

Developing SPAs with React and JSX/TSX



Agenda

- Getting Started with React.js
- Creating SPAs using React.js, TypeScript and Webpack
- Designing a React Component Hierarchy
- Extending a React Project with the React Router
- Understanding the React Component Lifecycle Methods
- Calling Across the Network using the Fetch API



Introducing React

- React is a library for building user interfaces
 - Not as all-encompassing as a framework like Angular
 - Focused on building HTML-based user experiences
 - Based on reusable component-based architecture
 - Components *react* to state changes by updating UI
 - React uses shadow DOM for efficient event handling
- React was originally designed for Facebook
 - Also a good fit for building SPFx web parts



Hello World with React.js

- Obtain the React library with npm or from a CDN
 - `npm install react --save`
 - `npm install react-dom --save`

```
<> SimpleReactApp.html x
1  <!DOCTYPE html>
2  <html>
3  <head>
4    <meta charset="utf-8" />
5    <title>Simple React App</title>
6  </head>
7  <body>
8
9    <div id="app">
10     <!-- this is where your app renders -->
11   </div>
12
13   <!-- React Libraries -->
14   <script src="https://cdnjs.cloudflare.com/ajax/libs/react/15.5.4/react.min.js"></script>
15   <script src="https://cdnjs.cloudflare.com/ajax/libs/react/15.5.4/react-dom.min.js"></script>
16
17   <script>
18     var reactComponentent = React.DOM.h1(null, "Hello, React!");
19     var target = document.getElementById("app");
20     ReactDOM.render(reactComponentent, target);
21   </script>
22
23 </body>
24 </html>
```

Hello, React!



React versus ReactDOM

- **React** and **ReactDOM** are separate libraries
 - **React** (**react.js**) is the primary library used to build out user experiences
 - **ReactDOM** (**react-dom.js**) is used to render **React** user experience in the browser
- **React** library exposes global **React** object
 - **React** object is the main entry point into React API
 - **React.DOM** wraps standard HTML elements
- **ReactDOM** library exposes global **ReactDOM** object
 - **ReactDOM** object used to render React components on web page

```
var reactComponent = React.DOM.h1(null, "Hello, React!");  
  
var target = document.getElementById("app");  
  
ReactDOM.render(reactComponent, target);
```



React Component Created Using ES5

- React component can be created using EcmaScript 5
 - React component definition created using **React.createClass**
 - React component must be defined with **render** method
 - React component can be instantiated with **React.createElement**

```
var myComponent = React.createClass({
  render: () => {
    return React.DOM.h1(null, "Hello React!")
  }
});

ReactDOM.render(
  React.createElement(myComponent),
  document.getElementById("app")
);
```



Initializing Element Properties

- Elements created using properties object
 - Object properties used to initialize element properties
 - Use **className** instead of **class** to assign CSS class
 - Use **htmlFor** instead of **for** to define HTML label

```
render: () => {  
  
  var elementProperties = {  
    id: "myElementId",  
    className: "myCssClass"  
  };  
  
  return React.DOM.h1( elementProperties , "Hello React!");  
}
```



Initializing Element Styles

- Elements styles initialized using style object
 - style must be defined using an object not a string
 - CSS properties referenced using camel casing

```
render: () => {  
  
  var elementProperties = {  
    id: "myElementId",  
    style: {  
      backgroundColor: "yellow",  
      borderStyle: "Solid",  
      borderColor: "green",  
      padding: 8,  
      color: "Blue",  
      fontSize: 48  
    }  
  };  
  
  return React.DOM.h1( elementProperties , "Hello React!");  
}
```



