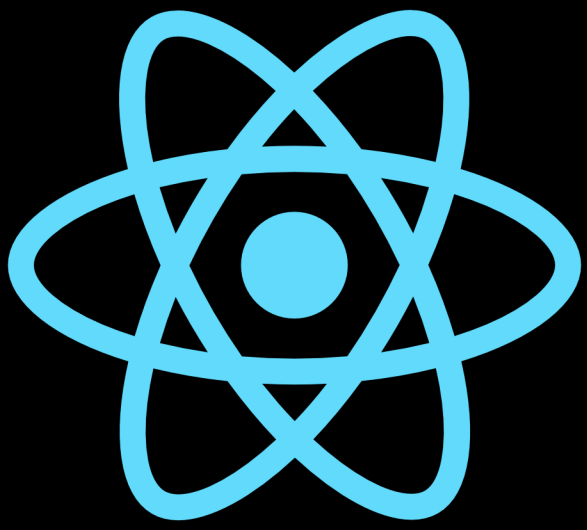
LARGE SCALE APPS WITH REACT AND TYPESCRIPT



DAMIANO FUSCO

Large Scale Apps with React and TypeScript

Build Large and Scalable front-ends that leverage component isolation, a centralized state manager, internationalization, localization, Custom Component Libraries, API-client code that easily can switch between mocked data and live data and more.

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LARGE SCALE APPS WITH REACT AND TYPESCRIPT

This book is a guide for developers looking to build large-scale front-end applications with React and TypeScript. With the growth of the web and mobile app development, there is an increasing demand for robust, scalable, and maintainable front-end solutions. This book provides a comprehensive approach to building large scale code bases that use React and TypeScript.

The book covers key concepts and best practices like:

- **Building front-ends** that can grow to a large code base that is organized and easy to expand and maintain.
- **Development of UI components in isolation** using an API client that can easily serve live data or mocked data.
- **Centralized State Manager** organized into domain/area modules, providing a unified and consistent way to manage the application state.
- **Internationalization and Localization** for language translation and number/dates formatting according to a specific culture, making it easier to reach a global audience.
- **TypeScript** type-checking at development time to decrease run-time bugs or errors, reducing the risk of costly bugs and enhancing the overall quality of the code.
- **Directory structure**, **file**, **and code naming conventions**, ensuring a consistent and organized project structure for both developers and future maintainers.
- **Hooks and Compositional Patterns**, providing a flexible and reusable way to implement functionality in components.
- **Components Libraries**, allowing developers to build a library of reusable components, reducing development time and increasing code quality.
- **Unit tests** for models and components, ensuring code quality and reducing the risk of regressions.

The book is designed for developers with intermediate to advanced React and TypeScript skills who are looking to take their applications to the next level. Whether you are building a new large-scale app or optimizing an existing one, this book will provide you with the tools and knowledge to achieve your goals. Throughout the book, practical examples and real-world scenarios are used to illustrate key concepts and best practices, providing you with a solid understanding of how to build large scale apps with React and TypeScript.

Preface

Why React, Vite and what we mean by “large scale apps” in this book.

React is a popular JavaScript library for building user interfaces. It offers several benefits for developers, such as:

- Declarative code structure: React uses a declarative syntax, making it easier for developers to understand how the UI should react to changes in data.
- Reusable components: React’s component-based architecture allows for building reusable UI components, making it easier to maintain and scale the codebase.
- Virtual DOM: React uses a virtual DOM, which optimizes updates and rendering, resulting in improved performance compared to directly manipulating the actual DOM.
- Server-side rendering: React allows for server-side rendering, improving the initial load time and making it easier to optimize search engine optimization (SEO).
- Large community: React has a large and active community, which means developers have access to a wealth of resources, including tutorials, libraries, and support.

Vite is a modern build tool for JavaScript projects that aims to provide fast and efficient builds. It offers several benefits, including:

- Faster build times and development experience compared to traditional bundlers.
- Lower initial load times, as only the essential code is loaded
- Improved build size, as Vite only includes the necessary code
- Lightweight and optimized for modern web development.

When we refer to “**large scale apps**”, we mean applications that have a large code base, a large number of users, and a wide range of functionality. These applications typically require efficient and scalable code that can handle high traffic and large amounts of data.

In this kind of projects there are several common concerns that arise, such as:

- Code maintenance and scalability
- Code quality and performance
- Code organization and structure

To address these concerns, here we will outline best practices for code organization and structure, such as using a centralized state manager and implementing strong-type checking with TypeScript. Additionally, we will focus on writing unit tests for our models and components, which will help improve code quality and catch bugs early in the development process.

Our ultimate goal is to build a foundation that can handle the demands of our app and be easy to expand and maintain as the code base grows.

Goal

The primary aim of this book is to guide you through the process of building a scalable React application by following best practices for project structure, file organization, naming conventions, state management, type checking with TypeScript, and compositional approaches using hooks.

Throughout the chapters, we will grow our simple project into a robust, large-scale application that is easy to expand and maintain, showcasing how patterns, conventions, and strategies can lay a solid foundation and keep the code organized and uncluttered.

We will build a TypeScript API client that can seamlessly switch between serving static mock data and communicating with a live API, allowing for front-end development to commence even before the back-end API is fully functional. Additionally, we will delve into topics such as internationalization, localization, and advanced techniques, to round out our comprehensive guide to building a scalable React application.

IMPORTANT: We will initially write code that allows us to achieve the desired functionality quickly, even if it requires more code, but then we constantly "rework" it (**refactoring**) to improve it and find solutions that allow us to reduce the amount of code used, or to organize it in a clear and easy way that is easy to expand and maintain. So arm yourself with a lot of patience!

Audience

The audience for this book is from beginners with some experience in **MV*** applications, to intermediate developers. The format is similar to a cookbook, but instead of individual recipes we'll go through creating a project and keep enhancing, refactoring, and make it better as we move forward to more advanced chapters to show different patterns, architectures, and technologies.

Note: Some of the patterns illustrated here are not specific to **React**[1], but can applied in any

[1] *Official website:* https://reactjs.org

application written in **TypeScript** or **JavaScript**. For example, most code from Chapters 3, 7, 9 can also be used in Vue.js/Svelte/Angular or other front-end frameworks, and even be used in **NodeJS** apps.

Text Conventions

I will highlight most terms or names in bold, rather than define different fonts/styles depending on whether a term is code, or a directory name or something else.

Thanks

I would like to thank my son for helping me proof read and validate the steps in each chapter by building the same project. I also would like to thank all the developers that over the time helped me correct things in the book and provided valuable feedback.

About me

I have worked as a software developer for more than 20 years. I switched career from being a full time musician when I was 30 years-old and then became a graphic designer, then transition to a web designer when internet became "a thing", and for many years after that worked as full-stack developer using Microsoft .NET, JavaScript, Node.js and many other technologies. You can read more about me on my personal website https://www.damianofusco.com and LinkedIn profile https://www.linkedin.com/in/damianofusco/. You will find me also on Twitter, @damianome, and GitHub github.com/damianof

Prerequisites

This book assumes that you are familiar with the **terminal** (**command prompt** on Windows), have already worked with the **Node.js** and **NPM** (**Node Package Manager**), know how to install packages, and are familiar with the **package.json** file.

It also assumes you are familiar with **JavaScript**, **HTML**, **CSS** and in particular with **HTML DOM** elements properties and events.

It will also help if you have some preliminary knowledge of **TypeScript**[2] as we won't get into details about the language itself or all of its features but mostly illustrate how to enforce type checking at development time with it.

You will need a text editor like **VS Code** or **Sublime Text**, better if you have extensions/plugins installed that can help specifically for React/JSX code. For VS Code for example, you could use extensions like **react-vscode-extension-pack**[3] (just search for it within the VS code extensions tab).

[2] https://www.typescriptlang.org
[3] jawandarajbir.react-vscode-extension-pack

Companion Code

The entire companion code for the book can be found on **GitHub** at: github.com/damianof/large-scale-apps-my-react-project

If you find any errors, or have difficulty completing any of the steps described in the book, please report them to me through the GitHub **issues** section here: github.com/damianof/large-scale-apps-my-react-project/issues

You are also free to reach out to me directly through Twitter at: @damianome

Chapter 1 - Setting Up The Project

***IMPORTANT**: This chapter assumes that you already have installed a recent version of **Node.js** on your computer. If you do not have it yet, you can download it here: https://nodejs.org/en/download/*

There are many different ways to create a React app. Here we'll be leveraging TypeScript and therefore will need to setup an project with a build/transpile process that will let us make changes and verify them in real time. You could manually create this project, install all the npm packages required, create each individual file. However, it is just much easier to do this by leveraging **vite**[4]

However, since **vite** is still relatively new at the time of this book writing, it might be harder for you to find help as your code-base grows larger, so this is something to keep in mind.

I added a bonus chapter at the end of the boook with instructions on how to setup the project using **create-react-app**[5] instead of vite if you prefer that. Keep in mind that the use of environment variables (which will cover in chapter 7 and 9), will differ.

Create Project Wizard

To set up the project, use the terminal and execute the following node.js command:

```
npm init vite@latest
```

If you do not have already installed the package `create-vite@latest`[6] it will prompt you to install it. In this case, type **y** and then **enter** to proceed:

```
Need to install the following packages:
  create-vite@latest
Ok to proceed? (y)
```

The create-vite wizard will start and will ask you the name of the project. The default is vite-project, so change this to **my-react-project** and hit enter:

[4] https://vitejs.dev
[5] https://github.com/facebook/create-react-app
[6] https://www.npmjs.com/package/create-vite

```
? Project name: › my-react-project
```

The second step will ask to select a framework. Use the keyboard arrows to scroll down the list and stop at **React**, then hit enter:

```
? Select a framework: › - Use arrow-keys. Return to submit.
    Vanilla
    Vue
□   React
    Preact
    Lit
    Svelte
```

The third step will asking which "variant" you want o use. Scroll down to **TypeScript** and hit enter:

```
? Select a variant: › - Use arrow-keys. Return to submit.
    JavaScript
□   TypeScript
```

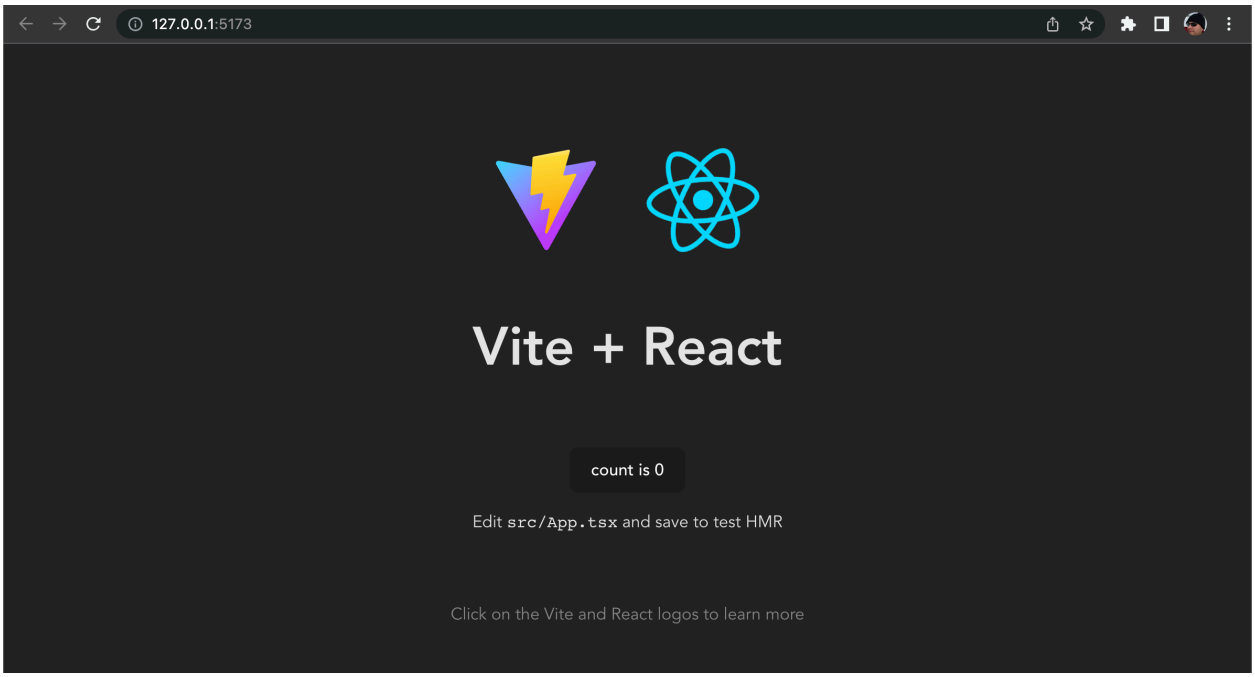
This will create a folder called **my-react-project** which is also the name of our project.
At the end it should display a message similar to this:

```
Scaffolding project in /Volumes/projects/my-react-project...

Done. Now run:

  cd my-react-project
  npm install
  npm run dev
```

The first command will navigate to the current sub-directory called **my-react-project**, the second one will install all the npm dependencies, the third one will serve the app locally. You'll see a message similar to this displayed:

```
VITE v3.1.4  ready in 303 ms

  □  Local:   http://127.0.0.1:5173/
  □  Network: use --host to expose
```

From the web browser, navigate to the http://localhost:5173 address and you'll see application home page rendered:



The **my-react-project** has been created with one main view called **App.tsx**.

Chapter 1 Recap

What We Learned

How to create the basic plumbing for a **React** app using the **vite** and `create-vite@latest`

- How to serve the app locally through the command **npm run dev**

Observations

- The app has been created with only preliminary code
- The app does not do much yet, has only the main App view with some static html in it

Based on these observations, there are a few improvements that will be making into the next chapter:

Improvements

- Expand our app functionality by creating our first component

Chapter 2 - Your First Component

The Items List

Let's now pretend we have been giving requirements for our app to have a component that displays a list of "**items**". We will keep this simple initially and as we move towards more advanced chapter expand on it to show how we can better structure our application to support:

- Quick prototyping and development using mocked data
- Component Organization
- Unit Testing
- State Management
- Internationalization support so we can render our user interface using different languages
- Localization for number and date formatting for different cultures

ItemsList Component Requirements

Your initial version of the **ItemsList** component, will have to implement the following requirements (later, in more advanced chapters, we will expand on these as we get into more advanced topics):

- The component will display a list of items
- An **item** will have 3 properties:

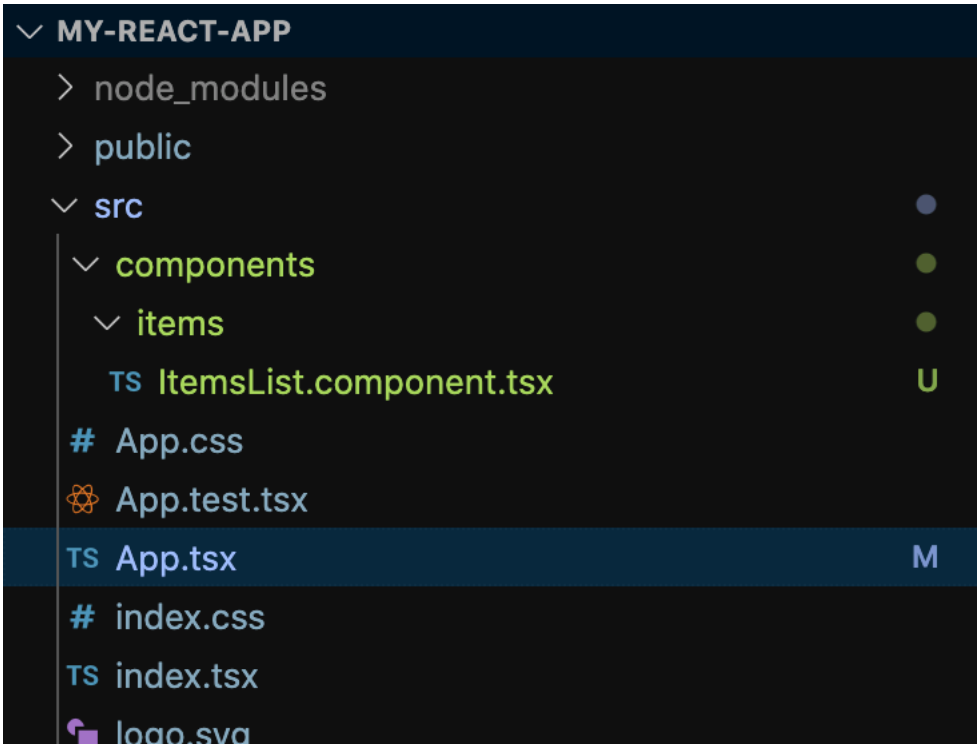
* **id**
* **name**
* **selected**

- The item **name** will be displayed to the user
- The user should be able to **select/deselect** one or more item
- An **icon** will be shown next to the name to indicate if the item is selected

ItemsList Component Code

Within the **src/components** directory, create a sub-directory called **items**. Within this folder add a new file called **ItemsList.component.tsx**[7]

Your directory structure will now look like this:



Within the **ItemsList.component.tsx** file, paste the following code:

```
// example using const of type React.FC:
import React from 'react'

export const ItemsListComponent: React.FC<{
    items: any[]
  }> = (props) => {

  return (
    <div>
      <h3>Items:</h3>
      <ul>
```

[7] *We are following a file naming convention where higher level components' names are pascal-case and follow this format [Component-Name].component.tsx - Reference: Naming Conventions section at the end of this book*

```
        {
          props.items.map((item, index) => <li key={index}>{item.name}</li>
          )
        }
      </ul>
    </div>
  )
}
```

A few things to notice here. There are different ways to create a React component. You could just return a **function**, a **class**, or like in the example above, a **const** of type **React.FC**[8]

NOTE: Deciding whether to use a function or a class might be a matter of personal preference, or just abiding the coding standard you have defined with your team in your organization. If you google `React.FC vs class` you'll get several blogs/articles where it seems the majority of developers prefer pure function or classes, rather than React.FC. Going forward, I'll try to use classes or functions throughout the book and avoid React.FC (but there might be cases where I use any of the three)

When using a const of type React.FC, you will need to return the component html wrapped with parentheses. If using a class, you will need to implement a **render** function that returns the html.

For example, using the **class** syntax, the above component can be re-written as:

```
// example using class extending component
import React from 'react'

export class ItemsListComponent extends React.Component<{
  items: any[]
}> {
  constructor(props: {
    items: any[]
  }) {
    super(props)
  }

  render(): React.ReactNode {
    const { items } = this.props

    return <div>
        <h3>Items:</h3>
```

[8] *React.FC*

```
        <ul>
          {
            items.map((item: any, index: number) => <li key={index}>{item.name}</li>)
          }
        </ul>
      </div>
  }
}
```

Please go ahead and replace the code with the above using the class syntax. Then save and verify everything still renders as before without error in the browser console.

Here is what we are doing int he component code above:

For our html, we are returning a ** ** element containing:

- a **<h3>** element with hard-coded text just saying "**Items**:"
- a **<ul>** element with some code that will render all our **items** as **<li>** elements.

We use the JavaScript Array native **map** method to loop through the **Items** array and return an **<li>** element for each item in the array. The **<li>** element will display the item name in the browser. Note how we have to also specify the **key** attribute which is required to be unique within a list rendered by React. Here we leverage the fact the the **map** method returns the **index** of the item in the array as the second argument to our handler function (index). The index is good enough for now to use for the key attribute.

Note that with map you can either inline the return expression, thus not needing the keyword return:

```
items.map((item, index) => <li key={index}>{item.name}</li>)
```

Or you could use {} (curly braces) for the function body, and use the return keyword in this case:

```
items.map((item, index) => {
  return <li key={index}>{item.name}</li>
})
```

Which syntax you use is up to your preference. However, remember that in a team, especialy in a large organization, there will be coding standards that will dictacte how you consistently write code. You should always abide the standard that you and your team have agreeed upon.

Note also that we declared the **items** property as an array of **any**[9] for now (later we'll replace

[9] *With 'any', TypeScript does not enforce type-checking on a property or variable. However, this is considered a bad practice as we lose the main benefit of TypeScript. There might be exceptions to this rule when using older 3rd party packages/libraries/plugins that do not offer type definitions. However, even in those cases it would be strongly recommended to provide interfaces and types so that you can still avoid using 'any'.*

any with an interface we'll create):

```
...
  {
    items: any[] // avoid using "any", in later chapters we'll replace with a TS int\
erface
  }
...
```

Main App View

Open the **src/App.tsx** file. Replace the entire existing code with this:

```
//file: src/App.tsx

// component:
function App() {
  return (
    <div>
      ...
    </div>
  );
}

export default App
```

Let's start by adding at the top an import to reference our **ItemsList.component.tsx**:

```
//file: src/App.tsx

// import reference to your ItemsList component:
import { ItemsListComponent } from './components/items/ItemsList.component'
...
```

For now, quickly mock some data for our list of **items** that we will feed to our **ItemsList-Component**. For this we instantiate a local variable called **items** and initialize it with some hard-coded data[10].

We do this before the App function declaration:

[10] *Note: using hard-coded data is a bad practice and here we are only doing it to first illustrate how things flow, and later in the next chapters will remove in favor of best practices and patterns (see Chapter 5)*

```
//file: src/App.tsx

// import reference to your ItemsList component:
import { ItemsListComponent } from './components/items/ItemsList.component'

// mock data:
const items: any[] = [{
          id: 1,
          name: 'Item 1'
        }, {
          id: 2,
          name: 'Item 2'
        }, {
          id: 3,
          name: 'Item 3'
        }]

// component:
function App() {
...
```

Finally, we modify the content inside the (within the return statement). Let just add our **ItemsListComponent** and pass the hard-coded **items** data to it through its property **items**.

The complete code within the **App.tsx** file should now look like this:

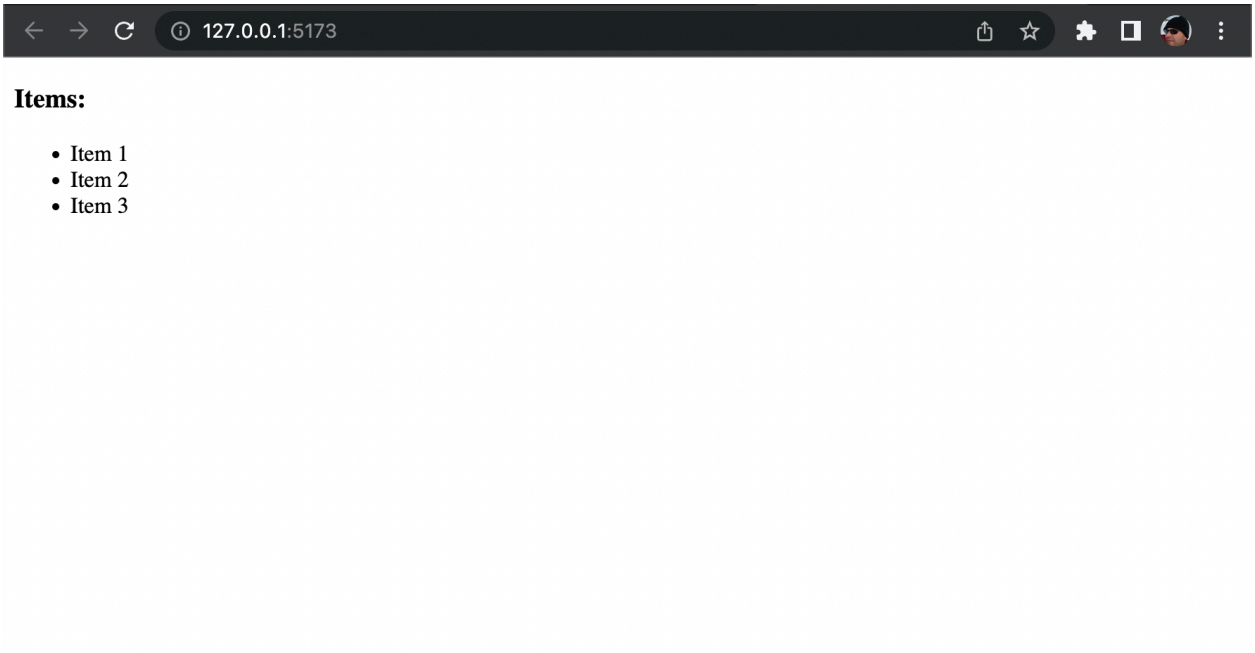
```
//file: src/App.tsx

// import reference to your ItemsList component:
import { ItemsListComponent } from './components/items/ItemsList.component'

// mock data:
const items: any[] = [{
  id: 1,
  name: 'Item 1'
}, {
  id: 2,
  name: 'Item 2'
}, {
  id: 3,
  name: 'Item 3'
}]
```

```
// component:
function App() {
  return (
    <div>
      <ItemsListComponent items={items}/>
    </div>
  );
}

export default App
```

Update src/main.tsx by removing or commenting the imported index.css file:

```
import React from 'react'
import ReactDOM from 'react-dom/client'
import App from './App'
// import './index.css' // <-- comment out or remove this line

ReactDOM.createRoot(document.getElementById('root') as HTMLElement).render(
  <React.StrictMode>
    <App />
  </React.StrictMode>
)
```

Save the file. The web browser will refresh and display our preliminary items list being rendered more or less like this:


127.0.0.1:5173
Items:
Item 1
Item 2
Item 3

Chapter 2 Recap

What We Learned

- How to create a basic component that displays a list of items
- How to consume that component from another component or view

Observations

- The **items** property within the **ItemsList.component.tsx** is declared as an array of type **any**
- The **App.tsx** view contains hard-coded data (items) which is also declared as an array of **any**
- This means we are not leveraging strong-type checking at development time using TypeScript interfaces/models/types

Based on these observations, there are a few improvements that we will make in the next chapters:

Improvements

- Create a TypeScript interface called **ItemInterface** for enforcing type checking at development time for our **items** data
- Update our code so it uses the new **ItemInterface** interface

Chapter 3 - Data Models and Interfaces

In this chapter, we will delve into the power of **TypeScript** by leveraging its strong-type checking capabilities through the use of interfaces. One of the main challenges with pure JavaScript is its loosely typed nature, which can lead to unexpected behavior and bugs at run-time. This is due to the lack of checks on the type or properties of values or objects being passed around in the code. TypeScript solves this problem by providing developers with the ability to enforce strict type checking at development time through the use of interfaces, types, classes, and more.

By incorporating TypeScript into our project, we'll be able to catch potential issues and bugs before they reach the production environment, saving us time and resources in debugging and fixing. Moreover, strong-typing also improves the readability and maintainability of our code, making it easier for developers to understand the purpose and usage of values and objects in the codebase. In this chapter, we'll explore how to use interfaces and types to implement strong-typing in our project, and how it can help us ensure the reliability and quality of our code.

Models Directory

To lay the foundation for building large-scale applications, we will start by creating a new sub-directory under **src** called **models**. The organization of files and directories plays a critical role in the success of large-scale code bases. As such, it's essential to establish a consistent naming **convention** and directory structure from the outset. This will help ensure that the code remains organized, easy to understand, and maintainable as the application grows and the number of source files and directories increases.

You and your team are free to determine the standards that work best for you, but it's crucial to establish a set of conventions and stick to them. This will save you a significant amount of time and effort in the long run and prevent confusion and headaches as the application grows and evolves.

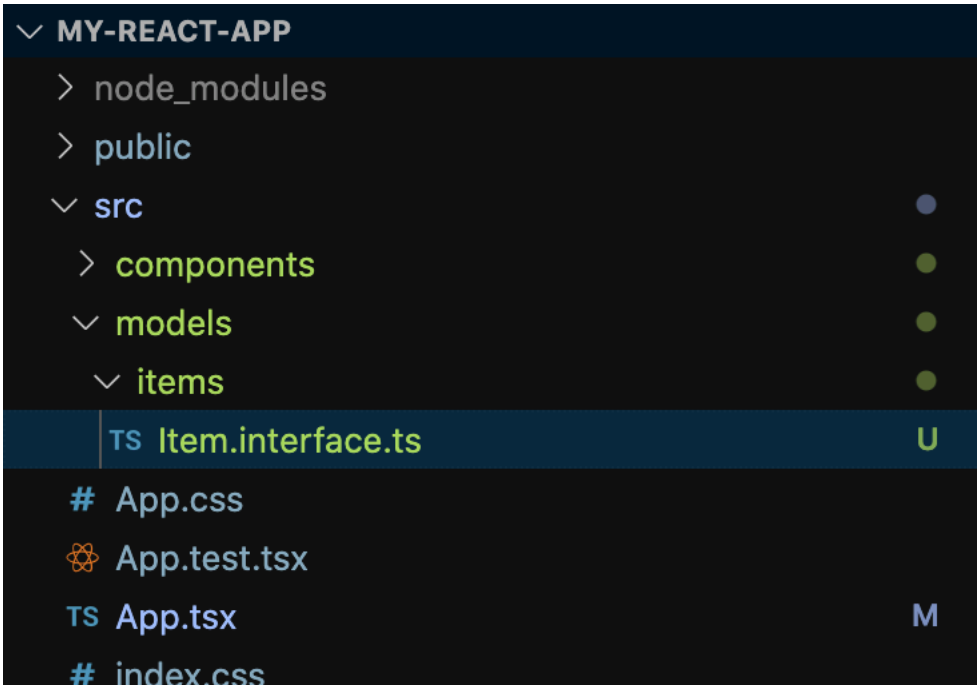
Interface ItemInterface

To create the interface for our items, we will create a new directory called **src/models/items** and add a TypeScript file named **Item.interface.ts**.

It's worth noting that there are different naming conventions for TypeScript interfaces, with some preferring to use a suffix like **Interface**, while others use a prefix like **I**. In this book, we will follow the suffix convention, using **Item.interface.ts** as the file name. However, you are free to choose your preferred naming convention or align with your organization's coding standards.

It's important to keep each interface in its own file, as this makes it easier to maintain and manage. For more information on naming conventions, please refer to the Naming Conventions section at the end of this book.

Your directory structure should now look similar to this:



Let's write an interface that represents one item that will be rendered in our **Item** component. Our interface will have three properties:

- **id**: this is a unique number for each item in the list
- **name**: is a string containing the name of the item
- **selected**: is a boolean value that shows if the user has selected the item

The code for your interface should look like this:

```
// file: src/models/items/Item.interface.ts

export interface ItemInterface {
  id: number
  name: string
  selected: boolean
}
```

For now, that is all we need. Since this will only represent a piece of data, we do not need to implement a class.

NOTE: In this case our ItemInterface only holds fields, but no methods. You can think of this more like the type struct in language like C or C#. Unfortunately TypeScript does not have an explicit struct type[11] *and their guidance is to use interfaces for this.*

ItemsList Component

Now that we have our interface, we can finally leverage TypeScript type checking ability by changing our items property on the items component from **any[]** to **ItemInterface[]**. First, import a reference for **ItemInterface**:

```
// file: src/components/items/ItemsList.component.tsx

import React from 'react'
// import reference to our interface
import { ItemInterface } from '../../models/items/Item.interface'
...
```

Then modify our items property declaration from any[] to ItemInterface[]:

[11] *There have been suggestions presented, but I do not think they will ever add a struct type. See the TypeScript team answers here:* https://github.com/microsoft/TypeScript/issues/22101

```
// file: src/components/items/ItemsList.component.tsx

// example using const of type React.FC:
import React from 'react'
// import reference to our interface
import { ItemInterface } from '../../models/items/Item.interface'

export const ItemsListComponent: React.FC<{
    items: ItemInterface[] // replace any[] with ItemInterface[]
  }> = (props) => {

...
```

The complete update code should look like this:

```
// file: src/components/items/ItemsList.component.tsx

// example using const of type React.FC:
import React from 'react'
// import reference to our interface
import { ItemInterface } from '../../models/items/Item.interface'

export const ItemsListComponent: React.FC<{
    items: ItemInterface[] // replace any[] with ItemInterface[]
  }> = (props) => {

  return (
    <div>
      <h3>Items:</h3>
      <ul>
        {
          props.items.map((item, index) => <li key={index}>{item.name}</li>
          )
        }
      </ul>
    </div>
  )
}
```

Or if you went with the class syntax:

```
// file: src/components/items/ItemsList.with-class-syntax.tsx

// example using class extending component
import React from 'react'
// import reference to our interface
import { ItemInterface } from '../../models/items/Item.interface'

export class ItemsListComponent extends React.Component<{
  items: ItemInterface[] // replace any[] with ItemInterface[]
}> {
  constructor(props: {
    items: ItemInterface[] // replace any[] with ItemInterface[]
  }) {
    super(props)
  }

  render(): React.ReactNode {
    const { items } = this.props

    return <div>
        <h3>Items:</h3>
        <ul>
          {
            items.map((item: any, index: number) => <li key={index}>{item.name}</li>)
          }
        </ul>
      </div>
  }
}
```

Make sure the terminal does not display any error, and that the web browser refreshed and no error are displayed in the browser console.

App View

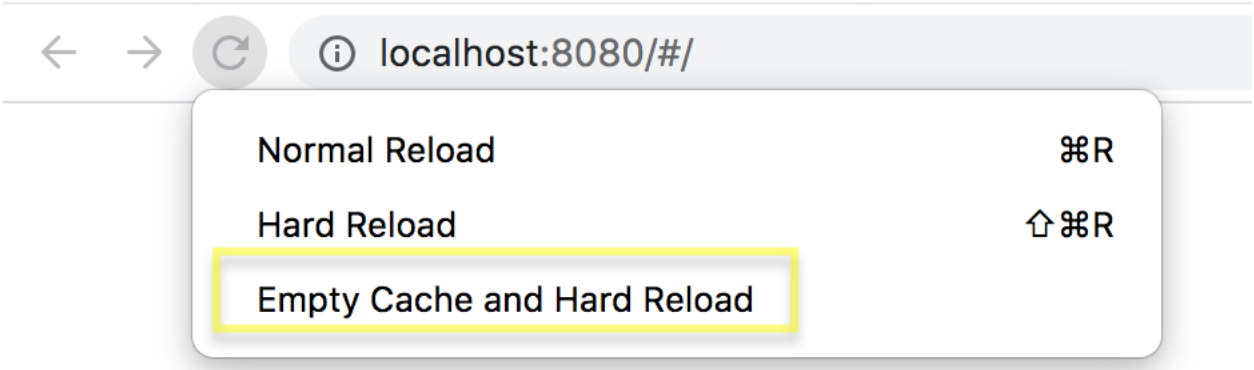
We should also update the **App.tsx** code so it uses the **ItemInterface** interface for the locally private property also called **items**.

Please note, that as soon as you change the items property from any[] to ItemInterface[] it will complain that each item does not correctly implement the interface. This is because we did not initially include the selected property required by the interface. This is one of the powerful

things of using TypeScript correctly. It will help catch errors like this at development time rather than run time, increase the code quality and make it less prone to bugs. So make sure each item has now also a selected field with a default of false.

```
// file: src/App.tsx

import './App.css'
// import reference to our interface
import { ItemInterface } from './models/items/Item.interface'
// import reference to your ItemsList component:
import { ItemsListComponent } from './components/items/ItemsList.component'

// mock data:
const items: ItemInterface[] = [{ // change any[] to ItemInterface[]
  id: 1,
  name: 'Item 1',
  selected: false // add selected: false to each item
}, {
  id: 2,
  name: 'Item 2',
  selected: false
}, {
  id: 3,
  name: 'Item 3',
  selected: false
}]
...
```

Again, make sure the terminal does not display any errors, and that the web browser refreshed and no error are displayed in the browser console. As you make changes is also a good idea occasionally to do an **Empty Cache and Hard Reload** by right clicking on the Chrome refresh icon and selecting the last option:


localhost:8080/#/
Normal Reload ⌘R
Hard Reload ⇧⌘R
Empty Cache and Hard Reload

Chapter 3 Recap

What We Learned

- It's important to follow files and directories naming convention and structure convention
- How to leverage **TypeScript** interfaces and avoid using **any** so that strong-type checking is enforced at development time and avoiding potential runtime errors or hidden bugs

Observations

- The **App.tsx** contains a local variable that holds hard-coded mocked data that enabled us to prototype our component quickly
- **ItemsList.component.tsx** just displays the list of items, but the user has still no ability to click on them to change their **selected** property

Based on these observations, there are a few improvements that we will make into the next chapter:

Improvements

- Update our component so that when a user clicks on an item displayed on the page, the item selected property will toggle from false to true (and vice versa)

Chapter 4 - Adding Events To the Items Component

In this chapter we keep building our **ItemsList.component.tsx** so we can handle when the user clicks on an item in the list.

ItemsList Component

Start by adding a function called **handleItemClick** just before the render() function. This function will handle a click on each of the **<li>** elements and will toggle the **item.selected** property from true to false or vice versa. It will also logs the item **id** and **selected** properties to the console for preliminary debugging:

```
// file: ItemsList.component.tsx
...
// if using class syntax
handleItemClick (item: ItemInterface) {
  item.selected = !item.selected
  console.log('handleItemClick', item.id, item.selected)
}

render() {
  ...

// or if using React.FC syntax:
const handleItemClick = (item: ItemInterface) => {
  item.selected = !item.selected
  console.log('handleItemClick', item.id, item.selected)
}

return (
  ...
```

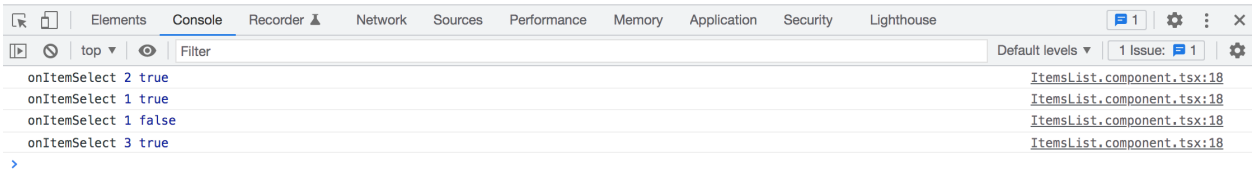
Then update the return/render section of the render() function by adding an **onClick** attribute to the **<li>** element, pointing to an handler called **handleItemClick** and passing a reference to **item** as the argument:

```
// file: ItemsList.component.tsx
...
// if using class syntax:
render(): React.ReactNode {
    const { items } = this.props

    return (
      <div>
        <h3>Items:</h3>
        <ul>
          {
            items.map((item: any, index: number) => <li key={index} onClick={() => t\
his.handleItemClick(item)}>{item.name}</li>)
          }
        </ul>
      </div>
    )
  }
...

// or if using React.FC syntax:
...
return (
    <div>
      <h3>Items:</h3>
      <ul>
        {
          props.items.map((item, index) => <li key={index} onClick={() => handleItem\
Click(item)}>{item.name}</li>
          )
        }
      </ul>
    </div>
  )
...
```

Note that React uses its own syntax for html attributes (because of JSX), and the standard html onclick event is called **onClick** (note the letter casing) in React. Additionally, the onClick attribute expect a method with a specific signature, and we should add wrap it within an inline funciton in this (or TypeSCript will throw an error):

```
() => handleItemClick(item)
```

Save the file. The web browser should have refreshed, and when clicking on the items in the list you should see the message being displayed in the browser developer console, and when clicking multiple time on the same item it should print true then false etc showing that toggling is working:



Now, we learned how to add a click handler to our component and changing the data item selected property that way. However, updating the selected property within the onItemSelect will not cause React to re-render the html. This is because the data we are working with is not yet **reactive**.

Let's verify this. Start by slightly modifying the text output by our list element, outputting also the selected value within [] (square brackets) like "[]":

```
// file: ItemsList.component.tsx
...
props.items.map((item, index) => {
            return (
              <li key={index}
                onClick={() => handleItemClick(item)}>
                  {item.name} [{ String(item.selected) }] {/* output item.selected n\
ext to the name */}
              </li>
            )
          })
...
```

Note: React is peculiar when rendering some types of properties. If you were trying to just render item.selected, which is a boolean, without either wrapping with String() or call item.selected.toString(), then it will never render its value.

Save and check the browser again. Notice that even though after clicking on the list items you see a message in the console with the updated value for the selected property, the html is not being re-rendered.

In order to make our data reactive, we have to use React's hook **useState**. Let's try this. First, lets modify the code in our ItemsListComponent so that it takes also a second property called **onItemSelect**.

While we add onItemSelect property, let's also refactor a bit and create a type/interface for our component properties called simply **Props**. There is no need for a better name as we'll not be exporting this type/interface but using it only within the ItemsList.component.tsx code:

```
// file: ItemsList.component.tsx

// if using the class syntax:
...
// extract type for component properties:
type Props = {
  items: ItemInterface[],
  onItemSelect: (item: ItemInterface) => void
}
// remove the type declaration within React.Component<> and replace it with Props.
// also, change the constructor signature to use Props as the type of the props argu\
ment:
export class ItemsListComponent extends React.Component<Props> {
  constructor(props: Props) {
    super(props)
  }
  ...

// or if using React.FC syntax:
...
// change the function type signature to use Props as the type of the props argument:
export const ItemsListComponent: React.FC<Props> = (props) => {
  ...
// NOTE: React is perfectly happy with normal function signatures so you could simpl\
y use this if you prefer: export const ItemsListComponent = (props: Props) => { ...


 ...
```

Then, modify the function onClick to just invoke the props.onItemSelect functoin that is passed by the parent component:

```
// file: ItemsList.component.tsx
...
handleItemClick (item: ItemInterface) {
  this.props.onItemSelect(item) // Note: you need to use the "this" prefix here only\
 if using class syntax
}
...
```

Now, open the App.tsx file and lets modify some code in here. Start by importing a reference at the top to the hook **useState**:

```
import { useState } from 'react'
```

Then remove our mock data array. Instead, within the function App(), add this code:

```
// file: App.tsx
...
// begin: remove code block
// mock data:
// const items: ItemInterface[] = [{
//   id: 1,
//   name: 'Item 1',
//   selected: false
// }, {
//   id: 2,
//   name: 'Item 2',
//   selected: false
// }, {
//   id: 3,
//   name: 'Item 3',
//   selected: false
// }]
// end: remove code block

function App() {
  // begin: add code block
  // add the useState declaration here passing our mock-data array as an argument
  const [items, setItems] = useState<ItemInterface[]>([{
    id: 1,
    name: 'Item 1',
    selected: true
  }, {
```

```
    id: 2,
    name: 'Item 2',
    selected: false
  }, {
    id: 3,
    name: 'Item 3',
    selected: false
  }])
  // end: add code block
  ...
```

What we are doing here is invoke the hook **useState**, specifying the type to be ItemInterface[], and pass our initial mock data array in it. The **useState** hook returns an array where the first parameter is a reference to your data, in this case **items**, the second parameter is a funciton that allow to update the data, in this case we called it **setState**.

Now let's add a function called **onItemSelect**. Since we are already within a function (App), we can either declare is as a arrow functoin stored into a const, or as a pure function:

```
// file: App.tsx
...
// either as:
function onItemSelect (item: ItemInterface) {
   ...
// or as:
const onItemSelect = (item: ItemInterface) => {
   ....
```

Let's go with an arrow function. Here is the full code for the function:

```
// file: App.tsx
...

  // begin: add code block
  const onItemSelect = (item: ItemInterface) => {
    const updatedItems = [...items]
    const found = updatedItems.find(o => o.id === item.id) as ItemInterface
    found.selected = !item.selected
    setItems(updatedItems)
    console.log('App.tsx: onItemSelect', found.id, found.selected, updatedItems)
  }
  // end: add code block
```

```
...
```

Finally, modify the return() section to pass our **onItemSelect** handler function through a property with the same on **ItemsListComponent**:

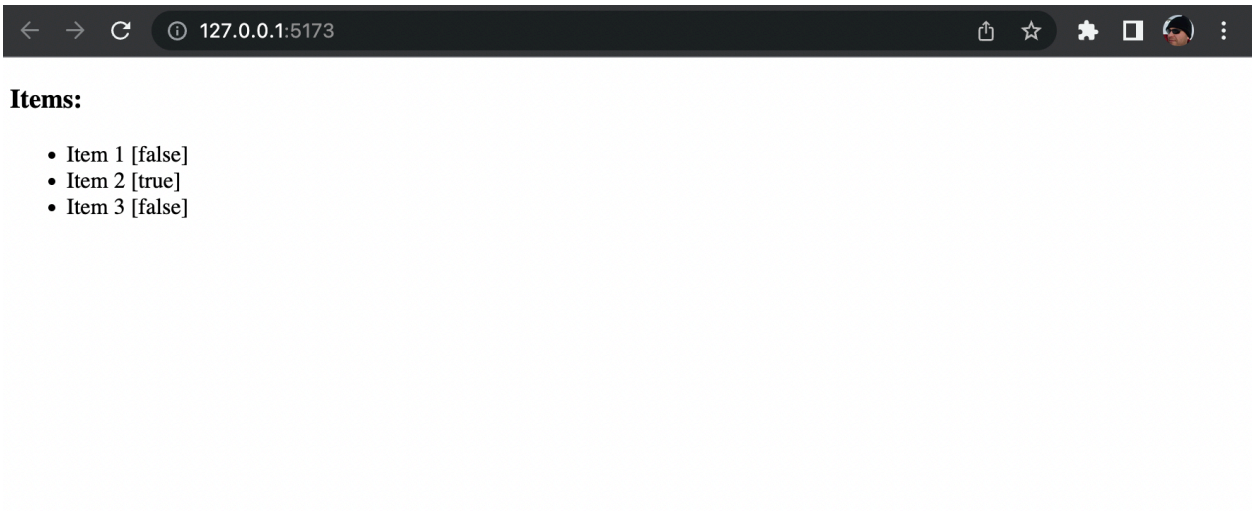
```
// file: App.tsx
...
return (
  <div className="App">
    <ItemsListComponent items={items} onItemSelect={onItemSelect}/>
  </div>
)
```

Here is the full update code of App.tsx:

```
// file: src/App.tsx
import { useState } from 'react'
// import reference to our interface
import { ItemInterface } from './models/items/Item.interface'
// import reference to your ItemsList component:
import { ItemsListComponent } from './components/items/ItemsList.component'

// component:
function App() {
  // add the useState declaration here passing our mock-data array as an argument
  const [items, setItems] = useState<ItemInterface[]>([{
    id: 1,
    name: 'Item 1',
    selected: true
  }, {
    id: 2,
    name: 'Item 2',
    selected: false
  }, {
    id: 3,
    name: 'Item 3',
    selected: false
  }])

  const onItemSelect = (item: ItemInterface) => {
    const updatedItems = [...items]
```

```
    const found = updatedItems.find(o => o.id === item.id) as ItemInterface
    found.selected = !item.selected
    setItems(updatedItems)
    console.log('App.tsx: onItemSelect', found.id, found.selected, updatedItems)
  }

  return (
    <div>
      <ItemsListComponent items={items} onItemSelect={onItemSelect}/>
    </div>
  );
}

export default App
```

Save the file, and check the web browser. This time, you can see the html re-rendering and the correct value, either true/false, displayed next to each item as you click on them.



