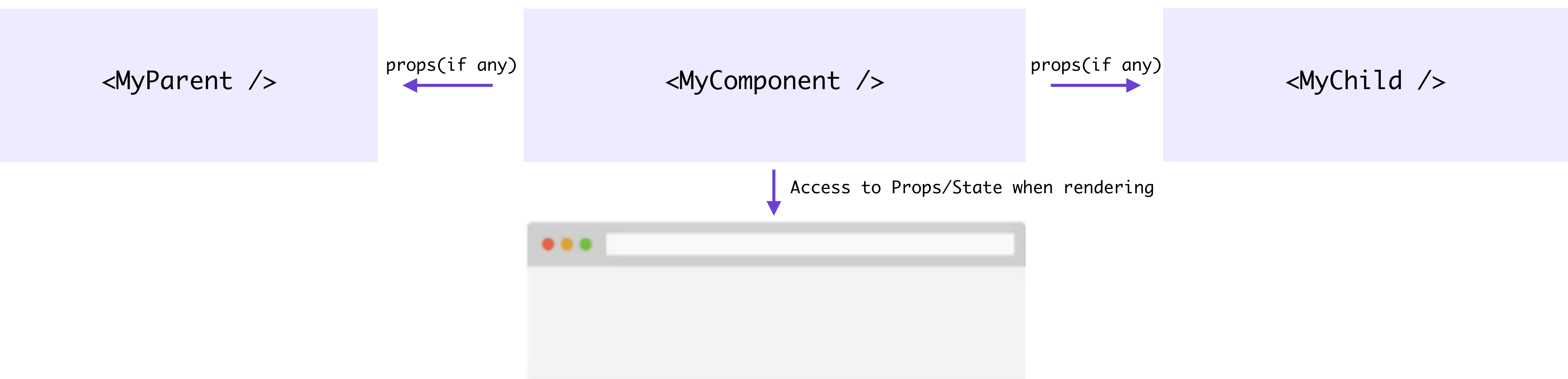
It is advisable to stay away from this alternative method as there are rumours that React going forward will only use updater functions within the this.setState() function method which is the preferred syntax. It allows us to build our applications without running into pitfalls like the above example.

SUMMARY: PROPS VS STATE

We know that something at some point rendered MyComponent (whether rendered by another Parent Component or ReactDOM render call). We also know that MyComponent could have optionally rendered a Child Component.

We know that data props flow in one direction. This allows us to pass things between components e.g. the Parent could pass some data, if any, to MyComponent and MyCompnent could pass some data, if any, to its Child.

We also know that my component if going to render something to the screen i.e. rendered output. This is JSX and we have access to props and state when we are rendering.



Similarity:
Both Props and State are just objects.
Both Props and State can be used when we are rendering the component.
Changes to Props and State causes re-renders.

Differences:
Props come from above, whether it's a Parent Component or just some JSX that gets passed into the React Render state. Whereas the State is defined in the component itself.
Props cannot be changed by the component itself. If you want to want to track changing the data, you have to use a State because the State can be changed by the component itself.

<MyComponent />

Props	State
• An Object	• An object
• Can be used when rendering	• Can be used when rendering
• Changes (from above) causes re-render	• Changes causes re-render
• Comes from above	• Defined in component itself
• Can't be changed by component itself	• Can be changed by component itself

Section 3

STATELESS FUNCTIONAL COMPONENTS

- The Stateless Functional Component
- Default Prop Values
- Lifecycle Methods
- Local Storage

In this section we are going to learn a new way to create React Components. We already know how to create a class based components in the previous section and in this section we will learn how to create a stateless functional component.

We will compare and contrast the two types of React Component and view their own set of advantages and disadvantages. This will allow us to have an understanding of when we would use a class based function and when we would decide to use a stateless functional component.

THE STATELESS FUNCTIONAL COMPONENT

The Stateless Functional Component is an alternative to the Class Based Component. We would use a combination of both Components within your Projects.

A Stateless Functional Component has 3 characteristics:

1. A React Component (just like class based components).
2. It is also just a Function (unlike class based components).
3. It is Stateless.

Example Syntax for a Stateless Functional Component:

```
const User = () => {
    return (
        <div><p>User Name</p></div>
    )
};
```

```
const User = function () {
    return (
        <div><p>User Name</p></div>
    )
};
```

Stateless Functional Components don't allow you to manage state but they do allow you to manage props. These components do not have access to 'this'. To get the props, they get passed in from the function as the first argument (which is your object with all of your key value pairs). For example:

```
const User = (props) => {
    return (
        <div>
            <p>Name: {props.name}</p>
            <p>Age: {props.age}</p>
        </div>
    )
};
ReactDOM.render(<User name="John Doe" age={28} />, document.getElementById('app'));
```

While we cannot use state inside our Stateless Functional Components, we can indeed use Props.

The advantages of Stateless Functional Components are: they are faster than class based components (so when we can we should use them i.e. in cases of simple presentational component), they are a little easier to read and write and finally they are much easier to test.

Process of creating a Stateless Functional Component is simple:

1. Create a new const with component name (first letter capital).
2. Set it to a function (this function is equivalent to the render() function.
3. If there are props, the first argument to your function should pass in this object so that your component has access to the props key value pairs.
4. Return your JSX expressions to render.

DEFAULT PROP VALUES

Whether our components are classes or functions, they can have props passed into them, however, what if a prop is not passed into them? We can assign a default prop values.

To add a default value to our component props we can add a property after we define the component. For example if we want to add a default title property:

```
const Header = (props) => {
    return (
        <div> <h1>{props.title}</h1> <h2>{props.subtitle}</h2> </div>
    )
};


Header.defaultProps = {
    title: 'Default Title'
};
```

This will allow us to have a default title if no properties are passed into the Header component and where we want a different title for other pages we would add the prop values in our JSX to override the default values to render something different. This allows for a much flexible component.

We can add a default prop value to our class component state. This allows our component to be flexible for example:

```
class Counter extends React.Component {
    constructor(props) {
        super(props);
        this.state = {
            count: props.count
        }
    }
    render() {
        return ( <div> <h1>Count: {this.state.count}</h1> </div> )
    };
};
Counter.defaultProps = {
    count: 0
};


ReactDOM.render(<Counter count={30} />, document.getElementById('app'));
```

We can pass in a count prop value to override the default property value. This makes our Counter class component flexible as we can allow the user to define/override the default values. Note the this.state count key value references to the props.count value (this will default to 0 if no attributes for count is passed into the component).

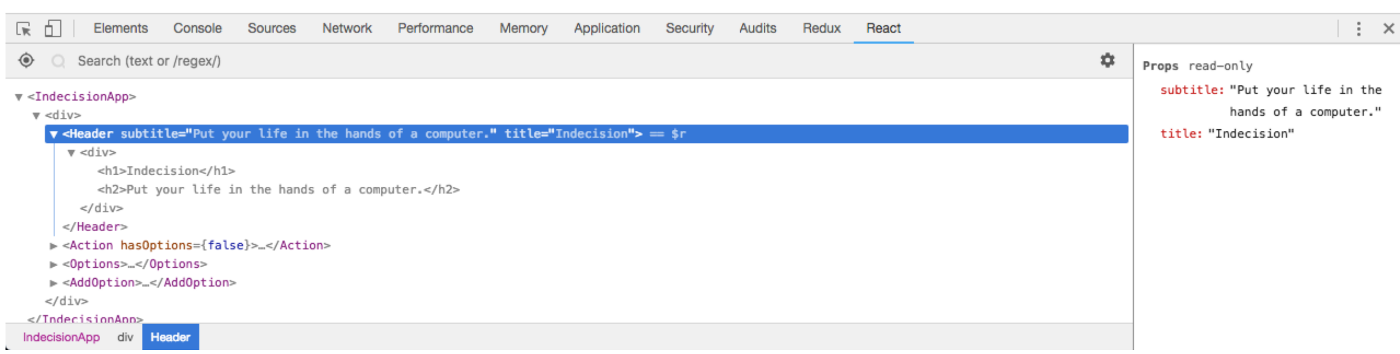
REACT DEV TOOLS

There is a set of React Dev Tools that we can install in our browsers as extensions (which are available on both Google Chrome and Mozilla Firefox). This will add a new tab into the developer tools for React with React specific information. This will make debugging a whole lot easier.

If you google the term Google React Devtools or Firefox React Devtools, this will bring up a link for you to install the extension in your browser of choice. Once you install the extension you will need to reopen the tab/browser to see the changes in the dev tool tabs.

What you see in the React tab is similar to what we would see in the Elements tab. In the Elements tab we get our html markup while in the React tab we get our JSX tree view. This will show the parent component and the child component and the JSX expressions within each component. The components are highlighted while regular html are shown in grey. On the right hand side we have access to more data to the component that is currently selected i.e. the Props and State of the component.

As you application grows, you can also search for components to make it easier to locate the component you are looking for. This allows you to isolate the component. We can play around within the React Tools to make changes and these will take affect in the application which is really useful for testing. However, the tool is also in development and not everything will work (e.g. we can change the value of state objects but cannot add a new one through the React devtools).



Finally, when you highlight a component, the React devtools assigns a ==$r variable. We have access to this variable in the JavaScript console tab of our developer tools by typing $r which will show all the Props/States and functions for the selected component.

LIFECYCLE METHODS

Lifecycle Methods fire off at various times in a given component life. These are built in methods available on our class based components but not available to our stateless functional components. This is one of the reason for why stateless functional components are much faster because they do not need to handle state nor lifecycle methods.

Example of lifecycle methods include the ability to populate an array with data from a database when the component first gets mounted to the browser or we can watch the state change to make saves/updates to our database whenever the component updates with new data.

Lifecycle Methods:
componentDidMount() – this will fire when the instance of the class based component first mounts.
componentDidUpdate(prevProp, prevState) – this will fire when the component updates i.e. when the props or state value changes. With this lifecycle method we have access to the this.prop and this.state for the new prop and state values. We can also access previous props and previous states by passing in the two arguments. The first is for the previous props while the second argument is for the previous state.
componentWillUnmount() – this will fire just before the component goes away i.e. when the given component unmount (the whole component is removed from the browser screen).