React Provides Synthetic Events

- Replaces standard DOM-based event handling
 - React creates virtual DOM for elements in component
 - React interacts with real DOM when required
 - Provides faster event registration and processing
 - No need to write browser-specific code

```
private incrementCounter() {  
    var previousCount: number = this.state.count;  
    this.setState({ count: previousCount + 1 });  
}  
  
public render(): React.ReactElement<IBeanCounterProps> {  
    return (  
        <div className={styles.beanCounter}>  
            <h3>Mr Bean Counter</h3>  
            <div className={styles.toolbar}>  
                <button onClick={(event) => { this.incrementCounter(); }} >Add another Bean</button>  
            </div>  
            <div className={styles.beanCounterDisplay} >  
                Bean Count: {this.state.count}  
            </div>  
        </div>  
    );  
}
```



Understanding JSX (and TSX)

- JSX provides better syntax for HTML composition
 - JSX allows extends JavaScript with XML-like syntax
 - JSX syntax must be transpiled into JavaScript code

```
var myHtml = <div id="myAppContainer" style={{ backgroundColor:"yellow", padding:8 }}>
    <h2>Hello JSX</h2>
    <p>I'm composing HTML elements using JSX syntax.</p>
</div>;

ReactDOM.render( myHtml , document.getElementById("app") );
```

- JSX/TSX is separate from React library
 - JSX/TSX commonly used in React development
 - Babel compiler used to transpile JSX to JavaScript
 - TypeScript compiler used to transpile TSX to JavaScript



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Defining React Components using TypeScript

- Component is class extending `React.Component`
 - Component usually defined in its own **tsx** file
 - Component class must define **render** method

```
my-component.tsx •
import * as React from 'react';

export class MyComponent extends React.Component<any, any> {
  render() {
    return <h2>Hello from my component</h2>;
  }
}
```

- Component can be instantiated with JSX/TSX syntax

```
app.tsx •
import * as ReactDOM from 'react-dom';

import { MyComponent } from './components/my-component'

window.onload = () => {
  // Create and render component
  ReactDOM.render( <MyComponent/>, document.getElementById("app") );
}
```



Component Properties and State

- Component can contain properties and state
 - Properties are initialized by external components
 - Properties are read-only to hosting component
 - State is set internally by hosting component
 - Changing state triggers UI refresh by calling render
 - UI experience created by ***reacting*** to changes in state



React Component Properties

- Defining component with a property

```
component1.tsx •  
  
import * as React from 'react';  
  
export interface MyCustomProps {  
  Name: string;  
}  
  
export class Component1 extends React.Component<MyCustomProps, {}> {  
  render() {  
    return <div>Hello, my name is {this.props.Name}</div>;  
  }  
}
```

- Instantiating component with a property

```
ReactDOM.render(  
  <Component1 Name="Fred" />,  
  document.getElementById("app")  
)
```



Stateful Component

TS IBeanCounterProps.ts •

```
export interface IBeanCounterProps {  
  StartingValue: number;  
}
```

TS IBeanCounterState.ts •

```
export interface IBeanCounterState {  
  count: number;  
}
```

BeanCounter.tsx •

```
import * as React from 'react';  
import styles from './BeanCounter.module.scss';  
import { IBeanCounterProps } from './IBeanCounterProps';  
import { IBeanCounterState } from './IBeanCounterState';  
  
export default class BeanCounter extends React.Component<IBeanCounterProps, IBeanCounterState> {  
  constructor(props: any) {  
    super(props);  
    this.state = { count: this.props.StartingValue };  
  }  
  
  private incrementCounter() {  
    var previousCount: number = this.state.count;  
    this.setState({ count: previousCount + 1 });  
  }  
}
```