Chapter 4 Recap

What We Learned

- How to add a click handler to our **ItemsList** component
- How to manipulate the **item.selected** property through our click handler
- How to use the React hook **useState** to create a reactive property named **items**, and a method to update the React state

Observations

- The **items selected** property is being manipulated directly within our component
- We need a more centralized way to handle changes on the data and state of the application

Based on these observations, there are a few improvements that we will make in the next chapters:

Improvements

- Implement a state manager to control our application state from a centralized place

Chapter 5 - Intro to Unit Testing While Refactoring a Bit

We will now delve into writing unit tests for our project. Unit tests serve as a critical aspect of ensuring the stability and reliability of our code. In this book, we will cover two main categories of unit tests:

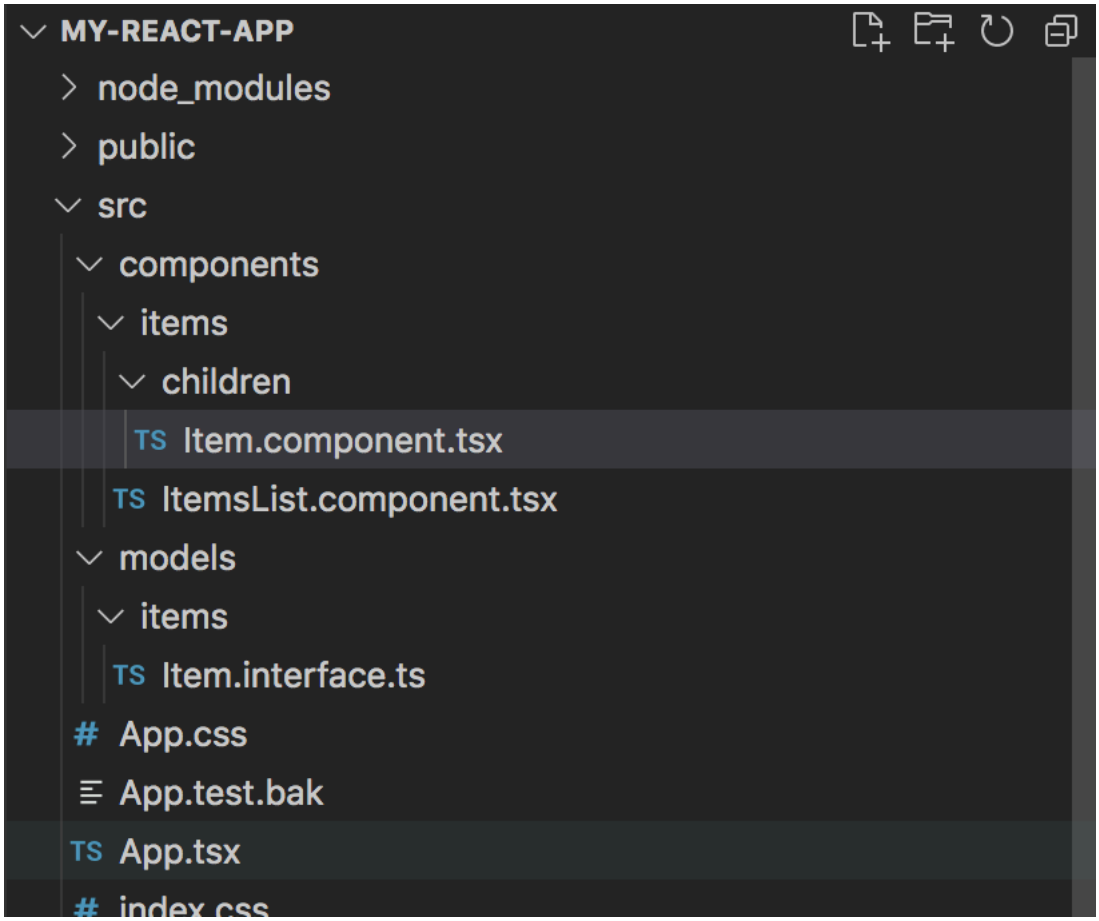
- Unit tests for models, classes, structures, and interfaces (such as the API client and helpers)
- Unit tests for React components

Note: It's worth mentioning that there is a third category of tests, known as end-to-end (e2e) tests, but we will not be covering those in this book.

Our first step will be to write unit tests for our React components. We will start with the **ItemsList** component and while doing so, we will make some refactors to improve its implementation. The unit tests will validate the changes we make, ensuring that our code remains functional and free of bugs.

ItemComponent

Remember how in our **ItemsList** component we have a loop that creates **<li>** elements, one for each item in our **items** property? Let's extract the code for the **<li>** element and create a child component just for that. Let's start by adding a new file called **Item.component.tsx** under the **src/components/items/children** directory:



Paste the following code in the Item.component.tsx file:

```
// file: Item.component.tsx

import React from 'react'
// import reference to our interface
import { ItemInterface } from '../../../models/items/Item.interface'

// component props type:
type Props = {
  testid: string
  model: ItemInterface,
  onItemSelect: (item: ItemInterface) => void
}

// example using class syntax
export class ItemComponent extends React.Component<Props> {
  constructor(props: Props) {
```

```
    super(props)
  }

  get cssClass () {
    let css = 'item'
    if (this.props.model?.selected) {
      css += ' selected'
    }
    return css.trim()
  }

  handleItemClick (item: ItemInterface) {
    this.props.onItemSelect(item)
  }

  render(): React.ReactNode {
    const { model } = this.props
    const testid = this.props.testid || 'not-set'

    return (
      <li data-testid={testid} className={this.cssClass} onClick={() => this.handleI\
temClick(model)}>
        <div className="selected-indicator">*</div>
        <div className="name">{model.name}</div>
      </li>
    )
  }
}
```

*Note: we added also a **testid** property that will bind to the **data-testid** property of the outer html DOM element of our component. This will make it easier to select the element during the unit tests or automation tests.*

We just created a template for a single **<li>** element. We also enhanced this a bit by replacing the rendering of the name with binding **{ item.name }** with two child ** ** elements:

- one to display the Item name
- one that will show a star icon (*we are just using a char here, but in the next chapters we'll be replacing this with real icons from the font library material-icons*)

Then we added a computed property called **cssClass** that will return the string "**item**" or "**item selected**". We then bind this to the ** className** attribute, based on whether the **model.selected** property is true or false: **<li className={this.cssClass} onClick={() ⇒ this.handleItemClick(model)}>**

This will have the effect to render the **<li>** element in two possible ways:

- <li class="item"> (when not selected)
- <li class="item selected"> (when selected)

We also bind to the click event with **onClick** binding and in the local **onClick** handler we just invoke the parent handler through the prop **onItemSelect** and pass it the model as the argument (props.model). We will then handle this in the parent component (**ItemsList** component as before).

App.css

Let's also replace the content of the file App.css with this quick-and-dirty css:

```
/* file: App.css */

.App {
  padding: 20px;
}
ul {
  padding-inline-start: 0;
  margin-block-start: 0;
  margin-block-end: 0;
  margin-inline-start: 0px;
  margin-inline-end: 0px;
  padding-inline-start: 0px;
}
li.item {
  padding: 5px;
  outline: solid 1px #eee;
  display: flex;
  align-items: center;
  height: 30px;
  cursor: pointer;
  transition: background-color 0.3s ease;
}
li.item .name {
  margin-left: 6px;
}
li.item .selected-indicator {
  font-size: 2em;
  line-height: 0.5em;
  margin: 10px 8px 0 8px;
  color: lightgray;
```

```
}
li.item.selected .selected-indicator {
  color: skyblue;
}
li.item:hover {
  background-color: #eee;
}
```

Note: the css above is just a quick-and-dirty bit of styling so we can make our list look a bit prettier for now. In later chapters we'll introduce TailwindCSS and keep working with that instead of writing our own css.

Within the src/App.tsx you went to restore/uncomment the line we commented out or removed in earlier chapters:

```
// file: src/App.tsx
import './App.css' // <-- restore this import
...
```

Install npm dependencies for unit tests

Let's install Vitest and other npm libraries we need to be able to run the unit tests:

```
npm i -D vitest jsdom @testing-library/react @testing-library/user-event @types/jest
```

Configuration

Now we need to configure a few things to be able to run unit tests.

tsconfig.json file

Add "vite/client" and "vitest/globals" to tsconfig.json compilerOptions types:

```
// file: my-react-project/tsconfig.json

...

  "compilerOptions": {
    ...
    "baseUrl": ".",
    "paths": {
      "@/*": [
        "src/*"
      ]
    },
    "types": [
      "react",
      "vite/client",
      "vitest/globals"
    ]
    ...
```

vite.config.js files

Add “test” section with the following settings to the vite.config.js files:

```
// file: my-react-project/vite.config.js (and any other vite.config.xyz.js file)

/// <reference types="vitest" />
/// <reference types="vite/client" />
import { defineConfig } from 'vite'
import react from '@vitejs/plugin-react'

// https://vitejs.dev/config/
export default defineConfig({
  plugins: [
    react()
  ],
  test: {
    globals: true,
    environment: 'jsdom',
    exclude: [
      'node_modules'
    ]
  }
})
```

package.json

Within the package.json file, add the following command shortcuts within the script section:

```
...

  "scripts": {
    ...
    "test": "vitest run",
    "test-watch": "npm run test -- --watch"
  }
...
```

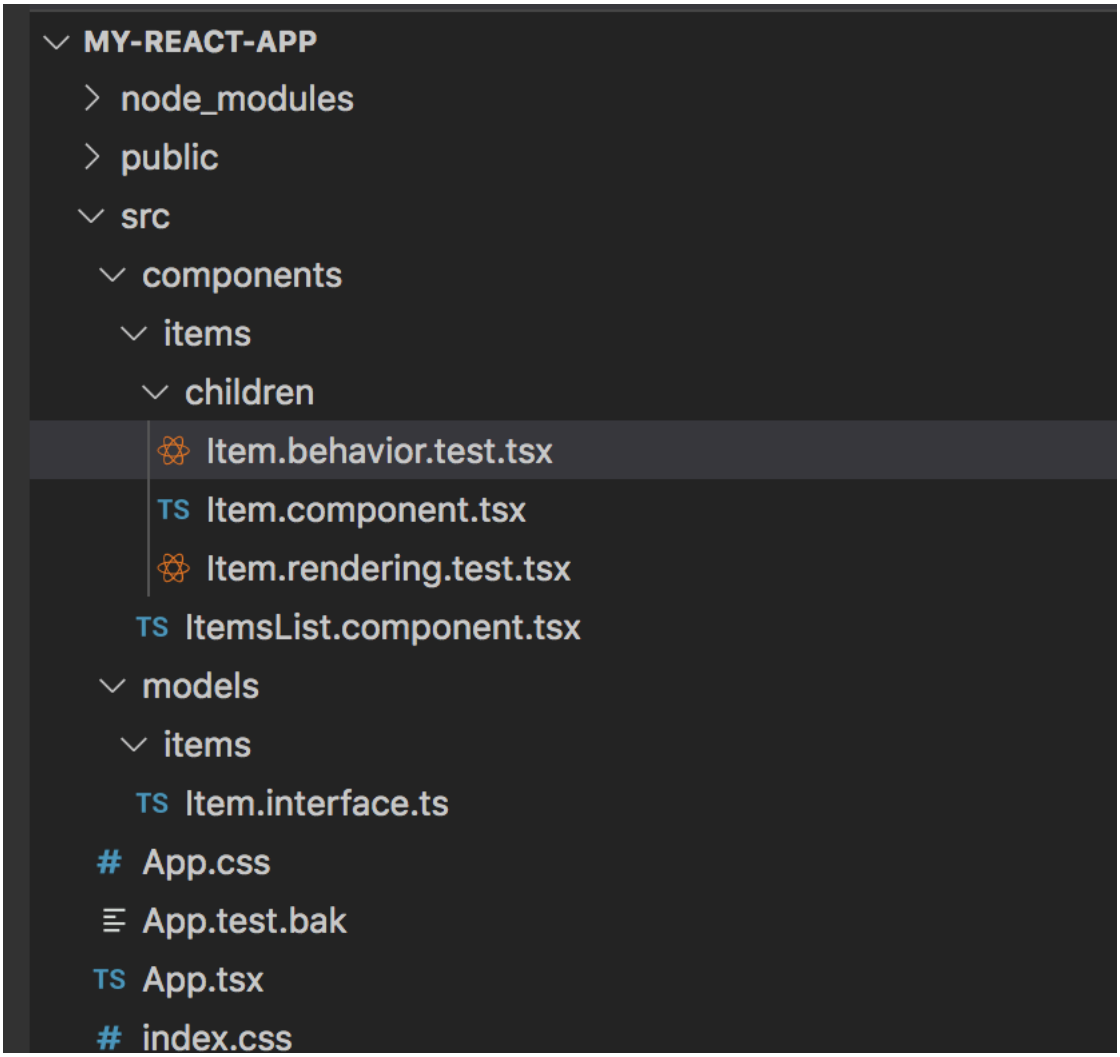
ItemComponent Unit Tests

Now, let's add our first **unit tests** for our newly created component.

Within the same directory where our **Item.component.tsx** is located, add two new files:

- one called **Item.rendering.test.tsx**
- one called **Item.behavior.test.tsx**

Your directory structure will look now ike this:



NOTE: Jest has become quite old at this point and hard to work with epecially in Vite as it requires a lot of dependencies and setup. I strongly suggest to use ***Vitest***[12] *and added a bonus chapter at the end of the book with instructions on how to do this. Furthermore, additional unit tests will add in the more advanced chapters will be using Vitest.*

Item.rendering.test.tsx

Open the file Item.rendering.test.tsx and paste the following code in it:

[12] https://vitest.dev

```
// file: Item.rendering.test.tsx

import { render, screen, prettyDOM } from '@testing-library/react'

// import reference to our interface
import { ItemInterface } from '../../../models/items/Item.interface'
// import reference to your Item component:
import { ItemComponent } from './Item.component'

describe('Item.component: rendering' , () => {

    it('renders an Item text correctly', () => {
    const testid = 'unit-test-item'
    const model: ItemInterface = {
      id: 1,
      name: 'Unit test item 1',
      selected: false
    }

      // render component
    render(<ItemComponent testid={testid} model={model} onItemSelect={() => {}} />)
      // get element reference by testid
      const liElement = screen.getByTestId(testid)

      // test
      expect(liElement).not.toBeNull()

      // get element children
      const children = liElement.children
    expect(children).toHaveLength(2)
    expect(children.item(1)?.innerHTML).toContain('Unit test item 1')
  })

  it('renders an Item indicator correctly', () => {
    const testid = 'unit-test-item'
    const model: ItemInterface = {
      id: 1,
      name: 'Unit test item 2',
      selected: false
    }

      // render component
      render(<ItemComponent testid={testid} model={model} onItemSelect={() => {}} />)
```

```
      // get element reference by testid
      const liElement = screen.getByTestId(testid)

      // test
      expect(liElement).not.toBeNull()

      // get element children
      const children = liElement.children
      expect(children).toHaveLength(2)
      expect(children.item(0)?.innerHTML).toEqual('*')
  })

  // we'll add more here in a second

})
...
```

*Note: we are leveraging here the React **testing-library**[13], make sure you install the necessary dependencies (see the repository for the book code on GitHub).*

We test that the component renders the data model properties as expected. For now, we are checking if the entire text rendered by the component contains the model.name and also that there is an element rendering the *. This is not very precise as our component later might render additional labels and our test might match these instead resulting in possible false positives.

Note: These example are just to get you started. Later you can look at more precise ways to test what our component has rendered or even trigger events on them.

Run our unit tests from the terminal with this command:

```
npm run test
```

It should run the unit tests and print the results on the terminal, similar to this:

[13] https://testing-library.com/docs/react-testing-library/intro

```
> vitest run

 RUN  v0.23.4 /my-react-project/

 ✓ src/components/items/children/Item.rendering.test.tsx (2)

Test Files  1 passed (1)
     Tests  2 passed (2)
  Start at  08:45:41
  Duration  829ms (transform 269ms, setup 0ms, collect 132ms, tests 15ms)
```

Let's add two more tests within the same file to check that the component has the expected CSS classes.
Test to check that it has the class "selected" when **item.selected** is **true**, and that does NOT have the css class "selected" when **item.selected** is **false**:

```
// file: Item.rendering.test.tsx

...

describe('Item.component: rendering' , () => {

  ...

  it('has expected css class when selected is true', () => {
    const testid = 'unit-test-item'
    const model: ItemInterface = {
      id: 1,
      name: 'Unit test item 3',
      selected: true
    }

    // render component
    render(<ItemComponent testid={testid} model={model} onItemSelect={() => {}} />)
    // get element reference by testid
    const liElement = screen.getByTestId(testid)

    // test
    expect(liElement).not.toBeNull()

    // check that the element class attribute has the expected value
    expect(liElement.className).toContain('selected')
```

```
  })

  it('has expected css class when selected is false', () => {
    const testid = 'unit-test-item'
    const model: ItemInterface = {
      id: 1,
      name: 'Unit test item 3',
      selected: false
    }

    // render component
    render(<ItemComponent testid={testid} model={model} onItemSelect={() => {}} />)
    // get element reference by testid
    const liElement = screen.getByTestId(testid)

    // test
    expect(liElement).not.toBeNull()

    // check that the element class attribute does not contain 'selected'
    expect(liElement.className).not.toContain('selected')
  })

})
```

Item.behavior.test.tsx

We can also test the behavior of our component by programmatifcally triggering the onClick event. Let's open the file **Item.behavior.test.tsx** and paste the following code in it:

```
// file: Item.behavior.test.tsx

import { render, fireEvent, prettyDOM } from '@testing-library/react'

// import reference to our interface
import { ItemInterface } from '../../../models/items/Item.interface'
// import reference to your Item component:
import { ItemComponent } from './Item.component'

describe('Item.component: behavior' , () => {

  // test our component click event
  it('click event invokes onItemSelect handler as expected', () => {
```

```
    const model: ItemInterface = {
      id: 1,
      name: 'Unit test item 1',
      selected: false
    }

    // create a spy function with vitest.fn()
    const onItemSelect = vitest.fn()

    const testid = 'unit-test-item'

    // render our component
    const { container } = render(<ItemComponent testid={testid} model={model} onItem\
Select={onItemSelect} />)
    // get a reference to the <li> element
    const liElement = container.firstChild as HTMLElement
    // fire click
    fireEvent.click(liElement)
    // check test result
    expect(onItemSelect).toHaveBeenCalledTimes(1)
  })

})
```

Save and check the test results and make sure all pass (if you had stopped it, run `npm run test` again).

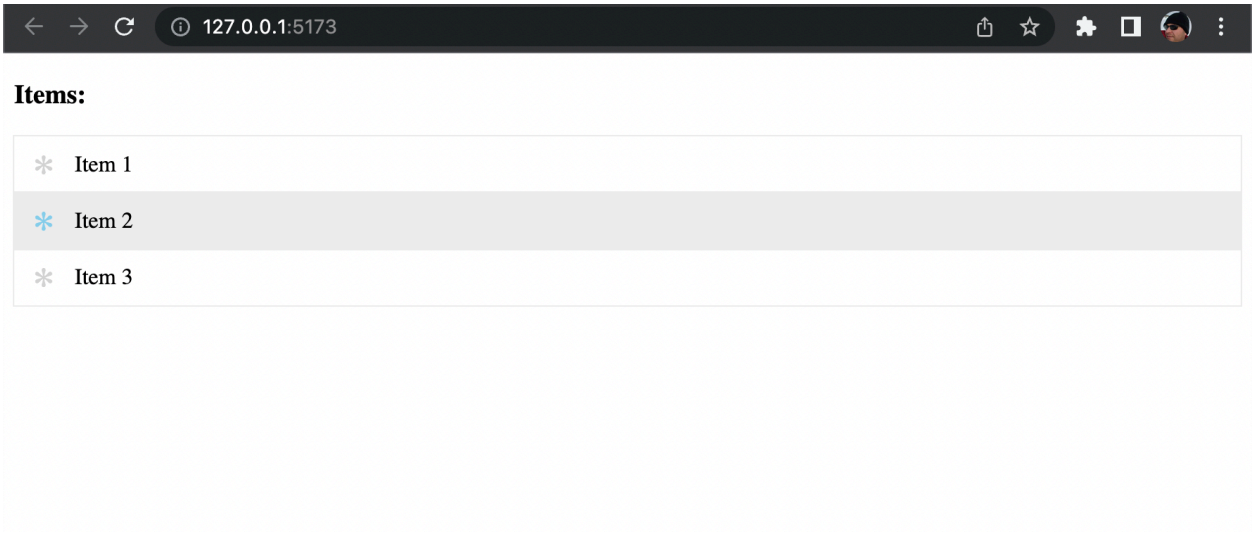
ItemsList component

Now we can finally modify our **ItemsList.component.tsx** to consume our newly created Item component. Import a reference to ItemComponent, then replace the return section within the **items.map** to use our component instead of the **<li>** element:

```
// file: ItemsList.component.tsx

import React from 'react'
// import reference to our interface
import { ItemInterface } from '../../models/items/Item.interface'
// import reference to your Item component:
import { ItemComponent } from './children/Item.component'

// if using class syntax:
type Props = {
  items: ItemInterface[],
  onItemSelect: (item: ItemInterface) => void
}

export class ItemsListComponent extends React.Component<Props> {
  constructor(props: Props) {
    super(props)
  }

  handleItemClick (item: ItemInterface) {
    this.props.onItemSelect(item)
  }

  render(): React.ReactNode {
    const { items } = this.props

    return (
      <div>
        <h3>Items:</h3>
        <ul>
          {
            items.map((item: any, index: number) => {
              // remove this line:
              // return <li key={index} onClick={() => this.handleItemClick(item)}>{\
item.name}</li>
              // replace with this line that replaces <li> with <ItemComponent>:
              return <ItemComponent testid={`item-${ item.id }`} key={index} model={\
item} onItemSelect={() => this.handleItemClick(item)}></ItemComponent>
            })
          }
        </ul>
      </div>
    )
```

```
  }
}

// if using function syntax:
type Props = {
  items: ItemInterface[],
  onItemSelect: (item: ItemInterface) => void
}

export const ItemsListComponent: React.FC<Props> = (props) => {

  const handleItemClick = (item: ItemInterface) => {
    props.onItemSelect(item)
  }

  return (
    <div>
      <h3>Items:</h3>
      <ul>
        {
          props.items.map((item, index) => {
            // remove this return block:
            // return (
            //   <li key={index}
            //     onClick={() => handleItemClick(item)}>
            //       {item.name} [{ String(item.selected) }] {/* output item.selecte\
d next to the name */}
            //   </li>
            // )
            // add this return block:
            return (
              <ItemComponent testid={`item-${ item.id }`} key={index} model={item} o\
nItemSelect={() => handleItemClick(item)}></ItemComponent>
            )
          })
        }
      </ul>
    </div>
  )
}
```

In the web browser, the list should now render similar to this (here we are showing it after we clicked on the 2nd item element and is now selected):


127.0.0.1:5173
Items:
Item 1
Item 2
Item 3

Chapter 5 Recap

What We Learned

- How to write **unit tests** against a component
- How to test that components render specific DOM elements, or have specific text, or attributes like CSS classes, etc.
- How to test events on our components by programmatically triggering them with **fireEvent** (from React Testing Library)
- How to re-factor parts of a component to create a child component and use unit tests to validate our changes

Observations

- We did not test our ItemsList.component.tsx or more advanced behaviors

Based on these observations, there are a few improvements that you could make:

Improvements

- Add additional unit tests for ItemsList.component.tsx as well

Chapter 6 - Introducing State Management

One of the most important part of an app that will grow large is to decided how to manage its state.

For many years in MV* frameworks like **React**[14] or **Vue**[15] etc. that meant using a state manager that usually implemented the **Flux**[16] State Management pattern.

With React that usually meant using **Redux**[17], while with Vue it meant using **Vuex**[18], even though nowadays there are other alternatives (inluding building your own custom state In Vue using just Vue **reactive**[19], or the **useState**[20] hooks in React, etc).

Flux offers an architectural pattern that is a slight modification of the observer-observable pattern and it is not a library or a framework.

Single source of truth:

The most important reason to implement a centralized state manager is to have a "single source of truth" for the application state/data. This simply means that our application state has only one global, centralized source. The responsibility of changing that state is only in the hand of our state manager. That means you can expect a consistent behavior in your app as the source of your data cannot be changed outside the state manager.

Unfortunately, Redux comes with a learning curve, complexity, and during the years alternatives have come up that offer simpler ways to manage the app state. There has been also a lot of debate where is it really worth it for most small to medium apps. I'd argue that is most likely a valid choice for large scale apps. However, It is outside the scope of this book to tell you which statemanagement solution you should use for your application. If you work in an organization, it will most likely be that the team will dictate that decision, or maybe they already have a code base that use Redux or another state manager.

Just remember that there are alternative like **MobX**[21], **pullstate**[22] and others. You should at

[14] https://reactjs.org
[15] https://vuejs.org
[16] https://facebook.github.io/flux
[17] https://redux.js.org
[18] https://vuex.vuejs.org
[19] https://vuejs.org/v2/guide/reactivity.html
[20] https://reactjs.org/docs/hooks-state.html
[21] https://mobx.js.org
[22] [https://lostpebble.github.io/pullstate

least research and analyze the pros/cons of each and decide which might best serve your specific needs.

In this book, we'll start by using a library called **Redux Toolkit**[23] which makes working with Redux much simpler. We'll implement our own peculiar centralized state manager by leveraging Redux Toolkit that will help us deliver the goals of this book. For this, we'll create a set of interfaces and a structure that will allow use to keep our state manager organized into modules/domains.

Note: Just remember to be open minded to different ideas, but also challenge them, and take time to explore your own ideas as well. Different patterns and code organization strategy can be implemented, and some might be better or worse than others. This is always the case when writing code in general, but even more important when writing state managements patterns.

Let's start by stopping the running application and installing the required npm packages for Redux Toolkit which are react-redux and @reduxjs/toolkit:

```
npm install @reduxjs/toolkit react-redux
```

Now let's proceed creating our store interfaces and implementations.

Store Interfaces

One thing I learned from my past experience using React, Angular, Vue.js, Svelete, and more, is that there are some advantages adopting a certain flow that is closer to Flux, but does not have to follow it to the letter. We definitely won't need this in every component, as in some cases using just local state is the right thing to do. But we'll need it for global state changes on which many components within the same app will depend on.

One things that often drives the code pattern is the framework itself. Especially React has a peculiar way as a lot of plumbing has to happen within the React context itself for React to be aware of changes. Other frameworks are more flexible in this (Vue 3 reactive for example) and are less prone to drive your architectural and patterns decisisions, thus allowing more easily to decouple your state manager from the actual framework. There are many libraries out there that have been trying to improve decoupling React from the state manager. You are again welcome to research them and explore different ideas etc.

In this chapter we'll offer a bit of an opinionated structure, but I found that is helps better understanding how the data and events flow, especially to beginners.

Let's try to implement a state manager that follow more or less this pattern:

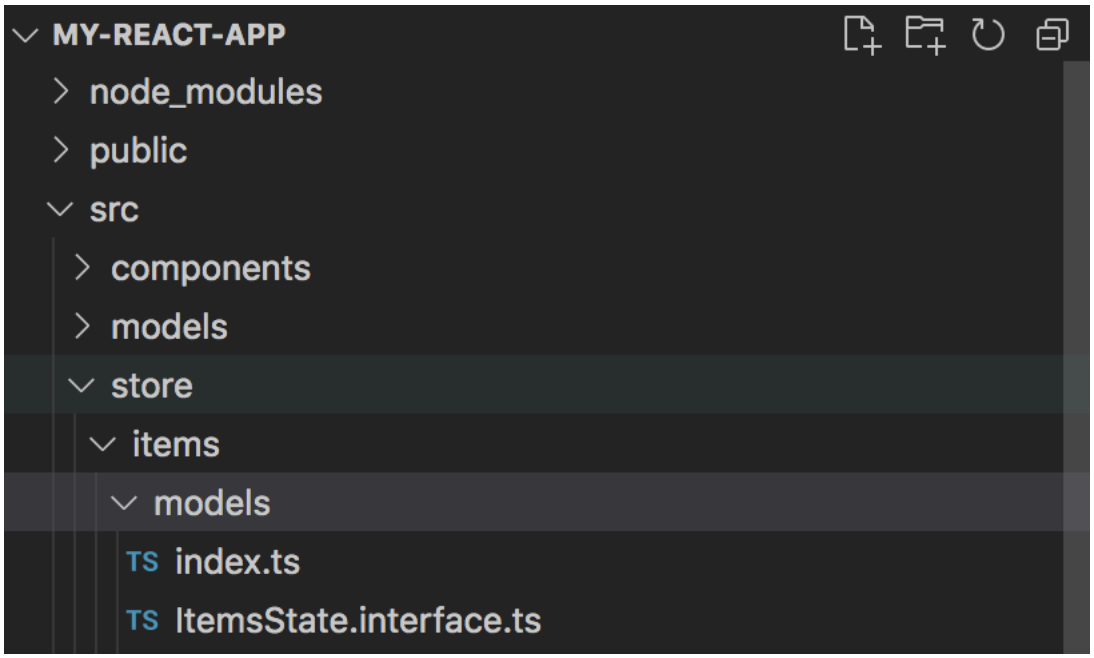
[23] https://redux-toolkit.js.org

- we will invoke an action on our state manager from a component
- the state manager will perform some tasks within that action
- the state manager will commit a change to our state
- the state manager will be organized into modules (each module will represent a domain/area of the application. I.e. items, authors, companies, projects, products, categories, etc)

Start creating all the interfaces we need so we can better understand the abstraction of what we are trying to accomplish.

Items Store Interfaces

We will create first the interfaces for the **items** store module. Create the directory **src/store/items**. Inside here, create a directory called **models**.



ItemsState.interface.ts

Here add a file called **ItemsState.interface.ts** and paste the following code in it:

```
// file: src/store/items/models/ItemsState.interface.ts

import { ItemInterface } from '../../../models/items/Item.interface'

/**
 * @name ItemsStateInterface
 * @description Interface represnets our Items state
 */
export interface ItemsStateInterface {
  loading: boolean
  items: ItemInterface[]
}
```

In the code above we just export an interface that represents our **Items** domain state. This will be an object with a property called **items** which will contain an array of objects of type **ItemInterface**., and one called **loading** which is a boolean and will indicate if we are loading data or not (so that we can eventually display a loading indicator/component in the UI).

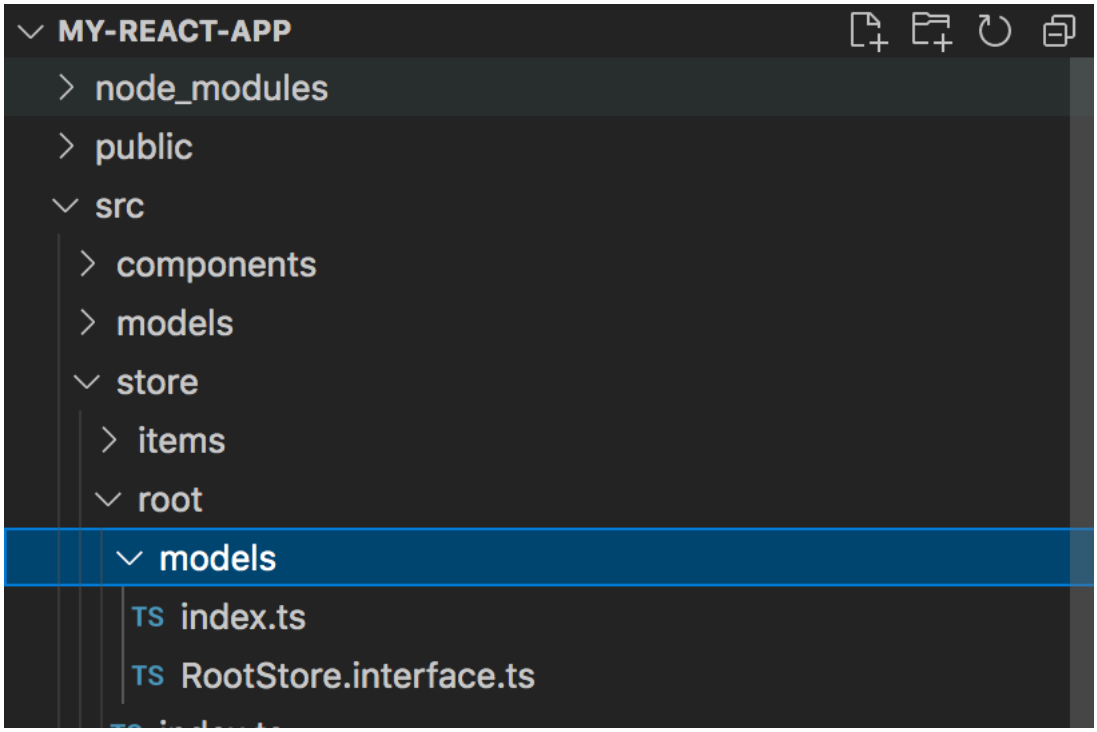
Finally, let's add an **index.ts**[24] to just export our interfaces:

```
// file: src/store/items/models/index.ts

export * from './ItemsState.interface'
```

Root Store Interfaces

Create now the root store interfaces. Create the directory **src/store/root**. Inside here, create a directory called **models**.

[24] *index.ts files that just export code from the same folder are called "Barrels" files*



RootStore.interface.ts

Here add a file called **RootState.interface.ts** and paste the following code in it:

```
// file: src/store/root/models/RootStore.interface.ts

import { ItemsStoreInterface } from '../../items'
// additional domain store interfaces will be imported here as needed

/**
 * @name RootStoreInterface
 * @description Interface represents our root state manager (store)
 */
export interface RootStoreInterface {
  itemsStore: ItemsStoreInterface
  // additional domain store modules will be added here as needed
}
```

*Note that this interface will represent an object that wrap references to each individual domain module. In this case, we only have one for now called **itemsStore**.*

Here too add a barrel **index.ts** file to just export the RooStore interface:

```
// file: src/store/root/models/index.ts

export * from './RootStore.interface'
```

Store Implementation

Now let's write the implementations for our interfaces.

Items Store instance

Let's implement the **items** store module.

Items.slice.ts

The term **slice** is specific to Redux Toolkit. Ultimately what we care about is that the **reducers** in here are just used to perform the final mutations to our state in a **synchronous** way.

Within the directory, create a file called **Items.slice.ts** and paste the following code in it:

```
// src/store/items/Items.slice.ts

// import createSlice and PayloadAction from redux toolkit
import { createSlice, PayloadAction } from '@reduxjs/toolkit'

// import out items state interface, and the item interface
import { ItemsStateInterface } from './models'
import { ItemInterface } from '../../models/items/Item.interface'

// create an object that represents our initial items state
const initialItemsState: ItemsStateInterface = {
  loading: false,
  items: []
}

// create the itemsStoreSlice with createSlice:
export const itemsStoreSlice = createSlice({
  name: 'itemsStoreSlice',
  initialState: initialItemsState,
  reducers: {
    // reducers are functions that commit final mutations to the state
```

```
    // These will commit final mutation/changes to the state

    setLoading: (state, action: PayloadAction<boolean>) => {
      state.loading = action.payload
    },

    setItems: (state, action: PayloadAction<ItemInterface[]>) => {
      // update our state:
      // set our items
      state.items = action.payload || []
      // set loading to false so the loader will be hidden in the UI
      state.loading = false
    },

    setItemSelected: (state, action: PayloadAction<ItemInterface>) => {
      const item = action.payload
      const found = state.items.find((o) => o.id === item.id) as ItemInterface
      found.selected = !found.selected
    }
  }
})
```

As you can see in the code above, we use Redux Toolkit **createSlice** to setup our store module by specifying the **name**, the **initialState**, and the **reducers**. Reducers are simply functions that **commit** the final **mutations** to the state. Reducer is a terminology specific to Redux. These are usually called in other ways in other state management frameworks (**mutations** in Vuex for example). It helps thinking of reducers as function that commit the final changes to your state in a **synchronous** way, and they are only invoked from the store **actions** (which, on the other hand, are **asynchronous**).

Note that in the store implementation (Items.store.ts) we'll extract the slice "actions" into a local variable named mutations to avoid confusion (i.e. `const mutations = itemsStoreSlice.actions` *)*

Items.store.ts

Add another files called **Items.store.ts** and paste the following code in it:

```
// src/store/items/Items.store.ts

// import hooks useSelector and useDispatch from react-redux
import { useSelector } from 'react-redux'
import { Dispatch } from 'react'

// import a reference to our RootStateInterface
import { RootStateInterface } from '../root'
// import a reference to our ItemInterface
import { ItemInterface } from '../../models/items/Item.interface'

// import a refence to our itemsStoreSlice
import { itemsStoreSlice } from './Items.slice'

/**
 * @name useItemsActions
 * @description
 * Actions hook that allows us to invoke the Items store actions from our components
 */
export function useItemsActions(commit: Dispatch<any>) {
  // get a reference to our slice actions (which are really our mutations/commits)
  const mutations = itemsStoreSlice.actions

  // our items store actions implementation:
  const actions = {
    loadItems: async () => {
      // set loading to true
      commit(mutations.setLoading(true))

      // mock some data
      const mockItems: ItemInterface[] = [{
        id: 1,
        name: 'Item 1',
        selected: false
      }, {
        id: 2,
        name: 'Item 2',
        selected: false
      }, {
        id: 3,
        name: 'Item 3',
        selected: false
      }]
```

```
      // let's pretend we called some API end-point
      // and it takes 1 second to return the data
      // by using javascript setTimeout with 1000 for the milliseconds option
      setTimeout(() => {
        // commit our mutation by setting state.items to the data loaded
        commit(mutations.setItems(mockItems))
      }, 1000)
    },
    toggleItemSelected: async (item: ItemInterface) => {
      console.log('ItemsStore: action: toggleItemSelected', item)
      commit(mutations.setItemSelected(item))
    }
  }

  // return our store actions
  return actions
}

// hook to allows us to consume read-only state properties from our components
export function useItemsGetters() {
  // return our store getters
  return {
    loading: useSelector((s: RootStateInterface) => s.itemsState.loading),
    items: useSelector((s: RootStateInterface) => s.itemsState.items)
  }
}

/**
 * @name ItemsStoreInterface
 * @description Interface represents our Items store module
 */
 export interface ItemsStoreInterface {
  actions: ReturnType<typeof useItemsActions> // use TS type inference
  getters: ReturnType<typeof useItemsGetters> // use TS type inference
}
```

We are following a pattern here where we export two hooks:

- **useItemsActions** (used to initiate a state change from components or other store modules)
- **useItemsGetters** (used to retrieve data from the store only from components)

This gives us the power to use actions also from both components and other store modules. Additionally, use getters only from components.

*Note that in the code above, we also export an interface called **ItemsStoreInterface** leveraging TypeScript type inference.*

Here too add a barrel **index.ts** file to export the itemsStoreSlice instance and useItemsStore hook:

```
// file: src/store/items/index.ts
export * from './Items.slice'
export * from './Items.store'
```

Root Store Instance

Let's now implement our root store instance.

Root.store.ts

Inside the directory src/store/root add a file called **Root.store.ts** and paste the following code in it:

```
// file: src/store/root/Root.store.ts

// import configureStore from redux toolkit
import { configureStore } from '@reduxjs/toolkit'
import { useDispatch } from 'react-redux'

// import our root store interface
import { RootStoreInterface } from './models'

// import our modules slices and actions/getters
import { itemsStoreSlice, useItemsActions, useItemsGetters } from '../items/'

// configure root redux store for the whole app.
// this will be consumed by App.tsx
export const rootStore = configureStore({
  reducer: {
    // add reducers here
    itemsState: itemsStoreSlice.reducer
    // keep adding more domain-specific reducers here as needed
  }
```

```
})

// Infer the `RootStateInterface` type from the store itself (rootStore.getState)
// thus avoiding to explicitely having to create an additional interface for the
export type RootStateInterface = ReturnType<typeof rootStore.getState>

// hook that returns our root store instance and will allow us to consume our app st\
ore from our components
export function useAppStore(): RootStoreInterface {
  // note: we are callin dispatch "commit" here, as it make more sense to call it th\
is way
  // feel free to just call it dispatch if you prefer
  const commit = useDispatch()

  return {
    itemsStore: {
      actions: useItemsActions(commit),
      getters: useItemsGetters()
    },
    // additional domain store modules will be added here as needed
  }
}

// infer the type of the entire app state
type IAppState = ReturnType<typeof rootStore.getState>

/**
 * @name getAppState
 * @description
 * Returnss a snapshot of the current app state (non-reactive)
 * This will be used mainly across store modules (i.e. items/etc)
 * In components we'll usually use getters, not this.
 * @returns
 */
export function getAppState(): IAppState {
  const appState = rootStore.getState()
  return {
    ...appState
  }
}
```

In the code above, notice how we ultimately export a hook called **useAppStore**. This will return our root store that conains all the domain-specific stores (**itemsStore** etc). Here we use

the interface **RootStoreInterface** which was created earlier through TypeScript inference.

Additionally, we also export function called **getAppState** that returns a read-only non-reactive snapshot of the current state. This allows us to read the state from other store modules. We should not use this in components but only from other store modules. Components will most of the time use only **getters**.

Add a barrel **index.ts** file to export our root store hooks and getAppState:

```
// file: src/store/root/index.ts

export * from './Root.store'
```

Up one directory, finally add one last barrel **index.ts** file at src/store/index.ts to export only the root store:

```
// file: src/store/index.ts

export * from './root'
```

Let's now go back to our components and start consuming our state.

App.tsx

First we have to modify our App.tsx code so we can "provide" the Redux store to our React app.

