
CSE 331

Software Design & Implementation

Spring 2022

Section 8 – HW8 & React

Administrivia

- Midterm grades released yesterday
 - Received a low score on the midterm and worried about not passing? If you submit all of the assignments and receive reasonable scores on all of them, there is **no risk at all** of failing this course.
- HW7 due tonight!
 - Make sure to tag right!
- HW8 due next Thursday (11 PM)
 - No Gitlab pipeline, but you still need to tag!
 - No re-runs (no staff tests). It's your responsibility to check that your submission runs **without any compilation errors!**

Agenda

- Overview of HW8 – “Draw Lines”
- React examples
- Using Leaflet for Maps in React



Priyal goyash moody



Tomorrow · 🌸

What's difference between Java and JavaScript ?

👍😂 1.2k



Like



Share



Jay Prakash

It is like "car and carpet".

Like · Reply

210 😂👍



Faisal

It's like "moon and honeymoon".

Haha · Reply

2.3k 😂👍



Node and NPM

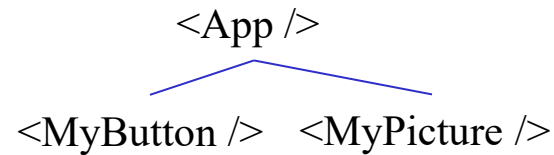
- Used to manage our React development environment
- Install Node.js: <https://nodejs.org/en/>
 - This will also install NPM
- Install the LTS version (**not** the **current** version)
 - Windows Users: Make sure you “Add to PATH” (should be automatically selected by default)
 - MacOS Users: may get a warning about the installer not coming from a “verified developer.”
To resolve this, open System Preferences and navigate to Security & Privacy > General. There, you'll be able to click “Open” to run the Node/NPM installer.

React (JavaScript library)

- React (also known as React.js or ReactJS) is an open-source front-end JavaScript library
- React code is made of entities called components, which allow you to implement different UI in different classes
 - Think of a component like a synthetic HTML tag
- Allow direct addition of HTML to the code
- Check HTML syntax (refer to the lecture material for this)

React Components

- Each component has a render method to determine what it looks like on the page



- Components form a tree:
- Components can have **state**, which is local information used for rendering
- Components can receive information from its parent using **props**
 - Use functions as props as **callbacks**

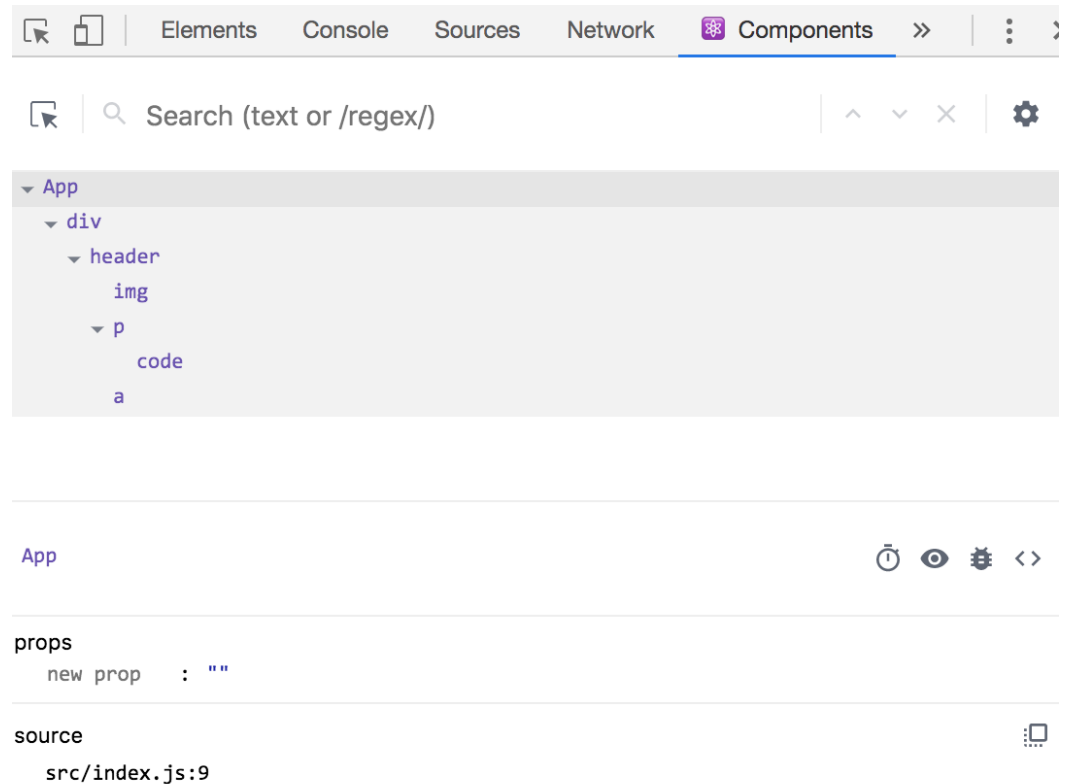
React Components

```
<MyComponentName value={"Hello World"}  
  onChange={() => doSomething()} />
```