Stateful Component Rendering

BeanCounter.tsx •

```
import * as React from 'react';
import styles from './BeanCounter.module.scss';
import { IBeanCounterProps } from './IBeanCounterProps';
import { IBeanCounterState } from './IBeanCounterState';

export default class BeanCounter extends React.Component<IBeanCounterProps, IBeanCounterState> {

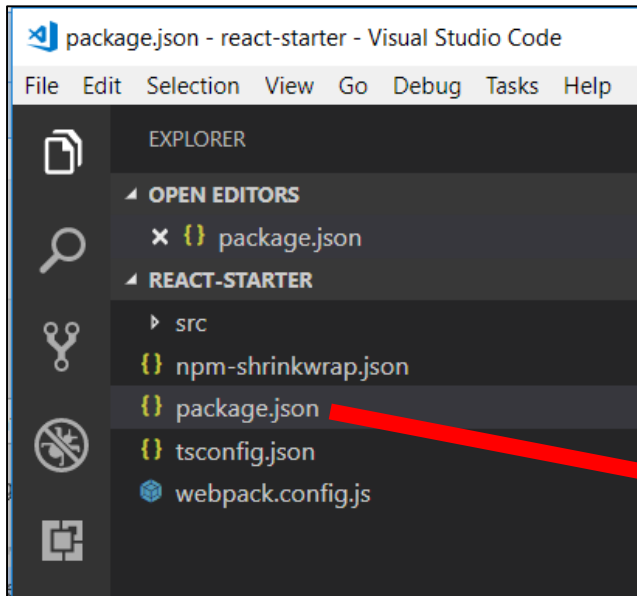
  constructor(props: any) {
    super(props);
    this.state = { count: this.props.StartingValue };
  }

  private incrementCounter() {
    var previousCount: number = this.state.count;
    this.setState({ count: previousCount + 1 });
  }

  public render(): React.ReactElement<IBeanCounterProps> {
    return (
      <div className={styles.beanCounter}>
        <h3>Mr Bean Counter</h3>
        <div className={styles.toolbar}>
          <button onClick={(event) => { this.incrementCounter(); }} >Add another Bean</button>
        </div>
        <div className={styles.beanCounterDisplay} >
          Bean Count: {this.state.count}
        </div>
      </div>
    );
  }
}
```

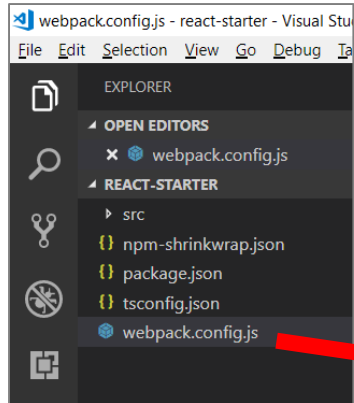


Starter Project - package.json



```
{ package.json •
{
  "name": "react-starter",
  "version": "1.0.0",
  "description": "",
  "main": "index.js",
  "scripts": {
    "build": "webpack",
    "start": "webpack-dev-server --open --history-api-fallback"
  },
  "devDependencies": {
    "@types/react": "^16.4.13",
    "@types/react-dom": "^16.0.7",
    "awesome-typescript-loader": "^5.2.0",
    "bootstrap": "^4.1.3",
    "clean-webpack-plugin": "^0.1.19",
    "copy-webpack-plugin": "^4.5.2",
    "css-loader": "^0.28.11",
    "expose-loader": "^0.7.5",
    "file-loader": "^1.1.11",
    "html-webpack-plugin": "^3.2.0",
    "jquery": "3.3.1",
    "popper.js": "1.14.4",
    "react": "^16.4.2",
    "react-dom": "^16.4.2",
    "style-loader": "^0.21.0",
    "typescript": "3.0.1",
    "url-loader": "1.0.1",
    "webpack": "4.16.4",
    "webpack-cli": "3.1.0",
    "webpack-dev-server": "3.1.5"
  }
}
```