Add the following two imports to get a reference to the Redux Provider, and a reference to out **rootStore** instance:

```
// file: App.tsx

// import a reference to Redux Provider and our rootStore
import { Provider } from 'react-redux'
import { rootStore } from './store'
...
```

Then, in the render function we need to wrap the existing root with our Redux Provider:

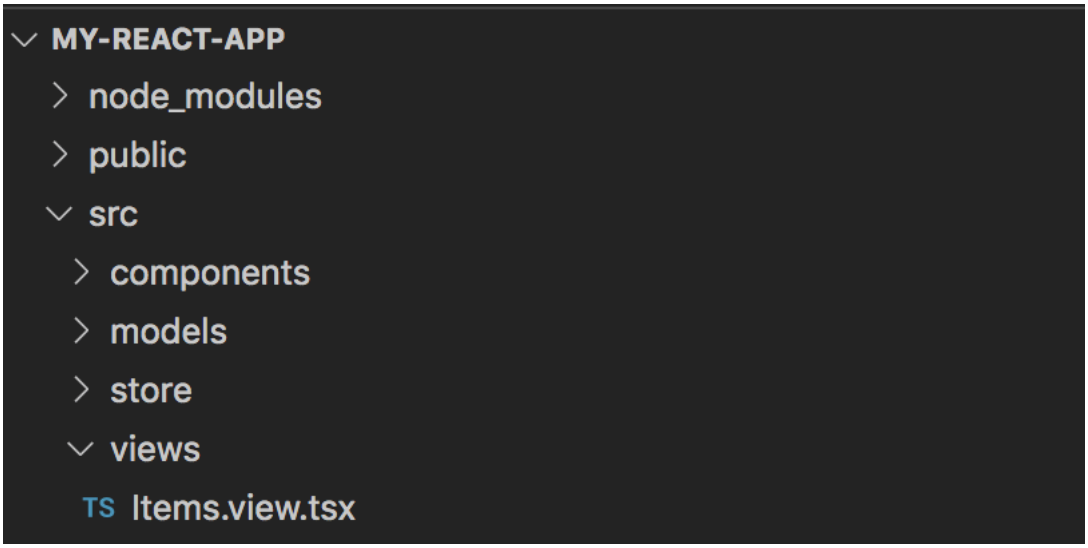
```
// file: App.tsx

...
  return (
    <Provider store={rootStore}>{/* wrap the root App element with Redux store provi\
der */}
      <div className="App">
        ...
      </div>
    </Provider>
  )
...
```

For now just save. We are going to add another component called **Items.view.tsx** and then come back to our App.tsx for more changes.

Items.view.tsx

First we are going to add a new directory called **views** under **src**.

Here we add a new higher-level component called **Items.view.tsx**. Your directory structure will be like this:



Note that in React anything is a component and we could have just called this Items.component.tsx and put it under component/items. This is only for organizational purposes. We are really free to organize the code as we see fit. In this case I also wanted to better separate what the lower components are doing and accessing the global state only in the higher-level component.

Paste the following code within the file **Items.view.tsx**:

```
// file: src/views/Items.view.tsx

// import hook useEffect from react
import { useEffect } from 'react'
// import a reference to our ItemInterface
import { ItemInterface } from '../models/items/Item.interface'
// import a reference to your ItemsList component:
import { ItemsListComponent } from '../components/items/ItemsList.component'
// import our useAppStore hook from our store
import { useAppStore } from '../store'

// ItemsView component:
function ItemsView() {
  // get a reference to our itemsStore instanceusing our useAppStore() hook:
  const {
    itemsStore
  } = useAppStore()

  // get a reference to the items state data through our itemsStore getters:
  const {
    loading,
    items
  } = itemsStore.getters

  // item select event handler
  const onItemSelect = (item: ItemInterface) => {
    itemsStore.actions.toggleItemSelected(item)
  }

  // use React useEffect to invoke our itemsStore loadItems action only once after t\
his component is rendered:
  useEffect(() => {
    itemsStore.actions.loadItems()
  }, []); // <-- empty array means 'run once'

  // return our render function containing our ItemslistComponent as we did earlier \
in the App.tsx file
  return (
    <div>
      <ItemsListComponent items={items} onItemSelect={onItemSelect} />
    </div>
```

```
  )
}

export default ItemsView
```

In the code above we are basically rendering the same itemsListComponent as we did earlier in the App.tsx file. However, here we are consuming the data from our items store and invoking our store actions that will mutate our data.

Back to the App.tsx file

Let's finally modify the App.tsx so we can consume our ItemsView component in it. Replace the entire content of the file with this:

```
// file: App.tsx

// import our app.css
import './App.css'

// import a reference to Redux Proivder and our rootStore
import { Provider } from 'react-redux'
import { rootStore } from './store'

// import a reference to our ItemsView component
import ItemsView from './views/Items.view'

// App component:
function App() {
  return (
    <Provider store={rootStore}>{/* wrap the root App element with Redux store provi\
der */}
      <div className="App">
        <ItemsView />
      </div>
    </Provider>
  )
}

export default App
```

Save the file.

Web Browser

The web browser should refresh and display the content similar to before. Notice that now it will take about 1 second before the items will be rendered. This is because in our **loadItems** action implementation we used a **setTimeout** with a 1 second delay to simulate a possible call to an API for example.

ItemsList.component.tsx

Let's add a property to our **ItemsList.component.tsx** called **loading** of type **boolean**:

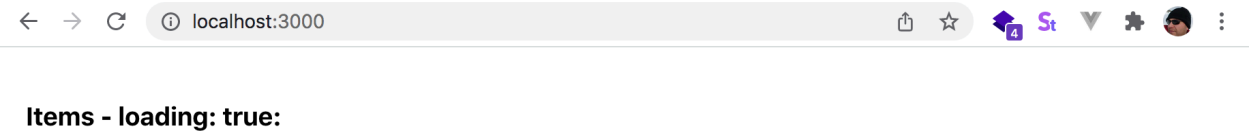
```
// file: ItemsList.component.tsx
...
export class ItemsListComponent extends React.Component<{
  loading: boolean, // add this
  items: ItemInterface[],
  onItemSelect: (item: ItemInterface) => void
}> {
  constructor(props: {
    loading: boolean, // add this
    items: ItemInterface[],
    onItemSelect: (item: ItemInterface) => void
  }) {
    super(props)
  }
...
```

Now within the **<h3>** element, add a one-way binding using the single curly braces to print out the value of the **loading** property:

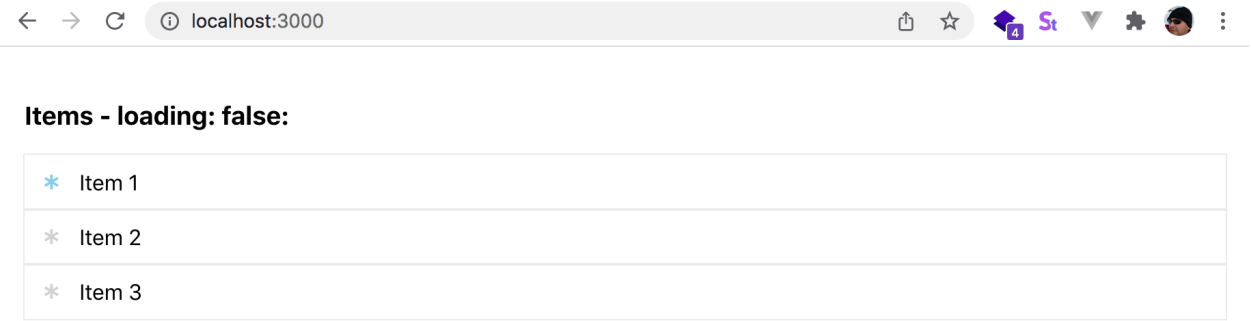
```
// file: ItemsList.component.tsx
...
render(): React.ReactNode {
    const { loading, items } = this.props // include loading here

    return <div>
        <h3>Items - loading: { String(loading) }:</h3>
...
```

Back to the Web Browser

Now, when we refresh the browser, we'll first see a blank list, but in the header we'll see the text **My items - loading: true**:



After 1 second the items will render and the h3 element will display the text **My items - loading: false**:



Loader Component

Let's create a quick-and-dirty loader component that we can show to indicate a loading operation.

Create the directory **src/components/shared**. Within this directory create a file called **Loader.component.tsx**. Within the file, paste the following code:

```
// file: Loader.component.tsx

import React from 'react'

// Loader component
export class Loader extends React.Component {
  render(): React.ReactNode {
    return <div className="loader">
            <div className="bounceball"></div>
          </div>
  }
}
```

Save the file. Now open the App.css file and append the following css to the existing code:

```
/* begin: loader component */
.loader {
  display: inline-block;
}
.loader .bounceball {
  position: relative;
  width: 30px;
}
.loader .bounceball:before {
  position: absolute;
  content: '';
  top: 0;
  width: 30px;
  height: 30px;
  border-radius: 50%;
  background-color: #61dafa;
  transform-origin: 50%;
  animation: bounce 500ms alternate infinite ease;
}
@keyframes bounce {
  0% {
    top: 60px;
    height: 10px;
    border-radius: 60px 60px 20px 20px;
    transform: scaleX(2);
  }
  25% {
    height: 60px;
```

```
    border-radius: 50%;
    transform: scaleX(1);
  }
  100% {
    top: 0;
  }
}
/* end: loader component */
```

This provides a basic loader that uses pure CSS for the animation. You are free to use an animated **gif**, or **svg** image, or **font-icon** etc. In later chapter we might modify this to implement a versin that uses TailwindCSS.

Now, lets go back into our **ItemsList.component.tsx** code and import a reference to our new **Loader** component, and update our render() function as follow (complete code):

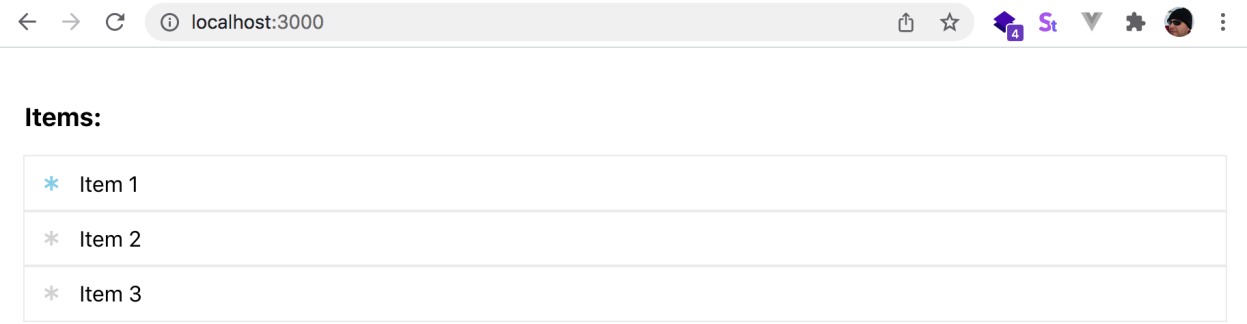
```
// file: ItemsList.component.tsx

import React from 'react'
// import reference to our interface
import { ItemInterface } from '../../models/items/Item.interface'
// import reference to your Item component:
import { ItemComponent } from './children/Item.component'
// import a reference to our Loader component:
import { Loader } from '../shared/Loader.component'

// ItemsList component
export class ItemsListComponent extends React.Component<{
  loading: boolean,
  items: ItemInterface[],
  onItemSelect: (item: ItemInterface) => void
}> {
  constructor(props: {
    loading: boolean,
    items: ItemInterface[],
    onItemSelect: (item: ItemInterface) => void
  }) {
    super(props)
  }

  handleItemClick (item: ItemInterface) {
    this.props.onItemSelect(item)
  }
```

```
  render(): React.ReactNode {
    const { loading, items } = this.props

    let element
    if (loading) {
      // render Loader
      element = <Loader />
    } else {
      // render <ul>
      element = <ul>
        {
          items.map((item, index) => {
            return <ItemComponent key={index} model={item} onItemSelect={() => this.\
handleItemClick(item)}></ItemComponent>
          })
        }
      </ul>
    }

    return <div>
        <h3>Items - loading: { String(loading) }:</h3>
        {element}
      </div>
  }
}
```

Save the file and the refreshed the web page will show the loader bouncing for about 1 second before it renders the items:

Items:

Then the loader will hide and the items list is rendered:



Congratulations on completing this chapter and learning how to build a state manager organized into domains to easily manage the application state in a consistent and predictable way. It's a long chapter, the concepts outlined here require a lot of code to implement, and not everyone gets through it in a straightforward fashion the first time around. In the next chapters we will try to improve this code even more so arm yourself with a lot of patience!

Chapter 6 Recap

What We Learned

- How to create a centralized state manager organized into modules, leveraging Redux Toolkit
- How to use our state manager to update our **Items** state
- How to create **actions** and **reducers** (reducers are just final mutations/commits of state changes)
- How to invoke state **actions** from our components
- How to use a **loading** property on our state to provide feedback to the user about long-running processes through a **loader** (animation)
- How to create a simple and reusable **Loader** component

Observations

- We are still using hard-coded data (**mockItems** within the **actions** in the **store/items/Items.store.ts** file), instead of loading the data through an API client

Based on these observations, there are a few improvements we will make in the next chapters:

Improvements

- Create an API client that can serve mocked data for quick front-end development and prototyping, and an API client that can communicate with real API end-points

Chapter 7 - Api Client

So far we have worked by manipulating the app state/data through our state manager (store). However, we are still ”pretending” to load data by using a **mockItems** variable with hard-coded mock data within our **loadItems** action, and using the **setTimeout** trick to add a bit of delay before returning the data (so we have at least 1 second to show our Loader to the user).

In the real world, we'll be most likely writing a component that has to load the data from a server-side API end-point. At the same time, we do not want to lose our ability to do quick prototyping and development of our front-end, even if the server-side API has not been developed yet. Now there are different ways of accomplishing this. Some people like to use mock data returned by a real API (there are packages and services out there that do just this[25]). Others prefer to have 2 different implementations for each API client, one that returns the mocked data (either by loading from disk or invoking a mocked API service), and one that returns the live data from the real server API. We'll be implementing the latter pattern in this chapter so we have better control on our data and also have better control on different scenarios.

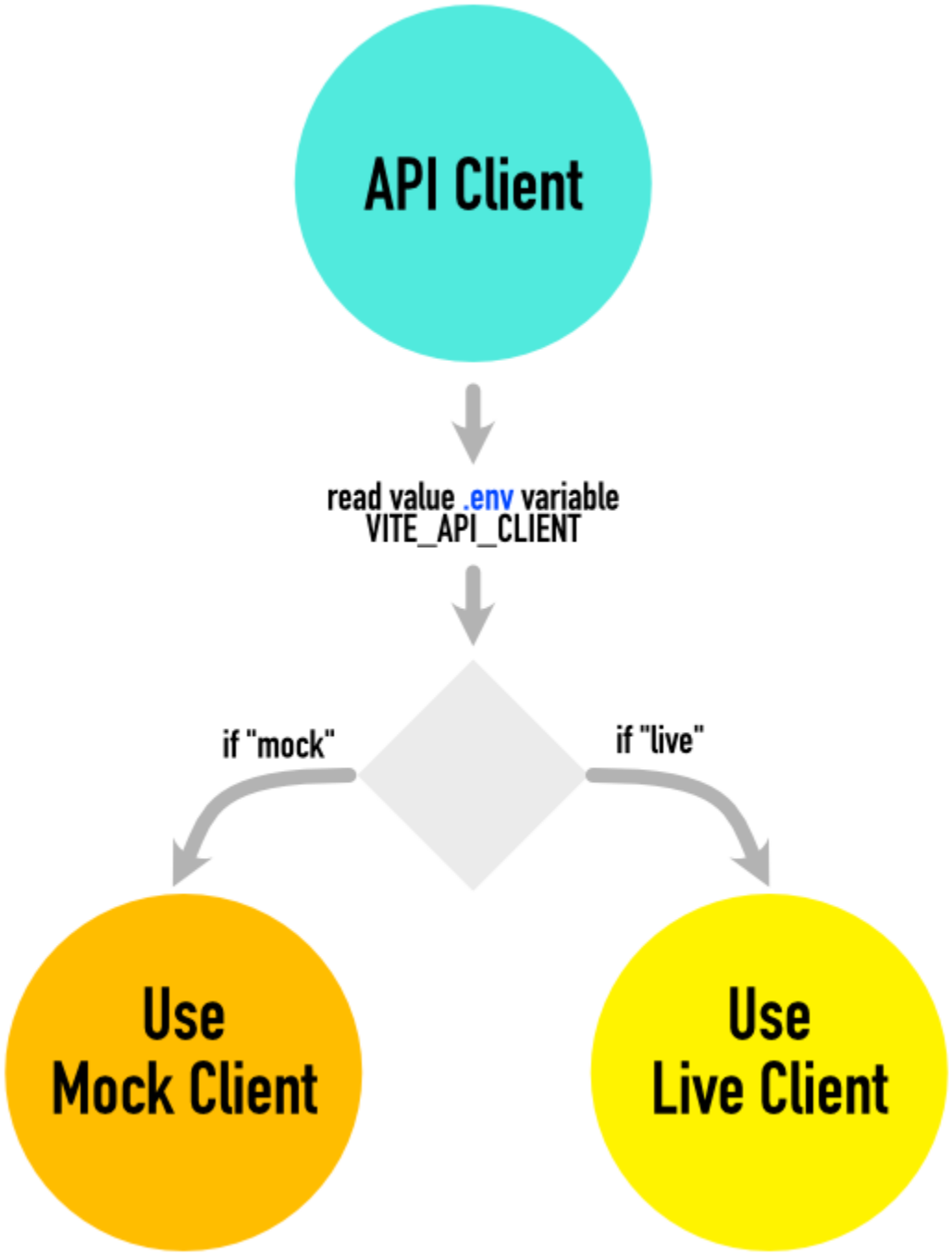
Another pattern is to create a separate API client for each area of our application. This will enable for better separation of concerns, avoid code cluttering, more easily write unit tests against each client. This is the pattern we'll be following in this book, but remember this is not the only way to accomplish this. You should always evaluate what is the best solution for your specific requirements and evaluate that it fits your needs.

You should also read about **Domain Driver Design**, even though this book is not strictly following DDD principles, still the overall idea here is to try to keep code organized by application domain.

API Client Overview

Here is an overview of our API client architecture:

[25] JsonPlaceHolder *or* miragejs *for example*



API Client module will read the custom environment variable called VITE_API_CLIENT and there are two possible outcomes:

- when VITE_API_CLIENT is Mock: it will return the Mock API Client
- when VITE_API_CLIENT is Live: it will return the Live API Client

Domains

We'll create a global **ApiClient** that wraps additional clients organized by application domain. Our **ApiClient** will have for example a property called items which is the actual API client for the **Items** domain. As our application grows, we'll be adding more domains specific API clients.

Our goal is to eventually consume our API client code from our store in this way:

```
apiClient
  .items
  .fetchItems()
```

Here we have an instance of our main **ApiClientInterface**. We then access its **items** property which is the domain-specific API client (of type **ItemsApiClientInterface**) and call its methods or access its properties.

Later, if for example need to add a new **people** domain, we will add a **people** property to our main **ApiClientInterface** that points to an instance of **PeopleApiClientInterface**. Then we will be able to call its methods like this:

```
apiClient
  .people
  .fetchPeople()
```

As you can see, this makes the code much more concise and readable.

NOTE: This might seem to complicate things at first. However, remember that the scope of this book is to build a foundation for large-scale applications. Our primary goal is a solid code organization and structuring to avoid cluttering as the code might grow very large with many files.

The Main ApiClient

Create the directory **src/api-client/models**. Inside this directory, create the file **ApiClient.interface.ts** with the following code:

```
// file: src/api-client/models/ApiClient.interface.ts

import { ItemsApiClientInterface } from './items'

/**
 * @Name ApiClientInterface
 * @description
 * Interface wraps all api client modules into one places for keeping code organized.
 */
export interface ApiClientInterface {
  items: ItemsApiClientInterface
}
```

As you can see in the code above, our ApiClient will have a property called items of type **ItemsApiClientInterface**, which will be the API client specific to the **Items** domain.

Now let's create the the **Items** API client.

Items domain Api Client

Now we create the interfaces and model that defines a domain-specific API client.

Create the directory **src/api-client/models/items**. Inside thisd directory, create the following files:

- index.ts
- ItemsApiClient.interface.ts
- ItemsApiClient.model.ts
- ItemsApiClientOptions.interface.ts

Your directory structure will look like this:

Following is the the description and code for each of the files.

ItemsApiClientOptions.interface.ts

In order to avoid using hard-coded strings, and to enforce type-checking at development time, we'll be using interface **ItemsApiClientOptionsInterface** for the values that indicates the API end-points consumed by the **ItemsApiClient**. Also, we'll have a **mockDelay** parameter that we can use to simulate the delay when loading data from static json files. Here is the code:

```
// file: src/api-client/models/items/ItemsApiClientOptions.interface.ts

/**
 * @Name ItemsApiClientEndpoints
 * @description
 * Interface for the Items urls used to avoid hard-coded strings
 */
 export interface ItemsApiClientEndpoints {
  fetchItems: string
}

/**
 * @Name ItemsApiClientOptions
 * @description
 * Interface for the Items api client options (includes endpoints used to avoid hard\
-coded strings)
 */
 export interface ItemsApiClientOptions {
  mockDelay?: number
  endpoints: ItemsApiClientEndpoints
}
```

ItemsApiClient.interface.ts

This is the interface for our **ItemsApiClient**. Our interface requires implementing a method called **fetchItems** the will return a list of items. Here is the code to paste into **ItemsApiClient.interface.ts**:

```
// file: src/api-client/models/items/ItemsApiClient.interface.ts

import { ItemInterface } from '../../../models/items/Item.interface'

/**
 * @Name ItemsApiClientInterface
 * @description
 * Interface for the Items api client module
 */
export interface ItemsApiClientInterface {
  fetchItems: () => Promise<ItemInterface[]>
}
```

ItemsApiClient.model.ts

This is the model (class) for our **ItemsApiClient** which implements our Items API client interface.

For the initial version of this, we will be using a third-part open-source NPM package called **axios**. This is just a library that allows to make Ajax call in a much easier way. Let's go back to the terminal, from within **my-react-project** directory, and install **axios** with the command:

```
npm install axios --save
```

NOTE: we will improve this even more later to avoid having references to a third-party NPM package spread throughout the code. Also note, we are showing here to use a 3rd party package like axios on purpose, instead of the browser built-in fetch api, to show in later chapters how we should always try to abstract and encapsulate dependencies to avoid polluting our code.

Back to the editor, open **ItemsApiClient.model.ts** and start importing all the things we need:

```
// file: src/api-client/models/items/ItemsApiClient.model.ts

import axios, { AxiosRequestConfig, AxiosError, AxiosResponse } from 'axios'

import { ItemsApiClientOptions, ItemsApiClientEndpoints } from './ItemsApiClientOpti\
ons.interface'
import { ItemsApiClientInterface } from './ItemsApiClient.interface'
import { ItemInterface } from '../../../models/items/Item.interface'

…
```

And here is the class that implement our **ItemsApiClientInterface**:

```
// file: src/api-client/models/items/ItemsApiClient.model.ts
...

/**
 * @Name ItemsApiClientModel
 * @description
 * Implements the ItemsApiClientInterface interface
 */
export class ItemsApiClientModel implements ItemsApiClientInterface {
  private readonly endpoints!: ItemsApiClientOptions
  private readonly mockDelay: number = 0

  constructor(options: ItemsApiClientOptions) {
    this.endpoints = options.endpoints
    if (options.mockDelay) {
      this.mockDelay = options.mockDelay
    }
  }

  fetchItems(): Promise<ItemInterface[]> {
    return new Promise<ItemInterface[]>((resolve) => {
      const endpoint = this.endpoints.fetchItems

      // axios options
      const options: AxiosRequestConfig = {
        headers: {
        }
      }

      axios
        .get(endpoint, options)
        .then((response: AxiosResponse) => {
            if (!this.mockDelay) {
              resolve(response.data as ItemInterface[])
            } else {
              setTimeout(() => {
                resolve(response.data as ItemInterface[])
              }, this.mockDelay)
            }
        })
        .catch((error: any) => {
            console.error('ItemsApiClient: HttpClient: Get: error', error)
        })
```

```
    })
  }
}
```

index.ts (barrel file)

This just exports all our interfaces and models under items/ so that we can more easily import them later in other parts of the code:

```
// file: src/api-client/models/items/index.ts

export * from './ItemsApiClientOptions.interface'
export * from './ItemsApiClient.interface'
export * from './ItemsApiClient.model'
```

Mock and Live Api Clients

Now that we have defined our models for **ApiClientInterface** and **ItemsApiClientInterface**, let's implement a mechanism that will allow us to either use a **mock** api-client that returns static **json** data, or a **live** api-client that returns data from as real API.

Under the **src/api-client** directory, create two new sub-directories called:

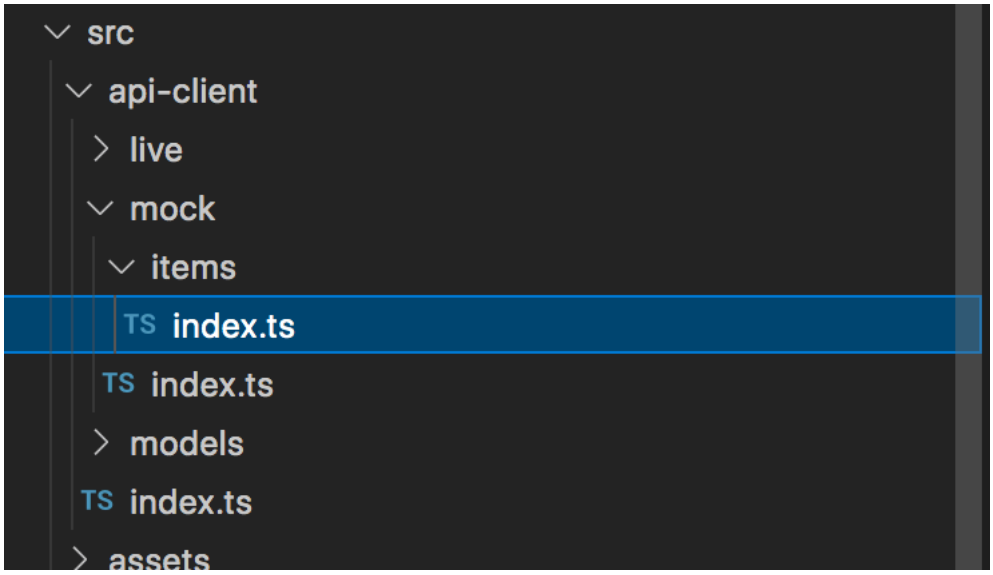
- **mock** (this will contain our mock implementations to return static **json** data)
- **live** (this will contain the implementation that call the real API end-points)

We'll be writing a mock implementation of our **ApiClientInterface** and its child **ItemsApiClientInterface**. We'll be also instantiating either the mock or live api-client based on config..

Mock Api Client

Items domain mock API instance

Within the **mock** directory, add a child directory called **items**, and within that one create a new file named **index.ts**. Your directory structure should look like this:



Inside the **src/api-client/mock/items/index.ts** file, paste the following code:

```
// file: src/api-client/mock/items/index.ts

import {
  ItemsApiClientOptions,
  ItemsApiClientInterface,
  ItemsApiClientModel
} from '../../models/items'

const options: ItemsApiClientOptions = {
  endpoints: {
    fetchItems: '/static/mock-data/items/items.json'
  },
  mockDelay: 1000
}

// instantiate the ItemsApiClient pointing at the url that returns static json mock \
data
const itemsApiClient: ItemsApiClientInterface = new ItemsApiClientModel(options)

// export our instance
export {
  itemsApiClient
}
```

Here we import all our interfaces and models, then we instantiate a variable called **options**

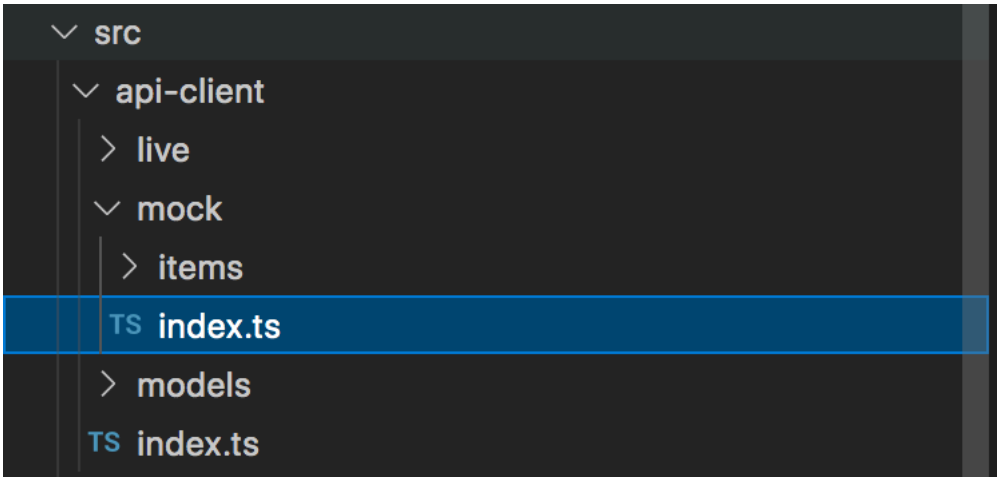
of type **ItemsApiClientOptions** that holds the API end-points values and the mockDelay option. In this case, since this is the mock implementation, for fetchItems we will point to some static **json** file with the mock data. Note that we have only **fetchItems**, but we could have multiple end-points. For now we'll focus only on returning data. Later, in more advanced chapter I'll show you how to do something similar for CRUD operations.

We then create an instance of our **ItemsApiClient** class by passing our **options** instance into the constructor (as you can see, later in our live implementation we'll pass an instance of ItemsApiClientOptions that contains the paths/urls to the real end-points)

Finally, we just export our instance called **itemsApiClient**.

Mock API instance

Now let's move one directory up, under **src/api-client/mock** and create another **index.ts** file here. Your directory structure should look like this:



Inside the **src/api-client/mock/index.ts** file, paste the following code:

```
// file: src/api-client/mock/index.ts

import { ApiClientInterface } from '../models/ApiClient.interface'
import { itemsApiClient } from './items'

// create an instance of our main ApiClient that wraps the mock child clients
const apiMockClient: ApiClientInterface = {
  items: itemsApiClient
}

// export our instance
```

```
export {
  apiMockClient
}
```

This is the mock implementation of our main ApiClient that wraps that items client.

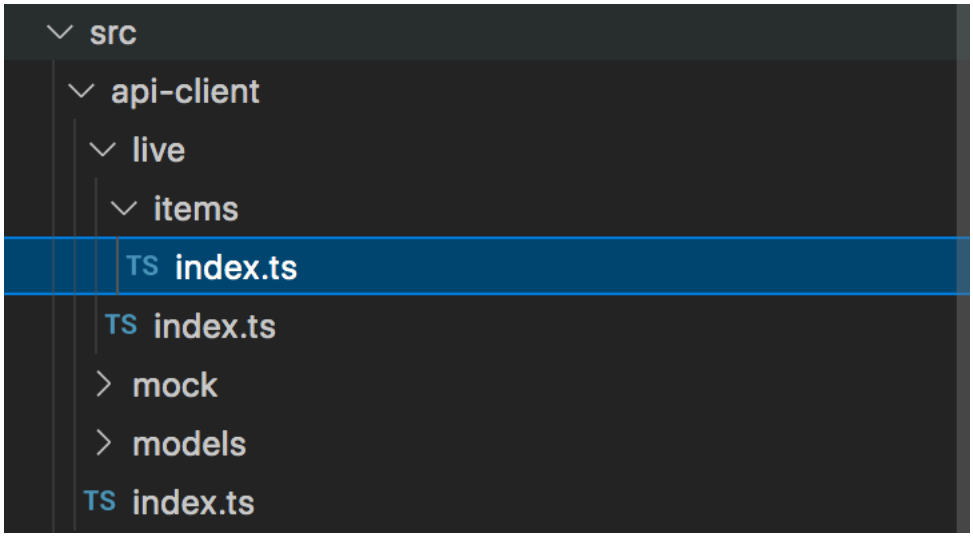
Here we import our **ApiClientInterface** interface, and our mock instance of **ItemsApiClient**. We then create an instance of our **ApiClientInterface** that is called **apiMockClient** because it will use the mock implementation of the **ItemsApiClient**.

Live Api Client

Items domain live API instance

Similar to what we did with our mock api client, we'll be implementing the live api client now. Note that the **live** directory structure will be the same as the **mock** directory structure.

Create directory **src/api-client/live/items** and here add a new file named **index.ts**. Your directory structure should look like this:



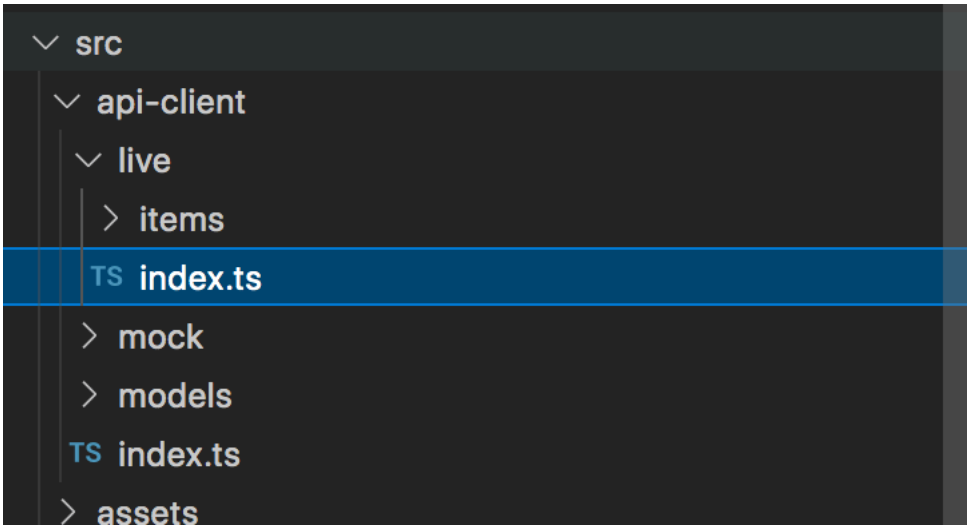
Inside the **src/api-client/live/items/index.ts** file, paste the following code:

```
// file: src/api-client/live/items/index.ts

import {
  ItemsApiClientOptions,
  ItemsApiClientInterface,
  ItemsApiClientModel
} from '../../models/items'

const options: ItemsApiClientOptions = {
  endpoints: {
    // this should be pointing to the live API end-point
    fetchItems: '/path/to/your/real/api/end-point'
  }
}

// instantiate the ItemsApiClient pointing at the url that returns live data
const itemsApiClient: ItemsApiClientInterface = new ItemsApiClientModel(options)

// export our instance
export {
  itemsApiClient
}
```

*NOTE: this code is almost exactly the same as the mock client. The only difference is the **fetchItems** property that here says for now "/path/to/your/real/api/end-point". You'll replace this with the actual value of your real server API end-point url/path. If you do not have one yet, leave the current value as a place holder and updated once in the future you'll have your server API ready.*

Live API instance

Now let's move one directory up, under **src/api-client/live** and create another **index.ts** file here. Your directory structure should look like this:



Inside the **src/api-client/live/index.ts** file, paste the following code:

```
// file: src/api-client/live/index.ts

import { ApiClientInterface } from '../models'
// import module instances
import { itemsApiClient } from './items'

// create an instance of our main ApiClient that wraps the live child clients
const apiLiveClient: ApiClientInterface = {
  items: itemsApiClient
}
// export our instance
export {
  apiLiveClient
}
```

This code is also almost identical to the related mock **index.ts** file. The only exceptions are:

1. We use the live **ItemsApiClient** from **api-client/live-items**
2. We name the instance **apiLiveClient** for more clarity

We then just export our **apiLiveClient** instance.

In a bit we'll be adding one final index.ts at the root of src/api-client that will act as our API client "provider". This will return either the mock or the live instance based on an environemnt variable. So let's first setup some things to work with environment variables.

Environment Variables

Since Vite uses **dotenv**[26] to load environment variables, we'll have to create two **.env** files[27] at root of your src directory:

```
.env.dev          # loaded when mode is dev for local development
.env.production          # loaded when mode is production
```

Inside the .env.mock put the following:

```
# file src/.env.dev

VITE_API_CLIENT=mock
```

Inside the .env.production put the following:

```
# file src/.env.production

VITE_API_CLIENT=live
```

You might have to add declarations for the **import.meta.env** types within the **src/vite-env.d.ts** file[28]:

```
// file: src/vite-env.d.ts

/// <reference types="vite/client" />
/// <reference types="react" />

// types for Vite env variables:
// (reference: https://vitejs.dev/guide/env-and-mode.html#intellisense-for-typescrip\
t)
interface ImportMetaEnv {
  readonly VITE_API_CLIENT: string
  // more env variables...
}

interface ImportMeta {
  readonly env: ImportMetaEnv
}
```

[26] https://github.com/motdotla/dotenv
[27] https://vitejs.dev/guide/env-and-mode.html#production-replacement
[28] https://vitejs.dev/guide/env-and-mode.html#intellisense-for-typescript

NOTE: Only variables prefixed with `VITE_` are exposed to the Vite-processed code.[29]

We'll be now able to access the value of our environment variables in TypeScript with **import.meta.env** (i.e. import.meta.dev.VITE_API_CLIENT). Before we can do this, we need to do one final change in our **package.json scripts** configurationso it will correctly set the expected environment variables when running locally for development with **npm start**, or when building for production with **npm run build**. The current content of your script section should be like this:

```
file: package.json
...
  "scripts": {
    "start": "npm run dev",
    "dev": "vite --mode mock", // here add --mode mock
    "build": "tsc && vite build --mode production", // here add --mode production
    ...
  },
...
```

Change the **dev** command to:

```
"dev": "vite --mode mock",
```

Change the **build** command to:

```
"build": "tsc && vite build --mode production"
```

Optional: You could also add a **build-mock** command that uses the mock api client, if you are do not plan to have a real API in your project, or maybe to test new front-end functionality in production when the server API is not yet ready:

```
"build-mock": "tsc && vite build --mode mock"
```

*Note: when running the app, if you make a change to the –mode value in the package.json, or the values within the .env files, you'll have to stop it with CTRL+C and restart with **npm start** for changes to take into effect.*

One last thing: we put our .env files within the src/ directory for now. To make sure Vite is aware of where they are, open the **vite.config.ts** file and make sure the **envDir** option is configured with the following value (we added this at the end of Chapter 5, but is a good idea to verify that is there):

[29] import.meta.env

```
// file: vite.config.js
/// <reference types="vite/client" />

import { defineConfig } from "vite"
import reactRefresh from "@vitejs/plugin-react-refresh"

// https://vitejs.dev/config/
export default defineConfig({
  plugins: [reactRefresh()],
  envDir: './src/' // <-- make sure this is there
})
```

To test that the configuration is working, temporarily modify the **App.tsx** code to ourput all the content of the import.meta.env like this:

```
// file: src/App.tsx

...

  <div className="App">
    [{JSON.stringify(import.meta.env)}] <!-- add this to output the current content \
of import.meta.env -->

...
```

Stop the app with CTRL+C and run it again with npm start. Verify that in the browser our App.tsx renders something like this at the top:

```
[{"VITE_API_CLIENT":"mock","BASE_URL":"/","MODE":"mock","DEV":true,"PROD":false, ...
```

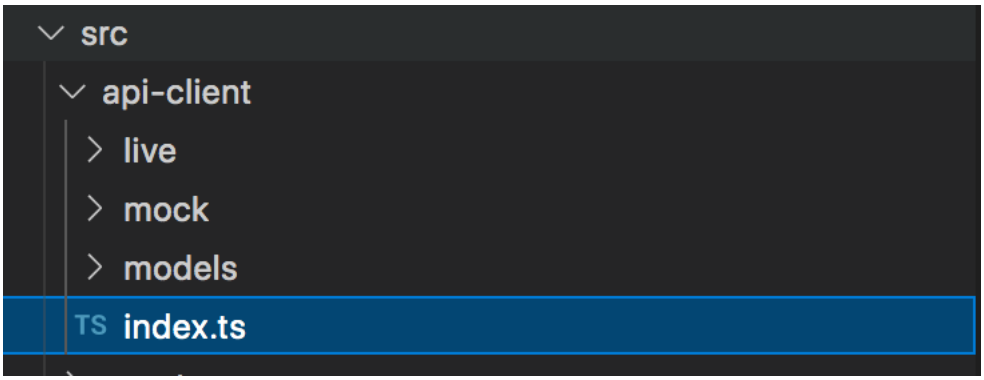
As you can see, our VITE_API_CLIENT environment variable contains the correct value "mock" and we are able to read this in our views or other client-side code.

Now remove the code we just added to App.tsx and let's proceed creating our Api Client Provider.

Api Client Provider

Now we need one final **index.ts** that will server our main API client factory and return either the **mock** or the **live** API client based on an environment variable (later you might

find easier to drive this with different configuration files). Create an the file at the root of **src/api-client**:



Inside the **src/api-client/index.ts** file, import a reference to our **ApiClientInterface** interface, and both the instances for the **mock** and the **live** clients:

```
// file: src/api-client/index.ts

import { ApiClientInterface } from './models'
import { apiMockClient } from './mock'
import { apiLiveClient } from './live'

...
```

Now we will add some code that will export either the **mock** or **live** clients based on the **VITE_API_CLIENT** environment variable:

```
// file: src/api-client/index.ts

...

let env: string = 'mock'
// Note: Vite uses import.meta.env (reference: https://vitejs.dev/guide/env-and-mode\
.html)
// optional: you can console.log the content of import.meta.env to inspect its value\
s like this: console.log('import.meta.env', JSON.stringify(import.meta.env))
if (import.meta.env && import.meta.env.VITE_API_CLIENT) {
  env = import.meta.env.VITE_API_CLIENT.trim()
}
// return either the live or the mock client
let apiClient: ApiClientInterface
if (env === 'live') {
```

```
  apiClient = apiLiveClient
} else {
  // default is always apiMockClient
  apiClient = apiMockClient
}

export {
  apiClient
}
```

Now let's proceed to update our store to consume the data from our newly created Api Client.

Store Instance updates

Back into our **src/store/items/Items.store.ts** code, we can now finally remove the reference to the hard-coded data and use our new API client to retrieve these data. Start by adding an import for our **apiClient** (note how we no longer have to worry about using the **mock** or the **live** one, the system we'll handle that automatically based on the **VITE_API_CLIENT** environment variable we created earlier):

```
// src/store/items/Items.store.ts
...
// import a reference to our apiClient instance
import { apiClient } from '../../api-client'
...
```

Then, within the **loadItems** action, remove the hard-coded **mockItems** variable and its data. Then remove the **setTimeout** lines with the call to **commit(setItems(mockItems))**.

Replace the loadItems code with a call to **apiClient.items.fetchItems** and this time dispatch/-commit **setItems** passing it the **data** returned by our **fetchItems**:

```
// src/store/items/Items.store.ts
...

  // our items store actions implementation:
  const actions: ItemsStoreActionsInterface = {
    // action that we invoke to load the items from an api:
    loadItems: async () => {
      // set loading to true
      commit(mutations.setLoading(true))

                          // begin: remove code
      // mock some data
      const mockItems: ItemInterface[] = [{
        id: 1,
        name: 'Item 1',
        selected: false
      }, {
        id: 2,
        name: 'Item 2',
        selected: false
      }, {
        id: 3,
        name: 'Item 3',
        selected: false
      }]

      // let's pretend we called some API end-point
      // and it takes 1 second to return the data
      // by using javascript setTimeout with 1000 for the milliseconds option
      setTimeout(() => {
        // commit our mutations by setting state.items to the data loaded
        commit(mutations.setItems(mockItems))
      }, 1000)
      // end: remove code

      // begin: add code
      // invoke our API cient fetchItems to load the data from an API end-point
      const data = await apiClient.items.fetchItems()

      // commit our mutations by setting state.items to the data loaded
      commit(mutations.setItems(data))
      // end: add code
    },
```

```
...
```

We also need to create a data folder from where our **mock** api-client will load the static **json** files.

If you remember, earlier during our Mock Api Client implementation we set the **urls fetchItems** end-point path to be **/static/mock-data/items/items.json**.

We need to create a directory called **static** under our **public** folder, because that is what app considers our root directory to be when running the application. Within the static directory create a sub-directory called **mock-data**, within mock-data add one more sub-directory called **items**. Here create a file called **items.json**.

Within the **items.json** files and paste in the following data:

```
# File: public/static/mock-data/items/items.json:

[{
  "id": 1,
  "name": "Item 1",
  "selected": false
}, {
  "id": 2,
  "name": "Item 2",
  "selected": false
}, {
  "id": 3,
  "name": "Item 3",
  "selected": false
}, {
  "id": 4,
  "name": "Item 4",
  "selected": false
}, {
  "id": 5,
  "name": "Item 5",
  "selected": false
}]
```

Make sure there are no errors in the terminal. If needed stop it with **CTRL-C** and run again with **npm start**. The browser should display a loader, then render our items list as before, but this time should display 5 items (because the data now is loaded through our Api client from the file public/static/mock-data/items/items.json):

Notice how powerful is this pattern we just implemented as it allows us to easily build our front-end components in isolation without a real API, and later everything we'll just work with a live API client that returns the same data structure as our static json data.

Alternatives

There are other ways in which you could use a mocked API. There are services or libraries out there that can help you build a mocked API like Miragejs or JSONPlaceHolder[30], and you could simplify the code here by having only one **apiClient** that uses either mock or live API end-points based on environment variables only etc. Some of these alternatives require running an additional server app that will serve your mocked API.