- **MyComponentName** is the name of your component/class
- In this case, the **props** are **value** and **onChange**
- **onChange** takes in a function, which we call a **callback**
 - this is how we can pass information up the tree, from a child to a parent

React Developer Tools

- You should download the [React Developer Tools](#)!
- This is a Chrome/Edge extension that allows you to view additional details about your React app

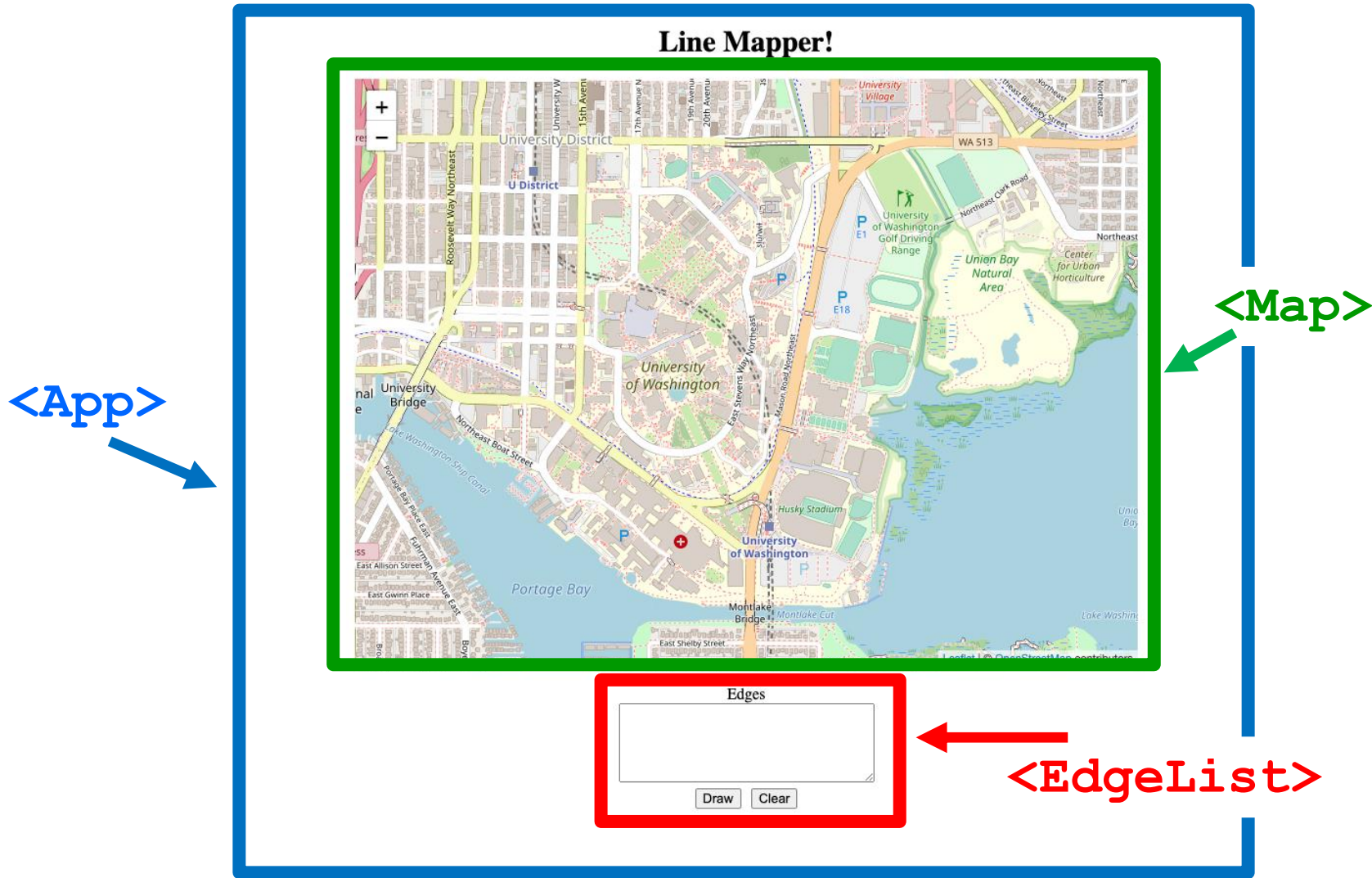


HW8

HW8 Overview

- Draw lines on a map in React
- Starter code has (most of) the pieces, but not much functionality.
 - Lots of hard-coded values, placeholders (`console.log` instead of doing stuff), etc..
- Your job: "wire all the pieces together"
 - Accept user input
 - Process/parse the data
 - Error check – users do weird stuff, make sure you can't crash
 - Move data between components as necessary
 - Add the actual functionality in response to user input.
- Structure:
 - Top-level `<App>` component, with two child components.