Starter Project - webpack.config.js



```
webpack.config.js x

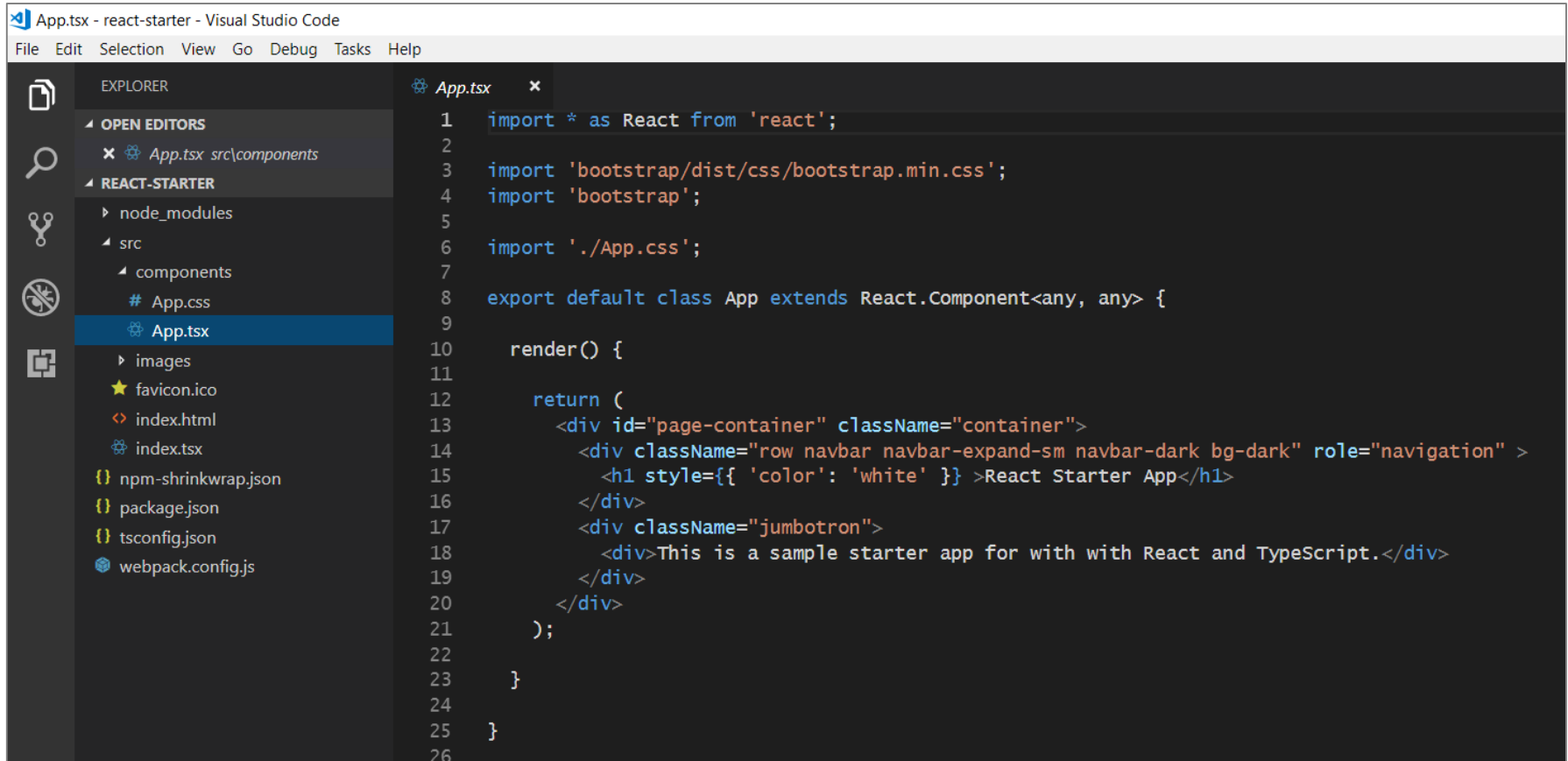
const path = require('path');

const HtmlWebpackPlugin = require('html-webpack-plugin');
const CopyWebpackPlugin = require('copy-webpack-plugin');
const CleanWebpackPlugin = require('clean-webpack-plugin')

module.exports = {
  entry: './src/index.tsx',
  output: {
    filename: 'scripts/bundle.js',
    path: path.resolve(__dirname, 'dist'),
  },
  resolve: {
    extensions: ['.js', '.json', '.ts', '.tsx'],
  },
  plugins: [
    new CleanWebpackPlugin(['dist']),
    new HtmlWebpackPlugin({ template: path.join(__dirname, 'src', 'index.html') }),
    new CopyWebpackPlugin([{ from: './src/favicon.ico', to: 'favicon.ico' }])
  ],
  module: {
    rules: [
      { test: /\.ts|tsx$/, loader: 'awesome-typescript-loader' },
      { test: /\.css$/, use: ['style-loader', 'css-loader'] },
      { test: /\.(png|jpg|gif)$/, use: [{ loader: 'url-loader', options: { limit: 8192 } }] }
    ],
  },
  mode: "development",
  devtool: 'source-map',
  devtool: 'cheap-eval-source-map'
};
```