There are many more lifecycle methods which are available to read on:
https://reactjs.org/docs/state-and-lifecycle.html

The categories for lifecycle methods are:
1) Mounting
2) Updating
3) Unmounting

LOCAL STORAGE

Local Storage is simply a key value store, for example we can name a key person and give it a value of John. We can later on fetch the value of John based off of the key name.

We use the localStorage object and call on a few methods on that object:

```
localStorage.setItem('key', 'value');

localStorage.getItem('key');

localStorage.removeItem('key');

localStorage.clear();
```

The setItem method takes in two arguments i.e. the key and value and the getItem method takes in one argument of the key which will return the corresponding value. If we reload the webpage we can still have access to the key:value items because this is saved to local storage and the items persist. The removeItem method takes in one argument which is the key and it removes the item (key:value pair) from local storage. Finally, the localStorage.clear() method will clear everything stored in local storage.

This is a great starter database mechanism to explore the general principals before exploring actual databases.

It is important to note that localStorage only works with string data only. Even if we use numbers, it will actually implicitly convert it to a string. To convert the string back into a number we would use the parseInt() method.

How would we work with objects and arrays in localStorage? We would use JSON.
JSON is a string representation of a JavaScript object or an array. JSON stands for JavaScript Object Notation. There are two JSON method we would always use:

JSON.stringify()

JSON.parse()

The stringify method is going to take a regular JavaScript object and get the string representation, while the parse method takes the string representation and returns a true JavaScript object. In JSON all of the keys are wrapped in double quotes which is one of the many rules JSON enforces.

Example Code:

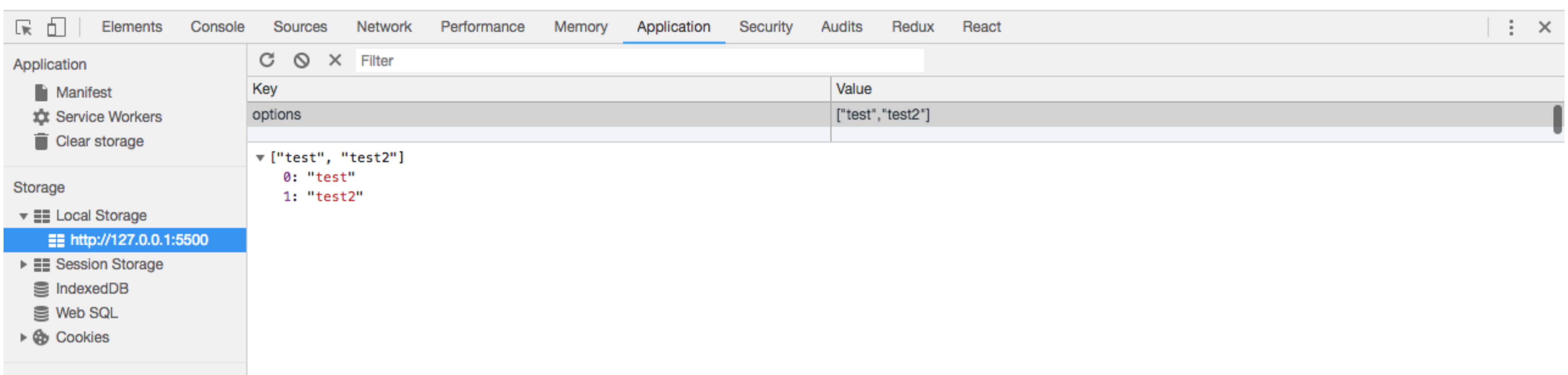
const json = JSON.stringfy({age: 26}); –> json returns string representation of "*{"age": 26}*"

JSON.parse(json); –> returns *Object {age: 26}*

JSON.parse(json).age –> returns 26

If we try to parse in erroneous data into the parse method this will through a 'Uncaught SyntaxError: Unexpected Token in JSON at…' in these cases would use the JavaScript try/catch function to try a JavaScript code and where it fails use the catch to do something else.

We can see the key value pairs in our browser dev tools by going into the Applications tab within the Local Storage area we can view all our key value pairs that is saved.



Section 4

WEBPACK

- What is Webpack?
- Installing & Configuring Webpack
- ES6 Import/Export
- Default Exports
- Importing npm Modules
- Setting up Babel with Webpack
- Source Maps with Webpack
- Webpack Dev Server
- ES6 Class Properties

In this section we are going to learn all about a tool called Webpack.

Webpack is an asset bundler, meaning that it will take in all our files that makes up our application, combine it with things from third party libraries and then spit out a single JavaScript file.

This allows us to break our application into multiple smaller files e.g. having a single file for each component.

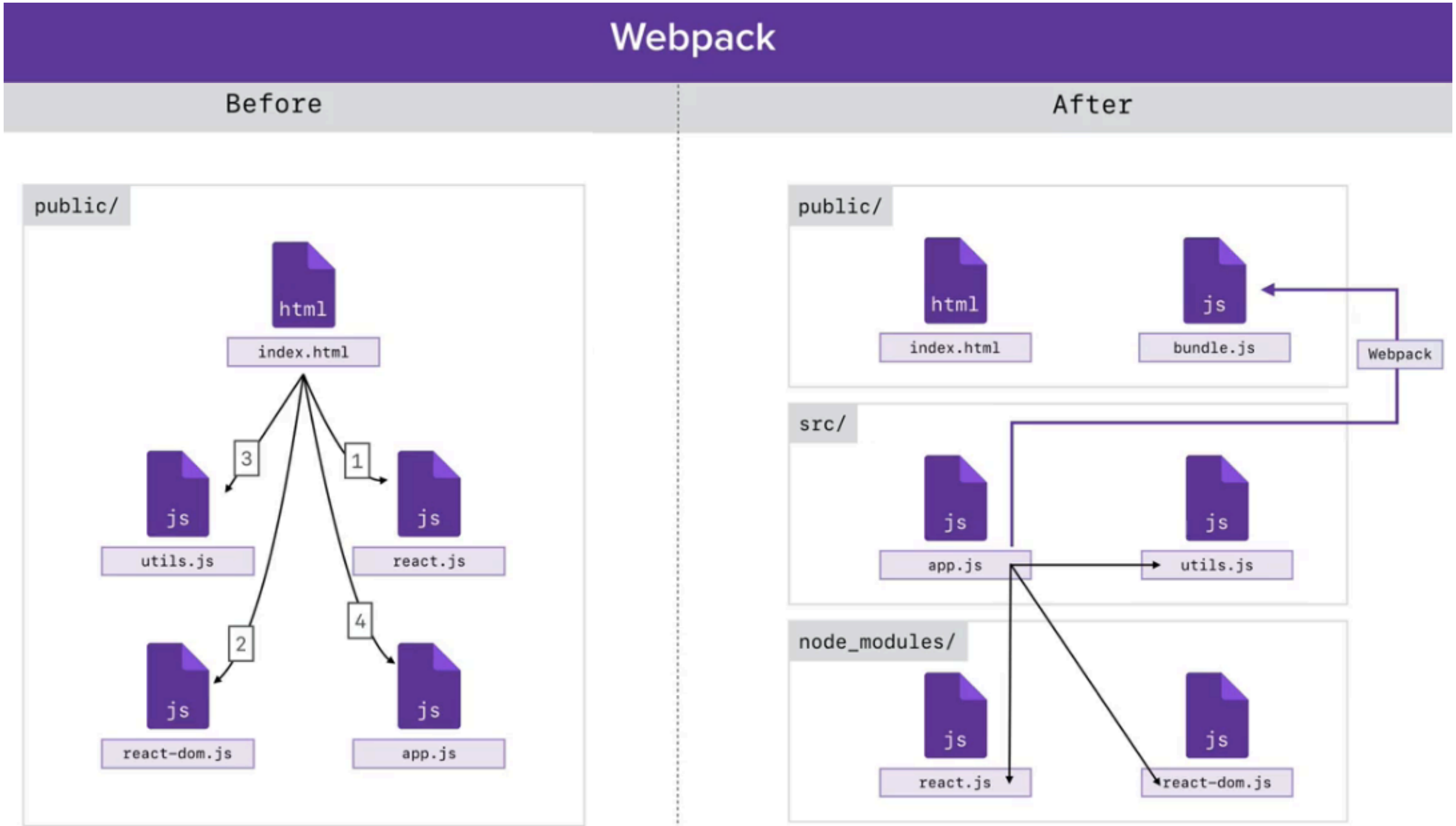
We will learn how to configure Webpack and how to use all the features that is available to us such as ES6 Import/Export, Default exports, importing npm modules, setting up Babel with Webpack, setting up a Webpack dev server and many more.

WHAT IS WEBPACK?

We could define Webpack as a module bundler for modern JavaScript applications, however, this does not really explain or show what Webpack does or how it helps build better applications. There are many advantages to Webpack:

1. Webpack allows us to organise our JavaScript. At the end of the day when we run our application through Webpack, we are going to get back a single JavaScript file (called the bundle) which contains everything our application needs to run. This will contain the depnedencies and application code. Our index.html will only need a single <script> tag to this single file as apposed to multiple <script> tags for multiple JavaScript files which will get unwieldy. Having too many <script> tags can also slow down your web application because it would need to make multiple request for all the file to load the website.
2. Gulp and Grunt are alternative tools which concatenates/minifies all your JavaScript into a single file. However, Webpack is a little unique: It is breaking up all of the files in our application into their own little islands, and these islands can then communicate using the ES6 import/export syntax. This mean Webpack allows us to break up our application into multiple files that can communicate with one another. This allows our application to be modular and more scalable.
3. Webpack allows us to grab our third party dependencies that were installed by npm or yarn and live in the node_modules directory. This means we can install/uninstall/update our dependencies using the package.json file and our application will take care of the rest.

Before Webpack we had a public folder which had everything our application needed. We have our html file and all of our JavaScript code and also our third party dependancies codes all living in the public directory. We would have loaded them all via <script> tags in our html file, but in the correct order because we are relying on the global JavaScript namespace e.g. react.js has to come first to setup the global variable, then react-dom.js, utils.js and finally app.js which has to come last in order to take advantages of the things created in the other files.
This caused issues with managing all the dependencies which was annoying and polluting the global namespace adding a bunch global variables which didn't need to be in the global namespace (causing weird situations such as accidentally wiping/overriding variables without noticing).



