

React

Shan-Hung Wu & DataLab
CS, NTHU

Separation of Concerns

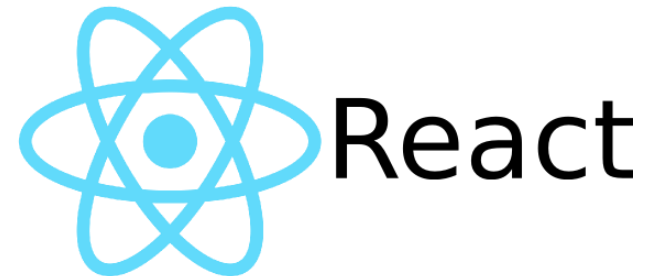
- HTML: noun
- CSS: adjective
- JS: verb
- Applies well to *static* pages
- But for *dynamic* content, JS usually “crosses the line”

```
el.textContent = '...';
```

Modern Frontend Framework



- Write JS *in HTML*



- Write HTML *in JS*



React

- Component-based
- Debug-friendly
 - Syntax errors fails at compile time
 - **Declarative** properties make runtime debugging easy
- Extends to mobile landscape (React Native)

```
$ npm install --save react react-dom
$ npm install --save-dev babel-preset-react
```

```
// in webpack.config.js
entry: {
  index: './index.jsx',
  vendor: ['react', 'react-dom']
}
module: {
  rules: [{
    test: /\.(\js|jsx)$/,
    exclude: [/node_modules/],
    use: [{
      loader: 'babel-loader',
      options: {
        presets: [
          ['es2015', {'modules': false}],
          'react'
        ]
      }
    }]
  }], ...
}
```

Hello React

- `*.jsx` are JS files with HTML embedded

Webpack Aliasing

- Components are move to `src/components`
 - **C**omponent.js**x** by convention
- Use aliasing to resolve path dependency:

```
// under "module.exports" in webpack.config.js
resolve: {
  alias: {
    components: path.resolve(srcPath, 'components')
  }
}, ...
```

```
// in index.js
import ... from 'components/Component.jsx';
```

Development Server

```
$ npm install --save-dev \
  webpack-dev-server
```

```
// in webpack.config.js
module.exports = {
  ...,
  devServer: {
    contentBase: distPath,
    compress: true,
    port: 8080
  }
}
```

```
// under "scripts" in package.json:
"start": "webpack-dev-server",
```

- React requires a web server to run

Outline

- React components and JSX
 - States and data flows
 - Forms
 - More JSX
- Thinking in React: WeatherMood
 - Routing
 - Promises and AJAX requests
 - UI
- Debugging

Outline

- React components and JSX
 - States and data flows
 - Forms
 - More JSX
- Thinking in React: WeatherMood
 - Routing
 - Promises and AJAX requests
 - UI
- Debugging

Hello React

```
// in index.js
import React from 'react';
import ReactDOM from 'react-dom';

window.onload = function() {
  let name = 'Bob';
  ReactDOM.render(
    <h1>Hello {name}</h1>, // JSX, no quotes
    document.getElementById('root')
  );
};
```

- **JSX** allows writing HTML in JS
- Compiled to normal **objects** by Babel

```
const el = <h1>Hello {name}</h1>;
// compiled to
const el = React.createElement('h1', ...);
```

JSX Basics

```
// embedded expressions
const el = <div>Number {1+1}</div>;

// multi-line with nested elements
const el = (
  <div>
    <h1>Title</h1>
    <p>Paragraph.</p>
  </div>
); // use (...) to prevent auto ';' insertion

// attributes (in lower-camel-case)
const url = '...';
const el = <img className='fliud' src={url}>;
```

- Everything is converted to a string before rendered
- Prevents injection attacks, e.g., [cross-site-scripting \(XSS\)](#)

Fast Re-rendering

- React keeps a virtual DOM in memory
 - Updates only *changed elements* in real DOM

```
function tick() {  
  const date = new Date().toLocaleTimeString();  
  const el = (  
    <div>  
      <h1>Hello</h1>  
      <h2>It's {date}</h2>  
    </div>  
  );  
  ReactDOM.render(el, document.getElementById('root'));  
}  
setInterval(tick, 1000);
```

Components & Props

```
// functional component
function Component(props) {
  return <h2>This is {props.name}<h2>;
}

// class component
class Component extends React.Component {
  constructor(props) {
    super(props); ...
  }
  render() {
    return <h2>This is {this.props.name}<h2>;
  }
}

// in index.js
ReactDOM.render(
  <div>
    <Component name='Alice'>
    <Component name='Bob'>
  </div>,
  document.getElementById('root');
);
```

- `render()` accepts only a single root element
- Multiple instances created

Never change props in a component!