I opted to show you how you can do this using static .**json** files that are located in the same project under **public/static/mock-data** as this gives you a lot of flexibility to play around with different things when you are starting out. The other thing is that by having a specific implementation of the mock **apiClient** you do not have to necessarily return the .json files, but you could simulate fake responses or pretend to have saved or deleted an item without actually modifying any static data (so it will be just in memory, and when you refresh the web browser the data would be reloaded as in its original state).

Additionally, this gives you the flexibility to use either: static JSON files, or maybe for the url end points use something like Miragejs etc for some of the API clients.

You can research alternatives as you see fit and make the decision you feel works better for you, but remember you are not confined to one way or another if you keep following the patterns I am showing you in this book. Indeed, let me finish by adding a few more instructions on how to use for example an NPM package called **json-server**.

[30] JsonPlaceHolder *or* miragejs *for example*

Alternative: using json-server

Let's start by install json-server:

```
npm install -D json-server
```

Now let's rename the **vite.config.ts** file to vite.config.jsonserver.ts. Make 2 more copies of this file and name one **vite.config.mock.ts** and the other **vite.config.production.ts**:

The content for **vite.config.mock.ts** will be:

```
/// <reference types="vitest" />
/// <reference types="vite/client" />

import { defineConfig } from 'vite'
import react from '@vitejs/plugin-react'
import { fileURLToPath, URL } from 'url'

// https://vitejs.dev/config/
export default defineConfig({
  plugins: [react()],
  envDir: './src/',
  resolve: {
    alias: {
      // @ts-ignore
      '@': fileURLToPath(new URL('./src', import.meta.url)),
    },
  },
  server: {
    port: 3000,
    origin: 'http://localhost:3000/',
    open: 'http://localhost:3000/'
  },
  test: {
```

```
    globals: true,
    environment: 'jsdom',
    exclude: [
      'node_modules'
    ]
  }
})
```

The content for **vite.config.production.ts** will be:

```
/// <reference types="vitest" />
/// <reference types="vite/client" />

import { defineConfig } from 'vite'
import react from '@vitejs/plugin-react'
import { fileURLToPath, URL } from 'url'

// https://vitejs.dev/config/
export default defineConfig({
  plugins: [react()],
  envDir: './src/',
  resolve: {
    alias: {
      // @ts-ignore
      '@': fileURLToPath(new URL('./src', import.meta.url)),
    },
  },
  test: {
    globals: true,
    environment: 'jsdom',
    exclude: [
      'node_modules'
    ]
  }
})
```

The content for **vite.config.jsonserver.ts** will be:

```
/// <reference types="vitest" />
/// <reference types="vite/client" />

import { defineConfig } from 'vite'
import react from '@vitejs/plugin-react'
import { fileURLToPath, URL } from 'url'

// https://vitejs.dev/config/
export default defineConfig({
  plugins: [react()],
  envDir: './src/',
  resolve: {
    alias: {
      // @ts-ignore
      '@': fileURLToPath(new URL('./src', import.meta.url)),
    },
  },
  server: {
    port: 3000,
    origin: 'http://localhost:3000/',
    open: 'http://localhost:3000/',
    proxy: {
      '/jsonserver': {
        target: 'http://localhost:3111',
        changeOrigin: true,
        secure: false,
        ws: false,
        rewrite: (path) => path.replace(/^\/jsonserver/, '')
      }
    }
  },
  test: {
    globals: true,
    environment: 'jsdom',
    exclude: [
      'node_modules'
    ]
  }
})
```

Note how the main difference in the vite.config.jsonserver.ts is the addition of the proxy section:

```
...

    proxy: {
      '/jsonserver': {
        target: 'http://localhost:3111',
        changeOrigin: true,
        secure: false,
        ws: false,
        rewrite: (path) => path.replace(/^\/jsonserver/, '')
      }
    }

...
```

This is telling Vite to proxy all the requests for endpoints that start with `/jsonserver` to the url `http://localhost:3111` (this is where the json-server API will run from)

Modify **tsconfig.node.json** include section like this (if you don't have this file, please create it):

```
{
  "compilerOptions": {
    "composite": true,
    "module": "esnext",
    "moduleResolution": "node"
  },
  "include": [
    "vite.config.jsonserver.ts",
    "vite.config.mock.ts",
    "vite.config.production.ts"
  ]
}
```

Modify tsconfig.json to reference also tsconfig.node.json:

```
{
  ...

  "references": [{ "path": "./tsconfig.node.json" }]
}
```

Modify the script section of the package.json file to have two additional commands:

- with-jsonserver (we'll use this to run the app using the vite.config.jsonserver.ts)
- json-server-api (with this we'll start json-server on port 3111)

Also update the current command to explicitely set which Vite config file to use with –config:

```
  ...

  "scripts": {
    "dev": "vite --config vite.config.mock.ts --mode mock",
    "build": "tsc && vite build --config vite.config.production.ts  --mode productio\
n",
    "build-beta": "tsc && vite build --config vite.config.production.ts  --mode beta\
",
    "build-local": "tsc && vite build --config vite.config.production.ts  --mode loc\
alapis",
    "build-mock": "tsc && vite build --config vite.config.mock.ts --mode mock",
    "preview": "vite preview --config vite.config.mock.ts --mode mock",
    "start": "npm run dev",
    "start-local": "vite --config vite.config.production.ts --mode localapis",
    "with-jsonserver": "vite --config vite.config.jsonserver.ts --mode jsonserver",
    "json-server-api": "json-server --port 3111 --watch json-server/db.json",

     ...
```

Create json-server data under src/json-server/db.json with this:

```
// file: src/json-server/db.json
{

  "items": [
    {
      "id": 1,
      "name": "Item 1 from json-server",
      "selected": false
    },
    {
      "id": 2,
      "name": "Item 2 from json-server",
      "selected": false
    },
    {
      "id": 3,
```

```
      "name": "Item 3 from json-server",
      "selected": false
    },
    {
      "id": 4,
      "name": "Item 4 from json-server",
      "selected": false
    },
    {
      "id": 5,
      "name": "Item 5 from json-server",
      "selected": false
    }
  ]

}
```

Now to finally test it, temporarily modify the file `src/api-client/mock/items/index.ts` to use `/jsonserver/items` for the fetchItems url:

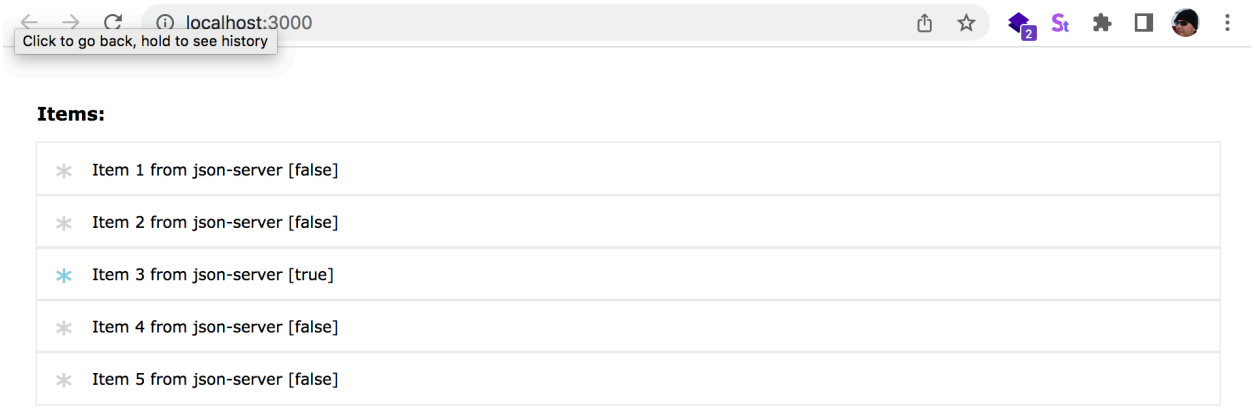
```
// file: src/api-client/mock/items/index.ts

...

const options: ItemsApiClientOptions = {
  endpoints: {
    //fetchItems: '/static/mock-data/items/items.json' // <-- comment this line out
    fetchItems: '/jsonserver/items' // <-- add this line
  },
  mockDelay: 1000
}

...
```

Note: we'll drive the API urls end-points through a much better configuration strategy in the next chapters.

Now stop the app, and this time open 2 terminal windows:

- in terminal one, execute **npm run json-server-api** (this will run json-server API on port 3111)
- in therminal two, execute **npm run with-jsonserver** (this will start our app but tell Vite to use the vite.config.jsonserver.ts which contains our proxy configuration)

The browser should now display:



NOTE: Do not forget to revert your change for the URL end-point within the file `src/api-client/mock/items/`. Later, when we introduce the apllication configuration in the next chapters, we'll drive the end-points from configuration and will not have to modify eny code to test different environments.

Chapter 7 Recap

What We Learned

- How to implement an **apiClient** that automatically can serve either mock or real data depending on environment variables configuration
- How to continue enforcing type checking at development time with TypeScript interfaces and models
- How to structure directories and files in an organized way
- How to invoke our api client from the store

Observations

- We have a reference to a third NPM package (**axios**) in our **ItemsApiClient** mode and if we keep following this pattern we'll keep polluting new api client implementations for different areas with references to this NPM package in several parts of our code. This will cause a build up in technical debt that will make it harder to later replace **axios** with something else one day we'll have to. This might happen either because **axios** will no longer be supported, or maybe better NPM packages will be available that we want o use in its place. Either way, we should structure our code in a way so that we can more easily replace **axios** with something else without having to change a lot of code in too many places.

Based on these observations, there are a few improvements that will be making into the next two chapters:

Improvements

- Create an **HttpClient** model that implements an **HttpClientInterface** where we can encapsulate the reference to **axios** all in one place and make it easier to change later if we find the need to use a different NPM package.

Chapter 8 - Enhance the Api Client

From the previous chapter recap, we observed that the **ItemsApiClient** contains hard-coded references to the **axios** NPM package. We understand that is not a good practice to follow as, when adding more API clients, we do not want to have references to a 3rd party NPM packages spread throughout our code.

Imagine if we had built a huge code base with many components and state modules and now we wanted to using something like **Fetch Api**[31] or another library insteaf of **axios**. We would have to replace all the calls that use **axios** in our entire code base.

What we need to do is abstract the http client methods into their own implementation that we can then consume from our **ItemsApiClient** and future API clients implementations that we'll be adding later.

There are multiple ways we could do this, but the most straigh-forward way is to create a class that wraps our calls done with **axios** in one place. We'll call this the **HttpClient** class and here we'll implement code that allow us to perform http requests using axios for now. If later we have to switch to a different NPM library or use the Fetch API etc, we'll jsut need to update the code without our HttpClient. Ass long as we do not change the signature of our HttpClient methods, everything should still work as before without having to change the code that consumes our HttpClient throughout our application.

Here I will show you how this pattern works by offering both an implementation that uses axios and one that uses the browser Fetch API. Then in the net chapter will drive which client we use through the app configuration.

HttpClient Interfaces and Models

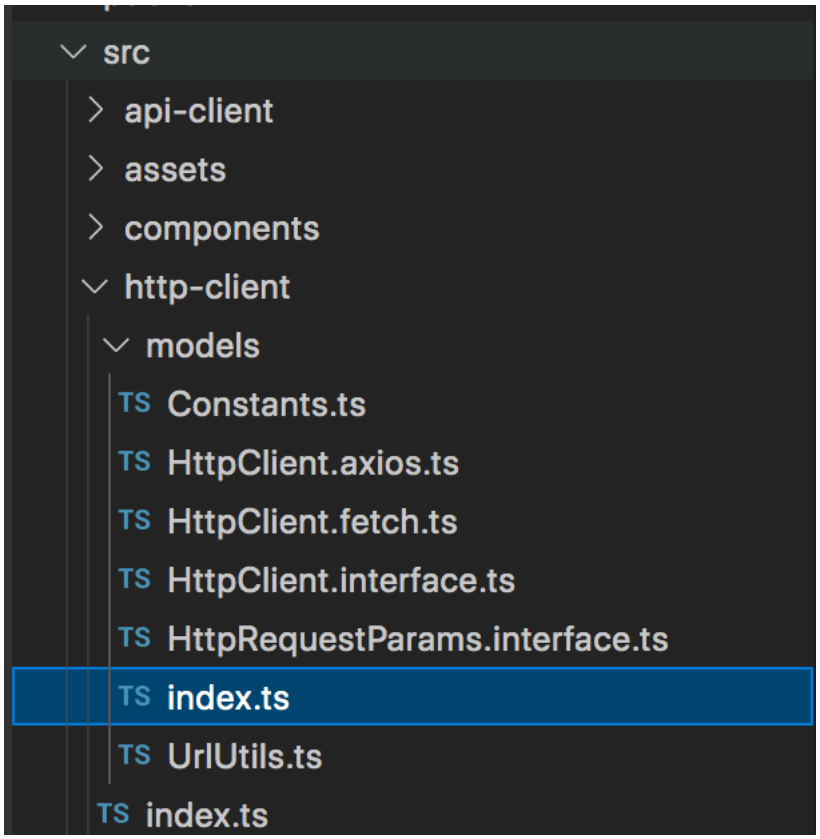
Create the directory **src/http-client/models**. Within this directory, create the following files

- Constants.ts
- HttpRequestParams.interface.ts
- UrlUtils.ts
- HttpClient.interface.ts
- HttpClient.axios.ts

[31] https://developer.mozilla.org/en-US/docs/Web/API/Fetch_API

- HttpClient.fetch.ts
- index.ts

Your directory structure will look like this:



Following is the the description and code for each of the files.

Constants.ts

Within the Constants.ts file, we'll add an enum representing the type of http request we want our HttpClient to execute. For now we just add the 4 most common http verbs: get/post/put/delete:

```
// file: src/http-client/models/HttpRequestType.ts

/**
 * @name HttpRequestType
 * @description
 * The type of http request we need to execute in our HttpClient request method
 */
export const enum HttpRequestType {
  get,
  post,
  put,
  delete,
  patch
}

...
```

We'll also add two readonly objects to avoid using hard-coded strings later:

```
// file: src/http-client/models/HttpRequestType.ts

...

// http content types
export const HttpContentTypes = Object.freeze({
  applicationJson: 'application/json',
  formUrlEncoded: 'application/x-www-form-urlencoded;charset=UTF-8'
})

// constant for http request methods names
export const HttpRequestMethods = Object.freeze({
  get: 'GET',
  post: 'POST',
  put: 'PUT',
  delete: 'DELETE',
  patch: 'PATCH'
})
```

HttpRequestParams.interface.ts

The **HttpRequestParamsInterface** will allow us to pass parameters to the HttpClient request method. These are things like the type of request (GET/POST/etc), the API **endpoint**, an

optional **payload** (if POST or PUT), and a flag that indicates if the request must include an authentication token.

```
// file: src/http-client/models/HttpRequestParams.interface.ts

import { HttpRequestType } from './Constants'

/**
 * @name HttpRequestParamsInterface
 * @description
 * Interface represents an object we'll use to pass arguments into our HttpClient re\
quest method.
 * This allow us to specify the type of request we want to execute, the end-point ur\
l,
 * if the request should include an authentication token, and an optional payload (i\
f POST or PUT for example)
 */
export interface HttpRequestParamsInterface<P = void> {
  requestType: HttpRequestType
  endpoint: string
  requiresToken: boolean
  headers?: { [key: string]: string }
  payload?: P
  mockDelay?: number
}
```

*NOTE: With **P ** we are trying to enfore more type-checking with TypeScript when we'll consume this, at the same time we need to add as **P = void** as this is not always required.*

UrlUtils.ts

This mainly contains an helper to dynamically build urls with parameters:

```
// file: src/http-client/models/UrlUtils.ts
export interface UrlUtilsInterface {
  getFullUrlWithParams(baseUrl: string, params: { [key: string]: number | string }):\
 string
}

export const UrlUtils: UrlUtilsInterface = {
  /**
   * @name getFullUrlWithParams
   * @description Returns the full formatted url for an API end-point
   * by replacing parameters place holder with the actual values.
   * @param baseUrl The base API end-point witht he params placeholders like {projec\
tId}
   * @param params The request params object with the key/value entries for each par\
ameter
   * @returns The fully formatted API end-point url with the actual parameter values
   */
  getFullUrlWithParams: (baseUrl: string, params: { [key: string]: number | string }\
): string => {
    const keys: string[] = Object.keys(params || {})
    if ((baseUrl || '').indexOf('[') === -1 || keys.length === 0) {
      return baseUrl
    }
    let fullUrl = baseUrl
    keys.forEach((key) => {
      fullUrl = fullUrl.replace(`[${key}]`, (params[key] || 'null').toString())
    })
    return fullUrl
  }
}
```

Note: you could alternatively implement getFullUrlWithParams using the JavaScript built-in Url.

HttpClient.interface.ts

The **HttpClientInterface** is the interface that defines the methods that the **HttpClient** will have to implement. There will be only one method called **request** which can execute different types of http request based on the parameters argument provided, and returns a **Promise**[32] with the results (if any):

[32] https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global_Objects/Promise

```
// files: src/http-client/models/HttpClient.interface.ts

import { HttpRequestParamsInterface } from './HttpRequestParams.interface'

/**
 * @name HttpClientConfigInterface
 * @description
 * We'll drive the HttpClient from configuration in later chapters.
 */
export interface HttpClientConfigInterface {
  tokenKey: string
  clientType: string
}

/**
 * @name HttpClientInterface
 * @description
 * Represents our HttpClient.
 */
 export interface HttpClientInterface {
  /**
   * @name request
   * @description
   * A method that executes different types of http requests (i.e. GET/POST/etc)
   * based on the parameters argument.
   * The type R specify the type of the result returned
   * The type P specify the type of payload if any
   * @returns A Promise<R> as the implementation of this method will be async.
   */
  request<R, P = void>(parameters: HttpRequestParamsInterface<P>): Promise<R>
}
```

*Note: in the code above the request method can take 2 generic types. The first one, **R**, define the type of the result/data returned. The second, **P**, is optional and defines the type of the **payload** (if any) passed with the **parameters** argument.*

HttpClient.axios.ts

The **HttpClientAxios** is the class that implements our **HttpClientInterface** using axios. Since the code here is longer, let me split in multiple parts.

First the import section:

```
// file: src/http-client/models/HttpClient.axios.ts

import axios, {
  AxiosRequestConfig,
  AxiosResponse
} from 'axios'

import { HttpRequestParamsInterface } from './HttpRequestParams.interface'
import { HttpClientInterface, HttpClientConfigInterface } from './HttpClient.interfa\
ce'
import { HttpRequestType, HttpContentTypes } from './Constants'
import { UrlUtils } from './UrlUtils'

/**
 * @name HttpClientAxios
 * @description
 * Wraps http client functionality to avoid directly using a third party npm package\
 like axios
 * and simplify replacement in the future if such npm package would stop being devel\
oped or other reasons
 */
export class HttpClientAxios implements HttpClientInterface {

  constructor() {
    // OPTIONAL for now: Add request interceptor to handle errors or other things fo\
r each request in one place
  }

  /**
   * @name request
   * @description
   * A method that executes different types of http requests (i.e. GET/POST/etc)
   * based on the parameters argument.
   * The type R specify the type of the result returned
   * The type P specify the type of payload if any
   * @returns A Promise<R> as the implementation of this method will be async.
   */
  async request<R, P>(parameters: HttpRequestParamsInterface<P>): Promise<R> {
    // use destructuring to extract our parameters into local variables
    const { requestType, endpoint, requiresToken, payload, headers, mockDelay } = pa\
rameters

    // use helper to build the fullUrl with request parameters derived from the payl\
```

```
oad
    const fullUrl = UrlUtils.getFullUrlWithParams(endpoint, payload as any)
    console.log('HttpClientAxios: fullUrl: ', fullUrl, payload)

    // set axios options
    const options: AxiosRequestConfig = {
      headers: {},
      maxRedirects: 0
    }

    if (headers) {
      options.headers = {
        //...options.headers,
        ...headers
      }
    }

    // set headers Authorization
    if (requiresToken && options.headers) {
      options.withCredentials = true
      // optional: you could add coded here to set the Authorization header with a b\
earer token
      // options.headers.Authorization = `bearer ${ JwtHelpers.getJwtToken() }`
    }

    let result!: R

    try {
      switch(requestType) {

        // TODO: implement a case statement for each request type

        default: {
          console.warn('HttpClientAxios: invalid requestType argument or request typ\
e not implemented')
        }
      }
    } catch (e) {
      console.error('HttpClientAxios: exception', e)
      throw Error('HttpClientAxios: exception')
    }

    if ((mockDelay || 0) > 0) {
```

```
      return new Promise<R>((resolve) => {
        setTimeout(() => {
          resolve(result)
        }, mockDelay)
      })
    }

    return result
  }
}
```

Note how we added a constructor placeholder, but not doing anything with it yet. Later, you could add things like request interceptors within the contructor so you can log or capture errors in one place. One more thing to notice is that we are using a try/catch block and just log the error in the console, but we are not gracefully rejecting the promise return by our request method. You are welcome to enhance and improve this code as you see fit based on your sepcific requirements.

The implementation of the request method starts by destructuring our request **parameters**, creates the fullUrl, setting some axios **options**, optionally setting an **Authorization** header (commented out for now, but to show how you can do that if you need it), and a **switch** statement that will execute the type of request we want. Let's implement now the different type of requests within each case block of our switch statement.

The **get** implementation:

```
// file: src/http-client/models/HttpClient.axios.ts

...

// executes a get request:
case HttpRequestType.get: {
  const response = await axios.get(fullUrl, options)
  result = response?.data as R
  break
}

...
```

The **post** implementation:

```
// file: src/http-client/models/HttpClient.axios.ts

...

// executes a post request:
case HttpRequestType.post: {
  const response = await axios.post(fullUrl, payload, options)
  result = response?.data as R
  break
}

...
```

The **put** implementation:

```
// file: src/http-client/models/HttpClient.axios.ts

...

// executes a put request:
case HttpRequestType.put: {
  const response = await axios.put(fullUrl, payload, options)
  result = response?.data as R
  break
}

...
```

The **delete** implementation:

```
// file: src/http-client/models/HttpClient.axios.ts

...

// executes a delete request:
case HttpRequestType.delete: {
  const response = await axios.delete(fullUrl, options)
  result = response?.data as R
  break
}

...
```

The **patch** implementation:

```
// file: src/http-client/models/HttpClient.axios.ts

...

// executes a patch request:
case HttpRequestType.patch: {
  const response = await axios.patch(fullUrl, payload, options)
  result = response?.data as R
  break
}

...
```

HttpClient.fetch.ts

The **HttpClientFetch** is the class that implements our **HttpClientInterface** using fetch. Since the code here is longer, let me split in multiple parts.

```
// file: src/http-client/models/HttpClient.fetch.ts
import { HttpRequestParamsInterface } from './HttpRequestParams.interface'
import { HttpClientInterface, HttpClientConfigInterface } from './HttpClient.interfa\
ce'
import { HttpRequestType, HttpRequestMethods, HttpContentTypes } from './Constants'
import { UrlUtils } from './UrlUtils'

/**
 * @name HttpClientFetch
 * @description
 * Wraps http client functionality to avoid directly using fetch
 * and simplify replacement in the future if such npm package would stop being devel\
oped or other reasons
 */
export class HttpClientFetch implements HttpClientInterface {

  constructor() {
    // OPTIONAL for now: Add request interceptor to handle errors or other things fo\
r each request in one place
  }

  /**
   * @name request
   * @description
```

```
   * A method that executes different types of http requests (i.e. GET/POST/etc)
   * based on the parameters argument.
   * The type R specify the type of the result returned
   * The type P specify the type of payload if any
   * @returns A Promise<R> as the implementation of this method will be async.
   */
  async request<R, P = void>(parameters: HttpRequestParamsInterface<P>): Promise<R> {
    // use destructuring to extract our parameters into local variables
    const { requestType, endpoint, requiresToken, payload, headers, mockDelay } = pa\
rameters

    // use helper to build the fullUrl with request parameters derived from the payl\
oad
    const fullUrl = UrlUtils.getFullUrlWithParams(endpoint, payload as any)
    console.log('HttpClientFetch: fullUrl: ', fullUrl, payload)

    // set fetch options
    const options: RequestInit = {
      credentials: 'include',
      redirect: 'follow',
      headers: {}
    }

    if (headers) {
      options.headers = {
        ...headers
      }
    }

    if (!options.headers?.hasOwnProperty('Content-Type')) {
      // default to content-type json
      options.headers = {
        ...headers,
        'Content-Type': HttpContentTypes.applicationJson
      }
    }

    // set headers Authorization
    if (requiresToken && options.headers) {
      // optional: you could add coded here to set the Authorization header with a b\
earer token
      // options.headers.Authorization = `bearer ${ JwtHelpers.getJwtToken() }`
    }
```

```
    let result!: R

    // helper for checking if response is being redirected (302) in fetch
    const checkRedirect = async (resp: any) => {
      if (resp.redirected) {
        // if so, redirect to response url
        document.location = resp.url
        return true
      }
      return false
    }

    try {
      switch (requestType) {

        // TODO: implement a case statement for each request type

        default: {
          console.warn('HttpClientFetch: invalid requestType argument or request typ\
e not implemented')
        }
      }
    } catch (e) {
      //console.error('HttpClientFetch: exception', e)
      throw Error('HttpClientFetch: exception')
    }

    if ((mockDelay || 0) > 0) {
      return new Promise<R>((resolve) => {
        setTimeout(() => {
          resolve(result)
        }, mockDelay)
      })
    }

    return result
  }
}
```

The implementation of the request method starts by destructuring our request **parameters**, creates the fullUrl, setting some fetch **options**, optionally setting an **Authorization** header (commented out for now, but to show how you can do that if you need it), and a **switch**

statement that will execute the type of request we want. Let's implement now the different type of requests within each case block of our switch statement.

The **get** implementation:

```
// file: src/http-client/models/HttpClient.fetch.ts

...

// executes a get request:
case HttpRequestType.get: {
  options.method = HttpRequestMethods.get
  const response = (await fetch(fullUrl, options)) as any
  const redirected = await checkRedirect(response)
  if (!redirected) {
    result = (await response.json()) as R
  }
  break
}

...
```

The **post** implementation:

```
// file: src/http-client/models/HttpClient.fetch.ts

...

// executes a post request:
case HttpRequestType.post: {
  options.method = HttpRequestMethods.post
  options.body = typeof payload === 'string' ? payload : JSON.stringify(payload)
  const response = (await fetch(fullUrl, options)) as any
  const redirected = await checkRedirect(response)
  if (!redirected) {
    result = (await response.json()) as R
  }
  break
}

...
```

The **put** implementation:

```
// file: src/http-client/models/HttpClient.fetch.ts

...

// executes a put request:
case HttpRequestType.put: {
  options.method = HttpRequestMethods.put
  options.body = typeof payload === 'string' ? payload : JSON.stringify(payload)
  const response = (await fetch(fullUrl, options)) as any
  const redirected = await checkRedirect(response)
  if (!redirected) {
    result = (await response.json()) as R
  }
  break
}

...
```

The **delete** implementation:

```
// file: src/http-client/models/HttpClient.fetch.ts

...

// executes a delete request:
case HttpRequestType.delete: {
  options.method = HttpRequestMethods.delete
  const response = (await fetch(fullUrl, options)) as any
  const redirected = await checkRedirect(response)
  if (!redirected) {
    result = (await response.json()) as R
  }
  break
}

...
```

The **patch** implementation:

```
// file: src/http-client/models/HttpClient.fetch.ts

...

// executes a patch request:
case HttpRequestType.patch: {
  options.method = HttpRequestMethods.patch
  options.body = typeof payload === 'string' ? payload : JSON.stringify(payload)
  const response = (await fetch(fullUrl, options)) as any
  const redirected = await checkRedirect(response)
  if (!redirected) {
    result = (await response.json()) as R
  }
  break
}

...
```

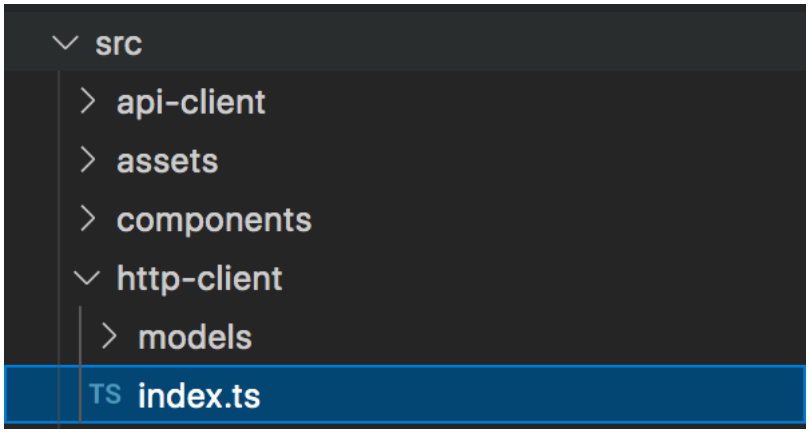
http-client/models/index.ts (barrel file)

Inside the index file paste the following to export all the enums/ interfaces/models:

```
// file: src/http-client/models/index.ts

export * from './Constants'
export * from './HttpClient.axios'
export * from './HttpClient.fetch'
export * from './HttpClient.interface'
export * from './HttpRequestParams.interface'
export * from './UrlUtils'
```

http-client/index.ts (client factory)

Add another index file under src/http-client:



This file contains the export of a single instance of our **HttpClient**. This is what we'll be consuming in our API client. For now, we'll create an instance of the HttpClient.fetch implementation, but in later chapters we'll drive this from configuration (appConfig):

```
// file: src/http-client/index.ts

import { HttpClientInterface } from './models/HttpClient.interface'
//import { appConfig } from '@/app-config'

import { HttpClientAxios } from './models/HttpClient.axios'
import { HttpClientFetch } from './models/HttpClient.fetch'

// export all our interfaces/models/enums
export * from './models'

let _httpClient: HttpClientInterface | undefined = undefined

// export out hook
export const useHttpClient = () => {
  if (!_httpClient) {
    // export instance of HttpClientInterface
    const clientType = 'fetch'
    // const clientType = config.httpClient.clientType // later will drive from conf\
ig

    // if you'd like to use axios, set "clientType": "axios" within the config files\
 httpClient section
    if (clientType === 'fetch') {
      _httpClient = new HttpClientFetch()
    } else if (clientType === 'axios') {
      _httpClient = new HttpClientAxios()
```

```
    }
  }

  return _httpClient as HttpClientInterface
}
```

UrlUtils Unit Tests

Create the directory **tests/unit/http-client** directory and add a new file called **UrlUtils.getFullUrlWithParams.test.ts** with the following:

```
// file: src/tests/unit/http-client/UrlUtils.getFullUrlWithParams.test.ts

import { UrlUtils } from '@/http-client'

describe('UrlUtils: getFullUrlWithParams', () => {
  it('should return fullUrl formatted as expected with one param', () => {
    const endpoint = 'https://unit-test-api/v1/domain/[catalogId]/[partId]'
    const params = {
      catalogId: 5346782,
      partId: 'abcde23'
    }
    const result = UrlUtils.getFullUrlWithParams(endpoint, params)

    expect('https://unit-test-api/v1/domain/5346782/abcde23').toEqual(result)
  })

  // test our component click event
  it('should return fullUrl formatted as expected with multiple params', () => {
    const endpoint = 'https://unit-test-api/v1/domain/[country]/[state]/[cityId]'
    const params = {
      country: 'USA',
      state: 'NY',
      cityId: 'gtref345ytr'
    }
    const result = UrlUtils.getFullUrlWithParams(endpoint, params)

    expect('https://unit-test-api/v1/domain/USA/NY/gtref345ytr').toEqual(result)
  })
})
```

HttpClient: Unit Tests

We need to add unit tests against **HttpClientAxios** and **HttpClientFetch** before we can re-factor the **ItemApiClient** code to use it.

HttpClientAxios tests

Testing a successful "get" response

Within the directory **tests/unit/http-client** directory create a sub-directory called **axios-client** and here and add a new file called **AxiosClient.request.get.test.ts**. Within the file, paste the following code:

```
// file: src/tests/unit/http-client/axios-client/AxiosClient.request.get.test.ts

import axios from 'axios'
import { HttpClientAxios, HttpRequestType, HttpRequestParamsInterface } from '@/http\
-client'

let mockRequestParams: HttpRequestParamsInterface<any> = {
  requestType: HttpRequestType.get,
  endpoint: 'path/to/a/get/api/endpoint',
  requiresToken: false
}

describe('HttpClient: axios-client: request: get', () => {
  const httpClient = new HttpClientAxios()

  it('should execute get request succesfully', () => {
    vitest
      .spyOn(axios, 'get')
      .mockImplementation(async () => Promise.resolve({ data: `request completed: ${\
mockRequestParams.endpoint}` }))

    httpClient
      .request(mockRequestParams)
      .then((response) => {
        //console.debug('response:', response)
        expect(response).toEqual(`request completed: ${mockRequestParams.endpoint}`)
      })
      .catch((error) => {
```

```
        console.info('AxiosClient.request.get.test.ts: error', error)
      })
  })

  ...
```

Testing an unsuccessful "get" response

Within the same file, add the following code:

```
// file: src/tests/unit/http-client/axios-client/AxiosClient.request.get.test.ts

...

describe('HttpClient: axios-client: request: get', () => {

  ...

  it('get should throw error on rejection', () => {
    vitest
      .spyOn(axios, 'get')
      .mockImplementation(async () => Promise.reject({ data: `request completed: ${m\
ockRequestParams.endpoint}` }))

    httpClient.request(mockRequestParams).catch((error) => {
      expect(error).toBeDefined()
      expect(error.toString()).toEqual('Error: HttpClientAxios: exception')
    })
  })
})
```

Testing a successful "post" response

Within the directory **tests/unit/http-client/axios-client** directory and add a new file called **AxiosClient.request.post.test.ts**. Within the file, paste the following code:

```
// file: src/tests/unit/http-client/axios-client/AxiosClient.request.post.test.ts

import axios from 'axios'
import { HttpClientAxios, HttpRequestType, HttpRequestParamsInterface } from '@/http\
-client'

let mockRequestParams: HttpRequestParamsInterface<any> = {
  requestType: HttpRequestType.post,
  endpoint: 'path/to/a/post/api/endpoint',
  requiresToken: false,
  payload: {}
}

type P = typeof mockRequestParams.payload

describe('HttpClient: axios-client: request: post', () => {
  const httpClient = new HttpClientAxios()

  it('should execute post request succesfully', () => {
    vitest
      .spyOn(axios, 'post')
      .mockImplementation(async () => Promise.resolve({ data: `request completed: ${\
mockRequestParams.endpoint}` }))

    httpClient
      .request<string, P>(mockRequestParams)
      .then((response) => {
        //console.debug('response:', response)
        expect(response).toEqual(`request completed: ${mockRequestParams.endpoint}`)
      })
      .catch((error) => {
        console.info('AxiosClient.request.post.test.ts: post error', error)
      })
  })
})
```

Note: you can keep adding more test in a similar way for the rest of the request type like PUT/DELETE/etc

HttpClientFetch tests

Testing “get” responses

Within the directory **tests/unit/http-client** directory create a sub-directory called **fetch-client** and here and add a new file called **FetchClient.request.get.test.ts**. Within the file, paste the following code:

```
// file: src/tests/unit/http-client/fetch-client/FetchClient.request.get.test.ts

import { HttpClientFetch, HttpRequestType, HttpRequestParamsInterface, HttpRequestMe\
thods } from '@/http-client'

let mockRequestParams: HttpRequestParamsInterface<any> = {
  requestType: HttpRequestType.get,
  endpoint: 'path/to/a/get/api/endpoint',
  requiresToken: false
}

describe('HttpClient: axios-client: request: get', (done) => {
  const httpClient = new HttpClientFetch()

  it('should execute get request succesfully', async () => {

    // could not find an easy way to use spyOn for fetch so overriding global.fetch
    // save original fetch
    const unmockedFetch = global.fetch || (() => {})
    global.fetch = unmockedFetch

    const expectedResult = {
      result: `request completed: ${mockRequestParams.endpoint}`
    }

    vitest
      .spyOn(global, 'fetch')
      .mockImplementation(async () => Promise.resolve({
        redirected: false,
        json: () => Promise.resolve(JSON.stringify(expectedResult))
      } as any))

    try {
      const response = await httpClient.request(mockRequestParams)
```

```
      expect(response).not.toBeNull()
      expect(response).toEqual(expectedResult)
    } catch (error) {
      console.info('AxiosClient.request.get.test.ts: error', error)
    }

    // restore globa.fetch
    global.fetch = unmockedFetch
  })

  it('get should throw error on rejection', () => {
    // could not find an easy way to use spyOn for fetch so overriding global.fetch
    // save original fetch
    const unmockedFetch = global.fetch || (() => {})
    global.fetch = unmockedFetch

    vitest
      .spyOn(global, 'fetch')
      .mockImplementation(async () => Promise.reject())

    httpClient.request(mockRequestParams).catch((error) => {
      expect(error).toBeDefined()
      expect(error.toString()).toEqual('Error: HttpClientFetch: exception')
    })
  })
})
```

And so on, you can keep adding more unit tests for each request type like you did for the axios-client.

We can finally change our **ItemApiClient** so it uses our newly implemented HttpClient instead of axios.

ItemsApiClientModel Update

Open the file **src/api-client/models/items/ItemsApiClient.model.ts**.
Remove the import **axios** line and replace it with an import for our **HttpClient** instance and the **HttpRequestParamsInterface**:

```
// file: src/api-client/models/items/ItemsApiClient.model.ts

import axios, { AxiosRequestConfig, AxiosError, AxiosResponse } from 'axios' // <-- \
remove this line
import { useHttpClient, HttpRequestType, HttpRequestParamsInterface } from '@/http-c\
lient' // <-- add this line
```

Then replace the **fetchItems** implementation with the following:

```
// file: src/api-client/models/items/ItemsApiClient.model.ts

...

  fetchItems(): Promise<ItemInterface[]> {
    const requestParameters: HttpRequestParamsInterface = {
      requestType: HttpRequestType.get,
      endpoint: this.endpoints.fetchItems,
      requiresToken: false,
      mockDelay: this.mockDelay
    }

    return useHttpClient().request<ItemInterface[]>(requestParameters)
  }

...
```

This creates a const variable to hold our **HttpRequestParamsInterface** parameters, and then return the call to **httpClient.request** (which is already a Promise, so we do not have to do anything else here):

Now, make sure there are no errors in the terminal and the browser refreshes correctly and load the data correctly.

Chapter 8 Recap

What We Learned

- How to abstract an http client into interfaces and models that are generic
- How to implement the **HttpClientInterface** into a model that **encapsulate** the use of a 3rd party package in one place. We show this by implement two different clients: HttpClientAxios and HttpClientFetch.
- How to use **vitest.spyON** for stubs so we can test the HttpClient **request** method responses for different scenarios.

Observations

- We did not write unit tests against the **HttpClient** put/delete/patch methods
- We did not write unit tests against the **ItemsApiClientModel**

Based on these observations, there are a few improvements that you could make on your own:

Improvements

- Add unit tests against the **HttpClient** put/delete/patch methods as well
- Add unit tests against the **ItemsApiClient** methods as well
- Experiment by adding another HttpClient implementation that uses another Ajax library other than axios or fetch and then and modify the file src/http-client/index.ts so that it instantiate this one instead of the axios or fetch implementation. Then verify that the app still run as expected.

Chapter 9 - App Configuration

We need now to add a way to configure our app through configuration files for different environments (i.e. **mock**, **beta**, **production**, etc).

*NOTE: The code in this chapter is not just specific to **React**. These concepts can be applied to any front-end app (i.e. React/Vue/Svelte/Angular/etc).*

As you recall from Chapter 7, we extended **import.meta.env** declaration types (file src/vite-env.d.ts) to include a new variable called **VITE_API_CLIENT**. This currently drives the selection of the API client at run time (mock or live). As you can imagine, as we add more configuration, we might end adding a lot of new variables prefixed with ***VITE_***. This works, but can quickly become very hard to manage, especially for large configurations that will drive many settings.

A better approach is to drive the entire configuration through only one variable that we are going to call **VITE_APP_CONFIG**. We'll store all the settings in dedicated JSON files. We'll have one configuration file for each environment (mock/beta/production/etc) and then load that dynamically at run-time (or build time) based on our new **VITE_APP_CONFIG** environment variable.

vite-env.d.ts updates (or env.d.ts)

Let's start by modifying the code within the **Vite** types declarations file. Rename the current variable VITE_API_CLIENT to **VITE_APP_CONFIG**:

```
// file: src/vite-env.d.ts (or src/env.d.ts)

...


// types for Vite env variables:
// (reference: https://vitejs.dev/guide/env-and-mode.html#intellisense-for-typescrip\
t)
interface ImportMetaEnv {
  readonly VITE_APP_CONFIG: string // rename this from VITE_API_CLIENT to VITE_APP_C\
ONFIG
  // more env variables...
```

```
}

interface ImportMeta {
  readonly env: ImportMetaEnv
}
```

.env files updates

Make sure to also update each '.env' file by renaming VITE_API_CLIENT to **VITE_APP_CONFIG**:

```
// file: src/.env.mock

VITE_APP_CONFIG=mock


// file: src/.env.production

VITE_APP_CONFIG=production
```

Add also three additional files, `.env.jsonserver`, `.env.localapis` and `.env.beta`:

```
// file: src/.env.jsonserver

VITE_APP_CONFIG=jsonserver


// file: src/.env.localapis

VITE_APP_CONFIG=localapis


// file: src/.env.beta

VITE_APP_CONFIG=beta
```

Note: remember that VITE read from the .env files based on the **–mode** flag specified in the scripts shortcut (within the package.json file). Here we did not add any command for **localapis** or **beta**. But you could add things like **start-local** or build-beta etc:

```
// file: package.json

...

  "scripts": {
    "start": "npm run dev",
    "dev": "vite --config vite.config.mock.ts --mode mock",
    "build": "tsc && vite build --config vite.config.production.ts --mode production\
",
    "build-mock": "tsc && vite build --config vite.config.mock.ts --mode mock",
    "build-beta": "tsc && vite build --config vite.config.production.ts --mode beta"\
, /* you could add this */
    "start-local": "vite --config vite.config.production.ts --mode localapis", /* yo\
u could add this */
    "preview": "vite preview --config vite.config.mock.ts --mode mock",
    "test": "vitest run --config vite.config.mock.ts --mode mock",
    "test-watch": "vitest watch --config vite.config.mock.ts --mode mock",
    "test-coverage": "vitest run --coverage --config vite.config.mock.ts --mode mock\
",
  }

...
```

Config Interface

Create the directory **src/config/models/** and under this directory create a file called **Config.interface.ts**. This contains the declaration for our **config** interface. You will keep expanding this as you add more **settings** or **app domains** (i.e. like Items), for now let's just have the interface contain four sections:

- **global**: this will be for settings that span all domains
- **httpClient**: this is for things related to the **HttpClient**
- **apiClient**: this is for things related to the **ApiClient**
- **items**: this is for the **Items** domain settings (as we add more functionality/components etc we will add more areas/domains similar to this)

For the items section, we'll have only the **apiClientOptions** child section for now. This will be of type **ItemsApiClientOptions**.

Here is the code for the **src/config/models/Config.interface.ts** file:

```
// file: src/config/models/Config.interface.ts

import {
  ItemsApiClientOptions // NOTE: we'll create this a bit later
} from '@/api-client/models'

export interface HttpClientConfigInterface {
  tokenKey: string
  clientType: string
}

/**
 * @Name ConfigInterface
 * @description
 * Describes the structure of a configuration file
 */
export interface ConfigInterface {
  global: {
    // ... things that are not specific to a single app domain
    version: number
  }

  httpClient: HttpClientConfigInterface,

  apiClient: {
    type: string
  }

  items: {
    apiClientOptions: ItemsApiClientOptions
  }

}
```

Config files

Now create a sub-directory called **config-files** under this directory. The full path for this will be **src/config/config-files/**

Inside this directory, add 4 JSON files with the following names:

- **mock.json**

- **jsonserver.json**
- **localapis.json**
- **beta.json**
- **production.json**

The content of each file will have to match what is required by our **ConfigInterface**. In a little bit we'll be also adding some unit tests against this files to make sure they are as expected.