Wepack allows us to break up our application into a directory structure. We have a public directory to serve up the web application assets, while the src directory contains the client side JavaScript and a node_modules directory which contains all the application third party dependencies such as react.

Webpack is a module bundler, so the JavaScript files are going to be setup to depend on one another. We would create a little dependency tree by defining the dependencies clearly within the app.js file which will be considered as the main file. When Webpack is run, it will start with app.js file (as the main file) and get everything it needs to run the application. We will end up with a single file in the public folder called bundle.js and this single file will be loaded in the html file using the <script> tag. Not only does Webpack compress the JavaScript code but it can also run the Babel command for us.

AVOID GLOBAL MODULES

Installing packages globally is not ideal for the following reasons:

1) The package.json file no longer defines all of the dependencies. This means that if people are trying to collaborate on your project or making your project open source for others to download and use, we are not giving all of the tools required.
2) If you have multiple projects and installed the modules globally, this would mean all of the different projects would need to be on the same version of the dependencies. Therefore, it is best to define all of your dependencies and versions within the package.json file for each of the projects.
3) The final disadvantages of global modules is the fact that we have to type out the entire command in the terminal. It would be nice if we had a alias script.

To remove the global dependencies we can run the following command in the terminal:

$ npm uninstall -g babel-cli live-server or $ yarn global remove babel-cli live-server

We will no longer have access to the babel or live-server global commands within our terminal, reversing what we installed in Section 1. Instead we would install these dependencies locally to our projects. In the terminal within the project file directory run the following commands to install locally to the project:

$ npm install live-server babel-cli@6.24.1 or $ yarn add live-server babel-cli@6.24.1

You will now see the two dependencies within the package.json file and the modules will be installed in the node_modules folder within your project directory. Having installed these dependencies locally, we do not have access to the commands in the global terminal. Instead we will be setting up scripts inside of package.json where we are going to define how we want to use those dependencies.

To setup these scripts we would:
Step 1 – define these scripts inside of package.json – we need to add a new property onto the root object (we can add this wherever we want). The name "scripts" is important in the creation:

```
"scripts": { }
```

Step 2 – inside of our scripts object we are going to define all of the scripts we want. This uses a key value pair where the key is the name of the script and the value is the script itself:

```
"scripts": {
    "serve": "live-server public/",
    "build": "babel src/app.js --out-file=public/scripts/app.js --presets=env, react --watch"
}
```

Step 3 – we can now run the script by calling on the script name. There is no need to retype the value as we previously did in the terminal. This script will use the local installed module to run the script command.
To run the script in the terminal we will use the following command:

```
$ node run serve        or        $ yarn run serve
$ node run build        or        $ yarn run build
```

The advantages of this is:
1) All dependencies are defined in the package.json file, this makes it easy for anyone to use the app and have everything installed that they need to start coding within the project using the same tools.
2) The versions of the tools are defined. This ensures everyone is using the same version of the tools. This also allows us to use different versions across different applications.
3) This allows us to create scripts which defines what we want to run in the terminal. These scripts can be called within the terminal using the script name rather than typing out the long command(s).

We can avoid using global modules moving forward.

INSTALLING & CONFIGURING WEBPACK

To install webpack locally in your project directory enter the following command in the terminal:

$ npm install webpack@3.1.0 or $ yarn add webpack@3.1.0

This will add webpack in the node_modules directory within your project files. We can now go to the package.json file to setup the script object for webpack:

```
"scripts": {
    "build": "webpack ––watch"
}
```

We don't need to provide any other arguments, instead we are going to setup the webpack config file where we define all the necessary things we require. By default webpack does nothing, we have to specify how to work with our application, otherwise this webpack command will do nothing.

We would need to create a file within the root of the application with the specific file name of **webpack.config.js** otherwise webpack will not be able to locate the config file. This file is actually a node script, so we actually have access to everything we would have access to inside of a node.js application. We will not be focusing on node.js but we require a little nodge.js to setup our webpack config (note: node is just JavaScript).

There are two critical pieces of information we have to provide in order to get webpack working:

1. Where the entry point is i.e. where does our application kick off for us (app.js); and
2. Where to output the final bundle file.

```
module.export = {
	entry: './src/app.js',
	output: {
		path: path.join(__dirname, 'public'),
		filename: 'bundle.js'
	}
};
```

The path needs to be an absolute path, which means that we have to provide the path to this project on our machine. This will clearly be different for everyone if you are on a different operating system or your username is different. The path is going to be different as well. There is a variable which makes this easier for us called __dirname which provides the absolute path location of the current location.

The below link provides documentation on the node path api – there are a bunch of methods for path manipulation e.g. path.join():
https://nodejs.org/api/path.html

We have a minimal webpack setup and can now run our webpack script command within the terminal. Whenever the script is run, this will create the bundle.js file within the public folder within your project.
Webpack offers a lot of features that we can add to our setup file such as automatically running babel, ES6 import/export syntax and many more features we are unaware of. For more documentation on Webpack and how to setup the config file visit the following website:
https://webpack.js.org/

ES6 IMPORT/EXPORT

ES6 Import/Export statements allows us to break up our code into multiple files. Instead of having a single large code file that contains all the code for your application to run, ES6 import/export will allow multiple smaller files that can communicate with one another which in effect allows you to make web applications that actually scale as you add more components and libraries.

If we remember from the previous section on installing webpack, we have a single entry point called app.js – this file is used to create the bundle.js file (i.e. the final minified JavaScript file that contains all the application code). If we create other .js files, these in effect would have no affect on webpack as there are no entry points for these additional files. In order to bring these other .js files into our application, we would need to import them into the app.js file using the import statement. Take the example of importing a utils.js file into our app.js file, we would write the following statement:

Folder Files:
app.js
utils.js

Code for app.js:

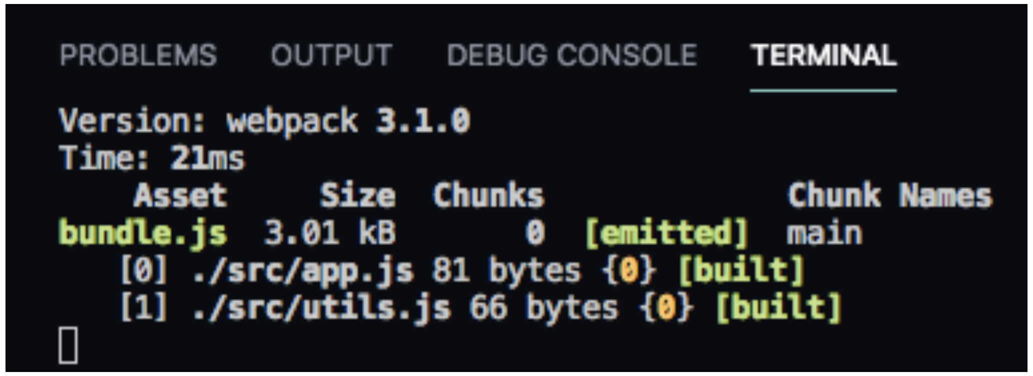
```
import './utils.js';
console.log('app.js is running');
```

Code for utils.js:

```
console.log('utils.js is running');
```

We would use the import keyword followed by within quotes the relative path to the file we want to import from app.js file – in the above case utils.js file lives in the same path as the app.js file. This will cause the app.js to run the utils.js code first to print to the console and then run its own code to print to the console (resulting in the two console.log messages printed to the console).

Webpack will now use both the app.js and utils.js files to generate the minified code in bundle.js file as seen in the screenshot to the rights.



This allows us to modularise our code for example we could create a function within our utils.js file (e.g. square root of a number) and call on that function passing in the necessary function arguments in our app.js file. However this leads to our first important note about all our files inside of the webpack application:

Each file maintains their own local scope which means variables declared in one file are not automatically accessible by all other files. Just because we import a file into another does not mean we have access to everything inside of it (*if this was the case, this would mean webpack would pollute the global namespace, and if more and more files are added, the likely chance for some sort of naming conflict causing the application to crash*). This is where we would use the export statement.

Import does half the battle of letting us grab some values from a given file, but that file has to choose to export some values as well. There are two types of exports:

1. Every file can have a single default export and
2. You can have many named exports as you like.

Named Exports – use the export keyword followed by the name of the export within curly brackets:
Code for utils.js:

```
export { square };
```

It is important to note that the export is not an object definition (i.e. we cannot use key value pairs). Instead we define what we want to export from the file for example the square variable. Even though we exported square, we would need to import it within our app.js file in order to have access to it. We would use the following import statement:

Code for app.js:

```
import { square } from './utils.js';
```

Again we would use the import keyword, but now we would use the curly braces (*this is not an object*) and specify any of the named exports we provided (*it is important the export names match up*) then followed by the from keyword and then provide the file path.

The import/export now allows us to use the function/variables from utils.js file within our app.js file.

When you add multiple named exports, we provide a comma between the list to separate the multiple named exports:
export { square, add }

We can have access to multiple named exports within our app.js file by specifying the same in our import statement:
import { square, add } from './utils.js';

Just because you exported multiple named exports does not mean you need to import all the named exports. You can pick and choose which named exports you wish to import into the files. The order of the export names does not matter.

The alternative method for exporting our named export is adding the export keyword in front of each of our functions/variables we want to export, which has the same effect as the above syntax:

Code from utils.js:
export const square = (x) => x * x;

export const add = (a, b) => a + b;

(Note: the export name will come from the variable name(s)).

We have learned that all the files within the application live in isolation. Just because a variable has been created in a file, this does not mean that other files will have access to it. To give access to another file the variable we would need to export and specify what we want to export in the file. The same is true when importing. Just because a file has imported something from another file this does not mean the file will have access to it. In order to have access to the exports in another file, we must need to import the named exports by their names.

Default Exports – we can only have one default export. Each file, if you choose to, can have a single default export. We would add the keyword as default to the export we want as a default:

const { square, add, subtract as default }; ––> subtract is a default export and not a named export.

––> square and add are both named export.

~~const { square as default, add, subtract as default };~~ ––> We can only have one default, this will error.