HW8 Component Structure



Running a React App

npm: Similar to gradle, but we need to install manually the first time.

In the terminal, change directory until you're in the same place as the "**package.json**" file for the project you want to run.

To Install (first time): **npm install**

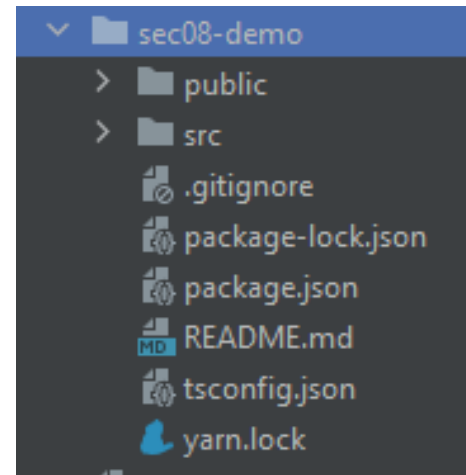
To Run (every time): **npm start**

Once started, you can edit and save files and the page will automatically reload – no need to restart. Use Control-C to shut down when you're done developing.

Section Demo

Running The Section Demo

- Download and unzip the section demo.
- IntelliJ: File > Open...



- From the IntelliJ terminal:
 - `npm install`

- Success!
(These warnings are **normal**).

```
added 1820 packages from 770 contributors and audited 1829 packages in 344.443s

159 packages are looking for funding
  run `npm fund` for details

found 41 vulnerabilities (2 low, 12 moderate, 13 high, 14 critical)
  run `npm audit fix` to fix them, or `npm audit` for details
```

Running The Section Demo

- After installation finishes, run `npm start`
- A browser window should open up automatically

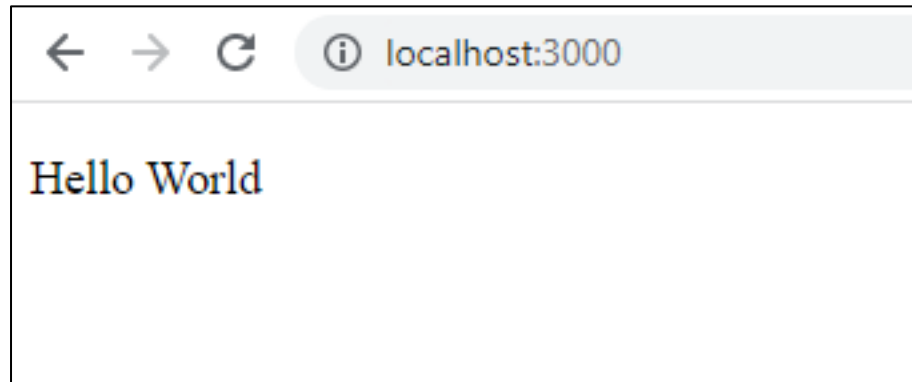
```
Compiled successfully!  
  
You can now view hw-campuspaths in the browser.  
  
Local: http://localhost:3000  
On Your Network: http://192.168.1.9:3000  
  
Note that the development build is not optimized.  
To create a production build, use yarn build.
```


Example 1:

React Boilerplate

- This is a React component with minimum parts needed to display a Hello World message.

```
render() {  
  return (  
    <p>Hello World</p>  
  );  
}
```



Example 2:

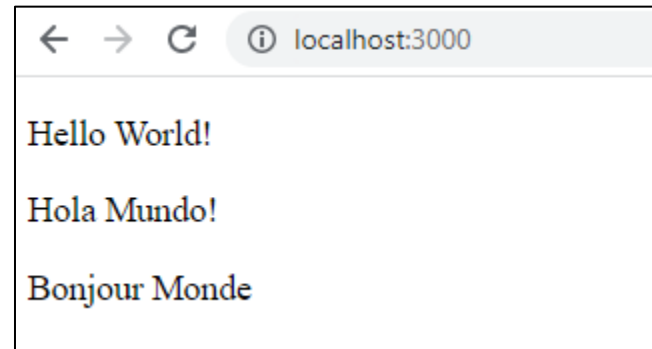
Rendering an Array of Elements

- This shows you how to render an **array** of JSX Elements

- Recall:

```
let myParagraph: JSX.Element = <p>Hello World</p>;
```

```
render() {  
  let arr: JSX.Element[] = [<p>Hello World!</p>,  
                             <p>Hola Mundo!</p>,  
                             <p>Bonjour Monde</p>];  
  
  return (  
    <div>  
      {arr}  
    </div>  
  );  
}
```