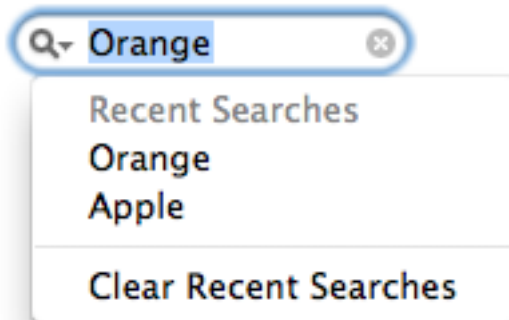
- So, React can efficiently detect whether a component should be re-rendered

Outline

- React components and JSX
 - States and data flows
 - Forms
 - More JSX
- Thinking in React: WeatherMood
 - Routing
 - Promises and AJAX requests
 - UI
- Debugging

States

- A component may have its own ***states***
- Keep track of e.g., user input or program status



Countdown: 5

Example: Counter

Countdown: 5

```
class Counter extends React.Component {
  constructor(props) {
    super(props);
    this.state = {
      count: 5
    };
  }
  render() {
    return <h2>Countdown: {this.state.count}</h2>;
  }

  // lifecycle methods
  componentDidMount() {
    this.countdownId = setInterval(() => {
      this.setState({ // triggers re-rendering
        count: this.state.count - 1
      }); // obj merged to this.state
    }, 1000);
  }
  componentWillUnmount() {
    clearInterval(this.countdownId);
  }
}
```

- More [lifecycle methods](#)

Data Flows

Main

Hello React

Countdown: 5

Reset

Component

- Downward:

```
// in Main.render()  
<Component count={this.state.count}>
```

```
// in Component.render()  
<h2>Countdown: {this.props.count}</h2>
```

Data Flows

Main

Hello React

Countdown: 5

Reset

Component

- Upward:

```
// in Main.render()  
<Component onReset={this.handleReset}>
```

```
// in Component.render()  
<button onClick={this.props.onReset}>Reset</button>
```

Advantages

- Data flows are *declarative*
 - JSX declares both downward and upward flows
 - Simplifies debugging (by investigating `props`)
- States are local to component *objects*
 - Simplifies state management in complex UIs

```
// in index.js
ReactDOM.render(
  <div>
    <Main />
    <Main />
  </div>,
  document.getElementById('root');
);
```

Bug 1: this in handleReset()

```
// in Main.render()  
<Component onReset={this.handleReset}>
```

```
// in Component.render()  
<button onClick={this.props.onReset}>Reset</button>
```

- this does not bind to Main when called

- Fix:

```
// in Main.constructor()  
this.handleReset = this.handleReset.bind(this);
```

```
// or use ES7 property initializer  
class Main extends React.Component {  
  handleReset = () => {  
    ...  
  };  
}
```

Bug 2: `setState()` is Asynchronous

- React batches multiple `setState` calls for better rendering performance
- If new state depends on previous one (or props):
- Actions assuming new state is set:

```
setState({  
  count: this.state.count - 1  
});  
... // uses new count
```

```
setState((prevState, props) => ({  
  count: prevState.count - 1  
}));
```

```
setState({  
  count: prevState.count - 1  
}, () => {  
  ... // uses new count  
});
```

Outline

- React components and JSX
 - States and data flows
 - **Forms**
 - More JSX
- Thinking in React: WeatherMood
 - Routing
 - Promises and AJAX requests
 - UI
- Debugging

Form Elements

- Form elements manages their own state in normal JS
- ***Uncontrolled*** form elements:

```
// JSX in render()
<form>
  <input type='text' ref={el => {this.inputEl = el}} />
</form onSubmit={this.handleSubmit}>

// method
handleSubmit(e) {
  const v = this.inputEl.value;
  this.inputEl.blur();
  ...
}
```


Controlled Form Elements

- States managed explicitly (recommended)
 - More declarative in JSX

```
// JSX in render()
<form>
  <input type='text' value={this.state.inputValue}
    onChange={this.handleInputChange} />
</form onSubmit={this.handleSubmit}>
```

```
// methods
handleInputChnage(e) {
  this.setState({inputValue: e.target.value});
}
handleSubmit(e) {
  const v = this.state.inputValue;
  ...
}
```

Outline

- React components and JSX
 - States and data flows
 - Forms
 - **More JSX**
- Thinking in React: WeatherMood
 - Routing
 - Promises and AJAX requests
 - UI
- Debugging

Conditions

- Only expressions in { }: no `if`, `for`, etc.
- { } must be evaluated to DOM element(s)

```
// if
<h1>Hello</h1> {
  unreadMsgs.length > 0 && // short circuit
    <h2>You have {unreadMsgs.length} messages.</h2>
}
// if else
<h1>Hello</h1> {
  unreadMsgs.length == 0 ? <h2>No message.</h2> :
    <h2>You have {unreadMsgs.length} messages.</h2>
}
```

Loops

```
// for
<h1>Unread messages:</h1>
<ul> {
  unreadMsgs.map( (m => <li key={m.id}>{m.title}</li>))
}
</ul>
```