The Top-level App Component

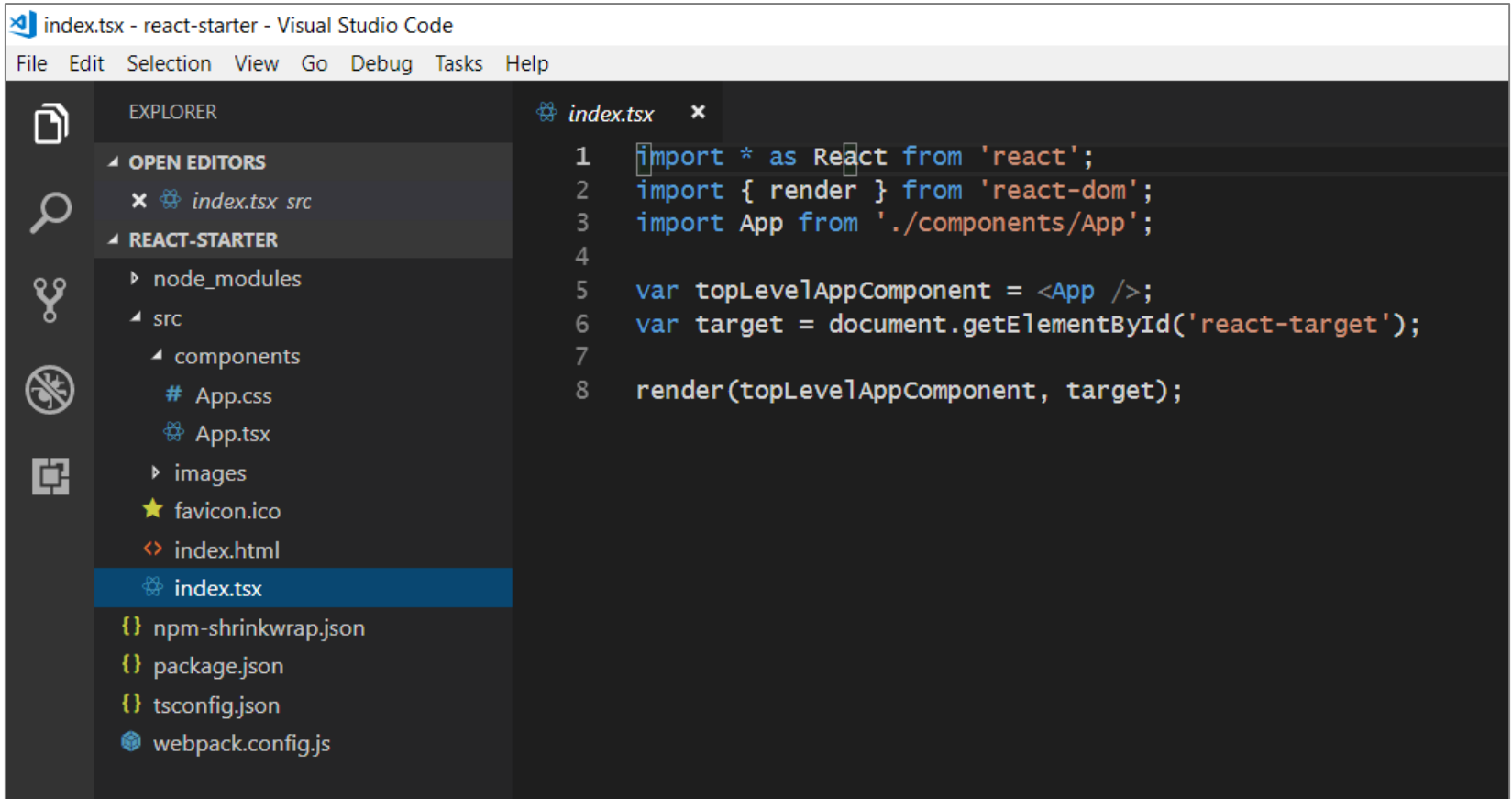


The screenshot shows the Visual Studio Code editor with the 'App.tsx' file open. The Explorer sidebar on the left shows the project structure, including 'node_modules', 'src', 'components', and 'App.css'. The main editor area displays the following TypeScript code:

```
1 import * as React from 'react';
2
3 import 'bootstrap/dist/css/bootstrap.min.css';
4 import 'bootstrap';
5
6 import './App.css';
7
8 export default class App extends React.Component<any, any> {
9
10   render() {
11
12     return (
13       <div id="page-container" className="container">
14         <div className="row navbar navbar-expand-sm navbar-dark bg-dark" role="navigation" >
15           <h1 style={{ 'color': 'white' }} >React Starter App</h1>
16         </div>
17         <div className="jumbotron">
18           <div>This is a sample starter app for with with React and TypeScript.</div>
19         </div>
20       </div>
21     );
22   }
23 }
24
25 }
```



Bootstrapping the App Component



The screenshot shows the Visual Studio Code editor with a file explorer on the left and a code editor on the right. The file explorer displays the project structure for a React starter, including folders like node_modules, src, components, images, and files like index.html, index.tsx, and various configuration files. The code editor shows the content of index.tsx, which imports React and ReactDOM, and renders the App component into a target element with the ID 'react-target'.

```
index.tsx - react-starter - Visual Studio Code
File Edit Selection View Go Debug Tasks Help

EXPLORER
├─ OPEN EDITORS
│   └─ index.tsx src
├─ REACT-STARTER
│   ├── node_modules
│   └─ src
│       ├── components
│       │   ├── App.css
│       │   └─ App.tsx
│       ├── images
│       ├── favicon.ico
│       ├── index.html
│       └─ index.tsx
├─ npm-shrinkwrap.json
├─ package.json
├─ tsconfig.json
└─ webpack.config.js

index.tsx
1 import * as React from 'react';
2 import { render } from 'react-dom';
3 import App from './components/App';
4
5 var topLevelAppComponent = <App />;
6 var target = document.getElementById('react-target');
7
8 render(topLevelAppComponent, target);
```