Here is the content of each file:

mock.json

```
// file: src/config/config-files/mock.json
{
  "global": {
    "version": 0.103
  },

  "httpClient": {
    "tokenKey": "myapp-token",
    "clientType": "fetch"
  },

  "apiClient": {
    "type": "mock"
  },

  "items": {
    "apiClientOptions": {
      "endpoints": {
        "fetchItems": "/static/mock-data/items/items.json"
      },
      "mockDelay": 250
    }
  }
}
```

jsonserver.json

```
// file: src/config/config-files/jsonserver.json
{
  "global": {
    "version": 0.1
  },

  "httpClient": {
    "tokenKey": "myapp-token",
    "clientType": "fetch"
  },

  "apiClient": {
    "type": "live"
  },

  "items": {
    "apiClientOptions": {
      "endpoints": {
        "fetchItems": "/jsonserver/items"
      },
      "mockDelay": 0
    }
  }
}
```

localapis.json

```
// file: src/config/config-files/localapis.json
{
  "global": {
    "version": 0.1
  },

  "httpClient": {
    "tokenKey": "myapp-token",
    "clientType": "fetch"
  },

  "apiClient": {
    "type": "live"
  },
```

```
  "items": {
    "apiClientOptions": {
      "endpoints": {
        "fetchItems": "http://api.localhost:4111/items"
      },
      "mockDelay": 0
    }
  }
}
```

beta.json

```
// file: src/config/config-files/beta.json
{
  "global": {
    "version": 0.1
  },

  "httpClient": {
    "tokenKey": "myapp-token",
    "clientType": "fetch"
  },

  "apiClient": {
    "type": "live"
  },

  "items": {
    "apiClientOptions": {
      "endpoints": {
        "fetchItems": "/path/to/your/real/BETA/api/and-point"
      },
      "mockDelay": 0
    }
  }
}
```

production.json

```
// file: src/config/config-files/production.json
{
  "global": {
    "version": 0.1
  },

  "httpClient": {
    "tokenKey": "myapp-token",
    "clientType": "fetch"
  },

  "apiClient": {
    "type": "live"
  },

  "items": {
    "apiClientOptions": {
      "endpoints": {
        "fetchItems": "/path/to/your/real/PRODUCTION/api/and-point"
      },
      "mockDelay": 0
    }
  }
}
```

tsconfig.json updates

In the next section, we'll be loading the individual **config** files through **import** statements. In order to enable this in **TypeScript**, we have to modify the **tsconfig.json** file located in the root of your project. We need to add option **resolveJsonModule** with **true** to the **compilerOptions** section:

```
{
  "compilerOptions": {

...
    "resolveJsonModule": true, /* this allows to import .json file as if they were .\
ts files: using to load config files */
  }
...
```

NOTE: your tsconfig.json might already have the resolveJsonModule flag, if so just make sure that is set to true.

Config files map

Within the directory **src/config/** add a file called **config-files-map.ts**.
Here we just import a reference to each of the configuration JSON files and create either a **strategy pattern** or a **JavaScript Map** that contains a map to our files by environment key (here we are showing this with **Map**):

```
// file: src/config/config-files-map.ts

// import a reference to our Config interface:
import { ConfigInterface } from './models/Config.interface'

// individual environments configs:
import configMock from './config-files/mock.json'
import configJsonServer from './config-files/jsonserver.json'
import configLocal from './config-files/localapis.json'
import configBeta from './config-files/beta.json'
import configProduction from './config-files/production.json'

// example with javascript Map()
export const configFilesMap: Map<string, ConfigInterface> = new Map<string, ConfigIn\
terface>([
  ['mock', configMock],
  ['jsonserver', configJsonServer],
  ['localapis', configLocal],
  ['beta', configBeta],
  ['production', configProduction]
])
```

Config provider

File utils.ts

Add a new file called **utils.ts** under src/config. Here we implement an helper function called **getAppConfigKey** that will return the value of our **VITE_APP_CONFIG** environment variable.

```
// file: src/config/utils.ts

// helper to read the value of REACT_APP_CONFIG (or VITE_APP_CONFIG if using vite)
export function getAppConfigKey() {
  // if using webpack:
  // let env: string = 'mock'
  // // @ts-ignore
  // if (process.env && process.env.REACT_APP_CONFIG) {
  //  // @ts-ignore
  //   env = process.env.REACT_APP_CONFIG.trim()
  // }
  // return env

  // Note: Vite uses import.meta.env (reference: https://vitejs.dev/guide/env-and-mo\
de.html)
  // optional: you can console.log the content of import.meta.env to inspect its val\
ues like this: console.log('import.meta.env', JSON.stringify(import.meta.env))
  // @ts-ignore
  return (import.meta.env.VITE_APP_CONFIG || '').trim()
}
```

Note that by wrapping this in one place, we could easily re-use this code in a project created with webpack. Since that uses process.env instead of Vite's import.meta.env we just need to uncomment the related code above and comment out the one that uses import.meta.env.

File index.ts (config provider)

Still within **src/config** directory, add another file called **index.ts**. Here we'll be consuming the **JSON** file that matches the environment specified by the current **VITE_APP_CONFIG** value.

Let's start by importing a reference to **ConfigInterface**, **configFilesMap**, and our helper **getAppConfigKey**:

```
// file: src/config/index.ts
// returns appropriate config based on env VITE_APP_CONFIG

// import a reference to our Config interface:
import { ConfigInterface } from './models/Config.interface'

// import reference to configFilesMap
import { configFilesMap } from './config-files-map'

// import reference to our getAppConfigKey helper function
import { getAppConfigKey } from './utils'

...
```

Then add a check and throw and error if our map does not contain an entry for the current environment key:

```
// file: src/config/index.ts

...

if (!configFilesMap.has(getAppConfigKey())) {
  throw Error(`Could not find config for VITE_APP_CONFIG key "${ getAppConfigKey() }\
"`)
}

...
```

Finally we export an instance of our **ConfigInterface** called **config**:

```
// file: src/config/index.ts

...

export const config = configFilesMap.get(getAppConfigKey()) as ConfigInterface
```

Here is the entire content of src/config/index.ts:

```
// file: src/config/index.ts
// returns appropriate config based on env VITE_APP_CONFIG

// import a reference to our Config interface:
import { ConfigInterface } from './models/Config.interface'

// import reference to configFilesMap
import { configFilesMap } from './config-files-map'

// import reference to our getAppConfigKey helper function
import { getAppConfigKey } from './utils'

// optional: you can console.log the content of import.meta.env to inspect its value:
console.log(`------ env ---- "${getAppConfigKey()}"`)

if (!configFilesMap.has(getAppConfigKey())) {
  throw Error(`Could not find config for VITE_APP_CONFIG key "${getAppConfigKey()}"`)
}

export const config = configFilesMap.get(getAppConfigKey()) as ConfigInterface
```

Unit Tests

Le's now write a few **unit tests** to validate that our **config** is being set as expected. This will also validate that the config **JSON** files contains the expected data structure.

Unit Tests against configsMap

Create directory **tests/unit/config** and add a new file called **Config.configsMap.spec.ts**. Here we'll be testing that our **configsMap** instance contains at least one entry for each environment, as expected:

```
// file: src/tests/unit/config/config-files-map.test.ts

import { configFilesMap } from '@/config/config-files-map'

describe('configFilesMap', () => {

  it('instance should have "mock" key', () => {
    expect(configFilesMap.has('mock')).toBe(true)
  })

  it('instance should have "jsonserver" key', () => {
    expect(configFilesMap.has('jsonserver')).toBe(true)
  })

  it('instance should have "localapis" key', () => {
    expect(configFilesMap.has('localapis')).toBe(true)
  })

  it('instance should have "beta" key', () => {
    expect(configFilesMap.has('beta')).toBe(true)
  })

  it('instance should have "production" key', () => {
    expect(configFilesMap.has('production')).toBe(true)
  })
}
```

Unit Tests against Config instances by environment

Note: if using Jest, we cannot just write unit tests against the config instance already created in the **src/config/index.ts** file because Jest will throw the following error:

```
SyntaxError: Cannot use 'import.meta' outside a module
```

Note: Jest does not understand VITE's import.meta.dev our of the box. There are discussion on the web if you google this and some people are using plugins or specific babel config etc. Here will simply do not test the config instance from the src/config/index.ts file but create a new one in our unit tests

Vitest does not have this issue but I thought it was worth mentioning it.

To be safe in either case, we will write our unit tests by creating an instance of ConfigInterface within the unit tests. We can easily do this by specifying the environment key as a hard-coded string to the map.get method, i.e. `configFilesMap.get('mock')`.

Tests config.mock.test.ts

Still under directory **tests/unit/config** add another file called **config.mock.test.ts** with the following code:

```
// file: src/tests/unit/config/config.mock.test.ts

// import the Config interface
import { ConfigInterface } from '@/config/models/Config.interface'
// import a reference to the confiFilesMap
import { configFilesMap } from '@/config/config-files-map'

describe('config: mock', () => {
  const config: ConfigInterface = configFilesMap.get('mock') as ConfigInterface

  it('instance should have "global" section', () => {
    expect(config).toHaveProperty('global')
  })

  it('instance should have "httpClient" section', () => {
    expect(config).toHaveProperty('httpClient')
  })

  it('instance should have "items" section', () => {
    expect(config).toHaveProperty('items')
  })

  describe('global', () => {
    const section = config.global
    it('section should have "version" property', () => {
      expect(section).toHaveProperty('version')
      expect(typeof section.version).toBe('number')
      expect(section.version).toBeGreaterThan(0)
    })
  })

  describe('httpClient', () => {
    const section = config.httpClient
    it('section should have "tokenKey" property', () => {
      expect(section).toHaveProperty('tokenKey')
    })

    it('section should have "clientType" property', () => {
```

```
      expect(section).toHaveProperty('clientType')
    })
  })

  describe('apiClient', () => {
    const section = config.apiClient
    it('section should have "type" property', () => {
      expect(section).toHaveProperty('type')
    })
  })

  describe('items', () => {
    const section = config.items

    it('section should have "apiClientOptions" property', () => {
      expect(section).toHaveProperty('apiClientOptions')
    })

    describe('apiClientOptions', () => {
      const apiClientOptions = section.apiClientOptions

      describe('endpoints', () => {
        const endpoints = apiClientOptions.endpoints

        it('section should have "fetchItems" property', () => {
          expect(endpoints).toHaveProperty('fetchItems')
          // verify that fetchItems url is a string and has a reasonable length
          expect(typeof endpoints.fetchItems).toBe('string')
          expect(endpoints.fetchItems.length).toBeGreaterThan(10)
        })
      })
    })
  })
})
```

Run the unit tests with **npm run test**: and verify all succeed:

```
// terminal output:

...

Test Files  8 passed (8)
     Tests  25 passed (24)
      Time  1.18s (in thread 77ms, 1537.16%)

...
```

Please keep adding additional unit tests for each environment (i.e. config.jsonserver.test.ts, config.production.test.ts etc).

HttpClient code updates

file src/http-client/index.ts

Now we need to update the file **src/http-client/index.ts** and remove the hard-coded value for the **clientType** variable. We'll be instead reading the value from the config instance (**config.httpClient.type**):

```
// file: src/http-client/index.ts

import { HttpClientInterface } from './models/HttpClient.interface'
import { config } from '@/config' // <-- uncomment (or add) this line

import { HttpClientAxios } from './models/HttpClient.axios'
import { HttpClientFetch } from './models/HttpClient.fetch'

// export all our interfaces/models/enums
export * from './models'

let _httpClient: HttpClientInterface | undefined = undefined

// export out hook
export const useHttpClient = () => {
  if (!_httpClient) {
    // export instance of HttpClientInterface
    const clientType = 'fetch' // <-- uncomment this line
    const clientType: string = 'fetch' // <-- remove this line
```

```
    // if you'd like to use axios, set "clientType": "axios" within the config files\
 (section "httpClient")
    if (clientType === 'fetch') {
      _httpClient = new HttpClientFetch()
    } else if (clientType === 'axios') {
      _httpClient = new HttpClientAxios()
    }
  }

  return _httpClient as HttpClientInterface
}
```

Api Client code updates

file src/api-client/index.ts

Update also the file **src/api-client/index.ts** and remove the code currently using the previous env variable and replace it by consuming our value from the config instance (**config.apiClient.type**). Here is the updated code:

```
// file: src/api-client/index.ts

import { ApiClientInterface } from './models'
import { apiMockClient } from './mock'
import { apiLiveClient } from './live'

import { config } from '@/config'

// return either the live or the mock client
let apiClient: ApiClientInterface
if (config.apiClient.type === 'live') { // this time we just read our config.apiClie\
nt.type
  apiClient = apiLiveClient
} else {
  // default is always apiMockClient
  apiClient = apiMockClient
}

export { apiClient }
```

file src/api-client/mock/items/index.ts

Update the code that returns the mock Items API client instance to use the **apiClientOptions** from the **config**:

```
// file: src/api-client/mock/items/index.ts

import { config } from '@/config' // <-- add this line

import {
  ItemsApiClientInterface,
  ItemsApiClientModel
} from '../../models/items'

// remove this block:
// const options: ItemsApiClientOptions = {
//   mockDelay: 250,
//   endpoints: {
//     fetchItems: '/static/mock-data/items/items.json'
//   }
// }

// instantiate the ItemsApiClient pointing at the url that returns static json mock \
data
const itemsApiClient: ItemsApiClientInterface = new ItemsApiClientModel(config.items\
.apiClientOptions) // <-- this time we'll pass the options from the config

// export our instance
export {
  itemsApiClient
}
```

file src/api-client/live/items/index.ts

Similarly, update the code that returns the live Items API client instance to use the **apiClientOptions** from the **config**:

```
// file: src/api-client/live/items/index.ts

// import a reference to the app config
import { config } from '@/config'

import { ItemsApiClientInterface, ItemsApiClientModel } from '../../models'

// instantiate the ItemsApiClient pointing at the url that returns static json live \
data
const itemsApiClient: ItemsApiClientInterface = new ItemsApiClientModel(config.items\
.apiClientOptions)

// export our instance
export { itemsApiClient }
```

*IMPORTANT: At this point, thanks to the new way of driving things through the **config**, the code in both files **src/api-client/live/items/index.ts** and **src/api-client/mock/items/index.ts** is basically identical. In later chapters we will simplify and reduce the amount of code we initially created to serve either **mock** or **live** data. But for now, we'll keep the duplicated code to avoid making this chapter too long.*

Now make sure you run all the unit tests again, then serve the app again to make sure all compiles and works as before.

Chapter 9 Recap

What We Learned

- We learned how to use static **JSON** files to have multiple configuration settings, one for each environment
- How to dynamically return the appropriate config file based on the new environment variable **VITE_APP_CONFIG**
- How to add option **resolveJsonModule** to the the **TypeScript tsconfig.json** file, section **compilerOptions** to allow importing static **JSON** files through import statement
- How to write unit tests against our configuration code

Observations

- For now our configuration is pretty small, but might grow larger as the application itself grows and we need to add more configurable options.
- We did not write unit tests again each config file like we did for config.mock.test.ts

Improvements

- Going forward we'll be expanding the configuration as we keep growing our application components and logic.
- You can write additional unit tests similar to config.mock.test.ts for beta and production as well (i.e. config.beta.test.ts, config.mock.production.ts, etc)

Chapter 10 - Localization and Internationalization - Language Localization

"Localization refers to the adaptation of a product, application or document content to meet the language, cultural and other requirements of a specific target market (a locale)..."

"...Internationalization is the design and development of a product, application or document content that enables easy localization for target audiences that vary in culture, region, or language"[33]

NOTE: This chapter applies to you only if the application you are working on will be used or marketed to multiple countries and it is desired to present labels in the local language, as well as date/number formats in the local culture.

Most modern applications that target multiple countries or cultures are architected in a way that is easy to present the UI in different languages and also present values like numbers or dates formatted as expected by the culture specific to that country (hence, localized).

In this book we'll first leverage plugins that allows us to present labels in different languages (**i18next**, **react-i18next**) and later we'll add also a custom plugin based on the **Intl API** (supported by most modern browsers) to provide for numbers/date formatting functionality based on different locales (cultures).

Plugins: i18next, react-i18next

There are many JavaScript libraries out there that simplify localization of a frontend app, but the most widely used is the **i18n** library. The organization **i18next**[34] maintains a very nice **React** plugin called **react-i18next**, which is published on NPM here https://www.npmjs.com/package/react-i18next[35]

In this book we'll be creating an hook that wraps around **react-i18next** an additional code. This will allow us to avoid code cluttering and greatly simplify how we localize our components in our **React** application.

[33] https://www.w3.org/International/questions/qa-i18n
[34] https://github.com/i18next
[35] https://github.com/i18next/react-i18next

Let's start by first adding the **i18next** and **react-i18next** NPM packages to our application. We need to use the command **npm install -save i18next react-i18next**.

We need to use the **-save** option as we want this to be saved as part of the app "dependencies" in the **package.json**:

```
npm install --save i18next react-i18next
```

Now, before we proceed creating our boostrapping code for i18n and our useLocalization hook, let's first make a few changes to our application configuration.

Config updates

ConfigInterface

We will be introducing a concept of versioning here to dynamically drive different versions of data, introduce/retire views and components overtime, or expire cached data on the browser. You will see this in action first shortly when we'll use to expire our translation data stored in the browser cache.

Let's add a field called **version** to our **global** section (note: we might have added this already in the one of previous chapters):

```
// file: src/config/models/Config.interface.ts

...

export interface ConfigInterface {
  global: {
    version: number // add this line
  }

...
```

Let's also add a new section called **localization** like this:

```
// file: src/config/models/Config.interface.ts

...

export interface ConfigInterface {
  global: {
    version: number
  }

  ...
  // add this block:
  localization: {
    apiClientOptions: LocalizationApiClientOptions
    locales: { key: string, isDefault: boolean }[]
    localStorageCache: { enabled: boolean, expirationInMinutes: number }
  }

...
```

Here we reference a **apiClientOptions**. We don't have this yet. We'll add a new API client module called **localization** shortly.

First, let's finish updating the code related to the configuration.

file mock.json

Let's add the data we need in the **src/config/files/mock.json** as per our ConfigInterface updates:

```
// file: src/config/config-files/mock.json

{
  "global": {
    "version": 0.1 // add this line
  },

  ...

  // begin: add the localization section
  "localization": {
    "apiClientOptions": {
      "endpoints": {
```

```
        "fetchTranslation": "/static/mock-data/localization/[namespace]/[key].json"
      },
      "mockDelay": 250
    },
    "locales": [
      // each of this objects represent a locale available in our app
      { "key": "en-US", "isDefault": true },
      { "key": "it-IT", "isDefault": false },
      { "key": "fr-FR", "isDefault": false },
      { "key": "es-ES", "isDefault": false }
    ],
    "localStorageCache": {
      // these are settings we'll use to cache JSON locale translation data into loc\
aleStorage
      "enabled": true,
      "expirationInMinutes": 60
    }
  }
  // end: add the localization section
}
```

Please feel free to also update the beta.json/production.json/localapis.json files as well, and possibly add unit tests to validate your changes. Note that we have also an array called **locales** which hold a list of object that represent each of the locales available in or application. We also have a section caled localeStorageCache that we'll use to drive how we cache the locale translation JSON data into the browser **localStorage**.[36]

Translation JSON data

Note that for the **fetchTranslation** end-point, we'll use two parameters: **[namespace]** and **[key]**.
We'll create the files under `/public/static/mock-data/localization/`.
For the [namespace] parameter we'll always use 'translation' in our case, so go ahead and create a sub-directory called **translation** at the path /public/static/mock-data/localization/translation.
Then, add 4 files:

- en-US.json
- es-ES.json
- fr-FR.json

[36] https://developer.mozilla.org/en-US/docs/Web/API/Window/localStorage

- it-IT.json

Here is the content for the **en-US.json** one:

```
// file: public/static/mock-data/localization/translation/en-US.json
{
  "locale.selector.en-US": "English",
  "locale.selector.it-IT": "Italian",
  "locale.selector.fr-FR": "French",
  "locale.selector.es-ES": "Spanish",

  "home.welcome": "Welcome: this message is localized in English",

  "navigation.home": "Home",
  "navigation.about": "About",

  "items.list.header": "My Items"
}
```

Here is the content for the **es-ES.json** one:

```
// file: public/static/mock-data/localization/translation/es-ES.json
{
  "locale.selector.en-US": "Inglés",
  "locale.selector.it-IT": "Italiano",
  "locale.selector.fr-FR": "Francés",
  "locale.selector.es-ES": "Español",

  "home.welcome": "Bienvenido: this message is localized in Spanish",

  "navigation.home": "Inicio",
  "navigation.about": "Acerca de",

  "items.list.header": "Mis cosas"
}
```

Here is the content for the **fr-FR.json** one:

```
// file: public/static/mock-data/localization/translation/fr-FR.json
{
  "locale.selector.en-US": "Anglais",
  "locale.selector.it-IT": "Italien",
  "locale.selector.fr-FR": "Français",
  "locale.selector.es-ES": "Espagnol",

  "home.welcome": "Bienvenue: this message is localized in French",

  "navigation.home": "Accueil",
  "navigation.about": "À propos de nous",

  "items.list.header": "Mes articles"
}
```

Here is the content for the **it-IT.json** one:

```
// file: public/static/mock-data/localization/translation/it-IT.json
{
  "locale.selector.en-US": "Inglese",
  "locale.selector.it-IT": "Italiano",
  "locale.selector.fr-FR": "Francese",
  "locale.selector.es-ES": "Spagnolo",

  "home.welcome": "Benvenuti: this message is localized in Italian",

  "navigation.home": "Home",
  "navigation.about": "Chi Siamo",

  "items.list.header": "I miei articoli"
}
```

We now have to add a new API client module for loading our **localization** data.

API Client updates

Create the directory **src/api-client/models/localization**.
Here we'll create the interfaces and model for our localization API module.
Add the following 4 files:

- LocalizationApiClient.interface.ts

- LocalizationApiClientOptions.interface.ts
- LocalizationApiClient.model.ts
- index.ts

file LocalizationApiClient.interface.ts

Our localization API client will exposes one method called fetchTranslation:

```
// file: src/api-client/models/localization/LocalizationApiClient.interface.ts

/**
 * @Name LocalizationApiClientInterface
 * @description
 * Interface for the Localization api client module
 */
export interface LocalizationApiClientInterface {
  fetchTranslation: (namespace: string, key: string) => Promise<{ [key: string]: str\
ing }>
}
```

file LocalizationApiClientOptions.interface.ts

Here we have the itnerfaces for the API client configuration:

```
// file: src/api-client/models/localization/LocalizationApiClientOptions.interface.ts

export interface LocalizationApiClientEndpoints {
  fetchTranslation: string
}

/**
 * @Name LocalizationApiClientOptions
 * @description
 * Interface for the Localization api client options (includes endpoints used to avo\
id hard-coded strings)
 */
export interface LocalizationApiClientOptions {
  mockDelay?: number
  endpoints: LocalizationApiClientEndpoints
}
```

file LocalizationApiClient.model.ts

Here is the implementation of our localization API client:

```
// file: src/api-client/models/localization/LocalizationApiClient.model.ts

import { useHttpClient, HttpRequestParamsInterface, HttpRequestType } from '@/http-c\
lient'

import { LocalizationApiClientOptions, LocalizationApiClientEndpoints } from './Loca\
lizationApiClientOptions.interface'
import { LocalizationApiClientInterface } from './LocalizationApiClient.interface'

/**
 * @Name LocalizationApiClientModel
 * @description
 * Implements the LocalizationApiClientInterface interface
 */
export class LocalizationApiClientModel implements LocalizationApiClientInterface {
  private readonly endpoints!: LocalizationApiClientEndpoints
  private readonly mockDelay: number = 0

  constructor(options: LocalizationApiClientOptions) {
    this.endpoints = options.endpoints
    if (options.mockDelay) {
      this.mockDelay = options.mockDelay
    }
  }

  fetchTranslation(namespace: string, key: string): Promise<{ [key: string]: string \
}> {
    const requestParameters: HttpRequestParamsInterface = {
      requestType: HttpRequestType.get,
      endpoint: this.endpoints.fetchTranslation,
      requiresToken: false,
      payload: {
        namespace,
        key
      } as any,
      mockDelay: this.mockDelay
    }

    return useHttpClient().request<{ [key: string]: string }>(requestParameters)
```

```
  }
}
```

file src/api-client/models/localization/index.ts

Just a barrel file:

```
// file: src/api-client/models/localization/index.ts

export * from './LocalizationApiClientOptions.interface'
export * from './LocalizationApiClient.interface'
export * from './LocalizationApiClient.model'
```

Updates to ApiClient.interface.ts

Import and add our localization module:

```
// file: src/api-client/models/ApiClient.interface.ts

import { LocalizationApiClientInterface } from './localization'
import { ItemsApiClientInterface } from './items'

/**
 * @Name ApiClientInterface
 * @description
 * Interface wraps all api client modules into one places for keeping code organized.
 */
export interface ApiClientInterface {
  localization: LocalizationApiClientInterface
  items: ItemsApiClientInterface
}
```

Updates to the main models barrel file (api-client/models/index.ts)

```
// file: src/api-client/models/index.ts

export * from './ApiClient.interface'
export * from './localization'
export * from './items'
```

Updates to ApiClient instances

localization mock instance (api-client/mock/localization/index.ts)

Create the file api-client/mock/localization/index.ts with this code:

```
// file: src/api-client/mock/localization/index.ts

// import a reference to the app config
import { config } from '@/config'

import { LocalizationApiClientInterface, LocalizationApiClientModel } from '../../mo\
dels'

// instantiate the LocalizationApiClient pointing at the url that returns static jso\
n mock data
const localizationApiClient: LocalizationApiClientInterface = new LocalizationApiCli\
entModel(config.localization.apiClientOptions)

// export our instance
export { localizationApiClient }
```

mock instance (api-client/mock/index.ts)

Update the code within the api-client/mock/index.ts file like this:

```
// file: src/api-client/mock/index.ts

import { ApiClientInterface } from '../models'
// import module instances
import { localizationApiClient } from './localization'
import { itemsApiClient } from './items'

// create an instance of our main ApiClient that wraps the mock child clients
const apiMockClient: ApiClientInterface = {
  localization: localizationApiClient,
  items: itemsApiClient
}

// export our instance
export { apiMockClient }
```

live instance (api-client/live/index.ts)

Update the code within the api-client/live/index.ts file like this :

```
// file: src/api-client/live/index.ts

// import a reference to the app config
import { config } from '@/config'

import {
  ApiClientInterface,
  LocalizationApiClientModel,
  ItemsApiClientModel
} from '../models'

// create an instance of our main ApiClient that wraps the live child clients
const apiLiveClient: ApiClientInterface = {
  localization: new LocalizationApiClientModel(config.localization.apiClientOptions),
  items: new ItemsApiClientModel(config.items.apiClientOptions)
}
// export our instance
export { apiLiveClient }
```

Note: for the live instance going forward we'll just initialize the client modules within this file so you can go ahead and delete theapi-client/live/items sub-directory.

i18n initialization and useLocalization hook

Create the directory **src/localization**. Inside the localization folder we'll create the following files:

- I18n.init.ts
- useLocalization.ts
- index.ts

file i18n.init.ts

For the **i18n.init.ts** code, we'll start by importing a few types and utils from both **i18next** and **react-i18next**. Also import reference to our **config** and **apiClient**:

```
// file: src/localization/i18n.init.ts

import { initReactI18next } from 'react-i18next'
import i18n, {
  BackendModule,
  Services,
  TOptions,
  InitOptions,
  ReadCallback
} from 'i18next'

import { config } from '../config'
import { apiClient } from '../api-client'

...
```

Let's get a reference to the localeStorageCache configuration:

```
// file: src/localization/i18n.init.ts
...

// get reference to out localization config
const localStorageConfig = config.localization.localStorageCache

...
```

Create a constant that we'll use as the key for saving or retrieving information about the user preferred locale from the browser localStorage:

```
// file: src/localization/i18n.init.ts
...

// key that will use to save the user preferred locale id
export const userPreferredLocaleStorageKey = 'user-lcid'

...
```

Add two helper methods used to retrieve or save the user preferred locale id to localStorage, called **getUserPreferredLocale** and **setUserPreferredLocale**:

```
// file: src/localization/i18n.init.ts
...

// helper method to retrieve the user preferred locale from localStorage
export const getUserPreferredLocale = () => {
  // get a reference from the available locales array from our config
  const availableLocales = config.localization.locales
  // try to retrive from local storage if they have one saved
  const preferredLocale = localStorage.getItem(userPreferredLocaleStorageKey)
  if (!preferredLocale) {
    // if not, use the default locale from config
    const defaultLocale = availableLocales.find(o => o.isDefault)?.key
    return defaultLocale
  }
  return preferredLocale
}

// helper to save the user preferred locale to localStorage
export const setUserPreferredLocale = (lcid: string) => {
  localStorage.setItem(userPreferredLocaleStorageKey, lcid)
```

```
}

...
```

Note that in getUserPreferredLocale we return the default locale from config if there is not preferred locale in localStorage yet

Add an helper called **getLocaleData** that will help us load JSON translation data for a specific locale from an API and cache it into localStorage (so subsequent calls to this method will retrieve the JSON data from cache):

```
// file: src/localization/i18n.init.ts
...

// helper to get JSON locale translation data
const getLocaleData = async (namespace: string, lcid: string): Promise<Object> => {
  // try to get it from locale storage
  // dynamic key we use to cache the actual locale JSON data in the browser local st\
orage
  const localeStorageKey = `lcid-data-${ lcid }`
  // retrieve JSON as string
  const cacheEntryStr = localStorage.getItem(localeStorageKey) || '{}'
  // a variable to hold the parsed JSON data:
  let cacheEntry: { appVersion: number, expiresAt: number, json: string } = { appVer\
sion: -1, expiresAt: 0, json: '' }

  // if localeStorage is enabled through config, then proced trying parsing the  cac\
heEntryStr
  if (localStorageConfig.enabled) {
    try {
      cacheEntry = JSON.parse(cacheEntryStr)
    } catch (e) {
      console.warn('error parsing data', cacheEntryStr)
    }
  }

  // check if we have cacheEntry and if matches app version and also did not expire
  if (cacheEntry && cacheEntry.appVersion === config.global.version && cacheEntry.ex\
piresAt - Date.now() > 0) {
    // return value from cache
    return cacheEntry.json
  } else {
    // retrieve data from API end point (or CDN etc)
```

```
    const translationData = await apiClient.localization.fetchTranslation(namespace,\
 lcid)

    // if localeStorage is enabled ...
    if (localStorageConfig.enabled) {
      // cache the translation data into localStorage
      const dt = new Date()
      // calculate expiration by adding N minutes as per config expirationInMinutes
      const expiresAt = dt.setMinutes(dt.getMinutes() + Number(localStorageConfig.ex\
pirationInMinutes))
      // save our data to localStorage
      localStorage.setItem(localeStorageKey, JSON.stringify({
        appVersion: config.global.version,
        expiresAt: expiresAt,
        json: translationData
      }))
    }

    // return value we retrieved from API
    return translationData
  }
}

...
```

Create a custom **backendModule** that will invoke our helper **getLocaleData** when i18n need to load JSON translation data for a new locale:

```
// file: src/localization/i18n.init.ts
...

// custom backend module that allow us to use our own api client
const backendModule: BackendModule = {
  type: 'backend',
  init(services: Services, backendOptions: TOptions, i18nextOptions: InitOptions): v\
oid {
  },
  read(language: string, namespace: string, callback: ReadCallback): void {
    console.log('backendModule read', language, namespace)

    const key = language
    // invoke our helper method
    getLocaleData(namespace, key).then(obj => callback(null, obj))
```

```
  }
}

...
```

Note that in a small application with very small translation files, you might want to just to import them and add them as resources to the i18n initialization. Here, I am showing you how to load them through the API client on demand and cache them in localStorage with an expiration and versioning.

Finally initialize i18n:

```
// file: src/localization/i18n.init.ts
...

i18n
  .use(initReactI18next) // passes i18n down to react-i18next
  .use(backendModule) // use our custom backend module
  .init({
    lng: getUserPreferredLocale(), // invoke our helper to get the user preferred lo\
cale (or the default)
    fallbackLng: 'en-US',
    keySeparator: false,
    interpolation: {
      escapeValue: false
    },
    load: 'currentOnly'
  });
```

file useLocalization.ts

Here we'll just export what we need, similar to a hook, and enable us to easily consume the different locale translations in our components:

```
// file: src/localization/useLocalization.ts

import { useTranslation } from 'react-i18next'
import i18n from 'i18next'
import { config } from '../config'

// import references to our localeStorage helpers:
import {
  getUserPreferredLocale,
  setUserPreferredLocale
 } from './i18n.init'

// useLocalization hook
export function useLocalization () {
  // we have to invoke react-i18next's useTranslation here
  const instance = useTranslation('translation')

  return {
    t: instance.t, //returna the t translator function from useTranslation
    currentLocale: i18n.language, // return the current locale from i18n
    changeLocale: (lcid: string) => { // return helper method changeLocale
      i18n.changeLanguage(lcid)
      // also save the user preference
      setUserPreferredLocale(lcid)
    },
    locales: config.localization.locales, // retrun vailable locales from our config
    getUserPreferredLocale
  }
}
```

file src/localization/index.ts (barrel file)

Just a barrel file to export our hook (in one of the next chapters will be exporting additional things like formatters here as well):

```
// file: src/localization/index.ts

export * from './useLocalization'
```

main.tsx or index.tsx updates

Here we just to import the initialization code, and also wrap our <App/> with a **Suspense**[37] element that will show a loading message while the i18n code is initialized and the initial JSON locale data is loaded:

```
import React from 'react'
import ReactDOM from 'react-dom'
import './index.css'
import App from './App'
// add this line:
import './localization/i18n.init'

ReactDOM.render(
  <React.StrictMode>
    <React.Suspense fallback="loading">
      <App />
    </React.Suspense>
  </React.StrictMode>,
  document.getElementById('root')
)
```

NOTE: Suspense allows you specify a <Loader> or other JSX.Element for the "fallback" attribute

App.tsx updates

Let's now consume our **useLocalization** within the App.tsx file by adding a quick way to change locale and also display the translated home welcome message:

[37] https://reactjs.org/docs/react-api.html#reactsuspense

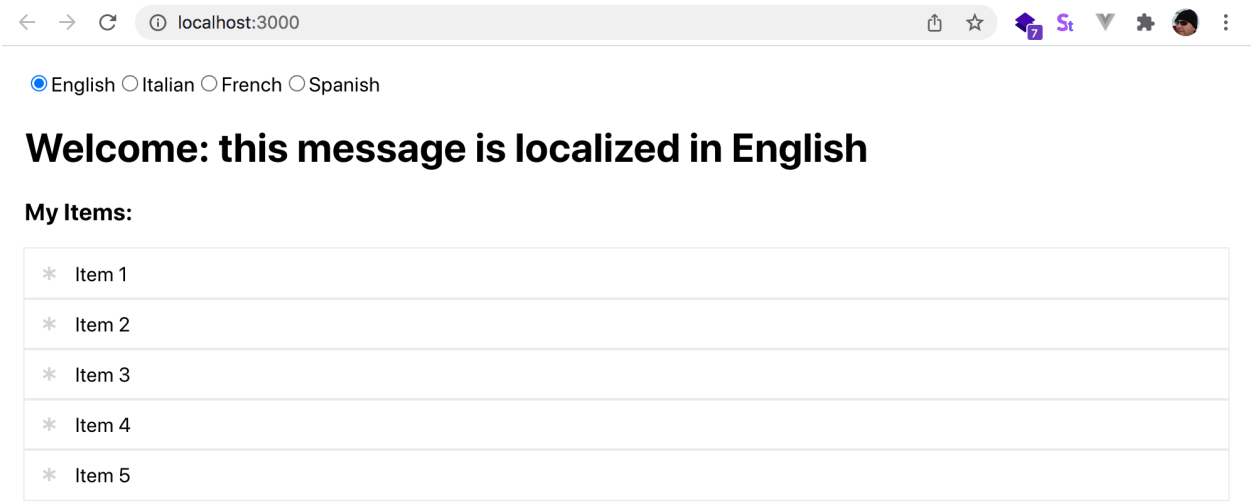
```
// file: src/App.tsx

...

// import a reference to useLocalization
import { useLocalization } from './localization/useLocalization'

...
// App component:
function App() {
  // get what we need from useLocalization:
  const {
    t,
    locales,
    currentLocale,
    getUserPreferredLocale,
    changeLocale,
  } = useLocalization()

  // on load, check if locale has been set. If not invoke changeLocale
  $: if (!$isLocaleLoaded) {
    changeLocale(getUserPreferredLocale())
  }

  // an event handler from changing the locale from our locale-selector
  const onLocaleClick = (lcid: string) => {
    changeLocale(lcid)
  }

  return (
    <Provider store={rootStore}>
      <div className="App">
        <div className="locale-selector">
          { /* loop through the locales and create a radio button for each locale */
            locales.map((item) => {
              const radioId = `radio-locale-${item.key}`
              return (
                <label key={item.key} htmlFor={radioId} className="cursor-pointer" o\
nClick={() => onLocaleClick(item.key)}>
                  <input type="radio" id={radioId} radioGroup={currentLocale} name="\
locale" value={item.key} checked={ currentLocale === item.key } onChange={() => {}} \
/>
                  {
```

```
                /* use the t function to translate the label of this radio */
                t(`locale.selector.${ item.key }`)
                }
              </label>
            )
          })
        }
      </div>
      <h1>{ t('home.welcome') } {/* update this to use the t function to translate\
our welcome message */}
      <ItemsView />
    </div>
  </Provider>
)
```

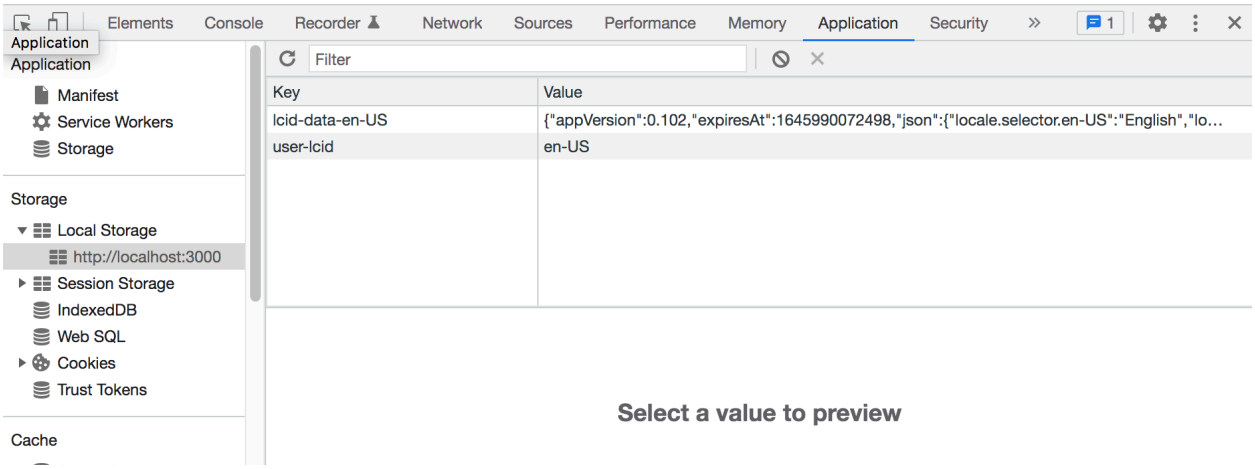
You can similarly update the ItemsList.component.tsx code as well to use the translations. I'll let you do that on your own. You can always refer tot he github repo if you need help.

Browser

Now run the app and you will see something like this:

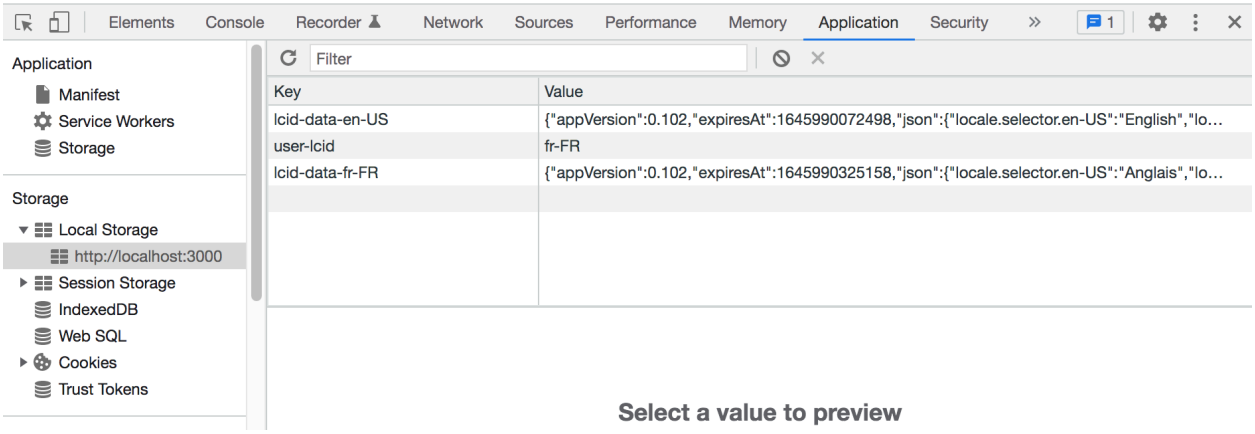


Now right-click and select inspect to open the Chrome dev tools, then select the Application tab, then Local storage > http://localhost:3000 note how our code has cached the en-US JSON data in localStorage and saved the current locale id under user-lcid:

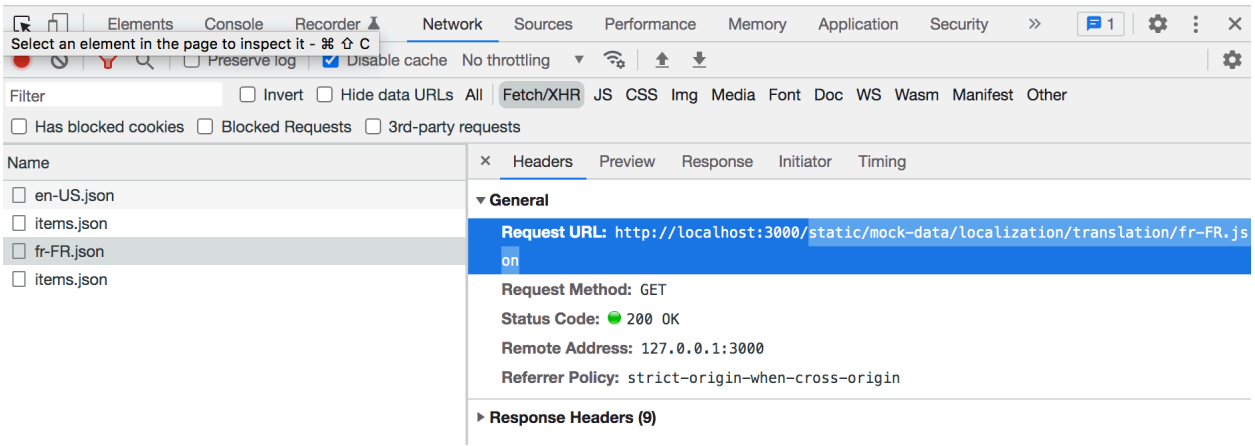


If you select a different locale, i.e. French, it should display the translated labels:

Now in the Local Storage inspector in the Chrome console, again notice how the fr-FR locale data has been also saved to localeStorage and the user preferred locale saved under user-lcid has been also updated:

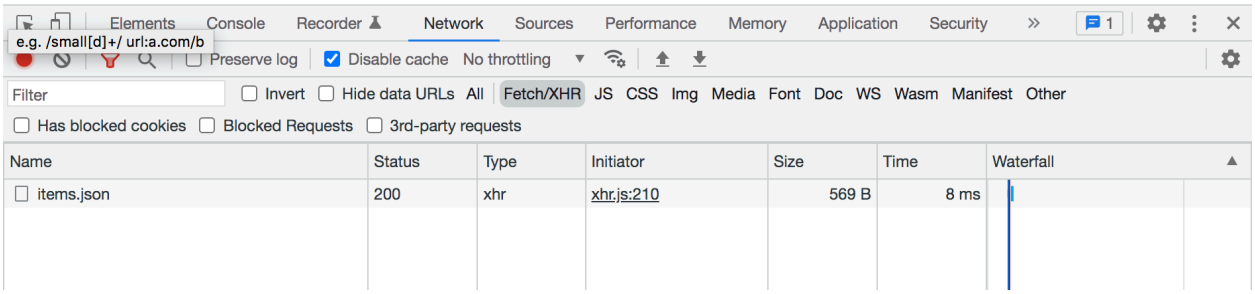


If you switch on the Netwrok tab in the Chrome console, you can see how our API client has loaded the data from static/mock-data/localization/translation/fr-FR.json:



Test that our caching logic is working:

To test that our code will load the user-preferred locale from local storage, along with the save JSON translation data, clear the Network tab and then refresh the Chrome tab with F5. Note how the network tab will NOT show a call to the static JSON file this time because our code is actually loading the data from localStorage this time:

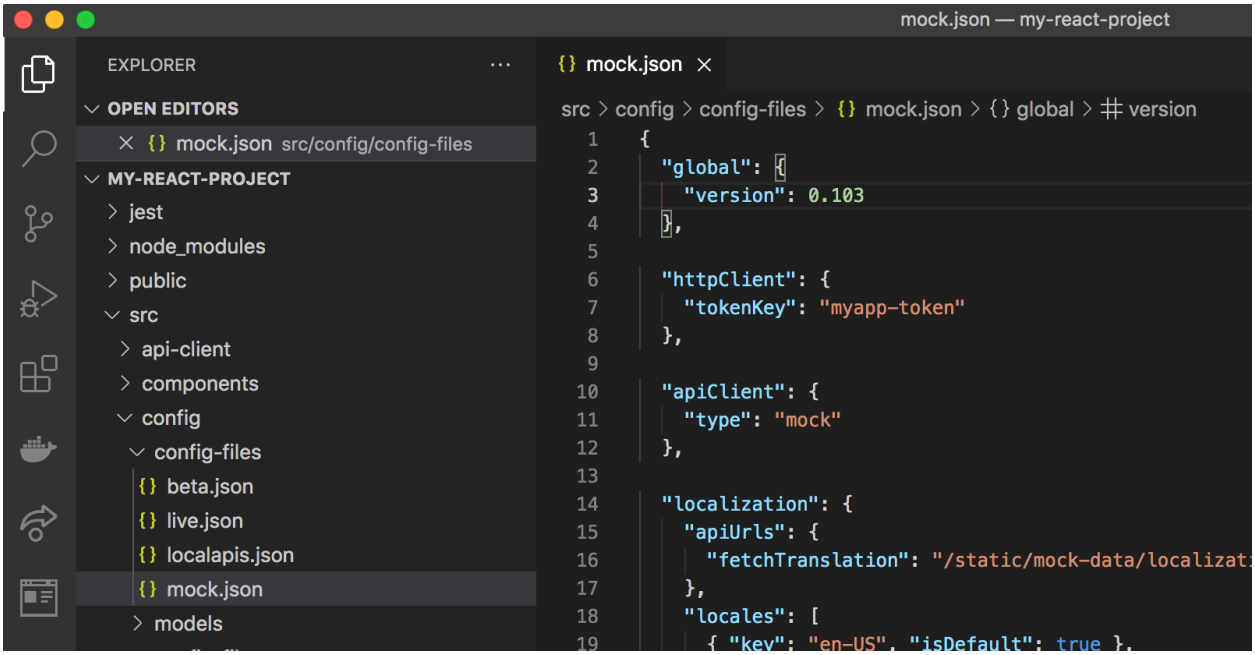


Also not how the selected locale is French:

Important

Remember that if you add additional keys to your translation files, or modify the data in any way, you'll have to either clear your local storage (if you are just playing with things locally), or increment that Application Configuration version in the config files (global section). The localStorage cache will also expire eventually based on the config.localization.localStorageCache.expirationInMinutes value.