We cannot import subtract as a named export as it will cause an reference error because webpack cannot find a named export called subtract, that is because subtract is a default export. To reference a default export we would place it before the curly braces:

Code for app.js:

~~import { square, add, subtract } from './utils.js'~~ —–> uncaught reference error.

```
import subtract, { square, add } from './utils.js';
```

What makes the default special? Importing defaults the naming is not important. We could classify the import of the default anything we would like (e.g. minusCalculations) and webpack will know behind the scenes that it would get its values from the default export that was specified in the file.

```
import minusCalculation, { square, add } from './utils.js';
```

An alternative way to code the export default statement is to write a single expression:

~~export default const subtract = (a, b) => a – b;~~ —–> This is invalid export syntax

```
const subtract = (a, b) => a – b;          —–> declare the variable function.

export default subtract;                   —–> must use a single expression to export default.
```

Alternatively to make this all inline we could get rid of the whole subtract variable/function and add the expression in our export default:

```
export default (a, b) => a – b;
```

There are no hard and fast rules of when to use the default export and named export. As a general rule you may decide to use export default for a huge chunk of code and use named exports for smaller codes to export.

IMPORTING NPM MODULES

In the previous section we learnt how ti import/export JavaScript codes that we wrote ourselves. In this section we will learn how to include code that we did not write ourselves i.e. third party code/npm modules.

You would normally run the npm install command to install a module into your application. In order to access the code you would use the import statement much like we have already seen, however, there is a slightly adjusted in order to account for the fact that we are loading in a library we did not write as opposed to a file we did write.

For example importing validator module:
https://www.npmjs.com/package/validator

Step 1 – Install:
In the terminal run the following command in your project directory (as specified in the documentation for the npm package you wish to install locally in your application).

$ npm install validator   or $ yarn add validator

The package.json file will be updated to add the validator as a dependency to your application and the code lives within the node_modules folder.

Step 2 – import:
This part is a little tricky as you need to know what exports is made available within the module. Usually you would have to dig around the documentation to figure out how to get what you want from the module. For example if we want to get the validator function for validating emails how is it exported? Is it a default export or a named export? All these answers should be within the documentation for the package installed. The documentation for all packages are different.

import validator from 'validator';

In the import statement above, we are importing the validator library and grabbing the default export. Notice how we are not starting with the ./ which is for relative files inside our application. When we provide just the name of the module, Webpack is actually going to look for a module with the same name in the node_modules folder. It is going to import that file location which is going to give us access to the export we specified.

Step 3 - Use Module Exports:
We have access to all the things provided to us from the validator module. Again you would need to look at the documentation to know what is available and how to use it. For example:

isEmail(str [, options])
check if the string is an email.

`options` is an object which defaults to `{ allow_display_name: false, require_display_name: false, allow_utf8_local_part: true, require_tld: true, allow_ip_domain: false, domain_specific_validation: false }`. If `allow_display_name` is set to true, the validator will also match `Display Name <email-address>`. If `require_display_name` is set to true, the validator will reject strings without the format `Display Name <email-address>`. If `allow_utf8_local_part` is set to false, the validator will not allow any non-English UTF8 character in email address' local part. If `require_tld` is set to false, e-mail addresses without having TLD in their domain will also be matched. If `allow_ip_domain` is set to true, the validator will allow IP addresses in the host part. If `domain_specific_validation` is true, some additional validation will be enabled, e.g. disallowing certain syntactically valid email addresses that are rejected by GMail.

console.log(validator.isEmail('email@gmail.com'); ——> returns true in the console.

The format is exactly the same as what we already learned in the previous section, the only difference is that instead of specifying the path to the file we want to load in, we just provide the module name.

We would be using the react and react-dom modules within our application projects and should be installed locally:
$ npm install react react-dom or $ yarn add react react-dom

SETTING UP BABEL WITH WEBPACK

We have learnt in the previous chapter how to import modules into our project. We can read the documentation on how to use react and react-dom modules within our application and what functions/methods are available through default export and named export:
https://www.npmjs.com/package/react
https://www.npmjs.com/package/react-dom
https://reactjs.org/

We are able to use react and react-dom functions/methods within our project; however, there is one problem and that is Babel has not been configured with webpack. When Webpack creates the bundle.js file, our JSX code has not been compiled into regular ES2015 syntax and therefore the browser will not be able to read the JSX expression.

To setup Babel with Webpack we would need to explore a more advanced Webpack technique. This technique is known as a loader. A loader allows you to customise the behaviour of Webpack when it loads a given file. For example, when Webpack sees a .js file such as app.js, person.js or utils.js, we can do something with that file i.e. run it through Babel (*we can do a similar thing with converting SCSS/SASS files into CSS files*). We are going to use Babel to convert ES6 into ES5 and JSX to regular JavaScript.

The first step is to install some new local dependencies within our application file which will appear in the package.json file. In terminal run the following command:

$ npm install babel-core@6.25.0 babel-loader@7.1.1 or $ yarn add babel-core@6.25.0 babel-loader@7.1.1

Babel-core is similar to the Babael-cli i.e. it allows you to run babel in tools such as Webpack whereas the latter allows you to run babel in the terminal. Babel-loader is a Webpack plugin which teaches Webpack how to run babel when Webpack sees certain files.

In our webpack.config.js file we need to setup the loader. This occurs via the module property which takes an object within the module.exports method:

```
module.exports = {
    entry: './src/app.js',
    output: {
        path: path.joint(__dirname, 'public'),
        filename: 'bundle.js'
    },
    module: {
        rules: [{
            loader: 'babel-loader',
            test: /\.js$/,
            exclude: /node_modules/
        }]
    }
};
```

Further information on configuring Webpack can be found on the Webpack documents page. In particular we can read more on module rules in the below link:
https://webpack.js.org/configuration/module/#module-rules

Modules has a rules array, which we are going to setup a single object where we are going to define what we want that rule to be - this takes in 3 properties: the loader, test and exclude.

- The loader property will take in the loader we wish to use which is the babel-loader.
- The test property uses regular expression to test to see if the file meets the test criteria (i.e. in our case we are checking if the file contains .js at the end of the file name which indicates that the file is a JavaScript file). Only files that meet the test criteria will run the babel loader through them.
- The exclude property lets us exclude a given set of files e.g. exclude the whole node_modules folder. We do not want to run Babel through those libraries as they have already been processed and ready for production and we do not want to make any changes to any of those file codes.

The three criteria above is saying that every time Webpack sees a JavaScript file and it is part of our application, run it through Babel.

The only problem is that Babel does nothing by default and we have not currently told Babel to use the env or the react presets. To do this we need to setup a separate configuration file for Babel in the root of your project and this file needs to be called .babelrc which is a JSON file. This file allows us to take in all the arguments we passed into the command line and place them in this file. This file will have a presets array:

Code for .babelrc file:

```
{

    “presets”: [“env”, “react”]

}
```

We can now use the webpack and our script ($ npm run build or $ yarn run build) which will watch for any changes in our files.

To recap: we learned that we cannot just use JSX inside of Webpack without first teaching Webpack how to run Babel. We do that by using babel-loader. This allows us to use babel under certain conditions. In our case we setup a rule that says, whenever Webpack sees a file ending in .js and not in the node_modules folder go ahead and run it through Babel. This includes our entry file app.js and any files app.js might import.
Important note: the code in the bundle.js file is not minified and will not be the code that would be used in a production - we will see in later chapters how to setup Webpack build for production which will vastly reduce the size of bundle.js but for now this is perfectly fine and everything is setup to run with JSX inside of our Webpack applications.

ONE COMPONENT PER FILE

Working with react and Webpack, it is a common practice to put each component in its own file. This makes it really easy to scale up your application (if you want to add more components, you would add more files). This also helps with have files with shorter code and it helps to find the component you are looking for and also easy to maintain, update and test those components.

In the application src folder we would generally create a folder called components and within this folder would live all of our app components. We would have one file for each component and will use the import/export statements to import these components within the main root file (app.j).

The naming convention for naming your component files is to use the same name as the component itself and the first letter of the file should be a capital letter. The component file needs to import React in order for the component class to work. Secondly, we would need to export the component in order to use the component within the app.js root file.

Example:
Code for AddOptions.js File:

```
import React from 'react';

export default class AddOption extends React.Component {...}
```

Important Note: we can add in the export default keyword in front of our class and this is completely valid (we cannot add the export default keyword in front of variables as we learned in the previous section).

Alternatively, we can define our class and export default at the bottom of our file:

```
export default AddOption;
```

We would then need to import the component in the app.js file e.g. import AddOption from './component/AddOption';

SOURCE MAPS WITH WEBPACK

Using Source Maps within webpack will allow us to easily debug errors within our application.

If we had some sort of error within our code for a component file for example a console.log(variable) and the variable did not exist, we will notice that we will not get an error message in the JavaScript until the function runs. When we do get an error it will relate to variable is not defined. Now if we had a large application and we started to get these errors, it will be really hard to track down where the error is actually coming from. In the JavaScript console we would get a stack trace and on on the right a link to exactly where the error is happening. However, this link takes you to the line within the bundle.js file which is a minified code that looks like nothing like the code we are use to. Using Source Maps will allow us to debug our errors within our applications much easier.

In the webpack.config.js file, we would need to setup a single property called devtools and this takes in a string to specify the type of source map we want. There are quite a few different values you can put inside of this devtool, some are better suited for development while others for production. For more documentation on webpack devtools:

https://webpack.js.org/configuration/devtool/

```
module.exports = {
    … ,
    devtool: 'cheap-module-eval-source-map'
}
```

Whenever you make a change to your webpack.config.js file you will need to restart your build script again for it to take effect with the new changes. When an error occurs, this will now create a link to the component file that is causing the error. This makes it easier to debug your code for errors especially when the project files starts to grow larger.

WEBPACK DEV SERVER

In this section we will learn how to install and setup a Webpack dev server. This is a little development server, similar to a live server, but this comes with some nice to have features specific to webpack for example speeding the process of changing our application files and actually seeing those changes reflected in the browser.

We can read up on more details about Webpack Dev Server from the documentations:
https://webpack.js.org/configuration/dev-server/

There are a tonne of different ways to setup the server.