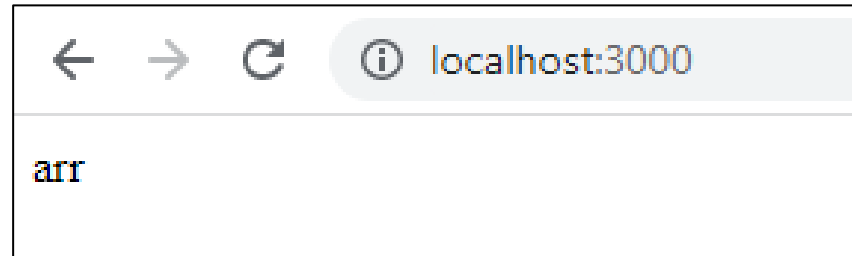


Example 2:

Rendering an Array of Elements

- What happens if you don't put curly-braces around `arr`?
 - It gets interpreted as plain text!

```
render() {  
  let arr: JSX.Element[] = [<p>Hello World!</p>,  
                             <p>Hola Mundo!</p>,  
                             <p>Bonjour Monde</p>];  
  
  return (  
    <div>  
      arr  
    </div>  
  );  
}
```



- Curly braces `{ }` are special syntax in JSX, **used to evaluate a JavaScript expression during compilation.**

Example 2:

Rendering an Array of Elements

- When rendering any **array** of JSX elements, each element needs a unique “key” **prop**. Keys can be anything as long as they are **unique**.

```
✘ Warning: Each child in a list should have a unique "key" prop. index.js:1  
Check the render method of `App`. See https://reactjs.org/link/warning-keys for more information.  
  at p  
  at App (http://localhost:3000/main.a5b9a06...hot-update.js:37:208)
```

```
render() {  
  let arr: JSX.Element[] = [    <p key={2}>Hola Mundo!</p>,  
    <p key={3}>Bonjour Monde</p>];  
  
  return (  
    <div>  
      {arr}  
    </div>  
  );  
}
```

Example 3:

Drawing on a Map

- We will use the React Leaflet plugin to display an interactive map of the campus using React.
- **<Map>** tag: creates an instance of the map component. This component is also provided with your HW8 starter code.
- We're using **<Map>** in HW8 and HW9 to draw lines/paths on top of images (like a map of campus!)
- **<MapContainer>** – Creates a container for the map with properties such as the default position and zoom level.
- **<MapLine>** – Represents an edge on the map.
 - Takes the source and destination coordinates as well as the color of each edge.
 - Map should be in the format provided in HW7.



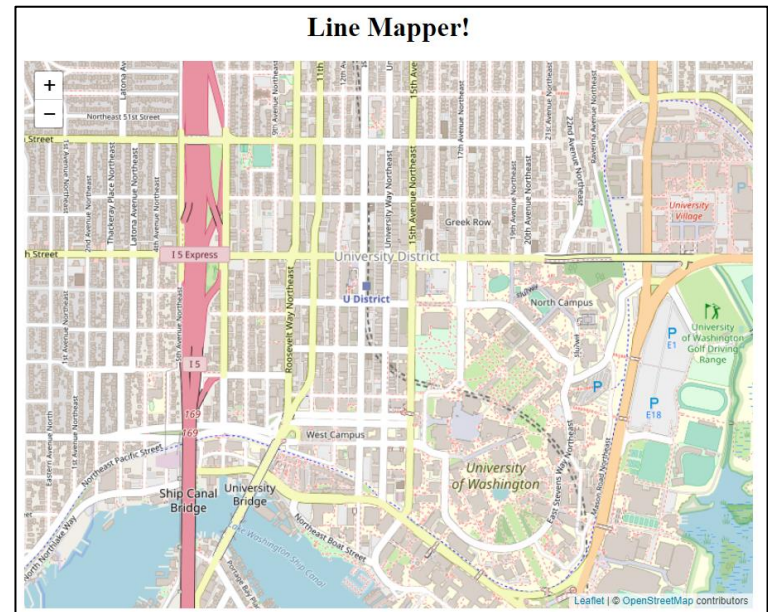
React Leaflet

Example 3:

Drawing on a Map

```
render() {  
  return (  
    <div>  
      <h1 id="app-title">Line Mapper!</h1>  
      <div>  
        <Map edgeList={[]} />  
      </div>  
    </div>  
  )  
}
```

We pass in an empty array into **Map** as the **edgeList** prop



Example 3:

Drawing on a Map

- Why did we need to pass in the `edgeList` prop into the `Map` element? `<Map edgeList={[]} />`

`Map.tsx`:

```
interface MapProps {  
  edgeList: ColoredEdge[]; // edges to be drawn  
}
```

```
class Map extends Component<MapProps, {}> {
```

All `Map` elements **must** have the `props` defined in the interface passed in on the left.