- Arrays/lists of elements can be rendered directly
- Key per item is necessary for fast re-rendering
 - Only needs to be unique among siblings
 - Added to the composing component (that calls `map`), rather than individual element components

Attributes

- Default to true

```
<Message isRead />    // same as  
<Message isRead={true} />
```

- Spread

```
const props = {name: 'Bob', age: 18}  
<User {...props} />
```

Composition

```
function GeneralComponent {  
  return (  
    <div>  
      <h1>Welcome</h1>  
      {props.children} // provided by React  
    </div>  
  );  
}  
  
function SpecializedComponent {  
  return (  
    <GeneralComponent>  
      <p>Content</p>  
      <p>Footer</p>  
    </GeneralComponent>  
  );  
}
```

- Facebook favors composition over inheritance

Outline

- React components and JSX
 - States and data flows
 - Forms
 - More JSX
- Thinking in React: WeatherMood
 - Routing
 - Promises and AJAX requests
 - UI
- Debugging

Clone lab-react-weathermood



Setup

```
$ npm install --save react-router axios  
$ npm install --save reactstrap \  
  react-addons-transition-group \  
  react-addons-css-transition-group
```

- [React Router](#)
 - Loads different components based on different URL paths
 - Declarative (in JSX)
- [Axios](#)
 - Makes AJAX (in-page HTTP) requests
 - ES6 Promise-based API
- [Reactstrap](#)
 - Bootstrap with JS replaced by React
 - Uses React [animation add-ons](#)

```
$ npm install --save-dev \
  babel-plugin-transform-object-rest-spread

// in webpack.config.js
loader: 'babel-loader',
options: {
  presets: [...],
  plugin: [..., 'transform-object-rest-spread']
}

// merge objects
const obj1 = {
  p1: 1,
  p2: 2
};
const obj2 = {
  ...obj1,
  p3: 3
}; // obj2 now has p1, p2, and p3
```

ES7 Spread in Object Literals

Turning off URL Translation in CSS

- By default, Babel CSS-loader translates `url (...)` 's into module imports
- Problematic when setting, e.g., background images

```
background-image: url('...');
```

- To turn this off:

```
// in rules of webpack.config.js
test: /\.css$/,
use: ['style-loader', {
  loader: 'css-loader',
  options : {
    url: false
  }
}]
```



- Sign up to get an App ID

Thinking in React

Step 1: Component Hierarchy

Main

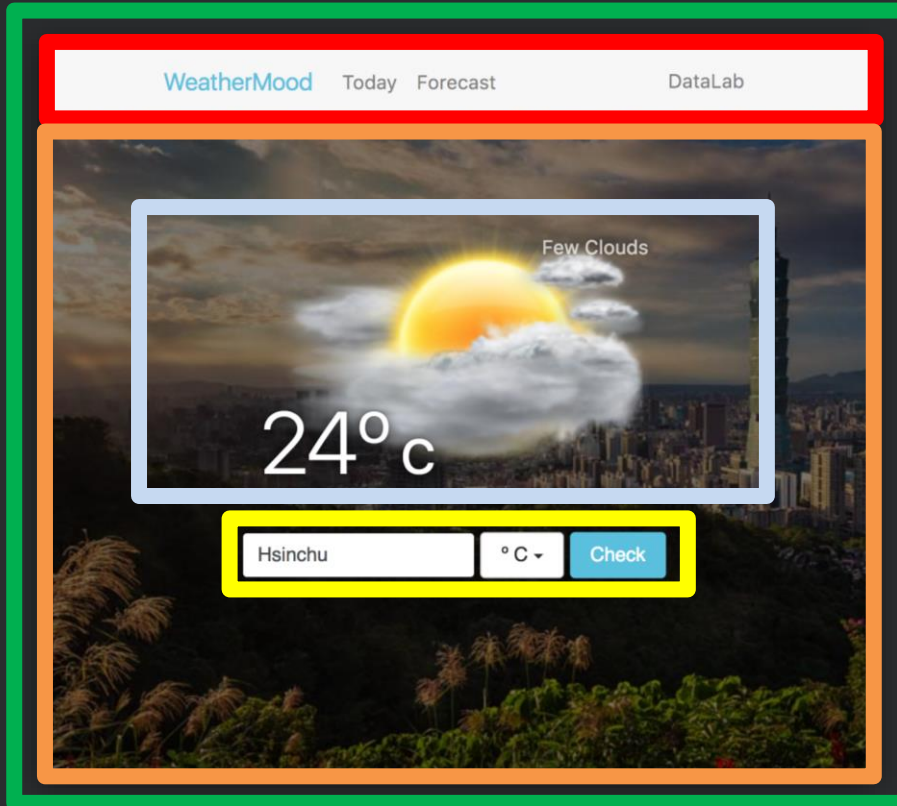


Navbar

Today /
Forecast

Step 2: Static Version (Downward Data Flow)