The first thing we would need to do is to install this new tool. Open the terminal and navigate to your project directory to install this locally (*we could install this globally but we already know that this is a bad idea*). Execute the following code:

```
$ npm install webpack-dev-server@2.5.1        or        $ yarn add webpack-dev-server@2.5.1
```

Once installed locally, we can setup the script within the webpack.config.js file properties.
For our purpose, we only need to setup one property in order to take advantage of the webpack dev server and this is contentBase (see documentation). This lets us tell the dev server where it can find our public files. In our case this is the public folder where our index.html and bundle.js (public assets) files lives. This is similar to how we setup live server to look for the public folder in our scripts within the package.json file – we are essentially doing the same thing within our webpack.config.js file by setting up the devServer property.

```
module.export = {

    … ,

    devServer: {
```

```
        contentBase: path.join(__dirname, 'public');
    }
};
```

We have now setup our Webpack dev server. Important note: we can add more settings using the documentation within our devServer property object if we would like to add more features other than contentBase. However, for our purposes this should be enough for our Webpack Dev Server.

Finally, in the package.json file, we would need to write a script that would run the Webpack Dev Server when we run the script from the terminal.

```
"scripts": {
    "build": "webpack"
    "dev-server": "webpack-dev-server"
},
```

We do not need to provide any arguments for the dev-server because they all sit inside of the webpack.config.js file. The webpack-dev-server is going to read the webpack.config.js file and use that to bootstrap itself. We can now run our dev-server which only needs one process running (i.e. we don't need live server and webpack ——watch (2 processes) anymore). We can execute the following command to run our Webpack-dev-server:

```
$ npm run dev-server     or     $ yarn run dev-server
```

This will start the development server with an output link, where the file is served from and where exactly the content is coming from on our machine i.e. the path we specified to the public folder. We have both the dev-server and webpack tools integrated into one script. We can go to http://localhost:8080/ to view our project within the browser.

This is essentially a replacement for live server with more features for Webpack specific features. On a final note the webpack-dev-server does not create a physical bundle.js file (we need the build script for that). The dev-server is holding the bundle.js file in memory in order to make the dev-server snappy but it never really serves the physical file. Even if we deleted this file in our project directory, the dev-server will continue to work as the file is stored in memory.

ES6 CLASS PROPERTIES

We are going to explore a new cutting edge JavaScript feature by adding in a new Babel plugin. This is going to add support for the class properties syntax which will allow us to add properties right onto our classes as opposed to just methods.

https://babeljs.io/docs/en/babel-plugin-proposal-class-properties

Run the following code in the terminal to install the babel feature/plugin locally in your project:

```
$ npm install babel-plugin-transform-class-properties@6.24.1          or

$ yarn add babel-plugin-transform-class-properties@6.24.1
```

After installing it locally, we need to configure our .babelrc file to include the plugins.

```
{
    "presets": ["env", "react"],
    "plugins": ["transform-class-properties"]
}
```

Our Babel configuration is now ready to use this brand new Babel feature. You would need to restart your dev-server in order to use the feature if it was already running before the changes were made to the files named above. This now allows us to use the new syntax.

Old ES6 Classes Syntax:
If we wanted to setup an instance property on every instances of OldSyntax, we would do that by creating a constructor function and setting this.something = 'some value'

```
class OldSyntax {

    constructor() {

        this.name = 'John';

    }

};
```

If we now create an instance of OldSyntax, we would be able to view that property.

```
const oldSyntax = new OldSyntax();

console.log(oldSyntax);                    -->returns OldSyntax {name: "John"}
```

This will show what makes up this instance i.e. the class object of OldSyntax and the single property of name set to John. We had to setup the constructor function to setup the single property value.

New Babel ES6 Classes Syntax:
The babel plugin allows us to use the new syntax to add in properties through key value pairs.

```
class NewSyntax {

    name = 'Beth';

};

const newSyntax = new NewSyntax();

console.log(newSyntax);
```

This plugin allows us to create new instances with properties without defining the constructor() function. This new syntax allows us to write a much more cleaner code and Babel compiles all this syntax down to regular ES2015 syntax.

The second advantage of using the class properties syntax is to be able to create functions that are not going to have their binding messed up (which is easy to do) and we do not need the binging workaround e.g. this.greeting = this.greeting.bind(this) in our code which is not an elegant solutions. Example function in the new syntax:

```
class NewSyntax {
    name = 'Beth';
    getGreeting = () => {
        return `Hi. My name is ${this.name}`;
    }
};
const newSyntax = new NewSyntax();
const getGreeting = newSyntax.getGreeting;
console.log(getGreeting());
```

We know that arrow functions do not have their own this binding, instead they just use whatever 'this' binding is in the parent scope and for classes, that is the class instance. This means that the getGreeting() function will always be bound to the class instance. The above function will work without breaking the this binding and we no longer require the old workaround solution for the binding using this new Babel class properties syntax.

SUMMARY: WEBPACK

What we have learned:

- How to setup Webpack from scratch
- How to use the ES6 import/export statements to modularise our JavaScript codes
- How to import third party npm modules and use them within our projects.
- Setting up Babel with Webpack
- Creating a Source Maps with Webpack to easily debug our application files when there are errors.
- How to setup a webpack-dev-server
- Install Babel Plugins for new cutting edge JavaScript features.

Recap of Babel ES6 Class Properties:

We setup a brand new babel plugin which allows us to access a cutting edge feature, in this case the transform-class-properties syntax. This allows us to customise how we use classes in our application. We are now able to setup state outside of the constructor function. We are also able to setup the class properties equal to arrow functions. This is a great candidate for event handlers which usually has problems maintaining the this binding, but with arrow functions this is not something we have to worry about.

Wrap up:

We now have a much more scalable architecture with each component living in their own JavaScript file within the components folder i.e. one component per file. This makes it to locate and find the component easily within your application.

Section 5

USING THIRD PARTY COMPONENTS

- Passing Children to Component
- React-Modal Example

In this section we are going to learn how we can utilise and integrate third party tools such as date-pickers, modals, animated lists and other sorts of great features that are available.

Once we know how to integrate one third party tool we would be in a position to be able to know how setup and use all other third party tools that are available to use in your projects.

PASSING CHILDREN TO COMPONENTS

In this section we are going to learn about the built in Children Prop which is a fantastic tool that makes it easy to pass in custom JSX to a given component.

Currently, all the components we create would already know exactly what they need to render i.e. it is explicitly defined within the component render method. However, what if we had a component like a layout component i.e. we render the header and footer and wanted everything in the middle to be dynamic that is specific to each individual page. How would we exactly set that up?

We already know that when we want to pass data into a component we just pass it as a prop. We can then reference that prop within our component. The first parameter argument that gets passed into our component is the props and we can then use that to render the props using a JSX expression. This is one approach we can take to make our content dynamic per page.

```
ReactDOM.render(<Layout content={template} />, document.getElementById(‘app’));
```

However, there is an alternative way to to pass in JSX into your components. Instead of using a self closing component tag in the ReactDOM.render() function we can use opening and closing tags for our component just like a HTML element. We can define our JSX in-between the opening and closing tags.

```
ReactDOM.render(<Layout><p>This is inline<p></Layout>, document.getElementById(‘app’));
```

When we pass something in the component like this, we have access to it via the children prop. This is created for us, which is why it is called a built in prop as opposed to a prop we would manually setup ourselves. This will be available through props for a stateless functional component or this.props for a class based component.

This allows us to create applications that give a little more context when you look at the code. We can use opening and closing brackets between our component tags to break up the code into multiple lines:

```
ReactDOM.render((
    <Layout>
        <p>This is inline<p>
    </Layout>
), document.getElementById('app'));
```

This is much more easier to visualise the code as opposed to have some JSX defined elsewhere and passed in as a prop. We can make the JSX within the component as complex as possible and this will all be passed in as a built in children prop.

Now this technique is important to understand because we are going to see it being used when we work with third party components that we did not write. This means that they are going to have their own API and are going to expect certain things to be passed in. This is going to involve us passing in JSX.

So for the moment all we need to know is that we can pass JSX into a component and that component can choose as to whether or not it wants to use the JSX.

REACT-MODAL EXAMPLE

In this section we will explore installing a third party React Component called React-Modal which allows us to create great looking modals. The React-Model uses children prop and therefore will help demonstrate and understand how to use third party react components as well as how it works behind the scenes. More documentation on this third party component can be read in the readme.md file at:
https://github.com/reactjs/react-modal

We are going to render a modal component and pass in some props such as if the modal should be open, or do stuff when the modal closes and we have access to a lot of nice features. Between the Modal component tags there are also the content that makes up the modal itself.

We would use the terminal to install the third party component by running the following command:
$ npm install react-modal@2.2.2 or $ yarn add react-modal@2.2.2

Once this installs into your project directory, we are able to use the third party component. We would create a new component file called OptionModal.js and inside this file we will get the necessary imports e.g. React from 'react'. To find the necessary imports from the third party component it is best to look at the documentation to find what is required to be imported and whether they are default or named exports. A good tip is to search the document page for the word import and this should provide a code snippet for setup. This will require you to do some research on the third party components you wish to implement (as all documentations are different).

```
import React from 'react';

import Modal from 'react-modal';
```

We will then create a stateless functional component which we will export default the component to use in our application file to render the modal component:

```
const OptionModal = (props) => (
	<Modal
		isOpen = {!!props.selectedOption}
		onRequestClose={props.handleClearSelectedOption}
		contentLabel = "Selected Option"
	>
		<h3>Selected Option</h3>
		{props.selectedOption && <p>{props.selectedOption}</p>}
		<button onClick={props.handleClearSelectedOption}>Okay</button>
	</Modal>
);
export default OptionModal;
```

We would import the above component within the Component file we want to render the modal inside of:

```
Import OptionModal from './OptionModal';
```

This file will also need to track using the state the props for the Modal.

```
State = {
	selectedOption: undefined
};
```

We can create a function called handleDeleteSelectedOption which will clear the state option when the button in the OptionModal is clicked.

```
handleDeleteSelectedOption = () => {
```

```
    this.setState( () => ({ selectedOption: undefined }));
}
```

We would need to render the OptionModal within our component file in order to view the modal. This is where we would have to pass in our child properties in our modal to which will pass in the the props into the OptionModal component to make the Modal dynamic with the data that is passed in:

```
<OptionModal
    selectedOption={this.state.selectedOption}
    handleClearSelectedOption={this.handleClearSelectedOption}
/>
```

The two children properties in <OptionModal /> are used to pass down the properties values in our OptionModal.js component file which is passed as the props argument. We can now use the props value within the OptionModal component file to make the component dynamic. For example:
The first property allows us to change the isOpen to either true or false. This checks if selectedOption state has a value and if it does this will return true, opening the Modal. If the selectedOption state is set to undefined then this will return false and close the modal. We can also use the selectedState value to populate the modal using <p> tags to display the text.
The second property allows us to call on the handleClearSelectedOption function passed down to our OptionModal component when we click on the onClick event handler button. This function sets the selectedOption state back to undefined which will close the Modal when the button is clicked.