Example 4:

State

- We are initializing the information about our lines in our constructor.
 - Initialize state with `this.state = {...}`
- We are storing our lines and the color of our lines in our **state**.
- **App's state** in this example is **never** getting updated after initialization.

Example 4:

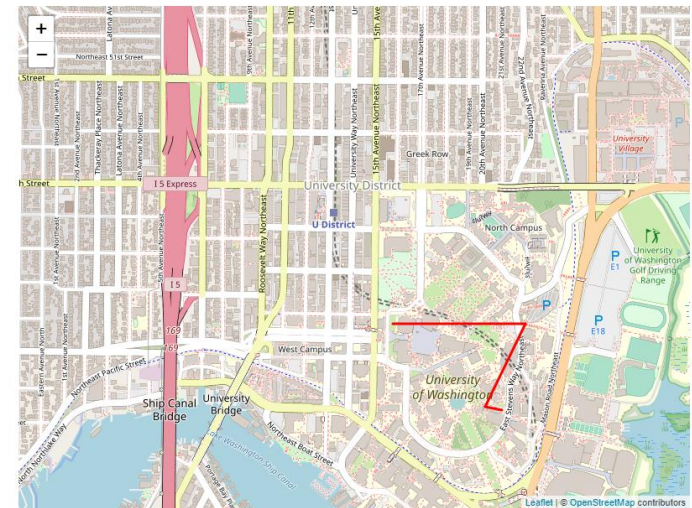
State

```
constructor(props: any) {  
  super(props);  
  // initialize tempLines  
  // and color_  
  this.state = {  
    color: color_,  
    lines: tempLines  
  };  
}
```

```
render() {  
  return (  
    ...  
    <Map edgeList={this.state.lines} />  
    ...  
  )  
}
```

We created lines in **App's** constructor, passed them through **this.state** into **Map** as the **edgeList** prop

Line Mapper!



Example 4:

State

```
interface AppState {  
    lines: ColoredEdge[];  
    color: string  
}
```

```
class App extends Component<{}, AppState> {
```

App's `state` object **must** follow the interface passed in on the right.

```
this.state = {};
```

Compiler Error: Type '{}' is missing the following properties from type 'ReadOnly ': lines, color

Aside: Interfaces

Interfaces define what properties an object is required to have.

- Conceptually: the “shape” of an object

```
interface HasLabel {           interface Empty {
    label: string;              // nothing
}                               }
```

```
let obj1: HasLabel = { label: "label1" };
let obj2: Empty = { label: "label2" };
```

```
console.log(obj1.label);
console.log(obj2.label);
```

Compiler Error: Property 'label' does not exist on type 'Empty'.

Example 5:

Changing State

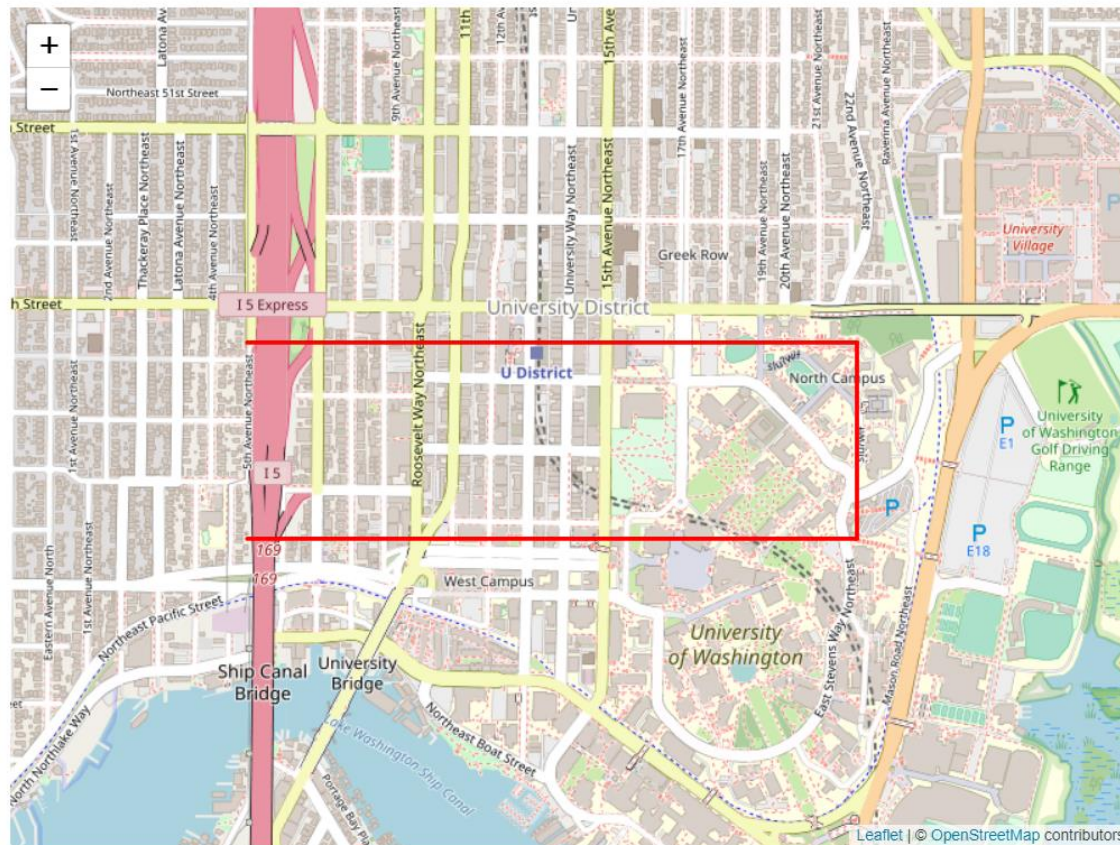
- **App** still stores a current color and a list of edges
- We have 3 buttons to update the color to **red**, **blue**, or **green**.
- Button's **onClick** event listener calls **setState** in **App** to change the color and trigger a **re-render** when the button is clicked.
 - Initialize state using **this.state = { ... }**
 - Use **this.setState** to update the **state** after initialization
 - Otherwise, React might not notice the **state** update and not update the UI!