For a new deploy, incrementing the version will make sure that the logic we added in our useLocalization code will ignore the currently cached data from localStorage and re-load fresh data through the AP. Here for example I increase it from 0.102 to 0.103:



Note: you dont have to use decimals for your version. You are free to just use integer2 like 1, 2, etc.

Chapter 10 Recap

What We Learned

- How to add the **i18n** plugins to our application
- How to wrap initialization code for i18n and lazy-loading of JSON translation data through our API client
- How to cache translation JSON data into localStorage with versioning and expiration
- How to drive available locales through configuration
- How to use multiple **locale** settings for text translation in order to localize our UI labels
- How to switch to different locales

Observations

- We did not add unit tests around switching locale through the radio buttons
- We did not create a component for switching locale

Improvements

- Add additional unit tests
- Extract the code that loops through each locale and adds a radio button (div with className set to locale-selector) into its own component and add unit tests against this. Maybe in your application requirements this has to be a dropdown instead of a radio group, so it is up to you how you will implement this.

Chapter 11 - Localization and Internationalization - Number and DateTime Formatters

In this chapter we are going to expand our support for localization by adding Number and DateTime value formatters. We'll leverage the **Intl API**[38] which is supported by all major web browsers.

We'll build a hook called useFormatters that will make it easier to consume different kind of formatters based on the currently selected locale.

Note: this is the same code from a plugin I published here and you could use it in other apps in the future without coding it yourself if you prefer: @builtwithjavascript/formatters

Note also that the code in this chapter is re-usable in any framework, not just React, as it does not have any dependency on React.

Directory localization/formatters

Start by creating a directory under **src/localization** called **formatters**. Inside this directory create the following files:

- useDateTimeFormatters.ts
- useNumberFormatters.ts
- index.ts

We'll create the 2 main hooks **useDateTimeFormatters** and **useNumberFormatters** and then just export them together as **useFormatters** from the index.ts file.

File: useDateTimeFormatters.ts

For date-time formatters we'll wrap around **Intl.DateTimeFormat** and make it easier to consume it. We'll cache each instance of **Intl.DateTimeFormat** by **localeId** and the different options to avoid keeping re-instantiating it everytime (this is for performance reasons).

[38] https://developer.mozilla.org/en-US/docs/Web/JavaScript/Reference/Global_Objects/Intl

For this reason, we need to first add a method that return a valid and unique cache key that uses localeId and the different options that might be passed when consuming it. The cache key will be a string in the format [localeId]-[dateStyle]-[timeStyle]:

```
// file: src/formatters/useDateTimeFormatters.ts

export type DayNameFormatType = 'long' | 'short' | 'narrow' | undefined
export type MonthNameFormatType = 'long' | 'short' | 'narrow' | 'numeric' | '2-digit\
' | undefined

const defaultDateStyle = 'short' // 'full', 'long', 'medium', 'short'

// helper to calculate the cache key for the datetime Intl.DateTimeFormat instances
export const getDateTimeFormattersCacheKey = (params: { lcid: string; dateStyle?: st\
ring; timeStyle?: string }) => {
  let { lcid, dateStyle, timeStyle } = params
  dateStyle = (dateStyle || defaultDateStyle).trim().toLowerCase()
  timeStyle = (timeStyle || '').trim().toLowerCase()

  let cacheKey = `${lcid}-${dateStyle}`
  if (timeStyle.length) {
    cacheKey = `${cacheKey}-${timeStyle}`
  }
  return cacheKey.trim().toLowerCase()
}

...
```

We can then add the code for the **useDateTimeFormatters** hook. This will return an object with 3 methods: **datetime**, **dayNames**, **monthNames**. Here is the preliminary implementation with just **datetime**:

```
// file: src/formatters/useDateTimeFormatters.ts

...

// hook to export the datetime, dayNames, monthNames utils
export const useDateTimeFormatters = (localeId: string) => {
  const _lcid = localeId
  const _cache = new Map<string, Intl.DateTimeFormat>()

  return {
```

```
    dateTime: (dateStyle?: string, timeStyle?: string) => {
      dateStyle = (dateStyle || defaultDateStyle).trim().toLowerCase()
      timeStyle = (timeStyle || '').trim().toLowerCase()

      const cacheKey = getDateTimeFormattersCacheKey({
        lcid: _lcid,
        dateStyle,
        timeStyle
      })

      if (!_cache.has(cacheKey)) {
        // if not in our cache yet, create it and cache it
        let options: { dateStyle?: string; timeStyle?: string } = {}
        if (dateStyle.length) {
          options.dateStyle = dateStyle
        }
        if (timeStyle.length) {
          options.timeStyle = timeStyle
        }
        // cache instance
        const instance = new Intl.DateTimeFormat(_lcid, options as Intl.DateTimeForm\
atOptions)
        _cache.set(cacheKey, instance)
      }
      // return instance from cache
      return _cache.get(cacheKey) as Intl.DateTimeFormat
    },

    // ... we'll be adding also dayNames and monthNames here shortly

  }
}
```

Now let's also return dayNames and monthNames:

```
// file: src/formatters/useDateTimeFormatters.ts

...

// hook to export the datetime, dayNames, monthNames utils
export const useDateTimeFormatters = (localeId: string) => {
  const _lcid = localeId
  const _cache = new Map<string, Intl.DateTimeFormat>()

  // add these two to cache also dayName and monthNames
  const _cacheDayNames = new Map<string, { id: number; name: string }[]>()
  const _cacheMonthNames = new Map<string, { id: number; name: string }[]>()

  return {
    dateTime: (dateStyle?: string, timeStyle?: string) => {
      ...
    },

    dayNames: (format: DayNameFormatType = 'long') => {
      if (!_cacheDayNames.has(format)) {
        // if not in our cache yet, create it and cache it
        const items: { id: number; name: string }[] = []
        for (let i = 0; i < 7; i++) {
                                        // start from March 1st 1970 which is a Sunday
          // calculate day and pad string start with zero
          const strDay = (i + 1).toString().padStart(2, '0')
          const date = new Date(`1970-03-${ strDay }T00:00:00.000Z`)
          const name = date.toLocaleString(_lcid, { weekday: format, timeZone: 'UTC'\
 })
          items.push({ id: i, name })
        }
        _cacheDayNames.set(format, items)
      }
      // return cached items
      return _cacheDayNames.get(format) as { id: number; name: string }[]
    },

    monthNames: (format: MonthNameFormatType = 'long') => {
      if (!_cacheMonthNames.has(format)) {
        // if not in our cache yet, create it and cache it
        const items: { id: number; name: string }[] = []
        for (let i = 0; i < 12; i++) {
          // calculate month and pad string start with zero
```

```
          const strMonth = (i + 1).toString().padStart(2, '0')
          const date = new Date(`1970-${ strMonth }-01T00:00:00.000Z`)
          const name = date.toLocaleString(_lcid, { month: format, timeZone: 'UTC' })
          items.push({ id: i, name })
        }
        _cacheMonthNames.set(format, items)
      }
      // return cached items
      return _cacheMonthNames.get(format) as { id: number; name: string }[]
    }

  }
}
```

As you can see in the code above we leverage **date.toLocaleString** to get either the day or month name. We use a calculated date from March 1st 1970 (which is a Sunday) to get the correct weekday name, and from January 1st 1970 to get the correct month name (irrelevant of the current user time zone).

File: useNumberFormatters.ts

For number formatters, similar to what we did for datetime in the previous section, we'll wrap around **Intl.NumberFormat** . We'll cache each instance of **Intl.NumberFormat** by **localeId** and the different options to avoid keeping re-instantiating it everytime (again for performance reasons).

Similaor to the datetime formatters hook, we'll need a function here as well that calculate the cache key dynamically. This is a bit more complex as it takes into account a few more parameters:

```
// file: src/formatters/useNumberFormatters.ts

const defaultcurrencyDisplay = 'symbol' // 'symbol', 'narrowSymbol', 'code', 'name'

// helper to calculate the cache key for the datetime Intl.NumberFormat instances
export const getNumberFormattersCacheKey = (params: {
  lcid: string
  style?: string
  currency?: string
  currencyDisplay?: string
  minimumFractionDigits: number
  maximumFractionDigits: number
```

```
}) => {
  let { lcid, style, currency, currencyDisplay, minimumFractionDigits, maximumFracti\
onDigits } = params
  style = (style || 'decimal').trim().toLowerCase()
  currency = (currency || '').trim()
  currencyDisplay = (currencyDisplay || defaultcurrencyDisplay).trim()

  let cacheKey = `${lcid}-${style}`
  if (currency.length > 0) {
    cacheKey = `${cacheKey}-${currency}`
    if (currencyDisplay.length > 0) {
      cacheKey = `${cacheKey}-${currencyDisplay}`
    }
  }
  cacheKey = `${cacheKey}-${minimumFractionDigits}-${maximumFractionDigits}`.trim().\
toLowerCase()
  return cacheKey
}

...
```

We can then add the code for the **useNumberFormatters** hook. This will return an object with 4 methods: **whole**, **decimal**, **currency**, **percent**. Here we start by implementing a private method called **_privateGetFormatter** that will use to avoid code duplication. This method also contains the logic to retrieve/set the instance into the cache:

```
// file: src/formatters/useNumberFormatters.ts

...

// hook to export the various number formatters utils
export const useNumberFormatters = (localeId: string) => {
  const _lcid = localeId
  const _cache = new Map<string, Intl.NumberFormat>()

  const _privateGetFormatter = (params: {
    style?: string
    currency?: string
    currencyDisplay?: string
    minimumFractionDigits: number
    maximumFractionDigits: number
  }) => {
```

```
    let { style, currency, currencyDisplay, minimumFractionDigits, maximumFractionDi\
gits } = params

    style = (style || 'decimal').trim().toLowerCase()
    currency = (currency || '').trim()
    currencyDisplay = (currencyDisplay || defaultcurrencyDisplay).trim()

    let cacheKey = getNumberFormattersCacheKey({
      lcid: _lcid,
      style,
      currency,
      currencyDisplay,
      minimumFractionDigits,
      maximumFractionDigits
    })

    if (!_cache.has(cacheKey)) {
      // if not in our cache yet, create it and cache it
      let options: Intl.NumberFormatOptions = {
        style,
        minimumFractionDigits,
        maximumFractionDigits
      }
      if (currency.length > 0) {
        options.currency = currency
        if (currencyDisplay.length > 0) {
          options.currencyDisplay = currencyDisplay
        }
      }
      // cache instance
      const instance = new Intl.NumberFormat(_lcid, options)
      _cache.set(cacheKey, instance)
    }
    // return instance from cache
    return _cache.get(cacheKey) as Intl.NumberFormat
  }

 ...
```

Then we can add the code to export our 4 utility methods by using the private method to construct each instance with the various options:

```
// file: src/formatters/useNumberFormatters.ts

...

  return {
    whole: () => {
      return _privateGetFormatter({
        style: 'decimal',
        minimumFractionDigits: 0,
        maximumFractionDigits: 0
      })
    },
    decimal: (minimumFractionDigits: number = 0, maximumFractionDigits: number = 2) \
=> {
      return _privateGetFormatter({
        style: 'decimal',
        minimumFractionDigits,
        maximumFractionDigits
      })
    },
    currency: (
      currency: string,
      currencyDisplay?: string,
      minimumFractionDigits: number = 0,
      maximumFractionDigits: number = 2
    ) => {
      return _privateGetFormatter({
        style: 'currency',
        currency,
        currencyDisplay,
        minimumFractionDigits,
        maximumFractionDigits
      })
    },
    percent: (minimumFractionDigits: number = 0, maximumFractionDigits: number = 2) \
=> {
      return _privateGetFormatter({
        style: 'percent',
        minimumFractionDigits,
        maximumFractionDigits
      })
    },
```

```
    unescapeResult(result: string) {
      return (result || '').replace(/\xa0/g, ' ').replace(/\u202f/g, ' ')
    }
  }
}
```

File: index.ts

For convenience, here we just export a global hook called **useFormatters**:

```
// file: src/formatters/index.ts

import { useDateTimeFormatters } from './useDateTimeFormatters'
import { useNumberFormatters } from './useNumberFormatters'

export const useFormatters = () => {
  return {
    useDateTimeFormatters,
    useNumberFormatters
  }
}
```

Note: this step is optional. You could just import individually either useDateTimeFormatters or useNumberFormatters when consuming them.

Later, when we need to consume our formatters, we can just import them as:

```
  import {
    useLocalization,
    useDateTimeFormatters,
    useNumberFormatters
  } from '@/localization/formatters'
```

Component DebugFormatters.component.tsx

Let's now create a component that we can just use to visually debug the output of the formatters. Here will also use the **useLocalization** hook to get the **currentLocale**. Then we'll have some computed properties that will return the correct formatters based on the currentLocale:

```
// file: src/components/shared/DebugFormatters.component.tsx
import React from 'react'
import {
  useLocalization,
  useDateTimeFormatters,
  useNumberFormatters
} from '@/localization'

export function DebugFormatters(props: {
  show: boolean
}) {
  // get what we need from useLocalization:
  const { currentLocale } = useLocalization()

  const dateTimeFormatter = (dateStyle: string = 'long', timeStyle: string = '') => {
    return useDateTimeFormatters(currentLocale).dateTime(dateStyle, timeStyle)
  }
  const dayNames = () => {
    return useDateTimeFormatters(currentLocale)
      .dayNames()
      .map(o => o.name)
      .join(', ')
  }
  const monthNames = () => {
    return useDateTimeFormatters(currentLocale)
      .monthNames()
      .map(o => o.name)
      .join(', ')
  }

  const wholeNumberFormatter = () => {
    return useNumberFormatters(currentLocale).whole()
  }
  const decimalNumberFormatter = () => {
    return useNumberFormatters(currentLocale).decimal()
  }
  const currencyNumberFormatter = (currency: string = 'USD') => {
    return useNumberFormatters(currentLocale).currency(currency)
  }
  const percentNumberFormatter = () => {
    return useNumberFormatters(currentLocale).percent()
  }
```

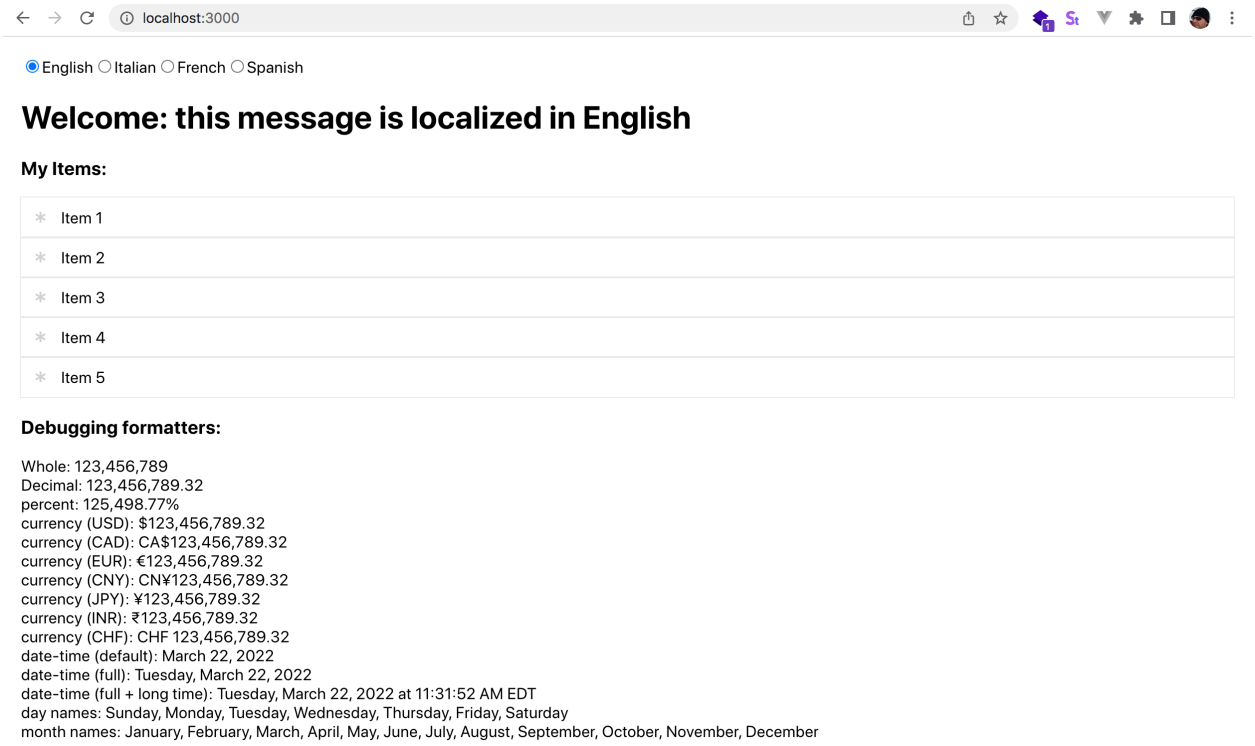
```
  if (props.show) {
    return (
      <div>
        <h3>Debugging formatters:</h3>
        <div>Whole: { wholeNumberFormatter().format(123456789.321654) }</div>
        <div>Decimal: { decimalNumberFormatter().format(123456789.321654) }</div>
        <div>percent: { percentNumberFormatter().format(1254.987654) }</div>

        <div>currency (USD): { currencyNumberFormatter().format(123456789.321654) }<\
/div>
        <div>currency (CAD): { currencyNumberFormatter('CAD').format(123456789.32165\
4) }</div>
        <div>currency (EUR): { currencyNumberFormatter('EUR').format(123456789.32165\
4) }</div>
        <div>currency (CNY): { currencyNumberFormatter('CNY').format(123456789.32165\
4) }</div>
        <div>currency (JPY): { currencyNumberFormatter('JPY').format(123456789.32165\
4) }</div>
        <div>currency (INR): { currencyNumberFormatter('INR').format(123456789.32165\
4) }</div>
        <div>currency (CHF): { currencyNumberFormatter('CHF').format(123456789.32165\
4) }</div>

        <div>date-time (default): { dateTimeFormatter().format(new Date()) }</div>
        <div>date-time (full): { dateTimeFormatter('full').format(new Date()) }</div>
        <div>date-time (full + long time): { dateTimeFormatter('full', 'long').forma\
t(new Date()) }</div>

        <div>day names: { dayNames() }</div>
        <div>month names: { monthNames() }</div>
      </div>
    )
  } else {
    return null
  }
}
```

Updates to App.tsx

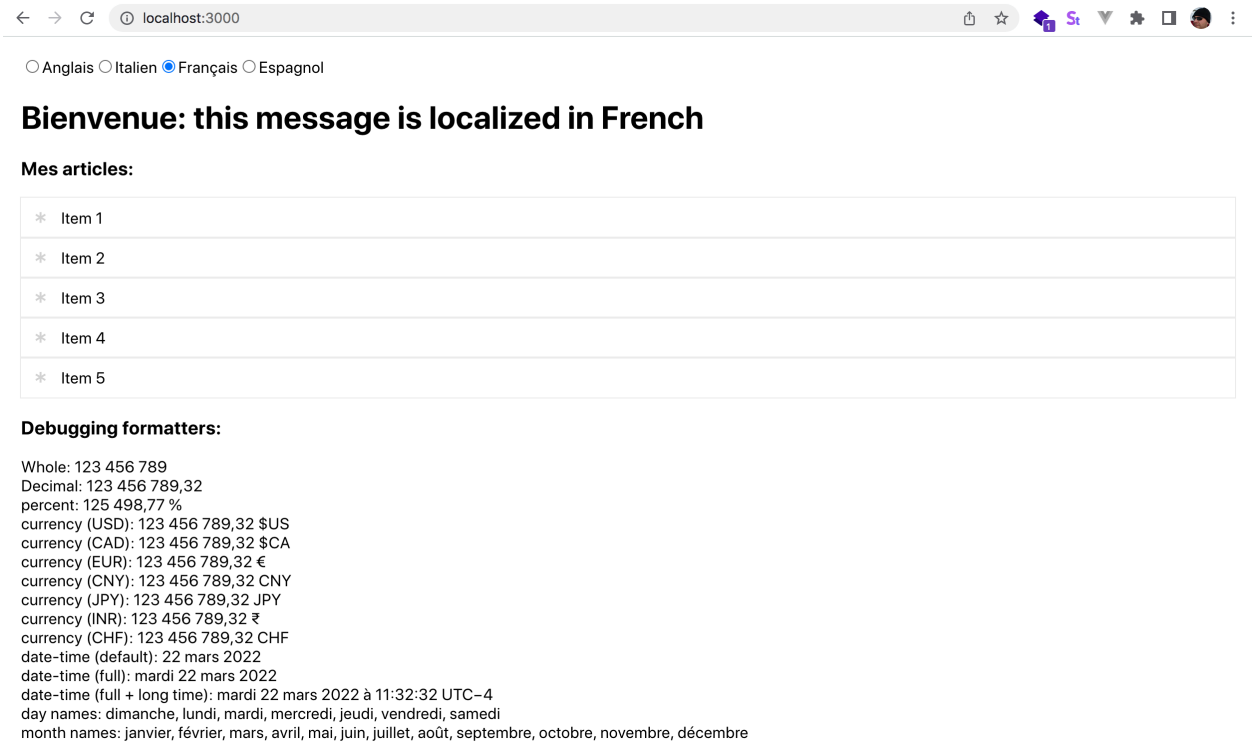
Now we can import the DebugFormatters component and render it within our App.tsx to quickly visually debug that the formatters are working as expected:

```
// file: src/App.tsx

...
import { DebugFormatters } from '@/components/shared/DebugFormatters.component'

// App component:
function App() {

  ...

    return (
    <Provider store={rootStore}>
      {/* wrap the root App element with Redux store provider */}
      <div className="App">
        <LocaleSelector locales={locales} currentLocale={currentLocale} onLocaleClic\
k={onLocaleClick} t={t} />
        <h1>{t('home.welcome')}</h1> {/* update this to use the t function to transl\
ate our welcome message */}
        <ItemsView />
        <DebugFormatters show={true} /> {/* add this line here */ }
      </div>
    </Provider>
  )
}

export default App
```

If you now run the app you will see the DebugFormatters rendering information at the bottom of the page:



And of course, if you select a different locale (i.e. French) you'll see the formatters displaying the value as per the current locale culture:


localhost:3000
Anglais Italien Français Espagnol
Bienvenue: this message is localized in French
Mes articles:
Item 1
Item 2
Item 3
Item 4
Item 5
Debugging formatters:
Whole: 123 456 789
Decimal: 123 456 789,32
percent: 125 498,77 %
currency (USD): 123 456 789,32 $US
currency (CAD): 123 456 789,32 $CA
currency (EUR): 123 456 789,32 €
currency (CNY): 123 456 789,32 CNY
currency (JPY): 123 456 789,32 JPY
currency (INR): 123 456 789,32 ₹
currency (CHF): 123 456 789,32 CHF
date-time (default): 22 mars 2022
date-time (full): mardi 22 mars 2022
date-time (full + long time): mardi 22 mars 2022 à 11:32:32 UTC−4
day names: dimanche, lundi, mardi, mercredi, jeudi, vendredi, samedi
month names: janvier, février, mars, avril, mai, juin, juillet, août, septembre, octobre, novembre, décembre

Chapter 11 Recap

What We Learned

- How to add code that wraps around Intl API **DateTimeFormat** and **NumberFormat**
- How to format values according to the current locale using the formatters we created

Observations

- We did not add unit tests against our formatters

Improvements

- Add unit tests again the formatters hooks

Chapter 12 - Adding Tailwind CSS

Going forward, we are going to use **Tailwind CSS**[39] as it makes it so easy to design components without having to mess with the CSS directly. We would eventually need to remove also the older CSS we wrote during the previous chapter, but there is no harm for now in leaving that there. But for our primitives library and new higher-level components, it will be written exclusively using Tailwind CSS.

To add TailwindCSS to our existing project execute this command. This will install the latest tailwindcss, postcss and autoprefixer npm packages:

```
npm install -D tailwindcss@latest postcss@latest autoprefixer@latest
```

Then let's init the Tailwind CSS configuration files. The following command will create the preliminary **tailwind.config.js** and postcss.config.js:

```
npx tailwindcss init -p
```

Open the file **tailwind.config.js** and verify it has been created. Ensure the content is like this:

```
// file: src/tailwind.config.js
module.exports = {
  content: ['./src/**/*.{html,js,ts,tsx}'], /* you might have to add this */
  theme: {
    extend: {},
  },
  plugins: [],
}
```

Also verify that **postcss.config.js** has been created and the content is like this:

[39] Tailwind CSS Official Website

```
// file: src/postcss.config.js
module.exports = {
  plugins: {
    tailwindcss: {},
    autoprefixer: {},
  },
}
```

Then, under src, create a new directory called tailwind and move the **app.css** file into it. The final path of this will be **src/tailwind/app.css**. Open the file and make sure contains this code:

```
/* file: src/tailwind/app.css */
@import 'tailwindcss/base';
@import 'tailwindcss/components';
@import 'tailwindcss/utilities';

@import './other.css'; /* note: we create this file in one of the next steps below */
```

Within the **main.tsx** file: remove the existing reference to the old index.css and import a reference to the new tailwind/app.css file:

```
// file: src/main.tsx
import React from 'react'
import ReactDOM from 'react-dom'
import './index.css' // <-- remove this line
import './tailwind/app.css' // <-- add this line

...
```

Delete the old src/index.css form the project.

Move the old src/App.css file into the src/tailwind folder and rename it **other.css**. Remove the .App and .cursor-pointer classes from this file:

```
/* file: src/tailwind/other.css */
// remove the following .App and .cursor-pointer classes:
.App {
  padding: 20px;
}
.cursor-pointer {
  cursor: pointer;
}

...
```

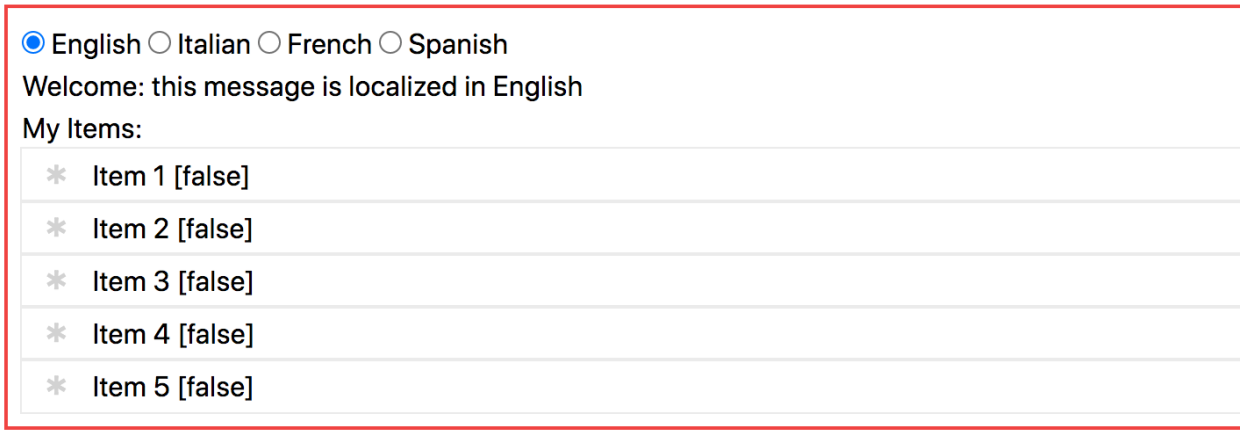
Within the **App.tsx** file: remove the reference to the old src/App.css file:

```
// file: src/App.tsx
import * as React from 'react'

// import our App.css // <- remove this line
import './App.css' // <- remove this line

...
```

Finally, to test that Tailwind CSS has been added and it is working, add the classes `m-2 p-2 border-2 border-red-500` to the div element within the App.tsx file:

```
// file: src/App.tsx

...

  return (
    <Provider store={rootStore}>
      <div className="app m-2 p-2 border-2 border-red-500"> { /* add css classes her\
e  */}

...
```

To confirm that Tailwind CSS is being add correctly, run the application and verify that it renders like this:


English Italian French Spanish
Welcome: this message is localized in English
My Items:
Item 1 [false]
Item 2 [false]
Item 3 [false]
Item 4 [false]
Item 5 [false]

Chapter 12 Recap

What We Learned

- We learned how to add Tailwind CSS to our existing project

Observations

- We did not talk about how to add support for something like Sass/Scss

Based on these observations, there are a few improvements that can be done:

Improvements

- You could learn how to add Sass/Scss if you do not want to use Tailwind CSS

Chapter 13 - Intro to Primitives

This chapter covers concepts on how to write and organize the most primitive components (i.e. Inputs, Buttons etc) in order to create a foundation for higher-level and more complex components.

Atomic Design and Similar Approaches

The way you can think of and organize your components might follow one or more methodologies. One methodology that has seen an increase in adoption recently is **Atomic Design** originally introduced by **Brad Frost**[40]. The great **Alba Silvente**[41] has also a terrific post about this that I strongly recommend you check out. You are free to follow this or other methodologies either strictly or more losely, as well as chose to implement your own or even use a mix of ideas from different ones.

In my personal and pragmatical way, I found over the years that all I really need is a **foundation** of the most **primitive** elements liek buttons/textboxes/dropdowns/etc. These primitives should be as simple as possible, even though in some cases the might contain quite a bit of logic to determine how they render. In my world, **primitives** are more or less the same as the **Atoms** in Atomic Design.

Then, you can build your higher level components by "composing" them from the **primitives**.

This is what I'll be describing in this chapter. We'll build a collection of primitives that are simply Buttons, Inputs and similar and see what better strategies we can use there to reduce the amount of code we have to write and maintain. We'll then explore in the next chapters how to build higher-level components from these.

Conventions

One of the convention we will follow is to put all our primitive components under the directory **src/components/primitives**

[40] *Brad Frost - Atomic Design https://bradfrost.com/blog/post/atomic-web-design/*

[41] *Alba Silvente - How to structure a Vue.js app using Atomic Design and TailwindCSS https://vuedose.tips/how-to-structure-a-vue-js-app-using-atomic-design-and-tailwindcss*

Within this directory we'll have sub-directories (folders) that leep the components organized by category. I.e. buttons will be under **src/components/primitives/buttons**, inputs will be under **src/components/primitives/inputs** etc.

We'll follow also a naming convention where each .vue file that represents a primitive will start with the **El** prefix. I.e. **ElText.tsx**, **ElIcon.t**sx, etc. In this case El is for "element". You are of course free to decide your own naming convention. But I strongly suggest using some kind of prefix to more quickly identify a **primitive** by just looking at its file name when it is open in your editor.

Create the following 5 sub-directories to get started:

- **src/components/primitives/buttons**
- **src/components/primitives/text**
- **src/components/primitives/modals**
- **src/components/primitives/inputs**
- **src/components/primitives/icons**

General Strategies

One of the things we are going to consistently need in each **primitive** is the main CSS class property. Often, this will have to be a computed property that returns the appropriate value based on other conditions. For example, a **Button** might have to render with an additional "**disabled**" CSS class if its **disabled** property is true.

For consistency, every time a primitive needs a dynamic CSS class, we'll add a computed property called **cssClass** that will return the appropriate value based on various conditions.

Here is a code example for an hypotethical **Button** component:

```
export function SomeButton (props: SomeButtonProps) {
  const {
    label
  } = props

  const disabled = props.disabled || false

  // a computed property to return a different css class based on the selected value
  const cssClass = (): string => {
    // here we concatenate the default CSS with 'disabled' only if disabled is true
    const defaultClasses = 'p-6' // in TailwindCSS this means we want a padding of 6
    return `${ defaultClasses } ${ disabled ? 'disabled' : '' }`.trim()
```

```
    // alternativately, you could use an array that is initialized with
    // the default CSS, and if disabled is true, then add 'disabled'
    // and return the result by joining the array with space as the separator
    // (I usually favor this approach especially when there
    // is more than one check and additional logic)
    const result = ['p-6']
    if (disabled) {
      // these are the button CSS classes when disabled
      result.push('disabled')
    }
    return result.join(' ').trim()
  }

  // click handler
  const handleClick = () => {
    // proceed only if the button is not disabled, otherwise ignore the click
    if (!disabled) {
      // invoke onClicked function from props
      onClicked(id)
    }
  }

  return (
    <button type="button"
      disabled={disabled}
      className={cssClass()} >
      <span className="name">{ label }</span>
    </button>
  )
}
```

Text Elements

Let's start creating one element for each group as a starting point and then we'll keep building more elements from there.

Create a file called **ElText.tsx** under directory **src/components/primitives/text**.

For the code, use the following:

```
// file: src/components/primitives/text/ElText.tsx
import * as React from 'react'

type ElTextProps = {
  testid?: string
  id?: string
  tag: string
  text: string
  addCss?: string
}

interface ComponentProps extends React.HTMLAttributes<HTMLOrSVGElement> {
  as?: React.ElementType
  id?: string
  'data-testid': string
}

const Component: React.FC<ComponentProps> = ({ as: Tag = 'p', ...otherProps }) => {
  return <Tag {...otherProps} />
}

export function ElText (props: ElTextProps) {
  const {
    id,
    tag,
    text
  } = props

  const testid = props.testid || 'testid-not-set'
  const addCss = (props.addCss || '').trim()

  // a computed property the returns the css class value of this component root elem\
ent
  const cssClass = (): string => {
    const cssClasses = ['p-1']
    if ((addCss || '').trim().length > 0) {
      cssClasses.push(addCss.trim())
    }
    return cssClasses.join(' ').trim()
  }

  return (
    <Component as={tag as any} id={id} data-testid={testid} className={cssClass()}>{\
```

```
text}</Component>
  )
}
```

Here our logic within the computed cssClass property is a bit more complex. Our component also has a property called **addCss** (for additional Css) that can be used to specify **CSS classes** for our component in addition to the ones internally set initially to the **const cssClasses** variable. Within the **cssClass** computed property we check if a value for the property **addCss** has been provided. If so, we add its value to our computed value.

Here is an example on how we'll consume our ElText component:

```
<ElText tag="h2" addCss="text-red-500" text="Here ElText will render an <h2> element\
"/>
```

As you can see we specified the value "**text-red-500**" for the addCss property. Thus, the final computed value for the cssClass will be "**p-1 text-red-500**".

Furthermore, since we are rendering the component dynamically based on the **tag** property specified, we can render our text as any valid Html element we wish for. In the example above, we specified the **tag** property to be "**h2**" and thus it will render an **<h2>** element. Or we could have specified a tag value of "**p**" and it will render as a **<p>** element etc.

Primitives View

Let's create a view where we can consume our primitives so that we can visually debug and prototype them as we develop them. This view can become apoint of reference for our basic library of primitives from which we will build more complex components later.

Create the following file:

- **src/views/Primitives.view.tsx**

The initial code for this file is the following:

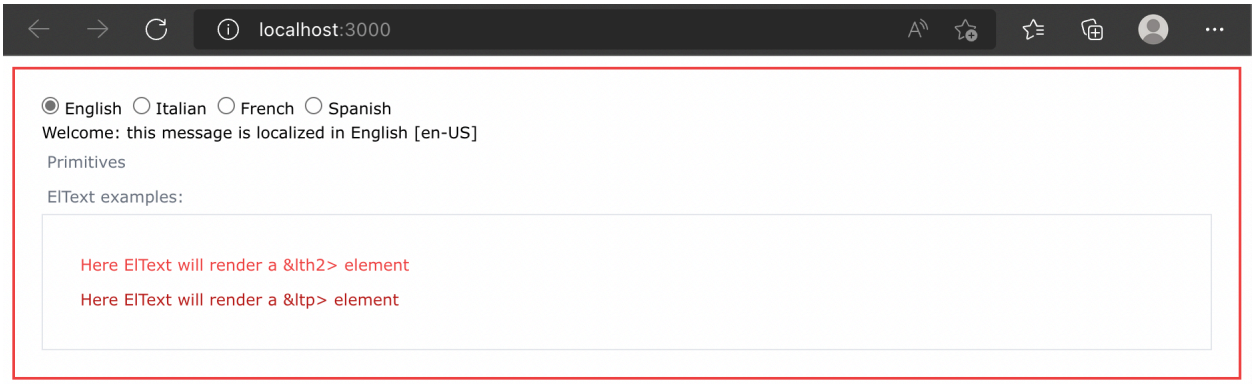
```
// file: src/views/Primitives.view.tsx
import * as React from 'react'
import { ElText } from '@/components/primitives/text/ElText'

// Primitives View:
function PrimitivesView() {

  // return our render function
  return (
    <div className="primitives">
      <ElText tag="h1" addCss="text-gray-500" text="Primitives"/>
      <ElText tag="h2" addCss="text-gray-500" text="ElText examples:"/>
      <div className="p-6 border">
        <ElText tag="h2" addCss="text-red-500" text="Here ElText will render a <h2> \
element"/>
        <ElText tag="p" addCss="text-red-700" text="Here ElText will render a <p> el\
ement"/>
      </div>
    </div>
  )
}

export default PrimitivesView
```

Let's now temporarily import the Primites view in our App.tsx and replace the ItemsList with it so we can verify it renders correctly:

```
// file: src/App.tsx

...

import ItemsView from '@/views/Items.view'
// import a reference for the Primitives View
import PrimitivesView from '@/views/Primitives.view'

...
return (
    <Provider store={rootStore}>
      <div className="app m-2 p-2 border-2 border-red-500">
        ...
        <PrimitivesView /> { /* temporarily replace ItemsList with PrimitivesView */\
 }
```

. . .

Now run the application and navigate to the **Primitives** view to see what we got. If all worked as expected, you should see something like this:



As you can see, the two ElText elements are rendered with different HTML tags. The first one as <h2> while the second one as a <p> element. We also specified some additional CSS class through their **addCss** property. The first has "text-red-500" which is a red, and the second one "text-red-700" which is a darker red in the default TailwindCSS colors.

Chapter 13 Recap

What We Learned

- We talked a bit about about atomic design
- We learned how to structure a directory of primitive elements from which we'll build higher-level components that are more complex

Observations

- We only created one primitive called ElText

Based on these observations, there are a few improvements that can be done:

Improvements

- We need to create a few more primitives
- We need to start consuming these primitives in higher-level components

Chapter 14 - More Primitives

Let's add now a few more primitives. This is just to give you some idea about the direction to take to build your own foundation library from which you can then derive all your higher level components.

Button Elements

Let's start for now by creating a button element for our primitives library, similar to how we created the **ElText** in the previous chapter.

Create a file called **ElButton.tsx** under directory **src/components/primitives/buttons**.

For the code, use the following:

```
// file: src/components/primitives/buttons/ElButton.tsx
type ElButtonProps = {
  testid?: string
  id: string
  label: string
  disabled?: boolean
  addCss?: string
  onClicked: Function
}

export function ElButton (props: ElButtonProps) {
  const { id, label, onClicked } = props
  const testid = props.testid || 'testid-not-set'
  const disabled = props.disabled || false
  const buttonType = props.buttonType || 'primary'
  const addCss = (props.addCss || '').trim()

  // a computed property to return a different css class based on the selected value
  const cssClass = (): string => {
    const result = ['font-bold py-1 px-2 inline-flex justify-center rounded-md borde\
r shadow-sm focus:outline-none focus:ring-2 focus:ring-offset-2']
    if (disabled) {
      // these are the button CSS classes when disabled
```

```
      result.push('bg-gray-500 text-gray-300 opacity-50 cursor-not-allowed')
    } else {
      // these are the button CSS classes when enabled
      result.push('bg-blue-500 text-white hover:bg-blue-400 focus:ring-blue-300')
    }

    // addCss will have additional CSS classes
    // we want to apply from where we consume this component
    if (addCss.length > 0) {
      result.push(addCss)
    }
    return result.join(' ').trim()
  }

  // click handler
  const handleClick = () => {
    // proceed only if the button is not disabled, otherwise ignore the click
    if (!disabled) {
      onClicked(id)
    }
  }

  return (
    <button type="button"
      aria-label={ label }
      data-testid={ testid }
      disabled={disabled}
      className={cssClass()}
      onClick={() => handleClick()}>
      <span className="name">{ label }</span>
    </button>
  )
}
```

Here as you can see we start having a bit more complexity than what we had in **ElText**. First, we have an **handleClick** method that calls the **onClicked** function when the button is clicked. This way, we can handle the click in the parent component where we will consume this primitive.

We have an **addCss** property (like we have in the ElText primitive), and a **label** property which is for the text of the button label. We also have a disabled **boolean** property to render the button either as enabled or disabled. Then we use this property in two places:

- Within the **handleClick** method, we make sure we proceed only if the button is not disabled
- Within the computed **cssClass** property, we check if the disabled property value is true to render a different set of CSS classes (with TailwindCSS here we set the text to gray with text-gray-300 for example, and a few other changes)

Here is an example on how we'll consume our **ElButton** component:

```
<ElButton id="my-button-1" disabled={false} label="This is a button" onClicked={onBu\
ttonClicked}/>
```

I hope you start seeing the power of organizing and building primitives this way. Ahead we'll soon compose higher-level components out of these primitives and you will see how easier to manage this will be, plus the code will be much cleaner and encapsulated.

Primitives View - update

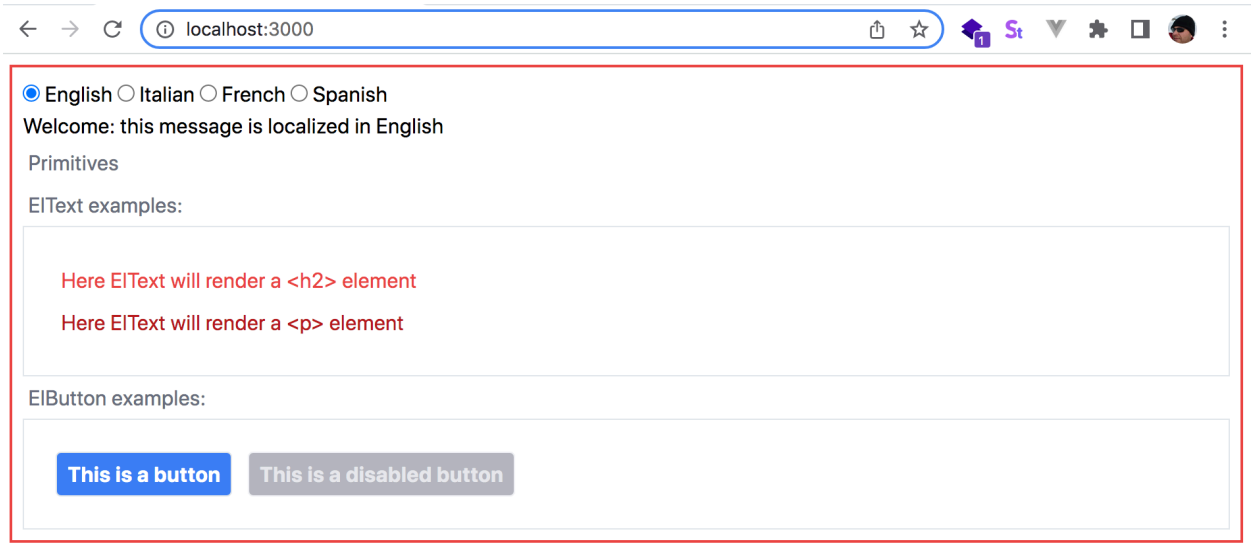
Within the primitives view, let's now consume the ElButton as in the example above so we can visually prototype the different button states.