Aside from the isOpen and contentLabel props, there are other props that the Modal Component supports for example onRequestClose takes in a function which gets called when the user clicks on the webpage outside the modal or presses the escape key on their keyboard (we can use the handleClearSelectedOption function to close the Modal).

This provides a working example of installing a third party component and using it with our application component passing in our component data to work with the third party component using children properties to pass down the props to the third party component.

Section 6

STYLING REACT

- Setting up Webpack with SCSS
- Architecture
- Reset CSS
- Theming with Variables
- Mobile Considerations
- Bonus: Favicons

In this section we are going to learn all about styling a React Application.

Up until now, we have focused on the functional aspects of coding a React Application and using ES6 features to create our react component and using Webpack as a tool for compiling our code using Babel and using the import/export features to modularise our application. However, the application would currently look horrible. This section will focus on adding some CSS to our application for styling.

We will be using SASS/SCSS pre-processor and configuring webpack to take our SASS/SCSS and compile it down into regular CSS. We will be able to take advantages of variables and mixins and all the other great features from SASS/SCSS.

SETTING UP WEBPACK WITH SCSS

SASS SCSS is a preprocessor for CSS. This adds support for things like variables, mixins and other great features that makes writing CSS styles a whole lot easier. In this section we will look at integrating SCSS with Webpack which will compile our SCSS into regular CSS and add it in our application. Note: we could write our own CSS styles and add it via a link tag in our html file.

We would create a new folder and file called styles and styles.css in our src directory.

In our webpack.config.js file we need to specify a new rule whenever webpack encounters a styles file (we already have one for when webpack encounters our .js files).

```
Module: {
    rules: [{
        ....
    }, {
        test: /\.css$/,
        use: [
            'style-loader', 'css-loader'
        ]
    }]
}
```

The test specifies that we want to look for any files that end with .css which would be our styles.css files we created. We will add two loader files to teach Webpack. One will take CSS and convert it into a JavaScript representation of CSS while the other will allow Webpack to take the CSS in JavaScript form and actually adds it to the DOM bu injecting a style tag which will show in the browser.

https://www.npmjs.com/package/css-loader
https://www.npmjs.com/package/style-loader

We will add them to our project by running the following commands in terminal:

$ npm install style-loader@0.18.2 css-loader@0.28.4 or $ yarn add style-loader@0.18.2 css-loader@0.28.4

Once they are installed locally, they can be added to the webpack.config.js file within the loader properties in order to make Webpack work with our CSS/SCSS. The use property allows us to use an array of loaders whereas the loader property only allows us to use one loader.

This is all it takes to setup CSS inside of Webpack. The end result is that whenever webpack encounters a CSS file, it is going to read that file and it is going to dump its content into the DOM in a style tag and the style will show in the browser. Save the webpack.congif.js file and restart your Webpack server for the config changes to take effect.

Inside of app.js we would need to import our styles.css file:

import './styles/styles.css'

We can now style our application using the styles.css file within our application and Webpack will be able to read the css file and add it to our app.js and inject it within style tages to display our styles in the browser. We can now style the whole application using regular CSS.

We now need to setup SCSS with CSS. This tool can be found on:
https://sass-lang.com/

We need to load in the loader and the compiler itself, much like how we installed the babel loader and babel-core compiler.

We would need to tweak our webpack.config.js file as we no longer want to be looking for .css files but rather for .scss files.

```
Module: {
    rules: [{
        ....
    }, {
        test: /\.scss$/,
        use: [
            'style-loader', 'css-loader', sass-loader',
        ]
    }]
}
```

In the terminal we will need to run the following commands to install the two new tools locally in our project.

```
$ npm install sass-loader@6.0.6 node-sass@4.5.3        or        $ yarn add sass-loader@6.0.6 node-sass@4.5.3
```

All we need to do is add the sass-loader to our use (loader) properties array. Behind the scenes the sass-loader is going to use the node-sass precompiler to convert the SASS/SCSS file into CSS. All we have to do is run the Webpack Dev Server similar to how we compile using Babel and Webpack.

We have to make sure the app.js is referencing/importing the scss file as we no longer have a .css file in our styles folder.

```
import './styles/styles.scss'
```

We should now be able to run SASS/SCSS code which will convert down into CSS and style our application.

ARCHITECTURE

In the app.js file, we use this file as a starting point to import code defined elsewhere. This allows us to have This allows us to have many small files as opposed to having one big code file. This is the very same architecture we would use to styles.scss file. Therefore, we are not going to actually define and selectors or styles in this file, instead we are going to import selectors and styles from other files. This is going to allow us to break up our application styles into multiple files as opposed to having everything defined inside of the styles.scss file.

SASS/SCSS supports the import syntax by default and so we can use this syntax to create the separate files that get loaded in. We can have a sub-folders within our styles folder that hold various styles:

Folder Name	File Name	Description
base	_base.scss	Setup things like the global font family that is going to be used throughout the entire application.
components	_componentName.scss	Style for each component.

The entry point will be called a [name].scss file, while the separate files that are going to be loaded in (known as partials) all start with an underscore _[name].scss as an example. To import the files in our main scss file we would use the SASS/SCSS syntax:

```
@import './base/base';
```

We leave off the extension and the underscore when importing the file.

We would use the BEM naming convention in our SCSS which refers to Block Element Modifier. The Block is the core building block e.g. the header, while the element is the things that go inside of that block to make them useful. We use the block and element together to target everything in our application. http://getbem.com/

RESET CSS

A CSS reset ensures all browsers are starting from the same place. Each browser has their own set of default styles and if they are not all starting from the same place, they will end up looking a little different when we actually apply our styles. To fix this we use a reset. Resets usually contains a ton of code, so we are not going to write our own. There are great libraries out there that contain reset for all sorts of weird situations so they handle all of the edge cases for us and we do not need to worry about sort of things.

To setup a CSS reset for our styles we are going to use normalize.css:

https://necolas.github.io/normalize.css/

Run the following command in terminal to install it locally to our project.

$ npm install normalize.css@7.0.0 or $ yarn add normalize.css@7.0.0

Once installed, in our app.js file we are going to import the normalize.css just above our styles.scss import.

Import ‘normalize.css/normalize.css’;

This will actually crash our application because we removed the ability to support regular css files in our webpack.config.js file. We would need to update this file to test for the regex:

test: /\s?css$/,

By adding in the ? before the s and after the css is going to make the s optional. This will therefore look for both CSS and SCSS files. Restart the dev-server and this will fix our issue with importing .css files in our app.js file. All browsers for example Chrome, Firefox, Internet Explorer, Safari etc. are now all working off that same base. We can continue to write our styles knowing that they are going to work in a cross-browser setting.

THEMING WITH VARIABLES

It would be nice to have one place where a lot of common settings lived. We would be able to change settings in this file and have the application update to reflect those changes. This new file is going to live in the styles/base folder and the file is going to be called _settings.scss – this file is not going to contain a single selector nor any styles. Instead this file will be used to define a theme for our application. We will be defining a bunch of variables within this file.

We would need to import the _settings.scss file way at the top of our stles.scss file, this is to ensure the variables are defined before any other styles are loaded into our application.

```
@import './base/settings';
```

We can now use the settings file to define variables which we can use in our other .scss files such as the colour, sizing etc. To define a variable in SASS/SCSS we would use the $ sign before the name of the variable. We then assign the variable with a value.

```
$dark-black: #20222b;
```

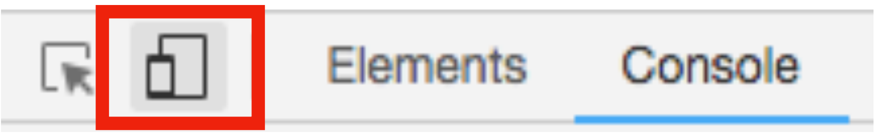
We can now reference the variable in our other .scss files.

```
.header {
	background: $dark-black;
}
```

As long as our variables are loaded in first within our styles.scss file, the other .scss files are able to make use of the variables. In essence we can create a theme for our application and we can change the theme by changing the variable values.

MOBILE CONSIDERATIONS

It is important to consider mobile user interface to ensure that the user experiences (UX) is also good for mobile users. So when we are testing for mobile, it is not enough just to make our browser skinny, this is because things are actually rendered a little differently. What you should use, is the device simulation tools that the browser has built in. On the right is a picture example of Google Chrome's Toggle device toolbar setting.



This provides a better idea of how the application will actually look like on a wide variety of mobile devices e.g. iOS/Android devices which we can toggle between. This will indicate whether a website/webapp has been optimised for mobile - if it has not then the page will look very zoomed out.

To fix this issue we need to tell the device that the application would like to use the actual width of the device as the application width for the content. We would need to use the meta tag in the index.html file for the viewport.

<meta name="viewport" content="width=device-width, initial-scale=1.0">

The content property takes in key=value pairs, we have two key=value pairs for this meta viewport tag. If you are using emmet in your text editor, the html snippet will add this in automatically for you. The application will now scale correctly to the device screens.

To change/target block elements in your UI to view differently on mobile screens, we can use media queries in our CSS files. We would use the @media keyword (which is a CSS feature) followed by the condition and then the styling output if the condition is met.

@media (condition) {css styling properties};

@media (min-width: 45rem) {…}; ––> Apply these styles at the minimum width of 45rem.