Example 5:

Changing State

Red Blue Green

Line Mapper!



Example 5:

Changing State

```
<button onClick={this.onGreenClick}>Green</button>
```

```
onGreenClick = () => {  
  const tempLines = this.state.lines;  
  for (let i in tempLines){  
    tempLines[i].color = "green";  
  }  
  let newState = {  
    color: "green",  
    lines: tempLines  
  };  
  this.setState(newState);  
};
```

When the button is clicked, we grab the **old state**, modify it, and then **replace the old state** with our **new state!**

Example 5:

Changing State

React's re-renderer watches for **state** updates. When it detects a **state** update, a re-render is **queued**. It does not happen instantly, as React might group multiple **state** updates in one re-render.

`this.setState(someNewState)`  Queue a re-render!

```
render() {  
  return(  
    ...  
    <div>  
      <Map edgeList={this.state.lines} />  
    </div>  
    ...  
  )  
}
```

Aside: Passing Functions Around

```
render() {  
  let text: string = "Hello!";  
  return (  
    <p>{text}</p>  
  )  
}
```

Notice how these two are *pretty much* equivalent!

```
render() {  
  return (  
    <p>Hello!</p>  
  )  
}
```


Aside: Passing Functions Around

```
onGreenClick = () => {  
    // function body  
};  
  
render() {  
    return (  
        <button onClick={this.onGreenClick}>Green</button>  
    )  
}
```

Similarly, these two are also *pretty much* equivalent!

```
<button onClick={() => {  
    // function body  
};  

```

Example 6:

Children and Props

- We have a new component that puts a title above the Map, called **ColorTitle**
 - **ColorTitleProps** includes a color that it will display
- We must include **ColorTitle** in **App**'s render method
- Current color is passed to child component in **props**

Example 6:

Children and Props

We pass in `this.state.color` as the `color prop` of our `ColorTitle` element.

```
render() {  
  return (  
    <div>  
      ...  
      <ColorTitle color={this.state.color} />  
      ...  
    </div>  
  );  
}
```

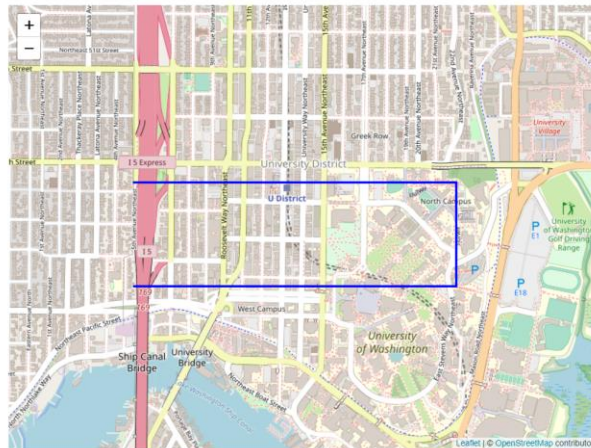
Example 6:

Children and Props

The `ColorTitle` element takes the `color prop` and displays it!

```
render() {  
  return (  
    <h1 id="app-title"  
      style={{color: this.props.color}}>  
      Your favorite color is {this.props.color}!  
    </h1>  
  );  
}
```

Your favorite color is blue!