Main



Navbar { link1, link2 }

**WeatherDisplay {
temp, unit
weather, desc
}**

**WeatherForm {
city, unit
}**

Today { weather }

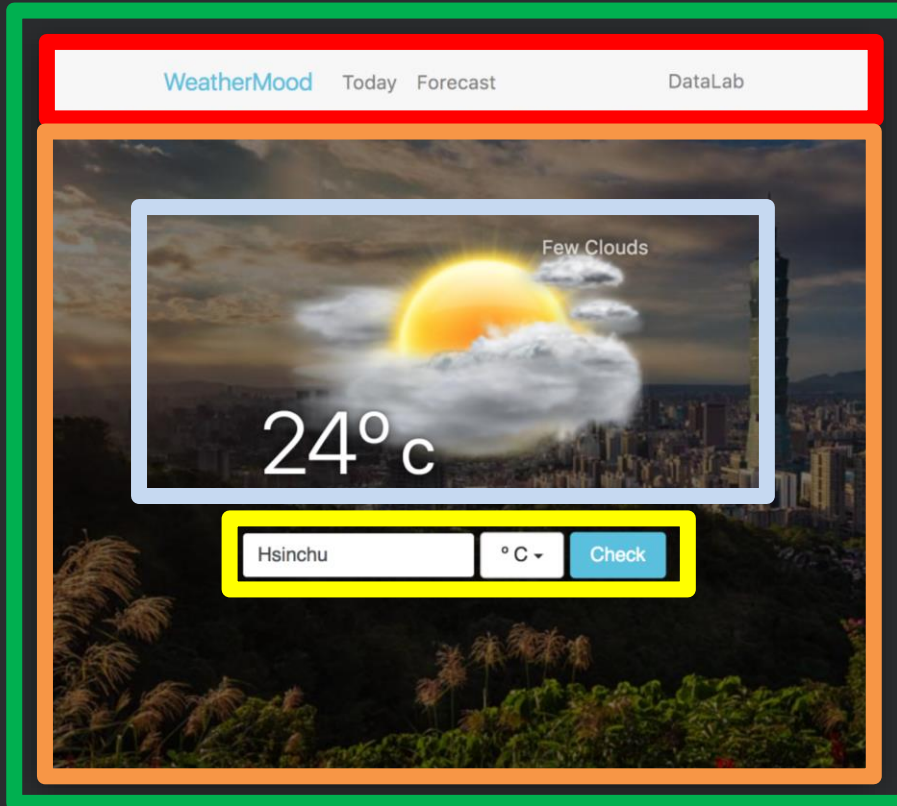
Forecast { weather }

Step3: Identifying States

- The “changing parts” of a component
 - By user or program logic
- Passed in from a parent via props?
 - Not a state
- Remain unchanged over time?
 - Not a state
- Can be computed based other states/props?
 - Not a state