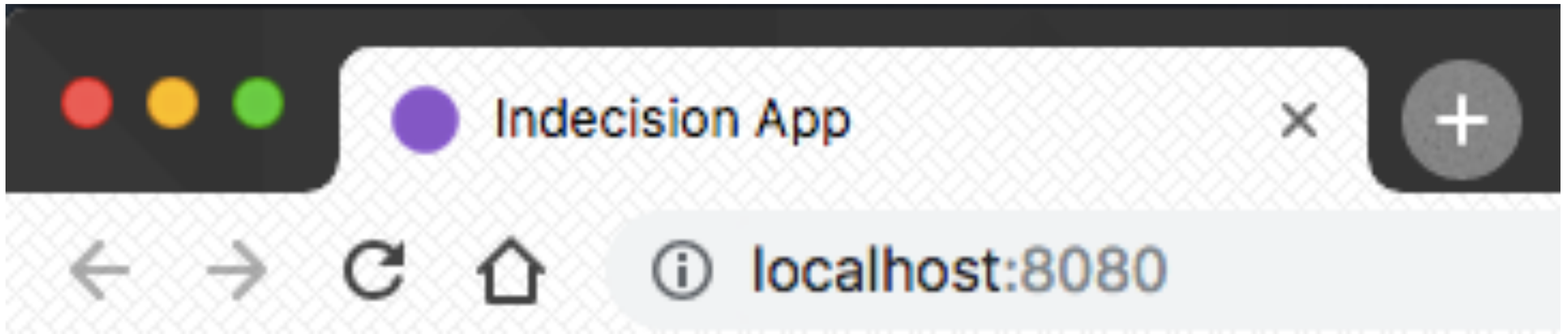
FAVICON

The Favicon is the little icon that appears in the browser tab for the webpage/app that you are visiting in that tab. To set a Favicon for your webpage/webapp:

1. Create a png icon image for your application.
2. Copy and paste the image file into the project's public folder which holds the index.html and bundle.js files. We could create a new folder called images and store all the project image files within this folder.
3. In the index.html file we would need to load in the favicon image using a <link> tag in the <head> section.

```
<link rel='icon' type='image/png' href='/images/favicon.png' />
```

After saving the files. When you reload the application or refresh the page, you should see the favicon appearing in the tab.



Section 7

REACT-ROUTER

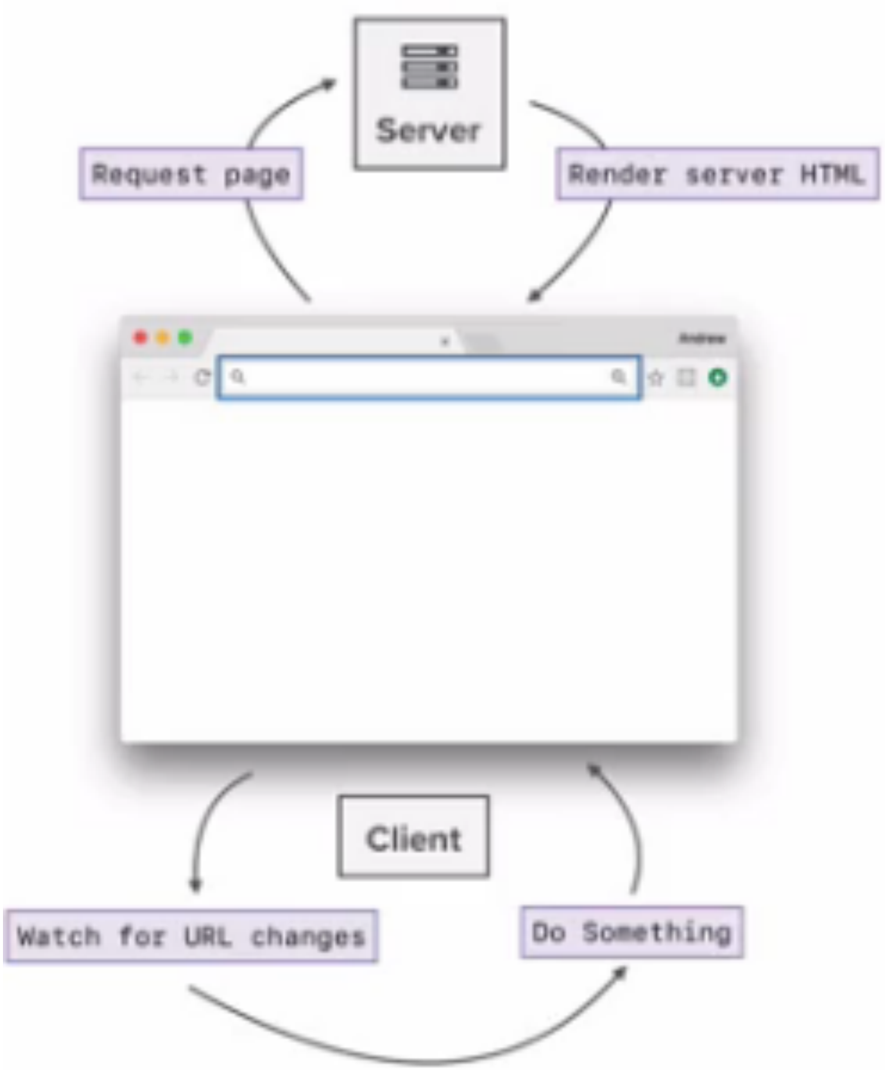
- Server vs Client Routing
- React-Router 101
- Setting up a 404 Page
- Linking between Routes
- Organising Routes
- Query Strings and URL Parameters

In the following chapters, we are going to explore a lot of libraries that are not part of React-core and React-Router is the first of many libraries that we are going to look at.

React-Router allows us to create a simulation of a multi-page websites/web applications using routes. In this section we will explore this library and how we can add it into our projects to extend the React-Core library.

SERVER VS CLIENT ROUTING

Server-side routing is the more traditional approach where we define the routes on the server, while client-side routing is the more modern approach where we use JavaScript to dynamically change what gets shown to the screen. Client-side routing has been made popular by all sorts of tools such as Angular, Backbone, Ember, View and React (they all use client side routing). The implementation may be different in each tool but at the core they all work the same.

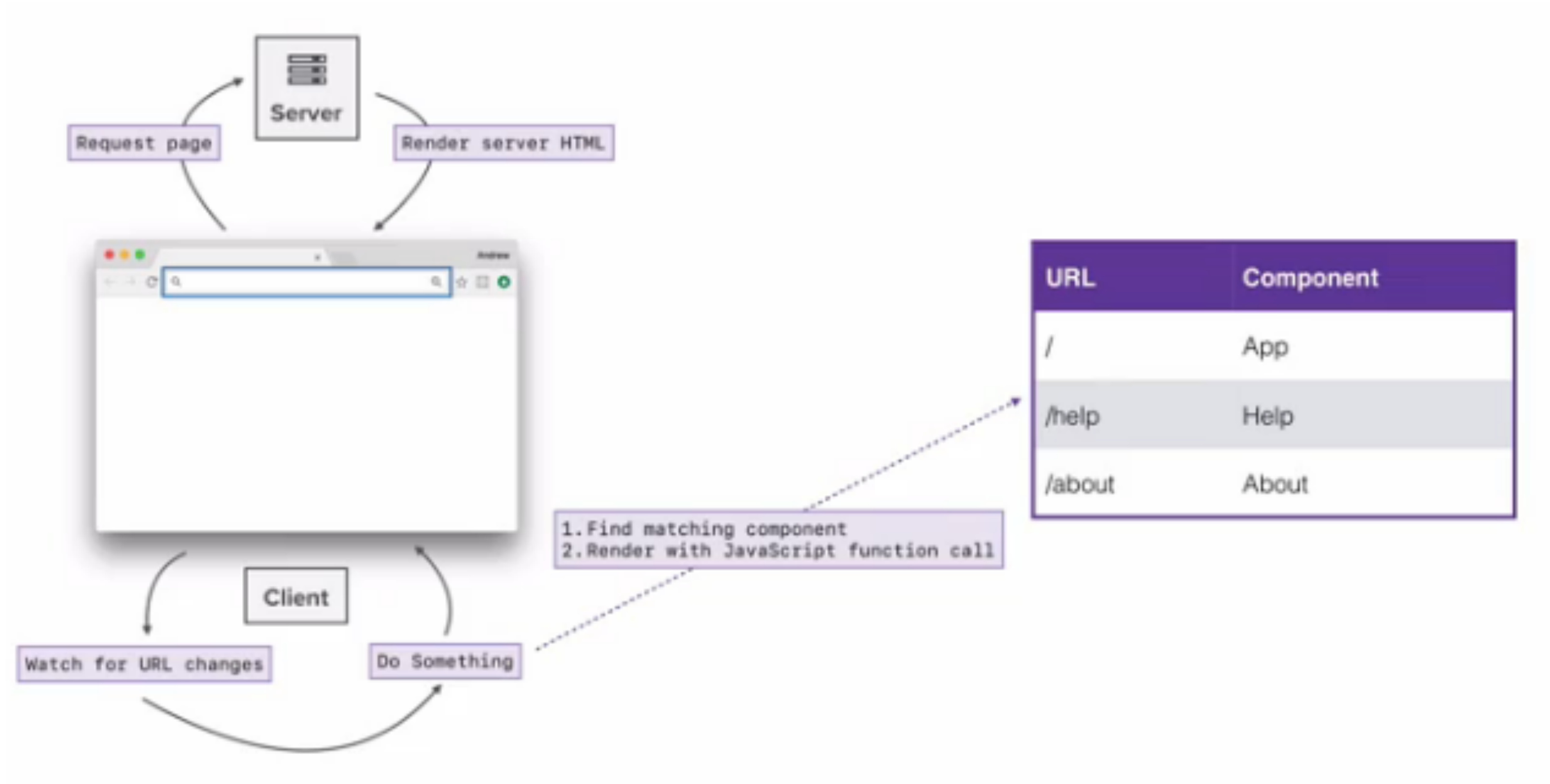


In the server-side routing the browser detects the change in the URL and it knows in order to render the correct thing for that URL, it needs to communicate with the server. The browser makes a HTTP request off to the server and server responds with the html that should get shown and then the browser goes ahead and re-renders things on the browser screen. This process is expensive, making the HTTP request and waiting for the response takes time. Not only are we using computational power but we are now introducing the network i.e. the network latency etc. is going to come into play and it is going to cause a small delay before the browser can actually re-render things.