Example 7:

Callbacks

- We factor out the three buttons into **ButtonGroup**
- **ButtonGroup** uses a **callback** function to notify **App** that a new color has been chosen
 - Remember: **ButtonGroup** is a child of **App**
- **Callback** function is passed in via **props** also

Example 7:

Callbacks

In our `App` component:

```
update_color = (color_: string) => {  
  // create newState by getting the old state and modifying  
  // it using the color_ parameter, then replacing the old  
  // state with our new state!  
  this.setState(newState);  
}
```

We pass this `update_color` function as a `prop` into our `ButtonGroup` element. This function updates `App`'s `state`.

```
<ButtonGroup onColorChange={this.update_color} />
```

Example 7:

Callbacks

In the `ButtonGroup` component:

```
onGreenClick = () => {  
  this.props.onChange("green");  
};
```

...

```
render() {  
  return (  
    <div>  
      <button onClick={this.onGreenClick}>Green</button>  
      ...  
    </div>  
  );  
}
```

We pass **information** from
`ButtonGroup` to `App`

when we call the
callback function



When `ButtonGroup`'s button is clicked, it calls `onGreenClick`, which calls the **callback** function that we passed in as a **prop**!

Example 7:

Callbacks

`update_color` updates App's **state** using the information received through the `color_` parameter ("**green**").

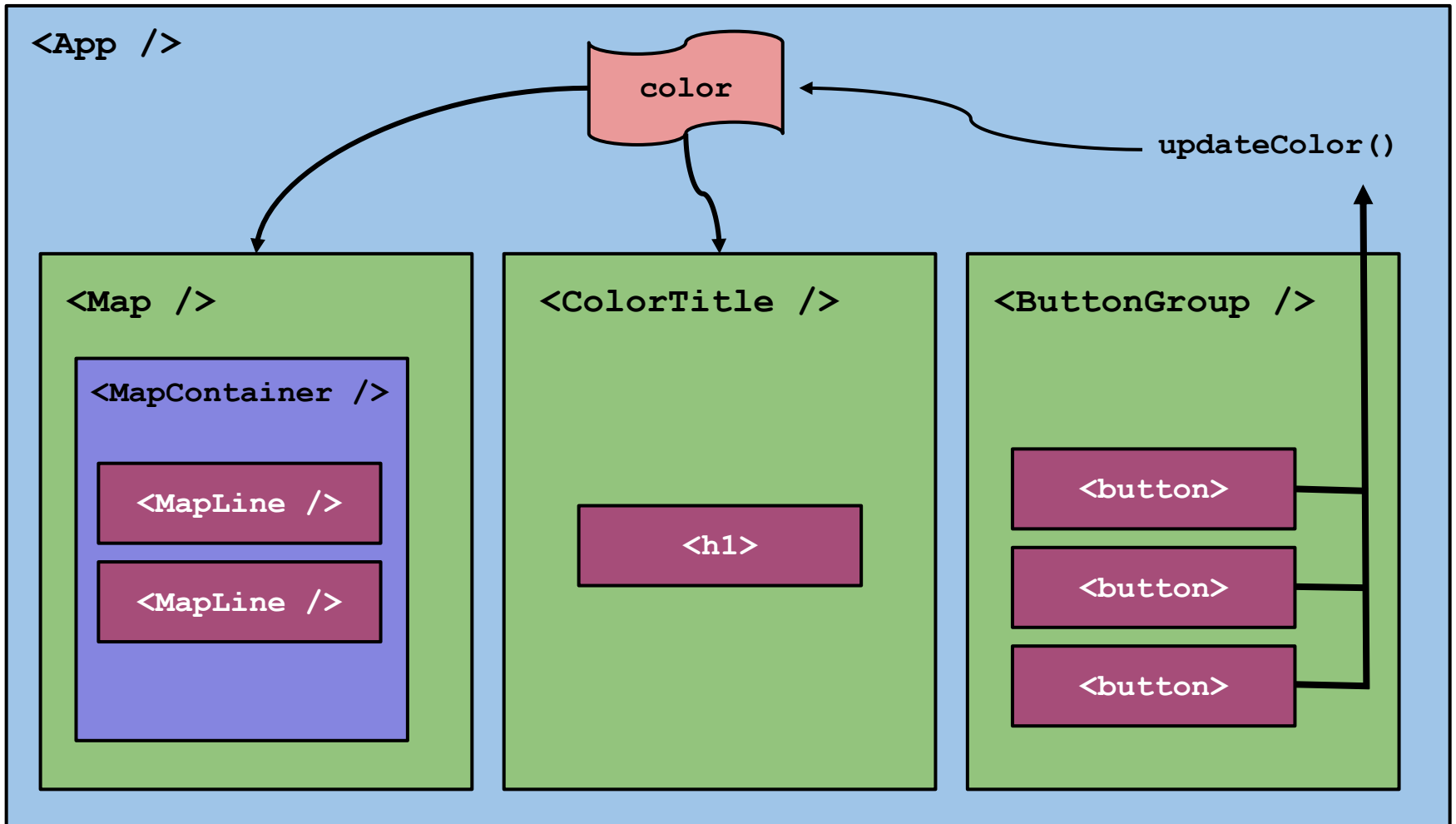


Queue a re-render!

```
render() {  
  return (  
    <div>  
      <ButtonGroup onColorChange={this.update_color} />  
      <br />  
      <ColorTitle color={this.state.color} />  
    </div>  
    <Map edgeList={this.state.lines} />  
  </div>  
) ;  
}
```

When `ButtonGroup`'s button is clicked, it calls `onGreenClick`, which calls the **callback** function that we passed in as a **prop**, which updates App's **state**, and re-renders the `ColorTitle` and `Map` elements using App's **updated state as props**!