Step 3: Identifying States

Main



Navbar { ~~link1~~, link2 }

WeatherDisplay {
temp, unit
~~weather~~, desc
}

WeatherForm {
city, unit
}

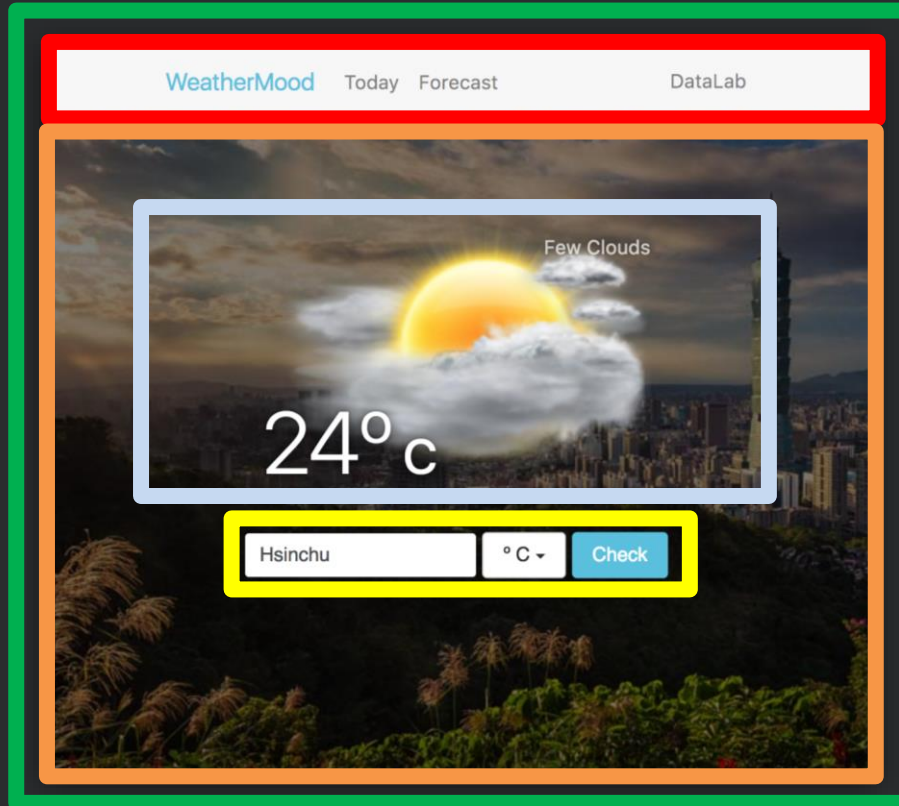
Today { weather }

Forecast { weather }

Step 4: Lifting States Up

- What if several components need to reflect the same/corresponding states?
- Lift the states up to the *closest common ancestor*

Step 4: Lifting States Up



Navbar { ~~link1~~, ~~link2~~ }

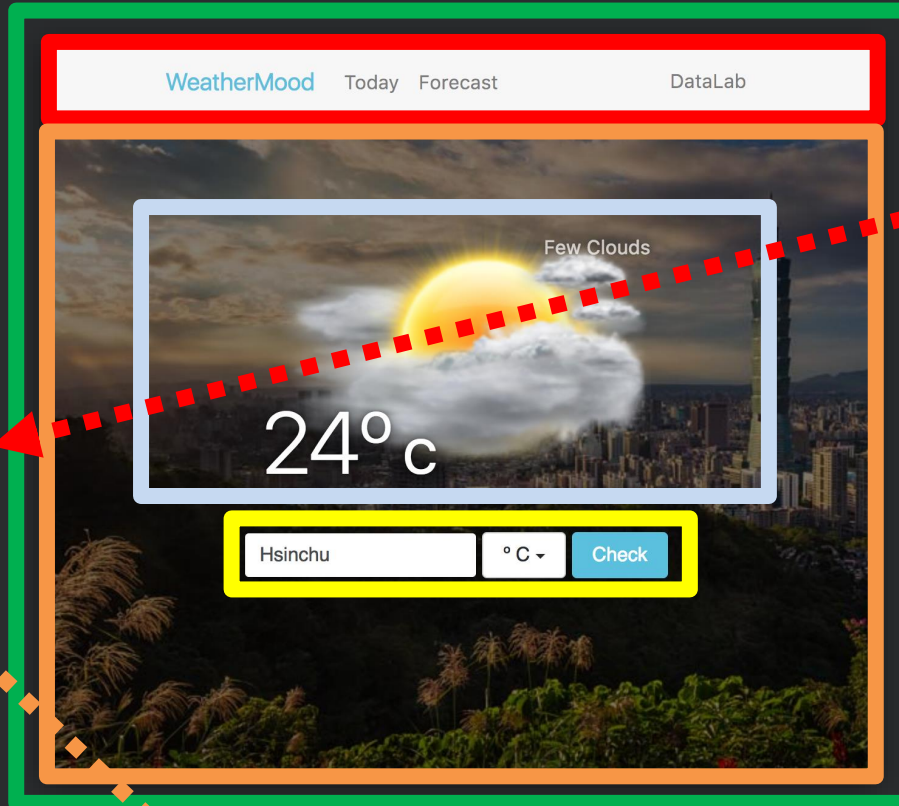
WeatherDisplay {
temp, unit
weather, desc
}

WeatherForm {
city, unit
}

Today { weather, temp, desc, city }

Forecast { weather, temp, desc, city }

Step 5: Upward Data Flow



Main {
unit
}

Navbar { ~~link1~~, ~~link2~~ }

WeatherDisplay {
temp, unit
weather, desc
}

WeatherForm {
city, unit
}

Today { weather, temp, desc, city }

Forecast { weather, temp, desc, city }

Outline

- React components and JSX
 - States and data flows
 - Forms
 - More JSX
- Thinking in React: WeatherMood
 - Routing
 - Promises and AJAX requests
 - UI
- Debugging

Client-Side Routing

- A single-page app may want to load different components based on different URL paths
 - At client side to minimize latency
- Implementation: a `Link` component that
 - Fires an event when clicked
 - Tells which path to go
- Container component can then mount/unmount relevant components

React Router

- Declarative client-side routing:

```
// in Main.jsx
render() {
  return (
    <Router>
      <Link to='/'>Today</Link>
      <Link to='/forecast'>Forecast</Link>
      ...
      <Route exact path='/'
        render={() => <Today />}></Route>
      <Route path='/forecast'
        render={() => <Forecast />}></Route>
    </Router>
  );
}
```

- More [matching rules](#)

Outline

- React components and JSX
 - States and data flows
 - Forms
 - More JSX
- Thinking in React: WeatherMood
 - Routing
 - Promises and AJAX requests
 - UI
- Debugging