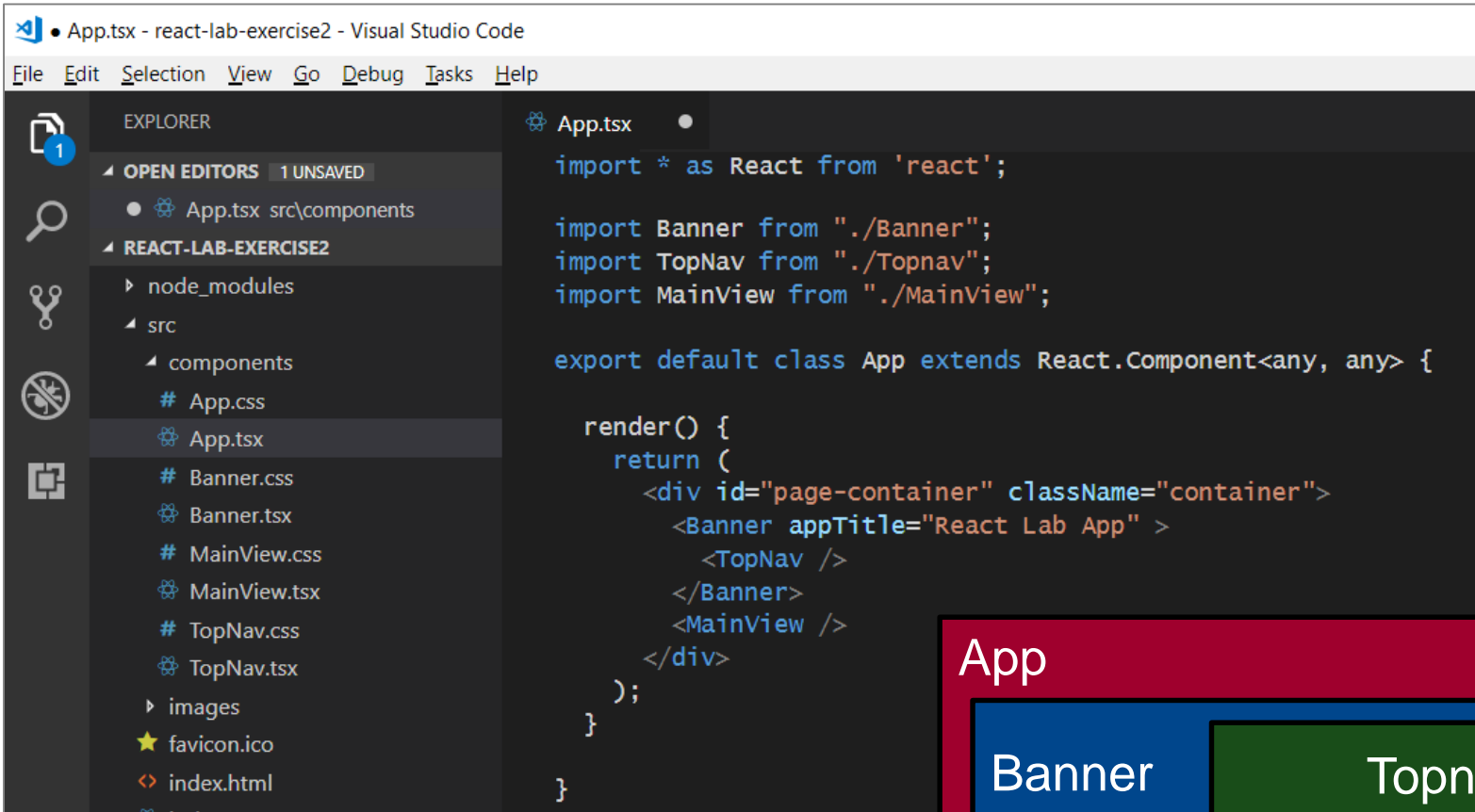


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React Component Hierarchies



The screenshot shows the Visual Studio Code interface with the file `App.tsx` open. The Explorer sidebar on the left displays the project structure, including the `src` directory and its subdirectories `components` and `images`. The `App.tsx` file is selected in the Explorer. The main editor area shows the code for `App.tsx`, which imports `React`, `Banner`, `TopNav`, and `MainView` from their respective files. The `render` method returns a JSX element that renders the `Banner` and `MainView` components, with the `TopNav` component nested inside the `Banner` component.

```
import * as React from 'react';

import Banner from './Banner';
import TopNav from './Topnav';
import MainView from './MainView';

export default class App extends React.Component<any, any> {

  render() {
    return (
      <div id="page-container" className="container">
        <Banner appTitle="React Lab App" >
          <TopNav />
        </Banner>
        <MainView />
      </div>
    );
  }
}
```

App

Banner

Topnav

MainView

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React Router

- Used to create route map in single page application (SPA)
 - Installed as a pair of npm packages
`npm install react-router @types/react-router --save-dev`
`npm install react-router-dom @types/react-router-dom --save-dev`
- Router must be added in as top-level component above App

```
index.tsx x
import * as React from 'react';
import { render } from 'react-dom';
import App from './components/App';
import { HashRouter } from 'react-router-dom';

var topLevelAppComponent =
  <HashRouter>
    <App />
  </HashRouter>;

var target = document.getElementById('react-target');

render(topLevelAppComponent, target);
```