Modify the file code within **src/views/Primitives.tsx**:

```
// file: src/views/Primitives.view.tsx
import * as React from 'react'
import { ElText } from '@/components/primitives/text/ElText'
import { ElButton } from '@/components/primitives/buttons/ElButton'

// Primitives View:
function PrimitivesView() {

  // add this handler:
  const onButtonClicked = (args: any) => {
    console.log('onButtonClicked', args)
  }

  // return our render function
  return (
    <div className="primitives">
      <ElText tag="h1" addCss="text-gray-500" text="Primitives"/>
      <ElText tag="h2" addCss="text-gray-500" text="ElText examples:"/>
```

```
      <div className="p-6 border">
        <ElText tag="h2" addCss="text-red-500" text="Here ElText will render a <h2> \
element"/>
        <ElText tag="p" addCss="text-red-700" text="Here ElText will render a <p> el\
ement"/>
      </div>
                        { /* begin: add code block */ }
      <ElText tag="h2" addCss="text-gray-500" text="ElButton examples:"/>
      <div className="p-6 border">
        <ElButton id="my-button-1" disabled={false} label="This is a button" onClick\
ed={onButtonClicked}/>
        <ElButton id="my-button-2" disabled={true} label="This is a disabled button"\
 addCss="ml-2" onClicked={onButtonClicked}/>
      </div>
                        { /* end: add code block */ }
    </div>
  )
}

export default PrimitivesView
```

Now run the application and navigate to the **Primitives** view to see what we got. If all worked as expected, you should see something like this:



As you can see, the buttons are rendered with our specified label text, and the one on the right is rendering as "disabled" (Note that we also specified a margin-left with the **addCss** property using TailwindCSS **ml-2** value).

NOTE: I did not add a handler for @clicked event yet, but you are welcome to add one in the Primitives view and log a message to the console to test that is working

Toggle/Checkbox Elements

Let's add one more primitive called **ElToggle** that will behave like a checkbox but looks like a toggle.

Create a file called **ElToggle.tsx** under directory **src/components/primitives/toggles**.

For the code, use the following:

```
// file: src/components/primitives/toggles/ElToggle.tsx
type ElToggleProps = {
  testid?: string
  id: string
  checked?: boolean
  disabled?: boolean
  addCss?: string
  onClicked: Function
}

export function ElToggle (props: ElToggleProps) {
  const { id, onClicked } = props
  const testid = props.testid || 'testid-not-set'
  const disabled = props.disabled || false
  const checked = props.checked || false
  const addCss = (props.addCss || '').trim()

  // a computed property to return a different css class based on the selected value
  const cssClass = (): string => {
    const result = ['relative inline-flex flex-shrink-0 h-6 w-12 border-1 rounded-fu\
ll cursor-pointer transition-colors duration-200 focus:outline-none']
    if (checked) {
      result.push('bg-green-400')
    } else {
      result.push('bg-gray-300')
    }
    if (disabled) {
      result.push('opacity-40 cursor-not-allowed')
    }
    if (addCss.length > 0) {
```

```
      result.push(addCss.trim())
    }
    return result.join(' ').trim()
  }

  const innerCssClass = (): string => {
    const result = ['bg-white shadow pointer-events-none inline-block h-6 w-6 rounde\
d-full transform ring-0 transition duration-200']
    if (checked) {
      result.push('translate-x-6')
    } else {
      result.push('translate-x-0')
    }
    return result.join(' ').trim()
  }

  // click handler
  const handleClick = () => {
    // proceed only if the button is not disabled, otherwise ignore the click
    if (!disabled) {
      onClicked(id)
    }
  }

  return (
    <button type="button"
      role="checkbox"
      data-testid={ testid }
      aria-checked={ checked }
      disabled={disabled}
      className={cssClass()}
      onClick={() => handleClick()}>
      <span className={innerCssClass()} ></span>
    </button>
  )
}
```

As you can see this looks a lot similar to the ElButton primitive we created earlier.
Here too we have an **handleClick** method that invokes the **onClicked** function when the toggle is clicked. This way, we can handle the click in the parent component where we will consume this primitive.

We have an **addCss** property (like we have in the ElButton primitive), and a **checked**

property which we'll use to specify whether the toggle is on or off. We also have a disabled **boolean** property to render the toggle as either enabled or disabled. Then we use this property in two places:

- Within the **handleClick** method, we make sure we proceed only if the toggle is not disabled
- Within the computed **cssClass** property, we check if the disabled property value is true to render a different set of CSS classes, we do the something similar for the **checked** property as well to change the background color of the toggle track
- We have an additional computed property called **innerCssClass** (this is for the inner of the toggle which will render as a white circle). Inside here we check for the **checked** property value to determine how much we have to shift the circle horizontally (through the TailwindCSS **translate-x** property)

Here is an example on how we'll consume our **ElButton** component:

```
<ElToggle id="my-toggle" checked={somestate.checked} disabled={false} onClicked={onT\
oggleClicked} />
```

Primitives View - one more update

Within the primitives view, let's now consume the ElToggle as in the example above so we can visually prototype the **ElToggle**.

Modify the file code within **src/views/Primitives.tsx** so that we add the ElToggle just created, and some state to better track multiple instance and verify visually that is working. Here is the full updated code:

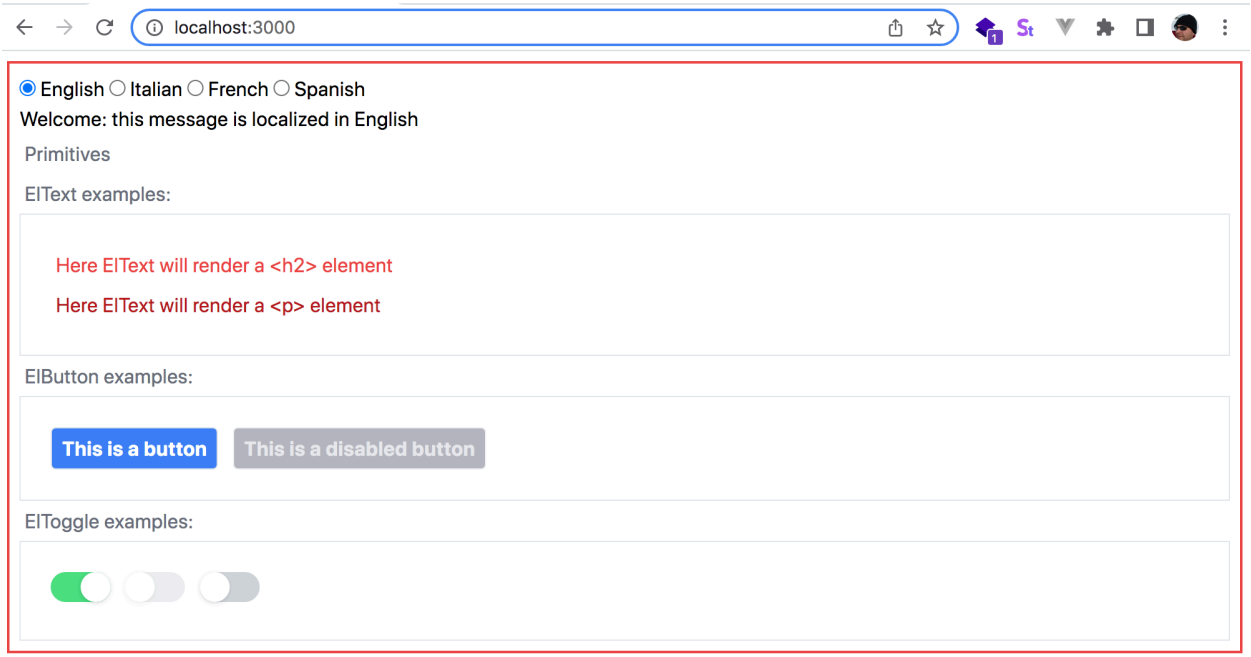
```
// file: src/views/Primitives.view.tsx
import * as React from 'react'
import { ElText } from '@/components/primitives/text/ElText'
import { ElButton } from '@/components/primitives/buttons/ElButton'
import { ElToggle } from '@/components/primitives/toggles/ElToggle'

// Primitives View:
function PrimitivesView() {
        // add some state to track the varius instance of ElToggle components
  const [state, setState] = React.useState({
    toggleItemState: [
      {
```

```
        id: 'toggle-a',
        checked: true
      }, {
        id: 'toggle-b',
        checked: false
      }, {
        id: 'toggle-c',
        checked: false
      }
    ]
  })

  const onButtonClicked = (id: string) => {
    console.log('onButtonClicked', id)
  }

  // add this event handler to handle when the toggle is clicked
  const onToggleClicked = (id: string) => {
    console.log(`You clicked the "${id}" toggle`)
    const stateItem = state.toggleItemState.find(item => item.id === id)
    if (stateItem) {
      // toggle the value of the ElToggle that was clicked
      stateItem.checked = !stateItem.checked
      // update the state
      setState({
        ...state
      })
    }
  }

  // return our render function
  return (
    <div className="primitives">

      ...
      { /* add this block for the ElToggle instances */ }
      <ElText tag="h2" addCss="text-gray-500" text="ElToggle examples:"/>
      <div className="p-6 border">
        <ElToggle id="toggle-a" checked={state.toggleItemState.find(item => item.id \
=== 'toggle-a')?.checked} disabled={false} onClicked={onToggleClicked} />
        <ElToggle id="toggle-b" checked={state.toggleItemState.find(item => item.id \
=== 'toggle-b')?.checked} disabled={true} addCss="ml-2" onClicked={onToggleClicked} \
/>
```

```
        <ElToggle id="toggle-c" checked={state.toggleItemState.find(item => item.id \
=== 'toggle-c')?.checked} disabled={false} addCss="ml-2" onClicked={onToggleClicked}\
 />
      </div>
    </div>
  )
}

export default PrimitivesView
```

Note how here we are using React useState to create a simple local state to track the checked state of all toggles. Then in the onToggleClicked method we retrieve the state information for that toggle and invert its current checked value.

Now run the application and navigate to the Primitives view to see what we got. If all worked as expected, you should see something like this:



You are welcome to keep following this pattern and start creating more complex primitives like icons, textboxes, dropdowns, lists etc. For now we'll stop here, and in the next chapter we'll start consuming the primitives we have created to compose higher level components.

Optional: You might also want to add a barrel index.ts file under components/primitives and export all primitives in an organized fashion so that you can simplify your imports like, i.e. `import { ElText, ElButton, ElToggle } from '@/components/primitives':`

```ts
// file: src/components/primitives/index.ts

// text
import { ElText } from './text/ElText'

// buttons
import { ElButton } from './buttons/ElButton'

// toggles
import { ElToggle } from './toggles/ElToggle'

export {
  // text
  ElText,
  // buttons
  ElButton,
  // toggles
  ElToggle
}
```

Chapter 14 Recap

What We Learned

- We learned how to add additional components to our custom library by adding an ElButton and ElToggle primitives
- We learned how to render these primitives with different CSS classes conditionally to other properties like disabled, selected etc

Observations

- We did not consume these primitives in higher level components yet (besides the Primitive view used to visually prototype them)

Based on these observations, there are a few improvements that can be done:

Improvements

- We need to start consuming these primitives in higher-level coponents
- We need to start consuming the primitives and higher-level components in other existing component like our initial **ItemsList** and **Item** components

Chapter 15 - A Primitive Modal

I wanted to dedicate an additional chapter to creating a Modal component. There are many ways to create modals in React. There are also plug-ins created by various authors out there. You are free to choose anything you like of course and skip this chapter completely.

Here, I wanted to introduce a way of creating it a modal component that, in my experience over the years, has worked out to be one of the best ways in any front-end frameworks, including **Vue.js** or **Svelte.js**.

One of the main difference between a Modal component and a traditional component is that a Modal must prevent interaction with the rest of the application until the user dismisses the dialog.

The main use case for a dialog is to prompt the user to confirm an action, which might be usually destructive, like deleting a record or updating data (thus overwriting existing data, etc). The Modal will usually present a dialog box with a message and two buttons: one to **confirm** the action (primary) and one to **cancel** the action (secondary).

Our goal is to have a hook called **useModal** that will return a reference to a shared instance of a Modal component and we can consume like:

```
const modal = useModal({ cancelLabel: 'Cancel', confirmLabel: 'Ok' })

...

const result = await modal.prompt('Do you want to delete this record?')
// result will be true if the user has confirmed, otherwise false if they cancelled
```

We'll expect the prompt() method to be **async** and block execution of our code at that line till a **result** is returned. Similar to how the native JavaScript prompt works.

We also want to pass an icon to our dialog that will be rendered in the top part of the modal.

Icon: ElIconAlert

Before we start working on the modal code itself, let's create a preliminary icon icon primitive. Create the file **ElIconAlert.tsx** under **directory src/components/primitives/icons/** and put the following code in it:

```
// file: src/components/primitives/icons/ElIcon.tsx
import * as React from 'react'
import { IconProps } from './IconProps'

export function ElIconAlert(props: IconProps) {
  const testid = props.testid || 'testid-not-set'
  const addCss = (props.addCss || '').trim()

  // a computed property the returns the css class value of this component root elem\
ent
  const cssClass = (): string => {
    const result = ['h-6 w-6 ']
    if ((addCss || '').trim().length > 0) {
      result.push(addCss)
    }
    return result.join(' ').trim()
  }

  return (
    <svg data-testid={testid} className={cssClass()} xmlns="http://www.w3.org/2000/s\
vg" fill="none" viewBox="0 0 24 24" stroke="currentColor" aria-hidden="true">
      <path strokeLinecap="round" strokeLinejoin="round" strokeWidth="2" d="M12 9v2m\
0 4h.01m-6.938 4h13.856c1.54 0 2.502-1.667 1.732-3L13.732 4c-.77-1.333-2.694-1.333-3\
.464 0L3.34 16c-.77 1.333.192 3 1.732 3z" />
    </svg>
  )
}
```

Let's create a generic interface for all ElIcon primitives we might be creating in addition to the one above:

```
// file: src/components/primitives/icons/IconProps.ts
export interface IconProps {
  testid?: string
  addCss?: string
}
```

Create also a barrel indexts file within the icons directory with this:

```
// file: src/components/primitives/icons/index.ts
export * from './IconProps'
export * from './ElIconAlert'
```

We'll be dynamically adding the icon as one of the possible properties passed to our modal component.

Interface ModalProps

Within the directory **src/components/primitives/modals** add a new file called **ModalProps.interface.ts** with the following code:

```
// file: src/components/primitives/modals/ModalProps.interface.ts
import { FunctionComponent, ComponentClass } from 'react'

/**
 * @name ModalProps
 * @desrciption Interface that represents the public properties of the Modal compone\
nt
 */
 export interface ModalProps {
  testid?: string
  cancelLabel: string
  confirmLabel: string
  title?: string
  longDesc?: string // optional
  primaryButtonType?: string  // optional, defaults to 'primary'
  icon?: string | FunctionComponent<{addCss: string }> | ComponentClass<{ addCss: st\
ring }, any>
  iconAddCss?: string
}
```

File ElModal.ts (note: not .tsx)

Within the same directory, create a file called **ElModal.ts** (note: not .tsx) with the following code:

```
// file: src/components/primitives/modals/ElModal.ts

import * as React from 'react'
import { ModalProps } from './ModalProps.interface'
import { ElButton } from '../buttons/ElButton'

const getDefaultState = () => {
  return {
    testid: 'testid-not-set',
    cancelLabel: 'Cancel',
    confirmLabel: 'Confirm?',
    title: 'Do you confirm this action?',
    longDesc: undefined, // make sure you return undefined for optional props
    primaryButtonType: 'primary',
    icon: undefined,
    iconAddCss: undefined,
    isOpen: false
  }
}

interface ModalState extends ModalProps {
  isOpen: boolean
}

export class ElModal extends React.Component<ModalProps, ModalState> {
  // a variable that will store a reference to a "resolve" from a Promise we created\
 in the prompt() method
  private privateResolve!: (value: boolean | PromiseLike<boolean>) => void

  constructor(props: ModalProps) {
    super(props)

    // Set the internal state
    this.state = {
      ...getDefaultState(),
      ...props
    }
  }

  // public updateProps() method used to set the private props from our useModal hook
  public updateProps = (updatedProps: ModalProps) => {
    this.state = {
      ...getDefaultState(),
```

```
      ...updatedProps
    }
  }

  private open = () => {
    this.setState({ isOpen: true })
  }

  private close = () => {
    this.setState({ isOpen: false })
  }

  // handle click from Cancel button
  private onCancelClick = () => {
    this.close()
    this.privateResolve(false)
  }

  // handle click from Confirm button
  private onConfirmClick = () => {
    this.close()
    this.privateResolve(true)
  }

  private cssClass = () => {
    const result = ['fixed z-10 inset-0 overflow-y-auto transform transition-all']
    // might add additional css based on conditions...
    return result.join(' ').trim()
  }

  // public prompt() method:
  public prompt = async (title: string) => {
    // update internal props
    this.setState({ ...this.state, title: title })
    // open the modal
    this.open()
    // return a new promise that will be waited by the consuming code
    return new Promise<boolean>((resolve) => {
      // here we store a reference to the resolve returned with the Promise to the c\
onsuming code
      this.privateResolve = resolve
    })
  }
```

```
  // renders the Icon section
  private renderIconSection = () => {
    if (!this.state.icon) {
      return null
    }

    return React.createElement('div', {
      'key': 'modal-icon-section',
      'className': 'mx-auto flex items-center justify-center h-12 w-12 rounded-full \
bg-green-100'
    }, [
      // child element with the icon
      React.createElement(this.state.icon, {
        'key': 'modal-icon',
        'addCss': this.state.iconAddCss || ''
      })
    ])
  }

  private renderDescription = () => {
    if ((this.state.longDesc || '').trim().length < 1) {
      return
    }
    return React.createElement('div', {
      'key': 'modal-long-desc-section',
      'className': 'mt-2'
    }, [
      // description text as <p> element:
      React.createElement('p', {
        'key': 'modal-long-desc-text',
        'className': 'text-sm text-gray-500 text-center'
      }, this.state.longDesc)
    ])
  }

  // renders the text section with title and longDesc
  private renderTextSection = () => {
    return React.createElement('div', {
      'key': 'modal-text-section',
      'className': 'mt-3 text-center sm:mt-5'
    }, [
      // render title text as <h3> element:
```

```
      React.createElement('h3', {
        'key': 'modal-title',
        'className': 'text-lg leading-6 font-medium'
      }, this.state.title),
      // render description section
      this.renderDescription()
    ])
  }

  // renders the buttons section
  private renderButtonSection = () => {
    return React.createElement('div', {
      'key': 'modal-panel',
      'className': 'mt-5 sm:mt-6 grid gap-3 sm:grid-cols-2 sm:grid-flow-row-dense'
    }, [
      // cancel button:
      React.createElement(ElButton, {
        key: 'btn-modal-cancel',
        id: 'btn-modal-cancel',
        buttonType: 'secondary',
        disabled: false,
        label: this.state.cancelLabel,
        addCss: 'ml-2',
        onClicked: this.onCancelClick
      }),
      // confirm button:
      React.createElement(ElButton, {
        key: 'btn-modal-confirm',
        id: 'btn-modal-confirm',
        buttonType: this.state.primaryButtonType,
        disabled: false,
        label: this.state.confirmLabel,
        addCss: 'ml-2',
        onClicked: this.onConfirmClick
      })
    ])
  }

  private renderModalPanel = () => {
    return React.createElement('div', {
      'key': 'modal-panel',
      'className': 'relative inline-block align-bottom bg-white rounded-lg px-4 pt-5\
pb-4 text-left overflow-hidden shadow-xl sm:my-8 sm:align-middle sm:max-w-lg sm:w-f\
```

```
ull sm:p-6',
    }, [
      this.renderIconSection(),
      this.renderTextSection(),
      this.renderButtonSection()
    ])
  }

  private renderInnerDiv = () => {
    return React.createElement('div', {
      'key': 'inner-div',
      'className': 'flex items-end justify-center min-h-screen pt-4 px-4 pb-20 text-\
center sm:block sm:p-0'
    }, [
      // render background overlay:
      React.createElement('div', {
        'key': 'background-overlay',
        'className': 'fixed inset-0 bg-gray-400 bg-opacity-75',
        'aria-hidden': true
      }),
      // render trick:
      React.createElement('div', {
        'key': 'trick-div',
        'className': 'hidden sm:inline-block sm:align-middle sm:h-screen',
        'aria-hidden': true
      }, '\u200B'), // this renders &ZeroWidthSpace; to allow centering the dialog
      // render modal panel
      this.renderModalPanel()
    ])
  }

  render() {
    if (!this.state.isOpen) {
      return null
    }
    // render outer div
    return React.createElement('div', {
      'data-testid': this.state.testid,
      'className': this.cssClass(),
      'aria-labelledby': 'modal-title',
      'role': 'dialog',
      'aria-modal': true
    }, this.renderInnerDiv())
```

```
  }
}
```

Note: this component file extension is just .ts and does not use JSX, but rather React's createElement[42] functionality that allow us to create elements programmatically. This will enable us to more easily consume the ElModal without explicitely adding it to the render function of the parent component taht is consuming it.

The core concept here is to return a **Promise** from the prompt() method that will be **awaited** in the consuming code till the user clicks on either **Cancel** or **Confirm**. The promise will be resolved when the user clicks on Cancel or Confirm and the result will be either false (cancelled) or true (confirmed).

In additional to that, we will initialize the props with custom text labels for the Cancel and Confirm buttons. We can also initialize the title, or optionally set the title when we call prompt().

Now, for the html part, we'll just render the content only if the **isOpen** flag is true:

```
...

  render() {
    if (!this.state.isOpen) {
      return null
    }
    // render outer div
    return React.createElement('div', {
      'data-testid': this.state.testid,
      'className': this.cssClass(),
      'aria-labelledby': 'modal-title',
      'role': 'dialog',
      'aria-modal': true
    }, this.renderInnerDiv())
  }

...
```

Note: I made some enhancements to the ElButton to render with different css based on a type classification like primary/secondary/danger etc. Please see the public GitHub repository for the additional changes

[42] https://reactjs.org/docs/react-api.html

File useModal.ts

Create a file called **useModal.ts** under the same directory (src/components/primitives/-modals/) with the following code:

```
// file: src/components/primitives/modals/useModal.ts
import * as React from 'react'
import ReactDOM from 'react-dom'
import { ElModal } from './ElModal'
import { ModalProps } from './ModalProps.interface'

let instance!: any //ElModal
const domTargetId = 'modal'

/**
 * @name useModal
 * @param props The modal props
 * @returns the Modal component instance
 */
 export const useModal = (props: ModalProps) => {

  if (!instance) {
    // get the modal target dom element by id
    let domTarget = document.getElementById(domTargetId)
    // if not existing yet, create it with vanilla JS
    if (!domTarget) {
      domTarget = document.createElement('div')
      domTarget.setAttribute('id', domTargetId)
      document.body.appendChild(domTarget)
    }
    // create the ElModal instance
    const reactModal = React.createElement(ElModal, props, null)

    // render instance and store reference once
    instance = ReactDOM.render(reactModal, domTarget)
  }

  // update the Modal props
  instance.updateProps(props)

  // return the instance
  return instance
```

```
}
```

The code here just makes sure we create only one instance of the ElModal component (singleton pattern) and also only create a element as the target for the modal. Then create the modal instance programmatically, invoke its updateProps method to update its properties through the interal state, and return the instance to the consuming code.

An example on how we will consume our ElModal through the useModal hook is this:

```
// example:
const modal = useModal({
  cancelLabel: 'Cancel',
  confirmLabel: 'Confirm',
  longDesc: 'This has also a longer description and an icon',
  primaryButtonType: 'danger',
  icon: ElIconAlert, // here we can use an optional icon
  iconAddCss: 'text-red-600' // additional css classes for the icon
})
```

Let's now modify the Primitives.view.tsx so we can test a couple of different scenarios, for two different modals.

Updates to Primitives.view.tsx

Now let's consume our useModal hook. Open the Primitives.view.tsx file and make the following changes:

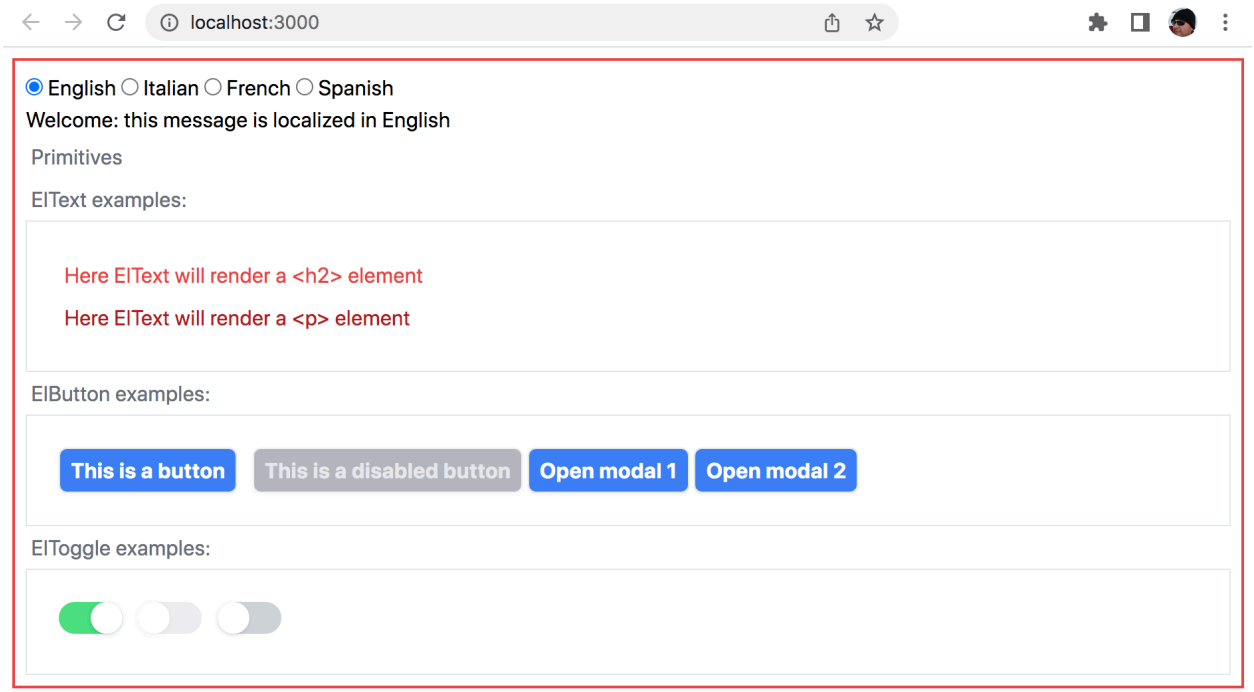
```
// file: src/views/Primitives.view.tsx

  ...
  // import a reference to ElIconAlert
  import { ElIconAlert } from '@/components/primitives/icons/'
  // import a reference to useModal
  import { useModal } from '@/components/primitives/modals/useModal'

  ...
  const onButtonClicked = (id: string) => {
    console.log('onButtonClicked', id)
  }
```

```
  // add this new handler for the two new Open Modal X buttons we'll add shortly
  const onOpenDialogClicked = async (id: string) => {
    console.log('PrimitivesView: onOpeanDialogClicked', id)

    // handle the new buttons with id "open-modal-x" (we'll be adding shortly)
    if (id === 'open-modal-1') {
      // here we invoke our useModal with the custom labels for the buttons
      const modal = useModal({
        cancelLabel: 'Cancel',
        confirmLabel: 'Ok',
        primaryButtonType: 'danger'
      })
      // then we invoke modal.prompt() and await it
      const result = await modal.prompt('Do you want to delete this record?')
      // the result will be true if the user click on COnfirm, or false if click on \
Cancel
      console.log('----- PrimitivesView: onButtonClicked: modal-1 prompt result', re\
sult)
    } else if (id === 'open-modal-2') {
      // here we invoke our useModal with the custom labels for the buttons + icon a\
nd iconAddCss props
      const modal = useModal({
        cancelLabel: 'Cancel',
        confirmLabel: 'Confirm?',
        longDesc: 'This has also a longer description and an icon',
        icon: ElIconAlert, // here we use the icon component created earlier
        iconAddCss: 'text-red-600'
      })
      // then we invoke modal.prompt() and await it
      const result = await modal.prompt('Do you confirm this action?')
      // the result will be true if the user click on COnfirm, or false if click on \
Cancel
      console.log('----- PrimitivesView: onButtonClicked: modal-2 prompt result', re\
sult)
    }
  }

  ...

  <div class="p-6 border">
    <ElButton id="my-button-1" disabled={false} label="This is a button" onClicked={\
onButtonClicked} />
    <ElButton id="my-button-2" disabled={true} label="This is a disabled button" add\
```

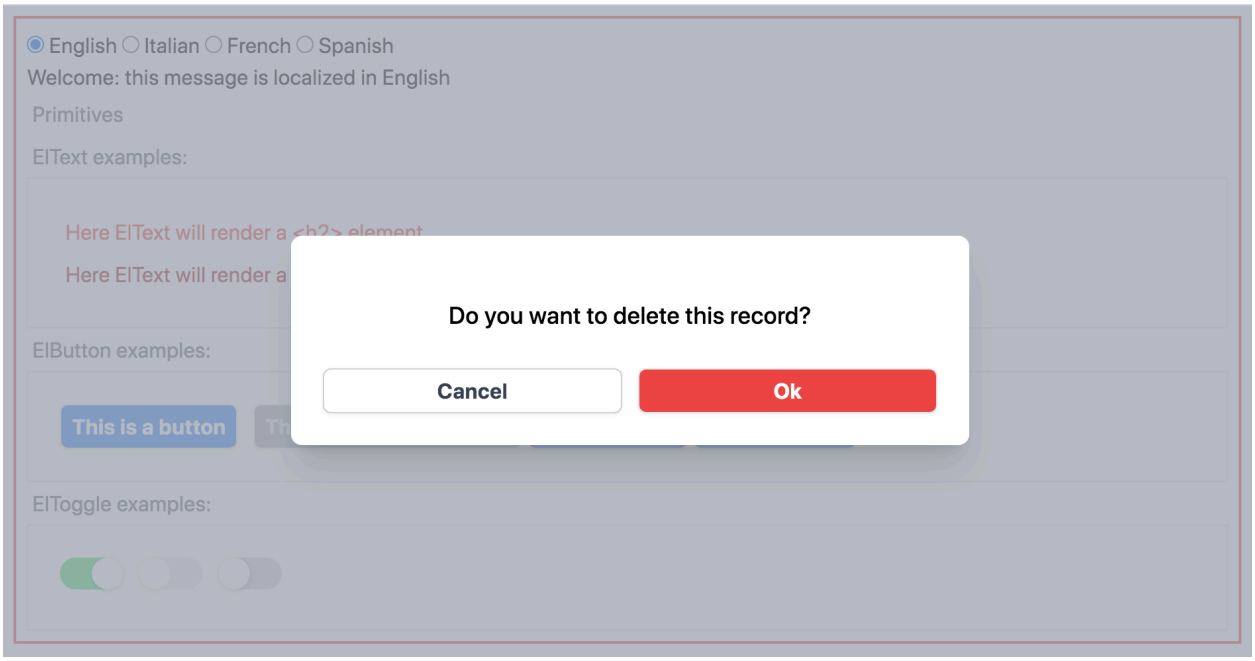
```
Css="ml-2" onClicked={onButtonClicked} />
    <!-- add these two buttons: -->
    <ElButton
      id="open-modal-1"
      disabled={false}
      label="Open modal 1"
      addCss="ml-2"
      onClicked={onOpenDialogClicked}
      />
    <ElButton
      id="open-modal-2"
      disabled={false}
      label="Open modal 2"
      addCss="ml-2"
      onClicked={onOpenDialogClicked}
      />

    ...
```

Browser

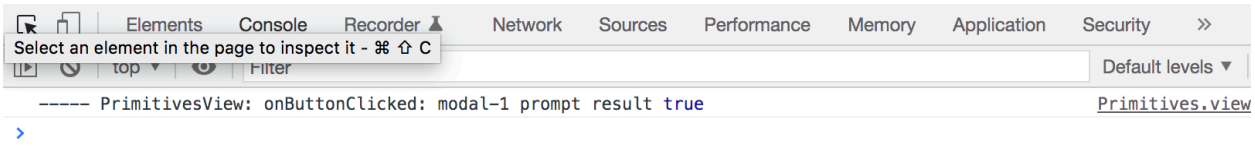
The app will now render our 3rd button:



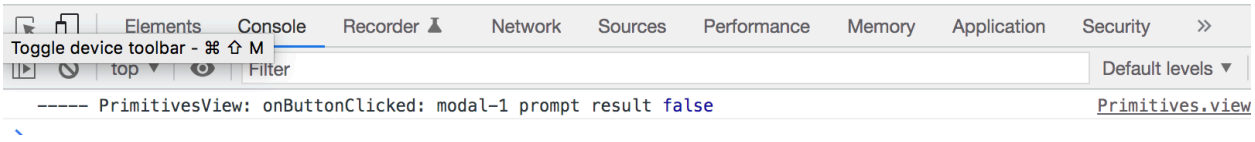
After clicking on the "**Open modal 1**" button, you will see a modal rendered without an icon:



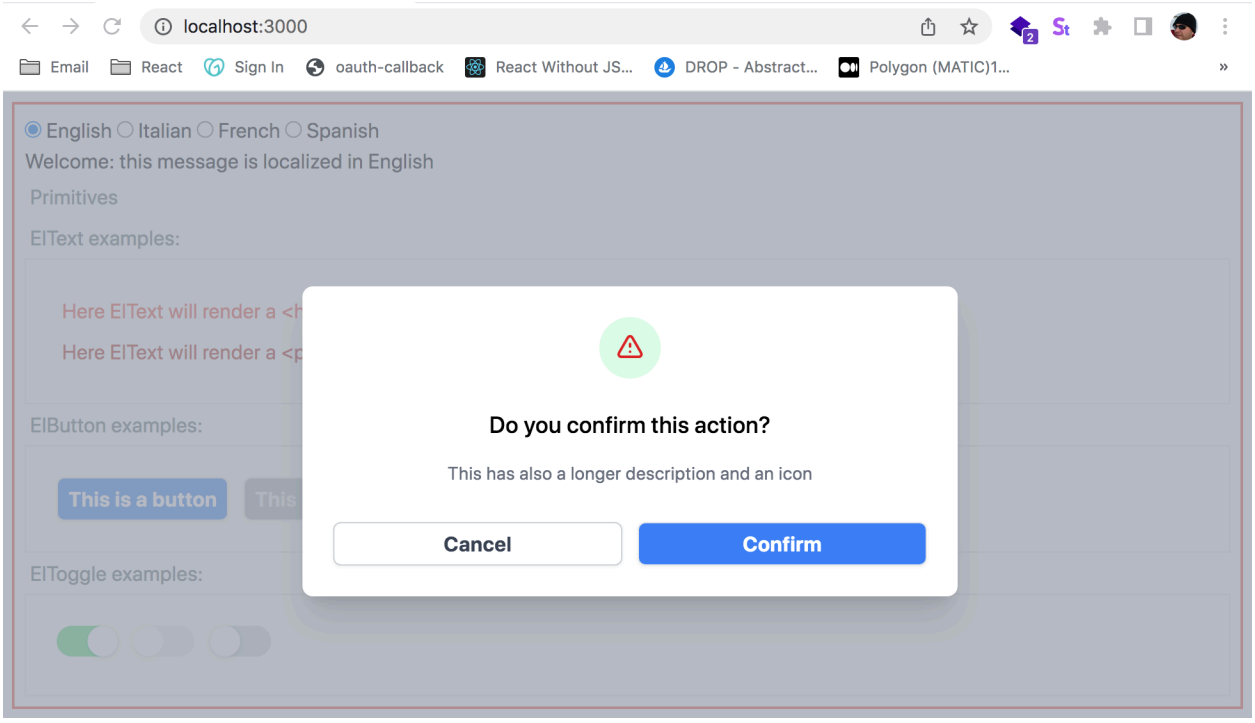
The Modal will block the execution at the await line where we call modal.prompt(). After clicking Ok, you should see it logging "result true" in the console:



If instead you click on Cancel, it will log "result false":

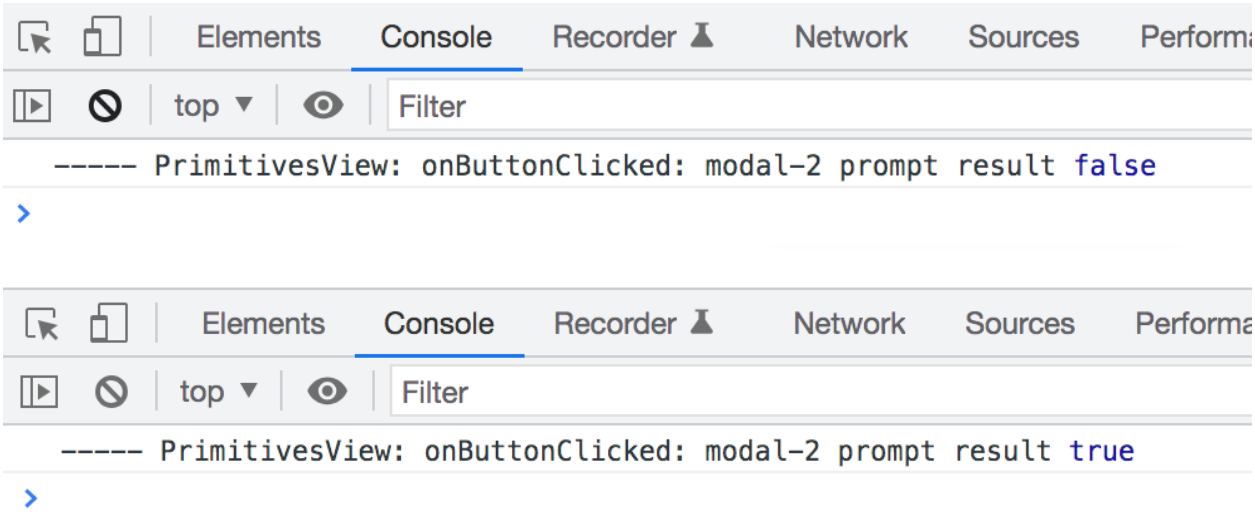


If you click on "**Open modal 2**" button, you will see a modal rendered with the alert icon:



Note: here the Confirm button type is "primary", which is teh default for Modal property "primaryButtonType" when we do not explicitely pass a value for it.

Here too click on Cancel/Confirm and make sure that the console logs "modal-2 result true/false" as well:



Chapter 15 Recap

What We Learned

- We learned how to build a Modal component that leverages some of our previous primitives like ElButton and uses a technique with Promises to block the execution when we invoke modal.prompt() from the consuming code and return true or false once the Promise is resolved by clicking on Cancel or Confirm
- We also learned how to use React.createElement[43] to programmatically render our component, instead of using JSX (in this case to more easily consume the modal through our useModal hook, without having to declaratively add the <ElModal> to our parent component where we consume it)

Observations

- We did not add unit tests against the Modal component

Based on these observations, there are a few improvements that can be done:

Improvements

- You could write unit tests against the Modal component to verify it renders and behaves as expected

[43] https://reactjs.org/docs/react-api.html

Chapter 16 - Higher-level components

Let's now consume the primitives we created so far within the **Item** component.
As we do this, we'll make any additional adjustment we discover necessary.
Finally, if needed, we might be creating additional primitives that we do not have yet (i.e. a list)

Item Component - updates

Let's start by opening the file **src/components/items/children/Item.component.tsx** and observe the current HTML template:

```
// file: src/components/items/children/Item.component.tsx

...

render(): React.ReactNode {
    const { model, testid } = this.props

    return (
      <li data-testid={testid || 'not-set'} className={this.cssClass} onClick={() =>\
 this.handleItemClick(model)}>
        <div className="selected-indicator">*</div>
        <div className="name">{model.name}</div>
      </li>
    )
  }

...
```

There are two elements that can be replaced with our primitives. We could use an **ElToggle** for the selected indicator, and an **ElText** for the name.

First, let's udpate our imports and also add a components block to the component definition that includes ElButton and ElText:

```
// file: src/components/items/children/Item.component.tsx

import * as React from 'react'
// import reference to our interface
import { ItemInterface } from '@/models/items/Item.interface'
// add the following two lines:
import { ElText } from '@/components/primitives/text/ElText'
import { ElToggle } from '@/components/primitives/toggles/ElToggle'

...
```

Then start updating the HTML template as follows:

```
// file: src/components/items/children/Item.component.tsx

...

render(): React.ReactNode {
    const { model, testid } = this.props

    return (
      <li data-testid={testid || 'not-set'} className={this.cssClass} onClick={() =>\
 this.handleItemClick(model)}>
        <div className="selected-indicator">*</div>
        <!-- remove this line: -->
        <div className="name">{model.name}</div>
        <!-- add this line: -->
        <ElText testid={`${testid}-text`} tag="div" text={model.name} />
      </li>
    )
  }

...
```

Run the application and make sure it still renders the list of items without errors.

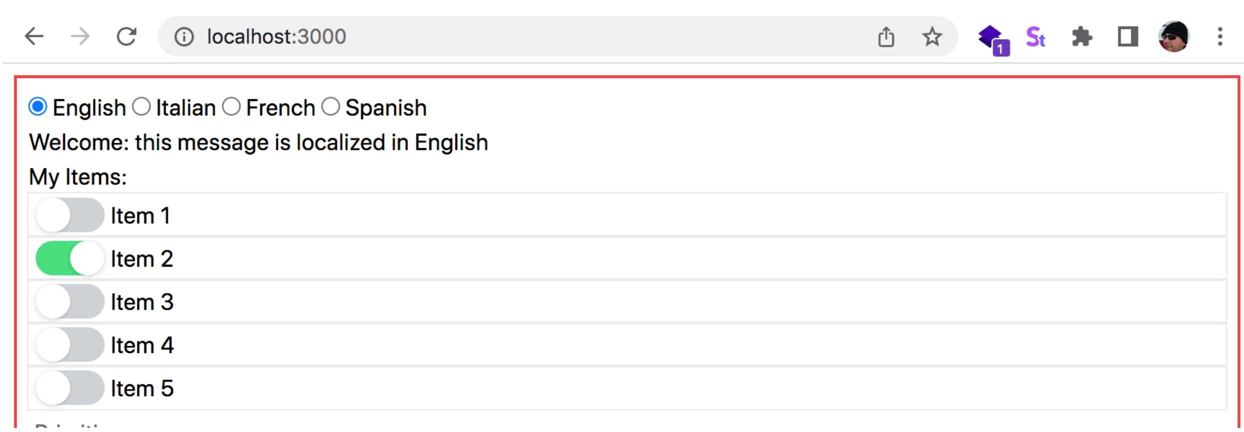
Now let's finish updating the HTML template by replacing the selected indicator with our **ElToggle**:

```
// file: src/components/items/children/Item.component.tsx

...

render(): React.ReactNode {
    const { model, testid } = this.props

    return (
      <li data-testid={testid || 'not-set'} className={this.cssClass} onClick={() =>\
 this.handleItemClick(model)}>
        <!-- remove this line: -->
        <div className="selected-indicator">*</div>
        <!-- add this line: -->
        <ElToggle testid={`${testid}-toggle`} checked={model.selected} />
        <ElText testid={`${testid}-text`} tag="div" text={model.name} />
      </li>
    )
  }

...
```

NOTE: we do not have to handle the onClicked event on the ElToggle here as we are already handling a onClick event on the entire <li> element.

Again, refresh the browser and make sure everything still renders without errors.