With client-side routing, we handle the re-rendering of our application on the client, using the client-side JavaScript. On the very first time the application loads, we would need to go off to the server to request the html and the client-side JavaScript will start to render the React app. But for every other page change, whether the user clicks a link switching pages or get redirected based off some action they took, we would be handling that with client-side JavaScript. This means we do not need to make the roundtrip to the server in order to re-render the page. Instead we are going to be using the HTML5 history API available by browsers. This allows us to watch for some changes and run some JavaScript code when the URL actually does change.

We can now start to render a new component to the screen, render part of the application and leaving other components in place or re-render the entire page regardless what we want to do. This process no longer requires us to communicate with the server and it is going to run a whole lot faster.

React-Router library will allow us to have a set of URLs and a set of components to render for those URLs. So when the URL changes we find the matching components and then render with a JavaScript function call. Client-side JavaScript is going to allow us to create a single page application where we can swap out components simulating a page change.



REACT-ROUTER 101

The React-Router documentation can be found in the below link:
https://github.com/ReactTraining/react-router
https://reacttraining.com/react-router/

React-Router is a tool that can be used in a few different environments. We can use it natively for Android and IOS as well as the web. The document in the **reacttraining.com** webpage provides a lot of guides and explains how things work the way they do.

To install the React-Router library locally to your project run the following code in the terminal within your project directory:

```
$ npm install react-router-dom@4.2.2          or          $ yarn add react-router-dom@4.2.2
```

Installing react-router would install both the web and native libraries to the project file whereas installing react-router-dom only installs the web library and react-router-native only installs the native (Android/IOS) library.

Once the library has been installed locally in your project, we can import the library and start using the React-Router in our projects. Within the app.js file we would need to import the new library:

```
import { BrowserRouter, Route } from 'react-router-dom';
```

We are going to be using the BrowserRouter once to create the new router and we are going to be using the Route for every single page in the application. We are going to provide things to Route such as the path we want to match and what we want to do when the user visits that path.

We define the router configuration for our application inside of JSX. We create a tree like structure using all the things from react-router-dom and that lets us define exactly how our application should render based on the current URL.

We need to create one instance of BrowserRouter with opening and closing tags because we would add some children inside similar to what we saw with components in the previous sections.

```
const routes = (
    <BrowserRouter></BrowserRouter>
);
```

We can now render our routes variable with the ReactDOM.render() method:

```
ReactDOM.render(routes, document.getElementById('app'));
```

This will render an empty screen because we have not provided any instances of route. This is how we will setup individual pages that make up our application e.g. a home page, about page, contact page etc. We would need to use Route from react-router-dom to create the different routes for the different pages.

In the Route we do not need to pass in any children and therefore do not need any opening and closing Route tags - but we are going to specify a couple of props for the Route. Route takes in two main properties which are:

1. the path i.e. what URL do we want to use for this route, and
2. the component i.e. when we match the URL, we would show the component to the screen.

```
<BrowserRouter>
    <div>
        <Route path='/' component={ HomeDashboardComponent } />
        <Route path='' component={  } />
    </div>
</BrowserRouter>
```

The path of forward slash / relates to the root of the application, even though the forward slash does not appear in the URL by default e.g. localhost:8080. For our components we would use JSX expression and reference a component to render. BrowserRouter requires a single element, therefore we would use a single <div> element to wrap all instances of our Routes.

You will notice that when we navigate to the localhost:8080/create page this will give us an error of Cannot GET /create. This is because the browser is using server-side routing. When we first load our application we need to request the index.html page from the server. However, we want to serve up index.html and allow react-router to determine what should get shown onto the screen. In order to do that, we need to make a small change to our webpack.config.js file in order to tell the dev server to always serve up the index.html file for all unknown 404's. All we have to do is add one new attribute onto the devServer object:

```
devServer: {
    contentBase: path.join(__dirname, 'public'),
    historyApiFallback: true
}
```

The hisyory.ApiFallback property when set to true will tell the devServer that we are going to be handling routing via our client-side code and that the devServer should return the index.html page for all 404 routes. Once the changes have been made you will need to restart the dev-server again. Once we refresh the page again, when we navigate to the /create page the dev-server will see a 404 and serve up the index.html page, the index.html page will load up the bundle.js file which is going to actually run our router code and determine the URL matches our Route and then show the component specified in the JSX code. This will end up providing a weird result whereby both components will be displayed. This is because both Routes paths matches. This is useful in some circumstances where you want multiple paths to match to render multiple components; however, where you do not want this to occur, there is another property you can add to your Route. This is the exact prop.

```
<Route path='/' component={ HomeDashboardComponent } exact={true} />
```

The exact prop by default is set to false, but we can specify this to be true. This will ensure that the component will render to the page if the route path exactly matches. This will ensure the component is not rendered when a user goes to the /create page because the path keeps going and no longer matches just the root path.

This is the core basics (fundamentals) of the react-router library which we can build off of. We will build on this foundation and learn how to do things such as redirect, link between pages, setup a 404 page etc.

SETTING UP A 404

If someone visits a URL that we do not have a route setup for that path, the React application will not throw an error, instead it will display an empty <div> i.e. empty page because none of the defined instances of Routes matched the users URL and no components was rendered to the screen.

To create a 404 page where we have not specified the route path elsewhere, we need to first create a 404 page component to render.

```
const NotFoundPage = (
    <div> 404! </div>
);
```

We would use another Route but leave out the path prop and only specify the component prop.

```
<BrowserRouter>
    <div>
        <Route path='/' component={ HomePage } />
        <Route component={ NotFoundPage } />
    </div>
</BrowserRouter>
```

This will render the NotFoundPage on all pages this is because React-Router still considers this to be a match. This is close to what we want to achieve but not exactly what we want. Instead we would need to import the Switch from react-router-dom.

```
import { BrowserRouter, Route, Switch } from 'react-router-dom';
```

Once we import the Switch component we can then replace the <div> element with the <Switch> element.

```
<BrowserRouter>
    <Switch>
        <Route path='/' component={ HomePage } />
        <Route component={ NotFoundPage } />
    </Switch>
</BrowserRouter>
```

When React-Router now sees Switch, it will go through each of the route definitions in order and it is going to stop when it finds a match (i.e. it will not look at the below Routes when it finds a match). This would mean when a user enters a URL which we have not setup a route for, React-Router will go through each route until it reaches the last Route which will always match and this will therefore display our 404 page not found component to the user for routes that are not defined.

LINKING BETWEEN ROUTES

Linking between Routes allows us to switch between pages without going through the full page refresh. When the app goes through a full page refresh it is essentially communicating with the server. The whole point of client-side routing is to avoid communicating with the server which is very expensive.

We can use a <a> link tag to switch between pages by providing the href prop value. However, this will continue to perform a full page refresh and communicate with the server.

```
const PageNotFound = () => (
    <div> 404! - <a href='/'>Home</a> </div>
)
```

Instead we would need to add an event listener for our links and override the browser default behaviour to prevent the full page refresh and use JavaScript instead to change what is rendered to the screen in order to simulate a page change. React-Router provides us with the Link components that use client side routing to achieve the above. We would import the named export in our app.js file and then use an instance of the Link component instead of a <a> tag:

```
import { BrowserRouter, Route, Switch, Link } from 'react-router-dom';
const PageNotFound = () => (
    <div> 404! - <Link to='/'>Home</Link> </div>
)
```

This is similar to the <a> tag, however, behind the scenes we are using client-side routing as opposed to server-side routing.

When linking internally within our application we want to make sure to use the <Link> component as opposed to the <a> tag to take advantage of the client-side routing, unless we are linking to pages outside of the application whereby the <a> tag would be perfectly fine because there will be no advantages of using client-side routing.

To create a component to appear on every single page we would add the component before the <Switch> component. This will ensure the component is always rendered. We would need a <div> wrapper to comply with the single element requirements of the React-Router API.

```
<BrowserRouter>
    <div>
        <Header />
        <Switch>
            <Route path='/' component={ HomePage } />
            <Route component={ NotFoundPage } />
        </Switch>
    </div>
</BrowserRouter>
```

The Link component is one way of navigating between pages but we also have the Nav Link component to switch between pages. The Nav Link component is better suited for situations like navigation i.e. where we have multiple links that are side by side and want to change the style of the link in some sort of custom way e.g. changing the link text colour for the active page. The Nav Link component is identical to the Link component, but it has a couple of extra props that we can take advantage of. The NavLink would be used for a navigation bar.

We would need to import it in order to use the Nav Link component. We can target with our CSS styles the activeClassName.

```
import { BrowserRouter, Route, Switch, Link, NavLink } from 'react-router-dom';
<NavLink to='/' activeClassName='is-active' exact={true}>Home</NavLink>
```

ORGANISING ROUTES

Now that we understand how React-Router routes works within the application, in order to organise the application routes and making your applications scalable, we would break the code into its own file rather than just having one big app.js file with all of the routes.

In the src folder of your application we would create a new sub-folder called routers. Within this folder we are going to have a single file called AppRouter.js (or whatever you like to call this file) for all of our application routes. The naming convention is exactly the same as our React Components, this is because at the end of the day this file will export a React Component but we are breaking it out in the Router folder as opposed to placing it within the components folder.

The AppRouter.js files requires a few imports:

```
import React from 'react';

import { BrowserRouter, Route, Switch, Link, NavLink } from 'react-router-dom';
```

The AppRouter is going to be a stateless functional component and implicitly return some JSX i.e. the instances of Routes.

```
const AppRouter = () => (
	<BrowserRouter>
		<div>
			<Switch>
				<Route path='/' component={ HomePage } />
```

```
                    <Route component={ NotFoundPage } />
                </Switch>
            </div>
        </BrowserRouter>
);
```

We can now export AppRouter as the default export.

```
export default AppRouter;
```

We can now import AppRouter into our app.js file and take advantage of it by rendering an instance of it.

```
import AppRouter from './routers/AppRouter';
ReactDOM.render(<AppRouter />, document.getElementById('app'));
```

Everything should continue to work even though the Routes have been broken into its own separate file to the app.js file. This allows us to better organise all our routes in one file rather than clogging up the app.js file.

We can now break up all the application components into separate components files and export default the components. Within the AppRouter.js file we can import all of the components within the application and create Routes for the component for the server-side routing.