Using React Router

- Import Route and Switch components

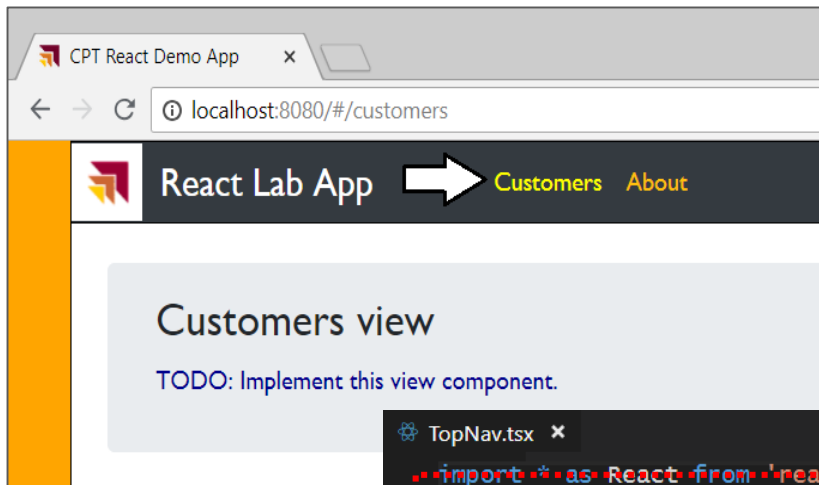
```
import * as React from 'react';  
import { Route, Switch } from 'react-router-dom';
```

- Create route map in HTML output

```
export default class App extends React.Component<any, any> {  
  
  render() {  
  
    return (  
      <div id="page-container" className="container">  
        <Banner appTitle="React Lab App" >  
          <TopNav />  
        </Banner>  
        <Switch>  
          <Route path="/" exact component={ViewHome} />  
          <Route path="/customers" component={ViewCustomers} />  
          <Route path="/about" component={ViewAbout} />  
        </Switch>  
      </div>  
    );  
  }  
}
```



Creating Route Links



```
TopNav.tsx x
import * as React from 'react';
import { Link, NavLink } from 'react-router-dom';
import './TopNav.css';

export default class TopNav extends React.Component<any, any> {

  render() {
    return (
      <div id="top-nav" className="navbar-collapse collapse" >
        <nav>
          <ul className="nav navbar-nav" >
            <li className="nav-item" >
              <NavLink exact to="/" className="navbar-link" activeClassName="active-nav-link" >
                Home
              </NavLink>
            </li>
            <li className="nav-item" >
              <NavLink to="/customers" className="navbar-link" activeClassName="active-nav-link" >
                Customers
              </NavLink>
            </li>
          </ul>
        </nav>
      </div>
    );
  }
}
```

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Component Lifecycle

- `componentWillUpdate`
 - executed before component is rendered
- `componentDidUpdate`
 - executed after component is rendered
- `componentWillMount`
 - executed before node is added to the DOM
- `componentDidMount`
 - executed after node is added to the DOM
- `componentWillUnmount`
 - executed before node is removed from the DOM
- `shouldComponentUpdate(newProps, newState)`
 - executed before component is updated



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Calling a Web Service using the Fetch API

```
getCustomers(): Promise<ICustomer[]> {  
  const restUrl =  
    "http://subliminalsystems.com/api/Customers/?" +  
    "$select=CustomerId,LastName,FirstName,EmailAddress,WorkPhone,HomePhone,Company" +  
    "&$filter=(CustomerId+1e+12)&$top=200";  
  return fetch(restUrl)  
    .then(response => response.json())  
    .then(response => {  
      console.log(response.value);  
      return response.value;  
    });  
}
```

```
getCustomer(customerId: string): Promise<ICustomerDetail> {  
  const restUrl = "http://subliminalsystems.com/api/Customers(" + customerId + ")";  
  return fetch(restUrl)  
    .then(response => response.json())  
    .then(response => {  
      console.log(response);  
      return response;  
    });  
}
```



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