It should look currently like this (the layout will be a bit off, so we'll need to tweak the Item component CSS and start using TailwindCSS here as well):



Let's move the toggle to the right side:

```
// file: src/components/items/children/Item.component.tsx

...

      <li data-testid={testid || 'not-set'} className={this.cssClass} onClick={() =>\
 this.handleItemClick(model)}>
        <ElText testid={`${testid}-text`} tag="div" text={model.name} />
        <ElToggle testid={`${testid}-toggle`} checked={model.selected} />
      </li>

...
```

Let's add a new property called isLast that we'll use to better control the border style:

```
// file: src/components/items/children/Item.component.tsx

...

export class ItemComponent extends React.Component<{
  testid?: string
  model: ItemInterface
  isLast?: boolean // <-- add this line
  onItemSelect: (item: ItemInterface) => void
}>

...
```

Modify the logic within the computed **cssClass** property:

```
...
  get cssClass() {
    // begin: remove code block
    let css = 'item'
    if (this.props.model?.selected) {
      css += ' selected'
    }
    // end: remove code block
    // begin: add code block
    let css = 'item flex items-center justify-between cursor-pointer border border-1\
-4 list-none rounded-sm px-3 py-3'
    if (this.props.model?.selected) {
      css += ' font-bold bg-pink-200 hover:bg-pink-100 selected'
```

```
    } else {
      css += ' text-gray-500 hover:bg-gray-100'
    }
    if (!this.props.isLast) {
      css += ' border-b-0'
    }
    // end: add code block
    return css.trim()
  }

...
```

Now, before we proceed, lets remove out all the custom SCSS we wrote at the beginning of this book for the ItemsList and Item component by removing the ul and li css class blocks from the file.

```
/* file: src/tailwind/other.css */

/* start: remove css block */
ul {
  list-style-type: none;
  margin-block-start: 0;
  margin-block-end: 0;
  margin-inline-start: 0px;
  margin-inline-end: 0px;
  padding-inline-start: 0px;
}
li.item {
  padding: 5px;
  outline: solid 1px #eee;
  display: flex;
  align-items: center;
  height: 30px;
  cursor: pointer;
  transition: background-color 0.3s ease;
}
li.item .name {
  margin-left: 6px;
}
li.item .selected-indicator {
  font-size: 2em;
  line-height: 0.5em;
```

```
  margin: 10px 8px 0 8px;
  color: lightgray;
}
li.item.selected .selected-indicator {
  color: skyblue;
}
li.item:hover {
  background-color: #eee;
}
/* end: remove css block*/

... // keep the css classes for the loader: .loader, etc
```

ItemsList Component - updates

We need to do a small update to the ItemsList.component.tsx code as well to pass a value for the new **isLast** property of the Item component. We are going to use the **index** property for this and comparing it against the total number of items. Modify the HTML template as this:

```
// file: src/components/items/ItemsList.component.tsx

...

    <ul>
      {items.map((item, index) => {
        return (
          <ItemComponent
            key={index}
            testid={`items.list.item.${item.id}`}
            model={item}
            <!-- add the following line: -->
            isLast={index === items.length - 1}
            onItemSelect={() => this.handleItemClick(item)}
            ></ItemComponent>
        )
      })}
    </ul>
...
```

NOTE: You will have to update also the unit tests accordingly as they would be now failing. Please see the GitHub repo for the updated unit tests if you need help.

Refresh the browser, and if everything is correct it should render like this:

Summary

Let's reflect a little bit on what we just did. We replaced two HTML elements within the **Item.component.tsx** with our new primitives. By doing this, we effectively "composed" the higher-level component "Item" from those primitives. I hope you start seeing the pattern here. Even though this was a very simple example, the sky is really the limit on how you can better structure your primitives and copose more complex primitives out of those, and ultimately the higher-level components that consume them.

Chapter 16 Recap

What We Learned

- We started to learn how to compose higher-level components by putting together the primitives we created in the previous chapters.

Observations

- We did not leverage localization and internationalization in our primitives.
- We did not write unit tests against our primitives

Based on these observations, there are a few improvements that can be done:

Improvements

- You can add localization and internationalization support through the i18n plugin as shown in other chapters
- You can write unit tests against the primitives to further create a solid foundation for your primitives library

Chapter 17 - Creating Component Libraries

In this chapter we'll leverage Vite to create a component library that can be shared across different projects. Once you know how to create a component library, you could choose to publish it as an NPM package (either public or private) for more easily sharing it between different projects, or across departments in your organization.

When creating a component library, there are different approaches and architecture decision to be made, depending on different factors. One of the main thing to keep in mind is the dependencies that your library will have (i.e. web framework, state, css frameworks, other frameworks, etc).

In this chapter we'll worry about only creating a library with a couple of simple components, we'll learn how to build it and package it and how to consume it into our sample project.

In the next chapter we'll build a more complex component that might require additional things like state etc.

Create my-component-library

To setup the library project, use the terminal and execute the following command (make sure you are at the same level of your my-react-project folder):

```
npm init vite@latest
```

The create-vite wizard will start and will ask you the name of the project. The default is vite-project, so change this to my-component-library and hit enter:

```
? Project name: › my-component-library
```

The second step will ask to select a framework. Use the keyboard arrows to scroll down the list and stop at react, then hit enter:

```
? Select a framework: › - Use arrow-keys. Return to submit.
    vanilla
    vue
❯   react
    preact
    lit
    svelte
```

The third step will asking which "variant" you want o use. Scroll down to **react-ts** (this is for the version that uses TypeScript) and hit enter:

```
? Select a variant: › - Use arrow-keys. Return to submit.
    react
❯   react-ts
```

This will create a folder called **my-component-library** which is also the name of our project. At the end it should display a message similar to this:

```
Scaffolding project in /Volumes/projects/my-component-library...

Done. Now run:

  cd my-component-library
  npm install
  npm run dev
```

The first command will navigate to the current sub-directory called **my-component-library**, the second one will install all the npm dependencies, and we do not need to run the third one in this case.

Now let's clean up a few things. We need to remove a few files that we are not going to need since this is a library, and we'll also need to update the project configuration so that it can correctly build and bundle our library.

Remove obsolete files

Remove the following files as they are not needed in a component library:

- index.html
- src/App.tsx
- src/index.css, src/app.css (or style.css)

- src/main.tsx
- src/assets/logo.svg (or react.svg)

Remove also the public directory and its content

Add main entry index.ts file

Add new new file under src/ called index.ts that will just export everything from the components/ sub-directory

```
// file: src/index.ts

export * from './components'
```

Update vite.config.ts

Update the Vite's config file as follows:

```
// file: vite.config.ts

import { defineConfig } from 'vite'
import react from '@vitejs/plugin-react'
import path from 'path'

// https://vitejs.dev/config/
export default defineConfig({
  plugins: [react()],
  envDir: './src/',
  resolve: {
    alias: {
      '@': path.resolve(__dirname, 'src/')
    },
  },
  build: {
    lib: {
      entry: path.resolve(__dirname, 'src/index.ts'),
      name: "MyComponentLib",
      fileName: (format) => `my-component-lib.${format}.js`,
    },
    rollupOptions: {
      // React should not be bundled with the cmoponent library
```

```
      // tell vite that this is an external dependency
      external: ['react'],
      output: {
        // To expose global variables for use in the UMD builds
        // for external dependencies
        globals: {
          vue: 'React'
        }
      }
    }
  }
})
```

A few things to notice in the config changes above:

- we are telling Vite that the environment directory for the source code is ./src/
- we added a "resolve" block so we can use the @ shortcut to point to src/ and avoid imports with relative paths (i.e. ../../../)
- we added a "build" block, and this is the most important change for setting up the project as a library. Here:
  - we tell Vite which is the main entry file for our library (src/index.ts),
  - set the name of our library to MyComponentLib
  - set the name of the main built files to be `my-component-lib.${format}.js` (where format will be set dynamically to `es` or `umd`)
  - set the rollupOptions so that React will not be bundled with our library (we'll assume this library is consumed in a project that already uses React thus we do not want to include it multiple times)

Finally, let's proceed updating the package.json commands so we can correctly build our library.

Update package.json commands

Update the package.json file. First, make sure we update the following scripts commands so that we can correctly build both JavaScript and the TypeScript types:

```
// file: src/package.json

{
  "name": "my-component-library",
  "version": "0.1.2",
  "scripts": {
    "clean": "rm -rf ./dist; rm -rf my-component-library-0.1.2.tgz; rm -rf ../my-com\
ponent-library-0.1.2.tgz",
    "build-types": "node svelte2tsx.index",
    "build-lib": "vite build",
    "build": "npm run clean && npm run build-lib && npm run build-types",
    "pack": "npm pack; mv my-component-library-0.1.2.tgz ../my-component-library-0.1\
.2.tgz",
    "all": "npm run build && npm run pack",
    "preversion": "npm run clean",
    "version": "npm run build",
    "postversion": "npm run pack",
    "version-patch": "npm version patch -m \"Patch version\""
  }

...
```

The most important thing to notice here is that we have a master command called “all” that will run the build and then the pack command. The pack command is optional and will create a single compressed (tgz) file with all our library code, then copy this up to one directory so we could more easily consume it from our my-vue-project.

The sub-commands run buy the build command are:

- clean: this will just remove the dist/ folder and the previously packed tgx file
- build-types: this will build the TypeScript types declarations
- build-lib: this will build our React library code
- build: this will run the clean + build-lib + build-types sub-commands

We need to also make changes to package.json so that it can correctly build the project as a library. We need to add these sectoins/properties:

- files: this tells which directory is the destinatio for the built JavaScript files (dist in our case)
- types: this indicates the entry file for the TypeScript definitions
- main: this indicates the main entry file for our library (umd module)
- module: this indicates the main entry file for our library (es module)
- exports: this section indicates what our package will export

```
// file: src/package.json

  ...

  "files": [
    "dist"
  ],
  "types": "./dist/src/index.d.ts",
  "main": "./dist/my-component-lib.umd.js",
  "module": "./dist/my-component-lib.es.js",
  "exports": {
    ".": {
      "import": [
        "./dist/my-component-lib.es.js"
      ],
      "require": "./dist/my-component-lib.umd.js"
    },
    "./package.json": "./package.json"
  },

  ...
```

Now let's add a couple of simple components to our library.

Create Counter.tsx component

Create a new file at src/components/counter/Counter.tsx with the following code:

```
// file: src/components/counter/Counter.tsx
import * as React from 'react'

export function Counter() {
  let [count, setCount] = React.useState(0)

  const increment = () => {
    setCount(count + 1)
  }

  return (
    <button onClick={increment}>
      count is {count}
    </button>
```

```
  )
}
```

Create SampleComp.tsx component

Create a new file at src/components/sample-component/SampleComp.tsx with the following code

```
// file: src/components/counter/SampleComp.tsx
import * as React from 'react'

type Props = {
  testid?: string
  text?: string
}

export function SampleComp(props: Props) {
  const testid = props.testid || 'not-set'
  const text = props.text || 'not-set'

  // a computed property to return the css class
  const cssClass = () => {
    return `p-2 border border-green-500`
  }

  return (
    <div data-testid={testid} className={cssClass()}>
      <span>{ text }</span>
    </div>
  )
}
```

Add components/index.ts barrel file

Under components/, add a barrel index.ts file and just export all our components in an organized way:

```
// file: src/components/index.ts

import Counter from './counter/Counter.tsx'
import SampleComp from './sample-component/SampleComp.tsx'

export {
  Counter,
  SampleComp
}
```

Build our library

Now finally run the "build" command (or you could run the "all" command) to compile and build our library:

```
npm run build
```

Consuming our library

To consume our library locally, let's switch now to our my-react-project and install a reference to our library by running this command:

```
npm install -D file:../my-component-library
```

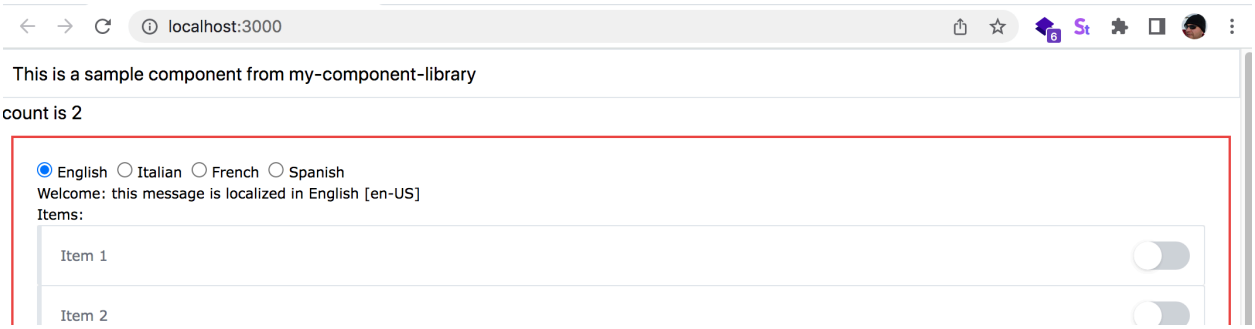
Then open the file **App.tsx** and add the following imports at the top:

```
// file: src/App.tsx
import { Counter, SampleComp } from 'my-component-library'

...
```

In the render section, let's consume our library components:

```
// file: src/App.svelte

...

  return (
    <Provider store={rootStore}>
      <div>
        <SampleComp text="This is a sample component from my-component-library" />
        <Counter />
      </div>

...
```

Save and run the application. If everything worked and there are no errors, you should see something like this in the browser (here shown after I clicked two times on the count button):



Chapter 17 Recap

What We Learned

- We create a new project called my-component-library that will export a couple of simple components
- We then consumed these components in our my-react-project

Observations

- We did not write unit tests against our components within my-component-library
- We did not publish our component library to NPM.
- We did not write more complex components that leverage other dependencies like application state or other libraries

Based on these observations, there are a few more things that can be done:

Improvements

- You can add unit tests within the my-component-library and test your components
- You could keep adding more complex components to your library that use application state or other dependencies

Chapter 18 - Creating a JavaScript library

Similarly to what we discussed in Chapter 17, we can create a library that we can publish as an NPM package that does not necessarily contains React components. This might be a collection of helpers, or a plugin, etc.

As you start building more complex application that will grow to a large code base, it starts to make sense to be more strict about following principles like Single Responsibility and Separation of Concerns[44].

Separating code that can be shared across different applications/projects into its own NPM package has many advantages, and if you publish it as an open-source project with a permissive license, other developers might start using it as well, providing more feedback and reporting or even helping with bugs. This might result in your package growing even stronger as time goes by.

There are a few downsides as well, like having to maintain a separate code base, having to publish a new version whenever you add new functionality or fix a bug.

Unless you are working only on one small application, and/or the code within your NPM package has not utility in other applications (or does not offer much benefits to other developers), usually the advantages will make it worth it to have it as an NPM package.

Create my-js-helpers

We'll create a new project called my-js-helpers by following similar to those as at the beginning of Chapter 17 for my-component-library (just make sure you use the name my-js-helpers this time).

Please note, this chapter will just illustrate how to create a simple NPM package that exposes some simple JavaScript helpers, thus the name my-js-helpers. But, of course, you are welcome to choose whatever name you wish for your NPM package.

One main difference after you run `npm init vite@latest` and set `my-js-helpers` as the name, is to choose `vanilla` for the framework selection:

[44] https://en.wikipedia.org/wiki/Separation_of_concerns

```
? Select a framework: › - Use arrow-keys. Return to submit.
❯   vanilla
    vue
    react
    preact
    lit
    svelte
```

And then `vanilla-ts` for the framework "variant":

```
? Select a variant: › - Use arrow-keys. Return to submit.
    vanilla
❯   vanilla-ts
```

After you are done creating the project and have run "npm install", let's continue by removing unecessary files (similarly to Chapter 17)

Remove obsolete files

Remove the following files as they are not needed in a NPM package:

- favicon.svg
- typescript.svg
- app.css (or style.css)
- index.html
- main.ts
- counter.ts

Remove also the public directory and all its contents.

Add main entry index.ts file

Add new new file under src/ called `index.ts` that export all the source code we want to exposes from our NPM package. In our case, we'll export everything from the sub-directory called `helpers` (which will create in a bit):

```
// file: src/index.ts
export * from './helpers'
```

Update vite.config.ts

Update the Vite's config file similarly to what we did in Chapter 17 (just make sure to replace my-component-library with my-js-library). Here is what it should look like:

```
// file: vite.config.ts

/// <reference types="vitest" />
/// <reference types="vite/client" />

import { defineConfig } from 'vite'
import path from 'path'

// https://vitejs.dev/config/
export default defineConfig({
  plugins: [
  ],
  envDir: './src/',
  resolve: {
    alias: {
      '@': path.resolve(__dirname, 'src/')
    },
  },
  test: {
    globals: true,
    environment: 'jsdom',
    exclude: [
      'node_modules'
    ]
  },
  build: {
    lib: {
      entry: path.resolve(__dirname, 'src/index.ts'),
      name: 'MyJsHelpers',
      fileName: (format) => `my-js-helpers.${format}.js`,
    },
    rollupOptions: {
      external: [],
      output: {
```

```
        // Provide global variables to use in the UMD build
        // Add external deps here
        globals: {
        },
      },
    },
  }
})
```

Update package.json commands

Update the package.json file. First, make sure we update the following scripts commands so that we can correctly build both JavaScript and the TypeScript types:

```
// file: src/package.json

{
  "name": "my-component-library",
  "version": "0.1.2",
  "scripts": {
    "clean": "rm -rf ./dist; rm -rf my-js-helpers-0.1.2.tgz; rm -rf ../my-js-helpers\
-0.1.2.tgz",
    "build-types": "tsc --declaration --emitDeclarationOnly --outDir ./dist",
    "build-lib": "vite build",
    "build": "npm run clean && npm run build-lib && npm run build-types",
    "pack": "npm pack; mv my-js-helpers-0.1.2.tgz ../my-js-helpers-0.1.2.tgz",
    "all": "npm run build && npm run pack",
    "preversion": "npm run clean",
    "version": "npm run build",
    "postversion": "npm run pack",
    "version-patch": "npm version patch -m \"Patch version\""
  }

...
```

And similarly to Chapter 17, lets add additional configuration so that the project will build as a library:

```
// file: src/package.json

  ...

  "files": [
    "dist"
  ],
  "types": "./dist/src/index.d.ts",
  "main": "./dist/my-js-helpers.umd.js",
  "module": "./dist/my-js-helpers.es.js",
  "exports": {
    ".": {
      "import": [
        "./dist/my-js-helpers.es.js"
      ],
      "require": "./dist/my-js-helpers.umd.js"
    },
    "./package.json": "./package.json"
  },

  ...
```

Now let's add a some JavaScript helpers to our NPM package.

random-id

Create the directory `src\helpers\random-id` and inside here add a file called `random-id.ts` (the full location path will be `src/helpers/random-id/random-id.ts`) with the following code:

```
// file: src/helpers/random-id/random-id.ts

export const randomid = (): string => {
  let result: string = ''
  if (typeof window !== 'undefined' && window.crypto && window.crypto.getRandomValue\
s) {
    const array: Uint32Array = new Uint32Array(1)
    window.crypto.getRandomValues(array)
    result = array[0].toString()
  } else {
    // throw error
    // throw Error('Browser does not support window.crypto.getRandomValues')
    // if node, we could use crypto to do the same thing
```

```
    result = require('crypto').randomBytes(5).toString('hex')
  }

  // pad the result with zero to make sure is always the same length (11 chars in ou\
r case)
  if (result.length < 11) {
    result = result.padStart(11, '0')
  }

  return result
}
```

Note: this is a very simple function that leverage the web browser native `crypto` api to generate a rabdin string. If the browser does not support `crypto` (or maybe you want to consume this package in a node.js app), you could either throw an error (commented out in the above code) or leverage node.js crypto library. We also make syre the string is always 11 chars long, and if not we leverage the string `padStart` method to pad the start of the string with zeros

Add also a barrel index.ts file to just export the code from random-id/random-id.ts.

random-id unit tests

Create the directory `src\tests\random-id` and here add a file called `randomid.test.ts` with the following:

```
// file: src/tests/random-id/randomid.test.ts

import { randomid } from '../../helpers'

describe('id', () => {

  it('should return value with expected length', () => {
    const result = randomid()
    expect(result.length).toEqual(11)
  })

  it('should return expected value', () => {
    // testing 10,000 different ids
    const attempts = 10000
    const results = []
    for (let i = 0; i < attempts; i++) {
      const value = randomid()
```

```
      results.push(value)
    }

    const distinctResults = new Set([...results])
    expect(results.length).toEqual(distinctResults.size)
  })
})
```

Here we have a unit test that ensure the result from randomid() is of the expected length, which is 11 chars. We also have a unit test that invokes randomid() ten thousand times and then checks that the distinct results count matches the results count. If these do not match it means that randomid is in some cases returning a non-unique id and thus fail.

Note: we leverage the JavaScript Set to get rid of potential duplicates.[45]

Before we try to run our tests, let's install `vitest` and additional unit-test depedencies we need with `npm install -D vitest @types/jest jsdom` and then add the following 2 new commands to the package.json scripts section:

```
// file: package.json

{
  "name": "@largescaleapps/my-js-helpers",
  "version": "0.1.2",
  "type": "module",
  "scripts": {

    ...

    "test": "vitest run",
    "test-watch": "vitest watch",

    ...
```

Now finally execute the command `npm run test` and it should output something like this:

[45] https://dev.to/soyleninjs/3-ways-to-remove-duplicates-in-an-array-in-javascript-259o

```
iMacRetina:my-js-helpers damiano$ npm run test

> @largescaleapps/my-js-helpers@0.1.2 test
> vitest run

 RUN  v0.19.0 /Volumes/code/large-scale-apps-my-react-project/my-js-helpers

 ✓ src/tests/random-id/randomid.test.ts (2)

Test Files  1 passed (1)
     Tests  2 passed (2)
      Time  3.29s (in thread 65ms, 5063.52%)
```

Build the library

To build the library, just run the command `npm run all` (note this will also pack the library into a compressed file with .tgz extension and we could later consume from there or just by referencing the local directory)

Consuming the my-js-helpers library

Now we have to open the my-react-project and consume our helpers library by referencing it from a local path. The easiest way is to run the following command `npm install -D file:../my-js-helpers`.

Note that we are referencing our helpers library with a relative directory path so it is important that oyu have create the my-js-helpers project at the same level of my-react-project.

To test that we can consume our library without problems, open one of the views, maybe App.tsx, and import a reference to randomid:

```
import {
    randomid
  } from 'my-js-helpers'
```

And then output the value in the UI with some HTML like:

```
<p>[randomid() result (from my-js-helpers): { randomid() }]</p>
```

Or maybe you could add the output to the `text` property of the SampleComp created in the previous chapter:

```
<SampleComp text={`This is a sample component from my-component-library: ${ randomid\
() }`} />
```

The first one will output in the browser something like:

```
[randomid() result (from my-js-helpers): 03627536338]
```

And the second one should output something like this:

```
This is a sample component from my-component-library: 00244391593
```

Chapter 18 Recap

What We Learned

- We created a new project called my-js-helpers that will export an helper method called randomid that returns a unique id value
- We wrote some basic unit tests against our randomid helper function
- We then built this library and consumed it in our my-react-project to display in the UI the value returned by the randomid() helper

Observations

- We did not publish our library to NPM yet.

Based on these observations, there are a few more things that can be done:

Improvements

- In the next chapter will learn how to publish our library to the NPM registry and then consume it from there

Chapter 19 - Publish a library as a NPM package

Publishing to the NPM registry is pretty straigh forward. However, there are many different options like publishing private packages etc that might also interested you. For this, is a good idea to review the official documentation here: https://docs.npmjs.com/packages-and-modules/contributing-packages-to-the-registry.

Here we'll explain only how to publish scoped public packages but will not cover private packages or unscoped packages.

Create an NPM user account

The first step will be for you to create an NPM user account, if you do not already have one. You can do this on the NPM signup page at https://www.npmjs.com/signup. If you need further help with that please see here https://docs.npmjs.com/creating-a-new-npm-user-account

Create an Organization under your NPM profile

To publish a scoped public package, I would suggest to create a fictitious organization that you can use to learn how to publish NPM packages. Once you have mastered this and are more confident, you can better organize your packages under a real organization name or publish them using your NPM username as the scope (which will have to be prefixed with the @ char).

On NPM, once you are logged in, click on your avatar and select "Add Organization +" (alternatively, you can click on Profile, then on the Organizations tab, then on the "+ Add New Organization" button). Enter a name of your choice in the Organization field and click on the Create button next to the "Unlimited public packages" option. In the next screen, where it asks if you want to invite other developers, just click Skip. Your organization is now created and will show under your Profile (Organizations tab).

Update my-js-helpers package.json

We need to scope our library name. In order to do this, you have to add a prefix to the name property in the package.json field follow by a slash character. Here you could either use your NPM username or organization name (note: you have to include the @ char at the beginning):

```
// file: package.json

{
  "name": "@your-org-name/my-js-helpers", // prefix is in the form @username/ or @or\
gname/
  "version": "0.1.21",

  ...
```

Publishing the library

First, you'll have to login to NPM with the command:

```
npm login
```

It will prompt you for username, password and email (careful: this email will be public so feel free to use an email that is different from the one used in the NPM account):

```
npm notice Log in on https://registry.npmjs.org/
Username: yourusername
Password: yourpassword
Email: (this IS public) youremail
```

Note: if you have 2FA (two-factor authentication) setup in NPM, it will also prompt you to enter an OTP code:

```
npm notice Please use the one-time password (OTP) from your authenticator application
Enter one-time password: [yourOtpCode]
```

Now you can publish the my-js-helpers package by first navigating to the root of the my-js-helpers directory, and then execute the command:

```
npm publish --access public
```

If everything goes well, your package will be published on NPM.

Consuming your NPM package

Let's switch back to the my-react-project code.
Here, we'll first uninstall the current local references to the my-js-helpers library:

```
npm uninstall my-js-helpers
```

Then we can install the one form the NPM registry with:

```
npm install -D @your-org-name/my-js-helpers
```

If you run the my-react-project everything should still work as before.

Chapter 19 Recap

What We Learned

- We learned how to publish our library as an NPM package on the NPM registry using a user-scope or organization-scope
- We learned how to install our NPM package from the NPM registry and consume it as we did before when it was installed form the local directory
- We learned how to bump the version of our NPM package and publish a new version on NPM

Observations

- We did not publish the other library we created in Chapter 17 which is a component library (my-component-library)

Based on these observations, there are a few more things that you could try:

Improvements

- You can try to publish also the my-component-library as an NPM package and then consume it from NPM

(More Chapters Coming Soon)

Bonus Chapter - using create-react-app

NOTE: using create-react-app is quickly becoming old and obsolete. I strongly recommend you use Vite going forward, but felt to add here instruction on how to use create-react-app if you are required to do so for some reason.

The package **create-react-app**[46] leverages **Webpack** to setup a development environment. If you want to set set up a React project using webpack instead of Vite, use the terminal and execute the following node.js command:

```
npx create-react-app another-react-app --template typescript
```

Note: we are passing the option `--template typescript` because we want to use TypeScript, not just vanilla JavaScript.

If you do not have the npm package **create-react-app** yet, it might prompt you to install it. In this case, type **y** and then **enter** to proceed:

```
Need to install the following packages:
  create-react-app
Ok to proceed? (y)
```

This will create a folder called **another-react-app** which is also the name of our project, install all the required NPM packages, create the configuration files, and stub some preliminary code (**src/App.tsx**, **src/index.tsx**, etc). While create-react-app is executing, you will see a message like this displayed:

```
Creating a new React app in /volumes/projects/another-react-app.

Installing packages. This might take a couple of minutes.
...
```

After it has completed, it should output a message similar to this:

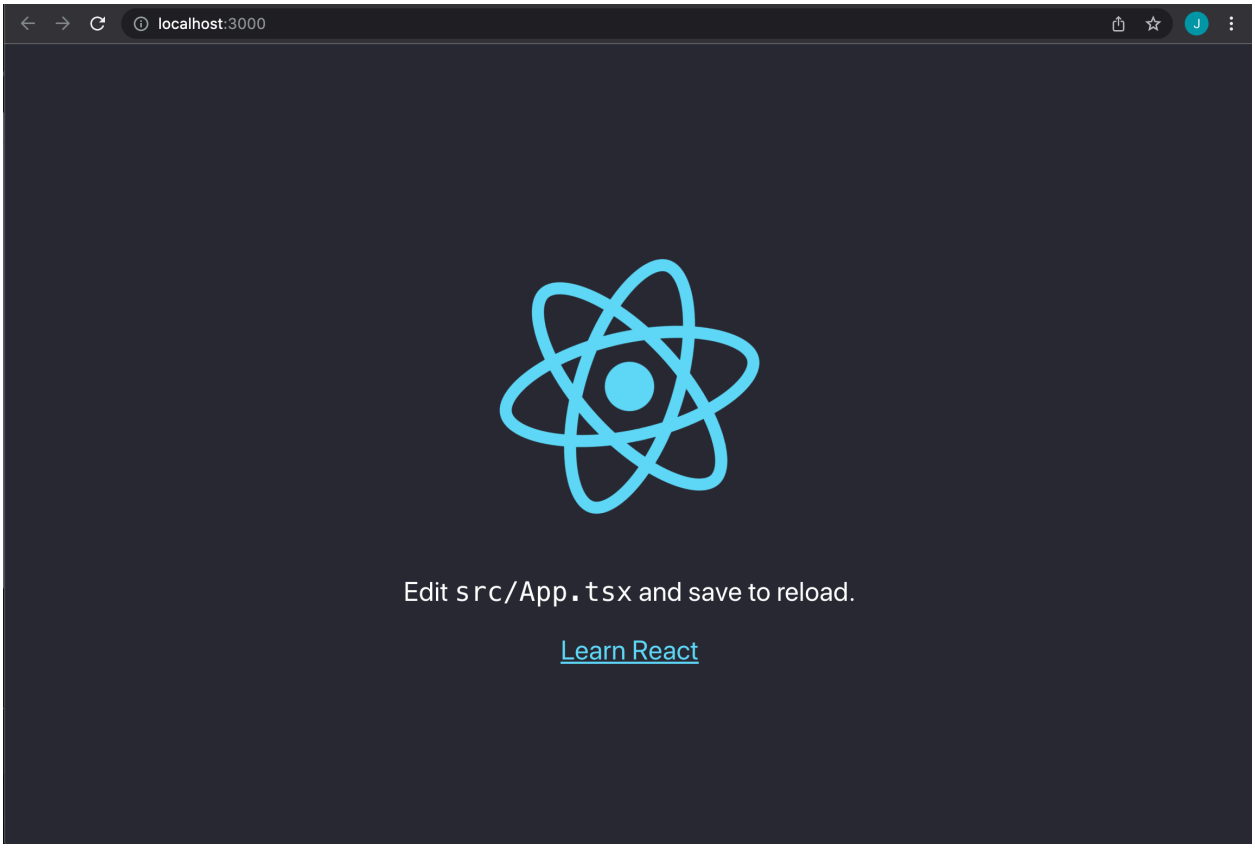
[46] https://github.com/facebook/create-react-app

```
Success! Created another-react-app at /volumes/projects/another-react-app
Inside that directory, you can run several commands:

  npm start
    Starts the development server.

  npm run build
    Bundles the app into static files for production.

  npm test
    Starts the test runner.

  npm run eject
    Removes this tool and copies build dependencies, configuration files
    and scripts into the app directory. If you do this, you can't go back!

We suggest that you begin by typing:

  cd another-react-app
  npm start

Happy hacking!
```

Execute the command `cd another-react-app` and then `npm start`. The first command will navigate to the current sub-directory called **another-react-app**, the second will serve the app. You'll see a message similar to this displayed:

```
cd another-react-app
npm start
```

It should automatically open your web browser and open the address http://localhost:3000/ (if not, please open the browser and navigate to it). You'll see the application being rendered:



Env Variables

NOTE: Keep in mind that the use of environment variables (which we covered in chapter 7 and 9), will differ from when we used vite. You will have to modify the code that loads the config based on process.env.REACT_APP_CONFIG instead of vite' import.meta.dev.VITE_APP_CONFIG)

You will want to install the npm package **cross-env** which allows to set environment variables across different operating systems using the same syntax.

Differences Between Operating Systems

There are some difference between different operating systems in the way we set environment variables in the "scripts" commands of our **package.json** file.

You can see the use of the keyword **export**. This works on **OSX** and **Linux** environment, but **Windows** uses a different keyword and syntax.

For example this command:

```
"start": "export REACT_APP_CONFIG=mock; react-scripts start"
```

On Windows it would have to be converted to this:

```
"start": "set \"REACT_APP_CONFIG=mock\" && react-scripts start"
```

Note how the **export** keyword becomes **set** and the **semi-colon** becomes **&&**. It is also recommended to wrap the **variable=value** expression within escaped quotes, like in **\"REACT_APP_CONFIG=mock\"**

You could add additional shortcuts that are **Windows** specific by prefixing them with **win-** like here fore example:

```
"win-start": "set \"REACT_APP_CONFIG=mock\" && react-scripts start",
```

However, thanks to the **cross-env** package, all we have to do is to update the commands to use the following syntax and stop worrying about specific operating systems:

```
 "start": "cross-env REACT_APP_CONFIG=mock react-scripts start",
 "build": "cross-env REACT_APP_CONFIG=production react-scripts build",
 "test": "cross-env REACT_APP_CONFIG=mock react-scripts test",
```

Just remember to be aware that these differences exists if you do not use something like **cross-env**.

Bonus Chapter - Vitest

Vitest[47] has become popular very quicly recently as makes unit-testing in a Vite app much easier than Jest. Please read more about it on the official website to learn more about its features.

NOTE: Jest has become quite old at this point and hard to work with epecially in Vite as it requires a lot of dependencies and setup. I strongly suggest you keep using Vitest going forward.

Here I am going to guide you on how to replace Jest with Vitest (note that I have already already done this in the book code repository on GitHub).

Remove Jest dependencies and setup files

First, run the following command to remove all jest dependencies we will no longer need:

```
npm uninstall --save jest @testing-library/jest-dom @types/jest ts-jest @types/testi\
ng-library__jest-dom
```

Delete the following directories and files:

- src/jest
- src/jest.config.js
- src/jest.setup.js

tsconfig.json updates

Remove reference to jest types from tsconfig.json compilerOptions:

[47] https://vitest.dev

```
// file: src/tsconfig.json
{
  "compilerOptions": {
    "target": "ESNext",
    "lib": ["DOM", "DOM.Iterable", "ESNext"],
    "types": [
      "vite/client",
      "jest", /* remove this */
      "testing-library__jest-dom"  /* remove this */
    ]

...
```

package.json updates

Remove test commands from package.json scripts section:

```
// file: src/package.json

{
  "name": "my-react-project",
  "version": "0.0.0",
  "scripts": {
    ...
    "test": "jest src", /* remove this line */
    "test:watch": "npm run test -- --watch", /* remove this line */

...
```

Add Vitest

Install Vitest npm package (note here we also install c8 and jsdom as well as user-event from testing-library):

```
npm install --save-dev vitest c8 jsdom @testing-library/user-event
```

tsconfig.json updates

Add references to Vitest types within the tsconfig.json compilerOptions (also ensure that skipLibCheck is set to true:

```
{
  "compilerOptions": {
    "target": "ESNext",
    "lib": ["DOM", "DOM.Iterable", "ESNext"],
    "types": [
      "vite/client",
      "vite/client", /* add this */
      "vitest/globals"  /* add this */
    ],
    "skipLibCheck": true, /* make sure you have this and it is set to true */

...
```

package.json updates

Add new test commands using Vitest within the package.json scripts section:

```
// file: src/package.json

{
  "name": "my-react-project",
  "version": "0.0.0",
  "scripts": {
    ...
    "test": "vitest run", /* add this line */
    "test-watch": "vitest wach", /* add this line */
    "test-coverage": "vitest run --coverage", /* add this line */

...
```

vite.config.js updates

Modify the code within the vite.config.js file. Start by adding 2 references lines, one for vitest and one for vite/client, at thet op of the file:

```
/// <reference types="vitest" />
/// <reference types="vite/client" />

...
```

Then, within the defineComponent section, add **test** section with as this:

```
...

export default defineConfig({
  ...

  test: {
    globals: true,
    environment: 'jsdom',
    exclude: [
      'node_modules'
    ]
  }
})
```

The complete update code within vite.config.js will be this:

```
/// <reference types="vitest" />
/// <reference types="vite/client" />

import { defineConfig } from 'vite'
import react from '@vitejs/plugin-react'

// https://vitejs.dev/config/
export default defineConfig({
  plugins: [react()],
  envDir: './src/',
  resolve: {
    alias: {
      '@/*': './src/*',
    },
  },
  test: {
    globals: true,
    environment: 'jsdom',
    exclude: [
      'node_modules'
    ]
  }
})
```

test-utils code

Add directory **src/test-utils** and within it create file **index.ts**. Here we are going to export all we need in our unit tests from one place, and export also a wrapper around testing-library **render** (customRender) that will avoid having to repeat code in our unit tests:

```
/* eslint-disable import/export */
import { render } from '@testing-library/react'

// return a wrapper to more ea
const customRender = (ui: React.ReactElement, options = {}) =>
  render(ui, {
    // wrap provider(s) here if needed
    wrapper: ({ children }) => children,
    ...options
  })

export * from '@testing-library/react'
export { default as userEvent } from '@testing-library/user-event'
// override render export
export { customRender as render }
```

Unit Tests updates

Finally, we just need to make a few changes to our unit tests.
In general, these changes will mostly be:

- adding directive `@vitest-environment jsdom` (only for .tsx components tests)
- importing "render/screen/fireEvent" from our `test-utils` instead of testing-library
- replacing `jest.fn` with `vitest.fn`
- replacing `jest.spyOn` with `vitest.spyOn`

Item component unit tests updates

Item.rendering.test.tsx updates

Here, modify the beginning by adding a directive to instruct vitest to use the jsdom environment, and also import what we need from our test-utils (render/screen, etc):

```
// file: src/components/items/children/Item.rendering.test.tsx
// directive to instruct vitest to use the jsdom environment:
// @vitest-environment jsdom
// import references to what we need from our test-utils:
import { render, screen } from '../../../test-utils'

...
```

Note: Everything else within the unit test code will stay the same.

Item.behavior.test.tsx updates

Here to, modify the beginning by adding a directive to instruct vitest to use the jsdom environment, and also import what we need from our test-utils (render/fireEvent, etc):

```
// file: src/components/items/children/Item.behavior.test.tsx
// directive to instruct vitest to use the jsdom environment:
// @vitest-environment jsdom
// import references to what we need from our test-utils:
import { render, fireEvent } from '../../../test-utils'

...
```

Also, replace **jest.fn** with **vitest.fn**:

```
// file: src/components/items/children/Item.behavior.test.tsx

...

describe('Item.component: behavior', () => {
  // test our component click event
  it('click event invokes onItemSelect handler as expected', () => {
    const model: ItemInterface = {
      id: 1,
      name: 'Unit test item 1',
      selected: false
    }

    // create a spy function with vitest.fn()
    const onItemSelect = vitest.fn() /* replace jest.fn with vitest.fn here */

...
```

HttpClient unit tests updates

HttpClient.request.get.test.ts updates

Here we need to replace jest.fn with vitest.fn:

```
// file: src/tests/unit/http-client/HttpClient.request.get.test.ts

...
describe('HttpClient: request: get', () => {
  it('should execute get request succesfully', () => {
    // replace jest.spyOn with vitest.spyOn
    vitest.spyOn(axios, 'get').mockImplementation(async () =>
      Promise.resolve({ data: `request completed: ${mockRequestParams.url}` })
    )

...
  it(' get should throw error on rejection', () => {
    // replace jest.spyOn with vitest.spyOn
    vitest.spyOn(axios, 'get').mockImplementation(async () =>

...
```

HttpClient.request.post.test.ts updates

Here too we need to replace jest.fn with vitest.fn:

```
// file: src/tests/unit/http-client/HttpClient.request.post.test.ts

...
describe('HttpClient: request: post', () => {
  it('should execute post request succesfully', () => {
    // replace jest.spyOn with vitest.spyOn
    vitest.spyOn(axios, 'post').mockImplementation(async () =>
      Promise.resolve({ data: `request completed: ${mockRequestParams.url}` })
    )

...
```

The rest of the unit tests (i.e. UrlUtils.getFullUrlWithParams.test.ts, config-files-map.test.ts, config.mock.test.ts, etc) should require no changes.

Run the command `npm run test` to verify that all the unit tests run and succeed.

Naming Conventions

In this book we have been providing some direction on both naming standards for code elements like interface, classes etc, as well as for directory and file names. Here is a detailed description of the standard we followed in this book.

NOTE: These are mostly suggestions, a starting point. You should always agree with your team on the naming conventions and directory structure standards that will work best for your company. Then the whole team should commit to follow those conventions.

Coding Standards

TypeScript any

Avoid using **any** and rather always choose an interface/type/class

Interfaces

Interfaces are named with an **Interface** suffix. For example, an interface representing **Item** will be named **ItemInterface**.

Each interface will be contained in its own file. The file naming convention will be **Item.interface.ts**.

Directory/File Naming and Structure

Directory Names

In general, we'll use lower-case for naming directories. When this contains multiple words, they will be separated by a hyphen (dash). I.e. **order-history**

We try to keep code files organized in directories by category (i.e. **components**, **models**, **plugins**) and sub-directories

Sub-directories are organized by app domain for models, i.e. **models/items**, **models/customers**, **models/order-history**, **models/locales** etc

For components, they are organized by component domain or functionality, i.e. **components/items**, **components/locales**, **components/order-history** etc.

In general, if a model or a component is used across all domains, then the sub-directory name is **shared** (or **common** if you prefer), i.e. **components/shared**

Primitive components will be under the directory **primitives** (src/primitives).

File Names

In general, files will be named with a pascal-case convention, I.e. **OrderHistory.ts**

Barrel files will always be named **index.ts** (all lower case)

Files that export one instance of a class, or serve as a provider/factory will be also named **index.ts** (as long as the folder in which they are contained specify the domain/rea name, i.e. **http-client/index.ts**)

Interface File Names

Files containining interfaces will follow the convention **[Name].interface.ts**, i.e. **Item.interface.ts**.

Components File Names

Higher-order components files will be under **src/components** directory. Their names follow the convention **[ComponentName].component.tsx**. I.e. **ItemsList.component.tsx**

Primitive components will be under **src/primitives**. Their names follow the convention **El[ComponentName].tsx**. I.e. **ElButton.tsx**, **ElTextbox.tsx**, etc

Views/Pages File Names

Views files will be under **src/views** directory.
Their names follow the convention **[ViewName].tsx** (*NOTE: in **React**, everything is really a component, including views. The separation is mostly for organization purposes. The way we consume views and components differs and we talk more about this throughout the book*).

Unit Tests file names

For unit tests, we'll follow the convention **[ClassOrComponentBeingTested].test.ts(x)**. I.e. **ItemsList.test.ts(x)** *(NOTE that test against models/classes will be stored under tests/unit directory, while a test against a component will be located where each corresponding component is)*

NOTE: If you have to write many unit tests against the same class or component to test specific areas (i.e. security, permissions etc) might be a good idea to also split the code into additional

files named with additional suffixes (as long as you adopt a standard that makes sense and it's easy to follow).

This could be a convention to follow in that case: **[ClassOrComponentBeingTested].[area-tested].[condition].[value].test.ts** and here are a couple of examples:

- **ItemsList.permissions.view.no.ts** (to test when user does not have View permisions)
- **ItemsList.permissions.view.yes.ts** (to test when user has View permisions)

Directory src

Contains the **React** source code

- src/assets: contains static assets like image files etc (organized in further sub-directories)

src/api: contains the API clients implementations

- **src/api/mock**: contains the API clients that return mock data
- **src/api/live**: contains the API clients that communicate with the live API end-points

src/components: contains the higher order components (while primitives are within a sub-directory)

- **src/components/[lowercase-component-name]**: directory contains all the files that make up a specific component. I.e. **src/components/items**
  - **src/components/[lowercase-component-name]/children**: contains all the sub-components, if any, consumed only by our main component. I.e. **src/components/items/children** *(NOTE: this is not a strict requirement. Might have multiple sub-directory at the same level as children with more specific names for more complex component that have many child components)*

src/components/primitives: contains all the primitives (i.e. buttons, inputs, etc) organized in sub-directories by families:

- buttons
- icons
- etc // add more directories as you keep building your primitives foundation

src/models: contains all the pure TypeScript interface/types/classes/models/etc (extension .ts)

- **src/models/[domain]**: contains all the interfaces/classes/etc that are related to a particular domain, I.e. **items**

src/store: contains the state manager implementation

- **src/store/[domain]**: contains the store module implementation for a specific domain, I.e. **items**

src/views: contains all the views, except for the **App.tsx** which is located directly under **src/**

Directory tests/unit

Contains all the unit tests that are not for components. (each component unit test will be located at the same level of the corresponding component)

- **tests/unit**: contains the unit tests against TypeScript models (not components) organized in sub-directories by domain/area or however you see fit

Resources

Websites

Official React Website:
https://reactjs.org

React testing library:
https://testing-library.com/docs/react-testing-library/intro/

Official TailwindCSS Website:
https://tailwindcss.com

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