The Flow



Aside: console.log output

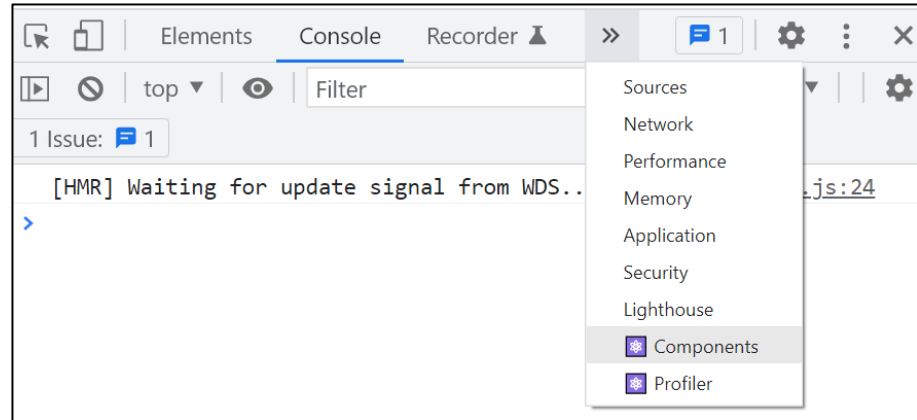
- Kebab menu > More tools > Developer tools

The image shows a Chrome browser window with the 'More tools' menu open, highlighting 'Developer tools'. A secondary window shows the 'Developer tools' interface with the 'Console' tab selected. The console displays a message: '[HMR] Waiting for update signal from WDS...' with a file path `_log.js:24`. Above the console window, the text `console.log` will get output here is written.

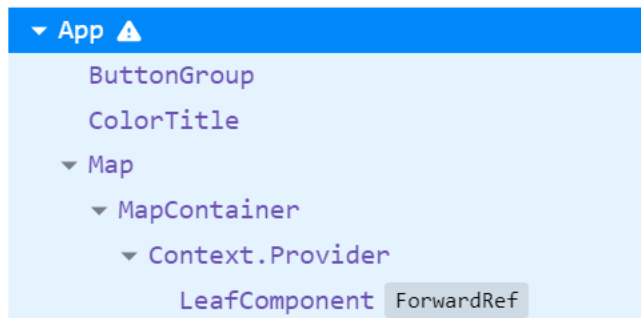
`console.log` will get output here

Using React Developer Tools

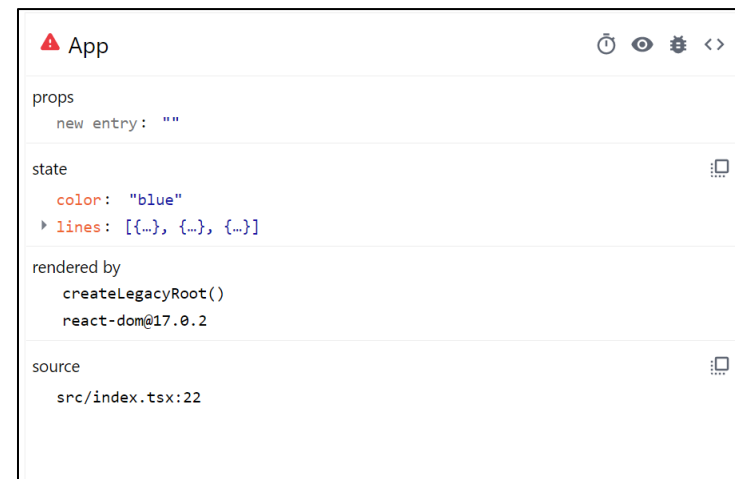
-  Components Tab



- See the component structure!



- Verify the **props** and **state**!



Summary

- Components are reusable blocks of code that allow **modular design** and **proper cohesion**.
- Components contain other components and HTML tags to determine how they appear on a webpage.
 - React is responsible for managing the underlying webpage.
- Data owned/controlled by a component is stored in that component's **state**.
- Data flows *down* from parent to child through **props**.
- Data flows *up* from child to parent through **callbacks** from the child into the parent's code.
- React notifies components of changes to their data, and re-renders happen accordingly.