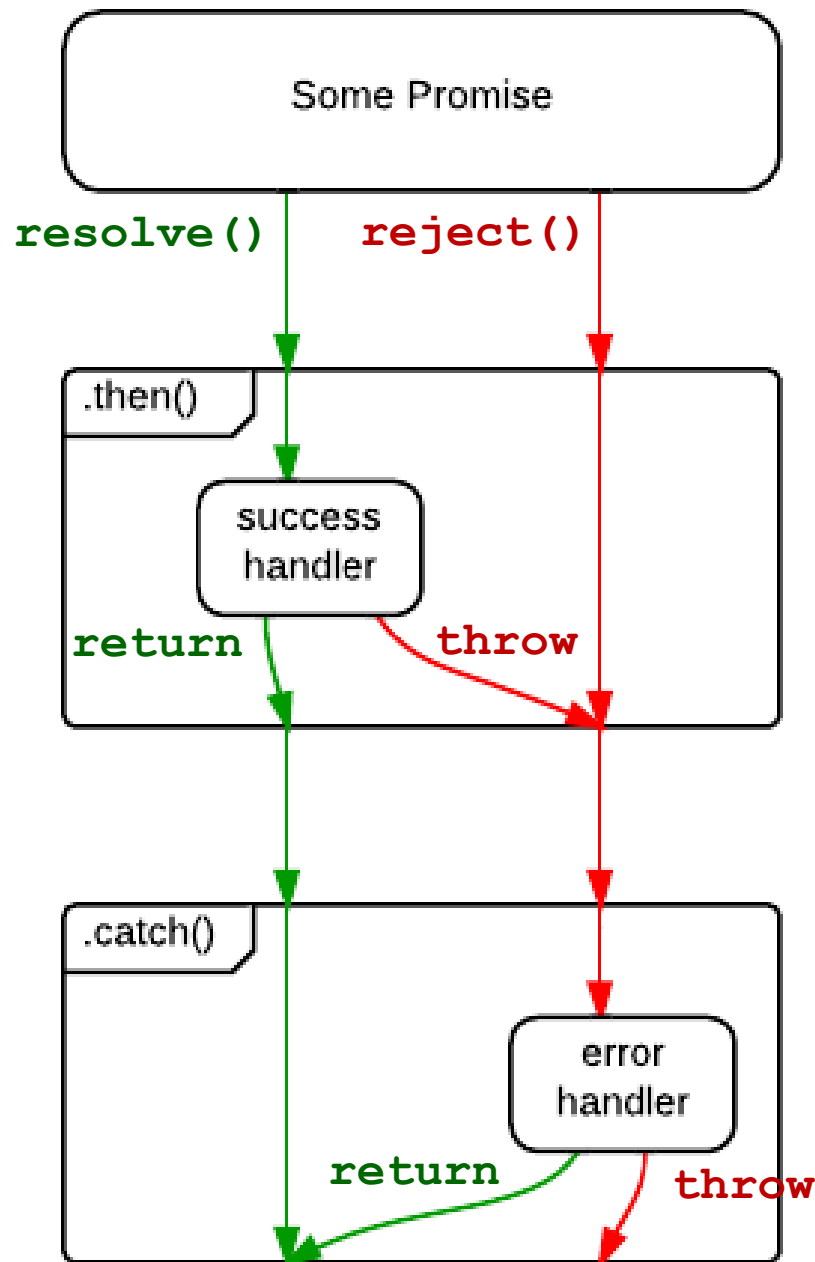

```
// in method1()
const p = new Promise((resolve, reject) => {
  ... // do asynchronous job here
  if (success) resolve(data);
  else reject(err);
});
return p;
```

```
// in method2(p)
const p2 = p.then(data => {
  ... // process data
  return data2
}); // always returns a new Promise
return p2;
```

```
// in method3(p2)
p2.then(data2 => {
  ... process data2
}).catch(err => {
  ... // handle err
}); // always returns a new Promise
```

ES6 Promise

- A value available *in the future*
- Separation of concerns
 - Handlers can be written in different places
- Use arrow func for this



Execution Flow

- Chain `then` and/or `catch` as long as you like
- Reject mode:
 - `throw new Error()`
- Resolve mode:
 - `return`

Axios and AJAX Requests

```
// GET request
axios.get('...url...').then(res => {
  res.status    // HTTP response code (e.g., 200, 401)
  res.data      // object parsed from HTTP response body
  res.headers   // HTTP response headers
}).catch(err => {
  console.log(err);
});
```

```
// POST request
axios.post('...url...', {
  ... // request body
}).then(...).catch(...);
```

- Requests can be [canceled](#)

Outline

- React components and JSX
 - States and data flows
 - Forms
 - More JSX
- Thinking in React: WeatherMood
 - Routing
 - Promises and AJAX requests
 - UI
- Debugging

Reactstrap

- Bootstrap with JS replaced by React
 - Integrates to virtual DOM for better performance

```
import {Button} from 'reactstrap';
```

```
// JSX
```

```
<Button color='primary'  
  onClick={this.handleClick}>primary</Button>
```

```
handleClick(e) {  
  ...  
}
```



- More [components](#)

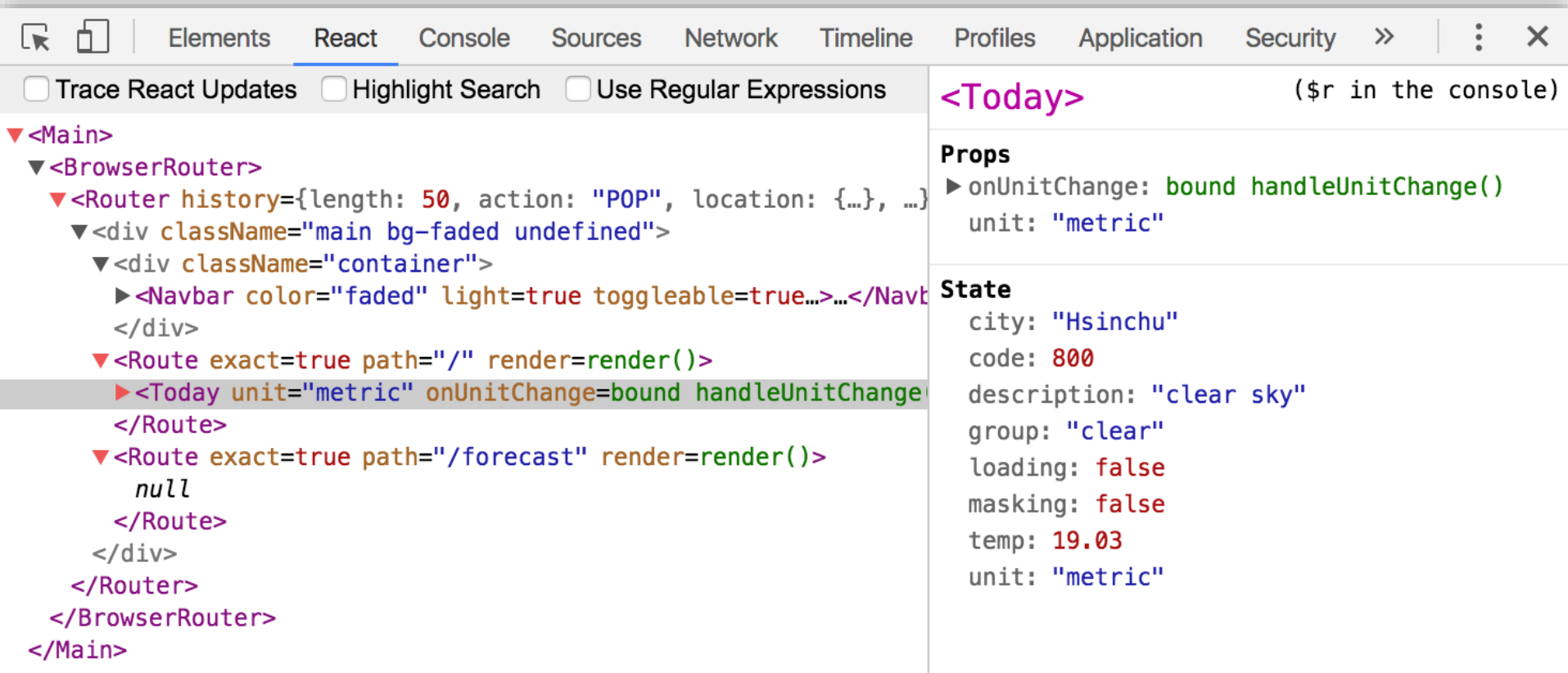
More React UI Libraries

- [Material-UI](#)
- [React-Bootstrap](#)
- and [more](#)

Outline

- React components and JSX
 - States and data flows
 - Forms
 - More JSX
- Thinking in React: WeatherMood
 - Routing
 - Promises and AJAX requests
 - UI
- **Debugging**

React DevTools



- Breakpoints: `debugger;`

Type Checking

```
class WeatherForm extends Ract.Component {  
  // ES7 property initializer  
  static propTypes = {  
    city: React.PropTypes.string,  
    unit: React.PropTypes.string  
  
    // bool, number, array, object, func, ...  
  
  };  
  
  constructor(props) {...}  
  render() {...}  
}
```

- [More type checking](#)

Source Map

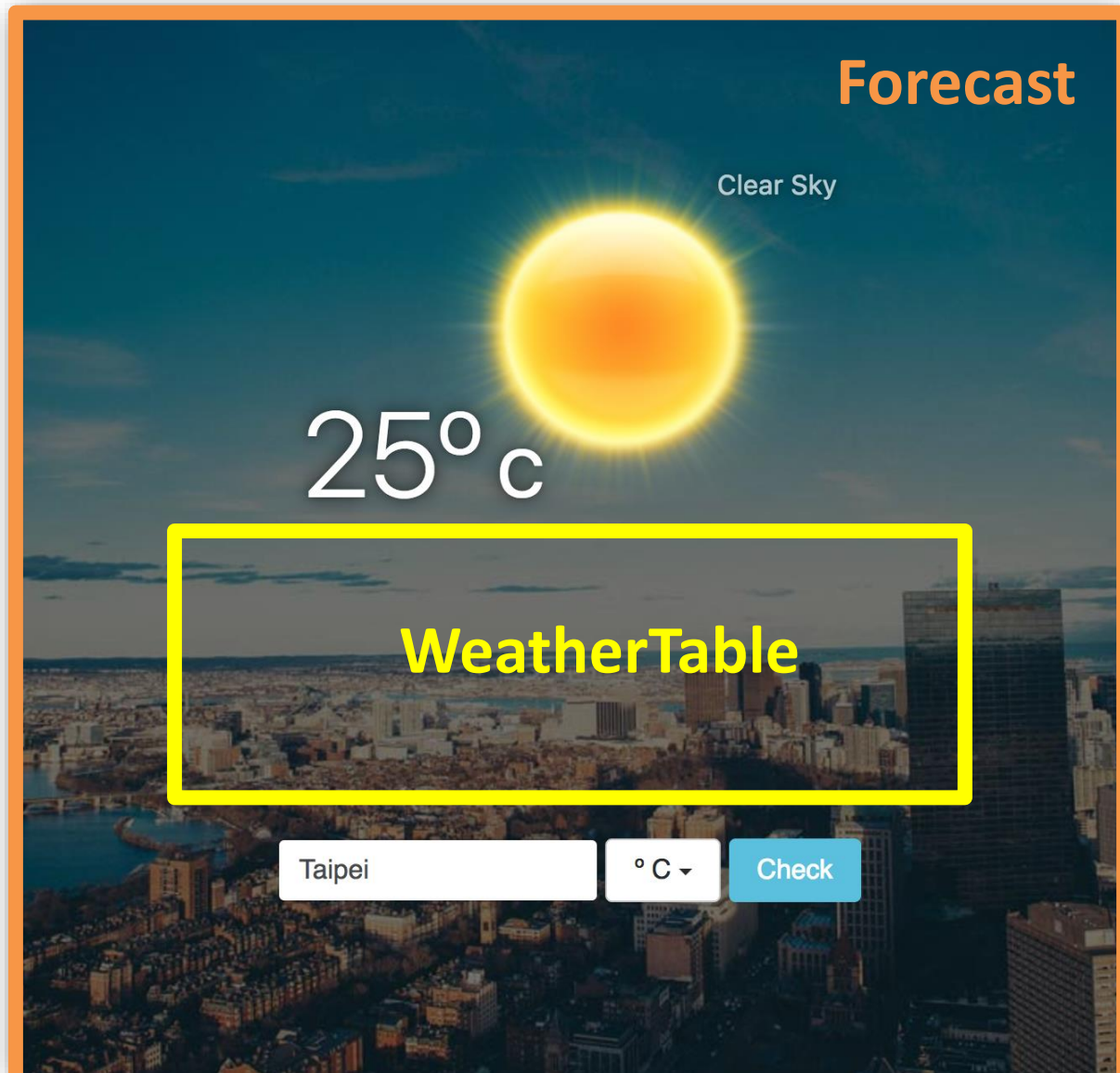
```
// in webpack.config.js
module.exports = {
  ...
  devtool: 'source-map'
};
```

- [Options & speed](#)
- Usually, 'cheap-source-map' is a good compromise

Assigned Readings

- [Tic Tac Toe in React](#)
- [JSX in depth](#) (optional)
- [Controlled form elements](#) (optional)
- [Refs](#) and [uncontrolled components](#) (optional)

Assignment: 5-Days Forecast



Requirements

- Use the [5-days forecast API](#)
- Show “tomorrow” in `WeatherDisplay`
- `WeatherTable` for the rest days
- Each day in `WeatherTable`:
 - Day of week: “Sat,” “Sun ,” “Mon,” and so on
 - Temperature in correct unit
 - [Weather condition icon](#) (based on code)
- Responsive: show only 2 days in `WeatherTable` on portrait mobile devices

Bonus

- Query OWM using users' current geo-coordinates (latitudes and longitudes):

```
navigator.geolocation
    .getCurrentPosition(function(position) {
      // called back asynchronously
      const lat = position.coords.latitude;
      const lng = position.coords.longitude; ...
    })
```

- Read this [tutorial](#) first
 - Watch out the privacy settings
- Change background to [Google Map](#), and allow “pin to query”
 - You can use [react-google-maps](#) or similar